International Journal of Pure and Applied Mathematics
Volume 119 No. 16 2018, 3485-3489
ISSN: 1314-3395 (on-line version)
url: http://www.acadpubl.eu/hub/
Special Issue



# A Smart walking stick for visually impaired using Raspberry pi

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***Abstract*— Visually impaired persons find it more challenging to move out independently. There are millions of visually impaired or blind people in this world who are always in need of helping hands. The smart walking stick that we have designed will help the blind society by providing more convenient means of life and to move around independently. The stick consists of 4 ultrasonic sensors, one camera and an earphone. Out of 4 sensors 3 of them used for obstacle detection and the last one is used for pothole detection. The camera is used for text and object recognition. Thus it works as a virtual eye for blind people. The output will be from an earpiece.**

## I. INTRODUCTION

Electronic Travel Aids are the devices which are used for mobility. The function of ETA is to provide information to the blind people about road and obstacles. Our smart walk stick is also an ETA which helps the blind people to know about the objects opposite to them, color of the objects, and text reading.

In this smart walking stick we use Raspberry pi to control the sensors and camera. The feature of object identification helps the blind people to recognize what kind of object is before them and helps them to move around safely. Text reading helps them by reading out the reading out the texts before them and finally color identification helps them to identify the colors before them. These are all done using technique of digital image processing by using compute vision2. This smart walk stick is light weight to carry around and this helps the blind people to move around as a normal people.

## II. REVIEW OF EXISTING DEVICES

A variety of ETAs and various technologies have been applied for the betterment and safety of the blind society and to guide them 24/7 by detecting obstacles on the ground, uneven Surfaces, holes, steps and puddles.

### *A. C-5 Laser Cane*

The laser cane has three laser diodes and three photo diodes in it. This laser cane is based on optical triangulation. The photo diodes act as receivers. This laser diode can detect obstacles at head height and up to the range of 1.5m or 3m [1].

### *B. Sonic Torch*

It is a hand held device operated using battery, it operates by transmitting ultra sound and receiving back the reflected sound. The distance is calculated by using the time taken for the reflection of the ultrasound [2].

### *C. Sonic Path Finder*

It uses the technology of acoustic difference. It helps the blind people by detecting the obstacles and alarming them. But it does not provide accurate outputs.

### *D. Miniguide*

This device was developed in United States. The price was $545 which is quite expensive for the blind to buy [2].

### *E. Mowat Sensor*

It is a hand held ultrasonic-based device that informs the user of the distance of detected objects by means of tactile vibrations. The frequency of the vibration is inversely proportional to the distance between the sensor and the object .

### *F. Meldog*

It uses the artificial intelligence which provides the accurate position of an obstacle using the ultrasonic sensors and lasers. But it is very heavy to carry and move around.

### *G. Navbelt*

It is a portable device with ultrasonic sensors and a computer. It gives a 120o-wide view of the obstacles in front of user. This image was then translated into audio output [3].

## III. SYSTEM DESCRIPTION

This smart stick is an electronic walking guide which has four ultrasonic sensors. Out of these four sensors 3 sensors are used for obstacle detection which is placed on the side of the stick. The other sensor is responsible for pothole detection which is placed below the smart stick. These ultrasonic sensors range from 2-250cms. A camera is used for object identification and text identification. A toggle switch is kept which is operated by the user to enable the different features of the smart stick. Finally the output of the stick is through an earpiece.

### *A. Ultrasonic Sensor*

Ultrasonic sensor is a type of sensor that detects an object using sound waves. Its principle is similar to that of radar or sonar, which generates high frequency sound waves and receives it back. Sensors calculate the distance using the time

taken for the reception of the echo signal sending the signals and receiving back the echo signals to determine the distance of an object [6].

### *B. Camera*

A camera is used in this smart blind stick for capturing images which is used for object identification and text reading. The image captured in camera is processed using the technology of digital image processing.

### *C. Ear phones*

Earphones are used as output device which gives the audio output of all the features of smart stick such as object identification, text identification, and pothole detection.

### *D. Raspberry pi*

***Fig I. Raspberry pi board***

Low cost high performance computer which can be plugged in TV and monitor and can be used as computer which is very small as credit card.

- Its CPU is 700Mhz single core ARM1176JZF-S,
- It has 4 USB ports
- It has dual core video core iv multimedia co-processor
- Size of its RAM is 512mb
- It has micro SDHC plot for storage
- Power rating of raspberry pi is 600mA i.e, 3.0W
- It has 17*GPIO plus the same specific functions

This raspberry pi works as the computer of the smart walking stick [4].

