IMPLEMENTATION OF MOTOR TESTING FOR SINGLE PHASE INDUCTION USING IoT

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Abstract
In this paper single phase induction is tested automatically to determine the performance characteristics covered in the ISO standards. The test readings and performance details are stored in Server and it can be viewed and download from the server through internet. For that latest technology like IoT programming are included. The calculations are done by the system automatically and the result will be uploaded in the server through IoT (Apache web service) & MySQL. The test results can be downloaded or viewed at our hand set or our personal computers where ever it needed. Arduino UNO which is an intermediated has installed, so that the user can easily interface to the system. The output is either graphical representation or digital value. These outputs are stored in the system memory.

Index Terms: Single phase induction motor, Motor Testing, Internet of Things

I. INTRODUCTION

Demand of energy is growing day by day and along with it cost of energy rising rapidly, so it is necessary that the health of large motors which consumes maximum power should be taken care off. Tests are required to check the condition of the induction motor and to get the basic idea of malfunctioning of the motor. Now a day lots of techniques like IoT are available in which test results can be stored in the server. By monitoring some parameters of the motor like voltage, current, temperature, and vibration problem could be diagnosed and by correcting these faults the overall efficiency of the single phase induction motor can be improved. This will reduce the energy consumption and operational costs.

In general we need to know every motor should be tested after manufacturing to classify the standards of the motor. In this paper the motor is tested automatically and classified according to ISO standard. The motor testing is performed with the help of various types of sensors and microcontroller. The steady, safe, and efficient operation of electric motors is essential to the productivity of all plants and facilities. Some facilities, including electrical utilities, pulp and paper mills, and innumerable others, have many critical and/or expensive motors. In this paper, tests are done automatically by using several sensors, and using some of the software's like IoT, Arduino, and MySQL.

BASIC PARAMETERS TO BE CONSIDERED

(i) Current: As line current is the phase currents, both line currents and phase currents are to be for evaluating machine performance.

(ii) Voltage: Voltage is measured at the motor terminals at the time of test. Machine performance can be calculated by using the phase voltage.

(iii) Speed: Speed of the motor is to be measured with the help of tachometer in terms of RPM (Rotation per Minute). Through this speed test, the efficiency of the motor is determined and the motor are approved for the environmental use.

TESTS TO BE PERFORMED

In industries there are several tests to be performed when the motor is manufactured. Our

project implements some of the testing method which are listed below:

Resistance Test
No load Test
Low voltage Test
Load Test
Temperature rise Test
Insulation resistance Test
Speed Test
Leakage current

II. HARDWARE REALIZATION

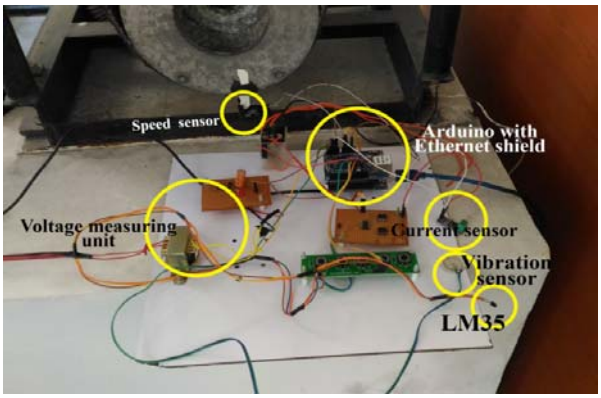

FIGURE 1 COMPLETE EXPERIMENTAL SETUP

This figure 1 describes the complete experimental setup of the single phase induction motor testing machine with the sensors to measure speed, voltage, current, vibration and temperature. This setup also has the control selection mode to perform the test through selection mode with the help of push buttons.

The AC supply is fed to the single phase induction motor. The various sensors that are interfaced with induction motor are speed sensor, Vibration sensor, current sensor and temperature sensor. The parameters like Voltage, Current and Speed are measured and the values are uploaded in the server connected to that respective motor.

CURRENT SENSOR

A current sensor detects electric current in a wire, and generates a signal proportional on it. The generated signal could be analog voltage or current or even digital output. It can be displayed in an ammeter or can be stored for further analysis in a data acquisition system. This current sensor values are also used in performing the leakage current test too. This process is automatically preceded, where the C programming are internally saved to do this performance.

