Gharda Institute of Technology
A/P: LAVEL, TAL.KHED, DIST.RATNAGIRI.
Tel.: 02356 - 273134, Fax: 02356 – 262980
Website: www.git-india.edu.in, Email: principal@git-india.edu.in

Laser Security Alarm System

A PROJECT REPORT

SUBMITTED TO

FIRST YEAR ENGINEERING DEPARTMENT

Academic Year: 2024-25

FOR THE TERM-WORK OF

APPLIED PHYSICS BY

Sr no.	Division	Name
1.	D	Kokate Krish Ashish
2.	B	Sagvekar Yash Anant
3.	B	Panhalkar Manthan Rajesh
4.	B	Katre Parth Manoj
5.	B	Patil Omkar Sanjay

UNDER THE GUIDANCE OF

Asst. Prof. Chetan S. Shinde

Assistant Professor in Engineering Physics

Gharda Institute of Technology, Lavel

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Gharda Institute of Technology, Lavel

DEPARTMENT OF

APPLIED SCIENCES AND HUMANITIES

CERTIFICATE

This is to certified that the project report **" Laser Security Alarm "** being submitted by ,

Roll No.	Division	Name
17	D	Krish Ashish Kokate
52	B	Sagvekar Yash Anant
40	B	Panhalkar Manthan Rajesh
24	B	Katre Parth Manoj
43	B	Patil Omkar Sanjay

In partial fulfillment of requirement for the award of degree of Bachelor in Engineering in First Year Engineering is a bonafide work carried out under my/our supervision

M. S. Satpute
Asso. Prof. & Head of the Department.Gharda Institute of Technology Lavel, Khed

Asst. Prof. Chetan S Shinde
Asst. Prof. in Applied Physics
Project Guide
Gharda Institute of Technology Lavel, Khed

Gharda Institute of Technology
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DECLARATION

We solemnly declare that the project report " **LASER SECURITY ALARM** " is based on our own work carried out during the course of our study under the supervision of **MR. CHETAN S. SHINDE**. The main idea of the project was suggested by **MR. CHETAN S. SHINDE**. I assert the statements made and conclusions drawn are an outcome of my Project work.

I further certify that,

1. The work contained in the report has been done by us, under the general supervision of my guide.
2. The work has not been submitted to any other Institution for any other degree/diploma/certificate in this university or any other University of India. 3. We have followed the guidelines provided by the institute in writing the report. 4. Whenever we have used materials (data, theoretical analysis, and text) from other sources, we have given proper references wherever required.

Roll No	Division	Name	Signature
17	D	Kokate Krish Ashish	
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We also acknowledged our institution, Gharda institute of Technology, for providing the necessary resources and infrastructure to carry out this project efficiently. Special thanks to our peers and friends for their insightful discussions and constructive feedback, which helped us refine our ideas.

Finally, last but not the least, we are grateful to our families for their continuous support and motivation, enabling us to complete this project successful

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Abstract and keywords :

The Laser Security Alarm System is an economical and efficient security mechanism designed to detect unauthorized access in restricted areas. The system utilizes a laser beam directed at a light-dependent resistor (LDR), forming an invisible barrier. When this beam is interrupted by any object or person, the change in light intensity is detected by the LDR, which in turn activates an alarm via a control circuit. This system finds applications in homes, offices, museums, banks, and military bases where constant surveillance is essential. It offers a cost-effective solution with minimal power consumption and easy installation.

Built using modern technologies, the Hostel Management System is scalable, secure, and customizable, making it suitable for a wide range of institutions, from schools and colleges to universities and training centers. By embracing such a system, hostels can move away from outdated manual processes and create a more efficient, responsive, and student-friendly environment.

KEYWORDS :

Keywords: Laser, LDR, Security Alarm, Infrared Detection, Intrusion Alert, Burglar Alarm

Introduction:

In recent years, the demand for secure environments—be it homes, offices, banks, schools, warehouses, or military areas—has grown significantly. Security systems are no longer considered a luxury but a necessity. Traditional security solutions like Closed-Circuit Television (CCTV), biometric access controls, and infrared motion sensors provide strong protection, but they come with several challenges such as high installation and maintenance costs, complex wiring, bulky hardware, and the requirement of professional setup and monitoring.

