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Editorial

The conference is designed to stimulate the young minds including Research Scholars, Academicians, and Practitioners to contribute their ideas, thoughts and nobility in these two integrated disciplines. Even a fraction of active participation deeply influences the magnanimity of this international event. I must acknowledge your response to this conference. I ought to convey that this conference is only a little step towards knowledge, network and relationship.

The conference is first of its kind and gets granted with lot of blessings. I wish all success to the paper presenters.

I congratulate the participants for getting selected at this conference. I extend heart full thanks to members of faculty from different institutions, research scholars, delegates, TROI Family members, members of the technical and organizing committee. Above all I note the salutation towards the almighty.

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OPTIMAL DESIGN OF WATER DISTRIBUTION SYSTEM FOR KITS CAMPUS

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Abstract— Distribution network consumes a considerable part of the total expenditure incurred on water supply system and thus networking is desirable. If the network is optimized there can be significant saving in expenditure. A system of network which fulfills all the demand of the consumer with minimum installation cost is termed as optimized network. Many network design and optimization techniques are available.

The method used here for optimization is Cost Head Loss Ratio Method. This approach however is presently applicable to single-source system only. The approach is a non-computer optimization technique which is suitable for hand calculation with the help of electronic calculator.

The selected method is used for designing the water distribution system for K.I.T.S campus located at Ramtek, Nagpur District, Maharashtra and finally the total cost of the network is obtained.

Index Terms—Optimization, water demand, cost function

I. INTRODUCTION

The purpose of the distribution system is to convey wholesome water to the consumer at adequate residual pressure in sufficient quantity at convenient points. Water distribution usually accounts for nearly 60% of the capital cost of the water supply system. As such proper design and layout of the system is of great importance.

The optimal design of large looped hydraulic pipe network is achieved using genetic algorithm method is studied by Cisty et al [2]. A case study on water distribution network of Suez City, Egypt in which genetic algorithm model is adapted to optimize pipe diameters is done by Djebedjian et al [3]. A nonlinear programming approach using the successive quadratic programming is used NLP formulations can handle more general water distribution problems such as nonlinear pumping cost is studied by Varma [7]. A non-computer optimization procedure for distribution systems is evolved by Bhave [8].

By studying the literature as mentioned above it is found that the optimal design of large looped pipe network is achieved and water distribution network of different cities are carried out. And also the nonlinear programming approach are used.

II. WATER DISTRIBUTION SYSTEM

The distribution consist of pipes of various sizes, valves, meters, pumps, distribution reservoir, hydrants, stand-post, etc. The pipelines carry the water to each and every street and road. Valves control the flow of water consumed by individual as well as by town. Hydrants are provided to connect the water to the firefighting equipment during fire service. Connections are done to connect the individual building with the water line passing through the streets. Pumps are provided to pump the water mains to obtain the required pressure in the pipe line.

A. Elevated storage reservoir

The existing elevated storage reservoir is located near the girls hostel in this campus. It is at the height of 18 m from the ground level. The capacity of the ESR is 1.5 lack liters. The capacity of the underground storage reservoir is 1.0 Lacks liter.

B. Methods of distribution

Gravity system- This system is used where source is lying at the elevated place and the community is lying at the lower level than the source. This is the most reliable method. If the conduit lead in from source to the city is adequate is size and well safeguards against accidental breaks.

Pumping system- In this system water is directly pumped into the mains. Since the pumps have to work at different rates in a day, the maintenance cost increases. The number of pumps required in this system depends upon the demand of the water. High lift pumps are requires and their operations are continuously watched. If the pump fails whole supply of the town will be stopped. Therefore it is better to have dual pumps. But this system is not preferred to the other system.

Combine system- This system is also known as dual system. In this system water is pumped and stored in the elevated distribution reservoir. The excess water during low consumption remains in the elevated reservoir and it is supplied during the peak period. As in this system water comes from two sources on from reservoir and second from service station, so it is called dual system. The water stored in the elevated reservoir to meet the requirement during break down of pumps and for firefighting.

C. Water demand

As an essential element of information for planning is the demand function for uses with water as the input factor. As these uses are not well known as yet it is difficult to estimate them. However the functional relationship of supply and demand is cyclic. This is because water uses varies from city to city, depending upon the climate, characteristics of the environment concern, population, industrialization, and other factors. Again in some cities it varies from season to season, day to day, and hour to hour. Thus in the planning of the water supply system, the probable water use and its variations must be estimated as accurately as possible. There are various types of demand such as-

1. Domestic water demand
2. Commercial and industrial water demand
3. Fire demand
4. Demand for public uses
5. Compensate losses demand

III. COST HEAD LOSS RATIO METHOD

A. Analysis

In the analysis of water supply system different elements such as the location of sources and sources of water, length of raw and clean water transmission mains, locations, capacity, and different levels of reservoir, layout of distribution network are known.

Analysis of the system may be necessary to known whether the capacity of the sources is adequate, whether the available storage capacity and water levels in the reservoir at different times are satisfactory, whether the system has acceptable behavior under emergency conditions such as fire failure of pumps, pipes valves and so on.

B. Design

In the design of the system, however the system is unknown and the designer had to decide the location and sizes of the different components, for ex. in the design of the water supply system the designer has decide the source and source of water of acceptable quality and adequate quantity, location and sizes of transmission mains, water treatment plant and reservoir, layout of the distribution network with the size of the pipe, location and type of different valves.

C. Parameters involved in water distribution system design

1. Hydraulic Gradient line value:

H.G.L value of the source is known and remains constant but HGL values of demand nodes are unknown parameters.

2. Source node or supply node:

Node which supplies water to the Distribution system and the HGL values of the node remains constant also called as head node. The source node is a starting node which receives flow outside and supplies it to the network.

3. Demand node:

A distribution node or a demand node is a node which receives flow through one or more links and distributes it. From this node the water is given to the consumer.

4. Branch network:

It is a combination of several network having dead ends.

5. Node:

It is a point where two or more pipes are meeting.

6. Link:

It is a line joining two successive nodes.

7. Minimum required HGL:

It is a HGL obtained by adding residual lead Generally two meter to the reduced level.

8. Equations (Continuity Equation):

Continuity equation is based on law of conservation of mass.

$Q = Q_1 + Q_2 + Q_3$ (Balance of Flow)

If V_1, V_2 are the average velocity at section 1-1, 2-2. With c/s area A_1 & A_2 respectively, the continuity equation for volumetric flow rate in incompressible flow becomes

$Q = A_1 * V_1 + A_2 * V_2$

D. Cost head loss ratio method

Cost head loss ratio method is the method which is used for optimal design of single source network. For optimal design we are using this method in which cost factor and head loss is considered simultaneously. This method is invented by Shri. Pramod Bhave. By this method the minimum cost for the design of water distribution network is achieved. This method is more favorable as it is done manually. By this method, the optimization of network is achieved by considering the less economy in the project.

There are certain assumptions in the method which are as follows:

1. The geometrical layout of the network is known and fixed.
2. The node demand are known and fixed i.e the flow in the system is in steady state condition.
3. The diameter of the link connecting different nodes is a continuous variable.
4. The capital cost per unit length of a link varies exponentially with its diameter.

E. Optimity criteria

For a distribution network the cost function can be shown to be unimodal continuous convex function of H_i and H_j.

Consider a node j of such a network when all Hj values are assumed the direction of flow in all the links meeting at are known. Thus these links either supply to the node j or distribute from the node j. let ij, i=1…m be the supply links and jk, k=1…n be the distribution links.

$$\frac{\delta}{\delta H_j}\left(\sum_{i=1}^{M} C_{ij} + \sum_{i=1}^{N} C_{jk}\right) = 0$$

Differentiating with respect to H_j and simplifying

$$\frac{\sum_{i=1}^{m} m_{ij} C_{ij}}{H_i - H_j} = \frac{\sum_{i=1}^{N} m_{jk} C_{jk}}{H_j - H_k}$$

Or

$$\sum_{i=1}^{M}\left(\frac{mc}{H_L}\right)_{ij} = \left(\sum_{i=1}^{N}\frac{mc}{HL}\right)_{jk}$$

Thus for the entire network

$$\frac{\sum m_{ij} C_{ij}}{H_i - H_j} = \frac{\sum m_{ik} C_{ik}}{H_j - H_k} \quad ; \quad j = 1 \ldots Y$$

Or

$$\sum\left(\frac{mC}{H_L}\right)_{ij} = \left(\sum\frac{mC}{H_L}\right)_{jk} \quad ; \quad j = 1 \ldots Y$$

This gives a set of optimality criteria, termed head loss ratio criteria.

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This gives a set of optimality criteria, termed head loss ratio criteria.

IV. METHODOLOGY AND DESIGN

4.1 Networking

A network is selected keeping in view to cover the entire area of the proposed campus. Sixteen nodes were established for the network. The network is selected along the sides of road length.

NETWORKING:

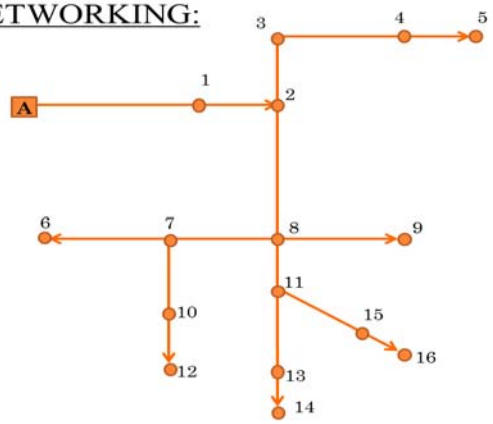

Fig: Selected water distribution network

4.2 Surveying

To know the HGL values of the nodes firstly RL of the nodes have to be known. For knowing the RL, survey of the location is required. The RL are taken with the help of Auto level. Simultaneously while taking RL, the lengths between the successive nodes are also measured and thus the total length for the various pipelines to be laid is measured.

I. Obtained reduced levels

Sr. No	Nodes To Node	Length (m)	Reduced Level
0	0	0	100
1	1	117	100.01
2	2	36	99.985
3	3	65	100.112
4	4	81	99.7
5	5	77	99.695
6	6	113	99.135
7	7	36	98.48
8	8	89	98.53
9	9	21	98.36
10	10	50	98.54
11	11	51	98.175
12	12	41	97.7
13	13	98	97.49
14	14	9	97.455
15	15	100	97.285
16	16	22	97.125

4.3 Estimation of demand

For calculation of the total demand at a source node, it is required to calculate demand at end node in the network. For the calculation of demand at the node, find out the various numbers of utilities including the population at that node. The demand and discharge at each node is to be found out and peak demand is to be calculated.

II. Different units in the campus and their demand

Node No.	Utilites involved	Total popul-ation	Per capita demand	Total demand lit/day
1	1.Worker Quarter	16	135	2160
				2160
2	1. Post Office PCO	10	15	150
	2.A Block	5	15	75
				225
3	1.B Block	100	135	13500
				13500
4	1.Jamuna Hostel	287	135	38745
	2.Jamuna Mess	287	70	20090
	3.Lawn		45	90
				58925
5	1. Triveni Hostel	351	135	47385
	2. Triveni Mess	351	70	24570
	3. Lawn		45	45
				72092
6	1.L type Quarter		135	2160
	2.R1 type Quarter	16	135	2160
	3.R2 type Quarter	24	135	3240
	4.R3 type Quarter	48	135	6840
	5.R4 type Quarter	48	135	6840
				20520
7	1.old Kaveri Hostel	128	135	17280

	2.Kaveri Hostel New	240	135	32400
	3.Kaveri Mess	368	70	31220
	4.Lawns	25	45	1125
				126245
8	1.Chairman Residence	10	135	4350
	2.Principal Residence	3	135	405
	3. New Guest House	4	135	540
	4.Old Guest House	4	135	540
				2835
9	1.Sports Complex	100	10	1000
	2.Project Engineer section	10	10	100
	3.lawns		45	45
				1145
10	1. Electrical lab	10	10	100
	2. Pump room	3	10	30
				130
11	1.Administrator Block	1400	45	63000
	2.lawn	5	45	1125
				64125
12	1.Fluid Mechanics Lab	10	100	100
	2.Lab1, Lab2	10	100	100
				200
13	1.Lawn		90	90
	2.MBA Block	270	45	12150
	3.Work Shop	20	45	900
14	1.Lawn		45	90
	2.Elec.,IT,Comp. Tech Building	590	45	26550
	3.Construction Yard			
				26640
15	1.Lawn		45	45
	2.Civil and Arch Dept.	340	45	15300
	3.Library	45	10	450
	4.Canteen	170	15	2550
	5.Fountain		$10m^3$	10000
				28345

Critical Slope is required for critical path. Calculation of the critical slope for various paths is shown in table III. The assumed HGL values s to be found out by

Assumed HGL = Ho – ScXL

III. Calculation of critical slope

Sr. No.	**Path**	**Path Length**	**Head Loss (H_L)**	**Slope = H_L /L**
1	0-1-2-3-4-5	376	6.305	0.0168
2	0-1-2-8-9	263	7.64	0.029
3	0-1-2-8-7-6	391	6.865	0.0179
4	0-1-2-8-7-10-12	369	8.3	0.0225
5	0-1-2-8-11-13-14	400	8.545	0.0214
6	0-1-2-8-11-15-16	415	8.875	0.0214

4.4 Head loss calculation

Head loss can be calculated by Hazen William Formula.

Hazen William formula: $H_L = \frac{10.6 \times L \times Q^n}{C_{HW}^n \times D^n}$

Where,

Q = Discharge in cumec hour

D = Diameter of pipe in mm

L = length of pipe

K = Constant depends on unit of pipe and material of the pipe

C_{HW} = Hazen and Williams coefficient

Where, $C = K \times L \times D^m$

m = cost function

The values of K and m are calculated by plotting graph of log of diameter of the pipes on X-axis verses log of cost of available pipes on Y-axis on a log-log graph.

IV. Values of cost function m and constant K for cast iron

Diameter	Cost	X= log D	Y=log C
80	380	1.903	2.580
100	412	2.00	2.615
125	495	2.097	2.695
150	592	2.176	2.772
200	874	2.301	2.941

4.5 Designing

For the design of the water distribution system, the main aim is to achieve the optimization .In this paper, the cost head loss ratio method is used. This method is evaluated by using the successive iteration with respect to cost of the network. The iteration gives the correction of the HGL values. The diameter of pipes obtained is converted to commercially available diameter.

V. HGL values of different node

Sr No	Node No	Length	Reduced Level	Min HGL	Max HGL
0	0	0	100	118	-
1	1	117	100.01	112.01	116.04
2	2	36	99.985	111.98	115.3
3	3	65	100.112	112.11	114.33
4	4	81	99.7	111.7	112.97
5	5	77	99.695	111.69	111.69
6	6	113	99.135	111.13	111.13
7	7	36	98.48	110.48	113.33
8	8	89	98.53	110.53	113.93
9	9	21	98.36	110.36	110.36
10	10	50	98.54	110.54	112.49
11	11	51	98.175	110.17	113.07
12	12	41	97.7	109.7	109.7
13	13	98	97.49	109.49	111.43
14	14	9	97.455	109.45	109.45
15	15	100	97.285	109.28	111.39
16	16	22	97.012	109.12	109.12

VI LENGTH OF THE LINK AND DISCHARGES

Sr. No.	Nodes To Node	Length (m)	Q (m^3/min)
1	0-1	117	0.5988
2	1-2	36	0.5965
3	2-3	65	0.1921
4	3-4	81	0.1779
5	4-5	77	0.1159
6	7-6	113	0.0214
7	9-7	36	0.2584
8	2-8	89	0.4041
9	8-9	21	0.0012
10	7-10	50	0.1054
11	8-11	51	0.1401
12	10-12	41	0.0001
13	11-13	98	0.016
14	13-14	9	0.0128
15	11-15	100	0.0573
16	15-16	22	0.0295

In this paper, cost head loss method is used. This method is evaluated by using the successive iteration with respect to cost of the network. The iteration gives the correction of the HGL values.

VII. Correction in HGL of intermediate nodes in 4^{th} iteration

Demand Node	Min. HGL	Assumed HGL	Correction in HGL
1	112.01	115.94	0.18
2	111.985	115.28	-0.281

3	112.112	114.108	0.105
4	111.7	112.77	-0.043
7	110.48	111.57	-0.115
8	110.53	112.76	-0.132
10	110.454	110.74	-0.986
11	110.175	112.16	-0.368
13	109.49	109.66	0.011
15	109.28	109.62	-0.084

VIII. Length of pipe and cost of pipe required for networking

Diameter	Length (m)	Rate per meter	Total cost
125	136.8	495	67740.75
100	129.2	412	53209.8
80	92.4	380	35112
75	177.8	218	38760.4
60	101.4	193	19750.2
50	33.8	112	3785.6
40	16	98	1568
25	104.4	68	7099.2
20	8.6	56	481.6
12	162	40	6480
Total Cost			233807.55 Rs.

V CONCLUSION

In this paper, the economy is achieved. This is achieved by adopting the cost head loss ratio method. The calculated diameters for various links are not commercially available in the market. so, the calculated diameters are converted into commercially available diameters. The correction obtained from each iteration gives the value of the assumed HGL if the assumed HGL values are less than the minimum required HGL values.

An attempt was made by cost head loss ratio method to optimise the Water distribution network for KITS campus. The cost of the network is reduced in each successive iteration. The total cost estimated for the distribution network is the summation of the cost of each pipe.

THE TOTAL COST OF PIPE LINE= 2,33,807.50Rs.

REFERENCES

[1]E. Alperovitsi, and U. Shamir, “Design of Optimal Water Distribution Systems”, the American Geophysical Union, Vol 13. No 6, Paper number 7W0382, 1977.

[2]M. Cisty, and Z. Bajtek, “Optimal design of water distribution system by a combination of Stochastic algorithms and mathematical programming”, Slovak journal of civil engineering, Vol 4 page 1-7, 2008.

[3]B. Djebedjian, A. Yaseen, and A. M. Rayan, “Optimization of large water distribution network design using genetic algorithm”, Tenth International Water Technology Conference, IWTC10 2006, Alexandria, Egypt, 2006.

[4]Y. D. Gao, and R. A. Simpson, “Optimal Design of Water Distribution Networks by Discrete State Transition Algorithm”, Journal of Latex class files, Vol 14 , January 2013.

[5]I. Sarbu, “Optimisation of water distribution network”, proceedings of the Romanian academy, series A, Vol 11, Number 4/2010, pp. 330–339, 2010.

[6]R. Soto, B. Crawford, S. Misra, E. Monfroy, W. Palma, C. Castro, and F. Paredes, “Constraint programming for optimal design of architectures for water distribution tanks and reservoirs: A case study”, ISSN 1330-3651, 2014..

[7]K. Varma, V. K. Narasimhan, and M. S. Bhallamudi, “Optimal design of water distribution system using an non-linear programming method”, Journal of environment engineering, page no. 388, 1997.

[8]P. R. Bhave, “Non computer Optimization of single-source Networks,” Journal of The Environmental Engineering Division, ASCE, Vol. 104, No EE4, Pp. 799-814, August 1978.

DEPLOYMENT OF PERFORMANCE IN LARGE SCALE WIRELESS MESH NETWORK

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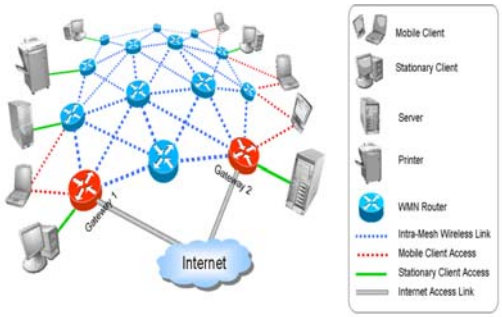
Abstract

In the propose system four parameters are introduced in order to determine the performance of wireless mesh network. The client coverage area, Backhaul tier connectivity, fair mesh connectivity and redundancy factor. In the existing study only three parameters are considered. In the proposed scheme four parameters are considered. Mesh topology indicates that there will be connectivity between every node with every other node. Hence the network is expensive in nature. In order to reduce the cost random topology is discarded from the mesh topology. The traffic will be deviated to the second route in order to reduce the traffic from the network. The utilization of resources will also be a factor determining the overall utilization. If the utilization is low resources will be wasted. In the proposed scheme performance will be estimated using above said factors.

Keywords: Mash Networks, Client server, Backhaul Tire, Mesh Capacity & redundancy

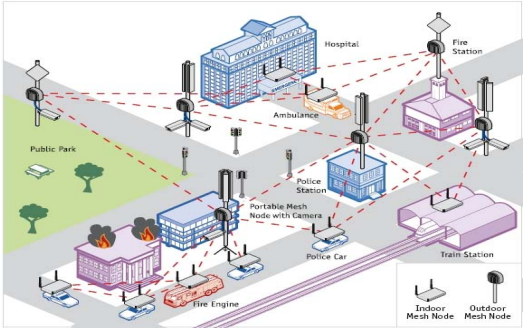
Introduction

The mesh network is used in order to transfer the data from one node to another. When information is transferred from source to destination than cost will be encountered. The cost associated with the transfer will be calculated by using the parameters present within proposed system. Wireless mesh network will provide low infrastructure cost and allow the city wide access to the internet.



The mesh network uses numbers of connecting devices. Also the workload on the individual device over the network is negligible. Hence load balancing is also present.

Our study first of all covers the area of the mesh topology. We find that slight deviation from ideal grid placement do not affect the coverage area. Random deployment will require twice the number of nodes to cover all the area defined by the mesh network. The coverage area will indicates that whether the data to the destination can be delivered successfully or not.



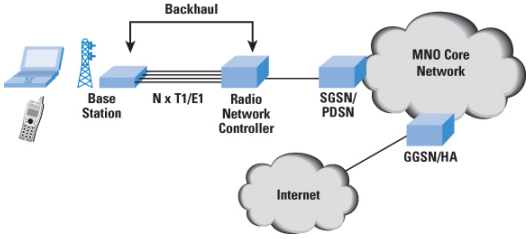
The second parameter which is considered is back haul tier rout. The average mesh node connectivity will be analyzed in this case. The nodes in mesh topology generally have

connection with every node on the network. If one connection is broken than the data can be transferred from other routes. The cost associated with the transfer is also low. When one path goes down than cost will be encountered while diverting the data to the other routes. Random node placement will degrade the performance slightly. However the data will be delivered to the destination for sure.

(Robinson & Knightly, 2007)Third, we calculate the ideal fair mesh capacity, i.e. the aggregate throughput at a wired gateway under per-user fairness constraints. (Robinson & Knightly, 2007)We show that separating the access and backhaul tiers with a second radio is not an efficient use of a second radio, as users in the network experience a fair capacity improvement of less than double. (Robinson & Knightly, 2007)This configuration does not fully take advantage of the second radio in the case where spatial reuse already allows some access links to operate without interfering with the wired gateway nodes. (Robinson & Knightly, 2007)Additionally, we find that a random network provides less than half the fair capacity of a regular grid topology due to increased contention for wireless airtime at wired gateway nodes and poor coverage area. Consequently, random networks are not suitable for a large-scale mesh deployment.

The forth parameter which we have introduced is redundancy factor. In this factor we calculate the packet redundancy by analyzing the packet number. If the same packet is already transferred than redundancy is present within the data transfer which will cause the bandwidth utilization. The overhead in terms of the channel utilization and cost will be introduced. So we will prevent the redundant packet to be transferred over the network.

A two tier back haul connectivity will be used which ensured that connection between client and server will be successfully established. In this case backhaul tier will be used for interconnection between infrastructure mesh nodes and wired connection to the internet.



There are number of factors which must be considered in the interconnection between source and destination. The factors are as listed below

A. Topology Factors

The topology will indicate the physical factors which are used in order to connect the source with the destination. The medium which is used will go to decide whether the coverage area is wide or not. The coverage area if high then only data is transferred to the desired destination. Best, Average and Worst cases will be considered in this case.

B. Grid Topology Perturbation

(Robinson & Knightly, 2007)In most mesh network deployment scenarios, the mesh operator does not have complete control over the placement of mesh nodes. (Robinson & Knightly, 2007)We next examine the impact of this realistic deployment scenario by introducing random perturbations to mesh node topologies.

RELATED WORK

In order to prove the worth of the study we have analyzed large number of papers. Some of the papers which are meaningful in the situation will be describes in this section

(Louis, Kedieng, & Nlong, 2015) Wireless Mesh Network is presented as an appealing solution for bridging the digital divide between developed and under-developed regions. (Louis et al., 2015)But the planning and deployment of these networks are not just a technical matter, since the success depends on many other factors tied to the related region. (Louis et al., 2015)Although we observe some deployments, to ensure usefulness and sustainability, there is still a need of concrete design process model and proper network planning approach for rural regions, especially in Sub-Saharan Africa. (Louis et al., 2015)This paper presents a design methodology to provide network

connectivity from a landline node in a rural region at very low cost. (Louis et al., 2015)We propose a methodology composed of ten steps, starting by a deep analysis of the region in order to identify relevant constraints and useful applications to sustain local activities and communication. (Louis et al., 2015)Approach for planning the physical architecture of the network is based on an indoor-outdoor deployment for reducing the overall cost of the network.

(Bondorf & Schmitt, 2010) the response time is considered as important factor in determining the performance of the mesh network. (Bondorf & Schmitt, 2010)The performance will be considered in terms of transfer process. The statistical time bounds (Bondorf & Schmitt, 2010)are determined in this case. t. With Monte Carlo method we derive estimates for quintiles of the maximum response time distribution under uncertainty about the topology. (Bondorf & Schmitt, 2010)In numerical experiments we show that the long but light tail of this distribution causes considerably lower bounds compared to the deterministic one even under small violation probabilities and, yet, on the other hand compare favorably with the median of the distribution.

(Brito, Stewart, & Hassan, n.d.) The WLAN is considered in this case. With the help of WLAN the wide area is covered and connectivity is also provided. A two tier mesh network is considered. A two tier network has relatively lower cost as compared to WAP (Wireless Access Point). Better coverage is presented in this case. (Si & Selvakennedy, 2008) For the emerging wireless mesh networks with multiple radios and directional antennas, this paper first proposes a position-based deployment and routing strategy, and then gives a concrete approach under this strategy.(Si & Selvakennedy, 2008) The main idea of this strategy is to deploy the mesh network in certain kind of geometric graph and then design a position-based routing protocol accordingly, so as to achieve efficiency and scalability.(Si & Selvakennedy, 2008) The proposed approach comprises two parts: (1) a topology generation algorithm based on Delaunay triangulations and (2) a routing protocol based on the greedy forwarding algorithm. (Si & Selvakennedy, 2008) Both parts have appealing properties for deployment or routing, with formal proofs provided when applicable. Our simulation results validate the proposed approach. (Knightly, n.d.) in this case four parameters are considered in order to measure the performance of the system. The four parameters which are considered involve Client Coverage Area, Protocol Dependent Throughput and Per User Fair Rates. (Akyildiz, Wang, & Wang, 2005) the performance of Ad-hoc network is presented in this case. The performance will increase when the performance metrics are followed successfully. The performance metrics which are considered are viable in nature. The redundancy is not considered in this case. (Fang, Administration, State, & Marcos, n.d.) the wireless mesh technology is considered in this case. It is cost effective way in order to transfer the data from source to the destination.

From the review we have conducted it is clear that most of the work which is does not considered redundancy as a factor in order to analyze the performance of the system. In the purposed system the forth parameter redundancy is considered.

COMPARISON OF TECHNOLOGY

The purposed scheme considered number of factors which are used in order to analyze the performance of the system. The techniques which are used in the existing system will be described through the following table.

Paper	Area of Concern	Advantages/Disadvantages
Rural Wireless Mesh Network : A Design Methodology	WLAN is considered	Relatively cheaper in nature. No performance metric is considered
Statistical response time bounds in randomly deployed wireless sensor networks	Randomly deployed wireless mesh network is considered.	Computation is less. Only one performance parameter is considered which is response time

Capacity optimization for VoWiFi on the AIT Campus Wireless Mesh Network Deployment	Wi-Fi is considered in this case	No performance metric is considered. The CAN(Campus Area Network) is Considered in this case
On Profitability and Efficiency of Wireless Mesh Networks	Wireless Technology used to connect source with destination	Performance and efficiency is considered as performance metrics. The area of concern is not wide enough
RICE UNIVERSITY A Performance Study of Deployment Factors in Wireless Mesh Networks by Joshua Robinson A Thesis Submitted in Partial Fulfillment of the Requirements for the Degree MASTER OF SCIENCE Approved , Thesis Committee : Houston , Texas ABSTRACT A	Wireless Mesh Technology	The set of four parameters are considered but redundancy is not considered as factor to measure the performance.
Rural Wireless Mesh Network : A Design Methodology	Wireless Mesh Technology	No particular parameters are defined in this case.
A Performance Study of Deployment Factors in Wireless Mesh Networks	Wireless Mesh Technology	The set of three parameters are considered. No redundancy factor is considered in this case.

CONCLUSION

In this work we have begun to take on some of the performance challenges facing in general wireless mesh networks. For this, we propose three metrics to capture four different components of a mesh network: coverage area, backhaul tier, capacity of the mesh topology and reduce redundancy. For coverage area, we find that the large amount of communication to be covered in large network and find the dead spots which areas are used very rarely. Backhaul tier connectivity depends upon to analyze the route present in wireless mesh network. There exist multiple route that we find all the exiting route with in the network from source to destination. In fair mesh capacity, find the throughput; that the amount of data can be transmitted from the network will depend upon the bandwidth. Finally, the redundancy is find the duplicate packets i.e in existing system, it detect and remove the redundancy so that same packet should not be transferred again and again. In our future work, we will concentrate on the initial interference estimation, which is a crucial factor of reduce redundancy assignment algorithm.

REFERENCES

1. Joshua Robinson and Edward W. Knightly, “Performance Study of Deployment factors in Wireless Mesh Networks”, Department of Electrical and Computer Engineering, September, 2014.
2. P. Gupta and P. R. Kumar, “The capacity of wireless networks,” IEEE Transactions on Information Theory, vol. 46, no. 2, Mar. 2000.
3. M. Kamenetsky and M. Unbehaun, “Coverage planning for outdoor wireless LAN systems,” in International Zurich Seminar on Broadband Communications, Zurich, Switz., February 2002.

4. Y. Zhang, J. Luo, and H. Hu, "Wireless mesh networking: architectures, protocols and standards," Auerbach Publications, 2007.
5. C. K. Verma, B. R. Tamma, B. S. Manoj, and R. Rao, "A realistic smallworld model for wireless mesh networks," IEEE Communications Letters, vol. 15, no. 4, pp. 455-457, April 2011.
6. A. Verma, C. K. Verma, B. R. Tamma, and B. S. Manoj, "New link addition strategies for multi-gateway small world wireless mesh networks," in Proc. IEEE 4th International symposium on Advanced Networks and Telecommunication systems, pp. 31-33, December 2010.

NUMERICAL STUDIES OF RCC FRAME WITH DIFFERENT POSITION OF FLOATING COLUMN

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Abstract— This paper pertains of analytical studies carried out to evaluate the performance of RCC frame under different position of floating column. Building with column that hangs or floats on beams at an intermediate storey and do not go all the way to the foundation, have discontinuities in the load transfer. The analysis has been carried out on a five storey RCC frame structure which has been analyzed. Analysis was carried out considering different positions of floating column by using STAAD pro. The effect of position of floating column was also studied. The bending moments are higher for all the floating column cases. The final maximum bending moments values are also influenced by the presence of floating column.

Key words—Floating column, frame, Maximum Bending moment, Seismic Force, STAAD. Pro V8i

I. INTRODUCTION

A column is supposed to be a vertical member starting from foundation level and suffering the load to the ground. The term floating column is also a vertical element which ends at its lower level rests on a beam which is a horizontal member. The beams in turn transfer the load to other column below it.

There are many projects in which floating columns are adopted, especially above the ground floor, where transfer girders are employed, so that more open space is available in the ground floor. These open spaces may be required for assembly hall or parking purpose. The column is a concentrated load on the beam which supports it. As far as analysis is concerned, the column is often assumed pinned at the base and is therefore taken as point load on the transfer beam. STAAD Pro, ETBS and SAP 2000 can be used to do the analysis of this type of structure.

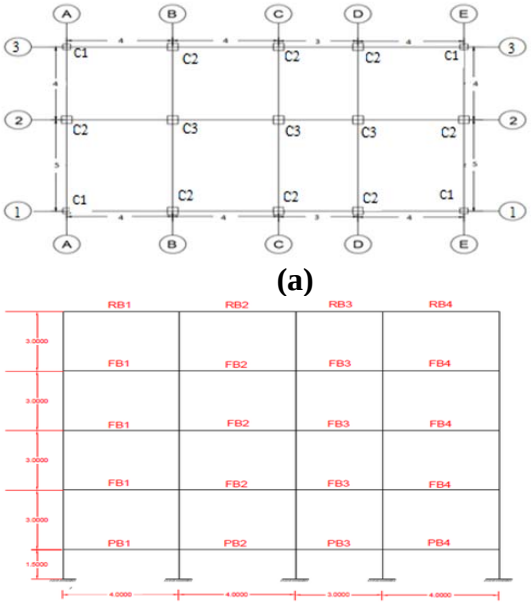
Several researchers have contributed their significant work in this direction direction e.g., [Ambadkar and Bawner(2012), Chandrasekaran and Rao (2002) Joshi and Pathak (2013), Malaviya and Saurav (2014)]. Prasad and shekha (2014) reported that the behavior of building frame with and without floating column is studied under static load free vibration and forced vibration condition. The equivalent static analysis is carried out on the entire project mathematical 3D model using the software STAAD. Pro V8i and the comparison of these models are been presented. This will help us to find the various analytical properties of the structure and we may also have a very

systematic and economical design for the structure. Sreekanth and Ramancharla etc.al (2014), studied the variations of the both structures by applying the intensities of the past earthquakes i.e., applying the ground motions to the both structures, from that displacement time history values are compared.

In this study an attempt has been made to evaluate the behaviour of RCC frame with floating column. The RCC frame was analysed and note down its shear force and bending moment. The effect of position of the floating on the frame is also studied and presented.

II. MODELLING

A five storey building was considered for analysis and then by using commercially available software STAAD Pro. Thereafter same frame was used for performing analysis to get shear force and bending moment by considering the different position of floating column. Fig. 1 shows the foundation plan and elevation of the frame considered for the analysis. Frame 1-1 and 2-2.



(a)

(b)

Fig. 1 Five storey frame considered for the analysis (a) foundation plan (b) elevation

There are many methods for the analysis but one of the most common approximations of floating column is Kani's. This method developed by Jasper Kani's of Germany. This is an excellent of slope deflection method, to analyze the building of five storeys only and dead load is taken into account.

The analysis of the frame was carried out using assumed loading input parameters. Live load on the roof and floor are 1.5 and 2 kN/m^2 respectively with slab thickness equal to 120 mm. Accordingly the dead loads were calculated and used in the analysis. Table 1 gives the initial assumed geometric properties of the five storey frame. By using STAAD Pro analysis was carried out to evaluate shear force and bending moment.

TABLE 1
Details of building models

Sr. No	Parameter	Specification
1	Live load on roof	1.5kN/m^2
2	Live load on floor slab	2 kN/m^2
3	Floor finish on slab	1.18 kN/m^2
4	Density of RCC	25 kN/m^3
5	Thickness of slab	120mm
6	Thickness of outside wall	230mm
7	Height of each floor	3m
8	Support condition	Fixed
9	Density of brick	18k N/m^3
10	Number of stories	5
11	Parpet wall height	900 mm
12	External thickness of plaster	12 mm
13	Density of plaster	20.4k N/m^3

14	Depth of foundation	1.5m B.G.L
15	Dimension of beam	300 x 300 mm
16	Dimension of column: Corner column	C1- 300 x 300 mm
	External column	C2- 400 x 400 mm
	Internal column	C3 – 400 x 450 mm

Table 2 gives the details of all the cases taken up for the analysis with consideration of different position of floating column.

