



(RESEARCH ARTICLE)



## Design and implementation of vehicle location tracking system for University Bus Developing Android Application

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### Abstract

In this modern era, studying Engineering is far more popular and prestigious than any other option. The demand for engineering students is increasing day by day and students are very eager to study engineering more than ever. To maintain the demand, Engineering institutes are enlarging their capacity as well as increasing their departments. Using this engineering knowledge, for a complete picture of vehicle locations, a vehicle tracking system combines the use of independent vehicle location in individual vehicles with software that gathers this fleet data. Other kinds of automatic car location technologies can also be utilized in modern vehicle tracking systems, which often use GPS or GLONASS technology to locate the vehicle. For cost optimization, only the Android application in mobile through a continuous internet connection can also be used. Only using the Google Map API (Application Program Interface), can be beneficial to third-world countries like Bangladesh. Additionally, using the Internet or particular software, you can display car information on electronic maps. Vehicle tracking systems are being used by urban transit authorities more frequently, especially in big cities. The efficiency of the production and the overall system of an organization can be increased by using the location tracking system. It may also reduce the unusual wastage of delivery time of workers.

**Keywords:** Vehicle Location Tracking System; GPS; Android Application; API.

### 1 Introduction

A transportation company with numerous vehicles requires tracking and monitoring both the drivers and the vehicles simultaneously. In metropolitan areas, the need for tracking systems for vehicles is expanding rapidly. There are several vehicle tracking systems on the market at the present time, but only certain systems are successful and efficient because they are able to utilize relevant and necessary information, and data appropriately and transmit feedback in a timely way. Effective information management is vital for controlling this process as it is an important issue nowadays.

Management information system (MIS) is capable of tackling the issue of poor information management. Management information systems, refer to the interconnected systems of both software and hardware working cooperatively to gather, process, retail outlet, and disseminate information in order to support the managerial role of utilizing information technology to increase company value and profits. In other words, MIS is the study of people, technology, and organizations. Anyone can major in information systems if he or she prefers technology, such as smartphones, iPods, and social media. The only prerequisites are a genuine interest in technology and a desire to use it to enhance people's lives. Information systems are used by every employee in a business, including those who wire and fire employees as well as those who pay the bills. For instance, a supermarket may monitor which products sell the best by utilizing a computer database.

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Since information is the fundamental driver behind every aspect, it is necessary to manage it skillfully. Information Systems is a subset of MIS, which itself has several ever-more-detailed subdivisions. Furthermore, decision-making, coordination, control, analysis, and visualization can all be performed in that setting using management information systems. Everyone needs to have a basic understanding of management information systems. The individual who is skilled at managing information will be one step ahead of the others. Developed countries place a strong emphasis on information because they believe that the more information available about a thing, the more control they have over it. Universities now encourage students to enroll in MIS because it is a noteworthy and in-demand subject in today's world. The academic field of management information systems emphasizes the interactions between companies, people, and technology. Along with other departments of relevant business disciplines, several business schools (or colleges of business within universities) offer an MIS department that offers degrees (at the undergraduate, master's, and/or doctorate levels) in management information systems. MIS experts help companies maximize their investments in personnel, technology, and operational processes.

As previously pointed out, if information is not used effectively and efficiently, it will not yield the intended outcomes. If it doesn't have a use, information isn't highly valuable. Students studying MIS learn how businesses use information to improve their operations. Students also learn how to handle a range of information systems to better satisfy the needs of management, workers, and customers. In addition to learning about databases, networks, computer security, and many other topics, MIS students also study how to design systems for figuring out and storing data. Students and professionals with MIS backgrounds in particular can contribute to the development of a vehicle monitoring system by creating the necessary databases and other relevant elements to control the system. A vehicle tracking system combines the use of autonomous vehicle positions in individual vehicles with software that compiles this fleet data to provide a comprehensive picture of vehicle locations. While other kinds of automatic car location technology may also be employed, GPS technology is the most popular choice for modern vehicle tracking systems. Through the Internet or specialized software, you can view vehicle information on electronic maps. As previously indicated, urban public transit authorities frequently deploy vehicle tracking systems, especially in major cities.

