Original Article

Design And Implementation Of Real-Time Web-Based Vehicle Tracking System Using Sim

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Abstract

Many Logistics and E-commerce companies need to actively monitor their product shipping fleets to ensure timely package delivery to the customers. According to the business point of view, they also need to monitor vehicle theft, package theft, fuel theft, and vehicle breakdown issues continuously. The best solution to all these regular problems is the use of a vehicle tracking system. Various Location tracking technologies such as GPS, GPRS, and Wi-Fi with android operating systems exist that are used and implemented by telecommunication managers and engineers. But all these technologies are internet-based and need smartphones for tracking purposes. The GPS system is a satellite-based navigation system, which requires a lot of signal processing power, so it consumes a battery. Also, most of the drivers use a mobile phone without internet connectivity. To overcome these drawbacks of internet-based tracking systems, here we have presented the Design and Implementation of a Real-Time Web-Based Vehicle Tracking System Using SIM. It is very cheap, convenient, and can be adopted by any transportation company.

Index Terms - SIM, Service provider, Google Latitude and Longitude, MEAN Stack.

I. INTRODUCTION

Shipping, logistics, and many more transportation business owners need continuous tracking and monitoring of their assets. For that, the vehicle tracking system is fully secured and a fleet management solution. The vehicle tracking system is a well-established technology in this era that is used by fleet systems and owners of vehicles all over the world. Nowadays various location-tracking technologies such as GPS, GPRS, and Wi-Fi with android operating systems exist [1], [2], [6]. But the drawback of these is that they require an active SIM plan and enabled internet connection. Sometimes internet connectivity is not available in remote areas. The GPS receiver in a smartphone must transmit a signal with enough strength to the satellites and then receives a signal back from the satellites to determine the device's location and time. This process requires a lot of power, to reach the satellites, which are orbiting in space at an altitude of about 20,000 kilometers (12,000 miles) from the earth. Also, the GPS is allowing the system to enter a sleep state, so the mobile battery will drain out within a few hours. So, GPS-based tracking systems need additional battery back for continuous tracking operation. location and time. Especially in Logistic for long trips, it is necessary to maintain battery backup for monitoring the vehicle location. GPS and other internet-based technologies are also not convenient and economical for vehicle drivers who are not having smartphones with the internet. To overcome these drawbacks Real-Time Web-based vehicle tracking system using SIM is developed to keep track of fleet activities across multiple locations using the location coordinates recorded by the driver's cellular network without the internet. Also, Power consumption in a SIM-based system is very less compared to the GPS system as it is not a satellite-based system. So, a basic mobile model can be used for SIM-based vehicle tracking without a GPS system. SIM-based tracking is done by the driver's cellular nearest three network location coordinates. Generally, mobile phones are for personal use, hence in a SIM-based tracking system it is necessary to take prior permission of tracking their SIM, so the privacy of the SIM holder can be maintained and misuse of tracking data can be avoided.

Initially, the client gets approved permission from the telecom service provider for tracking the SIM. Before starting the tracking and monitoring of the vehicle, owners need to inform the telecom service provider for getting the tracking data of a particular SIM. The Telecom service provider sends a request to the vehicle driver to get permission for tracking his mobile SIM for a particular time duration. After getting acknowledgment from the driver the telecom service provider will start tracking of vehicle's location. Then this data is sent to the client. The tracking system consists of mainly three parts- a vehicle

unit, a fixed base station, and a database with the software system. A mobile with an active SIM card is placed in the vehicle which is to be tracked. Then the GSM /SIM localization tests the situation using three locations close to a cell phone in the network using the phone's international mobile equipment identifier or IMEI number. Thus, the Cellular tower receiver receives the data or information mainly the latitude and longitude of the particular vehicle from the land-based towers. The GSM distribution system provides general status and stores the phone as well, but cannot provide accurate status information.

Due to real-time tracking facilities, vehicle tracking systems have become increasingly popular among owners of vehicles as they are able to monitor their vehicles continuously. In this project a flat-file database is created to store information on a host computer system and generated web page using Angular, Express, Node.js, and MariaDB software i.e., Mean Stack software which makes it possible to access the text file and view the position of the vehicle on the Google map. Here it is proposed to provide owners with the nearest location of the vehicle conveniently through a website.

II. SYSTEM ARCHITECTURE

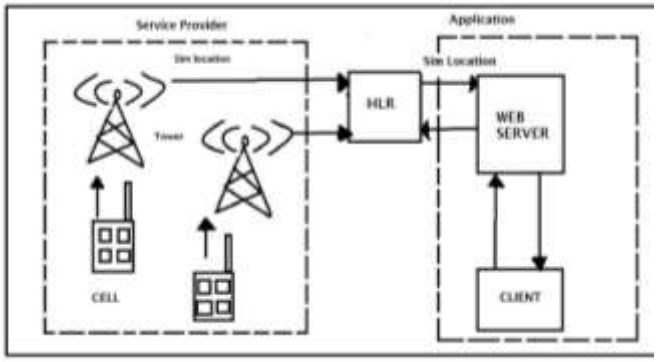

Fig. 1. System Architecture of Real-Time Web-Based Vehicle Tracking System Using SIM.

