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Trains Collision Avoidance System by Using RFID and GSM Technology

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Abstract: Now a day's in India most of the train accidents are occurs due to the human errors. It is very difficult to avoid to such train accidents because of the speed of train is very high and it requires some time to control it. In this paper the effective solution is present to avoid the train accidents by using Radio Frequency Identification (RFID). The primary goal of proposed system is to identify possible train collision ahead of time and to send the report to the main control room or driver before collision happens. Currently there is no solution to avoid train collision. Indian Railways have implemented solution based on ACD (Anti-Collision Device) system. Each locomotive is equipped with an automated surveillance system. The train tracks in railway network are divided into different frames and each segment has 10 km distance and given with distinct track numbers which are read by surveillance system inside the locomotive. Therefore the track id is needed to be given at 10 km distance on the train track. This track number will be shared with the base station by using Radio Frequency Communication system. The paper proposes specific way of numbering the train tracks in frames. Also a communication protocol is proposed to ensure data transfer among Radio Frequency transceivers of the systems under half duplex mode.

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

I. INTRODUCTION

One of the most widely used and comfortable nodes of transportation system is train, but occasionally, accidents occur due to collision. It is very difficult to stop such collisions because of speed of moving trains, which needs a lead distance to stop. There have been many train accidents all over the world. As per the report from CNN IBN India dates Sept 2011 85% of the train accidents are due to human errors.

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. Indian Railways have implemented solution based on ACD (anti-collision device) system. They have inherent problems in Station section and near mountains due to its design concept of using GPS for track detection and have high cost of implementation. My system is used to eliminate train accidents by exploiting automated surveillance system, it is based on RFID, ARM Controller and GSM, which will help eliminate problems stated above. By implementing this automatic system which could avoid human error and problems with ACD. In this system each train track is identified by track id, every train reads and sends its track id to nearby trains. If two trains are on same track id then alert is send to main control room or to the train drivers.

Association of this paper is as shown in the following way section II analyses the Literature survey of system, In section III Microcontroller Based Surveillance System is presents. In section IV presents the algorithm for RF Communication. In section V presents justification of proposed system. In section VI presents the experimental results. In section VII presents the advantages of proposed system. And in section VIII presents the algorithm for RF Communication.

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.MICROCONTROLLER BASED SURVEILLANCE SYSTEM

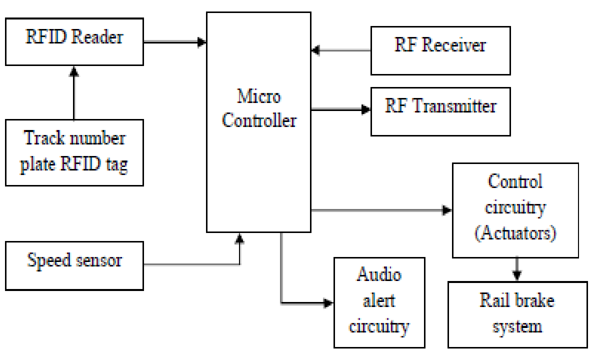

Fig. 1 Block diagram of the proposed system.

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The train tracks are divided into segments with individual track segment number. Whenever a train enters a segment of the track, the track number of that segment of track is read from the Radio Frequency Identification (RFID) tags present at the beginning of each segment of track. This track number read by the RFID reader is stored and then given to Radio Frequency (RF) Transceivers. The RF communication is established among the adjacent trains, which are in the range through an algorithm (which is explained later), so that the track numbers are shared. Now the track number of its own from RFID reader is compared with the track numbers of other trains from RF Receiver. Upon detection of same track number the system will alert the motorman. With no further action (detected with the help of speed sensor) taken by the motorman after an interval of human response time, the system will override the motorman by braking the train, with the help of actuators.

In Indian railway system the train tracks are divided into different frames and each segment there is separate track id number. In the proposed system the Radio Frequency Identification (RFID) tags are attached at the beginning of each segment of track at 10 km distance. When the train enters in the specific segment, the track number of that segment of track is read by the RFID reader in the RF receiver. Then this number is stored in the memory of microcontroller then given to Radio Frequency (RF) Transceivers. The RF transmitter sends this track id to the base station. And the GSM module sends the SMS to the authorized person to take appropriate action. In this way the RF communication is established among the train and the base station. At the base station there is LED is present which is the indication of two trains at the same track.

