

Prevention of Train Accidents using Android supported Embedded Systems

G. Kohila Warnan* and R. Balamurugan

Vels University, Chennai - 600117, Tamil Nadu, India; gk.warnan@gmail.com, bmurugan.scs@velsuniv.ac.in

Abstract

Objectives: The development in railway sector resulted in an increase in railway traffic. Due to absence of technology the number of accidents in railway has increased. This article discuss on how to prevent these accidents. **Method/Statistical Analysis:** In this paper, the proposed system uses Android supported embedded systems which aim at alerting the drivers/Railway loco pilot to prevent the collisions. The proposed system would overcome the existing wireless sensors based Anti-Collision Device (ACD). **Findings:** The proposed system makes use of the Android device for visual display, Wireless sensors and Microcontrollers. It also uses the GPS system for location tracking and GSM technology for wireless transmission. The proposed system aims at maintaining a safe distance of 1Km between the trains, and object collision avoidance. On detection of a fault/upcoming collision the device will alert the drivers/Railway loco pilots and shows a visual display on the Android device about the upcoming fault and the distance between them. **Applications/Improvement:** This system also aims at prevention of other train accidents such as fire accidents, object collision, etc. This system provides speed controllers, alerts on signal over jumping.

Keywords: Android Device, Microcontroller, Receiver, Transmitter, Wireless Sensors

1. Introduction

Railways being the largest and cheapest mode of public transportation, still it is most safe and easy way of transport. On average more than 10 Million people use the railway services annually. Railway is facing major challenges in its operation. In recent days due to increase in railway traffic a large number of accidents are happening due to the collisions, Over speed, track discontinuation etc., so it is necessary to implement an automated system that will overcome the human errors and overcome the railway accidents. The automated system will help in saving the human life from accidents.

In this paper, android supported embedded systems will be used for collision avoidance in trains. The railway tracks will be set with a track id accordingly. When a train travels in a track it will start communicating its track id through a transmitter, the nearest train can receive the signal through a receiver. When two trains travel on the same track an alert will be given to both the railway drivers for stopping the trains. The location of the train can also be viewed by through the android device. The

proposed system aims at prevention of both Head-to-Head and rear-end collisions. The proposed system also prevents other railway accidents.

In paper¹ wireless sensors are used for prevention of collisions. It consists of self-acting micro-controller and a two way zig-bee based data communication system, which alerts Collision. Zigbee is a specification for high level communication protocols. It uses the Direct-Sequence Spread Spectrum (DSSS). This system can communicate to a radius of 3000 meters. The system communicates to the nearest control station and the control station monitors the whole network in order. In paper² sensor networks are used for collision avoidance. The system consists of a microcontroller, Infra-red sensors and zig-bee device. The Infrared sensor connected to microcontroller detects the infrared waves and alarms about obstacles. The microcontroller is also connected to zig-bee device for communication between train and base station. A fire sensor is used for prevention of fire accidents. A LCD will show all the error and warning messages to the railway drivers. The IR sensor on detecting a train approaching on same track it will send the signal

* Author for correspondence

to the microcontroller. In paper³ embedded systems which mutually communicate prevents the collisions. The system uses buzzers, microcontrollers, Zigbee transmitter and receiver. In this system all trains travelling in a track will communicate their track id to the nearest trains if they travel in same tracks an alert is given by the system for stopping the trains. This system also aims at prevention of fire accidents and bomb using bomb detectors. In paper⁴ Zigbee based TACS (Train Anti Collision System) used for collision avoidance. The system will communicate with the nearest level crossing and control stations if any collision like situation is observed an alert is issued to the loco pilots. The data transmission and reception are done using RF module. The control station will also have a Zigbee module for receiving and sending data at regular intervals of time. In paper⁵ RFID (Radio Frequency Identification and Detection), RTSU (Railway Track side unit) and Wi-Fi data for broadcasting between trains are considered as moving nodes to broadcast the data using Ad-hoc routing protocol. If two trains detect a same RTSU then they automatically stops. In paper⁶ RFID and FLIR camera (Forward Looking Infrared imaging systems) are used. When a signal is received from RFID the camera is activated, then upon receiving a proper signal the loco pilot can take necessary actions. In paper⁷ MIWI (Microchip Wireless) protocol communication has been used. The data's are transmitted and received through Miwi. An ultrasonic sensor monitors the objects in front of the screen. Transmitter will alert the loco pilots if any object is found. A buzzer is used for alerting the loco pilot if any object is detected. Paper⁸ uses a system for preventing rear-end collisions in Vehicles. This system uses IR signals for alerting on Collision. It is observed from the paper that an alert can be issued when a collision ahead is detected. From paper⁹ it is observed that a GSM and GPS based technology can be used for location tracking, which will help in improving the location accuracy. In paper¹⁰ it is learnt that RFID technology has been used for automatic speed controls.

