

Smart Glass for Visually Impaired

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ABSTRACT: Unique smart glass for visually impaired people to overcome the travelling difficulties. It can detect the obstacle and measure the distance perfectly using the ultrasonic sensors and a microcontroller. After receiving information from the environment, it passes to the blind person through a headphone. The proposed devise is more comfortable and less expensive. The ultrasonic sensors are used in this device which is small, light in weight, and consume less power thus user friendly. Although our proposed model response quickly.

KEYWORDS: Wearable, Smart Camera Device, Recognize Objects, Recognize Obstacles and Bluetooth.

I. INTRODUCTION

According to the report of the world health organization (WHO), about 253 million people live with vision impairment. Among them, 36 million people are blind and 217 million have moderate to severe vision impairment. It is really hard for a blind person to go out alone and there are not so many available products that can assist them. However, Researches have been going on for decades for developing an effective device for visually impaired people. Some devices, such as Lightweight Smart Glass System with Audio Aid, NavBelt, Guidecane, VA-PAMAID, Electronic Travel Aid, and etc. have been made. In this paper, we present a new and unique design for the smart glasses that can aid in multiple tasks while maintaining at a very low building cost. The device can easily guide the visually impaired people and able to give proper direction. The RGB-D (Red, Green, Blue and Depth) sensor based ETA, can detect obstacles more easily and precisely than other sensor (e.g. ultrasonic sensor, mono-camera, etc.) based scheme. However, a drawback of the depth sensor is that it has a limited working range in measuring the distance of the obstacle and cannot work well in the face of transparent objects, such as glass, French window, French door, etc. To overcome this limitation, a multi-sensor fusion based obstacle avoiding algorithm, which utilizes both the depth sensor and the ultrasonic sensor, is proposed in this work. The totally blind people can be informed through auditory and/or tactile sensor. However, such an approach has the drawbacks of high power consumption and large size, which is not suitable for wearable ETA (like the glasses proposed in this work). Thus, sound or synthetic voice is the option for the first case. Some sound feedback based ETAs map the processed RGB image and/or depth image to acoustic patterns or semantic speech for helping the blind to perceive the surroundings. But, the blind still needs to understand the feedback sound and decide where they can go ahead by himself. Thus, such systems are hard to ensure the blind making a right decision according to the feedback sound. Focusing on the above problem, three kinds of auditory cues, which is converted from the traversable direction (produced by the multi-sensor fusion based obstacle avoiding algorithm) were developed in this paper for directly guiding the user where to go. Since the weak sighted people have some degree of visual perception, and vision can provide more information than other senses, e.g. touch and hearing, the visual enhancement, which uses the popular AR (Augmented Reality), technique for displaying the surroundings and the feasible direction on the eyeglasses, is proposed to help the users to avoid the obstacle.

II . RELATED WORK

We present a new smart glass system for people who are blind or have low vision. Individuals with visual disability are difficult to communicate effectively with their environment. The blind or visually impaired rely largely on their other senses such as hearing, touch, and smell in order to understand their surroundings. It is pretty hard for them to go out alone, not to mention finding toilets, subway stations, restaurants and so on. Giving blind people the great accessibility to their environment is the objective of the smart glass system. This smart glass system can see the world for them and give voice instructions and hints through wireless bone conduction headphones. This smart glass system will help visually impaired people gain increased independence and freedom in city life. And we have implemented an application of public signs recognition on the smart glass system. This application can detect and recognize the public signs in cities, and give corresponding voice hints to the blindness. The proposed prototype system is based on Intel Edison, and the application in the system is written in C++ with libraries of Open. Extended demonstration of the system will be presented to show how the system helps the blindness “see the world”.