TABLE II
MODELS OF FRAME 1-1

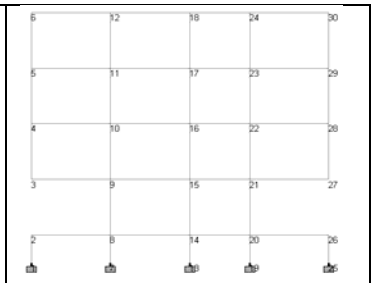
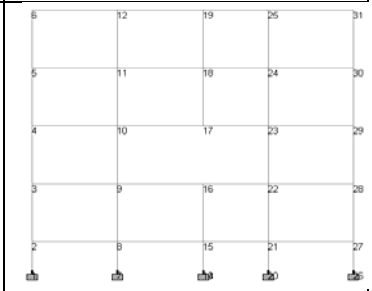
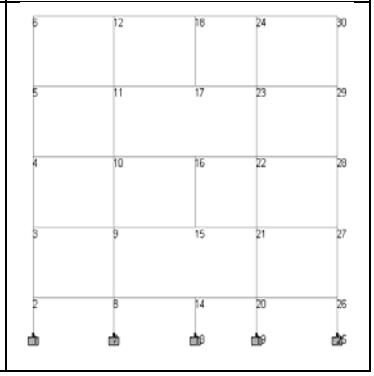
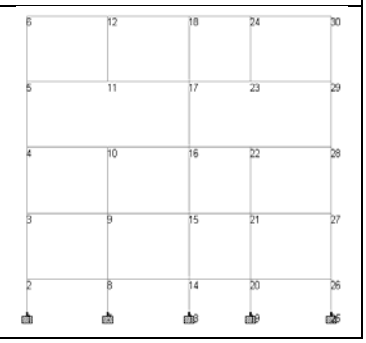
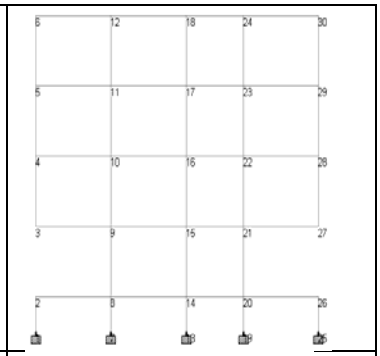
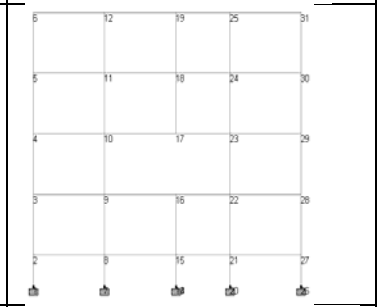
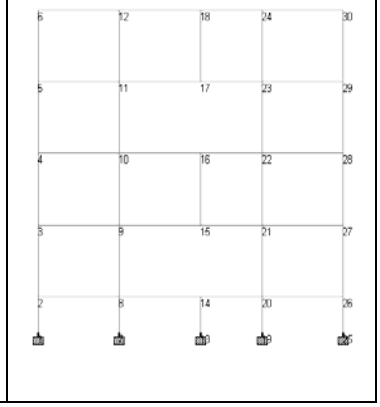
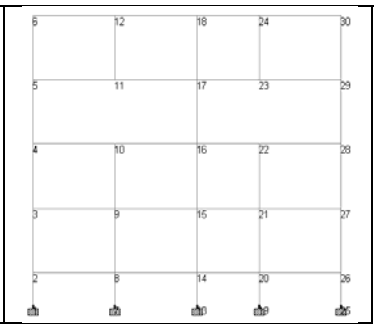
Model 1	Floating column located at ground floor on exterior frame	
Model 2	Floating column located at first floor on interior frame	
Model 3	Floating column located at ground floor and second floor on interior frame	
	interior frame	
Model 4	Floating column located at second floor on middle frame	

Table 3 gives the details of all the cases taken up for the analysis with consideration of different position of floating column.

TABLE IIII
MODELS OF FRAME 2-2

Model 1	Floating column located at ground floor on exterior frame	
Model 2	Floating column located at first floor on interior frame	
Model 3	Floating column located at ground floor and second floor on interior frame	

Model 4	Floating column located at second floor on middle frame	

IV. RESULT AND DISCUSSION

The performance of RCC frame considered in terms bending moments are significantly influenced by the position of floating column.

The bending moment significantly affected by the position of floating column .The maximum bending moment is found in Model frame 1-1. Table 4 gives the maximum bending moment in each floor. In comparison with all the cases, model 1 has shown maximum bending moment. This is due to the reason that by provision floating column on exterior side of ground floor.

Table IV: Maximum bending moment (kN-m) on each floor in column of frame 1-1

Condition of Floating Col.	Model A-1	Model A-2	Model A-3	Model A-4	Without floating col.
Storey level					
1	74.09	43.40	41.49	66.97	13.66
2	52.28	35.51	-26.04	38.04	13.02
3	54.75	-21.33	40.56	-11.75	-13.12
4	39.89	14.24	-25.04	12.97	-12.83
5	-22.47	-14.10	16.26	-14.08	-14.25

Table 5 gives the maximum bending moment values for all the cases with and without floating column.

Table V: Maximum bending moment (kN-m) on each floor in column of frame 2-2

Condition of Floating Col.	Model A-1	Model A-2	Model A-3	Model A-4	Without floating col.
Storey level					
1	-38.18	-21.49	-25.88	-21.59	-21.68
2	56.97	-23.53	-36.87	21.46	-21.05
3	75.74	-30.86	57.75	-20.06	21.35
4	71.28	50.12	-36.62	60.07	21.47
5	106.72	63.81	60.36	109.00	23.76

Figure 3 and 4 show the loading diagram from STAAD. Pro for model 2 from frame 1-1 and frame 2-2

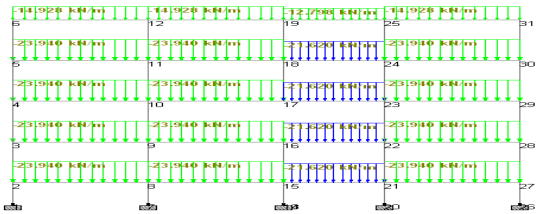


Fig.3 Loading diagram for model 2 from frame 1-1

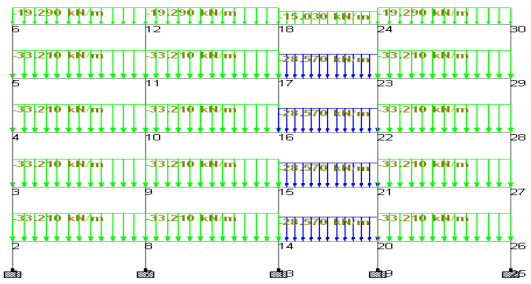


Fig.4 Loading diagram for model 2 from frame 2-2

Figure 4 and 5 show the bending moment diagram from STAAD. Pro for model 2 from frame 1-1 and frame2-2.

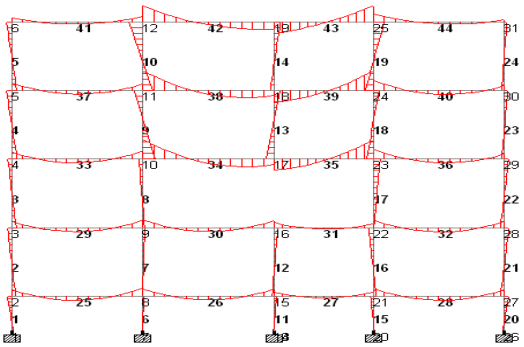


Fig.4 BMD for model 2 from frame 1-1

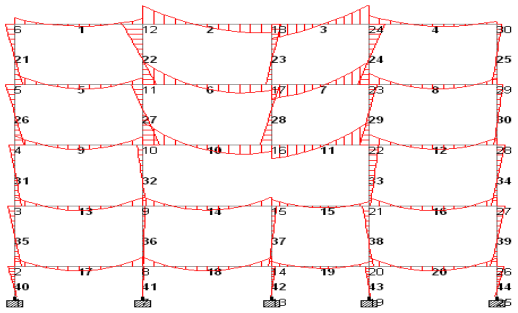


Fig.5 BMD for model 2 from frame 2-2

Table 6 and table 7 gives the shear force and bending moment values for the model 2 from frame 1-1 and frame 2-2.

Table VI : Bending moment of model 2 from frame 1-1

Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
1	1 LOAD CAS	1	215.470	-13.206	0.000	0.000	0.000	-6.003
		2	-215.470	13.206	0.000	0.000	0.000	-13.806
2	1 LOAD CAS	2	169.566	-8.649	0.000	0.000	0.000	-12.690
		3	-169.566	8.649	0.000	0.000	0.000	-13.258
3	1 LOAD CAS	3	123.027	-8.577	0.000	0.000	0.000	-13.857
		4	-123.027	8.577	0.000	0.000	0.000	-11.876
4	1 LOAD CAS	4	76.574	-11.002	0.000	0.000	0.000	-16.791
		5	-76.574	11.002	0.000	0.000	0.000	-16.215
5	1 LOAD CAS	5	27.983	-10.713	0.000	0.000	0.000	-15.629
		6	-27.983	10.713	0.000	0.000	0.000	-16.309
6	1 LOAD CAS	7	528.539	1.506	0.000	0.000	0.000	1.042
		8	-528.539	-1.506	0.000	0.000	0.000	1.218
7	1 LOAD CAS	8	430.871	2.309	0.000	0.000	0.000	1.618
		9	-430.871	-2.309	0.000	0.000	0.000	5.309
8	1 LOAD CAS	9	333.521	-6.188	0.000	0.000	0.000	-5.139
		10	-333.521	6.188	0.000	0.000	0.000	-13.426
9	1 LOAD CAS	10	209.064	-20.540	0.000	0.000	0.000	-35.514
		11	-209.064	20.540	0.000	0.000	0.000	-26.107

Table VII : Bending moment of model 2 from frame 2-2

Beam	L/C	Node	Fx kN	Fy kN	Fz kN	Mx kNm	My kNm	Mz kNm
1	1 LOAD CAS	6	17.991	39.473	0.000	0.000	0.000	28.617
		12	-17.991	37.687	0.000	0.000	0.000	-25.046
2	1 LOAD CAS	12	53.297	71.979	0.000	0.000	0.000	88.859
		18	-53.297	5.181	0.000	0.000	0.000	44.736
3	1 LOAD CAS	18	38.040	-32.080	0.000	0.000	0.000	-72.049
		24	-38.040	77.170	0.000	0.000	0.000	-91.826
4	1 LOAD CAS	24	9.909	45.320	0.000	0.000	0.000	40.684
		30	-9.909	31.840	0.000	0.000	0.000	-13.723
5	1 LOAD CAS	5	1.043	70.421	0.000	0.000	0.000	51.971
		11	-1.043	62.419	0.000	0.000	0.000	-35.968
6	1 LOAD CAS	11	-5.680	101.685	0.000	0.000	0.000	113.698
		17	5.680	31.155	0.000	0.000	0.000	27.361
7	1 LOAD CAS	17	-11.052	-18.281	0.000	0.000	0.000	-70.657
		23	11.052	103.991	0.000	0.000	0.000	-112.752
8	1 LOAD CAS	23	-0.295	71.538	0.000	0.000	0.000	54.238
		29	0.295	61.302	0.000	0.000	0.000	-33.766
9	1 LOAD CAS	4	-5.648	67.645	0.000	0.000	0.000	47.169
		10	5.648	65.195	0.000	0.000	0.000	-42.267
10	1 LOAD CAS	10	-24.430	102.002	0.000	0.000	0.000	112.106

V. CONCLUSIONS

The analysis proves that floating columns are harmful for the structures and it is important to have simpler and regular shapes of frames as well as uniform load distribution around the building. Therefore, as far as possible irregularities in a building must be avoided.

Two frames of the building i.e. frame 1-1 and frame 2-2 is analysed using software and KANI's method and the results are found to be nearly same. There are various methods of analysis of multi-storey building frame. The methods like KANI's and Moment Distribution method are iterative in nature hence give more accurate answers where a substitute method isvery approximate hence not followed. Matrix method isused in the form of software because programming of these is based on matrix methods.The results concluded on providingdifferent position of floating column is that there is increase in bending moment when floating condition is provided of model 1 to model 4 and bending moment is least in normal RCC frame.

REFERENCES

1] A. R. Chandrasekaran ,D. S. Prakash Rao, "A Seismic Design of Multi-storied RCC Buildings", Published in Proceedings of the12th

Symposium on Earthquake Engineering at IIT-Roorkee in December 2002.
2] G.Joshi ,K.K. Pathak , "Seismic Analysis of Soft Storey Buildings Considering Structural and Geometrical Parameters", Journal on Today's Ideas- Tomorrow's Technologies, Vol. 1, No.2, December 2013, pp. 73-84.
3]M.K.Srikanth ,R.Y. Holebagilu, "Seismic Response Of Complex Buildings with Floating Column for Zone II & Zone V", International Journal of Engineering Research, Vol. 2, Issue 4, July 2014, ISSN 2321-7758.
4] P.Malaviya , Saurav, "Comparative Study of Effect of Floating Columns On the Cost Analysis of a Structure Designed on STAAD PRO V8i", International Journal of Scientific & Engineering Research, Volume 5, Issue 5, May-2014, ISSN 2229-5518.
5] P. Nautiyal, S.Akhtar & G. Batham, "Seismic Response Evaluation of RC Frame Building with Floating Column Considering Different Soil Conditions", International Journal of Current Engineering and Technology, Vol. 4, No. 1, February 2014, E-ISSN 2277-4106
6] P.V. Prasad , S.T. Raja, "Study of Behavior of Seismic Analysis of Multi-storied Building with and Without Floating Column", Carib. j. SciTech, 2014, Vol.2, 697-710.
7] S. D. Ambadkar, V.S. Bawner, "Behaviour of Multi-storied Building under the Effect of Wind Load", International Journal of Applied Sciences & Engineering Research (IJASER), Volume 1, Issue 4, 2012, ISSN 2277-9442, (2012).
8] S.G. Nanabala , Ramancharla, E. Arunakanthi , "Seismic Analysis of a Normal Building and Floating Column Building", International Journal of Engineering Research and Technology (IJERT), ISSN: 2278-0181, Vol. 3, Issue 9, September-2014.

REVIEW OF DESIGN AND DEVELOPMENT OF AUTOMATIC AND EFFECTIVE BUG TRIAGING TECHNIQUE USING DATA MINING

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Abstract— Bug triaging is the important step of bug fixing. Bug triaging aims the assignment of a new bug to the correct developer. The automatic bug triage used to decrease the time and cost in manual work. In this paper, we focus on the efficient technique to overcome problem of data reduction for bug triage with reducing the scale and improve the quality of bug data. With the combination of instance selection and feature selection the data scale is reduced on the bug dimension and the word dimension and determined the order of applying instance selection and feature selection. The survey shows that data reduction can effectively reduce the data scale and improve the accuracy of bug triage.

Index Terms—bug triage, effective bug triage, instance selection, feature selection.

I. INTRODUCTION

As new software systems are getting larger and more complex every day, software bugs are becoming inevitable phenomenon. Bugs can occur from a various reasons such as ranging from ill-defined specifications, to carelessness of programmers and misunderstanding of the problem and technical issues [16]. Bugs are the programming errors that cause significant performance degradation. A software bug is an error, flaw, mistake, failure, or fault in a computer program or system that produces an incorrect or unexpected result, or causes it to behave in unplanned ways. Software repositories are a large-scale database that stores the output of software development such as source code, bugs, emails, and specifications. A bug repository plays an important role in managing software bugs. Fixing bugs is expensive in software development. In a bug repository, a bug is maintained as a bug report, which consists of textual description of bug details and updates according to the status of bug fixing. Selection of the most appropriate developer to fix a new bug report is one of the most important step in the bug triaging process and it has a significant effect in decreasing the time taken for the bug fixing process and the cost of the projects. Bug triage aims to correctly assign a potential developer to a new bug.

Fixing bug reports with the traditional bug triage system i.e manual bug triage is very time consuming and costly process [1].

Bug triager is the person who assigns the bug to a developer. Bug triager, must be aware of the activities of all the developers in the project. If the developer, to whom the bug report is assigned, could not resolve it, then it is assigned to another developer. This would consume both time and money. Thus, it is important to assign the bug report to a developer who could successfully fix the bug without need of any tossing. Hence, the job of bug triager is really crucial [1]. Figure 1.1 shows the life cycle of bug. It shows that by how many stages a single bug have to pass for getting fixed.

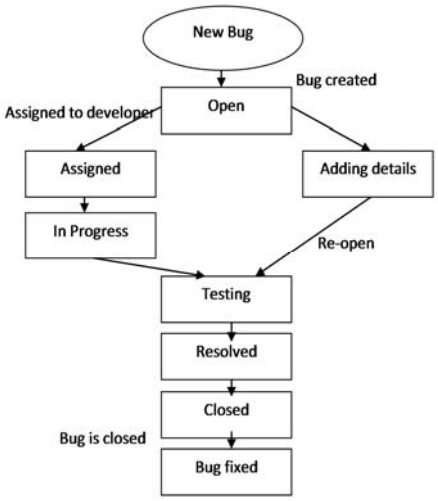

Fig. 1 Life cycle of bug

II. MOTIVATION AND RELATED WORK

A. Motivation

Open bug repository to which both developers and users can report, typically support an open source development projects. The reports that appear in this repository needs to be assigned to the proper developers for resolving the report. Noisy and redundant data always appears in real-world. Noisy data may produce problems in the data analysis techniques while redundant data may increase the cost of data processing. In bug repositories, all the bug reports are filled by developers in his own language. The low-quality bugs i.e. bugs with redundant data and noisy data accumulate in bug repositories with the growth in scale. Such large-scale and low-quality bug data may reduce the effectiveness of fixing bugs [1].

Who is the most suitable developer to fix the bug? Every day high numbers of new bugs being found and large numbers of developers working on the same software project development teams needs to dedicate the time to decide who is the most suitable person to fix each one of them. The bug assignment with very limited information such as the contents of the bug description in the bug report, the error message provided by the bug and their experimental knowledge about the expertise of each developer makes complexity in bug triage. [6]

B. Related work

The problem of data reduction for bug triage, i.e., how to reduce the scale and improve the quality of bug data, Xuan et al. [1] combine instance selection with feature selection to simultaneously reduce data scale on the bug dimension and the word dimension. To determine the order of applying instance selection and feature selection, they extract attributes from historical bug data sets and build a predictive model for a new bug data set. Jeong et al. [2] have proposed a graph model based on Markov chains, which captures bug tossing history. They analyzed 445,000 bug reports and their detailed activities from the Eclipse and Mozilla projects. They found that it takes a long time to assign and toss bugs. Zou et al. [1, 3] used different techniques for finding bugs in web applications using dynamic test generation and explicit-state model checking. To reduce time and cost of bug triaging, Alenezi and Magel present an automatic approach to predict a developer with relevant experience to solve the new coming report. [4]. John Anvik et al. [5] present a semi-automated approach intended to the assignment of reports to a developer. Francisco Servant proposed an automated technique to support bug investigation by using a novel analysis of the history of the source code [6]. Akila et al. [7] preserves the work done by all the intermediate software developers. Further the system uses actual path model instead of goal oriented path model. Thus an efficient system which captures the knowledge of the shortest paths has been highlighted. [8] Proposed new approach for selecting the developers who have appropriate expertise in the related area for handling the bug reports. A profile is created for each developer based on his previous work. This profile is mapped to a domain mapping matrix which indicates the expertise of each developer in their corresponding area. In order to evaluate our approach, they have experimented with bug reports of chromium dataset. Their experimental evaluation shows that proposed approach is able to achieve an efficiency of 86% for top-10 and 97% for top-20 developer ranking list. Kumar et al. [9] introduced a bug tracking system tools that analyze the bugs in two different ways, which help to classify bug reports. In first ways they introduce Naïve Bayes classification process by which they find probability of bugs categories on the basis of attributes of category of bug dataset.

And in second ways they use natural language processing in summary attributes of bug dataset. By compare the results of two methods they were able to classify more accurately and efficiently. Xindong Wu et al. [10] present a HACE theorem that characterizes the features of the Big Data revolution, and proposes a Big Data processing model, from the data mining perspective. This data-driven model involves demand-driven aggregation of information sources, mining and analysis, user interest modeling, and security and privacy considerations. They analyze the challenging issues in the data-driven model and also in the Big Data revolution. Herzig et al. [11] discuss the impact of this misclassification on earlier studies and recommend manual data validation for future studies. Tian et al. [13] compare the effectiveness of seven state-of-the-art POS taggers on bug reports. They build a ground truth set that contains 21,713 tagged words from 100 sampled bug reports from Eclipse and Mozilla project. [14] have classified the bugs in different labels on the basis of summary of the bug. Multinomial Naïve Bayes text classifier is used for classification purpose.

III. APPROACH

To reduce the time spent in triaging, we present an approach for automatic triaging by recommending one experienced developer for each new bug report. To improve the accuracy of bug triage, bug data reduce with reducing the scales of the bug dimension, word dimension. A combination approach to addressing the problem of data reduction can be viewed as an application of instance selection and feature selection in bug repositories [1]. The order of applying instance selection and feature selection is predicted by binary classifier.

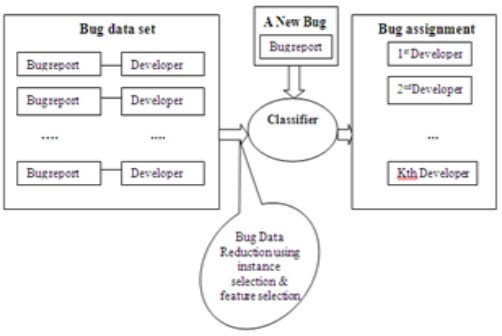

Fig.2 Block diagram of bug triage system

A. Instance Selection and Feature Selection

In bug triage, a bug data set is converted into a text matrix with two dimensions, namely the bug dimension and the word dimension. The combination of instance selection and feature selection use to generate a reduced bug data set. The original data set is replaced with the reduced data set for bug triage. Instance selection and feature selection are widely used techniques in data processing. Instance selection is to obtain a subset of relevant instances (i.e., bug reports in bug data) [1, 15] while feature selection aims to obtain a subset of relevant features.

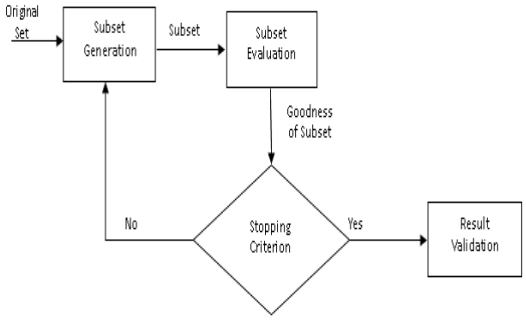

Fig.3. Four key steps for the feature selection process

IV. CONCLUSIONS

This survey provides a comprehensive overview of various techniques for bug triage used to reduce the scales of data sets and to improve the quality of bug reports. The techniques used for data reduction are instance selection and feature selection. The techniques of instance selection and feature selection are used to reduce noise and redundancy in bug data sets. The data reduction effectively reduces the bug data set into high quality bug data which can be used for effective bug triaging.

REFERENCES

[1] Lifeng Xuan, He Jiang,, Yan Hu, Zhilei Ren, Weiqin Zo, “Towards Effective Bug Triage with SoftwareData Reduction Technique”, IEEE transactions on knowledge and data engineering, vol. 27, no. 1, january 2015.

[2] Gaeul Jeong, Sunghun Kim, Thomas Zimmermann, “Improving Bug Triage with Bug Tossing Graphs”, 2009 ACM.

[3] Weiqin Zou Yan Hu, Jifeng Xuan, He Jiang “Towards Training Set Reduction for Bug Triage”, IEEE transactions on knowledge

and data engineering, vol. 27, no. 1, january 2015.

[4] Mamdouh Alenezi and Kenneth Magel, "Efficient Bug Triaging Using Text Mining" , ACADEMY PUBLISHER 2013.

[5] John Anvik, Lyndon Hiew and Gail C. Murphy, "Who Should Fix This Bug?", 2006 ACM.

[6] Francisco Servant "Supporting Bug Investigation using History Analysis", 2013 IEEE.

[7] V.Akila, Dr.G.Zayaraz, Dr.V.Govindasamy, "Effective Bug Triage – A Framework", International Conference on Intelligent Computing, Communication & Convergence (ICCC-2014), Procedia Computer Science 48 (2015) 114 – 120

[8] Anjali Sandeep and Kumar Singh, "Bug Triaging: Profile Oriented Developer Recommendation", International Journal of Innovative Research in Advanced Engineering (IJIRAE) ISSN: 2349-2163 Volume 2 Issue 1 (January 2015).

[9] Pankaj Kumar and Mr.Nishant Anand, "Two way classification approache of statistical bug reports", International Journal of Engineering Research and General Science Volume 3, Issue 3, May-June, 2015 ISSN 2091-2730

[10] Xindong Wu, Xingquan Zhu, Gong-Qing Wu and Wei Ding, "Data Mining with Big Data", IEEE transactions on knowledge and data engineering, vol. 26, no. 1, january 2014.

[11]Kim Herzig, Sascha, "It's Not a Bug, It's a Feature:How Misclassification Impacts Bug Prediction", 978-1-4673-3074-9/13/$31.00 c 2013 IEEE, ICSE 2013, San Francisco, CA, USA

[12]Pankaj Gakare, Yogita Dhole, " Bug Triage with Bug Data Reduction", International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056, Volume: 02 Issue: 04 | July-2015

[13]Yuan Tian and David Lo, "A Comparative Study on the Effectiveness of Part-of-Speech Tagging Techniques on Bug Reports", 978-1-4799-8469-5/15 c 2015 IEEE, SANER 2015, Montréal, Canada

[14]Gousiya Begum, S.Vijaya Lakshmi, Shaik Irfan Babu .Nagi Reddy, "Novel Design and Implementation of an Automated Approach for Software Bug Classification", International Journal of P2P Network Trends and Technology (IJPTT) – Volume 9 – June 2014, ISSN: 2249.

[15] Y. Fu, X. Zhu, and B. Li, "A survey on instance selection for active learning," Knowl. Inform. Syst., vol. 35, no. 2, pp. 249–283, 2013.

[16]Anahita Alipour, Abram Hindle, Eleni Stroulia, "A Contextual Approach towards More Accurate Duplicate Bug Report Detection", Natural Sciences and Engineering Research Council (NSERC), Alberta Innovates Technology Futures (AITF), and International Business Machines (IBM) corporation.

FAILURE MODE APPRAISAL IN DIE BLOCK

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Abstract— The die fatigue life is determined by the design of metalformed product and die, forming process configuration, die stress and the entire metal-forming system. In the metal formed industries die is an important tool for fabrication of metal formed product. At the same time failure of tool steel take place because of many numbers of causes and insufficient material selection criteria. Main objective is to study the effect on the hardness of three sample grades of tool steel i.e. EN-31, D2, and D3 after heat treatment processes such as Annealing, Normalizing, and Hardening & Tempering. After selection of material & heat treatment processes further aims to perform mechanical & chemical analysis. After composition testing aims to do heat treatment processes i.e. Annealing, Normalizing, and Hardening & Tempering to be carried on such material & after treatment aims to perform hardness testing on the treated and untreated work samples.

Keywords — Heat treatment, Annealing, Normalizing, hardening, Tempering, Hardness.

I. INTRODUCTION

Die is an important tool for deformation or fabrication of metal-formed products. Die is a work holding device, designed specifically for a particular design of a product. Die is rigidly held on the base of the press. To have good die performance and service life, the die should be optimally designed and precisely fabricated. [9] The block or plate made from highquality steel and mounted on the bottom portion of the die set to which section or parts of the die. It is subjected to extreme pressures and wear conditions. Hence the die block is made of superior quality of tool steel. [10] Tool steels are broadly divided into six categories like cold work, shock resisting, hot work, high speed, water hardening, plastic mould and specialpurpose tool steels. Among them, cold work tool steels are the most important category, as they are used for many types of tools, dies and other applications where high wear resistance and low cost are needed. [2]

II. TOOL STEEL FAILURES

Failures of punch in manufacturing operation generally results one or more of the following causes:

1. Improper design
2. Defective material
3. Improper heat treatment and finishing operations
4. Overheating and heat checking (crack caused by

temperature cycling)

5. Excessive wear
6. Overloading
7. Misuse
8. Improper handling. [5]

A. Some of the major factors leading to die failures are described below

Although these factors apply to die block made of tool steel, many are also applicable to other tool materials. The proper design of die block is as important as the proper selection of die material. In order to withstand forces in manufacturing process, a die must have proper cross-sectional and clearance. Sharp corner, radii, and the fillets, as well as abrupt changes in cross section, act as stress raiser and can have detrimental effects on die block life. [4]

III. EXPERIMENTAL APPROACH FOR METHOD & MATERIAL SELECTION

Step 1: Literature has been collected from research papers, journals, books etc. and literature gap analysis related to die block failure.

In today's industrial growth greater demands on products and materials, from which they are made. Years ago, many designers never figured out stress and strain, elasticity,
fatigue, or similar values.

Fig. 1 Die Block Failure

Under this failure analysis main purpose is selection effective tool steel material with appropriate grade is necessary in most common manufacturing industry. A tool steel material grade EN-31, D-3 and D-2 is selected for project work. The main reason to select the material is availability of material their heat treatment process and cost of tool steel.

Step 2: Industrial survey for selection of tool steel and preparation of objective function.

More number of tools steel materials are used in manufacturing industry under these most preferable material selection criteria is to be used under the cost of raw material and related to its heat treatment process. Overall analysis is necessary for maintain the objective function of the project work.

Step 3: Cutting and turning of tool steel specimens.

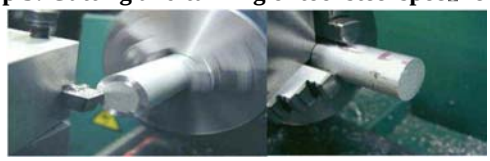

Fig 2 Turning of tool steel

There was requirement for two samples of each material for the heat treatment and testing purpose. So we cut the sample in 16 mm diameter with 250 mm to 100mm length. Three samples i.e. EN-31, D-3 and D-2 can be cut with power hack saw and turning which is carried out under the Lathe Machine.

Step 4: Composition testing of untreated tool steel i.e.
EN 31, D3, and D2.

Chemical composition is the most important influence upon shearing performance of the tool steel. Each alloying element in tool steel such as tungsten, chromium, molybdenum, vanadium, has a specific role in determining the mechanical properties. In chemical testing the components and purity of many raw or in-process materials, and finished product find out. Also Measure multiple constituents simultaneously. It takes about 5-6 minutes for the chemical composition testing of a single material. The readings of the test are shown on the Display of Computer in Tabulated Form. It Shows the Percentage Composition of Each Element .After Testing Chemical Composition of the material, the values Compared with that of Values as per International Standards. The Testing of a Single Sample is done 2-4 times from Different point on the smooth surface of the sample. The same Procedure for chemical testing is also done for EN-31, D-3 and D-2 also.

Step 5: Tensile testing of tool steel with measure their all parameters.

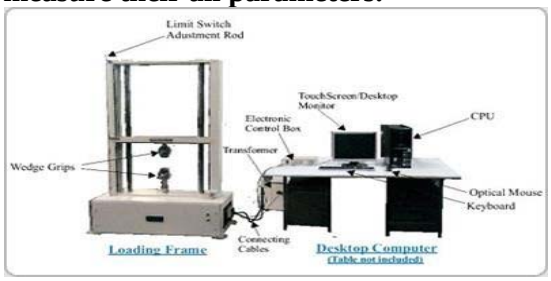

Fig. 3 Tensile test on Tool Steel

In tensile testing of tool steel measure the specimen Diameter, Gauge length also carried out yield load, ultimate load, yield stress, ultimate tensile strength and percentage of elongation. Overall tensile test is carried out on the Universal Testing Machine.

Table No. 1 Tensile test parameters

Material	EN-31	D-3	D-2
Thickness/ Dia. Mm	16.96	16.56	16.37
Area mm2	226.00	215.47	210.55
Gauge Length Mm	85.00	83.00	82.00
Final GL Mm	104.98	85.26	91.68
Yield load KN	111.02	97.20	87.12
Ultimate Load KN	158.90	204.56	152.46

Yield Stress Mpa	491.23	451.11	413.77
UTS Mpa	703.08	949.37	724.09
% E	23.51	2.72	11.80

Step 6: Applying heat treatment process such as annealing, hardening and tempering for EN-31, D-3, and D-2.

Using the heat treatment process one after one to maintain the required mechanical properties under the temperature range i.e. 800 ^{0}c to 820^0 c in annealing process and in hardening process 750^0 C to 850^{0}C.

Step 7: Hardness testing of treated tool steel i.e. EN-31, D-3 and D-2.

Fig. 4 Rockwell Hardness Tester

There are many types of material testing equipment, hardness testing machines provide the simplest and most economical testing methods and they play a vital role in research through to production and commercial transactions. Under which most suitable Rockwell hardness tester is used also Steel Hardness Calculator Used for Conversion of Values. Using that calculator we calculated HRB value & Brinell Hardness HB, Vickers HV.

Type of sample: - Round piece, Material - EN-31, D-3 and D-2.

Heat treatment: - Annealing, Hardening & Tempering.

IV. RESULT AND DISCUSSION

Table No. 2 Composition of tool steel after composition testing of test materials

Material	**EN-31**	**D-3**	**D-2**
C %	0.92	2.34	1.58
Si %	0.29	0.43	0.58
Mn %	0.34	0.28	0.3
S %	0.007	0.005	0.005
P %	0.02	0.026	0.02
Cr %	1.42	12.2	11.01
	---	0.11	1.02
W %	---	0.001	---
Mo %	---	---	1.05
Ni %	---	---	---

Type of the sample: - Round piece

Material sample: - EN-31, D-3 and D-2.

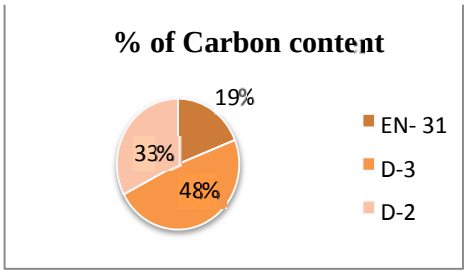

Fig.5 Carbon % of Tool steel material

To check the maximum and minimum carbon contents and chromium contents in EN-31, D-3 and D-2 samples tool steel materials.

Conclusion- In various types of material original carbon contents Shows the originality of Material used for testing leads to validity of performances outcomes that carried out in further comparative statements. Using this pie chart shows the

maximum carbon contents in particular type of material.

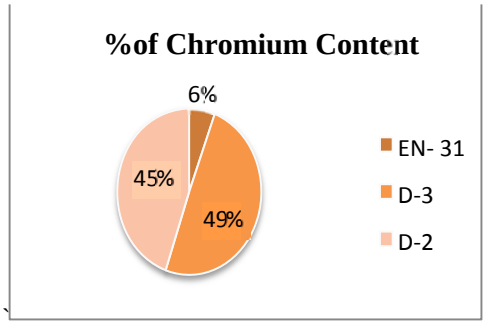

Fig.6 Chromium % of Tool steel material

Conclusion: - In above graphical representation shows the maximum chromium content in each type of material. As a result, chromium is very frequently used as a decorative, and simultaneously corrosion-resistant, coating. Under this conclusion D-3 and D-2 material chromium contents are high as compared to OHNS, EN-31 and EN-9.

Table No. 3 Hardness of tool steel EN-31 after Heat Treatment

Test Material	Heat Treatment	Rockwell CHRC	Rockwell BHRB	Brinell Hardness	Vickers HV
EN-31	Annealing	18	95	212	218
	Hardening & Tempering	50	117	469	505

Conclusion For EN-31:- In annealing and hardening and tempering process the Rockwell hardness grade HRB of material is to be change from 95 Rockwell HRB in annealing and 117 Rockwell HRB in hardening and tempering is to be shown in table.

