International Journal of Scientific Research in Computer Science, Engineering and Information Technology
 | Volume 2 | Issue 2 | ISSN : 2456-3307

Voice Operated Outdoor Navigation System for Blind Persons

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ABSTRACT

The blind persons use several types to detect and avoid obstacles . Guide dogs, white canes is said to have limited aid for finding the way to a location. So the main objective is to create a portable, simple less costly system that will allow them to travel through unfamiliar environments without the aid of guides. Several guidance system has been developed for vision impaired people, but these are tends to be expensive also make the use of a client server approach. By the advancement in modern day ultrasonic sensor, pyroelectric sensor and ARM microcontroller technology, the proposed system aids in navigation via audible output, helping in localizing where they are and to improve their mobility. The audio output gives information on the navigation direction that makes use of GPS and alerts using various sensors. The aim of the project is to help the visually impaired to improve their communication and provides independency to them.

Keywords : ARM Processor, GPS, Blind, Voice assisted Navigation, Sensors.

I. INTRODUCTION

According to the recent survey, in worldwide India is now having 350 million people affected by visually impaired and 15 million of them are considered to be blind. About 87% of the visually impaired living in the developing countries [10]. Then over 15 million are from India. [2] So in India blindness is the biggest problem. The main causes of blindness are cataract, uncorrected refractive errors, glaucoma, and macular degeneration.

Due to the huge population there is a lot of traffic in the road and everyone in this world has no time even to talk with each other especially in metro cities. So the blind people or vision impaired person feels alone in this environment .It can be overcome by the advancement in the technology using sensing and recognizing it [3].People who have impaired vision regularly use white canes or guide dogs to assist in obstacle avoidance and have limited assistance. Guide dogs can also be of limited assistance for finding the way to a remote location. This devices is simple but it has only limited range and not suitable for dynamic obstacle detection. Several electronic devices are currently available for providing guidance to a remote location, but these tend to be expensive, or make use of a Braille interface. [4]. There is also Wearable navigation system for the blind that will help in mapping and tracking the position of the pedestrian during the travel through the unknown environment. Travelling through an unfamiliar environment becomes a real challenge so our goal is to create a portable, self-contained system that will help the visually impaired individuals to travel through familiar and unfamiliar environments without the assistance of any guides.

The Navigation system, NAVIG device is used to complement conventional mobility aids and also for adding unique features to localize specific objects in the environment, restore some motor abilities and assist navigation.[6]. The paper described here develops a way that Navigation system, that makes use of GPS (the Global Positioning System)[7], ultrasonic sensor for obstacle detection[8] and pyroelectric sensor[10]. The cost of GPS units is decreased, so it is coupled with the recent growth in the availability and presents an opportunity to create a low cost solution. A main function of this system is to provide the users navigational needs by low cost and portability. [5]

The system will provide user the information about the currently located location and directions as the voice output. The visually impaired has the disadvantage, that they don't get needed information for bypassing obstacles and hazards and have relatively little information about landmarks, heading that is essential to sighted individuals navigating through familiar environments who have good knowledge of these environments. The others navigate through unfamiliar environments on the basis of external maps and verbal directions. The GPS way finding systems are primarily suitable for outdoor environments because the receivers are is tunable to perform good in an indoor environment. The relative positioning indoors include sensors using sonar, digital tags and accelerometers for sensing the obstacles. Some of them make use of Braille keyboard but is not as efficient as many of them don't know to use it. To ensure that a navigation system will be easily accessible by the greatest proportion of vision impaired people. The key focus of the paper, is to direct the people. The GPS is a portable navigation system which uses the NMEA protocol to get the location. The voice is to be heard by the user is displayed in the LCD display device [9]. The directions can be outputted as voice information from the system. The voice playback and recorder module functions by recording the input data and it outputs the data through the play option through a headphone/ speaker.

Figure 1. Blind People

II. METHODS AND MATERIAL

A. Working and Block Diagram

The block diagram of main board is shown in fig.2. In this diagram using the 32-bit ARM processor (TM4C123GH6PM), this is the heart of this project. The (TM4C 123GH6PM) microcontrollers are based on a 32-bit ARM CORTEX M4F CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 256 Kb.A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. The power supply is given to the processor.

GPS receiver is used to get the current location in the form of longitude and latitude. GPS Receiver which is a low power, ultra-high performance, easy to use GPS receiver. Its low power consumption and high performance enables the adoption of AVL and other location based applications. It supports different electrical interfaces RS232 etc.GPS receiver supports NMEA0183 Protocol. The output of GPS receiver is given to the processor using UART interface and it is displayed in the LCD display.