III. PROPOSED ALGORITHM

A. Design Considerations:

- Arduino UNO
- Ultrasonic sensors
- GSM module (sim800L model)
- Buzzer
- Power supply
- Button
- Arduino IDE
- Embedded C

B. Description of the Proposed Work:

Three ultrasonic sensors are placed left side, front side and right side of the wearable device for perfect detection. In this way, an obstacle can be detected from three sides. When an obstacle comes near to the blind within the range of 5 meters, the sensors measure the obstacle distance and send the value to the microcontroller. Here the data from ultrasonic sensors are processed by microcontroller. The SD card module has the ability to communicate with microcontroller. The voices are recorded in the SD card module to instruct the visually impaired users, which is played through a headphone according to the ultrasonic data. A switch is connected to the system which is used for an emergency task like sending SMS to the subject's guardian when the blind person falls in danger. GPRS SIM900A module collects such data like location, temperature and time from the internet. An SMS including time, temperature and location can be sent to the subject's guardian when the switch is pressed. The LED indicator is used for day or night indication for blind's safety. It is controlled by acquiring the time from the internet with the help of the GPRS module. During the night the LED turn ON automatically so that others can understand the presence of blind when there is no light in the street.

IV.PSEUDO CODE

```
#include <Arduino.h>
#include <NewPing.h>
#include <SoftwareSerial.h>
#include <DFRobotDFPlayerMini.h>

#define MAX_DISTANCE 400
const int trigPin1 = 2;
const int echoPin1 = 3;
const int trigPin2 = 4;
const int echoPin2 = 5;
const int trigPin3 = 6;
const int echoPin3 = 7;

const int motorPinRight = A0;
const int motorPinCenter = A1;
const int motorPinLeft = A2;

int minLeftDistance = 100;
int minCenterDistance = 100;
int minRightDistance = 100;

static unsigned long timer = millis();

int waitTime = 3500;
NewPing sonarLeft(trigPin1, echoPin1 ,MAX_DISTANCE);
NewPing sonarCenter(trigPin2, echoPin2 ,MAX_DISTANCE);
NewPing sonarRight(trigPin3, echoPin3 ,MAX_DISTANCE);
SoftwareSerial mp3SoftwareSerial(8, 9); // RX, TX
DFRobotDFPlayerMini DFPlayer;
```

```

void printDetail(uint8_t type, int value){
switch (type) {
case TimeOut:
Serial.println(F("Time Out!"));
break;
case WrongStack:
Serial.println(F("Stack Wrong!"));
break;
case DFPlayerCardInserted:
Serial.println(F("Card Inserted!"));
break;
case DFPlayerCardRemoved:
Serial.println(F("Card Removed!"));
break;
case DFPlayerCardOnline:
Serial.println(F("Card Online!"));
break;
case DFPlayerPlayFinished:
Serial.print(F("Number:"));
Serial.print(value);
Serial.println(F(" Play Finished!"));
break;
case DFPlayerError:
Serial.print(F("DFPlayerError:"));
switch (value) {
case Busy:
Serial.println(F("Card not found"));
break;
case Sleeping:
Serial.println(F("Sleeping"));
break;
case SerialWrongStack:
Serial.println(F("Get Wrong Stack"));
break;
case CheckSumNotMatch:
Serial.println(F("Check Sum Not Match"));
break;
case FileIndexOut:
Serial.println(F("File Index Out of Bound"));
break;
case FileMismatch:
Serial.println(F("Cannot Find File"));
break;
case Advertise:
Serial.println(F("In Advertise"));
break;
default:
break;
}
break;
default:
}
}

