# VOICE OPERATED OUTDOOR NAVIGATION SYSTEM FOR VISUALLY IMPAIRED PERSONS

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***Abstract*—**Blind **People uses white canes to** aid **in obstacle detection & avoidance. Guide dogs can also be of limited aid for finding the way to a remote location. So our goal is to create a portable, simple less costly system that will allow Blind peoples to travel through familiar and unfamiliar environments without the aid of guides. Several guidance system has been developed for vision impaired people, but these systems tends to be expensive, also make use of a client server approach. This Navigation system consists of two distinct components: sensing of the immediate environment for blind people to travel (e.g., obstacles and hazards) and navigating to remote destinations beyond the immediately perceptible environment. The paper described here focused on the development and evaluation of a Navigation system that makes use of GPS (the Global Positioning System), voice and ultrasonic sensor for obstacle detection.**

***Keywords*- GPS, Blind, Navigation,**
**ARM Processor, Impaired Vision, NMEA Protocol.**

## I. INTRODUCTION

According to survey done India is now home to the world's largest number of blind people. Of the 37 million people across the globe who are blind, over 15 million are from India.[5] So in India blindness is the biggest problem. The leading causes of blindness are cataract, uncorrected refractive errors, glaucoma, and macular degeneration.

India’s current population is 1.22 billion. Due to this huge population there is a lot of traffic in the road and in today’s world no one has time even to talk with each other especially in metro cities. So the blind people or vision impaired person feels alone in this environment. People who have impaired vision regularly use white canes and/or guide dogs to assist in obstacle avoidance. Guide dogs can also be of limited assistance for finding the way to a remote location, known as “way finding” So our goal is to create a portable, self-contained system that will allow visually impaired individuals to travel through familiar and unfamiliar environments without the assistance of guides. 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. [1]

The paper described here develops a way Navigation system that makes use of GPS (the Global Positioning System), voice and ultrasonic sensor for obstacle detection. The decreasing cost of GPS units, coupled with the recent growth in the availability of voice recognition services, presents an opportunity to create a low cost solution. A key priority of this system is to meet the users navigational needs while ensuring low cost and portability. [2]

The system can advise the user where he/she is currently located, and provide spoken directions to travel to a remote destination. The visually impaired are at a considerable disadvantage, for they often lack the needed information for bypassing obstacles and hazards and have relatively little information about landmarks, heading, and self velocity— information that is essential to sighted individuals navigating through familiar environments who have knowledge of these environments or who are navigating through unfamiliar environments on the basis of external maps and verbal directions. GPS way finding systems are primarily suitable for outdoor environments because the receivers are commonly unable to perform well in an indoor environment. Methods for relative positioning indoors include sensors using sonar, digital tags and accelerometers. Some of the current GPS systems make use of Braille keyboards for user input and/or system output. However, not all vision impaired people can read Braille.

To ensure that a navigation system will be accessible to the greatest proportion of vision impaired people, usability is a key focus of the project, and speech technology was identified as a priority feature of the system. Further, by replacing the Braille keyboard with a speech technology, the device will be more portable and less cumbersome to use while walking. Speech technology has been under development for more than three decades, and demand for this technology is expected to rise dramatically in the near future as people access the internet using mobile phones. Recent advances in speech recognition technology, coupled with the advent of modern operating systems and high powered affordable personal computers, have culminated in the first speech recognition systems that can be deployed on portable devices.[3],[4]

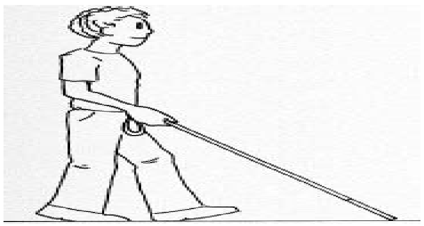


Figure-1 Blind People

## II. METHODOLOGY

The block diagram of main board is shown in fig.2. In this diagram using the 32-bit ARM processor (LPC2148), this is the heart of this project. The LPC2148 microcontrollers are based on a 16-bit/32-bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combine microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. A 128-bit wide memory interface and unique accelerator architecture enable 32-bit code execution at the maximum clock rate. For critical code size applications, the alternative 16-bit Thumb mode reduces code by more than 30 % with minimal performance penalty.

