ROBOTICS AND CONTROL

FINAL REPORT

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Human Following Robot

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ABSTRACT

A wide range of human-robot collaborative applications in diverse domains such as manufacturing, health care, the entertainment industry, and social interactions, require an autonomous robot to follow its human companion. Different working environments and applications pose diverse challenges by adding constraints on the choice of sensors, the degree of autonomy, and dynamics of a person-following robot.

The aim of our project is to build a human following robot using an Arduino microcontroller built with IR sensors and an ultrasonic sensor, Arduino and motor driver.

INTRODUCTION

Human following robot is very common in this technology era. Human following is a technique used by robot and autonomous vehicles to follow a human within a specific range. In this case, communication between the human and the robot is the most significant factor where sensors are needed to ensure its success.

A human-following robot requires several techniques such as human's target detection, robot control algorithm and obstacles avoidance. Human-following robots have been researched and developed actively these decades due to its plentiful applications in daily life and manufacturing. In this rapid moving world, now there is a need for such robots that can interact and co-exist with humans.

Ultrasonic sensor is preferred for human following robots due to its wide detection area, less light dependency, smaller in size, lightweight, use a very low memory, cheaper than Laser Range Finder (LRF) or camera and lower power consumption.

TECHNICAL SPECIFICATIONS

1. COMPONENTS USED

1) Arduino Uno

2) Motor Driver Shield

3) TT Gear Motor and wheels set

4) Servo Motor

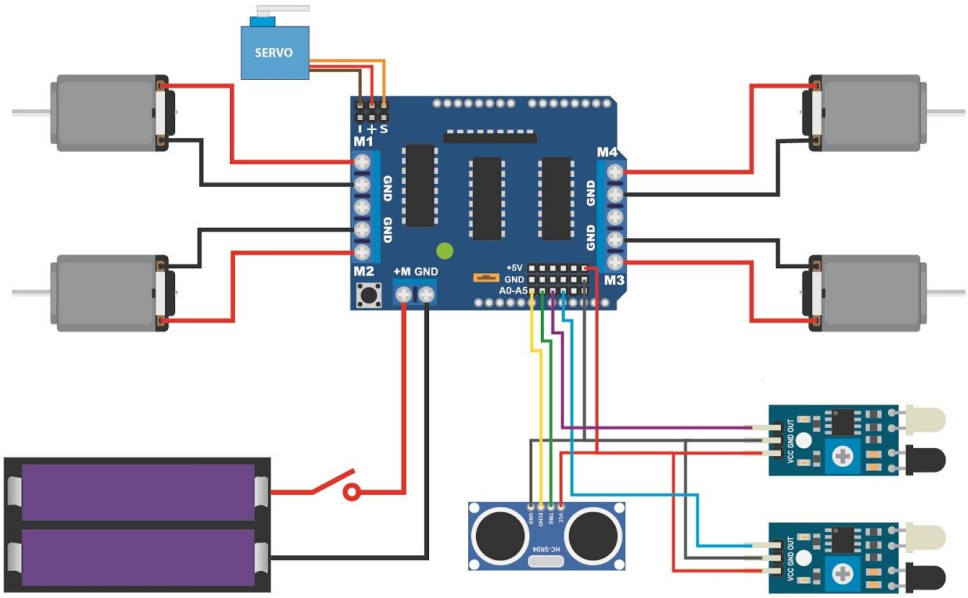
5) Ultrasonic Sensor

6) 9V batteries

7) IR sensors

8) Male and Female Jumper wire

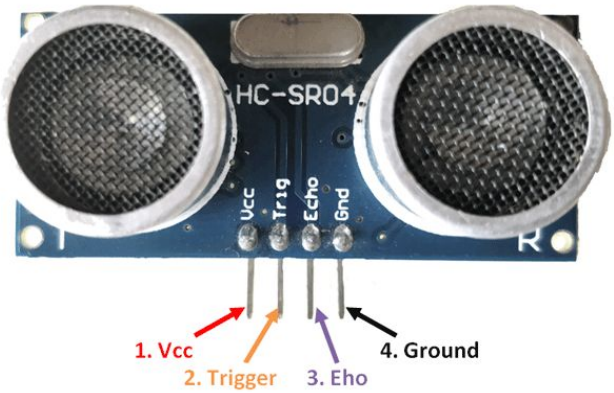
