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# MICROCONTROLLER BASED MODEL DESIGN OF A SAFETY SYSTEM FOR TRAINS USING GPS

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***Abstract:*** ***In every transport medium, safety is the utmost priority, especially in the case of railways. In recent years, with the introduction of high speed trains, speed and capability of railway system has exponentially improved, and in-turn the traffic density has also increased. As a result, the requirement to design a reliable and safer system of high speed railway transportation enhances increasingly.***
***This system introduces a safety concept to curb the train accidents, such as collisions. The basic role of the system is to plan and build up an ease security framework with high unwavering quality and respectability which wouldenhance safety aspect of the rail transportation by minimizing human errors. Also, the proposed system would curb the safety issues during adverse weather conditions such as heavy rain or foggy season, when the visibility is very less which might lead to a possible collision between two trains on the same track. The decommissioned ACD developed by KRCL had inherent issues as it failed to receive active inputs from the railway signal system. The proposed system comprises of the equipment to detect the presence of another train on the same track in the nearby vicinity, and triggering a cascade of mechanism both automatically and manually which will help to stop the train and subsequently avoid the collision. The hardware used in the project includes ATMega 328 microcontroller, GPS module, Bluetooth module for communication and RFID reader for track detection. This paper presents a solution in which a microcontroller is used to execute a predetermined software algorithm to perform the precise action. Successful implementation of the proposed system would yield the desired result, in which the control room would detect the presence of two trains in the same region (using GPS) and on the same track (using RFID), and subsequently send an alert message (using Bluetooth) to the loco pilots to take the required action.***

***Index Terms– ATMega 328, GPS SIM28, HC-05 Bluetooth Module, EM-18 RFID Reader, LCD Display, etc.***

## I.INTRODUCTION

A standout amongst the most broadly utilized, agreeable and favored method of transportation framework is train, however at times, mishaps and crashes happen because of impact of trains. It is a very tedious and difficult task to contain such collisions due to the high speed of trains, which require a lead distance to stop. As per a report by Factly for the fiscal year 2014-15, in the 6 year period 2009-10 and 2014-15, human failure has caused more than 86% of the total accidents. Out of this, 41% accidents were caused due to the failure of railway staff and the rest were caused due to failure of others. Equipment failure caused only 2.2% accidents. In the very recent time, Indian Railways has claimed to have reduced the number of train accidents in a year, against the last 57 years. There have been many such train accidents across the world as well due to human errors.
The essential objective of the proposed train impact discovery framework is to recognize a conceivable crash between two trains early and to report it to the control room and the loco pilot before the impact happens.The collision could be either head-on or rear-end collision. In head-on collision, the engines or the front end of the two trains collide and in rear-end collision, the train rams into another standing in front of it. At present, there is no answer for stay away from the train crashes. Indian Railways has executed an answer dependent on Anti-impact Device (ACD) framework, yet they have characteristic issues in station areas and close bumpy district. The proposed framework is utilized to avert train mishaps by exploiting automated surveillance system, it depends on GPS, RFID, Microcontroller and Bluetooth, which will take out the issues expressed previously. In this framework each train track is recognized by track ID, each train peruses and sends its track ID to adjacent control room.If two trains are on the same track, then alert is sent to the main control room which will sub sequentially send the alert the train drivers.

