Tracking And Speed Limiting In Vehicle Using RFID And LoRa

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ABSTRACT

In the fast-growing world many people are now having their own personal vehicle due to which the number of vehicles on the road are increasing at a huge pace. According to many reports the main reason for road accidents is not obeying speed limit guidelines. In addition to that cellular network coverage is poor in some portions of highway especially in remote areas many individuals face problems in contacting different authorities for help in case of emergency. In the proposed paper we have come up with an idea to solve these problems by having RFID tags be embedded to each and every speed limit board so that when the vehicle arrives in a particular speed zone the RFID receiver embedded in each vehicle should receive the tag information, which limits its maximum possible speed. The LoRa transmitter installed for emergency cases would enable the drivers to send information, which includes the current location from GPS and vehicle number to the authorities for providing emergency help.

Keywords: RFID, LoRa & GPS.

INTRODUCTION

According to a report by the World Bank in 2020 India accounts for 11% of the global deaths from road accidents while it has only 1% of the world's vehicles. Approximately 450,000 accidents occur of which an estimate of 150,000 people die in India every year. India has the highest number of casualties in road accidents. Every hour approximately 53 road accidents take place and every four minutes one death happens.

According to a report given by PRS research legislative In India both national and state highways comprise about 5% of the total road network and almost 52% of the total accidents. Since 2000,

while road length has increased by 39%, number of motor vehicles have increased by 158%. The main reason for more accidents on highways are higher vehicle speeds and higher volume of traffic on these roads. Almost 78.4% are caused due to driver's fault such as over speeding, driving after consuming alcohol or drugs etc. Road authorities had placed information on road safety boards and speed breakers to make the driver reduce their vehicle speed, but these road safety boards are not sufficient for reducing the road accidents.

In order to overcome these existing problems, we have come with an effective system. Where we make use of RFID tag for the speed alteration. Here, an RFID tag has to be installed for each speed limit board for notifying the speed limit. There would be an RFID receiver on the vehicle for receiving information from the tag about the speed limit board.

In addition to that cellular network coverage is poor in some portions of highway especially in remote areas many individuals face problems in contacting different authorities for help in case of emergency. In case of such emergency, the vehicle has been installed with the emergency button that transmits the vehicle information and the coordinates obtained from GPS module with the help of the LoRa transmitter and nearest the LoRa receiver which is installed on the speed limit board receives the signal and notifies the concerned authorities.

LITERATURE SURVEY

S.No.	Paper Title	Year of Publication	Inference	Advantages	Disadvantages
1	RFID Based Automatic Speed Limit Warning System	2010	This paper analyses the possibility to monitor and warn vehicle speed through RFID based system and thus provides the performance of different RFID based systems that can be implemented.	RFID can provide non-contact data transfer without need of line-of-sight data gathering. High read rates can be achieved from RFID tags. RFIDs can provide sufficient range for transfer of data for this application	This paper focuses on system to only monitor car speed.

2	RFID based virtual speed breakers: Perspective Bangladesh	2014	In this paper, RFID based virtual speed breaker will have three units. When the vehicle comes into the range of the RFID tag the reader will get specific signal from the tag. The ECU will control the electronic fuel injection system and electro-hydraulic Braking system in the vehicle that will reduce the speed of vehicle	This paper offers RFID based virtual speed breaker instead of the traditional speed breaker. It is a smart vehicle controlling system that will ensure the safety of the passengers whither the driver is conscious or not. The cost of implementatio n is low and the system is durable.	This is paper just proposed the conceptual idea and prototype is not made for this model.
3	A solution to speeding related problem in road vehicles using passive RFID tags	2014	This paper gives a prototype on speed controlling of vehicle using passive RFID which detects the tag and automate the speed of the vehicle.	The RFID used provides high read rates when compared to GPRS or RF. RFID provides wireless transmission of data without the need for direct line of sight data gathering.	This prototype won't work when the vehicle moves in high speed so can be used for the limited speed range. There is a chance when two vehicle moves parallelly the tag can't be recognized.

