ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

**International Journal of Innovative Research in Computer and Communication Engineering**

*(An ISO 3297: 2007 Certified Organization)*

**Vol. 3, Issue 6, June 2015**

# A Low Cost Outdoor Assistive Navigation System for Blind People

Varun Raj S P[1], Annie R Das[2]

M.Tech Scholar, Department of Computer Science, Mohandas College of Engineering and Technology, Kerala, India[1]

Assistant Professor, Department of Computer Science, Mohandas College of Engineering and Technology, Kerala, India[2]

**ABSTRACT:** Pathfinder is a low cost outdoor assistive navigation system. This project use audible feedback technology and for navigation, distance vectors are considered. This project demonstrates the ability to navigate a blind, based on audio which allows the user to move to a known location without the use of a visual aid. The system uses a portable computer, GPS, external memory and a central microcontroller module to generate sound based on the direction that the user must turn in order to face the correct direction. This project is implemented using microcontroller based embedded system connected to GPS. GPS satellites which regularly circle the earth send out signals which the unit detects and quickly interprets. The system can be set to the navigation mode by the user by a keystroke. The system then records the route data from the GPS at regular intervals. The device then stores this information to the system. The user can later replay route information. This helps the person to follow the exact route by getting the information from the stored voice data after comparing with the current GPS data, if the compared data is same as the previously stored location the system will give a message through ear phone using speech processing system otherwise it will give a warning message. This project use speech recognition system, which is done by using two machine learning techniques. They are Mel Frequency Cepstral Coefficients and k-means clustering. User gets feedback in the form of audio.

**KEYWORDS:** GPS Synthesized directional audio, audible feedback technology, Navigation system.

## I INTRODUCTION

Human way finding consists of two distinct components, sensing of the immediate environment for impediments to travel, navigating to remote destinations beyond the immediately perceptible environment. Navigation involves updating one's position and orientation during travel with respect to the intended route or desired destination. In the event of becoming lost, reorienting and re-establishing travel toward the destination. Imagine being blind and trying to find your way around a city you have never visited before. This is the situation faced by every blind people every day. Blind people can obtain information by exploring the environment and using their hands to understand the shape of an object. Blind people make use of sounds from the environment. Many researchers and companies are developing technologies and devices that emit sound to help blind peoples to navigate the world. 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. The visual sense provides a rich and complex set of information about the surrounding environment, and in particular it informs an organism about the positions and properties of objects in the world. Generally humans rely very heavily on visual input to perform a host of important functions including facial and object recognition, depth estimation, and navigation and object avoidance. When deprived of this information, however, a person may learn to compensate by relying on input from other sensory modalities. Visual sensory substitution can take a variety of forms and may be mediated by a device. The traditional white cane is perhaps the simplest example of a visual sensory substitution device; information about distant objects that could have been provided visually is instead collected by the tactile receptors of the hand. Obviously, this method is very limited compared to vision. In the past navigation has primarily relied on the use of a compass, a map or other assistive devices that must be interpreted visually. This project helps the blind to navigate,

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 6, June 2015

based on synthesized directional audio which allows the user to move to a known location without the use of a visual aid. The module uses a GPS, external memory, obstacle sensing device and a central microcontroller module to generate sound based on the direction that the user must turn in order to face the correct direction.

## II LITERATURE REVIEW

This project mainly concerns audible feedback technology. This project use distance vectors not motion vectors. So survey mainly focused on devices which used distance vectors.

DRISHTI [9]: An Integrated Indoor/Outdoor Blind Navigation System and Service. Drishti [9] consist of, a vocal communication interface a wireless connection, a wearable computer, and precise position measurement system to guide blind users. It uses DGPS as its location system; it provides the user with an optimal route by means of its dynamic routing and rerouting ability. An OEM ultrasound positioning system is used to provide precise indoor location measurements. The user can switch the system from an outdoor to an indoor environment with a simple vocal command. Limitations are, the algorithm used to calculate the location is for two-dimension using the average height of a person, which results in bigger error if the user sits or lies down. Only use 4 pilots to cover the “Smart House.” thereby the signal may be reflected or blocked by furniture and walls, there are some “dead spots” that have bad data reads.

