EASY BUS
(BUS TRACKING AND VIRTUAL BUS PASS)

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Abstract:

Unusual and unexpected conditions on the roads affect the smooth operation of the bus system and the movement of vehicles. Also, everyday problems such as traffic congestion, unexpected delays, randomness in student demand, irregular bus dispatching times take place and as a result of which the schedule of the students are affected and they inevitably have to wait for the arrival of their respective bus. This student inconvenience can be avoided by introducing a system which provides real-time information about the location of the buses.

EASY BUS is an interactive application that makes the process of availing college bus easy and feasible. The common problems faced by bus students are whether their bus will reach the stop on time or did it already pass by, or even if the bus is operating that day or not. This app solves these problems in an elegant and efficient manner. In order to make the best use of this, students need to install this app and ensure that they renew their bus passes regularly.

This app has two prominent features namely, GPS tracking of the bus location and virtual bus pass. Location of the bus is tracked by the sensor for every thirty seconds and this recorded information is sent to the server which in turn is displayed on the map to the user (student). The next facility provided by the app is bus pass facility, where they can create a new pass, or renew the pass they are currently using, either of which would be charged through online payment methods.

Keywords — **GPS, Location, Tracking, Mobile, Bus-pass, API, Cloud, Firebase**

I. INTRODUCTION

Bus Transportation already began on August 10, 1826, in Nantes called Omnibus. Omnibus consists of 2 horses and can hold 16 passengers at one time. The word bus is derived from the Latin word which is Omnibus that carries the meaning of carriage for all. After the development of Omnibus, people kept inventing the similar architecture of the system such as horsecars, cable cars, streetcars and modern buses. Public transportation in Malaysia started developing during the British era. Since then, public transportation in Malaysia has been getting better over time. However, over the years, many issues occurred such as the time management of the bus transportation has decreased due to the environment factors. For example, in university, the main passengers are students and staff members. They might be late to the class because they decide to wait for the bus without knowing the exact location of the bus. In this growing and evolving environment time is so precious that if you lose some it may cause you major incident like during exam days or students that may miss their bus are taking their time for last minute revision they need to do before the exam. Most of them feel unsure about the location of the bus. They do not know the current location of the bus and they could not

estimate the time of arrival and time for them to get prepared. Other than that, not knowing the unique identification for a bus will also complicate them on which bus they should take.

II. PROBLEM STATEMENT

The proposed system will help to detect the position of a bus and track the current GPS location of the bus in real time (through a user-friendly application which is simple, clear and has an upstanding interface) based on the fee status of the student [1].

III. EXISTING SYSTEMS

Around the world, many vehicle tracking systems have been developed [3]. These systems have their own uniqueness. An example of EVO GPS Tracker is developed to provide vehicle security and GPS location for personal and fleet vehicle 2 owners. This device combines advanced technology and safety features to keep the vehicles secured whenever they go [2]. Controlling and monitoring the vehicles can be done in an easy and convenient way. LiveViewGPS designed to provide vehicle security and GPS location for fleet vehicle owners. Now they have a variety of options to choose either personal, bus, professional vehicle, and all sorts of vehicle tracking systems [4]. They have a device that combines with advanced technology that keeps the vehicle secured whenever they are. XSSecure XTS Tracking System is GPS navigation engineered for use in vehicles. This device is manufactured in Conjoinix which is a multinational company and a producer of security equipment. It provides a huge list of features like, stolen vehicle recovery, asset tracking, video & audio surveillance, transit tracking, fuel monitoring, distance calculation, historic tracking data auditing.

IV. PROPOSED SYSTEM

The entire project is divided into three different modules. "Authentication" is the first module which verifies a user's identity from the database, before allowing access to the application. An SMTP server is set and it sends the verification and change password 3 mails to the registered email address [6]. "Sign-in" and "Sign-up" are the two sub modules in the Authentication module. In the Sign-in module, the user enters the registered email address and password and accesses the application.

In the Sign-up module, the user registers using GNITS student email address and sets a password. Each new user information is stored and updated accordingly in the database.

The second module is the "Tracking" module. In this module, the real time location of the bus is tracked using a sensor. This location is marked on the map. Location of the bus is updated on the map, every time the position is changed. The user location is displayed on the map. This feature is controlled by the user. If the user wishes not to share the location, then the user's location is not displayed on the map but the bus position is displayed regardless. Initial location and the final location of the bus are displayed.

