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VoSC : A Voice Based Smart Cane for Visually Impaired

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Abstract -Visually impaired people find it difficult to know whether object is present or not in front of them while walking down the street. We propose a solution, using a smart cane that notifies in which direction the objects are present with the help of fixed voice messages and also a ground level obstacles are notified to him through a beep sound. Smart cane would help visually impaired people to walk comfortably, keeping themselves safe from danger. The smart cane comes as a way to define the world around them. Around 314 million people are visually impaired out of which 45 million are absolutely blind. Blind people have the fear of falling, meeting accidents since they don't know what is present around them and they also feel less confident. How can we overcome these issues? This paper "VoSC : A Voice Based Smart Cane for Visually Impaired" provides a solution. This is a device composed of Arduino UNO, Ultrasonic sensor, flame sensor, Voice module and a buzzer to priorly inform the user in order to avoid injuries and accidents so that they feel secured and comfortable.

Key Words **:** Blind, Visually Impaired, Ultrasonic Sensor, Buzzer, Flame Sensor, Arduino UNO.

1. INTRODUCTION

According to WHO estimates, there are about 314 million visually impaired people worldwide, of whom 45 million are blind. Without any support and guidance blind people finds it difficult to move around. The use of voice based smart stick becomes a boon to overcome the challenges they face. The components which are embedded on a smart blind stick are Arduino UNO, Ultrasonic sensor, flame sensor, Buzzer and voice module. With the help of these components the voice based smart cane is developed which makes the life of blind comfortable. The Arduino UNO is an open source microcontroller board which is equipped with sets of digital and analog input/output pins that may be interfaced to various expansion boards and other circuits. Every other component of the device is connected to Arduino as it helps in coordination between them. Hence, Arduino UNO is considered as the heart of the device.

The ultrasonic sensor is an electronic device that measures the distance of a target object by emitting ultrasonic sound waves, and converts the reflected sound into an electrical signal. These ultrasonic sensors are placed in three different directions to sense objects and this will be notified to the user with the help of voice module which converts the fixed voice messages in text format to speech through which the blind can hear so that he can be aware of the environment before hand.

The flame sensor is one kind of detector which is mainly designed for detecting as well as responding to the occurrence of a flame or flame which is used in the design of the device to sense flame and it will notify with the help of fixed voice message. The Buzzer is a kind of voice device that converts audio model into sound signal. It is used to alarm when the ultrasonic sensor at ground level is sensed. The main problem what blind faces is dependency on others and unemployment since they are unable to move around independently. As jobs are minimal for blind, their dependency on others should not be a reason. Hence, with the use of voice based smart cane the blind can have healthy and happy life. Scientists have spent decades creating an interactive and responsive stick to support and warn visually impaired people from obstacles and provide knowledge about where they are. Work has been carried out over the last decades on new devices to develop a good and reliable system for visually impaired people to identify obstacles and alert them in areas of risk.

2. METHODOLOGY

The functionality in VoSC : A Voice Based Smart cane for visually impaired is indicated below.

2.1 Obstacle Detection

The smart cane detects the ground level obstacles using ultrasonic sensor and notify the blind via a beep sound produced by a buzzer.

2.2 Object Direction Detection

The smart cane detects the raised objects in different directions such as front, right and left with the help of ultrasonic sensors and outputs a fixed voice message to identify the direction of the object.

2.3 Danger Detection

The device additionally indicates the danger condition, placed above the ground level and detects the fire using flame sensor and notify the user with the voice alert.

3. MODELLING

3.1 System Design:

We have introduced a smart cane that helps the visually impaired people to move around comfortably in day-to-day life. The smart cane is built with Arduino UNO, Ultrasonic sensors, flame sensor and buzzer. The Block diagram for the device is shown in Fig-1.

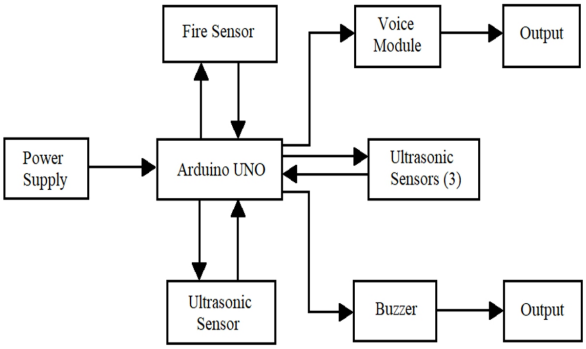

Fig-1: Block diagram

The use case diagram for the smart cane is depicted in Fig-2. The diagram gives a graphical depiction of user's possible interaction with the device. The use-cases and the actors i.e blind and visually impaired people describes what the device does and how the blind uses the device but not how exactly the device internally operates.

