

A Simple Obstacle Counter Improved Upon to Work as an Intruder Detection System

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Abstract: This paper presents an obstacle detector/counter which is further improved upon to work as an Intruder Detection System. The project is framed to count the number of obstacles as well as to provide security against any intruder either at home or at the workplace. The basic principle of this work is that whenever the light falling on the Light Dependent Resistor (LDR) is obstructed then at that instant the count on the counter is incremented and this counts the number of obstacles which has passed the given check point. This task is accomplished by using a simple LDR, a BCD counter and a seven segment display. This portion of the circuit is further incorporated with a buzzer and a light (LED) which is used to indicate an intrusion by the intruder and the system is improved to work as an Intruder Detection System.

Index Terms : BCD counter, Buzzer , Intruder Detection System, LDR, Light Emitting Diode, Obstacle, Obstacle counter, Op-Amp, seven segment display.

1. INTRODUCTION

'Obstacle' is defined as something which causes obstruction in one's path. In 1988, Delco Systems Operations in Goleta, California developed the first Near Obstacle Detection System which was used as a vehicle safety system that detected and warned the driver of the objects present in the driver's blind zone of the moving vehicle's back-up and adjacent lane[6]. This concept is confined to the vehicles which move on road. But the concept of the obstacle detection is not. A system for the obstacle detection for better navigation capabilities has also been developed for Unmanned Aerial Vehicles (UAV) or drones. This system also takes into account the problem encountered in the navigation in the scenario after the disaster following the common reference points are generally disturbed. This concept has been extensively explained in the reference [1]. Obstacle detection is also one of the key features of the mobile robots because while maneuvering it is important for them to detect obstructions present in their path. Generally, the range based obstacle detection systems are employed in such machines. The popular sensors for the task being ultrasonic sensors, radar, stereo vision etc. Another technique used for obstacle detection is the appearance based obstacle detection which treats the obstacle's look being different from the ground [2].

Eyes are the organs which provide vision to all the living

beings. For a visually impaired person, who cannot see, it becomes important to be able to detect the objects blocking their path while moving. Thus, an obstacle detection system has also been developed for them which allows them to overcome their maneuvering difficulties and helps them to lead an independent life. A breakthrough in this direction

has been achieved with the development of an obstacle detector for the visually impaired which uses the sonar sensors for sensing the environment and then sending back the vibro-tactile feedback signals to the users which are further used for detecting the actual placement of the objects[5]. Thus, the obstacle detection system is a device used for detecting the obstructions in a path and the obstacle counter is used to count them.

IDS, an acronym for Intruder Detection System, is a device or a software application or a combination of both, which detects an intrusion into a network, system or any place like office, home etc and raises an alarm on detection of an intruder. For any system, it monitors for any harmful activity and then reports it to the management station and at the same time raises an alarm. Thus, it can be thought of as being a counterpart of the burglar alarm for the network or the system.

The three tasks which any IDS performs are: monitoring, detecting and generating an alarm [7]

Computers were initially introduced as simple computing machines which were later used for various other applications as well, the most important one being the storage of huge amount of information. This application of the simple machine was further enhanced by the introduction of the concept of networking (exchange of information between two or more machines). Initially, this concept was used judiciously but as the networks became

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larger and larger, confidential information started flowing through them. This led to the attacks on the networks by the intruders, thus jeopardizing its security. Intruders usually attack both the commercial as well as the corporate systems and they are generally successful in their endeavours. It has become really common to hear about the network attacks every other day in the news like stealing of the credit card, leaking of the military secrets etc [3]. Due to these issues the problem of the intruders have become a grave issue and the best solution for the same is the use of the IDS.

The concept of the intruder detection system was initially given by James Anderson in 1980. He defined intrusion as an intentional attempt for retrieving some confidential information from the system or a try to change the information contained in a system. He also stated the intruders should be identified based on how they plan to access the system [4].

Apart from the normal intruders another category of intruders has been identified. These are the intruders who do not have a user account and attack the system through its network. These intruders are called the pseudo- internal intruders and a system has been developed to identify and prevent the attacks from such intruders [3]. There are six main Intruder Detection System technologies:

Host based IDS: It is installed on the host computer of the network and the system analyses the traffic which is meant for the host for any dubious activity [8].

Network based IDS: It is introduced on some important areas of the network and it analyses the traffic of the parts of the network for any dubious activity [8].

Wireless based IDS : It analyses the traffic of the wireless networks for any dubious activity[8].

Stack based IDS: It is a new technology which is used to monitor the packets as move through the OSI layers [9].

Signature based IDS : It is used to identify an attack by observing the chronology of the events which are same as the ones involved in some of the monotonous attacks[9].

Anamoly based IDS : It is used to identify the attack by detecting any unfavourable changes (anamolies) in the otherwise normal flow of the traffic[9].

The incidents of intrusion are not only confined to the networks and systems. According to the FBI, US there is at least one burglary in every 10 seconds [10] and the condition in India is far worse. Thus, the need of IDS is not only confined to just systems but there is a need to employ them even at homes and at workplaces. The common name given to such a device is a "Burglar Alarm".

