RAILWAY EMERGENCY DETECTION AND RESPONSE USING IOT

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ABSTRACT

The Internet of things (IoT) provides abundant opportunities to mitigate the problems in day to day life. Railway accidents prove to be fatal and are increasing eventually. The railway passenger safety is considered an utmost priority. An automatic emergency detection system consists of various sensors which trigger the microcontroller on detection of an accident. An emergency alert is sent to the railway drivers phone on detection of the accident using the Bluetooth module of the system and short message service (SMS) is sent to the emergency contacts along with the Global Positioning System (GPS) location from drivers phone automatically. The generated emergency message is also updated in the receiver module of the system using a cloud-based real-time database and alarm is activated. A quick passenger side manual emergency alert system for reporting the specific emergency to response team which has options of police, fire and doctor. The idea is to reduce the time of response by emergency response team during an emergency using IoT.

Index Terms—Global Positioning System, Internet of things, microcontroller

1.INTRODUCTION

Nowadays, more and more people are targeting their journey using railways as it is more comfortable, cheap and conventional. In India and many other countries, safety measures for any emergencies in railways are not much prioritized. Therefore, there is an immediate need to upgrade railways with automated emergency detection for crash and fire emergencies [2]. Also, automated quick response system with minimum latency for the safety of on-boarding passengers is required [1]. In case a railway accident occurs, passengers and the driver may not be in a condition to call for help and rescue the victims immediately. They may not know the exact location of the incident which can make the conditions worse if help does not reach the place of incident immediately. To overcome this problem and improvise the safety of railways, the idea of implementing automated emergency detection and a quick response system to resolve the issue is proposed. In this system, sensors like collision sensor and fire sensors are used to detect the corresponding emergency automatically. In case of emergency detected, alert is broadcast using cloud based realtime database and an SMS is sent to the emergency contacts with the type of emergency occurred and the exact GPS location of the incident using GPS tracker of the phone. In case sensor fails to detect accidents, a manual passenger side communication system is also developed to notify the onboarding railway staff to alert the police, doctor and fireman in case of any emergency. This would make the process to alert the emergency staff very simple and fast. The receiver side of the module will receive the notifications and alerts about any emergency occurred along with the details of the passenger using a cloud based realtime database. There is a very high possibility of an elevated number of deaths during any emergency due to more time required for the rescue management [1], [2]. It takes more time to reach in place of the incident. This situation happens because of delay to alert the rescue team about accident and many times victims could not notify the rescue team about the exact location due to lack of vision during the night or they may be travelling to a completely new place. There is a very high need to upgrade the railways using advanced technology for the safety measures of the travelling passengers [11]. An automated emergency detection for railways using the smartphone and IoT is proposed to set the delay rate of arriving rescue team minimum and reduce the number of deaths due to delay in arrival of help. There are some existing systems based on automated accident alert system but this system is much more accurate and efficient due to the usage of actual sensors and if SMS is not sent due to any failure alerts are broadcast using firebase realtime database to the receiver module and siren is raised in the phone and GPS location along with the type of emergency is also updated.

2. LITERATURE SURVEY

In et.al [1], the author focuses on automatic detection of railway track fastener defects using deep learning technology. It reviews relevant research on rail inspection and proposes a system architecture incorporating high-speed video cameras and Yolo v3 deep learning model for fastener inspection. Various related works in the field of railway track inspection are discussed, highlighting methods such as infrared sensors, GPS-based systems, and computer vision for fault detection and classification.

In [2] the author explores the challenges faced by railway companies in maintaining productivity amidst increasing maintenance costs and safety concerns. It highlights the importance of automated inspection methods, particularly machine vision-based approaches, to enhance efficiency and safety while reducing delays and costs. However, existing methods still face challenges such as adverse environmental conditions and the need for optimal illumination. The proposed thesis aims to address these challenges by developing a model capable of simultaneously detecting faults in railway tracks and their components, potentially revolutionizing maintenance procedures.

In [3], the authors discusses the importance of railway track line safety and maintenance, highlighting the need for automated detection systems to identify defects such as broken or missing fasteners and rail corrugation. It reviews existing methods for defect detection, focusing on image processing and deep learning-based approaches. The proposed approach includes image preprocessing, track and fastener positioning, feature extraction using Dense-SIFT and Bagof-Visual-Word model, and classification with Support Vector Machine (SVM). Experimental results demonstrate the effectiveness of the proposed method compared to traditional feature extraction methods like HOG and LBP. Finally, the paper introduces an improved YOLOv3-based model for multi-target defect identification, aiming to simplify the detection process and improve accuracy.

