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A state-of-the-art fleet management system that boasts real-time alerts, ETA estimates, and heightened safety measures has been

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The Computer Engineering Department's

Abstract— **In order to improve transportation services for tourists, businesspeople, and spies alike, this paper suggests the development of an android application. Real-time tracking of transportation through geofencing and warning allows executives to make the most of their time. The traveler's safety is ensured by a continuously recording video framework, and any potential threats are immediately communicated. The SOS function is enabled in the app in case of an emergency. The mobile app is built using android studio 3.1, JDK 1.8, and the firebase database, and it runs on high-end Android phones and other devices. The suggested software may be used for tracking vehicles, managing competitions, planning routes for hikes and marathons, and more. This software supports incremental updates that provide new cars, locations, and challenges. In the case of transportation delays or cancellations, the same warnings would be generated. Payments may be broken up into installments using a variety of wallet types, and instant digital receipts are provided. Google Maps depicts the transportation system's regions and stops in stunning detail. The application has been structured and tested, with users confirming that it provides stable organization and is valuable to them.**

Keywords— **JDK, Google Maps, and SOS**

INTRODUCTION

Vehicle tracking systems were first implemented for the shipping industry because people wanted to know where each vehicle was at any given time. These days, technology is growing at a fast pace, automated vehicle tracking system is being used in a variety of ways to track and display vehicle locations in real-time. Effective transportation system has effective movement of goods and people which leads to better quality of life and better social and economic growth of the society. Transportation system efficiency depends on its security, reliable speed, real time tracking.

optimized fleet tracking solution with reduced operating cost and predicative arrival timing system has features such as payment gateway API for paying the fees, Geo Fencing and tracking of bus employing GPS technologies. This all features can be implemented using various algorithms and techniques.

In this paper, geofencing and GPS techniques are deeply analyzed. GPS is location-based application used to track current location of bus and notifies other users whereas geofence is virtual fence at specified location and tracks buses coming into that area [1]. Geofence is implemented using different algorithms such as Ray-casting, Winding Number, TWC (Triangle Weight Characterization) and Circular Geofencing [2]. In this paper only circular geofencing is discussed as it is best algorithm among others.

People always seek for security and safety while travelling. For security purpose SOS signal and geofencing can be used. In section C, SOS signal is discussed. SOS signal is implemented with Morse code encoding and highly used in ship navigation systems [5]. Communication between user and admin and alerts generation by SOS in emergency condition is described with SOS applications [6].

This paper presents use of all features in our system and implementation of system. It shows analysis of literature paper and implementation of best method in our system to enhance system performance. System performance is calculated based on speed, cost, time, throughput. that is discussed in performance section in detail.

II LITERATURE REVIEW

The executives of transports of College/Organization transportation framework is the principle issue now daily. In light of to the present framework there is no such framework which gives data about the transport, its normal entry time, the normal holding up time and what is the current area of the transport. Primary goal of GPS based transport checking frameworks is to get constant area directions of the transport and the transport entry time so that travellers/Students can settle on better travel choices and to make easy to use framework to follow area and get estimated transport entry time. Such a framework could likewise be utilized by guardians to follow the area of the transport of their youngsters. Fundamental impacts of such a transport following framework are decreased hold up time, diminished vulnerability time, convenience, and more prominent feel of security, expanded readiness to pay and consumer loyalty.

- To Track transport with the GPS following.
- To settle on better choices.
- To diminish understudies sitting tight time for transports, better time Management.
- To improve Security.

ISSN: 1832-5505
Vol-6 Issue-04 Oct 2018

TABLE I
OBSERVED MOBILE DEVICES WITH GPS CHIPSET

Sr. No.	Categories		
	Device	**Platform OS**	**GPS chip**
1	Samsung galaxy s2	Android 2.3.3	Qualcomm SiRF star IV GST 4T
2	Samsung Nexus S	Android 2.3.6	Broadcom BCM4751 GPS
3	Nokia Lumia 800	Windows Phone 7	Qualcomm MSM 8255

SINS aided GPS integrity monitoring method dynamically detect GPS signal faults and isolate the low-quality satellite data in the same time [4] and provides security when two or three satellites are working

We contemplated all kills most noticeable features as a Dynamic guide, Geo-Fencing, Traffic Alert, Video Complaint Box/Image Feedback, Payment Gateway.

