International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 4 Issue 03, March-2015

Location-based Dynamic Advertisements Structure for Public Transit Systems

Prof. Swati Shinde[1], Tanveer Shaikh[2], Anilkumar Vandha[3], Harshil Sheth[4]
[1–4]Department of Electronics and Telecommunication
[1–4]K.J. Somaiya Institute of Engineering and Information Technology, University of Mumbai
[1–4]Mumbai, India

***Abstract*—Advertisements have become today's most direct marketing channel that provide information and discount offers about products to customers and allow marketers to reach a precise goal by creating campaigns. Making these Ads location-specific would not only render them more relevant but also personalized and targeted to specific audience. This paper presents a brief survey on Location-based Advertisements (LBA) with emphasis on their applications in Public Transportation Systems (Buses, Trains, Airplanes, etc.). Furthermore, this paper also proposes the design and implementation of a low-cost embedded system using Global Positioning System (GPS) which displays these Ads on real-time passenger information display system inside the vehicle. The objective of this review is to summarize and compare some of the well-known extensive research done in the field of LBA in order to make the existing technology even better.**

Keywords—Location-based Advertisements; Location-based Services; Embedded Systems; Microcontrollers; GPS; GIS; Geofencing; GSM; Public Transport Systems; SMS; Digital Signages; Push vs. Pull Approach

I. INTRODUCTION

Digital Signs are rapidly becoming so common-place, so natural, that we use them without even thinking. These signs are becoming ubiquitous, because Liquid Crystal Displays (LCD) displays have decreased in cost more than tenfold over the past decade. The rising demand for flat-panel digital Televisions (TVs) has largely driven these cost reductions. It's estimated that the current approximately US$5 billion digital signage market will triple by 2016 [1]. The constant evolution in flat-screen technology (LCD, LED, OLED, etc.) have given us extremely high resolution displays, thereby increasing display sizes. Hence, the following factors have made digital displays apt for displaying advertisements and information about promotional offers to consumers across a wide range of market segments. Digital signboards are also gaining popularity in information systems due to their dynamic and programmable nature.

As advertisement of products is one of the vital parts of commerce, business organizations spend a significant amount of their investments in publicizing these Ads. The booming smartphone adoption is accelerating the implementation of location-based services (LBS). LBS are services that serve the user based on their physical location [2]. Ads play an important role in spreading information of products to consumers which generate more profit for the company. Proper marketing of a product would create awareness about its usage and the convenience offered by that product. The increasing integration of location-sensitivity is one of the key developments in mobile advertising [3]. In addition to that, location-based advertisements (LBA) improve the exposure of these ads by making them targeted to a consumer belonging to a specific place. LBA being the subset of LBS provides flexibility of location-sensing and feasibility of an ingenious way of marketing at the same time.

In India, advertisement management is poor and so is space management in public transport systems. A system which delivers the information of upcoming destinations is used in Railway Trains, Buses, Metro and Monorails but the system which delivers useful information along with advertisements to the passengers using display visuals in mass transit systems has not yet been introduced. Hence, LBA can be easily implemented by little customization on already existing displays in public transportation systems [4].

Advertisement applications and management in public transit vehicles is still done using posters and bills which makes advertisement available for unknown periods of time, also a lot of harm to nature is caused due to cutting of trees for the manufacturing of paper which is required for making pamphlets and banners [5]. Thus, Location-based Ads enabled on digital displays in public transport systems would prove to be a better and eco-friendly alternative.

II. RELATED WORK

Since the past decade, a great deal of research and surveys have been conducted in the field of LBA to design a good and reliable system for enhancing the current technology. Consumer behavior is thoroughly understood in order to generate more Ad revenue by using location-based marketing. This section enlists a Literature Survey of recent papers published pertaining to the field of Location-based Advertisements.

In 2006, Steiniger, S., Neun, M., & Edwardes, A. [6] proposed the idea of location-based services which led on to become the most popular and highly researched topics in the field of Geographical Information Systems (GIS). In their paper the authors have laid the foundation of location-based services by defining the components of LBS and highlighting their applications. This paper has also compared various location-sensing technologies like Global Positioning System (GPS), RFID, WLAN, etc., in their use in mobile communication systems and have concluded that GPS is the best suitable and economic option for location retrieval.

Rifat, M. R., Moutushy, S., & Ferdous, H. S. [3] in their paper published in 2012 have elaborated on a location-based advertisement scheme using an open-source map. Their paper includes the market share of various mobile operating system (OS) platforms and have developed an android application to implement this ad scheme using the Open-Street Map. Their idea is innovative in the sense that the software which they have used in this project is entirely open-source, as a result they need not acquire any licenses from anybody asking permission to use these technologies.

Dwivedi, S., Gairola, R., Lavania, P., Mittal, L., & Goudar, R. H. [5] have stated about the improvement of advertisement technique in Indian public transport systems by using digital signage in the year 2013. They have implemented an ad structure which categorizes many ads based on different parameters like their duration, relevance, investment, etc., and assigns a state priority to each ad. On the other hand, they have assigned a normal priority to every ad using a general algorithm. Using these two priorities they have developed a Web application which can register different advertisers and display their ads in a dynamic order based on the current location of the vehicle in which this screen is installed. The use of World Wide Web in their system makes the system platform-independent and gives seamless access to various advertisers. This paper serves as a benchmark for engineers and researchers in the field of LBA in developing an array of GPS-based services.