2. Existing System

The Indian Railways are currently using Anti-Collision Device¹¹ (ACD) which was designed and developed by Konkan railway. The ACD is a fully electronic controlled system. ACD is designed for preventing of accidents like

- Head on collisions.
- Rear end collision.

- Collisions at railway level crossings.

ACD's communicate through radio frequency. The current system is fitted with transmitter and sensors with an automated microcontroller which makes use of the GPS. When a collision like situation is deducted the system is designed in such a way that automatic brake controllers are activated and the trains are stopped. However this system is not considered as effective due to the certain factors.

2.1 Advantages

- Acts automatically.
- Does not depend upon human action.

2.2 Disadvantages

- The range of system depends upon the range of transmitter.
- The system is affected by weather conditions.
- Fails to prevent other train accidents like fire accidents, over speed in bridges etc.
- ACD does not have differential GPS that gives accuracy close to 2.5 meters, hence it has errors that lead to erratic breaking that disrupted train movements and proved to be ineffective.

3. Proposed System

The proposed system consists of an automated microcontroller that will monitor all other devices connected.

This system operates without replacing any of the existing controls and does not degrade the existing system. This system can communicate to the nearest train and can send and receive the information. A transmitter and receiver that use the radio frequency are used for sending and receiving the information. A GPS module in android will identify the location and communicate with the microcontroller. The wireless ultrasonic sensors are used for sensing the obstacles present in the railway track. The system will assist the loco pilots in preventing the accidents. The cost of implementation would be reasonable as it does not replaces the existing system instead it adds extra features. The proposed system will prevent

- Train collision.
- Object collision.
- Fire accidents.
- Speed control.

The entire unit will be connected to an android device through GSM or Wi-Fi technology. The android device will display the error message and other warnings. It will also display an over Functioning of the embedded system.

4. Hardware Implementation

4.1 Microcontroller

A microcontroller is a low cost computer that deals with specific tasks. A microcontroller is a small computer on a single integrated circuit which contains a core processor, Memory and Input/output peripherals. Microcontrollers are specially designed for embedded applications. Their main advantage is that they are small in size and less in cost. They can automatically control the other devices connected to it i.e., it can control the Buzzer, Transmitter, Receiver, Temperature sensors and automatic brake controllers. Figure 1 shows the block diagram of the proposed system.

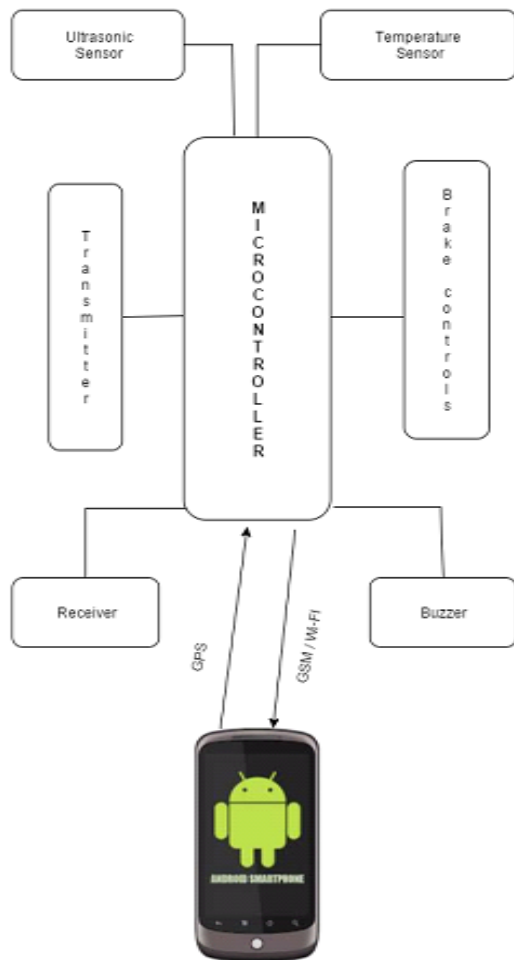


Figure 1. Block diagram of proposed system.