Basically, a tracking system is used to keep track of moving people or things and to provide timely, sequential position data for processing. Vehicle location tracking technology became widespread in industrialized nations by utilizing this concept. This approach is employed by developed nations for specialized purposes. For instance, improving an organization's efficiency or decreasing the amount of time that employees generally waste delivering goods, this system is mostly under the control of an organization's top or main level of management. The staff is included in this system so that they can't misuse the product delivery schedule. This technology can also be used to locate the position of buses being utilized for simple purposes at a university. In this regard, Khulna University of Engineering and Technology (KUET), a reputed university in Bangladesh, where this technology can be used to locate the locations of the students' buses by developing an Android Application.

The primary desire of both private and public vehicle users is safety, which a vehicle location tracking system may offer to its users. Having a GPS vehicle tracking system protects their safety while traveling, which is a key worry today. Customers' cars may have this vehicle tracking system installed as a theft prevention and retrieval device. To find a stolen car, police can use the tracking system's signal as a point of reference. Although this system is often built for four-wheelers, it is the most affordable choice for a country like India, where the majority of people drive two-wheelers. Vehicle tracking systems are frequently used by fleet managers for fleet operations like dispatch, routing, onboard data, and safety. Another purpose for a car location tracking system is to track driving behavior, such as by the parent of a young driver or the employer of an employee. Consumer vehicles frequently have vehicle tracking systems installed as a theft deterrent and recovery tool. The stolen vehicle can be found by police by simply following the signal that the tracking system generates.

VLTS improves security and efficiency for enterprises. Using this technology, industrialized countries are expanding this field. Therefore, developing nations like Bangladesh can utilize this technology. The objective of this proposed paper is to reduce costs. Only using the Google Maps API and an Android application can keep up with the process. To use this system, at least two people must be connected through the app using a constant internet connection in order to operate the system smoothly and without interruption. The Google Map API permits the application to receive the precise position. The main advantages of this project are the low cost and the increasing efficiency. Because using the Google Map API to create an Android application does not require a significant investment.

The main objectives of the project are:

- To study and evaluate the current condition of the existing systems.
- To use the Android Application for University Buses.

## 2 Literature Review

This chapter provides a comprehensive review of the relevant literature regarding Vehicle Location Tracking Systems and recommended solutions for management. The information included all the significance and importance of using this technology for vehicles.