Perceived effectiveness of Push vs. Pull mobile Location-based Advertising is deeply discussed in the paper published by Unni R. and Harmon R. [7] in 2007. This paper gives a brief introduction on the background of LBA and comprises of a market research on LBA using location-tracking technology in mobile networks. Various statistical distributions and methods of executing LBA are thoroughly discussed in this paper. Furthermore, the pros and cons of Push-based and Pull-based LBA are broadly compared on the parameters of its value, benefits, limitations and effectiveness. Lastly, it is concluded that advertising and promotions in Pull LBA are better than Push LBA due to personalized Ads and less privacy concerns.

III. LOCATION-SENSING TECHNOLOGIES

A. Indoor and Outdoor Location Sensing

Location awareness is proving to be a vital issue in various discrete activities in our day-to-day life, such as when an unexpected accident needs the nearest doctor in a hospital urgently, or as trivial as the need to know exactly where are we right now. Therefore, it is equally important to study the methods and techniques used in location sensing.

For Indoor location sensing, sets of antennas with wireless tags are majorly used in practice. These tags are compact in size and can be carried by people or installed in fixed positions. The technologies used for communicating include Passive Radio-frequency identification (RFID), Infrared (IR), Bluetooth (IEEE 802.15) and Wireless Local Area Network (WLAN). RFID is excellent for indoor applications where close proximity to tag readers is feasible. The reflected Electromagnetic Waves from the targeting object are analyzed to sense the location on a reader.

On the other hand, Outdoor location sensing is a broader concept because it encompasses a larger perimeter over a vast geographical area. Wireless tags prove to be futile as the region covered can be as big as the whole continent [6]. For outdoor location sensing applications, technologies such as Ultra Wide Band (UWB) Radio, Active RFID, GPS and WLAN are popularly used.

Table I. gives a general comparison of these outdoor location sensing techniques with respect to a variety of performance parameters.

TABLE I. COMPARISON OF OUTDOOR LOCATION SENSING TECHNOLOGIES

Parameter	UWB Radio	Active RFID	GPS	WLAN
Communication Range	Good	Moderate	Excellent	Good
Location Accuracy	Good	Moderate	Excellent	Excellent
Sensor Capability	Moderate	Good	Good	Excellent
Data Storage	Moderate	Moderate	Excellent	Excellent
Power Consumption	Poor	Poor	Moderate	Moderate
Refresh Rate	Excellent	Good	Excellent	Good
Ease of Deployment	Poor	Poor	Excellent	Good
Cost	Excellent	Excellent	Good	Moderate

From Table I. it is clear that GPS is the best suitable technique for outdoor location sensing applications. GPS which is maintained by U.S. Department of Defense (DoD) has advanced to become the most up-to-date system with each generation giving enhanced features and reliability. As soon as a GPS Receiver establishes a Line of Sight (LOS) with at least 4 out of a total of 68 GPS Satellites (As of October 2014), the system starts fetching the location of that receiver by a process known as Trilateration for determining the accurate position of the receiver [8]. After fetching all the information, GPS receivers can relay location data to a Personal Computer (PC) or other device using the National Marine Electronics Association 0183 (NMEA 0183) protocol. In spite of having global coverage, the availability of GPS can be limited by LOS issues caused by tall buildings, urban canyons, thick clouds, etc.

B. Geofencing

Geo-fencing is a virtual perimeter set around a particular location in a software program that uses the GPS or RFID to define geographical boundaries. Programs that incorporate geo-fencing allow an administrator to set up triggers so when a device enters (or exits) the boundaries defined by the administrator, a text message (SMS) or email alert is sent. A variety of geo-fencing applications incorporate Google Earth, enabling administrators to define boundaries on top of a satellite view of a specific geographical area [9]. Other alternative applications define boundaries by longitude and latitude or through user-created and Web-based maps.

This technology has many practical uses. For example, a marketer can geo-fence a retail store in a mall and send a coupon to a customer who has downloaded a particular mobile app when the customer (and his smartphone) crosses

the boundary. Geofence informs marketers about the real-time location of consumers when they are in a prime area to be engaged. It is also used to trigger alerts whenever a device enters or leaves the boundary of the defined area within a certain radius of the location.

The GPS satellite data is free and works anywhere in the world. A GPS navigation device accurately calculates geographical location by receiving information from GPS satellites. This data is then used to create a Geofence around the GPS Receiver and the desired application can be incorporated. In our system, GPS Receivers installed in public vehicles is used to create a mobile and dynamic Geofence.

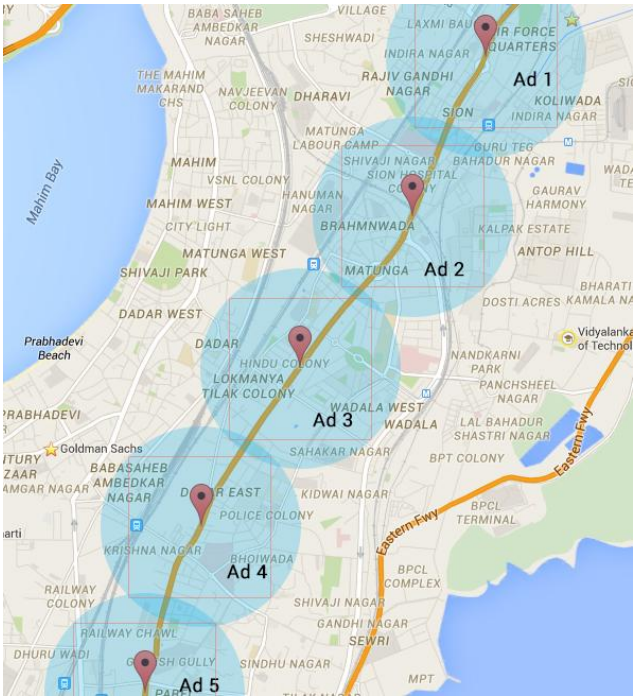

Fig 1. Dynamic LBA displayed in a vehicle using mobile Geofencing.