NAVBELT: Navbelt [2] consist of a belt, a portable computer and ultrasonic sensors. The computer processes the signals from the sensors and gives the results to the obstacle avoidance algorithm. The resulting signals are given to the user by stereophonic headphones, using a stereo imaging technique. It provides acoustic signals via a set of stereo earphones that guide the user around obstacles or displace a virtual acoustic panoramic image of the traveler's surroundings. Limitations are it is difficult for the user to comprehend the guidance signals in time. Navbelt [2] lacked the ability to detect overhanging objects, steps, sidewalks, edges etc. It does not allow fast-motion. The system is unsafe when approaching bumps and holes due to its 2D representation. The system emphasis only on 2D

GUIDE CANE: The Guide Cane [9] uses the same mobile robotics technology as the Navbelt [2] but is a wheeled device pushed ahead of the user via an attached cane. When an obstacle is detected, guide cane [9] steers away from the obstacle. The user immediately feels this steering action and can follow the Guide Cane's [9] new path easily without any conscious effort. The user no longer needs to actively scan the area ahead of him/her. Determines an appropriate direction to avoid the obstacle, steers the wheels in that direction. The Guide Cane [9] does not use acoustic feedback, so that there is no masking of audio. Limitations are limited number of sonar’s is used for indoor navigation. Accuracy is reduced. Braking systems are not so efficient. Wheel configurations are poor. When the user walks into a dead-end where no avoidance manoeuvre is possible.

SWAN [3], System for Wearable Audio Navigation: SWAN [3] is a wearable computer consisting of audio-only output and tactile input via a handheld interface. SWAN [3] relies on a Geographic Information System (GIS) infrastructure for supporting geocoding and spatialization of data. SWAN [3] utilizes novel tracking technology. Limitations are, High cost. Different sounds are used for identifying obstacles and navigation. Navigation Beacon sounds guides the listener along a predetermined path. Object Sounds indicate the location and type of objects around the listener. Surface Transition sounds signify a change in the walking surface.

A camera computer system to support safe walking of a blind people [4]: A system for detecting moving objects in front of a person on a walk road by a camera mounted on his/her body. The system [4] is equipped with a single camera placed on the chest of a person. It [4] detects moving objects from the camera images by analyzing motion vectors. Limitations are collision detection is not implemented. Hardware implementation is costly. High definition camera is required. Higher precision is required in detecting motion vector. From the literature review it is clear that, better performance is obtained from audible feedback technologies. By using distance vector, system gives better accuracy. The proposed design use audible feedback technology and distance vectors for its implementation.

## III PROPOSED DESIGN

Pathfinder is a low cost outdoor assistive navigation system. Helps to navigate a blind, based on synthesized directional audio and which allows the user to move to a location without the use of a visual aid. Pathfinder use Audible Feedback

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

*(An ISO 3297: 2007 Certified Organization)*

Vol. 3, Issue 6, June 2015

technology. Audio feedback is a special kind of positive feedback which occurs when a sound loop exists between an audio input and an audio output. Pathfinder allows the user to move only to a known location. Pathfinder is an offline device. i.e., no internet connection is used to operate. Destination address is stored in a database. Destination address is obtained from the user during the implementation phase. Pathfinder use speech recognition techniques. To move to a known location, the user has to provide destination name via microphone. Pathfinder use GPS module to access user's current location. GPS coordinate value is obtained from GPS module which is interfaced with AURDUINO microcontroller. For the determination of path, pathfinder checks whether the user's current position match with the preloaded destination coordinates. If doesn't match, instruct the user to move on. Output of pathfinder is in the form of audio. The proposed design is an offline system for navigation. The system uses 3D sounds to provide navigation instructions to the user.

