Autonomous Walking And Guiding Stick For Blind Using Echolocation And Image Processing

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Abstract-This project describes the development of a navigation aid in order to help blind and visually impaired people to handle easily, safely and to detect any obstacles. This system is based up on a Raspberry Pi with text to speech output. In addition, it consists of ultrasonic sensors placed on the user's stick and another one united into the cane. This aid is able toprovide the information to the blind people about urban walking routes and to provide real-time information on the distance of over-hanging obstacles within six meters along the travel path ahead of the user. Visually impaired people are helped by the process in which the image to text and text to speech is given by the Tesseract OCR. This project also deals with the obstacle detection with voice output.

Keywords: Python, Raspberry Pi, Ultrasonic Sensor, Flex Sensor, Raspbian OS, Text to Speech and Speech to Text Conversion.

I. INTRODUCTION

The ETA, Electronic Travel Aid is used to give information about the roads and obstacles to the blind peoples. Ourautonomous waking and guiding smart stick is also an ETA which guides the visually impaired people to know about theobstacle on the road while walking, and text reading. In this autonomous walking and guiding smartstick Raspberry pi are used to control the camera and various sensors. The feature of the project is face recognition which helps the visually impaired person to know about the people whom they are talking and they can easily identify the thief and the people to whom he meets on the regular basis. Text reading helps them to read the texts with the help of image processing. Everything is done usingdigital image processing technique with the help of computer vision. This autonomous walking and guiding stick helps the blind people to spend their life easily and they can also do the normal works like a normal people.

As we know that Eye sight playsverycrucial role in gatheringvarious information from the rea time environment and process that imagination lifetime, visually impaired people lags behind the society as they can't process the things as fast as the normal people do, so this system will help them to process the things very easily like if they want to read any type of book they can easily read the book with the help of image to speech conversion and they can easily identify the person with the help of face recognition method used in the project, they can easily check the environment and know what is going their around them by the object classification method used in the project and they need not to be dependent on other people for controlling the appliances in home, they can easily control the various home appliances with the help of this project system. assistants like Siri, Google Now, and Cortana which are all smartphone and PC features. And this idea moved on to the rise of intelligent personal assistants for a vehicle or a car.

Raspberry Pi is known as the credit-card sized computer which was initially designed for education, inspired by the 1981 BBC Micro. It is a low-cost device through which various applications of IOT can be developed. Knowledge of an Operating System is a must to work with a Raspberry Pi board. With inbuilt Wi-Fi and Bluetooth connectivity, it makes Raspberry Pi the most suitable hardware to work on. It runs on a Quad core ARM Cortex A-53 at a clock speed of 1.2GHz. It has a 1 Gigabyte DDR2 RAM with a clock speed of 900MHz.

Figure.1 - Raspberry Pi 3 Model

II. LITERATURE SURVEY

Literature survey has been done on various present smart cane. Comparison between various smart cane helps in selecting an optimal smart stick for the visually impaired people.

In paper [3] theproposed system is a smart stick for the blind and visually impaired people. The obstacle is sensed by the sensor present in the stick and the proper guidance is provided to the blind people. It detects all the objects in the path through various sensors which are inbuilt in this model. This device is handy and can be easily carried out by the blind person.

In paper [13]the system used hand gesture of the blind people for controlling the various appliances like light, fan, lock the door by using the flex sensor and the relay which recognized the gesture and perform the action according to that.

In paper [8] the system is based on rangefinder in robotics application. Its main advantages are low cast, robustness, small size, and good precision. This system can measure the distance of multiple objects very accurately.

Several other surveyswere carried out which includedultrasonic sensors as Intelligent sensors, image processing, GPS and GPRS combined system, 2G and 3G mobile communication link for navigation system.

III. PROPOSED MODEL

The below block diagram provides a brief overview on the construction and working principle of the proposed IOT Based smart stick for the blind person which is to be designed.