In this system voice playback/voice recorder is used to use to store the location information and voice data. In this the voice can be recorded and then played when it is needed. It also contains erase, volume options in it. It is connected to processor by SPI (Serial Peripheral Interface). The other important parts of the system are joystick, ultrasonic sensor, magnetometer and pyroelectric sensor. Joystick is used for direction selection (i.e. north, south, east & west. Ultrasonic sensor is used for obstacle detection which gives an alert when obstacle is detected. It is connected to a processor by Parallel port interface. Pyroelectric sensor is used to detect the presence of living being, on identifying it gives a voice input as living body. It is interfaced to a processor by ADC Interface. In this system output is in the form of voice so we are using audio amplifier & speaker/headphone. Audio amplifier is used to amplify the voice signal stored in the voice IC so that it is properly hearable. This amplified voice is then heard by using speaker or headphone. The LED is connected to indicate the working.

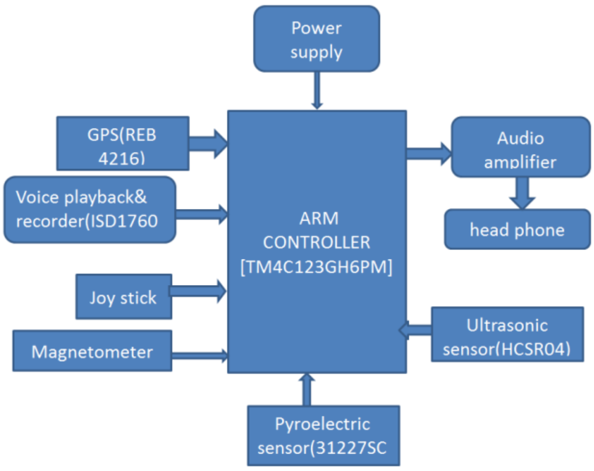

Figure 2. Block Diagram

B. **Hardware Description**

1. Microcontroller

The TM4C123GH6PM microcontroller package contains 64-pin LQFP combines complex integration and high performance with core which is ARM Cortex-M4F processor. Its performance is 80MHz operation and 100 DMIPS performance. It has a flash memory of 256KB single-cycle. It has system SRAM of 32KB single-cycle. It has EEPROM of 2KB.The communication interfaces in microcontroller are eight UART's, four SSI modules, four I2C ,two CAN2.0 A/B controllers, and USB 2.0 OTG/Host/Device. The system has Micro Direct Memory Access, General-purpose Timer, Watchdog Timer, and Hibernation module, General-Purpose Input / Output. The advanced motion controls are PWM, Quadrature Encoder Interface. It also has analog support of ADC, Analog Comparator Controller. Digital Comparator, JTAG and Serial Wire Debug.[11].

2. AUDIO AMPLIFIER

The LM386 is a power amplifier which is used in low voltage consumer applications. The gain is internally set to 20 to keep external part count low, but the addition of an external resistor and capacitor between pins 1 and 8 will increase the gain to any value from 20 to 200. The inputs are ground referenced while the output automatically biases to one-half the supply voltage. The quiescent power drain is only 24 milli watts when operating from a 6 volt supply, making the LM386 ideal for battery operation.

3. GPS MODULE

RoyalTek REB-4216 is the GPS module of SiRFstar IV. The module is powered by latest SiRF Star IV GSD4e ROM chip and RoyalTek proprietary navigation technology that provides you with stable and accurate navigation data. The smallest form factor and miniature design is the best choice to be embedded in a device such as portable navigation device, personal locator, speed camera detector and vehicle locator. The Product Features are given below. It have 48 track verification channels and power supply 3.3V voltage. SMT type with stamp holes. The small form factor with embedded SiRF Star IV technology. It also removes in-band jammers upto 80 dB-Hz, track up to 8 CW jammers. It has an excellent sensitivity for urban canyon and foliage environments.

The technical specification of GPS Module is described below.It has an Impedance of 50Ω. It has an operating/Storage temperature of -40 ~ 85°c. The Humidity is less than or equal to 95%. The Position accuracy is within 10m for 90% (24hr static, -130dBm). The protocol is of default 9600bps they are GGA(1),GSA(1),GSV(5),RMC(1).

