**Following Mirror**

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**Abstract**

Have you ever felt inconvenience, when you look into a mirror. For example, when wear contact lenses, cannot use your both hands. For solving this problem, we made a following mirror. Actually, following mirror is for disabled people. When we made a following mirror, we used four ultrasonic distance sensors. The mirror can follow my motion to use ultrasonic distance sensors. Also servo motors can control four directions.

**Introduction**

Ultrasonic distance sensor is used in many things today. For example stair censer for visually handicapped, hand dry censer, obstacle sensor of cleaning robot. Evenly the sensor used solar panel. For example solar panel can follow sun to use ultrasonic distance sensor when sun is covered by clouds. So we used ultrasonic distance sensor advantage for making following mirror. If I move my face, the ultrasonic distance sensor recognize my motion. And then Arduino receive electronic signal from ultrasonic. Then servo motor work along Arduino code that inputted in Arduino in advance. So the mirror can move along my motion. Actually we can control ultrasonic distance sensor to change code. For example, recognize distance, Also we can change moving distance, velocity of servo motor by changing code.



**Materials**

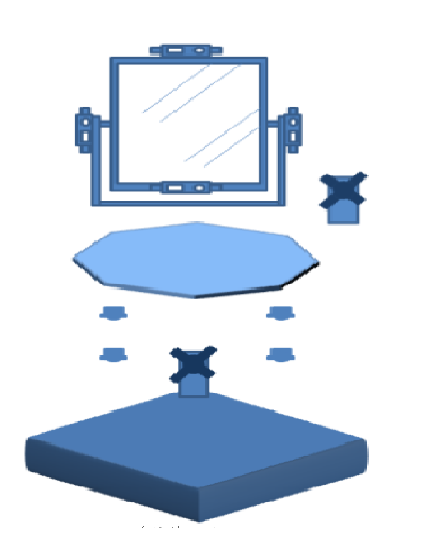
We need to materials to create the following mirror.

|  |  |  |
| --- | --- | --- |
| **Materials** | **The number** | **Each of the Price** |
| **Roller Ball** | **4** | **$3** |
| **Standard station Servo motor** | **2** | **$22** |
| **Parallax Ping Ultransonic Range Sensor** | **4** | **$6** |
| **Square Mirror** | **1** | **$20** |
| **Arduino Proto Shield** | **1** | **$15** |

As you see the table, we need four Roller Ball, two standard station Servo, four Parallax Ping Ultrasonic Range Sensor, proper box and Rotary plate, Rectangular mirror, Arduino Proto Shield. Why these materials need? First of all, we need box and Rotary plate that we design. The reason is that we need to box to support servo motor and Rotary plate to support mirror and attach servo motor beside Rotary plate. Also we need four Ultrasonic Range Sensor to detect face easily left right side and up and down. Do you know Ultrasonic Range Sensor? Ultrasonic Range Sensor is to work on a principle similar to [radar](http://en.wikipedia.org/wiki/Radar) or [sonar](http://en.wikipedia.org/wiki/Sonar), which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively Sensor .

I will explain the rest materials in Assembly part.

**Assembly**

 I think you are curious about how to move the mirror left right and up and down by the servo motor. As you see Assembly design, you notice that 4 Roller Ball is attached under the Rotary plate. This enable the rotary plate to spin by motor left right. Furthermore, as you see the picture, we attached four Ultrasonic Range Sensor to the four side of mirror. This enable Ultrasonic Range Sensor to detect the face left right and up down. Also, we use the other servo motor to control vertical and bottom movement. We connect the stick to the back part of mirror pushes lower part of mirror. So when the servo motor turns clockwise rotation, we made mirror move vertical-bottom

**Code**

const int pingPin = 7; //define distance sensor1

const int pingPin2 = 8; //define distance sensor2

const int pingPin3 = 12; //define distance sensor3

const int pingPin4 = 13; //define distance sensor4

unsigned int duration, inches; //define duration of sensor1

unsigned int duration2, inches2; //define duration of sensor2

unsigned int duration3, inches3; //define duration of sensor3

unsigned int duration4, inches4; //define duration of sensor4

#include<Servo.h> //sensor library

Servo myservo; //define servo motor1 which controls right and left

Servo myservo2; //define servo motor2 which controls up and down

void setup() {

  Serial.begin(9600);

   myservo.attach(3); //one servo motor which controls right and left

   myservo2.attach(5); //the other servo motor which controls up and down

}

void loop() {

  pinMode(pingPin, OUTPUT);          // Set pin to OUTPUT

  digitalWrite(pingPin, LOW);        // Ensure pin is low

  delayMicroseconds(2); //   with 2 microsecond burst

  digitalWrite(pingPin, HIGH);       // Start ranging

  delayMicroseconds(5);              //   with 5 microsecond burst

  digitalWrite(pingPin, LOW);        // End ranging

  pinMode(pingPin, INPUT);           // Set pin to INPUT

duration = pulseIn(pingPin, HIGH);  // Read echo pulse,

 pinMode(pingPin2, OUTPUT);