ARCHITECTURE

The proposed system architecture in Fig.8 shows GPS receiver which receives latitude and longitude from satellite using haversian formula and uses circular geofencing algorithm. This data is fetched by GPS module using NMEA protocol. This protocol was developed by National Marine Electronic Appliances. This information is passed to Arduino Uno using SPI (Serial Peripheral Interface), I^2C (Inter Integrated Circuit) protocols. Arduino Uno uses GSM module and pass this information to firebase. Firebase server maintains this information on cloud and user can access his location using this information. Firebase allows real time data storage and maintains data on cloud.

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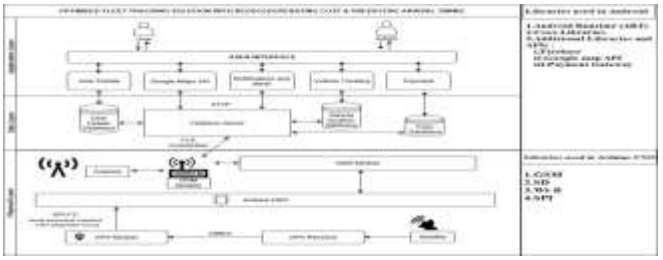


Fig. 1. Optimized fleet tracking system architecture

ISSN: 1832-5505
Vol-6 Issue-04 Oct 2018

A. *Android Development tools:*

Android Development Tools (ADT) is a plug-in for the Eclipse IDE that is designed to give you a powerful, integrated environment in which to build Android applications' extends the capabilities of Eclipse to let you quickly set up new Android projects, create an application UI, add components based on the Android Framework API, debug your applications using the Android SDK tools, and even export signed (or unsigned) .apk files in order to distribute your application. Developing in Eclipse with ADT is highly recommended and is the fastest way to get started.

- Location Provider is a tiny class that abstracts away a lot of the pain of getting a user's location from the phone (without having to call location APIs), provides a fully configurable standard Builder pattern and a set of call-backs.
- Android library when the GPS is turned off, displays a dialog box and if the user agrees, GPS is turned on.

B. *Firebase:*

Firebase is useful for real time data storage and communication. It is built on Google infrastructure and supports large scale apps with huge amount of data. Proposed application is connected with firebase as it is compatible with GPS module and Arduino Uno. Firebase provides cloud storage, real time database which provides great efficiency over other databases.

C. *Arduino Uno:*

In Arduino Uno following libraries are used for communication. EEPROM library is used for reading and writing to "permanent" storage Ethernet for connecting to the internet using the Arduino Ethernet Shield, Arduino Ethernet Shield 2 and Arduino Leonardo ETH. Firmata for communicating with applications on the computer using a standard serial protocol. GSM for connecting to a GSM/GRPS network with the GSM shield. SD for reading writing into SD card. SPI for communicating with devices using the Serial Peripheral Interface (SPI) Bus WIFI for connecting to the internet using the Arduino Wi-Fi shield Two Wire Interface (TWI/I2C) for sending and receiving data over a net of devices or sensors.

D. *GPS module:*

A GPS device can retrieve from the GPS system location and time information in all weather conditions and from anywhere on or near the Earth. A GPS reception requires an unobstructed line of sight to four or more GPS satellites and provides accuracy in detection of location. It also shows great performance on smartphones as discussed in literature survey.

IMPLEMENTATION

In the implementation section, we will discuss the steps that were followed to build the optimized fleet management system. Furthermore, this section will also focus the reasons behind choosing specific components used in the tracking system. Following steps were taken to build the system: Selecting the right component, choosing the programming language and appropriate softwareto simulate the design.

This proposed project expects to determine the issue with long holding up times of the client who are looking for transports. The aim is to provide to get real time location coordinates of the bus and the bus arrival time so that passengers/Students can make better travel decisions and to make user friendly system to track location and get approximate bus arrival time. Main effects of such a bus tracking system are reduced wait time, reduced uncertainty time, ease of use, and greater feel of security, increased willingness to pay and customer satisfaction.

