Project 6
Team 10

Indian Institute
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Computer Vision Based Goal Line Technology

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Abstract

goal-line technology is the use of electronic aid to determine if a goal has been scored or not. In detail, it is a method used to determine when the ball has completely crossed the goal line in between the goal-posts and underneath the crossbar with the assistance of electronic devices and at the same time assisting the referee in awarding a goal or not. We can simply determine this by the use of some sensors like Ultrasonic sensor , PIR sensor etc. by placing the sensors at a suitable position behind the goal line so that the motion of the object is detected only when the object crosses the line .
for detection buzzer/LED is used.

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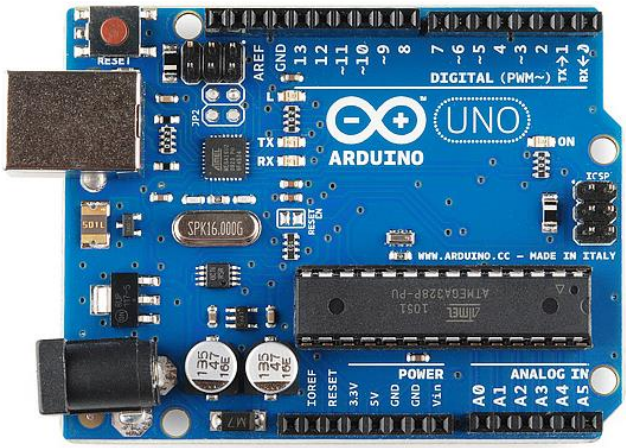
Introduction

The computer based vision for goal line becomes certainly important as this proves to be more accurate than the dependence of the human eye and more efficient than video replay Also it enforces complete accuracy while detecting a goal. In this project we will show how we can perform this technology by using some basic sensors like Ultrasonic sensor and PIR sensor.

Materials and prcoess.

Materials used:

1. Arduino Uno



Arduino Uno is a microcontroller board based on the ATmega328P . It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

Arduino code used:

```
int LED = 10;             // the pin that the LED is atteched to
int PIR = 2;              // the pin that the sensor is atteched to
int const trigPin = 13;
int const echoPin = 11;
int const buzzPin = 7;
void setup() {
  pinMode(LED, OUTPUT);   // initalize LED as an output
  pinMode(PIR, INPUT);    // initialize sensor as an input
  pinMode(LED_BUILTIN, OUTPUT);
  pinMode(trigPin, OUTPUT); // trig pin will have pulses output
  pinMode(echoPin, INPUT); // echo pin should be input to get pulse width
  pinMode(buzzPin, OUTPUT); // buzz pin is output to control buzzering

  Serial.begin(9600);
  // initialize serial
}

void loop(){
  if (digitalRead(PIR) == HIGH) { // check if the sensor is HIGH
    digitalWrite(LED, HIGH);
    digitalWrite(LED_BUILTIN, HIGH);// turn LED ON
    Serial.println("Motion detected!");
    delay(10);                    // delay 100 milliseconds
  }
  else {
    digitalWrite(LED, LOW);
    digitalWrite(LED_BUILTIN, LOW);// turn LED OFF
    Serial.println("Motion stopped!");
    delay(10);                    // delay 100 milliseconds
  }
  int duration, distance;
// Output pulse with 1ms width on trigPin
digitalWrite(trigPin, HIGH);
delay(1);
digitalWrite(trigPin, LOW);
// Measure the pulse input in echo pin
duration = pulseIn(echoPin, HIGH);
// Distance is half the duration devided by 29.1 (from datasheet)
distance = (duration/2) / 29.1;
// if distance less than 0.5 meter and more than 0 (0 or less means over range)
if (distance <= 50 && distance >= 0) {
// Buzz
digitalWrite(buzzPin, HIGH);
} else {
// Don't buzz
digitalWrite(buzzPin, LOW);
}
// Waiting 60 ms won't hurt any one
delay(60);
```

2. **PIR Sensor**.

A **passive infrared sensor** (**PIR sensor**) is an electronic sensor that measures infrared (IR) light radiating from objects in its field of view. They are most often used in PIR-based motion detectors PIR sensors are commonly called simply "PIR", or sometimes "PID", for "passive infrared detector". The term *passive* refers to the fact that PIR devices do not radiate energy for detection purposes. They work entirely by detecting infrared radiation (radiant heat) emitted by or reflected from objects.

