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AUTOMATIC REAL-TIME RAILWAY FISHPLATE MONITORINGSYSTEM FOR EARLY WARNING USING IOT

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Abstract - *As the population is increasing day by day, number of trains are also increasing. People would like to prefer rail transportation other than road transportation. With the increase in count, safety requirements are not maintained properly. Many rail accidents are prevailing now-a-days due to the negligence of higher authorities. The main cause for the rail accidents is derailment. The fundamental reason for derailment is loosening of fishplates. Therefore, keeping an eye on alignment of rails and fishplates is very important. Here, a continuous monitoring system is picked up based on IoT which can keep track of every fish bolt present in the system. The indicated system uses GPS for tracking the exact latitude and longitude of fault location. This system consists of microcontroller which can control the working of all the components embedded on it. Proximity sensors are used to detect the loosened fishplates. Node MCU is used for the wireless communication in which a wi-fi chip is embedded onit. The number of accidents going to decrease by using this proposed system.*

Key Words: **Node MCU ESP8266, Arduino ATMEGA328P, Blynk IoT Mobile Application, Proximity Sensor, GPS, Solar Panel.**

1. INTRODUCTION

In this populated world, railways have become the primary means of transportation. Rail communication has been used byboth people and the goods. The probability of accidents has been increased due to increase in population. When we consider the number of rail accidents in FY 2014-2022 as per the statistics released by Indian government, it is recognized as 34. We are losing many lives due to the railway accidents. So,monitoring the rail fishplates is necessary task in order to maintain safety. Basically, a rail fishplate is a steel or iron plate which slides among the corners of two rails to maintain alignment. Fishplate is simply a metal plate used to connect two fishplates.Physical monitoring is a time taking process and noteconomical. To overcome this problem, we have come up with an idea which takes less time and gives high reliability. Arduino UNOis an embedded system which can store and record the data processed by different sensors. At the input side, we can use proximity sensors and ultrasonic sensors to detect the fault location. At the output side, GPS and Node MCU are used to track the exact latitude and longitude of the fish bolt and to ensure a wireless communication with the cloud networks. So, by this automated system we can reduce the number of accidents that are occurring due to the derailment.

1.1 OBJECTIVE

The major objectives for developing the prototype modelfor fishplate monitoring are to detect if the fish bolts are in the right place or not and to trace the exact location of the fault through the GPS module.

2. PROPOSED SYSTEM

In this proposed system, an IoT based sensor fault detection is used. Addition to that a user-friendly mobile application is used to know the location of the fault and exact latitude and longitude. It also shows that someone is on the track if any person is standing on the track. The fault location can be highlighted in the mobile application from any area where internet is available. The position of fishplates can be known by the wireless communication through ESP8266 Wi-Fi module and the same information can be stored in the cloud server and can be communicated with the base station.

The proposed system comprises of ESP8266 Wi-Fi module, Node MCU, Inductive proximity sensor, Ultrasonic sensor, Solar panel, GPS and Arduino UNO. The wi-fi chip which is embedded on the node microcontroller unit is connected to the hotspot of the host. When the fish bolt is rotated, the proximity sensor will detect the rotation and shares this information to the Arduino uno. If the rotation is up to the mark, then Arduino commands GPS and wi-fi module to communicate with the base station. Warning signal is sent until the fault is cleared. This proposed system has one more application which uses ultrasonic sensor to warn track.

2.1 BLOCK DIAGRAM

From the block diagram,

The whole operation of components is controlled by Arduino. In this system, android application called Blynk IoT communicates with the wi-fi module embedded on microcontroller unit. The operation of GPS and the sensors can be observed in the application.

GPS and wi-fi module receive the commands from Arduino microcontroller as coded in it. The results can be observed in the IoT platform as either danger mode or idle mode. It will

show danger mode until the fault is cleared. The procedure canbe explained in five steps.

1.Detection of rotation of fish bolts through proximity sensors.

2.Processing of data by embedded system.

3.Transmission of data through wi-fi module.

4.Enhancing the data to cloud storage.

5.Distribution of data through base station.