The third module is the "Bus Pass" module. After the user signs in into the application the bus location is displayed on the map only if the student pays the bus fare. In this module, a virtual bass pass is displayed on the screen. If the student has paid the bus fare then the bus location is displayed and the student can board the bus, but if the student hasn't paid the bus fare then a note is popped up implying the student to pay the bus fees to access the location of the bus and to board the bus.

V. OBJECTIVES

- To get real-time location coordinates of the bus and reduce the waiting time.
- Generating a Bus Pass if the student's bus fee is cleared.

VI. LITERATURE SURVEY

"Real Time Bus Position and Time Monitoring System": Many passengers are usually late to work, students are late for classes as a result of they decide to anticipate the bus rather than simply merely using another alternate transportation. A variable message shown on the web which will be real time info regarding the bus showing the time of arrival at a particular bus stop might scale back the anxiety of passengers expecting the bus. With the advent of GPS and also the ubiquitous cellular network, real time vehicle tracking for higher transport management has become attainable. These technologies can be applied to conveyance systems particularly buses, which are not ready to adhere to predefined timetables owing to reasons like traffic

jams, breakdowns etc. The increased waiting time and the uncertainty in bus arrival make the conveyance system unattractive for passengers. The real-time bus position and time observance system uses GPS technology alongside totally different applications to fetch knowledge and with code that displays the information online on different buses on a special route to the user. When this info is conferred to the traveler by wired or wireless media or online internet media, they can use their time with efficiency and reach the stop simply before the bus arrives, or take alternate means of transport if the bus is delayed. They can even arrange their journeys long before they really undertake them. This will build the general public transport system competitive and passenger- friendly. The use of personal vehicles is reduced when additional individuals use transit vehicles, which in turn reduces traffic and pollution.

"Real-time GPS/GPRS based vehicle tracking system": The Real Time Bus Monitoring and Passenger Information bus tracking device will serve as a viable notification system that will effectively assist pedestrians in making the decision of whether to wait for the bus or walk. This device is a standalone system designed to display the real-time location(s) of the buses in Mumbai city. The system will consist of a transmitter module installed on the buses, receiver boards installed on the bus stops, LED embedded map of the BEST bus transportation routes at the centralized controller.

It will also have passenger information system software installed at the bus stops, which will provide a user the relevant information regarding all the bus numbers going for his source to destination along with the route details and the cost. Assembly of these modules will enable the tracking device to obtain GPS data from the bus locations, which will then transfer it to the centralized control unit and depict it by activating LEDs in the approximate geographic positions of the buses on the route map. It will also transmit its bus numbers and route names continuously as soon as the bus comes within the range of the receiver at the bus stop. In addition, the device will be portable and sustainable; it will not require an external power source, which will eliminate long-term energy costs.

"Real Time Availability System": This Paper is a survey to implement a method that makes transport much convenient for individuals who commute daily using the public bus transport of the city, for effective time management and making it trouble free, not just for the commuters but the Transport Department to create an efficient public transport system. There are applications available in the market today which specifies the route and the timings, predict arrival times of different buses but the survey presented here aims to build an application that takes it to the next step by making information about the vacant seats and the current location of any bus in Real-Time, accessible to the daily commuters with a novel and economical wireless system. These methodologies offer incremental improvements in bus systems to meet the capacity requirements of different size cities and presents a review of strategies which can be employed to satisfy public transport demands of different city sizes. Their aim is to build a flexible, comfortable, easily available and reliable bus service which may encourage shift from private vehicles to public transport.

VII. METHODOLOGY

EASY BUS is a mobile application which provides real time bus tracking and a virtual bus pass. As the name indicates, a "real-time bus tracking system" tracks the movement and locations of buses traveling along various routes at different times and provides live data in "real-time" and displays on the map. Students can fetch the initial location and final location of the bus along with the current location of the bus. This helps in maintaining the uniqueness of the bus while displaying its location on the map.