9) Wooden chassis



Circuit diagram

2. SENSORS USED

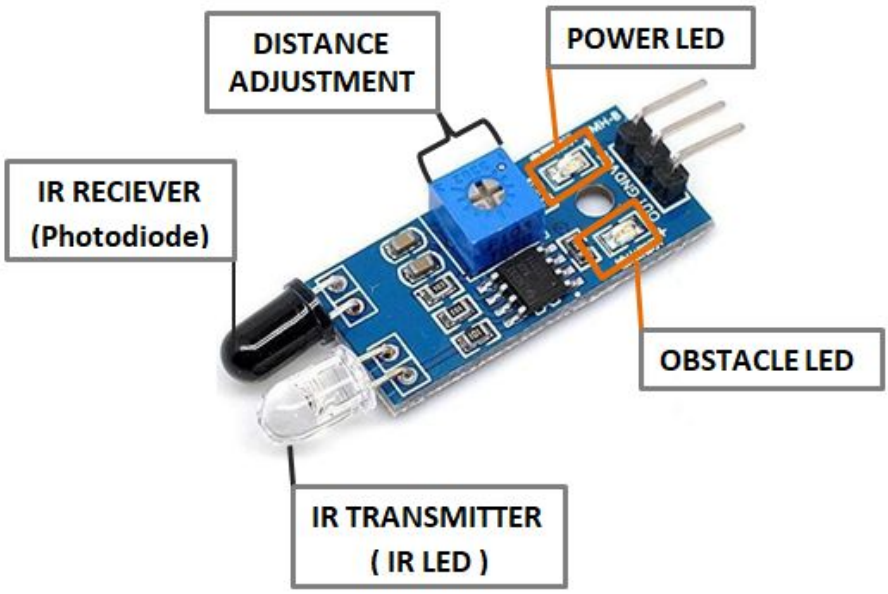
Ultrasonic Sensor



An 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. Ultrasonic waves travel faster than the speed of audible sound (i.e. the sound that humans can hear). Ultrasonic sensors have two main components: the transmitter (which emits the sound using piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the target).

Ultrasonic sensors are used primarily as proximity sensors. They can be found in automobile self-parking technology and anti-collision safety systems. Ultrasonic sensors are also used in robotic obstacle detection systems, as well as manufacturing technology. In comparison to infrared (IR) sensors in proximity sensing applications, ultrasonic sensors are not as susceptible to interference of smoke, gas, and other airborne particles (though the physical components are still affected by variables such as heat).

IR Sensor



Robots use infrared or ultrasound sensors to see obstacles. These sensors work the same way as animal echolocation: The robot sends out a sound signal or a beam of infrared light and detects the signal's reflection. IR sensor is an electronic device that emits light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensors can detect these radiations.

The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode . Photodiode is sensitive to IR light of the same wavelength which is emitted by the IR LED. When IR light falls on the

photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

There are five basic elements used in a typical infrared detection system: an infrared source, a transmission medium, optical component, infrared detectors or receivers and signal processing. Infrared lasers and Infrared LED’s of specific wavelength used as infrared sources.

The three main types of media used for infrared transmission are vacuum, atmosphere and optical fibers. Optical components are used to focus the infrared radiation or to limit the spectral response.