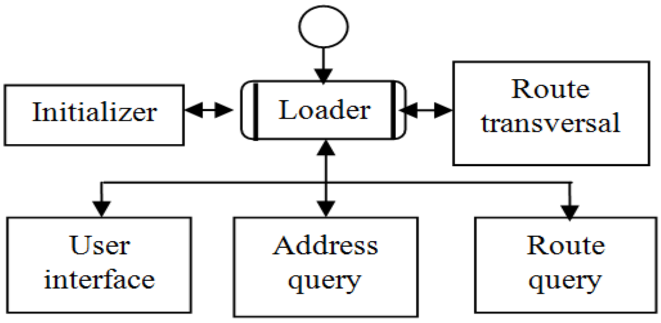


Fig1: System Architecture

The entire system consists of five modules and it is controlled by a loader program. The entire system does not use internet to operate. The initializer module verifies all the data files for the operation of the system exist or not. It also verifies whether all the library files are installed or not. In the user interface module, the user only controls a power switch and three buttons. The user can input the responses through the three buttons and a microphone. Once the destination address is obtained, the system will determine the user's current position through a Bluetooth GPS receiver. A compass provides the system with the user's heading. Three buttons are used as user interface. Three buttons include, UP button to select an address that has been previously loaded into the system's memory. Down button to input a new address. Middle button is used to continue to next step. If the new address entered through microphone is correct. To compute the route, Current location is obtained from the GPS. Save the nearest neighbor coordinate values from current location to destination. Compare current position with neighbor coordinates to determine the route. Neighbor coordinates are stored in a database. Navigation is done by using Transversal algorithm.

## IV SYSTEM DESIGN

This project demonstrates the ability to navigate a blind, based on synthesized directional audio which allows the user to move to a known location without the use of a visual aid. The module uses a GPS, external memory, a central microcontroller module to generate sound based on the direction that the user must turn in order to face the correct direction. This project is implemented using microcontroller based embedded system connected to GPS, a portable computer, external Memory, GPS satellites which regularly circle the earth send out signals which the unit detects and quickly interprets. The system can be set to the navigation mode by the user by a keystroke. The system then records the route data from the GPS at regular intervals. The device then stores this information in an external memory storage device attached to the system. Based on the memory size of External Memory, the data can be stored for a long time. The user can later replay route information. This helps the person to follow the exact route by getting the information from the stored voice data after comparing with the current GPS data, if the compared data is same as the previously stored location the system will give a message through ear phone using speech processing IC otherwise it will give a warning message. The GPS module calculates the geographical position of the module. This helps in detecting the location/position of the module. The GPS system functions on the basis of NMEA protocol. The NMEA protocol has output messages and input messages. The module outputs data like Global positioning system fixed data, Geographic

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

*(An ISO 3297: 2007 Certified Organization)*

**Vol. 3, Issue 6, June 2015**

recommended minimum specific GNSS data. Accuracy of GPS module is varied from 5-10 meters according to the manufacturer or satellite orbiting.