VOLTAGE SENSOR

The Voltage Sensor is a sensing agent that measures the voltage supplied to the motor and the values are sending to the server through the IoT software. This voltage reading is useful to set the pre-set value and to performing the low voltage test in motor test.

SPEED SENSOR

The major goal is to check the rate of an electric motor. The module can be used in association with a controller for motor speed detection, pulse count, position limit, etc. Tachogenerator is a measuring agent that is included in this project to measure the speed rate.

TEMPURATURE SENSOR

Temperature sensors are most frequently used device to measure the temperature in the motor. And it is used to identify the temperature rise in the motor. Whenever the temperature rise in the motor cross the limit of the motor standard temperature level the motor will intimate or send a notification to the user or manual controller.

In this paper LM35 is used as a temperature sensor. The LM35 is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature .

VIBRATION SENSOR

Mostly, the motors will be affected by friction and vibrations. This vibration causes the breakage in the motor. This will be avoided by implementing the piezoelectric sensor. This sensor will monitor the motor vibrations for every second. When there is an existing vibration produced in motor means it will sense the value and pass to the controller. The controller will intimate this error to the user. Then that error will be cured and the motor attains its stable position.

This sensor will also define as the sound maker which will make sound when the error occurred while motor at running condition.

LOAD CELL

A load cell is a transducer which converts force into a measurable electrical output.

Although there are many varieties of load cells, this paper implements the 'S' Type load cell, which is compact in size, and used for lower level applications, reduced cost. This 'S' Type load cell is used among the laboratory usages. And give more than 0.09% of efficiency in the load test.

III. SOFTWARE INTEGRATION

The programs used here are C, HTML, PHP and SQL. Through these programs the values from the sensors connected with the motors are will be updated into the server. This values can be easily then taken and verified. This scheme provides the time saving mechanism.

Software's that are used listed below:

- XAMPP
  - APACHE
  - MYSQL
- ARDUINO

  Through this software's the automation in motor testing had achieved successfully.

C PROGRAM

C program is used for operation of controller to collect the analogue value from the sensor and convert it into the appropriate values. Also the program instructs the controller to send the collected values into the server through the defined URL.

PHP

PHP is web based server side programming language which collects the data from the defined URL and inserts it into the database. For the client/user side the values from the database are collected and the calculations are performed.

SQL

SQL is a query language which is used to perform the operation of data manipulation to manipulate the data of motor reading in the database.

HTML

HTML is used for the purpose of displaying the appropriate output in the web browser from the calculation done by the PHP and arrange in understanding manner.

SOFTWARE CALCULATION

Calculation is the major part in machine testing. These calculations are done to find the motor performance and are noticed by the user. This setup is followed at every motor testing process.

The program has defined for default values required for the calculations such as Radius of the brake drum. The formulas to perform the testing are programmed. The tabulation for the load test single phase induction motor is drawn and the values are calculated by the program. This tabulation does not include the temperature rise value and vibration plot

The calculation will be perfromed and the formulas are listed below with the tabulations of singls phase induction motor load test.
This paper implements Automatics Calculation process. This saves the time, error occurrence.
This process includes some of the advantages in it. They are:

- Faster and accurate.
- Less energy consumption.
- Low cost.
- Online monitoring.
- Can get information of the motor from anywhere in the world through Internet.

The below shown formulas are been feed to the server through the IoT programs and that formula actions are done automatically by controller and the calculated values are stored in the serve memory.

FORMULAE:

1. Circumference of the brake drum = 2ΠR (m)
   R = Radius of the brake drum
2. Input power =W (watts)
   W = wattmeter readings
3. Torque (T) = 9.81* R * (S_1 ~ S_2) (N-m)
   S_1, S_2 = spring balance readings (Kg)
4. Output power = $\frac{2\pi NT}{60}$ (watts)
   N- Speed in rpm
5. % Efficiency (η) = $\frac{output\ power}{input\ power} x100$
6. Power factor, cos Φ= $\frac{W}{VI}$
7. % Slip, s = $\frac{Ns - N}{Ns} \times 100$

   N_S = synchronous speed = $\frac{120f}{P}$ (rpm)

   P = no. of poles

   f=frequency of supply (Hz)

IV. INTERNET OF THINGS

Internet of Things (IoT) is the most commonly used software among all the deployment of applications that monitor, manage and control the connected device. In our papeer the job of IoT is to transfer the values from the sensors connected with the motor to the main server to store the data's in digital value. Through IoT we can able to check the status and can view the output of the machines readings and can downloaded through this IoT software. For Example, We have knowledge about ATM machine, were the request is send and the amount is deposited. Same process is preceded here.