Table No. 4 Hardness of tool steel D-3 after Heat Treatment

Test Material	Heat Treatment	Rockwell CHRC	Rockwell B-HRB	Brinell Hardness HB	Vickers HV
D-3	Annealing	27	103	262	262
	Hardening & Tempering	56	-	572	694

Conclusion for D-3:- In the above table shows the Rockwell C-HRC hardness of D-3 material under annealing heat treatment process is 27 C-HRC and after hardening and tempering it is 56 C-HRC.

Table No. 5 Hardness of tool steel D-2 after Heat Treatment

Test Material	Heat Treatment	Rockwell C-HRC	Rockwell B-HRB	Brinell Hardness HB	Vickers HV
D-2	Annealing	12	91	186	184
	Hardening & Tempering	60	-	627	-

Conclusion for D-2:- In the above table shows the Rockwell C-HRC hardness of D-2 material under annealing heat treatment process is 12 C-HRC and after hardening and tempering it is 60 C-HRC.

V. COMPARATIVE RESULTS AFTER HEAT TREATMENT PROCESS

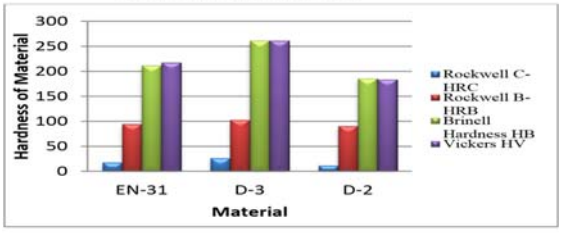

Fig. 7 Graphical representation of Hardness of Tool Steel after Annealing

***A. After Annealing* :-** If we consider annealing heat treatment process Brinell Hardness- Grade of material D-3, D-2 and EN-31 grade material shows the 212HB, 262HB and 186HB. After annealing heat treatment process Brinell hardness of D-3 grade tool steel material is higher as compared to D-2 and EN31. It means that the D-3 grade tool steel material is harder than the remaining tool steel material. Generally its hardness is increase or decrees after the hardening and tempering process. If we again consider the Vickers hardness test result the hardness of D-3 grade material is 262 HV which is higher as compared to D-2 and EN-31 tool steel material.

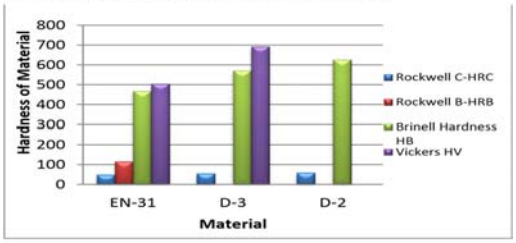

Fig. 8 Graphical representation of Hardness of Tool Steel after Hardening and Tempering

***B. After Hardening and Tempering*: -** After hardening and tempering heat treatment process Brinell hardness HB of D-3 and D-2 material is 572 HB and 627HB. D-2 material shows the maximum Brinell hardness as

compared to EN-31 and D-3 Also in Vickers hardness HV for D-3 material is 694 HV means Vickers hardness of D-3 material is maximum as compared to EN-31 and D-2.

***C. Comparison*:** After annealing specimen becomes harder than untreated specimen. After annealing hardness is more as compared to untreated specimen. But specimen has not obtained good microstructure. After hardening and tempering specimen are hardest then other three specimens also having a good corrosion resistance.

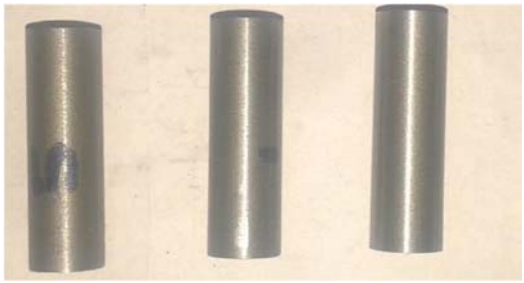

Fig. 9 Overview of the test sample used for heat treatment process

VI. CONCLUSION

In this work different methods are studied for increasing the mechanical properties and Heat treatment method is used to find the mechanical properties of EN31, D2, and D3 materials. And also know the effect of heat treatment on the mechanical properties of EN31, D2, and D3 materials. It is observed that the effect of hardness of work piece material after treatment of Tool Steel i.e. EN-31, EN-8, and D3 have not been explored yet, so it‘s interesting to study the effect on the hardness of three sample grades of tool steel i.e. EN-31, D2, and D3 after heat treatment processes such as annealing, normalizing, and hardening & tempering. A future aspect of this study to carry out further is very wide. Selecting of different tool steel material and compare them the effects on their mechanical properties. Using Different analytical approaches is also making an effective outcome which is also recommended.

REFERENCES

[1] Pawan Kumar Rai, Dr. Aas Mohammad, Hasan Zakir Jafri, “Causes & Preventation of Defects (Burr) in Sheet Metal Component,” International Journal of Engineering Research and Applications (IJERA),Vol.-3, Issue-4, pp. 511-515, JulAug 2013.

[2] Ashish Bhateja, Aditya Varma, Ashish Kashyap, Bhupinder Singh, “ Study the Effect on the Hardness of three Sample Grades of Tool Steel i.e. EN-31, EN-8, and D3 after Heat Treatment Processes such as Annealing, Normalizing, Hardening & Tempering,” The International Journal of Engineering and Science (IJES), Volume-1,Issue- 2, pp. 253259, 2012.

[3] A.D. Wale, Prof. V.D. Wakchaure, “Effect of Cryogenic Treatment on Mechanical Properties of Cold Work Tool Steels,” International Journal of Modern Engineering Research (IJMER), Vol.3, Issue.1, pp.149-154, Jan-Feb. 2013.

[4] Jatin Garg, Arun Kapil Kumar, “Design and Manufacturing of Deep Drawing Dies for Warm Forming,” April 2013.

[5] Dr. Taylan Altan, Mayur Deshpande, “Selection of Die Materials and Surface Treatments for Increasing Die Life in Hot and Warm Forging”, Paper no 644-FIA Tech Conference, April 2011.

[6] M.W.Fu, J. Lu, W.L.Chan, “Die fatigue life improvement through the rational design of metal-forming system,” Elsevier journal of materials processing technology 209(2009), pp. 1074-1084, 15 March 2008.

[7] Guangyong Sun, Guangyao Li, Zhihui Gong, Xiangyang Cui, Xujing Yang, Qing Li, “Multiobjective robust optimization method for draw bead design in sheet metal forming”, Elsevier journal of Materials and Design 31 (2010), pp. 1917-1929, 28 October 2009.

[8] Michael P. Pereira, MatthiasWeiss, Bernard F. Rolfe, Tim B. Hilditch, , “The effect of the die radius profile accuracy on wear in sheet metal stamping,” Elsevier International Journal of Machine Tools & Manufacture, pp.44-53, 21 November 2012.

REFERENCE BOOKS

[9] Handbook of Die by J.R. Paquine and R.E. Crowley.

[10]Press Tool Design and Construction by P. H. Joshi, S. Chand Publication. 01 -15.

[11] A Book of Production Engineering by P.C. Sharma, S.
Chand Publication. 69 -146.

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STRING COMPRESSION TECHNIQUE WITH MODIFIED AES ENCRYPTION

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ABSTRACT

In this work of research, the three layered architecture is been developed with introduction of a strong encryption algorithm called AES RINJDAEL. The three layered architecture is been developed for the purpose of high security which is needed to secure the highly confidential database systems. Each level have its own significance. All the parameters of security is fulfilled by the approach on four levels. No malicious users can interfere with the system, attacks such as brute force are successfully overcomes. The AES RINJDAEL will save all the data in form of private and public key along the network saving the data from man in middle attacks. Below is the brief summary about what thesis outlines.

INTRODUCTION

Cloud computing is the service that provide the user the power of sharing computer resources. Instead of running applications yourself, the applications runs on the cloud, a shared data center, you have to just plug in like a utility. It is the type of internet based computing where services like servers, storage, applications are delivered to a computer or device through the internet. In cloud computing one does not need to buy any application, just have to pay according to the usage and need not to worry about storage space and computation speed of device or computer. It is very useful for micro and medium organizations because it is fast to get started; it costs less and provides more reliability, scalability and security.

In the traditional model of computing, both data and software are fully contained on the user's computer; in cloud computing, the user's computer may contain almost no software or data (perhaps a minimal operating system and web browser, display terminal for processes occurring on a network). Cloud computing is based on five attributes: multi-tenancy (shared resources), massive scalability, elasticity, pay as you go, and self-provisioning of resources, it makes new advances in processors, Virtualization technology, disk storage, broadband Internet connection, and fast, inexpensive servers have combined to make the cloud a more compelling solution.

The main attributes of cloud computing is illustrated as follows:

- Multi-tenancy (shared resources): Cloud computing is based on a business model in which resources are shared (i.e., multiple users use the same resource) at the network level, host level, and application level.
- Massive scalability: Cloud computing provides the ability to scale to tens of thousands of systems, as well as the ability to massively scale bandwidth and storage space
- Elasticity: Users can rapidly increase and decrease their computing resources as needed.
- Pay as you used: Users to pay for only the resources they actually use and for only the time they require them.
- Self-provisioning of resources: Users self-provision resources, such as additional systems (processing capability, software, storage) and network resources. [12]

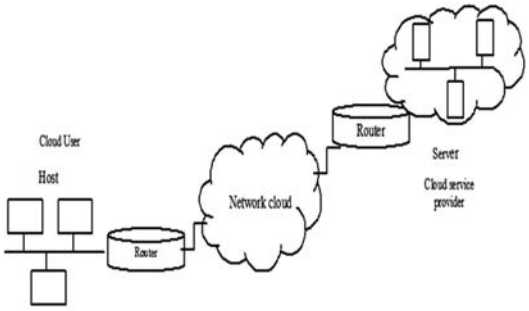

Figure 1.1 Cloud computing

1.1.1ARCHITECTURE OF CLOUD COMPUTING

Cloud computing architecture specifies the components and subcomponents required in delivery of cloud services. These components typically consist of front end platform, back end platform, cloud based delivery, and network and these components make up the cloud computing architecture. The front end platform includes fat client, thin client, and mobile

Devices, systems etc. the back end platform includes server, storages. Cloud architecture,the systems architecture of the software systems involved in the delivery of cloud computing, typically involves multiple cloud components communicating with each other over a loose coupling mechanism such as a messaging queue. Elastic provision implies intelligence in the use of tight or loose coupling as applied to mechanisms such as these and others.

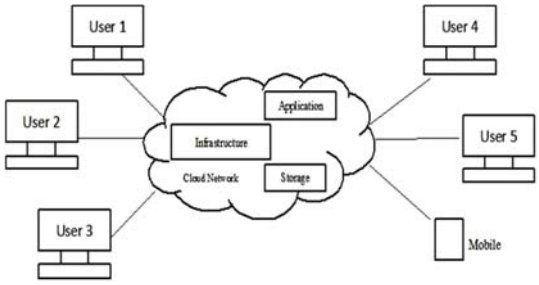

Figure 1.2 Cloud Computing Architecture

1.1.2 SERVICE MODELS

Cloud computing providers offer their services according to several fundamental models:

Infrastructure as a service (IaaS)

IaaS clouds often offer additional resources such as a virtual-machine disk image library, raw block storage, and file or object storage, firewalls, load balancers, IP addresses, Virtual local area networks(VLANs), and software bundlesIaaS-cloud providers supply these resources on-demand from their large pools installed in data centers. For wide area connectivity, customers can use either the Internet or carrier clouds (dedicated virtual private networks).

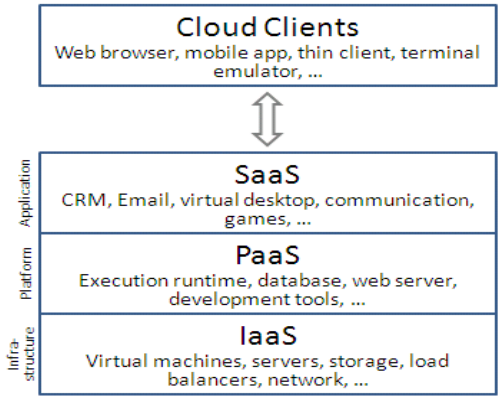

Figure 1.3 Service model

Platform as a service (PaaS)

In the PaaS models, cloud providers deliver a computing platform, typically including operating system, programming language execution environment, database, and web server. Application developers can develop and run their software solutions on a cloud platform without the cost and complexity of buying and managing the underlying hardware and software layers. With some PaaS offers like Microsoft Azure and Google app engine, the underlying computer and storage resources scale automatically to match application demand so that the cloud user does not have to allocate resources manually. The latter has also been proposed by an architecture aiming to facilitate real-time in cloud environments.

Software as a service (SaaS)

In the business model using software as a service (SaaS), users are provided access to application software and databases. Cloud providers manage the infrastructure and platforms that run the applications. SaaS is sometimes referred to as "on-demand software" and is usually priced on a pay-per-use basis. SaaS providers generally price applications using a subscription fee.

1.1.3 DEPLOYMENT MODEL

Private cloud

Private cloud is cloud infrastructure operated solely for a single organization, whether managed internally or by a third-party, and hosted either internally or externally.Undertaking a private cloud project requires a significant level and degree of engagement to virtualize the business environment, and requires the organization to

reevaluate decisions about existing resources. When done right, it can improve business, but every step in the project raises security issues that must be addressed to prevent serious vulnerabilities.

Public cloud

A cloud is called a "public cloud" when the services are rendered over a network that is open for public use. Public cloud services may be free or offered on a pay-per-usage model.Generally, public cloud service providers like Amazon AWS, Microsoft and Google own and operate the infrastructure at their data center and access is generally via the Internet.

Hybrid cloud

Hybrid cloud is a composition of two or more clouds (private, community or public) that remain distinct entities but are bound together, offering the benefits of multiple deployment models.

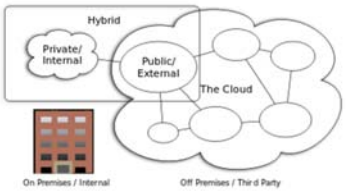

Figure 1.4 Deployment Model

1.1.4. CLOUD COMPUTING FEATURES

Cloud computing brings an array of new features compared to any other computing paradigms. These are briefly described in this section [31].

• **Scalability and On-Demand Services** - Cloud computing provides resources and services for users on demand. The resources are scalable over several data centers.

• **Quality of Service (QoS)** - Cloud computing can guarantee QoS for users in terms of hardware or CPU performance, bandwidth, and memory capacity.

• **User-Centric Interface** - Cloud interfaces are location independent and they can be accessed by well established interfaces such as Web services and Web browsers.

• **Autonomous System** - Cloud computing systems are autonomous systems managed transparently to users. However, software and data inside clouds can be automatically reconfigured and consolidated to a simple platform depending on user's needs.

• **Pricing** - Cloud computing does not require upfront investment. No capital expenditure is required. Users may pay and use or pay for services and capacity as they need them.

1.1.5. CLOUD COMPUTING CHALLENGES

The new paradigm of cloud computing provides an array of benefits and advantages over the previous computing paradigms and many organizations are migrating and adopting it. However, there are still a number of challenges, which are currently addressed by researchers, academicians and practitioners in the field [31].

a. Performance

The major issue in performance can be for some intensive transaction-oriented and other data intensive applications, in which cloud computing may lack adequate performance. Also, users who are at a long distance from cloud providers may experience high latency and delays.

b. Security and Privacy

Companies are still concerned about security when using cloud computing. Users are worried about the vulnerability to attacks, when information and critical IT resources are outside the firewall.

c. Control

A quantity of IT wings or departments are concerned because cloud computing providers have a full control of the platforms. Cloud computing providers typically do not design platforms for specific companies and their business practices.

d. Bandwidth Costs

Cloud computing, companies can save money on hardware and software; however they could incur higher network bandwidth charges. Bandwidth cost may be low for smaller Internet-based applications, which are not data intensive, but could significantly grow for data-intensive applications.

e. Reliability

Cloud computing still does not always offer round the clock reliability. There were cases where cloud computing services suffered few hours' outages. In the present and future days to expect more cloud computing providers, richer services, established standards and best practices.

1.2CLOUD COMPUTING SECURITY ISSUES

In distributed cloud database another issue that we consider is security. High growth in the field of networks leads a common problem for changing of the data at very fast rate. Hence it will be appropriate if we duplicate the data, hence our major concern is that our information

must be protected while transferring the important information like banking transaction for this purpose we use many encryption techniques and also protect the confidential data from the unauthorized use. Security means protection of information and information system from unauthorized access, modification and misuse of information or destruction. Moreover distributed system poses four main components t hat are security authentication (creates password), authorization (prove his identity), and encryption. Hence encryption plays very vital role in the security. Hence we use some encryption techniques that will be helpful in dealing with some of the security issues

There is a number of security issues/concerns associated with cloud computing but these issues fall into two broad categories

i) Cloud provider
ii) Client

The responsibility goes both ways, however: the provider must ensure that their infrastructure is secure and that their clients' data and applications are protected while the user must ensure that the provider has taken the proper security measures to protect their information, and the user must take measures to use strong passwords and authentication measures.

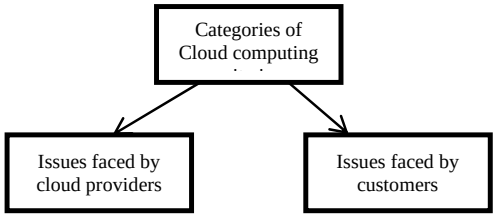

Figure 1.5 Categories of cloud computing security issues

One method to solve this problem is Encryption. Encryption can be done on three ways:

1. Server encryption – It also means provide security to data at rest. It provides security to data that is stored on the server from one or more threat like losing data.
2. Client Encryption – It also means providing security to moving data i.e., encrypting data while transmission. To encrypt data before sending it.
3. Proxy Encryption - Encryption is done using a third part alliance that either resides on your network or public or private cloud.

1.3CLIENT SERVER FRAMEWORK AND CRYPTOGRAPHY

1.3.1 CLIENT SERVER ARCHITECTURE

Client-server architecture (client/server) is network architecture in which each computer or process on the network is either a client or a server. Servers are powerful computers or processes dedicated to managing disk drive (file servers), printers (print servers), or network traffic (network servers). Clients are Personal computers or workstations on which users run applications. Clients rely on servers for resources, such as files, devices, and even processing power. Another type of network architecture is known as peer-to-peer architecture because each node has equivalent responsibilities. Both client/server and peer-to-peer architectures are widely used and each has unique advantages and disadvantages. Client-server architectures are sometimes called two-tier architectures.

1.3.2 CRYPTOGRAPHY

The art of protecting information by transforming it (encrypting it) into an unreadable format, called cipher text. Only those who possess a secret *key* can decipher (or decrypt) the message into plain text. Encrypted messages can sometimes be broken by cryptanalysis, also called codebreaking, although modern cryptography techniques are virtually unbreakable.

As the Internet and other forms of electronic communication become more prevalent, electronic security is becoming increasingly important. Cryptography is used to protect e-mail messages, credit card information and corporate data.

Cryptography is closely related to the disciplines of cryptology and cryptanalysis. Cryptography includes techniques such as microdots, merging words with images and other ways to hide information in storage or transit. However, in today's computer-centric world, cryptography is most often associated with scrambling plaintext (ordinary text, sometimes referred to as clear text) into cipher text (a process called encryption), then back again (known as decryption). Individuals who practice this field are known as cryptographers.

The main feature of the encryption/decryption program implementation is the generation of the encryption key. Now a day, cryptography has many commercial applications. If we are protecting confidential information then cryptography is provide high level of privacy of individuals and groups. However, the main

purpose of the cryptography is used not only to provide confidentiality, but also to provide solutions for other problems like: data integrity, authentication, non-repudiation. Cryptography is the methods that allow information to be sent in a secure from in such a way that the only receiver able to retrieve this information. Presently continuous researches on the new cryptographic algorithms are going on. However, it is a very difficult to find out the specific algorithm, because we have already known that they must consider many factors like: security, the features of algorithm, the time complexity and space complexity. [9]

Modern cryptography concerns itself with the following four objectives:

1) **Confidentiality** (the information cannot be understood by anyone for whom it was unintended)

2) **Integrity** (the information cannot be altered in storage or transit between sender and intended receiver without the alteration being detected)

3) **Non-repudiation** (the creator/sender of the information cannot deny at a later stage his or her intentions in the creation or transmission of the information)

4) **Authentication** (the sender and receiver can confirm each other's identity and the origin/destination of the information)

Cryptography systems can be broadly classified into symmetric-key systems that use a single key that both the sender and recipient have, and public key systems that use two keys, a public key known to everyone and a private key that only the recipient of messages uses.These schemes are:

- **Symmetric key algorithm:** In this cryptographic scheme a common key is used for enciphering and deciphering the message.
- **Asymmetric key algorithm:** This cryptographic scheme uses two keys for encryption and decryption known as Public key and Private Key.

1.3.2.1 Public Key Encryption

A cryptographic system uses two keys - a public key known to everyone and a private or secret key known only to the recipient of the message. E.g. When John wants to send a secure message to Jane, he uses Jane's public key to encrypt the message. Jane then uses her private key to decrypt it. An important element to the public key system is that the public and private keys are related in such a way that only the public key can be used to encrypt messages and only the corresponding private key can be used to decrypt them. Moreover, it is virtually impossible to deduce the private key if you know the public key. Public-key systems, such as Pretty Good Privacy (PGP), are becoming popular for transmitting information via the Internet. They are extremely secure and relatively simple to use. The only difficulty with public-key systems is that you need to know the recipient's public key to encrypt a message for him or her. What's needed, therefore, is a global registry of public keys, which is one of the promises of the new LDAP technology. One of the weaknesses some point out about symmetric key encryption is that two users attempting to communicate with each other need a secure way to do so; otherwise, an attacker can easily pluck the necessary data from the stream. In November 1976, a paper published in the journal IEEE Transactions on Information Theory, titled "New Directions in Cryptography," addressed this problem and offered up a solution: **public-key encryption**.

Also known as **asymmetric-key** encryption, public-key encryption uses two different keys at once - a combination of a private key and a public key. The private key is known only to your computer, while the public key is given by your computer to any computer that wants to communicate securely with it. To decode an encrypted message, a computer must use the public key, provided by the originating computer, and its own private key. Although a message sent from one computer to another won't be secure since the public key used for encryption is published and available to anyone, anyone who picks it up can't read it without the private key. The key pair is based on prime numbers (numbers that only have divisors of itself and one, such as 2, 3, 5, 7, 11 and so on) of long length. This makes the system extremely secure, because there is essentially an infinite number of prime numbers available, meaning there are nearly infinite possibilities for keys. One very popular public-key encryption program is **Pretty Good Privacy (PGP)**, which allows you to encrypt almost anything. In symmetric-key encryption, each computer has a secret key (code) that it can use to encrypt a packet of information before it is sent over the network to another computer. Symmetric-key requires that you know which computers will be talking to each other so you can install the key on each one. Symmetric-key encryption is essentially the

same as a secret code that each of the two computers must know in order to decode the information. The code provides the key to decoding the message. Think of it like this: You create a coded message to send to a friend in which each letter is substituted with the letter that is two down from it in the alphabet. So "A" becomes "C," and "B" becomes "D". You have already told a trusted friend that the code is "Shift by 2". Your friend gets the message and decodes it. Anyone else who sees the message will see only nonsense. The same goes for computers, but, of course, the keys are usually much longer. The first major symmetric algorithm developed for computers in the United States was the Data Encryption Standard (DES), approved for use in the 1970s. The DES uses a 56-bit key. Because computers have become increasingly faster since the '70s, security experts no longer consider DES secure -- although a 56-bit key offers more than 70 quadrillion possible combinations (70,000,000,000,000,000), an attack of brute force (simply trying every possible combination in order to find the right key) could easily decipher encrypted data in a short while. DES has since been replaced by the Advanced Encryption Standard (AES RINJDAEL), which uses 128-, 192- or 256-bit keys. Most people believe that AES RINJDAEL will be a sufficient encryption standard for a long time coming: A 128-bit key, for instance, can have more than 300,000,000,000,000,000,000,000,000,000,000, 000 key combinations. The sending computer encrypts the document with a symmetric key, and then encrypts the symmetric key with the public key of the receiving computer. The receiving computer uses its private key to decode the symmetric key. It then uses the symmetric key to decode the document.

To implement public-key encryption on a large scale, such as a secure Web server might need, requires a different approach. This is where digital certificates come in. A digital certificate is basically a unique piece of code or a large number that says that the Web server is trusted by an independent source known as a certificate authority. The certificate authority acts as a middleman that both computers trust. It confirms that each computer is in fact who it says it is, and then provides the public keys of each computer to the other.

1.4 CRYPTOGRAPHY ALGORITHM

1.4.1 AES RIJNDAEL

AES is based on the Rijndael cipher developed by two Belgian cryptographers, Joan Daemen and Vincent Rijmen, who submitted a proposal to NIST during the AES selection process.Rijndael is a family of ciphers with different key and block sizes. AES has block size of 128 bits, but three different key lengths: 128, 192 and 256 bits. AES is a symmetric-key algorithm, meaning the same key is used for both encrypting and decrypting the data.

AES is based on a design principle known as a substitution-permutation network, combination of both substitution and permutation, and is fast in both software and hardware. Unlike its predecessor DES, AES does not use a Fiestel network (In Cryptography, a **Feistel cipher** is a symmetric structure used in the construction of block ciphers, it is also commonly known as a **Feistel network**. The Feistel structure has the advantage that encryption and decryption operations are very similar, even identical in some cases, requiring only a reversal of the key schedule. Therefore the size of the code or circuitry required to implement such a cipher is nearly halved. A Feistel network is an iterated cipher with an internal function called a round function).

AES operates on a 4×4 column major order matrix of bytes, termed the *state*, although some versions of Rijndael have a larger block size and have additional columns in the state. Most AES calculations are done in a special finite field.

In this algorithm, substitute bytes indicate that the algorithm should substitute the byte of the state with a byte from the S-box, which replaces each byte with the inverse transformation. The shift row procedure indicated that it does not change the value of the row elements but changes their order and does a circular left shift to the rows.

The algorithm begins with an **Add round key** stage followed by 9 rounds of four stages and a tenth round of three stages. This applies for both encryption and decryption with the exception that each stage of a round the decryption algorithm is the inverse of its counterpart in the encryption algorithm.

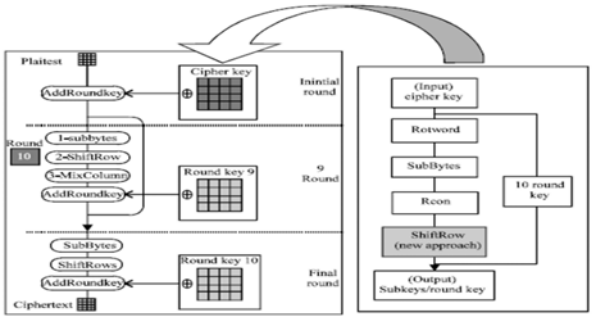

Figure 1.6 AES algorithm working

The four stages are as follows:

1. Substitute bytes
2. Shift rows
3. Mix Columns
4. Add Round Key

The tenth round simply leaves out the **Mix Columns** stage.

The first nine rounds of the decryption algorithm consist of the following:

1. Inverse Shift rows
2. Inverse Substitute bytes
3. Inverse Add Round Key
4. Inverse Mix Columns

Again, the tenth round simply leaves out the **Inverse Mix Columns** stage.

AES Algorithm has following steps:

Step1: Key Expansion: In this step round keys are derived from the cipher key using Rijndael's key schedule.

Step2: Initial Round: This step consists of following sub-steps

i)Add Round Key:- In this step each byte of the state is combined with the round key using bitwise XOR

Step 3: Rounds: This step consists of following sub-steps

1. Sub Bytes:- It is a non-linear substitution step where each byte is replaced with another according to a lookup table.
2. Shift Rows:- This is a transposition step where each row of the state is shifted cyclically a certain number of steps.
3. Mix Columns:- it is a mixing operation which operates on the columns of the state, by combining the four bytes in each column.

Step 4: Final Round (no Mix Columns):It has following substeps:

1. Sub Bytes
2. Shift Rows

1. Add Round Key

AES algorithm Encryption process: The flowchart of the AES algorithm encryption process is given below

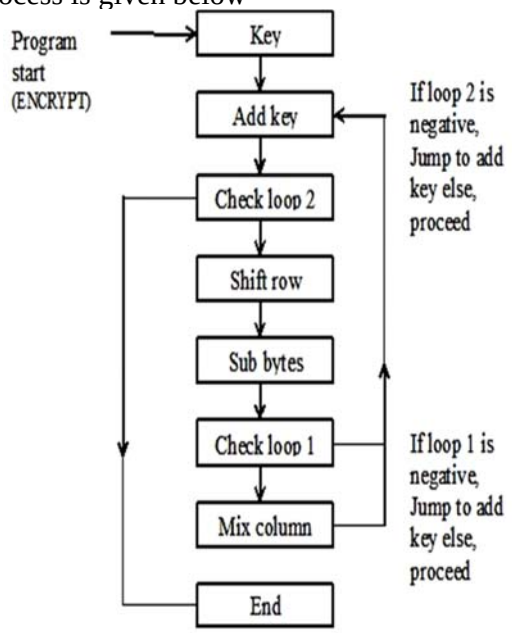

Figure 1.7 AES Encryption Process

AES algorithm Decryption process: The flowchart of the AES algorithm decryption process is given below

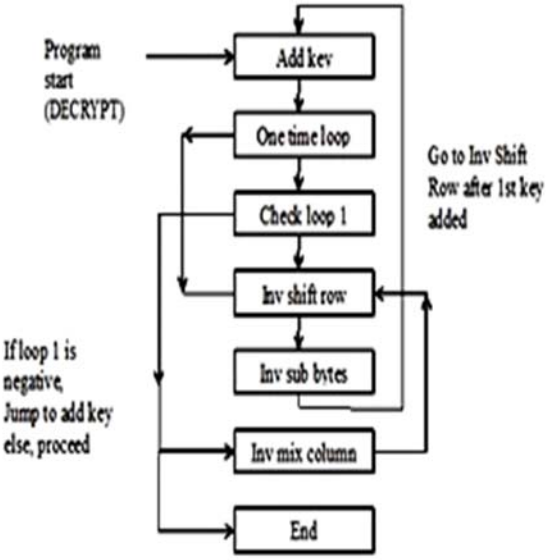

Figure 1.8 AES Decryption process

ADVANTAGES OF THE AES ALGORITHM ARE:

Security: AES is one of the more secure algorithms. Due to the ease of access to various components of the code, the security breaches

that may arise can be detected very easily and corrected efficiently

Memory: AES does not require excessive memory to complete its functionality. The maximum bits used for encryption is 128 bits and this allows memory saving for both hardware and the software features.

Flexibility: AES algorithm works for a combination of a large number of blocks and bits. This encryption algorithm is very versatile and customizable since it can be modified depending on the problem to which it is applied.

1.4.2 BASE64 ENCODER

Base64 is a group of similar binary-to-text (A binary-to-text encoding is encoding of data in plain text. More precisely, it is an encoding of binary data in a sequence of characters. These encodings are necessary for transmission of data when the channel does not allow binary data (such as email or NNTP) or is not 8-bit clean) encoding schemes that represent binary data in an ASCII string format by translating it into a radix-64 representation. The term *Base64* originates from a specific MIME content transfer encoding.

Base64 encoding schemes are commonly used when there is a need to encode binary data that needs to be stored and transferred over media that are designed to deal with textual data. This is to ensure that the data remains intact without modification during transport. Base64 is commonly used in a number of applications including email via MIME, and storing complex data in XML.

This encoding generally works in very less negligible time. This algorithm is very popular I e-commerce websites and application as lot of files are needed to come from server to your device in which if bandwidth is less it will take more time in loading those files as file size can vary from small to large and very large. This encoder converts the text into string value or whole data into string.

Base64 encoding takes three bytes, each consisting of eight bits, and represents them as four printable characters in the ASCII standard. It does that in essentially two steps.

Step 1: The first step is to convert three bytes to four numbers of six bits. Each character in the ASCII standard consists of seven bits. Base64 only uses 6 bits (corresponding to 2^6 = 64 characters) to ensure encoded data is printable and humanly readable. None of the special characters available in ASCII are used. The 64 characters (hence the name Base64) are 10 digits, 26 lowercase characters, 26 uppercase characters as well as '+' and '/'. For example, the three bytes are 150, 167 and 238; the corresponding (and frightening) bit stream is 100101101010011111101110, which in turn corresponds to the 6-bit values 37, 42, 31 and 46.

Step 2: These numbers are converted to ASCII characters in the second step using the Base64 encoding table. The 6-bit values of our example translate to the ASCII sequence "lqfu".

Data bytes in decimal form	150	167	238	
Data bytes in binary form	10010110	10100111	11101110	
Data rearranged into 6-bit groups	100101	101010	011111	101110
6-bit group into binary form	37	42	31	46
Groups converted into ASCII characters	l	q	f	u

Figure 1.9 Base64 Encoder working example

This two-step process is applied to the whole sequence of bytes that are encoded. To ensure the encoded data can be properly printed and does not exceed any mail server's line length limit, newline characters are inserted to keep line lengths below 76 characters. The newline characters are encoded like all other data.

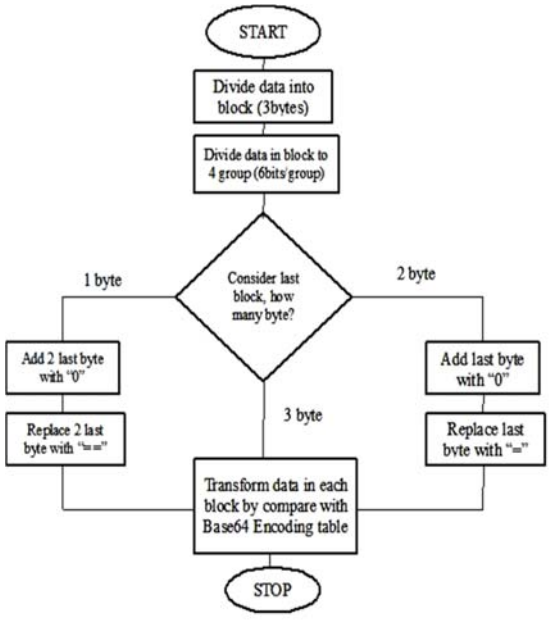

Figure 1.10 Base64 Encoder Flowchart

At the end of the encoding process we might run into a problem. If the size of the original data in bytes is a multiple of three, everything works

fine. If it is not, we might end up with one or two 8-bit bytes. For proper encoding, we need exactly three bytes, however.

The solution is to append enough bytes with a value of '0' to create a 3-byte group. Two such values are appended if we have one extra byte of data; one is appended for two extra bytes.

Of course, these artificial trailing '0's cannot be encoded using the encoding table. They must be represented by a 65th character. The Base64 padding character is '='. Naturally, it can only ever appear at the end of encoded data.

2. PRESENT WORK

2.1 PROBLEM STATEMENT

We are going to analyze the AES RINJDAEL algorithm based encryption to cloud server. The AES RINJDAEL being fast and secure hashing algorithm will provide the more security to the database in cloud computing system. The system will have number of databases connected through them. The users do not knowing where the content has been uploaded on which particular database but the data of the user kept safe without the danger of being used by the unauthorized user and also further the database should be secured so that user can put his or her content. The proposed work is been extended by adding a compression technique known as lossless data compression which deals with audio and text data types. In future this work can be extended to public cloud database on Wide Area Network also since now public want to store their data into the cloud storage.

2.2 ISSUES IN CLIENT SERVER ARCHITECTURE

Since this thesis outlines the problem of security in cloud computing. There are various issues related to security in Cloud Computing which are been studied are as under.