4.2 Transmitter

Transmitter is an electronic device that uses radio waves for carrying messages or signals. A device that generates microwave or radio signals that can carry information. The main functions of transmitter are

- To transmit signal from one unit to another.
- To process the signal from microcontroller.

4.3 Receiver

Receiver is an electronic device that uses radio waves. It converts the carried information into a usable form. They receive the signal send from another unit.

4.4 Buzzer

Buzzer is an audio device the main purpose of buzzer is to give a warning tone. It works with the signal received from microcontroller.

4.5 Ultrasonic Sensors

A sensor is a device that emits waves, whose purpose is to identify the environment. Here the sensors are used for identifying any obstacles in railway track. In this system ultrasonic sensor is used. Ultrasonic sensors are self-operated sensors designed for detecting the objects. These sensors transmit ultrasonic waves. These sensors can identify the changes in the environment and alerts if there is any change in the track i.e., there is any obstacles or discontinuation of track.

4.6 Automatic Break Control

Automatic break controls is a technology to prevent collisions and any other accidents. When an undesirable situation is deducted the automatic break controls are activated.

4.7 Temperature Sensor

Temperature sensors are thermally sensitive resistors whose function is to find the change in temperature. When a fire accident is occurred they can pass the information to the microcontroller.

4.8 Android Device

Android is an OS specially designed for touch screen devices. They are connected to the complete unit with the help of GSM/Wi-Fi technology. The main function of the device is to display the error messages, warnings and the process that is undergoing.

5. Working of Proposed System

The proposed system aims at preventing the following accidents, the microcontroller will act as the master of all other devices. The android device will assist the loco pilots by displaying a warning message. The microcontroller will also help in displaying any fault occurred within the system. Working of the proposed system is shown in Figure 2. Switches control the power supply to the entire system as shown in Figure 3.

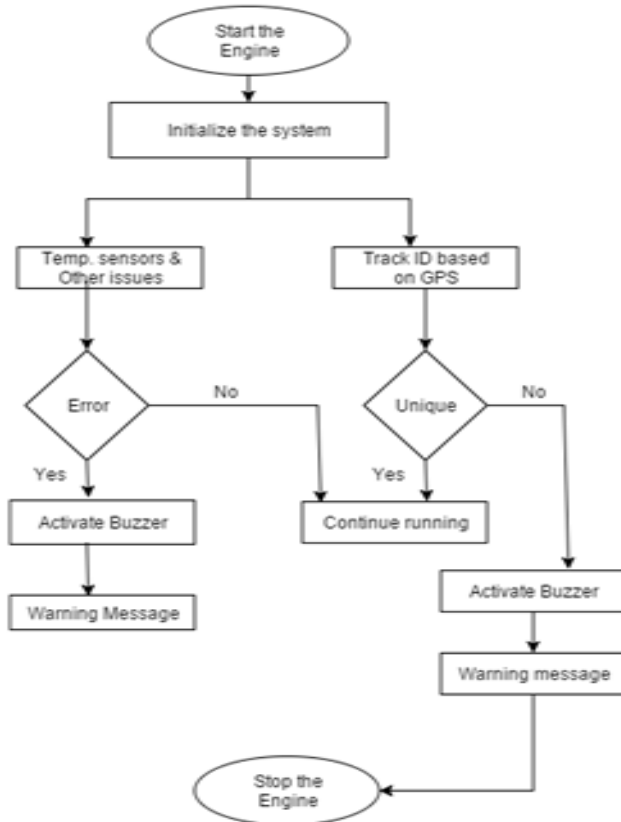


Figure 2. Working of the proposed system.

5.1 Collision Avoidance

The collision avoidance of trains will be processed based on their locations. The android device will keep communicating the location of train to microcontroller with the help of GPS. When a train starts travelling in a track it will start communicating its track id through transmitter. Similarly it can also receive the signal from another train through receiver. When the microcontroller receives a signal about another train on same track within a distance of 2km it will activate the automatic braking

system to stop the trains. An error message will also be displayed in android device. The buzzer will be activated with the warning tone.