Selecting the right components, language and simulation tool is important in any implementation process. An extensive research has been carried out to find the right components to build the optimized fleet tracking system. Some of the components used are listed above in architecture section with a brief description and following are some inputs and features of system that are implemented.

A. User Details:

This module is used to access user location using GPS of user's android phone. All verified details of authenticated user are storedin user details document in database.

B. User location:

This module is used to access user location using GPS of user's android phone

C. Notifications and alerts:

By dynamic map, we imply that the map will be refreshed consequently for the client (E.g. Understudy, Employee and so forth.) and drivers which will encourage to discover the client (E.g. Understudy, Employee and so on.) correct positions and decide each transport stop. User will receive notifications on detection of vehicle in user's area. In accidental condition or emergency, SOS alert SMS is sent to admin, nearest hospital and police station.

D. Vehicle tracking with dynamic maps:

Using geofencing, a bus within 100-200 metres from user's location can be tracked and this information is communicated withnotification module

E. Payment gateway:

Payment Gateways can help us to make fees payment for the bus services can be done online. Online receipts can be generatedrecord of money can be take place.

ISSN: 1832-5505
Vol-6 Issue-04 Oct 2018

F. Hardware Structure:

This includes hardware components and communication between hardware and software. GPS and GSM modem Neo6M is used which provides high accuracy in vehicle tracking. It also works great with smartphones. Node MCU8266 is used as Arduino to calculate longitude and latitude of vehicle.

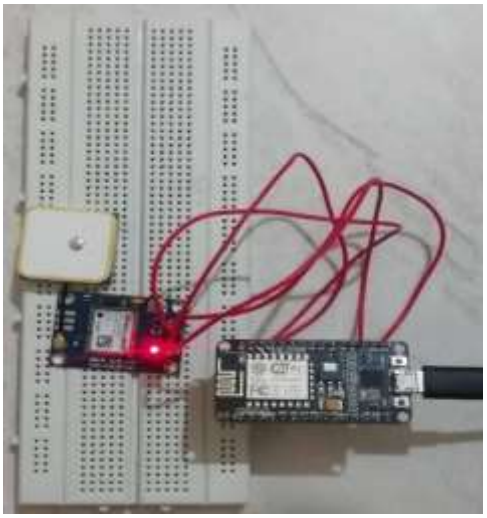


Fig. 1 Hardware connection

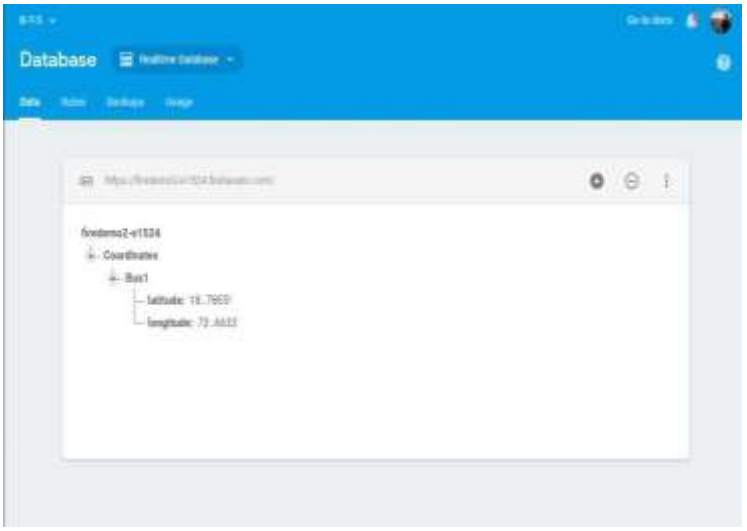


Fig. 2 output of hardware connection in firebase with latitude and longitude

F.Software Components:

- *Vehicle tracking module:*
  This module uses Google Map API to track user location accurately and tracks vehicle position using GPS, GSM modem and sends user notification about nearest vehicle.

