Design and Modeling of an Infrared Sensor-Based Object Detection Circuit for Computer Vision Applications

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Abstract Infrared (IR) sensor utilizes the principle of selective light sensing by distinguishing a particular light wavelength within the entire infrared (IR) spectrum. Currently, the cutting-edge industries are utilizing infrared sensors in various applications. In this chapter, the authors have proposed a contemporary demonstration of Infrared Sensor-based object detection circuit (ODC) by using Multisim software. The proposed circuit will be useful for various computer vision applications.

1 Introduction

Theoretical analysis of object detection, by utilizing the infrared (IR) spectrum, has already shown various potential capabilities. The essential deep neural network for object detection is already over-feat. Object detection combines the tasks of object classification and localization. An object detector can be defined as a network separating the task of deciding the placement of objects and classification [1].

An IR device measures and recognizes infrared wavelength in its encompassing air medium. The infrared radiation from the semiconductor light emitting diode gets reflected by the object and that reflected IR's wavelength is sensed by the IR sensor [2]. Object detection is a crucial task that deals with various kinds of investigation on the instances of visual objects (such as humans, animals, or cars) in one or more digital pictures. The target of object detection is to develop procedural models and techniques. The IR sensing component may be a simple device that transmits IR radiation, senses the reflected wave and identifies the object from the reflected IR radiation in order to detect the bound obstacles [3]. Object detection is the process of finding and classifying a variety of objects on an image. The output of an object detector may be very complex in nature, since the quantity of the detected objects

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might change from image to image [4]. In order to overcome those drawbacks, the authors have used the associate degree IR sensing element [5] in their design.

The authors are aiming to modify and improve the model of the IR (infrared) sensor-based circuit of the existing object detection system for physically challenged persons, which is a part of computer vision application.

2 Circuit Design and Principle

Figure 1 shows the basic IR sensor-based circuit which was reported in Ref. [6]. The circuit is capable of detecting a single object at a time. But the major drawback of this circuit is that it cannot detect multiple-objects simultaneously, which is essential for the real-world scenario.

The circuit shown in Fig. 1 is implemented and analyzed using Multisim Software. An infrared sensor is an electronic device which can recognize the degree of the transmitted infrared radiation in its surrounding environment. As a result, when any obstacle or a body comes close to the sensor, the infrared light emitted from the circuit gets reflected by the obstacle or body and that the reflected light is recognized by the beneficiary IR sensor. Figure 2 shows the modified circuit designed by the authors using IR sensor, Zener diode, P–N Junction diode. It is capable of detecting multiple objects simultaneously. This circuit is also simulated by the Multisim software.

Table 1 provides the list of basic components which are used for the circuit implementation. Therefore, the above mentioned new design model is a very promising circuit for multiple signal detection circuit analysis for Computer Vision Applications.

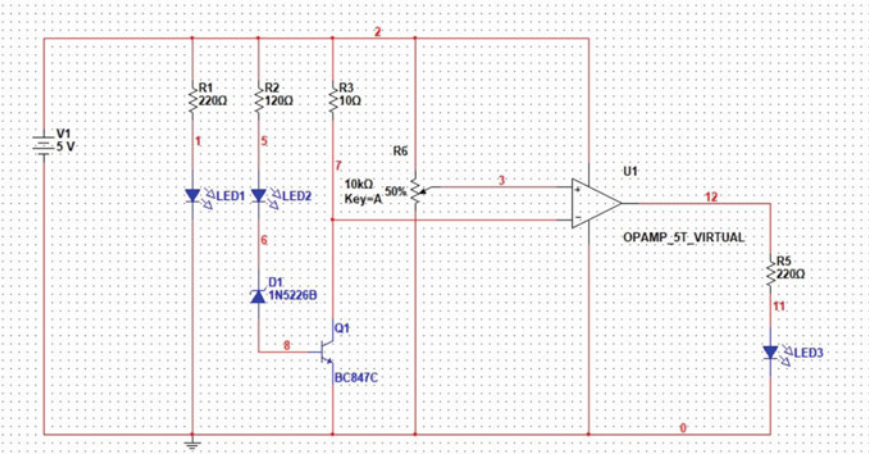

Fig. 1 IR sensor-based circuit for object detection [6]

