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Electronic Shoe: To Assist Visually Impaired

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Abstract

The greatest things conquered on the earth are not with the eyes, but through the vision built on it. According to the WHO 2019 survey report globally it is estimated that 2.2 billion people suffer from vision impairment or blindness. The rapid growth of the technology which has placed its strongest footstep in every field has played a vital role in assisting the blind people to communicate with the real world independently by voice guidance. In this research "Electronic Shoe to assist visually impaired" that helps in obstacle detection using ultrasonic sensors and water detection using moisture sensors. The Webcam captures the text in the image and converts it into speech by using OCR (Optical Character Recognition) algorithm and object identification using YOLO Classifier. Accelerometer is used for recognizing whether the person is in an emergency situation and sends an SMS alert through twilio to the authorized person and GPS in the android application will be utilized for navigation purposes during the emergency situation.

Keywords: *Obstacle detection, visually impaired, Assistive application, YOLO Classifier, Optical Character Recognition (OCR), Twilio.*

1. Introduction

Eyes are considered as one of the most important sense organs for humans to communicate with their surroundings independently. Visual disability is perceived to be a deficiency of the visual system's behavior and functions. Visual impairment is not curable by glasses, contact lenses, drugs or surgery that disrupt the ability to perform daily life activities.

A total of 285 million people are reported to be visually impaired, 246 have poor vision and 39 million are completely blind. 80% of all visual disability is believed to be avoided or cured. In India there are 7.8 million blind people, while 45 million are visually challenged.

The country reports for 20% of the 39 million blind population across the world. It is said that the incidence of Childhood Blindness in India is 0.8/1,000 children in less than 16 years of age, which means a total of 3, 00,000 blind children in our country. Out of 62% are of cataract, 19.7% ophthalmology, 5.8% glaucoma and 1% corneal blindness.

The visual system has 4 levels of visual function, Normal vision, Mild vision impairment, severe visual impairment, Blindness. Blindness is described as a person's incapability to count fingers from a separation of 6 meters or 20 feet. The main causes of blindness are cataract which contributes 62.6% to visual deficiency, refractive error 19.7%, corneal blindness 0.90%, glaucoma 5.8%, surgical disability 1.2 %, posterior capsular opacification 0.90%, and posterior segment distortion 4.7%. [Refer figure1]

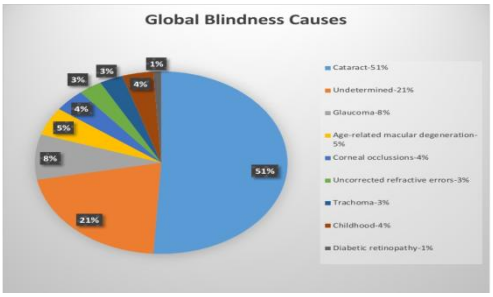

Figure 1: Global Blindness Causes

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Estimated that National Pervasiveness of Childhood Blindness/Low Vision was 0.80 per thousand. It is said that 93% of blindness cases are avoidable. Bijnor, Uttar Pradesh has the largest blindness-stricken population, around 3.67 percent of the district is blind and 21.82 percent is visually impaired.

In this paper we have proposed an effortless navigation system for the blind person which helps him to navigate independently even amongst the obstacles. Ultrasonic sensors help in detecting the obstacles and Moisture sensorhelps in detecting the presence of water on the surface of the earth. We are not just predicting the presence of obstacles but also we are explaining what kind of obstacle is hindering their path through YOLO Classifier (Refer this algorithm in the Algorithm section below) in object detection technology. Webcamcaptures the text in the image and converts that text into speech via Bluetooth or earphones by using OCR algorithm there by updating all current affairs to the blind person. Accelerometerhelps in recognizing that the person is in an emergency situation and sends an alert message through twilio to the registered mobile number, when the blind person is in an emergency situation the available GPS in the Android application will be utilized for navigation purposes.

