INGENIOUS LIGHTING SYSTEM (ILS) FOR SMART CITIES

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ABSTRACT

The main aim of the smart city relates to safer, convenient, comfortable operation, and better energy conservation. The street lamp as an essential part of urban infrastructure in the city, closely relates to the safety and energy conservation. Presently, the street lamps mainly adopt manual management or light perception control. Therefore, the maintenance period is long, especially for the suburban street lamps, it can be even longer than few months. For the light perception control, the flexibility is almost limited. Remote and real time controls are not part of current management systems. The energy consumption of current street lamps is high and have only two states, on and off. Moreover, they cannot adjust their brightness sometimes, the street lamps can be dim to reduce energy consumption. By using a dynamical light intensity adjustment according to current demands, energy consumption can be reduced. In this paper, we propose raspberry pi based ingenious lighting system (ISL) to improve energy efficiency and meet the above needs. In this proposed system, ingenious lighting system is implemented by raspberry pi, and it is used to trace and adjust the entire node. In this proposed system, it consists of three sensors namely LDR, IR and Current sensor which are connected to one lamp node, if one node gets failure then, raspberry pi gets network from another node and it provides to the failure node. This project is highly automated and traces street lamp status. Automatically finds node failure and it is immediately resolved by raspberry pi using another node network.

Keywords-: Energy Saving, Light Intensity adjustment, Raspberry pi, LDR sensor, IR sensor, Current sensor and light dimmer.

I. INTRODUCTION

Energy conservation is very important factor of smart cities[1][2]. Namely, town lamp is correlate with each safety and energy conservation. Therefore, lamp is an important a part of the sensible smart cities[3][4]. However, current street lamps have lack of sensible characteristics, which increases both danger and energy consumption. In order to overcome these problems, Ingenious Lighting system is proposed in this paper. Ingenious Lighting System has the advantage of automation control with the help of networking[5][6]. Automation plays associate degree progressively vital role within the world economy and in standard of living. Automatic systems are being preferred over manual system[13]. The analysis work shows automatic management of streetlights as a results of that power is saved to some extent. In the industrialization, automation is a step beyond mechanization. Whereas mechanization provided human operators with machinery to assist the users with muscular necessities of labor, automation greatly decreases the requirement for human sensory and mental necessities yet.

In existence, the street lamps mainly based on manual management or light perception control, which both have certain disadvantages:

1. Long Maintenance period.

2. Hard fine grain control.

3. High Energy Consumption.

To overcome the above three problems, we proposed the Ingenious lighting system. To reduce the maintenance period, we are moving to the automation, and in case of broken lamp there must be mechanism to check broken lamps in real time. Brighter the street lamp lights ups, the more energy is consumed.

To reduce the energy consumption dynamical light intensity adjustment is used according to current demands. To satisfy fine grain control, every street lamp need unique identification; second, every street lamp should be controlled independently; third, all street lamps should be controlled all the time; fourth, every street lamp has to be able to adjust its brightness according to current demands. The current street light system uses incandescent lamp, mercury vapour lamp etc. Different style of light-weight technology employed in lighting style with their glowing potency, lamp service life and their consideration. Due to its advantages like low power consumption and long life, LEDs are considered to be the promising source for modern street lighting system[11]. Because of these advantages, LEDs are likely to replace the traditional street lamps in future. Materials of top quality with high-precision and also advanced production lines are needed for diode technology. Therefore, the analysis work highlights the energy economical system of the road lights system victimisation diode lamps with IR device interface for dominant and managing.

II. LITERATURE SURVEY

1. Survey on LPWA technology: LoRa and NB-IOT: Rashmi Sharan Sinha, Yiqiao Wei, Seung-Hoon Hwang. Year of Publishing:2018.In this paper, they provide a survey on NB-IoT and LoRa as efficient solutions connecting the devices. Interference on open frequency makes data rate low.

2. An overview of Bluetooth Wireless Technology™ and some competing LAN Standards: Ruisi He, Bo Ai, Gongpu Wang, Ke Guan, Zhangdui Zhong, Andreas F.Molisch, Cesar Briso-Rodriguez, and Claude OestgesYearofPublishing:2017. In this paper to handle increasing traffic, ensure passenger safety, and provide real-time multimedia information, a new communication system for HSR is required. It uses UDP,so no acknowledgement is done or requested.

