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Integrated Intelligent Train System

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Research Article

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Abstract - The railway network carries out most of the transport in India. Railways provide the most cost-effective method for transporting people and cargo. About 60% of accidents occur at level crossings or as a result of cracks in railway tracks, resulting in fatalities and economic harm. To tackle the various challenges our railway department is currently dealing with, we need to take into account new technology that is efficient, robust, and stable. The goal of this project is to use IR sensors to find cracks in rails and to monitor the functioning of unmanned railway gates. In the event of automatic fire detection, train compartments detach from the engine to avert fire propagation. Station intimation facilities are provided for passengers. A user's mobile device can have an app installed on it that detects theft of baggage. Smoke can be detected using sensors and other methods.

Keywords: Crack Detection; unmanned gate operation; Fire Detection; Baggage Theft; Station Intimation; Problem Information; Smoke detection.

INTRODUCTION

Travelling constitutes a vital aspect of life. One of the most notable, efficient, and economical forms of transport is train travel. Railways are encountering numerous difficulties because of human mistakes, damaged tracks, and fire incidents.

The system we are going to develop mitigates all the major issues encountered in railways. By catering to the requirements and service needs of the railway sector, we offer consistent, timely, and cost-effective services and solutions that enhance the enjoyment of train travel and instill complete trust in the system.

The aim of this project is to develop a cohesive, smart train system, which will include embedded systems and sensors. The suggested Embedded System utilizes the sensors to complete tasks.

The primary issue concerning railway crack analysis is identifying the crack at its specific location. Due to this issue, trains can go off the rails; such derailments result in significant casualties and damage. Furthermore, a delay in the railway gate's opening and closing can result in accidents. The proposed paper utilizes an IR sensor for unmanned gate operation and assists in identifying faulty tracks to prevent accidents that happen during gate operation and due to cracks. We have utilized GPS to read and transmit the current latitude and longitude data to the hosted server.

This system offers a compartment detachment mechanism and water sprinkler feature to protect precious lives, as we have seen numerous train accidents caused by fire. This project offers an intimation and train tracking system at the station for passengers traveling to unfamiliar destinations. Another significant issue that train passengers encounter is baggage theft. To address this, we have created an application designed to identify incidents of bag theft.

The smoke sensor employed detects smoke within the compartment and notifies passengers via the buzzer output.

EXISTING SYSTEM

Currently, the most advanced method for identifying immediate and long-term issues with railway tracks combines two approaches: inspectors who walk along and examine the track lines, and train cars equipped with accelerometers and ultrasonic sensors that can identify rail cracks and breaks. This process takes a lot of time, and it is not feasible to check all the installed railway lines by hand.

No measures are implemented for fire accidents; once a fire ignites, it easily spreads to other compartments. Despite the significant advancement of technology, the operation of railway gates is still performed manually. No measures are implemented to identify smoke within the compartment.

The passengers are not informed about the train's current position, will not receive notifications regarding their destination station, and there are no actions implemented to mitigate baggage theft, which is a significant issue for all passengers.

LITERATURE SURVEY

Many various systems have been proposed and some implemented but they have some disadvantages. Some system have poor stability and performance while others utilize active sensor which leads to instability and short reliable life cycle, hence requiring replacement every few years and thereby making the system expensive. Two IR sensors are present on either side of the level crossing at the distance of 1km, depending on the activation of corresponding sensors the closing and opening of the gates are performed [1]. Microcontrollers and IR sensorshave been employed to automatically close the gates at the level

crossings. Hence, the errors due to manual error can be avoided and the fast response system is obtained [2]. A track monitoring system using a probe-vehicle system was designed and rail irregularities are estimated. GPS and map matching techniques have been used to locate the fault on the tracks [3]. Pressure sensor is used for automatic railway gate control. It consists of motor, IR sensor and microcontroller. Operation of the system is controlled by microcontroller [4]. Detection of the cracks in the rails using IR sensors and unmanned operation of railway gates using IOT [5].