2. Literature survey

According to the World Health Organization (WHO), there are around 285 visually impaired people worldwide. Out of 285 million people, 39 million are fully blind and 246 million have poor vision. The poor vision of the sightless experience problems when hearing, finding objects, etc. Blind people require certain assistance to help them communicate with the world. They use sticks for years to help them locate obstacles in their path. [7]
The smart white cane is an ideal technological tool built to detect solid ground obstacles, pits, irregular walls, stairs and other dangers by easy tactile force input. The drawback of this system is that it cannot detect all the obstacles, it is capable of detecting obstacles only below the waistline. [2]

The machine comprises two components: detecting the ambient atmosphere against barriers for the visually disabled individual and alerting the barrier through vibration along with the input device. [4]

The technology can help in diminishing many barriers that people with disabilities face. These kinds of technology are cited as Assistive Technology (AT). Different large numbers of the ultrasonic sensors and servo motors are used in detecting the presence of the obstacles. The drawback of this system is that large ultrasonic sensors and servo motors are very expensive. Therefore, not all blind people can afford this system. [3]
Wang Rong developed a fall detection device, which offered a solution for the identification of older people's gestures. Even, as a danger alert device, a dropping monitoring system does not prevent blind and visually disabled individuals and notify their families when an unexpected incident arises. [5]

For this article, the device uses a multi-sensor architecture and very complicated smart processing to provide the user with knowledge that is useful for performing urban mobility activities, such as human identification and walking for crowded environments, etc. [6]

3. Proposed model

Addressing the issues of people with visual problems through a single aiding system is a tough job. This project aims to provide a proper navigation for individuals suffering from less vision and blindness. The system is mainly composed of a Raspberry PI B+, Ultrasonic sensor (HC-SR04), Moisture sensor, Bluetooth, Accelerometer, Webcam.

Raspberry PI is a miniature credit card-sized device(refer Figure 3) used to monitor the entire machine. It offers a series of GPIO pins that enable you to monitor electronic components (Ultrasonic sensors, Water sensors, Accelerometer, webcams) for physical computing. The SD card is placed into the space where the board serves as the Raspberry PI hard drive. It is operated by USB and has a PCB antenna for use on 2.4GHz and 5GHz ISM frequencies, ideal for Bluetooth applications.

Ultrasonic sensors are available for detecting the obstacles(refer Figure 4) which are placedat a specified distance. This consists of two ultrasound transducers. One transducer serves as a transmitter that transforms an electrical signal into 40 KHz ultrasonic pulses. The receiver listens to the emitted pulses. When the pulse is transmitted, it generates an output signal, the duration of which can be used to evaluate the distance the signal travelled from which the presence or absence of an object can be sensed. The sensors are compact and give outstanding non-contact range detection from 0.02m to 4m (about 1 inch to 13 feet) with a precision of 3mm.

Moisture sensor is used for the measurement of the water level (refer Figure 5) and it is responsible for handling situations like rain. Hydraulic sensors are typically referred to as devices that calculate the quantitative water content. This system requires two scans to transfer the current across the surface, and then tests the resistance to moisture. If the soil has sufficient water, the performance of the instrument is small, then the performance is sufficient.

The wireless connectivity can be achieved with the help of Bluetooth devices to the Android application. These Ultrasonic sensor and Moisture sensor provide an input voltage to the Raspberry PI, which then alerts the user via Android Smartphone via the use of the Bluetooth module.

An accelerometer is an electromechanical device(refer Figure 6) used for the measurement of the change in velocity by measuring the current angle at any given time.

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During the emergency situations the available GPS in the Android application will be utilized for navigation purposes. When the person falls down this device delivers an input voltage to the Raspberry PI which sends an alert message to the registered mobile number with the help of twilio.

