Effective Fast Response Smart Stick for the Blind and Visually Impaired People

Shital Ramesh Sonawane[1], Prof. N. S. Vaidya[2], Prof. D. L. Bhuyar [3]

M. Tech Student[1], Professor[2], Professor[3]
[1, 2, 3]Department of Electronics & Telecommunication Engineering,
[1, 2, 3]CSMSS Chh. Shahu College of Engineering, Aurangabad, Maharashtra, India.

Abstract-*This paper proposed mainly concentrate on visually impaired people to make their life easier because blindness snatches the visual beauty of the world from an individual's life. In this system one part contains detect obstruct in front of visually impaired people and alert them. And another part is it can capture the image and read the text which are available on the image. With the help of "eSpeak converter", it converts the Text into Speech. This is the new innovation described in given paper.*

Key words: Smart Stick; Water Sensor, Ultrasonic Sensor, Power supply, Microcontroller, USB Camera, Raspberry Pi, wi-fi, Audio Speaker.

I. INTRODUCTION

There are several issues over which humans have no control. Blindness is one kind of such issue. Main purpose to work on this project is to focus the blind population of the world and to support them in every walk of life through the aid of technology. Blind people are suffering lot to perform their day to day task due to this problem. One of their most leading problems is of transport, such as crossing roads, traveling in trains, or other public places also they are finding difficulties while detecting obstacles in front of them, during walking in the street, which makes it dangerous. They always need human assistance to do it. But sometimes they are helpless when no such assistance offered. Their dependencies deteriorate their confidence. Hence to overcome this kind of issue they can use trained dogs, but such dogs are very expensive and not very reliable. Some other products available in the market are the smart belt, smart ring. But these devices have very limited usability and lack approach due to more cost. The smart stick comes as a proposed solution to enable them to identify the world around. In this paper we propose a solution, represented in a smart stick with low cost, fast response, low power consumption, light weight and ability to fold. It consist of ultrasonic sensor to detect obstacles in front of the user, Water sensor is used to sense the water ,oil or slippery area in the path and. The camera is used for text recognition. It works as a virtual eye for blind people, It recognized the text from Image and with the help of Raspberry Pi module its converted into Audio signal and the output will be from an earpiece. All Sensors serve as its eyes and the microcontroller, Raspberry 'Pi' serve as its brain, hence this device is efficient and unique in its capability in specifying the source and distance of the objects that may be encounter by the blind. It is able to scan areas left, right, and in front of the blind person regardless of its height or depth.

II. "GLOBAL STATUS REPORT OF BLIND PEOPLES 2019" PREPARED BY WORLD HEALTH ORGANIZATION [1, 2, 3, 4]

1. Globally, at least 2.2 billion people have a vision impairment or blindness, of whom at least 1 billion have a vision impairment that could have been prevented or has yet to be addressed.[1,2]

2. This 1 billion people includes those with moderate or severe distance vision impairment or blindness due to unaddressed refractive error, as well as near vision impairment caused by unaddressed presbyopia[1,2]

3. Globally the number of people of all ages visually impaired is estimated to be 285 million, of whom 39 million are blind. According to the report by Times of India, India is now home to the world's largest number of blind people. Of the 39 million people across the globe who are blind, over 15 million are from India.[3]

4. Also on the other hand, India needs 2.5 lakh donated eye every year, the country's 109 eye banks manage to collect a maximum of just 25,000 eyes, 30% of which cannot be used.[4]

III. SMART STICK INNOVATION [5]

In this paper different development in Smart stick which can be helpful to avoid accidents of blind people. It focuses on blind people comfort increase safety is the important factors while doing the Transport from one place to other. Data is sent to the microcontroller when the stick encounters different obstacles in the path of blind person that means depending upon the type of obstacles data will sent to the microcontroller, Saved data is analyzed by microcontroller based upon judgment command is sent to the output. Vibrations occur in

predefined sequences set up during software implementation. No two vibration sequences will seem similar. Data sent by the microcontroller to the output is in electrical form and this electrical data is converted into vibrations and alerts goes to blind, this type of complete automation is used in smart stick. Smartly it's recognized the thinks and immediate massage goes to blind or visually impaired person. We are hoping to greatly impact the lives of blind people and console the general differently-able population that even if we cannot medically heal them, we still can vastly improve their daily lives by utilizing advanced technology. This a new start in developing devices which can aid not only people with disabilities but even normal people in their day to day lives. Allowing humans to become much more efficient in their work.