**Table 1** Related Research Work

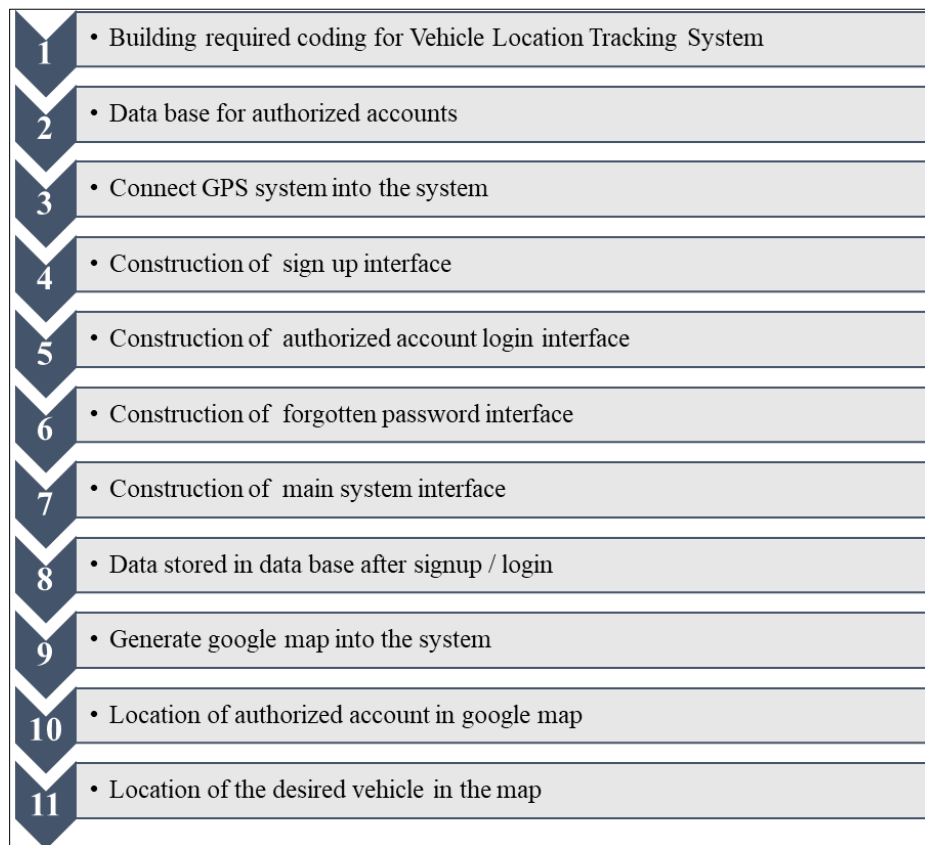
Reference	Target	Result
Alamgir, Jahan, Aktar, and Ramisa (2019)	To continue keeping track of the faculty buses, Chittagong University (CU) planned and created the implementation of a real-time bus tracking system. Additionally, to more effectively alert the teachers about buses via an Android application (app).	This study examined how a user may use their smartphone app to obtain information about their current location, the distance to nearby bus stops, and the time it will take the bus to get them there. As a result, the developed tracking system offered consumers a more practical, quick, and user-friendly environment.
Alquhali, Roslee, Alias, and Mohamed (2019)	In this research, a real-time vehicle tracking and monitoring device was suggested. A system combining Arduino Uno R3, a global system for mobile (GSM) device, and a global positioning system (GPS) was also being built to track the precise position of the car at any location.	In this study, clients were able to simply track the location of their vehicles using a mobile phone and the internet. The entire system was put through rigorous real-time testing, and it has succeeded in assisting users in locating their vehicles in a case of theft.
Andutan, and Ucat (2022)	To create a prototype vehicle monitoring system including route detection, an emergency button, and a STATUS command to track the vehicle's present location.	A vehicle tracking prototype with route diversion identification, urgent command, and current status command was suggested to be created by this research. The prototype could tell whether or not the user had pressed the SOS button and whether or not the user had sent a "STATUS>" command. The outcomes also revealed that, based on the actual testing, the prototype accomplished its overall functional goal.
Bhat, Vashishtha, Goel, and Sisode (2013)	To bring fairness to the Indian Auto rickshaw industry finding the optimal paths and calculating the fare of Rented Vehicle by using Android SDK (Software Development Kit) and GPS.	This study suggested that to use this application one should have an android operating system and internet connection for connectivity.
Darekar, Chikane, Diwate, Deshmukh, and Shinde (2012)	To combine GSM and GPS technologies into a single system and offer a useful application for both human and vehicle tracking.	This paper tracked a vehicle using 5 stages. These were, in order, a client PC, a tracking server, a car or person with a suitable device, a GSM service provider, and a GPS satellite. The following are some other applications for this system: tracking of precious assets, controlling public transportation including buses and trains, and anti-theft systems for cars and bikes.
Dewan, and Agarwal (2020)	The smart system described in this study is intended to identify the accident right away. Utilizing ultrasonic sensors, this system constantly keeps track of the distance	This study demonstrated that the GPS/GPRS system continuously monitors the location of the vehicle and may be used in the event of an accident or theft.

