Wearable Technology for Visually Challenged People Commutation using Ultrasonic Mapping

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Abstract. 253 Million People live visual impairment Globally according to World Health Organization (WHO). Assistive technologies plays a major role for the improvement in the quality of life for Visually challenged persons. Visually impairment Blind people can lead their life either by using manual or technological support. Vision is the dominant sense that assist in execution of day to day activities effectively. The proposed prototype takes care of transition of manual support to technological support with the help of a Wearable device. The Wearable device is being attached with the belt to the top wear of the person and Ultrasonic mapping is used for the commutation of Visually challenged/Blind people without the help of other Human. The Ultrasonic wave is used to detect the obstacle in front and back. It indicates while the obstacle is close enough. If the obstacle is within a reach of 100cm radius, the vibrator connected to it will vibrate and alert the User.

Key words: Visually challenged, Blind, Wearable device, Ultrasonic Sensor.

1. Introduction
Across Globe, the people affected with near/distance vision impairment is 2.2 Billion out of it 50%(1 Billion) are affected by various types of symptoms such as Cataract, Diabetic Retinopathy, Glaucoma and others. There is a gigantic Global financial burden due to Vision impairment poses a productivity losses appraise to US$ 250 Billion[1]. Assistive Technology, subspace of Technology aids in improve the quality well-being of the needed. In the absence of assistive technology, people with disabilities will be isolated and leads to poverty and burden on morbidity. Assistive products include hearing aids, spectacles, wheelchairs, walking frames, prosthetic legs and pill organisers and also with the use of ICT. In 2015, United Nations (UN) Member States endorses Sustainable Development Goals (SDG), where Goal 3 address on Ensure Health Lives and promoted well-being for all Ages [2].

2. Literature Survey
P. E. Lanigan [3] enumerates on the assistive technology for the Blind in Grocery shopping which a cost-effective prototype is named Trinetra. A. Johnson [4] discusses about a Wearable device converting visual information into tactile signal for the Blind /visually impaired people as it improves the Quality of Life by restoring their ability to self-navigate. D. Yang [5] elaborates on a framework in assisting Blind people to see the World by auditory pathway.
based on Embedded block coding with optimized truncation (EBCOT) which operates in real-time. EBCOT algorithm [15, 19] applies two-tier coding and optimal Wavelet base with its ability to code with minimum rate-distortion. It compares the various Wavelets with SPIHT and EZW. H. Jabnoun [6] discuss about Object recognition for Blind people based on Feature extraction. It provides an overview of various visual substitution systems.

G. A. Farulla [7] enumerates on the designing an effective and low cost Navigation system for Blind and visually impaired persons named as Orientoma. F. Puente-Mansilla [8] discuss upon a Wearable UV Sensor for blind people for offering an appropriate skin care recommendations based on Ultraviolet Index (UVI), exposure time and skin color. To obtain Vitamin D for the Human body is achieved from Ultraviolet radiation from the Sun. C. S. Silva [9] discuss about a multi-sensor fusion approach for an electronic navigation aid for the blind and visually impaired persons. F. Ahmad [10] address on a Wearable bionic Kinect device by Haptic & Voice feedback for Visually challenged persons. The prototype is light weight & portable.

Ali Jasim Ramadhan [11] describes on a Wearable Smart System to help Visually Impaired Persons (VIPs) walk by themselves. J. Bai [12] enumerates on a prototype to help the blind people walk to the destination efficiently and safely in indoor environment with a novel Wearable navigation device. G. Sareeka [13] discuss about designing a Wearable device which identifies the texts in the surroundings of the wearer and convert it to voice message which will be given as feedback. S. Khan [14] enumerates in developing a smart and intelligent guiding mechanism at indoor and outdoor locations for blind and visually impaired people (BVIPs).

3. Proposed System
Main objective is to develop a small, comfortable and user friendly device to detect obstacles ahead of a Blind/visually challenged person. The idea is to develop a Jacket with the belt to help to make the Blind/visually challenged people commutation easier and safe. The Jacket is comes with the Ultrasonic sensor in its Waist for detecting the obstacle while movement and the vibrator connected to the sensor picks up the signal and indicate to the blind/visually challenged person moving through vibration signal. It process the data received from Sensor [16, 20] and measures it sends it to vibrator for indication. It also detects different vibration levels for the obstacle gets closer in regular intervals and alerts the blind person, helps to improve the mobility constraint in real-time.

![Figure 1. Block diagram](image-url)
The proposed model consists of four modules integrated together to perform the operation namely, Arduino Power Source, Microcontroller Unit [17, 18], Display Unit & Software Unit. ATmega2560 Microcontroller is used for Signal transmission and also used to monitor the messages or signals send from the sensor and it gives the desired message to the vibrator motor to vibrate. Figure 1 displays the block diagram of the proposed model. The main components consists of Arduino Mega 2560, Ultrasonic Sensor, LCD Screen & Motor driver. LCD is used to display sensor values for improving the functionality of the prototype and used to represent the distance for the analysis purpose and to calibrate sensor and to measure the performances. In this unit compile the program for execution of operation in proper manner. Codec is used in will corresponds with the Arduino programming to drive the board and its peripherals in a synchronized way. Figure 2 displays the Process flow chart. Figure 3 displays the block diagram of the proposed model.

4. Hardware Module

Figure 3 displays the Circuit diagram for the proposed model. Figure 4 displays the block diagram of the proposed model. Ultrasonic Sensor implemented in the prototype senses the distance between Obstacle and user. When the Obstacle is very close to the Visually challenged/ blind, then the sensor detects the Obstacle and sends this message to vibrator motor.
5. Results and Discussions

The various responses from Front Sensor A are displayed in Fig. 5 based on the distance of the Visually challenged/Blind people to the obstacle. Front Sensor for 100 cm and above, the vibrator motor does not work for safety. Front Sensor A displays “ALERT” if any obstacles crosses between 50 cm-100 cm and Pulse mode (150) analog signal vibrations will turn “ON”. Front Sensor A displays “CLOSE WARNING” if any obstacles crosses between 2 cm-50 cm and Pulse mode (200) analog signal vibrations will turn “ON”.

The various responses from Back Sensor B are displayed in Fig. 6 based on the distance of the Visually challenged/Blind people to the obstacle. Back Sensor for 100 cm and above, the
vibrator motor does not work for safety. Back Sensor B displays “ALERT” if any obstacles crosses between 50 cm-100 cm and Pulse mode (150) analog signal vibrations will turn “ON”. Back Sensor B displays “CLOSE WARNING” if any obstacles crosses between 2 cm-50cm and Pulse mode (200) analog signal vibrations will turn “ON”.

Figure 6. Snapshot of response from Front Sensor A

6. Conclusion
The designed prototype of Wearable Technology assist for Visually challenged/Blind people Commutation using Ultrasonic mapping based on Ultrasonic Sensor. The proposed model has the benefits over the conventional methods in terms of design time, production Cost & power consumption. The prototype can be further enhanced with inclusion of sound alert system instead of vibration alert and also inclusion of GPS and GSM to detect the current location of the Visually challenged/Blind people.

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