2. METHODOLOGY

The first step of our work was to design a sensor which could sense the presence of an obstacle. There were many

ways in which this could be done but we decided that the obstruction of the light falling on the sensor by the obstacle be made the criteria of doing the same as it could be incorporated easily and effectively in our work.

So in order to make this idea a reality we thought of incorporating a **Light Dependent Resistor (LDR)** in our circuit. It is a resistor whose resistance varies with the change in the intensity of light. The resistance of the LDR decreases with the increase in the incident light intensity and vice-versa. Thus, the resistance of the LDR is inversely proportional to the intensity of light incident on it.

While working with the LDR we needed a light source from which we could make the light completely incident on it. So, we used a laser light (or a pointer) so that a direct light could fall over the LDR and found that it was working. Although, it worked but there was a significant amount of distortion produced in the signals due to the presence of unwanted light in the surroundings. So to remove this distortion we placed the LDR in a small box which we designed in such a manner so that only the beam of the laser light could enter the box through the hole and it fell directly on the LDR which was placed on the face of the box opposite to the hole.

The circuit of the LDR consisted of a 9V supply which was given to one end of the LDR and to the other end we connected two resistances (47 ohms each) which were grounded. This resistance was used for preventing the OP-AMP to go in the saturation region. Another twelve kilo ohms resistance was connected to the 3rd pin of the Op-Amp IC (Operational Amplifier Integrated Circuit) **LM324N**. On the 2nd pin of the IC we connected two resistors: one of 12k Ω which was grounded and another 1M Ω which was connected to the 1st pin of the IC. The supply was given to the 4th pin of the IC and the 11th pin was grounded.

This completed our basic circuit which was used to detect as well as to produce signals with the changing intensity of light.

Our next step was to design a circuit which could count these changes and give us the count of the obstacles passing the dedicated path.

To count the number of obstacles crossing a path we used a **7490 BCD counter**. A BCD counter counts in the binary-coded decimal form from 0000 to 1001 and then back to 0000.

After the incorporation of this decade counter in our project, we had two independent circuits: one that of the LDR and the other of the counter. To avoid the overloading of the second circuit by the first we interposed a buffer amplifier circuit between the two circuits. LM324 was used for the purpose of the buffer.

Our next step was to find a means to display the count. Generally, two ICs are used for BCD to seven segment decoder: 7447 for common anode display and 7448 for the common cathode display. There are several other devices

which can be used for the purpose of displaying viz. Liquid Crystal Display(LCD),Liquid Vapour Display (LVD),Electroluminescent Display etc. But for our project we chose to use a seven segment display because it is most common electronic component used for this purpose. For our circuit we used a common anode seven segment as its connections are considered to be easy. A seven segment driver is required to drive the display. The driver used for the common anode display is **7447**. But we could use the driver 7448 for common anode as well. We cannot give the direct signal from the driver to the display as it can overload the 7 segment display thus, resulting in a short circuit, burning it out. So, in order to avoid this we used 470Ω resistors in series between them to give the seven segment display a measured amount of current. Another important consideration to be taken into account was to limit the supply to 5V for the counter, the seven-segment driver and the seven segment display. So a **voltage regulator 7805** was used which gave a constant DC output of 5V.

Now, we could count and display the number of obstacles passing through the path and the circuit was almost complete. At the end, we wanted to improve our circuit so that it could work like an Intruder Detection System. So we added a 5V **buzzer** and a **LED (Light Emittng Diode)**

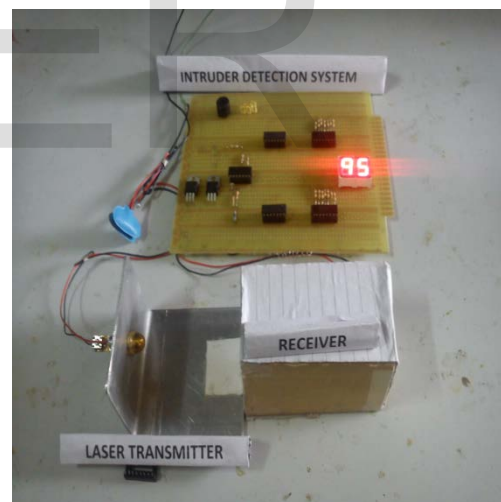
which formed the alarm system of our circuit. Our counter counted the obstacles when the light falling on the LDR was obstructed by the obstacle. But it was at that instant that we wanted that the LED and buzzer to work and alert the user of the intrusion. So in order to accomplish this we had to design an inverter circuit. It could be designed either by using a transistor or an Op-Amp. When the positive voltage is applied to the positive terminal of the Op-Amp, it drives the output to a positive level but if the same input is applied to its negative terminal then the output is driven to the negative level.

Since LM324 ,a quad Op-Amp IC, was already incorporated as a buffer in the circuit, we used the free Op-Amp of the same IC to design our inverter circuit.

