Navigation of Blind People Using Passenger Bus Alert System

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Abstract-The major challenge to any visually impaired person is to identify and avoid obstacles and to adapt themselves to the surrounding environment. Some of the conventional methods used by the visually impaired/challenged people to reach their destination are talking sign, guide cans, echolocations etc. In this paper, we have discussed some of the existing systems in this domain and we have proposed a novel idea that can be implemented with the help of wireless sensor networks (WSN) for easy navigation of visually impaired through public transport. According to the proposed idea, an RF unit is placed at the bus stop where the visually impaired are waiting and this unit is recognized by another unit in the bus. By using an RFID tag the visually impaired will give the input about his/her presence at the bus stop. The signals are generated by ARM-7 and these signals are sent by the ARM controller to the bus via RF module. A voice synthesizer APR9600 is used to convert the bus routes into an audio output. The visually impaired are alerted using a buzzer which will be turned ON as soon as the bus enter the bus stop. According to the wish of the visually impaired individual to aboard a specific route bus, this is notified to him/her with the help of voice synthesizer system. The bus routes from the bus are sent through the RF transceiver to the transceiver with the visually impaired and the announcement about the bus routes are made through the speaker to the visually impaired individual. The secondary aim of the project is to help senior citizen & illiterate people for independent navigation through public transport.

Index Terms- WSN, ARM7, AVR16, RFID, RF Module.

I. INTRODUCTION

In any unknown environment, navigation and orientation are traditional challenges. Orientation can be defined as feasibility of locating specific targets and of building routes to them. This indicates an ability to develop and to maintain an awareness of one's position in space with respect to landmark in the surrounding environment and with respect to particular destination. Navigation will extend the orientation problems by the obstacle identification and avoidance.

The knowledge of obstacles is taken in consideration for constructing new routes and planning [4]. The two components in human way finding are: environment detection and avoidance of obstacles [5]. There are various means of transportation like the bus, the metros, the tramways and many other public transportation, the normal people faces many day to day problem in public transportation then a huge question in case of visually impaired/challenged. According to the survey carried out by WHO, it estimated that there were 285 million people visually impaired; out of which 39 million are blind. The challenges faced by the blind are truly complex and troublesome especially when they need to navigate through public transportation system. Reading traffic signal and street signs is an impossible task for any visually impaired [10]. There are various organization like helping hands that have come forward to help the visually impaired community. It provided an important form of assistance through a mobility instructor. When a blind person is new to an area, it is important that they are shown how to get around by a trained and knowledgeable instructor.

II. RELATED WORK

Some of traditional means like long cane is used by the blind community as a primary mode of identifying obstacles, further the long cane with electronic travel aids such as laser cane and ultrasonic obstacle avoiders were also used. Although even with this device the visually impaired has the lack of freedom to travel without assistance and for efficient navigation through unfamiliar environment relies on information that goes beyond the sensing range of this devices. The visually impaired might also use guide dogs (GBD). It was established in mid-90 in response to need of service dogs to help wounded servicemen that went blind during WWII [2]. As this all assistance mode for visually impaired had some limitation, so the GPS enable mobility system which were used to reach specific destination were important to traveler as well as the visually impaired also. Although it provide an indication about orientation it still possess many disadvantages like unfavorable weather and skyscraper can both interfere with the signal reception, Another disadvantage it is works on battery power, as using a battery make the GPS portable the battery can fail without any warning. The biggest drawback of the GPS based navigation system is it cannot alert the visually impaired about a drop-off on the sidewalk or a rise in elevation of the ground.so the visually impaired pedestrian cannot use the GPS based system to identity ordinary obstacles that may be ahead or decide whether it is safe to cross the street or not and another major drawback is that the GPS system is not reliable in several parts of the world where the blind as to travel. The solution to the GPS problem is a navigation system for visually impaired based on ZIGBEE. The ZigBee based navigation system has many advantages like the range of ZigBee based navigation system is 300-400 meter. In real case scenario, it will add an benefit to the project based on ZigBee technology as the bus could be stopped at any location where the visually impaired has to aboard but if the other point of view is taken into consideration it will be very difficult to manage because of some obvious reasons. The

visually impaired has to carry a ZigBee mobile unit in this system, as this unit has certain physical dimension and weight which make this unit difficult and troublesome to carry for visually impaired. As in this system a microphone/earphone is required to be carried by the visually impaired which provides details of routes, bus number and location but this may lead to hearing impaired(ear damage) of the visually impaired.

