Public Transportation Management Service using GPS-GSM

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Abstract

Transportation management service includes vehicle tracking & security system by embedding of an electronic device in a vehicle, or fleet of vehicles, with purpose-designed computer software to enable the owner or a third party to track the vehicle's location, collecting data in the process. This project work proposes and implements a solution for enhancing public transportation management services based on GPS and GSM. The system consists of four modules: BUS Station Module, In-BUS Module, BASE Station Module and BUS Stop Module. BUS Station Module sends the initialization information containing the bus number and license plate number to In-BUS Module and BASE Station Module using SMS. In-BUS Module then starts transmitting its location and number of passengers to BASE Station Module. BASE Station Module is designed to keep track record of every bus, processes user request about a particular bus location out of BUS Station Module and updates bus locations on bus stops. BUS Stop Module receives bus location information coming towards that stop from BASE Station module and displays the information on a dot matrix display. The experimental analysis has been done based on the number of passengers and a recommendation report more over its check on the performance and services offered by transporters to common people.

Key words- base station, In bus, GPS, dot matrix display, GSM.

I. Introduction

Every day we are witnessing the breakthrough of new technologies in all forms of passenger transport. The meaning of technology, future development, and application are based primarily on the finding of methods how to make life easier. Today's development of information and communication technologies is directed to wide population of users equipped with sophisticated terminal devices. The starting point has been guided by the idea that the implementation of new technologies should fulfil the users' requirements: what they want, where they want it and in the best possible way in which they want it[1].

In this paper, a transportation management system is developed for enhancing public transportation services based on integration of GPS and GSM. GPS and GSM. GPS is used as a positioning device while GSM is used as communication link between different modules. These modules include BUS Station Module, In-Bus Module, BASE Station Module and BUS Stop Module. Bus Station Module contains a GSM engine interfaced to PC and transmits the bus index and its license plate number to BASE Station. At the same time, it turns on GPS receiver installed in the bus. The bus then starts transmitting its location to the BASE Station. The BASE Station comprises of a GSM engine interfaced to a microcontroller for processing user request of bus location as well as a number of other GSM engines interfaced to various PCs each reserved for a separate bus to update the location information of that bus. The buses location data from BASE Station is sent to each bus stop. BUS Stop Module after receiving buses location data through GSM engine displays it on dot matrix display installed at each bus stop. The block diagram of the proposed system is shown in Fig. 1.
AT89C52 microcontroller is interfaced serially to a GSM Modem and GPS Receiver. A GSM modem is used to send the position (Latitude and Longitude) of the vehicle from a remote place. The GPS modem continuously gives the data i.e. Latitude and Longitude indicating the position of the vehicle[2]. The GPS modem gives many parameters as output, but only NMEA data coming out is read and displayed on the LCD. The same data is sent to the mobile at the other end from where the position of the vehicle is demanded. An EEPROM[3] is used to store the mobile number. The hardware interfaces to microcontroller are LCD display GSM modem and GPS receiver. The design uses RS 232 protocol for serial communication between modems and microcontroller[4,5]. A serial driver IC is used for converting TTL voltage levels into RS 232 voltage levels. When the request by user is sent to the number at the modem, the system automatically sends a return reply to that mobile indicating the position of the vehicle in terms of Latitude and Longitude.

II. Hardware Specification

There are some hardware components used to develop the system which are given below, and shown in Figure 2.

A. GPS: This provides highly accurate position information and can be used for a variety of land, sea, and air applications. GPS was developed by the U.S. Department of Defense (DoD)[6]. The system consists of a constellation of 24 geostationary satellites, orbiting around 11,000 miles above the Earth’s surface [9]. GPS was dedicated solely for military use and has recently been declassified for civilian use. To acquire GPS information, a wireless receiver capable of the civilian L1 frequency (1575.42 MHz) is required. The GPS receiver measures distances to four or more satellites simultaneously. Using triangulation [9] the receiver can determine its latitude, longitude, and altitude.

B. GSM: It has become the world’s fastest growing mobile communication standard. It allows for seamless and secure connectivity between networks on a global scale. Digital encoding is used for voice communication, and time division multiple access (TDMA) transmission methods provide a very efficient data rate/information content ratio [10]. While GSM is becoming the standard for person-to-person communication, the circuit-switched network limits data transmission. General Packet Radio Service (GPRS) was developed to relieve this limitation.

C. Microcontroller: A Micro controller consists of a powerful CPU tightly coupled with memory, various I/O interfaces such as serial port, parallel port timer or counter, interrupt controller, data acquisition interfaces-Analog to Digital converter, Digital to Analog converter, integrated on to a single silicon chip. If a system is developed with a microprocessor, the designer has to go for external memory such as RAM, ROM, EPROM and peripherals. But controller is provided all these facilities on a single chip. Development of a Micro controller reduces PCB size and cost of design.

D. Memory: The 89C51 have three general types of memory. They are on-chip memory, external Code memory and external Ram. n-Chip memory refers to physically existing memory on the micro controller itself. External code memory is the code memory that resides off chip. This is often in the form of an external EPROM. External RAM is the Ram that resides off chip. This often is in the form of standard static RAM or flash RAM. 256K Nonvolatile RAM (NV-Ram) DS1230Y-85 is used for storing data in In-BUS Module (in case of sparse GSM coverage) and at BUS Stop Module for displaying on dot matrix display.

