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Design and Implementation of IoT Based Object Detection using IR and Ultrasonic Sensors

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Abstract

Sensors which are connected to IoT board send data to either a local network or the Internet. The Internet of Things is the accretion of connected sensors. It is assumed that in the year 2025 approximately 75.44 billion devices are connected to the Internet of Things. In IoT greatest number of devices will be small sensors that send information about what they are sensing. Here we are going to design how an infrared sensor works with ESP8266 NodeMCU board and also implement these sensors to select object and measure the distance of the object by using ultrasonic sensor. These sensors provides both digital and analog output. Here we are performing only digital output which will be directly connected to a NodeMCU with Arduino platform to read the sensor output. Infrared sensor is used for object detection and Ultrasonic sensor is used for distance measurement.

Keywords: Analog Signal; Arduino UNO; Digital Signal; ESP8266; Internet of Things (IoT); Infrared Sensor (IR); Light Emitting Diode (LED); NodeMCU; Object Detection; Signal; Ultrasonic Sensors

Introduction

In 2005 the world came across new emerging technology Internet of Things (IoT). The IoT secure protocol system gives new dreams to the IT industries. Operating the devices from anywhere through mobile phone or laptop is a magical things. IoT brings or hardware data from one place to another place as well as gives away to control any electronics devices. This domain help to automies productions medical devices and many more industries [1].

The sensors are of two types active and passive. The active sensors needs power supply to operate. The passive sensors operate surrounding variables [2].

In the field of automation ultrasonic sensor is a remarkably useful sensor. The sensors give an output in the form of digital and analog. In this studies perform only digital output format that can be directly connected to a NodeMCU and couple with Arduino platform to read the sensor output. The motion and heat can be detected by An Infrared sensors. Usually Ultrasonic sensor is used to determine the distance without damage to the object [3, 4].

Architecture and Working of The system

Figure 1 present a pictorial representation of the working module. Primarily, the IR sensor checks for the presence of the object. And the Ultrasonic sensor continuously checks the distance. If the distance is below 5 cm, only then the object will be detected otherwise it will not be detected.

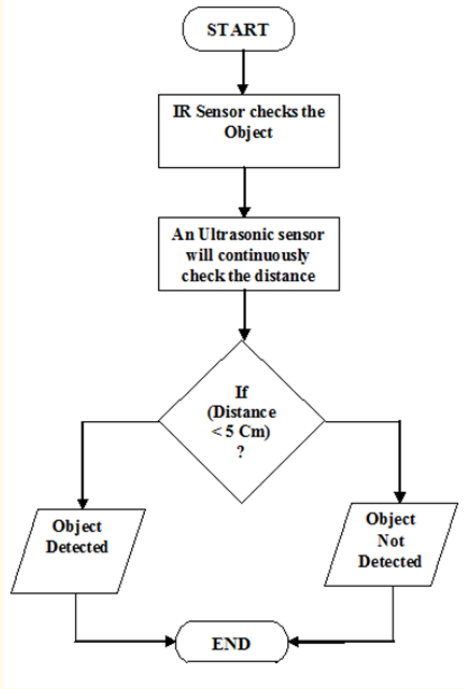

Figure 1: Flowchart of the System.

Implementation and Working on Nodemcu

To select a suitable sensor that suits the particular environment for a particular application it's a major task [5].

NODEMCU

In the year 2013 Node Microcontroller Unit was firstly launched. It is open source platform called the ESP8266. The NodeMCU integrated with Wi-Fi network so reduced the size of the board as shown in figure 2.

NodeMCU has a more powerful processor; larger memory supports with a smaller board size, low cost, lower energy consumption and can interact with more complex external devices. It has a smaller size and packs several additional features [6].

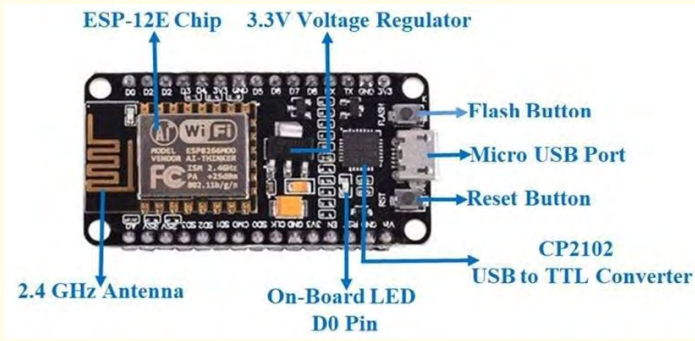

Figure 2: NodeMCU Module.