In et al. [4] the authors proposed design aims to automate the detection of faults in railway tracks using IoT technology. By integrating components like a Raspberry Pi, stepper motor, ultrasonic sensor, LCD display, and cloud server, the system can efficiently detect track faults and relay information to railway control rooms, thereby preventing accidents. This project represents a significant advancement in railway track fault detection systems, leveraging IoT for enhanced efficiency and safety.

In [5], the authors proposed method, Multi-Stage Pipeline for Defect Detection (MPDD), addresses the need for automatic defect detection in Electric Multiple Units (EMU) key components. MPDD utilizes deep learning techniques, including modified Faster R-CNN and super-resolution strategies, to achieve accurate detection and classification. Evaluation on various datasets demonstrates significant performance improvements compared to traditional methods. In [7], the authors discusses the importance of maintenance strategies in optimizing production facilities, particularly in the railway industry. It explores various maintenance approaches, including traditional and Industry 4.0 methods, and emphasizes the need for effective maintenance to ensure reliability and minimize costs.

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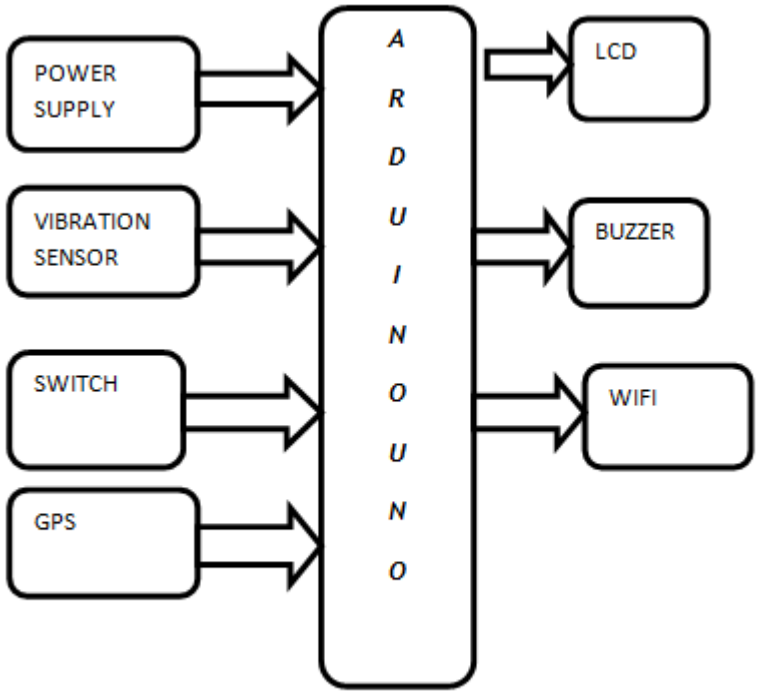
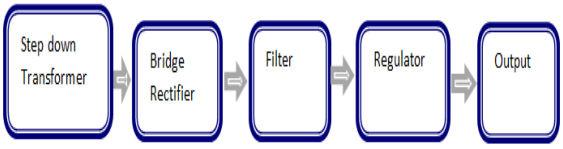
3. BLOCK DIAGRAM

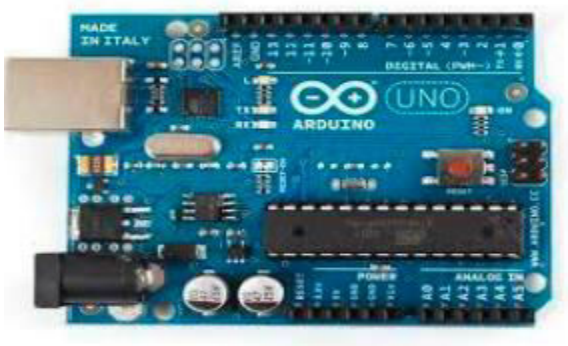


4. Power Supply Block diagram:

A power supply block diagram represents the flow of electrical energy from AC input to regulated DC output through components like transformer, rectifier, filter, and voltage regulation.