1. Man in Middle attack: This attack is performed by a hacker on Network Layer 1 of ISO model. The information which is passed in bits between 2 devices (client and server) is passed through network cables. If a hacker in middle attacks the network layer the data shall get vulnerable to be hacked. The hacker can manipulate the data, ed the data, steel the data etc.
2. Low throughput and high encryption an decryption timings: Though cloud application uses data, and data passing capacity along th network is known as throughput. The throughput is directly proportional to data size. If data size is large and it takes maximum time to convert into cipher text yielding more execution timings of encryption/decryption as a result it yields lower throughput.
3. Privacy Leakage and Authentication: Since the research deals with Cloud service as storage i.e., the user will upload its confidential data to the cloud system. The authentication problem can lead to leakage of privacy of particular user of the cloud application. The authentication system of this cloud based system must be strong enough to build a trust level towards a cloud server company who is offering a service of storage based services to general public. The information uploaded to cloud servers can range from very ordinary to very confidential even a pin number of debit/credit card.

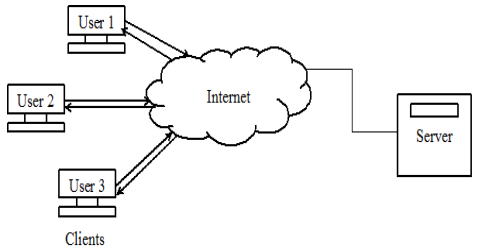

Figure 2.1 Client server architecture

2.3 OBJECTIVE

The main objective of this research work is to develop an efficient encryption system combined with compression technique that can encrypt the data and thus saving time and increasing the throughput.

The main contributions of the research work are:

1. A survey of existing AES algorithm in order to understand it's working.
2. Development of method that combine encryption feature of AES and compression feature of base 64 encoder.
3. Comparing the performance of AES and AES with compression to check the timings reduced and increased throughput

We are going to implement security architecture of the base paper in WLAN on real world using java web socket programming, consider it a real working protocol implementation.

There will be 3 levels of this protocol developed in java

1. Client Server Architecture: This is a main backbone of network. Internet – LAN/WAN are all relies on client and server architecture. This is developed via socket programming in java which a main basic approach of this thesis.

2. We will create the WLAN (wireless LAN) of system and existing authorized users will make connection to server of the organization where they work. In case the worker is unauthorized it will not be able to make the connection to server. This will need the database verification. The database will be present on server and all the data of existing user will be present on server's database which will be cross verified dynamically. In the detail of particular authorized user we will maintain the unique ID of the user which will be hidden and will be asked when the user tries to establish the connection. Every user will have his unique key with them.
3. Encryption at client end via AES takes place on this 3rd level along with compression technique known as lossless data compression, which will pass the data along the network by reducing the actual size of data

   Our research or part of thesis is to implement this 3 layer system architecture on real world Wlan system. The users have to cross this 3 layered architecture. We will implement this layered system on LAN which is a real world example and will test it on network we will use the web socket programming in java to implement this protocol in real world which also a part of future work of this base paper. Looking at above six points this thesis successfully overcomes the objectives and aims stated above. The security issue is been successfully resolved which leads to data leakage and man in middle attack. The architecture followed was secured with AES RINJDAEL Encryption Algorithm where the throughput of devices is needed to be maximized for ruling out the scalability issues reducing the size of actual data and passing it along the network will obviously takes less time. Cloud computing systems generally have a front end, which is what the user sees, and a back end, which does all the work. Cloud computing shares some similarities with an older model of computing called timesharing

2.4 PROPOSED SCHEME

In our work we mainly deal with the cloud database, and in that we try to solve the security and improve the efficiency (throughput) by reducing the size and reducing the time required for encryption and decryption. We will work on three parameters of AES viz. time required to encrypt and decrypt the data, size of the file and throughput. Throughput refers to the performance of tasks by a computing service or device over a specified period. It measure the amount of completed work against time consumed and may be used to measure the performance of processor, memory and/or network communications. Security plays important role in this work as to protect our sensitive information from the unauthorized user this will be conducted with the help of certain algorithm and in that algorithm

The proposed system exhibits the solid frameworks which were designed during the planning phase of this thesis. Firstly the framework of client-server architecture was been studied which has a Linux based kernel.

The encryption process uses a set of specially derived keys called **round keys**. These are applied, along with other operations, on an array of data that holds exactly one block of data that is to be encrypted. This array we call the state array.

We can take the following steps to encrypt a 128-bit block:

1. Derive the set of round keys from the cipher key.
2. Initialize the state array with the block data (plaintext).
3. Add the initial round key to the starting state array.
4. Perform nine rounds of state manipulation.
5. Perform the tenth and final round of state manipulation.
6. Copy the final state array out as the encrypted data (cipher text).

The reason that the rounds have been listed as "nine followed by a final tenth round" is because the tenth round involves a slightly different manipulation from the others. The block to be encrypted is just a sequence of 128 bits. AES RINJDAEL works with byte quantities so we first convert the 128 bits into 16 bytes. We say "convert," but, in reality, it is almost certainly stored this way already. Operations in RSN/AES RINJDAEL are performed on a two-dimensional byte array of four rows and four columns. At the start of the encryption, the 16 bytes of data, numbered D_0-D_{15}, are loaded into the array.

Method	DES	AES RINJDAEL	Modified AES

			RINJDAEL
Approach	Symmetric	Asymmetric	Asymmetric
Encryption	Faster	Slow	Fastest
Decryption	Fastest	Slow	Faster
Key Distribution	Difficult	Easy	Easy
Complexity	O(log N)	O(N^3)	O(N log N)
Security	Moderate	Highest	Highest

Table 2.1: Performance analysis and comparison of symmetric and asymmetric key in DES, AES RINJDAEL, and Modified AES RINJDAEL

Following are the parameters on the basis of which working of this technique and already existing technique is measured.

1. **Time**: In this method, time depicts the time required to encode, decode, encrypt and decrypt the plain text. The time is measured in milliseconds. The time taken by AES modified (AES + Base 64 Encoder) is far less than the time taken by simple AES.
2. **Size**: Size depicts the size of file that is being fed for encryption and decryption. After encoding the size of file is further reduced and is then sent to encryption that further reduces the time for processing. The time used in encoding and encryption depends on the size of the file.
3. **Throughput**: Throughput refers to the performance of tasks by a computing service or device over a specified period. It measure the amount of completed work against time consumed and may be used to measure the performance of processor, memory and/or network communications.

   Throughput = size/time

   The efficiency of the research work is examined by calculating these parameters and comparing these parameters with the existing techniques.

2.5 WORKING METHODOLOGY

With the help of AES RINJDAEL we can not only encrypt the data but also protect it from unauthorized access. AES RINJDAEL works on 12 bit of data therefore it is faster as compared to the other algorithms. Encryption requires more time but the data remain safe because decryption become difficult. The work methodology is explained below that describes how plain text will be converted into cipher text using AES and AES with string compression technique.

Step 1. Cloud Server will be made from where the communication will take place.

Step 2. Peer to peer communication application or other cloud service applications will be made.

Step 3. Connection of established cloud server with local client is established.

Step 4. The file to be sent is selected after logging in with appropriate username and password.

Step 5: The file is first encoded using base 64 encoder, then this encoded file will be sent to AES algorithm foe encryption

Step 6. Encryption process is as below

It is the process of converting the original text into the cipher text data.

Following are some of the steps:

1. Provider should transmit the public key (n, e) to the user who wants to store the data with him or her. Public key is the key that can be shared easily
2. User data is now mapped to an integer by using an agreed upon reversible protocol, known as padding scheme
3. Data is encrypted and the resultant cipher text (data) c is:

   C = me (mod n)
4. This cipher text or encrypted data is now stored so that later on can be used when required

Step 7. At the receiver end decryption process is performed.

Decryption is the process of converting the cipher text (data) to the original plain text (data)

Following are some of the steps:

1. User request the service provider for the data
2. The service provider verifies the authenticity of the user and then gives the encrypted data i.e. C
3. The user decrypts the data by computing

   m = Cd (mod n).
4. Once the m is obtained the user can get back the original data by reversing the padding scheme

Step 8. This decrypted file is then sent to base64 encoder for decoding process to obtain the plain text.

Step 9. Reduces encryption and decryption time along with increased throughput is obtained.

2.5.1 SYSTEM FLOW DESIGN

Following is the system flow design of the proposed system. In this a file is uploaded from the computer and sent to the server. First the file is encoded by Base 64 encoder and then encrypted by AES algorithm; finally cipher text

is generated and saved in the database. From there the user will select the file to be decrypted and reverse process starts. First the file is decrypted and then decoded and finally plain text is obtained.

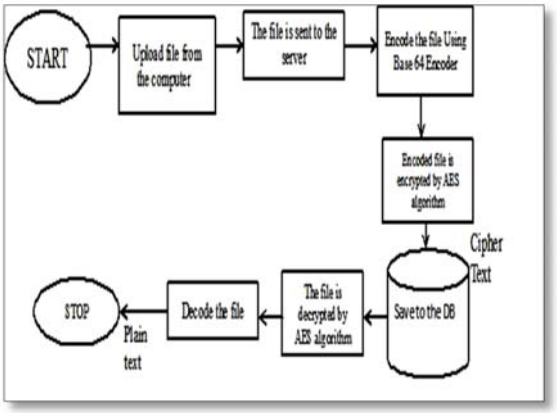

Figure 3.2 System Flow Design

3. RESULTS AND DISCUSSIONS

The result obtained using AES Modified technique is shown following:

3.1 RESULTS USING MODIFIED TECHNIQUE

The Table 3.1 represents the six different sizes of files and corresponding encryption execution time taken by AES and AES Modified algorithms in seconds. By analyzing the Table 3.1, we conclude that the encryption time taken by AES Modified is very small as compare to AES. The encryption time taken by AES Modified and AES and six different size input files

Table 3.1Encryption Execution Time (Seconds)

Input File Size (MB)	Encryption Execution Time(Seconds)	
	AES	AES Modified
5	31.600	30.588
10	72.839	64.649
15	100.201	90.180
20	136.978	125.382
25	162.795	154.465
30	190.847	178.471

The Table 3.2 represents the six different sizes of files and corresponding decryption execution time taken by AES Modified and AES algorithms in seconds. By analyzing the Table 3.2, we conclude that the decryption time taken by AES Modified is very small as compare to AES. The decryption time taken by AES Modified and AES and six different size input files

Table 3.2Decryption Execution Time (Seconds)

Input File Size (MB)	Decryption Execution Time(Seconds)	
	AES	AES Modified
5	33.135	31.871
10	69.353	60.489
15	94.794	87.506
20	126.381	111.735
25	154.715	148.656
30	191.437	188.754

The Table 3.3 represents the six different sizes of files and corresponding throughput execution time taken by AES Modified and AES algorithms in KB/Seconds. By analyzing the Table 3.3, we conclude that the throughput time taken by AES Modified is large as compare to AES. The throughput time taken by AES Modified and AES and six different size input files.

Table 3.3Throughput Execution Time (Seconds)

Input File Size (MB)	Throughput Execution Time(MB/Seconds)	
	AES	AES Modified
5	3.7130	3.7134
10	7.4185	7.4401
15	1.1110	1.1132
20	1.4836	1.4858
25	1.8528	1.8550
30	2.2220	2.2242

4. CONCLUSION AND FUTURE WORK

4.1 CONCLUSION

During research on issues on secured client-server architecture and after its successful implementation, it's been concluded that AES RINJDAEL was successful and provides a strong point of security to existing client-server cloud architecture. The Purpose of adding three layered system in client and server side was successful and gave marginal better outcomes than previous research. In architecture while adding secured layers we kept in mind the different scenarios of authentication and authorization. The AES RINJDAEL at last level gave this research a brilliant security that this architecture is fully

secured for any kind of confidential data preservation along with good results than previous basic AES

4.2 FUTURE WORK

Since AES RINJDAEL provides a strong security measure to existing system. It will be always an area of research as AES RINJDAEL takes less of power during generation of public and private key and yields higher throughput. On mobile OS AES RINJDAEL performance can be analyzed in terms of battery consumption and throughput. Preserving the power of smart phones can be new area of research in mobile cloud computing since every application back-end phase is shifting from clusters/grid to cloud based system. These applications usually take lot of battery power and can affect the battery life of particular phones. Since smart phones processor and RAM runs 24 hours if it's not on switched-off mode the application running in background can eat up RAM and Processor which leads to decrease in battery life of a smart phone.

REFERENCES

1. SanjoliSingla, Jasmeet Singh., "Implementing Cloud Data Security by Encryption Using Rijndael Algorithm", Global Journal of Computer Science and Technology Cloud and Distributed, Vol 13, Issue 4, version 1.0, 2013
2. G. Jai Arul Jose, C.Sajeev, Dr.C.Suyambulingom., "Implementation of Data Security in cloud Computing", International Journal of P2P Network Trends and Technology, Vol 1, Issue 1, 2011.
3. Navraj Khatri, Jagtar Singh, Rajeev Dhanda., "Comparison of Performance of AES standards Based upon Encryption/Decryption Time and Throughput", International Journal of Engineering Research and Technology (IJERT), Vol 1, Issue 5, July 2012.
4. Tanzilur Rahman, Shengyi Pan, Qi Zhang., "Design of a High Throughput 128-bit AES (Rijndael Block Cipher)", International Multiconference of Engineers and Computer Scientists (IMECS), Vol 2, March 2010.
5. Daniel Fowles., "Implementation and analysis of the Rijndael encryption algorithm in different programming languages", Bachelor of Science in Computer Science with Honors, The University of Bath, April 2008.
6. Jasmeet Singh, SanjoliSingla., "Survey on Enhancing Cloud data security using EAP with Rijndael Encryption Algorithm", Global Journal of Computer Science and Technology Software and Data Engineering, Volume 13 Issue 5 Version 1.0, 2013
7. PrashantRewagad, YogitaPawar., "Use of Digital Signature and Rijndael Encryption algorithm to Enhanced security of data in Cloud Computing Services", International Journal of Computer Applications, Emerging trends in Computer Science and Information Technology, 2012
8. Vishwagupta, Gajendra Singh, Ravinder Gupta., "Advance Cryptography algorithm for improving data security", International Journal of Advanced Research in Computer Science and Engineering, Volume 2, Issue 1, January 2012.
9. DiaaSalamaAbdElminaam, Hatem Mohamed Abdual Kader, Mohiy Mohamed Hadhoud., "Evaluating the Performance of Symmetric Encryption Algorithms", International Journal of Network Security, Volume 10, No.3, May 2010.
10. Amit Sangroya, Saurabh Kumar, JaideepDhok, VasudevaVarma. "Towards analyzing data security risks in Cloud Computing Environments".
11. EmanM.Mohamed, HatemS.Abdelkader, Sherif El-Etriby., "Data security model for Cloud Computing", The twelfth international conference on networks, 2013.
12. Navraj Khatri, Rajeev Dhanda, Jagtar Singh., "Comparison of Power Consumption and Strict Avalanche criteria at Encryption/Decryption side of Different AES standards", International Journal of Computational Engineering Research (IJCER), Volume 2 Issue 4, August 2012.
13. Dr. Chander Kant, Yogesh Sharma., "Enhanced Security architecture for cloud security", International Journal of Advanced research in computer science and software engineering (IJARCSSE),Volume 3, Issue 5, May 2013.
14. Bruce Schneier, John Kelseyy, Doug Whitingz, David Wagnerx, Chris Hall, NielsFrguson, "Performance Comparison of the AES submissions", Version 2, February 1, 1999.
15. SubedariMithila, P. Pradeep Kumar., "Data security through Confidentiality in cloud computing environment", International Journal of Computer Science and Information Technologies (IJCSIT), Volume 2 (5), 2011.

WEB SECURITY TECHNIQUES, ANALYSIS USING CAPTCHA AND ENHANCEMENT FOR FUTURE

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Abstract—There are many services in the internet including Email, search engine, social networking are provided with free of cost. To access these web services users have to register regarding the websites. During registration, some intruders or attackers write malicious programs that waste the website resources by making automatic false enrolments which are called as bots. Security researchers developed many techniques to prevent from accessing web resources by these bots. CAPTCHA (Completely Automated Public Turing test to tell Computers and Humans Apart) is a human authentication technique that generates tests to differentiate between human user and a malicious computer program. CAPTCHA techniques tries to maximize the difficulty for automated programs to pass tests .We can see many CAPTCHAs in web site with their own approach to provide security. In this article we take an overview of different and recently proposed CAPTCHA techniques. It proposes an approach to generate a robust CAPTCHA. The CAPTCHA is generated in two steps fist by randomizing alphanumeric characters and finally different queries are attached with it. The generated CAPTCHA is simple and can improve the usability and security with reduced solving time of human.

Keywords— Text based CAPTCHA, Web based security

I. INTRODUCTION

Internet has definitely made many aspects of modern life much more convenient by allowing users to access several online services. Security is an important issue for any website since there are many ways to intrude those services by programmed bots. CAPTCHA are well adopted solution for securing online services from programmed bots. This article proposes a new robust and two tier CAPTCHA to secure websites. First it studies history, importance of Internet and security along with different techniques to secure web services and applications. It also gives an overview of previous work and recently proposed CAPTCHA techniques. On the basis of their analysis we developed an algorithm and designed a CAPTCHA which can be generated easily with some randomness. It can also improve usability and ease for human user and maintain the robustness for programmed bots.

II. WAYS TO IMPEMENT WEB BASED SECURITY

A. Web security defence strategy

There are two techniques for finding excellent security. On one we would assign all of the resources required to maintain constant attentive to new security issues. we might ensure that all patches and updates are carried out at one time, have got all of the existing applications reviewed for correct security, be sure that only security knowledgeable programmers will deliver with your site and have absolutely their work checked carefully by security professionals. You would

also maintain a good firewall, antivirus protection and run IPS/IDS.

Our other option is to use an online scanning means to fix try out your existing equipment, applications and website code to discover in case a KNOWN vulnerability actually exists. While firewalls, antivirus and IPS/IDS are all worthwhile, it can be simple logic to also lock leading door. It's much more effective to correct half-dozen actual risks compared to leave them constantly in place and try to build higher and better walls around them. Network and site vulnerability scanning is regarded as the efficient security investment coming from all.

B. Web security using website security audit

Healthy defense against a attack on our website is always to regularly scan a competently setup domain that is certainly running current applications and whose website code was done well. Internet site testing, often known as web scanning or auditing, is really a hosted service furnished by Beyond Security called WSSA - Web page Security Audit. This particular repair requires no installing software or hardware and it is done without any interruption of web services. WSSA is usually run using regularly which means that your site are going to be tested against new vulnerabilities as they become known and offer you with solid data whether or not action is vital, needed or low priority. We will even be alerted if new code have been put into your website which is insecure, a different port continues to be opened that's unexpected, or May be a new service may be loaded and started that may present a chance to burglary. In complex, large systems it may be that daily web scanning would be the Best way to make sure that none of the many changes designed to site code or by using an application could possibly have opened an opening with your carefully established security perimeter. [1]

C. Network based security

Network-Based Security offers multiple, complementary services to help you protect our enterprise internally. These layers work in conjunction with endpoint computer antimalware software and internal company firewalls to intercept diverse threats.

D. CAPTCHA based web and appliction security

A CAPTCHA (Completely Automated Public Turing test to tell Computers and Humans Apart) is a kind of challenge response test used to determine whether the user is human or not. Computers cannot decode the distorted words in a CAPTCHA easily, while humans can easily decipher the text. In the most common type of CAPTCHA user is provided with letters of a distorted image. Then the user is asked to solve the CAPTCHA by entering the correct characters. By definition CAPTCHAs are fully automated, it requires human maintenance very less. A CAPTCHA may have two characteristics such as usability and security. Security means the strength for preventing the variant attacks, while usability means the user friendliness of the CAPTCHA. The CAPTCHA is often a visual or audio challenge towards user in order to avoid bots and automated scripts from accessing the services protected because of it. It really is valuable for forums looking to prevent spambots/adbots from joining and protecting downloads from automated access by bots (that is not really a security risk in itself, but a bandwidth drain). A CAPTCHA will not provide some other form of security, it only provides defence against bots and the rate limiting that includes it. A CAPTCHA is really a program that protects websites against bots by generating and grading tests that humans can pass but current computer programs cannot. One example is, humans can read distorted text as the one shown below, but current computer programs can't.

E. Types of CAPTCHA

Text based CAPTCHA

These are generally an easy task to implement. The most convenient yet novel approach would be to present anyone with a few questions which a human user can solve. Gimpy: Created by Yahoo and CMU Accumulates 10 random words from dictionary and distorts, fills with noise User has to recognize at least 3 words If user is correct, he's admitted EZGimpy: A modified version of Gimpy Yahoo used this version in Messenger Has only 1 random string of characters Not just a dictionary word, so not at risk of dictionary attack A bad implementation, already broken by OCRs

Fig1 Gimpy & EZ-Gimpy Text CAPTCHA

Advantages of Text-based images

1) Text-based CAPTCHA is straightforward to implement so that it's mostly found in websites.
2) Battle Text-based CAPTCHA can be used to defeat dictionary attacks.
3) Re- CAPTCHA Text-based CAPTCHA uses new dictionary words that can't read using optical character recognition

Disadvantages of Text-based images

1) Therein type of CAPTCHAs, users has faced some problems to get in the best text or characters or letter. Following include the few reasons that confuse a person to identify the precise text. i. By using various lines.
ii. Utilization of various shapes. iii. Using multiple fonts. iv. Font size variation.
v. By using Blurred Letters.
2) Text-based CAPTCHAs can be simply broken by OCR techniques (example: Content based image retrieval).
3) The peoples which have low visibility power cannot easily pass the test.

Graphic based CAPTCHA

Graphic CAPTCHAs are challenges that entail pictures or objects who have getting some sort of similarity how the users ought to guess. They are visual puzzles, a lot like Mensa tests. Computer generates the puzzles and grades the answers, but is itself cannot solve it.

Fig 2 Graphic CAPTCHA

PIX is really a program which has a large database of labeled images. Most of these images are pictures of concrete objects (a horse, a table, a property, a flower). This program picks an object haphazardly, finds six images of these object by reviewing the database, presents these to the consumer and then asks the question "exactly what these pictures of?" Hence, writing a course that may answer the question "exactly what these pictures of?" is simple: search the database to the images presented and locate their label. Fortunately, this can be fixed. One way for PIX to become a CAPTCHA is usually to randomly distort the photographs before presenting these phones anyone, so that computer programs cannot easily search the database for that undistorted image.

Advantages of Image-based CAPTCHA

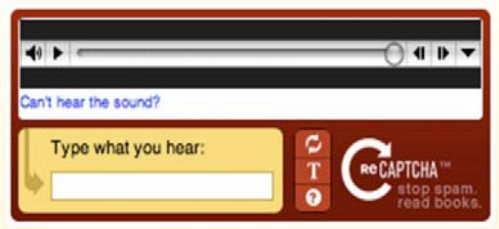
1) Within the text-based CAPTCHA zinc increases the safety.
2) Simple click based system so no necessity of typing.
3) Using Image-based CAPTCHA pattern recognition of image is tough AI program.

Disadvantages of Image-based CAPTCHA

1) Therein kind of CAPTCHAs, users have faced some problems to go in the precise text or characters or letter. Following are classified as the some reasons that confuse the users to recognize the correct text. i. Using various lines. ii. By using various shapes. iii. Usage of Multiple fonts. iv. Font size variation.
v. Usage of Blurred Letters
2) Text-based CAPTCHAs can be easily broken by OCR techniques (example: Content based image retrieval). 3) The peoples that contain low visibility power cannot easily pass quality.

Audio based CAPTCHA

The program picks a thing or even a sequence of numbers indiscriminately, renders the phrase or numbers in a sound clip and distorts the sound clip; it then is definitely the distorted sound clip towards the user and asks users to go into its contents. This CAPTCHA is founded on the real difference in ability between humans and computers in recognizing spoken communication. It is a crude strategy to filter humans in fact it is not so popular considering that the user must understand the language and also the accent the location where the sound clip is recorded.



Advantages of Audio-based CAPTCHA 1) It is employed for most people that have vision defect.

2) Friendly to peoples.

Disadvantages of Audio-based CAPTCHA

1) System available in the English so person needs to have a thorough English Vocabulary.

2) Similar sound characters.

3) Not working for dumb people or some people that have low listening power.

Video based CAPTCHA

Video CAPTCHA is a newer and fewer commonly seen CAPTCHA system. In video-based CAPTCHAs, three words (tags) are offered towards user which describes a movie. Anyone's tag must match into a set of automatically generated ground truth tags then exactly the test has been said to become passed. The phrase video CAPTCHA is used to any CAPTCHA which utilizes a relevant video since it's method for present information to your user Although video CAPTCHA is bound, both commercial and academic application do exist.

Advantages of Video-based CAPTCHA

1) It cannot break using Optical Character Recognition (OCR).

2) It cannot effect by laundry attacks.

3) In some cases it provides greater security than Text-based CAPTCHA and Image based CAPTCHA.

Disadvantages of Video-based CAPTCHA

1) Big is files are large, so problem face by users to download video and pass the CAPTCHA test.

2) Speed of video.

Puzzle based CAPTCHA

Usually in puzzle based CAPTCHA confirmed picture is divided to chunks. A user should combine these chunks so that you can make up the complete picture comparable to the first one. [2]

Advantages of Puzzle-based CAPTCHA

1) It looks like an exciting.

2) It helps the user to observe their brain.

3) It's just like a game so user can more communicate with this CAPTCHA system.

Disadvantages of Puzzle-based CAPTCHA 1) Time consuming.

2) User cannot identify the puzzle easily

III. LITRATURE REVIEW

This section studies and analyzes recently proposed CAPTCHAs and design principles. These would be useful to understand and develop robust CAPTCHA.

A. Question based CAPTCHA

Question based CAPTCHA was proposed in which on the basis of a series of pre-designed patterns of questions were prepared. In these patterns some of the elements of the problem were variable and changeable and they are chosen from some items randomly. For example question may be like "There are 5 cats, 3 apples, and 4 dogs on a table. How many pets are there on the table in total?" The answer is 7 (3 cats+4 dogs=7 pets). Here user only needs to enter a number. To increase the diversity and variety of the questions by designing different and various patterns and even make them more difficult and more sophisticated, too. In place of some words one can put an image of those words like in place of cat, apple, dogs and table one can put their images. Computer may recognize images but first it has to separate text from images which may be a difficult task. Probability of computers to successful answers of this type of question is very less because the computer requires the following abilities

1 Computer must recognize phrase shown in the image through OCR-based software.

2 Computer must recognize shapes shown in the image. Of course before that it must separate texts from the images which would be a difficult process in itself. 3 After recognition of texts and images the computer should be able to

understand the question.

4 At last and even if a computer does all the above-mentioned stages successfully it must be necessarily capable to answer the shown question.

Example of Question based CAPTCHA

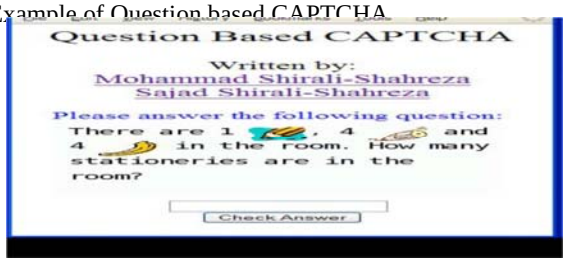


Fig 4 audio based CAPTCHA[3]

Advantages of Question based CAPTCHA

1. Unlike OCR-based CAPTCHA methods, this method requires only typing a number as the answer. So it is easy to use, saves users time and more comfortable for them.

2. In this method it is not necessary to have a keyboard and we have only to enter a number. Therefore we can use this method on devices which don't have a keyboard or on devices in which it is difficult to use a keyboard, such as mobile phones and Pocket PCs.

3. This method does not need any processing to be done by client and can be executed on small devices and on devices with limited resources. [3]

B. Word grouping CAPTCHA

The problem with current text based CAPTCHA (most popular CAPTCHA) schemes is that most of them have proven to be either not robust enough (easy to break them) or they are too complicated annoying to read even for humans.

Word grouping is a type of CAPTCHA in which user has to divide the given words in two subgroups. In word grouping CAPTCHA the user is presented with six words, and is asked to divide the group into two subsets, using any categorizing the user wishes. The words will be easier so that any user can do that.

Fig 5 Word Grouping CAPTCHA[4]

C. A more robust CAPTCHA

A more robust CAPTCHA was proposed in [5] article withmultiple secure characteristics and very effective for breaking attack but easy to answer by user. It may avoid replay attack as after each page refresh principle characteristics ofCAPTCHA would be changed as:

CAPTCHA's code is a series of numbers and characters (uppercase and lowercase). To generate a random code (stream of characters and numbers) in each test in order to make it not susceptible to a dictionary attack, multiple randomizing functions are used.

The length of the code may be varied (minimum length is 6 characters-numbers). Multiple font types can be used to prevent intrusion using image processing techniques.

String/codes can be rotated at different angels. Lines can be used to prevent segmentation. The numbers and the length of lines and their positions can be changed each time in order to deform the text image randomly before presenting to the user. Using some specific technique the text image may be blurred in order to make CAPTCHA difficult for spiteful software. Image dimensions may be changed inconsistent with all other characteristics mentioned above. Each time CAPTCHA's code and line color were kept in gray scale colors at different levels.

D. Two-Tier CAPTCHA

In article [8] introduces a new CAPTCHA scheme called Two-Tier CAPTCHA. First a alphanumeric CAPTCHA code with image is generated. Second Query related to that

CAPTCHA code. E.g. enter only Digits .Rate of its toughness can be increase d in order to improve its resistance against the attacks by adding more and more query and combination in database. The algorithm of this scheme makes it hard for bot programs which mean that it is more secure.

The advantage of using Two-Tier CAPTCHA is it can solved by human users easily and difficult to solve by bots. This Two-Tier CAPTCHA methods use a same input method as used by many well-known web sites and services where users type some keywords or characters into an input box.

E. Hybrid Collage CAPTCHA

This paper [22] introduces a new type of CAPTCHA called hybrid collage CAPTCHA. One of the CAPTCHA methods is Collage CAPTCHA. It is a procedure for distinction between human and computer programs through recognition and finding a picture of an object among some objects. This article improves the resistance of Collage CAPTCHA method by an improved method called Hybrid Collage CAPTCHA. This scheme displays images on left and right side of the screen.

On right side screen we have the corresponding images along with different texts in distorted form. Now the computer program asks user to choose the picture with correct texts. If the user select correctly, then user is allowed to enter the text of the image in the given text box. If entered name is correct, then we guess that user is human.

Fig 6 hybrid collage CAPTCHA [6]

F. Move & Select: 2-Layer CAPTCHA

This paper [23] proposes a technique differentiate human users and computer programs from each other by the fact that human user have exceptional cognitive processing abilities. A new CAPTCHA was proposed with some basic principles like Easy to solve for most people Difficult to solve for automated bots, Easy to create and estimate, User friendly

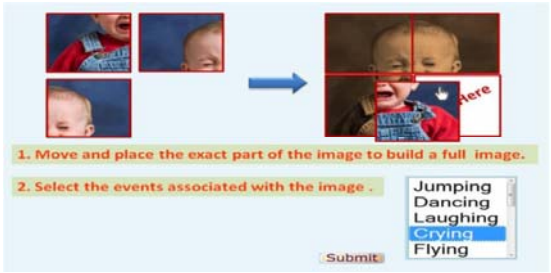


Fig7. 2-tier move & select CAPTCHA [7]

According to study and analysis in this article Move & Select CAPTCHA is more protected compare to other existing CAPTCHA techniques because of 2-layers. Here both layers may lead to hard AI problems for computer bots. Bots may try random guess attack based on probability.

B. Methods to design robust CAPTCHA

CAPTCHA designers may use methods to design a robust
CAPTCHA

1. Make it difficult to split the text from the background by using multiple colors for both foreground and background, leave no pattern that could help differentiate the foreground automatically, and contain some foreground colors into the background And vice versa.
2. Make it difficult to split each image by connecting characters with each other or add more cracks in each character.
3. Make it impossible to distinguish a character by counting its pixels by making all characters have the same pixel count all the time. Or make a character have very different pixel counts in different challenges (if the difference isn't large enough, an approximation method could almost certainly determine each character).
4. Random warping may provide good defense against the pixel count attack .for example, local warp can introduce "small ripples, waves, and elastic deformations along the pixels of the character" and global warp generates characterlevel, elastic deformations; both can make a character's pixel count less predictable[9].

IV. PROPOSED SCHEME

A. Existing text based CAPTCHA scheme

In this existing robust CAPTCHA scheme[8] algorithm random alphanumeric code of fixed length (size 6) is generated. This alphanumeric code is then converted into image with some noise. After this a random query is related to this code image in same session and user is asked to answer this query. Validation is done with user input and session value to allow user to proceed.

B. Proposed Scheme and Methodology

In this chapter, we propose a robust CAPTCHA technique which includes two stages: First is CAPTCHA generation in which a random series of characters was generated. Generated series of characters are combination of alphabets (upper or lower case) and numbers which may avoid the dictionary attack. In second stage a random query is associated with

generated query. After that user is asked to pass the test, in which according to associated query user requires submitting few characters rather than typing entire CAPTCHA. It saves time for user and associated query makes it hard to solve for program bots.

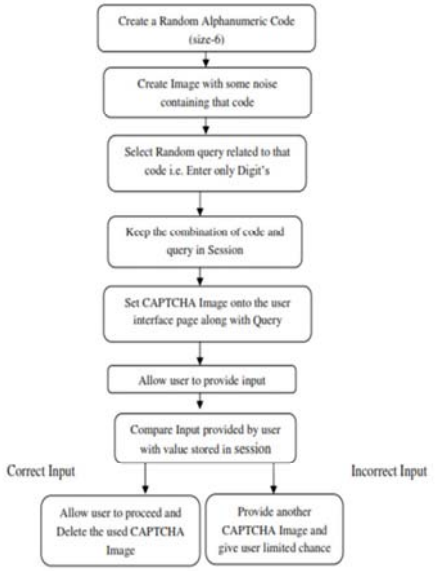


Fig 8 Algorithm of an existing robust CAPTCHA

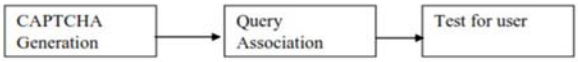


Fig 9 Block diagram of proposed scheme

C. Problem defination

In this work we analyzed previous works on CAPTCHA and found that so far many types of text based CAPTCHAS have been proposed and developed .All of them tried to make the test easier for human user and difficult enough for computer programs and bots. In their efforts to make a hard CAPTCHA many schemes used background confusion, blurring and tilting of texts which may lead to hard enough for human user to pass the test. More background confusion and tilting and twisting of test may cause recognition problem for human user also. Image based and group based CAPTCHA tests need large data base and may face usability problem. So the scheme should be simple and secured enough to avoid abuses from bots.

D. Objective for proposed scheme

1) To develop a robust text based CAPTCHA following the secure CAPTCHA design principles with random
character set made of alphabets (upper and lower case) and numbers.

2) To improve security and hardness length and font size of generated text is randomized every time.

3) Associate a random question to new generated CAPTCHA to improve usability and user response time.

E. Algorithm and flowchart of proposed scheme

1. Create random alphanumeric code

1.1. Vary the generated alphanumeric code by random length and font size.

2. Create Image with little background confusion

3. Randomly select a query related to that code.

4. Keeping the combination of generated code and query in session.

5. Set the CAPTCHA combination of generated code and query on user interface (login page).

6. Ask user to provide proper input.

7. Compare the input provided by user and session value.

7.1. If inputs provided by user and session value are same with correctness then user is allowed to access service page.

7.2. If inputs provided by user and session value are not same then user is asked to provide proper inputs again.

8. Stop

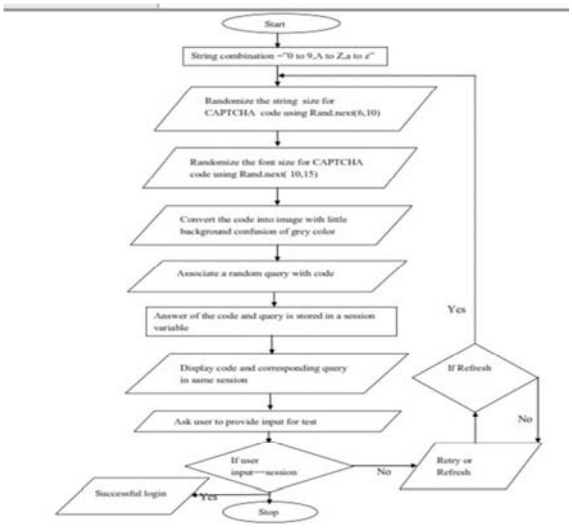


Fig 10 Flowchart of proposed scheme

F. Experiment table

User	Age	Response time (in sec.)	Input/solving time(in sec)	Experience of use
User-1	27	2	4.99	Good
User-2	24	3	6.10	Good
User-3	28	3	7.10	Good
User-4	25	4	6.80	Good
User-5	30	4	7.90	Good
User-6	23	3	5.50	Excellent
User-7	25	3	5.40	Good
User-8				

Table 1

Based on experiment it was found that a good experience of using the proposed CAPTCHA for every age group people which ensures better usability. It was also found that the average response time(3.14) and input/solving time(6.25) have been improved. It may be acceptable according to Bursztein's recommendations that the optimal recognition time for textbased CAPTCHAs is under 9 seconds [10].

