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Implementation of a Vehicle Tracking System using Smartphone and SMS service

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***Abstract*—In this dynamic life where everyone is in a hurry to reach their destinations, waiting for bus is hectic and even many of us are unaware of the bus timing. To overcome this difficulty, an easy system is proposed in this paper to aid tracking real time bus location. The proposed solution takes advantages of the two main features in mobile platform nowadays which are location services, mainly GPS based, and basic telephony services, mainly SMS based. The system consists of two sides, server side and client side. The server device's main responsibility is to provide the exact location of the bus to the server, or to the user in case of SMS based query from client's device. On the other hand, client's device can find bus location either using SMS service or using internet service. If clients' device is an android based smartphone, he can install our application to track bus location using internet service. The server's device will be placed on the vehicle of interest with android application installed on it. Experiments were made with this system and found that it performs better in many ways than other similar vehicle tracking systems.**

Keywords—Android; GPS based location service; Telephony services; Google Map, Real time vehicle tracking

I. INTRODUCTION

Today mobile phones are becoming more technologically advanced and offer more features. One of them is the remarkable features and capabilities that new smart phones offer especially Android based smart phones. Android is becoming very popular in embedded market for two mainstream reasons. First, source code is completely free; moreover there are no royalty fees for Java VM (Virtual Machine). Second, Android is highly suitable for expansion as the developer see fit. With that many features, the need for resourceful applications rises. Vehicle tracking systems combine the use of automatic vehicle location in individual vehicles with software that collects these fleet data for a comprehensive picture of vehicle locations. Vehicle information can be viewed on maps via the internet or specialized software. Some related works where formerly done but there is a fact of high cost and there is more complexity. Combination of GPS with one of the basic service of a smart phone which is GSM, more specifically SMS, in one system can be a solution.

We experimented our system on the bus service of Chittagong University of Engineering and Technology(CUET), which is a public university. The university authority runs the delivery system of transportation manually. Some vehicles are provided for the teachers, students and staffs for the purpose of transportation throughout the week. The vehicles take the students from some fixed spots. So student have to wait there from few times ago of the arrival time of the buses. But this arrival time is not fixed. It is not rare to encounter frustration when buses are not arriving on pre-made schedule due to real time uncertainties. Students have to wait for a long time in such situation. Again students can't catch a single bus at all, if the bus comes earlier. So they have to come to campus through local transport, which is costly for the students and sometimes unsafe too.

In this paper, we gave attention on the following specifications: tracking live position of bus and show it on Google Map. To get location information using SMS if internet connection is slow to load map. To get location information in the situation where no internet connection is available, even bar phone users will be able to know location information.

II. LITERATURE REVIEW

A system was developed in [1], using GPS and GSM technologies. The system is micro-controller based that consists of GPS, GSM, Atmega microcontroller MAX 232, 16x2 LCD and software part is used for interfacing all the required modules and a web application is also developed at the client side. The GPS satellite gives the exact position of the device which is situated in the vehicle. This device is in turn which is connected to the local GSM service provider via a GSM network as it has SIM card present in it thus the GPS parameters which the device has are send to the tracking server. There is a fact of high cost as the devices they use are costly and there is more complexity in integration of those devices in a simple box. A. Al-Mazloum et al. [2] developed an SMS based tracking system for tracking children's location. Parent's phone sends SMS to child's phone requesting a location information. Then child's phone replies with GPS data and after receiving the data, the parent's phone shows the location on map. Although the system was good for SMS based tracking, it does not provide online location tracking system using application software because it did not use any dedicated server. There is a system architecture as in [3], designed based on client-server. In server side, it contains a GPRS, a web and an SMS server along with database to store user details and data. For client, it is a box that contains a GPS

