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Safety Alerts near Tracks and Prevention of Train Accidents

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ABSTRACT

Generally, People use various types of transportation systems to travel from one place to another place. For a safer journey, they mostly rely on public transportation. A larger picture of transportation safety includes a major role for railway accident prevention and protection. In order to prevent or mitigate the frequency as well as severity of such accidents, an Arduino-based safety system is being used. In this research, an IoT based smart system is proposed for preventing train accidents. An ATMega328P microprocessor, ESP32 camera sensors including a flame, ultrasonic as well as PIR sensor are utilized to achieve this system. The blynk application communicates with the IoT Cloud platform through the WIFI-Module, which is employed to share data. Using the impact identification technology ultrasonic sound uses to generate an impact to avoid collision as well as it avoid from a train accident. In order to stop the train before an accident occurs, this technology is utilised to identify the impediment and gradually reduce the train's speed by applying the air brake. If there are any difficulties, they will be uploaded to the cloud and a monitoring person will be notified through the cloud. The railway industry's safety systems operate more reliably through this new modelled technology. As a result, the proposed techniques enhance the reliability of safety systems of railway systems.

Keywords: Railway accident, Arduino-based safety system, Internet of things, WIFI-Module, Ultrasonic sensor.

1 Introduction

In the world, railway is the most popular and environmentally friendly mode of transportation. According to the existing study on railway statistics, more than 5 billion passengers travel worldwide every year together with almost 10,000 billion freight tonne kilometres [1]. In India, the railway network handles the majority of commercial transportation because it has the most affordable choice and it is preferred over all other modes of transport, including buses, flights, etc. The number of incidents on railroads has increased recently [2-3]. Rail accidents arise when two trains travelling on the same tracks come into contact or when a train derails due to rolling stock technical problems, landslides, objects blocking the rails and other problems such as fog, rain, flood or fire [4]. Therefore, designing a system, which uses a limited area network

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by using a Zig-Bee module, microcontroller to regulate the Zig-Bee module, train motor, LCD display, sensors as well as a portion of internal memory for dumping the required programme to minimize the accident rate due to collision and breakage of rails to the lowest possible level [5-6]. Train accidents is prevented by adding safety devices to the current railway infrastructure [7]. The accidents caused by obstructions on the tracks have been happening more frequently. Introducing a camera based method for detecting objects at a distance and alerting the train control management system to halt the train [8]. A train will begin communicating through a transmitter as it moves along a track and the nearby train is pick up the signal through a receiver. Which attempted to prevent significant train accidents, such as crashes, over speeding, and track discontinuity, using these basic electrical components. However, these efforts have been unsuccessful and mechanical failures impacting the wheel set guiding on rails continue to cause derailments despite improved inspection methods and more dependable cars [9-11]. The most frequent causes of railway collisions include malfunctioning signals or lights, mechanical problems, absence of safety gates, unprotected crossings, train conductor irresponsibility as well as a lack of awareness on the portion of travellers [12].

2 Recent works

Saifuddin Mahmud et al [2015] [[13] have proposed the safe operation of train signal, which is controlled by electronic railway interlocking as well as crucial embedded systems. Due to the wide range of railway network topologies, high operational security level as well as flexible solution is required, an ability of taking corporate formal requirements and implement them in accordance with the desired application. Only four ultrasonic sensors are present in the train detection module, and only one ultrasonic sensor is present in the stuck detection module. When an echo is returned to the sensors by an object, the train detection device and the stuck detection device create high frequency signals through the ultrasonic sensors and identify the movement of the object.

Dwarakanath S K et al [2016] [14] have suggested that when automatic railway gate control is used at a level crossing to replace the gates, that were previously controlled by gatekeepers and to identify obstacles on the tracks, sensors installed in the side of the tracks, which are used to detect the approach of the train. Provide an automatic railway gate at the level crossing to replace the gates operated by the gatekeeper by recognising trains and stuck vehicles, which producing the appropriate alert signal and regulating the gate. Designing a train detection module, stuck detection module, a signal light module, alarm module, railway gate controller as well as a controller module provides the solution. There have been no successful efforts in these areas to date. Gatekeeper-operated railway gates are being replaced by automatic gates at intersections.

