

Research Article

# Implementation of Bus Information Prediction System on Embedded Server

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## Abstract

*In the present scenario road transport services usually provide bus timetables on the board but these bus timetables only provide very limited information e.g., operating hours, time intervals, etc. which are typically not timely updated according to instant traffic conditions. For this reason in this paper we propose a system which tracks location information of buses to help in estimate the arrival time at various bus stops for the community. The complete system is divided into three sections: 1) Querying user 2) Backend server 3) Bus section. The project work is based on GSM, GPS, ARM processor and Wireless communication. Passenger can send his query to the ITS (Intelligent Transportation System) toll free number and can get the bus location, seat availability and can book seat through the SMS.*

**Keywords:** ARM processor, wireless communication, Intelligent Transportation System, GSM, GSPS

## 1. Introduction

Intelligent transportation system plays a very important role in a country economy. Public transportation is getting uneasy for the passengers. When traveling with buses, the travelers usually want to know the accurate arrival time of the bus. Excessively long waiting time at bus stops may drive away the anxious travelers and make them reluctant to take buses. Nowadays, most bus operating companies have been providing their timetables on the web freely available for the travelers. The bus timetables, however, only provide very limited information (e.g., operating hours, time intervals, etc.), which are typically not timely updated. Other than those official timetables, many public services (e.g., Google Maps) are provided for travelers. Although such services offer useful information, they are far from satisfactory to the bus travelers. For example, the schedule of a bus may be delayed due to many unpredictable factors (e.g., traffic conditions, harsh weather situation, etc). The accurate arrival time of next bus will allow travelers to take alternative transport choices instead, and thus mitigate their anxiety and improve their experience. Towards this aim, many commercial bus information providers offer the real time bus arrival time to the public. Providing such services, however, usually requires the cooperation of the bus operating companies (e.g., installing special location tracking devices on the buses), and incurs substantial cost.

In this proposed work, to know the status of the required bus the querying passenger will be interacting with the backend server which tracks the particular bus within the city by its GPS coordinates, to achieve this Bus unit is equipped with onboard GPRS configuration. Furthermore with the on board capacitive seat sensors bus unit can also pass the information about seat vacancy.

If the passenger needs to book a seat in bus, he just have to send the seat registration request. So that, querying passenger will get an OTP Once the querying user OTP is confirmed on the bus it shows, the seat accessing permission in bus display.

### Architecture

This system comprises three major components: (1) GPS (placed inside the bus) (2) Backend server; (3) Querying user. Backend server collecting the instantly reported information from the GPS, and intellectually processing such information to the backend server to the querying user.

## 2. Design and Implementation

**Server:** Since our proposed work is a prototype system, we develop it on VB server which works on WINDOWS7 OS. The mathematical analysis to forecast the capacity and prediction needed. The computation overhead of backend server is mainly bounded by the bus GPS classification data.