G. Result

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Fig 11 snapshot before user logged in

This snapshot shows the login page CAPTCHA code and assiciated query before login of the user.Based on query user should enter first, 4th and 5th character of the CAPTCHA code only.

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Fig 12 snapshot when user logging in

This snapshot of result shows login page with CAPTCHA code and assciated queryAfter providing correct user name , password and CAPTCHA code according to query attached with it.

Snapshot of proposed scheme were shown above in which it can be obseved that here user needs to provide input according to query associated with the test. It saves time for user as it only provides few from entire code.Here type of query associated to CAPTCHA code is important and choosing query for query set should be done carefully. If query like" type how many numeric character? "," Type how many alphabets in the code?" are to be associated test may suffer with brute force or random guess attack. So we need to avoid query like this in which answer is single character or number.

We must consider queries whose answers will be easier for human user but difficult for bot programs.

V. CONCLUSION

In this article different recently and frequently used CAPTCHA were studied. According problem statement a robust CAPTCHA should not be only difficult to solve by computer programs, it should also be user friendly. Currently proposed scheme is designed in asp.net under visual studio platform with C# which is easy to implement. The solving process was kept simple so that human user can solve the test easily; they need to provide input according to associated query not entire CAPTCHA character set. Users require little time to provide input with accuracy. Principle design features were considered to provide better security and construct a generic text based CAPTCHA. To avoid several attacks like dictionary attack, segmentation attack and brute force attack (random guess attack) we have varied some considerable features and used different queries with randomness. It results improved usability, solving time and robustness of text based CAPTCHA. Using larger query set and choosing different kind of quires may improve the robustness of this type of CAPTCHA scheme in future.

REFERENCES

[1] Web Security, Your Site and Your Network beyond Security: Beyond security Inc.2015http://www.beyondsecurity.com/web-security-andweb-scanning.html -19/02/2015J.

[2] Ved Prakash Singh, Preet Pal" Survey of Different Types of CAPTCHA" ,IJCSIT Vol. 5 (2) , 2014, 2242-2245.

[3] Mohammad Shirali-Shahreza, Sajad Shahreza,"Question Based CAPTCHA", IEEE International Conference on Computational Intelligence, 2007..

[4] Dayanand,"WORD GROUPING CAPTCHA-A NOVEL APPROACH FOR SECURING WEB SERVICES" International Journal of Electrical, Electronics and Data Communication Volume-1, Issue-, July-2013.

[5] Mumtaz M. Ali AL-Mukhtar and Rana Riad K. AL-Tai "A More Robust Text Based CAPTCHA For Security in Web Applications" IJETTCS vol.3 issue 2 march-april 2014.

[6] Divya Shanker, Prashant Gupta, Aditya Jaiswal "Hybrid Collage CAPTCHA" International Journal of Communication and Computer Technologies Volume 01 – No.31, Issue: 05 May.

[7] Moin Mahmud Tanvee, Mir Tafseer Nayeem, Md. Mahmudul Hasan Rafee "Move & Select: 2-Layer CAPTCHA Based on Cognitive Psychology for Securing Web Services" International Journal of Video & Image Processing and Network Security IJVIPNS-IJENS Vol: 11 No: 05

[8] Poonam Yadav and Sujata"Security Issues in Cloud Computing Solution of DDOS and Introducing Two-Tier CAPTCHA", IJCCSA Volume 3 no 3 june 2013.

[9] Jeff Yen, Ahmad Salah, "CAPTCHA security-Case Study", IEEE CS, 2009

[10] E. Bursztein, S. Bethard, C. Fabry, J. C. Mitchell, andD. Jurafsky, "How good are humans at solving captchas? a large scale evaluation," in Proceedings of the 2010 IEEE Symposium on Security and Privacy, ser.

SP'10.

IMPROVING SPEECH EMOTION RECOGNITION SYSTEM

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Abstract—This paper presents modification of a speech emotion recognition system for a social robot. Emotion recognition is done using global acoustic features of the speech. Using speaker dependent classifiers with prior speaker identification step was proposed. Six speech signal parameters are computed with the specialised software. The feature extraction is based on calculation of global statistics of those parameters and their derivatives. Six emotions could be recognised by the system. Correlation based feature selection algorithms are used for reducing feature vector length. For the evaluation of the system three classifiers were used: Bayes Network, Radial Basis Function Network and Support Vector Machine. Several experiments were carried out: emotion recognition of the speaker not known to the system, speaker independent recognition of the known speakers, gender dependent classification as well as speaker dependent recognition with prior identification. The results of identification driven speech emotion recognition show significant improvement compared to the performance of the speaker independent system based on previous research. The use of the tailored speaker dependent recognition system led to increase in the Bayes Network classification accuracy from 74% to 96%, in the Support Vector Machine classification accuracy from 64% to 96% and in the Radial Basis Function Network classification accuracy from 67% to 88%.

I. INTRODUCTION

Emotion recognition is a crucial task in social robotics. In order to communicate in a natural way with human, the robot should be able to recognise different expressions of emotions: gestures, facial expressions, content of speech and the tone of voice. This work focuses on the last issue, i.e., the recognition of emotions encoded in the human voice intonation.

This research is based on the previous work presented in [1], [2], which showed significantly better performance of the speaker dependent system compared to the speaker independent system. The motivation of this research was to find out, whether the system can be expanded with speaker identification step, allowing speaker dependent classifiers utilisation. The intended application of the system is being part of software of the social robot, which credibility depends heavily on the emotion recognition system accuracy, because recognising emotions of the humans is one of the crucial competences of such robot.

The rest of the paper is organised as follows. In section II the structure of the discussed system and its modification is introduced. In the section III the results of system evaluation are presented. Finally, section IV presents conclusions and further research.

II. SYSTEM DESCRIPTION

Commonly used pattern recognition algorithms are applicable to the speech emotion recognition. However, there are at least two different approaches. One is estimating the short-time signal parameters and modelling their changes with Hidden Markov Models or similar tools [3], [4]. The other is extracting global features of the signal and applying statistical methods and various types of classifiers: SVM [5], [6], artificial neural networks [7], [8], decision trees [9], LDA [10]. The second approach was

chosen—each utterance is analysed as a whole, so global features are extracted and then used for classification.

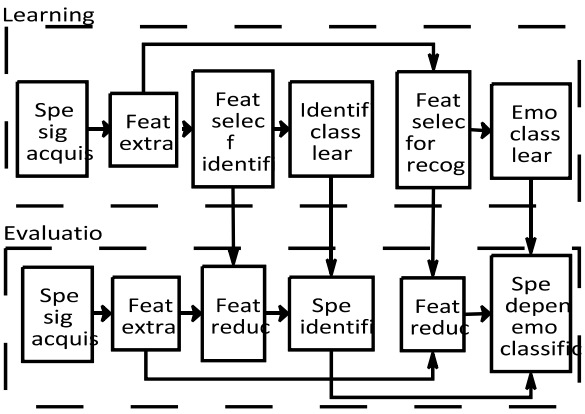
The speech emotion recognition system [2] developed by this author has the form of a set of MATLAB scripts using external tools — the programs Praat and Weka. Praat is a free (Open Source) program for phonetic analysis of speech. It can compute several parameters of speech: pitch, formants, spectrum, mel-frequency cepstral coefficients and many others [11]. Weka 3 (Waikato Environment for Knowledge Analysis) is a popular suite of machine learning software written in Java. It contains a collection of visualization tools and algorithms for data pre-processing, filtration, cauterisation, classification, feature selection and regression modelling [12]. It is freely available under GNU General Public License. The structure of the system is illustrated in figure 1. There are two phases of the system's operation: learning phase and evaluation phase. In the off-line learning phase feature selection and supervised learning of classifier is carried. In the evaluation phase the prepared system is used for on-line speech emotion classification.

A. Speech signal parametrisation

The speech signal is parametrised by the program Praat. Six parameters of the signal are computed.

a) *Intensity:* is the instantaneous sound pressure value measured in dB SPL, ie dB with respect to pressure of $2 \cdot 10^{-5}$Pa [11].
b) *Spectrogram:* The speech signal is split into 16ms frames with a 10ms step. Each frame is Fourier transformed to compute the magnitude of the frequency spectrum. The phase is neglected. Then logarithm is taken from the magnitude spectrum, and the result is appended to a matrix. This matrix is called spectrogram [13].
c) *Pitch:* is a fundamental frequency of the speech. It is produced by vocal folds (known commonly as vocal cords). Two algorithms were used to estimate the pitch: autocorrelation method [14] and cross-correlation method [15].

Figure 1. Block diagram of modified speech emotion recognition system.



The pitch exists only for the voiced parts of the signal, so resulting waveform is discontinuous. Built in smoothing and interpolation functions are used to overcome this issue.

a) Mel-frequency Cepstral Coefficients: (MFCC) are commonly used for parametrisation of the speech [11], [16]. Spectrum of the windowed signal is analysed by a bank of 26 bandpass filters with a central frequency equally spaced on a mel-scale, reflecting the subjectively perceived pitch. Subsequently, a discrete cosine transform is used to a logarithmised spectrum into a spectrum. Only the first 12 coefficients are used. Additionally, a 13rd series is computed as the average of all 12 series of the coefficients.

b)Harmonics to noise ratio: (HNR) is energy of the harmonic parts of the signal related to the energy of the noise parts. HNR is expressed in dB and computed using the autocorrelation method and the cross-correlation method [14].

c) Long-Term Average Spectrum: (LTAS) is averaged logarithmic power spectral density of the voiced parts of the signal with an influence of the pitch corrected away [17].

B. Feature extraction and selection

In order to extract more useful information from obtained vectors additional vectors are derived from them:

- first and second order difference,
- values of local minima,
- values of local maxima,
- distance between adjacent extrema,
- value difference of adjacent extrema,
- slopes between adjacent local extrema,

- absolute values of the two above.

These parameters are time-series — their length depends on the duration of analysed utterance. For classification purposes, it is necessary to convert the time series into a feature vector of fixed length. This is achieved by treating time series as outcomes of random variables and computing their statistics:

- arithmetic mean,
- median,
- standard deviation,
- global maximum,
- global minimum,
- first quartile,
- second quartile,
- range,
- interquartile range.

Using this method 1722 features are generated:

- 1050 from MFCC,
- 310 from pitch,
- 190 from HNR,
- 86 from intensity,
- 52 from spectrogram,
- 34 from LTAS.

The number of features is then reduced in the feature selection process.

Weka's function Attribute Selection was used to remove features that are redundant or not relevant for this particular task. This function requires subset evaluation and search functions. For evaluation correlation-based feature subset selection CfsSubsetEval was used — subsets of features that are highly correlated with the class while having low intercorrelation are preferred [18]. Search function was Best First, which searches the space of feature subsets by greedy hill climbing augmented with a backtracking facility. Feature selection is done in training phase. Therefore, the selected feature vector depends on the training set.

Three classifiers (also borrowed from Weka) were utilised:

- BayesNet — Bayes Network learning using a hill climbing search algorithm K2 with conditional probabilities estimated directly from the data.
- LibSVM — Support Vector Machine using *v*-SVC algorithm from LibSVM library.
- RBFNetwork — normalized Gaussian Radial Basis Function Network.

The respective abbreviations of the names of classifiers are: BNet, SVM and RBFNet.

C. Speaker identification

Several methods can be utilised for speaker identification [19]. In this case text-independent recognition based on the global features of the utterance is a natural choice. It allows using different subset of extracted features for speaker identification. In the training phase independent feature selection is made for the purpose of speaker identification and separate classifier is trained. In the evaluation phase each utterance is given speaker ID by the identification classifier and then emotion recognition is done using speaker dependent classifier.

III. EXPERIMENTAL RESULTS

A. Speech corpus

Database of Polish Emotional Speech consists of 240 recordings [20]. Four male and four female actor speakers were asked to enact in five phrases five different emotions (anger, joy, sadness, fear and boredom) as well as the emotionally neutral state. Phrases are uttered in Polish and their meaning is emotionally neutral. The number of recordings is the same for each emotion. These recordings were evaluated by 50 humans — each of them was asked to classify 60 randomly selected samples. The average recognition ratio was 72%.

B. Speaker independent emotion recognition

In the speaker independent approach, the goal is to build a general purpose speech emotion recognition system that allows the social robot to operate in different environments.

First case is that the social robot interacts with large number of people in broad environment. Such situation can occur during exhibitions and similar events. To simulate these conditions, the system was evaluated using eight-fold cross validation, where recordings of each speaker formed one fold. Female speakers are tagged F1-F4 and the male speakers M1M4. The

recognition process was carried out eight times, each time the recordings of seven speakers were used as training set, while the recordings of the remaining speaker were used for evaluation. The goal of this experiment was to test how speaker independent classifier performs, when it has to recognise emotion of a person not known before.

The results are shown in table I. The highest average classification accuracy (66%) was achieved using Bayes Network

Table I. CLASSIFICATION (IN %) ACCURACY FOR SPEAKER NOT KNOWN BEFORE, AVG IS AVERAGE PERFORMANCE OF CLASSIFIER.

	F1	F2	F3	F4	M1	M2	M3	M4	AVG
BNet	60	63	83	50	57	80	60	73	66
SVM	67	67	80	47	50	67	70	63	64
RBFN	70	63	77	40	47	77	47	50	59

Table II. CLASSIFICATION ACCURACY (IN %) FOR SPEAKER INDEPENDENT CLASSIFIER, AVG IS AVERAGE PERFORMANCE OF CLASSIFIER.

	F1	F2	F3	F4	M1	M2	M3	M4	AVG
BNet	70	77	90	53	67	80	80	73	74
SVM	57	67	70	57	60	70	70	64	64
RBFN	70	70	70	57	57	70	80	70	67

classifier. However, in some cases it was outperformed by other classifiers. The classification accuracy varies highly among speakers. This is because of personal differences in the tone of voice and manner of expressing emotions. Confusion matrices (not included here) show that there are also big variations in classification accuracy of each emotion for particular speaker. For example, using SVM for speaker F2, recognition rate for joy, neutral and sadness was 100%, for boredom 60% and for fear and anger only 20%. It can be noticed by listening to the recordings of speaker F2 that fear and anger are pretended in not so expressive manner as other emotions.

Different case is the social robot interacting with a small closed group of people e.g. family owning it. It can be assumed that all people belonging to this group are known to the robot. Even though the speaker independent system could be useful due to its simplicity. This time, stratified ten folds' cross validation was used to evaluate performance of the system, so the recordings of all eight speakers were used in training phase. The goal of this experiment was to test performance of the speaker independent system recognising emotions of known people.

The results are shown in table II. The highest average classification accuracy of 74% was achieved using Bayes network classifier and it was higher than in the previously described experiment. However, the level of improvement varied significantly between speakers — for the speaker M3 classification accuracy increased by 20 percentage points and for the speaker M4 there was no improvement at all.

C. Gender dependent emotion recognition

One of the major problems in designing speaker independent speech emotion recognition system is coping with differences between female and male voices. Using tailored recognition systems for female and male speakers promises improvement in classification accuracy. Methodology of tests was similar as in preceding subsection. However, in this case two separate systems were built, one using recordings of speakers F1-4 and other for speakers M1-4. Both of them were evaluated using stratified tenfold cross-validation.

The results, presented in table III, show improvement in average recognition accuracy compared to the speaker independent classifier. The highest average recognition rate was achieved with the Bayes network classifier and it was 81%.

Table III. CLASSIFICATION ACCURACY FOR GENDER DEPENDENT CLASSIFIERS, F1-4 AND M1-4 REPRESENT SPEAKERS.

	F1	F2	F3	F4	M1	M2	M3	M4	AVG
BNet	90	64	84	74	67	80	100	87	81
SVM	84	67	74	54	57	70	67	64	67
RBFN	80	60	74	60	60	67	74	77	69

Although results for particular speakers were not necessarily better than obtained with speaker independent classifier — classification accuracy for speakers F2 and F3 was lower. It should be noticed that in both cases the lowest recognition rate was achieved for speaker F4, but with gender dependent classifier it was significantly higher.

D. Identification-driven emotion recognition

The described speech emotion recognition system is intended to be part of personal social robot's software. As it was said before, such robot should interact with small group of people e.g. family. Moreover, this relation is meant to be regular and long-lasting, so that the prior knowledge about these people can be used to construct tailored emotion recognition system. Results presented in [1] showed the considerably better performance of the speaker dependent recognition system compared to the speaker independent system. Obviously, in order to utilise speaker dependent classifier, speaker has to be identified previously. It can be done using various methods. However, due to the fact that the speech signal parameters are used by this system for emotion recognition, natural choice is to use them also for speaker identification.

The purpose of this experiment was to build the emotion recognition system for the robot interacting with closed group of eight known people. Thus, prior knowledge about them can be utilised both for the speaker identification and the speaker dependent emotion recognition. The dataset was divided into five folds, stratified with respect to the speaker ID and the emotion ID. Training and evaluation of identification classifier were done in the first place. Then, training and test sets for speaker dependent emotion classification were prepared. Each of the previous training sets was divided into eight new sets, one for each speaker ID. Similarly, each test set was divided into eight new test sets, but with respect to the results of the previous identification. This gave 40 pairs of training and test sets. Processing the data in described manner ensured that all classifiers were evaluated using utterances that were not presented to them in the training phase.

The results of the speaker identification are shown in table IV. The highest average recognition rate of 99% was achieved using Radial Basis Function Network classifier. Important thing is that recognition rate does not vary significantly between speakers.

The results of the identification-driven emotion recognition are shown in table V. It can be seen that classification accuracy has improved greatly in comparison with speaker independent emotion recognition presented above. The best average classification accuracy achieved with speaker independent system was 74%, while the identification-driven system achieved average accuracy of 96% with Bayes network and SVM classifiers. For the credibility of the system important is that for both mentioned classifiers, the lowest per speaker classification accuracy was considerably high (93%).

Table IV. SPEAKER IDENTIFICATION ACCURACY, AVG IS AVERAGE PERFORMANCE OF CLASSIFIER.

	F1	F2	F3	F4	M1	M2	M3	M4	AVG
BNet	100	100	94	97	100	100	94	100	98
SVM	100	88	84	100	100	100	86	100	95
RBFN	100	100	96	96	100	100	100	100	99

Table V.CLASSIFICATION ACCURACY FOR THE IDENTIFICATION-DRIVEN EMOTION RECOGNITION, AVG IS AVERAGE PERFORMANCE OF CLASSIFIER.

	F1	F2	F3	F4	M1	M2	M3	M4	AVG
BNet	94	96	97	97	93	97	97	100	96
SVM	94	93	94	100	100	97	93	93	96
RBFN	72	93	87	93	90	93	93	83	88

IV.CONCLUSIONS

This paper presents modification of a speech emotion recognition system for a social robot. Using speaker dependent classifiers with prior speaker identification step was proposed. Emotion recognition is done using global acoustic features of the speech. Six speech signal parameters are computed with the specialised software. The feature extraction is based on calculation of global statistics of those parameters and their derivatives. Correlation based feature selection algorithms are used for reducing feature vector length. For the evaluation of the system three classifiers were used: Bayes Network, Radial Basis Function Network and Support Vector Machine. Six emotions could be recognised by the system.

Several experiments were carried out to simulate different operating environments of the social robot. The results of speech emotion recognition for the speaker not known before were presented as well as for the speaker independent recognition for known speakers. The performance of the gender dependent recognition system was also evaluated. It was shown that utilisation of knowledge about

particular speakers led to improvement in the system performance.

The results of identification-driven speech emotion recognition show significant improvement compared to the performance of the speaker independent system. For the Bayes Network classification accuracy increased from 74% to 96%, while Support Vector Machine classification accuracy increased from 64% to 96% and the Radial Basis Function Network classification accuracy increased from 67% to 88%.

The obtained results suggest that social robot may be able to recognise speech emotions of small group of people with good accuracy. Hence, the further research should include evaluating the system in human-robot interaction scenarios. Highly desirable modification of the system would be also allowing the system to learn speech emotion expression of new people. Also introducing gender identification step into system could be considered for improving performance in broad and changing environment.

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REFERENCES

[1] L. Juszkiewicz, "Speech emotion recognition system for social robots." *Journal of Automation, Mobile Robotics & Intelligent Systems.*, vol. 7, pp. 59–65, 2013.

[2] Łukasz Juszkiewicz, *Poste˛py robotyki*. Oficyna wydawnicza PW, 2012, ch. Speech emotion recognition system for social robots (in Polish), pp. 695–704.

[3] T. L. Nwe, S. W. Foo, and L. C. D. Silva, "Speech emotion recognition using hidden markov models," *Speech Communication*, vol. 41, pp. 603–623, 2003.

[4] X. Mao, B. Zhang, and Y. Luo, "Speech emotion recognition based on a hybrid of HMM/ANN," in *Proceedings of the 7th Conference on 7th WSEAS International Conference on Applied Informatics and Communications - Volume 7*. Stevens Point, Wisconsin, USA: World Scientific and Engineering Academy and Society (WSEAS), 2007, pp. 367–370.

[5] J. Zhou, G. Wang, Y. Yang, and P. Chen, "Speech emotion recognition based on rough set and SVM." in *IEEE ICCI*, Y. Yao, Z. Shi, Y. Wang, and W. Kinsner, Eds. IEEE, 2006, pp. 53–61.

[6] S. Casale, A. Russo, G. Scebba, and S. Serrano, "Speech emotion classification using machine learning algorithms," in *Proceedings of the 2008 IEEE International Conference on Semantic Computing*. Washington, DC, USA: IEEE Computer Society, 2008, pp. 158–165.

[7] Z. Xiao, E. Dellandréa, W. Dou, and L. Chen, "Hierarchical Classification of Emotional Speech," LIRIS UMR 5205 CNRS/INSA de Lyon/Université Claude Bernard Lyon 1/Université Lumiére Lyon 2/École Centrale de Lyon, Tech. Rep. RR-LIRIS-2007-006, Mar. 2007.

[8] K. Dautenhahn, *Socially intelligent agents: creating relationships with computers and robots*, ser. Multiagent systems, artificial societies, and simulated organizations. Kluwer Academic Publishers, 2002, ch. Creating emotion recognition agents for speech signal.

[9] J. Sidorova, "Speech emotion recognition with TGI+.2 classifier," in *Proceedings of the 12th Conference of the European Chapter of the Association for Computational Linguistics: Student Research Workshop*, ser. EACL '09. Association for Computational Linguistics, 2009, pp. 54–60.

[10] D. Neiberg and K. Elenius, "Automatic recognition of anger in spontaneous speech."

[11] D. W. Paul Boersma, "Praat: doing phonetics by computer (version 5.2.05)," 2010. [Online]. Available: http://www.praat.org/

[12] M. Hall, E. Frank, G. Holmes, B. Pfahringer, P. Reutemann, and I. H. Witten, "The WEKA data mining software: an update," *SIGKDD Explor. Newsl.*, vol. 11, pp. 10–18, November 2009.

[13] S. Haykin, *Advances in spectrum analysis and array processing*, ser. Prentice Hall advanced reference series: Engineering. Prentice Hall, 1995. [Online]. Available: http://books.google.pl/books?id=su1SAAAAMAAJ

[14] P. Boersma, "Accurate Short-Term Analysis of the Fundamental Frequency and the Harmonics-to-Noise Ratio of a Sampled Sound," *Institute of Phonetic Sciences, University of Amsterdam, Proceedings*, vol. 17, pp. 97–110, 1993. [Online]. Available: http://www.fon.hum. uva.nl/paul/papers/Proceedings_1993.pdf

[15] S. Samad, A. Hussain, and L. K. Fah, "Pitch detection of speech signals using the cross-correlation technique," in *TENCON 2000. Proceedings*, vol. 1, 2000, pp. 283 – 286.

[16] S. S. Stevens, J. Volkmann, and E. B. Newman, "A scale for the measurement of the psychological magnitude pitch," *Journal of the Acoustical Society of America*, vol. 8, no. 3, pp. 185–190, 1937. [Online]. Available: http://link.aip.org/link/?JAS/8/185/1&Agg =doi

[17] E. Keller, "The analysis of voice quality in speech processing," in *Lecture Notes in Computer Science*. Springer-Verlag, 2005, pp. 54–73.

[18] M. A. Hall, "Correlation-based Feature Subset Selection for Machine Learning," Ph.D. dissertation, Department of Computer Science, University of Waikato, Hamilton, New Zealand, Apr. 1999.

[19] S. Parthasarathy, *Springer Handbook of Speech Processing*. Springer, 2008, ch. Speaker Recognition.

[20] Lodz University of Technology, Medical Electronics Division, "Database of Polish Emotional Speech," http://www.eletel.p.lodz.pl/ bronakowski/med_catalog/docs/licence.txt.

A SURVEY ON GESTURE RECOGNITION METHODS

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***Abstract*—several methods have been proposed for the hand gesture recognition, but there is no single algorithm which can handle the all kind of situations, because of complex environment. The paper [01] describes the extension to the longest common subsequences [LCS] classification algorithm, in which gestures are unencumbered and drawn in free air. The paper [02] covers the concept of threshold model that calculates the likelihood threshold of an input pattern and provides a confirmation mechanism for a provisionally matched gesture pattern. With an adaptive window for each frame we can capture the Hand motion information by using Color-Based tracking algorithm. Use of Hidden Markov Models [HMMs] in recognition of alphabet characters (A-Z) and numbers (0-9) in real time from stereo image sequences is explained in paper [03]. The paper [04] describes the new method for the representation, recognition, and interpretation of parameterized gesture using a linear model of dependence and Expectation-Maximization (EM) method. Hand gesture recognition is widely used in information visualization, robotics, sign language understanding, medicine, and health care.**

Keywords- gesture recognition, threshold model, Hidden Markov Model, time series modelling.

I. INTRODUCTION

There are different types of gesture recognitions like hand gesture recognition, audio expression recognition and facial expression recognition. Due to the complexity of the problem no single algorithm can handle all kind of situations so there are different algorithms for the particular task, such as FSMs (Finite State Machines) [1], Particle Filtering and Condensation Algorithm [2], Connectionist Approach [3] and HMMs (Hidden Markov Models) [4]. Recently, CRF model [5] is proposed in glove-based gesture Recognition area. In the same manner LCS algorithm was developed for matching sub word sequences in deoxyribonucleic acid sequences and documents, and only a few authors have employed the LCS for gesture classification. This method is similar to DTW which attempts to line up a test and template sequence temporally, using feature distance costs. The LCS is more robust to noise and outliers than DTW. Instead of a complete mapping between all points, in the LCS algorithm, a point without a good matching can be ignored. LCS tasks can be solved using a brute-force approach, where all possible subsequences of one of the strings are found.

II. SPOTTING WITH THRESHOLD MODEL

Due to the segmentation ambiguity and spatio-temporal variability, it is very difficult to locate the starting point and end point of gesture spotting. Whereas, pattern spotting is a task of locating meaningful patterns from a stream of input signals.

A. Threshold Model

Distinct pattern of gesture model gives the exact gesture spotting. The best likelihood chosen by the HMM recognizer cannot guarantee that the pattern is really similar to the gesture unless the likelihood value is high enough. So we are going for *Threshold model,* where each likelihood values are used as threshold. A gesture is recognized only if the

likelihood of the best gesture model is higher than that of the threshold model.

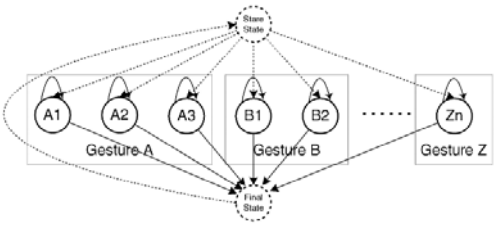

Figure 1.A simplified structure of the threshold model. The dotted arrows are null transitions.

Using HMM's internal segmentation property we can construct an ergodic model with the states copied from all gesture models in the system and then fully connect the states (Fig. 1). In this model, each state can be reached by all other states in a single transition. Output observation probabilities and self-transition probabilities in this model are kept as in the gesture models, but all outgoing transition probabilities are equally assigned as

$$a_{ij} = \frac{1 - a_{ij}}{N - 1}, \quad \text{for all } j, i \neq j,$$

Where a_{ij} is the transition probability from state s_i to s_j and N is the number of states (the sum of all states excluding the start and final states). The threshold model acts as a base-line.

B. Gesture Spotting Network

Using the circular gesture spotting network (GSN) input stream can be spotted as shown in Fig.2. In the figure, S is the dummy start state

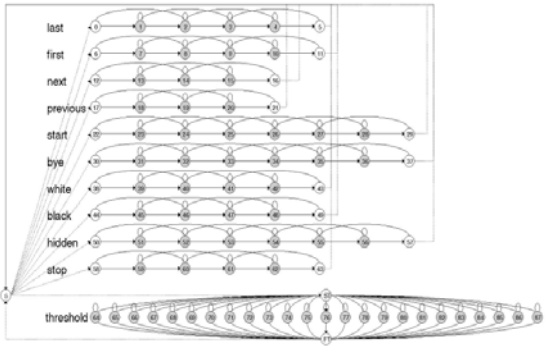

Fig. 2.Gesture Spotting Network. A label denotes the name of a gesture and each dotted line represents a transition between models

We can uncover a state sequence using the Viterbi algorithm. To find the single best state sequence, Q1; t= ˆ$q_1q_2...q_t$ for the given observation O1;t =ˆ$O_1O_2...O_t$, we need to define the quantity:

$$\delta_t(i) \cong \max_{Q_{1,t}} P(Q_{1,t-1}, q_t = s_i, O_{1,t} \mid \lambda)$$

With the highest probability along a single path arriving at

si at time t and accounting for the first t observations. Then

By induction:

$$\delta_1(j) = \pi_j b_j(O_1) \qquad 1 \leq j \leq N,$$
$$\delta_t(j) = \max_i[\delta_{t-1}(i)a_{ij}] \cdot b_j(O_t) \quad 2 \leq t \leq T,\ 1 \leq j \leq N.$$

For the back tracking information, we use t…j† to keep the

Argument that maximizes $\delta_t(j)$ for each t and j

$$\psi_t(j) = \arg\max_i[\delta_{t-1}(i)a_{ij}] \qquad 2 \leq t \leq T,\ 1 \leq j \leq N.$$

Where as In case of null transitions, the likelihood of the source state at time t is simply maximized without time delay as

$$\delta_t(j) = \max_i[\delta_t(i)a_{ij}],$$
$$i^* = \arg\max_i[\delta_t(i)a_{ij}],$$
$$\psi_t(j) = \psi_t(i^*).$$

To uncover the most likely state sequence Q*=ˆq*1 q*2 ….q*T after the preceding computation, we must trace back to the initial state by following the Viterbi path of ψs as:

$$q_T^* = s_N,$$
$$q_t^* = \psi_{t+1}(q_{t+1}^*) \quad t = T-1, T-2, \ldots 1.$$

This is known as the Viterbi algorithm. It can be efficiently implemented using a lattice structure. We use this algorithm for calculating likelihood and finding the start point from the end point. For reliable spotting, the model transition probability into the threshold model p(TM), is tuned to satisfy:

$$P(X_G \mid \lambda_G)p(G) > P(X_G \mid \lambda_{TM})p(TM) \qquad (1)$$

$$p(X_{TM} \mid \lambda_G)p(G) < P(X_{TM} \mid \lambda_{TM})p(TM), \qquad (2)$$

Where XG denotes a gesture pattern, XTM a non-gesture pattern, λ the target gesture model, λTM the threshold model, and NG the number of gesture models in the system. Inequalities (1) and (2) imply that a gesture should best match with the corresponding gesture model and a non-gesture with the threshold model, respectively. Model transition probabilities into gesture model p(G)†s are set equal using p(TM)†as

$$p(G) = \frac{1 - p(TM)}{N_G}.$$

With a sequence of spotting experiments, we have decided p(TM) †as the value generating the best result. Likelihood of a gesture model should be greater than that of the threshold model. The time satisfying such a condition can be called a candidate end point (CEP).

C. End-Point Detection

The end-point detection is nothing but the process of choosing the best among these CEPs. It removes nested gestures and makes the spotter fire only once when a gesture is encountered.

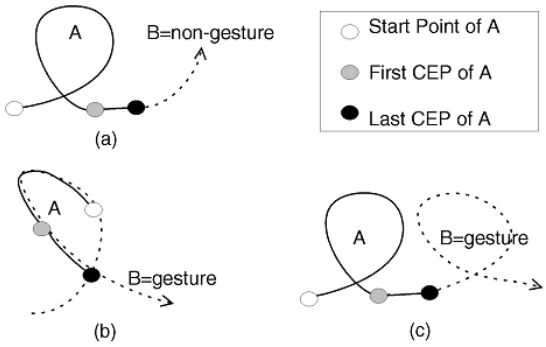

Fig. 3. Determination of an end point. (a) Non-gesture is following. (b) Nested gesture. (c) Gesture is following. Each dark curve A represents the preceding gesture that may be reported and the dotted curve B represents the immediately following pattern or gesture.

The detection criterion is defined as follows:

1. When the immediately following pattern B is not a gesture, as in Fig. 3a, the last CEP of the preceding gesture A is determined as the end point. A is reported.

2. When the immediately following pattern B is by itself a gesture, there are two alternatives:

a. When the start point of B precedes the first CEP, as in Fig. 3b of A, A is regarded as a part of a larger current gesture (B) which includes A and extends beyond the CEP of A. All the CEPs of A are ignored.

b. When B starts between the first and the last CEPs of A, as in Fig. 3c, the immediately preceding CEP is chosen as the end point of A. Here the stack checks the gesture embedding.

D. Enhancing the Performance

Threshold model is constructed by combining all the gesture models within the system, the number of states in the threshold model is equal to the sum of the states of all gesture models except the start and final states. This means that the number of states in the threshold model increases as the number of gesture models increases. Consequently, the increased number of states increases time and space requirements. To avoid this problem, we are using relative entropy to reduce the number of states of the threshold model. The entropy H(Z)† of a discrete random variable Z is defined by:

$H(Z)=\sum p(z)\log(z)$ where $z \in Z$

Where p(z) is a probability mass function.

III. 3D HAND GESTURE RECOGNITION SYSTEM

Author proposed an automatic system which is capable of recognizing isolated gesture for Alphabets (A-Z) and Arabic numbers (0-9) in real-time from stereo color image sequences by the motion trajectory of a single hand using HMMs. The proposed system consists of three main stages; an automatic hand segmentation and tracking, feature extraction and classification (Fig.4)

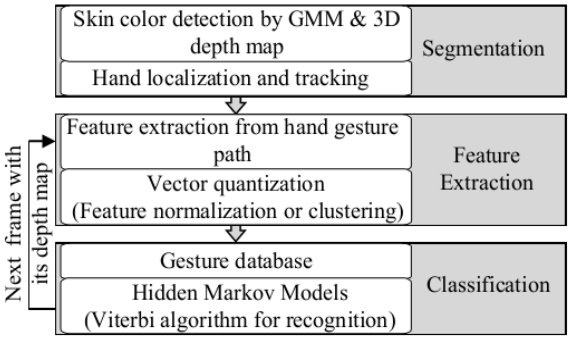

Figure 4. Simplified structure showing the main computational modules for isolated gesture recognition system.