As shown in Fig. 1, the Geofence around the GPS Receiver installed in a vehicle moves along with the vehicle. As the vehicle moves along a predefined path, the Geofence also moves and occupies different regions in regular intervals of time.

Whenever the retail shops or Ad content providers comes inside the region inhabited by the mobile Geofence, those Ads are continuously displayed in a loop after arranging each Ad according to its priority and duration. Hence, these regions are used to display different sets of Ads pertaining to that Geofence thereby incorporating LBA.

IV. SYSTEM DESCRIPTION

According to a new study from Strategy Analytics, where research conducted on many companies and organizations revealed that — on an average revenue generated by a company increases by 25% when they adopt location-based services. By exploiting LBS, passengers in a public transportation system could be shown Ads specific to the region they are travelling in. 'An advertisement which adjusts to the location of the consumer might be considered as more relevant and less inconvenient' [10]. LBA will help to facilitate mass media planning by making customers aware of the products in their respective areas and customize Ad communications and promotions more effectively. Thus, it would profit both the buyer (customers) as well as the seller (shopkeepers, retailers, restaurant owners, etc.).

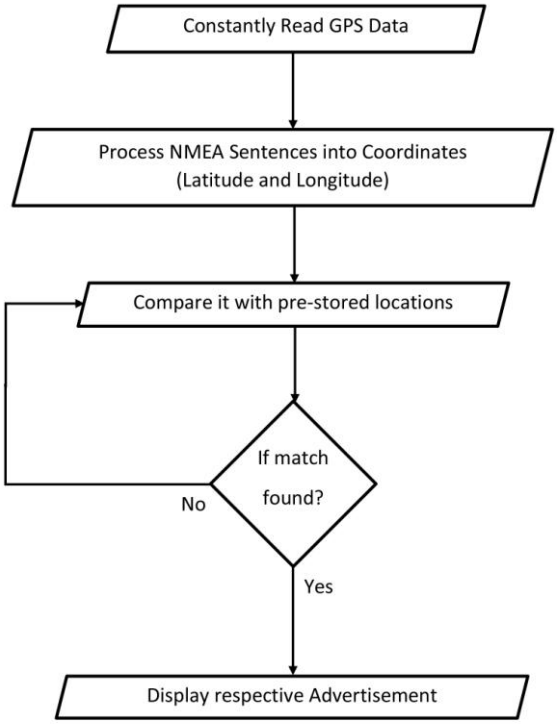

Fig 2. System Flowchart of GPS Receiver.

As shown in Fig. 2, the primary function of the system is as follows: The GPS Receiver constantly fetches data of current location as soon as it is powered on. GPS Receiver always gives output in the form of NMEA 0183 standard [11]. These NMEA sentences are processed into coordinates (Latitude and Longitude) by a suitable program in the microcontroller. After that, an optimum value of radius is chosen and a Geofence is created around the current location for targeting purposes. The coordinates ranging in the entire region of Geofence is continuously compared with the pre-defined locations of all the Ads to be displayed. If a match is found, then that respective Ad is displayed and rest all Ads are discarded. If the current location matches with two or more Ad locations, then all these Ads are displayed in a loop one after the other arranged in a decreasing order of their priority and duration.

The generic idea behind LBA is the efficient use of advertising media by attracting maximum customers. The design of an LBA system requires special attention to a number of parameters such as the medium to be used, area of advertisement, cost, productivity, etc. In general, there are two types of location-based Ad services:

A. Push-Based Ad Service

Push-based Ad Services are services in which the advertiser directly pushes the Advertisement onto the customer's device based on that consumer's location, previous purchases and buying preferences [7]. This type of

service is favorable for mass advertising and brand promotions in a strategic location. Push services are more prone to spamming because it reaches a wider audience.

A majority of purchase decisions being made on impulse, location-based push advertising can increase profits of retailers if the Ads are sufficiently attractive or relevant. Ad is displayed with or without the consent of the customer. Flow of Ads and promotions are largely controlled by marketers rather than customers in Push-based services. Push-based services are more adroit and are further divided into two types:

1) Opt-out Approach: This type of service is not requested by the user and is more common than the latter approach. This approach allows advertisers to target users until they do not want the ads to be sent to them.

2) Opt-in Approach: This type of approach refers to a contrasting paradigm in which users can determine what type of advertisements or promotional material they can receive from the advertisers. Advertisers have to respect users choices by abiding to certain legal regulations set in place.

B. Pull-Based Ad Service

The Pull-based Service is incoming communication which is initiated by the consumer [7]. As consumers commence the request to receive LBA, privacy concerns are likely to be less noticeable. Pull LBA happens to be less intrusive because consumers have finer control over receiving Ads.