4	A survey on LPWA technology: LoRa and NB-IoT	2017	This paper provides a survey on NB-IoT and LoRa as efficient solutions connecting the devices and compares their performance.	It is shown that unlicensed LoRa has advantages in terms of battery lifetime, capacity, and cost.	However, in terms of QoS, latency, reliability, and range LoRa doesn't perform well in comparison to other existing Low power Wide Area (LPWA) technology
5	An Economic Tracking Scheme for GPS-GSM Based Moving Object Tracking System	2018	This paper, proposes to reduce the tracking cost using GPS-GSM tracking system technology. The proposed methodology was implemented and tested.	Doesn't require internet connection. Tracking cost is reduced significantly. Majority of smart phones are equipped with GPS modules, and they can be easily loaded by mobile tracking application.	Requires cellular network. At bad weather low visibility and at remote areas getting GPS coordinates is difficult.
6	Wireless Speed Monitoring System using GNSS Technology	2018	This paper analyses the possibility to monitor and track vehicle speed through GSM and GNSS technology, where the present location and	This system can effectively monitor the vehicle for 24/7. This system can collect data even in remote areas. This system provides max security unless	This paper focuses on system to only on monitor car speed and location. When the GPS failed to track the coordinates, no data is

			speed of that location is remotely used by any specific third party with an windows-based application.	the data gets tampered by someone.	obtained for the instant.
7	Real Time Automatic Speed Control Unit for Vehicles	2018	The proposed paper aims to control speed of vehicle by using GPS module by tracking down the speed at the zone and control the motor speed with the help of PWM method.	This was the paper in which they made a prototype for controlling speed using PWM method. The GPS based speed technique was tested in lab view before implementing the actual prototype.	GPS is made as primary input for providing data about speed limits of the zone which sometimes doesn't give data is accurately. This prototype for real-time implementation is not possible.
8	RF Based Smart Zone Vehicle Speed Monitoring and Control System	2019	This paper aims to control speed by using RF receiver and transmitter thus if there is any speed limit zone then car speed would be reduced to the specified speed limit.	This can be implemented for speed limit for controlling speed in a specific small zone such as near school, hospitals etc. Simple method to control vehicular speed	RF signals can be easily intruded by the hackers and they can be modified tampered or jammed easily. It will be only work for controlling speed in a

					specific small zone
9	Implementation of a Speed Control System Using Arduino	2019	The proposed paper aims to monitor the speed of vehicles precisely. The system consists of an ultrasonic sensor, an Arduino board, and a webcam. If the vehicle exceeds the predefined speed, the system will take a high-resolution digital image of the vehicle and the license plate. The image taken will be presented as a guide to the competent authorities	Speed monitoring can be done in efficient way. It excludes ambulance (or fire engines) from the allowable specified speed of the road as they can sometime break the speed limit in case of emergency	This paper focuses on system to only monitor car speed and not to control the speed. Implementation of this system is costly as it requires high resolution camera and database is also need to managed. Under certain circumstance like bad weather and low visibility this system wouldn’t work.

10	Integrated Real-time Vehicle Speed Control System using RFID and GPS	2020	This paper proposes to integrate RFID and GPS for efficiently controlling the speed of vehicle based on allowable speed limit of the particular location	Uses passive RFID tags as they don't require any external power. Uses GPS and RFID tag thus incase GPS is unavailable RFID can be used to control speed of vehicle based on speed limit of that location. Used DES on data present on RFID tags to prevent it from tampering	GPS is made as primary input for providing data about speed limits this is not advisable especially in places where data is insufficiently provided. Would require higher amount of data processing to acquire data from GPS. Continuously monitors data from GPS hence would require a lot of memory and computational power.
11	Design of Automatic Speed Controlling System	2020	In this paper system uses RF technology. RF transmitters will transmit speed limit of the zone and a RF receiver placed in the vehicles which controls the speed of the vehicle.	This system is bit cheaper compared to other system which are based on GPS for controlling speed. This system is highly advantageous to other system under certain circumstance like low	RF signals can be easily intruded by the hackers and they can be modified tampered or jammed easily. It will be only work for controlling speed in a specific small zone such as near school, hospitals etc.

