LASER SECURITY SYSTEM

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IN

ELECTRONICS AND COMMUNICATION ENGINEERING

BY

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CERTIFICATE

Date: /01/2025

This is to certify that the project work entitled ***LASER SECURITY SYSTEM*** *is a bonofide work carried out by* ***G.RAMANA, S.SRIRAM VIJAY , A.DILEEP, G.LAXMI MOHITHA, P.VENNALA*** *and* ***N.ADITYA*** *bearing Roll Nos.* ***24RS5A0404, 23RS1A0445, 23RS1A0401, 23RS1A0414, 23RS1A0441,*** *and* ***24RS5A0407*** *in partial fulfillment of the requirements for the degree of* ***BACHELOR OF TECHNOLOGY*** *in* ***ELECTRONICS &COMMUNICATION ENGINEERING*** *by the Jawaharlal Nehru Technological University Hyderabad during the academic year 2024-25.*

The results embodied in this report have not been submitted to any other University or Institution for the award of any degree or diploma.

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ABSTRACT

A Laser security system is an advanced intrusion detection mechanism that utilizes a laser beam and a Light Dependent Resistor (LDR) to detect unauthorized access. This system is designed to provide a cost-effective and efficient solution for securing restricted areas, homes, offices, and other valuable locations. The primary working principle involves a continuous laser beam directed towards an LDR

When the beam is interrupted by an intruder, the change in resistance of the LDR triggers an operational amplifier (LM358) that activates a 555 timer circuit, which in tum powers an alarm system (buzzer and LED indicators). This setup ensures immediate alert generation upon breach detection,

The use of simple yet effective electronic reliable and easy to implement. This paper explores the design, working mechanism, and potential applications of the laser security system, highlighting its advantages in modem security implementations

CONTENTS

LIST OF FIGURES

CHAPTER-1

INTRODUCTION

1.1 Introduction

Laser Security alarm is a device used for security purposes. It has a wide application in fields of security and defense starting from the security of simple house hold material to a very high valued material of an organization. They once used to be expensive solutions for security needs. Owing to cost cutting and fast technological advancements, this form of security system is becoming more affordable.

Lasers differ from other light sources in a few significant ways. There are two features that are important for security systems. Unlike a light bulb or flashlight, laser light doesn't spread out, it is a narrow beam. And laser light is essentially a single color. Because laser light doesn't spread much, it can be sent it a long way and still have enough energy in a small area to trigger the security system detector. Because it's a single wavelength, it can put a blocking filter on the detector to let laser light through without letting background light onto the detector.

Laser light travels in a straight line. For instance, to protect the front of the yard, putting the laser at one comer and the detector at the other corner would do the job. That's not a very practical configuration, though. More typically, if it is needed to protect the perimeter of a room, or at least the enhances. So laser security systems start with a laser pointing to a small mirror. The first mirror is angled to direct the beam to a second small mirror, and so on until the final mirror directs the beam to the detector. If the beam is interrupted anywhere between the laser and the detector, the electronics will put the warning signal.

1.2 Aim of the Project

To design and implement a laser security system that utilizes laser beams and light sensors to detect unauthorized access

The objectives of the Project are as follows:-
1. Intrusion Detection: To detect unauthorized access or movement within a secured area using laser beams.
2. Real-Time Alerting: To trigger alarms or notifications instantly when the laser beam is interrupted.
3. Area Surveillance: To monitor specific zones such as doors, windows, or restricted areas for enhanced security.
4. Cost-Effective Security: To provide an affordable yet reliable alternative to more complex surveillance systems.
5. Automation Integration: To integrate with other security mechanisms like CCTV, GSM modules, or IoT systems for advanced monitoring.

1.3 Methodology

A laser security system works by using a low-power laser beam directed at a light-sensitive receiver, such as a photodiode or LDR. When the beam is uninterrupted, the receiver detects a constant signal and the system remains in a passive state. If someone crosses the path and interrupts the beam, the signal suddenly drops, which is detected by a microcontroller like an Arduino. This change triggers an alarm, buzzer, or other alert systems to indicate unauthorized access. The system can be extended using mirrors to cover larger areas or multiple entry points. It is typically powered by a 5V or 12V DC source and can include battery backup for reliability. Laser security systems are simple, cost-effective, and commonly used in homes, banks, museums, and restricted zones for intrusion detection.

1.4 Significance of the work

In this project we attempt to develop a device which can be used to security system. It has the following advantages:

- High Sensitivity and Accuracy
- Real-Time Alerts
- Invisible Barrier
- Low Maintenance
- Customizable Coverage

1.5 Organization of the thesis

This thesis is divided into 6 chapters including introduction and conclusions. The block diagram, features, and other functions information are explained in chapter2. The description of the various hardware components used in the project explained in chapter3. The main advantages, applications , features are explained in chapter4.The schematic diagram, experimental setup and results are discussed in chapter5.

CHAPTER-2

BLOCK DIAGRAM

2.1 Introduction

The block diagram of a laser security system represents the flow of operation through its core components. It generally includes the following blocks

2.2 Block Diagram

Fig 2.1: Block diagram

1. Laser – Emits a narrow, focused light beam which acts as the tripwire.

2. LDR – Receives the laser beam under normal conditions. If the beam is interrupted, its output changes.

3. Comparator – Compares the voltage from the photodetector with a reference voltage. If the beam is blocked, the voltage drops, causing the comparator to change its output.

4 .IC 555 Timer – Triggered by the output of the comparator. It generates a fixed-duration pulse to drive the alarm system. This ensures the buzzer doesn't stay on indefinitely.