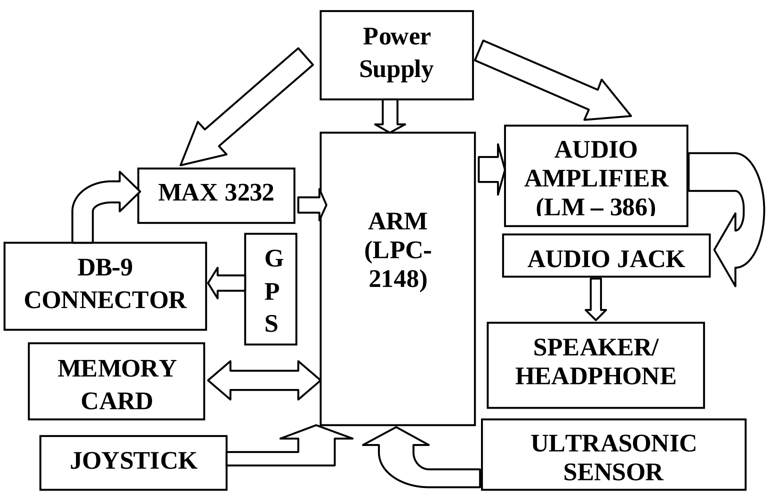


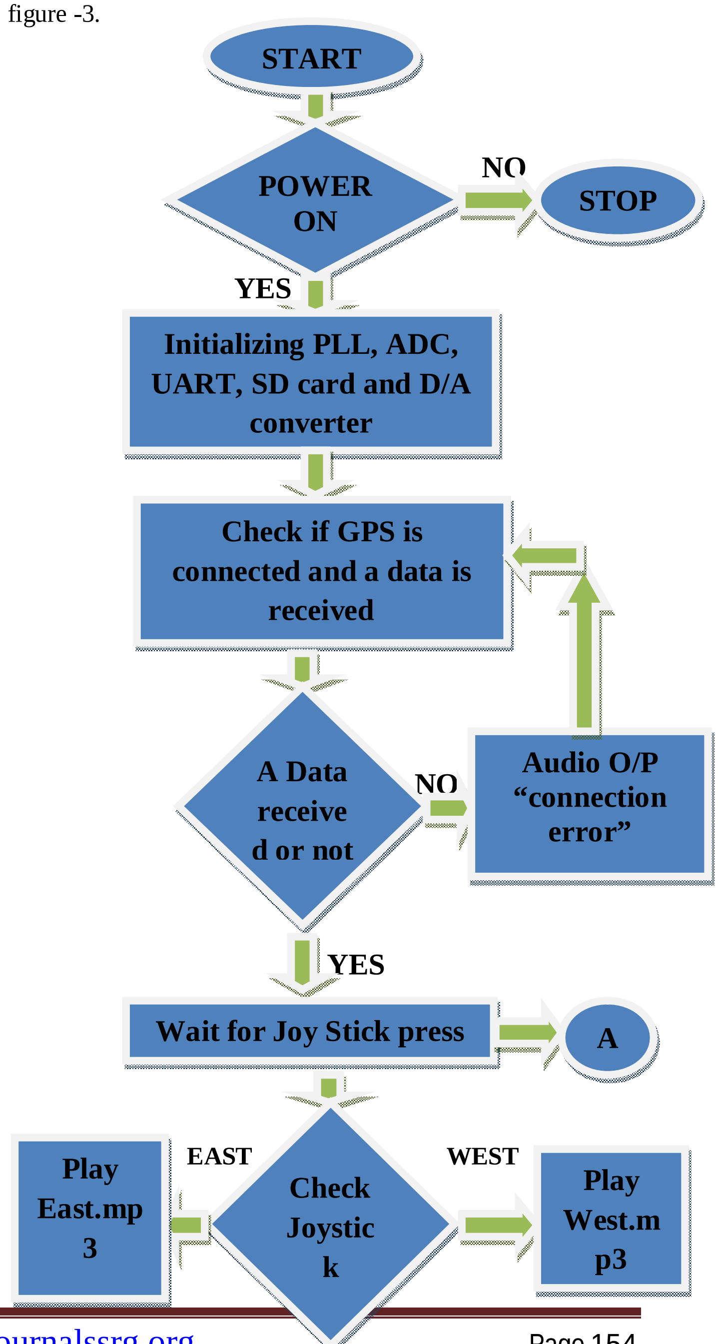

Figure -2 Block Diagram

GPS receiver is used to get the current location in the form of longitude and latitude. Here we are using SiRFstarIII GR-301 GPS Receiver which is a low-power, ultra-high performance, easy to use GPS receiver based on SiRF's latest third generation single chip. Its low power consumption and high performance enables the adoption of AVL and other location based applications. It supports different electrical interfaces such as USB, RS232, TTL etc. GPS receiver supports NMEA0183 Protocol. The output of GPS receiver is given to the processor using serial communication.