Infrared Sensor (IRSensor)

An infrared sensor is highly susceptible to ambient light and is suitably covered to reduce effect of ambient light on the target sensor. To calibrate the sensor as shown in figure 3 should be tested by on board potentiometer. An infrared light emitting diode emits light of infrared range is visible by a camera and invisible by naked eyes [7].

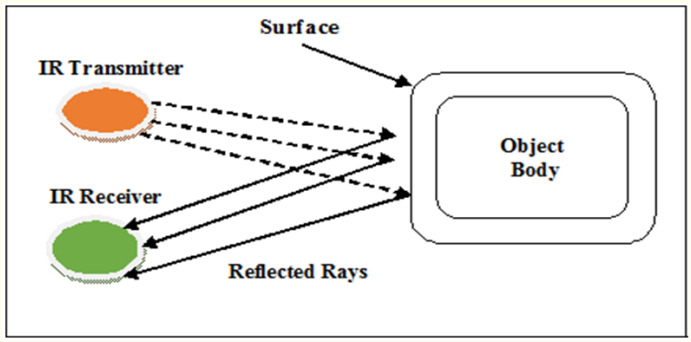

Figure 3: Infrared Sensing Principle for Object Detection.

Ultrasonic Sensor (HC-SR04)

An ultrasonic sensor is an electronic device which measure the distance of an intent object. Will be measure by emitting ultrasonic sound waves and also converts the reflected sound into an electrical signal. The speed of audible sound waves travel slower than ultrasonic sensor. The ultrasonic sensor has two main elements one is transmitter another is receiver.

1. ***Transmitter***: Emits the sound by using the piezoelectric effect to generate an electric charge.
2. ***Receiver***: Encounters the sound after it has travelled to and from the target [8].
   - *VCC*: Generally this pin supplies the power to the sensor in the form of volts.
   - *TRIGGER*: its input pin has to be kept high to initialize measurement by sending wave.
   - *ECHO*: its output pin goes high for a period of time which will be equal to the time taken for the wave to return back to the sensor.
   - *GROUND*: It's a base pin which is connected the system to the ground. The basic concepts of sound propagation are shown in Figure 4.

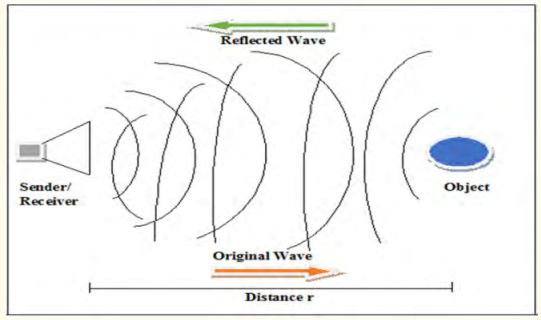

Figure 4: Ultrasonic Sensing Principle for Distance Measurement.

Result and Discussion

There are two ways in which we can use these two sensors that are IR sensor and Ultrasonic sensor with the NodeMCU on the Arduino platform that are analog and digital connections.

In this section we perform only digital output. To read the sensor output this is directly connected to a NodeMCU [9].

IR Sensor Object Detectors

The concept of reflected light as appeared in Figure 3 will be depended on Infrared detecting component by infrared signal. Transmitter source generates infrared signal and recipient source got that signal from a surface of the thing. The infrared detecting component can be utilized for obstacle and movement finding may be use for detecting heat emission from an object. When you remove the objects you will see it gets turned off the LED light and observe the changes when LED is connected to board [10].

- For serial communication adjust the baud rate to 115200.
- Define all the active pins positions if LED will be connected.
- In the loop section first initially turn on the LED.

Figure 5 suggests hardware a part of venture. Here we will be considering connections in our project. Here NodeMCU is the controller of the task Laptop is interfaced to the NodeMCU. Right here the circuits that are linked to the IR Sensor [11].

The disadvantage of IR sensor is not suitable for dim light environment; it's detected the object in bright surface environment [12].

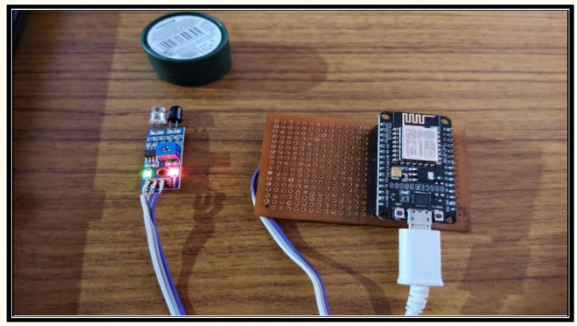

Figure 5: IR Sensor Object Detector Testing.