- **Block diagram of existing system**

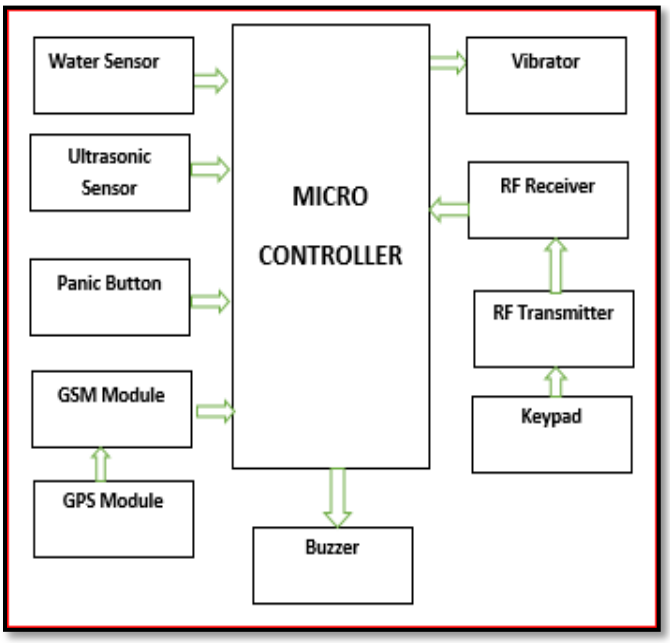


Figure1 : Block diagram of existing system

IV. GAP IDENTIFICATION

As mentioned in above systems are developed for blind person .In smart stick using Microcontroller they uses the sensors to indicate obstacles and slippery portion output is in vibration motion, but it is not effective as blind person cant able to listen it, hence to overcome these issue the new techniques is introduced with the help of Raspberry Pi module. In this system if any obstacles or water is available in front of blind person , the system will gives one audio information to them with help of headphone. Also the new innovation of proposed system is, Author are using Image processing technique to captured the image by camera WHICH AVAILABLE INFRONT OF Blind person and the text available on image is converted into audio by using Optical Character recognition, then that text message will be converted into Audio signals with help of "espeak application "by using cloud server networking.

V. PROPOSED METHODOLOGY OF IMAGE PROCESSING IN SMART STICK:

In this paper author has been explained and outlines all developments of Image processing techniques in Smart stick such communication connected to text available in images and blind people. Intelligent smart stick based on Image processing is creatively described in given paper, this paper is also focus on the new and updating generation in the smart stick. Paper have described the connectivity of blind person and images available in front of them, it converts the all available text message on an image to speech and provide it to blind person with the help of headphone. Images to text converter and Text to speech converter give details about image and blind people communication system in given paper. Image processing is done with the help of optical character recognition, it can captured the image and read the text which are available on the image. With the help of "eSpeakNG converter" it converts the Text into Speech.

- **Block diagram of proposed system**

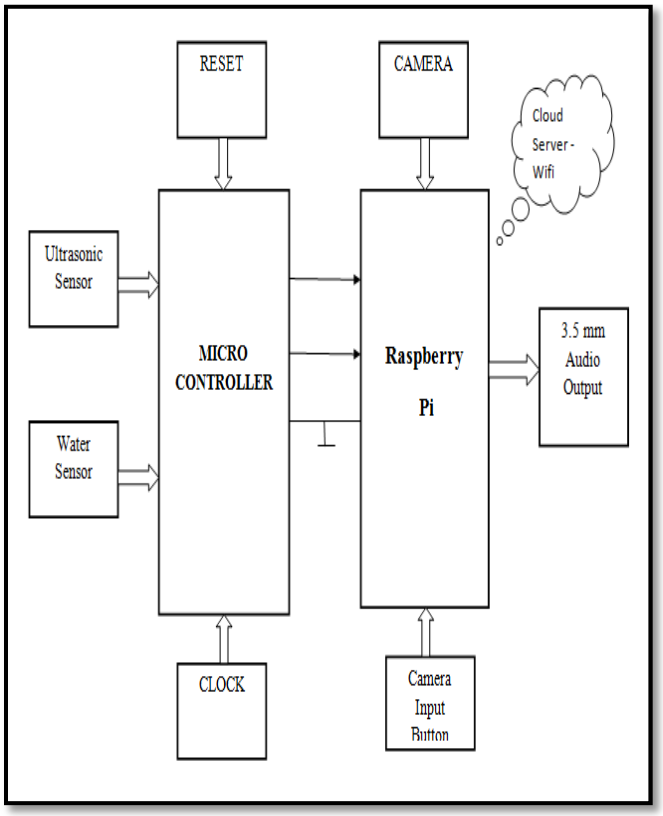


Figure 2 : Block diagram of proposed system

• Ultrasonic Sensor:

Author used ultrasonic sensor to detect the obstacles in the path. This sensor is based on measuring the properties of sound waves with frequency above the human audible range often at roughly 40 kHz. They typically operate by generating a high-frequency pulse of sound, and then receiving and evaluating the properties of the echo pulse.