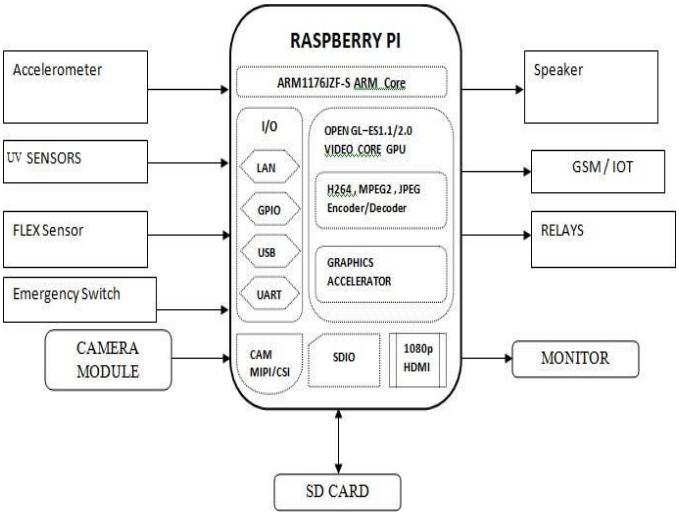


Figure2: Block diagram of proposed system.

The system consists of three ultrasonic sensors which are placed in the front, left, right side of the stick and it detects the distance of the obstacle by measuring the time difference of the rays travelling by the sensor and coming back to sensor from obstacle. Accelerometer is used to detect the fall detection of the blind person and intimating the care taker with the location of the blind person. Camera module is used to take the picture of and then convert the image to the text and finally the text is converted to the speech with the help of tesseract OCR. Relay module is used for the gesture to home automation. Raspberry pi masters all the activities of the system.

WORKING PRINCIPLE

This flow chart describes theoperations that takes places with respect to the project. The main feature of this project is image to text conversion.First of all, image will be capture by camera of a particular text which the blind person needs to read. Segmentation of the image takes place in order to receive the text from the image, which then makes use of the sign board to get the text identified. Extraction of text from the text board converts the images to the text that the blindperson wants to read. OCR (Optical Character Recognition) is used for the text recognition.In the next block this text is then converted into speech or audio which helps the visually impaired person to read anything he wants. This feature helps the bind person toinformabout the surrounding.

Our project mainly focuses on the visually impaired people and his safety. We are using raspberry pi in order to achieve

all the features declared. The main cases highlights are image to text and text to voice conversion, this feature is used in order to read anything that blind desires as the text will be converted to voice which the blind person can hear. It also explains features such as obstacle detectionwith the help of UV sensor. One important and last feature to be included would be the controlling of home automation and fall detection where an intimation would be given to the care taker through a message or email by using the accelerometer. Controlling of home automation is done by using Flex sensor which measure the amount of deflection or bending. This sensor is mounted on the stickwith the help of this feature a blind person can easily control their home automation such as automatic fan, light, door etc.

IV. OBJECTIVES AND METHODOLOGIES

The objectives and methodologies of the paperis outlined as below:

1. Obstacle Detection.

METHODOLOGY

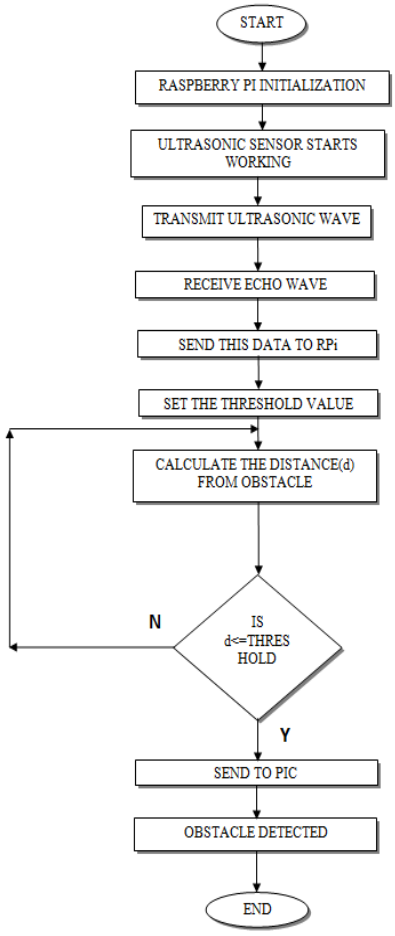
Figure 3: Connectivity of UV Sensor to RPi board

1) Firstly, the power supply is given to the Raspberry Pi. It initializes its operating system, it sparks the ultrasonic sensor to start sending burst signal.