Pablo Arboleya et al [2018] [15] have implemented a thorough collection of steady-state models for dc railway network power flow. This simulation framework covers all significant

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features and components of each component currently used direct current railways. The suggested models are condensed to maintain the necessary accuracy while maximising simulation speed. On-board and off board accumulation systems, as well as no reversible, controlled and uncontrolled reversible substations, are taken into consideration. For trains with regenerative braking, the low network receptivity as well as overcurrent protection are taken protectively. Additionally, dc/dc linkages between railway network nodes operate at the same voltage or a different voltage, which is incorporated into the simulation.

JimmiKumarBhaet al [2017] [16] have proposed the automatic railway gate control system employing a pneumatic cylinder with sensor enable for preserving valuable human lives and stopping significant catastrophes in railway track. All electronic components have been incorporated into the hardware development. The controller circuit controls the ultrasonic sensors that are used to sense the rail. Additionally, an alarm and LCD display are also activated by the input signal. Prior to the gate, the first ultrasonic sensor is fixed at a specific distance and the second sensor is fixed at the same distance after the gate. The microprocessor receives the detected signal when the foreside sensor is triggered and opens the gate using the pneumatic actuator then keeps it closed until the train passes through and reaches the after side sensors.

Juan Jesús García et al [2016] [17] proposes the construction of a multisensory system that consists of two barriers, one transmitting and the other receiving, that are positioned on opposite sides of the railway tracks and communicate with one another through infrared (IR) as well as ultrasonic (US) sensors to create optical and acoustic linkages. This suggested system is separated into low and high levels from a processing standpoint. Whereas the high-level stage corresponds to the monitoring system, providing information about the state of the tracks (free or occupied by obstacles), the low-level one is responsible for managing emissions and detections carried out by the sensory system.

3 Proposed methodology

IoT technology is suggested for a smart train accident prevention system. The proposed method utilize PIR sensors to identify obstacles in the train's path and ultrasonic sensors are used to determine how far the obstacles are occurred. A flame sensor detects a fire accident and generate an alarm to alert the passengers. For maintaining the train track, ESP32 Camera is used. Through the Wi-Fi module integrated into the microcontroller, the data is uploaded to the cloud database of the Blynk app. The train motor is controlled by the motor driver through the IoT to stop in an emergency and the block diagram of the proposed work is illustrated in figure 1.

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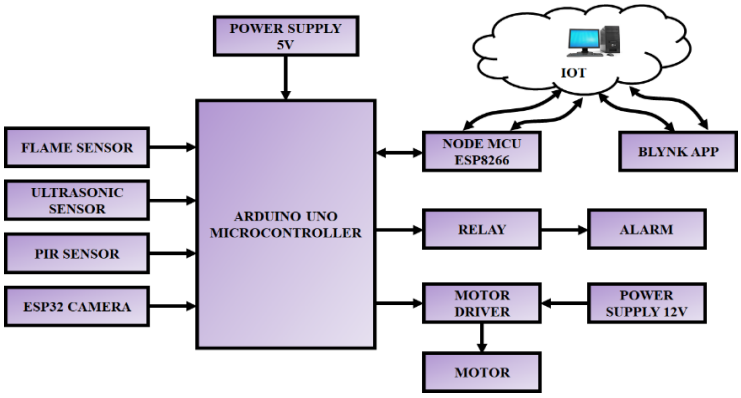

Figure 1: *Block diagram for the proposed work*

3.1 Power Supply

All electrical circuits depend heavily on the power supply component. A power supply is divided into a number of functionally distinct building parts. The step-down transformer in receives power from the main AC source. The transformer providing the various voltages. Transformer X1 steps down the 230V, 50Hz AC mains to produce a secondary output of 12V, 500 mA as represented in figure 2. Full-wave rectifier made up of diodes D1 through D4, which rectifies the transformer output. It is filtered by capacitor C1 and controlled by ICs 7812 (IC2) and 7805. (IC3). The regulated supply's waves are avoided by using capacitor C2. The AC voltage is changed into DC voltages in this rectifier circuit. The regulator circuit is supplied with the rectified DC voltage. The regulator's output is dependent on the regulator IC employed by the circuit.

