Vehicle Tracking System Using LoRa Module

S. Kulandaiyan[1], *B.E., Department of ECE, SVCE, Chennai, Tamil Nadu, India,*
D. Manimaran[2], *B.E., Department of ECE, SVCE, Chennai, Tamil Nadu, India,*
S. Raajesh Baabu[3] *, B.E., Department of ECE, SVCE, Chennai, Tamil Nadu, India,*
Dr. S. Muthukumar[4], *Professor & Head., Department of ECE, SVCE, Chennai, Tamil Nadu, India.*

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Abstract - *Nowadays, all new generation vehicles use internet technology which consumes more power and energy resources. However, the use of LoRa technology reduces the cost which is a one-time investment. LoRa uses license-free sub-gigahertz radio frequency bands. LoRa enables long-range transmissions with low power consumption. The technology covers the physical layer, while other technologies and protocols such as LoRaWAN cover the upper layers. It is based on spread spectrum technology. The spread spectrum LoRa modulation is performed by representing each bit of payload information by multiple chirps of information. It is easy to build and deploy, license free frequency band nodes, and the spectrum transmission stage is free. In this project, we use a Raspberry pi to interface the user to sub-stations. When the driver requires any health assistance, he presses the button which is fed as an input by the LoRa module, this request is sent to the nearby Base station, and so the driver is able to track the exact coordinates of the hospital. And next when the vehicle violates the signal, we use the RFID reader module to sense the tag. When the RFID reader reads the tag of the violated vehicle, it stores the vehicle's information in its database. Fine amount will be displayed in the violated vehicle. Accidents occur mostly because of over speeding. We use an inductive proximity sensor to measure the Rpm of the tire. If the Rpm reaches the threshold that is set, then the vehicle owner registered in our database is fined by an amount.*

Key Words: **LoRa, LoRaWAN, Speed Violation, Traffic Violation.**

1. INTRODUCTION

In these days, LoRa started to emerge as a great sensor among Internet of Things. They are capable of transmitting data and receiving data, gathering the latitude and longitude without any Global System for Mobile Communication (GSM) module. The people in other countries follow rules because the violation is being sensed in an efficient manner and the people who drives the vehicle realizes their violation respective to their driving, sooner the vehicle makes the violation. The network is formed by establishing each LoRa (HC-12) configured with a raspberry pi which will transmit and receive data to and from the respective base station. There are several base stations which are configured with an ESP32 and all these base stations are connected to another single Main Station, which is interfaced with Wi-Fi module to transmit data received from the each and every individual user.

1.1 BACKGROUND AND MOTIVATION

Collectively, accidents in India occurs mainly because of three reasons, viz., drive's health issue; Traffic Signal Violation; and Over speeding.

When we look into the accidents and death rate for instance, in all scenarios, the death rate rises when number of accidents rises as it is directly proportional. When keeping these things on account, there are several existing models which comprises of Speed Governor installed in all the vehicles (not possible), traffic signal violation is recognized by capturing the vehicle number in a camera and notifying that particular user with a penalty respective to that vehicle owner.

The over utilization of internet leads to the bird species to become more endogenous. In Fact, few birds have become extinct. To expand the life span of all the bird species and make the user very effective on thinking about spending money over and through the internet to find ways in order to navigate to few stops nearby like hospitals, garage, vehicle service centers, Fuel stoppages, Pit Stops, etc. on separate moves we use LoRa WAN. To find these things, we need a higher version of a vehicle they are possessing else need their mobile data to know the destination either. On keeping these things into consideration, we planned to build a prototype that satisfies these three major problems.

The LoRa can work in three frequencies, viz., 945 MHz; 816 MHz; 433 MHz In India, we are allowed to use only 816 MHz, which has a success rate of 15 to 20 Km Radius. So, we need to have a base Station or Sub- Station per fifteen kilometers for connecting the users within the network.

1.2 OVERVIEW AND OBJECTIVE

In general, the LoRa, HC-12 is verified with serial communicating the data in between the two lora's that each act as both transmitter and receiver. And the RFID module is configured with Node MCU for Traffic Signal Violation. Finally, the Inductive Proximity sensor is being interfaced with the wheel in each and every vehicle to check whether every vehicle follows the signal and speed resulting in following the protocols, and not exceeding the speed limit.

In order to make the system to get updated and an efficiency way of keeping bird safe from all the cellular towers as the LoRa require very low power for transmission and requires very less amount of current to drive through. However, these batteries need to be changed at least for every three years. By this way the accidents and death rates decrease proportionally making the rise of death in a very abate manner. The product's major advantage is its requirement of data for transmission is 150 to 200 kbps. And there is a transmission delay of 20 seconds.

2. SURVEY OF LITERATURE

People sometimes confuse the terms LoRa and LoRaWAN, however they are not interchangeable. LoRa is a means of sending radio signals that encodes data using a chirped, multi symbol format.