In this system memory card is used to use to store the location information and voice data. The other two important part of the system are joystick and ultrasonic sensor. Joystick is used for direction selection (i.e. north, south, east & west).ultrasonic sensor is used for obstacle detection. 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 memory card so that it is properly hearable. This amplified voice is then heard by using speaker or headphone.

## III.FLOW CHART

Flow diagram of the whole system is shown in the figure -3.



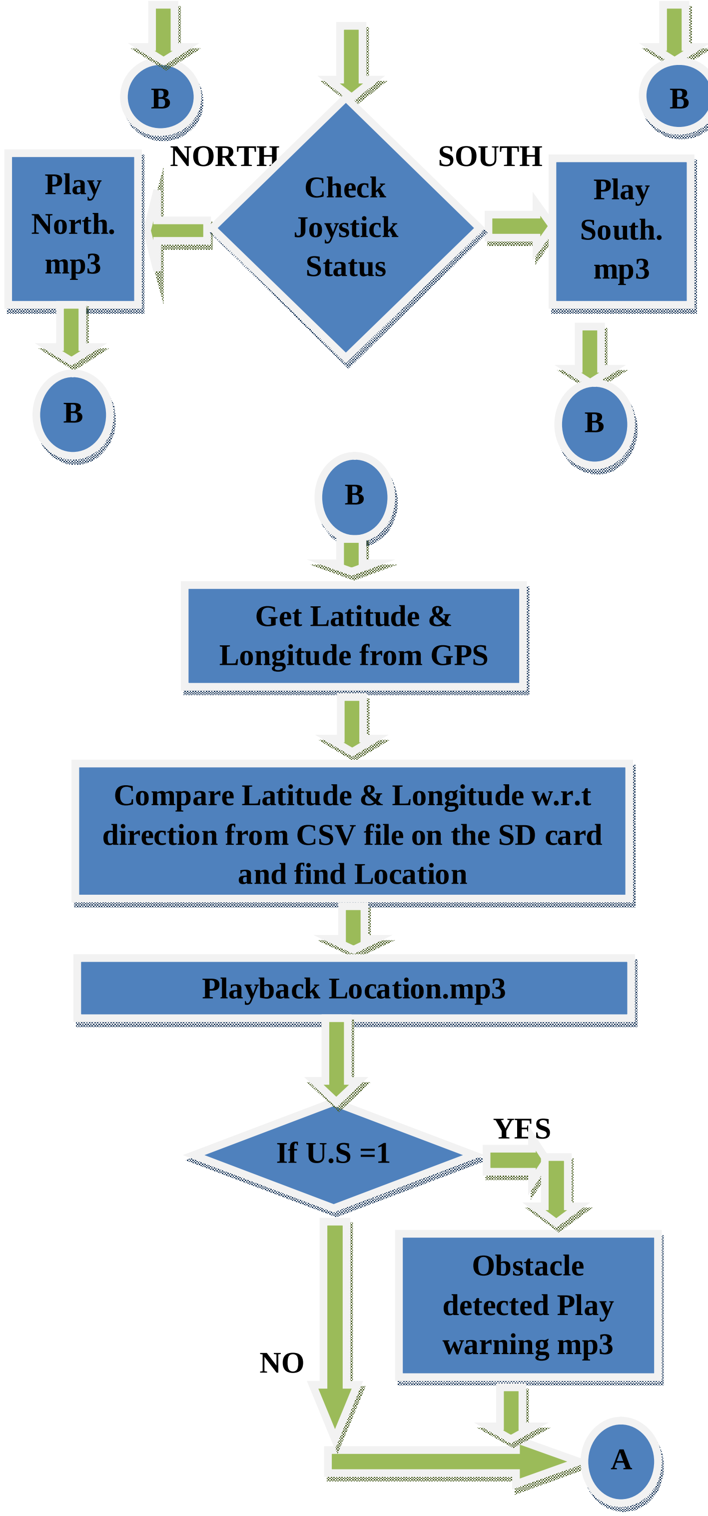



Figure -3 Flow Chart

## IV. HARDWARE DESCRIPTION

### 1.MICROCONTROLLER

Controller used will be ARM LPC2148 which is based on 32/16 bitARM7TDMI-S CPU with real-time emulation and embedded trace support that combines the microcontroller with embedded high speed flash memory ranging from 32 kB to 512 kB. It has many important features like. 16/32-bit ARM7 microcontroller in a tiny package. It has on-chip static RAM and on-chip flash program memory. It offers real-time debugging and high speed tracing of instruction execution. USB 2.0 Full Speed compliant Device Controller.10 bit A/D converters. Multiple serial interfaces including two UARTs. Low cost, low consumption, easy handling and flexibility. These features make controller reliable for the project.[7]

