International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-4, February 2020

Smart Wearable Visualizing System for People with Hearing Impairment

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Abstract:- ***In worldwide around 466 million people have struggling because of hearing impairment and 34 million of those are children. Hearing loss may cause due to aging and exploring of louder sounds, complications at birth, certain contagious diseases, prolonged ear infections. Nowadays people with hearing disability uses hearing aids, but due to the environment noise interference it won't be efficient and also they don't separate speech and noise in noisy environments. In order to intimate the deaf person, we have introduced a system which includes several means of visualizing both ambient and speech sounds and presents a combination of visualization displays incorporated into one system that would help the hearing impaired people to an enhanced awareness of their surroundings.***

Keywords: Hearing loss, Visualizing ambient and speech sounds, awareness of surroundings.

I. INTRODUCTION

As per the assessment one in three people over the age of 65 years and number of 466 million individuals worldwide are struggling with hearing impairment.
It causes a problem at any point in the hearing trail and depending on which type of loss.
There are two categories:

- Conductive hearing loss
- Sensory Neural hearing loss

Conductive hearing loss happens due to the defects in the part of outer and middle ear for example ear canal, eardrum and middle ear bones. It causes the problems like earwax, fluid or infections in middle ear, small holes in ear drum. People with a conductive hearing loss can be corrected medically or surgically. Another is sensory neural hearing loss happens due to the defects in the part of inner ear for example cochlea, nerve, vestibular organs. The one we discussed now is the most common type of hearing loss and is caused damage to tiny cell in inner ear; thereby it could not communicate the signal to brain. The wearable device will acts as assistive device for the hearing impaired. It will potentially modify the lives of millions of hearing impaired people. These kind of smart device aims to assist hearing impaired people to lead a comfortable life. It does this in two different methods.

Revised Manuscript Received on February 28, 2020.
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One is by converting sounds into vibration patterns, this in turn helps to people with hearing disability to communicate with others. Another is by converting sound to appropriate pre-loaded images based on the characterization of sound observed, which is very suitable for understanding the conversations through images. By converting these sound signals into vibration patterns and displaying appropriate images related to the sound in the display, this can also notify people about the sound signal propagating around them. This would be very much helpful to the people having hearing disability.

II. SYSTEM ARCHITECTURE

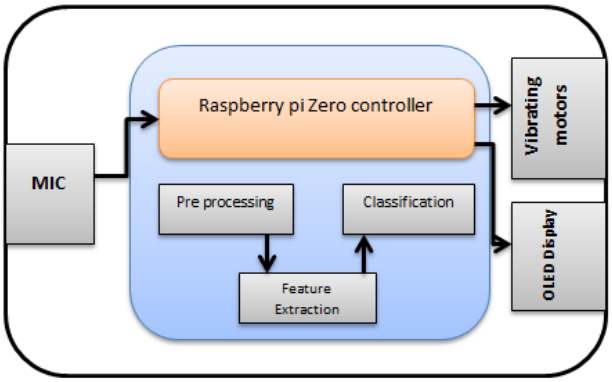

Figure 1.Block diagram of proposed system

A. Block diagram description

This system includes the high sensitive microphone to sense the sound signal around the device and it can be process by the Raspberry pi zero controller. It does the following image processing techniques like Preprocessing, Feature extraction and classification of the signal by using SVM (support vector machine) technique. Based on the classification of the signal, vibrating motors are actuated appropriately, example (illustrated in Table 1), knocking the door sound can be represented and indicate the deaf in the following manner.

Table 1. Illustration output for Door knock

Input	Vibrator	Display
Door knock	Vibrates 3 times with 1 sec delay between vibrations	

III. SYSYTEM DESIGN

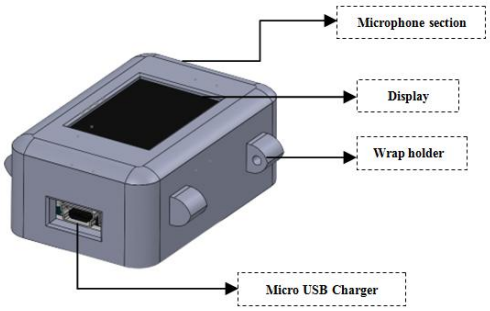

Figure 2.Proposed system design

Our proposed system incorporates two functional units, namely Audio-Visual Conversion and Audio-vibration pattern. Using these systems we ensure that the Conversion, helps the deaf and dumb to understand and react accordingly.

Both systems use artificial intelligence technique to determine specific sounds, like knocking the door, vehicle horns, animal sounds and convert them for hearing-impaired. Audio-Visual Conversion changes sounds into visual warnings that appear in a display associated with the system, whereas Audio-vibration pattern Conversion changes sound into vibrations.

B. Block diagram description

1. I2S MEMS Microphone

I2S microphone sensor is a MEMS type miniature, low power, bottom port microphone with digital output capability. It consists of a high performance sensor to converts an input acoustic signal into digital by an industry standard 24 bits format. I2S interface simplifies the interfacing methodology between the sensor and controller. Thereby it is entirely suitable for portable applications where the size and power consumption is a constraint.

2. Raspberry pi Zero

Raspberry Pi Zero is the 1 GHZ single core CPU, is an ideal solution for portable embedded systems. Here it can be incorporated to do the audio processing, including preprocessing of sound signal from the microphone, feature extraction and classification of the signal. Then drive the display and vibrator to perform appropriate action. .

3. Vibrating motor

In order to intimate the hearing impaired people a device gets vibrate by a very small electric motor with an eccentrically mounted weight on the shaft. When the motor spins, this unbalanced weight makes the device to vibrate with specified pattern.

4. OLED Displays

This display is made of 128x64 individual white OLED pixels interfaced to the controller chip where it can be used to display the pre-loaded image according to the acoustic signal observed. It can be interfaced to controller via SPI or I2C interface.

IV. RESULTS ANDANALYSIS

Table 2 illustrates results for different input sounds. Here it represents output for different input sounds like, Door knock, vehicle horn, human being voice, animal sounds and mobile phone ring. For instance a microphone in the device senses the mobile ring sound means, it can be intimated to the hearing impaired people through the preloaded vibration patterns and the images at the output side.

S.No	Input sound signal	Vibrator output	Visualized output
1.	Door knock	Vibrates 3 times with 1 sec delay between vibrations	
2.	Vehicle horn	Vibrates 2 times with 1 sec delay between vibrations	
3.	Human being voice	Vibrates no. of times until he/she can stop calling	
4.	Animal sound	vibrates 1 time	
5.	Mobile phone ring	vibrates 4 times with 0.5 sec delay between vibrations	

Table 2. Illustrations for Different input sounds

V. CONCLUSION

The design and prototype of smart wearable visualizing system for people with hearing impairments has been executed with the appropriate module. The current system is a tiny as well as well portable and wearable for hearing impairment people. The system such a way designed to capture the input sound signal from the environment and converts into appropriate vibrations and visualized output through the vibrating motors and OLED displays.

These kinds of innovation systems definitely assist the disability people in an enormous way and acts as a perfect solution for hearing impaired disability.

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