The software Interface uses NMEA Protocol. The NMEA Output Messages: the Engine board outputs the following messages as shown below,
GGA -Global positioning system fixed data
GSA -GNSS DOP and active satellites
GSV -GNSS satellites in view
RMC -Recommended minimum specific GNSS data
GLL -Geographic position – latitude/longitude
VTG -Course over ground and ground speed

The GGA-Global Positioning System Fixed Data contains the fixed data format as shown below,

$GPGGA, 161229.487, 3723.2475, N, 12158.3416, W, 1, 07, 1.0, 9.0, M, , , ,0000*17

Checksum	*18		
< CR > < LF >			End of message termination

GGA DATA FORMAT

NAME	Example	Units	Description
Message ID	$GPGGA		GGA protocol header
UTC Position	161229.5		hhmmss.sss
Latitude	3723.248		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.34		Dddmm.mmmm
E/W Indicator	W		E=east or W=west
Position Fix Indicator	1		

Satellites Used	7		Range 0 to 12
HDOP	1		Horizontal Dilution of Precision
MSL Altitude	9	meters	
Units	M	meters	
Geoid Separation		meters	
Units	M	meters	
Age of Diff. Corr.		second	Null fields when DGPS is not used
Diff. Ref. Station ID	0		

The GSA-GNSS DOP and Active Satellites

contains the values of the following example:
$GPGSA, A, 3, 07, 02, 26, 27, 09, 04, 15, , , , , , 1.8,1.0,1.5*33

Name	Example	Unit	Description
Message ID	$GPGSA		GSA protocol header
Mode 1	A		Automatic allowed
Mode 2	3		3D
ID of Satellite Used	7		Sv on Channel 1
ID of Satellite Used	2		Sv on Channel 2
ID of Satellite Used			Sv on Channel 12
PDOP	1.8		Position Dilution of Precision
HDOP	1		Horizontal Dilution of Precision
VDOP	1.5		Vertical Dilution of Precision
Checksum	*33		
<CR><LF>			End of message termination

The GLL-Geographic Position – Latitude/Longitude contains the values of the following example:

$GPGLL,2503.6319,N,12136.0099,E,053740.000,A,A*52

Name	Example	Units	Description
Message ID	$GPGSV		GSV protocol header
Total Number of Messages	2		Range 1 to 3
Messages Number	1		Range 1 to 3
Satellites in View	7		
Satellite ID	7		Channel 1(Range 1 to 32)
Elevation	79	Degrees	Channel 1(Range 00 to 90)
Azimuth	48	Degrees	Channel 1(True, Range 000 to 359)

SNR (C/No)	42	dBHz	Channel 1(Range 0 to 99, null when not tracking)
Satellite ID	27		Channel 4(Range 01 to 32)
Elevation	27	Degrees	Channel 4(Range 00 to 90)
Azimuth	138	Degrees	Channel 4(True, Range 000 to 359)
SNR (C/No)	42	dB-Hz	Channel 4(Range 00 to 99, null when not tracking)
Checksum	*71		
<CR> <LF>			End of message termination

Name	Example	Unit	Description
Message ID	$GPGLL		GLL protocol header
Latitude	#######		ddmm.mmmm
N/S indicator	N		N=north or S=south
Longitude	#######		Dddmm.mmmm
E/W indicator	E		E=east or W=west
UTC Time	53740		hhmmss.sss
Status	A		A=data valid or V=data not valid
Mode	A		A=autonomous, D=DGPS, E=DR
Checksum	*52		
<CR><LF>			End of message termination

GLL DATA FORMAT

The GSV-GNSS Satellites in View contains the values of the following example:

$GPGSV, 2, 1, 07, 07, 79, 048, 42, 02, 51, 062, 43, 26, 36, 256, 42, 27, 27, 138, 42*71

$GPGSV, 2, 2, 07, 09, 23, 313, 42, 04, 19, 159, 41, 15, 12, 041, 42*41

GSV DATA FORMAT

The RMC-Recommended Minimum Specific GNSS data contains the values of the following example:

$GPRMC, 161229.487, A, 3723.2475, N, 12158.3416, W, 0.13, 309.62, 120598, ,*10

Name	Example	Units	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	161229.47		hhmmss.sss
Status	A		A=data valid or V=data not valid
Latitude	3723.2475		ddmm.mmmm

N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Speed Over Ground	013	knots	True
Course Over Ground	309.62	degrees	
Date	120598		ddmmyy
Magnetic Variation		degrees	
Variation sense			E=east or W=west (Not
Mode	A		A=Autonomous, D=DGPS,
Checksum	*10		
<CR><LF>			End of message termination

RMC Data Format

The VTG-Course Over Ground and Ground Speed contains the values of the following example:

$GPVTG,79.65,T,,M,2.69,N,5.0,K,A*38

The data format of VTG is given below :