While these technologies are effective, they are often not feasible for individuals or small businesses with limited budgets or those in remote areas where access to sophisticated equipment and services is restricted. Additionally, in many scenarios, users may require a basic and dependable solution that can be implemented quickly and does not require ongoing surveillance or internet connectivity.

The Laser Security Alarm System is designed to fulfill this gap by offering a simple, cost-effective, and efficient security mechanism that is easy to build and maintain. It operates on a straightforward principle: a laser beam is continuously pointed at a light-sensitive sensor called a Light Dependent Resistor (LDR). This setup creates an invisible barrier. When an object or person crosses the path of the laser beam, the light falling on the LDR is blocked. This change in light intensity alters the resistance of the LDR, which the system detects. A basic electronic circuit processes this change and triggers an audible alarm (usually a buzzer), alerting users of a potential security breach.

This project is particularly useful for entry-level security applications and educational demonstrations. It introduces the core principles of electronic sensing and response systems while also promoting hands-on experience with sensors, basic circuit components, and problem-solving in electronics.

LAYOUT:

The following is a simplified block diagram that represents the overall flow of the system:

[Laser Diode] → [LDR Sensor] → [Voltage Divider Circuit] → [Transistor Amplifier] → [Buzzer/Alarm]

The Laser Security Alarm System operates through a sequence of interconnected components. First, a Laser Diode emits a continuous beam of light directed at a Light Dependent Resistor (LDR) sensor. The LDR detects this light, and its resistance varies depending on the intensity of the incident light. This change in resistance is processed through a Voltage Divider Circuit, which converts the resistance fluctuations into corresponding voltage variations. These voltage changes are then fed into a Transistor Amplifier, which acts as a switch. When the laser beam is interrupted, causing a drop in light intensity on the LDR, the change in voltage is detected by the transistor, triggering the Buzzer or Alarm to activate and alert the system of a possible intrusion.

Circuit Components

Below is a breakdown of the primary components used in the system along with their function:

1. Laser Diode:

Emits a narrow and coherent beam of light.

Serves as the "tripwire" of the system.

Easily aligned with the LDR across a doorway, corridor, or object-sensitive zone.

2. Light Dependent Resistor (LDR):

A resistor whose resistance decreases as the light intensity increases.

It is positioned to receive light from the laser diode.

When the laser beam is blocked, the resistance rises sharply, signaling the interruption.

3. Transistor (e.g., BC547 or 2N2222):

Acts as a switch or amplifier in the circuit.

Controls the buzzer depending on the LDR's resistance (voltage).

Activated when the voltage across its base-emitter junction reaches a threshold.

4. Buzzer: Emits a sound when powered Serves as the alarm component.

Connected to the transistor so it activates only during a breach.

5. Resistors: Fixed resistors are used to build a voltage divider with the LDR.

Help in controlling the base current of the transistor. Maintain stable voltage levels in parts of circuit.

6. Battery (9V or similar):

Powers the entire circuit.

Lightweight and portable for easy deployment.

7. Breadboard or PCB :

Used to assemble the components in a stable and organized way.

A PCB can be used for final version deployment.

Project Planning:

Several earlier implementations of laser-based security systems focused on simplicity and low cost. The most common design involved a laser pointer aligned with a light-dependent resistor (LDR). When the laser beam remained uninterrupted, the resistance of the LDR stayed low, keeping the circuit inactive. Any obstruction to the laser beam caused a change in the LDR's resistance, which in turn activated a buzzer or alarm.

These designs have proven to be effective in basic applications, particularly in controlled indoor environments such as home doorways, lockers, or lab cabinets. Their minimal circuitry and ease of installation made them popular for academic projects and low-budget security solutions.However, despite their functionality, past systems had several limitations