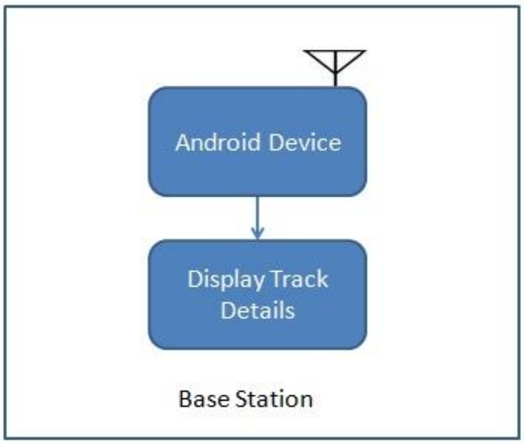

Fig.2. Base station unit

Figure 2 shows the android device which is present at the base station which is used as a receiver. On the android device the different track ids are displayed. If two trains are travelling on the same track then system sends the same track id to the base station at the base station there is sensor is present as shown in figure 3.

The two track ids which are same are senses by the sensor and given to the microcontroller. The microcontroller sends the signal to the LED and GSM module. The LED is blinked which is the indication of the two trains in the same track. Simultaneously the GSM module sends the SMS through GSM network to the authorized person to take appropriate action. In this way it avoids the collision.

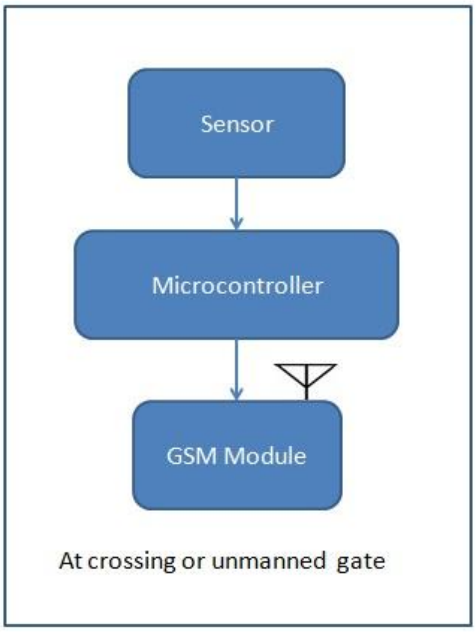

Fig.3. Crossing unit

IV. ALGORITHM FOR RF COMMUNICATION

The main aim of this algorithm is to achieve reliable communication between trains through half duplex mode. The algorithm follows a time division protocol without synchronised clock among the devices. Hence there is a susceptibility of data collision due to no synchronisation. This is removed by the introduction of randomness in the selection of instant for transmission.[4] This proposed algorithm is suitable for communication of small data which remains constant over a considerable period of time. In our proposal it is an 16 bit data, which remains constant for a minimum of 1 minute to several minutes depending on the speed of the train i.e. as long as the locomotive remains in the corresponding track segment of 2 to 4 km.

In areas where GSM network is poor then neighbouring trains compare track numbers through RF receiver and transmitter and inform the driver to take appropriate action.

- The RF receiver in all the systems of the locomotives will be active all the time, except at the instants when its own transmitter is active.
- From the instant the track number is read by the system, the system will transmit it on three random instants (calculated from the speed of train measured by the ADC) over a period.
- The speed of the train and the instant at which the track number is read, are considered the sources of randomness.
- The same way of transmitting at three instants is repeated for subsequent periods of interval. This period is maintained constant for all the modules.
- The time interval for which the transmitter is active is taken as the minimum time taken by it to transmit the track number completely.

The following is the simulation results of the above mentioned algorithm shows the possibility of data collision at all the three instants of transmissions in each period (trial). It is understood from the results that over 28914 of the trials out of 30000 trials encountered no data collision at any of the three random instants of transmission [5].

There are data collisions at one trial or sometimes at two trials in a period. But since they are immediately followed by successful data transmissions within the same period of transmission, those data collisions will have no impact on control action (if it has to be taken).

V. JUSTIFICATION OF THE PROPOSED SYSTEM

The following are the justifications of the proposed surveillance system,

- The proposed system is fully automated. Hence it will surpass the human negligence.
- Track number plates are RFID tags which are more reliable than other ways communicating the data (track number) to system. These are not affected by natural interference and nuisance.
- With the proposed way of track numbering, the track numbers can be repeated outside RF vicinity of previous track segments. This result in use of less number of bits (16 bits) for track numbers especially in case of large rail network, leading to less computation stress on microcontroller.
- Microcontroller with built-in peripherals needing less external components is used, lead to low complex system that facilitates ease of programming and reconfiguring the entire system.
- As RF Transceivers are programmed to communicate three times, at randomly selected time slots within a second, the possibility of data collision is reduced.