When an object is place in front of the sensor output will be 5 volt otherwise output will be 0 volt. As shown in Figure 6.

- Printing the values on the serial monitor screen we are continuously reading the output which is generated by the IR sensor. At the top most right corner of the Arduino IDE software you can find the serial monitor sub menu [13, 14].
- The LED will glow if the values are less than 5 cm. You can change this value accordingly as per your need. Also check out how an IR sensor works with the Arduino UNO board [15].

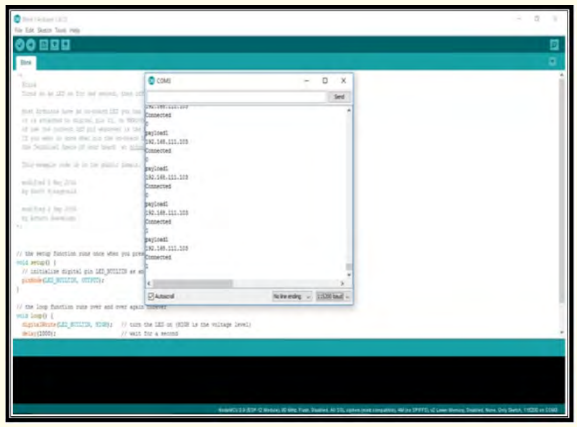

Figure 6: Object Detection by IR Sensor in software simulation digital output.

HC-SR04 Ultrasonic Sensor Distance Sense Module

To find out the distance to an object the ultrasonic sensor uses sonar. This sensor reads from 2cm to 400cm with an accuracy of 0.3 cm [16].

Figure 7 suggests hardware a part of venture. Here we will be considering connections in our project. Here NodeMCU is the controller of the task. Laptop is interfaced to the NodeMCU. Right here the circuits that are linked to the ultrasonic sensor [17, 18].

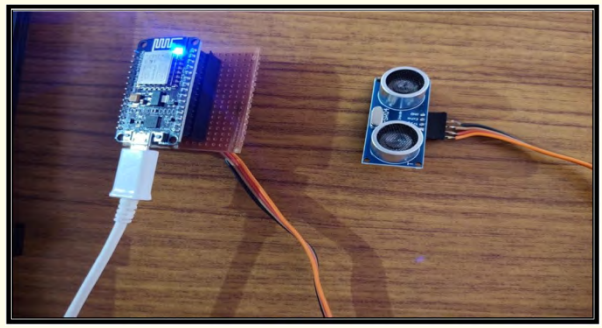

Figure 7: Ultrasonic Sensor Distance Measurer Testing.

Print the measurements on the serial monitor as shown in figure 8.

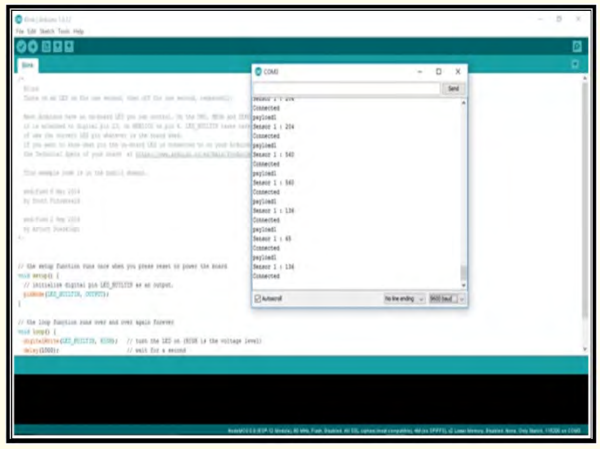

Figure 8: Distance Measurement by Ultrasonic Sensor in software simulation digital output.

Conclusion and Future scope

This study is aimed to detect object with respect to the distance measurement with the assistance of sensors. A classic sensor contains two major elements in which first element produces sound and second element catches reflected echo. The main aim of this study is for automotive sector for applying smart algorithm for obstacle detection as well as accurate detection of object. The infrared sensor is use to measure the distance of an object. The future of IoT sensor technology rests on potential growth value this enables organisations to manage their sensor domain at scale and also empowering them to understand an upraised.

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