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Train Accident Precaution and Station Information System

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Abstract - The Indian Railways is one of the largest railway networks in the world. The increased number of trains has resulted in increased amount of train accidents. Most of the accidents are due to the collision of trains. Because of the advancement and development in the field of embedded systems many systems have been evolved to prevent the accidents. Developing a system in a low cost with a good efficiency is a great challenge. This paper talks about a system which overcomes these challenges. The aim of the proposed system is to prevent the train from accidents and provide the information to the nearby station. It is based on the automatic safety control used in trains. This system makes use of the Li-Fi and ultrasonic sensor on the Arduino platform. This design consists of an ultrasonic sensor, Arduino processor, and a Li-Fi circuit (transmitter and receiver). Ultrasonic is used to measure the distance between the obstacle and the Arduino processes that data to get decisions accordingly. The data transmission between the train and the sub-station is done using Li-Fi transmitter and a receiver circuit [9]. The ultrasonic sensor will be mounted on front of the train to sense the obstacle. This information is then given to the nearby station via the Li – Fi transmitter. The Li – Fi receiver at the nearby station receives the information. In this paper, a system which can detect and thus avoid collision between trains and prevent the accidents is proposed and is studied.

Keywords – Ultrasonic Sensor, Li – Fi module, Arduino controller, GPS Module

I. INTRODUCTION

The increased growth of the Railway sector has resulted in an increase in traffic density across the country. This has resulted in an increased number of rail accidents. Consequential train accidents cause more damages in terms of loss of human life or injury, damage to railway property or interruption to rail traffic. A collision between two trains in northern India killed 358 people in the year 1995 [1]. It was one of the worst train accidents in the country's history. The free roaming of animals on the train track also caused many serious problems. In 1995, there was an accident at Firozabad because of a cow that tried crossing the railway track. The train transport is one of the cheapest modes of transportation that is easily affordable in India. This resulted in overcrowded coaches and hence maintenance has become difficult. These systems are highly required for the passenger train than that of a metro train. The metro trains have less probability of accidents since they travel only for the short routes.

The existing collision avoiding systems make use of the RF tags and RF readers[2]. These systems can sense the obstacle, but it cannot stop the train automatically. Also, this system does not have the feature of transmitting the information to the nearby station. Instead of the Ultrasonic sensors some of the systems make use of the Light Detection and Ranging (LiDAR) technology in order to detect the obstacles.

II. LITERATURE SURVEY

A. Android and Wireless Sensor Networks

Train tracking and collision avoidance for railway sector - R.Immanuel Rajkumar, G. Sundari Published in : 2017 IEEE International Conference on Computational Intelligence and Computing Research (ICCIC)

The signaling and tracking of trains are more dependent to avoid the accidents that occur every day. These devices will tell whether the train is crossing a particular point and based on that, the signaling for the trains will be issued. Due to the short come of these sensors and carelessness of human, huge train accidents have been increased day – by – day and taking life of massive people. The proposed system makes use of the Wireless Sensor Network (WSN) to resolve these problems.

Each train will act as a WSN node [5]. Their position will be updated through connected GPS and it provides that information back to server and updates the database through the WSN node. The proposed system consists of a mobile control room in an Android platform. The complete information about the nearby trains can be visualized in the android devices by using the internet or wireless communication [5]. The proposed system can be more beneficial for the loco - pilots in the rails for identifying the trains that are nearby which makes them be more comfortable with the work.

B. Wifi and Zigbee Based Monitoring System

Two – layer optimized railway monitoring system using Wi – Fi and Zigbee Interfaced WSN – Sunny, Rajat Kumar Singh, Kumar Shubam, Rajesh Kumar IEEE Sensors Journal (Volume: 17 , Issue: 7 , April1, 1 2017).

In this paper, [3] a two – layer optimized railway monitoring system using Wi – Fi and Zigbee interfaced wireless sensor network has been used for optimized bandwidth and power requirements. In the proposed network, a two-layer structure i.e., wireless local area network (WLAN) and wireless personal area network (WPAN) of WSN are implemented and analyzed. The two – layer structure is implemented to reduce the unbalance load at the gateway sensor node and in the intermediate wireless sensor nodes. In the first layer of the proposed architecture, WPAN is designed by using Wi – Fi because of its high data rate. The proposed architecture has provided reduced power which is less than half as that of the purely Wi – Fi based network that is still maintaining the bandwidth requirements.