	between the vehicles. The suggested design considered GPS/GPRS and GSM, which instantly alerts family members and the closest rescue squad.	
Hlaing, Naing, and Naing (2019)	To effectively utilize a popular piece of hardware that mated a smartphone with an Arduino UNO. The device was integrated inside the vehicle, allowing for real-time tracking and position determination.	The user can continually watch a vehicle that is moving on demand using a smartphone, and this article provided a minute-by-minute update about the location of the vehicle by sending SMS using a GSM modem. Identify the distance and time it will take the car to travel to a particular location.
Joseph, and Bharathy (2013)	To create a tracking system that was considerably more affordable than those currently on the market. When an SMS (Short Message Service) is sent to a certain number, the location of the college bus can be determined thanks to the tracking system in place and the mobile device.	The position of the device could be determined using the GPS and GSM modem given in this paper by sending an SMS to the designated number. The cost was decreased because no external server or internet connection was required to determine the user's location.
Kiattisin (2015)	Employing a general packet radio service (GPRS) technology module to connect to the internet, a microcontroller, and a GPS technology module to monitor the vehicle in actual time and show the location of the vehicle in real-time on the website.	Due to hardware and map reference ratio limitations, this study paper's overall results included a tiny mistake for tracking vehicles at an incorrect location by about 5 meters. Google Maps created a map that enables constant vehicle inspection.
Kotte, and Yanamadala (2013)	To put forth a very effective system that employs GPS and earth maps to aid the driver in navigating by clearly displaying the car's present location on a map. The major goal of this project was to create a system that could track the course of the vehicle continuously on a PC using the Google Earth application.	The Google Earth program will be used to track the vehicles utilizing the GPS-GSM integrated framework. The microcontroller was employed to transport the longitude and latitude coordinates from the PC to the map using Visual Basic (VB) and to receive data from the GPS.
Maurya, Singh, and Jain (2012)	To provide a design for a vehicle tracking system that utilizes GPS and GSM technologies. This system would be the least expensive way to track vehicles and would also function as an anti-theft system.	This study demonstrated that the GPS modem will provide data, such as both longitude and latitude for identifying the position of the vehicle, continually. The system automatically sends a reply message to that mobile device containing the request from the user together with the location of the vehicle in terms of latitude and longitude as of the moment.
Mukrimaa, Nurdyansyah, Fahyuni, Yulia Citra, Schulz, Taniredja, Faridli, and Harmianto (2016)	To develop a system that will track agricultural grain using GPS to secure food safety and contribute to the economy.	By enhancing food security and the effectiveness of the agricultural food supply chain, this study work offered significant possibilities for tracking grain and grain properties. This investigation is necessary to further assess the technology's viability from an economic standpoint.
Qian, Gao, and Liu (2018)	To create and implement an Android-based handheld communication terminal-based vehicle theft prevention alarm and tracking system.	This study developed good real-time performance, high practicability, high accuracy, and high extensibility.
Uddin, Ahmed, Alam,	To provide a smart anti-theft vehicle system based on the Internet of Things (IoT) to	This study made it possible to use a mobile application to remotely monitor and control (emergency stop by blocking the fuel supply) the

and Islam (2017)	track any fitted vehicle's movement in real-time from any location.	movement of cars. In accordance, the user application for tracking and managing vehicles as well as the hardware prototype of the suggested system were demonstrated.
Wong, Min, Jali, and Chai (2021)	To research, evaluate, and create a tracking system employing extreme programming techniques using the existing vehicle tracking system.	This research developed a tracking system with the help of an Arduino, GPS, and GSM. Tracking tests and GPS accuracy testing were performed and these gave good feedback.

### 3 Research Methodology

This research is conducted by following some step-by-step procedures. The flowchart of this research and its descriptions are discussed below in **Figure 1**.



**Figure 1** Flow diagram for research methodology

#### 3.1 Steps involved in research methodology

##### 3.1.1 Building required coding for vehicle location tracking system

Building a vehicle location tracking system involves several components and technologies, including hardware and software. Here's an overview of the coding and components that might be needed:

- **GPS Hardware:** GPS devices need to be installed in each vehicle to track their location. These devices often provide data through a serial interface or an API.
- **APIs:** API that allows the vehicles to send their GPS data to the server and provides access to this data for authorized users.