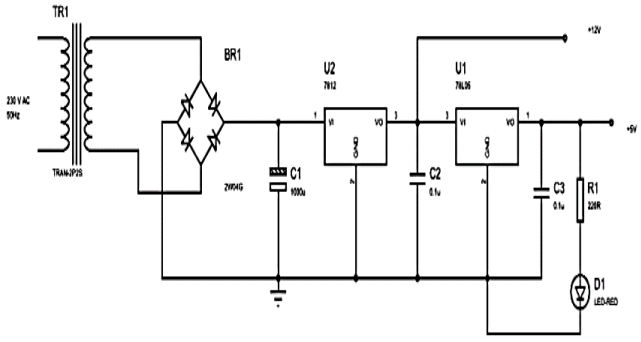

Figure 2: *Circuit diagram for Power supply*

3.2 Arduino Microcontroller

It is an ATmega328-based microcontroller board. It has a 16 MHz ceramic resonator, 6 analogue inputs, 14 digital input/output pins, USB port, power jack, an ICSP header and reset button as illustrated in figure 3. To get started, power it with an AC to DC adapter, a battery, or a USB connection to a computer.

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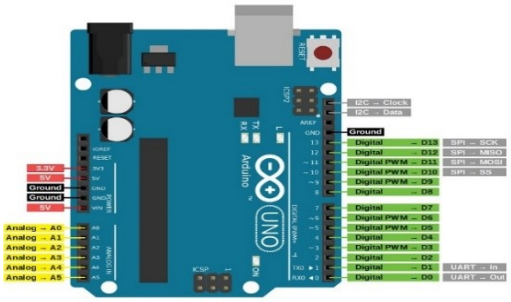

Figure 3: *Arduino micro controller*

3.3 Node MCU

There are open source prototyping board designs for Node MCU, which is an open source firmware as specified in figure 4. "Node MCU" is a combination of "node" and "MCU." (Micro-controller unit). The term "Node MCU" denotes to the firmware rather than the related development kits.

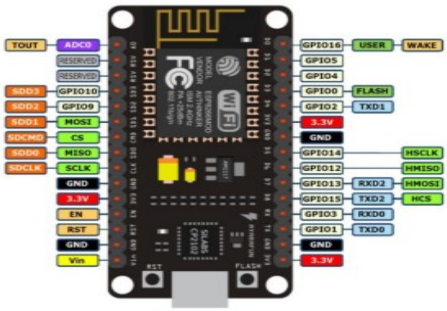

Figure 4: *Node MCU ESP8266*

3.4 Flame Sensor Module

The presence of a flame is detected by a flame detector. These detectors are recognise smoke-producing open fires as well as smokeless liquids. According to the temperature and velocity of the air, these devices are able to identify the fire accident. Based on the mechanics it employs to detect the flame, a flame sensor typically reacts quicker & more precisely than a heat or smoke sensor as well as it is typically used to check the efficiency of the furnaces.

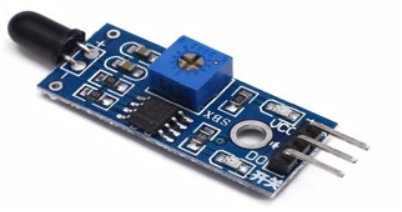

Figure 5: *Flame sensor module*

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3.5 Ultrasonic Sensor

Ultrasonic sensors, also referred to as transceivers, which is operate on an identical basis to radar and sonar, it assess a target's characteristics by analysing the echoes of radio or sound waves accordingly as represented in figure 6. High frequency sound waves are produced by ultrasonic sensors and they analyse the echo which is returned to them. When an object is present on the track, the ultrasonic sensor detects it. After it stops moving, the object is still detected by the sensor then the train has stopped. The departure is found using the exact same technique.

Figure 6: *Ultra sonic sensor*

3.6 Blynk App

Blynk is an Internet of Things platform with mobile apps for IOS and Android which allow users to remotely control Photons, Arduino, Raspberry Pi, NodeMCU and other similar devices as illustrated in figure 7. It installed on IoT devices and provide data to the Blynk Server as well as receive commands from the Blynk App and pass them through the Blynk Server.

