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# Collision Avoidance of Trains Using Arm Cortex M4, RF and GSM

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**Abstract:** The Railway network is the world's biggest transport network. There have been many accidents occurs in the railway network system. Most of the accidents occurred due to the collision between the trains and human negligence The proposed system is used to predict that kind of collision between trains and prevents them from occurring collision and accident .Railways are the convenient, reasonable and popular node of transport in almost all major cities of not only in India but also all over the World. The major reason for railway accidents is collision of trains on the same track or near crossing. It is very difficult to stop such collisions due to speed of moving trains, which is needs a lead distance to stop. The primary goal of our train collision detection system is to identify possible train collision ahead of time and to report these to the main control room or driver before collision happens. Train Collision Avoidance System includes the microcontroller ARM Cortex TM4C123GH6PM which controls the whole operation of the system. In this the train tracks in railway network are given distinct track numbers/track ids which are read by RFID reader. If two trains are travelling on the same track then system sends SMS through GSM network to the authorized person to take appropriate action. In areas where GSM network is poor then also the system avoid collision by using RF Module. Wherever at crossing LDR sensor and microcontroller unit take appropriate action if obstacle can be observed.

**Keywords:** RFID Tag, RFID Reader, GSM, ARM Cortex, RF Module, android device and LDR sensor.

## I . INTRODUCTION

As the railway transportation network is considered to be the safest and easiest network, but nowadays, it is not that much safer as the lot of collisions and accidents occur due to improper communication among the network, wrong signaling, worst weather condition, immediate change in track or route change. The train driver does not get proper information on or before time so that the hazardous condition can occur and would lead the accident. According to survey last year in India more than hundred people were lost their valuable life at unmanned crossing. It is very difficult to stop such accident or collisions because of the speed of moving trains, which needs a lead distance to stop. The primary goal of our train collision detection system is to identify possible train collision ahead of time and to report these to the main control room or driver before collision happens. Currently there is no solution to avoid train collision. There have been many train accidents all over the world.

## II. LITERATURE SURVEY

Indian Railway has implemented Anti Collision Device (ACD) patented by Konkan Railway. The ACD system is based on GPS for positioning and track detection. This had its own inherent problems as it is based on GPS- Standard Positioning, GPS service or coarse acquisition. The best possible horizontal accuracy is 10m. This is inadequate for detection of rail tracks separated by a distance of 10–15 feet. The ACD system though in use with the Indian Railways, has its own inherent problems in Station Sections due to its design concept of using GPS for track detection that is not viable. Shadowing (near mountains) is a problem in GPS. Cost of implementation is also high.

## III. BLOCK DIAGRAM OF PROPOSED SYSTEM

Every train unit in project is equipped with ARM Cortex TM4C123GH6PM, RFID reader, GSM Modem, RF transmitter and receiver unit and LED indicator. As shown below figure.

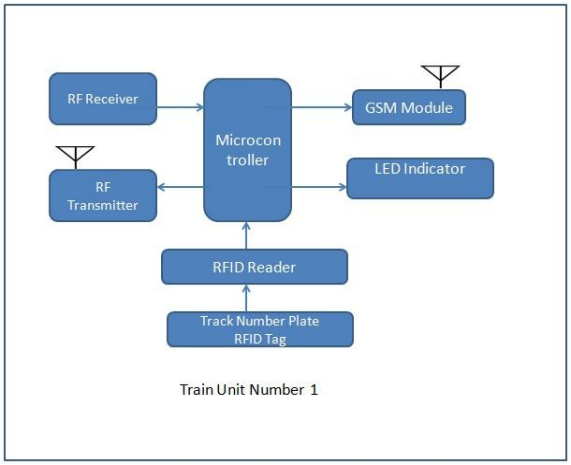


fig1 (a)

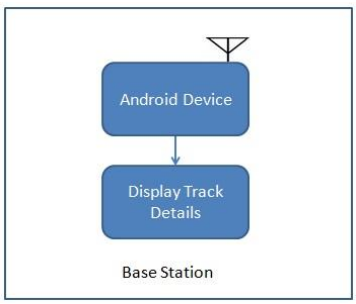


Fig1 (b)


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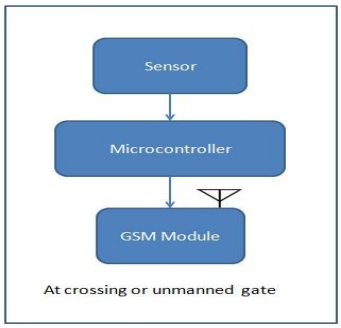


Fig.1 (c)

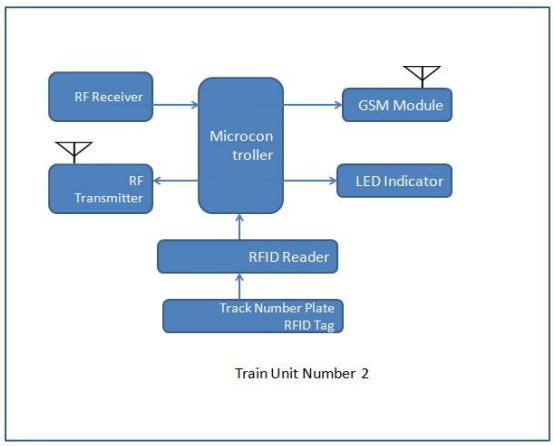


Fig.1 (d)

