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IoT Based Public Bus Boarding Aid for the Visually Impaired

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***Abstract*—Public bus is an important mode of transport for the blind to travel independently. But they still feel challenged to board a public bus without the aid of another person. So this IoT based system aims at helping them to board the public bus independently without any assistance from other people. It helps the blind to select a specific bus via voice command and also to let them know via audio playback when the bus arrives. At the same time bus will be informed with the location of the blind person via GPS. The system consists of a client module and a bus module. The bus module consists of an ATMEGA-328P-PU microcontroller from Atmel combined with a GPS receiver and a GSM mobile network transceiver. All buses transmit their location information using this device to a server. A switch is provided for the driver to push when the bus arrives at the client's location to transmit the information as audio message to the client. The client module is made with BCM2837R1FBG microprocessor from Broadcom. This microprocessor runs a custom version of Linux which is programmed to receive voice commands from the blind person and make adequate action. D-Link DWP-157 is used to connect this microprocessor to the internet**

Keywords—Blind, ATMEGA-328-PU microcontroller, GPS receiver, GSM mobile network transceiver, BCM2837R1FBG microprocessor, D-Link DWP-157, Linux, IoT based system

I. INTRODUCTION

Public transport bus is very important for the visually impaired to travel independently because they cannot drive a vehicle on their own without sight. Also, for most of them, public bus is the only viable option to socialize, seek education, employment and leisure. But still, using a public bus does not offer complete independence to the visually impaired. They still have to depend upon others in boarding the correct bus which travels in the desired route. According to the World Health Organization (WHO), 285 million people are estimated to be visually impaired worldwide out of which 36 million are blind and 249 million have low vision. With 7.8 million blind people in India, the country accounts for 20% of the 36 million blind population across the globe. Hence, we needed to come up with a solution which will make the lives of the visually impaired more comfortable by introducing a system that helps them enjoy public transportation independently without relying on others.

In this paper, an Internet of Things (IoT) based public bus boarding aid is designed, which helps the visually impaired people to select a public bus of a certain type and which is in the route of their desired destination. This system also notifies the blind person when the bus arrives at the bus stop via audio playback. Also the driver of the bus will get the information on the number of the blind people waiting at the next bus stop with the help of GPS tracker. Several papers have been published and work has been done on this issue yet there are many demerits. Papers such as "Embedded Based Public Transit Aid System for the Visually Impaired"[2], "Bus Identification System for Visually Impaired Person"[3] has been referred for proper understanding of the working of various device which is designed till date for the visually impaired.

II. OVERVIEW

The proposed system consists of two modules – User module and Bus module. The user module consists of a BCM2837R1FBG microprocessor from Broadcom, Audio card, GPS module and GSM transmitter. The bus module consists of a GSM receiver, an ATMEGA-328P-PU microcontroller, a 16x2 LCD display, push button and a GPS module. With the user module, the blind person inputs his desired destination via voice command. This is achieved using an Android phone via Google speech recognition. This speech is processed using the Linux based BCM2837R1FBG microprocessor. Then the person gets to choose the type of bus they desire to board. This information gets stored in a server via GSM module. After this, the bus module of the bus which is travelling in the route of the desired destination of the client and also which is the desired type of bus, receives the message from the server via GSM module and it is processed with the help of ATMEGA-328-PU microcontroller and lets the driver know the number of clients waiting in the next stop through an LCD display. And after reaching the bus where the client is waiting, the driver pushes the push button in the bus module to let the client know that the bus has arrived via audio playback.

III. System Architecture

A. Block Diagram

Fig. 1. *Block Diagram of the user module*

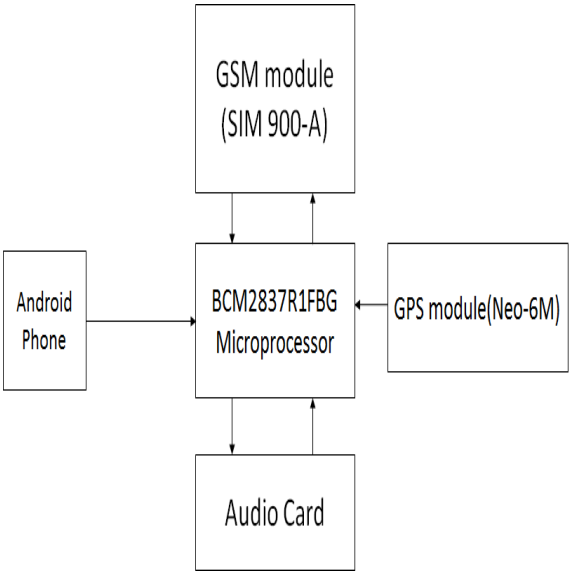
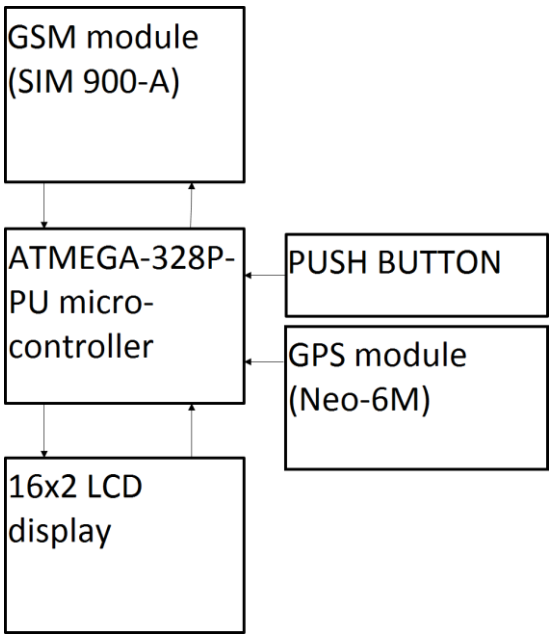