Whenever the user looks for any specific information by entering certain keywords in any search engine, that query is logged by that engine. The advertisers then use that information to provide Ads which are related to the search query. For example, a traveler visiting Mumbai could use a search application such as Google Now on her device to find the nearest local Indian restaurant in Thane. After she selects one of the restaurants, a map is provided to navigate to that restaurant as well as an offer of a free appetizer good for the next hour [6].

Perceived value and benefits for Pull LBA are greater than Push LBA as Pull-based Services tend to be more consumer-oriented and unobtrusive.

C. System Architecture

The low-cost embedded system for public transport vehicles presented in this paper consists of the following components:

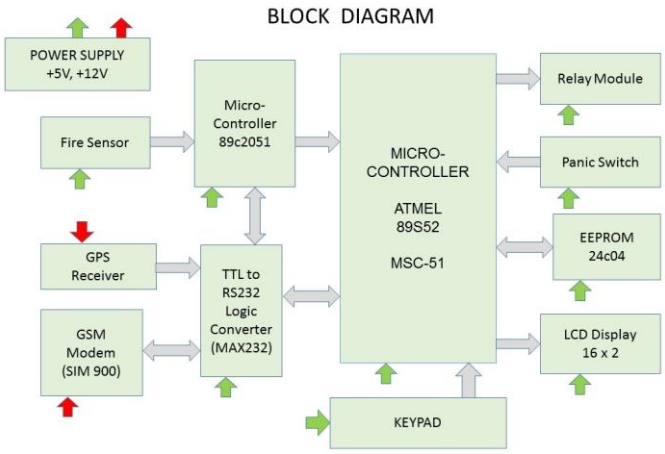

Fig 3. Block Diagram of the system for location-based dynamic Ads.

Fig. 3 above shows the block diagram of the complete Passenger Information System (PIS) for GPS-based Advertising. This system is supposed to be implemented in mass transportation systems. This is why this system uses the Push-based Ad Service Approach to display Location-based Ads [12]. The basic model of this system describes the different components to be used in the actual system. The location of the vehicle in which this system will be implemented would be fetched by the GPS Receiver. This location would be stored in the Electrically Erasable Programmable Read-Only Memory (EEPROM) Internal memory. Using the latitude and longitude stored in this coordinate, different regions of the entire route of the vehicle would be calculated. Each of these different regions can be called as a Geo-Fence. Lastly, a variety of Ads is displayed on the LCD screen in the vehicle pertaining to that Geo-Fence.

The shortest distance between two coordinates is calculated by spherical law of cosines. The spherical law of cosines computes the great-circle distances between two pairs of coordinates on a sphere.

$$D = R * \text{acos}\,(\cos(lat1).\cos(lat2).\cos(lng2 - lng1) + \sin(lat1).\sin(lat2)) \quad (1)$$

Where,

D is the distance between two coordinates (lat1, long1) and (lat2, long2)

R is the Radius of Earth

Equation (1) gives the shortest path between two locations with respect to their latitudes and longitudes. After giving the current location as one of the coordinates, this shortest distance is then used to determine the respective advertisement of the nearest shop or outlet to be displayed.

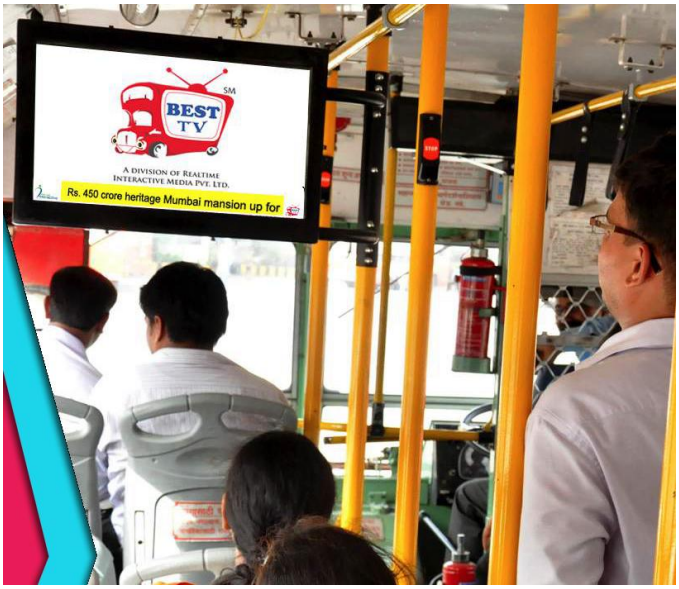

Fig 4. Passenger Infotainment System in B.E.S.T. Buses, Mumbai.

Two LCD Displays have been installed in each and every B.E.S.T. Bus in Mumbai which acts as the output to their PIS system as indicated in Fig. 4. The communication network is established through General Packet Radio Service (GPRS) which connects the system inside the Bus directly to their headquarters [13]. This system is used to display Ads, promotions, entertainment shows, news headlines, date and time, quizzes, estimated time of arrivals (ETA) and to automate announcement of next stops.

A society is comprised of people who are constantly on-the-go. On an average, an individual spends about 1.5 – 2 hours daily in travelling. India's passenger car and commercial vehicle manufacturing industry is the sixth largest in the world. Every day, people pile into buses, trains, subways and taxis to commute to and from work. LBA application gives commuters the opportunity to obtain information that is relevant towards their commutes. Our system is also designed and planned accordingly to be installed in a City Bus. Ads are displayed on integrated displays in Public Buses using Push-Based Approach [14]. The actual position of Bus, driving direction, next stop, speed and time of day are the parameters under consideration for appearance of the relevant Ads.