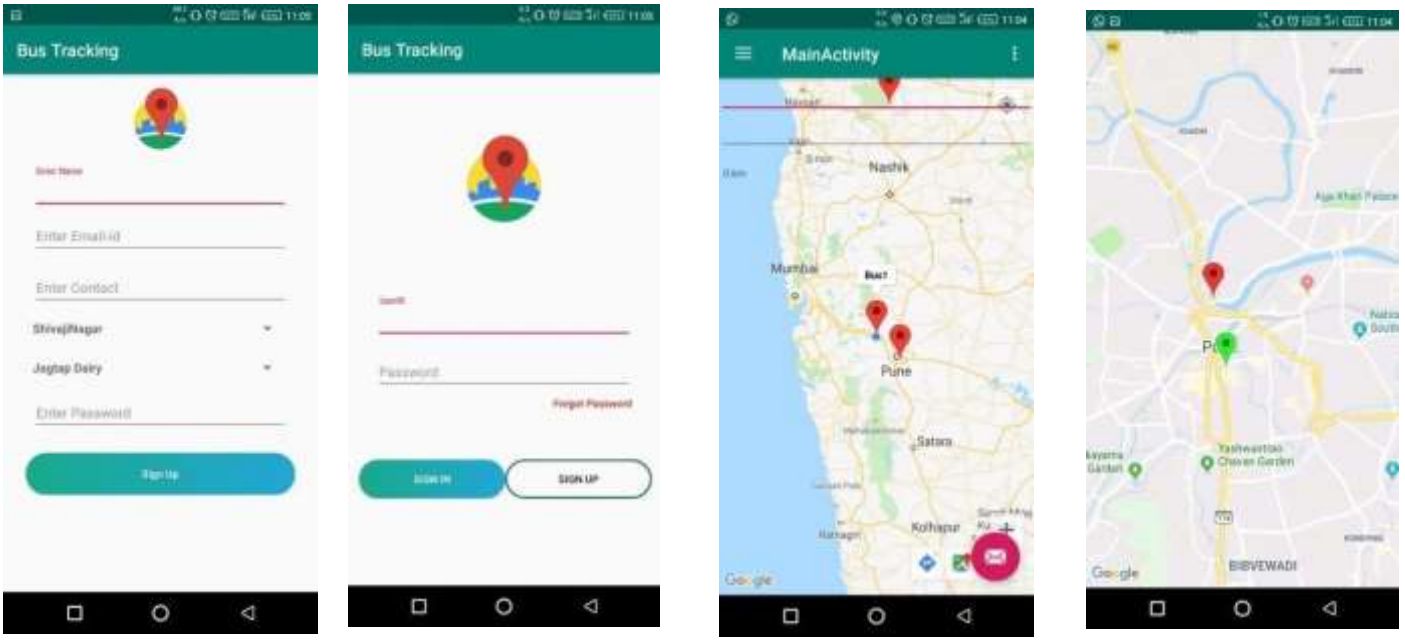
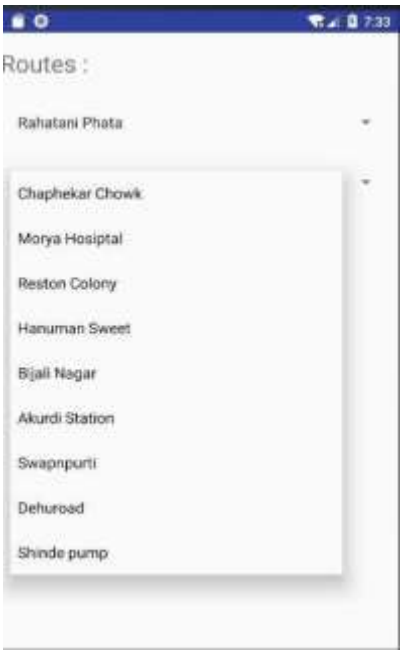


Fig. 4 User location and bus location tracking activity

- *Bus route and fees:*
  This module includes routes and stops of all vehicles for user convenience. Also, shows fees structure for corresponding stop and redirects user to payment module for payment.