				connectivity speed, bad weather and low visibility.	not suitable in highways.
12	An Experimental Study on the Use of LoRa Technology in Vehicle Communicatio n	2021	The purpose of this work is to evaluate the communicatio n between V2I, V2V, and stationary vehicles using LoRa technology in field tests with measurements of signal strength, reception ratio, and signal-to-noise ratio.	Lora is a long range, low power wireless communication system This system is highly advantageous to other system under certain circumstance like low connectivity speed, bad weather and low visibility.	Data transmission rate supported by LoRa is low.

PROPOSED ALGORITHM

In our proposed model RFID, LoRa transmitter and GPS module are interfaced to the microcontroller present in the vehicle. RFID receiver is used to detect and read any speed limit RFID tag present nearby. Motor control is also interfaced with microcontroller when speed has to be regulated. LoRa is used to transmit emergency signal when required. In our hardware demonstration, we have used two Arduino UNO microcontroller for the vehicle (due to limited no. of pins that are present in one Arduino UNO microcontroller), in one of the microcontroller RFID receiver and motor control are connected where RFID module is interfaced to microcontroller by SPI (Serial Peripheral Interface) protocol, while the other microcontroller is connected to LoRa transmitter and GPS module where LoRa transmitter is interfaced to Arduino by SPI protocol,

GPS module is interfaced to Arduino by UART communication protocol. The microcontroller present on speed limit board is connected to LoRa receiver. The speed limit tag is also affixed to the speed limit board.

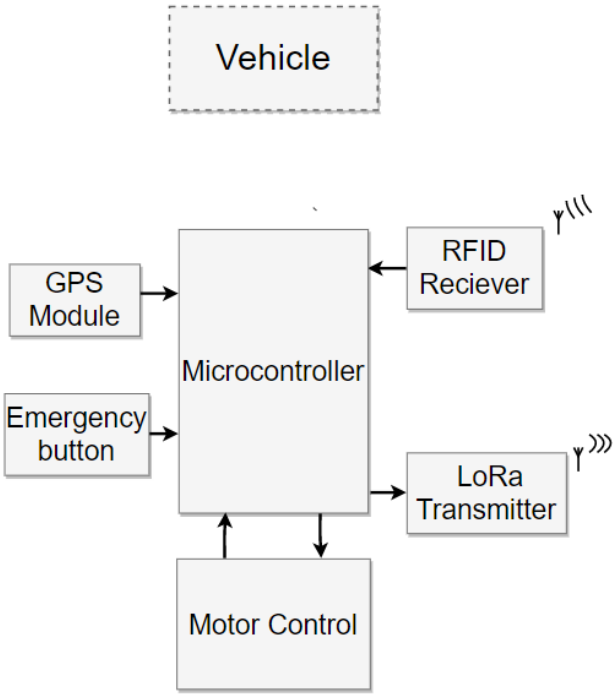


Fig.1a.

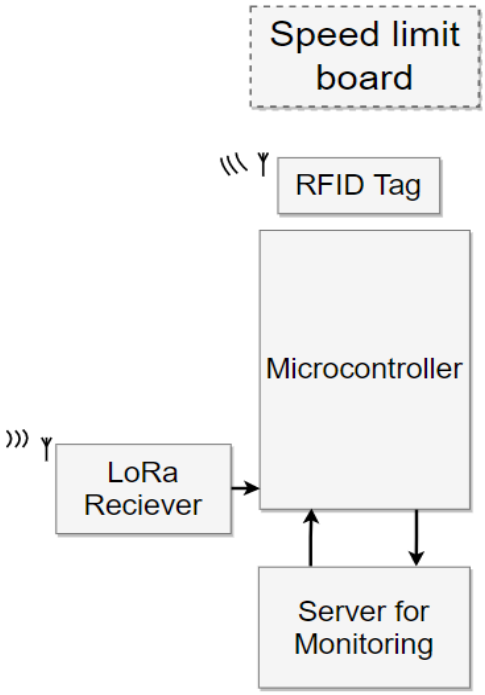


Fig.1b.