Figure 3 : Ultrasonic Sensor

It uses the following mathe- matical equation:

Distance = Time x Speed of Sound divided by 2

Time = the time between when an ultrasonic wave is transmitted and when it is received we divide this number by 2 because the sound wave has to travel to the object

• Water Sensor:

As water sensor we are using simply two probes of connectivity and one load resister is used across the two probes. When both probes will come in contact with water or oil it will gives the signal and audio output will be generated. .

• Microcontroller ATMEGA 328P

ATmega 328p is 8-bit high performance microcontroller of Atmel mega AVR family with low power consumption. It has interface input and output for communication with external components. It mounted on the Arduino UNO board. The microcontroller acts as a central processing unit in the system and executes all the functions in the prototype. In order to execute the instructions microcontroller is programmed in 'C' language with the help of Arduino IDE. The microcontroller development board is activated with power supply of 5V by using power adapter or USB from PC. By activating the serial ports in the microcontroller, communication path is established by using UART1 and MAX 232.

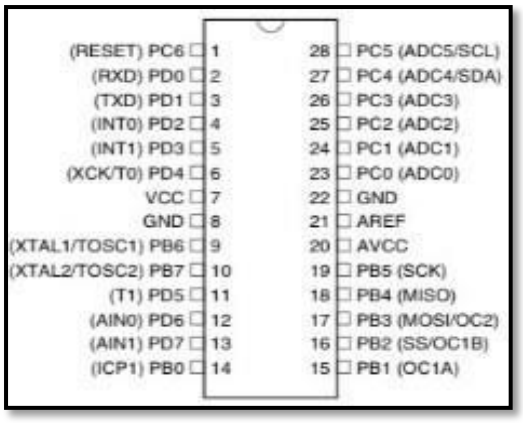


Figure 4 : ATMEGA 328P-PU Microcontroller

- **Power supply**

In our system we are using 5 volt power supply , A power supply is an electronic device that supplies electric energy to all system components. The primary function of a power supply is to convert one form of electrical energy to another. Power supply has a power input which receives energy from the energy source and a power output that delivers energy to the components.

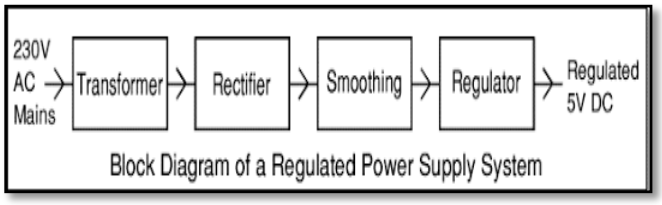


Figure 5: Basic Block diagram of Power supply

• Raspberry Pi

Raspberry Pi is nothing but a small computer , It's a very low cost ,highly effective and credit card sized small computer which can plugs into a monitor or TV, standard keyboard and mouse can also connected to it. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. Here we are using Raspberry Pi3 model B+ in our system, It is an advance model in Raspberry Pi series. It is having 64-bit quad core processor with frequency 1.4 GHz with built in metal heatsink, having dual band LAN one is 2.4 GHz and another is 5 GHz, faster (300 mbps) Ethernet, and PoE capability via a separate PoE HAT.