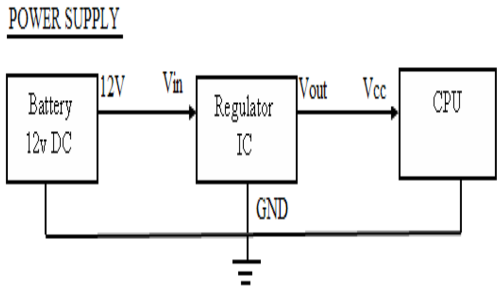


Fig 2: Power supply

A. Working of pathfinder

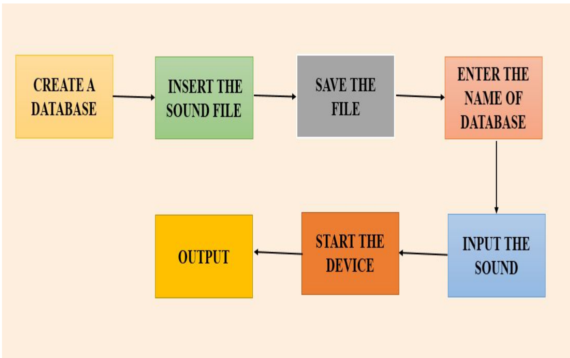


Fig 3: Flow chart of path finder

Create database of coordinate values, nearest neighbour coordinate values from destination to current position is saved in a database. Second step is to insert the sound file through microphone. The sound file contains the destination name. Then save the file. Enter the name of the database to give coordinate values. To obtain the destination coordinates. Each coordinates represent each destinations. Coordinates are in the form of latitude and longitude. Instead of giving a single destination coordinate path finder use all the nearest neighbour coordinates from current position to destination. This database helps to compute the route. The name of the database and name of the destination should be the same. To test whether the destination name is stored in the database or not, input the audio file again. The audio file should contain the destination name we already given in the database. If exist, the system outputs the destination name. Otherwise output as not exist. Final step is to start the device, the device output as the destination reached when the user reach at any of the coordinate values stored in the database. The system will output as path deviated when the user's current position is greater than the destination coordinates.

B. Speech Recognition System

Steps for speech recognition are, read the training and testing files then feature extraction for both the training and testing files then statistical modeling of the training files then testing each of the test files with the models created and

 DOI: 10.15680/ijircce.2015.0306149 

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

*(An ISO 3297: 2007 Certified Organization)*

Vol. 3, Issue 6, June 2015

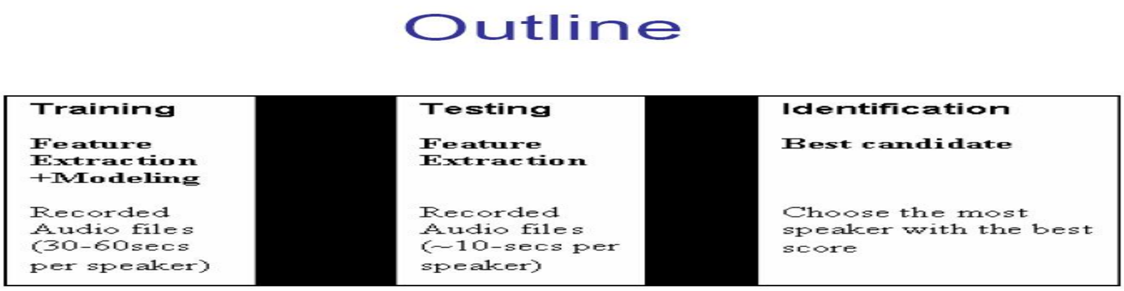


Fig 4: Outline of Speech Recognition System

finally choosing the 'best candidate' test file corresponding to a training model, and verifying whether both of them came from the same speaker.

Speech recognition system involves two machine learning techniques, Mel Frequency Cepstral Coefficients (MFCC) and K-means clustering.

C. K-means clustering

K-MEANS clustering is used to find the best candidate test file. K-means clustering is a partitioning method. The function k-means partitions data into k mutually exclusive clusters, and returns the index of the cluster to which it has assigned each observation.

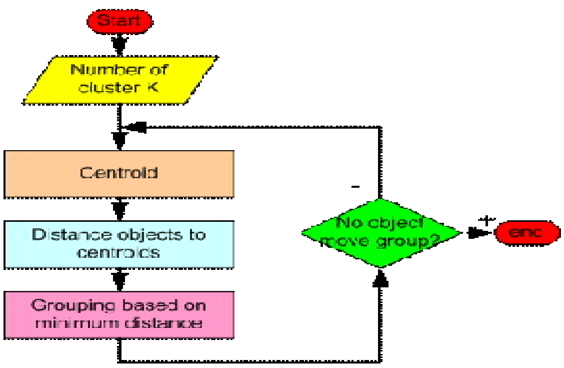


Fig 5: K-means clustering

Steps involved in speech recognition are, feature of sound is its frequency, so convert the input sound into frequency domain using MFCC. Frequency coefficients are arranged in ascending order. These coefficients are grouped into 8 clusters. Apply k-means clustering algorithm on each cluster. Output obtained is the best candidate test file. Best candidate test file contains features of Audio file in the database and features of input audio file.

