IJRAR.ORG E-ISSN: 2348-1269, P-ISSN: 2349-5138

INTERNATIONAL JOURNAL OF RESEARCH AND ANALYTICAL REVIEWS (IJRAR) | IJRAR.ORG

An International Open Access, Peer-reviewed, Refereed Journal

VEHICLE TRACKING SYSTEM

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Abstract: The System for Tracking Vehicles is a crucial modern navigation solution that provides real-time monitoring and management of vehicles geographical locations and activities. Utilizing GPS and satellite navigation technologies, it ensures the safety and security of vehicles and valuable assets. The system keeps stakeholders informed about vehicle locations, facilitating efficient fleet management and asset protection. Key features include real-time tracking, geo-fence setup with alerts, approximate destination duration calculation, and user-friendly web applications. This system enhances operational efficiency, minimizes risks of vehicle theft, and provides actionable insights into fleet operations.

I. INTRODUCTION

Navigation has many significant uses, which is primarily utilized by drivers, is vehicle navigation. For both users and transportation networks, the inability to track vehicles can have serious consequences. Users may experience missed connections, extended wait times, and frustration consequently of ambiguity and annoyance caused by their inability to track vehicles. Furthermore, not being able to track vehicles can cause daily disruptions, tardiness, and lost opportunities for individuals who rely on their transportation. Therefore, improving the general effectiveness, accessibility, and user experience of transportation networks depend on having accurate and dependable bus tracking systems.

It's not feasible trace the exact routes that the vehicle takes before the vehicle tracking technology is put into place. The identity of driver operating the vehicle remains unknown. Furthermore, it's not feasible to ascertain the total number of travellers are there on each vehicle at any one point of time. There is little information available on where the vehicle is right now and their timings, without this data it becomes challenging to optimize routes and provide accurate information to passenger. Prior to implementing a vehicle tracking system, it may be challenging to maintain track of vehicle licensing data and due date information. Enhancing the general effectiveness, accessibility, and user experience of transportation networks hence requires the provision of precise and dependable vehicle tracking systems. The key to overcoming these obstacles is to invest in and implement cutting-edge tracking technology, such as web applications and GPS-enabled tracking devices.

The project's goal is to create a web application that will let users plan their time so they can catch the vehicle of their choice, get where they're going on time, and take use of alternative forms of transportation. The foundation of this program is dynamic vehicle tracking, which enables GPS location sharing between the driver and users inside and outside the vehicle. Subsequently offers a interactive interface based on GPS modules allows for communication between the admin control panel and the driver or users. Drivers and users have separate login portals. A tracking system for vehicle can be useful expedite this process by providing real-time information on the vehicle's location and facilitating better administration of license-related tasks, such as registration renewal and deadline compliance. The transport networks may be improved by contemporary vehicle tracking technology, which gives passengers real-time information and helps transportation authority's better manage and optimize services.

II. LITERATURE SURVEY

Satellite technology is utilized by the utilising the Global Positioning System to monitor and monitor the location. Vehicle security and location are provided in real time by the GPS/GSM-based system. GPS shows the exact position of the vehicle and enables real-time tracking on Google Maps [1][8]. A GPS tracker is activated in the case of an accident to pinpoint the exact location of the vehicle. The precise position will be ascertained using the proposed vehicle monitoring system [1]. Using a new GPS signal receiver, the GPS capabilities will be able to obtain latitude and longitude. Connect the device to the vehicle's On- Board Diagnostic (OBD) is required to turn it on and detect any attempted thievery. Whenever the engine is started, the device will be activated by receiving information represented via impulses and using a consistent voltage. The network provider will provide GPRS for sending all data to the internet [2]. The driver and users can communicate in both directions via the system supplementary to the bus assigned to the individual the user has the choice to select any of the vehicles within close proximity. The intention is to develop a smartphone application that lets people better manage their time, so ensure they arrive at their destination on time and catch the vehicle. The foundation of this program is dynamic vehicle tracking, which enables GPS location sharing between the driver and passengers on the vehicle. Subsequently offers an interactive ensure that the GPS-moduleinterface, which enables communication between the administrator control panel and the driver or user. Drivers and users have separate login portals. Additional user authentication is performed via Android Firebase. The user eventually contacts the driver to come pick them up. [3]