It's a proprietary system developed by Sentech, a chip maker. The LoRa IP can be licensed to other manufacturers. To convert radio frequency to bits, these standard ISM band radio chips can employ LoRa (or other modulation types like FSK). Because of this modulation, no coding is required to implement the radio system. Outside of a vast area, this lower-level physical layer technology can benefit applications. LoRaWAN is a point-to multi point networking protocol based on the LoRa modulation method developed by Semtech. It's not just about the radio waves; it's about how they interface with LoRaWAN gateways to perform functions such as encryption and identification. There's also a cloud component to which many gateways can join. Most firms do not employ LoRaWAN for industrial (private network) applications due to restrictions.

2.1 STUDY OF LoRaWAN:

Radio technologies like LoRaWAN are straightforward at their most basic level. The way star networks communicate is similar to a lecture between a professor and pupils. The professor (the gateway) communicates with the end nodes (the class) and vice versa. In terms of communication, this is an asymmetrical connection. Everyone (in the class) may be trying to speak with the professor at the same time, but the professor will not be able to hear or comprehend everyone at the same time. Many aspects of star topologies can be traced back to this example, albeit oversimplified. For developers, see the LoRaWAN Gateway sample.

Let us now move away from the comparison and look at some real-life examples. Assume you have four gates and a single node. The node sends a blind transmission into the radio spectrum, and any gateway lucky enough to hear it can intercept it and send it up to the cloud. The message might be received by all four gateways. (The one advantage is that messages can still be sent even if the links are weak.) If a node sends five messages and only one of them gets through, your message is still delivered. There is no acknowledgement of receipt once a message has been dispatched nodes in the LoRaWAN network, on the other hand, can request acknowledgments. When an acknowledgment is requested and all four gateways receive the same message, the cloud selects one gateway to respond at a predetermined time. The issue is that when the gateway is sending back to the node, it turns off all other devices. So, if your application requires a large number of acknowledgement, it will almost certainly spend more time transmitting acknowledgement than listening, resulting in network failure.

LoRaWAN A, B, and C are the three types of classes. Three classes of LoRaWAN are active at the same time. Class A is an asynchronous system that we refer to as a pure ALOHA system. This means that the end nodes don't have to wait for a specific time to communicate with the gateway; instead, they transmit whenever they need to and then go dormant until then. You could fill every time slot with a message if you had an eight channel system that was flawlessly synchronized. As soon as one node finishes transmitting, another begins transmitting.

A pure aloha network's theoretical maximum capacity, without any communication interruptions, is around 18.4 percent of this maximum. Collisions account for this capacity. Two nodes will collide if they transmit on the same frequency channel with the same radio parameters. Battery-powered nodes are used in Class B systems. The gateway sends out a beacon every 128 seconds. (Note the time slots across the diagram's top.) At one pulse per second, all LoRaWAN base stations emit beacon signals at the same time (1PPS). This implies that at the start of every second, every GPS satellite in orbit delivers a message, allowing time to be synced around the world. Within the 128-second cycle, all Class B nodes are given a time slot and notified when to listen. For example, you can instruct a node to listen for every tenth time slot, and when one appears, a downlink message can be sent (see above diagram).

Nodes in Class C can listen indefinitely and send downlink messages at any moment. Because it takes a lot of energy to keep a node active, this method is generally utilized for AC-powered applications. The Challenges of Using LoRaWAN to Create Private Networks: LoRaWAN is a good fit for some applications, but not for customer- deployed (also known as private network) solutions. The following are the key causes for this:

Multiple gateways coexisting provides for interference. The same frequency is used by all LoRaWAN gateways. It makes no difference who owns or operates them. That means your LoRaWAN network sees all of my traffic and the other way around. To avoid collisions, it is preferable to have only one network functioning in a specific area. However, working with the LoRa Alliance to have particular channels set aside for certain uses is conceivable. Network operators can also limit the number of down-links in their networks on the server side to prevent low priority endpoints from "clogging" the network with downlink traffic. It does not guarantee that the message will be received. Packet error rates (PER) of more than 50% are common with LoRaWAN, an asynchronous, ALOHA-based protocol. For some meter-reading applications, these mistakes are acceptable, but for industrial or business sensor networks or control systems, a PER of 0 percent is required. Most industrial use cases do not require the "spray-and-pray" manner of information delivery. LoRaWAN is best suited for networks that focus on uplink.

It necessitates a significant amount of development time. Another issue for our customers is that LoRaWAN is essentially a data link (MAC) layer (OSI Layer 2), with only a few networks layer features (OSI Layer 3). No vendor currently offers an end-to-end LoRaWAN solution. You'll very certainly have to engage with various vendors to get nodes, gateways, a back end server, and every other component of the ecosystem independently. While this allows for application flexibility, it also leaves application developers with a lot of work to do in order to create a complete product offering. Packetization, downlink control, multicast, and so on are all examples of this. There are constraints to the duty cycle. In public networks, 868 MHz bands have several inherent constraints. The one percent duty cycle is the main constraint in Europe (in most cases).

This restriction indicates that the average length of time the gateway transmits cannot exceed one percent over time. As a result, the gateway's transmission capacity is severely limited. The FCC regulations for the ISM band in the United States do not include such a restriction. The payload size of the maximum transmission unit (MTU) is varied. The MTU payload size is determined by the spreading factor assigned to the node by the network. In other words, if you're a long way from the gateway, the amount of data you can send is limited.