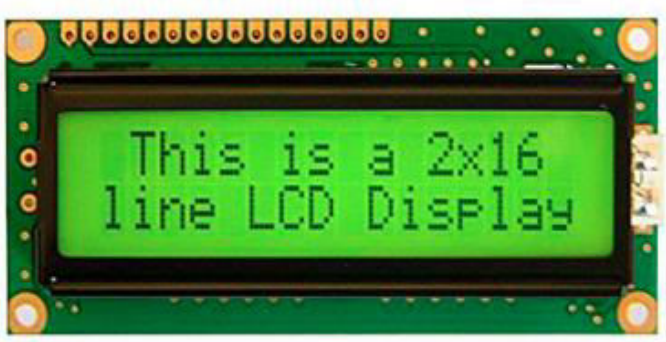


4.1 Arduino-Uno Microcontroller Board



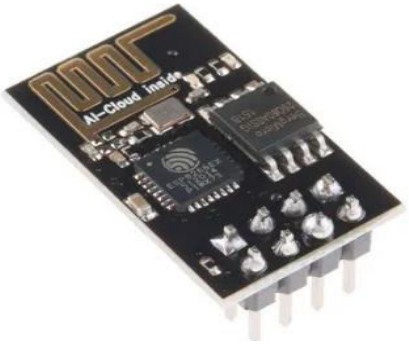
The Arduino Uno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino. Cc it is easy-to-use hardware and Software. Arduino can input various sensors as input and reproduce the given output required for actuators, motors, etc. It's user friendly to those who have an awareness of basic electronics and C programming language. Arduino platform mainly contains a Hardware Board called Arduino Board & Software Arduino IDE to program it. Other external hardware as Sensor Modules, Motors, Arduino UNO, and Arduino Software (IDE)- 1.0. The Uno is a microcontroller board based on the ATmega328P. The Arduino consists of 14 digital input/output pins in which 6 are PWM outputs, and 6 are analog inputs, a USB connection, a power jack, and a 16MHz quartz crystal, an ICSP header, and a reset button. The Arduino Integrated Development Environment (IDE) is a cross-platform application (for Windows, Mac, OS, Linux) written in the embedded programming language. It is used to write and load programs on the Arduino board to rise from room temperature. The sensors can convert the result, which involves the change of output voltage, which triggers the detection.[10].

4.2 LCD



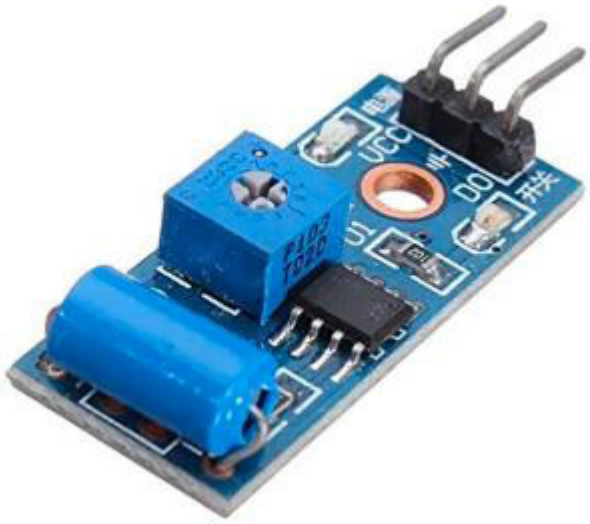
LCD signifies Liquid Crystal Display. An electronic display module, LCD finds its application in various electronic gadgets namely screens of calculators, mobile phones, television sets, computers etc. In this proposed module we utilize the 16× 2 LCD display. The representation- 16× 2, is indicative of the pixel matrix, having 16 columns and 2 rows, and thereby a possibility of having 32 characters. In here, each character is respectively made of 5× 8 pixel dots, thus making per character pixel count to be 40 pixels. The LCD display is easy to afford and extremely compatible.

4.3 WI-FI MODULE



ESP8266 Wi-Fi Module is an independent system on chip with built-in TCP/IP protocol stack which allows the microcontroller to access the Wi-Fi network. The ESP8266 has the potential of either hosting an application or discharging the Wi-Fi networking functions entirely from an additional application processor. This module has a powerful enough onboard processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime.