Buses can be converted into battery-powered smart buses, or"e-Bus" by integrating advanced sensors and Internet of Things devices. The design will function in a Wi-Fi setting and have no effect on the environment. With features including seat detection, tax deduction, accident detection, live bus location tracking, bus frequency analysis, and an e-ticketing system that cut down on paper waste, the system consists of electrically powered, ecologically friendly buses. [4] The theory behind the proposed remedy is to create a QR code that each student will scan when they enter or step out of the bus. By scanning each student's QR code and parent's phone number using an app, the driver is capable of to track absence and view the most recent list of students' names. Parents can follow the bus by checking its current location and getting the driver's information. Notifications can also be sent to them when their child arrives at home or school. Further, the school has access to the location and the data for every student and bus driver.[5] Its objective is to automatically fine vehicles that exceed the speed limit in order to improve road safety and reduce traffic accidents. The vehicle automatically issues fines and sends real-time data to the server when the vehicle owner exceeds the speed limit. When the vehicle crosses the limit, it utilizes GPS to transmit position and speed data to the centralized unit while monitoring the speed of the vehicle this allows for automated fines for drivers. [7]

The proposed accident prevention and detection system consists of a hospital unit, an ambulance unit, and a vehicle unit. The vehicle unit incorporates a tilt sensor, GPS, and GSM to track location and identify accidents. The ambulance unit is equipped with vital medical equipment, including blood pressure and heartbeat monitors, temperature sensors for basic treatment, and heartbeat sensors. The results are displayed on an LCD screen. The Wi-Fi module NODEMCU ESP8266 is used to store all patient records in a database, which connects to the hospital unit to transmit status updates generated by sensors. The hospital unit tracks the patient's status and schedules therapy using specialist Android cellphones or the BLYNK software installed in the hospital system. The BLYNK application functions as a toolkit for controlling electronic devices, and the recommended system's temperature and LCD sensors are essential parts. The display unit uses pulse and blood pressure sensors to display readings.[8]The system proposes an IoT-based college bus tracking and monitoring system using sensor modules such as MQ3 sensor, thermocouple sensor, flame sensor, and PIR sensor. Furthermore providing real-time information on student count, fire alerts, student body temperature, and driver health, the technology also enables users to track the bus's location on Google Maps over the internet. An Arduino Mega controls bus tracking. The GSM Module transmits the GPS receiver's coordinates to ThingSpeak. Sensor data is shown on the serial monitor of the Arduino IDE software. Furthermore, latitude and longitude, ThingSpeak shows information from PIR and flame sensors. The technology offers real-time information on student count, fire alerts, student body temperature, and driver health. Users may even utilise the internet as a resource to track bus's location on Google Maps. [9]

III. PROPOSED METHODOLOGY

The Vehicle Tracking System proposed here utilizes hardware components such as the Raspberry Pi, Neo 6M GPS module, SIM800L GSM module, RTC module and display seamlessly integrating with Firebase as the back end and employing the JavaScript API for Google Maps to visualize location data as shown in Figure 1. To initiate the project, a comprehensive definition of requirements is essential, outlining functionalities and data parameters.

The hardware setup involves configuring the Raspberry Pi with the selected operating system, ensuring proper connectivity integrating the Neo 6M GPS module, SIM800L GSM module, RTC module and display. Subsequently, the GPS data acquisition process is implemented on the Raspberry Pi, extracting crucial information like latitude and longitude. Firebase serves as the primary repository, where a Realtime Database is established to store and manage GPS data, setting up a Google Cloud Platform project requires API keys. Simultaneously, the Google Maps API is integrated into the web application, facilitating the visualizationof vehicle locations. The web application itself, constructed with HTML, CSS, and JavaScript, utilizes the Firebase SDK to fetch Realtime GPS data and displays that on the Google Maps interface.