If you are close, though, it is considerably larger. That is something you simply cannot know ahead of time. As a result, changes in the payload side at the application layer must be accommodated by the node firmware or application, which is difficult to do while designing firmware. Most programmers handle this problem by using the shortest available MTU at the highest spreading factor the network can assign, which is usually quite little, frequently less than 12 bytes in most circumstances. As a result, LoRaWAN nodes that need to transfer greater amounts of data, such as 300 bytes, will have to send it in 30 10-byte messages because they may be assigned a short MTU. If you wish to build on carrier-owned and operated public networks, LoRaWAN is fine. There are a lot of options because service providers want to compete in this market. LoRaWAN also works for basic applications that don't require a lot of acknowledgement and don't require a lot of nodes. However, if your requirements are more sophisticated, you will certainly run into difficulties.

Because their networks are still relatively small, many LoRaWAN users have not encountered those hurdles.If you try to run a public network with thousands of users doing different activities with LoRaWAN, we will quickly discover how tough it is.**[1]**

2.2 DEVELOPMENT AND VALIDATION OF A TRAFFIC GENERATOR:

An experimental examination has been performed in this part using SDR methods, with measurements taking place in a semi an-echoic chamber (in an interference-free environment). While taking into account the results that have already been presented. The development, implementation, and testing of a LoRa packet generator capable of generating packets that are compliant with the LoRaWAN specifications defined by the LoRa Alliance was the initial step. The SDR technology is used to implement the generator, and a Lime SDR hardware device is used to do it. The developed communication method is depicted. This advantage can be obtained by combining two or more SDR platforms, each of which is equipped with two transceivers, in a MIMO (Multiple Input Multiple Output) topology. As a result, an increase in performance level may be able to generate a huge amount of LoRa traffic.

The fact that the user has access to the mechanism tasked with generating the packet, such as payload or aspects connected to the ways of coding and manufacturing packets, is one of the implementation's advantages. This work's novelty is represented by these characteristics.

This is because, when evaluating an unlicensed frequency band where the transmitted signal intensity is very low, an isolated environment with no in-band interference is necessary (below RF noise level).

The employed GW is made up of a Raspberry PI 3B+ and an iC880A concentrate board with a Linux-based operating system and a forward-packet mechanism type coupled to the TTN data aggregation platform in a semi-an-echoic chamber. The authors have previously published work on the design and testing of the GW module.

The LoRa traffic generator acts as a source of interference in the tests. The LoRa sensor node, which employs an Atmega328 micro-controller with an RFM95 radio transceiver, is the communication link that is being analyzed in terms of performance.

The sensor connects with the GW module via several SFs across an 868.3 MHz communication channel, sending one packet every two seconds. The GW module sends the received packets to the TTN platform. One SF can be used at a time by the LoRa sensor node, which can be changed by modifying the software.

On the 868.3 MHz communication channel, a total of 6043 packets were sent. Only about 4230 results were received and recorded by the GW out of all of the experiment's outcomes. We may estimate that around 30% of the time was lost due to accidents on the receiving end. Closer examination reveals that the packets that were lost were sent at the same time and used the same SF, regardless of payload dimensions.**[2][3]**

2.3 SPEED SENSING SYSTEM FOR AUTOMOBILES WITH DATA TRANSMISSION AND MONITORING CAPABILITES:

The number of drivers who exceed the speed limit is on the rise. This is due to the government' ineffective approach of detecting and identifying the criminals. If a more effective system is not developed, the number of traffic of-fences will continue to rise, as will the number of accidents caused by speeding.

The major goal of this thesis is to create a system that will assist authorities in detecting and identifying violators while also giving proof of the infringement by recording the speed and video of the incident. The suggested system employs two RFID readers to identify a tagged vehicle's entry and leave times in order to calculate its speed over a predetermined road length.

When an over speeding offence is identified, it will send an SMS to the authorities with the violator's information as a violation notification. The authorities can be warned whenever a driver exceeds the speed limit by employing the technology,

Following the evaluation of each module of the system, it was determined that the planned Automobile Speed Sensing (A.S.S) System operates as intended and may be deployed as a full-scale system to aid in the detection of speeding automobiles.**[4]**

3. EXPERIMENTAL SETUP AND PROCEDURES:

The goal of our project is to build a working model for vehicle tracking using long range module HC-12. The utility of this HC-12 is able to send and receive data with low power and within long range of 1.8 kms. The highest and to use in practical time, lora module and has the success rate of 15 to 20 kms connectivity. The proposed work is split into two parts basically, into hardware and then integrating it with the software. Generally, when a management system is formed, there arises a formation of databases. These databases are linked to the server when being concerned with the software side. Whenever a vehicle is bought the user has the registration form in their end to enter the details and store the data in the Database which is already linked to the Server. The Server then stores the details of each and every user. Whenever, the vehicles are departed, the work flow starts and sensors check for speed and traffic violation. When the rules are violated, the user is asked to pay the fine amount from the server's database.