Sensors are placed in each bus and the moving coordinates of the bus are stored in a google sheet. Latitude and longitude from google sheets are stored in the "Cloud Firestore". Cloud Firestore is a cloud-hosted, NoSQL database that your Apple, Android, and web apps can access directly via native SDKs. Following Cloud Firestore's NoSQL data model, data can be stored in documents that contain fields mapping to values. These documents are stored in collections, which are containers for the documents that can be used to organize the data

and build queries. When the user selects that particular Bus ID, its location will be retrieved from the Cloud Firestore and is shown on the map. Since the 4 coordinates will be changing, the point on the map will keep on moving, hence the user can actually see the live location of the selected bus.

The application is developed using dart language in android studio which has a very simple yet efficient User Interface to use it. The user information is stored in Google Firebase. Google Firebase is a Google-backed application development software that enables developers to develop iOS, Android and Web apps. Firebase provides tools for tracking analytics, reporting and fixing app crashes, creating marketing and product experiments. Google maps API is the core component that will be used in it, which is very easy to use and explore maps with simple gestures such as pinch to zoom, tap to point etc. It will make tracking the bus very easy for the user. According to the fee status of the student which is stored in Google Firebase the virtual bus pass is generated [9]

The architectural style of this system is a three-tier layer as shown in Figure 6.1. The system is designed to be used on a mobile device application with the connection to a server using the Internet. Mobile application's core operation is to update the user interface with the newly requested information based on the user's input and retrieve data from a data store.

This system has a few modules which can break into three partitions. Those modules have their own characteristics. Following are the modules :
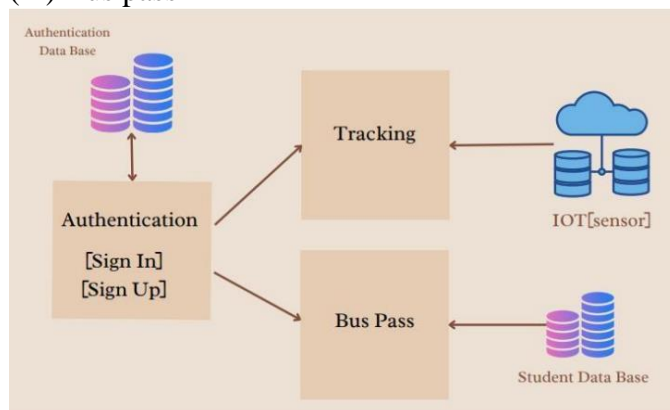
(i) Authentication
(ii) Tracking
(iii) Bus pass

Figure 6.1: Architecture of EASY BUS application

The module design is as follows:

A. Module 1: Authentication

The authentication module describes how the user interacts with the functionality to use the Real-Time Bus Tracking Mobile Application. The module describes the interfaces of all the functions provided with user interface to remote the end users. The authentication module is used to verify the user's identity from the database, before allowing access to the application. If the user credentials are valid, only then the user can access the location of the bus and a virtual bus pass. This module consists of two submodules namely Sign In and Sign Up.

➢ Sign-in: If the user has already created an account on EASY BUS, they can just provide their credentials to login to the app and find where the bus currently is. The data of the users is stored in the firebase real-time database which is used to authenticate the user details when they login. The Firebase Realtime Database is a cloud-hosted database. Data is stored as JSON and synchronized in real-time to every connected client. An SMTP server is set which sends a mail to the registered mail id to change or reset password.

➢ Sign-up: If a new user wants to know the location of the bus, they're first supposed to sign up by providing the required information. While registering, a verification link is sent to the provided mail id by the SMTP server to verify the user credentials. Later, these details are added to the firebase realtime database.

B. Module 2: Tracking

Tracking module describes how the bus is tracked by installing the GPS Tracker. The GPS satellite transmits microwave signals to a GPS bus tracker device that allows the device to give related information such as location, bus speed, estimation time arrival, and direction. This allows GPS tracker devices to update the historic navigation data in real time. The data received by GPS satellites is then transferred into GSM or Cellular Network for the location of the bus map in the mapping system. The client will receive the historic navigation data in the Bus Tracking Mobile Application when they make

a request to check where the current bus is. The main functions of the tracking module are:

➢ The real-time data, i.eThe current bus location fetched from the sensor is presented on the map.
➢ Displays the user location.
➢ Put on view the initial location of the bus and the destination.

C. Module 3: Bus pass

Bus pass module checks if a user has paid the bus fee and generates a virtual bus pass depending on the status, i.e., paid or unpaid. A database from the administration is used to check if the user has paid the fee or not when the user credentials are entered. A pass is provided if the user has paid the fee, else a message is displayed that the fee is due.

