An Enhanced Railway Transport System using FPGA through GPS & GSM

P.Vamsi Krishna, D.Yugandhar

Abstract- Travel time information is a vital component of many intelligent transportation systems (ITS) applications. In recent years, the number of passengers travels in train & number of trains in India has increased tremendously. Due to the increase in number of trains the train times may be delayed and the passengers have to wait at railway stations. A desirable strategy to deal with such issues is to provide better service (comfort, convenience and so on) the notification of location of time through GSM. One such application provides accurate information about train arrivals to passengers, leading to reduced waiting times at railway stations. This needs a real-time data collection technique, a quick and reliable data and informing the passengers regarding the same. The scope of this proposed system is to use global positioning system data collected from trains in the city in India, to show the location.

The system consists of three modules: Vehicle section Module, BASE Station section Module, User mobile section Module. Equipped with PC and GSM modem, BASE Station Module sends the initialization information containing the train number to Vehicle section Module using SMS. The microcontroller based vehicle section Module consisting mainly of a GPS receiver and GSM modem then starts transmitting its location to BASE Station Module. BASE Station Module equipped with a microcontroller unit and GSM modems interfaced to PCs is designed to keep track record of every train, processes user request about a particular train location out of BASE Station and updates trains location at stations. GPS Module is installed at every station and consists of a GSM modem, memory unit and dot matrix display all interfaced to a microcontroller. This module receives trains location information coming towards that station from BASE Station module and displays the information on a dot matrix display. The performance of the proposed system is found to be promising and expected to be valuable in the development of advanced public transportation systems (APTS) in India. The work presented here is one of the first attempts at real-time short-term prediction of arrival time for ITS applications in India.

Keywords- GPS;GSM; Intelligent transportation systems; Base Station Module; Vehicle section Module; User mobile section Module; rush statistical analysis

I. INTRODUCTION

Rail transport is a means of conveyance of passengers and goods by way of wheeled vehicles running on rail tracks. In contrast to road transport, where vehicles merely run on a prepared surface, rail vehicles are also directionally guided by the tracks they run on.

Manuscript received on January, 2013

P.Vamsi Krishna, MTech, IInd Year Aditya Institute of Technology and Management, India.

D.Yugandhar,M,Tech (Ph.D), Assoc Proffesor, Aditya Institute of Technology and Management, India.

Track usually consists of steel rails installed on sleepers/ties and ballast, on which the rolling stock, usually fitted with metal wheels, moves. However, other variations are also possible, such as slab track where the rails are fastened to a concrete foundation resting on a prepared subsurface. Rolling stock in railway transport systems generally has lower frictional resistance when compared with highway vehicles, and the passenger and freight cars (carriages and wagons) can be coupled into longer trains. The operation is carried out by a railway company, providing transport between train stations or freight customer facilities. Power is provided by locomotives which either draw electrical power from a railway electrification system or produce their own power, usually by diesel engines. Most tracks are accompanied by a signaling system. Railways are a safe land transport system when compared to other forms of transport. Railway transport is capable of high levels of passenger and cargo utilization and energy efficiency, but is often less flexible and more capital-intensive than highway transport is, when lower traffic levels are considered.

Most mass transit systems move people in groups over scheduled routes. This has inherent inefficiencies. For passengers, time is wasted by waiting for the next arrival, indirect routes to their destination, stopping for passengers with other destinations, and often confusing or inconsistent schedules. Slowing and accelerating large weights can undermine public transport's benefit to the environment while slowing other traffic. Personal rapid transit systems attempt to eliminate these wastes by moving small groups nonstop in automated vehicles on fixed tracks. Passengers can theoretically board a pod immediately upon arriving at a station, and can—with a sufficiently extensive network of tracks—take relatively direct routes to their destination without stops.

Existing system:

- People have to wait for the train.
- The location of the train is informed manually through telephone and RF communication.
- Don't know about the time of location & arrival of train accurately.
- No way to know about the arrival of train.
- People have to contact the station master.

Proposed system:

- Greatly reduces waiting time.
- Automatic information of train.
- Knowing about the train arrival time & location.
- Using a SMS people can find the location & about arrival.
- Tracking the train itself is possible.