- **Authentication:** Implementing authentication and authorization to ensure only authorized users can access the tracking data.
- **Real-Time Updates:** By using technologies like Web Sockets or Server-Sent Events (SSE) to provide real-time location updates to users or administrators.
- **Historical Data Analysis:** By developing features to analyze historical vehicle data, such as route optimization, trip history, and reporting.
- **Testing and Maintenance:** Regularly test the system for performance, security, and reliability and provide ongoing maintenance and updates to keep the system running smoothly.

### 3.1.2 Database for authorized accounts

To build a vehicle location tracking system, we need a database to store authorized accounts.

We've created a table called authorized accounts with the following columns:

- **Identifier:** which includes authorized email IDs.
- **Created:** this section provides when the authorized user created an ID for the system.
- **Signed in** This module stores the data when the authorized user signed in / used their accounts.
- **User ID:** while user create their account to use the system in that time the system gives them a user ID.

Mentioned all information is stored in the database.

### 3.1.3 Connect the GPS system to the system

Integrating a GPS system into the vehicle location tracking system involves several steps, including hardware setup, data acquisition, data reception and storage, backend integration and data processing, frontend integration, real-time monitoring and alerts, security and authentication, scalability, and reliability on the server.

### 3.1.4 Construction of sign-up interface

Designing and constructing a sign-up interface for a web application or mobile app involves creating a user-friendly interface that collects necessary information from users who want to create an account. Below are steps and considerations for building a sign-up interface:

- **Determine Required Information:** This includes Username or full name, Email address, Password, Confirm password, and Additional user details (e.g., date of birth, profile picture).

### 3.1.5 Construction of authorized account login interface

Constructing an authorized account login interface involves creating a user-friendly form that allows users to enter their credentials and access their accounts securely. Below are steps and considerations for building a login interface:

- Design the User Interface.
- Username or email input field.
- Password input field.
- "Remember Me" checkbox (optional).
- "Forgot Password" link for password recovery.
- A "Login" button to submit the form.

### 3.1.6 Construction of forgotten password interface

Creating a "Forgotten Password" or "Password Reset" interface is an essential feature for any system that requires user authentication. Here's how a user can construct a forgotten password discussed below:

- **Design the User Interface**

An input field for entering the email address associated with the account.

A "Submit" button to initiate the password reset process.

A confirmation message or link to indicate that the request has been sent successfully.

**Input Validation:** Implement input validation to ensure that users provide a valid email address. Notify users if they enter an invalid or non-existent email address.

- Backend Logic
- Email Communication
- Password Reset Page
- Password Reset Logic

### 3.1.7 Construction of the main system interface

Constructing the main system interface involves designing the primary user interface of the application, which users will interact with to access the system's features and functionalities.

Here are the steps and considerations for building the main system interface:

- **Define User Roles and Permissions**

Identify what each type of user should be able to access and do in the interface.

- **User Interface Design**

Navigation; Information Hierarchy; Consistency; Responsiveness; Accessibility

- **Dashboard or Landing Page**
- **Navigation Menu**
- **Feature Modules**

### 3.1.8 Data stored in the database after signup/login

After a user signs up or logs into the system, this user typically stores their data in a database to manage their account and provide personalized experiences. The required information mentioned in point 2 is stored in a database.

### 3.1.9 Generate Google map into the system

After successful login of the authorized account, the authorized user will enter into the main interface of the system. The main interface will generate the Google map for the user.

### 3.1.10 Location of authorized account in Google map

After generating the Google map into the main system interface, the system will show the exact location of an authorized user. Through this authorized user will be able to see his location as well as other locations in the map.

