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Multi-Objective Smart Cane for Blind People Navigation with Color Sonification Technique

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Abstract: ***Visual weakness is one of the genuine term used as a piece of today's populationdue to physiological or neurological division. The fractional visual impairment infers the absence of incorporation in development of optic nerve and aggregate visual impairment suggests nonattendance of visual light recognition. Visual impedance is one of the genuine term used as a piece of today's population due to physiological or The work melds clear, poor and particularly masterminded client wonderful ostensibly weakened bearing show wanted to enhance the adaptability of the apparently impaired people. The proposed work intertwines a wearable gear contains head top and little scale hand stick to help the apparently prevented individual to explore alone securely and to sidestep any deterrents that might be experienced, paying little regard to whether settled or smaller, to keep any conceivable disaster. Urological division. The primary part of this framework is the ultrasonic sensor, sensor which is utilized to output zone around visually impaired by radiating reflecting radio waves. The reflected signs gotten from the boundary articles are utilized as contributions to Raspberry Pi processor. The Processor is then used to decide the heading and separation of the articles around the visually impaired. A Camera is interfaced with the Raspberry Pi to give the thoughts regarding the items close to the individual and believers into a sound flag called the shading Sonification . At that point the Smart stick would have the ultrasonic sensor that would help in finding the pot openings in the way they are moving. A fall recognition sensor would caution the general population around by giving a hoot sound. For fall recognition a MEMs based accelerometer sensor is utilized.***

Keywords: Ultrasonic Sensor, Raspberry Pi, MEMs accelerometer sensor, Color Sonification

1. Introduction

Daze individuals are a term that generally used for the general population who perfectly aimlessly or still have leftover vision however can't bear the cost of their vision placidly. The event of the situations in the visual framework can be brought on by numerous things. Some of them are conceived in the condition of visually impaired, possibility, disease, and so forth. A visually impaired individual, generally use a stick to ambulate or peregrinate some place as a manual for sharp the course and verbalize the state of the passing street [1]. Nonetheless, the elements of the ordinary stick itself are as yet restrained in guiding and assessing the obstruction to visually impaired individuals, particularly when they are ambulating up to the remote goal [2].

Predicated on that condition, we guided a survey to the outwardly hindered people about what kind of increase module that would be completed on their stick. The eventual outcome of the survey verbally imparted that they require an intensely intellective stick which can give information about hitch, tangles whether static or dynamic and holes.

In light of the examination which we had experienced, chosen to outline a model named Smart guide augmentation that can be incorporated on customary stick. It helps the visually impaired individuals to explore securely by giving data about snags, hitch and openings. This model generally joins the ultrasonic sensor, sensor which is used to scope area around outwardly debilitated by creating reflecting radio waves. The reflected signs gotten from the deterrent articles are used as commitments to Raspberry Pi processor. The Processor is then used to decide the heading and separation of the items around the visually impaired. A Camera is interfaced with the Raspberry Pi to give the examinations as to the things close to the individual and supporters into a sound flag called the shading Sonification. At that point the Smart stick would have the ultrasonic sensor that would help in finding the pot gaps in the way they are moving.

2. Theory

A. Visually Impaired

Visual debilitation, furthermore kenned as vision weakness or vision misfortune, is a decremented workforce to optically observe to a degree that causes problems not fixable by standard means, for example, glasses. Visual hindrance is regularly characterized as a best reviewed visual sharpness of more awful than either 20/40 or 20/60.The term visual disability is used for consummate or proximately perfect vision misfortune. Visual prevention may achieve people issueswith ordinary step by step works out, for instance, driving, examining, blending, and ambulating.

The World Health Organization (WHO) surveys that 70% of visual impedance is either preventable or reparable with treatment [3].This joins waterfalls, the defilements conduit visual lack and trachoma, glaucoma, diabetic retinopathy, uncorrected refractive bungles, and a couple occurrences of youth visual weakness. Various individuals with monstrous visual debilitating favored angle from vision recovery, changes in their condition, and assistive gadgets.

Ultrasonic sensor is a handset that is both it can send the high recurrence sound waves and get the resound. It is utilized to figure the separation between the sensor and the obstructions that the ultrasonic waves hit and get reflected. Ultrasonic sensor is equipped for measuring the

separation till 3m. [4] It is comprehensively used as a piece of measuring the division when diverged from IR. The model of the Ultrasonic sensor is HC-SR04 has four pins: ground (GND), Echo Pulse Output (ECHO), Trigger Pulse Input (TRIG), and 5V Supply (Vcc).