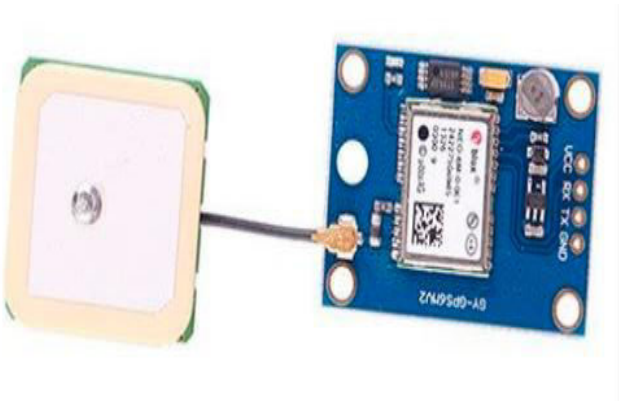
4.4 Vibration Sensor



The SW420 Vibration Sensor Module is based on SW-420 Vibration Sensor, which works on the principle that when the movement or vibration occurs, the circuit will be briefly disconnected and output low. Hence the normal state of this sensor is closed. The sensitivity

of the SW420 Sensor can be controlled by an onboard potentiometer and LM393 Comparator IC. This is very useful in detecting Collisions, Burglary protection alarm systems, Vibration alert systems, etc.

4.5 GPS Module



GPS Module GPS receivers are commonly used for monitoring or finding position in Smart Phones, fleet management system, military etc. The Global Positioning System (GPS) is a satellite system used to measure and calculate the location of satellites and ground stations on Earth. GPS is also known as GPS NAVSTAR (Navigation Device with Time and Ranging). For precision purposes, a GPS receiver needs to collect data from at least 4 satellites. No information is transmitted to satellites by the GPS receiver. In many applications, such as Smart Phones, Cabs, Fleet management etc, this GPS receiver is used. GPS receiver module gives output in standard (National Marine Electronics Association) NMEA string format. It provides output serially on Tx pin with default 9600 Baud rate. Figure 7 shows the image of GPS module.

Applications;

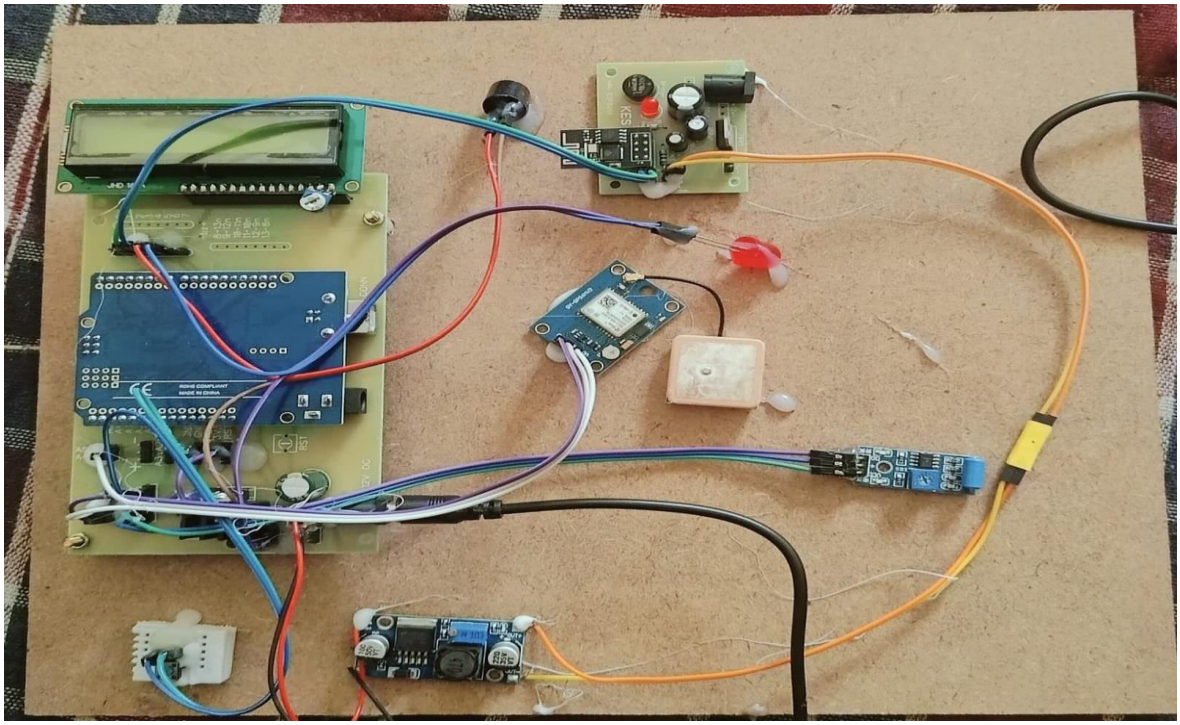
Use in emergency detection.