E. Power Backup

In-Bus Module is provided with an internal battery so that whenever power from main battery is disconnected, microcontroller continues to transmit the location to BASE station. A message is also sent to BASE station to notify it about the disconnection of main battery. When the power is resumed, the internal battery begins to recharge.

F. Alarms

The microcontroller unit in In-BUS Module sends different alarm signals for different events to BASE Station Module.

1) On Backup Battery: When the main battery is switched off, a notification is sent to BASE station.
2) Stoppage: When the bus is stationary for more than a specified time, BASE station is informed by a stoppage alarm. In case of an accident or any other fault occurred in bus, the driver can notify the BASE station by pressing a button in bus.
3) Getting Late: When the bus is not covering a certain distance in a defined range of time, an alarm signal of getting late is sent to BASE station.
4) Route Deviation: When the bus deviates from the
assigned route by a given margin, BASE station is notified.

Fig-2, Description diagram for the system

III. System Modules

The whole system consists of four modules: BUS Station Module, In-BUS Module, BASE Station Module, and BUS Stop Module.

A. Bus station module - BUS Station Module is installed at bus terminals from where the bus will depart. It consists of a LA SER and a GSM modem connected to a PC. At the time of entrance of a bus into a terminal, a LASER sensor detects it. The operator sitting at the terminal enters the license plate number in the database. A count number is then generated accordingly and assigned to the bus. For example, a bus leaving the terminal first will be assigned a number 1. The route number of the bus along with the direction information, assigned count number, and license plate number is sent to the BASE Station via GSM. An example of the transmitted header is of the form “99U01LZR7240” where ‘99’ is the bus route number issued by the Transportation Department, ‘U’ is the upward direction of the bus (“D” will be the downward direction), ‘01’ is the count number assigned to the bus, and ‘LZR7240’ is the license plate number of the bus. An ‘ON’ signal is also transmitted to the In-BUS Module installed in the bus for initialization. The flowchart of module software is shown in Fig. 3.

B. In-BUS Module

In-BUS Module is installed inside every bus and consists of a GPS receiver, a GSM modem, a NV-RAM, infrared object counting sensors, door opening/closing sensors, and an emergency button; all interfaced to an AT89C52 microcontroller. This module starts transmitting bus location to the BASE Station after receiving the initialization signal from the BUS Station Module. At each stop, when the driver opens the door, an interrupt is generated and the microcontroller starts counting the numbers of passengers entering and leaving the bus with the help of infrared sensors. This count value on a per-stop basis is transmitted to the BASE Station. In case of an emergency situation (e.g., when a fault occurs in a bus), the driver can press the emergency button to inform the BUS and BASE Station units about the location of the bus. The BUS station operator can then adjust the schedule accordingly and send an additional bus to facilitate the passengers. Flowchart of this module software is shown in Fig. 4.
C. BASE Station Module

This module is the central part of the network. The central component of the Network Subsystem is the Mobile services Switching Center (MSC). It acts like a normal switching node of the PSTN or ISDN, and additionally provides all the functionality needed to handle a mobile subscriber, such as registration, authentication, location updating, handovers, and call routing to a roaming subscriber. These services are provided in conjunction with several functional entities, which together form the Network Subsystem. The MSC provides the connection to the fixed networks (such as the PSTN or ISDN). Signalling between functional entities in the Network Subsystem uses Signalling System Number 7 (SS7), used for trunk signalling in ISDN and widely used in current public networks.

The Home Location Register (HLR) and Visitor Location Register (VLR), together with the MSC, provide the call-routing and roaming capabilities of GSM. The HLR contains all the administrative information of each subscriber registered in the corresponding GSM network, along with the current location of the mobile. The location of the mobile is typically in the form of the signalling address of the VLR associated with the mobile as a distributed database. The actual routing procedure will be described later. There is logically one HLR per GSM network, although it may be implemented as an independent unit, all manufacturers of switching equipment to date implement the VLR together with the MSC, so that the geographical area controlled by the MSC corresponds to that controlled by the VLR.

Note that the MSC contains no information about particular mobile stations --- this information is stored in the location registers. Fig-5 explains the working criteria of base station module.

D. BUS Stop Module

This module is installed at every bus stop to let the passenger know about the location of buses coming towards that stop. It comprises a GSM modem, a NV-RAM and dot matrix display; all interfaced to 89C52 microcontroller. After receiving the bus location data in the form of stop names from BASE station, microcontroller stores it in nonvolatile RAM.
Microcontroller after retrieving the stored information displays it on a 3x15 dot matrix display. The microcontroller refreshes the information with a rate of 10 seconds. In case of an emergency situation, the location of next incoming bus is displayed shown in fig-6, explains the LCD displaying at the bus station.

![Fig-6. Explains the working condition of display at bus station](image)

**IV. Conclusion**

In this paper, we design and developed a low cost transportation management system based on integration of GPS and GSM data. The system consist of various modules which are wirelessly linked with GSM modems. Cost effective SMS service of GSM network is used for the transfer of data between the modules. A new service, to facilitate the people who use public transport for traveling, is introduced inside the city. The service provides the user with current location information of desired buses based on which the user can adjust his schedule accordingly. The service therefore reduce the waiting time at the bus stop. For the passengers not utilizing the service, displays are installed at bus stop to let them know the buses location coming towards that stop. This system provides a user friendly environment to the people of a city to overcome the difficulty in finding bus route as well as saving lot of time.

**V. References**


[2] Muhammad Imran and Nicholas Low, “Time to change old paradigm: Figure 9. GUI Showing Statistical Data