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tracker and a GSM modem. When users request location from the web or application after registering and logging into the web server an SMS request will be sent to the GSM modem in client device. It requires internet connectivity on both sides of client and server which is not convenient for some cases where there is no internet connectivity at any of the server or client sides. Additionally, the relationship between the server and client should be controlled by both server and client. Sonia C.V et al. [4] developed an android application to track mobile phones. It has SMS based location tracking system using GPS data. It did not incorporate online tracking system with which one can find the location without using SMS service. KuanYew Tan, and KokSheik Wong [5] implemented a campus vehicle tracking system with the help of WiFi proximity method and GPS data. They used a web site and web server to upload the information there, and display the tracking information on map. The system is very useful but it demands a working data network for a user to view the map and know bus location. There is no method to get bus location from a data network less device. SJ Lee et al. [6] showed an integrated system with microcontroller and smartphone for continuous tracking of a vehicle. Microcontroller is places on the vehicle of interest and then it sends location data to the server. A user can then find the vehicle location from the server in his smartphone. The system is very efficient and showed a promising outcome. But, as it needs GSM/GPRS module and GPS module along with other hardware for implementing the system, it adds additional cost. Md. Marufi Rahman et al. [7] demonstrated an Arduino based vehicle tracking system. It needs Arduino, GPS and GSM module to be placed on the vehicle. The latitude longitude data received from the system was used to display location of google map. It does not need internet connection, except for displaying google map. Ulhas Patil et al. [8] discussed a vehicle location detection system that uses some sensors to detect an accident. When accident occurs, it sends the vehicle location to nearest police station and ambulance service numbers. It uses GPS, GSM module, Renesas microcontroller and RF endcode/decoder. Humaid Alshamsi et al. [9] implemented a real time vehicle tracking system using GSM, GPS with Arduino. Location data are fetched and stored in memory card. To get the vehicle location, on should send an SMS to the GSM module. The system then replies with the latitude and longitude of the vehicle. Dongjiang Li et al. [10] brought a vehicle remote monitoring system based on Android. The system comprises of ARM9 core processor, GPRS module, GPS module and sensors. Data collected by GPS and sensors are uploaded to a server. Android phone connects to the server via internet and fetch information to track the vehicle.

III. System Description

The proposed android application consists of two modules. First module will be installed into that android phone which will be in bus. This module will serve as the server module. It will periodically find out the GPS co-ordinates of the bus by using location service of the android phone that is GPS receiver of that phone. The module also includes a SMS gateway service.

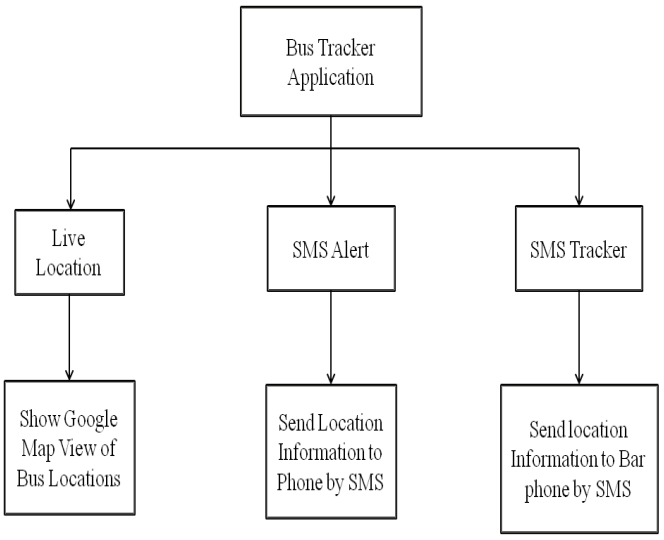

Figure 1: Block Diagram of Methodology

Second module is the application which will be installed into client's phone. It has three sub- modules. First one is live location module. It will show the location of particular bus along with its recorded time on the Google Map. Second one is SMS alert. It will give location information to client's phone as text message. Third one is SMS tracker for getting the location information without using any internet connection or Android phone.

A. Live Location Module

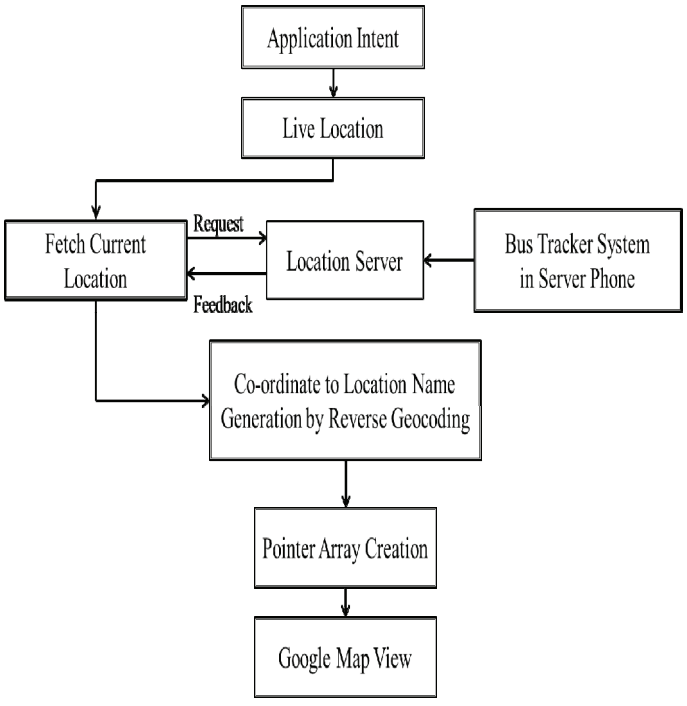

Figure 2: Block Diagram of Live Location Module

Server module in the server android phone will get the location information from GPS satellites using location service of the phone and send it to Location Server over internet.