Using the 8th, 9th and 10th pins of the same IC we designed the inverter. On the 10th pin or the positive terminal a voltage divider circuit was employed in order to achieve the desired voltage so that the Op-Amp was not driven to saturation. This voltage divider was formed by using two resistors of values 4.7K and 1K. The 1K resistance was grounded. On the 9th or the negative pin of the IC the signal coming from the 1st pin of the Op-Amp IC was given through a 1K resistor. And the 8th pin or the output pin through which we got

FIGURE 1 : Showing The Circuit With All The Components.

1. Buzzer
2. LED
3. Voltage Regulator
4. LM 324(Op-Amp)
5. BCD Counter 7490
6. Seven Segment Driver 7447
7. Seven Segment Display.



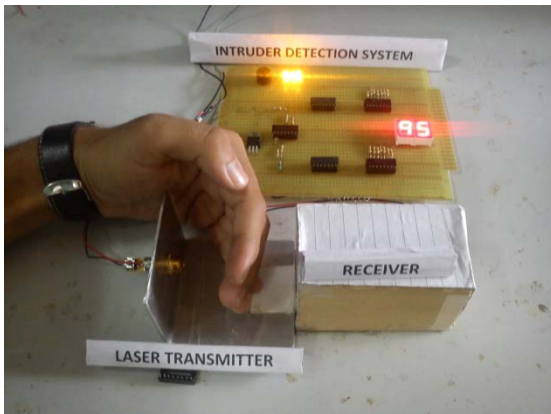


Figure 2 : Showing The Circuit Along With Obstruction In The Path Due To Which The Count In The Display Is Incremented.

the inverted output was connected to the LED and the buzzer.

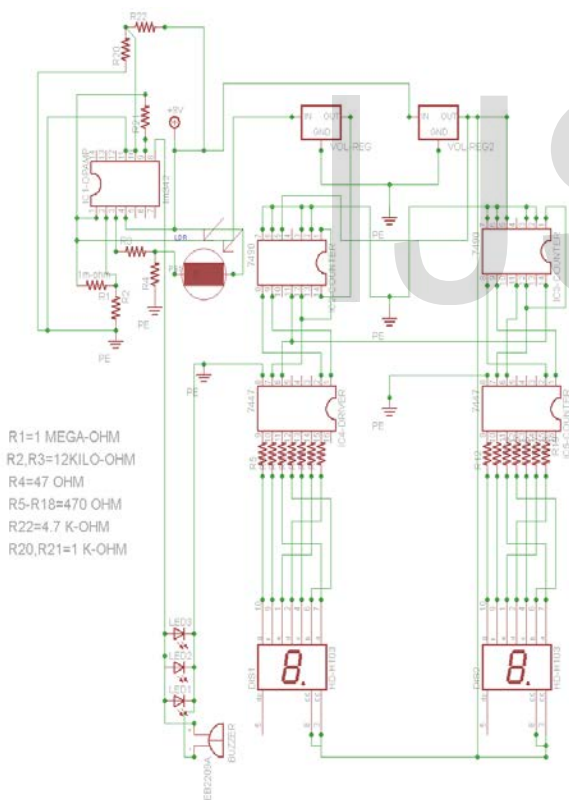


FIGURE 3 : Schematic showing the circuit diagram of the circuit.

3. APPLICATIONS

First and the foremost application of this circuit, as we have already explored in our project, is in the counter or an Intruder Detection System. In addition to this, it can also be used as a power saving system. It can be installed in homes or any of the work place. As and when a person enters a room, it will be detected and the lights of the room will be switched ON. On the way out, when the room is completely emptied then they will be automatically switched OFF thus saving the unnecessary wastage of power which is a critical issue these days. Another application of the same can be at places like airport or railway station to count the number of baggage moving on a conveyor belt.

4. DRAWBACKS

Since in our project we have incorporated only two 7-segment displays so it can count the obstacles only up to 99. Also, it works only when the laser light is directly incident on the LDR. In addition to this, the circuit won't function properly if any light other than laser light is incident on it. That is the foremost reason why it is necessary to place the LDR in a box in order to achieve the accurate outputs. Lastly, the counter when activated doesn't start counting from 0 every time. It picks up any random number and starts the count from that number only.

5. IMPROVEMENTS AND SUGGESTIONS

There are issues but they can be resolved. The count of the circuit can be increased to any desired number by adding more seven segment displays. By giving the output of the first 74LS90 and 74LS47 combination to the next 74LS90 counter combination the count can be increased. Secondly, the sensitivity of the circuit and the distance between the laser transmitter and the receiver (LDR) can be increased by using more sensitive light detecting devices like the photodiode instead of the LDR. Thirdly, the issue of the count starting from any random number can be resolved by introducing a simple set/reset switch in the circuit. Set/reset switch can be made using a push button, so that before starting the count the counter is momentarily given a signal that sets the counter to 0.

6. RESULT AND CONCLUSION

The circuit designed by us worked well as an Obstacle Counter and a Burglar Alarm or an Intruder Detection System.

But it still has a lot of scope of improvement which if correctly identified and properly applied can make this circuit better and more efficient.

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