The above figure, Fig.1a) & 1b) refers to the architectural diagram of the proposed system for Vehicle and Speed limit board respectively.

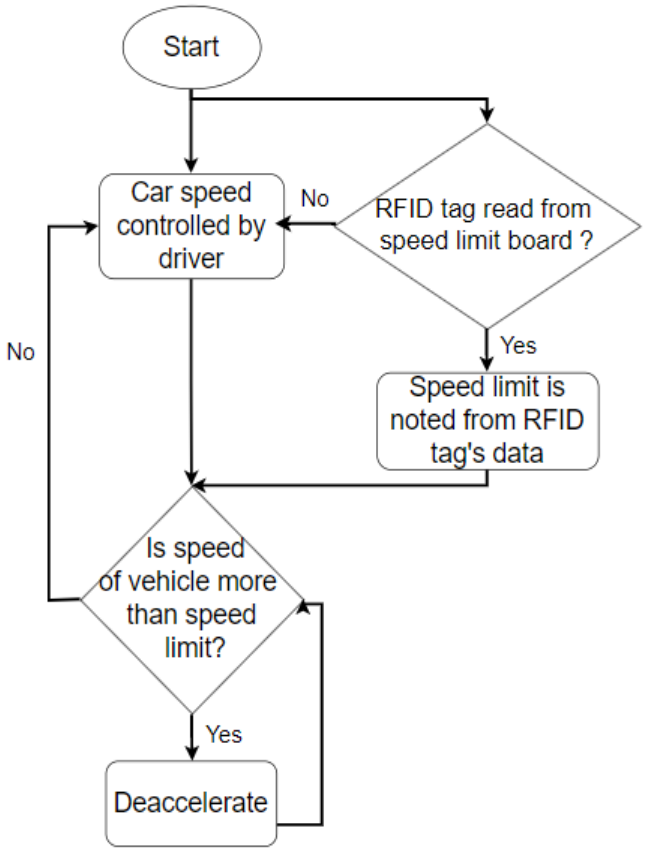


Fig.2 Flowchart for RFID Based Vehicle Speed Limiting Process

Before the RFID receiver reads any RFID tag from the speed limit board the vehicle speed is controlled by the driver. After a RFID tag is detected, the speed limit contained in the tag is read. The microcontroller then compares the speed of vehicle and the speed limit from the tag. If the speed of vehicle is more than the speed limit specified, then the microcontroller send a control signal to the motor control of vehicle to reduce the speed. Else the speed is not changed by the microcontroller. In our hardware demonstration we have pre-defined the speed for each tag individually. The speed is adjusted by varying the duty cycle of PWM signal passed to the motor control through microcontroller. The motor control here is achieved by L293D IC which is a H-bridge based motor driver. For different speed, the PWM duty cycle is adjusted, and the microcontroller regulates energy to the motor shaft accordingly when the tag is read.