Webcam will capture the static image (text) and that text will be converted to speech using the OCR algorithm (Refer to this algorithm in the Algorithm section below). Optical Character Recognition is an algorithm for the transforming photos of typed, handwritten or printed text into machine-encrypted language, if it is from a scanned document or a screenshot of a document into a speech that can be understood by a blind individual through Bluetooth. By using Webcam objects are detected and identified by YOLO Classifier(refer Figure 8). It draws boxes and scores around the objects of interest in each frame from the webcam and identifies that will be heed via Bluetooth. [Work flow of the project refer figure 2]

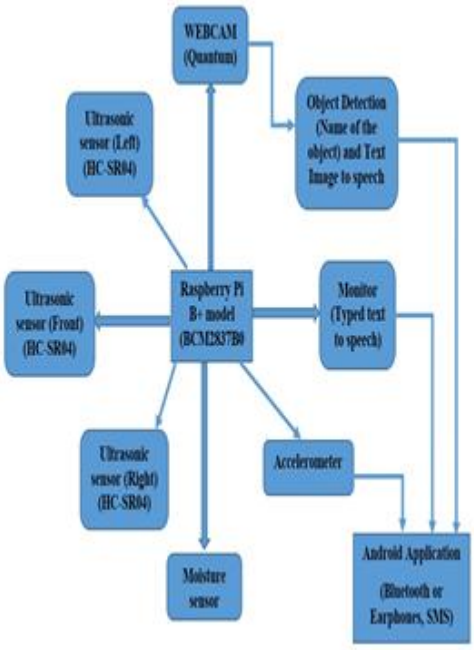

Figure 2: Block Diagram

Algorithms:

YOLO: You Look Only Once is a smart Convolutional Neural Network (CNN) for real-time entity tracking. It includes:

a) IMAGE CLASSIFICATION: The object of Image Classification is to allocate an image to one of many separate categories(e.g. vehicle, dog, cat, person, etc.).

b) OBJECT LOCALIZATION: Localization of objects then lets us find our target in the picture.

c) OBJECT DETECTION: Object recognition includes the means to locate all the artifacts in an image and create the bounding boxes around it.

Algorithm "just look at the picture only once" in the consequences, this takes only one forward distribution to travel across the neural network to render predictions. Upon non-max deletion (which means that the target detection algorithm recognizes every item only once), it then yields known artifacts together with attached frames.

OCR: First, test whether or not Win 32 API is enabled on the machine. If this is not available, an error will be created and the Win 32 SAPI library should be mounted to your machine.

a) Get your speech item from SAPI Win 32.
b) Correlate the input list to the Win 32 SAPI array.
c) Extracts voice by firstly choosing the voice which is available in the library.
d) Select the pace of voice.
e) Initializes the wave player, translates the text into speech.
f) Finally, for the given image speech is obtained.

MODULES IDENTIFIED:

RASPBERRY PI B+: The Raspberry Pi B+ interface has a Simple to use I/O, and it is perfect for Pi ventures. The scale of the RAM varies from 512MB to 1GB, getting the best in memory. The Raspberry Pi B+ has a 64-bit quad-core 1.2GHz processor, not only it is quicker, but it can also accommodate greater data sizes. One of the major advantages is power. They change the voltage regulators and are able to achieve close to half power savings and this model is faster with faster Ethernet, wireless, and wired network throughput has been increased by around three times.

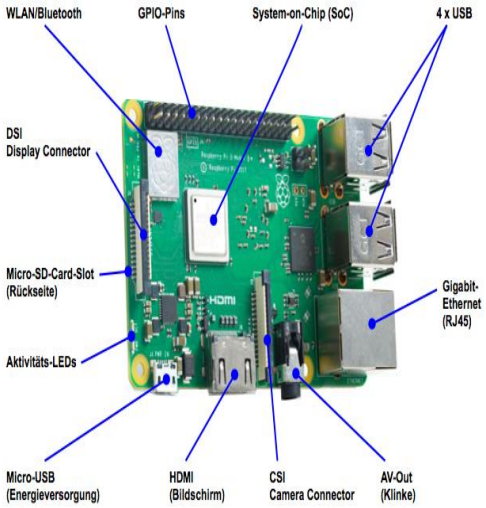

Figure 3: Raspberry Pi B+ Model

ULTRASONIC DISTANCE SENSOR (HC-SR04): The 8 ultrasonic waves are travelling into the air away from the transmitter. Meantime, the echo pins are going up and begin shaping the origin of the echo-back signal. When the received signals are not mirrored back, the echo pulse would then phase out after 38ms (38 milliseconds) and return low. Therefore, the 38 MS pulse does not mean interference inside the sensor field.

