Chittagong Independent University

Department of Computer Science and Engineering

A Project Report on
Smart Cane for the Visually Impaired

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Chapter 1: INTRODUCTION

1.1 Introduction to Peripherals:

Computer peripherals are the devices we use to expand our system's functionality. They are not essential for the computer to work. Many peripherals are external devices that give us a way to input information. For example, we might use a mouse or trackpad to navigate the screen, a keyboard to type text or a microphone to record audio. Other peripherals are output devices that let us see, print or listen to something, such monitors, printers and speakers. While debatable since they are key components for a functional computer, internal devices like hard drives and memory may be considered peripherals.

Data Storage Devices

Data storage devices are hardware devices capable of holding information and include system RAM, internal hard drives, external hard drives, solid state drives, flash drives, memory cards and cassettes. Any type of storage device that connects outside of the computer, or isn't necessary for the computer to run, is considered a peripheral. For example, we can connect and disconnect external hard drives, flash drives and memory cards without disabling the computer. However, system RAM and internal hard drives straddle the peripheral line. While the motherboard and CPU have small amounts of built-in memory, alone, they are not enough to utilize most of the computer's capabilities.

Audio and Video Output Devices

Unless a computer operates in a self-contained situation, without any need for human interaction, it's necessary for the computer to convey information to the user. The computer uses peripheral devices like monitors, speakers and screen readers to translate the system's binary data stream into something people can understand and interact with. Computer peripheral devices encompass all devices that the system uses to output data, including printers. The data output devices aren't essential for the computer to operate, they're just needed to make the system useful.

Keyboard, Mouse and Touch Pad Devices

Keyboards, mice, touch pads and other Human Interface Devices are very common peripherals of computer systems. An HID is a peripheral that lets the computer use input data or interact with the computer. HIDs are always considered peripheral devices because it is possible for a computer to operate and do countless jobs without the need for human interaction. We can disconnect an HID from a computer and replace it with a new one without affecting the core functionality of the system.

Computer Peripheral Cards and Components

Any type of peripheral card, like a graphics card, sound card, network card or controller card, is considered a peripheral. Most modern non-storage based internal storage devices use the Peripheral Component Internet and PCI Express connection standards. The connection standard name itself implies that whatever hardware uses it is a peripheral device. While peripheral devices are necessary for things like displaying video output and communicating with other computers on a network, the computer can still operate without them.

Introduction to Interfaces:

An interface may refer to any of the following:

1. When referring to software, an interface is a program that allows a user to interact computers in person or over a network. An interface may also refer to controls used in a program that allow the user to interact with the program. One of the best examples of an interface is a GUI (Graphical User Interface). This type of interface is what you are using now to navigate your computer and how you got to this page.

2. When referring to hardware, an interface is a physical device, port, or connection that interacts with the computer or other hardware device. For example, IDE is a disk drive interface for computer hard drives and ATAPI is an interface for CD-ROM drives.

1.2 Introduction to Project:

Despite advances in medical research for the treatment of visual impairments or even complete blindness it is still no prospect for the majority of the afflicted population. Because most of the treatments are only applicable for a subset of visual impairments and in addition often times very expensive. Therefore it is important to think about an interim solution which not only helps a big part of the suffering population in their daily life, but also has to be user friendly most if not all people. For this purpose we developed our guidance system which focuses on helping the visually impaired in an indoor environment, be it their home or a public space.

Chapter 2: LITERATURE REVIEW

2.1 Theoretical description of project:

Introduction: Eye sight is one of five basic senses of human body. It plays a major role in collecting information regarding human surrounding. Blindness or visual impairment is a condition which leads people to the loss of the valuable sense of vision.

Objectives: The main objective of our project is to provide a voice based assistance to visually impaired people. Our project focuses on designing a voice based assistant for blind people that help them to travel independently and also it must be comfortable to use. The proposed device can be used to guide individuals who are blind or partially sighted. The device will help them to move with the same ease and confidence as a sighted people.