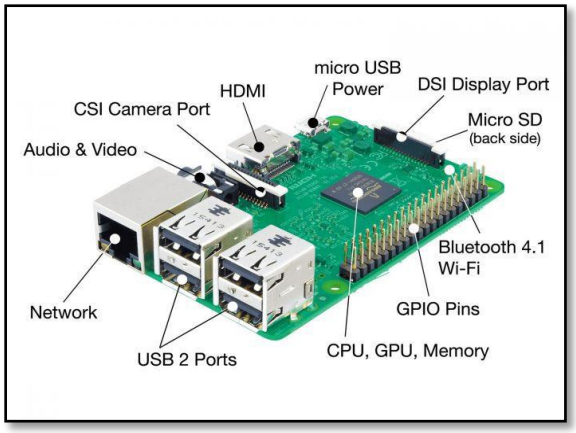


Figure 6: Raspberry Pi Model

• Optical Character Recorder (OCR)

Optical character recognition (OCR) is the recognition of printed or written text characters by a computer. It is the electronic or mechanical conversion of images of typed, handwritten or printed text into machine-encoded text, whether from a scanned document, a photo of a document, a scene-photo or from subtitle text superimposed on an image This involves photo scanning of the text character-by-character, analysis of the scanned-in image, and then translation of the character image into character codes, such as ASCII, commonly used in data processing.

• USB Camera

The camera of the mobile device is critical to use the application, since it will be essential for the user to take the picture of the brackets containing text that will be recognized and synthesized. The image capture is done inside the application itself, thus avoiding the use of additional applications such as access to the photo gallery. Input from camera is given to the raspberry pi module via USB cable. The autofocus and auto flash camera options will be set as switched on

Figure 7: USB Camera

- **eSpeakNG Application**

eSpeakNG is a compact, open-source, software speech synthesizer for Linux, Windows, and other platforms. It uses a formant synthesis method, providing many languages in a small size. Much of the programming for eSpeakNG's language support is done using rule files with feedback from native speakers. The eSpeak engine is a small, lightweight text-to-speech (TTS) program that supports a large number of languages. It has a more robotic sounding voice than other engines due to its small size.

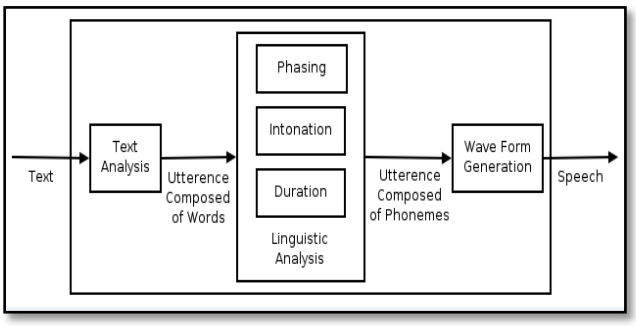


Figure 8 : Text to speech conversion model

VI. SYSTEM IMPLEMENTATION

- **Hardware Implementation**

We have developed the system which helps bind person to read the data by capturing the image. As India has one the largest blind populations in the world the system is very effective for them to increase their independence and indirectly growth of our society. First Initialize all the packages which are used in the system .Then Image is captured by Pi camera and using FS Web Cam package. The Image which captured is stored in the local directory. Then image is retrieved from the local directory .To convert the image in to the text format which is done by OCR (Optical Character Reader) .We apply OCR and extract the characters ,After extracting the image data it is saved in the text file .The text file save in the local directory .Then **eSpeak** is applied so that it generate audio file and generated file is saved in the MP3 format .Then File is saved in the local directory .By using OMX player MP3 file is play and we can get the audio .So blind person get the audio by headphone or Bluetooth. So that Capered image is converted in to the Audio.