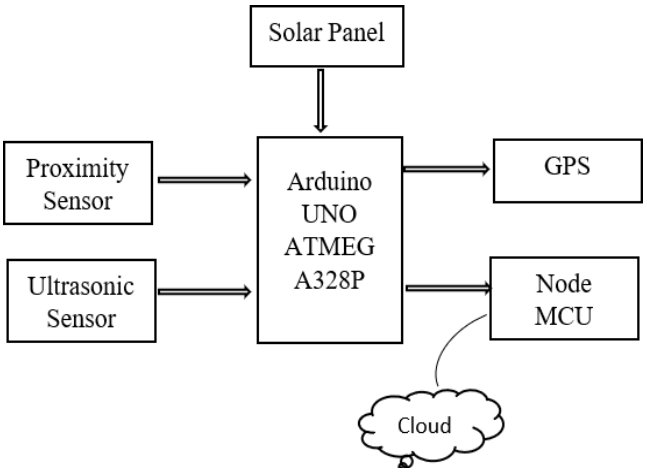

Fig-1: Block Diagram

2.2 MECHANISM

The automated system is designed by using different types of sensors like proximity sensors and ultrasonic sensors which areconnected to the fishplates. These sensors are the input deviceswhich can act as transducers i.e., the devices which can convert one form of energy into another form. Here, the proximity sensors output is electrical energy.

2.3 COMPONENTS

a) Proximity Sensor

A proximity sensor is a non-contact type of sensor helpfulin the detection of metallic objects. It can sense ferrous as well as non-ferrous material. The sensing range is up to 100 mm. We already have mechanical switches available for position detection but they are contact detection switches. This means if the objects get in touch with the switch only then it will operate. This is not in the case of inductive proximity sensor. Wearing out of mechanical parts is the major issue that is not in the case of an inductive sensor. Inductive proximity sensors have solid state assembly – no moving parts.

Fig-2: Proximity Sensor

b)Ultrasonic Sensor

An ultrasonic sensor is a device that detects an object and measures the distance to it. It measures distance by emitting ultrasound and receiving the wave that the objectreflects. These are also called as ultrasonic transceivers because the receiver and transmitter into a single unit

Fig-3: Ultrasonic Sensor

c) GPS

It is a Global Positioning System in which it is used to track the exact latitude and longitude. Whenever rotationof fish bolt is identified by the proximity sensor then the microcontroller commands the GPS. GPS consists of GPS antenna.

Fig-4: GPS

d)Solar Panel

Solar panels are devices which are used to absorb the sun rays and convert them into electricity or heat. A solar panel is actually a collection of solar cells, which can be used to generate electricity through photovoltaic effect. These cells are arranged in a grid-like pattern on the surface of solar panels. A photovoltaic module is a packaged and connected assembly of 6 x 10 solar cells. Solar power has become a very popular source of energyover the past decade or so as people

have come to recognize just how good it is. It's not only a free source of energy, eco-friendly.

Fig-5: Solar Panel

e) Arduino UNO

Arduino UNO is an 8-bit microcontroller based on AVR RISC architecture. Arduino UNO board have 14 digital input pins out of which it contains 6 PWM output pins and the analog input pins are having 6. i.e., from A0 to A5. ATmega328 is one kind of single-chip microcontroller and it is based on 8-bit RISC (Reduced Instruction Set Computing) processor. It has operating voltage of 5v. It will generate the PWM signals.

Fig-6: Arduino UNO

f) NodeMCU

It is an open-source software and hardware developing environment. It is embedded with ESP8266 wi-fi module. It consists of power pins, I2C pins, GPIO pins, UART pins, SPI pins, PWM pins, SDIO pins, Control pins.

Fig-7: NodeMCU

3. EXPERIMENT AND RESULTS

This proposed system was evaluated by range of proximity sensor and the measured distance between the proximity sensor and fishplate. The experimental setup is shown below.