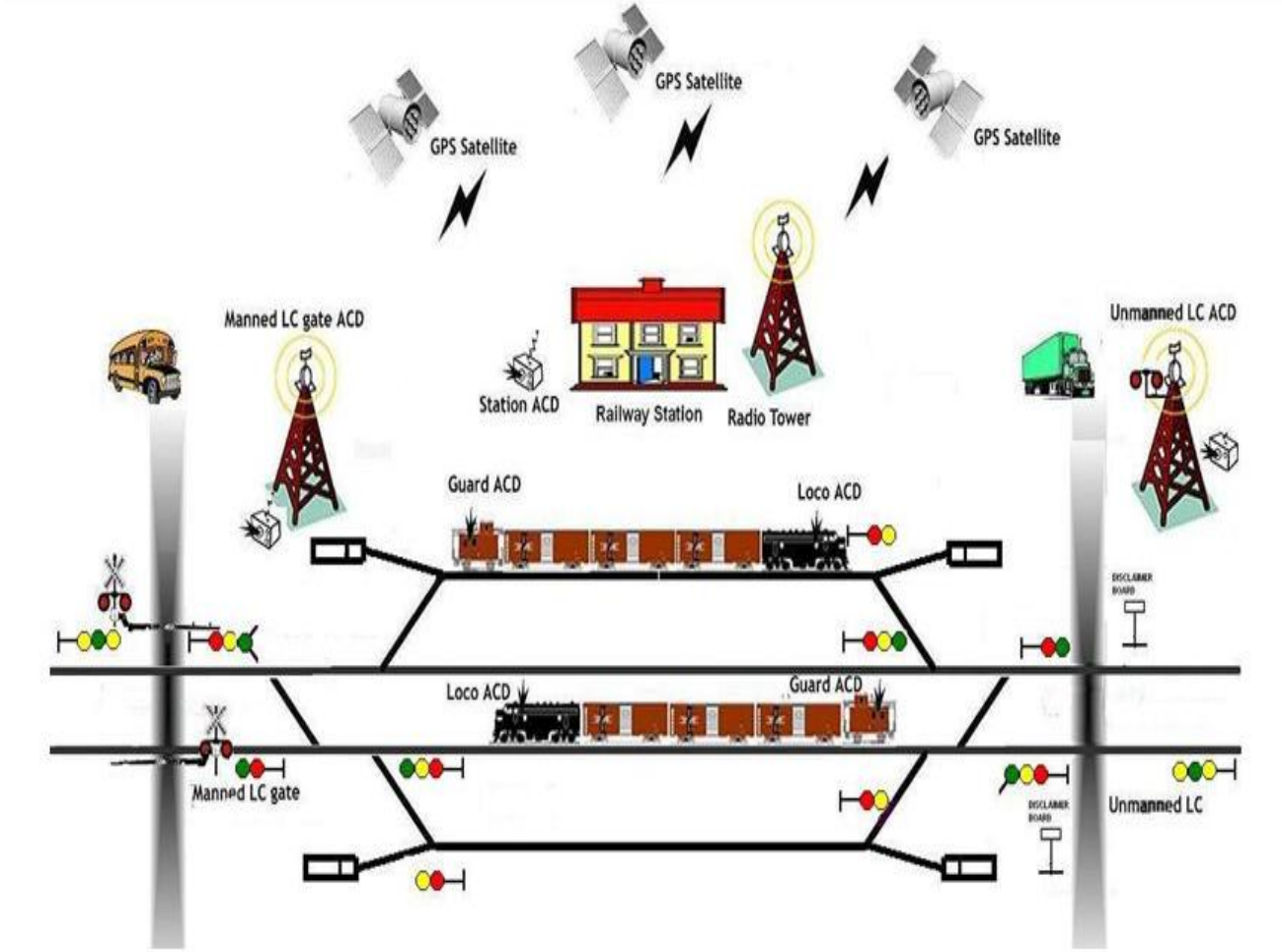
## II. LITERATURE REVIEW

In paper [1], wireless technology based collision avoidance system for railway sectors has been put forward. It uses ARM microcontroller along with android system integrated with ultrasonic and MEMS sensor which are in-built on the train. In paper [2], GPS technology is used to pinpoint the exact location of an obstacle on the railway track.The solution is based onthe combination of mobile computing, Global System for Mobile Communication (GSM), Global Positioning System (GPS) and software.In paper [3], a security framework for trains covering a few viewpoints has been advanced. It utilizes inserted framework which comprises of signals, switches, microcontroller, LCD, MAX 232 sequential correspondence, Bomb locators, Temperature Sensor, DC Motor, Motor drive, Zigbee transmitter and beneficiary. Bomb discovery is finished by exploiting the wonders of changing magnetic field in a coil, metal detectors rely upon distinguishing one of

the few impacts that could be seen when a metal item impacts the attractive field encompassing a loop of wire conveying an alternating current. In paper [4], UV sensors are used to detect the presence of objects on the railwaytrack. IR sensors are used to identify the cracks on the track. GSM technology is used for communication purpose. In paper [5], IR sensors have constraints because of the geographic idea of the tracks and furthermore utilized alongside Light Emitting Diode-Laser Dependent Resistor. The Anti-Collision Device system (ACD) presented by Konkan Railway (KR) additionally needs in correspondence capacity between the trains and the control centre or station, subsequently it was later decommissioned.