VIII.   IMPLEMENTATION

A. Databases
● User Verification:

From the EASY BUS application When the user signs up with their email ID their details along with the unique User ID created is recorded in the firebase authentication table as shown in Figure 8.1. This User ID is used for the Authentication Token.

An authentication token allows internet users to access applications, services, websites, and application programming interfaces (APIs) without having to enter their login credentials each time they visit. Instead, the user logs in once, and a unique token is generated and shared with connected applications or websites to verify their identity.

Figure 8.1: Firebase Authentication Table

The particular bus locations from the sensor in the bus are sent into the google sheets, the locations of the bus are stored in the Historic google sheet (as shown in Figure 8.3) for bus maintenance. The current location of the bus is updated in the Update Google sheet as shown in Figure 8.2.

Figure 8.2: Google Sheets – Update

Figure 8.3: Google Sheets – Historic

● Bus Pass Verification:

The bus details are taken from the google sheets into the Cloud Firestore under 'Location' collection (shown in Figure 8.4) with track document which has the current Latitude, Latitude, Date and Time sent from the sensor.
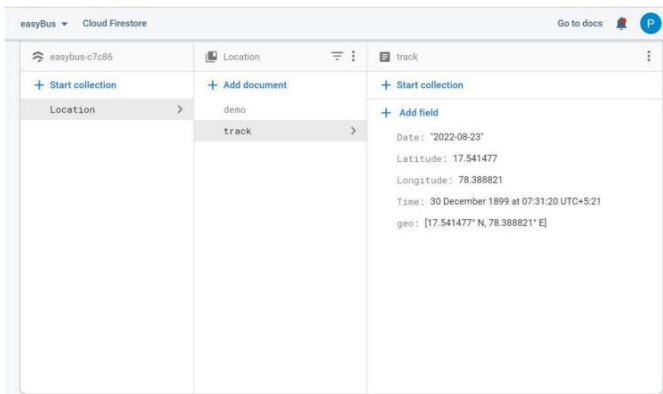
Figure 8.4: Firestore - Live Tracking

The fee details of the users are stored in the firebase-firestore and this collection is linked to the user collection via the unique student roll number as shown in Figure 8.5 (a) and Figure 8.5 (b).
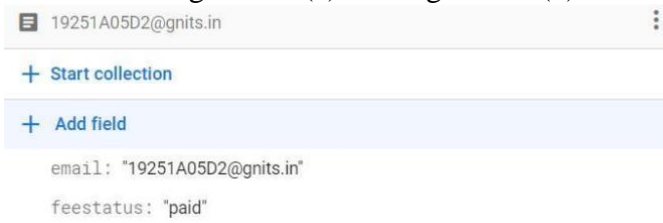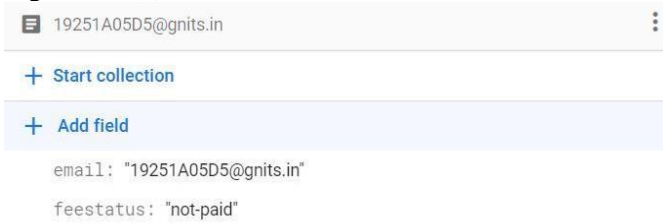

Figure 8.5 (a) Fee Paid

Figure 4.5 (b) Fee Not Paid
Figure 4.5: User Fee Status

B. Technologies Used:

- **Android Studios:**

  Android Studio is the official integrated development environment for Google's Android operating system, built on JetBrains' IntelliJ IDEA software and designed specifically for Android development. It is available for download on Windows, macOS and Linux based operating systems.

  Android Studio provides the fastest tools for building apps on every type of Android device.

- **Flutter:**

Flutter is an open-source UI software development kit created by Google. It is used to develop cross platform applications for Android, iOS, Linux, macOS, Windows, Google Fuchsia, and the web from a single codebase.Flutter's engine, written primarily in C++, provides low-level rendering support using Google's Skia graphics library. Additionally, it interfaces with platform-specific SDKs such as those provided by Android and iOS.Flutter apps are written in the Dart language and make use of many of the language's more advanced features.

- **Firebase:**

Google Firebase is a Google-backed application development software that enables developers to develop iOS, Android and Web apps. Firebase provides tools for tracking analytics, reporting and fixing app crashes, creating marketing and product experiments.