Fig. 1 shows the block diagram of a Real-time web-based vehicle tracking system using SIM. Automated real-time vehicle location tracking is done through a web application by interfacing the telecom service provider with the client-server through the network device known as HLR (Home Location Register). Client-server architecture is having components such as workstations, Web servers, and networking devices. Workstations are also known as client computers. Initially, the client will log in using the username and password on the login page. After login, the client sends the request through a web server to HLR with the user's SIM card details for tracking the vehicle. Servers are fast-processing computer that acts as centralized repositories of network files, programs, databases, and policies. Servers have huge storage space and robust memory to deal with requests, received simultaneously from various workstations. Here the server collects the SIM details of clients and sends requests to HLR to get its location.

Networking devices are medium that connects clients and servers in a client-server architecture. Many networking devices are used for connecting a server to various workstations. In this project the networking device is HLR. Home Location Register (HLR), will accept the request and start finding the location of the vehicle with the help of the service provider. The cellular network finds the vehicles nearest three base stations and assigns the data in the form of Google Latitude and Longitude to HLR in an encrypted format. HLR is going to send data to the web server and the client can access the data and monitor it. There are different types of service providers such as AIRTEL, JIO, BSNL, and VI in India.

Then, the tracking data which is in the form of latitude and longitude is processed to indicate the real-time location of the vehicle in readable and visual content form through mobile or computer apps. So, here web application is developed to give a detailed analysis of tracking data as well as to store the database [3]–[5]. A web application has been developed using HTML, and JavaScript which is a library of Angular with embedded Google Maps. The JavaScript runs in the browser and integrates this information into Google Maps through Google Maps Application Programming Interface (API) which

displays the position on a map. The positional information is also transferred to a remote server over Hypertext Transfer Protocol (HTTP) connection. HTTP server stores the acquired positional data in the database. Since the geographic positional

data is retrieved every second or according to the user's requirements and the maps are updated at the same interval, thus real-time vehicle tracking is achieved. In the monitoring section, different software is used to display the vehicle on Google Maps. This is how the system tracks automobiles in real time and maintains the records of tracking data using a web application.

III. WEB APPLICATION DESIGN

A shipping API/Web application is developed to automate shipping, logistics, and supply chain business. The web page for vehicle tracking and monitoring is designed by using Mean stack [7], [8]. Mean is a full stack, JavaScript technology that tends to accelerate the building process of web and mobile applications for modern developers. It is robust and can easily be maintained. MEAN is an abbreviation of MariaDB, Express.js, Angular, and Node.js8. Each component in the MEAN stack speaks the language of JavaScript Object Notation (JSON). The web is not a monolithic technology, it is a combination of web frameworks, programming languages, constructs, and libraries. Web Application design and development are implemented as per the following steps.

A. Front End Web page Development

There are four web pages created to design the web application firstly security is the main part so 1st page is the login page. When a new vehicle is present for freight it needs to register on this website hence second page is created for the registration of the vehicle, the vehicle owner needs to fill in all the information like vehicle no, mobile no, address, pin code, etc. and this all data will be shown on the third page contains a total list of registered vehicles so the owner can get the information about how many vehicles are there to delivering freight. The main part of the project is to track the vehicle and observe its location using the fourth page, there is a Google map so that a user can easily track the location of the vehicle. The following features are made available in this web page application.

- Client Registration
- The client login on the login page using the username and password
- Register the new user by filling in basic details
- Store the details in the database
- List of registered users
- Show the location of the registered user on Google Maps
- Deactivation of the unwanted registered user

Kockout.Js can also be used for Web application development. Here in this project, Angular.Js is used as it automatically manages the whole application and defines guidelines on how the application code is structured, while the Knockout application is managed by the developer.

B. Middle Tier

Express.js is nothing but a backend web application framework used for constructing RESTful APIs with node.js to send data or collect data in web applications. This web application provides broad features for building web and also APIs, using HTTP request one can store the data in the server and also collects the data from the server and it's a layer built on the top of the node.js that helps manage servers and routes. This application also provides connections between the service provider and client through APIs to take permission from the vehicle driver for tracking the vehicle. These services are firstly aimed to collect all vehicle details and store them in the database and when the client wants the list of registered vehicles then it will show that list. Springboot as it is an alternative option to Express.js. But, Express.js is better than Springboot as it uses node.js that handles high traffic means developers can send many requests at a time while Springboot uses Java where developers have to wait for every single request.