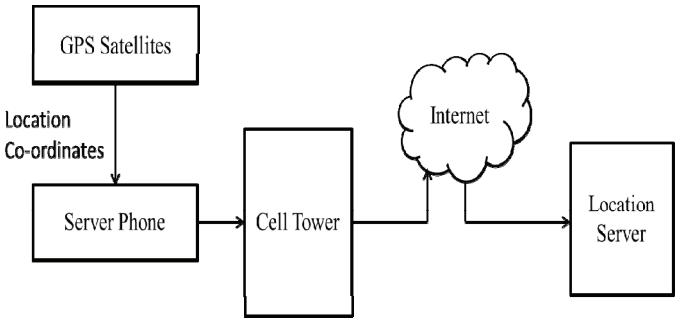

Figure 3: System Diagram of Location Tracking

In Location Server database, there will be storage of location co-ordinates that is longitudes and latitudes of bus positions which are sent by server module periodically. Their recording time will be stored too.

id	lat	lon	recorded_datetime
532	22.46085	91.97192	2015-09-02 17:00:17
535	22.45942	91.9693	2015-09-02 17:15:00
536	22.45648	91.95745	2015-09-02 17:38:00
537	22.45141	91.94554	2015-09-02 18:01:00

Figure 4: Screenshot of Location Server Database

Location information is requested to the Location Server and there will be feedback from the Location Server. After having GPS co-ordinates, reverse geocoding will be done for getting exact location name. After that, a pointer array will be created for saving all the location names along the route the requested bus passes through. Finally, there will be Google Map view of the locations using Google Maps API V2.

B. SMS Alert Module

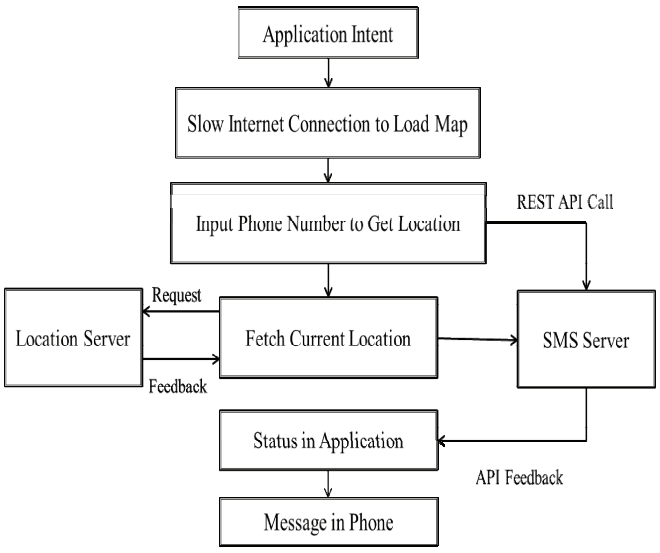

Figure 5: Block Diagram of SMS Alert Module

This module will be used if internet connection on client's phone is not fast enough to load the Google Map for showing the current location of the bus. In this case, this module will let the client to know about live location of the bus by sending text message with location information to the client's phone. At first, the cell number to which the location information message will be sent is taken as input. Current location information will be fetched from Location Server and sent it to SMS Server. REST API call is made to SMS Server. This is a HTTP POST call where the taken cell number will be in message body. The number in the message body will be in JSON format. In SMS Server, a message will be generated with the current location information. After that, there will be a feedback of API call. The recently generated message will be sent to the number which is got by the API call. The message sending information will be displayed on the application.