IV. COMPONENT OF THE SYSTEM

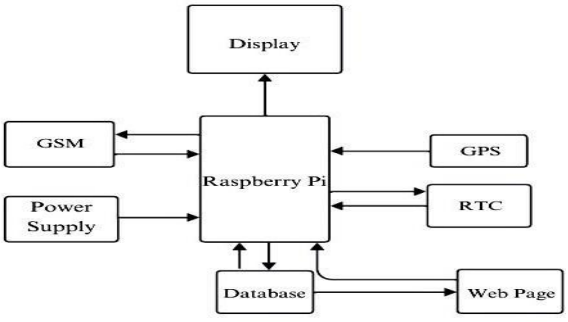

Figure 1. Block Diagram of vehicle tracking system

As shown in Figure 1 main hardware components of the system are Raspberry pi, GPS module, RTC module, GSM module.

i. Raspberry pi

The core component of system is Raspberry Pi. It works well with NEO 6M GPS tracker to collect, process and send accurate location data for vehicle tracking. In vehicle, a Raspberry Pi (a credit card-sized computer) is been used to manage andanalyze data collected by tracking devices. It acts as a computer to analyze GPS data, run tracking applications, and talk to tracking servers. The GSM module connects to the Raspberry Pi and sends the necessary data to Firebase over the network madefor Firebase sufficient detail is in Figure 2 which shows the detailed workflow of the system.

ii. GPS

The NEO 6M GPS tracker and Raspberry Pi are connected to obtain accurate, real-time data from the vehicle. The module's antenna is utilised to establish a connection with the satellite overhead. In case of connection between the satellite and the antenna, the GPS module receives data, which is metadata containing various types of information. The Raspberry Pi receives the data that the GPS module sends and processed there to provide the necessary controls.

iii. GSM module

The data is sent to Firebase after the Raspberry Pi and GSM Module are connected. Through GPRS via the cellular connection, the GSM module transmits the processed data from the Raspberry Pi to Firebase.

iv. RTC

Vehicle tracking combined with GPS technology with real-time data transmission through GSM modules to ensure accurateand timely tracking and monitoring of the vehicle. The RTC module guarantees time regardless of network connection. It uses abackup battery to store time when power is off, ensuring stable operation and accurate timestamping data at that moment. In general, the RTC module increases the reliability and time accuracy of the system.

v. Firebase

Firebase is a powerful platform for collecting and storing GPS data, including latitude and longitude coordinates. Real-timedata from the GPS module is received and transmitted via cellular connection with the GSM module and stored in Firebase. It collects real-time data from GPS module and creates different logs for recording. The system helps effectively manage and analyzelocation data, enabling applications such as instant tracking, geofencing and route optimization. The Firebase database containsthe site's content saved at a discrete point in time, and the time log provides information about time. GPS logs include time, longitude, and latitude lines, as shown in Figure 3. Timestamps provide information about travel by helping refine movement patterns over time. This information is useful for understanding the spatial dynamics of transportation and logistics. for. Web pages

When drivers and administrators use the system to track the position of the vehicle, web pages are utilised to provide location and additional details, in addition to displaying various forms of specialised data for all users.GPS vehicle tracking usessatellite signals to determine the exact location of the vehicle. It then sends data from the GPS receiver to the Raspberry Pi via the NEO 6M GPS tracker. Raspberry Pi receives, processes and stores the data sent by the GPS module. It often hosts softwarethat allows users to monitor and control traffic. Web-based interface allows users to access real-time monitoring data, create reports, set alerts and manage fleets

V.IMPLEMENTATION

The Internet of Things (IoT) based vehicle tracking system implementation requires a number of parts, including network infrastructure, software, and hardware which is shown in Figure 2.