In this paper, an advanced public transportation systems (APTS) is developed for enhancing public transportation services based on integration of GPS and GSM. GPS is used as a positioning device while GSM is used as communication link between different modules. These modules include BASE Station Module, Vehicle system Module, User mobile section Module. BASE Station Module contains a GSM engine interfaced to PC and transmits the train index and its number to BASE Station. At the same time, it turns on GPS receiver installed in the train. The train 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 train location as well as a number of other GSM engines interfaced to various PCs each reserved for a separate train to update the location information of that train. The trains location data from BASE Station is sent to each train station. Train station Module after receiving trains location data through GSM engine displays it on dot matrix display installed at each train station.

The block diagram of the proposed system is shown in Fig.1.

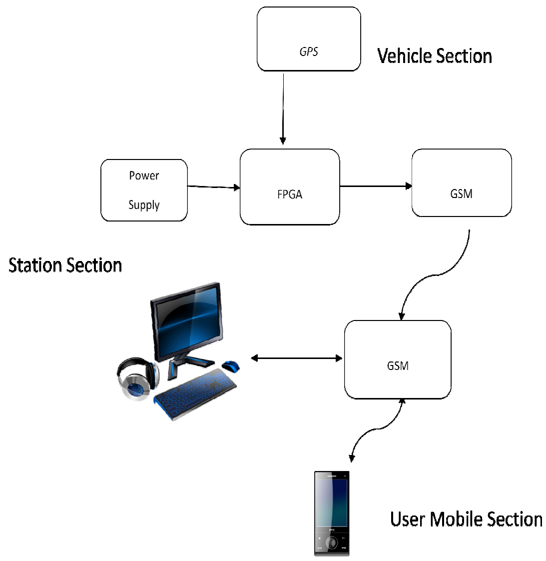

Fig. 1. Block diagram of the proposed system

II. HARDWARE SPECIFICATIONS

The following hardware components are used in building the entire system:

A. GPS Reciever

In order to keep track record of train, a Garmin GPS35 receiver, powered from the train main battery, is installed in each train. The Garmin GPS35 is a complete GPS receiver and embedded antenna designed for a broad spectrum of OEM system applications. The GPS35 tracks up to twelve satellites at a time while providing one-second navigation updates and low power consumption. Its far-reaching capability meets the sensitivity requirements of land navigation as well as the dynamics requirements of high performance aircraft. Internal memory backup allows the GPS35 to retain critical data such as satellite orbital parameters, last position, date, and time.

B. GSM Modem

A wireless link between the modules is provided with Nokia 12i GSM module. Nokia 12i offers advance GSM connectivity and supports EDGE/GPRS and HSCSD with automated GSM connection establishment It is equipped to provide reliable remote connections and offers application level watchdogs, inbuilt self check mechanisms and a reliable Virtual Machine (VM) for JAVATM. Nokia 12i also supports reliable inbuilt internet protocols: TCP/IP for reliable data transfer, UDP/IP for audio and video streaming and HTTP for accessing web pages. The module can also be connected to an external GPS device that supports National Marine Electronics Association (NMEA) standard. The inbuilt NMEA parser can parse the location data from the output that it receives from the GPS device. External microcontroller can use AT commands to communicate with Nokia 12i and simple remote I/O applications can easily be controlled via text messages.

C. Microcontroller

AT89C52 microcontroller is selected because it is a powerful microcomputer which has low power consumption and provides a highly flexible and cost-effective solution to many embedded control applications. It has 8K bytes of in system reprogrammable flash memory, 256 bytes of internal RAM, 32 programmable I/O lines, three 16 bit timers/counters, eight interrupt sources and a programmable serial channel.

D. Memory

256K Nonvolatile RAM (NV-Ram) DS1230Y-85 is used or storing data in vehicle section Module (in case of sparse GSM coverage) and at station Module for displaying on dot matrix display. NV-RAM is selected because it combines the best of RAM and ROM: the read and write ability of RAM and non-volatility of ROM. The DS1230 Nonvolatile SRAM is 262,144-bit, fully static, nonvolatile SRAM organized as 32,768 words by 8 bits. Each NV SRAM has a selfcontained lithium energy source and control circuitry which constantly monitors VCC for an out-of-tolerance condition. When such a condition occurs, the lithium energy source is automatically switched on and write protection is unconditionally enabled to prevent data corruption.

E. Battery Backup

Vehicle section 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 vehicle section 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 train 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 train, the driver can notify the BASE station by pressing a button in the train.

3) Getting Late: When the train 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 train deviates from the assigned route by a given margin, BASE station is notified.

III. SYSTEM MODULES AND NETWORK OPERATION

The entire system/network comprises of three modules:

BASE Station section Module, Vehicle section Module, and User mobile section Module.

