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RESEARCH ARTICLE OPEN ACCESS

AUTOMATIC AXLE HEAT MONITORING AND CONTROLLING IN RAILWAYS USING MICROCONTROLLER

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Abstract:

In recent years, the ranges of sensing technologies are expanding rapidly, whereas sensor devices are becoming cheaper. This led to a rapid expansion in condition monitoring of systems, structures, vehicles, machinery etc.,using sensors. Key factors are the recent advances in networking technologies such as wireless communication and mobile ad hoc networking coupled with the technology to integrate devices. WSN can be used for monitoring the railway infrastructure such as bridges, rail tracks, track beds, and track equipment along with vehicle health monitoring such as chassis, bogies, wheels, and wagons. Condition monitoring reduces human inspection requirements by means of automated monitoring, reduces maintenance with te help of detecting faults before they escalate and improves safety and reliability. This is vital for the development, upgrading, and expansion of railway networks. Overheated axle boxes and blocked brakes are the most important and immediate causes for the hazardous conditions in railway operation. A hot box may cause the axle box casting to break and leads the train to derail. So the heat of the axle has to be measured and analyzed regularly. In practice, INDIAN railways each of the axle's heat will be measured and noted manually by a person. In order to measure the heat of each axle with high efficiency we are putting forth a new methodology called AUTOMATED AXLE HEAT MEASUREMENT.

Keywords **—Arduino controller, Contactless temperature sensor, Transformer, LCD, Water pump, Relay**

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A. INTRODUCTION

The current situation in Indian railway is, when the train arrives at a station the SSE has to visit each axle individually with a device called THERMAL HUNTER that has to be operated manually. According to the temperature of the axle, SSE will decide whether the coach has to be retained or maintained or detached from the train. As it is measured by a human there is a need of human resources and there may be a possibility of human error and also once the train stops, the temperature falls to 30% which leads to error. So the accuracy of heat measured gets reduced. Also the person has to go each axle individually to measure the heat of each axle. Even the delay reduces the efficiency of

heat measured. In order to increase the efficiency in temperature measurement of axle, a new methodology called automated axle heat measurement using microcontroller is done. Here a contactless sensor Melexis MLX90614 Digital plug&amp, play Infrared Thermometer in a TO-can is used which measures temperature in a wide range. The sensor senses the temperature of the wheel and gives the result to the database. Then it is analyzed and processed in a efficient manner. The system is autonomous hence human errors can be eliminated. The efficiency of the temperature measured can be maintained at high level as it is measured during moving condition. Reduces the need of human resources. The efficiency of temperature at axle is maintained constant from the start to end of all coaches. The system also recquires the Knowledge in power electronics and sensors, knowledge in Microcontroller, knowledge in Embedded systems using assembly and C, Understanding interfacing techniques.

B. LITERATURE SURVEY

Authors and Affiliations:

"The wheel-rail interface-some recent accidents" during 2003 by Smith, R.A., gave information about importance of interface between the wheel and rail for the purpose of safe operation of railways in "Fatigue & Fracture of Engineering Materials & Structures"[1].

Schobel, M.Pisek, J.Karner in Austria reasearched on "Hot box detection systems as a part of automated train observation" in EURNEX -ZEL 2006, Zilina, 2006, pp. 157-161. Outcome of this research led to the development of hot box detection system[2].

G. Menaker presented a paper on the topic "A Train Hot Bearing Detection System Based on Infrared Array Sensor" in IEEE Transactions on Applications and Industry, Vol.82, No.67, 1963, pp.178-186[3].

S.D.Milic, M.Z. Sreckovic proposed an article in IEEE Transactions on Vehicular Technology named "A Stationary System of Noncontact temperature Measurement and Hotbox Detecting"[4].

A study on "railway wheel profile parameters used as indicators of an increased risk of wheel defects" was published in "Proceedings of the Institution of Mechanical Engineers" as a part of the journal-"Rail and Rapid Transit" by Asplund. M., Palo. M., Famurewa. S., Rantalo. M in 2014[5].

Brickle B, Morgan R, Smith E, identified the existing and new technologies for wheelset condition monitoring[6].