In India, Pune was the first city to experiment with Bus Rapid Transit System. PMPML started playing pilot routes in December 2006. Rainbow BRT is new BRT system now operational in Pune and Pimpri-Chinchwad. It consists of features like tickets at bus stops, level boarding, automatic doors, security and traffic management and information on bus arrivals is displayed on screens at the bus stops. Display screens and audio announcements in buses give information about the next stop. But there is no any alert system for blind persons [11].

The ZigBee based navigation system has many advantages like the range of ZigBee based navigation system is 300-400 meter. In real case scenario, it will add an benefit to the project based on ZigBee technology as the bus could be stopped at any location where the visually impaired has to aboard but if the other point of view is taken into consideration it will be very difficult to manage because of some obvious reasons [1]. The visually impaired has to carry a ZigBee mobile unit in this system, as this unit has certain physical dimension and weight which make this unit difficult and troublesome to carry for visually impaired [2]. As in this system a microphone/earphone is required to be carried by the visually impaired which provides details of routes, bus number and location but this may lead to hearing impaired(ear damage) of the visually impaired.

To overcome the drawbacks of conventional and existing navigation system for visually impaired for public transport, we a have proposed a system based on RF module. According to the project idea proposed by us, the visually impaired at the bus stop are provided with a RF unit which is identified by the RF in the bus. Implementing a Radio Frequency Identification (RFID) tags is a new means of giving information about the location to the users particularly visually impaired. This RFID tags can be embedded anywhere without any energy source due to its passive communication circuit [6]. The tags store information about the location and provide it to any reader that is with a radius of about 10-15 meters for UHF RFID system. RFID has an advantage as it is cost effective and feasible but it is more suitable for indoor communication. When the blind reaches the bus stop, input is given about his/her presence at the bus stop using a RFID tag. The RFID reader circuit is accompanied by ARM-7 which will generate the signals and send it to the ARM controller in the bus via a RF module. When the bus reaches the bus stop, the LED is turned ON in the bus indicating there is blind person at the bus stop and the buzzer will turn ON at the bus stop to alerting the blind person that the bus as entered the bus stop. The bus driver specifies the bus route using switches which is informed to the bus stop unit using RF transceiver. The voice synthesizer will convert the bus route into audio output. The blind get the notification about the bus he/she want to aboard with the aid of voice synthesizer. The transceiver with the blind will receive the bus routes send to it by the RF transceiver in the bus and the bus routes are announced to the blind through a speaker. This system overcomes all the drawbacks of existing system and it has added many advantages like switching facility for notifying the routes, cost effective, convenient to the visually impaired. And the purpose of the project proposed to reduce the difficulties faced by visually impaired is fulfilled.

III. BLOCK DAIGRAM AND CIRCUIT SCHEMATIC

A. BLOCK DAIGRAM

1. BUS STOP UNIT

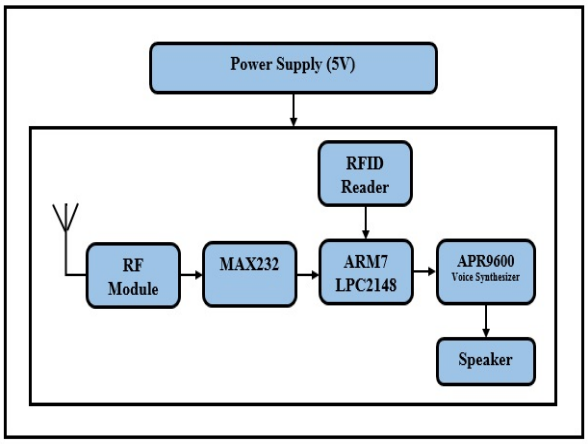

Figure 1: Functional Block Diagram of Bus Stop Unit.

2. BUS UNIT

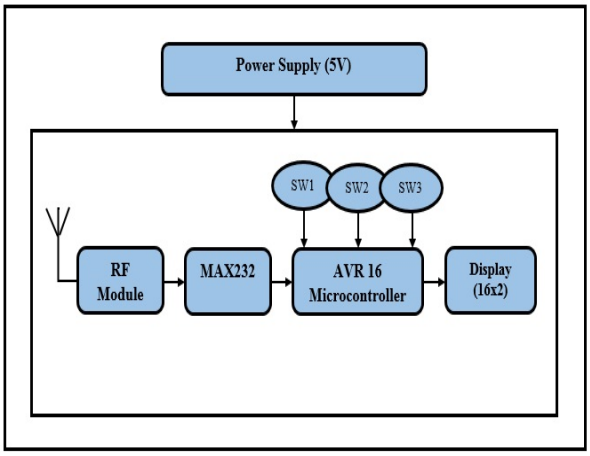

Figure 2: Functional Block Diagram of Bus Unit.