2) Three Ultrasonic sensors are used in all the three directions Left, Right and Front to calculate the distance of obstacle from either side. There is very less delay between the calculation of distance because all the sensors triggered approximately at same time.

3) The range of these ultrasonic sensors we are using in our project is range from 2-250cms. It will beep the alarm if obstacle identified at minimum distance specified.

4) If none object identified at minimum distance which is specified, the entire process start again. However, even if one of the sensors identify object at minimum distance then it triggers the pre-defined conditions.



.Figure 4: Flow Chart of the Obstacle Detection

2. Emergency Intimation.

METHODOLOGY

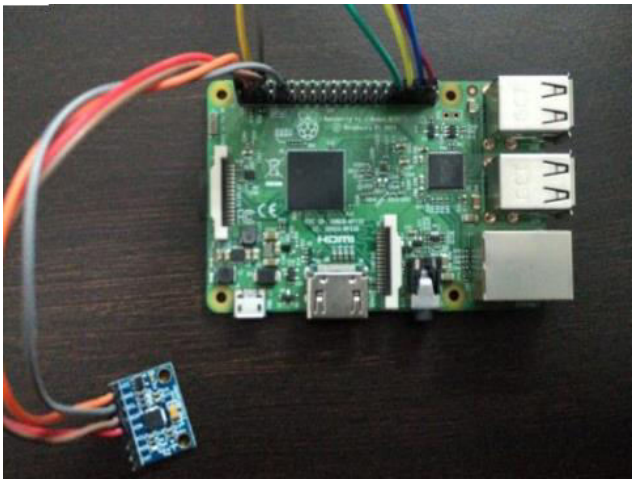


Figure5:Connection of Emergency Switch

1) When an acceleration is observed by accelerometer,at a point the mass is shown so that the spring is able to accelerate the mass at the same rate as the casing.

2) So, the displacement which we got is then measured to give the acceleration.

3) The structure over the surface of wafer is suspended by the polysilicon springs and providea resistance against acceleration forces.The differential capacitor is usedtomeasure the deflection of the structure which consist so find ependentfixedplates and plates fixed with the moving mass.

4) Due to Accelerationthe differential capacitor is unbalances andmass is deflectedit result in the sensor output whose amplitude is proportional to acceleration.

5) To determine the magnitude and direction of the acceleration Phase-sensitive demodulation techniques are used. The location of the place where the emergency with a blind person has taken placeissent to the pre-stored number of the caretaker'sasa message with a link using theTwilio app having the GSM interface. Thus,the blind person and the caretaker can coordinate well.

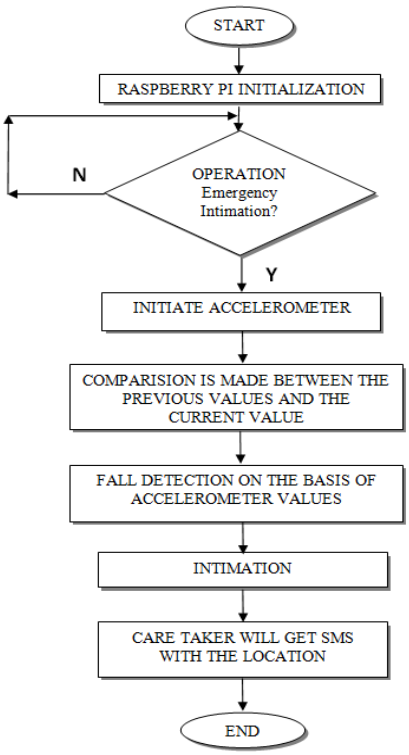


Figure 6: Flow Chart of the emergency intimation.