## III. EXISTING SYSTEM

The ACD Network is a train-crash anticipation framework developed by RajaramBojji and licensed by Konkan Railway Corporation Limited (KRCL),a public-sector undertaking of the Ministry of Railways, government of India. ACDs depend on GPS satellites for position refreshes. They trade data through radio recurrence (RF) transmissions to naturally brake and avoid impacts. Loco ACDs brake to decrease the train speed to 15 km/h. They get messages from the different ACDs on contiguous tracks. In the event that inbound ACDs of different trains read 'train separated', the trains decelerate until they have halted to forestall perilous side impacts that can happen when nearby tracks have been harmed.




The system failed to take any active inputs from existing Railway signal system, and additionally lacked in two ways communication capability between the trains and also the management centres or stations, hence it was later decommissioned. The proposed system avoids direct communication between the trains which may face issues at times, rather the communication is done through the control room which continuously monitors their position and sends an alert message if they're found to be on the same track.

## IV. SYSTEM ARCHITECHTURE

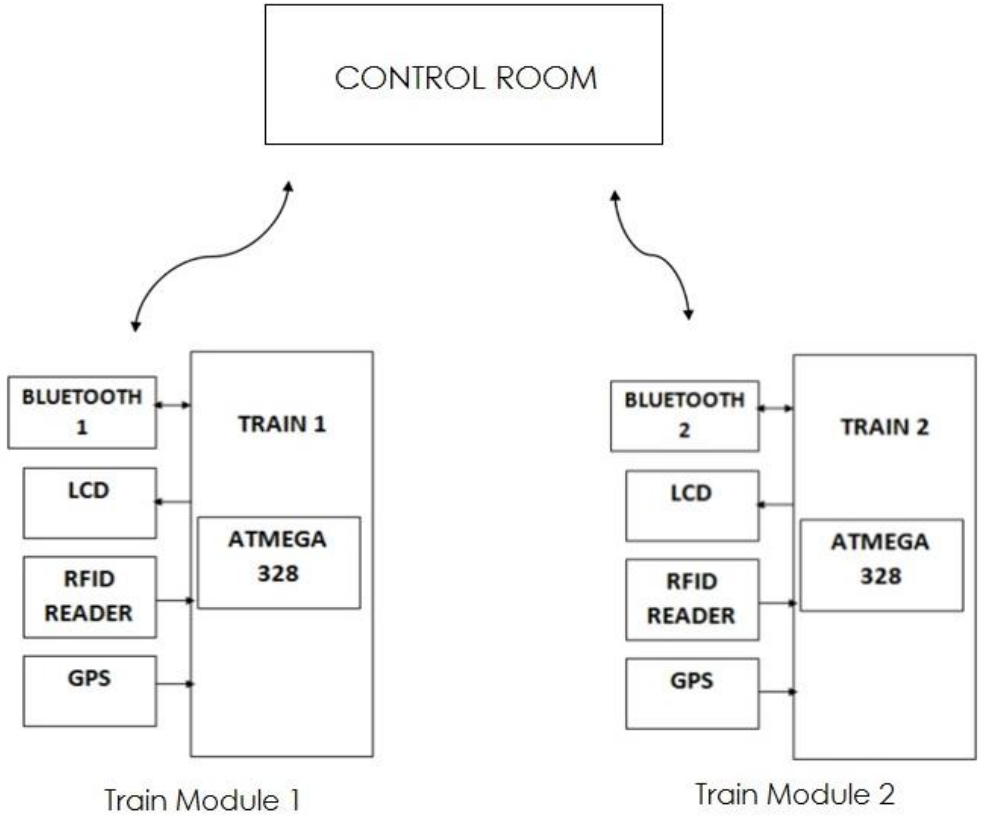



Fig.1 Block Diagram

The train tracks are partitioned into sections with individual track portion number. At whatever point a train enters a portion of the track, the track number of that fragment of track is perused from the Radio Frequency Identification (RFID) labels present toward the start of each section of track. This track number perused by the RFID tag is stored and after that given to Radio Frequency (RF) Transceivers. The RF correspondence is built up among the adjoining trains, which are in the range through a calculation, so 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 loco pilots and the control room.