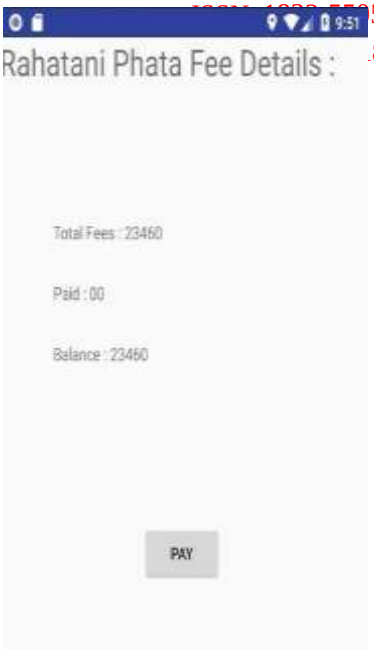


Fig. 5 Dynamic fees estimation according to selected route

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Vol-6 Issue-04 Oct 2018

•Payment module:
This module provides different ways of payment such as cash, net banking, card payment and Google pay like most used payment gateways for online payment. It uses highly secure payment methods.

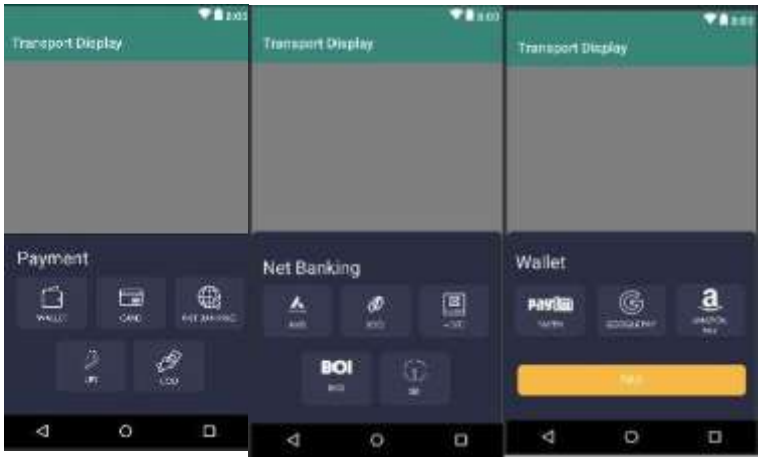

Fig. 6 Online payment methods with popular payment UPIs

- *SOS service:*
  This is the special feature which is important for security purposes.

II. PERFORMANCE

A. *Accuracy:*

Proposed system uses GPS and GSM modem which shows location in low connectivity network with up to 2 metres error within less than milliseconds and increases vehicle detection speed of the system.

TABLE III
OBSERVED LOCATION TRACKING AND ERROR IN POSITION

Sr. No.	Date	Time(sec)	Latitude	Longitude	Error (meter)
1	Sample 1	240	18.629782	73.799706	0.98915
2	Sample 2	270	18.629760	73.799717	1.035700
3	Sample 3	300	18.629782	73.799717	0.726033
4	Average		18.6297723	73.7997133	0.916961

ISSN: 1832-5505
Vol-6 Issue-04 Oct 2018

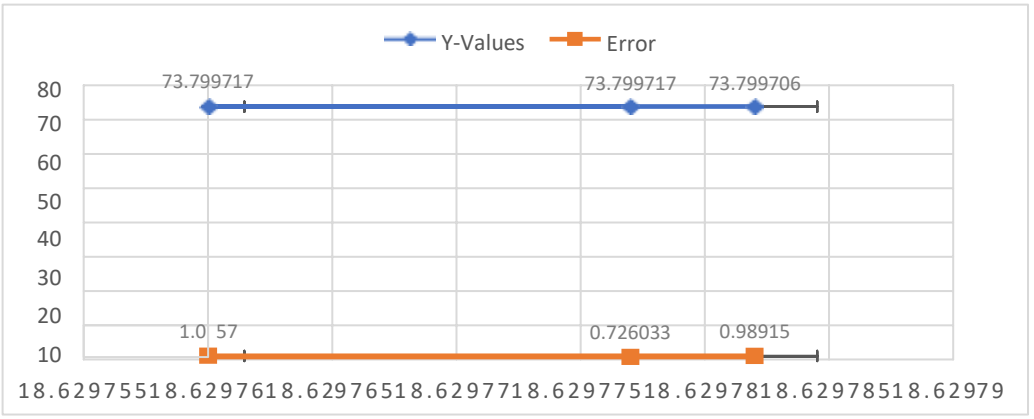

Fig. 7 Observed location tracing with error in actual position detection

The above figure 9 shows standard deviation in actual position and application through tracked position using GPS. It shows average error about 0.92 metres which is negligible. According to other tracking systems this error is about more than 2 metres approximately. While using proposed fleet tracking system anywhere, maximum 2 metres error is predicted from analysed samples.