Fig 1.1 433 MHz

Fig 1.2 868 MHz

Fig 1.3 900 MHz

There are generally three LoRa modules available and in India only the first two LoRa Modules Range (433MHz and 868MHz) are advised and allowed to use. And we have used the 433 MHz range module which is practically proven its success over 1.8 Km radius.

The Three Applications are explained below:1. Driver's Health Assistance System, 2. Traffic Signal Violation System 3. Speed Violation. The Network is aligned in such a way that each user is accessible to the base station and each base station is accessible to the Main Station. The Main Station is connected to a Node MCU (ESP32) which has both Internet Module (WiFi) and Bluetooth Module present inside. This Node MCU gets interfaced to the Database via Internet Module present in it. The Database has the details stored when a user enters into the network by registering his details in the database with the help of his Dashboard. Our Hardware components are configured in the beginning prior to that the software part of the project is built, i.e., for every instant when a user enters into the network as a fresher, he is asked to enter his general details for the back tracing purpose.

3.1 HARDWARE CONFIGURATION

3.1.1 INITIALIZING PI 3

The Raspbian OS with required software is installed in the Pi 4. The CP2102 is used to debug and connect the Raspbian Raspberry Pi 4 with the multichannel embedded wireless data transmission module. A Python Code is written in order to transfer data to the Base Station, display the response received for the request sent from this device.

Fig.2 LoRa HC-12 interfaced to Raspberry Pi 4 using CP2102

3.1.2 CONFIGURING THE MAIN STATION

The Node MCU is connected to another HC-12. The EM-18 is configured to this Node MCU. A two Channel relay circuit is designed and fabricated in order to configure the EM-18 to make them work as a real time traffic signal. A UNO Code is written commonly in order to configure these things as a whole Main Station.

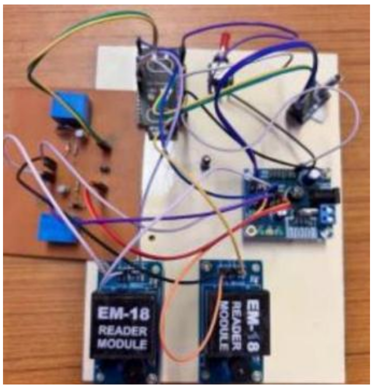


Fig 3 Main Station in the Network to which Internet Server is connected

3.1.3 SETTING UP THE PROXIMITY SENSOR

The So coded Raspberry Pi 4 is made with a change in order to interface proximity sensor with the same Pi 4. This Proximity sensor is Inductive and it can sense metal alone to detect the Rpm of a motor. The below diagram represents the proximity sensor that is interfaced with Raspberry Pi 4 through a Python Code and this device is which used to detect the Rpm to calculate speed using metal detection mechanism.

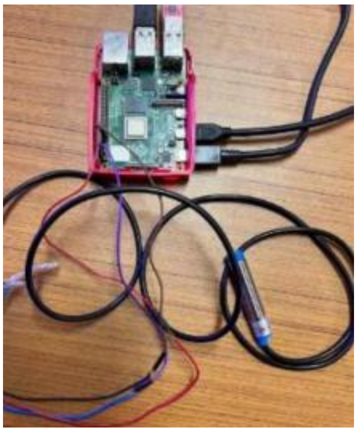


Fig 4 Inductive Proximity Sensor: LJ12A3-4-Z/BX

3.2 SOFTWARE CONFIGURATION

Considering about the software side, the database should be configured primarily. There are so many databases available, namely, PhpMyAdmin, Firebase, etc. To integrate the software and hardware, we have used VS Code. Using the VS code, a basic HTML, CSS file is coded in such a way that the web page is formed to collect details when a user enters the network. The database that we have used to store the details here is Google Console [Firebase].

3.2.1 FIREBASE

The Details are collected from the forms and stored in this database. The diagrammatic output is taken as the screenshot from the working model and shown below. The configuration files that were created with the project by the firebase is utilized while writing the JavaScript code. The JavaScript code generally pushes the details into the database while the user registers his data using the Registration Page. Authentication of the admin is performed in the Google Console. The rules of the Realtime database are changed to "always: True" in order to accept the response from a new user.