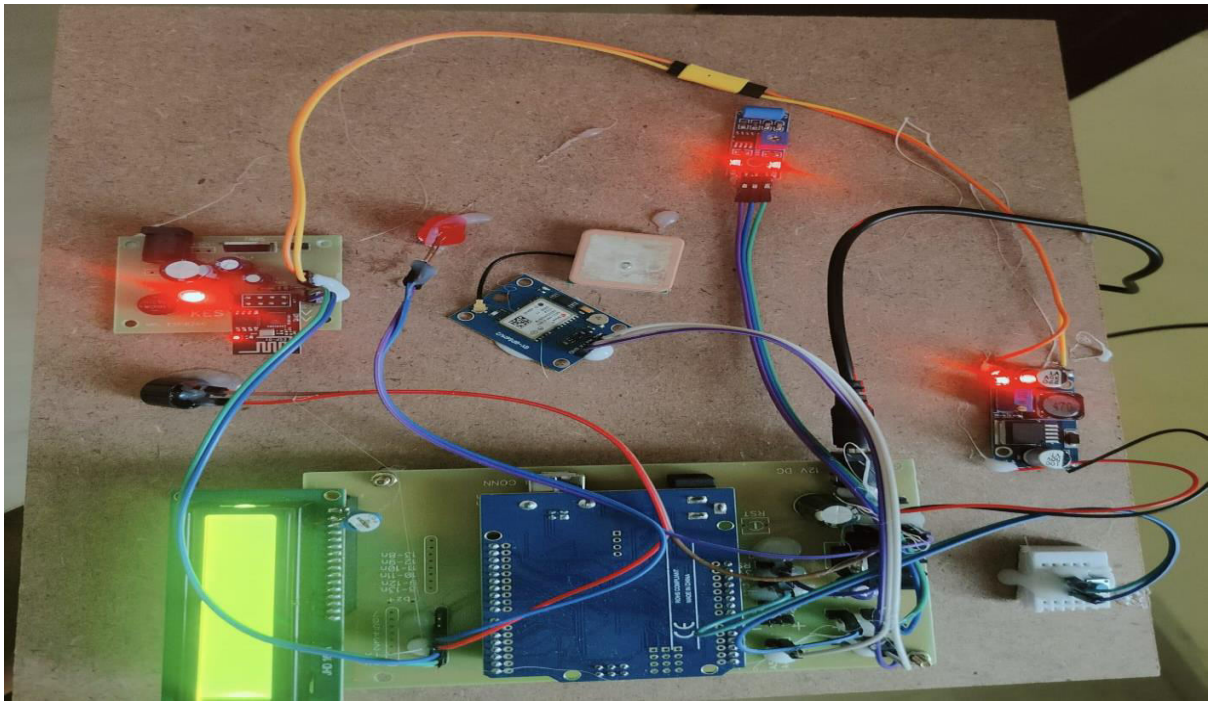
The railway department used in automotive sectors.

Advantages

A quick passenger side manual emergency alert system for reporting the specific emergency to response team which has options of police, fire and doctor.The idea is to reduce the time of response by emergency response team during an emergency using IoT.

5. Output Results





6. CONCLUSION

The numerous emergencies are witnessed everyday in railways. To reduce the loss of life and property an automated as well as manual emergency detection and response system is developed. And quick response. This system is connected to smart phone because of which GPS of the phone is used to send the location via SMS, update cloud hosted database with an emergency message alert and further broadcast the message to the receiver modules. The use of IoT enhances the system by providing a simple and fast way for communication during emergency in both automated as well as manual manner. Such safety measures are not available in railways thus this system is presented. Automated as well as manual alerts are produced. Hence, safety of passengers will be improved. There are few limitations like the system require internet connectivity all the time for alerting using cloud hosted database. Also, smartphone having GPS, internet connectivity, network signal is essential for the system to work. The data collected is not processed. So, the classification of accident is possible only after data processing.

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