  - **Cloud Firestore:**

    Cloud Firestore, which is also referred to as Google Firestore, is an integral part of the Google Firebase platform. It takes the form of a cloud-based NoSQL database server that does an excellent job of storing and syncing data. In fact, web and mobile apps can interact directly with Firestore with the use of native SDKs. Firestore is a high performance database that supports automatic scaling. Besides, it is quite easy to use and very reliable. Developers can work with Firebase using a wide variety of technologies such as Java, C++, Unity, Go, Node.js SDKs, REST, and RPC APIs.

● *Firebase Realtime Database:*

The purpose of the Realtime Database feature of Firebase is to allow data to be shared between multiple clients, where a "client" can take the form of apps running on Android and iOS mobile devices, or JavaScript running on a web server. The main goal of the system is to provide a secure, reliable and fast way to synchronize data with a minimal amount of coding effort on the part of the developer. The database system is also designed to scale to support millions of users.

The database is referred to as being "realtime" because the speed with which the data is synchronized across clients is probably as close to realtime as is currently achievable (taking into consideration the physical limitation of transmitting data over the internet and wireless connections). As will be demonstrated in later chapters, the elapsed time while a data change on one client propagates to another is visually imperceptible [9].

The Realtime Database also provides data persistence by storing data locally, thereby enabling the data to remain accessible even when a device is offline. When connectivity is re-established, the local data is automatically synchronized and merged with the remote data.

● *Google Maps API:*

Google Maps APIs are prepackaged pieces of code that let you quickly and easily include maps on your websites or in your mobile apps – and then add extra functions to your applications. They're available for Android, iOS and web browsers, and as HTTP web services that let you pass information between systems [8].

● *SMTP Server:*

SMTP stands for Simple Mail Transfer Protocol, and it's an application used by mail servers to send, receive, and/or relay outgoing mail between email senders and receivers. The SMTP server is simply a computer running SMTP, and which acts more or less like the postman.

An SMTP email server will have an address (or addresses) that can be set by the mail client or application that you are using and is generally formatted as smtp.server address.com. For example, the SMTP server Gmail uses is smtp.gmail.com, and Twilio SendGrid's is smtp.sendgrid.com.

IX.   CONCLUSION

A lot of mobile applications are installed in the user's smartphone, especially students who download some mobile applications for education purposes and manage their task using the mobile application. Nowadays, Internet connection in student smartphones is necessary since they need full internet access to know the current issue and use the facility for discussion through the mobile application. Real-Time Campus University Bus Tracking Mobile Application's project is believed to help students in managing their trip to class and help the management to validate the student's bus pass. Besides, students are able to use the Real-Time Campus University Bus Tracking Mobile Application as an opportunity to make a complaint to be heard by management. The main objective of

this project is to help in solving the problem faced by students regarding bus transportation on campus. The proposed system can be further improved to find the total available seats beforehand. It can also be extended to college canteen, libraries in the near future for ease of access. The project will be put up on a cloud platform, so that it will be accessible by every mobile user. It can also be improved by displaying the arrival time of the bus to the user's stop along with the predetermined route of the bus. An alert message can be sent to the user's mobile that the bus arrives in the next five minutes. If the user's commuting bus isn't available on a particular day then alternate buses and its routes can be displayed.