The bus route is linear and has a gradually increasing or decreasing value of coordinates. We have divided this complete route in different slots. The time it takes for the bus at average speed to cross each slot would be the total duration of Ads to be displayed in that particular slot. Now, we sell a part of each slot as a time duration to advertisers. For example, if Slot 1 is of 15 minutes, then it can hold 20 different ads of 45 seconds duration each. This type of management ensures equal opportunity to every advertiser within his/her location.

This system does not only focus on advertising but also would focus on passenger safety. Breaking news and contact numbers of Emergency Services Personnel such as police, ambulance and fire services is displayed. It is also enabled with a fire sensor to detect smoke & high temperature and immediately notify the nearest fire department through Short Message Services (SMS). The panic switch can be used in a crisis or disaster situation to send an SMS along with the current location of the bus to their headquarters asking for help [14].

Additionally, the connection between the accelerator and engine can be broken off with the help of Relay Module as a switch triggered by SMS. Hence, the bus is immobilized on the driver's will during hijacking or theft. All these features would enhance the security of the bus transportation network thereby making it a multi-purpose and robust system.

D. Proposed Design Components

The proposed hardware design for the PIS Embedded System installed inside Public Buses distinctly consists of the following units:

- GPS Receiver (SIM28ML)
- GSM Modem (SIM900A)
- Power Supply (+5V, +12V)
- Serial – TTL Logic Converter (MAX232)
- Micro-Controller (Master) Atmel AT89S52 MSC-51
- Micro-Controller (Slave) Atmel AT89C2051
- EEPROM 24C04
- Tactile Switch Keypad
- 16 x 2 LCD Screen Display
- Flame Detector (Infrared)
- Panic Switch
- Relay Module (Single Channel)

1) GPS Receiver: The Global Positioning System (GPS) is a constellation of at least 24 satellites that orbit our Earth twice daily at an altitude of about 12,000 miles (19,300 km). The primary function of GPS is to provide geographical location and time information to its users.

Suppose we know that a person is 8 km from a satellite X in the sky, he could be anywhere on the surface of a huge, imaginary sphere with an 8-km radius. If we also knows that he is 14 km from satellite Y, he is somewhere on the overlap of the first sphere with another larger sphere. The spheres intersect in a perfect circle. If we further know the distance to a third satellite, we gets a third sphere, which intersects with this circle at two points. The Earth itself can act as a fourth sphere and only one of the two possible points will actually be on the surface of the planet. By eliminating the one in space, we then know his/her current location. This process is known as trilateration [15].

SIM28ML GPS Receiver uses +12V DC Power Supply. All GPS Receivers fetch location data in the form of NMEA 0183 Protocol messages. The NMEA 0183 Interface Standard defines electrical signal requirements, data transmission protocol and time, and specific sentence formats for a 4800-baud serial data bus [16]. This standard is intended to support one-way serial data transmission from a single talker to one or more listeners [17].

The Location data is received in RS232 asynchronous communication protocol as GPS modems follow serial communication and NMEA-0183 are able to drive a single RS232 port, so it is first converted into Transistor-transistor Logic (TTL) format by logic conversion using MAX232 [11]. TTL is compatible with microcontrollers.

Asynchronous serial communication is carried out by sending a start signal prior to each byte of data followed by a stop signal sent after each code-word. Before commencing any communication, both the sender and receiver must agree on the frequency (speed) or bits/sec of the transmission line often referred to as the Baud Rate. This data can be condensed to only read the latitude and longitude by the microcontroller as the GPS Receiver is interfaced using Universal Asynchronous Receiver/Transmitter (UART) serial communication as the medium to communicate with the microcontroller.

The GPS receiver continuously gives the output in the form of NMEA sentences as shown in Table II. NMEA data includes PVT (Position, Velocity and Time) information calculated by the GPS Receiver.

The $GPRMC indicates that the succeeding message is recommended minimum specific GPS/Transit data where GP is the prefix for GPS. The current and fix data is provided by $GPGGA which reports 3-D location (With Altitude). GGA is the only NMEA sentence that notifies altitude [11].

TABLE II. FORMAT OF NMEA MESSAGES

Sentence ID	Description
$GPGGA	GPS Fix Data
$ GPGSA	GPS Dilution of Precision and active satellites
$GPGSV	GPS Satellite in view
$GPRMC	Recommended minimum specific GPS/Transit data
$GPVTG	Track made good and ground speed
$GPMSS	Beacon Receiver status
$GPZDA	UTC Date/Time and Local time Zone Offset

A common NMEA Sentence used for location-sensing is:

$GPRMC,225446,A,4916.450,N,12311.120,W,000.5,054.7,191194,020.3,E*68

Where:

RMC	Recommended Minimum Sentence C
225446	Fix taken at 22:54:46 UTC
A	Navigation receiver status A = OK (Active) or V = Warning (Void)
5218.300,N	Latitude 52 deg. 18.30 min. North
12311.120,W	Longitude 123 deg. 11.12 min. West
000.5	Speed over the ground (in knots)
054.7	Course Made Good, True Track angle (in degrees)
191194	Date - 19th of November 1994
024.7,E	Magnetic variation 24.7 deg. East
*68	Mandatory Checksum

SIMCom presents a small, high performance and reliable assisted GPS module—SIM28ML which is used in our system. This is a standalone L1 frequency GPS module with the MediaTek MT3337 high sensitivity navigation engine, which allows us to achieve the industry's highest levels of accuracy, sensitivity and Time-to-First-Fix (TTFF) with lowest power consumption. The maximum update rate of this receiver is 5 Hz.