### *E. GPIO pins*

The raspberry pi board has 17 GPIO ins in it. These GPIO pins provide ability to connect directly to electronic devices. The inputs will be like sensors, buttons or other communication with chips or modules using low level protocols SPI and serial UART connections. It uses 3.3V logic levels. No analog input or output is available in this GPIO pins but we can use external chords for this analog connection.

## IV. ALGORITHM

STEP 1: Start

STEP 2: Read the GPIO pins

STEP 3: If pin 1 is high go to step 4, if pin 2 is high go to step 7,if pin 3 is high go to step 10 else go to step 2

STEP 4: opens webcam, takes picture and saves the image as “sample.jpeg” and moves it to home/pi/webcam

STEP 4: Executes image to text conversion using python and saves the output as “output1.txt”

STEP 5: Moves “output1.txt” to “audio.txt” file and executes text to audio conversion

STEP 6: generates audio output moves to step 2

STEP 7: executes ultrasonic distance measurement using python and Saves the output as “output2.txt”

STEP 8: Moves the text in “output2.txt” to “audio.txt” and executes text to audio conversion

STEP 9: Generates audio output and moves to step 2

## V. BLOCK DIAGRAM

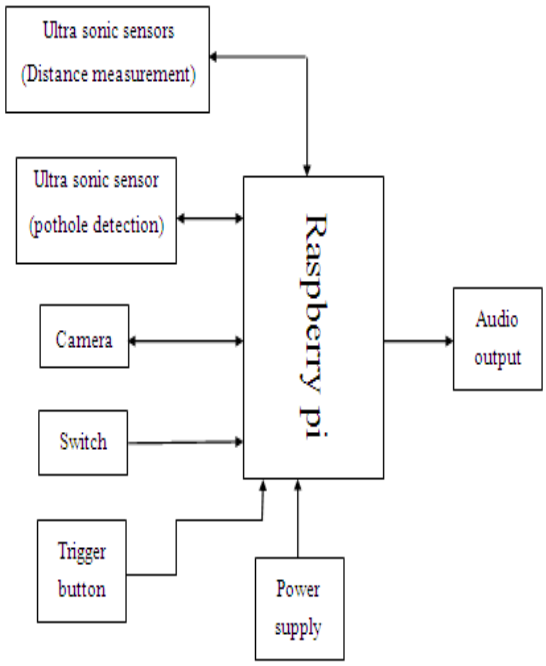



***Fig II. Block diagram representation***

The above block diagram represents the working of the raspberry pi. Many inputs such as ultrasonic sensors, switch input and camera are given to the raspberry pi board through the GPIO pins.

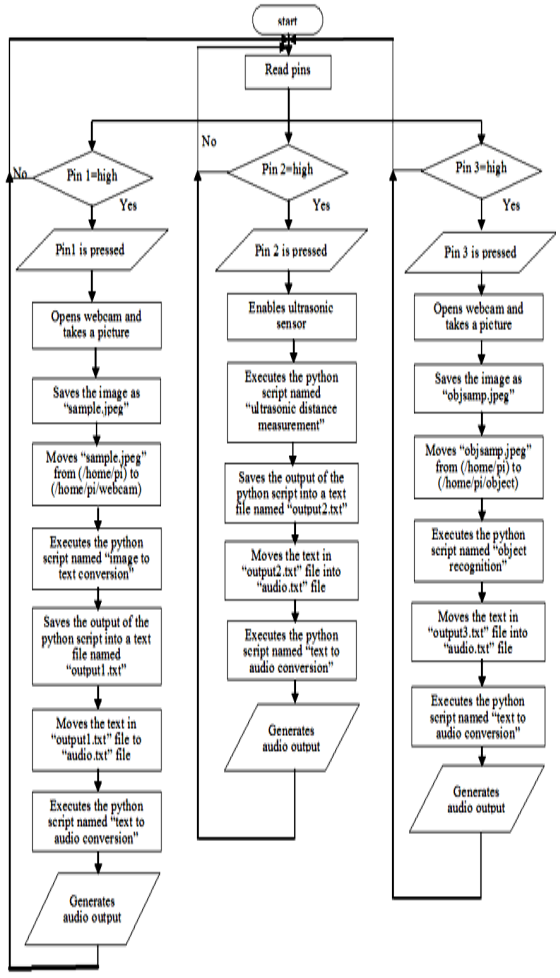
STEP 10: Opens webcam takes picture and save the image as "objsamp.jpeg" and moves it to home/pi/object