Arduino IDE Code

```
//Arduino Human Following Robot

#include<Servo.h>
#include<AFMotor.h>
#define LEFT A0
#define echopin A1 // echo pin
#define trigpin A2 // Trigger pin
#define RIGHT A3

AF_DCMotor Motor1(1,MOTOR12_1KHZ);
AF_DCMotor Motor2(2,MOTOR12_1KHZ);
AF_DCMotor Motor3(3,MOTOR34_1KHZ);
AF_DCMotor Motor4(4,MOTOR34_1KHZ);

Servo myservo;

int pos =0;
long time;

void setup(){
// put your setup code here, to run once:
Serial.begin(9600);
myservo.attach(10);

for(pos = 90; pos <= 180; pos += 1){
myservo.write(pos);
delay(15);
}

for(pos = 180; pos >= 0; pos-= 1) {
myservo.write(pos);
delay(15);
}
```

```
for(pos = 0; pos<=90; pos += 1) {
myservo.write(pos);
delay(15);
}

pinMode(RIGHT, INPUT);
pinMode(LEFT, INPUT);

pinMode(trigpin, OUTPUT);
pinMode(echopin, INPUT);

}

void loop(){
unsigned int distance = read_cm();

int Right_Value = digitalRead(RIGHT);
int Left_Value  = digitalRead(LEFT);

Serial.print("R= ");
Serial.print(Right_Value);
Serial.print(" L= ");
Serial.print(Left_Value);
Serial.print(" D= ");
Serial.println(distance);

    if((Right_Value==1) && (distance>=10 &&
distance<=30)&&(Left_Value==1)){forword();}
else if((Right_Value==0) && (Left_Value==1)){turnRight();}
else if((Right_Value==1) && (Left_Value==0)){turnLeft();}
else if((Right_Value==1) && (Left_Value==1)){stop();}
else if(distance > 5 && distance < 10){stop();}
else if(distance < 5){backword();}

delay(50);
}

long read_cm(){
  digitalWrite(trigpin, LOW);
  delayMicroseconds(2);
```

```
  digitalWrite(trigpin, HIGH);
  delayMicroseconds(10);
  time = pulseIn (echopin, HIGH);
  return time / 29 / 2;
}

void forword(){// turn it on going forward
Motor1.setSpeed(120);
Motor1.run(FORWARD);
Motor2.setSpeed(120);
Motor2.run(FORWARD);
Motor3.setSpeed(120);
Motor3.run(FORWARD);
Motor4.setSpeed(120);
Motor4.run(FORWARD);
}

void backword(){ // the other way
Motor1.setSpeed(120);
Motor1.run(BACKWARD);
Motor2.setSpeed(120);
Motor2.run(BACKWARD);
Motor3.setSpeed(120);
Motor3.run(BACKWARD);
Motor4.setSpeed(120);
Motor4.run(BACKWARD);
}

void turnRight(){ // the other right
Motor1.setSpeed(200);
Motor1.run(FORWARD);
Motor2.setSpeed(200);
Motor2.run(FORWARD);
Motor3.setSpeed(100);
Motor3.run(BACKWARD);
Motor4.setSpeed(100);
Motor4.run(BACKWARD);
}

void turnLeft(){ // turn it on going left
```

```
Motor1.setSpeed(100);
Motor1.run(BACKWARD);
Motor2.setSpeed(100);
Motor2.run(BACKWARD);
Motor3.setSpeed(200);
Motor3.run(FORWARD);
Motor4.setSpeed(200);
Motor4.run(FORWARD);
}

void stop(){ // stopped
Motor1.setSpeed(0);
Motor1.run(RELEASE);
Motor2.setSpeed(0);
Motor2.run(RELEASE);
Motor3.setSpeed(0);
Motor3.run(RELEASE);
Motor4.setSpeed(0);
Motor4.run(RELEASE);
}
```

WORKING PRINCIPLE

The robot is built using an ultrasonic sensor. An Ultrasonic sensor is a sensor that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back.

IR sensors used to follow the human who will be in constant motion. This is used to position the ultrasonic into its sensing range which is around 15 degrees.

By using all these parameters given out by the sensors the arduino UNO with the help of the motor drivers powers the TT gear motors to move the robot in the desired direction.

RESULT AND INFERENCE

Based on the given commands the robot was successfully operated and moved in the expected directions without any error.
From the techniques reviewed, there are several ways to design a person following robot. Using an ultrasonic sensor and IR sensors have proven to be the most convenient system.

In the future, the usage of robot in helping human's tasks would be massive. It will be normal one day to find out person following robot has taken over simple task, such as being a driver, maid, gardener, or even security guard.

Suggestions are presented to improve the method and adapt it to everyday life. From this project we were able to implement and understand how mobile robots can be used in personal home and assist people.

CONCLUSION

Together with the explosion of improving daily life services and manufacturing demands, human-following robots are used in numerous fields such as taking care of human in hospitals, carrying loads in industrial zones, airport, robotic vacuum cleaners, helping people during shopping.

This project has wide applications in automobile and manufacturing industries as it makes control easier and is user friendly. Moreover with further alteration this bot can be used in non-destructive testing in industries which is a major advantage.

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