The locations of Ads to be displayed on LCD Display Panels are already pre-stored in the external memory interfaced with the Master controller [18]. The controller then fetches the required latitude & longitude by continuously reading the GPS modem. This latitude and longitude is compared with the pre-stored one in the memory; if a match is found, it displays the respective Ad. This process continues in an Infinite Loop.

2) GSM Modem: Advertisements certainly tend to change over time, so hard-coding the microcontroller for a particular ad is not a good task, simply because then every time the developer will have to change the ad due to which the master microcontroller will need to be re-programmed. This becomes a quite impractical and hectic task. To overcome this drawback, we have interfaced GSM Modem in our system to update the data for ads through its SMS feature.

The Global System for Mobile Communications (GSM) Modem used in this project is SIM900A. SIM900A is built with Dual Band GSM/GPRS Read-Only Memory (ROM) engine and works on frequency bands (in MHz) of GSM–900 and GSM–1800. The Modem comes with RS232 interface, which allows you connect it to PC as well as microcontroller via a MAX232 logic converter. The baud rate is configurable from 9600-115200 through AT commands. The GSM/GPRS Modem is having internal Transmission Control Protocol/Internet Protocol (TCP/IP) stack to enable you to connect to internet via GPRS [19]. It is suitable for SMS, Voice as well as data transfer applications in Machine-to-Machine (M2M) interface.

The GSM Modem serves as a platform to input the Ad data by sponsors. Marketers can consult with the management of public transport services and directly submit their Ad to the system Over the Air (OTA) by sending a text message to the Subscriber Identity Module (SIM) Card installed in the GSM Module. Now to change or update the Ad, user just needs to send an SMS in a pre-defined format. As soon the message is received by the Modem, it will acknowledge the Microcontroller, retrieve the Ad information, discard useless data and store that message in the external memory interfaced with the Microcontroller on-the-go [19]. As soon as the Ad is saved in the external memory of microcontroller, it will acknowledge the user that his/her Ad request has been received, accepted and updated successfully. This automates the process of installing ads on the system. As GPS and GSM both use Universal Asynchronous Receiver/Transmitter (UART) for serial communication, the master microcontroller becomes short of available channels. Therefore, GSM Modem is interfaced to Port 1 & 3 of the slave microcontroller to enable uninterrupted service to GSM Modem as well as GPS Receiver.

3) Power Supply: The power supply is intricately designed so as to provide both +5V and +12V Direct Current (D.C.) power at 6Ah. We have decided to use a normal car battery giving +12V Alternating Current (A.C.) output at 6Ah. As all the electronic components work on D.C., we have converted the A.C. into D.C. by using a Bridge Rectifier. This much current is sufficient to drive both GPS, GSM and the microcontrollers as well. GPS and GSM need +12V D.C., so we have given it the output of Bridge Rectifier directly. On the other hand, microcontrollers, sensors and EEPROM work on +5V D.C., this is why we have used 7805 Voltage Regulator to step down the voltage keeping the current constant. This output is then given to all the delicate electronic components so that they don't get damaged by voltage surge.

4) MAX232 Logic Converter: MAX232 is an Integrated Circuit (IC) used to convert signals from an RS-232 serial port to signals suitable for use in TTL compatible digital logic circuits. RS232 is a serial data transmission standard in which the voltage signal levels ranging between -3V to -15V are interpreted as High (1) logical state and voltage levels ranging between +3V to +15V are interpreted as Low (0) logical state. On the contrary, in Transistor–Transistor Logic (TTL) 0V is considered as Low (0) logic level and +5V is considered as High (1) logic level. If MAX232 is not used then all the signals would get mixed up as high state may get interpreted as low state and vice-versa.

To solve this confusion in logic, MAX232 is interfaced as an intermediary block between GPS, GSM and the Master & Slave Microcontroller respectively. As MAX232 converts all the logic, proper communication can happen between GPS, GSM and both the Microcontrollers.

GPS Receiver and GSM Modem sends data and control signals in Asynchronous RS232 standard. The information is not sent in predefined time slots, but data bits are sent with a predefined frequency called the baud rate (bits/sec). Both the transmitter and receiver must be programmed to use the same bit frequency for communication.

5) Micro-Controller (Master) Atmel AT89S52 MSC-51: Master Microcontroller used in this PIS system is Atmel AT89S52. This Master controller acts as the main building block and controlling block of the entire system. Master Controller AT89S52 controls all the actions related to advertising. This master controller has a reference of many different pre-stored locations stored in the EEPROM external memory. It then commands the LCD to display that particular Ad which refers to that location.

The Atmel AT89S52 is an 8051 based Full Static Complementary Metal-Oxide Semiconductor (CMOS) controller with 32 I/O lines, 8 Interrupts Sources, Watchdog Timer, 8K Flash Memory and 256 Bytes On-chip Random Access Memory (RAM). It is available in a 40 Pin Dual In-line Package (DIP) Integrated Circuit.