C. SMS Tracker Module

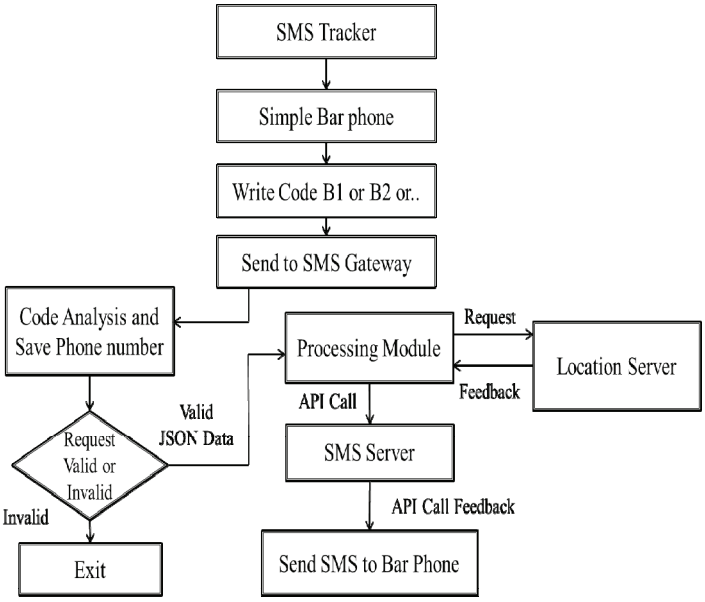

Figure 6: Block diagram of SMS Tracker Module

This module will be used if any client is not able to use the application as he/she has simple bar phone instead of Smartphone.

First of all, for getting location information, one has to write a text message in a specific format. For example, to get information about first bus, it will be B1, for second one, it will be B2 and so on. This message will be sent to server phone where a SMS gateway service is running.

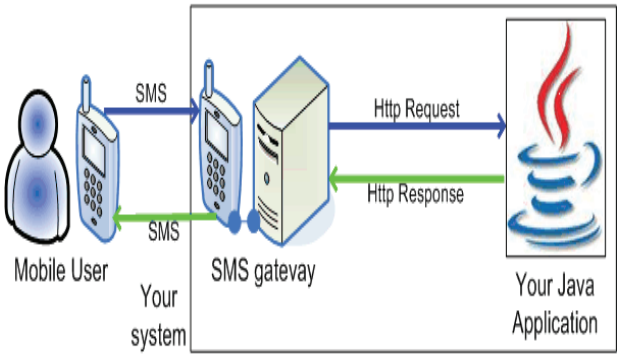

Figure 7: System Diagram of SMS Gateway

The message will be received by SMS gateway and it will be scanned. If the message it not found as location request then, there will be no further concern. If it is a location request, a JSON data will be sent to the Processing Module. The JSON data consists of validity confirmation and the cell number from which the location request has got. The Processing module will fetch the location information from the Location Server. After that, the Processing Module will make an API call to the SMS Server with location information and the cell number which is given by SMS gateway. Finally, the SMS Server will send the text message with location information to client's phone as the API call feedback.

IV. Implementation

Home activity of the application is shown in fig. 8

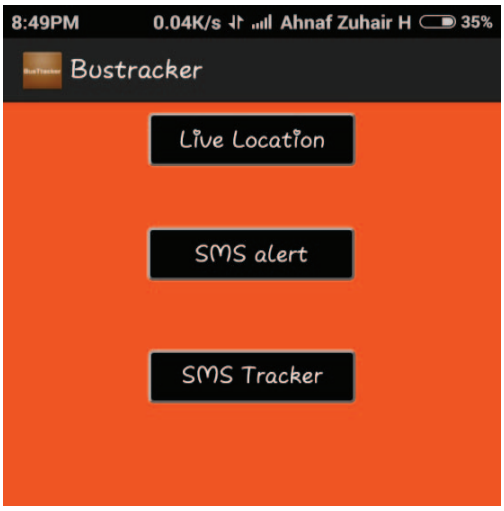

Figure 8: Home Activity

A. Implementation of Live Location Module

With clicking on the Live Location option on the home activity, the activity for Live Location will be launched.

There will be text box for submitting current date to show current location of bus on that particular day. One can see the location information of any previous day by submitting the date of that day as all the location information of each day is stored on location server. Fig. 10 shows that:

After that, the current updated location information will be showed on Google Map. All the locations, the bus have passed through along the route from the starting point will also be displayed.