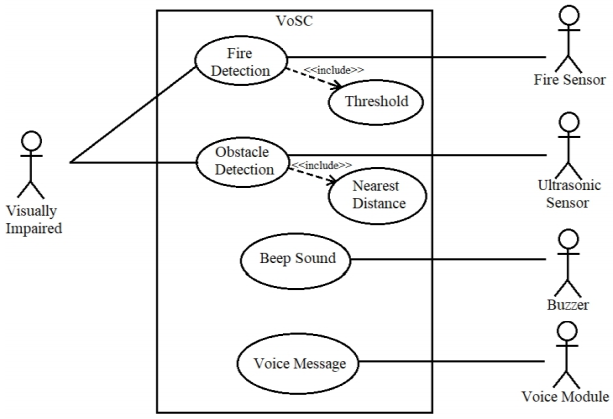

Fig-2: Use-case diagram

The smart cane work flow is represented using sequence diagram as shown in the Fig-3. The diagram depicts the interaction between the objects arranged in the time sequence. The sequence of messages exchanged between the objects required to carry out the working scenario.

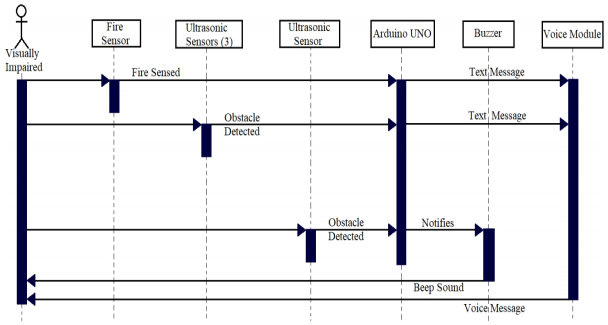

Fig-3: Sequence diagram

3.2 Hardware components:

3.2.1 : Arduino UNO R3:

The Arduino UNO R3 is a microcontroller board which is a removable, dual-inline-package (DIP) ATmega328 AVR microcontroller. It has 20 digital input/output pins. Programs can be uploaded on to the easy-to-use Arduino computer program. The Arduino UNO used in the smart cane is shown in Fig-4.

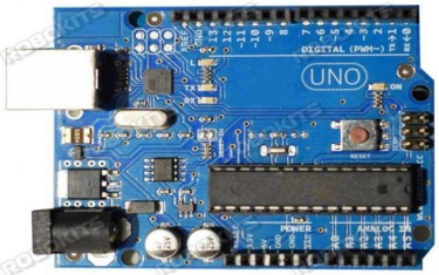

Fig-4: Arduino UNO R3

3.2.2 : Ultrasonic Sensor HC:

An ultrasonic sensor as shown in Fig-5 is an electronic device which measures the distance of a quarry object by emitting ultrasonic sound waves, and converts these waves that is reflected sound waves into an electrical signal. The distance calculated by ultrasonic sensor is :

Distance = (time * speed of sound)/2

The total distance is divided to half to get the actual distance travelled as the sound waves will travel away from the sensor and bounces back after running into the obstacle surface.

Fig-5: Ultrasonic Sensor HC

3.2.3 : Flame Sensor:

A flame-sensor is one kind of detector which is mainly designed for detecting as well as responding to the occurrence of a flame or flame.where the Flame or a light source has a wavelength in the range of 760 to 1100 nm. The buzzer used in the smart cane is depicted in the Fig-6.

Fig-6: Flame Sensor

3.2.4 : Buzzer:

A buzzer or beeper shown in Fig-7 is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Buzzer is used to provide alarm sound. Buzzer produces variety of frequencies.

Fig-7: Buzzer

3.2.5 : Voice Module :

The Voice Module includes a Text-to-speech (TTS), which is a type of assistive technology that reads digital text aloud. Text to voice can take words on a computer or other digital device and convert them into audio. The device uses earphone as depicted in Fig-8 which is a small loudspeaker which converts electrical to acoustical signals. These earphones are connected to arduino board and are triggered when signals are simulated.

Fig-8: Earphones

3.2.6 : Breadboard:

The breadboard is a rectangular plastic board with small tiny holes in it. These holes are used to insert electronic components to form an electronic circuit. The connection made are not permanent, it can be easily dispatched.

Fig-9: Breadboard

3.2.7: Battery:

A battery is a power source consisting of one or more electrochemical cells with external connections. When a battery is supplying electricity, its positive terminal is considered as cathode and its negative terminal is considered as anode. A common example are alkaline batteries used for flashlights and a multitude of portable devices. Batteries, such as secondary batteries can be recharged and discharged multiple times using number of charge/discharge cycles possible before the cells fail to finish the required task. For a non-rechargeable these lives are equal because the cells last for only one cycle by. Here we have used primary batteries which is of 9V.