B. CIRCUIT SCHEMATIC

1. BUS STOP UNIT

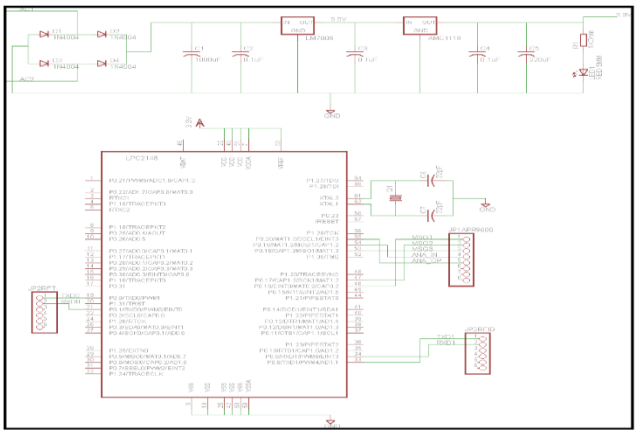

Figure 3: Circuit Schematic of Bus Stop Unit.

2. BUS UNIT

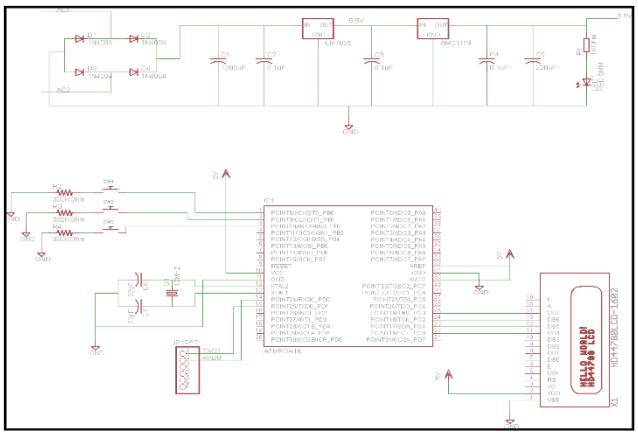

Figure 4: Circuit Schematic of Bus Unit.

IV. WORKING PRINCIPLE

When the blind person is at the bus stop, he/she gives the notification about their presence at the bus stop through a RFID tag. A RF unit is stationary at the bus stop and this unit is recognized by the RF unit in the bus which is mobile. The reader circuit detects the RFID tags possessed by the blind person. The ARM-7 is accompanied with a RFID reader circuit which initiates the signals. The signals are further transmitted via RF module to the bus unit by ARM microcontroller. The blind person is alerted about the bus entering the bus stop through a buzzer turning on as soon the bus is within the RF range. When the bus enters the bus stop, the LED in the bus is turned ON giving the notification about the presence of blind person at the bus stop. The switches are utilized by the bus driver to notify the bus routes and these routes are provided to the bus stop unit via a RF transceiver. These bus routes are converted into audio signals using a voice synthesizer (APR9600).The required bus that the blind want to aboard is notified to him/her with the aid of voice synthesizer and speaker system. The RF transceiver in the bus transmits the bus route to the RF transceiver at the bus stop, then the bus routes will be announced with the help of the speaker and blind person will decide whether to aboard the bus according to his/her required route to be travel.

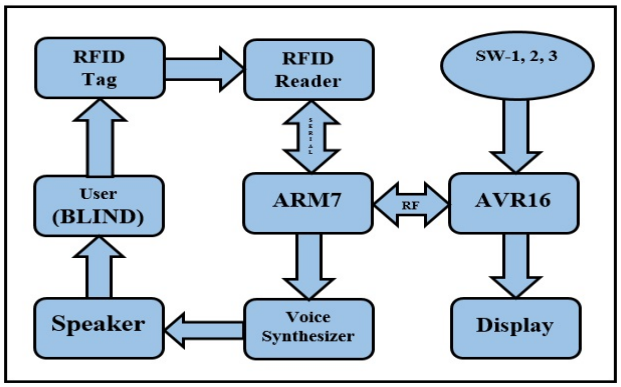

Figure 5: Complete Proposed System.