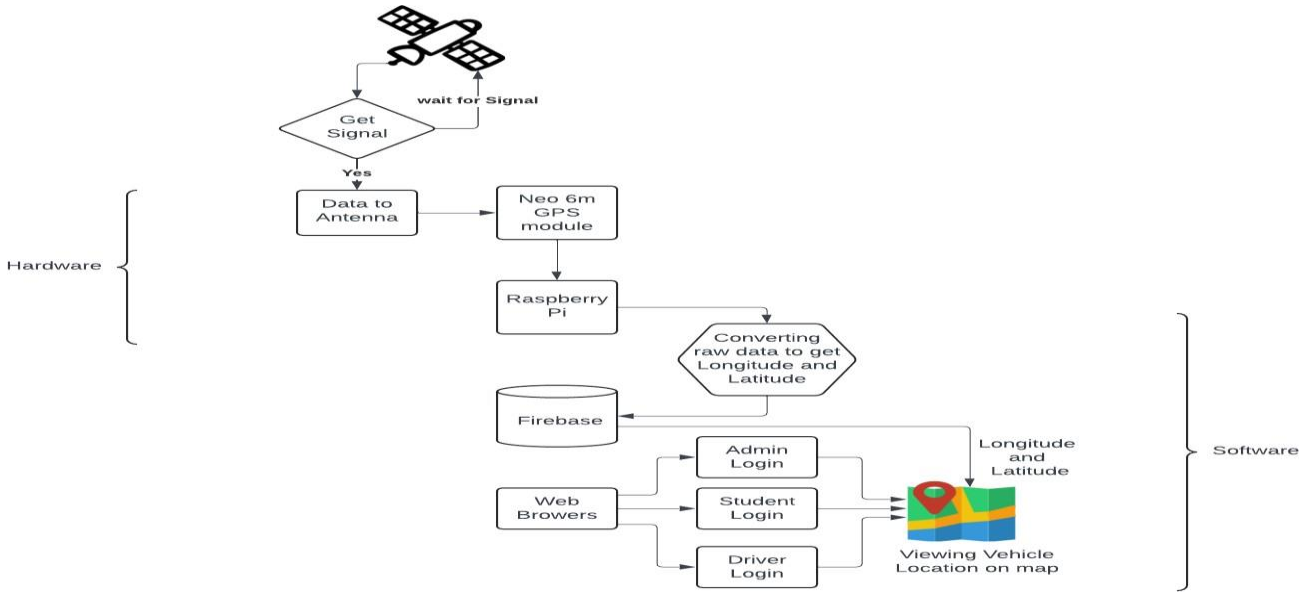

Figure 2. Vehicle Tracking System Flow Chart

A. Login Page

The login page in the vehicle tracking system allows the user to log in to the page and also access tracking details of the vehicle. If the user is registered, he can access the services offered.

B. Student's Home Page

This home page describes the student's home page that the student sees when they log in, which shows the user's details suchas their name, USN, and profile picture. In this they also have a option to update their details according to their needs.

C. Student's Route and Stop Selection Page

The next page provides the users to select the route from the list of displayed routes and the staring and end points of the routesare displayed automatically after which the routes to access the stop name in the next page. The stop selection page provides theoption for user to select the stop name and timing based on that a list of vehicles that arrive at the stop in the specified time is displayed along with link that displayed the location of vehicle on the web-page.

D. Admin's Login and Home Page

The home page has a number of features that allow the admin to control the entire vehicle system by adding, deleting, and changing features including vehicles, drivers, routes, stops, vehicle locations, and the ability to modify vehicle stop order. Additionally, it has the ability to configure tracking parameters like geofencing and update intervals. With a graphical form, thepage offers a vehicle management study.

E. Admin's Bus Location Page

The page shows the vehicle's current location on a Google map. The vehicle will get a warning message on the screen that reads," Vehicle is outside the Shimoga City!" if it crosses the geofence that has been imposed to the city of Shimoga. The displaying of the location along with the geofencing is given in Figure 5.

A	B	C
Timestamp	Latitude	Longitude
3/17/2024 20:43:52	13.953597	75.57339417
3/17/2024 20:45:30	13.95360433	75.57339983
3/17/2024 20:45:44	13.95361083	75.57339917
3/17/2024 20:45:46	13.95361133	75.57339967
3/17/2024 20:45:46	13.95361133	75.57339967
3/17/2024 20:45:47	13.95361133	75.57339983
3/17/2024 20:45:50	13.953613	75.5734005
3/17/2024 20:46:03	13.953616	75.57340133

