

## Microcontroller based Safety System for Railway Workers

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### Abstract

As per the recent survey in India nearly 50,000 people have lost their lives on the railway tracks. The workers working on the field or bridges are unable to detect the arrival of train and accident can occur. In rainy season most of time the water level of the river reaches highest point due to heavy rain and sometime bridge collapses to avoid this accident the system is implement. These are the major issues faced in day- to-day life. Our proposed system mainly deals with these issues.

Here we are introducing the concept of alarm system to alert the workers and monitoring the water level of bridges. The system mainly consists of Microcontroller, LCD Display, ADC, Siren, GSM Module, Keypad, Isolated Digital input and output, Water level recorder etc.

This project identifies the status of each train using train detector and informs it to microcontroller. The microcontroller produces the output and supplies it to LCD, GSM Module and Siren. LCD displays the train position while GSM sends the SMS to the workers and siren is used to alert the workers. When the water level exceeds the highest point, it is been recorded by the water level recorder and provides the input to the ADC, The ADC converts the analog signal into digital and informs the signal to microcontroller which alerts the pilot and accident can be avoided. The signals are installed before the bridges can be operated through the GSM. The communication takes places between Master and Slave units.

**Keywords-**Microcontroller, GSM, ADC, Keypad, LCD, Siren

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### I. INTRODUCTION

India has the fourth largest railway networking in the world after the United States, Russia and China. Indian Railways is the largest railway network under a single management in the world. With such a massive utilization of assets safety is of paramount importance for operational efficiency. A very high priority is accorded to safety to enable Railways to achieve still greater heights of performance. Railway Safety is concerned with the protection of life and property through regulation, management and technology development of all forms of rail transportation. [4]

Safety Information Management System (SIMS) is designed developed and hosted by CRIS. This application manages and processes information related to any train accidents that occur in Indian Railways.

Railway Transportation is associated with elevated initial investments for the infrastructure construction and also during the life cycle for its evaporation and maintenance.

As per investigation by the Railway Accident Investigation Branch (RAIB) said that the railway workers was unable to hear the horn of train until it came closer and accident can occur. The river bridges are also a problem during rainy seasons so it is the challenge to implement to new system which can overcome the issues.

### II. RELATED WORK

#### *Literature Review on Railway Worker Safety System*

This Survey Concludes that different Track worker safety system of various kinds of technologies used to implement this type of system. The implementation of such systems and technologies would have positive impacts on the safety of track workers in World. Following papers we are referred for identified options to set a baseline of knowledge and understanding that will be used in later stages of the project.

Aamir Ahamed and et al, They proposed a system Train Collision Avoidance Using GPS and GSM Module which will identify the obstacles that lie in the railway track. This system combines with PIC16F877A microcontroller, ultrasonic sensor and GPS and GSM.

The ultrasonic sensor which is interfaced with the microcontroller is used to detect the obstacle. GPS is used to locate the train after being stopped by detecting obstacles. This geographical position is sending to the control unit by using GSM. Except in severe weather condition, this system works perfectly. As it is an ultrasonic sensor-based project, that's why the efficiency of this project might be less when there is much humidity in the air.[1] B.S.Sathish and et al, Advanced Automatic Detection of Cracks in Railway Tracks

intended at serving the railway control apprehensive to make stronger and expand the surveyor equipment vital through recent protection supervision.[2]

R. Immanuel Rajkumar and et al proposed system Android and WSN Based Train Tracking and Collision Avoidance for Railway Sector[3]

The proposed system comes with a solution for the problems by using wireless sensor networks. Each trains will be act as a WSN node and update their position information through connected GPS and provide the same information back to server and update the database through WSN node.

Mitchell Mcclanchan and et al proposed Track Worker Safety: Investigating the Contributing Factors and Technology Solutions[4] The CRC for Rail Innovation has initiated a project which aims to support rail operators' use of the most effective track worker warning systems for the Australian network from existing systems. The project is not only about analyzing the technologies for suitability in the Australian network, it also evaluates the systems for their deficiencies and possible ways of improving the technology to develop a better track worker protection system.

Adoh lucky and et al proposed method Prevention of Railway Accident using Arduino Based Safety System[5].Obstacles on the right of way of the train, smoke on the train and flooding on the track can cause derailment, collision, injuries to train passengers, environmental damage and loss of properties, so there is a need to look at various ways to prevent or reduce the frequency and severity of these accidents by using Arduino based safety system to mitigate these accidents. The result shows that this new innovative technology will increase the reliability of safety systems of railway.