5. Buzzer – Activated by the 555 timer output to alert of an intrusion.

2.3 Conclusion

The block diagram of a laser security system demonstrates an efficient and low-cost method for intrusion detection. The system works by projecting a laser beam onto a light-dependent resistor (LDR) or photodiode, and any interruption in the beam triggers an alarm through a control circuit. Each component—from the laser emitter to the sensor, comparator, control unit, and output alarm—plays a critical role in ensuring prompt and accurate security alerts, making it suitable for homes, offices, and restricted areas.

CHAPTER-3

HARDWARE DESCRIPTION

3.1 INTRODUCTION

The hardware setup of the Laser Security System is designed to detect unauthorized access using a laser beam and a light-dependent resistor (LDR) integrated with a 555 timer IC. This system relies on the principle of interrupting a laser beam to trigger an alert mechanism. The 555 timer, configured in monostable or bistable mode, acts as the core component to process the input from the LDR and generate a corresponding output signal

3.2 CIRCUIT DIAGRAM

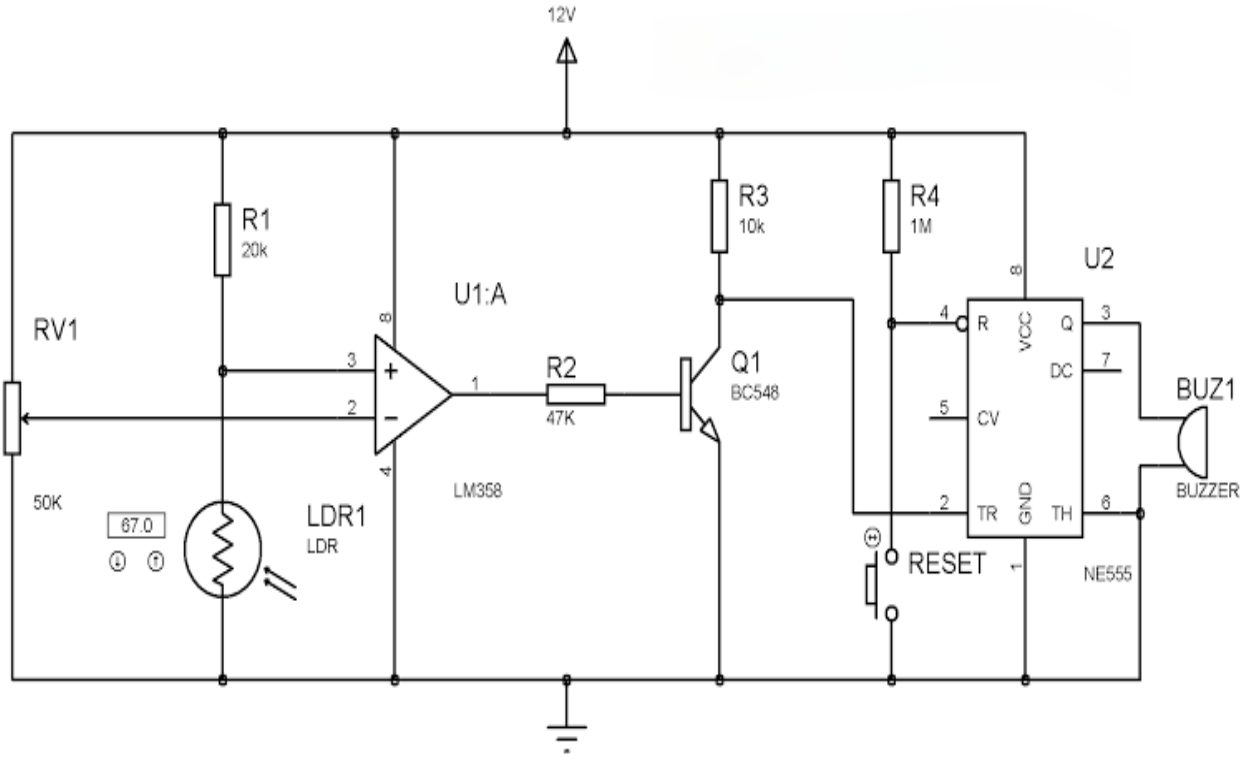

Fig 3.1: Circuit diagram of laser security system

This laser security system circuit operates on a 12V DC power supply, which powers all components including the LM358 comparator and NE555 timer. The LDR and a 50k potentiometer (RV1) form a voltage divider. The LDR is connected between ground and the non-inverting input (pin 3) of the LM358, while RV1, along with a 20k resistor (R1), sets a reference voltage to the inverting input (pin 2).Under normal conditions, when the laser beam hits the LDR, its resistance is low and the comparator output remains LOW. If the beam is interrupted, the LDR resistance increases, causing the voltage at pin 3 to drop below the reference. As a result, the comparator output goes HIGH. The comparator output is connected to the base of an NPN transistor (BC548) via a 10k resistor (R3). A 47k resistor (R2) helps pull up the output. When the comparator goes HIGH, it switches the transistor ON. This pulls the trigger pin (pin 2) of the NE555 timer LOW, activating it in monostable mode. A 1M resistor (R4) pulls the trigger pin HIGH when not active.

Once triggered, the 555 timer outputs a HIGH signal at pin 3 for a fixed time, which powers the buzzer (BUZ1), alerting of an intrusion. A push-button connected to pin 4 (RESET) allows manual resetting of the alarm. When the laser is restored, the system resets and waits for the next interruption.

3.3 IC 555 TIMER

3.3.1 Introduction IC 555 Timer

The 555 timer IC is an integrated circuit (chip) used in a variety of timer, pulse generation and oscillator applications. The 555 can be used to provide accurate time delays, as oscillator, and

as a flip-flop element. Derivatives provide two (556) or four (558) timing circuits in one package. In bistable mode, the 555 timer acts as a SR flip-flop. The trigger and reset inputs (pins 2 and 4 respectively on a 555) are held high via pull-up resistors while the threshold input (pin 6) is grounded. Thus configured, pulling the trigger momentarily to ground acts as a 'set' and transitions the output pin (pin 3) to Vce (high state). Pulling the reset input to ground acts as a 'reset' and transitions the output pin to ground (low state). No timing capacitors are required in a bistable configuration. Pin 7 (discharge) is left unconnected, or may be used as an open-collector output.