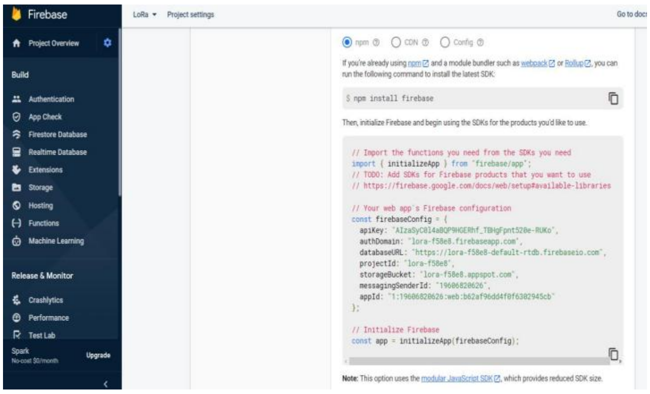
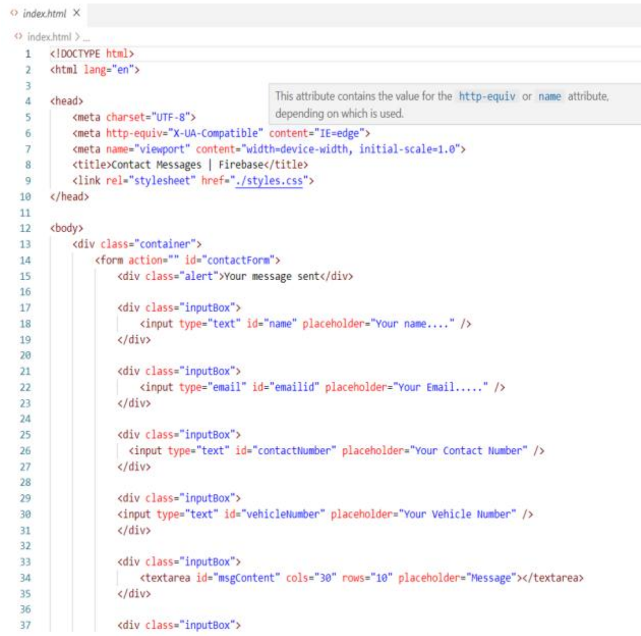


Fig 4. Firebase Configuration Setup

3.2.2 HTML

A basic Hyper Text Markup Language Code is written and the code snippet's snapshot of which is attached below.



```
<!DOCTYPE html>
<html lang="en">

<head>
    <meta charset="UTF-8">
    <meta http-equiv="X-UA-Compatible" content="IE=edge">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Contact Messages | Firebase</title>
    <link rel="stylesheet" href="./styles.css">
</head>

<body>
    <div class="container">
        <form action="" id="contactForm">
            <div class="alert">Your message sent</div>

            <div class="inputBox">
                <input type="text" id="name" placeholder="Your name...." />
            </div>

            <div class="inputBox">
                <input type="email" id="emailid" placeholder="Your Email....." />
            </div>

            <div class="inputBox">
                <input type="text" id="contactNumber" placeholder="Your Contact Number" />
            </div>

            <div class="inputBox">
            <input type="text" id="vehicleNumber" placeholder="Your Vehicle Number" />
            </div>

            <div class="inputBox">
                <textarea id="msgContent" cols="30" rows="10" placeholder="Message"></textarea>
            </div>

            <div class="inputBox">
```

Fig.5 HTML Code Snippet

The general Details of the user that are gathered from themselves are Name, their vehicle Number, email ID, Contact Number and Any necessary details like healthcare has to be taken care.

3.2.3 CSS

A basic Cascading Style Sheets Code is written and the code snippet is snapshot of which is attached below.

```css
*{
  margin: 0;
  padding: 0;
  box-sizing: border-box;
}

body{
  width: 100%;
  height: 100vh;
  display: flex;
  justify-content: center;
  align-items: center;
}

.container{
  width: 90%;
  height: 60vh;
  padding: 20px;
  border-radius: 20px;
  box-shadow:  0px 5px 25px rgba(0,0,0,0.2);
  display: flex;
  justify-content: space-evenly;
  align-items: center;
  flex-direction: column;
}

.container form{
  width: 100%;
  height: 100%;
  display: flex;
  justify-content: space-evenly;
  align-items: center;
  flex-direction: column;
}

.inputBox{
  width: 100%;
```

Fig.6 CSS Code Snippet

3.2.4 JavaScript

A basic HTML Code is written and the code snippet is snapshot of which is attached below.

```javascript
const firebaseConfig = {
  //   copy your firebase config informations
  apiKey: "AIzaSyC0l4aBQP9HGERhf_TBHgFpnt520e-RUKo",
  authDomain: "lora-f58e8.firebaseapp.com",
  databaseURL: "https://lora-f58e8-default-rtdb.firebaseio.com",
  projectId: "lora-f58e8",
  storageBucket: "lora-f58e8.appspot.com",
  messagingSenderId: "19606820626",
  appId: "1:19606820626:web:b62af96dd4f0f6302945cb",
};

// initialize firebase
firebase.initializeApp(firebaseConfig);

// reference your database
var contactFormDB = firebase.database().ref("contactForm");

document.getElementById("contactForm").addEventListener("submit", submitForm);

function submitForm(e) {
  e.preventDefault();

  var name = getElementVal("name");
  var emailid = getElementVal("emailid");
  var contactNumber= getElementVal("contactNumber");
  var vehicleNumber= getElementVal("vehicleNumber");
  var msgContent = getElementVal("msgContent");

  saveMessages(name, emailid, contactNumber, vehicleNumber, msgContent);

  //   enable alert
  document.querySelector(".alert").style.display = "block";

  //   remove the alert
  setTimeout(() => {
    document.querySelector(".alert").style.display = "none";
  }, 3000);
```

Fig.7 JavaScript Code Snippet

3.3 APPLICATIONS

3.3.1 DRIVER'S HEALTH ASSISTANCE SYSTEM

Generation these days, in all cities, districts, states, and even countries as well wander around and visiting hot-spots through Vehicles. All people in this world loves to lead a luxurious life and so these people show them by owning a vehicle for their own personal use. However, these vehicles consume more amount of internet for detecting the future happenings such as diversions along route, stoppage points before reaching the destination, etc. These creates the more usage and spending money which is not cost efficient too in this case, results in the deletion of bird species gradually because of the power generated by all the towers that produce data to all the vehicles for such purposes mainly.