### 2. AUDIO AMPLIFIER (LM -386)

The LM386 is a power amplifier designed for use 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 milliwatts when operating from a 6 volt supply, making the LM386 ideal for battery operation.[8]

### 3. GPS Receiver (SiRFstarIII GR-301)

NaviSys GR-301 is a low-power, ultra-high performance, easy to use GPS receiver based on SiRF's latest third generation single chip. Its low power consumption and high performance enables the adoption of AVL and other location based applications. It supports different electrical interfaces such as USB, RS232, TTL etc. The connector interface and cable length could also be customized based on MOQ. The standard NMEA0183 outputs data using datum of WGS-84.[10]

The GPS units are designed to meet NMEA requirements. The GPS receiver provides data in NMEA 0183 format with a 1Hz update rate. Data formatted according to this protocol consist of a sequence of ASCII characters, subdivided in different sentences Identified by their first six characters: the '$' symbol; followed by the talker ID, which is always GP for GPS receivers; and the sentence ID. NMEA 0183 devices are designated as either *talkers* or *listeners* (with some devices being both), employing an asynchronous serial interface with the following parameters:[6]

Baud rate: 4800
Number of data bits: 8 (bit 7 is 0)
Stop bits: 1 (or more)
Parity: none
Handshake: none

The various formats of NMEA messages are:

1. GGA which indicates Time, position and fix type data.
2. GLL which indicates Latitude, longitude, UTC time of position fix and status.
3. GSA which indicates GPS receiver operating mode, satellites used in the position solution and DOP values.
4. GSV which indicates the number of GPS satellites in view satellite ID numbers, elevation, azimuth, and SNR values.
5. MSS which indicates Signal-to-noise ratio, signal strength, frequency, and bit rate from a radio-beacon receiver.
6. RMC which indicates Time, date, position, course and speed data.
7. VTG which indicates Course and speed information relative to the ground.
8. ZDA which indicates PPS timing message (synchronized to PPS)

The identifier is followed by the sequence of the actual data fields delimited by a comma. The terminal character an asterisk is followed by a checksum value. GPS sentences beginning with the following specifications: $GPGGA, $GPGSA, $GPGSV, $GPRMC, and $GPVTG. And sentences also begins with $GPMSS, $GPZDA as shown in [table 1].
A common NMEA Sentence used for location is:

$GPRMC,161229.487,A,3723.2475,N,12158.3416,W,0.13,309.62,120598, ,*10
GPRMC,021709.000,A,3717.6077,N,12658.6237,E,2.14,17.03,280907,,,A
$GPGGA,002153.000,3342.6618,N,11751.3858,W,1,10,1.2,27.0,M,-34.2,M,,0000*5E
$GPGLL, 3723.2475, N,12158.3416,W,161229.487,A,A*41

| **Name** | **Example** | **Unit** | **Description** |
|---|---|---|---|
| Message ID | $GPGGA | | GGA protocol header |
| UTC Time | 002153.000 | | hhmmss.sss |
| Latitude | 3342.6618 | | ddmm.mmmm |
| N/S Indicator | N | | N=north or S=south |
| Longitude | 11751.3858 | | dddmm.mmmm |
| E/W Indicator | W | | E=east or W=west |
| Position Fix Indicator | 1 | | |
| Satellites Used | 10 | | Range 0 to 12 |
| HDOP | 1.2 | | Horizontal Dilution of Precision |
| MSL Altitude | 27.0 | meters | |
| Units | M | meters | |
| Geoid Separation | -34.2 | meters | Geoid-to-ellipsoid separation. Ellipsoid altitude = MSL Altitude + Geoid Separation. |
| Units | M | meters | |
| Age of Diff. Corr. | | sec | Null fields when DGPS is not used |
| Diff. Ref. Station ID | 0000 | | |
| Checksum | *5E | | |
| <CR> <LF> | | | End of message termination |

TABLE- 1 field description

The $GPGGA sentence has other information Including Latitude, Longitude and Altitude. Another $GPRMC sentence has information that includes Speed.