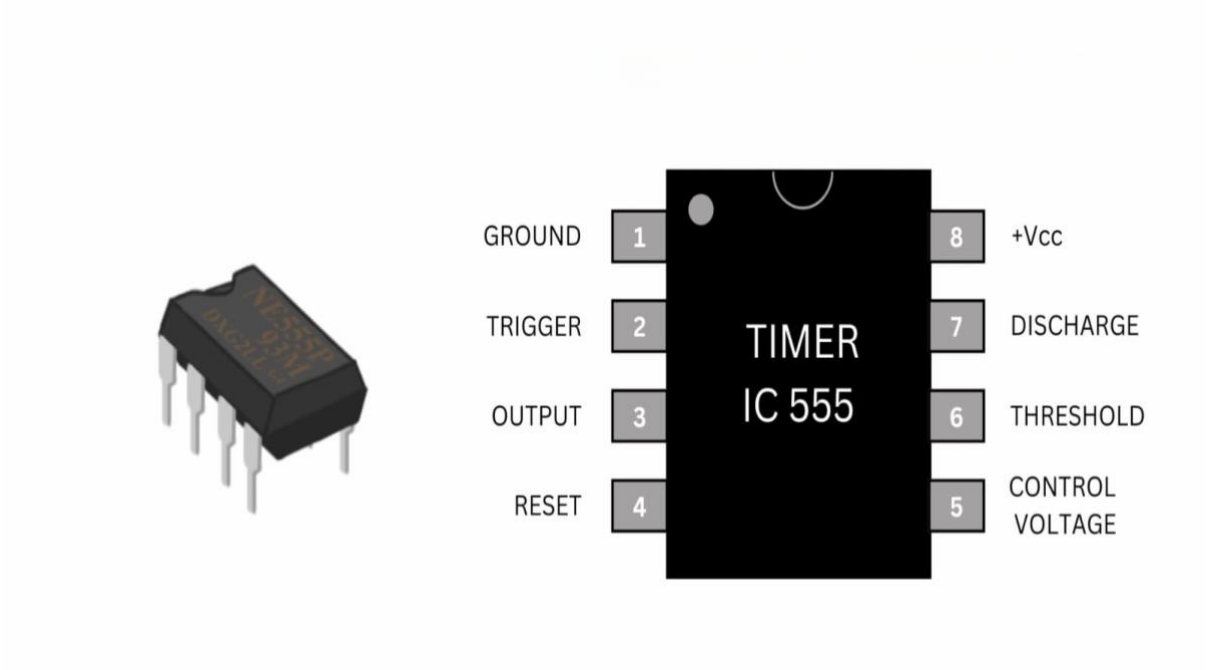

Fig 3.2 : pin diagram of IC 555 Timer

3.3.2 FEATURES:

1. Operating Modes
2. Wide Supply Voltage Range
3. High Output Current Capability
4. Adjustable Timing Intervals
5. High Temperature Stability
6. Low Power Consumption (CMOS versions)
7. Compatibility with TTL and CMOS
8. Built-in Flip-Flop and Comparator
9. Ease of Use with Few External Components
10. Available in Multiple Packages (DIP, SOIC, etc.)

3.4 LM-358

3.4.1 Introduction of LM-358

In this project, the LM358 is used as a Comparator. The LM358 IC is a great, low power easy to use dual channel op-amp IC. It is designed and introduced by national semiconductor A It consists of two internally frequency compensated, high gain, and independent op-amp This IC is designed for specially to operate from a single power supply over a wide range of voltages. DC gain blocks and transducer amplifiers. LM358 IC is a good, standard operational amplifier and it is suitable for your needs. It can handle 3-32V DC supply & source up to 20mA per channel. This op-amp is apt, if you want to operate two separate op-amps for a single power supply. It's available in an 8-pin DIP package

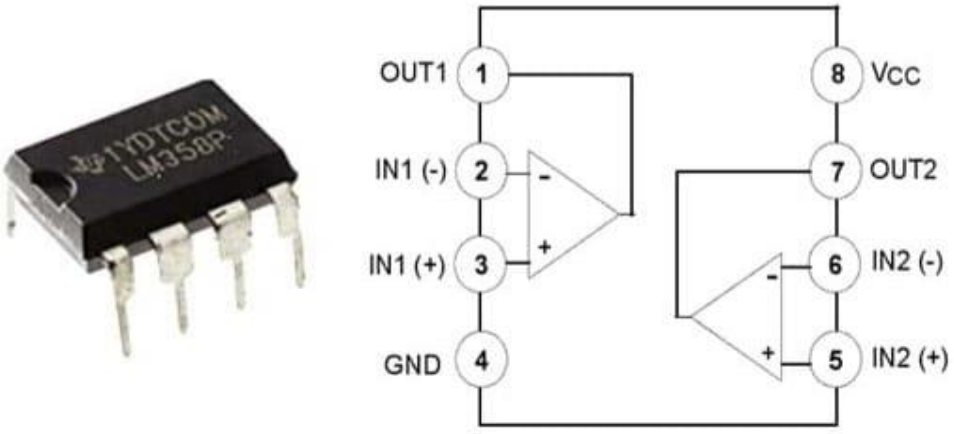

Fig 3.3 : pin diagram of LM 358

3.3.4 FEATURES

1. Dual Operational Amplifiers in One Package
2. Wide Supply Voltage Range
3. Low Power Consumption
4. Single or Dual Supply Operation
5. Internally Frequency Compensate
6. High Gain Bandwidth Product

3.5 LDR (Light Dependent Resistor)

A Photo resistor or light-dependent resistor (LDR) or photocell is a light-controlled variab resistor. The resistance of a photo resistor decreases with increasing incident light intensit in other words, exhibits photoconductivity. photo resistor can be applied light sensitive detector circuits, and light- and dark-activated switching circuits.