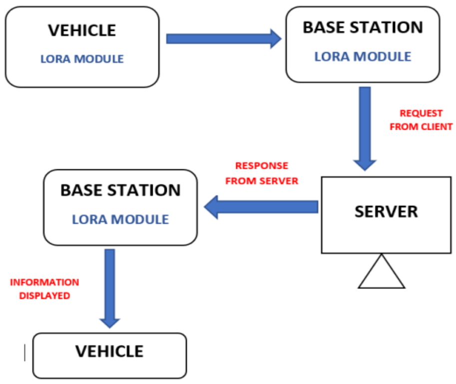


Fig.7 Block Diagram for Driver's health Assistance System

The Network is formed as per the protocol Stack and user's when diagnosed with a problem, they are given a button kind to send a request without internet which sends the request to the base station and the base station in turn passes on the request to the Main Station. This Main station in turn with its connectivity to the Internet Server, it again passes on the request to the server. The server realizes the place of the vehicle and with the help of the server's Database, there are data stored in the Server about each and every hospital.

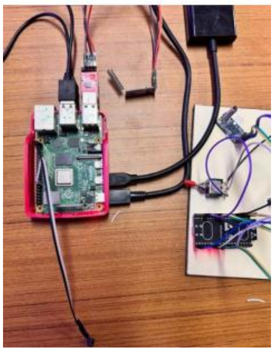


Fig.8 Hardware Setup

So, with the help of this database, the server responds for the request which was passed on by the Main Station as the Address of the hospital which is stored within a string will be passed on to the sub-station and then on to the driver's infotainment who raised a request over the button that was inserted in the vehicle. This process happens within a delay of 20 seconds as that would be the time taken to analyses the details of the vehicle and then searching of data in the server with the nearby hospital's details that has to be sent to the query requested driver.

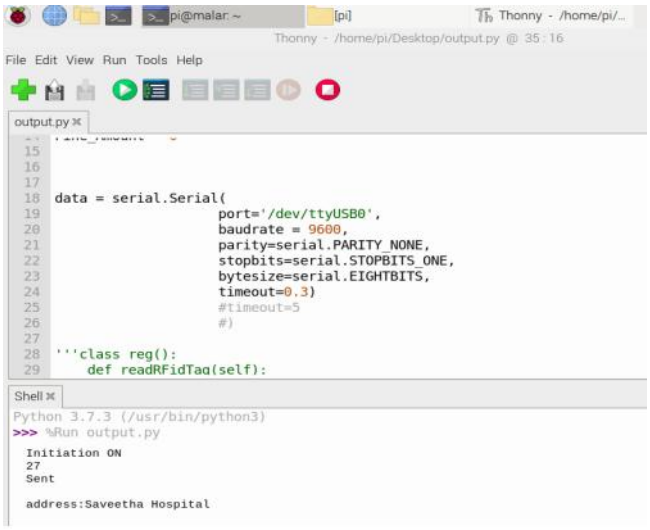


Fig.9 Output Window

3.3.2 TRAFFIC SIGNAL SPOTTER

In this most populated world, the population increases and proportionally the death rates have started to increase. It is majorly because of the accidents that take place in every instance and even every minute too. Even though, both the State and Central Governments levies heavy punishments to the crowd, these people because of the jampacked schedule, find a loop hole and penetrate through it. This is majorly because of the rules and protocols followed by the State government workers in most of the states. There is an existing model, which works in delay of maximum of a month in order for the fine to reach the actor. In order to stop this leisure rules and tight the protocols, this software and hardware integrated model which is proposed will seize the intruder and fine him as soon as he has violated the signal.

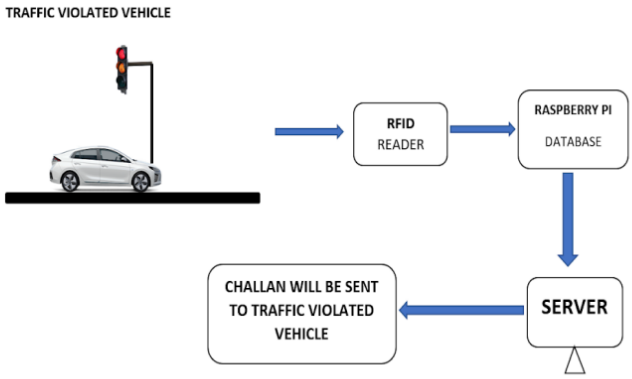


Fig.10 Block Diagram for Traffic Speed Spotter

As soon as the RFID Reader reads the tag for violating the signal, the reader sends the fine amount to the server through base station (Sub-Station) and Main Station (Connected to the Server). The server sends the fine amount after the verification of the details from the server within the same twenty seconds. The Two Channel Relay is actually designed in order to make the real time traffic signal.