A. Automatic Hand Segmentation

Using the 3D depth map and color information Hand segmentation can be done. Here it uses YCbCr color space where Y channel represents

$$q_u = F\sum_{i=1}^{n} k(\|x_i^*\|^2)\delta[b(x_i^*) - u] \qquad (2)$$

brightness and (Cb;Cr) channels refer to chrominance channel is used because only chrominance causes robustness in the colored regions. By ignoring the effect of brightness variation and using the chrominance we can get the color information. Gaussian model is trained by a huge database of skin and non-skin pixels.

The training set consists 18972 skin pixels from 36 different races persons and 88320 non-skin pixels from 84 different images. The GMM technique mainly does the modeling of skin using skin data base where a variant of k-means clustering algorithm performs the model training to determine the initial configuration of GMM

parameters.]. An algorithm is used for the skin segmentation of hands and face in stereo color image sequence, which calculates the depth value Z in addition to skin color information according to Eq. 1 (Fig. 5(d))

.

$$Z = \frac{f.b}{x_L - x_R} \quad (1)$$

where f is identical effective focal length. b is base line, it represents the distance between two optical centers left: OL, right: OR). The angle subtended by the two optical axes be 2. A point P (X; Y; Z) in 3D space is projected onto the points (x_L; y_L), (x_R; y_R) in the image plane of left and right camera. Derivation of the hand boundary area, bounding box and centroid point is done by using Blob analysis.

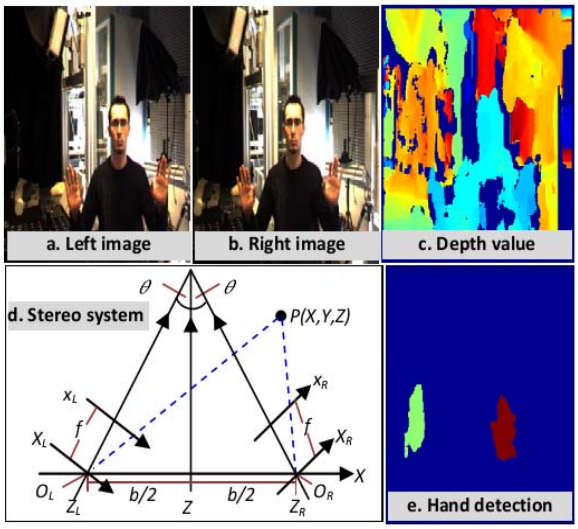

Figure 2. (a) Left image of video stream. (b) Right image. (c) Depth value of left and right image from the Bumblebee stereo camera. (d) Geometry of a stereo camera system. (c) Labeled skin color segmentation of two hands.

By using the Mean-shift algorithm which is a kernel (i.e. non-parametric) density estimator we can optimize a smooth similarity function to find the direction of the hand target's movement. Let us consider 16-bin histograms as the representation of the hand's color probabilities density function (pdf's), as they can satisfy the inexpensive requirement of real-time tracking. The probability of the feature u = 1…16 in the hand target model histogram is computed as (2) where is the Kronecker delta function, equal to 1 only at u and 0 otherwise. The normalization constant F is determined by imposing the condition ∑ qu=1 where u=1…..16

$$F = \frac{1}{\sum_{i=1}^{n} k(\|x_i^*\|^2)} \quad (3)$$

The probability of the feature u = 1…16 in hand candidate histogram is calculated as;

$$p_u(y) = F_n \sum_{i=1}^{n_h} k(\|\frac{y - x_i}{h}\|^2)\delta[b(x_i) - u] \quad (4)$$

Where

$$F_h = \frac{1}{\sum_{i=1}^{n_h} k(\|\frac{y-x_i}{h}\|^2)} \quad (5)$$

B. Feature Extraction

The very important three basic features are location, orientation and velocity. We scrutinize the effectiveness of these features that are extracted from a hand trajectory and also combine them to test their recognition rate. A gesture path is spatio-temporal pattern that consists of hand centroid points (x hand; y hand). The coordinates present in the Cartesian space can be extracted directly from gesture frames. let us first consider two types of location features. The first location feature is L_c which measures the distance from the centroid point to all points of the hand gesture path because different location features are generated for the same gesture according to different starting points (Eq. 10). The second location feature is L_{sc} which is computed from the start point to the current point of hand gesture path (Eq. 12).

$$Lc_t = \sqrt{(x_{t+1} - C_x)^2 + (y_{t+1} - C_y)^2} \quad (10)$$

$$(C_x, C_y) = \frac{1}{n}(\sum_{t=1}^{n} x_t, \sum_{t=1}^{n} y_t) \quad (11)$$

$$Lsc_t = \sqrt{(x_{t+1} - x_1)^2 + (y_{t+1} - y_1)^2} \quad (12)$$

The second basic feature is the orientation, which gives the way all along that the hand when traverses in space during the gesture building process. As described above, the orientation feature is mainly based on the computation of the hand displacement vector at every point and is represented by the orientation according to the centroid of gesture path (1t), the orientation between two successive points (2t) and the orientation between start and present gesture point (3t).

$$\theta_{1t} = \arctan\left(\frac{y_{t+1} - C_y}{x_{t+1} - C_x}\right), \theta_{2t} = \arctan\left(\frac{y_{t+1} - y_t}{x_{t+1} - x_t}\right)$$

$$\theta_{3t} = \arctan\left(\frac{y_{t+1} - y_1}{x_{t+1} - x_1}\right)$$

Last basic feature is the velocity, which plays a vital role during gesture recognition phase predominantly at some critical situations. The velocity is based on the reality that each gesture is made at different speeds where the velocity of the hand decreases at the corner point of a gesture path. The velocity is deliberate as the Euclidean distance between the two successive points divided by the time in terms of the number of video frames as follows;

$$V_t = \sqrt{(x_{t+1} - x_t)^2 + (y_{t+1} - y_t)^2}$$

C. *Classification*

We are using Markov model to generate random sequences of outcomes according to certain probabilities. A stochastic process is a sequence of features code words, the outcomes being the classification of hand gesture path. The HMMs have some major problems such as Evaluation, Decoding and Training and they can be solved by using Forward Backward, Viterbi and Baum-Welch (BW) algorithms respectively. And also, HMMs has three topologies; Fully Connected (i.e. Ergodic model) in which any state can be reached from other states, Left-Right (LR)model such that every state can go back to itself or to the following states and Left-Right Banded model where each state can go back to itself or the next state only. Each reference pattern in the gesture database for alpha-bets (A-Z) and Arabic numbers (0-9) is modeled by Left-Right Banded model with varying number of states ranging from 3 to 6 states based on its intricacy. As, the undue number of states can generate the over-fitting problem if the number of training samples is insufficient compared to the model parameters. The maximal gesture model is the gesture whose observation probability is the largest among all 36 gestures (A-Z & 0-9). Viterbi algorithm decides the type of observed gesture (o) frame by frame (i.e. accumulatively until it receives the gesture end signal).

IV. PARAMETRIC HIDDEN MARKOV MODELS

In this section we are focusing on gestures whose spatial Execution is determined by the parameter, as opposed to say, the temporal properties. And a frame-work which models spatially parameterized movements in such a way that, the recovery of the parameter of interest and the computation of likelihood proceed simultaneously.

A. *Defining Parameterized Gesture*

Parametric HMMs clearly model the dependence on the
Parameter of concern. Embark on with the usual HMM
Formulation [22] and change the form of the output probability distribution to depend on the gesture parameter to be estimated. Similar to earlier approaches to gesture recognition, we assume that a given gesture sequence is modeled as being generated by a first-order Markov finite state machine. The state that the machine is in at time t and its output are denoted q_t and x_t, respectively. Encode the Markov property by a set of transition probabilities, with a_{ij}= $P(q_t= m/q_{t-1}=n)$ the probability of moving to state m at time t given the system was in state n at time t-1.In a continuous density HMM, an output probability density $b_m(x_t)$ associated with each state m gives the probability of the feature vector x_t given the system is in state 'm' at time t: $P(x_t/q_t=m)$. A set of training data sequences known to be generated by a single machine the parameters of the machine need to be estimated. In a simple Gaussian HMM, the parameters are the amn, μm, and ∑m2. In this case define a parameterized gesture to be one in which the output densities bm(xt) are a function of the gesture parameter vector Θ: $bj(x_t:\Theta)$. The dimension of Θ matches that of the degree of freedom of the gesture. It's always scalar For the fish size gesture, in order to indicate the direction in space, Θ would have two dimensions. We know that our definition of parameterized gesture only modifies the spatial variation and does not model temporal variation. Only because the Viterbi parsing algorithm of the HMMs basically performs a dynamic time warp of the input signal. In fact, part of the demand of HMMs for gesture recognition is its insensitivity to temporal variation. Un-fortunately, this property means that it is hard to restrict the nature of the temporal variation .in recent times, Yacoob and Black derived a method for recognizing global temporal deformations of an activity; their method does not, however, represent the unambiguous spatial

parameter variation. Also, although Θ is a global parameter, further it affects all States the actual effect varies state to state. So the effect of Θ is local and will be set to maximize the total probability of the training set. Results of some experiments shows that if some state is best left unperturbed by Θ, then magnitude of the effect will automatically become small.

B. Linear Model

By modifying output densities, we can realize the parameterization on Θ. Therefore, we know that simplest useful model is a linear dependence of the mean of the Gaussian on Θ. For each state m of the HMM, we have:

$$\hat{\boldsymbol{\mu}}_j(\boldsymbol{\theta}) = W_j\boldsymbol{\theta} + \bar{\boldsymbol{\mu}}_j$$

$$P(\mathbf{x}_t \mid q_t = j, \boldsymbol{\theta}) = \mathcal{N}(\mathbf{x}_t, \hat{\mu}_j(\boldsymbol{\theta}), \Sigma_j),$$

For a pointing gesture of one hand W would be 3*2. The magnitude of the columns of W gives how much the mean of the density translates as the value of different components of Θ vary. We know that Θ is constant for the entire observation

Sequence, but is free to fluctuate from sequence to sequence. According to need, we write the value of Θ associated with a particular sequence k as Θ k.

C. Training

HMM parameter are estimated within the HMM paradigm of recognition, training entails by means of known, segmented examples of the gesture sequence the probability that the HMM would produce the training set is maximized, and is updated using The Baum-Welch form of the expectation-maximization (EM) algorithm. The expectation step of the Baum-Welch algorithm also called as the ªforward/backwardº algorithm. It is used for computing the probability that the HMM was in state k at time l given the entire sequence x; the probability is denoted as λ_{kl}. Φ' may contain all the parameters in φ or only a subset if several maximization steps are required to estimate all the parameters. In the appendix, we derive the derivative of Q for HMMs

$$\frac{\partial Q}{\partial \phi'} = \sum_t \sum_j \gamma_{tj} \frac{\frac{\partial}{\partial \phi'} P(\mathbf{x}_t \mid q_t = j, \phi')}{P(\mathbf{x}_t \mid q_t = j, \phi').}$$

D. Testing

The parameterized HMMs testing procedure is complicated by the dependence of the parse on the unknown Θ, as Compared to the usual HMM formulation, probability of the observation sequence is maximized by the desired value of Θ. Recognition using PHMMs proceeds by computing for each PHMM the value of Θ that maximizes the likelihood of the sequence. Highest likelihood PHMM is selected. In few cases it may be possible to categorize the sequence by the value of Θ as dogged by a single PHMM.

CONCLUSION

This paper offers different algorithms for hand gesture recognition. And shows combined features of location, orientation and velocity for Cartesian systems can yield sensible recognition rates. The paper also concludes that an HMM-based gesture spotting system with a threshold model that computes the threshold likelihood given an input pattern. Hand gesture recognition methods are widely used in information visualization, robotics, sign language understanding, medicine, and health care.

REFERENCES

[1] F. Chen, C. Fu, and C. Huang, "Hand gesture recognition using a real-time tracking method and hidden Markov models," Image Video Comput.,
vol. 21, no. 8, pp. 745–758, Aug. 2003.

[2] H. An and D. Kim, "Hand gesture recognition using 3D depth data," in
Proc. of 10th Postech-Kyutech Joint Workshop, Kyutech, Japan, 2010.

[3] G. Andrejkova, "The similarity of two strings of fuzzy sets,"Kybernetika, vol. 36, no. 6, pp. 671–687, 2000

[4] A. Just and S. Marcel, "A comparative study of two state-of-the-art sequence processing techniques for hand gesture recognition,"Comput. Vis.
Image Understand, vol. 113, no. 4, pp. 532–543, Apr. 2009

[5] J. Alon, V. Athitsos, Q. Yuan, and S. Sclaroff, "A unified framework
For gesture recognition and spatiotemporal gesture segmentation,"IEEE
Trans. Pattern Anal. Mach. Intel., vol. 31, no. 9, pp. 1685–1699, Sep. 2009

[6] Y.-K. Ahn, M.-W. Kim, Y.-C. Park, K.-S.Choi, W.-C.Park, H.-M Seo,and K.-M. Jung, "Virtual gesture screen system based on 3D visual in-formation and multi-layer perceptron," World Acad. Sci. Eng. Technol.,
vol. 59, pp. 405–408, Nov. 2009.
[7] L. Bergroth, H. Hakonen, and T. Raita, "A survey of longest common
subsequence algorithms," in Proc. 7th Int. Symp. String Process. Inf. Retriev., 2000, pp. 39–48.
[8] H. Bezine, M. A. Alimi, and N. Derbel, "An explanation for the feature of a handwriting trajectory movement controlled by a beta elliptic model,"
In Proc. 7th Int. Conf. Doc. Anal.Recognit., 2003, pp. 1228–1232.
[9] H. Chen, O. E. Agazzi, and C. Y. Suen, "Piecewise linear modulation
model of handwriting," inProc. Int. Conf. Doc. Anal. Recognit., 1997,
pp. 363–367.
[10] C. Choi, J.-H. Ahn, and H. Byun, "Visual recognition of aircraft mar-shalling signals using gesture phase analysis," inProc. IEEE Intell. Veh.
Symp., Eindhoven, Netherlands, Jun. 4–6, 2008, pp. 853–858.
[11] K. Tanaka, "Gesture recognition with a focus on important actions by
using a path searching method in weighted graph,"Int. J. Comput. Sci.,
vol. 6, no. 2, pp. 14–19, 2009.
[12] J. Hao and T. Shibata, "Digit-writing hand gesture recognition by hand-held camera motion analysis," inProc. 3rd Int. Conf. Signal Process. Commun. Syst., 2009, pp. 1–5.

DESIGN AND OPTIMIZATION OF SCISSOR JACK

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Abstract— Every engineering product involve cost effective manufacturing and its versatility in application maintaining its aesthetics as well as assign service life without failure keeping those parameters in mind we focused our intention on designing and analyzing the scissor jack model for actual loads for varying models of automobile L.M.V. sectors. Automobile sectors are very keen at their productivity and customer satisfaction. We also keen at designing and optimization of scissor jack at the same time maintaining its strength and service life. After studying failure modes we made a mathematical model analytically and by using software's thereby made a new versatile scissor jack that can be used for varying models of L.M.V automobile sector. Also modeling made by CATIA and mathematical model made by Visual Basic software can be tested by ANSYS software.

Index Terms-Mathematical Model, Optimization and Scissor.

I. INTRODUCTION

Car jack is a device used to lift up the cars while changing the tires during an emergency. Car jacks are available at the market has some disadvantages such as requiring more energy to operate, are not suitable for women and cannot be used on the uneven surface. The purpose of this project is to modify the design of the existing car jack in terms of its functionality and also human factors considerations.

The day to day usage of cars is keeping on increasing as the world moves on to a hectic stage. One big problem everyone faces is a flat tyre on a voyage to any destination. If the tyre gets punctured the driver has to undergo a lot of pressure and rigorous mechanical work to lift the car using a screw jack. Then the changing of a tyre is a job that can be done systematically and relatively easy.

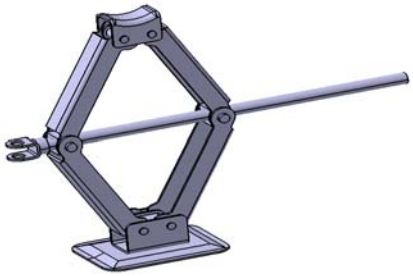


Fig.Scissor Jack

Today, many people are familiar with the jack that is included with their vehicle. Some vehicles bear screw jacks and others carry a hydraulic jack. Automotive jacks are of three types mainly:-

1. Screw Jacks
2. Trolley Jacks
3. Bottle Jacks

Each has its own advantages and disadvantages. Screw jack is lesser in cost, as compared to trolley jacks and bottle jacks. While trolley jack and bottle jack can provide a greater lift with lesser application of force. [5]

With the increasing levels of technology, the efforts being put to produce any kind of work has been continuously decreasing. The efforts required in achieving the desired output can be effectively and economically be decreased by the implementation of better designs.

Scissor or Toggle Jack

A toggle or Scissor jack is a device which lifts heavy equipment. The most common form is a car jack, floor jack or garage jack which lifts vehicles so that maintenance can be performed. Car jacks usually use toggle advantage to allow a human to lift a vehicle by manual force alone. More powerful jacks use hydraulic power to provide more lift over greater distances.

There is a one screw in the toggle jack which is rotating.

There are two nuts which are fixed.

There are four links connected to both nuts and eight pins to fix all links.

There are two rings at both ends of the screw.

There is a one platform which is connected to the upper two links for put load.

Working of Toggle Jack

• The jack can be raised and lowered with a metal bar that is inserted into the jack.

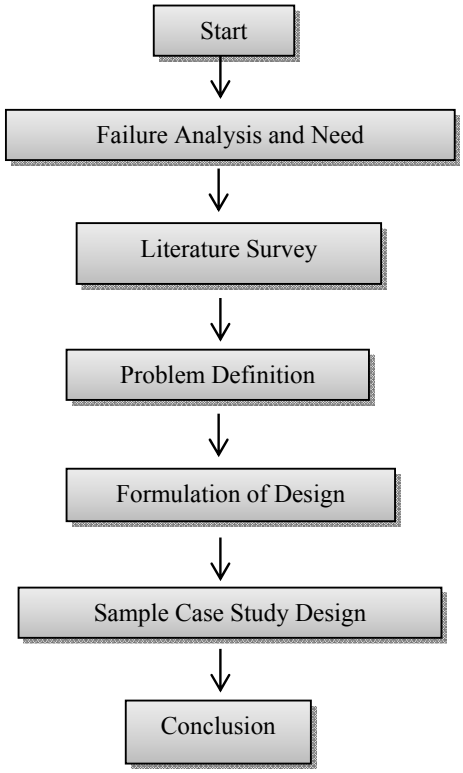
• The operator turns the bar with his hands in a clockwise direction for makes it go up.

• When the screw lifts the load on the platform which placed above will also raise.

• The bar is turned until the jack is raised to the level needed.

• To lower the jack the bar is turned in the opposite direction.

II. METHODOLOGY



III. FAILURE ANALYSIS OF SCISSOR JACK

To study the reliability and performance of scissor jack, it is tested under various conditions for failure analysis. In this case we will get to know the effectiveness & performance of scissor jack on field, when customer implements it for replacing the tire. The failure analysis is conducted under following cases.

Case I: Justification for failure analysis :

This analysis is required to be conducted due to its critical application under emergency, also it is essential due to following reasons:

A. Impact of the problem

- Impact on customer:
  1. Affecting safety of customer.
  2. Dissatisfaction of customer
- Impact on Departmental goal:
  1. Quality indicators effected.
  2. Increase in warranty cost.

Case II: Diagnosing the problem:

In this case, the actual area where the jack is failed is detected. Practical tests are conducted for this analysis by physically replacing the jack and results are calibrated for getting the solution by operating the jack for replacement of tire of Bolero. Following results are concluded by performing this case:

Failure I: Arm teeth wear:

The scissor jack is failed due to wear of teeth on both links at lower end. Due to this the jack gets toppled as shown in figure below. Due to the use of jack over and over again, the teeth starts getting wear and after certain time the jack gets toppled from actual position as shown below:

Fig. Teeth Wear of Lower Arm

Failure II: Screw Failure:

This failure is caused after using the jack for certain amount of time. Due to excessive use and high impact on screw, it starts getting wear. Due to this the jack gets toppled from its actual position as shown below:

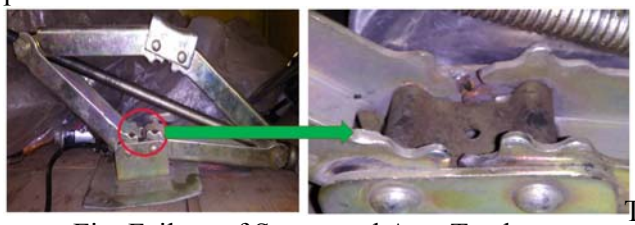


Fig. Failure of Screw and Arm Teeth

Fig. Toppled Scissor Jack due to Arm teeth Failure

Failure III: Jack head failure:

After certain duration and use of jack the head of jack starts bending due to the fatigue load acting continuously again & again over the head as shown in figure below. This defect occurs due to improper design of shape and geometry of existing head design.

Fig. Failure of Jack Head

IV. SAMPLE DESIGN CALCULATION

Type of Vehicle = Mahindra Bolero
Weight of Vehicle =1615 kg
Assuming 65-35 Distribution
Weight on Front Axle = 1050 kg
Weight on Each Wheel of Front Axle = 525 kg
For Safe Design we take maximum capacity of jack = 700kg
Since while jack is used other three wheels are in contact with ground so assumption of 700 kg is safe.
Ground Clearance of Vehicle = 280 mm
According tyre dimension, we take lift of jack as 100 mm
Maximum Height of Jack = 355.4 mm
Minimum height of jack = 254 mm

Assumption:-

Material for Link, Screw, Pin, Bracket is selected as Medium Carbon Steel (30C8)
Since links are in tension-compression and bending mode, higher yield strength as well as less elongation is primary requirement.
Medium Carbon Steel has good yield strength (S_{yt}) as well as due to medium carbon content (0.30%) has good hardness and toughness.
For Nut, Phosphor Bronze (Bearing Pressure = 10 Mpa) is Selected. Since in case of wear with screw, nut will fail and costly screw will be saved from failure.

Phosphor Bronze is softer than Medium Carbon Steel (30C8)
Length of link = 200 mm

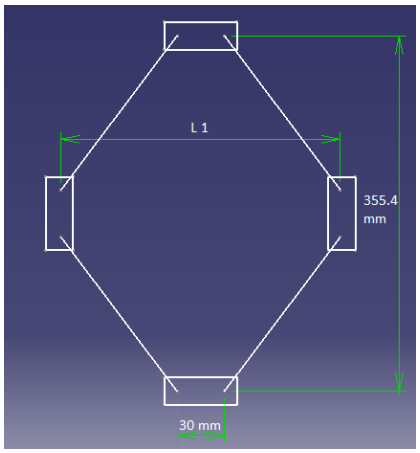


Fig. Jack Is In Top Most Position

$$L_1 = 30 + 2\sqrt{(200)^2 - (355.4/2)^2}$$

L_1= 216 mm

And Similarly, When Jack is in lowest position-

$$L_2 = 30 + 2\sqrt{(200)^2 - (254/2)^2}$$

L_2= 339 mm

A. Design of Screw:-

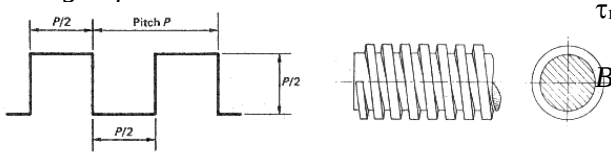


Fig. Geometry of Screw

Maximum load on screw will occurs when the jack is at bottom most position. The load in the screw will be tensile.

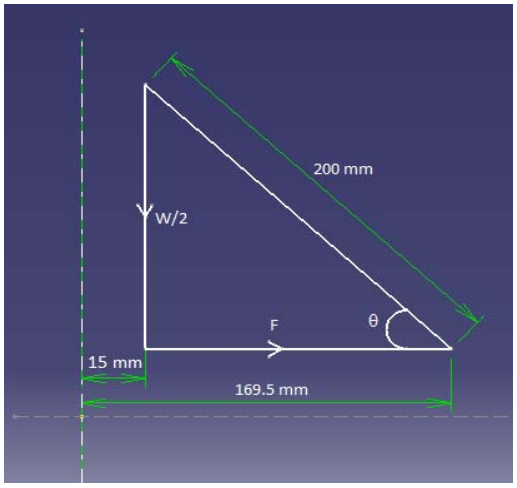


Fig. Diagram of Top Corner Link

When the jack is in bottom position, the link will be inclined at an angle

$$COS\,\theta = \frac{169.5 - 15}{200}$$

θ =39.42°
Maximum Capacity of Jack is 700 kg,
So that Load (W) =700×9.81=6867 N=7000 N (Approx.)
Load (W) = 7000 N
By Calculating Pull in the Screw, Total Force due to upper and lower link, Core Diameter, Outer Diameter, Mean Diameter, Helix Angle, Friction Angle, Effort Required to Rotate the Screw, Torque Required, Torsional Shear Stress, Maximum Principle Stress and Maximum Shear Stress etc.following results are obtained.

Material Selected for Screw= Medium Carbon Steel (30C8)
S_{yt} = 400 MPa
F.O.S. = 4
Permissible Tensile Stress (σ_t)=100 MPa
Permissible Shear Stress (S_{sy}) =0.5(S_{yt}) =50 MPa
∴Our Calculated Value,
τ= 30.84 < 50 MPa ∴τ is Safe.
σ_t= 42.34 <100 MPa ∴σ_t is Safe.
σ_{max}= 58.57 <100 MPa ∴σ_{max} is Safe.
τ_{max}= 37.40 <50 MPa ∴τ_{max} is Safe.

B. Design of Nut

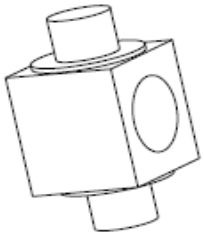


Fig.Geometry of Nut

There are two nuts in the assembly of Scissor or Toggle Jack.Nut is a stationary part having internal thread inside which is used to rotate the screw by meshing with external thread of the Screw.Nut is also used to hold the lifting arm or links at there both end.
By calculating Number of threads inside the nut, Height of nut etc. following results is obtained.
No. of Internal Thread =6
Height of Nut =36 mm

C. Design of Pin

Pins or Rivets are the most important parts in the assembly of Scissor jack or Toggle Jack which is used to make the Scissor Jack in assembled form throughout its operation and working. There are total six pins are used in the assembly of screw jack, out of that two pins are used to assemble load carrier member with upper lifting arm or links, Two pins are used to assemble base and lower lifting arm of the of the scissor jack and another two pins are used to assemble Nut and both lifting arms or links.

These pins are in Double Shear,

$$d_p = \sqrt{\frac{4F}{2\pi\tau}}$$

$$= \sqrt{\frac{4\times 4.257 \times 10^2}{2\pi \times 50}}$$

$$d_p = 7.36\ mm$$

So that,

We Select Diameter of Pin =8 mm

Length of Pin =40 mm

Diameter of Pin Head (d_{ph}) = 1.5 × d_p =1.5 × 8 = 12 mm

Thickness of Pin Head (t_{ph}) = 2 mm

Split Pins are used to keep the pins in position.

D. Design of Link

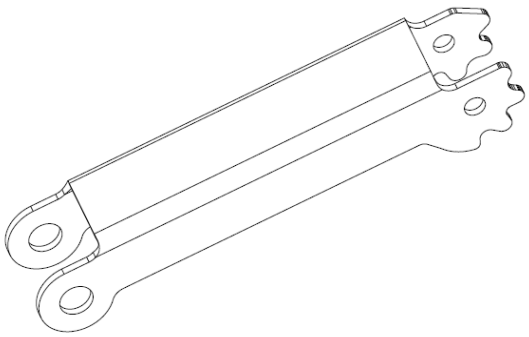


Fig. Geometry of Link

Links or Lifting Arms are the main component in the assembly of Scissor or Toggle Jack. We can say that links are the heart of Scissor Jack. There are set of four links in whole assembly out of which two links are at upper portion and another two links are at lower portion. The tooth profile on the one end of the links is used as a force and motion transmitting element like gear tooth. The whole operation of Scissor Jack i.e. movement of Scissor or Toggle Jack is basically depends on meshing of these tooth profile. If tooth gets wear due to misalignment of the jack at the time of operation then is affect on movement of the assembly of Scissor Jack.

Load on each link=F/2 sec θ

= F/2 sec 39.2

=2.7670 KN

Let b_1= width of link and t_1= thickness of link

Assuming, $b_1=3t_1$

Area of cross-section of link,

$A=3t_1^2$

For buckling of links in the vertical plane, the ends are considered hinged. Therefore by using Rankine - Gordon formula.

By calculating various values like Moment of Inertia, Least Radius of Gyration, Both critical loads etc. following results are obtained.

∴With F.O.S.=5

For design load, P_{cr} =F.O.S×(F/2) ×3

P_{cr} = 13.832 KN

Now, For Critical Load

$$P_{cr} = \frac{100 \times 24 \times 8}{1 + \frac{1}{7500}\left[\frac{200}{0.75 \times 8^2}\right]^2}$$

P_{cr} =17.28 KN

Here Critical Load (17.28 KN) > Design Load (13.832 KN)

∴Design of Link is Safe.

V. CONCLUSION

The result shows that alloy steel for screw and phosphorus bronze for nut is the best suitable combination for pair. The value shows that if there is a combination of MS – MS, it induces less magnitude of bearing stress in nut.

Based on the input parameter & result obtain from the design, As the helix angle increases the efficiency increases up to certain limit after which it decreases, the critical load decreases, the no of threads decreases, turning moment reduces, outer diameter decreases, core diameter decreases, the pitch does not change it remains constant up to certain value & then it reduces.

REFERENCES

[1] Prof. Nitinchandra R. Patel et.al. (2013), "Design Of Toggle Jack Considering Material Selection Of Scerw - Nutcombination" International Journal of Innovative Research in Science, Engineering and Technology Vol. 2, Issue 5, (2013).

[2] TianHongyu and Zhang Ziyi (2011), "Design and Simulation Based on Pro/E for a

Hydraulic LiftPlatform in Scissors Type", International Workshop on Automobile, Power and Energy Engineering, Beijing Union University, Beijing Chaowai baijiazhuang, Beijing 100020, China, Procedia Engineering 16 (2011), 772 – 781.

[3] Thirugnanam et.al.(2014) "Analysis of Power Screw Using 'Ansys' Middle-East Journal of Scientific Research 20 (7), ISSN 1990-9233, IDOSI Publications, (2014), 868-870.

[4] M.M. Noor et.al (2010) "Analysis Of Auto Car Jack", National Conference in Mechanical Engineering Research and Postgraduate Students 26-27 MAY 2010, FKM Conference Hall, UMP, Kuantan, Pahang, Malaysia, (2010) , 198-203.

[5] Vishesh Ranglani et.al.(2014) " Design and Modification in the Existing Model of Trolley Jack 20261" À Department of Mechanical Engineering, Shepherd School of Engineering & Technology, SHIATS, Allahabad, India Accepted 10 May 2014, Available online 01 June2014, Vol.4, No.3 (June 2014)

[6] Ademola A. Dare and Sunday A. Oke (2008) "Vehicle jack with wedge mechanism " Maejo International Journal of Science and Technology ISSN 1905-7873 Received: 29 November 2007 / Accepted: 28 March 2008 / Published: 31 March 2008

[7] Mohammed Abuzaid et.al. (2014) "Inbuilt Hydraulic Jack in Automobile Vehicles" International journal of innovation in engineering and technology (IJIET) Satyam Education and Social Welfare Sociaty Group of Institutions, Bhopal, MP, India

[8] P.S. Rana et.al. (2012) "Integrated Automated Jacks for 4-wheelers" European Journal of Applied Engineering and Scientific Research, 2012, 1 (4):167-172 ISSN: 2278 – 0041 Students of Priyadarshni College of Engineering, Nagpur, India Assistant Professor, Priyadarshni College of Engineering, Nagpur, India.

[9] Chinwuko Emmanuel Chuka et.al. (2014) in his paper of "Design and construction of a powered toggle jack system" American Journal of Mechanical Engineering and Automation 2014; 1(6): 66-71 Published online October 30, 2014

[10]S. Anish Mathew et.al. (2011) in his paper of "Engine Operated Screw jack" Deptt. of Mechanical, Thiagarajar College of Engineering, Madurai, India E-mail : anish.zaistev@gmail.com,

[11]R. Zhang et.al. (2012) "Theoretical analysis and experimental research on toggle-brace-damper system considering different installation modes" State Key Laboratory for Disaster Reduction in Civil Engineering, Tongji University, Shanghai, 200092, China. Received 29 August 2011; revised 15 June 2012; accepted 7 August 2012

[12]Gaurav Shashikant Udgirkar et.al. (2014) "Design, Development and analysis of electrically operated toggle jack using power of car battery" ISSN (e): 2250 – 3005 || Vol, 04 || Issue, 7 || July – 2014 || International Journal of Computational Engineering Research (IJCER)

[13]Tarachand G. Lokhande et.al. (2012) "Optimizing Efficiency of Square Threaded Mechanical Screw Jack by Varying Helix Angle" International Journal of Modern Engineering Research (IJMER) www.ijmer.com Vol.2, Issue.1, Jan-Feb 2012 pp-504-508 ISSN: 2249-6645

[14]Chul-Min Park et.al. (2005) "Scissor-Jack-Damper System for Reduction of Cable Vibration" The Eighteenth KKCNN Symposium on Civil Engineering-KAIST7 December 18-20, 2005, Taiwan

[15]Manoj R Patil and S D Kachave (2015) "DESIGN AND ANALYSIS OF SCISSOR JACK"International Journal of Mechanical Engineering and Robotics Research India. ISSN 2278 – 0149 Vol. 4, No.1, January 2015 © 2015 IJMERR.

DESIGN AND DEVELOPMENT OF PIPE INSPECTION ROBOT

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Abstract— project aims to create an autonomous robot used for in-pipe inspection. The mechanism used involves a central rod upon which a translational element is fitted which in turn is connected to three frames of links and wheels. DC motors are attached to the wheels to achieve the drive required. The mechanism allows for small accommodation in pipe diameters. An electronic circuit consisting of three relay switches is used to control the entire circuitry of DC motors, camera and translational element. The camera is mounted on the top of the assembly, which in itself can be rotated thus giving a wide field of view in the pipe. The robot allows for detection of cracks, buckle, corrosions, pitting and many others.

Index Terms— DC motor, defects, In-pipe inspection, links, Robot.

I. INTRODUCTION

Pipelines are proven to be the safest way to transport and distribute gases and liquids. Periodic inspection is required to maintain that status. Pipeline systems deteriorate progressively over time through various means. Robotics is one of the fastest growing engineering fields of today. Robots are designed to remove the human factor from labour intensive or dangerous work environments and also to act in inaccessible environment. The use of robots is more common today than ever and it is no longer exclusively used by the heavy production industrial plants. The specific operations such as inspection, maintenance, cleaning etc. are expensive. Thus, the application of the robots appears to be an attractive solution.

The project aims to create a robotic inspection technology. It is beneficial to have a robot with adaptable structure to the pipe diameter, which possesses enhanced dexterity, manoeuvrability and capability to operate under hostile conditions. Wheeled robots are simple, energy efficient and have a great potential for long range usage. A multi – frame robot as shown in fig. 1 offers few advantages in manoeuvrability with the ability to adapt to in-pipe unevenness, move vertically in pipes, and stay stable without slipping in pipes. This type of robot also has the advantage of easier miniaturization. A challenge in its design and implementation consists in combining the mobility with that of autonomy and low weight. Major design objectives are represented by the adaptability of the robot to the inner diameters of the pipes and making the machine autonomous.