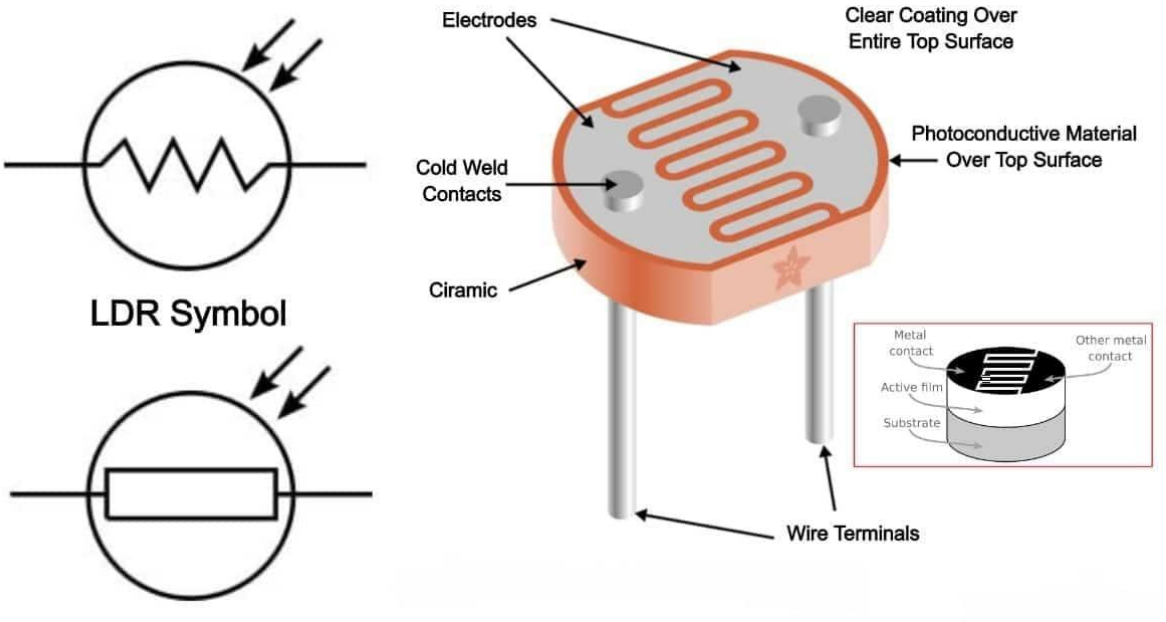

Fig 3.4: Symbol and label diagram of LDR

Photo resistors work based off of the principle of photoconductivity. Photoconductivity is an optical phenomenon in which the material's conductivity is increased when light is absorbed by the material. When light falls i.e. when the photons fall on the device, the electrons the valence band of the semiconductor material are excited to the conduction band. These photons in the incident light should have energy greater than the band gap of the semiconductor material to make the electrons jump from the valence band to the conduction band. Hence when light having enough energy strikes on the device, more and more electrons are excited to the conduction band which results in a large number of charge carriers. The result of this process is more and more current starts flowing through the device when the circuit is closed and hence it is said that the resistance of the device has been decreased. This the most common working principle of LDR. In the dark, a photo resistor can have a resistance as high as a few mega ohms (M ohms), while in the light, a photo resistor can have a resistance as low as few hundred ohms. If incident light on a photo resistor exceeds certain frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electrons conduct electricity, thereby lowering resistance. The resistance range and sensitivity of a photo resistor can substantially differ among dissimilar devices. Moreover, unique photo resistors may react substantially differently to photons within certain wavelength bands.

3.6 TRANSISTOR BC-547

A transistor is a semiconductor device used to amplify and switch electronic signals electrical power. Transistor has many functions, such as detecting, rectifying, amplifying switching, voltage stabilizing; signal modulating and so on. It is composed of semiconductor material with at least three terminals for connection to an external circuit. A voltage or current applied to one pair of the transistor's terminals changes the current through another pair of terminals. As a variable current switch, transistor can control the output current based on the input voltage. Because the controlled (output) power can be higher than the controlling (input) power, a transistor can amplify a signal.