The working and interconnection of these modules is described in this section.

A. BUS Station Module

This module is the central part of the network. It accepts location information of trains through respective GSM modems and maps the information on Google Map for visualization. The message received is of the form 2345.3522N, 09022.0288E". The first two strings denotes the location information; all separated by commas. Another GSM modem is used to get the user request of location information of a particular train. The microcontroller attached with this GSM modem passes on the user request to the PC dedicated for that route number. The PC after processing the request data sends desired location information in form of train station name to microcontroller. The microcontroller then transmits this information back to the user. The information that passenger will receive contains the location of all trains out of terminal in desired direction in former query while in case of later query, he will get the location of those trains which are coming towards the particular train station number in desired direction along with time information. The time information is embedded in message to account for any delay in processing the user request. An example of the information received by the user is of the form "venk Chowk, white hall, university Campus, bada market- 12:30 P.M." where first four strings are train stops names telling where the trains are currently followed by the time on which the location information is get from the map and message is sent to user. BASE station also monitors the emergency situations transmitted from vehicle section Module. In addition to this, the station keeps record of security issues and traffic congestion conditions and directs the driver to alert the route if desired.

BASE Station Module is installed at train terminals from where the train will depart. It contains a LASER and a GSM modem connected to a PC. When the train enters the terminal pad, it is detected by the LASER sensor. The operator at the terminal enters the train number in the database. A count number is then accordingly assigned to the train e.g., train leaving the terminal first will be assigned a number 1. The route number of the train along with the direction information, assigned count number is sent to the BASE Station via GSM. An example of the transmitted header is of the form "56U01VSKP2705" where '56' is the train route number issued by Indian central Government, 'U' is up direction of the train ('D' will be down direction), '01' is the count number assigned to the train and 'VSKP2705' is the train number. An 'ON' signal is also transmitted to the vehicle section Module installed in the train for initialization.

B. Vehicle section Module

Vehicle section Module is installed inside every train and consists of a GPS receiver, a GSM modem, a NV-RAM, infrared object counting sensors, and an emergency button; all interfaced to AT89C52 microcontroller. After receiving the initialization signal form BASE Station Module, this module starts transmitting train location to the BASE Station.In case of an emergency situation (e.g., when fault occurs in the train), driver can press the emergency button to inform train and BASE Station units about the location of the train. The train station operator can then adjust the schedule accordingly and send an additional engine for break down process. Microcontroller present in this module continuously calculates the difference in consecutive GPS locations. If the difference remains near zero for more than a designated time, then a getting late message is transmitted to the train and BASE stations. In case of sparse GSM coverage, location information is stored in non-volatile RAM. After regaining the GSM network, previous locations are updated to the BASE station.