VI. EXPERIMENTAL RESULTS

Frame Structure

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

Up Train =1

Down Train =0

Fig.3. Frame structure with Track number, direction of train and train numbers

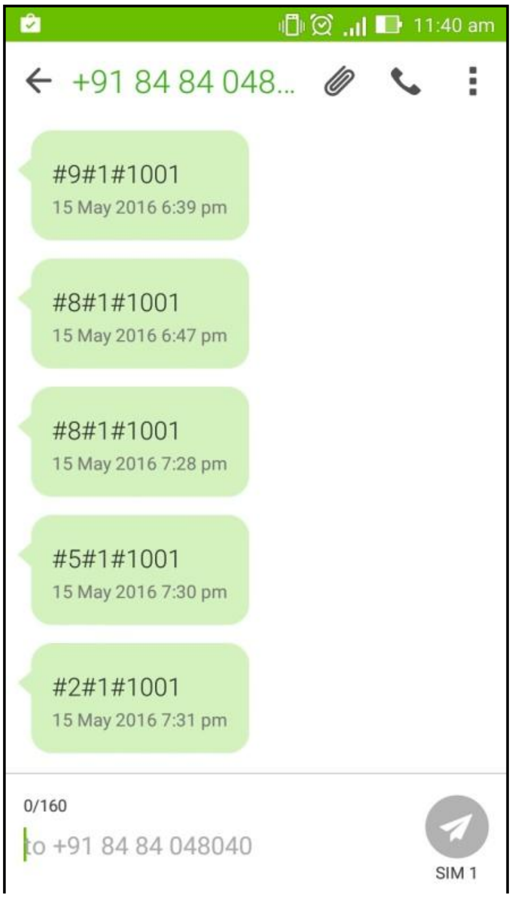

Fig.4.SMS Format

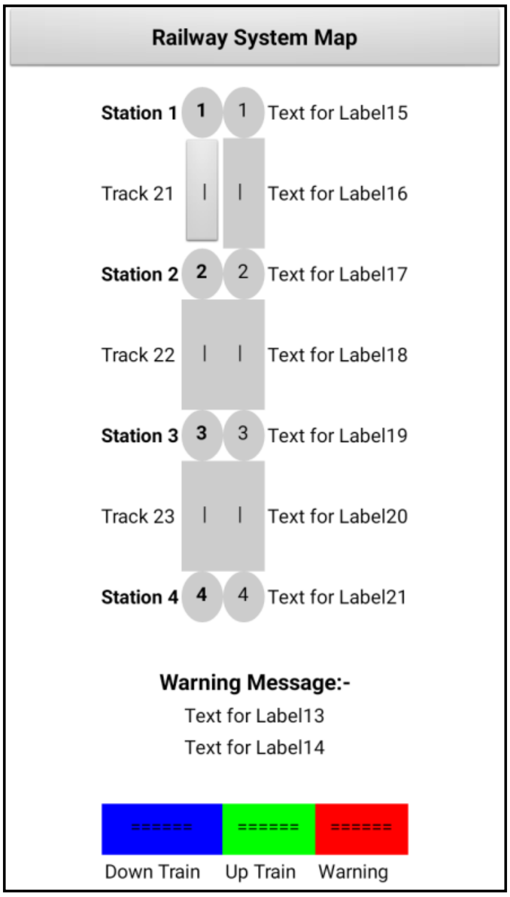

Fig.4. Railway Site map

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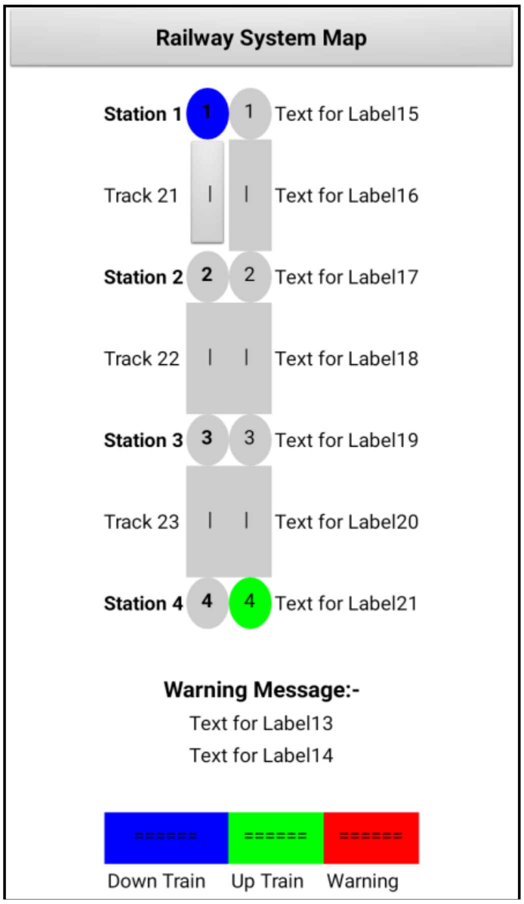