V. VOICE SYNTHESIZER (APR9600)

Reproduction of voice signal can be achieved in their natural form by using APR9600. The introduction of distortion due to requirement of encoding and compression can be eliminated by using a voice synthesizer. The internal architecture of the device can be explained by considering the block diagram of APR9600. The analog inputs are provided on the left hand side of the IC.A integrated AGC accompanied with a differential microphone amplifier is provided on-chip for various application. By connecting pin ANA_OUT to pin ANA_IN via an external DC blocking capacitor, the signals are fed into the device by the amplified microphone. For playback a connection between the ANA_IN and ANA_OUT is needed, the ANA_IN pin can be used to provide the recording through a DC blocking capacitor. The input signals are fed into an internal anti-aliasing filter, to satisfy the Shannon's sampling theorem for a particular sampling frequency the filter response is automatically modified. The signals are fed into the memory array. A combination of the Sample and Hold circuit and the Analog Write/Read circuit is used to achieve this storage. An internal oscillator or an external oscillator is used to clock the circuit. The prior stored recording can be recovered from the memory, low pass filter and it is amplified according to the desired playback. The speaker is connected to SP+ and SP- pins, so that the signals can be heard. The message control block can be control the message management.

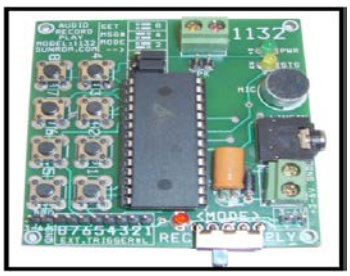

Figure 6: Audio Record and Playback Module.

VI. ARM7 PROCESSOR LPC2148

The LPC2148 is a 32-bit microprocessor, with outstanding features very less power consumption and greater performance. Reduced Instruction Set Computer (RISC) principle is used in ARM architecture because of advantage like the instruction set and the related decode mechanism is less complex as compare to the microprocessor working on Complex Instruction Set Computers (CISC).Because of the RISC architecture implemented in ARM, it results in high instruction throughput and impressive real-time interrupt response. The continuous operation of all the part of processing and memory system can be accomplished with the aid of pipeline technique, because of which if one instruction is being executed, the instruction following it will be decoded, while the third instruction is fetched from the memory. An outstanding architectural strategy known as Thumb is practiced by the ARM7TDMI-S, which is ideally appropriate for high-volume application with various memory restrictions where major issue is code density .The super-reduced instruction set is a key idea behind using Thumb instruction. There are two instruction set in ARM7TDMI-S: a 32-bit ARM set, 16-bit Thumb set. In comparison with other microcontrollers like 8051, PIC18, the ARM processor LPC2148 is mainly used because it consists of two UART's, out of which one is used for RFID reader circuit and another one for RF module.

VII. MICROCONTROLLER (AVR16)

ATmega16 is an 8-bit AVR microcontroller having high performance and low power consumption. It consists of enhanced RISC architecture with 131 powerful instructions. ATmega16 has maximum working frequency up to 16MHZ and instructions are executed in one machine cycle. Execution of instructions in single clock cycle yields throughputs of 1 MIPS per MHZ. As a result it achieves throughput 10 times faster than any conventional CISC controller. ATmega16 is a 40 pin package with four ports and various in built peripherals like JTAG, SPI, USART, DAC and ADC. In comparison with microcontrollers like 8051 and PIC18, it provides low power platform, high coding efficiency and less expenditure.

VIII. RF MODULES

An RF module (CC2500) is truly a single chip transceiver; basically it is a FSK transceiver module. It has a 3 wire digital serial interface and a Phase-Locked Loop (PLL) can be used for frequency setting through a local oscillator generation. The RF module (CC2500) can implement UART/NRZ/Manchester encoding or decoding. Along with an onboard antenna it gives a range of 30 meters. In any system, a microcontroller is accompanied with this transceiver. This RF module can be used in 2400-2483.5 MHz ISM/SRD band system. Because of this RF module, the designing of any product that requires a wireless connectivity is easy. It also has some application in wireless security system and other wireless system. It's one of the advantage is without the requirement of any external antenna its operating range is 30 meters.

Figure 7: RF Module.

IX. RFID READER AND RFID TAG

To read any passive RFID transponder tag which is in radius of 7cm, a Radio Frequency Identification (RFID) Card Readers can be utilized. The RFID card reader possess many advantages, so it has a wide variety of commercial application .The RFID tag is identified as soon as it comes within the range of RFID card reader and an output of a unique identification code of the tag is given. A microcontroller can be used to interfaces with the RFID reader, so that the data can be read. The RFID reader possess some outstanding features like 9600bps serial interface at 5V TTL level, 7cm range for 125KHz RFID cards. Each transponder tag contains a unique identifier (one of 240 possible combinations) that is identified by the RFID Reader and transmitted to the host via a simple serial interface. It means no two tags are same. Each tag has different value. This value is read by reader.