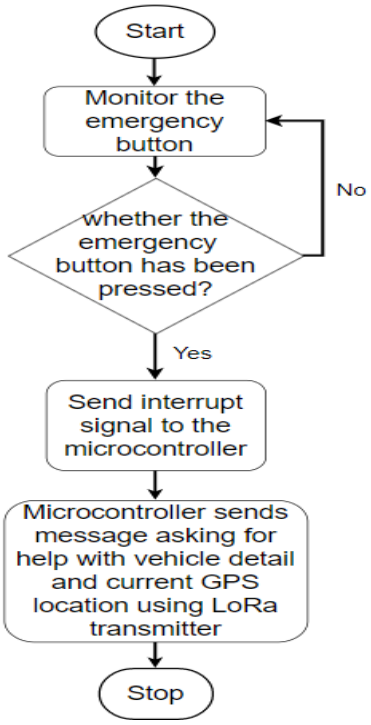
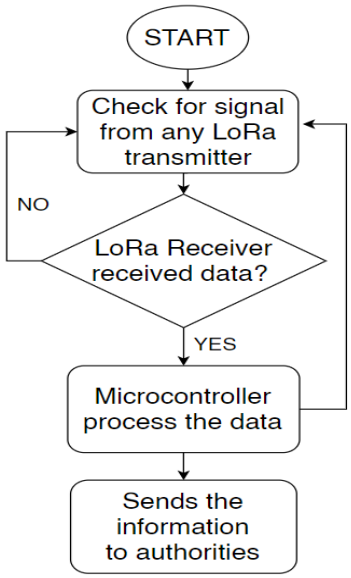


Fig3. Flowchart for Process involving Transmission of Emergency Signal

When the emergency button is pressed, an interrupt signal is sent to the microcontroller. Then the microcontroller gets the GPS location of the vehicle and this location along with the vehicle number details is transmitted using the LoRa transmitter to the nearby speed board which has the LoRa receiver. In case emergency button is not pressed it will keep monitoring the status.



Fig,4 Flowchart for Process involving Monitoring of Vehicle and Receiving of Emergency Signal.

When there is any emergency signal is received by LoRa receiver at the speed limit board then the information is processed by the microcontroller and that information can be sent to the respective authorities. If there is no received data, then the receiver will keep monitoring for any signal.

RESULTS AND DISCUSSION

The final implementation of the project prototype consists of 3 parts namely – 1) Vehicle Speed Limiting; 2) Transmission of Emergency Signal; 3) Receiving of Emergency Signal.

The prototype shown in Fig.5 includes Arduino UNO as microcontroller, RFID receiver, L239D motor driver module, DC motor and a wheel connected to it.

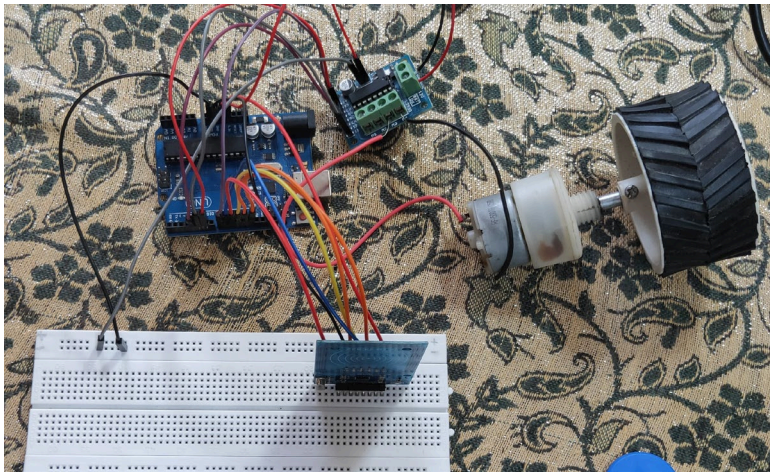


Fig.5. Vehicle Speed Limiting hardware setup

The prototype is made such a way that the vehicle is set to move in certain speed by default until it come across any speed limit board. In Fig.6, RFID tag containing 50 km/hr speed limit is read by the vehicle and the speed of motor is adjusted to the speed limit as per the tag.