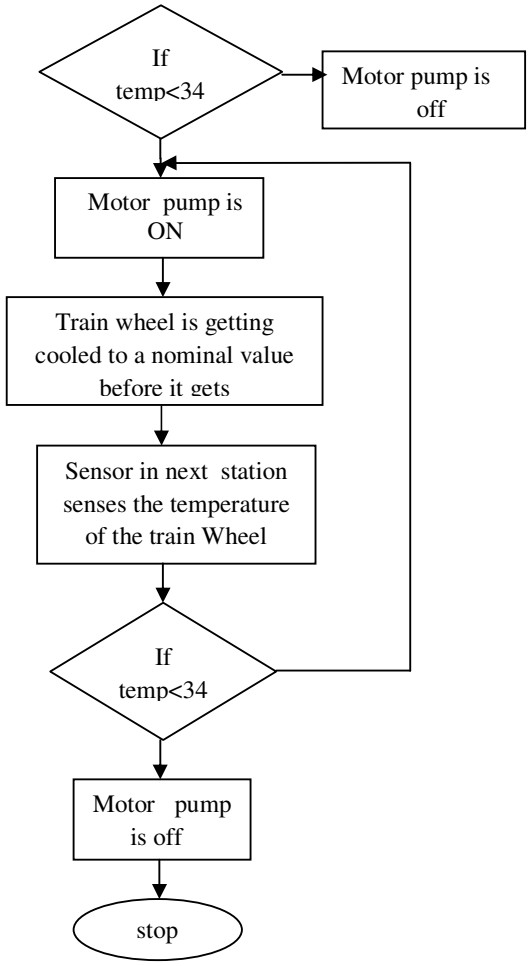
A research on "The Introduction of Railway Truck Hotbox Detection and Application" was done by Zhao ChangBo,Chen Lei in China by the year of 2010[7].

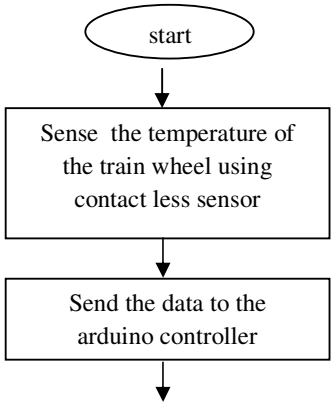
C. METHODOLOGY

This system is mainly used for high speed trains which travels for long distance. Wheel is the most important part of a train, that helps in the motion of train. Each wheel of a train is made with an axle arrangement. It is provided with bearings and gears for its easy motion. Due to the frictional effect in gears and bearings, there gets generated enormous amount of heat energy.application. In order to reduce the heat energy and frictional effect, greese is used. If the

greese becomes faulty the frictional effect increses which leads to the effective increase in heat. When the heat increases it still melts the greese which leads to ore worse situation.When the temperature is below 60°C (in reality) it means that the greese is in good working condition and it results effectively. At the same time when the temperature is more than 80°C, the greese could have been melted and has to be replaced. At times it may fail to operate.

Unavoidable human errors may occurs in monitoring and controlling the temperature. In order to avoid the above issue, "Automatic axle heat monitoring and controlling in railways using microcontroller" can be used to monitor the temperature with the help of a contact less sensor and control it with the help of microcontroller.checks the bill for confirming that no billed product is taken by the customer.





D. HARDWARE DESCRIPTION

The components used in our project are,

1.Arduino UNO

2.Contactless temperature sensor

3.Transformer

4.LCD

5.Relay

6.Water pump

Short description of components used:

1. Arduino UNO:

The Arduino Uno is a microcontroller board, based on the ATmega328. The Arduino Uno can be powered via the USB connection or with the help of an external power supply. The power source is selected automatically. External power can come either from an AC-to-DC adapter or from battery. The Atmega328 has 32 KB of flash memory for code storing. It has also 2 KB of SRAM and 1 KB of EEPROM.

2. Contactless temperature sensor- MLX90614 Infrared Thermometer Modules:

Unlike most temperature sensors, this sensor measures the IR light bouncing off of remote objects so it can sense temperature without having to touch them physically. The MLX90614 features a single pin serial interface for connection to most of the microcontrollers. Two models are available: #28040 with a 90° field of view, and #28042 with a 10° field of view. It can sense a wider range of temperatures than most digital sensors from -70°C to +380°C.

3. Transformer

A transformer is an electrical macine that transfers electrical energy between two or more circuits through electromagnetic induction. Transformers are used for increasing or decreasing the alternating voltages in electric power applications. This system uses a step down transformer in which the secondary winding is more than primary winding, because of this windings it can able to step down the voltage.

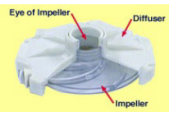
4. LCD- 16x2:

LCD is the technology used for displays in notebook and other smaller computers. Like LED and gas-plasma technologies, LCDs allow displays to be much thinner than CRT technology. LCDs consume much less power than LED and gas-display displays because they work on the principle of blocking light rather than emitting it.