3. Image to Speech Conversion and Face Recognition.

METHODOLOGY

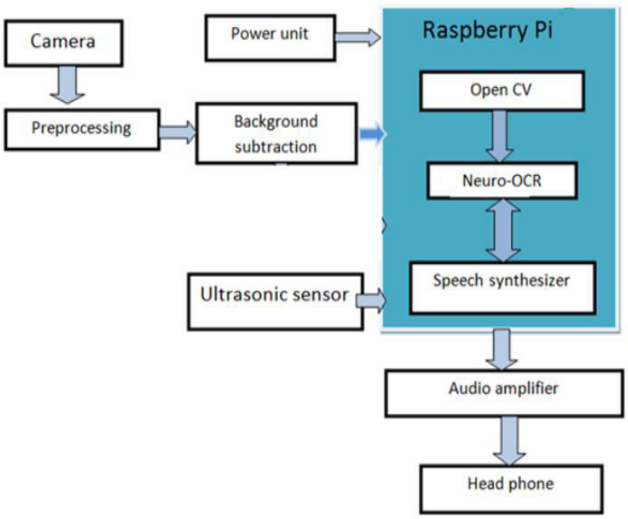


Figure7: Block Diagram for Conversion of Image to Speech

In this objective Image is first converted into text format then the text will be converted into speech with the help of Espeak.

1) Firstly, image will be capture through the camera and it is given as input for this process. The images will be depending up on quality of camera.

2) The second step is about image pre-processing consists of colour to gray scale conversion, edge detection, noise removal, warping and thresholding. OpenCV function is used by this system for the conversion of colour images into gray scale image. Bilateral filter is used for noise removal. For better detection of the figures Canny edge detection is performed on the gray scale image. The warping and cropping of the image are performed according to the contours. In the last, to look images similar to scanned document Thresholding is done.

3) The third step is image to text conversion. In this the pre-processing images will be converted into text file which is in png format. For this conversion we are using the Tesseract OCR.

4) The next block is text to audio conversion. In this .txt file will be converted into audio output.Now,with the help of speech synthesizer called Festival TTS the text is converted to speech. PWM output is generated by on-board audio jacket which is constitutes by Raspberry Pi.