3. SSL: Smart Street Lamp based on Fog Computing for Smarter Cities: Gangyong Jia, Member, IEEE, Guangjie Han, Member, IEEE, Aohan Li, Member, IEEE, JiaxinDu. In this paper they provide importance of 1) fine management, because every street lamp can be operated independently; 2)dynamic brightness adjustment, all street lamps can be adjusted dynamically; 3) autonomous alarm on abnormal states, each street lamp can report the abnormal status independently, such as broken, stolen, and so on. Auto Rectification of malfunctioning lamps are not available.

From this literature survey, the methods each one has implemented and used is simple and easy to understand. These papers and journals has given many ideas to further implement a much efficient system and make things automated. The presentations are simple and clean with all the necessary information needed for a basic learner or reader.

III. METHODOLOGY

The Ingenious Lighting System adopts a dynamic control methodology[7][8]. According to the proposed plan, initially when it becomes dark, all the street lights automatically glow. But throughout the night, only one street lights remain switched on for security concerns. When a vehicle passes by, a block of street lights glows and as the vehicle moves forward, the next block of lights starts glowing where the previous block switches off. In future this system can be realized using GSM or other high level wireless communication networks like 6LoWPAN which can be implemented worldwide[9][12][17].

IV. EXISTING SYSTEM

Due to its advantages like low power consumption and long life, LEDs are considered to be the promising source for modern street lighting system. Because of these advantages, LEDs are likely to replace the traditional street lamps in future. Materials of top quality with high-precision and also advanced production lines are needed for diode technology. Therefore, the analysis work highlights the energy economical system of the road lights system victimisation diode lamps with IR device interface for dominant and managing. Industries based on lighting systems are growing rapidly and complexly with growth and requirements.

In the present field of electronics and electrical technologies, the factors such as cost, power consumption, efficiency, automation are quite important[20]. Economical street lighting systems are developed with complex control and maintenance. For reducing and controlling energy consumption of public lighting system, many technologies like automation, cloud are being developed. Existing system is adopted by hybrid network[8], the Narrow Band Internet of Things (NB-IOT) is used for real-time communication between server and massive street lamps. Internet is used for real time communication between manager and server. A flexible platform is implemented. The flexible platform which is easy and highly automated and all street lamps can be traced and adjusted in real time.

V. PROPOSED SYSTEM

In this proposed system, Ingenious Lighting System is implemented by raspberry pi, and it is used to trace and adjust the entire node. Light Detecting Resistor, infrared and current sensors are the various sensors used. In this proposed system, if one node gets failed then Raspberry pi gets network from another node and it provides that to the failure node[18][19]. In this project is highly automated and trace street lamp status.Automatically it finds the node failure and immediately resolves by raspberry pi comparing another node in the network.

COMPARISON BETWEEN EXISTING AND PROPOSED

EXISTING SYSTEM:

- 10 LED bulbs of 150watts/hr glows for 12 hrs consumes about 18units(18kWhr).

PROPOSED SYSTEM:

- 10 LED bulbs of 150watts/hr glows for 12 hrs consumes only about 13units(13kWhr).
- Peak Hours(6PM TO 11PM)➔7.5UNITS for 10 bulbs.
- Ideal State ➔5.2UNITS(APPROX.) for 10 bulbs.

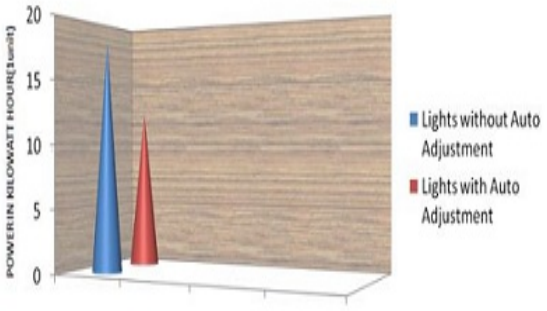

Figure 1

The above graph Fig.1 represents the comparison between the existing and proposed system's energy consumption.

The blue triangle shows the power consumed by existence system when there is no auto adjustment.

The red triangle shows the power consumed by proposed system when there is auto adjustment is present.

VI. BLOCK DIAGRAM EXPLANATION

In the below Fig.2, Ingenious lighting system is simply implemented by raspberry pi.