Fig.1. (a) It shows train unit 1 (b) Base station unit (c) Crossing unit (d) It shows train unit 2

The train tracks are divided into segments with individual track segment number. Radio Frequency Identification (RFID) tags present at the beginning of each segment of track. Whenever any train pass over the RFID tag this track number read by the RFID reader is stored and send the SMS through GSM to the base monitoring station. Base station is made up of an android running mobile device with our train position tracking and monitoring application. Base station as shown in fig.1. (b) Checks that only one train should be there on same track. If more than one train are on same track and travelling towards each other then it generate warning message and send it to corresponding trains. So that corresponding actions can be taken by the motorman to avoid collision.

Second part of the project is RF transceiver module which is used in communication where there is no coverage of GSM. The communication between two trains will be done by RF transceiver module. Whenever the train pass is over the RF tag RF reader reads it and send it to the receiver unit and through transmitter unit it transmit the train number and track number to the neighboring train the RF communication is established among the adjacent trains, which are in the range. If more than one train are on same track and travelling towards each other, depending upon detection of same track number, the system will alert the motorman by LED indicator to stop the train to avoid mishap. The track is segmented in 15 km range so even if there is any possibility the accident can be stopped in 15km range.

Third part is at crossing or unmanned gate. It is made up of LDR sensor. It continuously monitor the crossing whether is any object is in between or not. In everywhere at level crossing between railroad and highway there are so many railway accidents. The fig .1.(c) shows the railway gate control system using ARM Cortex TM4C123GH6PM microcontroller. LDR sensors detect presence of an object. The microcontroller forms the main unit of the system. It receives input signal from the sensors and sends information through GSM to the base station so that appropriate action can be taken to stop the train if there is any object in between the crossing. Snap action switches are placed on the tracks so if train is crossing at unmanned gate, GSM modem will not send any message to base station.

## IV. HARDWARE USED

A) RFID Tag and RF reader: Passive Radio Frequency Identification tags are used as track number plates. These plates are placed at the start of railway track at a distance of 10 Km. EM -18 used to read data from RFID tag.

B) RF Transceiver module: An RF transmitter receives serial data as radio signals and transmits it wirelessly through RF through its antenna connected at pin number 4. The transmission occurs at the rate of 1Kbps to 10Kbps. The transmitted data is received by an RF receiver, both transmitter and receiver operates at same frequency. The RF module is often used along with a pair of encoder/ decoder at 434 MHz

C) ARM Cortex TM4C123GH6PM: The ARM Cortex-M processor provides the core for a high-performance; low-cost platform that meets the needs of minimum memory implementation, reduced pin count, and low power consumption, while delivering outstanding and excellent computational performance and exceptional system response to interrupts. 32-bit ARM Cortex™-M4F operates on 80-MHz. 2Kb EEPROM, 256 Kb single cycle flash memory. Outstanding processing performance and combined with fast interrupt handling.

D) GSM Modem: is a mobile communication modem, it stands for global system for mobile communication (GSM). It is an open and digital cellular technique used for transmitting mobile voice and data services operates at the 850MHz, 900MHz, 1800MHz and 1900MHz different frequency bands. GSM system was developed as a digital system using time division multiple access (TDMA) means variation of time division technique for communication. GSM digitizes and reduces the data and sends it down through a channel with two different types of client data, each in its own particular time slot. The digital system has an ability to carry 64 kbps - 120 Mbps of data rates.

E) LDR Sensor: LDR's have low cost and simple structure. They are often used as light sensors. Light dependent resistors are used near unmanned gate or crossing to detect presences or absences of light. It works

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on the phenomenon of photo conductivity. Photo conductivity is an phenomenon in which the materials conductivity is increased when light is absorbed by the material.

F) Android Device: Google developed mobile operating system named Android. Here it is used as a base station with track mapping information. . It is used by several smart phones and tablets. Examples include the Sony Xperia, the Samsung Galaxy, and the Google Nexus One.

Train Collision Avoidance System includes the microcontroller ARM Cortex TM4C123GH6PM which controls the whole operation of the system. The RF ID and RF reader, GSM module, RF transmitter and RF Receiver, Sensor are interfaced with ARM microcontroller. The base unit consist of android device which includes entire data base of train no. and track no. through wire- less network i.e. GSM all units can communicate with each other.

## V. SOFTWARE USED

Energia: For burning code in Arm Cortex microcontroller Energia software is used. Energia is an open source & community-driven integrated development environment (IDE) & software framework. Based on the Wiring framework, Energia provides an intuitive coding environment as well as a robust framework of easy-to-use functional APIs & libraries for programming a microcontroller.