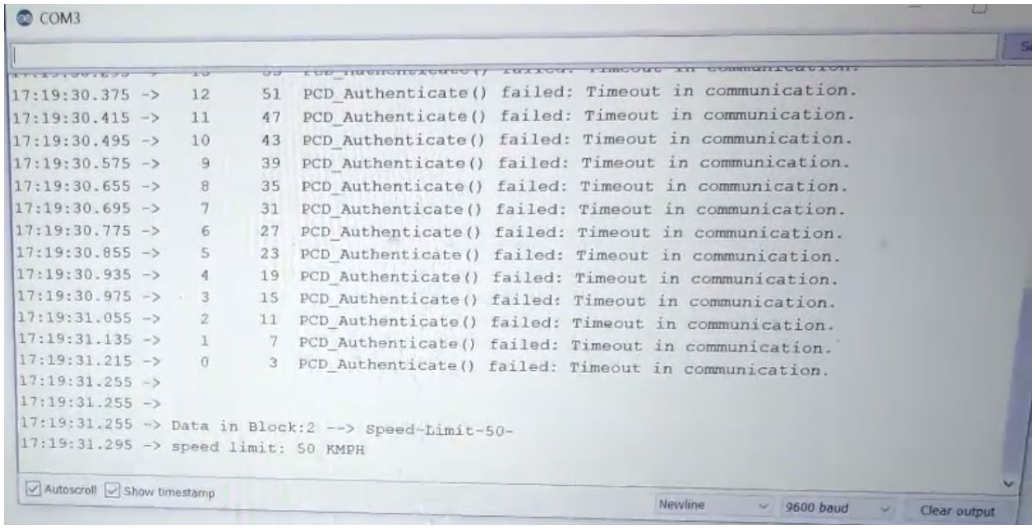


Fig.6. When the vehicle crossed across the speed limit board containing 50 km/hr has the speed limit.

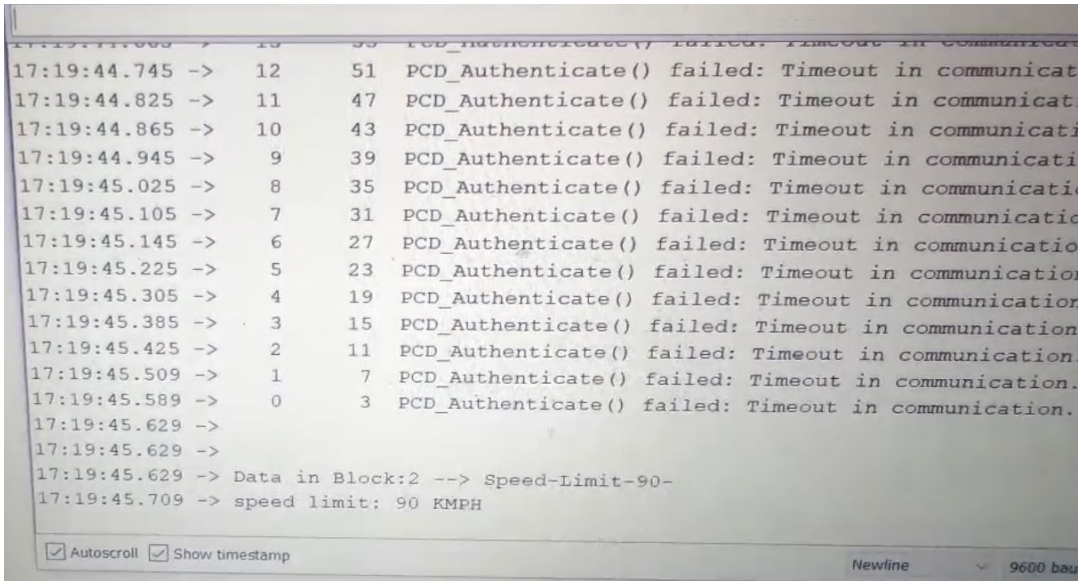


Fig.7. When the vehicle crossed across the speed limit board containing 90 km/hr has the speed limit.