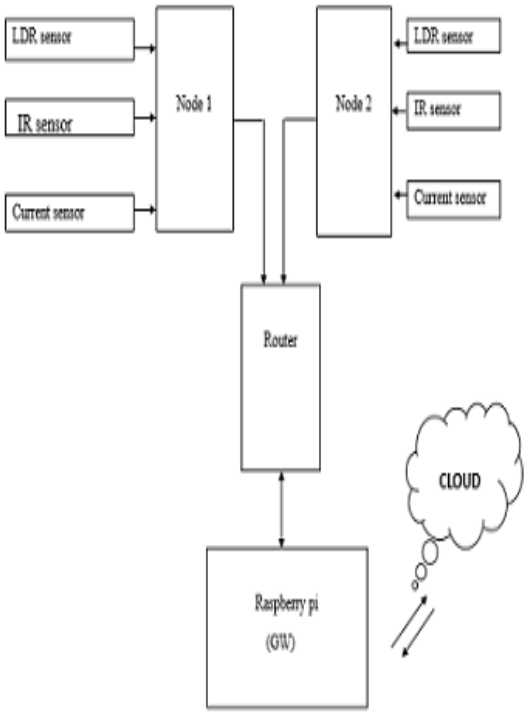

Figure 2

The above diagram is containing two nodes, router and raspberry pi. Three sensors are connected to each node. LDR sensor, IR sensor and current sensor these all the sensors are input to the node. The two nodes are connected to

raspberry pi via a router and the node status is obtained by every seconds. That time the any node will be failed the raspberry pi get data from another node and it given to failure node.

LDR SENSOR

LDR sensor can be abbreviated as Light Dependent Resistor sensor. Each node consists of its own LDR sensor[14]. A light dependent device works on the principle of photoconductivity (i.e.) the resistivity of the material depends on the amount of light incident on them. During day when the light falls on the LDR, the resistance value decreases and at dark the value of resistance increases called as dark resistance. The resistance begins to drop drastically if the device is allowed to absorb light[21]. When a constant voltage is applied to LDR or when the intensity of light increases falling on LDR, the current tends to get increased.

IR SENSOR

IR sensor can be abbreviated as Infrared Sensor. Each node consists of their own IR sensor. An IR sensor is a sensor which uses its transmitted infrared light to find the obstacle using the intensity of the reflected infrared light. The reflection mechanism is effective only with the range of about 10meters[10].It can be also used to find the the obstacle using the temperature or heat present in the obstacle. The infrared radiations are invisible to human eyes.IR sensor is simply a device which consists of two major parts, they are LED which acts as a source which emits infrared light and the photodetector which is used as a reception for the reflected beam. The photodetector is capable and sensitive only to the wavelength of infrared radiations that is emitted from the source.

CURRENT SENSOR

Current sensor is also connected to each node. Each nodes owns a current sensor. For easily measuring output voltage with respect to the current which is detected. The detected voltage is directly proportional to the current through the particular path. There will be a voltage drop when a current flow through a wire or circuit. The current carrying conductor is surrounded by a magnetic field which is generated. Designing of current sensors uses the above two phenomena.

VII.WORKING

All nodes are connected to a router as shown in Fig. 2.. The required power supply is provided to each node which comprises of sensors like IR, Current, LDR sensors.The server is turned ON. Using the IP address of the router connection is established between the server and router. Each node transmits its data from various sensors to the sensors via the router. During daylight, the LDR value reduces below 200 which keeps the light OFF. When the LDR value increases above 200 the lights are turned ON automatically. Initially the lights glow in dim state. When the IR sensor detects any obstacle or any motion of vehicles or auto-motives.

When Infra-Red light radiated from the source gets reflected by the obstacles or motion of vehicles and received by the photo detector. This increases the values of IR, which increases the intensity of light[15][16]. These values are continuously recorded in the server. The current sensor values are also being continuously recorded by server. Based on the current sensor values the state of light bulbs can be measured. When current is zero and voltage is not equal to zero, bulb is broken[23].