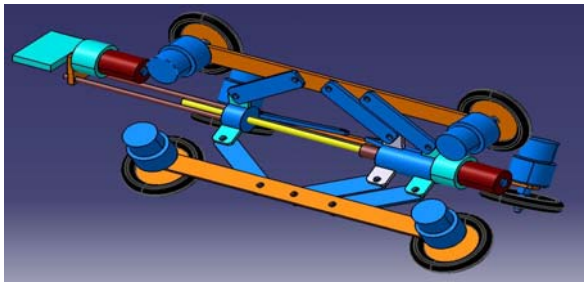

Fig. 1: Pipe inspection robot

II. DESIGN PARAMETERS

The parameter for design of the robot is the diameter of pipe. We have chosen 8'' and 10''

(approx. 200 mm and 260 mm) pipes as the lower and upper limits respectively for our robot.

Selection of the wheel:

The wheels of the robot should be chosen such that they should be capable of moving without slipping in the vertical direction by exerting the required traction force. They should also not wear out easily with use. These factors are determined by the co-efficient of friction between the wheel and the pipe. Rubber wheels are a natural choice for this environment as they meet the above demands. The co-efficient of friction between rubber and two commonly used pipe materials (concrete and PVC) are considered. Coefficient of friction between rubber and concrete is in the range of 0.6 – 0.85. Coefficient of friction between rubber and PVC is in the range of 0.5 – 0.7. The power requirements are calculated using a coefficient of friction of 0.8. The range of diameter of pipes considered in the present work is 200 to 260 mm. To accommodate the mechanism with rubber wheels and considering market availability of standard wheels, the diameter was chosen to be 80 mm.

Mechanism Synthesis:

The robot mechanism is to be designed in such a way as to expand and contract between the chosen limits. This necessitates the use of a mechanism where the input link causes the other links to move in a uniform fashion without any crossovers. A parallelogram linkage offers the required type of uniform motion.

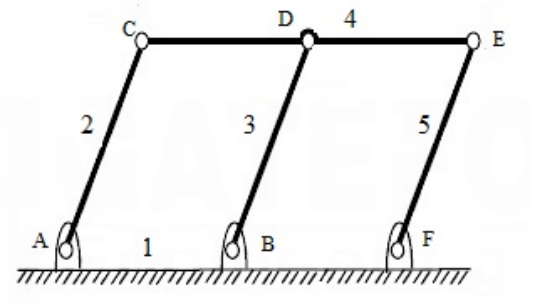

Fig. 2 – Simple Parallelogram Mechanism

But, the required way of motion is not achieved from this design. The joint F is made into a screw pair. The orientation of link 5 is changed so that when the input, link 2 moves in the clockwise direction, link 5 moves in the opposite direction pushing the screw pair forward and vice versa. This combination of linkages makes the mechanism contract in the clockwise direction and expands in counter clockwise direction.

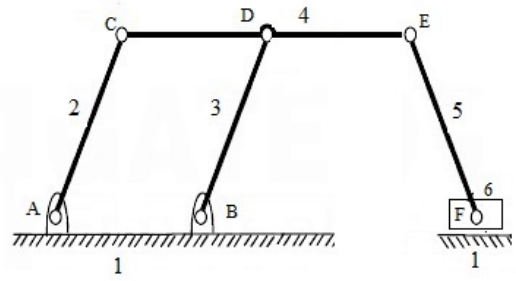

Fig. 3 – Modified Mechanism

Link dimensions are to be equal for execution of uniform motion. For the pipe diameter range of 200 mm to 260 mm, link length can be varied. Angular position of link at the maximum diameter must not exceed 90^{o}and not go below 45^o for proper functioning. The link dimensions can vary from 65 to 85 mm with angles ranging from 67.4^o to 44.9^o respectively at max diameter of 260 mm. The mechanism has been checked to work for all the values and the dimensions are chosen to be 75 mm.

Degrees of freedom of the mechanism is obtained from Gruebler's criterion

$F = 3(N - 1) - 2L -$ H..... (1)

Where, F – Number of degrees of freedom, N – Number of links, L – Number of lower pairs, H – Number of higher pairs. Substituting the values, we get F = 1, hence it is a single degree of freedom system.

Feasibility of the mechanism:

The feasibility of the mechanism is determined with the help of "Linkage", which is a computer program that lets one design and edit a two dimensional mechanism and then simulate the movement of that mechanism. The editing and simulation are both done in the same window and are part of the same user interface.

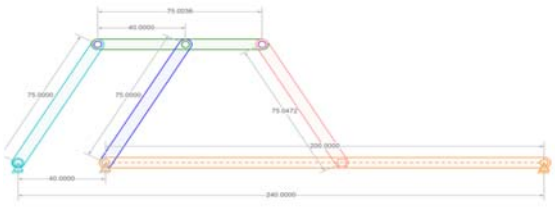

Fig. 4 – Simulation position 1

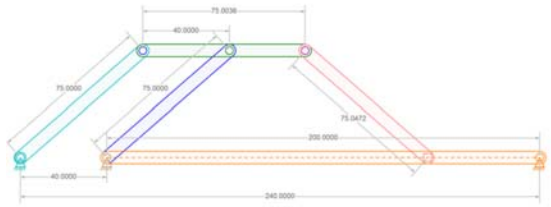

Fig. 5 – Simulation position 2

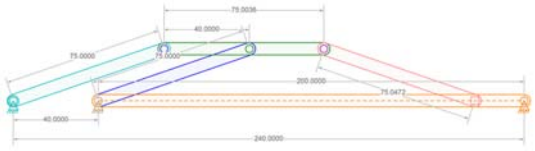

Fig. 6 – Simulation position 3

The figures 4, 5 and 6 show the motion of the mechanism. The simulation showed that the chosen dimensions for the links was capable of executing the desired motion.

Material Selection:

The materials used for this machine are to be rigid. Different materials can be used for different parts of the robot. For optimum use of power the materials used should be light and strong. Wood is light but it is subjected to wear if used for this machine. Metals are the ideal materials for the robot as most of the plastics cannot be as strong. Material chosen should be ductile, less brittle, malleable, and have high magnetic susceptibility. Among the metals/metal alloys, aluminium is a good choice. But, mild steel 1018 was chosen as the material for links and a translational element as it is sufficiently rigid and less brittle. It balances ductility and strength and has good wear resistance; used for large parts, forging and automotive components. However, mild steel is denser compared to aluminium and makes the robot heavier. C45 steel is chosen as the material for screw rod as it is a medium carbon steel, which is used when greater strength and hardness is desired than in the "as rolled" condition. Extreme size accuracy, straightness and concentricity combine to minimize wear in high speed applications. It is generally used for screws, forgings, wheel tyres, shafts, axes, knives, wood working drills and hammers.

Design calculations:

The material chosen is C45 steel. The diameter of a shaft with bending moment and torsional moment is given by the relation below.

$$d^3 = \frac{16}{\pi\tau_{max}} \times \sqrt{(C_m M)^2 + (C_t T)^2}$$

.....(2)

Where,

d = diameter of screw rod, m

C_m = numerical shock and fatigue factor for bending moment

C_t = numerical shock and fatigue factor for torsional moment

τ_{max}= maximum shear stress, MN/m²

M = bending moment, Nm

T = torsional moment, Nm

$C\_m = 1.5$ and $C\_t = 1.0$ for rotating shafts with gradual or steady loa

$\sigma_y = 353$ MPa for C45 steel, FOS is chosen as 2, $d = 0.007922$ m $= 7.922$ mm ≈ 8 mm. Therefore diameter of screw rod is 8 mm.

Motor power calculations:

$$\text{Gross robot weight, } W = 4.67 \text{ kg} \times 9.81 \text{m/s}^2 = 45.81 \text{ N}$$

$$\text{Weight per wheel, } W_w = \frac{45.81}{6} = 7.64 \text{ N}$$

$$\text{Radius of wheel, } r = 4 \text{ cm} = 0.04 \text{ m}$$

$$\text{Co} - \text{efficientoffrictionforpipe} - \text{rubberinterface}, \mu = 0.6 - 0.8$$

$$\text{Tractive effort, } F_T = W_w \times \mu = 6.1 \text{ N}$$

$$\text{Torque required per wheel, } T_w = F_T \times r = 0.244 \text{ Nm}$$

$$\text{Power required per wheel, } P_w = \frac{2\pi N T_w}{60} = 1.54 \text{ W}$$

Power of standard DC motor which is chosen, P = 2.88 W

Force on the screw rod due to torque from the motor:

$$T = \frac{W}{2}\left[d_2\left(\frac{\tan\alpha + f\sec\theta}{1 - f\tan\alpha\sec\theta}\right) + f_c d_c\right]$$

Where,

T – Torque applied, Nm

W – Force acting on the screw rod, N

d_2 – Pitch diameter of external thread, m

f – Friction coefficient between nut and screw

d_c - mean diameter of the friction collar, m
α - Helix angle, deg
θ - Half apex angle, deg
p – Pitch of thread = 1.25 mm
$\alpha = \frac{p}{\pi d} = \frac{1.25 \times 10^{-3}}{\pi \times 8 \times 10^{-3}} = 3.088$
θ = 30° for V- threads
f = 0.5
d_2 = 7.16 mm for M8 screw thread
$W = 194.5\ N$

Check for stress: Stress induced σ = 3.47 MPa

The yield strength of 1018 steel is 353 MPa. As 3.47 < 353 MPa, there will be no distortion or failure of the links.

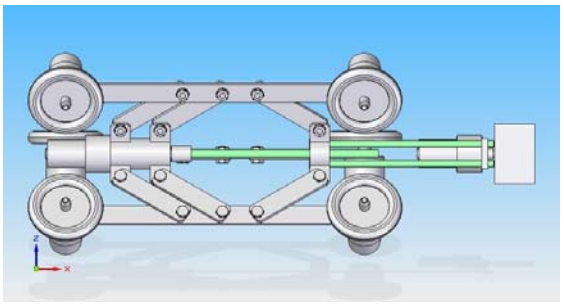

Fig. 7 – Assembly-Front view

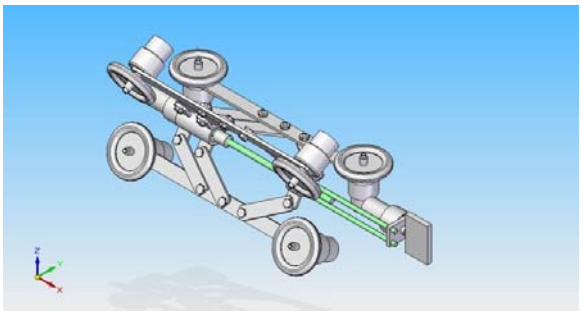

Fig. 8 – Assembly-Isometric view

III. FABRICATION AND WORKING

The fabrication phase of the project involves production of the parts designed. It also entails the selection of appropriate electronic circuitry which can be effectively used to achieve and control the robot motion. The various processes used in fabrication of the components are Cutting Drilling Welding Turning.

Fig. 9 – Holes drilled on link 1

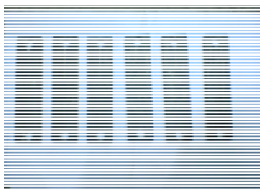

Fig. 10 – Pieces of link 2

Fig. 11 – Welding of Nut strips

Turning: Turning was performed on a C45 steel rod to make M8×1.25 using the turning process as per the calculations. The turning process was done on a lathe machine.

Fig. 12 – Assembled robot

Electronic circuit and components: The assembled robot needs to start or stop instantaneously. Also, its direction of motion ought to be easily switched over. This can be achieved by using a relay circuit and a remote control. Double Pole Double Throw (DPDT) relay is an electromagnetic device used to separate two circuits electrically and connect them magnetically. They are often used to interface an electronic circuit, which works at a low voltage to an electrical circuit which works at a high voltage.

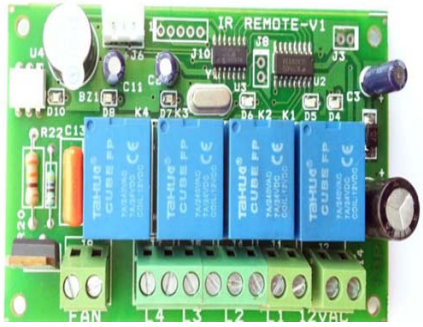

Fig. 13 –IR 4 Channel Remote Control Relay (Courtesy: hitechlogics.com)

Four channel relay circuit: IR Remote control relay is a combination of Infrared Transmitter and Receiver which contains 4 Relays and 1 Fan with Speed Control through TRiAC which can be controlled wirelessly is shown in Fig.13. This makes the unit very easy to operate and integrate with existing systems. The remote control operates the corresponding relay on the receiver board.

Power supply board: The power supply board as seen in Fig. 14 is used to regulate the voltage to the camera plate. A potentiometer present on the board can be used to change the resistance, thereby changing voltage. This results in control of the speed of the motor.

Fig.14Power supply board (Courtesy: nskelectronics.com)

Wireless camera: Wireless cameras are wireless transmitters carrying a camera signal. The components are shown in Fig.15. The camera is wired to a wireless transmitter and the signal travels between the camera and the receiver. This works much like radio. Wireless cameras also have a channel. The receiver has channels to tune in and then the picture is obtained. The wireless camera picture is sent by the transmitter the receiver collects this signal and outputs it to a Computer or TV Monitor depending on the receiver type.

Fig.15 Wireless camera with radio receiver (Courtesy: Google images)

DC motors: DC (direct current) motor works on the principle, when a current carrying conductor is placed in a magnetic field; it experiences a torque and has a tendency to move. If the direction of current in the wire is reversed, the direction of rotation also reverses. When magnetic field and electric field interact they produce a mechanical force, and based on that the working principle of dc motor established. DC motors are used to achieve the drive on wheels and rotation of rods. Two types of DC motors used in the project are shown in Fig.16 .

Fig. 16. 200 and 60 rpm DC motor (Courtesy: tomsonelectronics.com)

Circuit integration and assembly: At the end of fabrication, the electronic circuitry is implemented onto the robot. The DC motors are fitted for the wheels, screw rod and camera plate rod. The 4 channel relay is integrated with all the DC motors. Appropriate wiring is done and a 12 V battery is connected to all electronic components. The fully assembled robot is shown in Fig.17

Fig.17 – Fully assembled pipe inspection robot

Working: The complete assembly of the robot leads to the next phase of the project – Working.

Here the robot is checked for its performance of the desired functions.

Drive to the wheels is achieved through DC motors. These motors are connected through relay switches which govern the start/stop functions and rotational direction of the motors. The robot works through the electronic circuit - mechanism interface.

One relay switch, worked manually, is used to control the expansion or contraction of the frames.

The camera placed at the other end of the robot is switched on manually. RF receiver is set up with connections made to a TV monitor.

The DC motors to the wheels are started through the 4 channel relay circuit. This makes the wheels rotate at a set rpm of 60.

Once placed sufficiently inside the pipe, the manual relay switch is actuated to expand the frames so as to accommodate to the pipe diameter. The expansion is continued till sufficient gripping is achieved. The gripping ensures motion in horizontal or vertical direction. The 4 channel relay circuit is actuated through the remote for forward motion.

Camera plate is controlled through another relay on the circuit board. This is activated to initiate rotation of camera.

As the robot moves inside the pipe, wireless signals are conveyed to the receiver giving a view of the inside surface.

The surfaces are checked for defects visually.

Results: Pipeline systems are prone to degradation and corrosion resulting in a number of defects. Identification of defects is an important problem in chemical plants, sewage pipes and other industries. This project aimed to create an autonomous robot for in-pipe inspection capable of vertical and horizontal motion.

The following results were obtained from the completion of the project.

The robot was capable of adapting to pipe diameters in the range of 200 mm to 260 mm.

The robot was tested for motion in a 250 mm PVC pipe. It was found to move well in both horizontal and vertical direction.

The wireless camera transmitted the video feed through the RF transmitter onto a TV screen up to a range of 40 m.

The velocity of the robot is 30 cm/s.

Conclusions and future scope

Conclusions: Robots can be effectively used as tools to carry out work in labor intensive, hazardous and unreachable work environments. Pipeline systems are one such environment. Robots can be successfully implemented in pipe line inspections for better detection of defects.

The project aimed to create an in-pipe robot with adaptable structure, autonomy and achieve vertical motion. The following conclusions can be drawn from the project.

Future Scope:

The project is limited in several ways and can be worked upon to broaden its features and applications.

A few of the improvements that can be implemented are mentioned below.

Use of tilted and guide wheels for traversing curves and bends in pipes.

Use of lighter material for the links to reduce the weight.

Infrared/Ultrasonic inspection for better detection of defects.

Implementation of long range sensors.

Implementation as a bore well rescue robot.

Alternate design without links to facilitate better motion.

References:

[1] AA Hashem, M Eng - eng.cu.edu.eg; Oil and gas pipeline design, maintenance and repair, Cairo University, Department of Mining, petroleum and metallurgical Engineering, Egypt.

[2] AH Heidari, H Najjaran, M Mehrandezh, R Paranjape - 2010 - cdn.intechopen.com, Design, development, dynamic analysis, andcontrol of a pipe crawling robot.

[3] I Doroftei, M Horodinca, E Mignon - 2000 - irisa.fr,A conceptual wheeled robot for in-pipe inspection.

[4] M Horodinca, I Doroftei, E Mignon… - Proc. Int. Colloq. Mobile …, 2002 - researchgate.net,A simple architecture for in-pipe inspection robots.

[5] SS Rattan, Theory of machines, McGraw Hill, 3 Edition, 2009.

[6] K.Mahadevan, K. Balaveera Reddy, Design data hand book, CBS, 3 Edition, 1987.

DESIGNING AND MANUFACTURING OF CONTINUOUSLY VARIABLE TRANSMISSION (CVT)

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Abstract

The project aims at designing and manufacturing the Continuously Varying Transmission (CVT). The CVT is designed considering the requirements of SAE BAJA event and the engine used in the event i.e. B&S 10 hp engine. This gearbox provides better acceleration and ease in handling as compared to the manual transmission and cost effective as compared to the other transmissions available in the market.

I - Introduction

With growing demand for environment friendly technologies, automobile manufacturers today are increasingly focusing on 'Continuously Variable Transmissions' (CVTs) as an alternative to conventional gearbox transmission; to achieve a balance between fuel economy and vehicle performance. By allowing for a continuous band of gear ratios between the driver shaft and driven shaft, a CVT permits the engine to operate for the most part in a region of high combustion efficiency resulting in lower emissions, and higher fuel economy.

A continuously variable transmission (CVT) is a transmission which can gradually shift to any effective gear ratios between a set upper and lower limit. In contrast, most transmissions equipped on production cars have only 4-6 specific gear ratios that can be selected. The almost infinite variability of a CVT allows the engine to maintain a constant speed while the vehicle increases in velocity. This can result in better vehicle performance if the CVT is shifted such that the engine is held at the RPM that it runs most efficiently at and/or produces the most power.

Because there are no steps between effective gear ratios, CVTs operate smoothly with no sudden jerks commonly experienced in manual transmission. Since drivers expect a car to jerk or the engine sound to change as they press the accelerator pedal further, it is very confusing for them when the car smoothly accelerates without the engine revving faster. Drivers have unfortunately perceived this as the car lacking power which is causing a marketing problem for the transmissions. [1]

II – Various Components of CVT

Mainly the CVT has Primary and Secondary clutches which are connected by belt in which the primary clutch is connected with engine and the secondary clutch to the gear box and the power is transmitted form primary to the secondary clutch by Belt. Following are the components used in the CVT,

- Primary Clutch
  - Fix Pulley
  - Movable Pulley
  - Spider
  - Cam
  - Follower
  - Primary Spring
- Secondary Clutch
  - Pulleys
  - Secondary Spring
  - Spring Retainer Plate
- Belt [2]

III -Functions of Various Components

As CVT is different than the conventional transmission system, components used in the CVT has some definite functions to do and for the same the design of that components varies from the conventional design of such components like for pulleys, cam, belt etc.

1) Primary and Secondary Clutches Function

Primary and secondary clutches are made of pulleys. To have the required performance of the vehicle the speed of the engine has to be reduced in the CVT, this variation in the speed reduction can be achieved by changing the contact diameters of the belt on pulleys. In normal pulleys the diameter cannot be changed so to have change in the contact diameter between belt and pulley, the pulley used are different from the conventional pulleys.

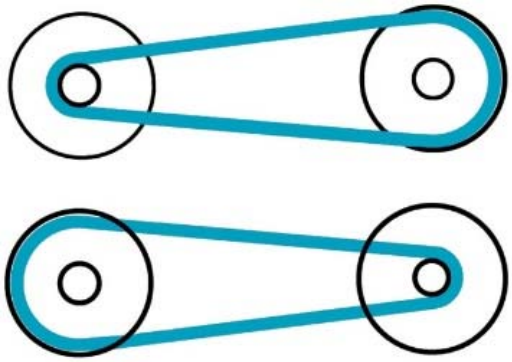

Fig. 1. Variation of speed ratio in belt driven CVT

Fig. 1. shows how the variation of speed ratio can be achieved in CVT. At staring when the speed of the engine is minimumthe belt is at minimum diameter in primary clutch and at maximum diameter in secondary clutch so have maximum speed reduction, which is shown in Fig. 1. by minimum position. Now when the speed of engine increased due to throttling the belt shifts in clutches such that have contact at maximum diameter in primary clutch and minimum diameter in secondary clutch so have minimum speed reduction, which is shown in Fig. 1. by maximum position.

2) Function of Pulley

Pulleys are the main components of the CVT. There is basically two types of pulleys are used in CVT, one is fixed pulley and second one is movable pulley in both primary and secondary clutches. The primary function of pulleys is to transfer power from input shaft to output shaft by means of belt. These pulleys are differing from conventional pulleys in terms of variable distance between two contact surfaces. [2]

2.1) Function of Fixed Pulley

Fixed pulley is used in both primary and secondary clutches, and it cannot slide on the shaft. The main function of the fixed pulley is to give support to the belt and to the secondary pulley. It has internal splines which meshes with the splines on the shaft and thus transmits the power and motion to the belt.

2.2) Function of Movable Pulley

Movable pulley is also used in both primary as well as secondary clutches. The main function of this pulley is to change the contact diameter of the belt on the pulleys, means to change the speed ratio. The pulley can slide on the shaft, thus the distance between the pulleys can vary and due to this the belt will move up or down due to wedge action. The primary clutch movable pulley moves on the shaft due to cam, which works on centrifugal force and came back to its original position by means of primary spring. While in secondary clutch the movable pulley will move due to belt tension generated by the primary pulley movement and it came back to original position by means of secondary spring. Which is shown in the Fig. 2. below. [2]

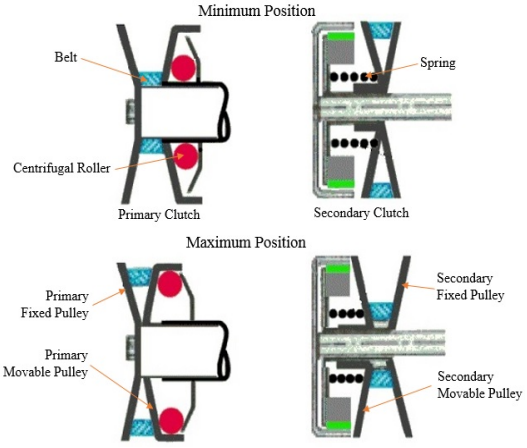

Fig. 2. Fixed and Movable pulleys

3) Function of Spider

Spider is used in the primary clutch. Its function is to support the cam and keep the cam in correct position. It keeps the cam aligned with the movable pulleys during the rotation of the clutch. Spider is fixed on the shaft so when the cam moves due to centrifugal force it actuates the movable pulley rather than moving itself.

4) Function of Cam and Follower

Function of cam is to actuate the primary clutch movable pulley. This is done by the centrifugal force. Means due to centrifugal force the cam move s apart and actuates the movable pulley, which shifts the belt outward and increase the contact diameter of belt on the pulley. Fig. 3. shows the cam shape used in the CVT.

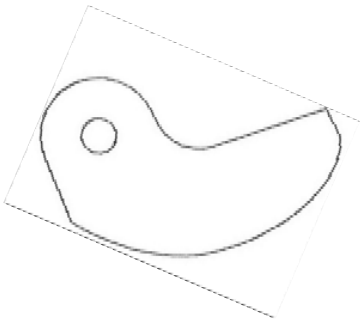

Fig. 3. Cam

Follower used in the CVT is of cylindrical shape. Which is mounted on the movable pulley. Three can and follower are used and followers are aligned with the cam and spaced 120˚apart.

5) Function of Springs

Springs are used in primary and secondary clutches. Function of springs are to return the movable pulleys to its original position when the speed of engine is reduced. Secondary spring has more importance than the primary spring, because secondary spring moves the secondary movable pulley return back to its original position and then due to belt tension the primary pulley also return back to its original position.

6) Function of Belt

Function of belt is to transmit the power from input primary clutch to the output secondary clutch. The power is transmitted by friction between belt and pulleys. Generally rubber belts are used for lower capacity CVTs and for higher capacity CVTs metal belts are used. Normal V rubber belts cannot be used as they are not capable to withstand the higher tension and the squeezing forces generated by pulleys to shift the belt, so special variable speed rubber belts are developed. For high torque transmission metal belts are used. [1]

Fig. 4. Rubber belt & Metal V-belt

IV - Designing of Continuously Variable Transmission

Pulley bases CVT is selected over other type of CVT, due to easy of manufacturing and its low cost. Continuously Variable Transmission (CVT) design is divided into number of steps,

- Engine selection and its performance
- Pulley and Belt design
- Variator design

Among all type of CVT most common CVT is belt and pulley type CVT. In this type of CVT there are so many variations, like CVT having metal belts, rubber belts and having variation in the actuating mechanism for the pulley like roller based, cam based, hydraulically operated, electrically operated etc. In this chapter the CVT having rubber belt and cam actuator is discussed. [3]

The CVT is design to use it in SAE BAJA competition vehicle, so the design parameters for the CVT are based on the rules and regulation of the competition and the specification of the BAJA vehicle. The vehicle performance considered for designing the CVT is as under. The maximum velocity required as 70 kmph and gradebility as 35° and assuming the weight of car as 400 kg and the tyre diameter as 22" (0.5588m). And it is assumed as the car has differential having gear reduction of 4.125.

1) Engine Parameter

For design of the CVT the engine selected is Briggs and Stratton "INTEK OHV 305 10HP (2044 Standard 2054 I/C) Engine". This engine is generally used in every SAE BAJA competition. Power output and torque output of engine at various engine RPM as shown in the Fig. 5. and in Fig. 6.

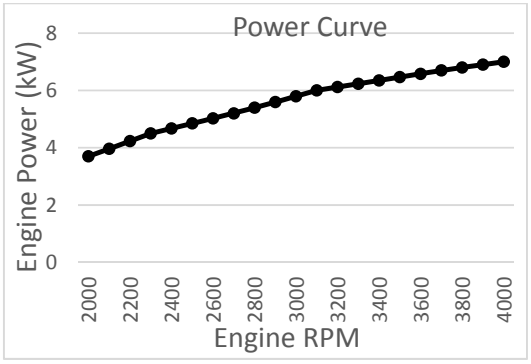

Fig. 5. Engine Power Curve

Fig. 5. shows that the maximum power is 7 kW at 4000 RPM and from figure 3.2 maximum torque is 18.6 Nm at 2600 RPM. But the maximum speed of engine is set to 3600 RPM using governor setting for smooth running and safety. The idling speed of engine is 1600 RPM. So the maximum velocity of the vehicle is calculated at 3600 RPM and the maximum acceleration and gradebility is calculated at 2600 RPM.

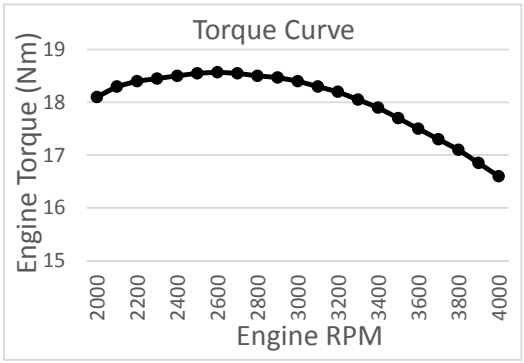

Fig. 6. Engine Torque Curve

2) Speed Ratio for CVT

First of all the maximum and the minimum speed reduction required to have the desired performance of car is calculated. Which can be calculated as shown below.

For a vehicle to have maximum speed of 70 kmph the required rpm of the wheel having 22" (0.5588m) tyre diameter can be calculated as,

Maximum speed of car (v) = 70 kmph = 19.44 m/s

Tire diameter (d) = 22 inches = 0.5588 m

Tire RPM for max speed (N) =

$$\frac{v*60}{\pi d} = \frac{19.44*60}{\pi*0.5588} = 664.41 \text{ rpm}$$

But the maximum rpm of the engine is 3600 rpm and in the drive train the differential is also used so the speed reduction required in the CVT can be calculated as,

Engine RPM (n) = 3600 rpm

Differential Gear Ratio (GR_{diff}) = 4.125

Tire RPM for max speed (N) = 664.41 rpm

Speed reduction required =

$$\frac{n}{N* GR_{diff}} = \frac{3600}{664.41* 4.125} = 1.31$$

So the minimum gear reduction required to have maximum speed of 70 kmph is 1.31 in the CVT.

Now to have the gradiability as 35 and enough the staring torque the required torque can be calculated as,

Mass of Car (M) = 400 kg

Gradebility (θ) = 35 °

Rolling Friction coefficient (μ) = 0.05

Torque required at Wheel (Mt) =

[M*g*(sinθ+μ)]*r =

[400*9.81*(sin35+0.05)]*0.2794

= 683.66 Nm

But the engine can produce the maximum torque of 19 Nm at the speed of 2600 rpm so the required speed reduction can be found as,

Max Torque of Engine (T) = 19 Nm @ 2600 rpm

Speed reduction required =

$$\frac{Mt}{T * 2*GR_{diff}} = \frac{683.66}{19*2* 4.125} = 4.36$$

So to have the required gradiability and smooth staring of the vehicle the required maximum speed reduction is 4.36.

Thus the CVT speed reduction ratio varies from 1.31 to 4.36 to have the required performance described above, which can be obtained by changing the contact diameters of belt on pulleys in the primary and secondary clutches.

3) Speed Ratio Distribution

In CVT the velocity of vehicle changes automatically with change in the speed of engine. So to have different speed of vehicle at different speed of engine the speed ratio of the CVT also varies with the engine speed form maximum to minimum.

At the initial stage of design the variation of speed ratio with the engine speed is assumed having linear variation. Assuming linear variation of the speed ratio vehicle velocity and acceleration is calculated, which are as shown in Fig. 7. Fig. 8. and Fig. 9.

As shown in Fig. 8. the velocity variation of vehicle is at the end of engine's maximum RPM and in Fig. 9. the acceleration is almost linear, which are not recommended for a vehicle. As well as for this type of variation of the speed ratio the belt length obtained is not constant, this is not

possible to transmit the power at different speeds. So the speed ratio variation is selected in such a way that the velocity variation is linear and the belt length is constant for all speed ratios. Which are shown in Fig. 10. Fig. 11 ans Fig. 12.

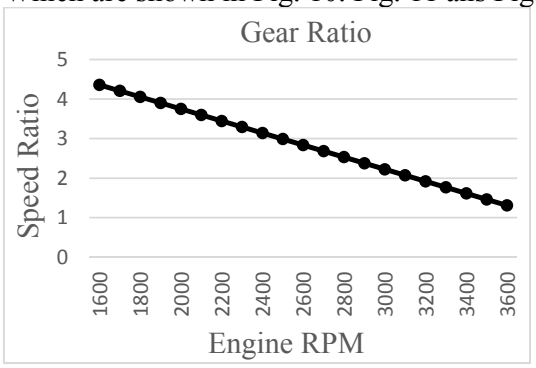

Fig. 7. Linear Variation of Speed Ratio

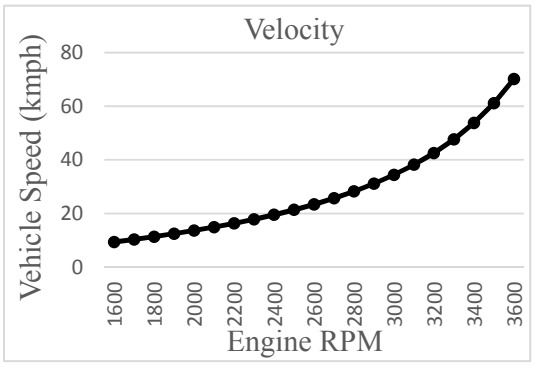

Fig. 8. Vehicle Velocity Having Linear Variation of Speed Ratio

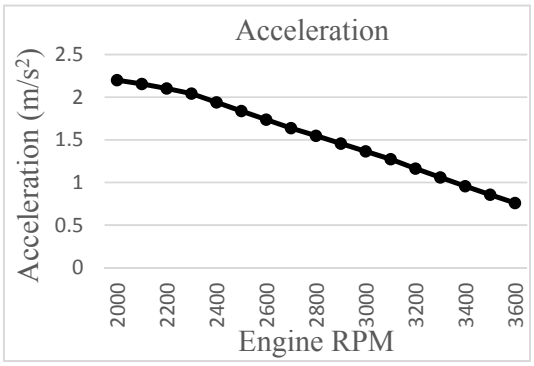

Fig. 9. Vehicle Acceleration Having Linear Variation of Speed Ratio

As shown in Fig. 10. the velocity of vehicle is varying linearly with the speed of engine and the speed ratios for the pulleys are calculated from this velocity variation keeping belt length constant. So the gear ratio obtained from this is shown in the Fig. 11.

For the same speed ratio and velocity the acceleration is calculated, which is as shown in the Fig. 10. Here the acceleration is higher at the beginning which is good to have good pickup of the vehicle. [3]

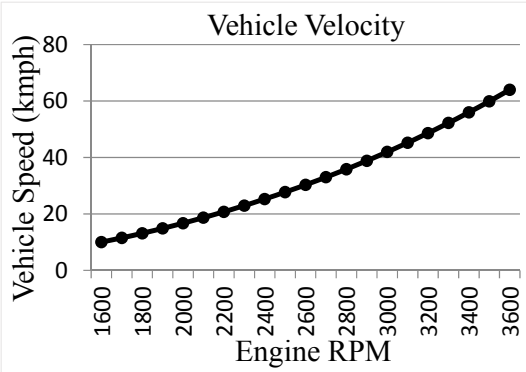

Fig. 10. Linear Variation of Speed

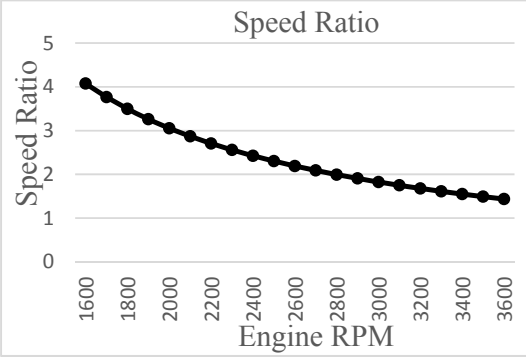

Fig. 11. Speed Ratio Variation Having Linear Variation of Velocity

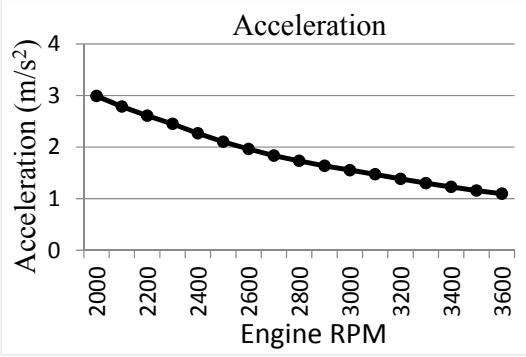

Fig. 12. Vehicle Acceleration Having Linear Variation of Vehicle Velocity

4) Pulley Dimension

Form the above speed ratio calculation and the constant belt length of 1012 mm the dimensions

of the driving (primary clutch) and driven (secondary clutch) pulley is calculated. As the standard belt have the groove angle as 30° the groove angle for driving pulley is taken as 26° and for driven pulley it is taken as 28s° to have firm grip of the pulley on the belt. The minimum and maximum pitch circle diameters of the driving pulley for the calculated speed ratio are 59.1mm and 139.8 mm respectively, and for driven pulley they are 180 mm and 241 mm respectively. So the total displacement of primary pulley required for the speed ratio change from maximum to minimum is 16.4 mm and for driven pulley it is 16.34 mm.