Resonate will be "low" (0V) until the sensor is enacted when it gets the resound beat. Once a landing beat has been discovered ECHO is set "high" (5V) for the length of that heartbeat. Beat length is the full time between the sensor yielding an ultrasonic pulse, and the arrival pulse being identified by the sensor beneficiary. Our Python script ought to thusly gauge the beat traverse and after that learn expel from this.

Figure 1: Ultrasonic Sensor with Jumper wires [1]

The HC-SR04 requires a 10sec trigger pulse to start its task or operation. The program running on the raspberry pi determines the distance of the obstacles.

34300=Distance/ (Time/2)(1)

17150xTime=Distance(2)

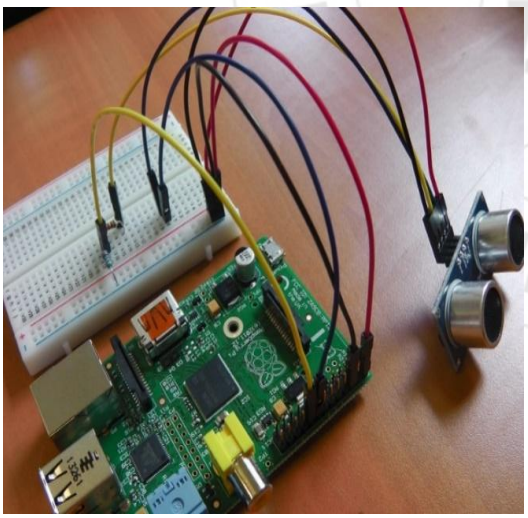


Figure 2: Ultrasonic Sensor interfacing with Raspberry pi 3

B. Raspberry Pi 3

Raspberry pi is a series of small single board computer. Here we had used Raspberry pi 3rd generation. It mainly consists of:

1.40gpio pins
2. Chip antenna
3. DSI (Display Serial Interface) connecter
4. Status led
5.1 GB RAM, 1.2 GHz quad core processor
6. Two usb 2.0 ports
7. Ethernet jack
8. Video and audio jack
9. Camera Serial interface (CSI) connecter
10. Memory card slot

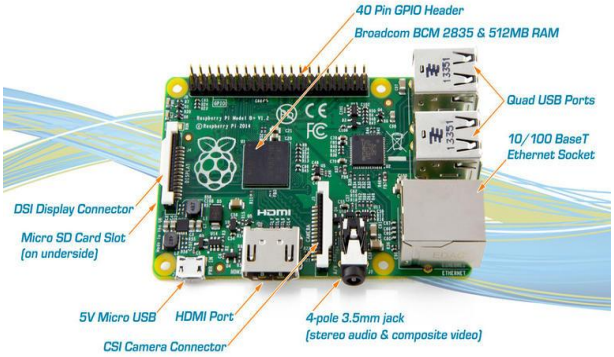


Figure 3: Raspberry pi 3

	Raspberry Pi 3 Model B	Raspberry Pi Zero	Raspberry Pi 2 Model B	Raspberry Pi Model B+
Introduction Date	2/29/2016	11/25/2015	2/2/2015	7/14/2014
SoC	BCM2837	BCM2835	BCM2836	BCM2835
CPU	Quad Cortex A53 @ 1.2GHz	ARM11 @ 1GHz	Quad Cortex A7 @ 900MHz	ARM11 @ 700MHz
Instruction set	ARMv8-A	ARMv6	ARMv7-A	ARMv6
GPU	400MHz VideoCore IV	250MHz VideoCore IV	250MHz VideoCore IV	250MHz VideoCore IV
RAM	1GB SDRAM	512 MB SDRAM	1GB SDRAM	512MB SDRAM
Storage	micro-SD	micro-SD	micro-SD	micro-SD
Ethernet	10/100	none	10/100	10/100
Wireless	802.11n / Bluetooth 4.0	none	none	none
Video Output	HDMI / Composite	HDMI / Composite	HDMI / Composite	HDMI / Composite
Audio Output	HDMI / Headphone	HDMI	HDMI / Headphone	HDMI / Headphone
GPIO	40	40	40	40
Price	$35	$5	$35	$35

Figure 4: Evolution of Raspberry pi

C. Raspberry Pi 3 Camera

It is used to take high definition video as well as Still photographs having five megapixel Fixed-focus camerathat supports 1080p30, 720p60 and VGA90 video modes. It attaches via a 15cm ribbon cable to the CSI port on the Raspberry Pi 3.

Figure 4: Raspberry Pi Camera

D. Buzzer

In order to assist the blind people by sound about the obstacles, a buzzer is attached to the raspberry pi processor using gpio. Instead of buzzer an ear phone is also attached using raspberry pi jack.

