The Photon Sentinel: A Light-Dependent Security System for Domestic and Professional Environments

Muhammad Shehzore Hashmi[1], Muhammad Shahjahan Hashmi[1], Bibi Alisha Sanam Talpur[1], Muhammad Saood[1], Saad Baloch[1]

[1] Department of Electrical Engineering, Isra University Hyderabad

Corresponding author e-mail: (mshehzorehashmi@gmail.com)

[**Received on:** 28/04/2023 **Accepted on**: 13/11/2023 **Published on:** 01/12/2023]

***Abstract* — Security in one's home has always been a worry. Numerous home-based security systems have been created and put into place to protect their welfare as technology develops at a rapid pace. A crucial tool for preventing unauthorized entry into our homes is a home security system. In this study, we introduce a security system that can be applied in both private and public settings. The proposed system measures the light intensity with a light-dependent resistor (LDR). The LDR sensor measures the brightness, produces a theft alarm, and illuminates the area. It is an easy-to-use, cost-effective, convenient, and reliable security system for room lockers in residences and offices. For urgent security, the buzzer alarm is necessary. The circuit was created on a breadboard and tested in various lighting settings. As a result, the system can accurately detect variations in light intensity and correctly activate the output devices. This cutting-edge security system can offer a workable, cheap solution for a variety of security applications.**

***Index Terms*—LDR, security system, LED, voltage regulator, BC547 transistor.**

I. INTRODUCTION

It is crucial to ensure the safety and security of workplaces, homes, banks, shopping centers, and other locations. Utilizing electronic security systems that can detect the presence of an object or person and initiate an alarm or response is one approach to accomplish this [1] [2]. In recent years, photocell sensors—light-sensitive equipment that can detect variations in light intensity—have drawn increasing interest as an inventive and cost-efficient option for a range of security applications[3] [4] [5].

The concept and implementation of the photon sentinel, a light-dependent security system for domestic and professional environments, is presented in this research paper. The proposed system is made to respond to variations in light intensity picked up by the LDR by activating output devices like a buzzer and an LED. The system is powered by a breadboard-implemented, 7805 voltage regulator-based steady power supply circuit. To confirm the system's functionality, we tested it in various lighting scenarios.

The proposed security system provides many benefits. It is not only simple and affordable, but also convenient, and trustworthy. It can help to brighten the area for better visibility and can also deliver fast security alerts via the buzzer. The system is also adaptable and scalable for a range of security applications in both household and commercial settings.

Ahmad Baballe et al. (2022) developed a smart house control system through Arduino Nano and Leonardo microcontroller boards. A push button for access, an LCD, temperature control for a fan, and a security-related external light were integrated into the system. To increase energy efficiency, provide security, and control the entrance to the residence, it also included an inside LDR sensor that managed the lights in the house [6]. Pica and Bănescu (2022) investigated how security systems for smart homes have changed and suggested workable fixes. They also highlight the difficulty in maintaining privacy and strong security in smart homes due to the elevated danger of data security breaches and information leaks [7].

II. BLOCK DIAGRAM

Figure 1 shows the block diagram of the proposed system.

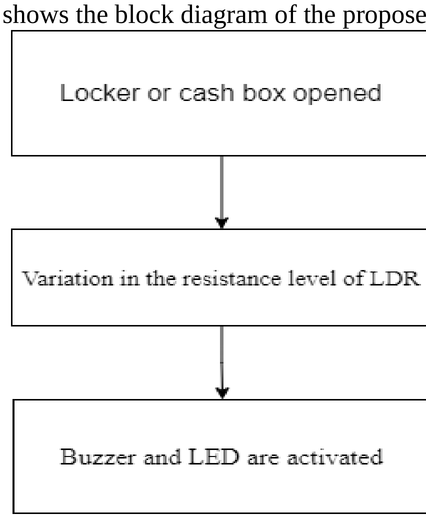

Fig. 1. Block diagram of the Photon Sentinel security system

In the proposed system, an LDR is used for detecting the presence of an object. The voltage regulator regulates the output voltage. When the LDR transmits the transistor a signal, the buzzer and LED are activated. Thus, the proposed system can improve security in both domestic and professional environments.