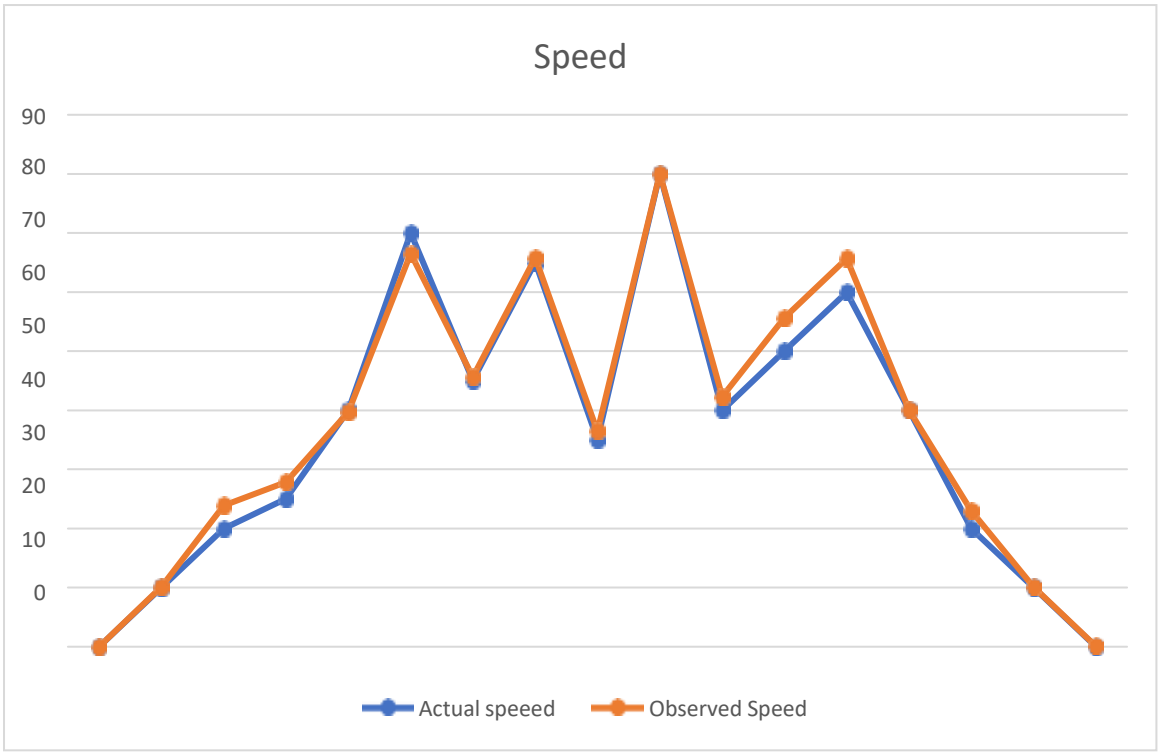

Fig. 8 Observed and calculated speed with actual speed

There is small deviation from actual speed and calculated speed from observed position of vehicle. But from the middle part of the graph, accuracy in both readings can be estimated.