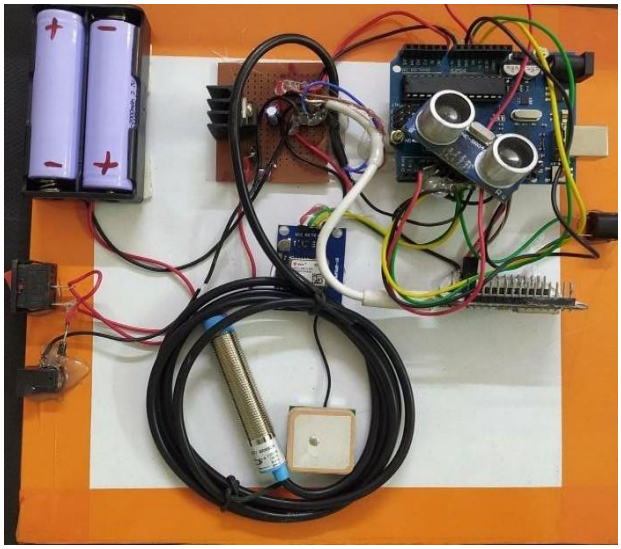

Fig-8: Experimental Setup

3.1 RESULT ANALYSIS

Fig-9,10,11 shows the result of the conducted experiment. These figures explain the monitoring system in the android application (Blynk IoT). Fig-9 shows that when a bolt is rotated, it shows the exact latitude and exact longitude and also indicates danger mode. In fig-10 the alert message was shown as someone is on the track which can be detected by ultrasonic sensor. The fig 11 shows the idle mode i.e., no bolt is rotated and there is no chance of loosening of fishplates.

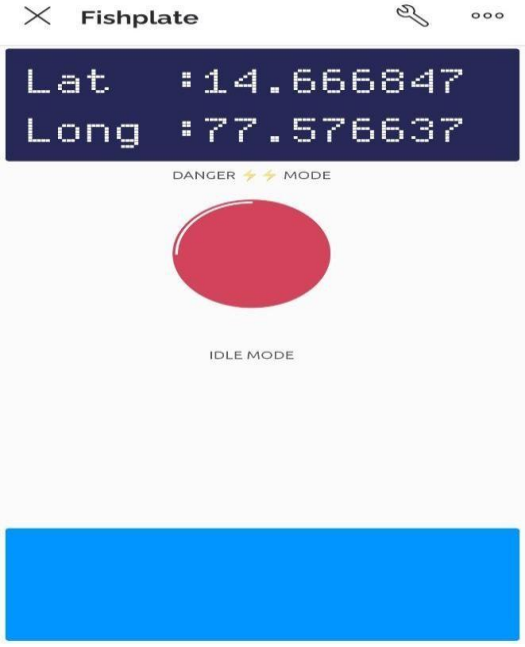

Fig-9: Fault Detection

Fig-10: Showing danger mode

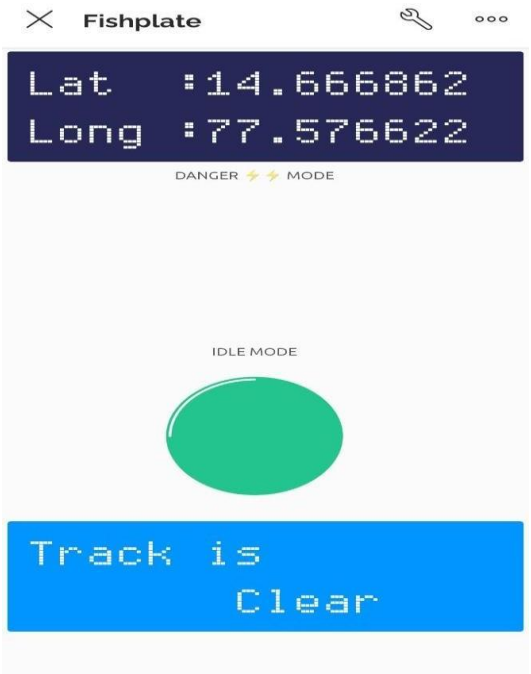

Fig-11: Showing idle mode

4.CONCLUSION

This project has presented an IoT based real time automated system that can monitor the condition of the bolts of the rail fishplates and send warning to the control room so that the concerned authority can make rapid decision to avoid severe accident. The proposed system is a very simple and cost effective one that can be easily implemented. This is a fairly high accuracy compared to the existing methods. The project has introduced a new design of an proximity sensors. The use of microcontroller along with wi-fi module communication enables loosened bolt location detection with high precision using GPS, reliable data transmission and overall cost reduction. Implementation of the proposed fault detection system is expected to have a significant effect in respect of safety and reduce the number of accidents bya high margin.

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