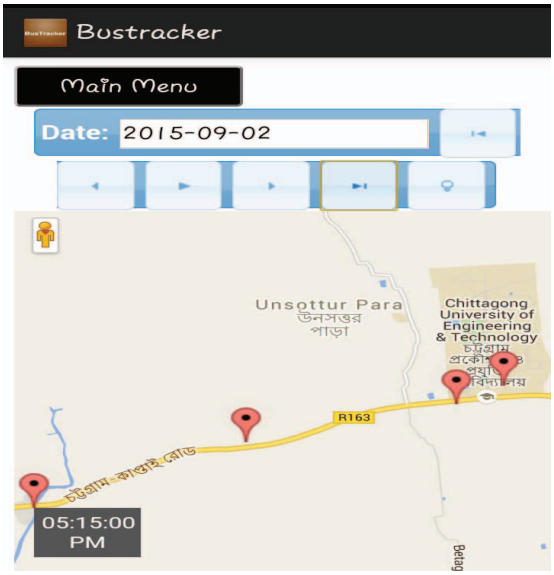

Figure 9 (a): Google Map view of locations

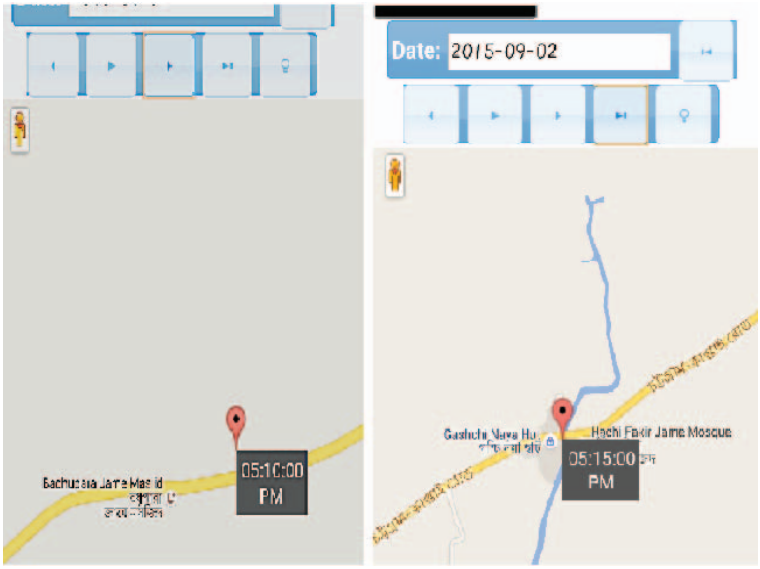

Figure 9 (b): Google Map view of locations

B. Implementation of SMS Alert Module

With clicking on SMS Alert option there will be activity like fig. 12. One has to put the cell number for getting message with location information.

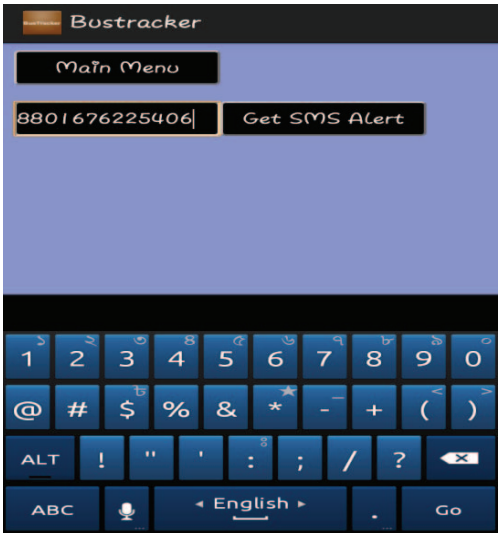

Figure 10: SMS Alert activity(Input Cell Number)

There will be sending information displayed on the screen. Finally the message will be received by desired phone.

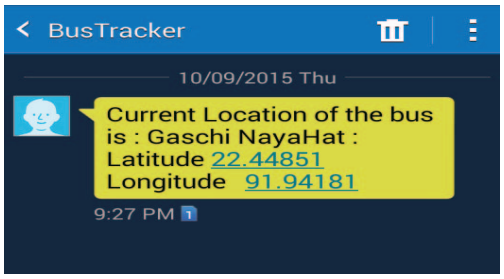

Figure 11: Text Message with Location Information

C. *Implementation of SMS Tracker Module*

One has to write text message with specific format like B1 or B2 or B3 and so on.

Figure 12: Message Written with Specific format

The message will be sent to the server where SMS gateway is running. Message will be received and scanned by SMS gateway. If it is valid request, the message will be forwarded to desired destination.