STEP 11: Executes object recognition using python and saves the output as "output3.txt"

STEP 12: Moves the text in "output3.txt" to "audio.txt" and executes text to audio conversion

STEP 13: Generates the audio output and moves to step 2

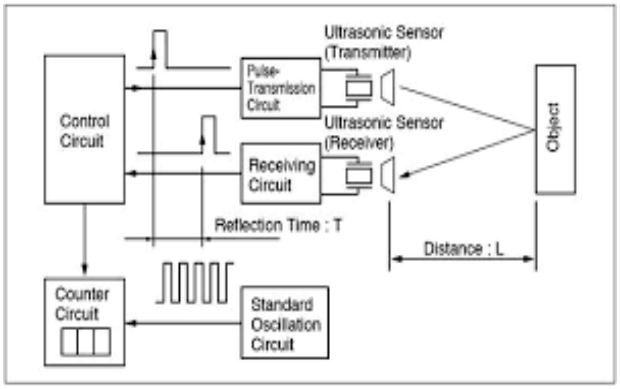
## VI. SMART FLOW CHART




The above flowchart shows the process details that takes place in the smart walking stick. And much easier algorithm of the smart stick is given below

## VII. FUNCTIONAL DESCRIPTION

### *A. Ultra sonic sensor*




The ultrasonic sensor is used to calculate the distance of the object or for pothole detection. These produce elastic waves with frequency greater than 20,000 Hz and exists in solid liquid and gases.

For object identification, the ultrasonic sensor is placed in three sides of the walking stick which sends ultrasounds and calculates the distance

For pothole detection, the sensor is placed below the smart walking stick. A distance more than an average distance is set. So when any pothole appears, its distance will be higher than the normal distance and hence we get alert

The method of distance calculation in the block diagram is known as pulse reflection method which count the number of reflection pulses reflected back comparing with the transmitted pulses [5].

### *B. Raspberry pi*

The Central processing unit is the brain of the raspberry pi board and that is responsible for carrying out the instructions of the computer through logical and mathematical operations. . The Ethernet port of the raspberry pi is the main gateway for communicating with additional devices. The raspberry pi Ethernet port is used to plug your home router to access the internet [9].

### *C. ARM 11 processor*

The raspberry pi uses ARM11 series processor

ARM11 is a group of older 32-bit RISC ARM processor

Its operating frequency is 335Mhz. power consumption is 0.4mV/Mhz

ARM Trust-Zone Technology for on chip security low power consumption and High performance integer processor the GPU is a specialized chip in the raspberry pi board and that is designed to speed up the operation of image calculations. This board designed with a Broadcom video core IV and it supports OpenGL [10].

### *D. GPIO pins*

The general purpose input & output pins are used in the raspberry pi to associate with the other electronic boards. These pins can accept input & output commands based on programming raspberry pi. The raspberry pi affords digital GPIO pins. These pins are used to connect other electronic components. For example, you can connect it to the temperature sensor to transmit digital data

Here in this smart walking stick the sensor, camera and switch are given as input and the output will be audio through earphones. This all input and output will be through GPIO pins [8].

### *E. Object identification*

The process of object identification takes place using the technology of digital image processing using a software named computer vision 2. In this process we feed the basic structures of objects such as stones, cars, humans etc., and if any variation is detected by ultrasonic sensors the camera will turn on to capture the image and it compares the captured image with the pre fed images to find the object [11].

### *F. Optical character recognition*

The process of OCR or optical character recognition is done using a supporting software in raspberry pi is known as Tesseract. In this software the image which is captured using camera is first converted into a black and white image and then the process of edge detection is done to find the edges in the image so as to find the different letters in the image. These letters are compared to the pre fetched characters of various language to find the correct character of the image [7].

### *G. Switch*

A toggle switch is used to enable ultrasonic sensor for obstacle detection, pothole detection or text reading. The user has to control the switch to get the required output of the smart walking stick.

## VIII. CONCLUSION AND DISCUSSION

This system gives the result for all $360^0$ from the position of the smart walking stick. So this system provides overall support for the blind society in guiding. The broad beam angle ultrasonic sensors helps in wide range obstacle detection. The main aim of this system is to act as a secure guard and helps the blind to be aware of their surroundings. Future work includes addition of GPS system along with designing an application and face recognition to find out the peoples before them. Addition of GPS system helps in locating the exact position of the blind person which helps their guardians to find them and provides a great guide.

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