III. SYSTEM DESIGN

The proposed system consists of the following components:

A. *Light-dependent resistor (LDR)*

A light-sensitive resistor that experiences a resistance drop with rising light intensity is known as an LDR. It serves as the proposed system's photocell sensor, which monitors changes in light intensity. Since it is a passive device, the LDR can only use energy—not produce it. It is commonly used to divide voltages, limit current flow, and construct I/O lines in many applications.

Fig. 2. LDR

B. *BC 547 Transistor*

There are three pins on this NPN bipolar junction transistor, which are referred to as the base, collector, and emitter, respectively. Between the collector and emitter, the BC547 transistor functions as a switch. This switch closes and current flows from the collector to the emitter when the transistor's base receives enough current. In the proposed system, it serves as a switch, with the base receiving the input signal from the LDR and the collector and emitter producing the output. The switch closes and current moves from the collector to the emitter when the transistor's base receives enough current.

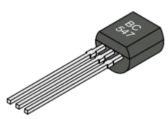

Fig. 3. BC 547 Transistor

C. *7805 Regulator*

It controls the power supply voltage in the proposed system and gives the logic circuit a stable voltage. The 7805 voltage regulator belongs to the 78xx class of fixed linear voltage regulator integrated circuits. The voltage source of a circuit can change and generate a voltage that is different from what was anticipated. The voltage regulator IC maintains a constant output voltage. The fixed output voltage it is supposed to provide is indicated by the xx in the number 78xx. The 7805 regulates the +5V supply.

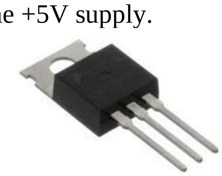

Fig. 4. 7805 Regulator

D. *IN4007 Diode*

A general-purpose diode with a 1000 V reverse breakdown is the 1N4007. In the proposed system, the diode serves as both a voltage drop across the diode and a safeguard against reverse polarity. It belongs to the 1N4000 series. Popular 1A (ampere) general-purpose silicon rectifier diodes from the 1N4000 series are frequently utilized in AC adapters for everyday home applications. Its blocking voltage ranges from a few to one thousand volts.

Fig. 5. 1N4007 Diode

E. *LED*

An LED produces light when current passes through it. It serves as an indicator of the system's state in the proposed system. An LED produces light when electricity passes through it due to the recombination of its electrons and holes. LEDs limit the direction that current can travel in and prevent it from going in the other direction.

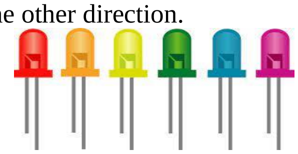

Fig. 6. LED

F. *Buzzer*

A buzzer is a mechanical device that makes a sound when it is activated. It serves as an alarm in the suggested system to alert users to the presence of an object or person. When the LDR detects variations in light intensity, the logic circuit can turn on the buzzer.

Fig. 7. Buzzer

G. *Breadboard*

A breadboard is designed to build temporary electrical prototypes and test circuit designs. Most of the electronic components can be linked together by putting their terminals in the circuits' holes, and afterward, if required, by creating connections using wires. Metal strips connect the holes over the top of the breadboard from underneath.

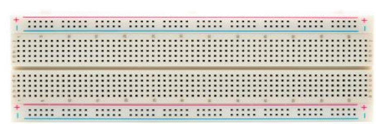

Fig. 8. Breadboard

H. *Connecting wires*

All components in the proposed system are connected using connecting wires. Connecting wires enable electrical current to flow from one point on a circuit to another.