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Kit Placed Inside the Bus

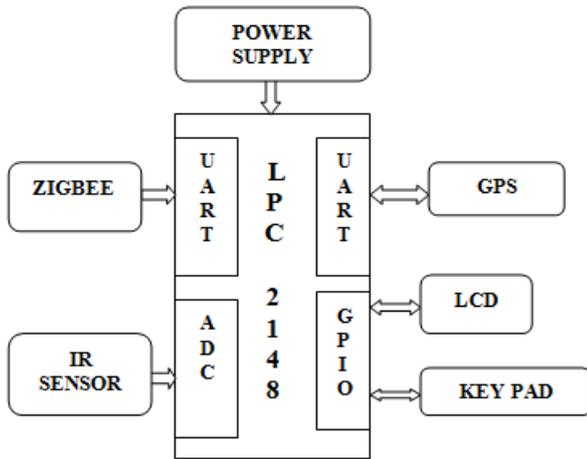


Fig: 1 BUS Section

Backend server

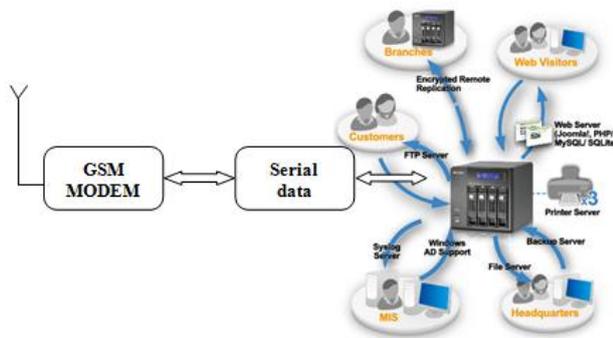


Fig 2: Server Section

Querying user



Fig 3: Querying Section

**Bus Section:** Here the Bus section is based on ARM7 TDMIS based LPC2148 microcontroller, this system is used to measure the seat available or not, booking, rejection, and client authorization with one time password.

**Mobile Client:** Here a user or client sends a request message to the server, where server responds with the bus position and number of free seats if available. Furthermore the user gets a OTP password for booking and conforming his/her trip when they enter inside the bus. In this proposal, three segments are implemented. The first segment is the users who request the information of the bus. The second segment is a device fitted in the bus, which provides real time updates about the location and the travel of the bus. The third segment is a backend server, that interacts with the device in the bus and gathers the location of the bus and when required gives this information to the user. The Information is not just about the number of a bus or the route of the bus, but more detailed information in terms of the current location of the bus and also the expected arrival time of the bus. In addition to this the seat availability in the bus will also be included. The project will implement a query responses structure, where in even a user who does not know anything about the place and just knows his starting and destination will be able to make use of the system. The device in the bus could be made to do dual function of ticketing as well as communicating with the server. There by the device already know the ticket status and the seat availability status in the bus. This device will be the replacement to the device used by the conductors for generating the tickets in the buses. In this manner the user knows the number of buses for a particular direction or route which is provided by the server based on the request.

3. Hardware

LPC2148 Processor

LPC2148 Microcontroller Architecture. The ARM7TDMI-S is a general purpose 32-bit microprocessor, which offers high performance and very low power consumption. The ARM architecture is based on Reduced Instruction Set Computer (RISC) principles, and the instruction set and related decode mechanism are much simpler than those of micro programmed Complex Instruction Set Computers (CISC). This simplicity results in a high instruction throughput and impressive real-time interrupt response from a small and cost-effective processor core. Pipeline techniques are employed so that all parts of the processing and memory systems can operate continuously. Typically, while one instruction is being executed, its successor is being decoded, and a third instruction is being fetched from memory. The ARM7TDMI-S processor also employs a unique architectural strategy known as Thumb, which makes it ideally suited to high-volume applications with

memory restrictions, or applications where code density is an issue. The key idea behind Thumb is that of a super-reduced instruction set. Essentially, the ARM7TDMI-S processor has two instruction sets:

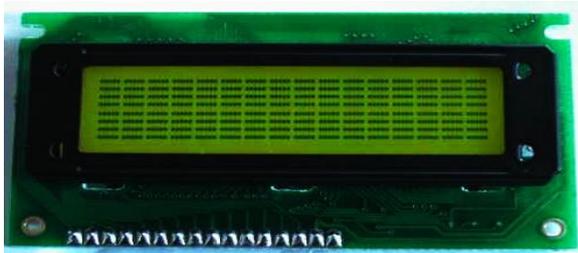
- The standard 32-bit ARM set.
- A 16-bit Thumb set.

#### Interrupt controller

The Vectored Interrupt Controller (VIC) accepts all of the interrupt request inputs from the User section and categorizes them as Fast Interrupt Request (FIQ), vectored Interrupt Request (IRQ), and non-vectored IRQ as defined by programmable settings.

#### LCD display

Liquid crystal displays (LCDs) have materials which combine the properties of both liquids and crystals. Rather than having a melting point, they have a temperature range within which the molecules are almost as mobile as they would be in a liquid, but are grouped together in an ordered form similar to a crystal.



**Fig4:** LCD display

#### GSM Module

A GSM modem is a wireless modem that works with a GSM wireless network. Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 mhz. GSM modems support an extended set of AT commands. These extended AT commands are defined in the GSM standards.