Features: Providing artificial vision and object detection, real time assistance. The system consists of ultrasonic sensors, line detector and the feedback is received through audio. Voice output works through TTS (text to speech). The proposed system detects an object around them and sends feedback in the form of speech which is warning messages via earphone. Hence the core features are:

- ***Line-tracking.***
- ***Normal Obstacle detection (larger and smaller).***
- ***Stair detection.***
- ***User friendly switching option.***
- ***Alerting through voice message.***

2.2 Technology:

The smart cane for the visually impaired as the name suggests is a device for the visually impaired to guide the user to respective destination and avoiding to collide with the obstacles. It uses 3 ultrasonic sensors HC SR 04 to detect the obstacles in between. Also an IR sensor is used to detect the line. Along with that it uses Arduino as the main controller. Whenever there is any obstacle in front. The sensor will detect the distance from the obstacle and send to the controller. The Arduino transmits required data to a raspberry pi3. Finally raspberry pi3 gives a voice notification to the user.

Chapter - 3: METHODOLOGY

3.1 Design Methodology:

The design consists of more on actual planning of hardware part than the code to be created. A number of software and hardware implementation techniques were used to design and develop the system.

Our system has two modes. One is obstacle mode and the other one is line following mode. These two modes can work together as well as separately. It depends on the user.

This design section can be divided into many parts: Ultrasonic sensor, IR sensors, switches, Arduino, raspberry pi and Power supply adapter.

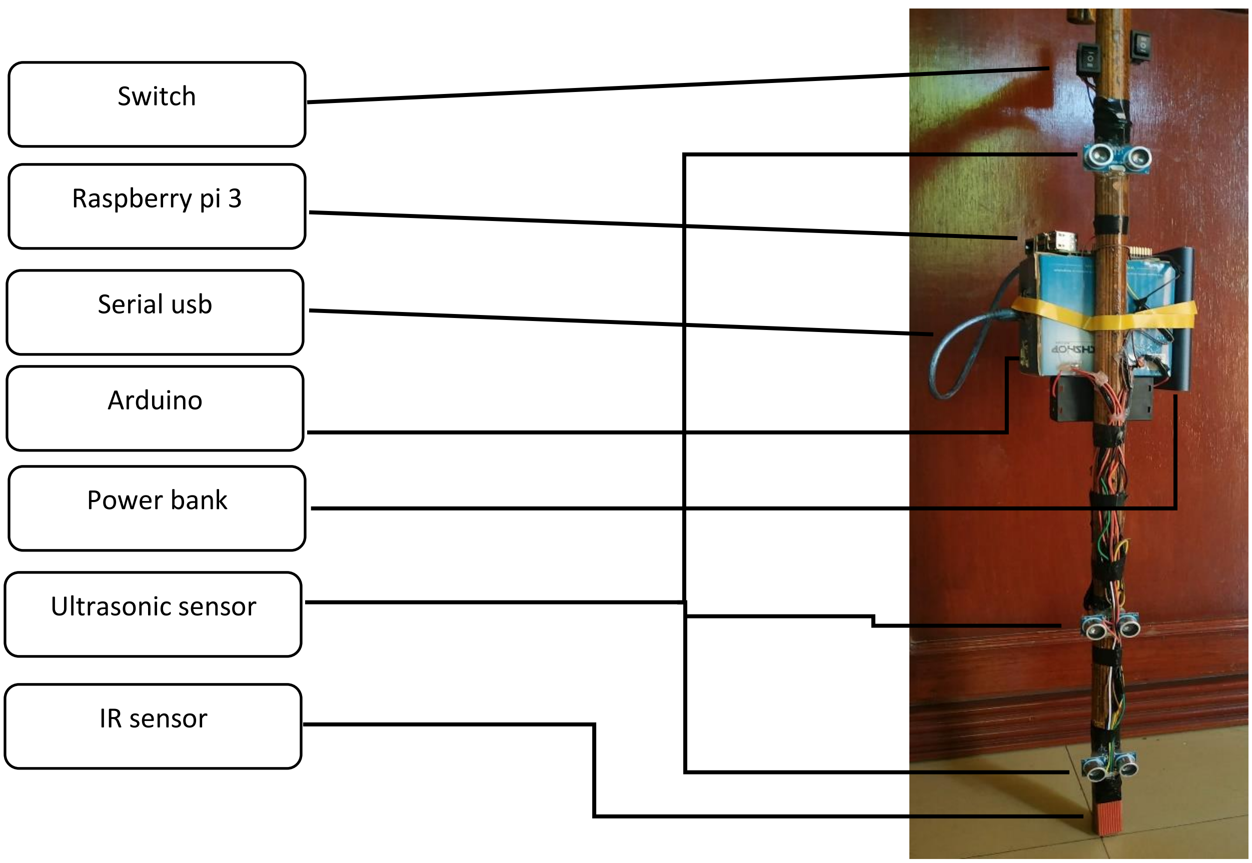

Fig: Smart Cane Components

Ultrasonic sensor: We have used three ultrasonic sensor. Two in the lower part and one in the upper part. The grounds of these are connected to Arduino grounds & VCCs are connected to 5V of Arduino.