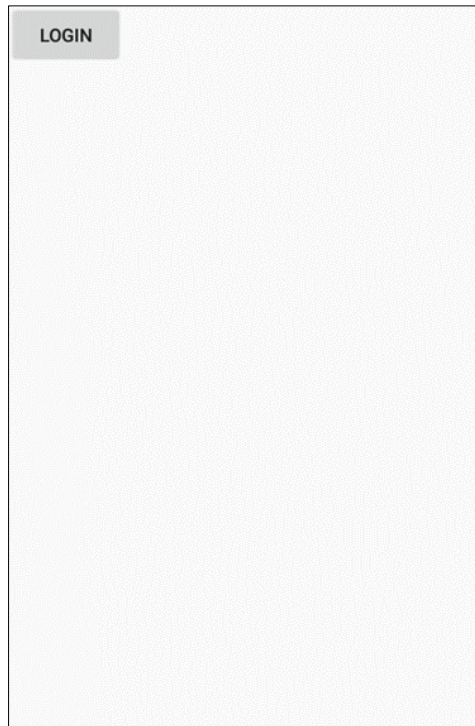
### 3.1.11 Location of the desired vehicle in the map

To track the vehicle, a vehicle will also connect with the system. So that whenever an authorized user opens the system the authorized user will be able to see the both location of the vehicle and his location as well.

## 3.2 General Procedure of the Application

### 3.2.1 Step One

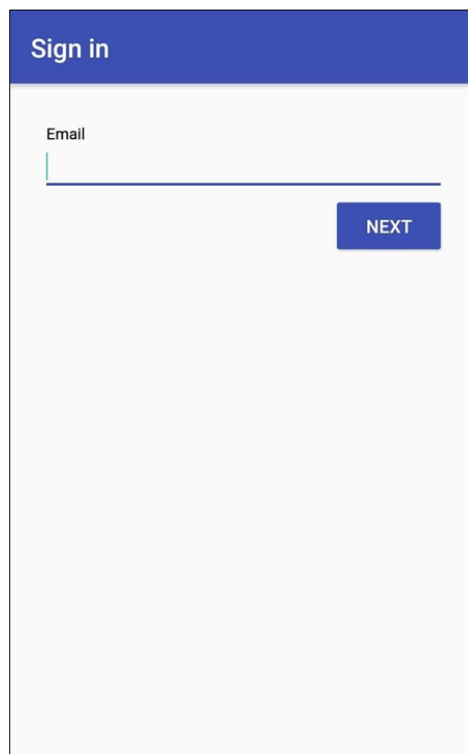
This is the first page after clicking the application shown in **Figure 2**.



**Figure 2** First step to log in to the application

### 3.2.2 Step Two

After the process of login, the user needs to give an email address to complete the sign-in process accordingly, which is shown in **Figure 3**.