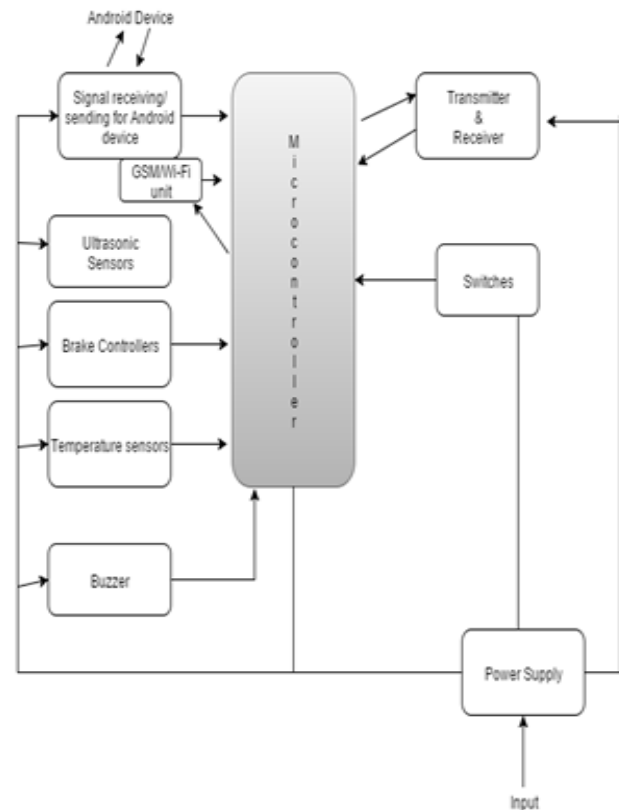


Figure 3. Circuit diagram of proposed system.

5.2 Object/Obstacle Deduction

For safety of a train it must be ensured that no heavy object is present in above the railway track. The heavy objects/obstacles present on the railway track may lead to derailment of the trains. This is checked with the help of ultrasonic sensor controls. The sensors keep deducting about the changes in the environment in the track. It keeps passing the message to the microcontroller. The sensors are designed in such a way that they identify the static and dynamic objects. When they deduct an obstacle on the railway track the signal is passed to the microcontroller. The microcontroller in turn will activate the buzzer. The warning message will be displayed in the android device. The loco pilot can slow up the train to look on it, and move the train further. This sensor will also keep checking with the continuation of the track and activates the buzzer if any fault is detected.

5.3 Fire Accidents

Nowadays fire accidents are happening in trains, so it is necessary to prevent it. Each coach will be fitted a temperature sensor which can deduct the variation in temperature in the coach. When an abnormal temperature is deducted in any of the coaches, the sensors will send signal to the microcontroller in the railway engine. Once the signal is received the microcontroller will activate the buzzer and display a warning message in the android device. The loco-pilot can look after the issue and take decision to move further.

5.4 Speed Controlling

There are certain restricted places such as tunnels, bridge where the speed of train has to be reduced. Over speed at such places may cause derailment. GPS based technology will be used to identify the location where the speed has to reduce. On arriving at the speed restricted place the system will make an alarm for reducing the speed.

5.5 Signals over Jump Prevention

In recent days mistakes are happening because of the signal over jump, which happen due to the human error. To prevent this transmitter is fixed at the railway signalling points which will keeps transmitting the operation to be performed. On the other hand, the receiver the system placed in the locomotive will the signal from the same. If the loco pilot violates the signal without looking into it, the system in turn will start activating the buzzer.

5.6 Features of the System

- The entire system is placed within the locomotive itself.
- The proposed system does not degrade or replace the existing system.
- Easy to operate as it provides a visual display for the loco-pilot through the android device.
- Reduces the chances of error.
- Does not depend upon human operation for controlling the system.
- Protection from external interferences.
- Pre-information of train arrival and other issues.
- Ensures safety and quality.
- Provides accuracy with the help of GPS and wireless sensors.

6. Results

This work helps in preventing train accidents efficiently. This system also comforts in reducing the possibility of errors. It is a new technology that combines Android and embedded system. With the help of android device a visual alert is shown which supports in identifying the error easily. Unlike other technology this system focuses on collision, fire accidents, Speed controls, object collision and signal over jumping. Combination of embedded and android device gives a perfect solution for preventing accidents. Overall result is that this system is effective and completely reduces the chances of error.

7. Future Scope

In Future the alert message can be passed to the nearest control station. The Android device can be implemented to make communication with the train and the control station. It will help in faster recovering. Specially designed application can be used for monitoring the system. The system can be extended to prevent the other kind of accidents also.

8. Conclusion

This paper presented a new technology based on Android with the embedded systems. This method improved the way of preventing the railway accidents. This technology has the early sensing of the accidents and thereby it can avoid accidents and ensures safety.

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