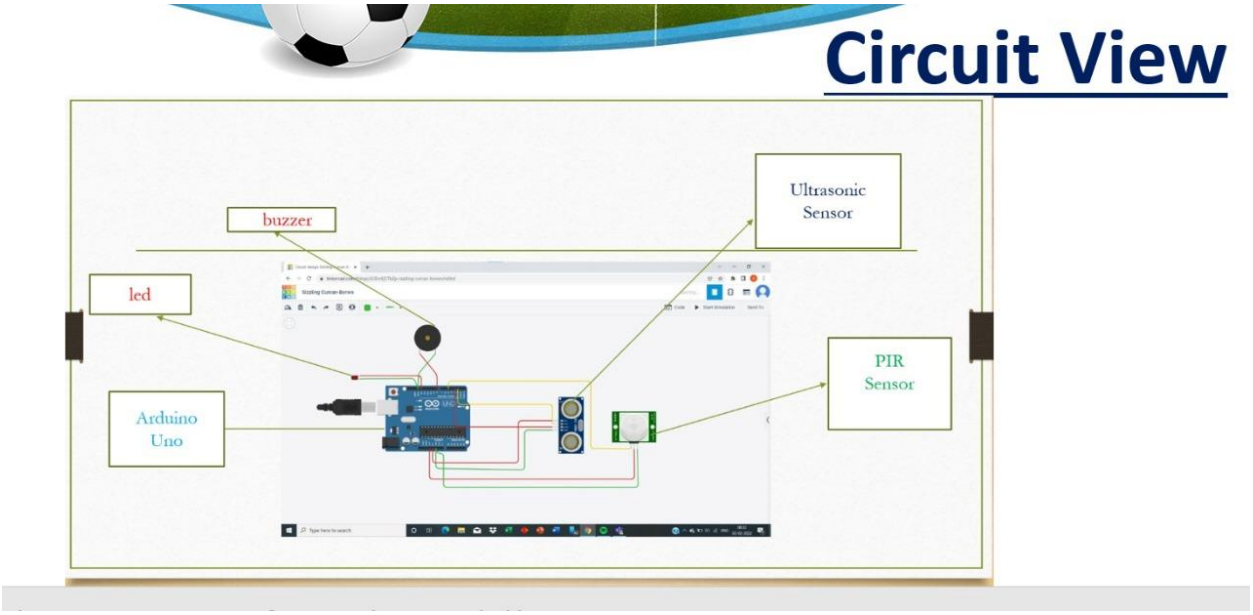
3. Ultrasonic Sensor.

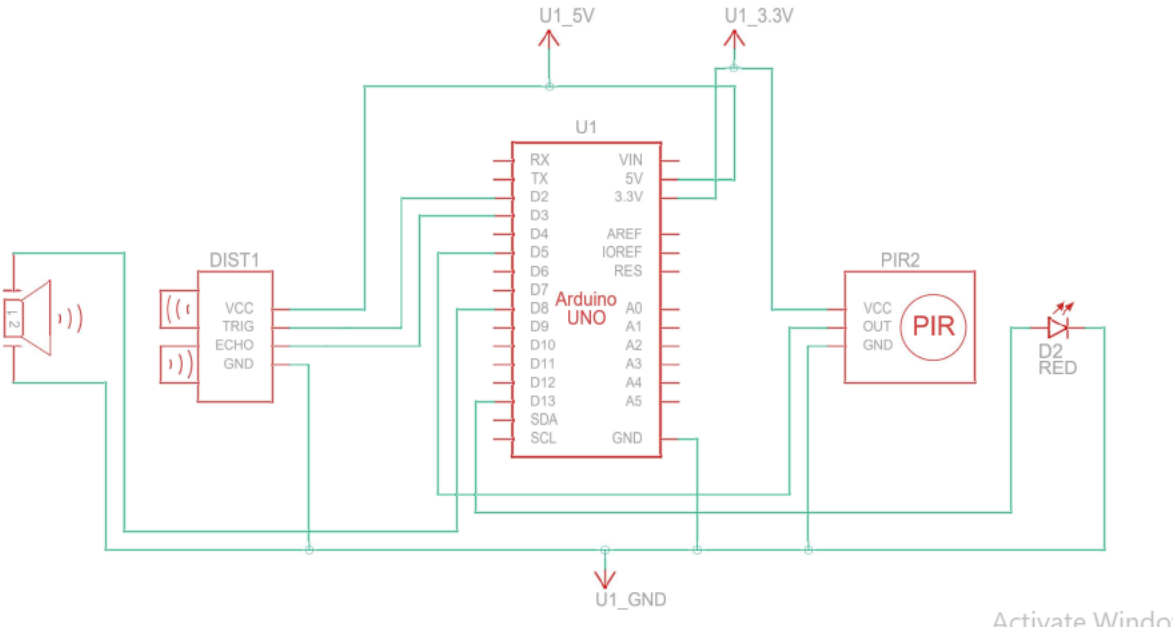
This is the HC-SR04 ultrasonic distance sensor. This economical sensor provides 2cm to 400cm of non-contact measurement functionality with a ranging accuracy that can reach up to 3mm. Each HC-SR04 module includes an ultrasonic transmitter, a receiver and a control circuit.

There are only four pins that you need to worry about on the HC-SR04: VCC (Power), Trig (Trigger), Echo (Receive), and GND (Ground).

In this ultrasonic proximity sensor, a special type of sonic transducer is used for alternate transmission and reception of sound waves.