In Indian railroad framework the train tracks are partitioned into various casings and for each fragment there is independent track id number. In the proposed framework the Radio Frequency Identification (RFID) labels are joined toward the start of each section of track at 10 km separation. At the point when the train enters in the particular section, the track number of that fragment of track is perused by the RFID tag in the RF reader. At that point 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. What's more, the remote module sends the SMS to the approved individual to make suitable move. Along these lines the RF correspondence is set up among the train and the base station. At the base station there is LED is available which is the sign of two trains at a similar track.

- **Hardware Specifications**

The microcontroller based safety system for trains consists of GPS module, RFID, Bluetooth module and ATMega 328 microcontroller. For displaying the alert messages, an LCD is used.

**a) ATMega 328**

The ATmega328 is a single-chip microcontroller created by Atmel in the megaAVR family (later Microchip Technology acquired Atmel in 2016). It has a modified Harvard architecture 8-bit RISC processor core.

**b) EM-18 RFID Reader**

The EM-18 RFID Reader module working at 125 kHz is a reasonable answer for your RFID based application. The Reader module accompanies an on-chip receiving wire and can be fuelled up with a 5V control supply. Catalyst the module and associate the transmit stick of the module to get stick of your microcontroller. Demonstrate your card inside the perusing separation and the card number is tossed at the yield.

**c) GPS SIM28**

SIM28 is a stand-alone or A-GPS receiver. With built-in LNA, SIM28 can relax antenna requirement and don't need for external LNA. SIM28 can track as low as -165dBm signal even without network assistance. The SIM28 has excellent low power consumption characteristic (acquisition 24mA, tracking 19mA).

**d) HC-05 Bluetooth Module**

HC-05 Bluetooth Module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Its communication is via serial communication which makes an easy way to interface with controller or PC. HC-05 Bluetooth module provides switching mode between master and slave mode which means it able to use neither receiving nor transmitting data.