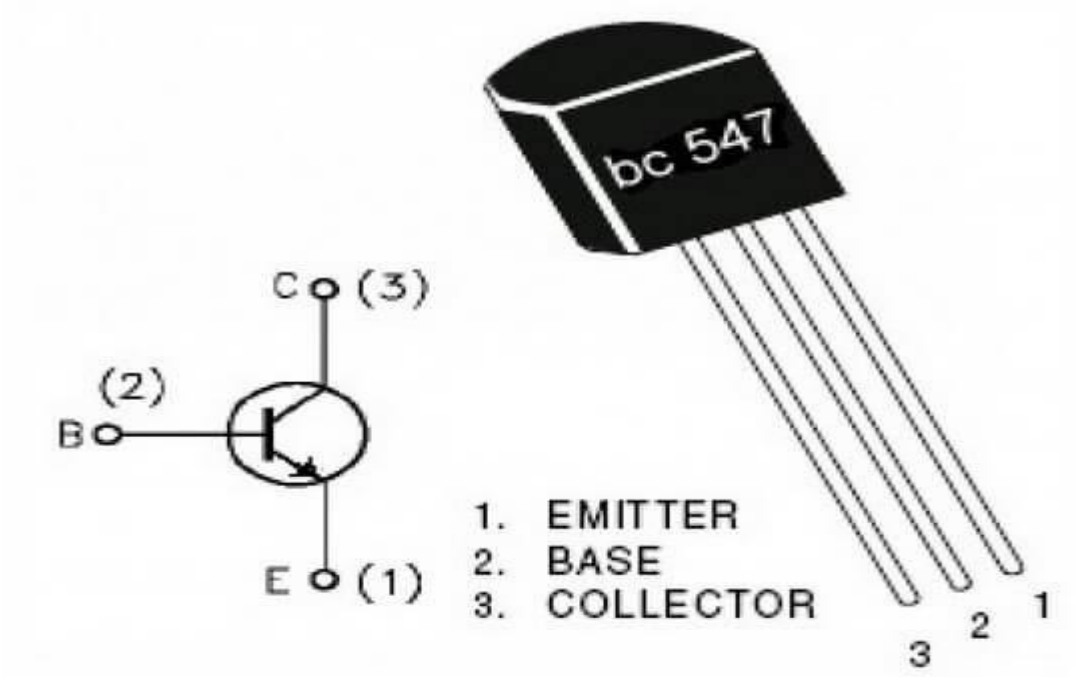

Fig 3.5 : Symbol and pin diagram of transistor

The fundamental principle behind all transistors is simple: Current flow between two terminals is prevented by an energy barrier that has been set up between them. To operate the transistor, a third terminal is provided that allows you to lower the energy barrier. Common applications of transistor comprise of analog & digital switches, power regulators, signal amplifiers & equipment controllers. Transistors are also the constructing units of incorporated circuits and most up to date electronics.

3.7 BREADBOARD

3.7.1 Introduction of Breadboard

A breadboard is a rectangular plastic board with a grid of holes used to build and test electronic circuits without soldering. It allows components like resistors, capacitors, ICs, and wires to be easily inserted and removed.

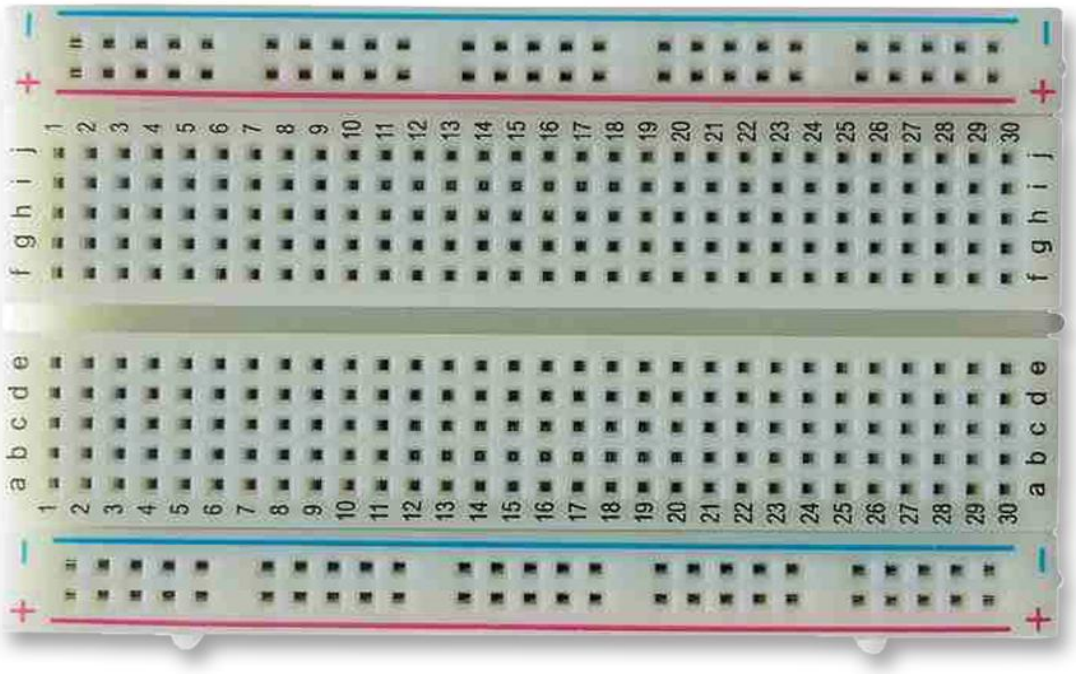

Fig 3.6 : Breadboard

3.7.2 FEATURES:

- No soldering required, making it reusable and ideal for prototyping.
- Rows and columns of holes are internally connected in specific patterns.
- Power rails run along the sides for easy power distribution.
- Central area is split by a groove to fit ICs with separate left and right connections. Breadboards are essential tools for beginners and professionals to experiment with and debug circuits quickly.

3.8 RESISTOR

A resistor is one of the most fundamental components in electronics. It is a passive device that limits or regulates the flow of electric current in a circuit. The primary function of a resistor is to provide resistance, which is the opposition to current flow. This resistance is measured in ohms (Ω), named after the German physicist Georg Simon Ohm who formulated Ohm's Law.

Fig 3.7 : Resistors

Most resistors have colored bands on their bodies, known as the resistor color code, which indicate their resistance value and tolerance. This makes it easy to identify and select the right resistor for a specific circuit. Resistors come in various types, such as fixed resistors, which have a constant resistance, and variable resistors like potentiometers and rheostats, which can be adjusted manually.

3.9 POTENTIOMETER

A potentiometer is a three-terminal resistor with a sliding or rotating contact that forms an adjustable voltage divider. If only two terminals are used, one end and the wiper, it acts as a variable resistor or rheostat. The potentiometer is a simple device used to measure the electrical potentials (or compare the e.g. of a cell). One form of potentiometer is a uniform high-resistance wire attached to an insulating support, marked with a linear measuring scale. The basic working principle of this is based on the fact that the fall of the potential across any portion of the wire is directly proportional to the length of the wire, provided wire has

uniform cross-sectional area and the constant current flowing through it. "When there По potential difference between any two nodes there is electric current will flow".