Figure 5: Buzzer

E. Color Sonification

It is the process of converting the image into the sound, which is by using the raspberry camera an image is captured and saved. The color in the captured image is extracted, that is getting the pixel value of the color and a beep sound is produced based on the color value.

3. Design and implementation

a) Design of system

We designed the prototype based on the research as the figure below shows the details of design. It includes mainly camera which is interfaced with raspberry pi 3, where the Ultrasonic sensor from hat, waist, shoes or belt also interfaced with raspberry pi 3. In order to provide indication to the blind people a speaker or buzzer is used which provides a beep sound based on the static or dynamic obstacles. The Raspbian camera which captures the images and provides input to the raspberry pi where it process and provides the output in the form of sound. Same function is performed by the ultrasonic sensor for measuring the distance between the sonar sensor and the obstacles. An MEM's based accelerometer is used to detect the falling of the blind people and which alert the surrounding by beep sound.

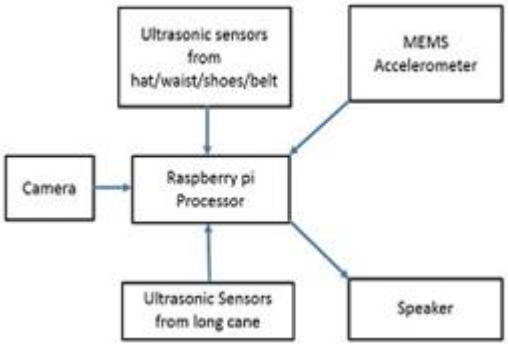


Figure 6: Block Diagram of System

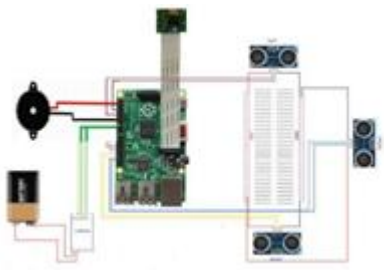


Figure 7: Schematic diagram of system

Figure 8: Flow chart of system

Based on the flow chart in fig 8, two on/off buttons one is for sensors and other is for camera. Here when sensor on/off button is pressed by the blind people the high frequency radio waves is emitted in order to measure the distance of the obstacles and Accelerometer sensor for fall detection which undergoes a loop until it detects the obstacles, pot holes and hitch. After detecting the beep sound will be produced, nearer the obstacles faster the beep sounds. Another push button is for camera where the images are captured, stored and processed using raspberry pi 3 which extracts the color pixels and based on the color values beep sound will be produced.

Table 1: System Requirements

Sl No	*Hardware*	*Description*
1.	Ultrasonic Sensor	Distance detection
2.	Raspberry Pi 3	Central control system
3.	Raspberry Pi Camera	Capturing images
4.	Power Supply	Supply power to the system
5.	On/off Button	Activated system
6.	Buzzer	Sounding beep buzzer

b) Implementation of System

The Implementation of the user interface of the design is integrated on the long cane as described in fig 9 and fig 10. Here the ultrasonic sensor is attached to the ordinary cane along with the buzzer for beep sound.

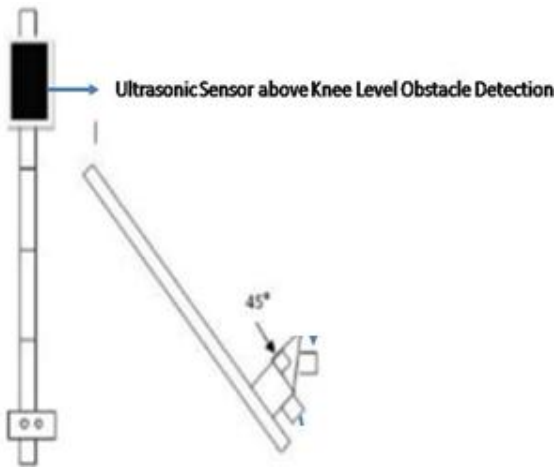


Figure 9: Implemented smart cane

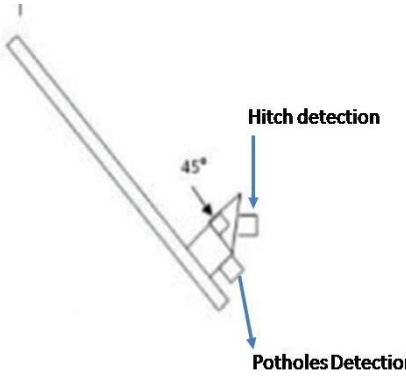


Figure 10: Implemented Ultrasonic Sensor

Two ultrasonic sensor is used one is used to detect the obstacles at the head level and other is used at the knee level. Here MEMs based accelerometer sensor is used to detect the fall of the blind people so that a beep sound is produced to alert the surrounding.