Fig 1. Fire accident



Fig 2. Crack in rails



Fig 3. Train derailment

PROPOSED SYSTEM

By taking the valuable inputs from the above mentioned research papers in this proposed system we have found solution for all the above mentioned present day problems and the features of the proposed system is explained in detail in the further segments.

A. ***Implementation Of Crack Detection***

In this paper, we propose a fundamentally different approach to improve the current practices in railway operations using wireless sensor network (WSN). In this system we are deploying the IR sensors in the train to detect the crack in rails. Two IR sensors are used for two railway lines. Whenever the IR sensor detects the crack it automatically applies the brakes and the train is stopped. In this system the loco pilot is provided with an application that helps in sending the problem information to the control unit. This system helps to reduce the occurrence rate of accidents and improving the efficiency of railroad maintenance activities thus by saving many lives.

B. ***Unmanned Railway Gate Operation***

For this purpose we are using two IR sensors, one several meters before the railway gate and the other several meters after the railway gate. When the first sensor detects the train, the railway gate closes automatically and when the train get passes through the second sensor the railway gate opens automatically.

C. ***Smoke Indicator***

Smoke detectors warns about fire when the gas level in the area reaches a certain level. Heat detectors do not notice smoke. A gas detector is a valuable additional protection in areas where heat detectors are not recommended. The gas of a particular area is monitored, indicated with different set points and the data will be transmitted to control unit and alarm is raised through the buzzer.

D. ***Fire Detection & Alarm System***

Fire / Flame identification system is implemented in this project to identify the fire / flame in the train. If any fire accident happens, the message will be sent to the main station and the compartments automatically get detached from the engine by a specially designed compartment locking system to stop fire spreading to other compartments and passengers can easily get out of the train once the train is halted. A water pump is provided to pump the stored water to the sprinklers installed in the compartment to extinguish fire.

E. ***Train Tracking And Intimation***

In this system we are using both GPS and GSM module in the train. The GPS module helps the passenger to track the train and it also helps in identifying the current location of the train by the control units in case of accidents. The GSM module helps in intimating the passenger about his/her destination by sending a message to the passenger prior to the destination station and it also helps in sending the information to the control units in case of accidents.*Baggage Theft*

It is one of the major problem faced by the passengers in the train. To overcome this we are developing a mobile

application which indicates the bag theft and it also helps in tracking the bag. For this, a sensor is kept in the bag which will be continuously communicating with the application installed in user phone in a defined range, if the sensor moves out of this range it assumes bag has been theft and an alarm sound will be heard in the user phone.

I. BLOCK DIAGRAM

To accomplish the above mentioned features the proposed system has to be designed as shown in the below figures.