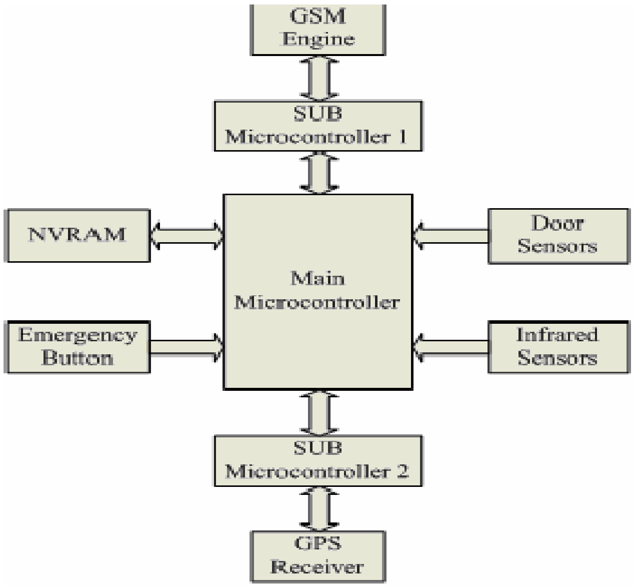

Fig. 2.Block Diagram of vehicle section Module

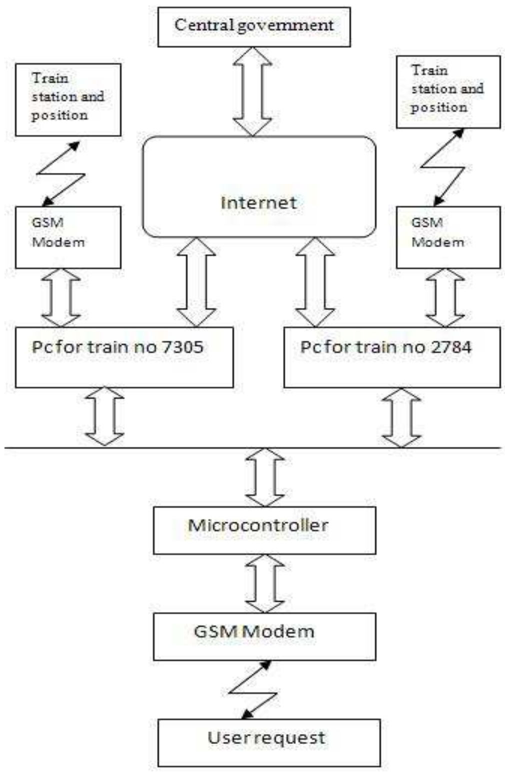

Fig. 3. Block Diagram of BASE Station Module

C. User mobile section Module

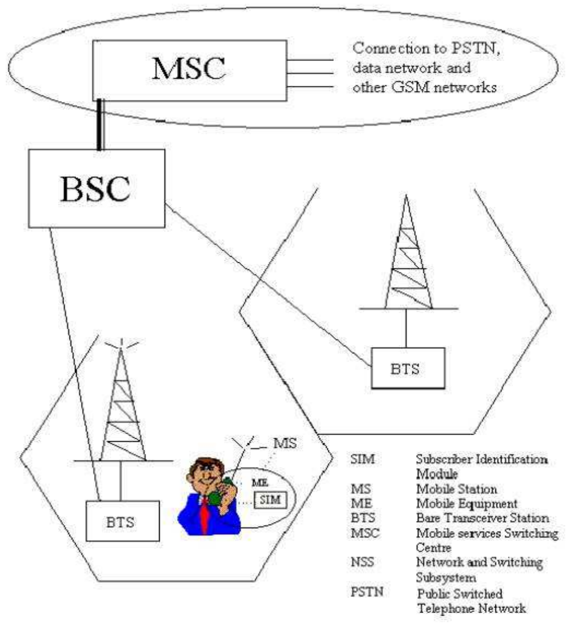

Fig.4. Block Diagram of User mobile section Module

IV. CONCLUSIONS

In this paper, design and development of a low cost transportation management system based on integration of GPS and GSM data is described. The system comprises 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 country. The service provides the user with current location information of desired trains based on which the user can adjust his schedule accordingly. The service therefore vanishes the need of waiting at the train stations thus saving a lot of time. For the passengers not utilizing the service, displays are installed at railway stations to let them know the trains location coming towards that junction. The system is also efficient in handling the emergency situations e.g., in case some kind of technical fault occurred in the train, the operator at the train terminal is informed and the departure time between the trains is reduced.

V. FUTURE WORK

The system can be made automatic by installing cameras at train junction terminals which can automatically read the train number of the trains passed by and thereby eliminating the operator. An automatic route guider display can be installed in the trains to better update the alternative route in case of serious rail route congestions. Fare collecting system can also be automated by providing another mobile service to which all the passengers using public railway transport are subscribed.

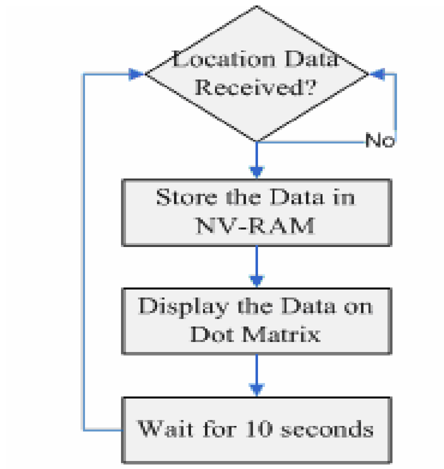

Fig. 5. Flow Chart of junction module

REFERENCES

[1] P & D Department Punjab and Dainichi Consultants Inc., “Urbantransport policy study for five cities of PunjabProvinc,” Nov 2008.

[2] Available [online]: www.garmin.com/products/gps35

[3] Available [online]: www.d-d-s.nl/fotos-nokia/n12i_datasheet_a4_v2.pdf

[4] Available [online]: www.alldatasheet.com

[5] M. A. Mazidi, J. C. Mazidi, R. D. Mckinaly, The 8051Microcontroller and Embedded Systems, PearsonEducation, 2006.

[6] Available [online]: www.mathworks.com