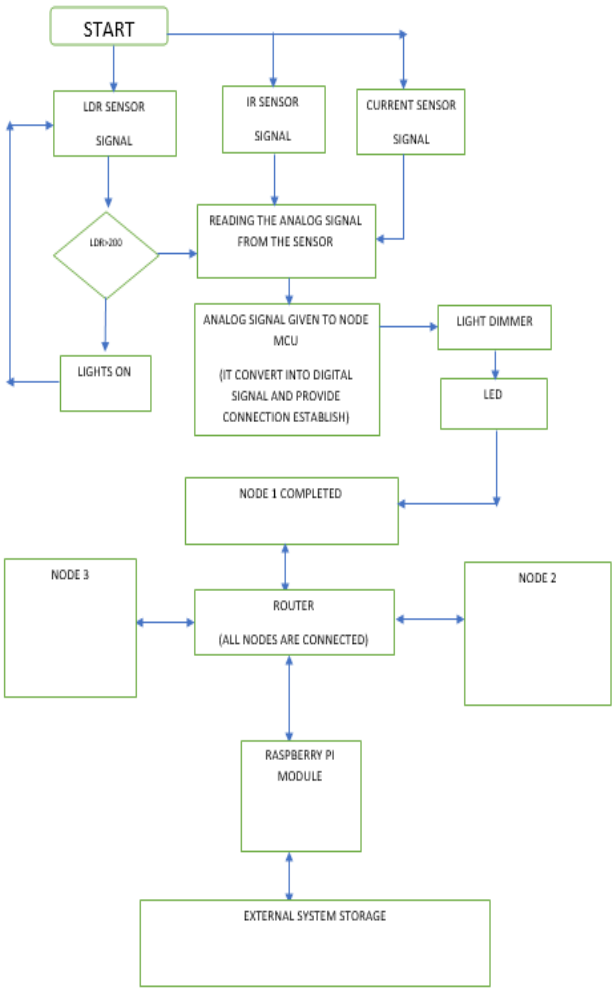

Fig. 3: Flow Chart

When current is not equal to zero and voltage is zero, bulb goes to power saving mode. When current and voltage is zero, bulb is open circuit or short circuited i.e the power line is broken[24]. In this system if one node gets failed then Raspberry pi gets network from another node and it provides that to the failure node[22].For example during day when an LDR sensor of one node fails Raspberry pi checks the other nodes output of LDR sensor and rectifies the value of failure node's LDR sensor. The working is explained by the flowchart Fig.3.

VIII. EXPECTED OUTPUT

Digital values of the measured analog outputs are from various sensors as follows,

1. Current sensor
2. Infrared sensor
3. Light dependent resistor sensor

The following are the expected outputs,

- Based on the values of LDR the light is made OFF or ON.
- Based on the values of Current sensor the following can be inferred.
- Current=0, Voltage!=0 ➔ Bulb is broken.
- Current!=0,Voltage=0 ➔ Power Saving Mode.
- Current=0, Voltage=0 ➔ Bulb is stolen or Open circuit.
- Based on the values of Infrared Sensor the light can be made to glow bright or dim and acts as Dynamic Light intensity adjuster.

IX. RESPONSE TIME

For single measurement, this causes large response time,

For example: 35 ms for objects placed 6m away.

The response time is an important factor for any sensor. It changes according to the increase in the distance between the object is far more than 6m.IR sensor can detect upto 10m i.e upto 30ft.IR response time also vary with respect to angle of the object.

X. SOCIAL RELEVANCE AND USEFULLNESS

[1]The main aim of the smart city relates to safer, more convenient, and more comfortable operation, and better energy conservation.

[2]Therefore, make an urban infrastructure be smarter is necessary for promoting the smart cities.

[3]The street lamp as an essential part of urban infrastructure in the city, closely relates to the safety and energy conservation.

[4]Nowadays, it is impossible to imagine how the city would look like without street lamps. However, it is easy to predict that in that case the danger from traffic, robbery, and stealing would increase seriously.

[5]Moreover, it is necessary to optimize the current street lamp management because of its high energy consumption on daily basis.

[6]Here we can even solve the problems with no man power,(i.e) using the LDR sensor of one lamp system other system can be rectified automatically.

[7]Thus,by using this ingenious lighting system,amount of electricity can be reduced by one fifth.

[8]This fact again relevant to the social awarness about the Energy Saving And Efficient Energy Consumption.

XI. CONCLUSION

By using INGENIOUS LIGHTING SYSTEM, one can save surplus amount of energy which is done by replacing normal lamps by LED and adding an additional feature for security reasons. It prevents consumption of electricity, caused due to manual procedure of streetlights when it's not required. It provides an efficient and auto-rectification streetlamp control system with the assist of LDR sensor, IR sensor, current sensor and provides smart lighting system in cities. It can reduce the energy consumption and maintain the cost. The system is versatile, extendable and totally adjustable to user needs. The system is now used only for one way traffic in highways. Continuous use of LDR and IR sensors even in day time. Not switched on before the sunset. The Smart light system can be further extended to make the current system in two-way traffic, making the system more flexible in case of rainy days and introduction of ways to control the lights through GSM based service.

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