C. Backend framework

Database servers are used to store the information which is going to fetch from the client side. In this project, tables are created using the database to gather information on vehicles such as vehicle number, driver name, driver number, start date, and time to track that vehicle at a given registered date and time. Here MariaDB [9] server application is used because it's not only the most popular database server but also is very fast and versatile while performing queries and replication rather than MySQL. MariaDB is an open-source RDBMS intended for Rational Database Management Systems. HeidiSQL is also used during the

designing of the database and it is an open-source and free administration tool for MariaDB. It helps out to operate databases, and edit or add data as well as tables. MongoDB is an alternative to MariaDB which is more popular than MariaDB. But this project holds MariaDB because it provides good performance, and security, and is easily available.

IV. FEATURES OF SIM-BASED VEHICLE TRACKING SYSTEM

In this project, real-time vehicle location tracking is implemented. Nowadays, with more advancement in Real Time SIM-based vehicle tracking systems, additional features can be obtained for the transportation business.

- Route Management
- Transport Schedule Management
- Real-time Visibility
- Route Optimization
- Sending SMS and Email Alert
- Driver and Assets Safety
- Analytics Detailed Reports
- Web and Mobile Platform
- Paperless Documentation
- Ensure On-time Delivery
- Geofencing Technology
- Accepting the Driver's Consent,
- Analyzing Calls and Texts, and
- Optimizing The Route for Delivery

V. APPLICATIONS

1) Vehicle Tracking System helps transportation companies by monitoring the transported vehicle's movements in the given location so that the exact time of distribution to the destination can be monitored. Drivers can also send messages to the owners in case of any emergency, accidents, mishaps, etc. [10].

2) With more developments in SIM tracking technology, it has been found very useful in fully automated Logistics, Public Transport, Heavy Equipment Industry, and E-Commerce.

3) The SIM tracking system finds an unusual application in the care of elderly or weak citizens. This system is used to keep track of elderly or vulnerable patients if they get lost because of memory problems or any other problems. This application is very useful for these people as it does not require any smartphone. The real-time location of these people will be obtained so the caretaking persons can reach them or emergency help can be made available for them immediately.

VI. RESULTS AND DISCUSSION

In this section design of a web application for a real-time vehicle tracking system using SIM is implemented. Fig. 2 shows the login page for the web user. To get vehicle tracking information users need to log in to the system through the login page. Only the authorized user can log in to this web page.

Registration of New Users is shown in Fig. 3. For every new trip of a vehicle, it is necessary to register the driver. The user should enter all details required in the new entry of a vehicle. It includes freight ID, vehicle register number along with the driver's name and mobile number, start and end date of the trip, also, the start and end time of the trip. Tracking will be done strictly only for this mentioned duration with permission to maintain the privacy of the driver. At the same time, the driver's details are sent to the telecom service provider along with the request from the user. The driver's registration will be temporary for the mentioned duration of tracking. The registration page is designed using HTML and the styling of the page is done by

CSS i.e., page color, alignment of text, and font size of the text. This page is a responsive page according to the user device screen.

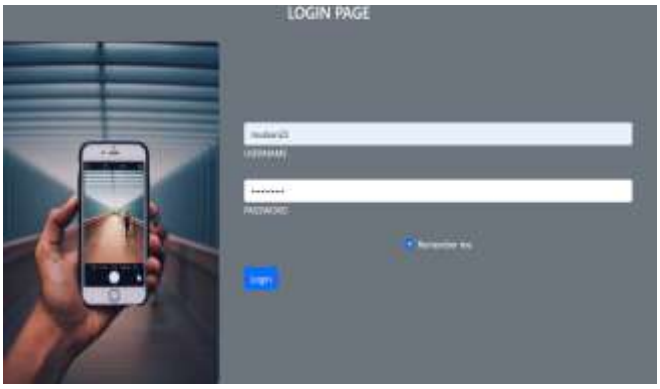

Fig. 2. Registration of New User

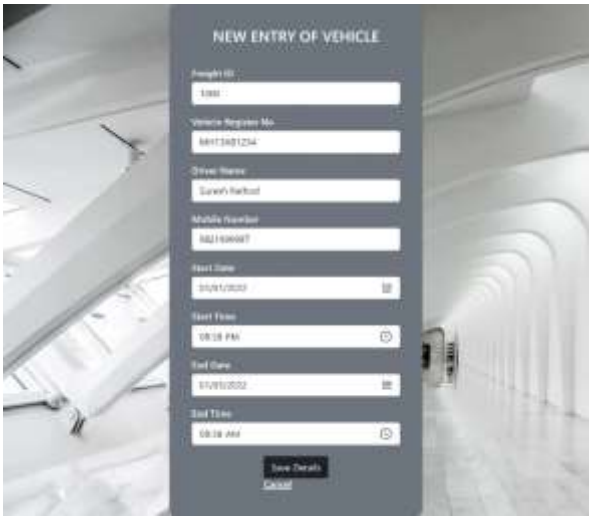

Fig. 3. Registration of New User

Fig. 4 shows the list of registered vehicles. After the vehicle registration, a list of users is maintained by the client. This is the SIM owner list which is made available for the client to check the no of registered vehicles in the system. The total no of vehicles which can do registrations will depend on the server's database storage capacity.