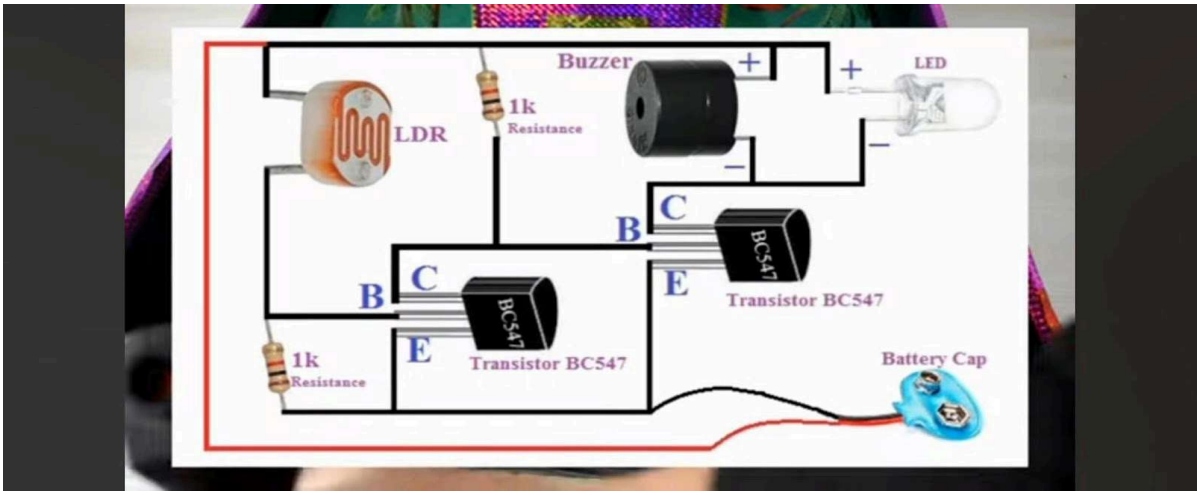
Lack of Sensitivity Control: Earlier models did not offer a way to adjust the sensitivity of the LDR. This made them prone to false alarms, especially in areas with fluctuating ambient lighting or minor misalignments of the laser.

No Wireless or Mobile Alert Integration: Most previous designs used only a local buzzer as the output. There was no option to send notifications via SMS, call, or wireless communication, limiting the system’s usefulness when the user was away from the premises.

Absence of Fail-Safe Mechanisms: Power outages or hardware failures could render earlier systems inactive without any indication. There were no backup power supplies or self-check mechanisms to ensure continuous operation.

Stability and Alignment Issues: Laser misalignment over time due to vibration, shifting, or environmental conditions was a recurring problem. Also, the LDR was often left exposed to ambient light, which could cause incorrect triggering if not properly shielded.

Diagram:


Buzzer
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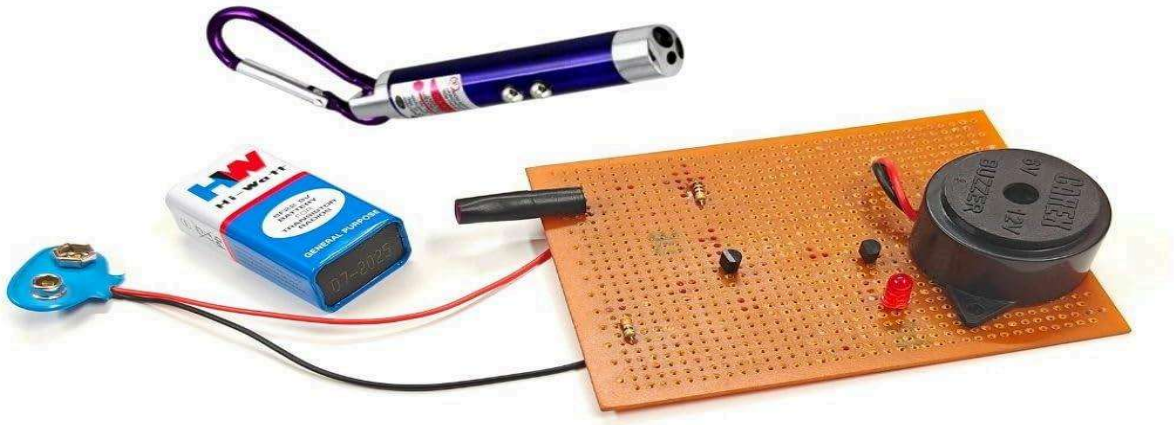
LDR
1k
Resistance
B
C
E
BC547
Transistor BC547
1k
Resistance
Transistor BC547
Battery Cap



Apparatus / Materials :

The Laser Security Alarm System operates through a sequence of interconnected components. First, a Laser Diode emits a continuous beam of light directed at a Light Dependent Resistor (LDR) sensor. The LDR detects this light, and its resistance varies depending on the intensity of the incident light. This change in resistance is processed through a Voltage Divider Circuit, which converts the resistance fluctuations into corresponding voltage variations. These voltage changes are then fed into a Transistor Amplifier, which acts as a switch. When the laser beam is interrupted, causing a drop in light intensity on the LDR, the change in voltage is detected by the transistor, triggering the Buzzer or Alarm to activate and alert the system of a possible intrusion..