4. GH-311Ultrasound Motion Sensor

The GH-311 ultrasonic Motion sensor provides precise, non-contact distance measurements from about 2 cm (0.8 inches) to 3 meters (3.3 yards). It is very easy to connect to microcontrollers such as the BASIC Stamp®, SX or Propeller chip, requiring only one I/O pin. The GH-311 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. By measuring the echo pulse width, the distance to target can easily be calculated.[9]

## V.RESULT & DISCUSSION

Complete system as shown in fig.4 contains complete connection of 32-bit ARM processor along with GPS system, ultrasonic sensor & joystick.

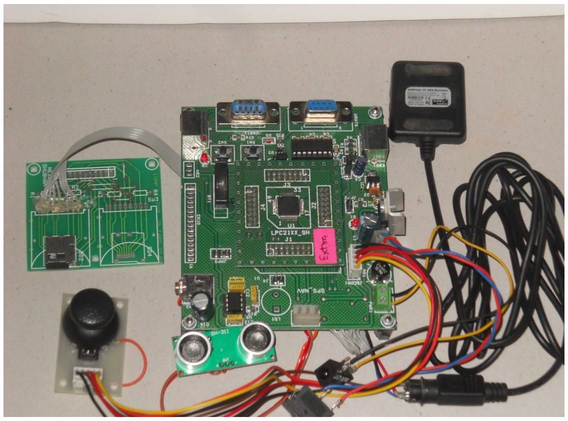


Figure.4 complete system

The voice data & GSV file stored in the memory card is shown in the fig below.

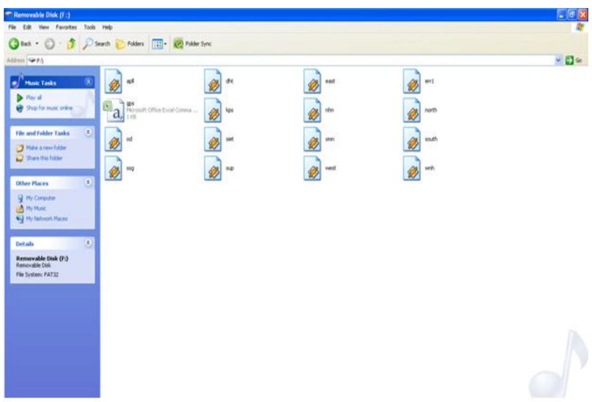


Figure.5 Data inside memory card.

Fig shows that GSV file contains the latitude & longitude and the place related to it

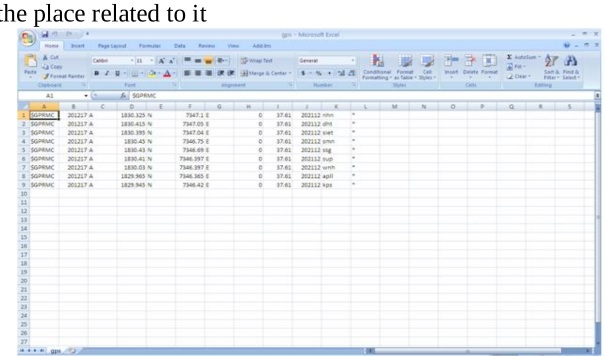


Fig 6 GSV file.

A voice operated GPS based navigation system has been developed in this thesis. The ultrasonic sensor is used for obstacle detection. In comparison with the existing systems, this system has a high speed processor LPC2148. We have tested GPS by checking the output message stream in pc through hyper terminal. The GPS receiver in this project supports NMEA protocol and out of the different NMEA messages we are using GPRMC string in our project .Joystick is used for direction selection. The voice output and the GSV file are stored in memory card.

## VI.CONCLUSION

As we have discussed that India is now home to the world's largest number of blind people and India's current population is over 1.22 billion. Earlier majority of visually impaired people prefer to not use electronic aids, and use only canes or guide dogs. The underlying reasons for this include the relatively high costs and relatively poor levels of user satisfaction associated with existing electronic systems. So we tried to develop a low cost and user friendly system for blind people with greatest possible accuracy. In this project we have used ARM processor which contains more memory and its operating speed is high. We have use ultrasonic sensor for obstacle detection instead of white cane. We guide or navigate the blind people using voice. However, there are still limitations of our system. Our system cannot work indoors because no signals can be received from the GPS navigation system. On the other hand, the accuracy of the signals from the GPS navigation system still needs to improve although we can control it within 5 meters. Further, the users often need to learn for a period of time to trust the system and more evaluation of the system in the real situation is required. Therefore, future work lies in how to improve user trust in terms of its accuracy of perceiving environmental information as well as the user interface. For example, how to improve its accuracy of the GPS signals and provide explanation to the user rather than descriptive information on how to navigate in real situations.

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