MIT App Inventor 2: It is an application development tool with the help of this app it is possible to develop applications for android phone. MIT's App Inventor 2, is an excellent tool for learning mobile development The drag and drop mechanism is really simple and well thought out, and is quite useful as a teaching tool. App Inventor for Android is an open-source web application originally provided by Google, and now maintained by the Massachusetts Institute of Technology (MIT). Simple & easy-to-use code editor & compiler with built-in Serial Monitor/terminal.

## VI. EXPERIMENTAL SETUP

## VII. EXPERIMENTAL RESULTS

**Frame Structure**

| # | Track Number | # | Direction Of Train | # | Train Number |
|---|---|---|---|---|---|
| # | 0 | # | 1 | # | 1001 |
| # | 1 | # | 0 | # | 1002 |

Up Train =1

Down Train =0

Fig.2. Frame structure with Track number, direction of train and train numbers


Fig.3.SMS Format

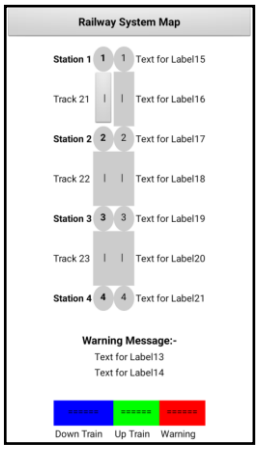


Fig.4.(a) Railway system map

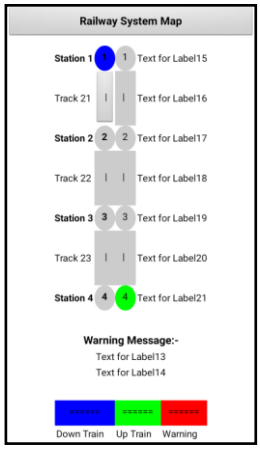


Fig.4.(b)

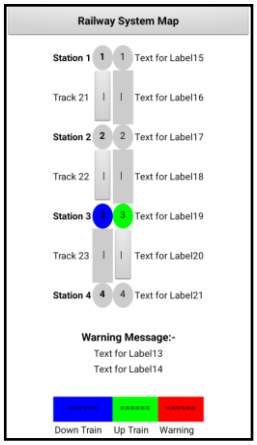


Fig.4. (c)

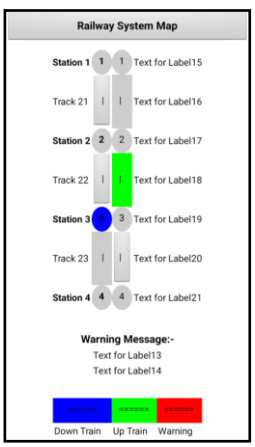


Fig.4. (d)

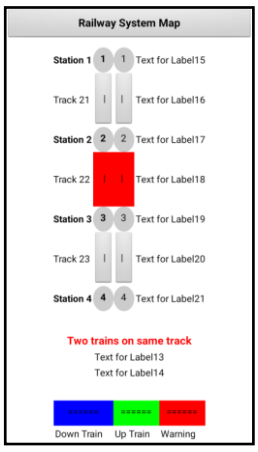


Fig.4. (e)

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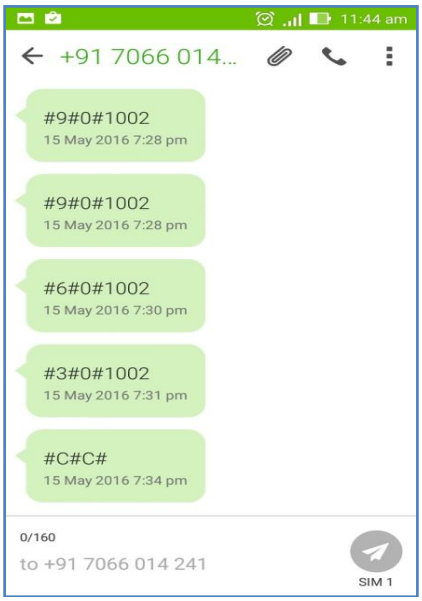

fig.4.(f)

Figure 4 as follows
(b) It shows Up and Down train at station
(c) It shows Down and up trains are at same station
(d) It shows Down and up trains are at nearest station
(e) Two trains are on the same track warning message can be generated
f) If Object is present at unmanned crossing then #C#C# displyed on android decice.All above results are taken on android mobile which is acts as a base station.

## VIII. ADVANTAGES OF THE SYSTEM

Following are the advantages over existing system
(a) Cost effective, economical and small in size.
(b) No personal skilled are required to operate the system
(c) It can be suitable for all kind of railway tracks.

## IX. DISADVANTAGES OF THE SYSTEM

We are sending SMS through GSM but because of some network problem it may be delayed so OTP service can be used.

## X. CONCLUSION

Collision avoidance systems are especially useful as it automatically alerting train collisions and accidents at level crossing gate. Implementing this system in railways we can save human lives. The scenario of accident in trains due to collision will be controlled with the help of this project.

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