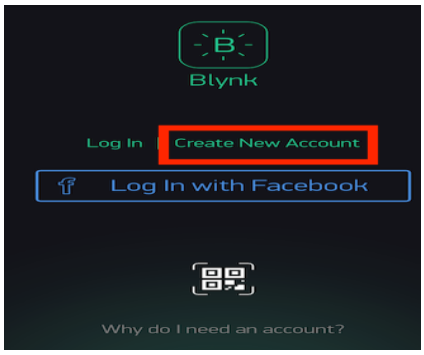

Figure 7: *BLYNK app*

4 Results and Discussion

The railway industry's safety systems operate more reliably through this proposed modelled technology. The sensors applied to detect and protect from the fire accident as well as the alarm is applied to alert the passengers. As a result the proposed technique increase the reliability of safety systems of railway and the train accident protection by the IoT smart system is the best solution than the existing techniques. The consequences and graphs are illustrated in below,

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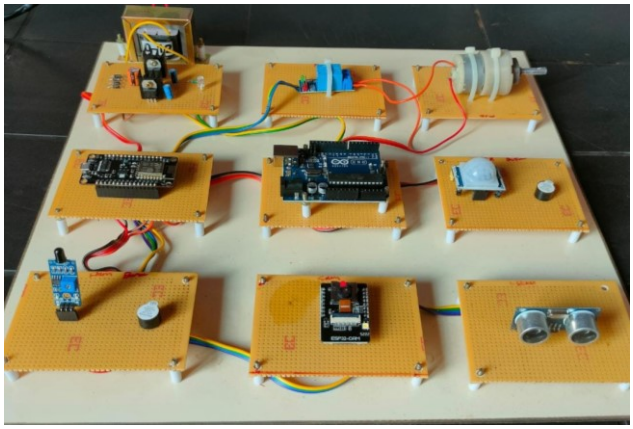

Figure 8: *Hardware setup*

In this experimental work, flame sensor, ultrasonic sensor, PIR sensor are utilized as illustrated in figure 8. The Arduino Uno microcontroller is employed to interface between the sensors and IoT. The information collected by the sensors are stored in to the IoT webpage by using the Node MCU.

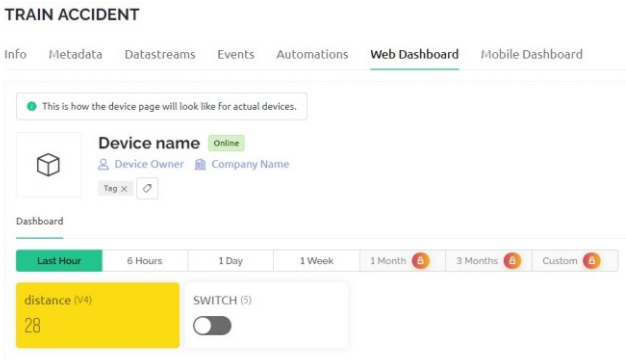

Figure 9: *IoT webpage display*

The output for the IoT webpage is displayed in figure 9, from the observation it is noted that by using IoT the distance is stored and the motor switch is in OFF condition as represented in figure, the switch is ON when it is required.

5 Conclusion

An intelligent system for preventing train accidents is presented in this proposed work. A flame sensor, ultrasonic sensor, PIR sensor and an ESP32 camera are utilized to protect the accident. PIR sensors are used to identify train track obstructions, when a fire occurs as well as flame sensor is used to detect the fire and sound the alarm to notify the passengers. Utilizing IoT technology, which allows the motor driver to gradually reduce the train's speed in order to stop it before an accident occurs. ESP32 Camera is used to monitor the train track. Ultrasonic sensors are used to determine the distance to the barrier. It will be uploaded to the cloud and

warns the monitoring person through the cloud if there occur any problems. The railway industry's safety systems will operate more reliably owing to this new modern technology. As a result, the hardware setup and IoT webpage is displayed in above and it observed that the proposed technique attains high reliability of safety protection than the conventional techniques.

Reference

1. Kyatsandra Anand Kumar; R. K. Saket; Sachin Kumar; Kumari Sarita; Aanchal Singh S. Vardhan; Akanksha Singh S. Vardhan, Year: 2022, "Development of trinetra: a sensor based vision enhancement system for obstacle detection on railway tracks," IEEE Sensors Journal, Vol: 22, no: 4, pp. 3147-3156.

2. Pushpa Y; H. Mahalakshmi; J. Nikhitha; B. Varsha, Year: 2018, "Prevention of Railway Accidents by Track and Fire Detection Using IoT," Perspectives in Communication, Embedded-systems and Signal-processing-PiCES, Vol: 2, no: 1, pp. 10-14.