Figure 3. GPS recorder for automobile tracking system

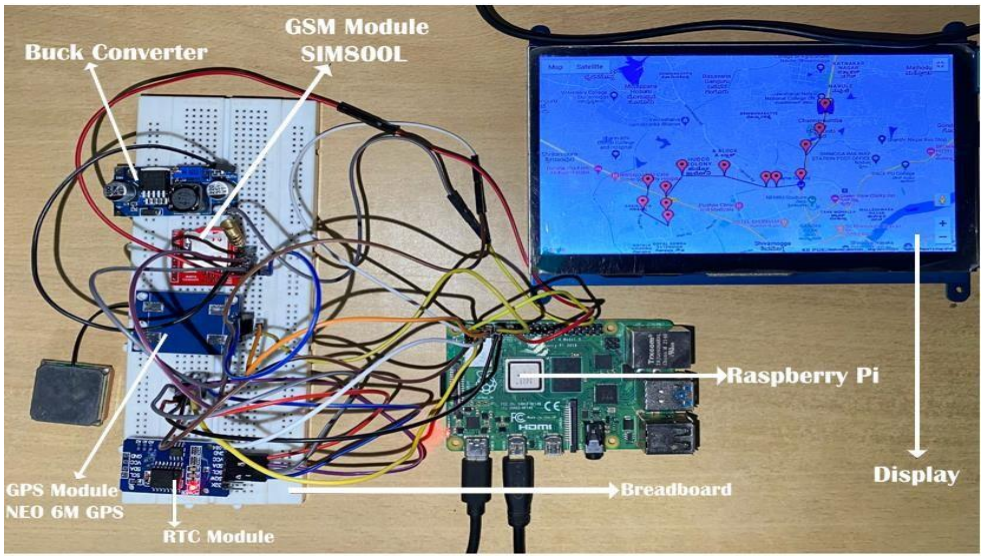

Figure 4. Vehicle Tracking System Hardware

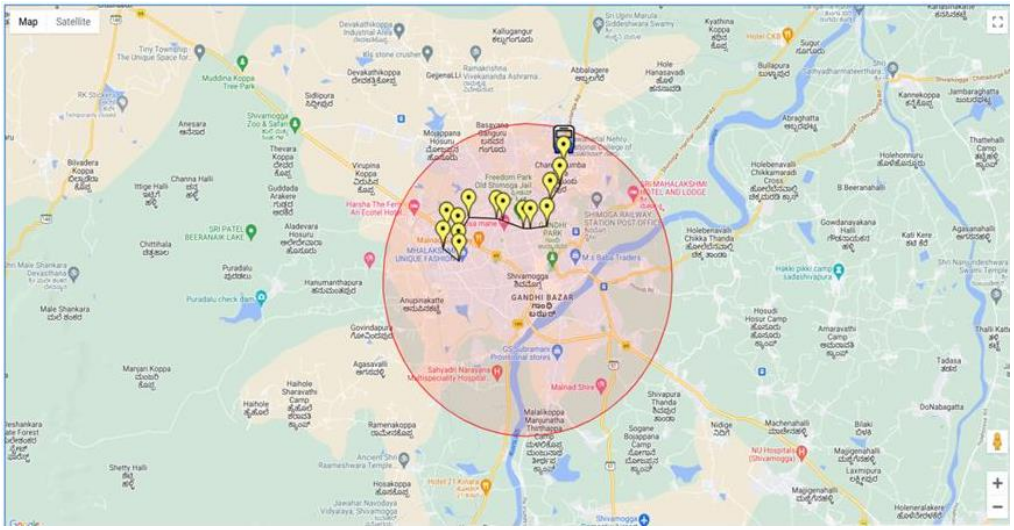

Fig. 5. Displaying location with geofencing

VI.RESULT

Satellite navigation and Global Positioning Solution (GPS) is used by the system to accurately track vehicles and assets. It ensures that information important for both private and professional purposes can be instantly monitored and stored. Thanks to GPS-enabled technology, customers can easily track the location of their assets on their phone, tablet or online desktop. We also provide users with the ability to create geofences using Google's geofencing API to identify restricted areas and trigger notifications when traffic approaches or leaves those areas. Additionally, the system analyzes a lot of data to estimate travel time and provide accurate results to users. The technology, which can be accessed via the web or mobile application, ensures effectiveasset management and security by providing up-to-date information to staff.

VII. CONCLUSION

In summary, the vehicle tracking project uses GPS technology and GSM modules for data transfer in order to address the demand for real-time vehicle tracking. The system's goals include real-time vehicle tracking, establishment of border warning geofences, and creation of web or mobile applications for end users. The plan includes tracking data extraction using GPS module, visual coordination using device, transmission data using GSM module, and connection time using RTC time. When the Raspberry Pi's GPS module sends its coordinates, it processes them and sends the data to Firebase, where it is stored until the user or operator uses a web page to examine it. The scope of the project includes tracking vehicles in a specific geographical area, monitoring the location of time and conditions, and using network connections to transfer data. This application project provides in-depth information about the functionality and features of vehicle tracking systems. Potential applications of the system range from ensuring the safety of vehicles to calculating the estimated time to reach a destination. Finally, the project aims to provide a good and reliable solution for vehicle tracking, helping to increase the safety and control of vehicle movement.

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