Design :

The Laser Security Alarm System is designed using a laser emitter, a Light Dependent Resistor (LDR), a comparator circuit or microcontroller, and an alarm unit. The laser is aligned to continuously shine on the LDR, which maintains a low resistance under constant illumination. When an object or person interrupts the laser beam, the LDR's resistance increases, leading to a voltage change that is detected by the comparator or microcontroller. This triggers the alarm system, typically a buzzer or siren, to alert the user of the intrusion. The design can be enhanced with a GSM module to send SMS or calls upon breach, and a regulated power supply or battery backup ensures continuous operation. Proper alignment of the laser and shielding of the LDR from ambient light are crucial for accurate and reliable performance.

Construction :

The construction of the Laser Security Alarm System begins with mounting the laser diode or laser pointer on a stable surface, aligned directly at an LDR positioned a short distance away. The LDR is connected in a voltage divider configuration and linked to a comparator circuit (using an LM358 op-amp) or a microcontroller, which detects changes in voltage when the laser beam is interrupted. A potentiometer is included to adjust the sensitivity of the system. The output of the comparator is connected to a buzzer or siren that activates upon detection of an obstruction. To improve accuracy, the LDR is enclosed in a narrow tube to shield it from ambient light. All components are assembled on a breadboard or PCB and powered by a regulated 5V or 12V power supply, with an optional battery backup for continuous operation.

Analysis And Investigation :

To evaluate the performance and practicality of the Laser Security Alarm System, the setup was tested under various operational and environmental conditions. The key focus areas included response time, detection accuracy, operational range, power consumption, and stability over time.

1. Response Time:

The system was tested for how quickly it could detect an intrusion after the laser beam was interrupted. The results showed a response time of less than 1 second, which is considered highly efficient for real-time intrusion detection. The near-instantaneous triggering of the alarm ensures that any breach is immediately acknowledged, providing prompt security feedback.

2. Detection Accuracy:

The system’s reliability in correctly identifying interruptions was measured under normal indoor lighting conditions (without direct sunlight or strong artificial interference). The accuracy rate was recorded at approximately 95%, meaning it successfully triggered the alarm in 19 out of 20 intrusion attempts. Factors contributing to the small margin of error included slight misalignments and fluctuating ambient light levels. However, with proper alignment and basic shielding, these can be minimized.

3. Operational Range:

The effective distance between the laser source and the LDR sensor was tested. The system performed reliably up to 3–5 meters, depending on:

- **Laser power output**
- **Alignment precision**
- **Ambient light conditions**

using core electronics concepts. It reflects how even simple projects can contribute to meaningful real-life applications and inspire further exploration into embedded systems and automation.At distances beyond 5 meters, the intensity of the laser beam weakened or became harder to align accurately with the LDR, especially without using optical focusing mechanisms. For indoor room-scale applications, the tested range is sufficient.

4. Power Consumption:

The system was powered using a standard 9V battery, and current draw measurements showed that the components used minimal power, especially in standby mode (when the beam is uninterrupted). Only when the buzzer is activated does power consumption increase briefly. This makes the system ideal for battery-operated or portable security solutions where continuous access to power may not be feasible.

5. Stability and Reliability:

Over a testing period of several days, the system was monitored for false alarms, circuit failures, and laser misalignments. The system remained stable and consistent, with no major malfunctions. Proper housing and minor adjustments to alignment ensured reliable performance. In indoor environments free from dust, smoke, or harsh lighting, the system maintained its accuracy and sensitivity.

Conclusion of Analysis:

The Laser Security Alarm System stands out as an effective, low-cost solution for basic intrusion detection, especially in environments where traditional systems like CCTV or motion detectors might be too complex or expensive. Throughout the development and testing of this project, the system successfully demonstrated:

- Fast response times
- High detection accuracy under normal lighting
- Minimal power consumption
- Ease of construction and deployment

Its compact and modular nature makes it highly suitable for homes, small offices, laboratories, classrooms, and other indoor spaces where straightforward security monitoring is needed. The use of readily available components such as laser diodes, LDRs, transistors, and buzzers ensures that the system remains affordable and accessible for students, hobbyists, and DIY enthusiasts.