V. RESULT AND DISCUSSION

SPEED MEASUREMENT- High Speed

Fig 2. Demo picture of motor at high speed

The figure 2 shows the experimental setup, and the model readings of the experiments. Here the motor runs at high voltage where speed reaches about 1500 RPM, and the readings are saved and displayed in the server (LAPTOP). That value can be able to store in the server, and can be able to take it at any time.

SPEED MEASUREMENT- High Speed

Fig 3. Demo picture of motor at Low Speed speed

The figure 3 shows the low voltage readings at low speed and the values are in digital. And then it will be transferred as analog value and again converted as digital which will store in database

DATABASE

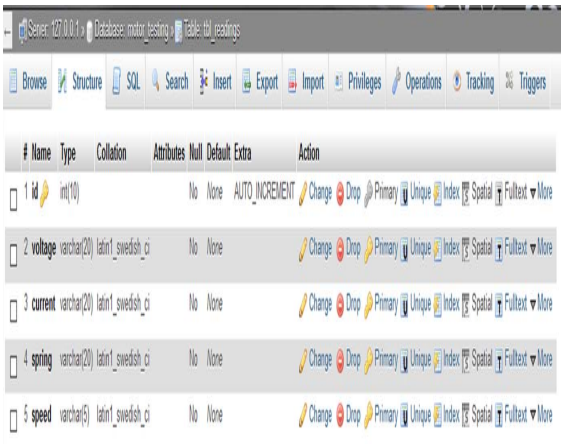

Figure 4 Table Structure to Store Motor Readings

The figure 4 shows table the readings of the motor testing which is collected by the sensor will be stored.

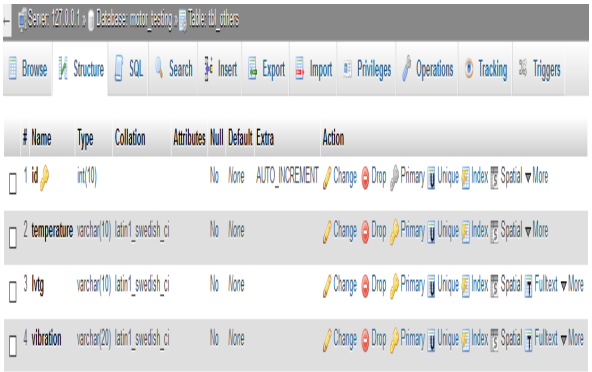

Figure 5 Table Structure To Store Temperature And Vibration

The figure 5 shows table the temperature readings and vibration readings are collected from the sensor and stored for the further calculations.

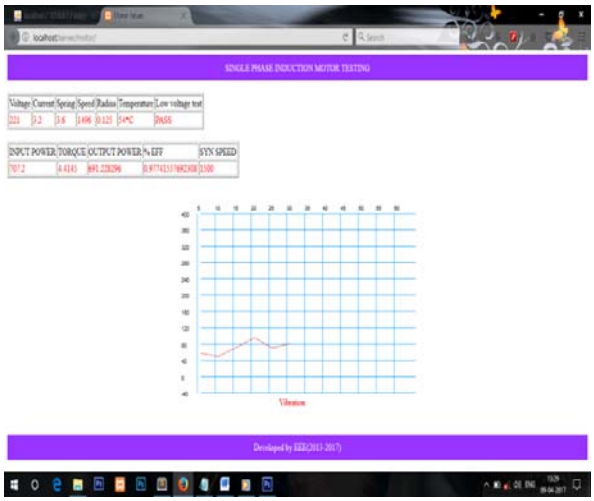

Figure 6 Output of the motor

This figure describes the output of the motor calculated from the readings collected by the controller from the sensor. The readings are collected from the database to calculate the appropriate values by the program itself.

The result also has the low voltage test pass sign, temperature rise value and the vibration graph for the identification.

VI. CONCLUSION

IoT based automatic motor testing is the key reduction to reduce the Man Power and to reduce the error occurs in the motor while testing. Also with this the automatic calculation is one of the major topic that we are covered and done that process. This help to reduce the time of calculation and also reduce the error occurrence while calculating the motor efficiency. Also this reduce the Usage of Current, Also these process are monitored and controlled by the processor installed in this project. By performing the various type of testing in motor helps in finding out the Efficiency of the motor.

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