Prof.Anap.S.D and et al proposed system Railway Track Monitoring and Accident Avoidance Using Smart Sensor Network [6]. In this paper, the proposed framework incorporates a few elements which forestall train mishaps. It incorporates flame recognition, water level identification, Railway track split discovery. This framework makes utilization of IR sensors, fire sensor, GSM and other inserted frameworks Rail mischances have been expanded because of the surge streaming over the Railway tracks. They are proposing a surge identification framework to overcome such mischances. Here, at whatever point we distinguish that there is a flood over tracks, we will send a sign to the train through GSM which will stop the train furthermore send messages to higher powers of south focal railroad.

Velmurugan.K, Rajesh .T In his paper, the authors present a new crack detection method for rail, which utilizes the change in infrared emission of the rail surface during the passage of a train wheel. Initial data from this infrared method are presented, from studies of both a laboratory-based three-point bend specimen and a short section of rail. The results of these two studies confirm the ability of the proposed method to locate and quantify surface-connected notches and cracks.[7]

Ruma Sinha, In her paper Detection of Crack in Railway Track using Ultrasonic Sensors, a crack detection system is proposed which detects the crack without human intervention and sends the location of fault to the authorized personnel using GSM. Crack detection by this method can be done during both day and night time and exact location of fault can be obtained.[8]

Ranjith.A Vijayaragavan and et al in paper Internet of Things (IoT) Based Real Time Railway Track Monitoring System.[9] This paper addresses the major challenges and an opportunity associated with the smart railway and verifies an IoT-based railway track monitoring methodology. The proposed IoT solution, in general, is the first approach to tackle systemic and interdisciplinary system-level issues to the best of our knowledge in the railway sector. The analysis shows that the IoT is an important enabler for improving maintenance performance. Because the IoT could bring cost-cutting impact. We are convinced that IoT will be implemented to increase productivity and safety in the railway application.

### **III. PROPOSED SYSTEM**

#### *A. Methodology*

Site: -

- 1) Collecting information about accident take place with railway workers while working on the railway track.
- 2) Generating information regarding current and deployed system by the Indian railway in this regard and studying available technology from reliable resources.
- 3) Study about communication system/technology, GSM, microcontroller etc. used in project work.
- 4) Proposing application-based solution for avoiding worker accident
- 5) Testing - Offsite Testing
- 6) Resolve the errors occurred during outside testing

Development: -

- 1) Figure out the Block Diagram
- 2) Selection of components according to the system

- 3) Design of schematic
  - 4) Designing PCB layout
  - 5) Generating the Gerber files to the manufacture
  - 6) Manufacture the PCB
  - 7) Board Bringing up
  - 8) Testing of the System
  - 9) Trial of the System *B. Algorithm*
1. Start
  2. Initialize the system
  3. Sense Train or object on Railway track using ultrasonic sensor.[8]
    - ✓ If Train detected on railway track send message to track workers or railway driver
    - ✓ If not detected continue detection
  4. Sense Water Level on the track or Bridges
    - ✓ If water level exceeds prefixed level then send message to railway driver.
    - ✓ If water level not exceeding or no water

present then continuous detection

5. Continue the whole process. *C. Flowchart*

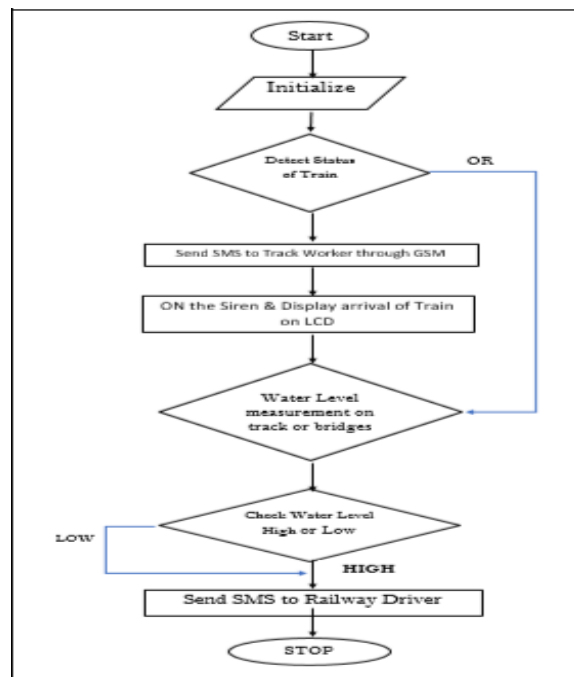


Figure 1. Flow chart

Figure 1 shows flow of our system. It shows steps in sequential order and presenting the flow of algorithm.