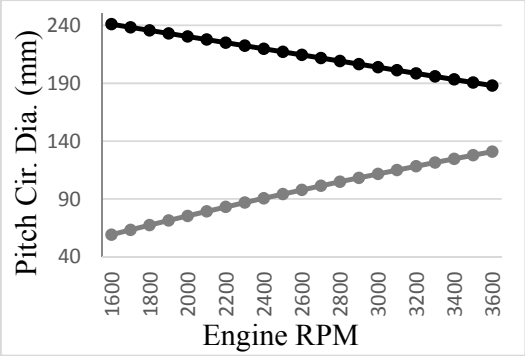

Fig.13. Driving and Driven Pulleys Pitch Circle Diameter Variation with Engine speed

As shown in the Fig. 13. diameter of driving pulley increases and the diameter of the driven pulley decreases with increase in speed of engine. Means the speed ratio varies from 4.36 to 1.31 as the engine speed increase from 1600 RPM to 3600 RPM. Here the belt length and the centre distance between the two clutches are selected in such a way that linear variation of the pitch circle diameter of driven pulley (secondary clutch) results in linier variation of pitch circle diameter of driving pulley (primary clutch). For calculation of the pulley dimension refer the Appendix I.

5) Belt Selection

5.1) Belt Tension

From the engine supply power, pulley dimension and torque required to be transmitted the tension in the belt can be calculated. Variation in belt tension with change in the engine speed is shown in the Fig. 14. For calculation refer Appendix II.

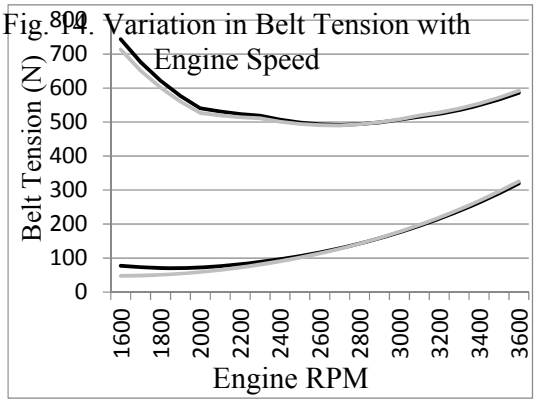

Fig.14. Variation in Belt Tension with Engine Speed

As shown in the Fig.14. the tension in the belt various with the speed of engine, because the power and torque vasriation with the speed and as the speed ratio also changes with the speed of engine so torque also varies. From the graph it is cleared that the maximum tension in the belt is about 750 N, thus the normal belts can't be used for the CVT. So special CVT belt should be used to withstand this high tension. [4]

5.2) Belt Specification

Variable Speed Belt which is special type of belt for CVT is selected to withstand the higher tension. Specification of the belt is obtained from the catalogue of the Dunlop Industrial Belts, which are as follow.

- Belt Grove Angle : 30°
- Mass of Belt : 0.5 kg/m
- Belt Length : 1012 mm
- Main Cross Section : 33 mm x 10 mm

6) Variator Design

Different types of variators are used to have desire movement of the pulley, they are roller based, slider based and cam base, these all are mechanically actuated variators, while hydraulically operated and electrically operated actuators are also available. Basically all the variator is used to actuate the pulley to have the required speed ratio.

Mechanical variators are simple in construction but less accurate while the other variators are complex but accurate. In this CVT mechanical variator is used with cam based actuator, which is smoother than the roller and slider type actuators.

Cam is designed base on the displacement of the driving pulley required. This displacement is converted into the rotating motion of the cam and the CG location of the cam. Profile of the cam is generated in such a way that the cam is always being in contact with the slider roller.

Cam push the movable pulley of the primary clutch to make them closer to each other while the belt and the primary spring resist the motion of the pulley and try to expands the pulley. So cam has to produce enough force to overcome the belt force and the spring force. But forces in cam is generated only due to centrifugal action. Forces generated and transmitted in primary clutch is shown in the Fig. 15. [4]

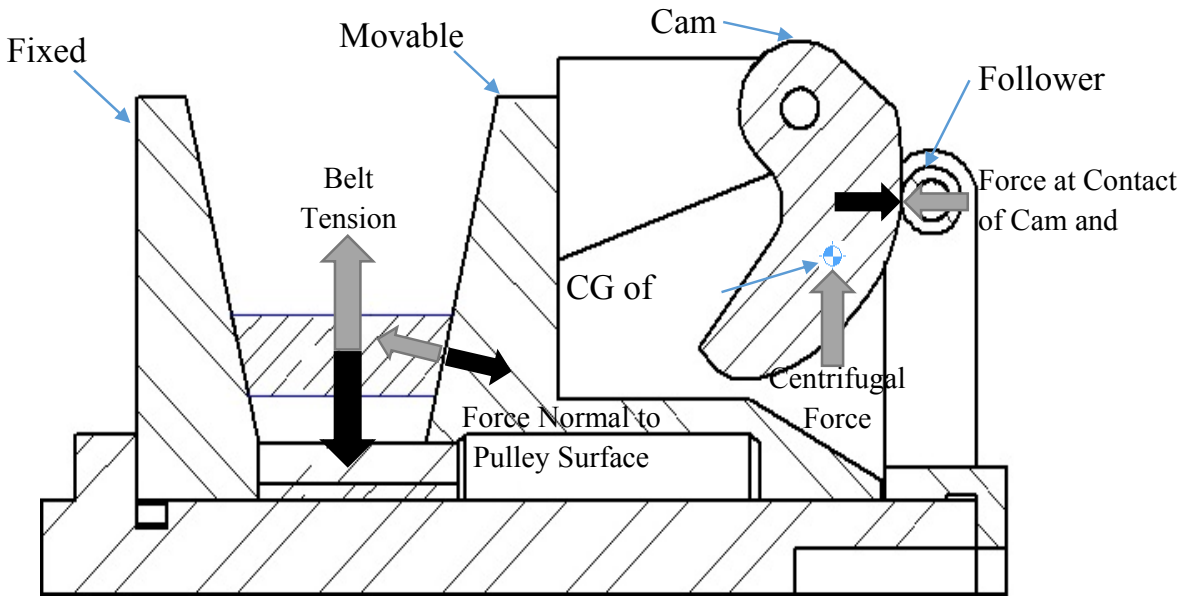

Fig. 15. Forces in the Primary Pulley

Fig. 15. shows the forces transferred from belt to cam and roller. In the Fig. 15.c the forces shown by black colour is generated due to belt tension and shows the components of the force transfer to roller. The forces shown by grey colour is generated due to centrifugal force and shows the force transfer back to belt. Half of the force generated due to belt is transferred to the movable pulley from which its component normal to surface is responsible for motion. Now this normal force produce thrust on the cam. This thrust force is transferred from cam to follower.

The thrust force of belt on the follower must have the opposite and equivalent force generated by cam centrifugal force. The cam generates the centrifugal force due to rotational motion. Here the cam weight is first assumes as 56 grams and the CG of the cam is taken at 24 mm from the pin mounting. To compensate the force generated by the belt the cam profile is generated in such a way that the required force can be produced at the cam contact.

The total force generated by the belt and spring is shown in the Fig.16. It is cleared from the Fig. 16. that the force generated increase with increase of speed of engine.

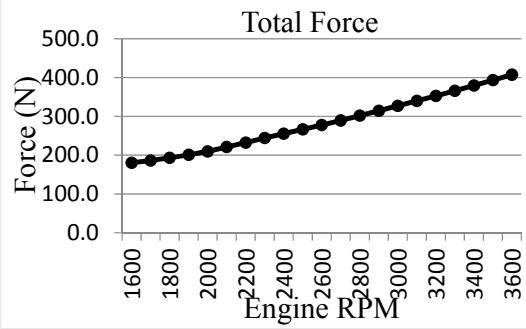

Fig. 16. Total Force generated by belt on the follower

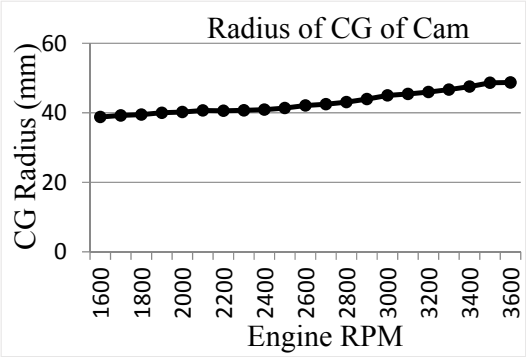

Fig. 17. Radius of rotation of CG of Cam at different engine speed

From the thrust force generated by the belt the radius of CG of Cam required to generate equal and opposite force can be calculated. Fig.17. shows the variation of the radius of CG of Cam. From the radius of rotation of the CG of the Cam and from the displacement of the movable pulley required the rotation of cam can be calculated. Fig. 18. show the rotation of the cam required to have the desired displacement of the pulley and to generate the enough force to keep the system in equilibrium.

Fig. 18. shows that the rotation of cam is more at the initial stage as the change in the speed ratio is more at initial stage compare to the last stage change in the speed ratio. Base on above calculation the cam profile is generated considering the radius of rotation of CG of the Cam and the rotation of the cam. The generated cam profile is shown in Fig. 19.

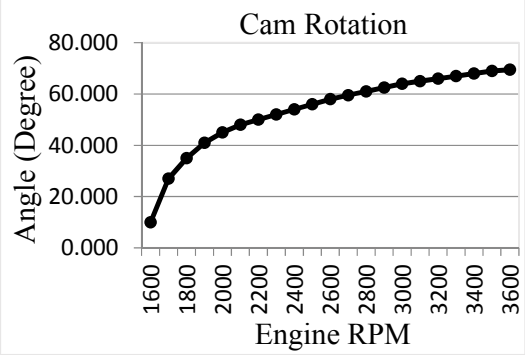

Fig. 18. Calculated Cam rotation required at different speed of engine

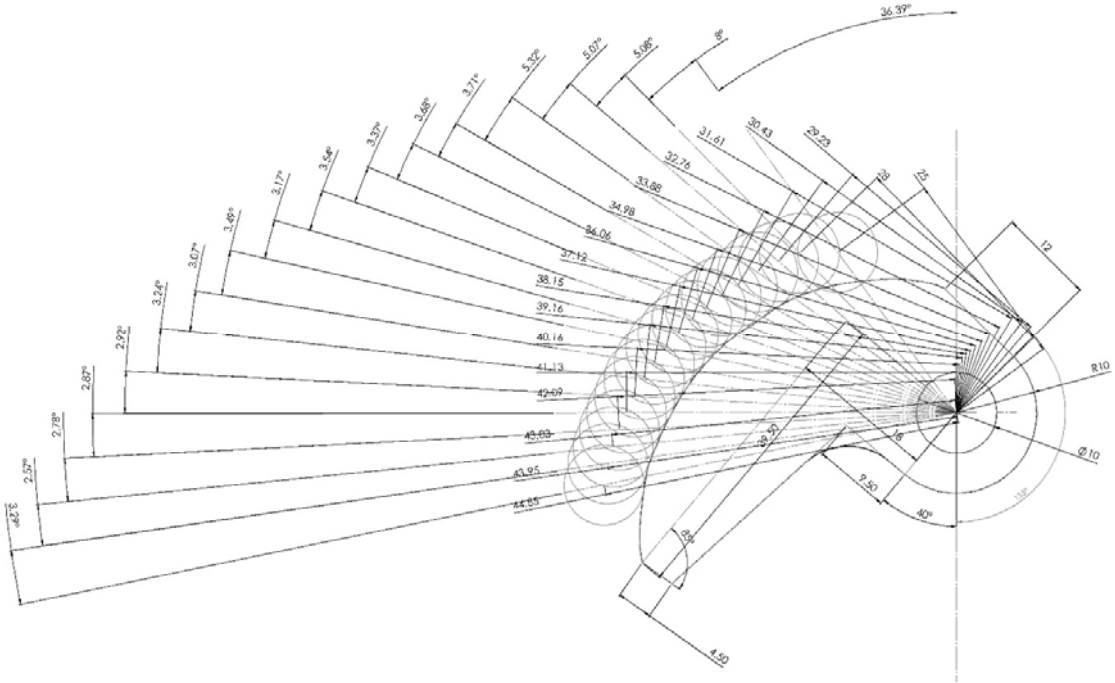

Fig.19. Cam Profile

Form the required speed ratio in CVT the displacement of the driving pulley can be calculate and it is as shown in the Fig.20. and result of the simulation is shown in the Fig.21.

Simulation of the CVT is done in the Solid Works motion analysis. In simulation the speed of the CVT varies from 1600 RPM to 3600 RPM. The speed of CVT is 1600 RPM at 2 sec and become 3600 RPM at 18 sec, variation of speed is linear. From Fig.20 and Fig.21. it is clear that the simulation results are almost similar to the theoretical values. [4]

The secondary clutch actuates with help of belt tension and spring force, in which the belt tries to separate the pulley and spring pushes the pulleys to keep they nearer to each other. Spring stiffness for secondary clutch can be calculated as 14 N/mm.

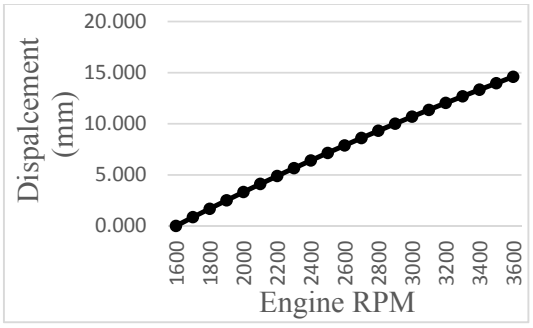

Fig.20. Required Pulley Displacement from Calculation

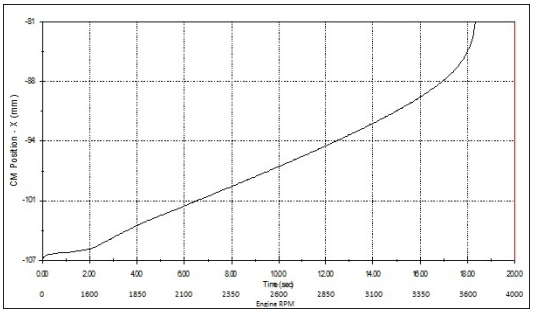

Fig. 21. Simulation Result for Displacement of Driving Pulley

7) Clutch Less Concept

In normal power train the clutch is required to start the car (engine) to shift the gear in manual transmission gear box car. But in CVT the speed reduction is changed automatically, there no requirement of gear shifting and as such the clutch. But at the same time when the car is started as the CVT is engaged with engine the car runs in ideal condition. So to prevent this motion the clutch is required, but in CVT manual clutching cannot be preferred so generally centrifugal clutch is used in the CVT. [5]

The clutch less concept is introduced in our CVT to eliminate the requirement of clutch at starting. In this concept initially play is provided between the belt and the primary clutch. So that when the engine is running in the ideal condition the belt can move freely between the primary pulleys. Thus the power is not transmitted to the secondary clutch. So to compensate this initial play the cam has to be provided with initial free rotation and same has to be introduced in the pulley movement. [5]

8) Final Drawings of Components

Fig. 22. to Fig. 26. shows the final drawing of various components of CVT designed above with its overall dimensions and images of manufactured components

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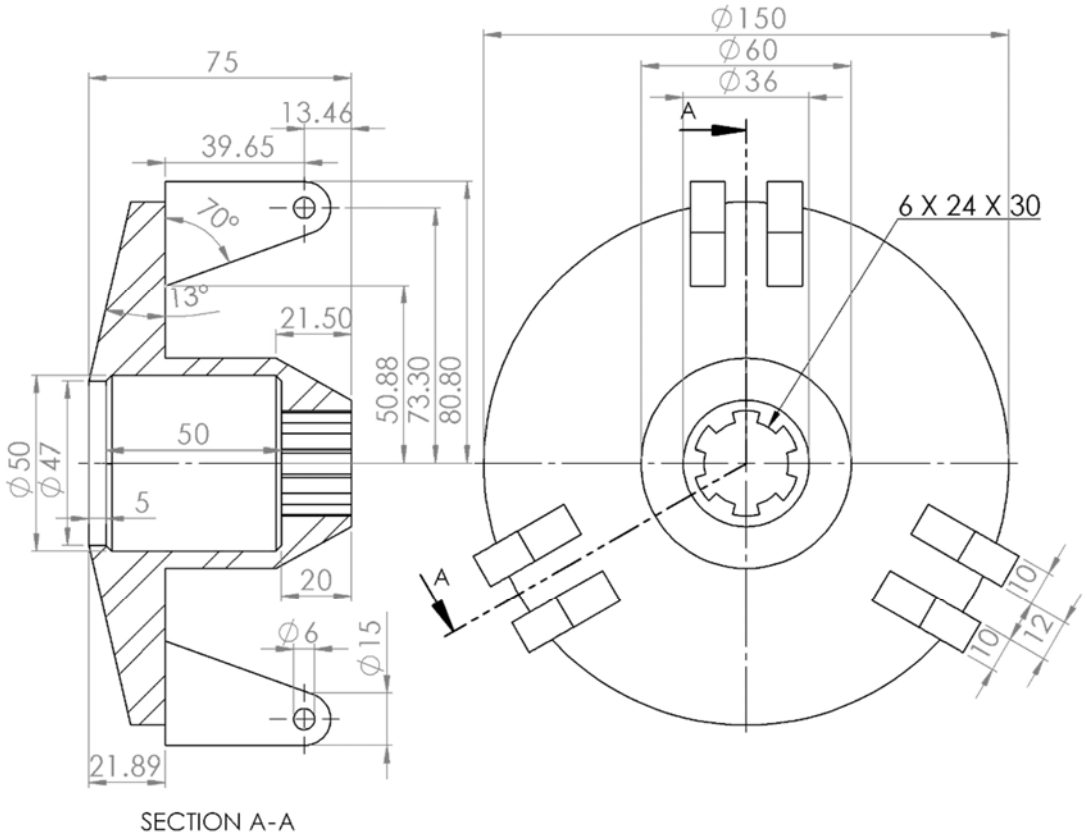

Fig. 22. Primary Clutch – Movable Pulley

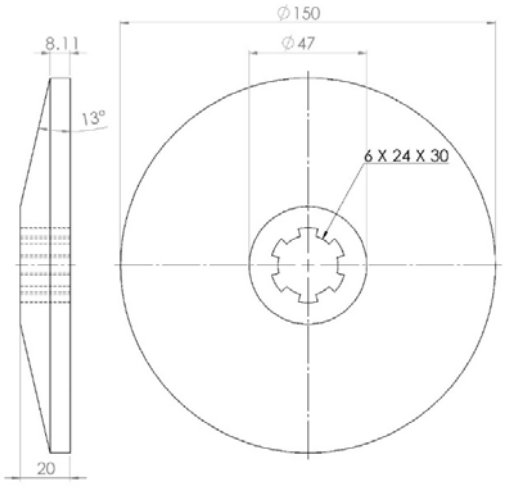

Fig. 23. Primary Clutch – Fixed Pulley

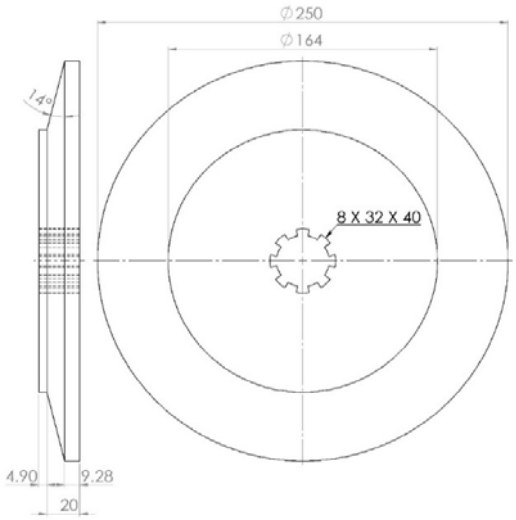

Fig. 24. Secondary Clutch – Pulleys

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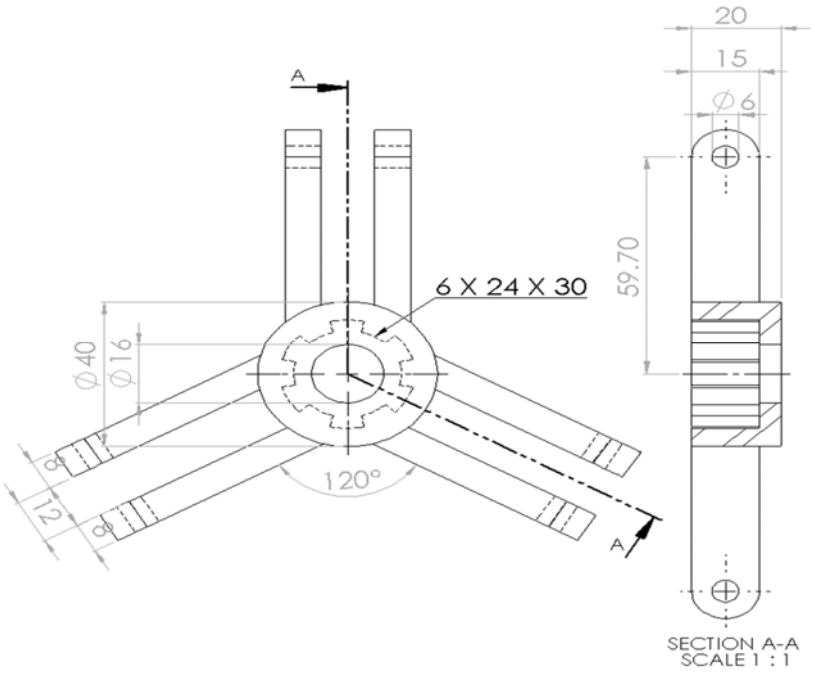
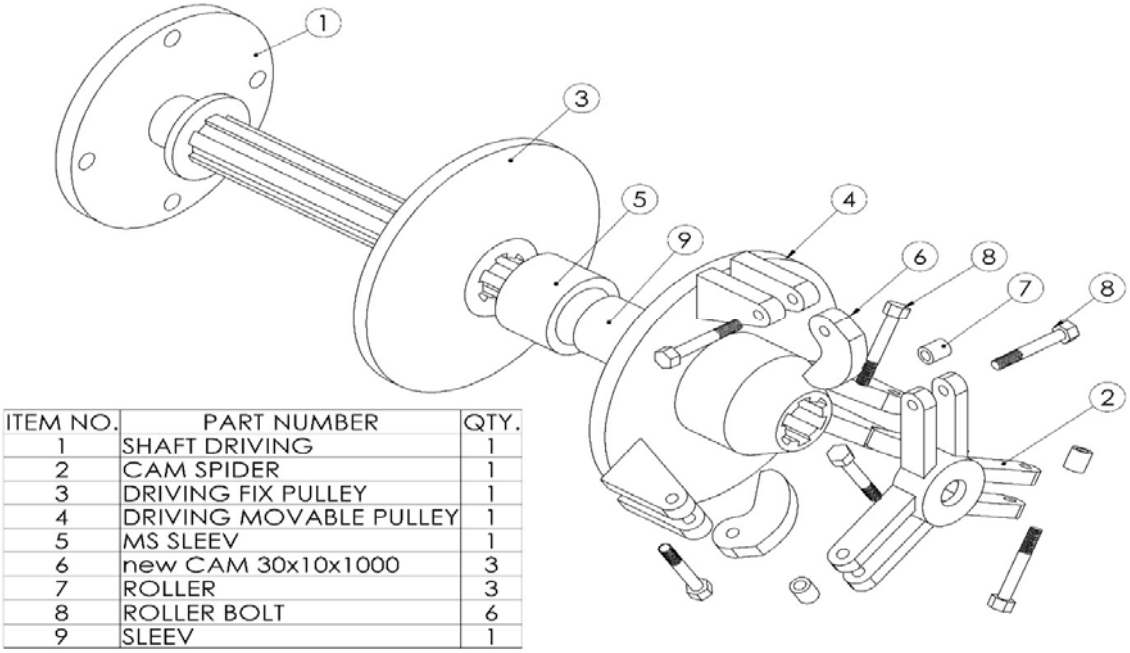


Fig. 25. Primary Clutch – Spider



ITEM NO.	PART NUMBER	QTY.
1	SHAFT DRIVING	1
2	CAM SPIDER	1
3	DRIVING FIX PULLEY	1
4	DRIVING MOVABLE PULLEY	1
5	MS SLEEV	1
6	new CAM 30x10x1000	3
7	ROLLER	3
8	ROLLER BOLT	6
9	SLEEV	1

Fig. 26. Primary Clutch – Exploded View with Bill of Material

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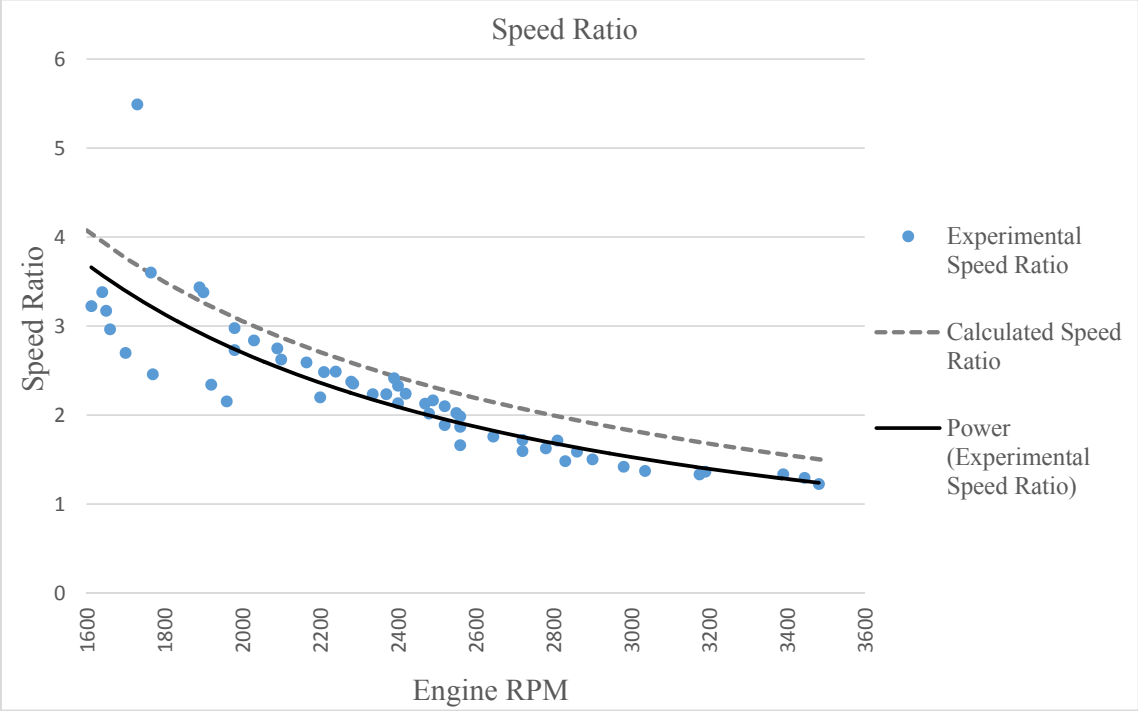
V-Performance Testing

CsVT is not a positive drive, means there will be more chances to have power loss. So it required to test the performance of the CVT in its working conditions and envionment. For testing the CVT the output power, torque and the speed ratio are required to check. In the experiment the toque is measured with help of rope brake drum dynamometer and the speed of input shaft (engine shaft) and the output shaft (secondary clutch) is measured with help of tachometer. [6]
Outcome of rope brake drum dynamometer is weight shown by the weight scale. From which the torque at the output shaft can be calculated by multiplying it with the radius of drum. And power output can be calculated from this torque and the rotational speed of the output shaft.

1) Speed Ratio

Speed ratio is obtained by measuring the RPM of the input shaft (Engine shaft) and the output shaft (Secondary clutch). Fig. 27. shows experimental results for the variation of the speed ratio varying with change in the RPM of engine.
From Fig. 27. it is clear that the experimental speed ratio achieved is varying same as the theoretical speed ratio. But the experimental speed ratio is less compare to theoretical speed ratio, which may be caused due to slip between belt and the pulley as it a non-positive drive. [6]



2) Efficiency

Efficiency of the system can be calculated from the ratio of output power to input power. Here the input power is from engine which can be obtained from the engine power curve, while the output power can be calculated from torque and the speed of the output shaft (secondary Clutch). Fig. 28 shows the efficiency of the CVT at various speed of the engine.[7]

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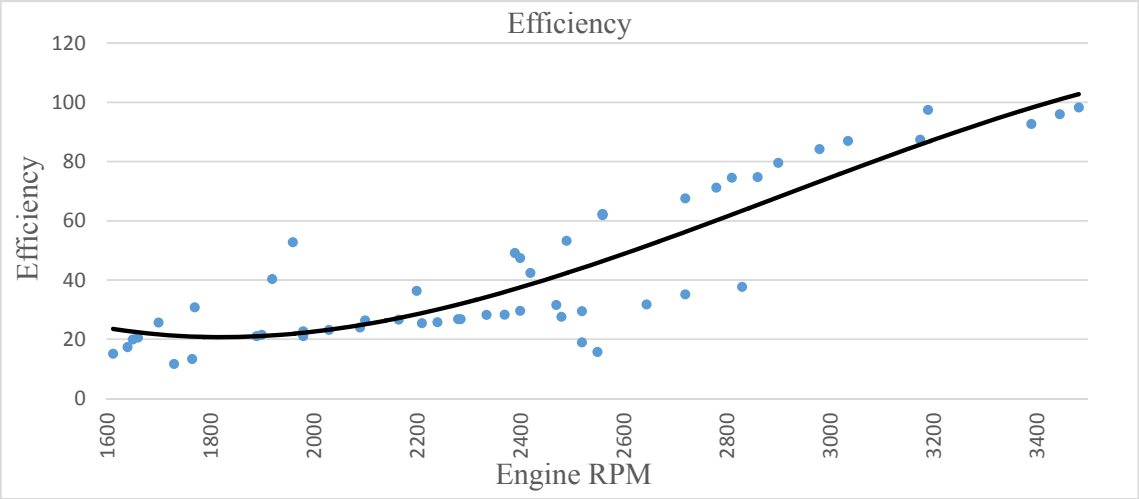

Fig. 28. Efficiency of CVT at Various Engine Speed

From Fig.28. it is clear that the efficiency of the CVT is very less at the starting but as the speed increase the efficiency also increase. This happens due to the clutch less concept because in that initially there is some play is provided between the belt and the pulley so it don't provides the firm contact between them, but as speed increase due to centrifugal force normal gripping force increase and the losses is reduced. More over as it is non positive dive the losses due to slip also take place and the efficiency may further reduced. During measurement of the torque the rope brake drum dynamometer also has some frictional and heat losses so that has to be take care in the final efficiency of the CVT.

VI - Conclusion

Form the experiments the results obtained shows that the efficiency of the CVT at lower RPM of engine is low as enough centrifugal force is not generated by the cam. As well as when the speed increase the output torque obtained is not as much as designed, for this one additional component can be introduced in the secondary clutch. This component has helix which determine the required output torque and by this it adjust the speed ratio and thus by reducing the speed the required torque can be obtained from the CVT.

Due to manufacturing defect of components like imbalance in component the performance of the CVT will be affected. More over the measuring instrument for torque also has some losses in terms of heat loss. And the components are made from mild steel so the components are heavier and has more inertia, so the losses in the components due to higher inertia is more. So these components can be made from the lighter material like aluminum.

Appendix – I: Pulley Dimension

Centre distance between pulleys (C) = 10 inches = 0.254 m

Belt Length (L) = 0.915 m

Driven pulley diameter (D) = assuming

Driving pulley diameter (d) = $D - \pi C + 2C\sqrt{(\frac{\pi}{2} - \frac{D}{2C})^2 - \frac{1}{C}(\frac{\pi}{2}D + \frac{D^2}{4C} + 2C - L)}$

Pulley grove angle (α) = 26°

Variation in the diameter of driving pulley (t) = 139.8 – 59.1 = 80.7 mm

Variation in the diameter of driven pulley (T) = 241 – 180 = 161mm

Total displacement of the driving pulley = (t/2)*tan(α/2) = (80.7/2)*tan(13) = 18.6 mm
Total displacement of the driven pulley = (T/2)*tan(α/2) = (161/2)*tan(14) = 15.2 mm

Appendix II - Belt Tension

Mass of Belt (m) = 0.5 kg/m
Co efficient of friction between belt and pulley (μ) = 0.2
Power transmitted (Power output from engine) = P
Angle of wrap = θ
Velocity of belt (v) = (π * D * n) / (60 * 1000) [8]
Tension in slag side (P_2) = $mv^2 + \frac{P*1000}{v*(e^{\frac{\mu\theta}{\sin(\frac{\alpha}{2})}}-1)}$

Tension in tight side (P_1) = P_2 + P*1000/v

Appendix 3 - FINAL CVT AND SETUP

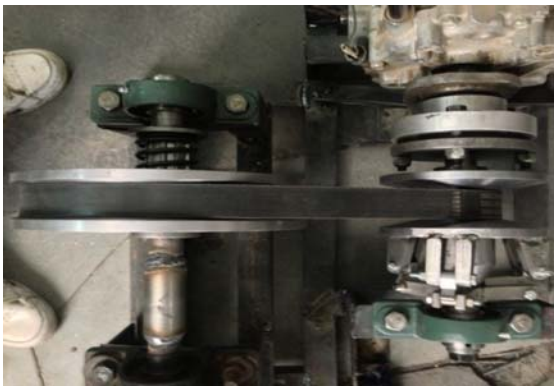

Figure 29 : Manufactured CVT

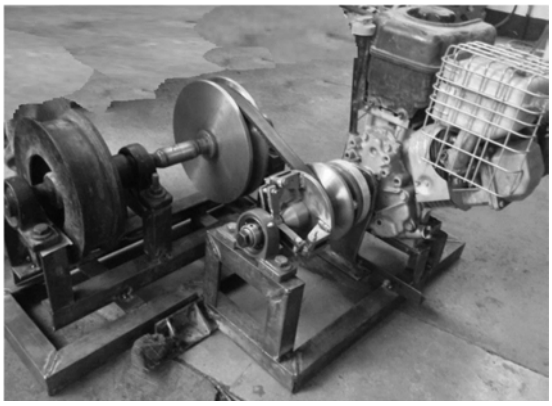

Figure 30 : CVT with Test setup

REFERENCES

[1] Kevin R. Lang , 2000 , "Continuously Variable Transmissions, An Overview of CVT Research Past, Present, and Future".

[2] Norman H. Beachley and Andrew A. Frank , 1979 ," CONTINUOUSLY VARIABLE TRANSMISSIONS:THEORY AND PRACTICE" , College of Engineering ,University of Wisconsin, Madison.

[3] Kluger, M. and Fussner, D., 1997, "An Overview of Current CVT Mechanisms, Forces, and Efficiencies," SAE Technical Paper No. 970688.

[4] Kluger, M. and Long, D., 1999, "An Overview of Current Automatic, Manual and Continuously Variable Transmission Efficiencies and Their Projected Future Improvements," SAE Technical Paper No. 1999-01-1259.

[5] Hewko, L., 1986, "Automotive Traction Drive CVTs – An Overview," SAE Technical Paper No. 861355.
[6] Fenton, J., 1996, "Handbook of Vehicle Design Analysis," Society of Automotive Engineers, Inc., Warrendale, PA, Ch. 19.

[7] Hyunsuk Kim Hyundai Motor Company, 772-1, Changduk-dong, Whasung- shi; Kyunggi-tio, 445-706, Korea.

[8] Allen, Mark and LeMaster, Robert. "A Hybrid Transmission for SAE Mini Baja Vehicles",SAE Publication 2003-32-0045.