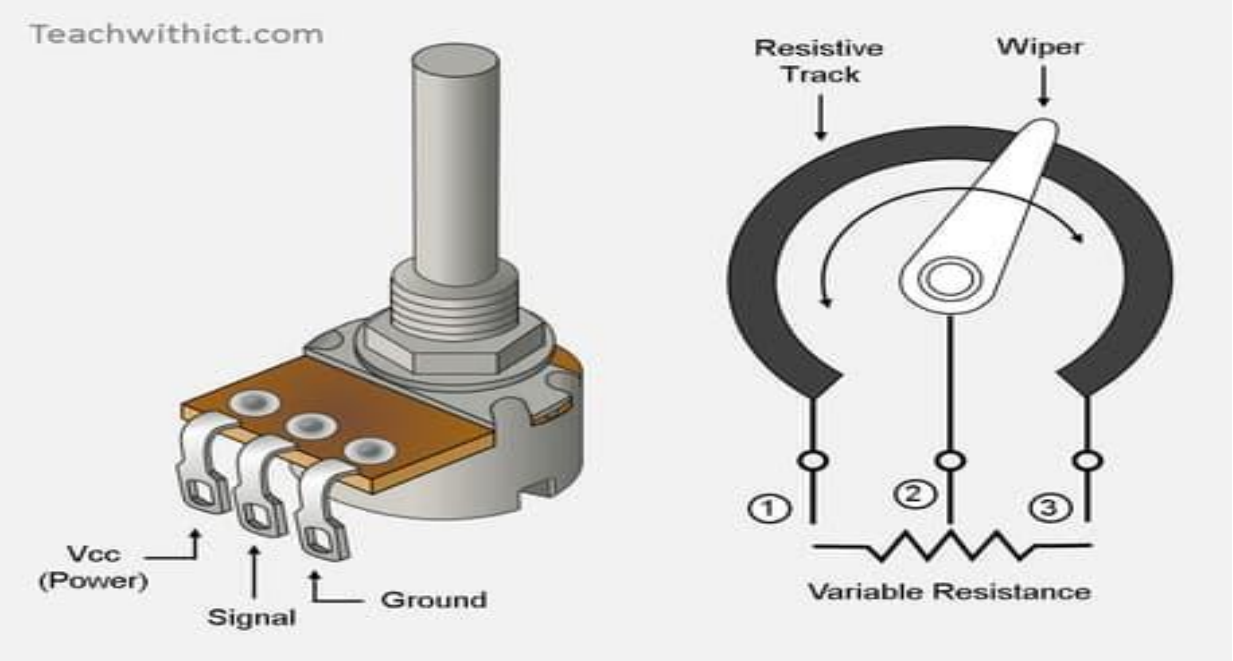

Fig 3.8 : Pin diagram of potentiometer

3.10 BATTERY

An electric battery is a device consisting of two or more electrochemical cells that convert stored chemical energy into electrical energy. Each cell contains a positive terminal, or cathode, and a negative terminal, or anode. Electrolytes allow ions to move between the electrodes and terminals, which allows current to flow out of the battery to perform work. Primary (single-use or "disposable") batteries are used once and discarded, the electrode materials are irreversibly changed during discharge. Common examples are the alkaline battery used for flashlights and a multitude of portable device. Secondary (rechargeable batteries) can be discharged and recharged multiple times, the original composition of the electrodes can be restored by reverse current. Examples include the lead-acid batteries used in vehicles and lithium ion batteries used for portable electronics. Batteries come il many shapes and sizes, from miniature cells used to power bearing aids and wristwatches to hattery banks the size of rooms that provide standby power for telephone exchanges and computer data centers

Fig 3.9 : Battery

3.11 BUZZER

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, and piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke.

Early devices were based on an electromechanical system identical to an electric bell without the metal gong. Similarly, a relay may be connected to interrupt its own actuating current, causing the contacts to buzz. Often these units were anchored to a wall or ceiling to use it as a sounding board. The word "buzzer" comes from the rasping noise that electromechanical buzzers made.

The buzzer consists of an outside case with two pins to attach it to power and ground. When current is applied to the buzzer it causes the ceramic disk to contract or expand. Changing this then causes the surrounding disc to vibrate. That's the sound that you hear. Adjust the potentiometer to increase or decrease the resistance of the potentiometer. If you increase the resistance of the potentiometer then it will decrease the Volume of the buzzer. If you decrease the resistance of the potentiometer then it will increase the Volume of the buzzer.

Fig 3.10 : Buzzer

3.12 CONNECTING WIRES

Jump wires (also called jumper wires) for solderless bread boarding can be obtained in ready-to-use jump wire sets or can be manually manufactured. The latter can become tedious work for larger circuits. Ready-to-use jump wires come in different qualities, some even with tiny plugs attached to the wire ends. Jump wire material for ready-made should usually be solid copper, tin-plated wire

assuming no tiny plugs are to be attached to the wire ends. Shorter stripped wires might result in bad contact with the board's spring clips (insulation being caught in the springs). Longer stripped wires increase the likelihood of short-circuits on the board. Needle-nose pliers and tweezers are helpful when inserting or removing wires, particularly on crowded boards.

Fig3.11 : jumper wires

3.13 LASER LIGHT

A laser is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. The term "laser" originated as an acronym for "light amplification by stimulated emission of radiation"

laser differs from other sources of light in that it emits light coherently. Spatial coherence allows a laser to be focused to a tight spot, enabling applications such as laser cutting and lithography. Spatial coherence also allows a laser beam to stay narrow over great distances (collimation), enabling applications such as laser pointers. Lasers can also have high temporal coherence, which allows them to emit light with a very narrow spectrum, i.e., they can emit a single colour of light. Temporal coherence can be used to produce pulses of light as short as a femtosecond.