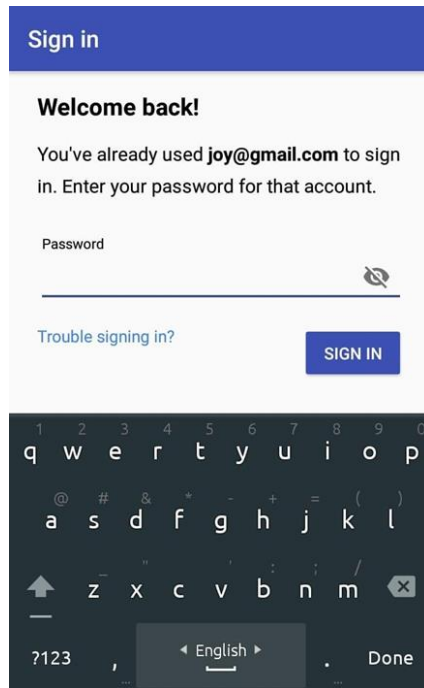


**Figure 3** After the login, there will be required an email address that is authorized access to the database



### 3.2.3 Step Three

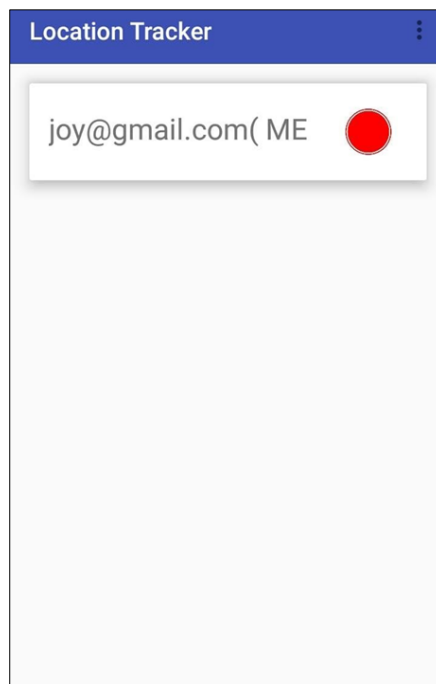
After giving the required email address, you have to enter a valid password that is authorized access to the database, as shown in **Figure 4**.



**Figure 4** There will be a requirement for a valid password

### 3.2.4 Step Four

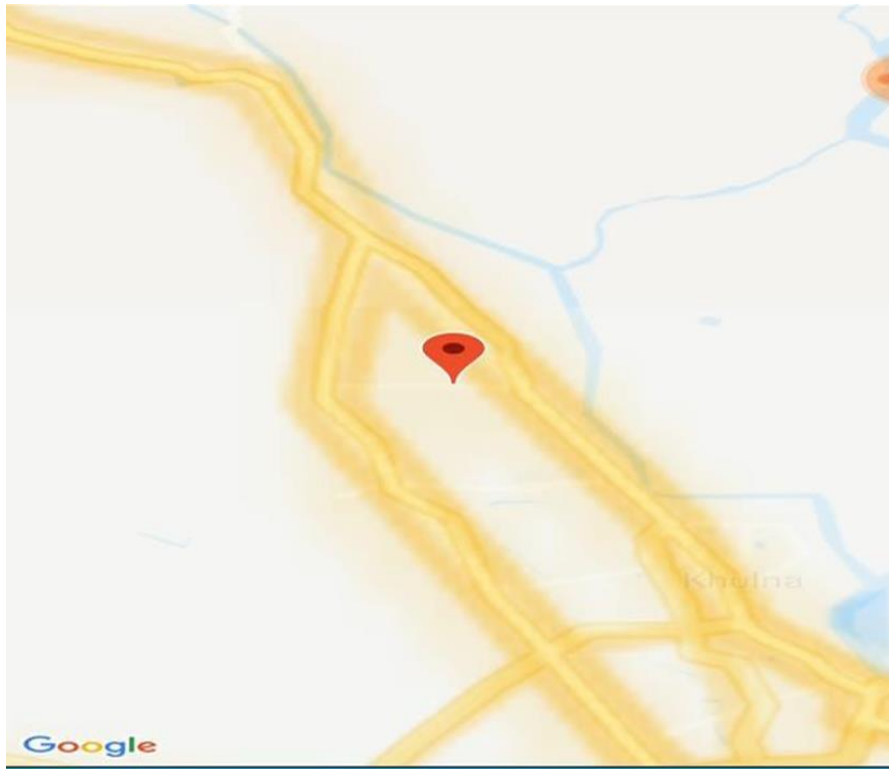
After giving the authorized email address and a valid password, the authorized email address will be linked with Google Maps. The location of the user can be tracked by Google Maps application which is shown in **Figure 5**.



**Figure 5** Authorized email accounts that will appear with Google Maps

### 3.2.5 Final Step

This is the final step of the total process in which the location of the user will be shown in the Google Maps application which is shown in **Figure 6**.



**Figure 6** Final step showing the position in Google Maps

### 3.3 Authorized Accounts

There are some authorized accounts for showing the practical implementation in the database which is shown in **Figure 7**.