Fig-10: 9V Battery

3.3 Software requirements:

3.3.1: Arduino IDE :

The Arduino Software (IDE) is an open-source software which makes it easy to program the code andupload it to the board. This software can be employed with any Arduino board. The functions are written in C and C++ languages. Default functions in Arduino IDE is setup() and loop(). Void setup() is the function is executed only once when the program starts running. The pin modes, variables and libraries are initialized in this function. Void loop() is the function is used to actively control the arduino board. It keeps repeatedly executing until a new code is uploaded or the arduino is restarted.

4. RESULTS

The Fig-11 depicts a smart cane which consists of an ultrasonic sensor and buzzer at the ground level which is used to sense the lower level objects and also flame sensor is placed at the ground level to detect the fire and a voice message is given as an output to the visually impaired person. The waist level obstacles is detected and the direction in which the objects are present are sensed by three ultrasonic sensors placed in three different directions i.e left, right and front. This is notified with the help of fixed voice messages. The output of this voice module is sent to the user with the help of earphones. User after getting notification about direction of obstacle and danger condition makes them feel comfortable in the surrounding.

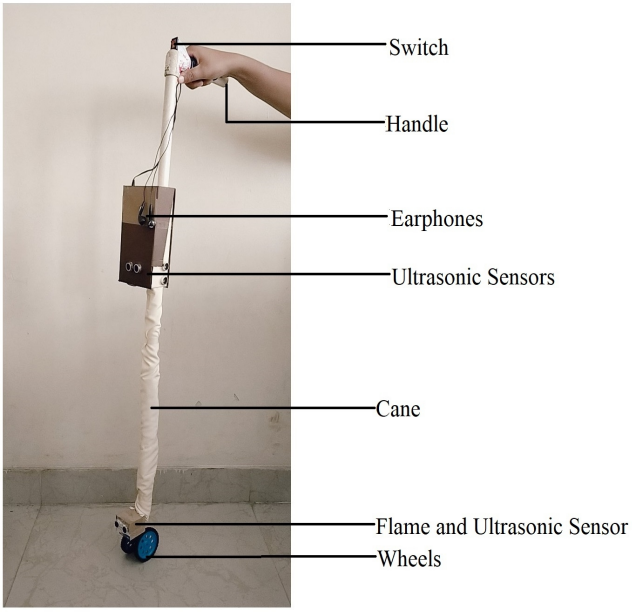

Fig-11: Smart Cane for visually impaired

The Fig-12 depicts the Danger condition detection such as fire by using flame sensor whose output is produced with the help of voice module and earplugs.The lower level obstacles can be detected with the help of ultrasonic sensor and this is notified to the user with the help of beep sound produced by buzzer and wheels are used for movement of the device.

Fig-12: Ground Level obstacle detection

The Fig-13 depicts the upper part of the smart cane which consists of three ultrasonic sensors in three different directions, one in left to detect the obstacles at the left side of the user, other in right direction to detect the obstacles at the right side and also in front to detect the front obstacles. The switch is used to control the power supply to the device.

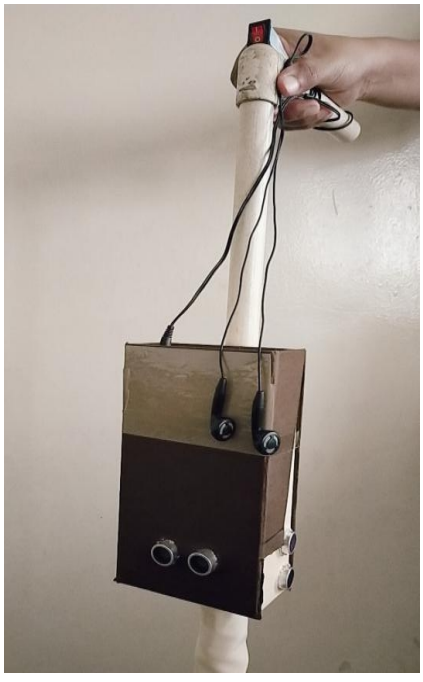

Fig-13: Higher Level obstacle detection

5. CONCLUSION

The VoSC : A Voice Based Smart Cane for Visually Impaired can be used to guide the blind. The goal is to solve the problems that blind people face in their day to day lives. The project is also taking the step to assure the blind's safety by notifying the objects direction and obstacles beforehand. The main purpose of the project is to develop a model in the form of voice messages and beep sound that an IoT based Voice Controlled Blind Stick to guide blind and visually impaired people. This device makes the blind to feel comfortable around them, by letting them know the direction of the object are present in front of them. Not only objects, it can also notify the user with the beep sound if it detects any obstacles which is very near to him. This device provides a low cost, less power utilization, simple and light weighted. The smart cane was developed by keeping blind and visually impaired person as our top priorities.

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