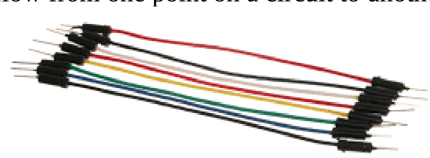

Fig. 9. Connecting wires

I. Resistors (220Ω, 1kΩ, 100kΩ)

Resistors with different values, such as 220Ω, 1kΩ, and 100kΩ, are used in the proposed system to regulate current flow and divide voltages. A resistor's resistance limits how easily electrons can move around a circuit. Because they are passive components, they can only consume energy and not create it. To divide voltages, restrict current flow, and build I/O lines, resistors are widely utilized.

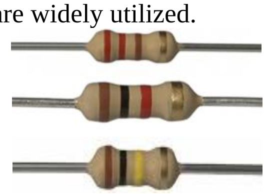

Fig. 10. Resistors

J. Capacitors (1µF and 10µF)

Capacitors with different values, such as 1µF and 10µF, are used in the proposed system to store electrical charge and smooth out fluctuations in the power supply voltage. A capacitor can store electrical charge, which produces a potential difference across its plates, as energy. From small capacitor beads used in resonance circuits to massive power factor correction capacitors, capacitors exist in a wide range of sizes, but they all store charge.

Fig. 11. Capacitors

K. Battery 9V

The aforementioned hardware components are all powered by a 9V battery. The 9V battery, which is very popular nowadays, was initially used in transistor radios. It has two snap connectors that are placed at the top of the battery and has a rectangular prism form. There are numerous applications for the 9V battery. Radios, smoke alarms, wall clocks, walkie-talkies, portable devices, and much more regularly use 9-volt batteries.

Fig. 12. Battery 9 Volt

IV. DESIGN

The proposed system is built utilizing a 7805 voltage regulator to create a reliable power supply circuit and an LDR as the photocell sensor. As a voltage divider, the LDR is linked in series with a 100K resistor, with the resistance of the LDR changing according to the brightness of the light striking it. The LDR has a high resistance and produces a high output logic value when it is dark. The LDR's resistance value decreases when it is lighted, resulting in a low logic voltage at the output.

The LDR’s output is attached to the transistor’s base, the buzzer and LED are connected to the emitter, and the voltage supply is connected to the collector. When the output of LDR is high, the buzzer, LED, and transistor are turned on, whereas, when the output of LDR is low, the opposite happens. The voltage regulator was used to provide a steady power supply and reduce ripples.

As part of the system design, we also utilized a variety of resistors and capacitors in addition to the LDR, transistor, regulator, diode, LED, and buzzer. While 1k and 100k resistors serve as voltage dividers in the LDR circuit, a 220 resistor controls the current to the LED. The regulator's input voltage is filtered with a 1µF capacitor, while the regulator's output voltage is filtered with a 10µF capacitor.

Figure 13 shows the circuit's overall design.

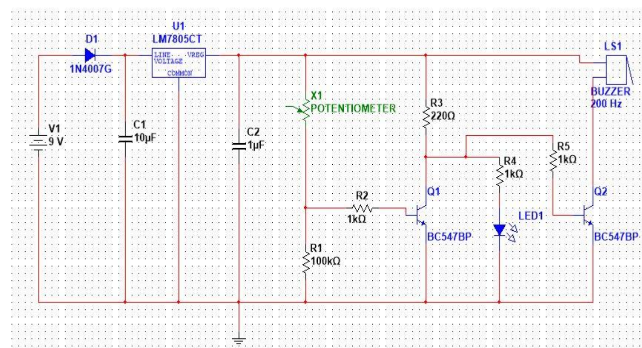

Fig. 13. Circuit design

V. IMPLEMENTATION

To prevent reverse polarity, the regulator input was initially linked to the 9V battery. The input and output capacitors were then attached to it to filter the input and output voltages, respectively. To create a dependable 5V supply for the logic circuit, the regulator's output was next connected to the breadboard.