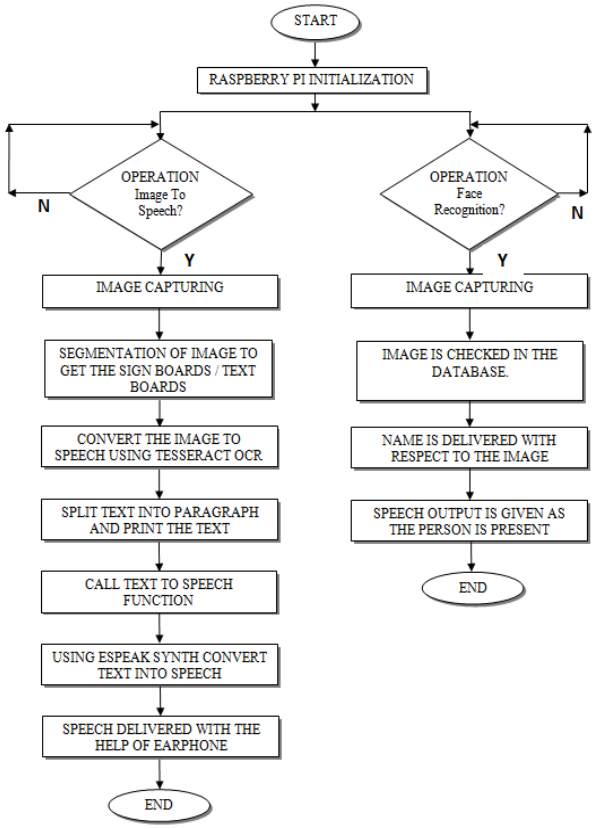


Figure 8: Flow Chart of Image to Speech Conversion and Face Recognition

4. Gesture to Home Automation.

METHODOLOGY

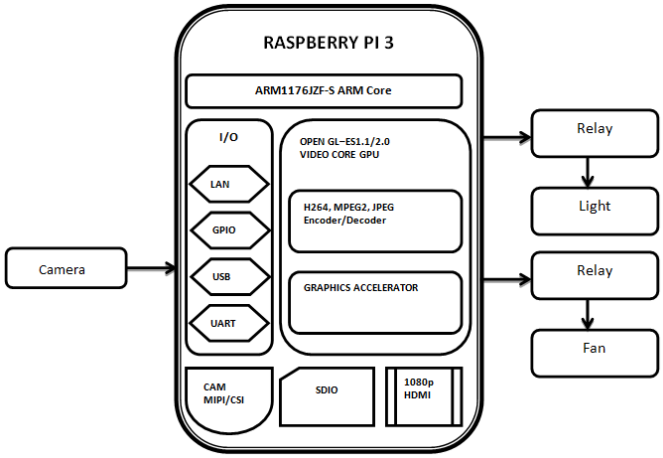


Figure 9: Block Diagram of Home Automation using gesture

1) The fourth objective is about control of home automation using flex sensor. The flex sensor is used to measureamount of bending. Power supply is given to the raspberry pi hence raspberry pi is initialized.

2) In this project we are controlling the home automation i.e. Fan on, Fan off, Light on and Light off. First it will check gesture to home automation if it is true then it will observe the gesture using camera or else it will again start the operation.

3) After observation it will check it will check whether gesture is recognized or not. If the gesture recognized the home automation will operate like Fan and Light will turn on and off.If it is not recognized again it will observe the gesture with the help of camera. At last, if the operation is successful the process will be end.

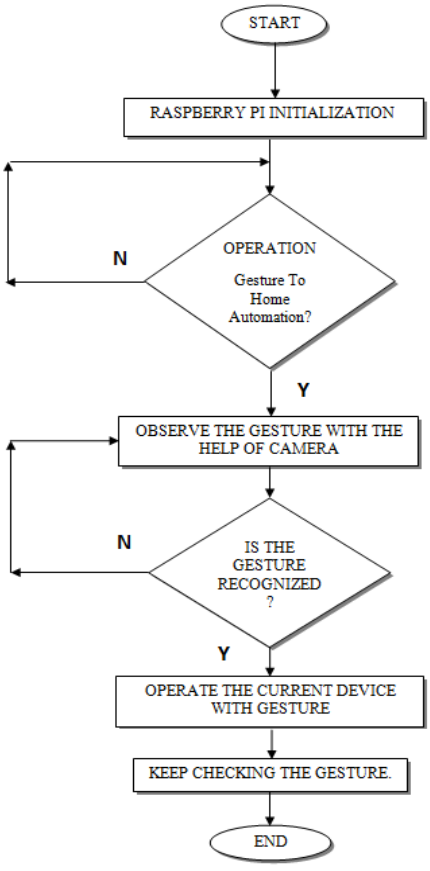


Figure 10: Flow Chart of Gesture to Home Automation

V. ADVANTAGES

1) Portability: This device very comfortable for the blind person because it is light weight and can easily carry away.

2) Cost Effective: We are using simple hardware modules to make it cost effective. The existing Braille scripts methods are very expensive.

3) Platform: By uses of different sensors it makes the system to useful in all environment.

4) Easy to Operate: This system is not complicated it can be easily handling by the blind person.

VI. CONCLUSION

The blind stick helps the blind person to navigate from one place to another place. So, this system is like a guide and provide much support to blind people.Ultrasonic sensor uses broad beam angle so that it can detect the wide range obstacles. The main focus of this project is to help and navigate blind society.This project includes many features like a blind person can easily read the book with the help of image processing. We included addition feature called face recognition in this it recognizes the face and tell the name of that particular person. The data of the person will store in the database. We are using the GPS system which tell us the exact location of the blind person as well as if any emergency will be there it will send the message to the care taker.This project is like a guide for the blind person. A visually impaired person can become self-independent and easily move for his purpose. This help the person move freely it can detect the pit and obstacles using ultrasonic sensors and send the messages to the person. The delay time is very less so that it can tell that from which direction the obstacles is coming.

VII. ACKNOWLEDGEMENT

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