III. LI – FI TECHNOLOGY

LiDAR consists of a Laser transmitter that emits laser pulses and the reflected laser pulse is captured by the receiver to measure the distance. The ultrasonic sensor transmits ultrasonic waves to detect the obstacle in front of it. The ultrasonic sensors have the ability to work in any weather whereas the LiDAR can work only under a clear sky [8]. The Ultrasonic sensors are cost efficient when compared to the LiDAR. The LiDAR has an accuracy of ±0.5 whereas an Ultrasonic sensor has an accuracy of ±0.03 [6]. Because of the above advantages the Ultrasonic sensor is considered to have more advantages than a LiDAR.

Li-Fi or Light Fidelity is a communication scheme based on the Visible Light Communication (VLC) [8]. It is the light version of the Wi – Fi (Wireless fidelity) technology. This wireless optical networking technology makes use of the Light – Emitting Diodes (LEDs) for data transmission. Li – Fi is designed to use LED light bulbs that we use in homes and offices for a better power consumption. It has a chip that modulates the light for further data transmission.

The Li – Fi data is transmitted by an LED and is received by the photoreceptors. The earliest Li – Fi modules had a speed of 150 megabits-per-second [4]. Now the speed of Li – Fi has been increased to 10 gigabits-per-second [8]. It also has a larger frequency bandwidth of about 300THz. This visible spectrum does not require any licensing since it is absolutely free. The Li – Fi has the following advantages:

- Eliminates network interface from the neighboring devices
- Does not has the effect of interference in sensitive electronics
- Higher speed when compared to Wi – Fi
- 1000 times the frequency spectrum of RF
- More secure because data cannot be interrupted without a clear line of sight (LOS)

Li-Fi consists of 2 sections; namely a transmitter section and a receiver section. At the transmitter end, the LEDs are used for transmission of data and at the silicon photodiodes are used at the receiver end to receive the data. The data to be transmitted is encoded in the digital form i.e., "0" and "1" [4] and the LED blinks to produce the corresponding digital signal. The flickering or switching "ON" or "OFF" of LEDs are done rapidly within the nanoseconds and so they cannot be seen in naked eyes.

The frequency of operation of the system depends only on the color as the LEDs come in different colors. Mostly the preferred color for LED is white as its intensity is more when compared to other colored LEDs and the transmission depends on the intensity and wavelength of the LED that is used. Thus, Li-Fi can be concluded as the technology of future for the transmission of data. This technology is cheaper, safer and secure than the traditional Radio wave transmitter and also it serves as a motivation to work and create different applications using Li-Fi which will be of high speed and are reliable.