IR sensor: We have used one IR sensor to detect line. Whenever the stick is out of black line the sensor detects it. Ground pin is connected to Arduino ground and VCC is connected to 3.3V of Arduino.

Switch: We have kept two switches. One is for ultrasonic sensor, another is for IR sensor.

Arduino: All the sensors are controlled by Arduino. Arduino collects all the data from the sensors.

Raspberry pi: The raspberry pi gets information from Arduino and then gives a voice alert to the user by using tts (text to speech).

Power supply: Raspberry pi is powered by a power bank. Arduino is connected to raspberry pi by a serial usb.

3.2 Software Implementation:

Arduino: For Arduino we have used Arduino IDE & c++

Raspberry pi: For raspberry pi we have used Thonny python IDE.

Text to Speech: For test to speech implementation we were looking for a software package that works in offline. So we have used Festival Speech Synthesis System.

3.3 Circuit Diagram:

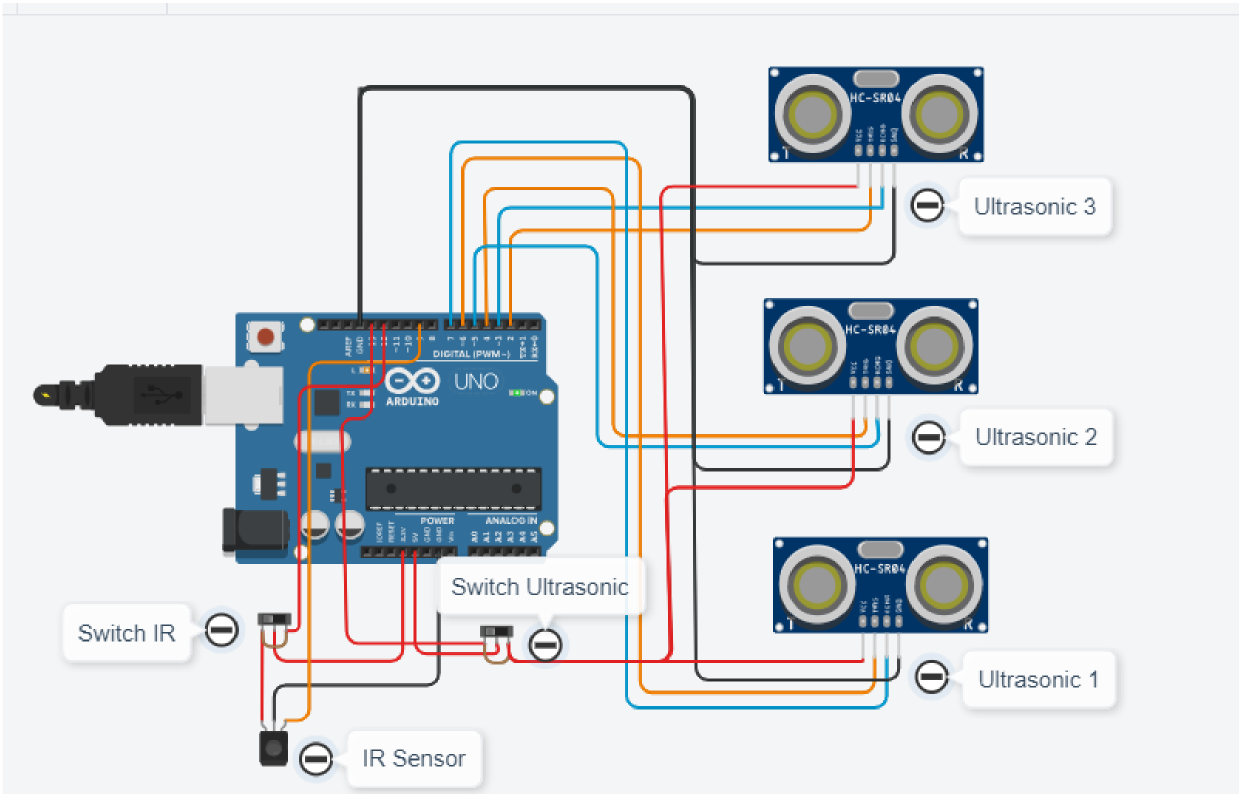

Fig: Circuit Diagram of the Smart Cane

Chapter – 4: IMPLEMENTATION

4.1 System requirements:

Arduino IDE with <newping.h> included, Python IDE with festival.