Freight ID	Register Number	Driver Name	Mobile Number	Actions
1000	MH13AB1234	Suresh Rathod	9822000000	View Log Deactivate
1001	MH13BC2345	Ritik Patil	9822000001	View Log Deactivate
1002	MH1375196	Mahesh Kumar	96969235213	View Log Deactivate
1003	MH14AB1234	Ramesh Patil	9821999992	View Log Deactivate

New Registration

Fig. 4. List of Users

Fig. 5 shows Real-time vehicle location on Google Maps The telephone service provider shares the tracking data with the user's server and now, it will be available for user. The location page of the particular vehicle will be displayed after clicking

on the VIEW LOG button from the list as shown in Figure 4. Users can see the location of a particular vehicle on Google Maps. Users will get real-time vehicle locations along with the date, time, longitude, and latitude measurements.

Fig. 6 shows any undesired driver's registration deactivation window. At the end of the vehicle trip, the

Fig. 5. User location on the Google map with its details.

driver's registration can be deactivated and removed the data from memory. For that, it needs to 'click' on the red button Deactivate. Then it will show a pop-up window with the message of confirmation of the deactivation of the driver's number. After clicking on OK the registered vehicle will be Deactivated, so that the memory space will be available for the

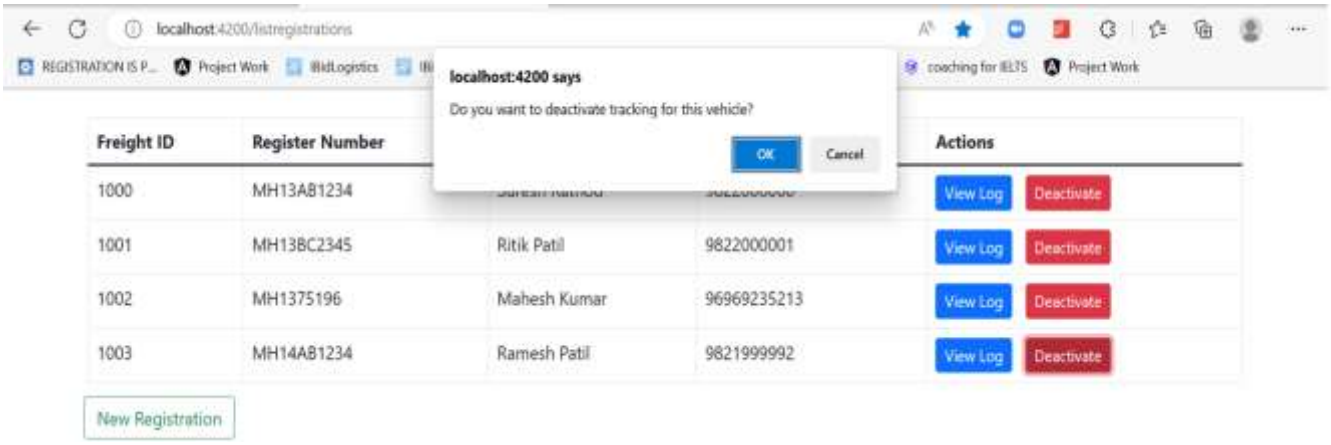

Fig. 6. Deactivation of the User.

new driver's data. Thus, web service helped to make the system fully automated and to save huge data for a longer time for analysis purposes.

VII. CONCLUSION

Real-time web-based vehicle tracking system using SIM is developed for all Logistic and E-commerce transportation businesses for the safety of divers and assets without using a GPS device. It uses only SIM and mobile phones to track, so it is a more safe and more reliable system. SIM-based tracking helps the owner to track the fleet driver's mobile number to get the location of the vehicle on a trip. SIM Tracking doesn't consume more battery power as it is based on the cellular network. Nowadays, the real-time SIM-based vehicle tracking web application is the best solution to track, locate and monitor the day-to-day activities of the fleet without the need for a conventional GPS tracker. Web applications support the tracking system to maintain and analyze the tracking data continuously. The SIM-based tracker services can be obtained even on low-cost feature phone as it doesn't necessitate a smartphone with an internet facility. It is suitable for all telephone service providers in India. There is scope to estimate and intimate the probable time required for the vehicle to reach the destination using a machine learning process.

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