X.   RESULTS AND DISCUSSIONS
A. User Registration:

A new user can access the application by registering themselves with GNITS email and password. The email and password fields are provided on the registration page as shown in Figure 10.1. Once the password is set for the new account created, a message pops up suggesting the user to verify the registered email (implying a verification link has been sent to the registered email) as shown in Figure 10.2.
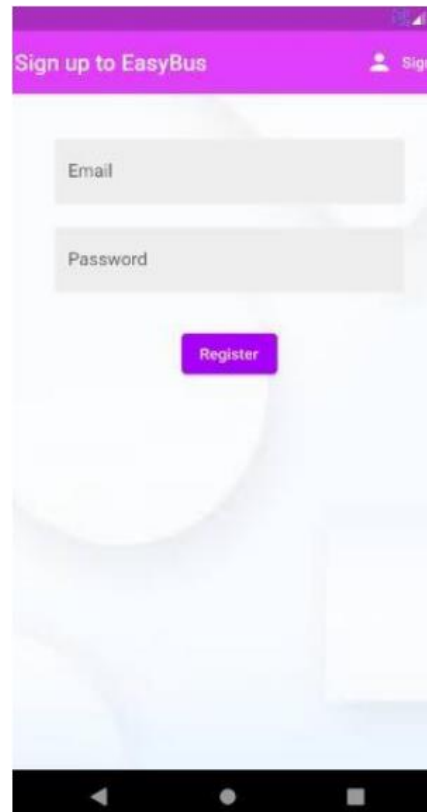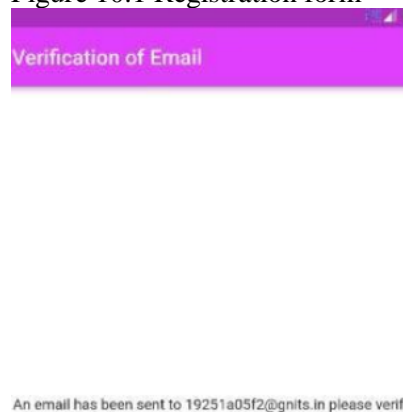

Figure 10.1 Registration form

An email has been sent to 19251a05f2@gnits.in please verify

Figure 10.2 Verification alert

B. Email Verification:

Once the registration form is filled, a verification mail is sent to the email address by the SMTP

server set. The mail consists of a verification link as shown in Figure 10.3, which directs you to another page Figure 10.4 after the completion of the verification process and updated into the database accordingly.
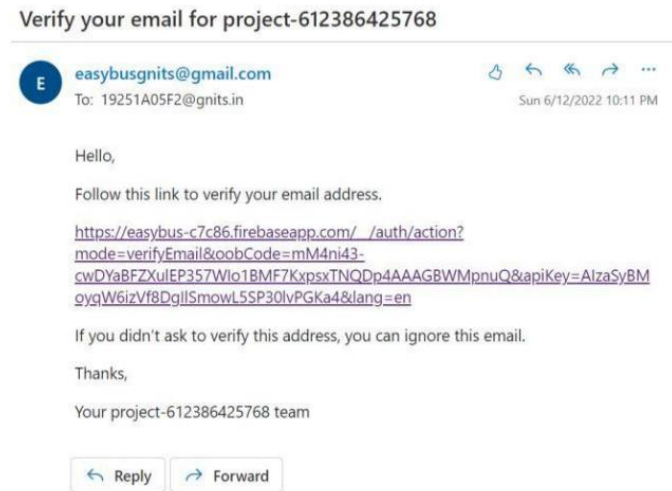

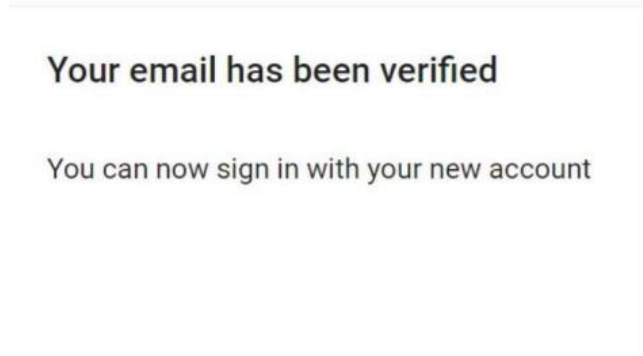Figure 10.3 Verification mail sent by the SMTP server