  digitalWrite(pingPin2, LOW);

  delayMicroseconds(2);

  digitalWrite(pingPin2, HIGH);

  delayMicroseconds(5);

  digitalWrite(pingPin2, LOW);

  pinMode(pingPin2, INPUT);

   duration2 = pulseIn(pingPin2, HIGH);

   pinMode(pingPin3, OUTPUT);

  digitalWrite(pingPin3, LOW);

  delayMicroseconds(2);

  digitalWrite(pingPin3, HIGH);

  delayMicroseconds(5);

  digitalWrite(pingPin3, LOW);

  pinMode(pingPin3, INPUT);

  duration3 = pulseIn(pingPin3, HIGH);

   pinMode(pingPin4, OUTPUT);

  digitalWrite(pingPin4, LOW);

  delayMicroseconds(2);

  digitalWrite(pingPin4, HIGH);

  delayMicroseconds(5);

  digitalWrite(pingPin4, LOW);

  pinMode(pingPin4, INPUT);

   duration4 = pulseIn(pingPin4, HIGH);

  inches = duration / 74 / 2;    // Convert to inches

  inches2 = duration2 / 74 / 2;

  inches3 = duration3 / 74 / 2;

  inches4 = duration4 / 74 / 2;

  Serial.println(inches);

if(inches < 5){ //when distance sensor1 perceive something in 5 inches, servo motor1 rotate:45

  myservo.write(45);

}

delay(100);

if(inches2 < 5) { // when distance sensor2 perceive something in 5 inches, servo motor1 rotate:-45

  myservo.write(-45);

}

delay(100);

if(inches3 <5) { // when distance sensor3 perceive something in 5 inches, servo motor2 rotate: 45

  myservo2.write(45);

}

delay(100);

if(inches4 <5) { // when distance sensor4 perceive something in 5 inches, servo motor2 rotate:-45

  myservo2.write(-45);

}

delay(100);

}

**Difficulty**

When we start to make following mirror, we had to make square box, rotating circular plate and also stick each other not to detach. While we make following mirror, we spent time in idea shop. At first, we didn’t know where it is. But my professor, Jeremy introduced John who helps us a lot. It was difficult to use autocad which can be useful as a draft. We had to know how to use it because it is imperative to make structures. And we didn’t know laser print which is used to cut something. So we ask John everything in idea shop. We made structures as we want owing to him.

What we had a problem is we didn’t know there are two types of servo motors which are standard and continuous. The only difference between them is whether servo motor keeps rotating or not. Standard servo motor rotates when distance sensors perceive something and then stop. Continuous servo motor also rotates when distance sensors perceive something but it doesn’t stop. We didn’t know that. So we ordered continuous one instead of standard one. To make following mirror which is controlled by perceiving action, we need standard servo motor. Because it should stop when perceived something disappears.

**Future plan**

In the present, ultrasonic distance sensor used in many field such as stair censer for visually handicapped, hand dry censer, obstacle sensor of cleaning robot. But there are many field what will be used ultrasonic distance sensor in the future such as ATM machine. This ATM machine can recognize human so that can on or off automatically by using ultrasonic distance sensor. If people approach in front of machine, the machine turn on, or far away from machine, the machine turn off. And Ultrasonic Distance Sensor can used in touch panel, so Ultrasonic Distance Sensor can recognize human so can prevent malfunction of touch pane. Also this ultrasonic distance sensor can used Vein Authentication equipment. The principle is very simple. Because he sensor can recognize vein of each people. We made a following mirror using Ultrasonic Distance Sensor but can make many things using Ultrasonic Distance Sensor. So we predict more application of Ultrasonic Distance Sensor.

**Summary**

As a final project, we spent time deciding what we are going to make. There are a lot of things we want to make. But we can’t make all of things and also there are a lot of complicated procedures. We thought controlled helicopters, moving snake toys as a final project. But former is complicated, latter is too easy. Finally, we decided to make following mirror which can be controlled by distance sensors.

We made and ordered the materials which we need. After we gathered materials, we assembled the following mirror. We had many difficulties from assembling the following mirror. However, we overcome the difficulty, we finally made it

When it comes to coding, we had to try and try because it was sometimes not working. But it is good chance to learn how they work between coding and sensors.

After making following mirror as a final project, we were so happy. It took so long time to make it. I think it was good to be cooperated with each other and divided roles such as how to make materials, cutting, drafts, coding and presentation.

In addition to making the mirror, we learned a lot of things useful in my life.

**Summary**

Reference:

Ultrasonicsensors code in arduino:

<http://arduino.cc/en/Tutorial/Ping?from=Tutorial.UltrasoundSensor>

Servo motor in arduino:

http://arduino.cc/en/reference/servo