#### D. System Design

##### 1] Hardware:

1. **STM 32 Microcontroller:** A Microcontroller is an integrated circuit (IC) device used for controlling other portions of an electronic system. The Microcontroller produces the output and supplies it to LCD, GSM Module and siren.[1]
2. **GSM:** GSM stands for Global System for Module Communication. It is a digital cellular technology used for transmitting mobile voice and data services. GSM sends SMS to the workers.[1]
3. **Display:** A Display is an output device for presentation of information in visual or tactile form. LCD displays the train position.

4. **Power Supply:** A power supply is an electrical device that supplies electrical power to electrical load. The primary function of power supply is to convert electric current from a source to the correct voltage, current, and frequency to power between two points the load.
5. **Siren:** A siren is a loud noise- making device. Here we are using siren to alert the workers.
6. **Internal ADC:** ADC stands for analog to digital converter. Analog to digital converter is a system that converts analog signal into digital signal.
7. **Keypad:** A keypad is a set of buttons arranged in a block or pad which bear digits, symbols or alphabetical letters. Pads mostly containing numbers and used with computers are numeric keypads.
8. **Isolated Digital Input:** Isolated digital inputs provide galvanic isolation between a sensor input, or other input type, and a logic output for a host controller interface

**E. Block Diagram**

Figure 2 shows the block diagram of system. It Consists both Master and Slave.

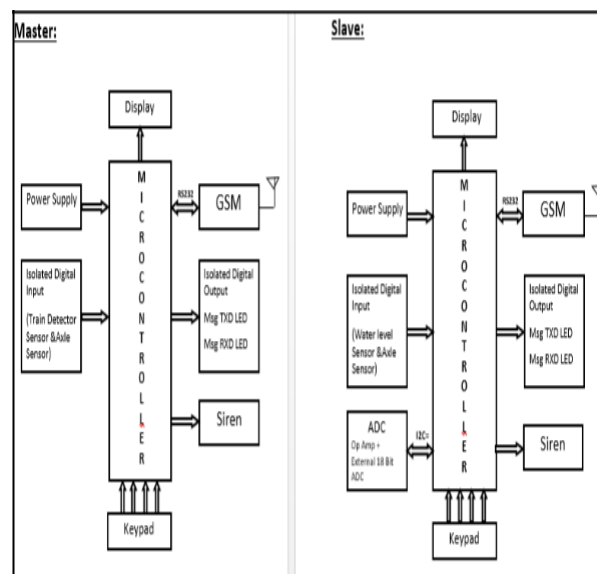
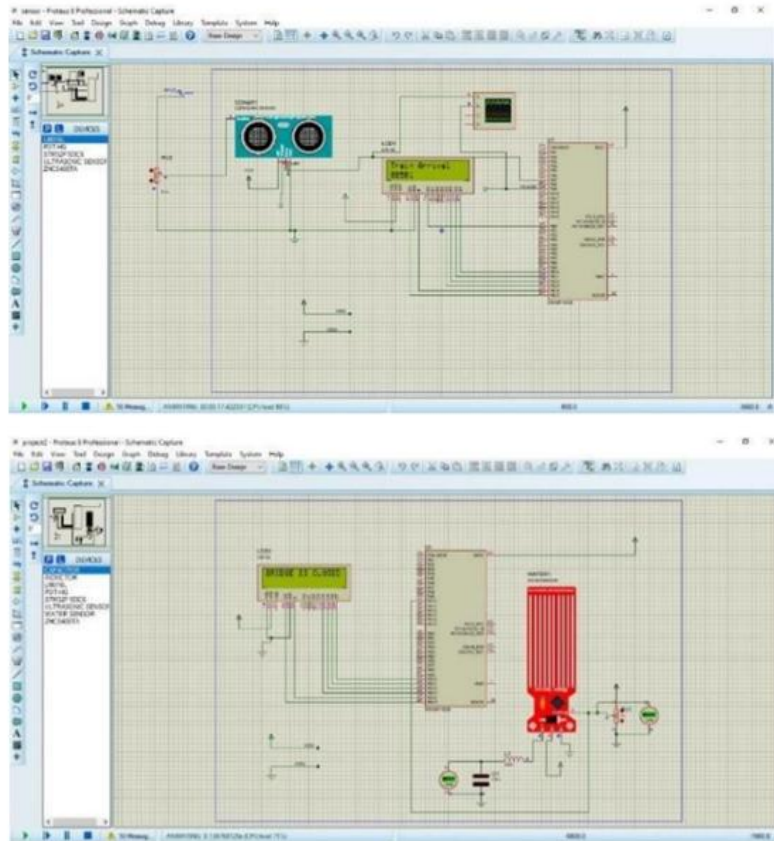