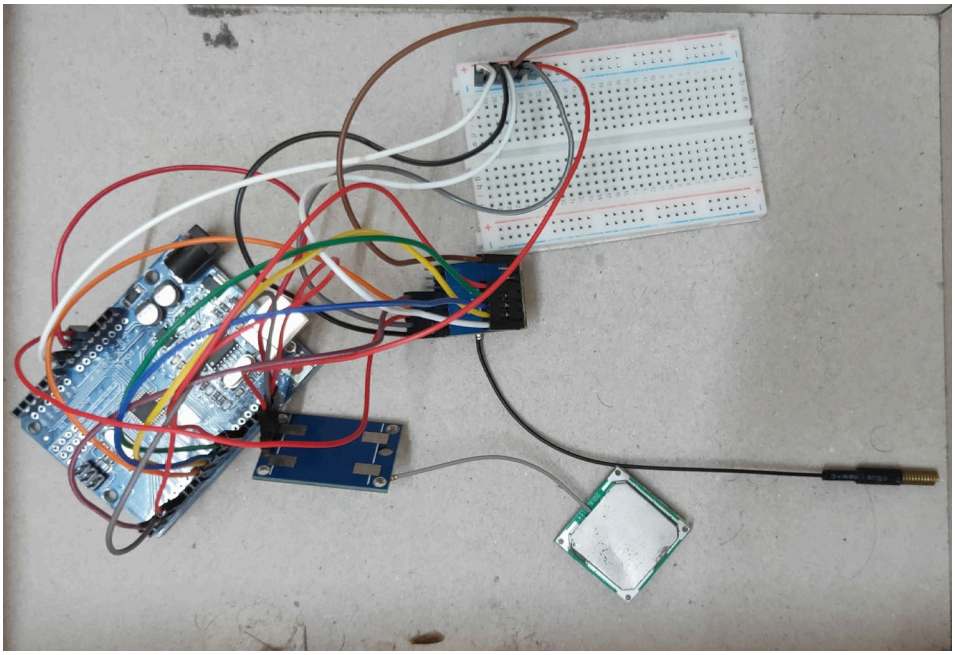


Fig.8.Transmission of Emergency Signal hardware setup

The prototype shown in Fig.8 includes Arduino UNO as microcontroller, LoRa module transmitter and GPS module. When the emergency case is met by the vehicle, an emergency signal containing vehicle number and the GPS coordinates of the vehicle location is transmitted to the nearby LoRa receiver end as shown in Fig.10.

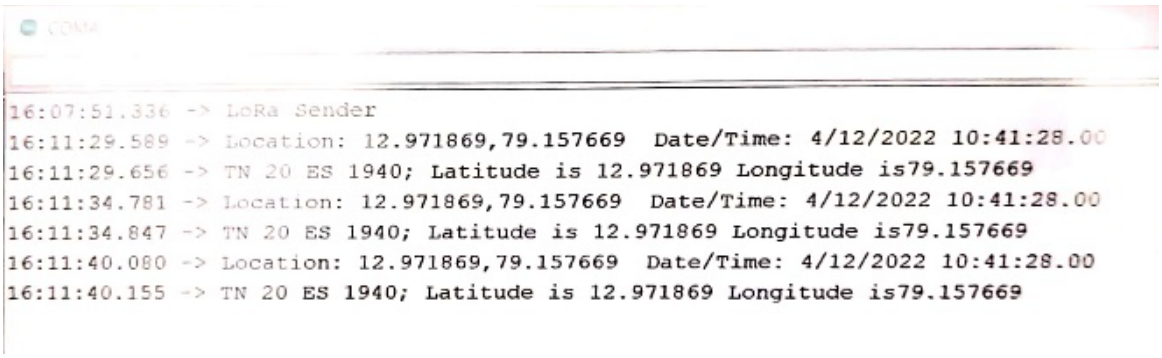


Fig.9. Emergency signal sent using LoRa module sender to the nearby LoRa module receiver.