D. Determination of path

In path finder, Current location is obtained from the GPS. Save the nearest neighbor coordinate values from current location to destination. Compare current position with neighbor coordinates to determine the route. Neighbor coordinates are stored in a database.

Transversal algorithm for navigation

Compute GPS coordinate and

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

*(An ISO 3297: 2007 Certified Organization)*

Vol. 3, Issue 6, June 2015

If is above a certain threshold:

Increment the path (i.e. current path is set to next path)

If current path does not exist:

The user has reached the destination

Finished.

Else if the next path does not exist:

The user is on the final path, and has no meaning

Else:

Compute

Compute the minimum distance of the user from the current path and

If is above a certain threshold:

Inform the user that they are straying from the current path.

Else:

Play sound in the direction the user needs to walk.

Pathfinder use transversal algorithm for navigation. The threshold value taken is 0.5.

## V. RESULTS AND DISCUSSIONS

Output of pathfinder is an audio file. Simulator gives output in the form of text, which is then converted to audio. Start and Stop labels are excluded from the snapshots. Start and stop labels represent two buttons of path finder. The user interface given by the path finder. By pressing the start button, the device starts working. The stop button is used to stop the device. After pressing the start button results are shown. Implementation tools are

- IDE: MATLAB
- Front end: C
- Back end: MATLAB
- Operating system: Windows 7
- Microcontroller: Arduino Duemilanove.

Step 1: To give the destination address, user has to give destination name via microphone. To input the sound file, press on the record label then a dialogue box appears with a message PRESS OK then click on the ok button and start recording the destination name. Step 2: Labelling the audio file, enter the name for the file and press Ok button. Step 3: Enter the coordinate values for the destination name then press OK button. After destination address is obtained from the user and all the above process are completed then the simulator gives an output as recorded. Step 4: Store the destination address, to add the audio file to database press on the ADD DATABASE label. The destination name and audio file is stored in the database. Step 5: To test whether the destination name is stored in the database or not. Click on the test label and a dialogue box appears with message PRESS OK AND SPEAK then press on the OK button and input the audio file of destination name that already entered. If the destination name is in the database, the simulator will output the destination name given. Otherwise, output as not exist. If the current location match with the destination coordinates, the device gives an output DESTINATION REACHED. Output is in the form of audio. If the coordinates of the current location is greater than the destination coordinates then the system gives an output PATH DEVIATED as audio.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 3, Issue 6, June 2015