Figure 2. Block Diagram

**F. Working**

1. This methodology mainly works on the principle of master and slave.
2. The system mainly consists of Microcontroller, LCD Display, ADC, Siren, GSM Module, Keypad, Isolated Digital input and output, Water level recorder, etc.
3. When the train arrived, the train detector will detect the position of train.
4. If train is detected by train detector, it will provide signal to microcontroller.
5. The microcontroller will respond to output of detector and provide signal to GSM, display and siren.
6. The GSM will alert the workers about the arrival of train
7. LCD will display that the train is arriving.
8. Then the siren will alert the track workers by making sound.
9. When the water level exceeds the highest point it is been recorded by the water level recorder.
10. As the output of recorder is analog signal and the IC needs digital input, so we need to convert analog signal into digital signal.
11. So ADC convert analog signal into digital which is provided to microcontroller.
12. As the microcontroller gets the signal, it will alert driver by turning on led.
13. The signals are installed before the bridges can be operated through the GSM. The communication takes places between Master and Slave units.

## IV. SIMULATION RESULT



## V. ADVANTAGES

1. Lives saving is the biggest advantage of this system
2. Warning messages of Preventive maintenance and Bogie link breakage can decrease the chances of train accidents due to track damages.
3. Bogie counter helps to get confirmation of complete pass of train.
4. An axle counter is a system used in railway signaling to detect the clear or occupied status of a section of tracked between two points.

## VI. CONCLUSION

“The method is looking at better track worker protection with technology. The main objective of the project is to identify the best available technology or suggest new systems that will help to improve track worker safety.”

## VII. FUTURE SCOPE

In the future e may use RFID reader in track worker safety system and the data collected by the sensors used in this system can also be uploaded to the server for other train applications. The implementation of such a system or technology will have a positive impact on the safety of track workers in INDIA.

## REFERENCES

- [1]. Aamir Ahamed, Naeemul Islam, Md.Atikul Shahadat Soikot, Md.Sayed Hossen, Rubel Ahmed, Mohammad Anisul Hasan, “Train Collision Avoidance Using GPS and GSM Module” proceedings of 2019 International Conference on Power Electronics,Control and Automation(ICPECA), IEEE,2019
- [2]. B.S.Sathish, P.Ganesan, A.Ranganayakulu, Sanjay S.Dola, S.Jagan Mohan Rao, “Advanced Automatic Detection of Cracks in Railway Tracks” Proceedings of 2019 5th International Conference on Advanced Computing & Communication Systems (ICACCS), IEEE, 2019
- [3]. R. Immanuel Rajkumar, G. Sundari, “Android & WSN Train Tracking and Collision Avoidance ForRailway Sector” proceedings of 2017 International Conference on Computational Intelligent and Computing Research (ICCIC), IEEE, 2017
- [4]. Mitchell Mcclanchan, Nusra Noorudheen, Yvonne Toft, “Track Workers Safety: Investigation the Contributing Factors and Technology Solutions” proceedings of international conference, 2012
- [5]. Adoh lucky Ugochukw, Akello Fiona Mercy, Nyabgassa Faraja, Ishimwe Pascasie, “Prevention of Railway Accident using Arduino Based Safety System” proceedings of International Journal of Engineering Research & Technology, 2019

- [6]. Prof.Anap.S.D, Ronge Prasanna, Bhalerao Lalit P, Dharme Sandip, "Railway Track Monitoring and Accident Avoidance Using Smart Sensor Network" Proceedings on International Conference of Advanced Research in Computer and Communication Engineering, 2016
- [7]. Velmurugan.K, Rajesh .T "Advanced Railway Safety Monitoring System based on Wireless Sensor Networks", 2016
- [8]. Ruma Sinha, "Detection of crack in railway track using Ultrasonic Sensor" proceedings of International Journal of Scientific Development and Research, 2017
- [9]. Ranjith.A Vijayaragavan S.P, Karthikeyan Balasundaram "IoT Based Real Time Railway Track Monitoring System", 2020