5. Relay:

A relay is an electrically operated device. It has control system and controlled system. It is frequently used in automatic control circuit. It is an automatic switch for controlling a high-current circuit with a low-current signal. The advantages of a relay lie in its lower inertia of the moving, stability, long-term reliability and small volume.

6.Water pump:



The water pump used here is centrifugal pump. It is of very simple design. The two main parts of this pump are i) impeller(only moving part) ii) diffuser. Water enters the eye of the impeller and is thrown out with the help of centrifugal force.

E. DESIGN AND IPLEMENTATION

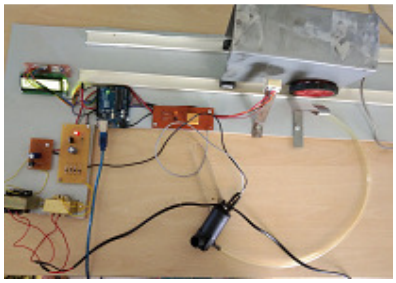
Automatic axle heat monitoring and controlling using microcontroller have two modules i) monitoring the temperature ii) controlling the temperature.

Here we have used a contact less sensor named MLX90614 which uses IR rays for the purpose of measuring the temperature without actually touhcing it. The sensor after measuring the temperature gives it to the microcontroller. Arduino UNO process the input signal and takes necessary action for the safe operation of the train.

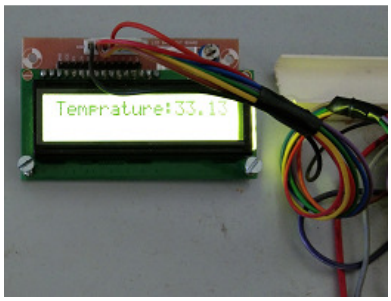
When the train arrives at a station, the sensor senses the temperature of all compartments. The temperature measured has to be stored in a database with the details of coach number and axle number. When the temperature is greater than or equal to 34 degree celscius (as per the program) it gives signal to the arduino. Arduino on receiving the signal initiates the signal, so that the water pump get powered and waters the wheel. Flow of water is allowed until temperature becomes less than 34 degree celscius. Reducing the temperature of the wheel is done before it starts from the station. Here we have LCD module with 16 columns and 2 rows to display the data information about the temperature and condition of the train. This is also controlled by means of arduino UNO.

F. EXPERIMENTAL RESULTS

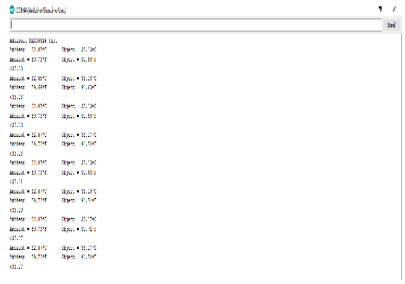
A)Prototype model



B)Temperature less than 34 degree celscius

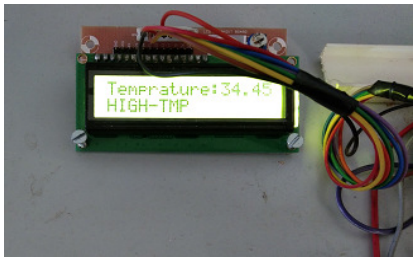


Hardware output

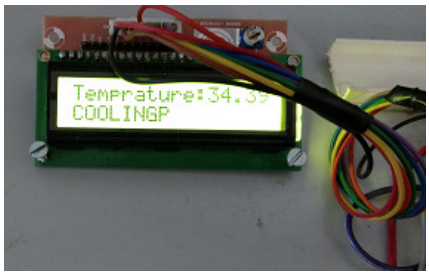


Software output

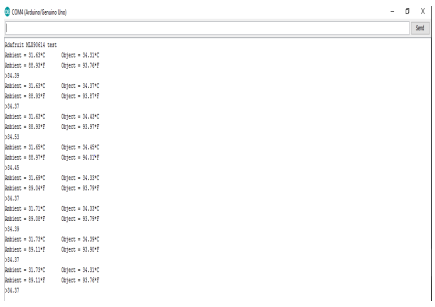
C)Temperature greater than 34 degree celscius



Hardware output(high temperature)



Hardware output(cooling)



Software output

G. CONCLUSION

H. Thus by this we can surely say that axle heat of a coach can be measured and processed efficiently.As the methodology involves automation human errors can be reduced and also accuracy can be increased. By implementing this concept we can easily maintain the database on train axle and wheel temperatures. Also as in current system the heat measured in static position, thus we can increase the efficiency of axle/wheel heat measurement by measuring in motion, which gives exact result for analysis.

H. REFERENCES

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