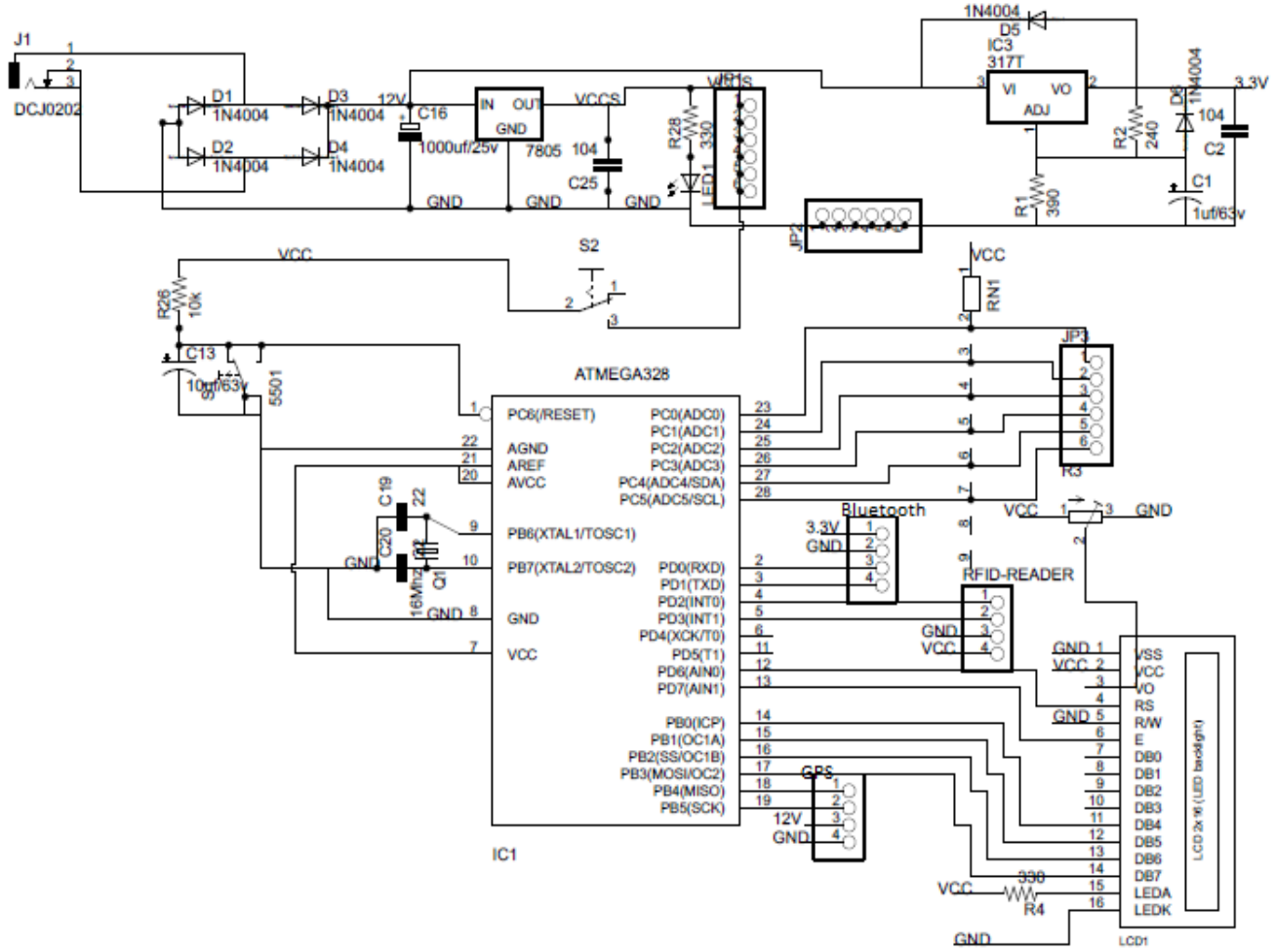



Fig.2 Circuit Diagram

## V. IMPLEMENTATION

1. Foremost, one needs tostudy about the existing safety system in Indian Railways. Conventional train control systems using track circuits for train detection require huge investment in equipment and maintenance. There are several reasons: various ground facilities must be installed on and around the tracks, train positions cannot be detected very accurately; many signal cables are required to connect the ground units, etc. In addition, since train control is implemented by block, conventional systems cannot effectively support changes in transportation mode, such as development of new and high performance vehicles.
2. The designer will acquire the hardware components which are suitable to be used in the project.He'll interface ATmega 328 microcontroller to the GPS module (SIM 28), Bluetooth Module (EM-18) and LCD display. This whole unit will be mounted onto the locomotives and external power supply will be fed to the circuit by the locomotives itself which will be fetched by the pantograph from the OHE (Over Head Electricity) cables. Microcontroller with implicit peripherals requiring less outer segments is utilized, this lead to low complex framework that encourages simplicity of programming and reconfiguring the whole framework.
3. The GPS module will consistently follow the situation of the trains in the region. The RF recipient in every one of the trains will be active constantly, except at the instants when its own transmitter is active. At the instant, when both the

conditions become true i.e. GPS shows that the trains are in the region and RFID tag implicates that the trains are on the same track. An alert will be sent to the control room which in-turn will pass it on to the locopilots of the individual trains and the alert message will be displayed on the LCD. This wireless communication will be done using Bluetooth. (In real life implementation of such system, a GSM module would be used to facilitate the communication and mobile handset would be used to display the alert message. We have used Bluetooth in our project for the mere benefit of uninterrupted connectivity in a small region. A GSM signal is more prone to the network fluctuations. Such issue would be curbed in the real life application by installing network towers at certain distances near the railway tracks.)

4. The interfacing of the hardware components is done using Arduino IDE software. Also, the control room is depicted using Matlab server. It will execute a predetermined software algorithm which will confirm if the trains are on the same track.
5. The PCB layout of the circuit has been prepared on EAGLE(Easily Applicable Graphic Layout Editor) software.
6. In the final stage, on needs to test the prototype for its successful implementation. The proposed framework is completely automated. Subsequently it will outperform the human carelessness. Track number plates are RFID labels which are more dependable than different ways conveying the information (track number) to framework. These are not influenced by common obstruction and aggravation. With the proposed method for track numbering, the track numbers can be rehashed outside RF region of past track sections. This outcomes being used of less number of bits (16 bits) for track numbers particularly if there should arise an occurrence of huge rail organize, prompting less calculation weight on microcontroller.

## VI. EXPECTED RESULT

When two trains are detected in the same region by GPS, and their track is found out to be same by the RFID tag, the control room continuously sensing their position would realise the possibility of a collision and immediately send an alert message to the both loco pilots. After receiving the alert, both trains will begin to decelerate and the collision would be prevented.

While realising the proposed system, it was found that out of 4 attempts, the system responded in the desired way all the times. Hence, we can firmly state that the proposed system is suitable to be implemented along the existing railway network.