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Figure 4: Ultrasonic Sensor (HC-SR04)

MOISTURE SENSOR: The moisture sensor uses the capacitance to test the dielectric allow ability of the surrounding area. In soil, dielectric permittivity is a feature of the substance of liquids. The electrode generates a voltage equal to dielectric allow ability and then, identify the soil water material.

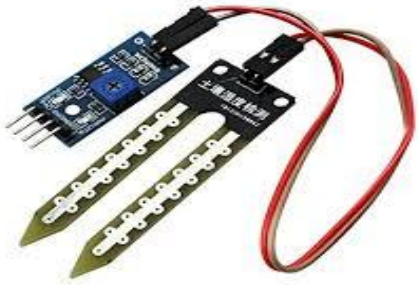

Figure 5: Moisture Sensor

ACCELEROMETER: Accelerometer helps the operator to fully grasp the climate of the product. With this tiny tool, you can decide whether an entity falls to the sky, if it's going to tip over whether it's going to move even further, or whether it's heading upwards or angling downwards. Dynamic accelerometer tests gravitational force in order to determine the tilt, where the unit is inclined to the ground. Through detecting the acceleration intensity, users can perceive how the system travels.

Figure 6: Accelerometer

WEBCAMERA: The camera is fitted with a compact circuit board(25mm by 20mm by 9mm), which is connected to the Raspberry Pi Camera Serial Interface(CSI) bus adapter via a flexible cord wire. Camera Module is a CMOS 5MP camera with a solid objective lens that is worthy of capturing still images as well as high resolution videos.

Figure 7: Quantum WEBCAM

4. Experimental result

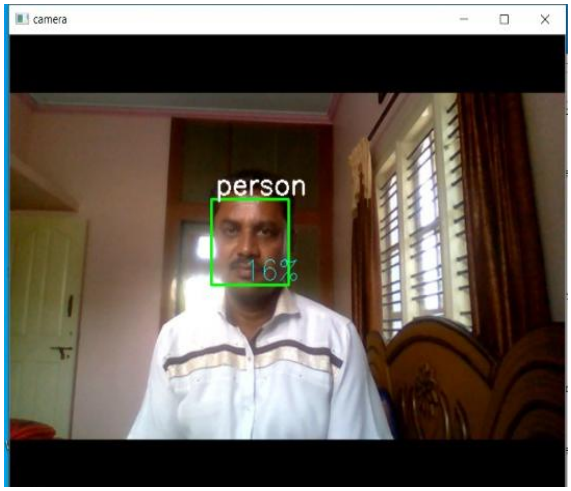

Figure 8: Object detection

Figure 9: Implemented Module

5. Future Enhancement

In the future, enabling the user to add objects themselves is endorsed. Implementation of this project at commodity level including spy camera goggles that transforms text picture to voice over Bluetooth or earphones for the visual disabilities. We also recommended creating an app

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that monitors blind people in cases of disaster or distress. We send notice to the applicant's guardian and even whenever the guardian sends a message to the blind person, this software will ensure that the document is translated into a voice message.

6. Conclusion

This paper includes distinctive intelligent solutions to support visually impaired individuals which help to maneuver without taking aid from anyone. Our project electronic shoe is less expensive, comfortable and effortless navigation. The Ultrasonic sensor and moisture sensor that calculates the gap between the artifacts and also detects potholes. Webcam tracks items in front of it and also transforms text pictures to speech with OCR. The accelerometer transmits SMS in twilio to a registered mobile number when the blind person is in an emergency scenario. This instrument is a concept and yet there is scope for development by adding additional functionality and getting it fit for industry.

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