After that, a 100K ohm resistor was added in series with the LDR's output and linked to the transistor's base to create a voltage divider. A 220 ohm current-limiting resistor was used to connect the transistor's collector to the 5V supply voltage and its emitter to the buzzer and LED. The buzzer and LED were wired to the breadboard using male-to-male jumper wires.

We also tested the response of the system to bright light and abrupt changes in light intensity, such as when a hand was waved in front of the LDR or the light was turned on or off. In each of these experiments, the system performed as expected, with the output devices turning on or off in response to changes in light intensity detected by the LDR.

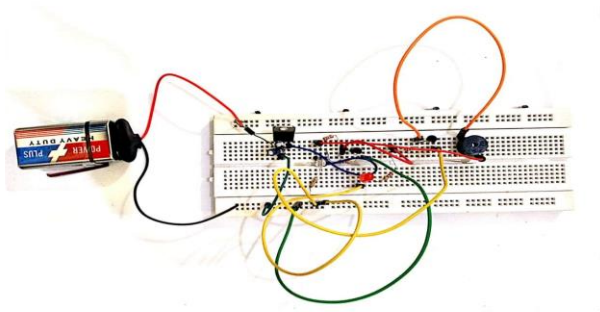

Fig. 14. Breadboard Implementation

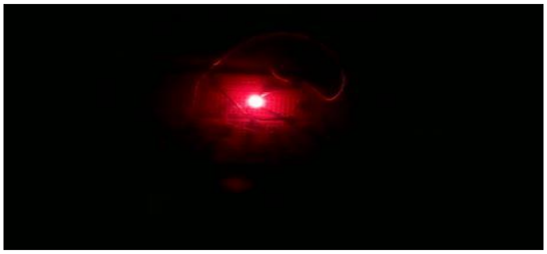

Fig. 15. LDR sensor activating the Photon Sentinel alarm in darkness

VI. RESULTS

Table 1 shows the proposed system's sensitivity and response time.

TABLE I: Results of experiments measuring sensitivity and response time

Light Intensity (lux)	Response Time (s)
0	1
50	1
100	1
200	1
500	1
1000	1

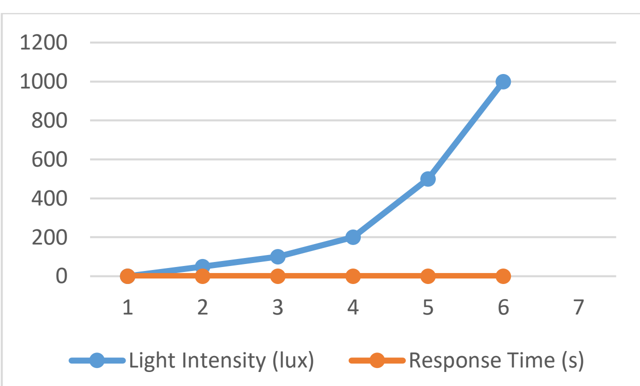

Fig. 15. Sensitivity and response time

The sensitivity and response time of the system are within the ranges allowed for security applications. For example, a sensor with a 100 lux sensitivity may detect changes in light levels brought on by an object or a person moving about a room. With a response time of less than one second, a timely alarm or response can be triggered.

Thus, the results of our testing demonstrate how effectively the suggested security system can recognize and respond to changes in light intensity. The system's ease of use, dependability, and speed of development and testing make it a viable solution for a variety of security applications.

VII. CONCLUSION

With the effective development and testing of the proposed system, crime can be readily avoided. The Photon sentinel has been successful in identifying the existence of an object when its shadow passes on an LDR sensor, which could be beneficial for security purposes. This method is extremely effective, reasonably priced, and power-efficient. It has also been successfully tested and run. An Arduino UNO board could be added in the future to facilitate work, which will make it easier to communicate via mobile phones with the concerned owner and security personnel. The implementation of image and data processing is suggested for the near future.

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