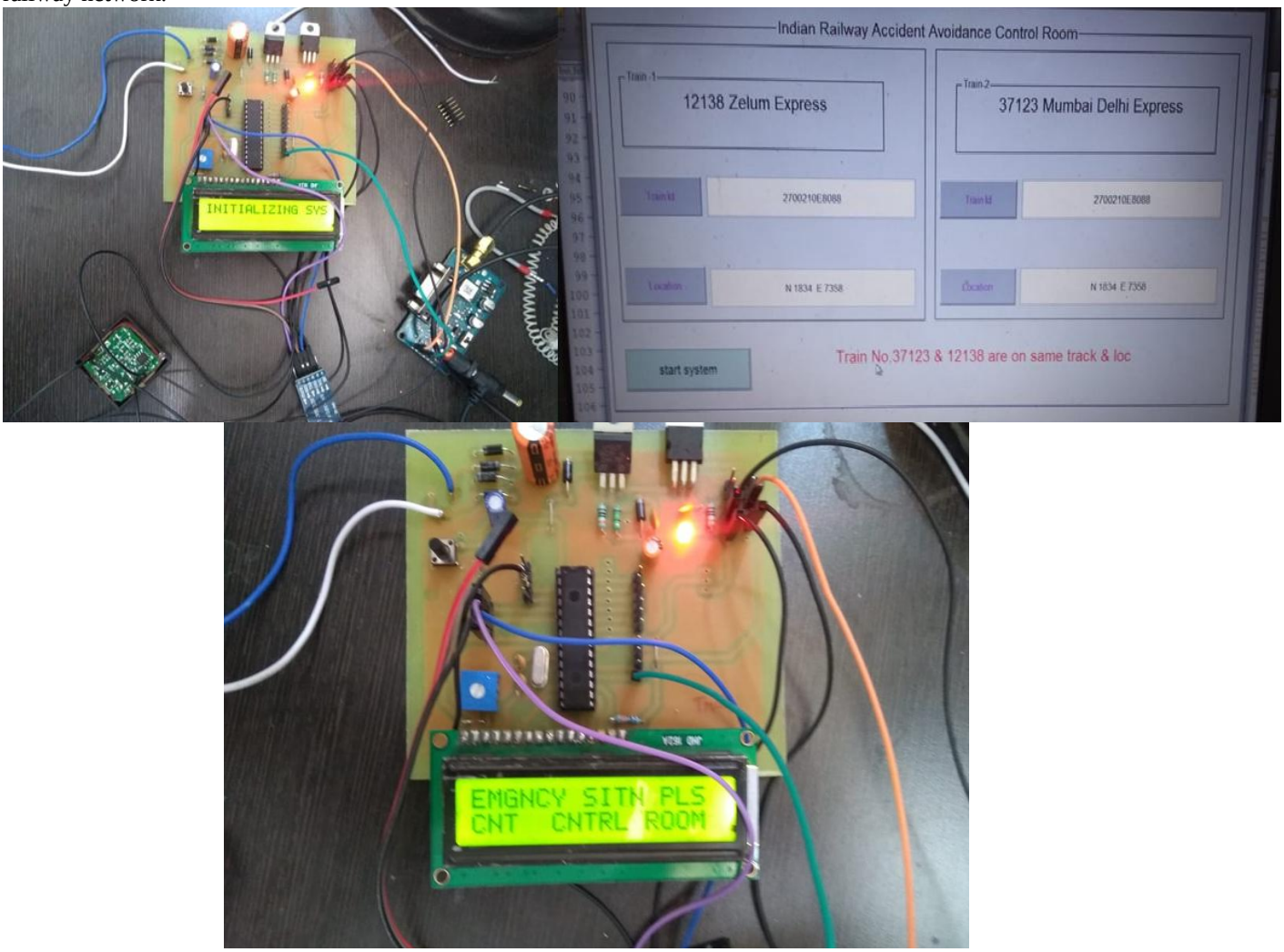



Fig. 3 Implementation of the proposed system

## VII. CONCLUSION

In this paper, a design for an enhanced safety system for the railway network using wireless communication technology has been put forward. The system will setup an apt communication system between the control room and the loco pilots using GPS and Bluetooth and confirm their track ID using RFID tag. This system can also turn out to be a boon during winter season. Especially in the northern part of the country where there is presence of dense fog and visibility is hardly of a few meters.

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