#### Sending the message

To send the SMS message, type the following command:

```
AT+CMGS=+31638740161<ENTER>
```

Replace the above phone number with your own cell phone number. The modem will respond with:

```
>
```

You can now type the message text and send the message using the <CTRL>-<Z> key combination:  
TEST GSM! <CTRL-Z>

Here CTRL-Z is keyword for sending an sms through the mobile device. After some seconds the modem will respond with the message ID of the message, indicating that the message was sent correctly:

```
+CMGS: 62
```



**Fig5:** GSM Module

For this project, GSM will acts as a bi directional communication between the Querying passenger, server and the Bus section.

#### GPS system

The Global Positioning System (GPS) comprises three segments: The space segment (all functional satellites). The control segment (all ground stations involved in the monitoring of the system master control station, Monitor stations, and ground control stations)The user segment (all civil and military GPS users).GPS Was developed by the U.S. Department of Defense (DOD) and can be used both by civilians and military Personnel.



**Fig 6:** GPS Module

The civil signal SPS (Standard Positioning Service) can be used freely by the general public, whilst the Military signal PPS (Precise Positioning Service) can only is used-This unit will receive all the coordinates needed from the GPS satellites and will update the Processor

memory buffer When the user sends a query to the server, server will get the location from the bus through the wireless communication.

*Zigbee*

The XBee/XBee-PRO RF Modules are designed to operate within the ZigBee protocol and support the unique needs of low-cost, low-power wireless sensor networks. The modules require minimal power and provide reliable delivery of data between remote devices. The modules operate within the ISM 2.4 GHz frequency band and are compatible with the following.

*Advanced Networking & Security*

- Point-to-point topology
- point-to-multipoint topology
- Self-routing, self-healing and fault-tolerant
- Mesh networking

*Low Power*

- TX Current: 295 mA
- RX Current: 45 mA
- Power-down Current: < 1  $\mu$ A

*RS232 Communication*

Information being transferred between data processing equipment and peripherals is in the form of digital data which is transmitted in either a serial or parallel mode. Parallel communications are used mainly for connections between test instruments or computers and printers, while serial is often used between computers and other peripherals. Serial transmission involves the sending of data one bit at a time, over a single communications line. In contrast, parallel communications require at least as many lines as there are bits in a word being transmitted (for an 8-bit word, minimum of 8 lines are needed). Serial transmission is beneficial for long distance communications, whereas parallel is designed for short distances or when very high transmission rates are required.

*IR sensor*

Infrared (IR) radiation is electromagnetic radiation of a wavelength longer than that of visible light, but shorter than that of microwaves. The name means below red (from the Latin infra, below), red being the color of visible light with the longest wavelength. Infrared radiation has wavelengths between about 750 nm and 1 mm, spanning five orders of magnitude. Humans at normal body temperature can radiate at a wavelength of 10 microns.

- transmitter: a blinking IR light
- receiver: a light dependent resistor

*Keypad*

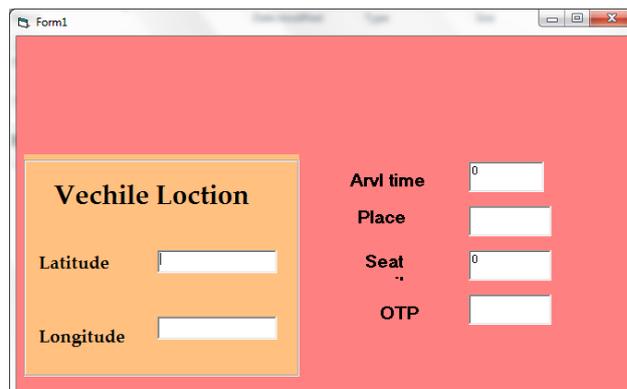
A keypad is a set of buttons arranged in a block or pad which usually bear digits, symbols and usually a complete set of alphabetical letters. If it mostly contains numbers then it can also be called a numeric keypad. Here we are using 4 X 3 matrix numeric keypad.