Fig. 2. *Block diagram of the Bus module*



The various blocks are explained below:

A) GSM module:
The GSM module used here is SIM 900A. It is an ultra-compact and reliable wireless module. The SIM900A is a complete Dual-band GSM/GPRS solution in a SMT module which can be embedded in the customer applications. Featuring an industry-standard interface, the SIM900A delivers GSM/GPRS 900/1800MHz performance for voice, SMS, Data, and Fax in a small form factor and with low power consumption. With a tiny configuration of 24mmx24mmx3mm, SIM900A can fit in almost all the space requirements in user applications, especially for slim and compact demand of design.

B) BCM2837R1FBG Microprocessor:
It is an ARM based, 64-bit, ARM cortex quad core microprocessor with a clock speed of 1.2GHz.

C) GPS Module:
The NEO-6 module series is a family of standalone GPS receivers featuring the high performance u-blox 6 positioning engine. These flexible and cost effective receivers offer numerous connectivity options in a miniature 16 x 12.2 x 2.4 mm package. Their compact architecture and power and memory options make NEO-6 modules ideal for battery

operated mobile devices with very strict cost and space constraints.

D) Audio Card:

An audio card is an internal expansion card that provides input and output of audio signals to and from a computer under control of computer programs.

E) ATMEGA-328P-PU Microcontroller:

It is a single-chip microcontroller created by Atmel in the megaAVR family. The Atmel 8-bit AVR RISC-based microcontroller combines 32 kB ISP flash memory with read-while-write capabilities, 1 kB EEPROM, 2 kB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz.

F) 16x2 LCD display:

A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. These modules are preferred over seven segments and other multi segment LEDs. The reasons being: LCDs are economical; easily programmable; have no limitation of displaying special & even custom characters (unlike in seven segments), animations and so on. A 16x2 LCD means it can display 16 characters per line and there are 2 such lines. In this LCD each character is displayed in 5x7 pixel matrix. This LCD has two registers, namely, Command and Data. The command register stores the command instructions given to the LCD. A command is an instruction given to LCD to do a predefined task like initializing it, clearing its screen, setting the cursor position, controlling display etc. The data register stores the data to be displayed on the LCD. The data is the ASCII value of the character to be displayed on the LCD.

IV. WORKING AND EXECUTION

A. PHASE I: BUS SELECTION

First, the user says the name of the desired destination as a voice command to an Android phone. The voice segment is converted into text with the help of Google Speech API. This text is sent by the Android phone to a web based server and from there to the BCM2837R1FBG microprocessor, where it is processed. Then the processer checks whether a meaningful data is received. Else an error message will be sent to the user via audio playback and the user will be prompted to say the name of the destination again. When the meaningful data is received by the processor, it is sent to a Linux server. In the Linux server, the list of different types of buses available for the route of that particular destination is available. The user will be prompted to choose the type of bus. After the user selects a particular bus, the message is sent to the web server via internet and from there, to the bus module of the particular bus. Also, with the help of the GPS module, the data regarding the current location of the client is also transmitted to the bus module through the server.

B. PHASE II: CLIENT LOCATION

The bus module receives the message sent from the server via GSM module along with location of the bus stop where the client is waiting. The received data is processed to get a display on the 16x2 LCD screen. This display shows the number of such blind people waiting at the upcoming bus stop. When the bus reaches the stop where the client is waiting, the driver pushes a push button provided in the bus module to let the client know via audio playback from the server that the bus has arrived at the bus stop. Also, when the button is pushed, the LCD display shows the details of the next stop.

V. CONCLUSION

There are nearly 285 million blind people in the world which is a huge segment of society. The main aim of this project is helping blind people to get familiar with technology in order to become more independent on their daily life is a necessity that everyone should be aware of. This new proposed prototype has many advantages which make it a good alternative to the current approaches since the cost, power consumption and space requirement is less, but giving high performance. This system can also be provided with additional features like tracking the whereabouts of the blind person via GPS by close relatives. And it has really good future scope for further development.

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