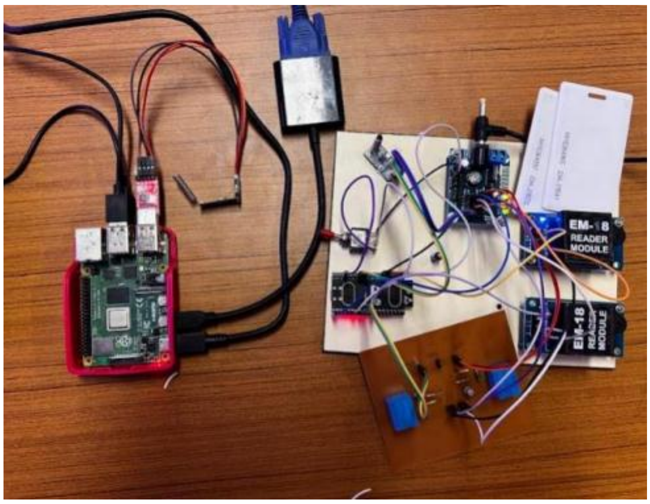


Fig.11 Hardware Setup

This Project demonstrates the two-way traffic signal and so the use of two channel relay would be seen evidently. The two EM-18 are connected to the two-channel relay.

In order to provide the same output in real time, active readers must be used. The Below window shows the output that when the vehicle has violated the signal the driver gets an intimation of fine amount.

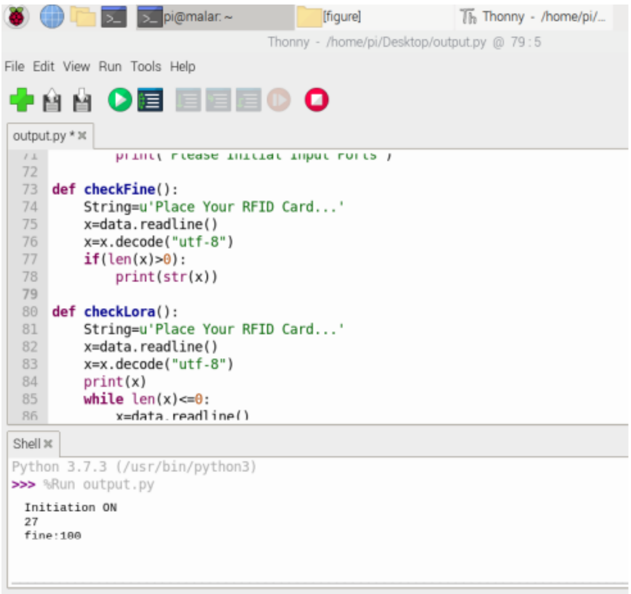


Fig.12 Output Window

3.3.3 OVER SPEED DETECTION SYSTEM

Increase in death rate are because of accidents and in specific that is all about the violation of traffic signals. It is also because of over speeding caused by the vehicles itself. The speed can be found by measuring the Rpm of the motor or wheel and converting the Rpm value with a formula mentioned below: Vehicle Speed = 0.1885 * Wheel Rpm * diameter of the tire Speed of the motor in kilometer per hour is equal to 0.1885 times of the speed N(Rpm) [Rpm Of the Wheel]. Rpm is calculated by the Rpm measurement sensor. Diameter of the tire will be programmed whenever the vehicle is designed. The proximity sensor is primarily interfaced with a general code in the raspberry Pi 4 to check whether this inductive proximity sensor detects metal or not.

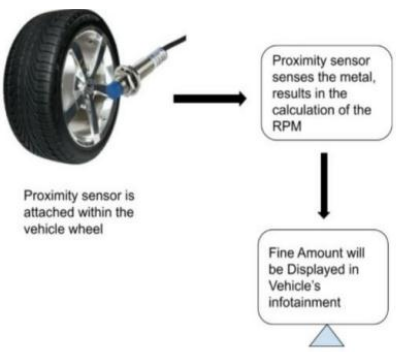


Fig.13 Block Diagram for Over Speed Detection System

Then the general code is modified in such a way that when the vehicle is driven more than eighty kilometer per hour, it intimates the fine amount of 100 per violation. If the vehicle owner drives more than one time, the fine amount itself gets added to the previous amount. The fine amount after getting displayed in the infotainment, the data is stored in the Database for future reference.

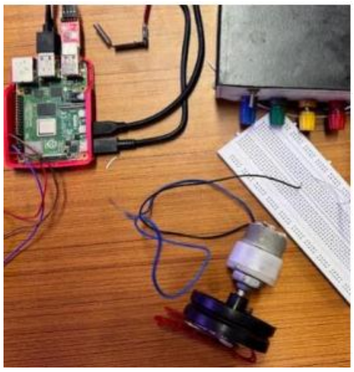


Fig.14 Hardware Setup

The Below window shows the logic that falls behind the Rpm Measurement. It is well designed and made that when the vehicles speed increases more than 20 in this prototype, the fine amount is displayed and further violation is added with the previous amount in that particular variable. An example of both the instances are shown.