*Kile IDE*

This tool is used to develop the source code needed for the design. The tool helps us not only to develop but also compile the code and simulate the code. The keil tool is also used to convert the compiled Embedded C code to its equivalent hex code. In writing applications for a typical computer, the operating system handles memory on behalf of the programs, eliminating their need to know about the memory structure of the hardware. Even more important, most computers having a unified memory space, with the code and data sharing the same RAM. This is not true with the 8051, which has separate memory spaces for code, on-chip data, and external data. To accommodate for this when writing C code, Keil added extensions to variable declarations to specify which memory space the variable is allocated from, or points to.

*VB Platform*

In this system we are using a monitoring section to display the bus detail including the location of latitude , longitude, arrival time, seat availability. This output will be displayed on the monitoring screen using visual basic software. This will acts as the back ground server. When the Querying user send a request to get the bus location then this VB platform will send an interrupt request to the BUS unit to collect the location and will be returned back to the user .Now user can get the seat availability by send a request to the back ground server. This will increase the passenger interaction with the public transportation system.



**Fig 7:** Background server window

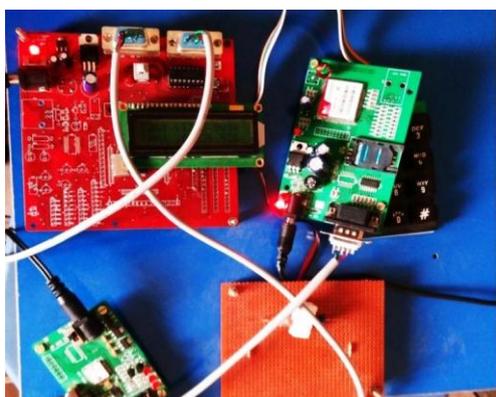
The seat availability will be cross checked by the Back ground server with the bus section and the seat will be

send to the passenger. If passenger confirmed to travel, then he/she can book the seat. For booking, passenger will receive an OTP. This OTP will be generated by the

VB platform and will be send to the query passenger. Which is typed on the keypad, If OTP is correct then LCD displays seat is provided otherwise seat is not booked for the passenger LCD displays invalid OTP.

#### 4. Experimental Results

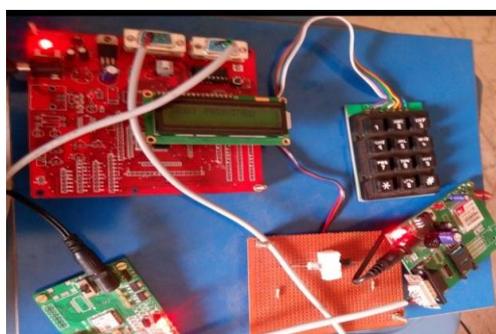
##### Project Kit Result



**Fig 8:** Hardware of Bus Section

GPS finds the location with the help of satellites, and displays the latitude and longitude in the LCD (Liquid crystal display).

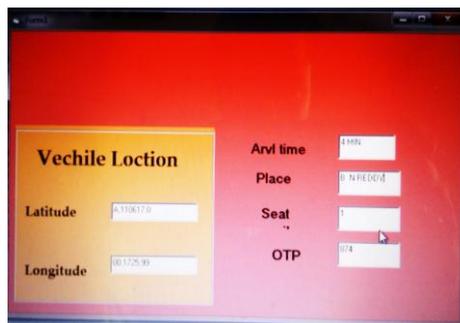
LCD displays OTP (one time password) it is send to querying user through GSM, which is typed on the keypad by the passenger. If one time password is correct booked for the passenger LCD displays invalid OTP.



**Fig 9:** Result displayed on LCD

##### Visual Basic Result

Visual basic (VB) software is used in my project as sever, which automatically update the information from bus kit i.e. latitude and longitude values (through GPS), seat availability from IR sensor. One time password (OTP) is also updated for every single use of booking the ticket.



**Fig 10:** Server Page Result

#### Conclusion

In order to improve the public transportation, we proposed this system which tracks bus information including the location of latitude and longitude, seat availability. The combination of wireless technologies will improves the efficiency of the project. Passenger can get the information from the standing place itself. The seat availability checking and the OTP based seat reservation in the bus improve the transportation of the country.

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