3. Krishna B. R; D. Seshendra; G. Raja; T. Sudharshan; K. Srikanth, Year: 2017, "Railway track fault detection system by using ir sensors and bluetooth technology," Asian Journal of Applied Science and Technology (AJAST), Vol: 1, no: 6, pp. 82-84.

4. Sivanantham N; A. Dinakaran; M. Sujith, Year: 2021, "Arduino based footboard accident prevention system for electric locomotives," In Advances in science and technology, Vol: 105, pp. 172-178. Trans Tech Publications Ltd.

5. Bhojwani N. L; A. S. Ansari; S. S. Jirge; M. B. Baviskar; D. N. Pawar, Year: 2020, "Railway Track–Crack Detection System by Using Arduino Microcontroller," International Journal of Scientific Research and Engineering Development, Vol: 3, no. 2, pp. 356.

6. Kumar Amit; Ankit Singh; Adity Pandey; Mansi Srivastava, Year: 2022, "Monitoring of Driverless Metro Train using Arduino UNO," i-Manager's Journal on Instrumentation & Control Engineering, Vol: 10, no: 1, pp. 1.

7. Kyatsandra Anand Kumar; R. K. Saket; Sachin Kumar; Kumari Sarita; Aanchal Singh S. Vardhan; and Akanksha Singh S. Vardhan, Year: 2022, "Development of trinetra: a sensor based vision enhancement system for obstacle detection on railway tracks," IEEE Sensors Journal, Vol: 22, no: 4, pp. 3147-3156.

8. SV Dharani Kumar; Mohan Kumar CE; Naresh Kumar; A. S. Loganathan, Year: 2020, "Real Time Obstacle Detection and Alert System Based On Digital Image Processing For Trains," International Journal of Advances in Engineering and Management (IJAEM), Vol: 2, no: 9, pp: 214-218.

9. Mallikarjuna M; M. Swetha, Year: 2016, "Identification of Train Collision Avoidance Based on Sensor," International journal of advanced technology and innovative research, ISSN 2348–2370 Vol: 08, no: 24.

10. Dwarakanath S K; Sanjay S B; Soumya G B; Arjun V; Vivek R; Year: 2016, "Arduino Based Automatic Railway Gate Control and Obstacle Detection System", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol: 05, no: 05, pp. 4335-4341.

11. Dr. S. Anila; B. Saranya; G. Kiruthikamani; P. Devi, Year: 2017, "Intelligent system for automatic railway gate controlling and obstacle detection", Vol: 4, no: 8, pp. 24-30.

12. Dr .I. Lakshmi; Maria Viji, Year: 2019, "Analysis on Smart Railway Gate Control Using Iot", SSRG International Journal of Computer Science and Engineering, Vol: 06, no: 02, pp. 19-22

13. Saifuddin Mahmud; Ishtiaq Reza Emon; Md. Mohaimin Billah, Year: 2020, "Automated Railway Gate Controlling System", Vol: 27, no: 1, pp. 1-5.

14. Shuo Wang; Liyan Zhang; Guanghui Yu; Enyuan Dong; Jiyan Zou; Yu Cong; Yu Tian, Year: 2019, "Hybrid phase-controlled circuit breaker with switch system used in the railway auto-passing neutral section with an electric load", CSEE Journal of Power and Energy Systems, Vol: 05, no: 04, pp. 545 – 552.

15. Pablo Arboleya; Bassam Mohamed; Islam El-Sayed, Year: 2018, "DC Railway Simulation Including Controllable Power Electronic and Energy Storage Devices", IEEE Transactions on Power Systems, Vol: 33, no: 05, pp. 5319 – 5329.

16. Yash Dev Varshney; Akash Kumar Singh; Rohit Ranjan; Praveen Singh, Year: 2019, "Automatic Railway Gate Control using Arduino Uno", International Journal of Research in Engineering, Science and Management, Vol: 02, no: 04, pp. 343-346.

17. Juan Jesús García; Álvaro Hernández; Jesús Ureña; Enrique García, Year: 2016, "FPGA-Based Architecture for a Multisensory Barrier to Enhance Railway Safety", IEEE Transactions on Instrumentation and Measurement, Vol: 65, no: 06, pp. 1352 – 1363.