Figure 10.4 Successful verification of the registered mail id

C. Sign-in:

Users can get access to the application features in Fig-6 using their login credentials, i.e, by entering their GNITS email id and password in the login form as shown in Figure 10.5. To reset the password, a reset password link is sent to their maid id using the SMTP server as shown in case of email verification during registration process in Figure 10.3. After signing into the application, the user can either view the location of the bus or their virtual bus pass as shown in Figure 10.6.
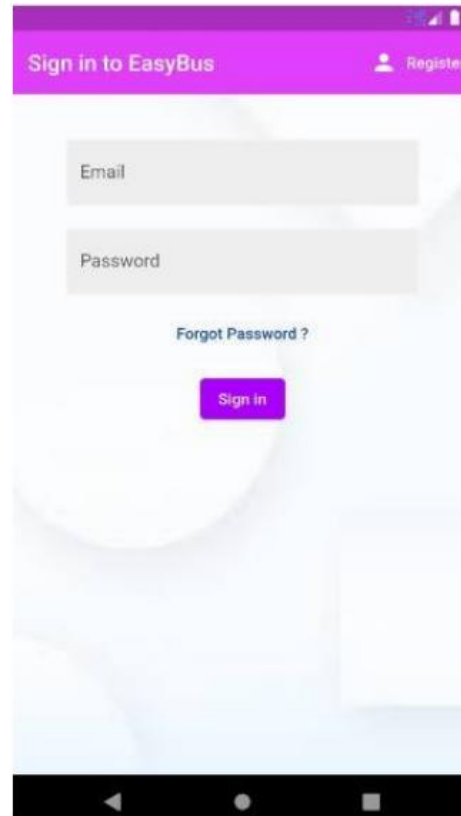

Figure 10.5 Login form

Figure 5.6 Features of EASY BUS

D. Bus Tracking:

After successful login, the user is given access to view the location of the bus. Users are prompted to allow access to their location, in case of denial only three markers are displayed on the map. The three markers denote the current location of the bus, initial location of the bus and the destination, i.e, the college location as depicted in Figure 10.7.
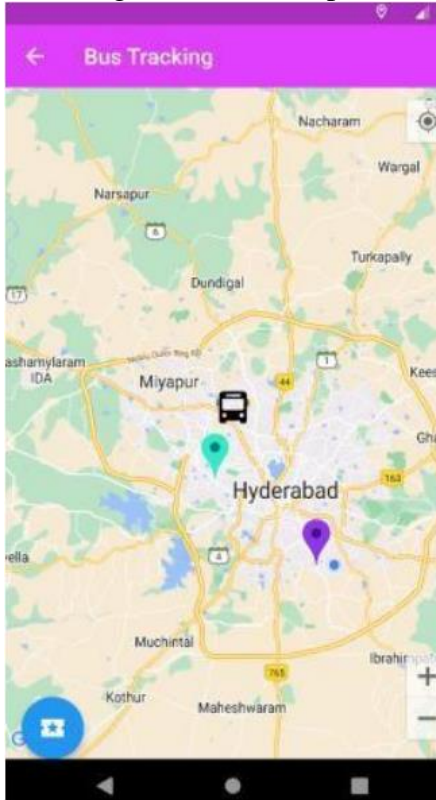

Figure 10.7 Real Time Bus Tracking

E. Bus Pass:

A virtual bus pass is generated for each user who has cleared the bus fare. The status of the bus fee is communicated to the user after comparing the user details with the administration database. A note is popped up that discloses the status of the fare to the user as in Figure 10.8 (a) and Figure 10.8 (b).
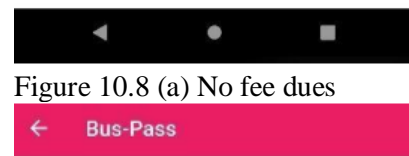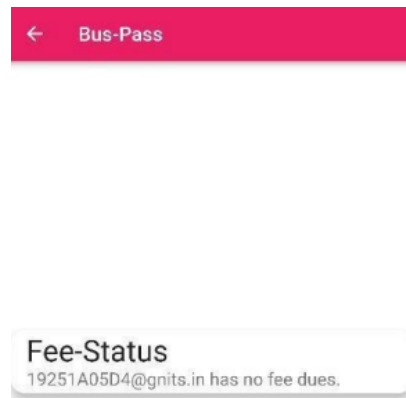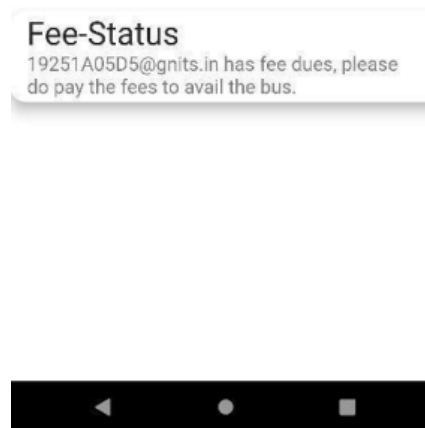

Figure 10.8 (a) No fee dues

Figure 10.8 (b) Fee dues
Figure 10.8 Note stating the status of the bus fare

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