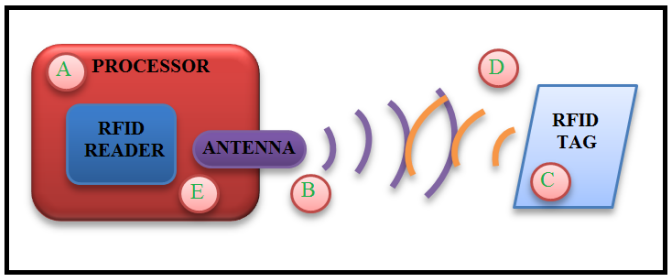

Figure 8: RFID Communication.

RFID communication is shown in above figure and explained as follows:

A) Processor controls RFID transmission and reception.
B) Antenna sends high frequency EM waves out.
C) RFID Tag converts EM waves into an electric current.
D) RFID Tag responds to its own unique radio waves.
E) RFID unit gets the Tag's wave, which is further processed to achieve information.

X. MAX232

The MAX232 is any integrated circuit that converts signal from the RS232 serial port to the signals that are appropriate for use in TTL compatible digital logic circuit. The Max232 is a dual driver/receiver that is it has two set of line drivers for transferring and receiving data that is TX and RX.

Figure 9: MAX232 Module.

XI. SPEAKER

A speaker is a transducer which will convert electrical signal into sound. The output provided by the voice synthesizer is fed to the speaker. The speaker will convert electrical signals provided by the voice synthesizer into sound, which can be used for notification at the bus stop.

Figure 10: Speaker.

XII. FLOWCHART

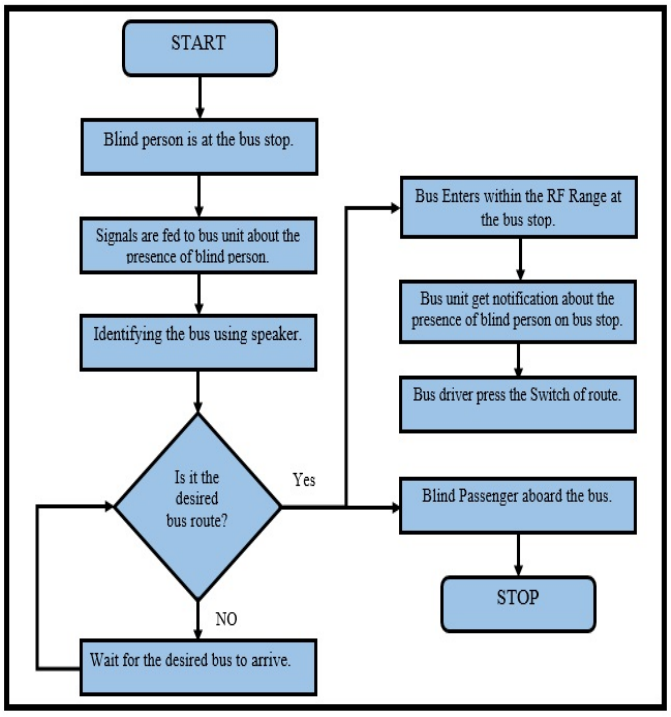

Figure 11: Flowchart of operation.

XIII. ADVANTAGES AND APPLICATIONS

A. ADVANTAGES

- The entire system is very cost effective.
- All the modules are very easy to handle.
- Convenient to the users.
- Low Power platform.

B. APPLICATIONS

- Easy navigation of blind.
- Independent navigation of senior citizen/illiterate people.
- Bus Rapid Transit System (BRT).
- Public transport system.

XIV. CONCLUSION

In the previous system, the blind person used to carry a bus stop unit but according to the system proposed, the bus stop unit is made stationary at the bus stop. The combination of a voice synthesizer and the speaker system will help the blind at the bus stop, to find his/her bus that passes through a required/desired route. As soon as the bus approaches the bus stop, the LED in the bus starts blinking indicating the presence of blind person at the bus stop. And simultaneously the buzzer will turn on at the bus stop alerting the blind person about the approaching bus at the bus stop. These two tasks are accomplished with the aid of a RF unit which is in the bus (mobile) and at the bus stop (stationary).Finally a speaker system is used to convey the information about the bus like bus name, bus route and number. The aim of the proposed system is to provide a helping hand to the visually impaired for convenient navigation is fulfilled.

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