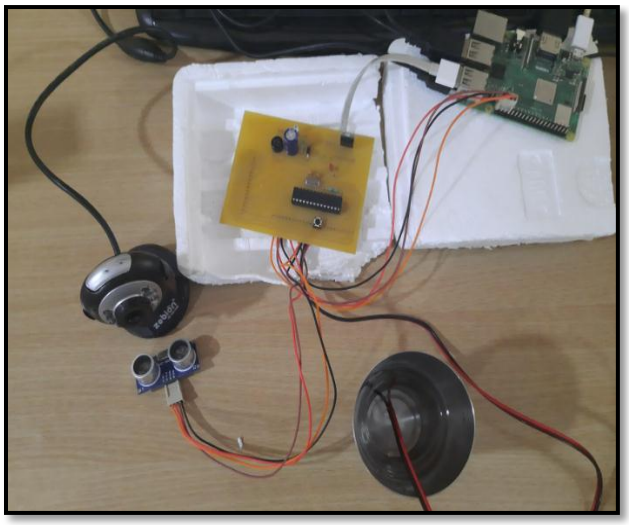


Figure 9 : Complete Hardware of Smart stick system

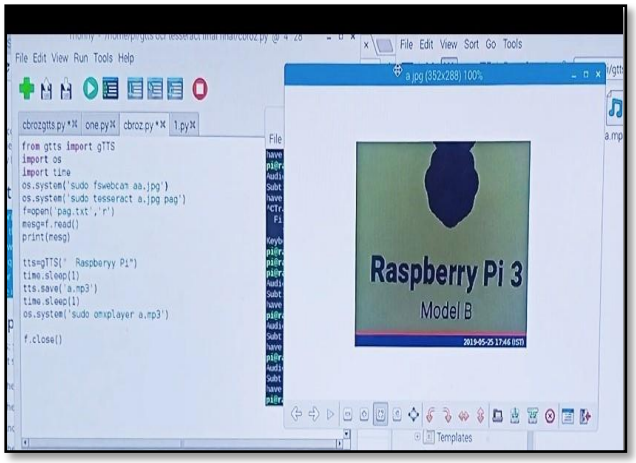
- **Software Design**

Raspbian is the operating system which we are using in Raspberry PI. Raspbian Raspbian is a Debian-based computer operating system for Raspberry Pi. There are several versions of Raspbian including Raspbian Buster and Raspbian Stretch. Raspbian is highly optimized for the Raspberry Pi line's low-performance ARM CPUs. • Raspbian uses PIXEL, Pi Improved X-Window It is composed of a modified LXDE desktop environment and the Open box stacking window manager . The distribution is shipped with a copy of computer algebra program Mathematical and a version of Mine craft called Mine craft Pi as well as a lightweight version of Chromium as of the latest version.

VII. RESULT

We have captured the Image through Pi camera 'Raspberry PI 3' and it stored as a.jpgand below output we can get and after the text the output it is converted in the Audio by "eSpeak" Application and output file is also save in the local directory.

Below image is captured and stored as a.jpg figure



The Image to be captured is not aligned properly then the image text will not be shown clearly .It cannot recognize the alphabet so that it cannot search in the directory of open CV.For example if the word is 'ABCD' and the image is not aligned in the straight line and the proper size then the output will show the error, It will captured the wrong words .In the ABCD it will capture the words as 'APED' .The word camera will see it will capture that and compare with the library. We have tested the system by giving various input as below .By giving all upper case latter we have found some miss make in the output from the input data and that by visuaually we can identify the difference in both input and output .If we observed instead of letter B it captured letter P as the alignment for both is same, and same in case of C it captured E. For small letter also we tested same result found as similar words showing in alignment it is capturing wrong words. For f it has captured b and for r the result is e.

Table 1 Output analysis:

Sr.No	Input Alphabet	Observed output on screen/Audio generated
1	ABCD	APED
2	PARLE	BARLD
3	PRICOL	BRECOL
4	Efgh	Ebgh
5	Prince	Peinec

From this we have concluded the input alignment should be more than 90% so that we can get the correct output. As we have given 15 alphabet to the input in that percentage of correct output is 80%. .Background color shade will also affect our output. As the color is dark then the image which we are capturing will be not be focused to the image, it will be burred as the color effect is dark. We have captures 10 images with dark backgrounds and we seems that our output percentage is 20%. So we can conclude the image should be captured with the light

background color. Then we have taken samples of images with the light backgrounds then result is near about 85-90%.So we should consider the background as light shade not dark shade.

VIII. CONCLUSION

The proposed system, was designed such that the system captures the image of any hand held object is placed in front of the Raspberry Pi camera.Pi Camera is placed in front of the image and the image is given to theThe captured image or text details are fed as input to the Raspberry Pi processor with OCR (Optical Character Reader) .OCR is used to convert type written text or photo or scanned documents in to the machine or computer language .As computer doesn't understand the picture data and scanned documents. In OCR first image is preprocessed in that it improve the Quality of the image so that OCR gives accurate output .Then in character Recognition involves the comparing of the image with the open cv dictionary and in post processing we got the text output again so it convert turning a picture of text into text itself. eSpeak Application is used to convert the text output to the audio output .The audio output is get through the speaker, earphone or with the use of headphone .so Blind person can hear the audio so that he can recognize the image which he captured .If the image is not align or blurred then output will not come .So alignment is primarily requirement.We have tested our system and found 80% corrected as output and time require to capture image to the output is 3 minute. In this way Blind person can improve their independence as they can walk alone and do their activity by alone. Now a days in this busy schedule everyone should be independent so this system will help blind person. If any label or product bar code they want to read they can read by simply taking the picture. This will enhance their personal growth as well as growth of society and country.

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