Fig.5. Up and Down train at station

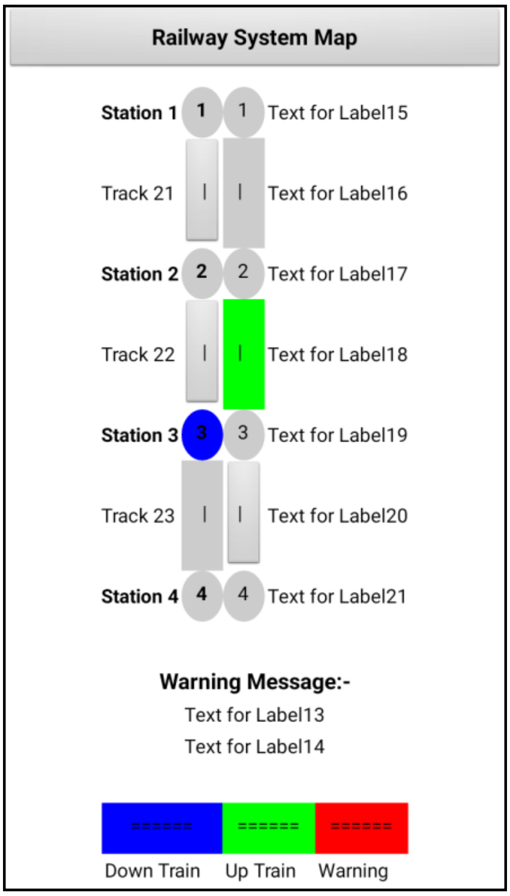

Fig.7. Down and up trains are at nearest station

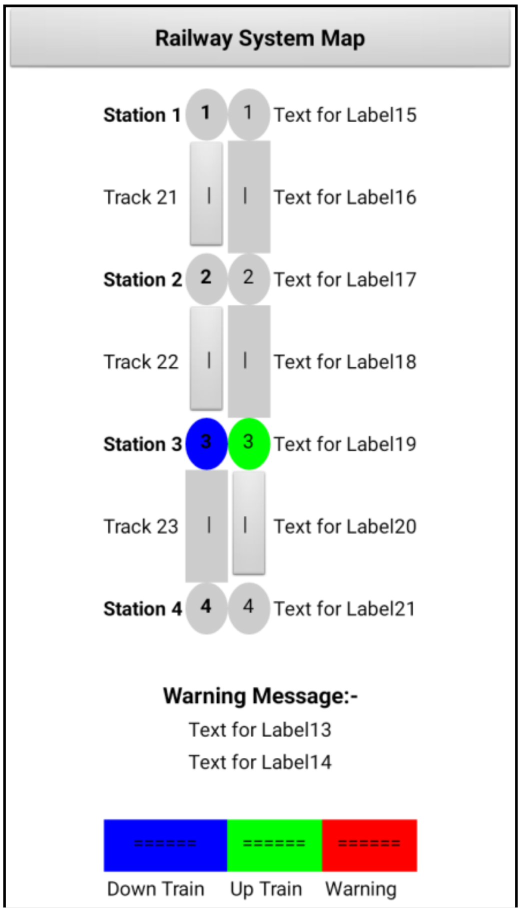

Fig.6. Down and up trains are at same station

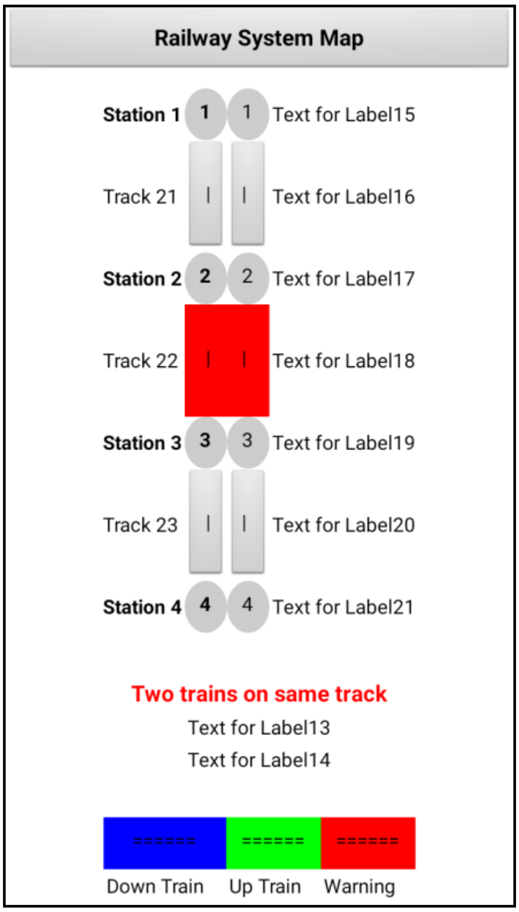

Fig.7. Two trains are on the same track

All above results are taken on android mobile which is acts as a base station.

VII. ADVANTAGES OF THE SYSTEM

Following are the advantages of the existing system.
(a) Cost effective , economical and small in size.
(b) No personal skilled are required to operate the system.

VIII. 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.

IX. 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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