```

```

void leftAlert(int distance) {
    if (millis() - timer > waitTime) {
        timer = millis();
        DFPlayer.playLargeFolder(01, distance+1);
    }
    if (DFPlayer.available()) {
        printDetail(DFPlayer.readType(), DFPlayer.read()); //Print the detail message from DFPlayer
    }
}

void centerAlert(int distance) {
    if (millis() - timer > waitTime) {
        timer = millis();
        DFPlayer.playLargeFolder(02, distance+1);
    }
    if (DFPlayer.available()) {
        printDetail(DFPlayer.readType(), DFPlayer.read()); //Print the detail message from DFPlayer
    }
}

void rightAlert(int distance) {
    if (millis() - timer > waitTime) {
        timer = millis();
        DFPlayer.playLargeFolder(03, distance+1);
    }
    if (DFPlayer.available()) {
        printDetail(DFPlayer.readType(), DFPlayer.read()); //Print the detail message from DFPlayer
    }
}

void setupDFPlayer() {
    mp3SoftwareSerial.begin(9600);
    Serial.println();
    Serial.println(F("Blind assistances smart glass..."));
    Serial.println(F("Initializing DFPlayer ... (May take 3~5 seconds)"));
    if (!DFPlayer.begin(mp3SoftwareSerial)){
        Serial.println(F("Unable to begin:"));
        Serial.println(F("1.Please recheck the connection!"));
        Serial.println(F("2.Please insert the SD card!"));
        while(true);
    }
    Serial.println(F("DFPlayer Mini online."));
}

DFPlayer.setTimeOut(500); //Set serial communictaion time out 500ms
DFPlayer.volume(29); //Set volume value (0~30)
DFPlayer.EQ(DFPLAYER_EQ_NORMAL);
DFPlayer.outputDevice(DFPLAYER_DEVICE_SD);
}

void setup() {
    Serial.begin(9600);
    setupDFPlayer();
}

```

```

void loop() {
delay(29);
int leftDistance = sonarLeft.ping_cm();
int centerDistance = sonarCenter.ping_cm();
int rightDistance = sonarRight.ping_cm();

// For debugging
// Serial.print("Left: ");
// Serial.print(leftDistance);
// Serial.print(", Center: ");
// Serial.print(centerDistance);
// Serial.print(", Right: ");
// Serial.println(rightDistance);

if(leftDistance < minLeftDistance && leftDistance > 1) {

Serial.print("Obstacle ");
Serial.print(leftDistance);
Serial.println(" CM to the left");

leftAlert(leftDistance);
analogWrite(motorPinLeft, 512);
}
else {
analogWrite(motorPinLeft, 0);
}

if(centerDistance < minCenterDistance && centerDistance > 1) {

Serial.print("Obstacle ");
Serial.print(centerDistance);
Serial.println(" CM ahed");

centerAlert(centerDistance);
analogWrite(motorPinCenter, 512);
}
else {
analogWrite(motorPinCenter, 0);
}

if(rightDistance < minRightDistance && rightDistance > 1) {

Serial.print("Obstacle ");
Serial.print(rightDistance);
Serial.println(" CM to the right");

rightAlert(rightDistance);
analogWrite(motorPinRight, 512);
}
else {
analogWrite(motorPinRight, 0);
}
}

```

V.SIMULATION RESULTS

First of all, this system is just a guidance system and it doesn't do anything on its own but just guides the blind person how to traverse. In no way does this system guarantee if a blind person use this, he will be able to walk similar to a normal person because system needs time to process the sensor values and guide them so they need to be walking at an appropriate speed so as to allow the system to process and guide them, it won't be similar to a normal person who can see. This system has been tested on 10 blind persons and some limitations and usage problems has been traced. They are as follows:

- (1) The sensor being highly directional, at times it may happen if there may be a diagonally situated obstacle in between front and right sensor, the guidance frequently changes, but it happens for a specific range and not always at every spot, 2-3 out of 10 people faced this problem.
- (2) If not placed appropriately, the knee cap sensor may overlook or may not sense obstacles of 10-15cm height lying on the ground, which may be steps, speed breakers, etc. 3-4 out of 10 people faced this problem
- (3) Front part and appropriate level of smaller obstacles for knee cap sensor worked flawlessly most of the time.
- (4) The blind man should normally be on its straight path, as per their feeling, unless and until system guides them to turn in any direction, otherwise it was noticed that some kind of avoidance of an obstacle may happen.

VI.CONCLUSION AND FUTURE WORK

The paper objective is underlined by the necessity of voice assistant system for the increasing number of blind people all over the globe. The "Smart Glass for Blind People" is practically, a feasible device can be conveniently carried by any blind person. It does have few limitations which we'll target to solve in its future developments.

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