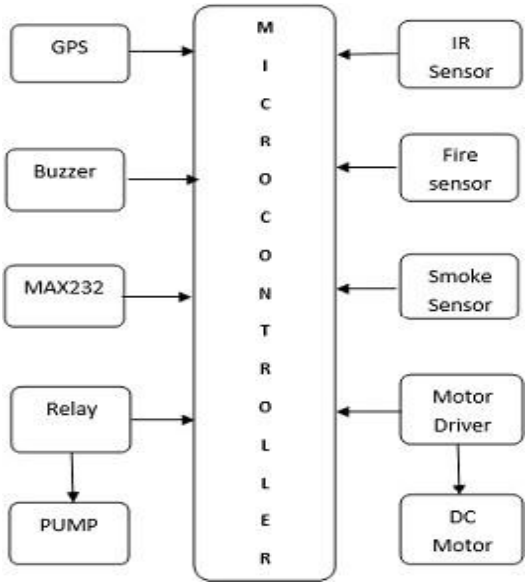


Fig 4. Block Diagram

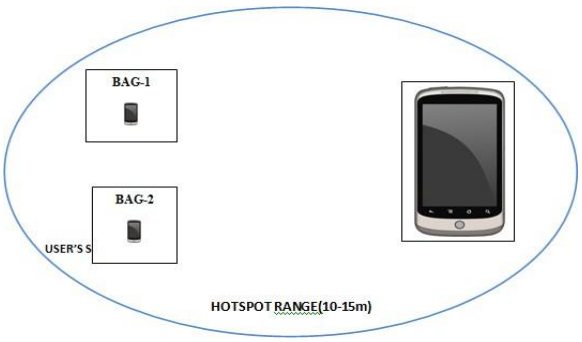


Fig 5. Bag Theft

II. RESULT AND DISCUSSION

To make the above proposed system possible, in this project we are using the SST89E516RD microcontroller which is a 40 pin IC along with all the sensors and modules which are mentioned in the above block diagram. The IR sensors, fire sensor and smoke sensor are connected to the microcontroller to detect and take the respective measures. The GPS provides the features of identifying train location and helps in sending the message to the passengers and control unit with respect to different situations. DC motors are used for operation of wheels. A 12V DC supply is used for the operation of the circuit. The relay is used to turn the water pump on/ off. Motor drivers are used for the operation of DC motor. Buzzer is used in the compartment for alerting the passengers in emergency conditions. MAX 232 is used for external hardware interfaces. The final output of Integrated Intelligent Train System as shown in the below figure

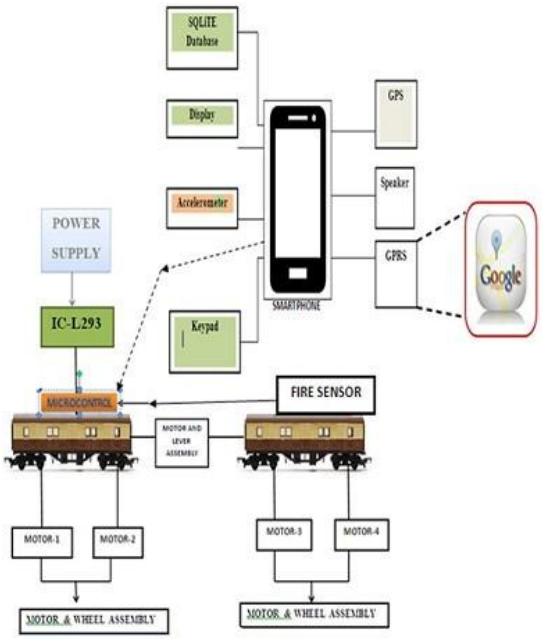


Fig 6. Mobile Interface

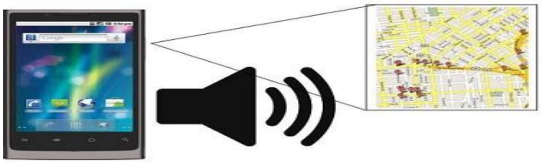


Fig 7. Station Intimation

III. ADVANTAGES

- Time consistent system
- Cost effective method
- Highly efficient
- Passenger trustworthy

IV. FUTURE SCOPE

This project highlights the benefits of applying distributed techniques to rail transportation system modeling. It can be further enhanced by adding the ZigBee to the system for communication. This enables us to detect the crack in rails before several meters hence it prevents the sudden halting of the train thus by preventing passengers from injuries. Solar panels can be added on top of the train and the generated power can be used for various applications.

CONCLUSIONS

The proposed project allows for the management of more complex issues than current technology can address. This system is highly dependable and prevents significant loss of life through the use of the aforementioned sensors and modules. It contributes to the prevention of various train accidents, including derailments and fires, by reducing the need for human involvement. Additionally, it enhances passenger comfort through features such as station notifications, train tracking, and alerts for potential baggage theft. This project offers a comprehensive solution for all issues related to railway management systems.



Fig 8. Final Model

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