ISSN: 1832-5505
Vol-6 Issue-04 Oct 2018

B. Throughput based performance evolution:

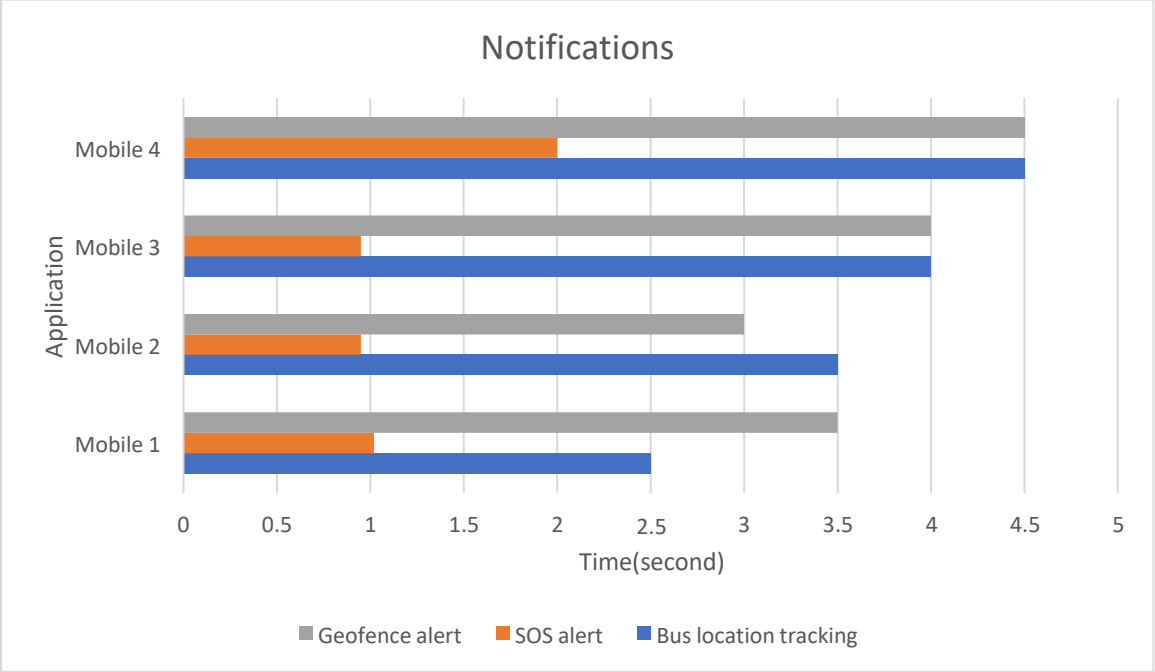

Fig. 9 Observed time taken by application to send Geofence, SOS, bus location tracking notifications to user

C. Cost based performance evolution:

The proposed system uses Neo6M and MCU8266 which costs around 1500.Antenna, battery, wires and other components with maintenance, cost around 1100. This system is compared with other systems.

TABLE IIIII
OBSERVED RECENT VEHICLE TRACKING SYSTEMS WITH THEIR COST AND FEATURES

Sr. No.	Popular Vehicle Tracking System	Features				Cost
		GPS tracking	SOS	Real time auto notification	Geofencing	
1	Realtime GPS Tracker for Car/Kids/Bike/Trucks With Live Audio, Panic Button & Theft Protection (Free Lifetime Licence)	Yes	Yes	No	No	Rs. 1,999/-
2	GPS Vehicle Tracking System	Yes	Yes	Yes	Yes	Rs.5,499/-
3	Tiger TRACK Smart SOS Tracker	Yes	Yes	No	No	Rs. 5,999/-
4	GPS fleet tracking company	Yes	Yes	Yes	Yes	$75-$100
5	Proposed System- **Optimized fleet tracking system**	**Yes**	**Yes**	**Yes**	**Yes**	**Rs. 2600/-**

As discussed in table III, recent popular GPS tracking systems found on Amazon, Flipkart are discussed which shows higher price up to 5000 and above with our stated features where our system provides all features with half of the market price. In Realtime GPS Tracker system it shows location when users request and sender approve which is not at all convenient and also does not send text messages. It is useful only when user has seamless network access. But in our system user can set his routine bus and will be notified about bus entering into nearest corresponding area.

CONCLUSIONS

This paper presents optimized fleet tracking solution with reduced operating cost and predicative arrival timing features with all algorithms and describes best suitable algorithms to increase the efficiency of

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Vol-6 Issue-04 Oct 2018

system. This paper presents implementation of our system with performance evolution based on certain parameters like throughput, cost, accuracy. From all analysis conducted on the system, it is concluded that system may predict maximum 2 metres error in GPS location detection and average time taken by system to show notifications is less than 2 second, whereas other systems take more than a minute. This shows the proposed system is low cost, optimized, more accurate fleet tracking system than recent market systems

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