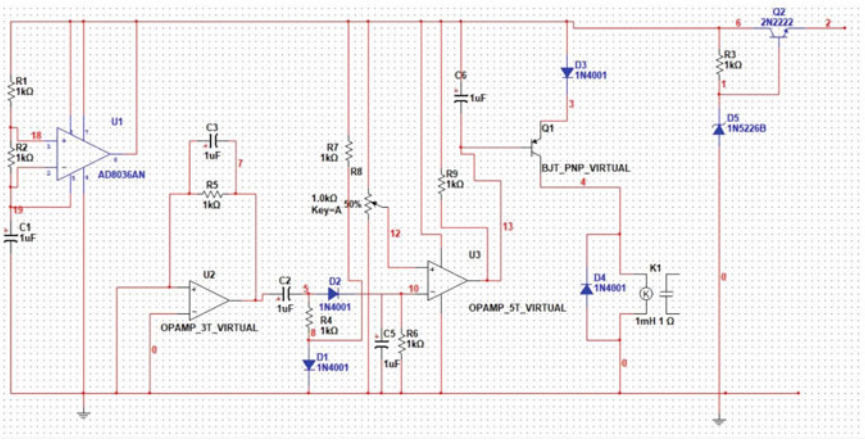

Fig. 2 Infrared sensor-based modified object detection circuit

Table 1 List of basic components

Serial number	Parts list	Values
01	Resistance R1	10 k (2 W)
02	Resistance R2, R5, R6, R9	1 k (2 W)
03	Resistance R3	33R (2 W)
04	Resistance R4, R8	1 M (2 W)
05	Trimmer Cermet R7	10 k
06	Resistance R10	22 k (2 W)
07	Capacitance C1, C4	1 uF
08	Capacitance C2	47 pF
09	Capacitance C3, C5, C6	100 uF
10	Diode D1	IR LED
11	Diode D2	IR photo-diode
12	Diode D3, D4	1N4148 (75 W/150 mA)
13	Diode D5	LED
14	Diode D6, D7	1 N 4002
15	PNP Transistor Q1	BC 558 (45v/800 mA)
16	Timer IC IC1	NE 555
17	PNP transistor	BC 558
18	NPN transistor	BC 548
19	Relay	SPDT (2A/220v)

3 Circuit Operation

The circuit uses a yield of IC1 555 IC implied for a prerequisite cycle of 0.8 ms, with a recurrence of 120 Hz and 300 mA top current. It is utilized to drive the ruddy intersection rectifier (D1) diode. From the connection, it is clear that the diodes D1 and D2 are in a straight-line and essentially a few centimeters separated on the board. Hence, the diode D2 gets the infra-red yield from the diode D1. The diode flag that is connected to the rearranging terminal of the op-amp IC LM358 gets intensified IR radiation and finally it is recognized by diode D4 and capacitor C4. The forward voltage developed across diode D4 is compensated by diode D3 and resistances R5 and R6. According to the separation between the infra-red transmitter and receiver, a relative DC voltage is applied to the modifying input of IC2. According to the yield of the comparator, the intersection rectifier is either turned ON or OFF. It is often regularly recognized by the semiconductor device Q1. Thus the hand-off is driven as per the output of Q1. This circuit is mainly utilized for discovering the fluid level location or its vicinity. A leading advantage of this circuit is that no physical contact is required from the distance measurement. Accurate remote distance measurement is possible.

4 Summary

In this chapter, the authors have presented a modified and improved design of IR sensor-based object detection circuit by using Multisim software simulation tools. This system can distinguish the infrared signal for detecting any object in its proximity and can be very useful for physically challenged people to identify obstacles.

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