Schematic , circuit view and actual circuit



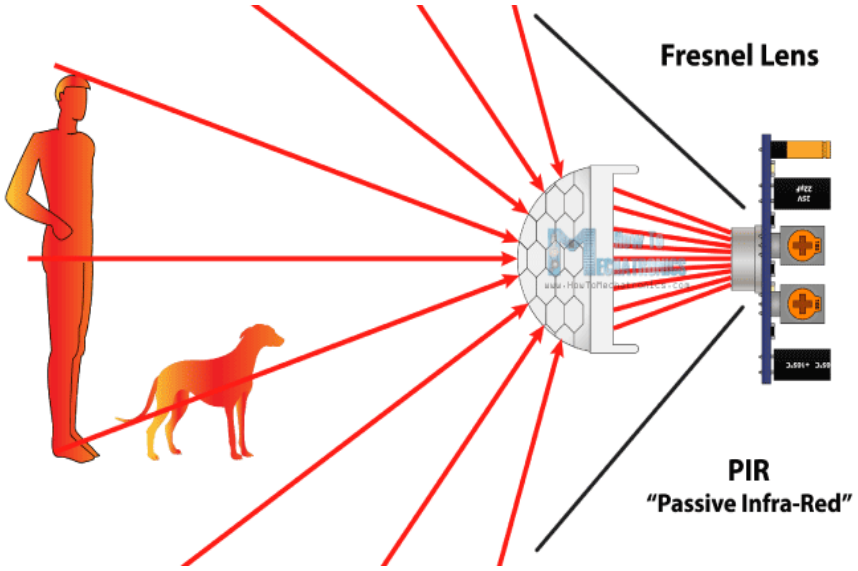


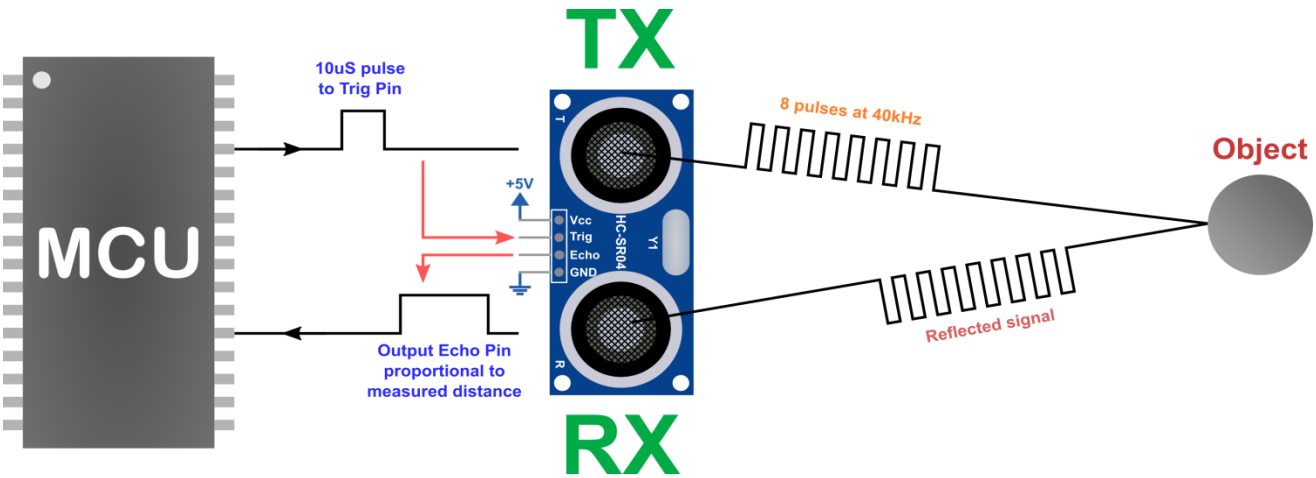
Process:

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 traveled to and from the target)

Therefore to calculate the distance it uses the time taken by the sound to travel the distance.
Similarly,

Passive infrared (PIR) sensors use a pair of pyroelectric sensors to detect heat energy in the surrounding environment. These two sensors sit beside each other, and when the signal differential between the two sensors changes (when the object crosses the line), the sensor will engage.
And this information is received by human with the help of buzzer/LED.


Fresnel Lens
PIR
"Passive Infra-Red"


TX
10uS pulse
to Trig Pin
8 pulses at 40kHz
Object
MCU
+5V
Vcc
Trig
Echo
GND
HC-SR04
Y1
T
R
Reflected signal
Output Echo Pin
proportional to
measured distance
RX

Result

By using our circuit we are able to detect the object only when it crosses the goal line completely.

Conclusion

We are successfully able to detect the motion of the object behind the goal line with the help of the sensors . The circuit response is fast . Through this project we were able to learn about the working of different sensors and their use. This technology is very important in today's modern world to overcome the errors made by human eye and much more accurate then replay video.

https://youtu.be/l6IyIaKap7A
Here is the demonstration video of our project.

Acknowledgement

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