Fig 6: Simulation result

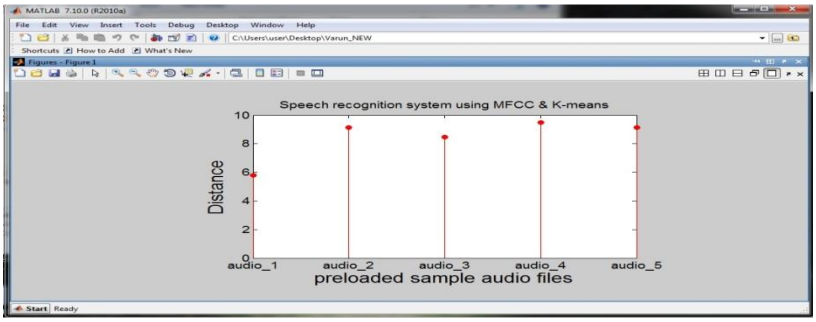


Fig 7: Speech recognition result

## VI. CONCLUSION AND FUTURE SCOPE

Path finder is an assistive device for the blind, which helps to navigate a blind, based on synthesized directional audio which allows the user to move to a known location without the use of a visual aid. Path finder has the following features, Path finder is of low cost. The entire cost for the system is only Rs.2500/-. Path finder shows better performance than any other assistive devices currently available. Path finder use Arduino Duemilanove microcontroller. Path finder shows better accuracy. Path finder use GCT GPS module for better accuracy. Modern technologies are used in pathfinder. For speech recognition MFCC and K-means clustering techniques are used. Path finder is the best low cost outdoor assistive navigation system for blind. Pathfinder helps the blind people to navigate, only to a known location. Path finder has the following drawbacks, in Pathfinder there is no collision detection. There is no mechanism for choosing an alternate path, if the current path fails. Path finder does not give any notification of direction. If the user is deviated from the path there is no notification of direction. User can't understand in which direction to walk to reach the path. In path finder user can only move to a known location which is already loaded during the implementation phase. User can't add new locations after implementation. In path finder adding new locations is only possible at the time of implementation. For the implementation of Collision Detection, make use of Ultrasonic Sensors .Path finder use Arduino compatible ultrasonic sensors. Choice of Alternate path, if current path fails, chooses the alternate path.. Pathfinder is going to use vibrotactile technology along with the audible technology. Pathfinder gives vibrations along with the audio feedback. Notification of Direction, if the path is deviated or a collision occurs; user will get a notification of direction as audio. Adding new locations by the user, User can add new locations through microphone.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

*(An ISO 3297: 2007 Certified Organization)*

Vol. 3, Issue 6, June 2015

## REFERENCES

[1] Dr.Jizhong Xiao, KevinnRamdath, Manor losilevish, Dharmdeo sigh, AnastasisTsakas, "A low cost outdoor assistive navigation system for blind people."2013 IEEE 8th conference on Industrial Electronics and applications, 2013.

[2] J. Borenstein, "The Navbelt—A computerized multi-sensor travel aid for active guidance of the blind," in Proc. CSUN's 5th Annu. Conf. Technol. Persons Disabilities, Los Angeles, CA, Mar. 21–24, 1990, pp. 107–116.

[3] Aug. 1997.213, april, 2007Wilson Jeff,et al." SWAN: System for wearable audio navigation. "Wearable computers, 2007 11thIEEE International symposium on. IEEE, 2007.

[4] Ai Kanayama ,JooKooi Tan, Hyoungseop Kim, and Seiji Ishikawa "A Camera-computer System to Support Safe Walking of a Blind Person," 2012 12thIEEE International Conference on Control, Automation and Systems Oct. 17-21, 2012.

[5] Lisa Ran, SumiHelal and Steve Moore, "Drishti: An Integrated Indoor/Outdoor Blind Navigation System and Service", Proceedings of the 5th International symposium on wearable computer, October 2001, Zurich, Switzerland.

[6] A. Helal, S. Moore, and B. Ramachandran, "Drishti: An Integrated Navigation System for Visually Impaired and Disabled," in Fifth International Symposium on Wearable Computers (ISWC'01), Zurich, 2001.

[7] S. E. Moore, "Drishti: An Integrated Navigation System for the Visually Impaired and Disabled," Master's Thesis Gainesville, FL: University of Florida, 2002.

[8] B. D. Lucas, T. Kanade: "An interactive image registration technique with an application to stereo vision", Proceedings of the 7th International Joint Conference on Artificial Intelligence, pp.674-679, 1981.

[9] J. Borenstein and I. Ulrich, "The GuideCane—A computerized travel aid for the active guidance of blind pedestrians," in *IEEE Int. Conf. Roboticsand Automation*, Albuquerque, NM, Apr. 1997, pp. 1283–1288.