Search by email address, phone number, or user UID				
Identifier	Providers	Created	Signed In	User UID ↑
joy@gmail.com	✉	Apr 9, 2018	Jun 24, 2018	4KB7HRbooXWeXIXTucuubdSGp6s2
mdrafee03@gmail.com	✉	May 24, 2018	May 24, 2018	JJBhrV7n02clB8SJ5VyHMMvs05u1
mahbubur@kuet.com	✉	Apr 13, 2018	Jun 24, 2018	ZQVGm3J4WSdtqZhNmyJKfNCoGaU2
pranto00250@gmail.com	✉	Apr 9, 2018	Apr 13, 2018	bAbEag27evS249MBjVArCU1UefD3

Rows per page: 50 1-4 of 4

**Figure 7** Some of the authorized accounts

#### 4 Research Result Analysis

Several important factors are related to this research activity. Some good outcomes are gained after the completion of the research.

- For example, the delivery time will be saved because of the continuous location tracking through the Android application. So, overall delivery time will be minimized for a specific company.
- Moreover, a less costly process is used in this research as it uses only a continuous internet connection and it is also a quick process to achieve results.
- The unnecessary workings of workmen will be reduced as the authorized persons look after the whole system through the continuous process using an Android Application.
- As it is a quick process, the incidents of theft in these places can be easily located by using the location tracker application system.
- The overall efficiency of an organization can be increased as time is saved and also the unnecessary costing is reduced as the number of workers are in only regular working procedures.

#### *Future of this Project*

In this research, the Android Application system is used and also developed with Google Maps for cost optimization. For the cost-minimizing process, only an internet connection is used for the connection between at least two authentic persons of this system.

To have more accuracy and better output for industry, this research can be further developed by using GPS (Global Positioning System) which is the satellite navigation system that uses four or more satellites to give location and time data in all weather conditions, but it will be costly than the previous one.

GPS is a costlier process than the previous one, but it can be more beneficial for the particular organization. It may increase the efficiency of the previous one and will help the top management control the overall vehicle location tracking system.

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#### 5 Conclusion

An essential part of a nation's economy is played by businesses and organizations. Vehicle delivery time is wasted far less frequently in industrialized countries than it is in developing ones. The Vehicle Location Tracker System may be the best option to address this issue. It can be applied to both expensive and inexpensive tasks. In this attempt, the system is solely operated by utilizing an Android application with a constant internet connection. Due to the work's code, specifically for companies and industries, this method is only available to approved individuals. For the bus services in universities, this idea may also be accessible to everyone.

In addition, it can be utilized for vehicle recovery, tracking wildlife, and asset tracking. In the future, a vehicle might consist of sensors and other useful devices. The course of the vehicle can also be preserved by setting up a server that allows us to view its route and other data on our personal computers. The vehicle tracking system we created using the sensors we installed in it may transmit information about the vehicle to our server. This arrangement is preferred by both car owners and public transportation operators for a variety of reasons. When traveling domestically or internationally, being able to track your precise location with a GPS or an Android app is unquestionably useful. If you think you're lost, you can use your GPS receiver to locate yourself precisely. For fleet management duties like routing, shipment, onboard data, and safety, fleet managers typically use vehicle tracking systems. Another usage of driving behavior monitoring is by a supervisor of a worker or a parent of a young driver.

The following are some other applications for this system such as the mechanism to prevent theft of bikes and autos, controlling modes of public transit, such as buses and trains, and monitoring of valuable goods. The system contains a variety of elements that ensure its efficiency, dependability, and security. Sensitive location data can be transmitted securely using the key exchange method and secure session management method without slowing down the processing. The encoding technique makes effective use of network traffic to send location data, resulting in a lengthy real-time

transmission time. By utilizing the necessary low-cost devices and encoding techniques for effective network traffic utilization, the system has been developed to be cost-effective with appropriate running costs, which results in the low operating cost of General Packet Radio Services (GPRS).

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## Compliance with ethical standards

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### *Disclosure of conflict of interest*

Every procedure carried out in research involving human subjects complied with both the national and institutional research ethical requirements. Regarding the topics, resources, and techniques covered in this study, the researchers have no connections to, or engagement with, any organizations or entities that have a financial or nonfinancial interest in them. No conflict of interest is to be disclosed.

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