Name	Example	Unit	Description
Message ID	$GPVTG		VTG protocol header
Course over gound	79.65	Degre	Measured heading
Reference	T		True
Course over		Deg	Measured heading
Reference	M		Magnetic
Speed over ground	269	Knots	Measured speed
Units	N		Knots
Speed over ground	5	Km/hr	Measured speed
Units	K		Kilometer per hour
Mode	A		A-autonomous, D=DGPS, E=DR
Checksum	*38		
<CR><LF>			End of message termination

VTG Data Format

4. HC-SR04 Ultrasound Motion Sensor

The HCSR04 ultrasonic Motion sensor provides precise, non- contact distance measurements from about 2 cm - 400cm. It is very easy to connect to microcontrollers requiring only one I/O pin. The HCSR04 sensor works by transmitting an ultrasonic (well above human hearing range) burst and providing an output pulse that corresponds to the time required for the burst echo to return to the sensor. This module encloses ultrasonic Transmitters, receiver and control circuits. By measuring the echo pulse width, the distance to target can easily be calculated

5. Voice Playback and Recorder

This module is a single-chip single-message record/playback device. Recordings are stored into on-chip non-volatile memory, providing zero-power message storage. Time for recording is 8-20 seconds. Its power input is DC 2.4-5.5v.With the internal audio amplifier, this board can drive 8ohm,0.5w speaker directly. Microphone is present on this module. All the spins are extended with a connector, which can be powered and controlled.

6. Pyroelectric Sensor

This module is an infrared sensitive optoelectronic component which are specifically used for detecting electromagnetic radiation in the wavelength range from 2-14 um. It consists of a single crystalline lithium

Tantalite .It has extremely low temperature coefficient with a excellent long term stability of a single voltage.It has two slots in it each slot is made up of special material that is sensitive to IR

7.LCD(16x2)

LCD (Liquid Crystal Display) screen is an electronic display module and it is used in a wide range of applications. A 16x2 LCD display is very basic module and it is very commonly used in various devices and circuits for displaying. These modules are preferred over seven segments and other multi segment LEDs because they are economical; easily programmable; have no limitation of displaying special & even custom characters which is an drawback in seven segment. The command register stores the command instructions given.A instruction given to LCD is to do a predefined task like initializing it, clearing 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.

III. CONCLUSION

In this paper, the discussion is about that India is now having 1.22 billion blind people. So this project is to help the blind people with greatest possible accuracy and a low cost, user friendly system that which aid them without any guidance by others. In this project we use ARM processor which contains interfaces, memory and its operating speed is high. The GPS module is used for navigation which plays the main role for finding the current location. Also we use ultrasonic sensor, pyroelectric sensor for detection of obstacles and to identify the living body. The magnetometer is used to find the direction. The temperature is known using the internal temperature sensor present in the processor. In future it can be enhanced for providing end-to-end information on route from source and destination.

IV. REFERENCES

[1]. Katherine J. Kuchenbecker, "HALO: Haptic Alerts for Low-hanging Obstacles", White Cane Navigation Departmental Papers (MEAM), 2012.

[2]. Esteban Bayro Kaiser, Michael Lawo,"Wearable Navigation System for the Visually Impaired and Blind People", IEEE, 2012.

[3]. P.Jae-Han, B.Seung-Ho, B.Moon-Hong, "An intelligent navigation method for services robots in the Smart Environment," International Conference on Control, Automation and Systems, pp. 494, 2007.

[4]. 2009, Bruce Moulton, Gauri Pradhan, Zenon Chaczko," Voice Operated Guidance Systems for Vision Impaired People: Investigating a User-Centered Open Source Model", International Journal of Digital Content Technology and its Applications, Volume 3 Number 4, December :pp 60-68.

[5]. 1999, K.Magatani, K.Yanashima et al. "The Navigation System for the Visually Impaired",Proceedings of the First Joint BMES/EMBS Conference, 652 .

[6]. S. Kammouna, G. Parseihian, O. Gutierrez, "Navigation and space perception assistance for the visually impaired- The NAVIG project", IRBM Vol.33, 2012.

[7]. https://www.jiuzhouhx.com.cn/admin/fileadmin/upfile/pdf.ziliao/REB-4216pdf

[8]. https://www.micropik.com/PDF/HCSRO4.PDF

[9]. https://www.engineersgarage.com/electronic-components/16x2-lcd-module-datasheet

[10]. http://timesofindia.indiatimes.com/india/India-has-largest-blind population/articleshow/2447603.cms

[11]. https://mpja.com/download/31227sc.pdf

[12]. https://www.ti.com/lit/ds/spms376e/spms376e/pdf