i. Rpm=10; Speed=19.97

ii. Rpm = 14; Speed = 27.96; Fine Amount: 100

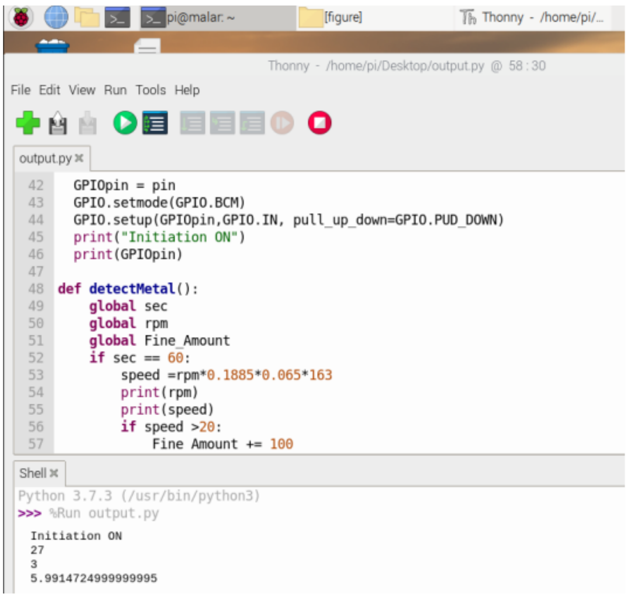


Fig.15 Speed Detection of the Vehicle

Non-contact detection of metallic objects is accomplished with inductive proximity sensors. Capacitive Proximity Sensors are used to detect metallic and nonmetallic things such as liquid, plastic, paper, and more without requiring touch.

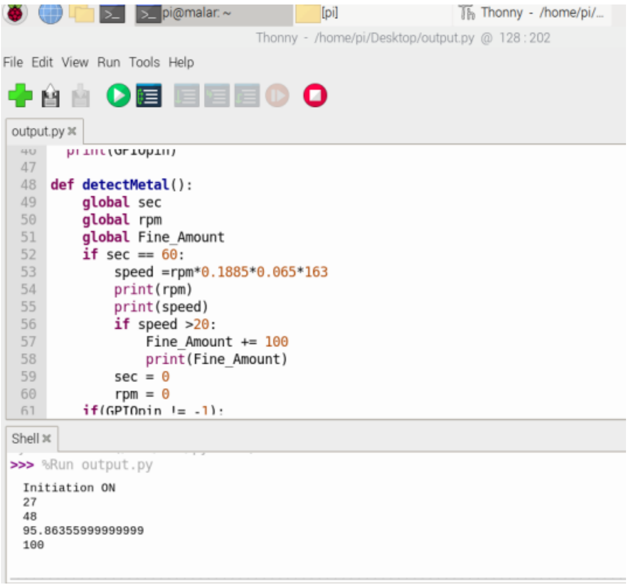


Fig.16 Speed Violated vehicle's Infotainment

The rotation is sensed per minute and given to the System itself for speed calculation (Km/hr). The speed violation protocol for every vehicle must be programmed priory before the vehicle is brought to roads.

4. CONCLUSION

In this project, we demonstrate a LoRa-based open-source vehicle tracking system. The prototype was created successfully, and the system's operation was proven to be right. Future enhancements can be made in a variety of ways. The transponder can be shrunk in terms of hardware and then tested in more rugged environments. The scripts should be refactored in terms of software to guarantee improved maintainability as the system grows.

5. FUTURE WORK

Other significant parameters in LoRa communication could be altered in the future work, for example, utilizing a larger range antenna in the gateway or using a different brand/model of gateway, in order to obtain the broadest possible range in communication and avoid higher deployment costs. In the future, it will be critical to test the system's operation with a larger number of end devices to see if packet loss exceeds 2% of the total. And we can interface several buttons for each and every application namely, searching fuel station, charging station, reaching out to hotels on the way.

For Speed violation system to get updated while registering the vehicle details, there must be a scanner to fix the range of speed for each and every type of vehicle, so that the speed is not fixed as 80 for all the vehicles. As the Heavy Loaded vehicle, cannot reach that much speed that a car or bike does. For the Vehicle traffic violation, the fine amount will be added and displayed. It is achievable in an easy manner.

A. ABBREVIATIONS AND ACRONYMS

LoRa - Long Range Communication

WAN - Wide Area Network

Rpm - Revolutions per minute

RFID - Radio Frequency Identification

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BIOGRAPHIES:

Kulandaiyan S
Electronics and Communication Engineering, Sri Venkateswara College of Engineering Post Bag No.1, Pennalur, Sriperumbudur, TamilNadu, India

Manimaran D
Electronics and Communication Engineering, Sri Venkateswara College of Engineering Post Bag No.1, Pennalur, Sriperumbudur, TamilNadu, India

Raajesh Baabu S
Electronics and Communication Engineering, Sri Venkateswara College of Engineering Post Bag No.1, Pennalur, Sriperumbudur, TamilNadu, India

Dr S Muthukumar
Electronics and Communication Engineering, Sri Venkateswara College of Engineering Post Bag No.1, Pennalur, Sriperumbudur, TamilNadu, India