IV. METHODOLOGY

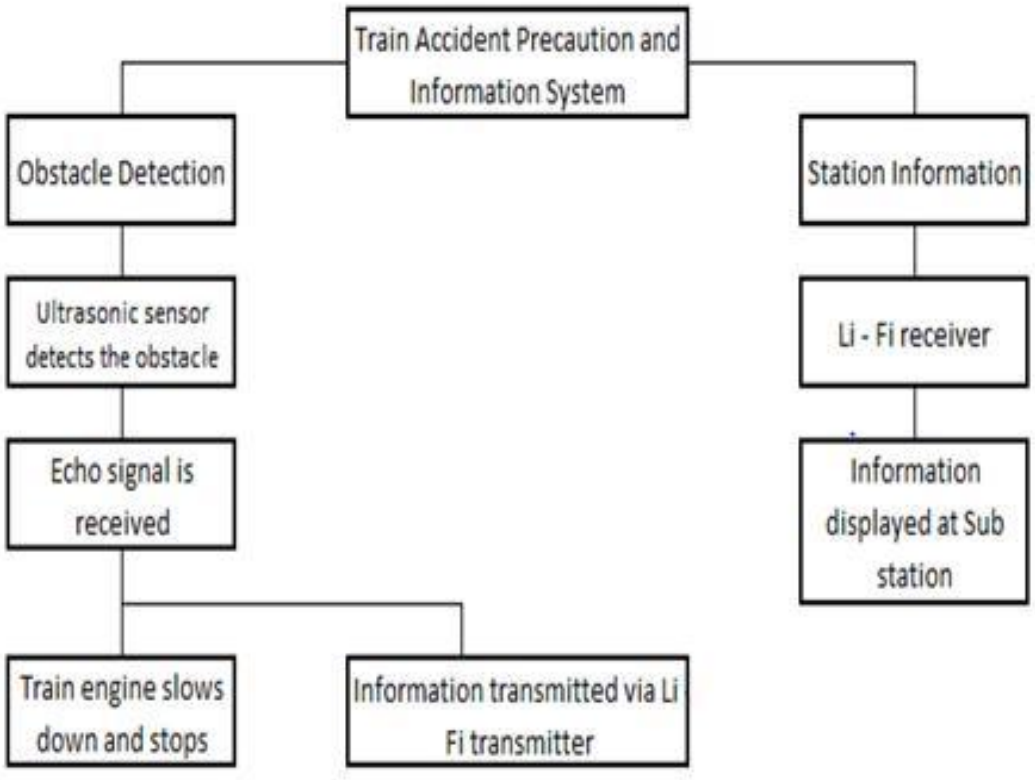

Fig 4.1 Methodology

The above diagram shows the flow of the system. This proposed system consists of two modules. First module is the accident precaution system. Here ultrasonic sensor plays the major role for obstacle detection, where the detected obstacle information is sent to both Loco pilot and the nearest substation through Li – Fi. The second module is the station information system, where GPS is used to find the exact station information.

VI. FLOW CHART

The flow logic is explained as follows:

- Initiate the microcontroller and all the interfaced components
- Calculate the speed of the train and the distance between the obstacle and the train
- Check if the train reached the maximum allowed distance
- Stop the train based on the given condition
- Transmit the details if the sensor detects an obstacle.

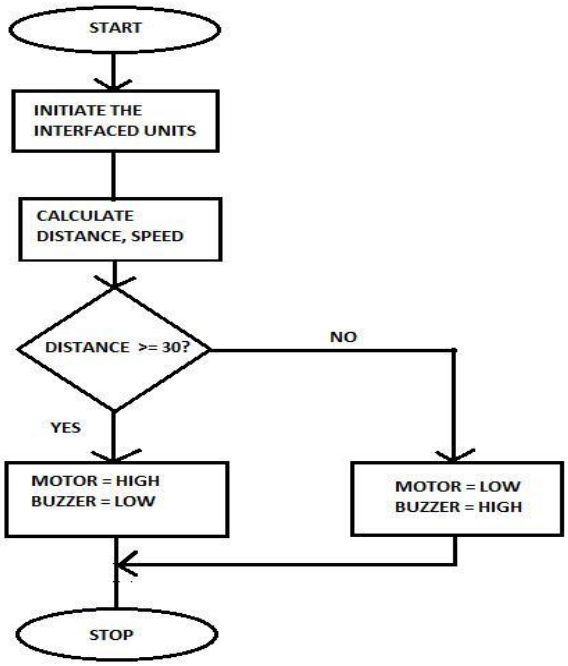

Fig 6.1 Flow chart

VII. CONCLUSION

The increased growth in the railway sector has resulted in an increase in the train traffic density across the country. This has resulted in the increase in the number of train accidents. The Railways has the most complex and involved interdependencies. A single flaw in the 64,600 route kms of track around the country will result in a defect in over 9,500 locos, 55,000 coaches and 2.39 lakhs wagons that haul about 23 million passengers and nearly 2.7 million tons of freight every day [1], an incorrect indication on one of the thousands of signals will jam the entire network.

Many existing systems have discussed about the safeties and many methods are proposed for detecting the faults in the track. These innovative technologies will increase the reliability of the safety systems in the railway transport. By implementing these features in real time applications, the train accidents can be avoided up to 70% in approx.

The existing conventional signaling system rely on the oral communication through telephonic and telegraphic conversations as input for the decision making in track allocation for trains at most of the times. There are great chances for miscommunication of the information or communication gap due to the higher human interference in the system. This miscommunication may lead to wrong allocation of the track for trains, which will result in train collisions.

The statistics in the developing countries showing that 80% of the train collisions occurred so far is due to either human error or incorrect decision making through miscommunication in signaling and its implementation.

The existing anti – collision device systems are also found to be ineffective as it is not considering any active inputs from existing railway signaling system and lacks full - duplex communication capability between the trains and the sub - stations. Later the usage of geographical sensors has been introduced which makes use of satellites for communication. But the system was costly and complicated to implement.

This Train Accident Precaution and Station Information uses the most important and necessity safety parameters by monitoring and indicating the information about the obstacle. The Station Information System provides the location of the train to the nearby sub - station.

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