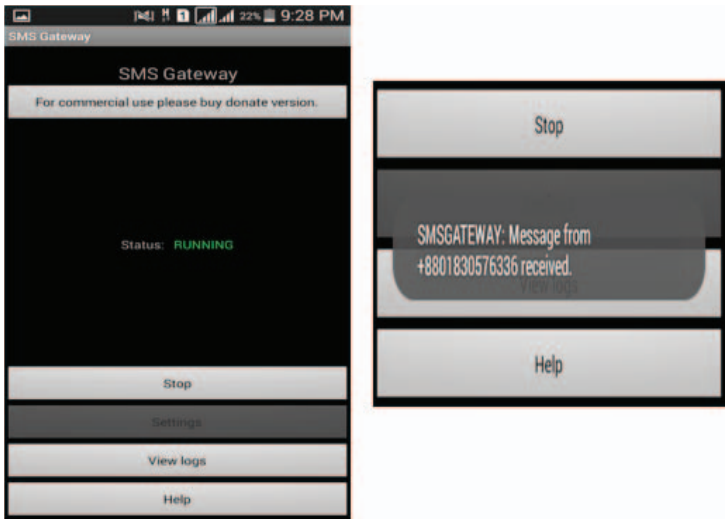

Figure 13: Message Reception by SMS Gateway

Finally, the reply message with location will be received by desired phone.

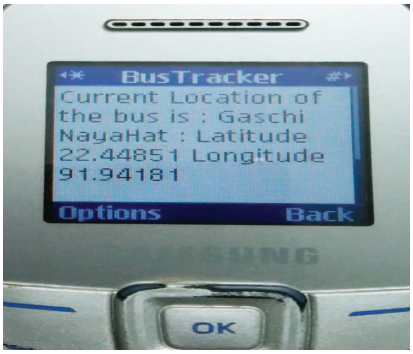

Figure 14: Text Message with Location Information

V. Experimental Results and Comparison

We have examined if the application is providing desired results or not. Table I demonstrates the results.

TABLE I. Experimental Results

User	Using Android?	Time at which application is using	Is data Connection available?	Is data connection fast enough?	Location on Google Map	Location get by SMS
Student-1	Yes	5.03.00 PM	Yes	Yes	CUET	-------
Student-2	Yes	5.07.00 PM	Yes	Yes	Pahartali	-------
Student-3	Yes	5.17.00 PM	Yes	No	-----	Gashchi Naya Hut
Student-4	Yes	5.17.00 PM	No	No	-----	Gashchi Naya Hut
Student-5	No	5.17.00 PM	No	No	-----	Gashchi Naya Hut

We compared our proposed method with some prominent related works in Table II.

TABLE II. COMPARISON WITH OTHER SIMILAR WORKS

Related works	Online tracking	Offline tracking	Live Location Display on Map	Previous Tracking History	Hardware Requirement
P. Verma et al. [1]	Yes	Yes	No	No	Microcontroller
A. Al-Mazloum et al. [2]	No	Yes	No	No	Android Phone, Server
Iman M. Almomani et al. [3]	Yes	No	Yes	Yes	Android Phone, Server
Sonia C.V et al. [4]	No	Yes	No	No	Android Phone
Md. Marufi Rahman et al. [7]	No	Yes	No	No	Microcontroller
Dongjiang Li et al. [10]	Yes	No	Yes	Yes	Microcontroller, Android Phone, Server
Nusrath Jahan et al. (Our Proposed System)	YES	YES	YES	YES	Android Phone, Server

The accuracy of location detection of our system is measured and found that it is accurate to within a 5 meter radius under open sky. Some sample values of location is shown in Table III. The actual value of latitude and longitude was taken from Google map.

TABLE III. COMPARISON OF LOCATION DATA

ID	Latitude	Longitude	Actual Latitude	Actual Longitude
532	22.46085	91.97192	22.46080	91.97190
535	22.46942	91.9693	22.46943	91.9695
600	22.45648	91.95745	22.45648	91.95742
620	22.45141	91.94554	22.45144	91.94554
690	22.46332	91.94324	22.46332	91.94324

Lastly, experimental observation proved that the system was successful in transmitting the location information to the client's phone on demand, as shown in Table I.

CONCLUSION

In this project, we introduced an android application for tracking live location of CUET bus. This application mainly makes use of GPS, Google Map, SMS gateway, web server and database server. With this application, students can get location information of the bus in both situations where internet connectivity is available and where it is not available. However, the system has limitations in some respects. Here, we are using network provided location information where there is problem of getting information from GPS. But network provided location in not more accurate than GPS. Again, there is no time prediction about arriving of bus at a specific location. And, there is no automatic notification system when the bus arrives at chosen location. In future we hope to extend this work and implement these features to make this system more beneficial.

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