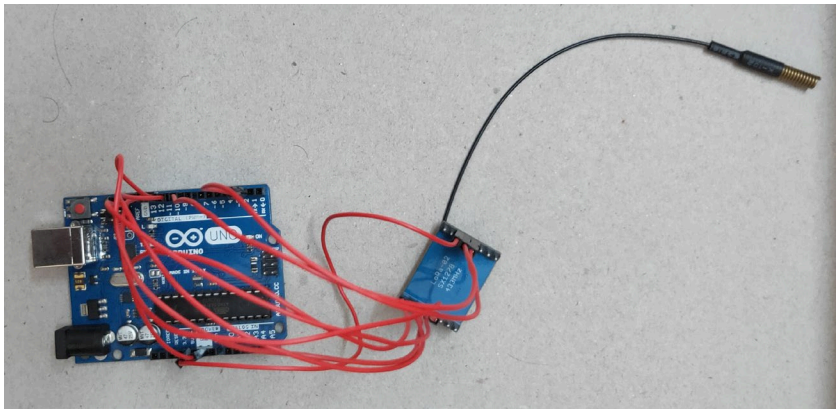


Fig.10. Receiving of Emergency Signal hardware setup

The emergency signal received at the LoRa receiver is collected and this information is passed to the concern authorities for further necessary actions.

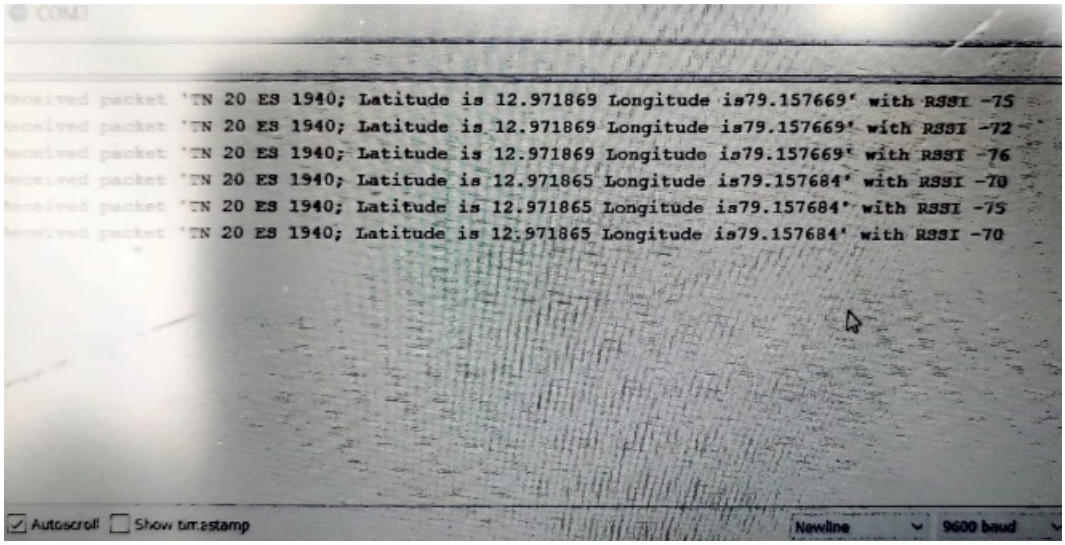


Fig.11. The emergency signal received by LoRa module receiver.

For simplicity and demonstration of our proposed idea we have used an inexpensive RFID module i.e., MFRC522 RFID reader/writer module which is used to transfer data over short distances along

with this we have passive RFID tag thus the range of detection of RFID tag by the reader is small. The GPS module used for sending coordinates of the vehicle may not be able to procure the vehicle location when the weather is bad or when the vehicle is present inside a tunnel.

CONCLUSION

The prototype designed for the vehicle speed control was working efficiently and the communication made for the emergency situation will provides better service for the drivers when there is any disturbances in their way. The model can further be improved by using IoT and cloud services for establishing much faster communication for the emergency cases with the concerned authorities.

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