Programs in the master and slave microcontrollers are written using Keil and burned into them using ProgISP Burner using USBAsp hardware for connecting the controller to PC.

6) Micro-Controller (Slave) Atmel AT89C2051: Slave Microcontroller used in this PIS system is Atmel AT89C2051. It is used to overcome the shortage of Receiver and Transmitter pins on Master controller as they are being used by GPS. Both the Master and the Slave Microcontrollers are based on 8051 architecture and are variants of it. This greatly reduces the cost of system and is sufficient for our application as there are 6 usable Ports available (4 ports of Master Microcontroller and 2 ports of Slave Microcontroller).

AT89S52 is a low-power high performance microcontroller with 8-bit Central Processing Unit (CPU). It has 2K bytes of flash memory, 15 (Input/Output) I/O lines and 128 bytes of RAM. It is used as a 20 Pin DIP Integrated Circuit.

As far as software is concerned, it is advisable to use a slave microcontroller to serve the advertising needs in an efficient manner. This slave controller can communicate with the GSM Modem, decode the SMS and if the message is found to be in a pre-defined format, extract the coordinates from it and store that ad as well as its corresponding location in the EEPROM chip. The slave controller then interrupts the master microcontroller to refresh the Ad data from EEPROM.

7) EEPROM 24C04: Electrically Erasable Programmable Read-Only Memory (EEPROM) is interfaced with the Microcontrollers which serves the purpose of using an external memory. The 24C04 has 4Kbits (512Kbytes) of On-Chip memory and is directly connected to Master Microcontroller. This EEPROM stores the predefined database (Matrix Table) of Ads along with the location within which they are to be displayed. Non-Volatile memory of EEPROM serves the purpose of storing the changes and updates of the location information. Users can also modify the ads which they want to show at that location.

8) Tactile Switch Keypad: This consists of an array of tactile switches as input devices. The number of switches can be extended by the designer to suit the number of ads to be displayed and stored on database (Matrix Table) in the EEPROM. This component serves as an input device in our system. The user should first go to that particular location and long press the desired tactile switch. By doing this, the current coordinates of that location would be fetched from GPS and stored in EEPROM to display the set Ads on that location in future if the vehicle reaches the same location. Keypad also gives ability to the user to change the pre-stored locations with a new one.

9) 16 x 2 LCD Screen Display: A 16 x 2 LCD Screen Display is connected to Master Microcontroller which displays the Ads according to particular location which is fetched by GPS. It is an output device in our system. LCD as an advertising medium provides alphanumeric and graphical interface. Predefined location form EEPROM and current location from GPS is compared and if they match then only that particular Advertisement is displayed on the LCD Screen in a scrolling fashion.

10) Features that Enhance Security: The system is equipped with sensors providing input about the real-time conditions of the vehicle. These three features make the public transport system (Bus and Trains) more secure by alerting the passengers and the transit system's main control room as follows.

a) Flame Detector (Infrared): This fire sensor based on Infrared can easily detect the presence of flame at a distance of 100 m. Flame contains a part of radiation in the infrared spectrum and hence can be sensed by the Flame Detector. After detecting the presence of fire, this sensor can alert the headquarters by a text message which also shares the location of the vehicle.

b) Panic Switch: This is simply a tactile switch to be pressed in an emergency situation such as a natural calamity or during a sudden failure of the vehicle. This also notifies the main control room by sending an SMS. Additionally, there is also an option of breaking the connection with the help of a Relay Module, which disconnects the Accelerator and Engine bringing the vehicle to a grinding halt.

c) Relay Module (Single Channel): As stated earlier, the Single Channel Relay Module is connected between the Accelerator Pedal and the Engine. By activating the relay, normally connected (NC) terminal of the relay becomes open breaking the circuit and stopping the vehicle. This event can instantly immobilize the vehicle at that same spot. This is a precautionary measure taken to enhance the security of Bus. It would come in handy during the aftermath of theft or sudden hijacking of the vehicle.

V. DISCUSSION

"Wireless advertising makes the most sense when delivered contextually through media on a geo-targeted basis, and not to IP addresses based on profiles, as most companies largely deliver their ads." [14]. LBA is not a plug and play solution. It needs to be configured and constantly managed as per the industry requirements and market scenarios.

Suppose that the No. 18 bus was about to pass a local supermarket. As the bus approaches the nearest stop, a digital ad could promote the products that are currently on sale. Additionally, advertisements can be made relevant to a specific time of day. For example, a local restaurant could advertise the breakfast menu in the morning and the business lunch special in the afternoon. LBA can also be integrated with passenger information systems in order to retrieve the arrival and departure times of transit vehicles by tracking it on a map which can be strategically used to display more ads during rush hours or when there is more crowd of commuters [18]. As a result, time-based ads can reach even more people and can healthily engage a captive audience. This system can also be beneficial to tourists as a city guide inside tour buses in an unknown city which can alert them the points of interest as they move along the tour.

Due to the advent of better and faster wireless network technologies like 4G/LTE (Long-Term Evolution), we can ensure the deployment of the whole infrastructure and database of location-based ads on a remote server as a future scope. This would prove to be a great Internet of Things (IoT) application considering the business model to have strong commercial value, social impact and uniqueness.