4. Results

We have designed the model of the project based on the requirements of the blind people. The model showed below which detects obstacles, hitch and also the pot holes. It also uses the raspberry pi camera to detect the potholes. Here the color sonification technique is used to detect the obstacles free path, where the color images are extracted and based on the color detected beep sound will be produced to notify the blind people.

The Result snapshots are as follows:

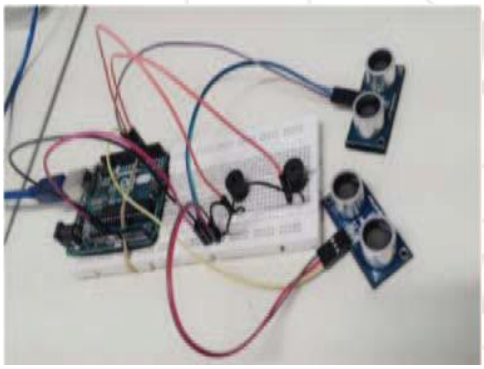


Figure 11: Demonstration of Detecting Hitch and Pot Holes

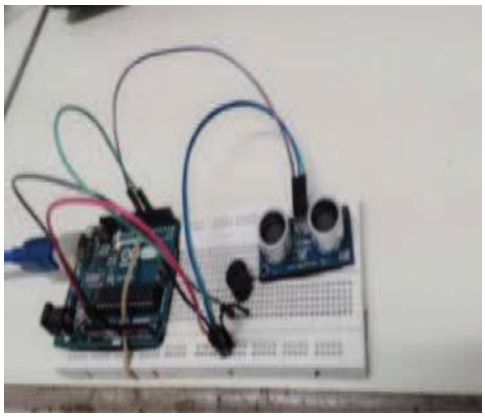


Figure 12: Demonstration of fall detecting sensor

5. Testing System

After completing the designing of the prototype, the testing is one of the thing we need to carry on to check whether the product or system is working correctly or not. The result of testing the hitch detection around the blind people started from distance 152-2cm.The speed of the sound beep started from 1.3s to 0.2s.

The Testing table is shown below:

Table 2: Testing Table of Hitch Detection

Sl No	Distance	Output	Speed of beep sound(ms)
1.	2-25	Sound on	0.2
2.	26-62	Sound on	0.6
3.	63-92	Sound on	0.9
4.	93-122	Sound on	1.1
5.	122-151	Sound on	1.3
6.	152-...	Sound of	No sound

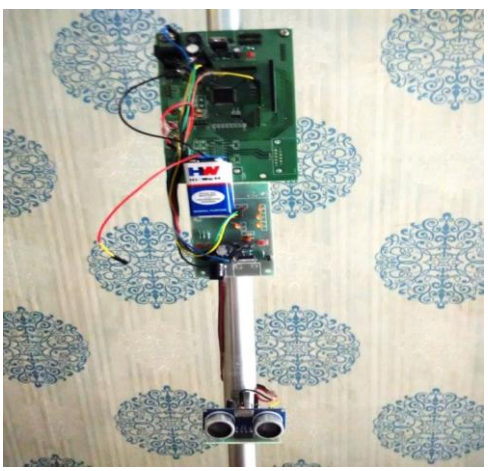
The result of testing the hole detection around the blind people stated that any pot holes are detected. It detects the pot hole having depth from 10cm to 60cm.

The Testing table is shown below:

Table 3: Testing Table of Pot Hole Detection

Sl No	Depth	Output
1.	3-9	No Beep Sound
2.	10-60	Beep Sound
3.	60-...	No Beep sound

6. Snapshots of Smart Cane



7. Conclusion

In light of the testing and examination result, it can be expressed that, the keen guide augmentation for visually impaired stick can be executed as an expansion module for a regular stick. The UID result testing arranged the model into "Great" class which implies that the keen guide expansion is sufficiently amicable and helpful for the client. This provides 360 deg help to blind people, which means detecting the obstacles from top to bottom horizontally and vertical objects.

8. Future Enhancement

In this project we have used a technique called color sonification. This technique is implemented and tested first time. It has some of the drawbacks in extracting the color pixels from the captured image. So in future we will overcome drawbacks. Instead of implementing the model on the ordinary cane we are planning to design a model small as Bluetooth so that it can be implemented on head hat, cost will be less and provides 360 deg help.

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