Language: c++, python

4.2 Project code:

Arduino code:

```
// Include NewPing Library

// Hooking  up  4 HC-SR04 with Rduino in Three wire Mood

// Maximum Distance is 400 cm

//IR sensor black surface 1, white 0


#include "NewPing.h"

#define MAX_DISTANCE1 400

#define MAX_DISTANCE2 400

#define MAX_DISTANCE3 400

int nd= 30; //notification distance

int us3d = 37;

int us4d = 40;

int data=0;

int trigPin2 = 2;

int echoPin2 = 3

int trigPin3 = 4;
```

```
int echoPin3 = 5;

int trigPin4 = 6;

int echoPin4 = 7;

int ir = 9;

int irp = 12; //arduino reads 1 if ir sensor switch is on

int usp =13; // arduino reads 1 if ultrasonic sensor switch is on

NewPing sonar2(trigPin2 ,echoPin2, MAX_DISTANCE1);

NewPing sonar3(trigPin3 ,echoPin3, MAX_DISTANCE2);

NewPing sonar4(trigPin4 ,echoPin4, MAX_DISTANCE3);


float distance2; // Stores calculated distance in cm for Second Sensor

float distance3; // Stores calculated distance in cm for Third Sensor

float distance4; // Stores calculated distance in cm for Third Sensor


void setup() {

  Serial.begin (9600);

  pinMode(ir, INPUT);

  pinMode(irp, INPUT);

  pinMode(usp, INPUT);

  //No need to define  inputs and outputs as we are using ping library

}


void loop()
```

```
{
  data =0;
  distance2 = sonar2.ping_cm();
  distance3 = sonar3.ping_cm();
  distance4 = sonar4.ping_cm();
  delay(1000);
  if(digitalRead(irp)==1) //switch is on
  {
     if(digitalRead(ir)==0) //white surface
    {
      data = 4;
      Serial.println(data);
      delay(1000);
    }
    else
    {
      data = 0;     //black surface
      delay(1000);
    }
  }
  if(digitalRead(usp)==1) //ultrasonic switch is on
  {
    if(distance2>nd || distance2 ==0)
```

```
{
  data = 0; //no obstacle
  Serial.println(data);
  delay(1000);
}
else     // distance2<=nd
{
  if(distance3 <= us3d)
  {

    if(distance4 <= us4d)
    {
      data = 1; //larger
      Serial.println(data);
      delay(1000);
    }
    else    //distance4 > us4d
    {
      data = 3; //smaller
      Serial.println(data);
      delay(1000);
    }
  }
```

```
      else if(distance3>=us3d)
      {
        data=2; //stair detection
        Serial.println(data);
        delay(1000);
      }
      else
      {
        delay(1000);
      }
    }
  delay(1000);
}
data = 0;
}
```

Raspberry pi code:

```
import serial
import RPi.GPIO as GPIO
import time
import subprocess
```

```
ser=serial.Serial("/dev/ttyACM0",9600)  #change ACM number as found from ls /dev/tty/ACM*
ser.baudrate=9600

while True:
    read_ser = ser.readline()
    print(read_ser)
    if(read_ser == b'1\r\n'):
        text1 = '''Sir, There is a, larger, obstacle'''
        subprocess.call('echo '+text1+'|festival --tts', shell=True)

    if(read_ser == b'2\r\n'):
        text2 = '''Sir, careful! There is an upstair'''
        subprocess.call('echo '+text2+'|festival --tts', shell=True)

    if(read_ser == b'3\r\n'):
        text3 = '''Sir, Careful! There is a, smaller, obstacle'''
        subprocess.call('echo '+text3+'|festival --tts', shell=True)

    if(read_ser == b'4\r\n'):
        text3 = '''Sir, stick is out of line!'''
        subprocess.call('echo '+text3+'|festival --tts', shell=True)
```

Chapter – 5: CONCLUSION

5.1 Summary: In this work we presented a novel knee-above obstacle-detection and warning system for the visually impaired to enhance personal mobility for the visually impaired. The system reduces dependence on sighted assistance, improves independent mobility.

5.2 Limitation: Though this cane gives a smart support to the visually impaired but still it doesn't guarantee the complete independence mobility. Moreover it has lacking in outdoor environment.