VI. CONCLUSION

The vitality of Location Based Services (LBS) and the commercial promise it presents to both the traditional GIS industry and the emerging wireless devices industry is now well publicized. Consumers who were served a geo-fenced ad near an advertiser's store were 3.9 times more likely to check in the store than those who did not see the ad. These consumers were also 23% less likely to visit a competitor. Public transit is therefore perceived as a sector ripe for early adoption of location-based information services and implementing advertising services. Hence, LBA helps to trigger relevant ads at the perfect time and place. The main advantage of our system is that it is cost effective and trivial. As the location services are GPS-based, it makes the system accurate, sturdy and agile. Our project presented in this paper give innovative and efficient solutions to generate revenue by marketers and at the same time ensure happy customers. Better analysis of consumers is possible with real-time market research resulting in a higher advertising impact.

ACKNOWLEDGMENT

We would like to add a few heartfelt words for the people who were part of our project in numerous ways and who gave us unending support right from the beginning. We owe a debt of gratitude to our guide, Prof. Swati Shinde for providing her timely advice, constructive criticism and excellent guidance. We would like to show appreciation to our Head of Department (HOD) for his invaluable contributions and hard work that he has put for the betterment of this paper. Lastly, we would like to take this opportunity to praise the entire department of Electronics and Telecommunication Engineering of our college for helping us and supporting us in every way possible without which we could not have achieved this feat.

REFERENCES

[1] Roy Want, and Bill N. Schilit, "Interactive Digital Signage," IEEE *Computer Society*, vol. 45, no. 5, pp. 21-24, May 2012. doi:10.1109/MC.2012.169

[2] Bruner II, Gordon C, and Anand Kumar. "Attitude toward location-based advertising'." Journal of Interactive Advertising 7.2 (2007) : 3-15.

[3] Rifat M. R., Moutushy S., and Ferdous H. S., "A Location Based Advertisement scheme using OpenStreetMap," *15th International Conference on Computer and Information Technology (ICCIT)*, pp. 423–428, June 2012. doi:10.1109/ICCITechn.2012.6509801

[4] Wesam M. Ayada, "Determining Ways of Using Digital Out of Home Signage to Advertise on Static Traffic Signals," International Journal of Engineering Research & Technology (IJERT), pp. 713-719, Vol. 3, Issue 6, June 2014.

[5] Dwivedi S., Gairola R., Lavania P., Mittal L., and Goudar R. H. (2013). Advanced Advertising Technique in Indian Public Transport System : A Better Way to Disseminate Information Using Electronic Display, (248002), pp. 1–7.

[6] Steiniger, S., Neun, M., & Edwardes, A., "Foundations of Location Based Services," *Cartography*, no. *1*, pp. 1-28, (2006).

[7] Unni R., and Harmon R. (2007). "Perceived effectiveness of push vs. pull mobile location-based advertising," *Journal of Interactive Advertising*, vol. 7, no. 2, pp. 1.

[8] Kracht M. (2004). "Tracking and Interviewing Individuals with GPS and GSM Technology on Mobile Electronic Devices," *7th International Conference on Travel Survey Methods*, *49*(0), 1–14.

[9] Chitravalavan, Jayasri, C., & Vinothini K. R., "Vehicle Monitoring and Intelligent Data Analysis using GPS Based Open Source Software,"

International Journal of Engineering Research & Technology (IJERT), Vol. *3*, *Issue 2*, pp. 383–387, February 2014.

[10] Banerjee S., & Dholakia R. R. (2008). Mobile Advertising: Does location-based advertising work? *International Journal of Mobile Marketing*, *3*(2), 68–74.

[11] Kaplan, E. D., & Hegarty, C. J.: '*Understanding GPS'* (Artech House, p. 685, 2005, 2nd edn. 2006).

[12] Dumond, D. I., & Brooks, B. J. (1993). Communication system for message display onboard mass transit vehicles. Google Patents. Retrieved from http://www.google.com/patents/US5218629

[13] Hannan, M.A.; Mustapha, A.M.; Hussain, A.; Basri, H., "Communication technologies for an intelligent bus monitoring system," *Sustainable Technologies (WCST), 2011 World Congress on*, pp. 36-43, 7 - 10 Nov. 2011.

[14] Kölmel B., & Alexakis S. (2002). Location Based Advertising. *M-Business 2002, The First International Conference on Mobile Business*, 1–7.

[15] Al Khedher M. (2011). Hybrid GPS-GSM Localization of Automobile Tracking System. *International Journal of Computer Science and Information Technology*, *3*(6), 75–85. doi:10.5121/ijcsit.2011.3606

[16] 'NMEA 0183 Standard', http://www.nmea.org/content/nmea_standards/nmea_0183_v_410.asp, accessed April 2008.

[17] Sahoo B. P. S. & Rath S., (1978). Integrating GPS, GSM and Cellular Phone for Location Tracking and Monitoring. International Conference on Geospatial Technologies and Applications, Geomatrix '12, February 26-29, 2012, IIT Bombay, Mumbai, India.

[18] Steele, S. A., & Alberth, W. P. (2002). Remotely configurable multimedia entertainment and information system with location based advertising. Google Patents. Retrieved from http://www.google.com/patents/US20020046084

[19] Musa Y. Y., & Wang J., "Vehicle Tracking and Anti-theft System using GPS-GSM," International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181, Vol. 1, Issue 10, pp. 1-4, December-2012.