

ROBOTS FOR DISABILITY TERM PROJECT REPORT

ASSISTIVE CANE FOR VISUALLY IMPAIRED

ME-GY7913
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1. INTRODUCTION

- Problem : There are a lot of challenges that a blind person has to face in their daily lives like social, environmental and technological challenges. Talking of environmental challenges, they usually have a difficult time navigating outside the spaces like the streets, the market, in commuting, in need to find a washroom and several things likewise etc. Travelling or merely walking down a crowded street seems to be very difficult for them with lack of assistance. In several occasions they are unable to get help even if someone is around or passing by because they can't see.
- Solution : Visually impaired in particular those who belong to low or middle class families cannot afford expensive heavy equip devices for their assistance and so a solution can be proposed that can provide them assistance is to equip their sticks with audio message signals that can be played by them using their stick so that people nearby can listen and come forward for their assistance. Along with this, a feature for their safety that will be included in the prototype is the detection of any object that comes along their way. The obstacle detection feature will prevent them from getting hurt or help in avoiding any accidents or injuries.
- The main goal of this project is to help the disabled who cannot afford expensive assistive devices by providing them easy to use and affordable assistive solutions.

2. MATERIALS

The following materials were used in making the prototype

- Arduino UNO microcontroller boards (2)

- SD card
- SD card reader module
- 8 ohm 1W mini speaker
- Push buttons (4)
- Ultrasonic sensor
- Active buzzer
- 9V battery (2)
- 10k potentiometer
- LM386 audio amplifier

3. DESIGN

- The features that provided assistance were mounted on the cane used by visually impaired.
- A compact model of the cane was made using 3D printing.
- An ultrasonic sensor for object detection was mounted at the base of the cane configured with an active buzzer that indicates the presence of obstacle in the front while walking.
- The ultrasonic sensor and the active buzzer were integrated with an arduino uno microcontroller board.
- The audio message play feature was incorporated with the pressing of a push button. Four push buttons were used, a 8 ohm speaker was connected along with a SD card and a SD card reader module for reading the audio files and playing them on the speaker.
- The amplify the volume of the audio files on the speaker, a LM386 audio amplifier to amplify the audio along with a 10k potentiometer to increase or decrease the volume.

The wiring connections for obstacle detection was done as follows:

- Ultrasonic sensor was powered using 5V pin of the arduino.
- Active buzzer uses a PWM output and was connected to pin 9 of the microcontroller board.
- The arduino was powered externally using a 9V battery.

The wiring connections for the audio play was as follows:

- Four push buttons were connected to digital pins 1,2,3 and 5 of the arduino uno board with common ground and all powered using 5V pin of the arduino board.
- The 8 ohm speaker uses PWM output and so the positive of the speaker was connected directly to the PWM pin 9 and negative connected to one of the GND pins of the arduino board.
- The audio files are stored in an SD card in .wav format with 16000 Hz of sampling rate and mono audio channel.
- The arduino uses SPI communication protocol to communicate with SD card and the SD card reader module to read audio files from the SD card.
- The SD card is connected on digital pins 11,12 and 13 for MISO, MOSI and SCK pins for communication and digital pin 4 of the board was connected to the chip select (CS) pin of the SD card module to detect and initialise the SD card.
- The arduino was powered externally using a 9V battery.

4. METHOD

The execution of the prototype consists of two sections

Section 1 : Obstacle detection while walking

- In this section, the code begins with the ultrasonic sensor emitting sound waves using the trig pin.

- These sound waves are then reflected back as they hit an object which are then received by the echo pin of the sensor.
- Once, the sound waves are received back, the active buzzer is turned ON, producing an alarming sound to indicate the presence of obstacle.
- The buzzer turns ON only if the distance calculated for the sound to be reflected is less than or equal to 10cms.

Section 2 : Message play for assistance

- Here, the visually impaired individual can press a button that will play audio messages to grab attention of the passersby on the street to ask for help.
- The code uses a <tmrpcm.h> library to play audio files on the speaker from the SD card.
- This library is used for asynchronous playback of PCM/WAV files directly from the SD card.
- First the arduino detects the SD card and initialises it if found, which is done using the SD card module's chip select (CS) pin connected to digital pin 4 of the arduino board.
- Once, the card is initialised, the tmrpcm library sets the volume of the audio file on the speaker. The library uses a class volume that sets the volume of the audio file in the range of 0 to 7.
- In the loop, with each press of the push button, an audio file is played on the speaker. Here, the status of the push button, pressed == LOW or not pressed == HIGH is checked. If the status read is LOW, then the file associated is played.
- There are different messages stored, keeping in mind the general assistance required by the visually impaired when they are on the streets that can be played by them in situations when they need help.

5. CODES

- **Code 1 : Obstacle detection**

//Ultrasonic Distance alarm

```
const int trigPin = 9;  
const int echoPin = 10;  
const int buzzer = 11;
```

// defines variables

```
long duration;  
int distance;
```

```
int safetyDistance;

void setup() {
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
pinMode(buzzer, OUTPUT);
Serial.begin(9600);
}

void loop() {
digitalWrite(trigPin, LOW);
delayMicroseconds(2);

digitalWrite(trigPin, HIGH);
delayMicroseconds(10);
digitalWrite(trigPin, LOW);

duration = pulseIn(echoPin, HIGH);

distance= duration*0.034/2;

safetyDistance = distance;
if (safetyDistance <= 10){
  digitalWrite(buzzer, HIGH);
}
else{
  digitalWrite(buzzer, LOW);
}

Serial.print("Distance: ");
Serial.println(distance);
}
```

- **Code 2 : Audio message play**

```
#include <SD.h>
#define SD_ChipSelectPin 4
#include <SPI.h>
#include <TMRpcm.h>

TMRpcm tmrpcm;
int potpin = A0;
int SW1;
int SW2;
int SW3;
int SW4;
void setup() {
  pinMode(1,INPUT_PULLUP);
```

```

pinMode(2,INPUT_PULLUP);
pinMode(3,INPUT_PULLUP);
pinMode(5,INPUT_PULLUP);

tmrpcm.speakerPin = 9;

if (!SD.begin(SD_ChipSelectPin)) {
    return;
}
tmrpcm.volume(7);
}

void loop() {
    SW1 = digitalRead(1);
    SW2=digitalRead(2);
    SW3=digitalRead(3);
    SW4=digitalRead(5);

    if (SW1 == LOW) {
        tmrpcm.play((char*)"1.wav");
    } else if(SW2 == LOW){
        tmrpcm.play((char*)"2.wav");
    } else if(SW3 == LOW){
        tmrpcm.play((char*)"3.wav");
    } else if(SW4 == LOW){
        tmrpcm.play((char*)"4.wav");
    }
}

```