Fig 3.12: laser light

3.14 CONCLUSION

In this chapter different hardware components involved in the project are discussed and their interfacing is explained

CHAPTER-4

KEY FEATURES AND APPLICATIONS

4.1 INTRODUCTION

In this chapter we discuss the advantages, applications, and features of laser security system

4.2 ADVANTAGES

1. Low Cost & Simple Design:-

Laser security systems can be built with inexpensive components like laser diodes, LDRs (Light Dependent Resistors), and basic circuitry, making it budget-friendly for students and hobbyists.

2. High Sensitivity:-

Even a small interruption in the laser beam can trigger the system, making it highly effective in detecting unauthorized entry or movement.

3. Energy Efficient:-

Laser and LDR components consume very little power, making the system ideal for continuous operation.

4. Real-Time Intrusion Detection:-

The system can immediately alert the user through buzzers, alarms, or even notifications if integrated with IoT.

5. Wide Range of Applications:-

Can be used in homes, banks, museums, and other high-security areas, or even in school/college labs for demo purposes.

6. Compact and Easy to Conceal:-

The system components are small and can be easily hidden from sight, increasing security.

7. Customizable:-

It can be combined with other technologies like GSM modules, cameras, or Arduino for advanced features like remote monitoring.

4.3 APPLICATIONS

1. Home and Office Security:

Perimeter protection by setting up laser tripwires to detect unauthorized access.

Integration with alarms or surveillance systems for real-time alerts.

2. Bank and Vault Protection:

High-security laser grids to safeguard valuables and detect any tampering or intrusion.

3. Museums and Art Galleries:

Protect priceless artifacts or paintings with invisible laser beams that trigger alarms if crossed

4. Military and Defense:

Securing sensitive zones or equipment with high-grade laser systems.

Detecting movements across borders or restricted areas.

5. Industrial Safety:

Ensuring personnel safety around hazardous machinery by disabling equipment if laser beams are broken

6. Smart Buildings:

Automated lighting or access control activated by laser motion detection.

7. Robotics and Automation:

Used in navigation and obstacle detection by detecting objects using reflected laser beams.

8. Warehouse Security:

Monitoring storage areas and loading docks to prevent unauthorized access or theft.

9.Office Spaces:

Secures server rooms, document storage areas, or other sensitive spaces.

10. ATMs and Cash Counters:

Adds an extra layer of intrusion detection after working hours.

4.4 FEATURES

1.High Precision and Accuracy

2. Quick Response Time

3.Invisible Protection

4. Long-Range Coverage

5. Adjustable Sensitivity

6. Versatility

7.Low Maintenance

8. Compact and Easy to Install

9.Multi-Zone Monitoring

4.5 CONCLUSION

In this chapter we have seen the advantages, applications and features of laser security system

CHAPTER-5

RESULTS AND CONCLUSIONS

5.1 INTRODUCTION

In this chapter we discuss the project outputs and results of the project

5.2 SCHEMATIC DIAGRAM

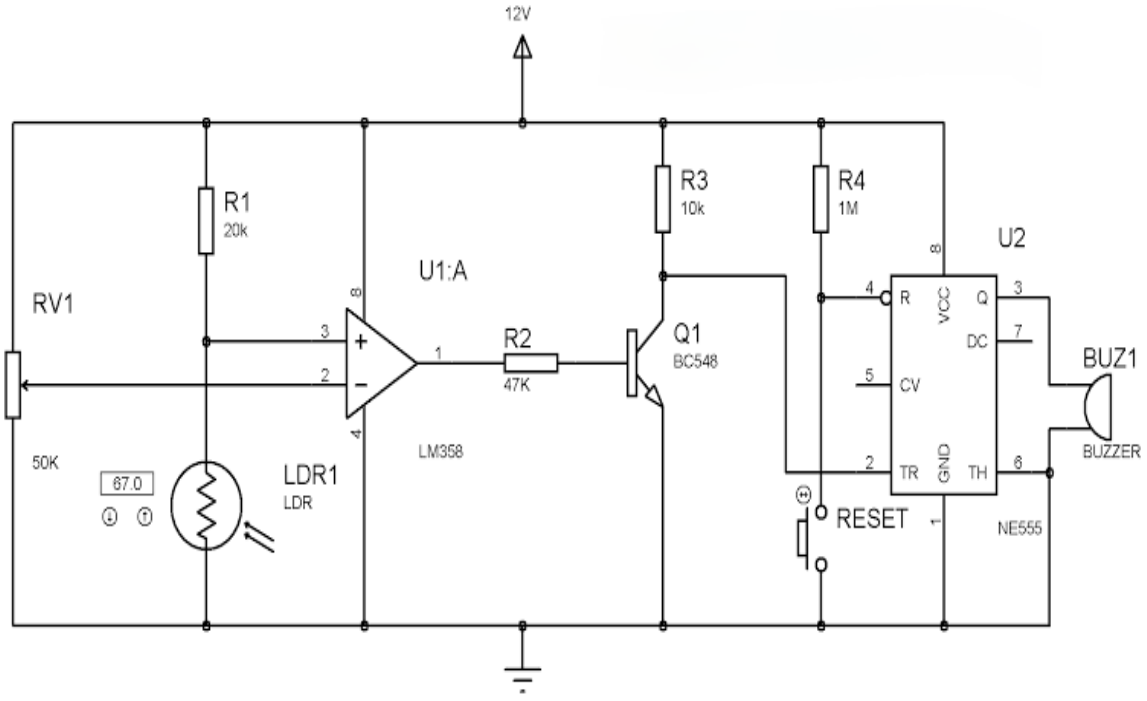

Fig5.1: Schematic diagram of the project

5.3 EXPERIMENTAL SETUP

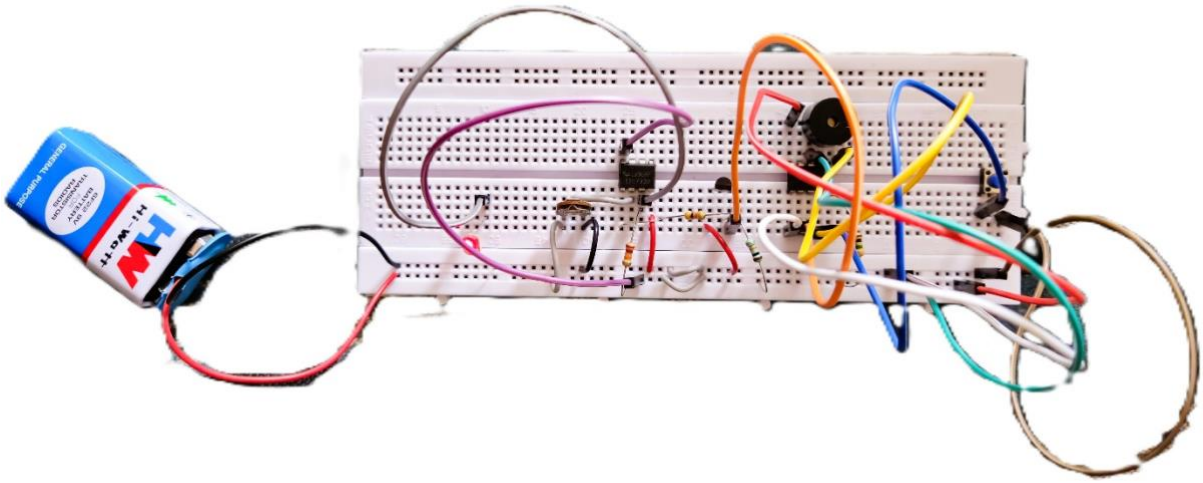

Fig5.2:Experimental output

5.4 RESULT

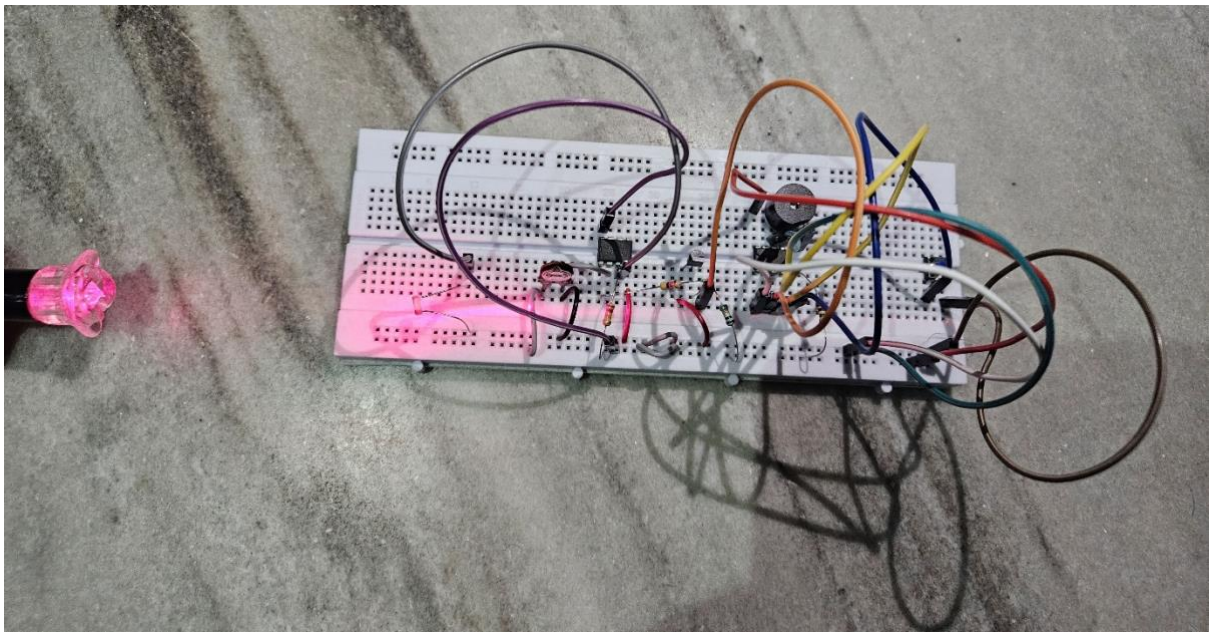

Fig5.3 Result

5.5 CONCLUSION

In this chapter we have seen the schematic diagram, experimental setup of the project and their results during various operations

CHAPTER-6

CONCLUSION

In conclusion, our laser security system project successfully showcases how basic electronics can be used to build a functional and reliable security solution. The system uses a laser beam and a light-dependent resistor (LDR) to detect interruptions in the beam. When someone passes through the path of the laser, the beam is broken, which is immediately sensed by the LDR. This triggers an alert mechanism, such as a buzzer or alarm, to notify that unauthorized movement has occurred.

Through this project, we have not only developed a working model of a laser-based security system but also gained practical knowledge in handling components like resistors, transistors, LDRs, lasers, and buzzers. We also improved our skills in circuit designing, soldering, and understanding how input sensors interact with output devices.

This system is especially useful for securing doors, lockers, or small rooms, and is ideal for environments like homes, schools, or offices where a cost-effective and straightforward security setup is needed. Although basic in design, this project lays the foundation for more advanced systems which could include features like GSM-based alerts, wireless connectivity, and integration with CCTV cameras.

Overall, this project has helped us bridge the gap between theoretical knowledge and real-world application, while also highlighting the importance of innovation and problem-solving in electronics and security technology.