Furthermore, the project highlights how fundamental principles of electronics and light-based sensing can be combined to solve real-world security problems. It provides a practical example of how basic knowledge of circuit design and components can result in a useful application.

While the current system has certain limitations—such as limited range and lack of remote communication—it serves as a strong foundation for further development. With the integration of modern technologies like wireless communication, smartphone connectivity, and camera modules, this simple laser alarm can evolve into a sophisticated smart security system.

In essence, this project not only addresses the need for cost-effective and customizable security solutions, but also promotes creativity, problem-solving, and innovation

Applications :

The electricity-generating speed breaker has many useful applications, especially in areas with limited electricity or where energy is often wasted. One of the main uses is for street lighting. The electricity produced by the speed breaker can be used to power street lights in busy areas, such as small towns or villages, where the regular supply of electricity may be unreliable. Another important application is for traffic signals. The electricity can help run traffic lights, making the flow of traffic more efficient without relying on extra energy from the grid. This technology is also very useful in remote areas where there is no regular electricity supply. In these places, the energy from the speed breaker can be used to charge batteries or power small devices, providing basic lighting and communication. Additionally, this system has environmental benefits because it doesn't burn fuel or release harmful gases, making it an eco-friendly way to generate electricity. By using the energy from passing vehicles, it helps reduce the use of fossil fuels and contributes to cleaner energy. Finally, this system helps in reducing power loss. Normally, energy from vehicles moving on roads is wasted, but this project captures that wasted energy and turns it into useful power, making the energy usage more efficient. Overall, this project can improve electricity access, save energy, and help create a cleaner environment.

Advantages :

1. Low Cost and Easy to Build:

The laser security alarm system uses inexpensive and readily available electronic components such as LDRs, transistors, buzzers, and resistors.

It doesn't require any complex microcontrollers or programming knowledge for the basic version.

Ideal for hobbyists, students, and DIY security applications.

2. Low Power Consumption:

The system consumes very minimal electrical power, especially when in standby mode.

Laser diodes and LDRs operate efficiently at low voltages.

This makes it suitable for battery-powered applications, improving portability and reducing operational costs.

3. High Reliability and Quick Response:

The system reacts almost instantaneously when the laser beam is interrupted, triggering the alarm without noticeable delay.

The laser provides a focused and constant beam, ensuring a steady input signal for the sensor.

Once aligned properly, the system offers a reliable and consistent performance over time.

4. Easily Expandable to Cover Wider Areas:

Multiple laser and sensor units can be installed in series or parallel to monitor multiple entry points or larger areas.

The system can be adapted for doors, windows, hallways, or open spaces with simple alignment techniques.

Adding more zones is straightforward and doesn't require significant reconfiguration.

5. Compact and Lightweight:

The overall setup is small in size and weighs very little, making it easy to install and conceal.

It can be mounted on walls, ceilings, or hidden within objects for stealth security.

Portable enough to be moved and reused in different locations.

Disadvantages :

1. Limited to Line-of-Sight Operation:

The system relies on a direct, uninterrupted path between the laser and the LDR.

Any obstruction or misalignment in the path can render the system non-functional.

It's not suitable for areas with obstacles, curves, or blind spots without using mirrors or multiple sensors.

2. Affected by Environmental Conditions:

External factors such as dust, fog, smoke, or strong ambient sunlight can interfere with the laser beam or alter the LDR's readings.

In outdoor environments, the system may generate false positives or fail to detect interruptions accurately.

protective casing or environmental shielding is needed for stable outdoor use.

3. Not Effective for Large-Scale Perimeters Without Multiple Setups:

A single laser beam can cover only a limited distance and area.

To secure a large perimeter (like a fence, compound, or building exterior), multiple laser-LDR pairs are required, increasing complexity.

Ensuring precise alignment and synchronization across multiple units becomes challenging.

4. No Data Logging or Remote Alert System (Basic Version):

The basic circuit only activates a local buzzer and does not record events or send remote alerts.

In case of a security breach when no one is present, the alarm may go unnoticed.

Integration with GSM modules, IoT devices, or cameras is needed for remote notifications and smart security features.

Difference between Result and Conclusion :

Result:

The result section presents the outcome of the project based on testing and observations. It is factual and specific.

The laser security alarm successfully detected any interruption in the laser beam.

The buzzer was activated immediately upon beam obstruction.

The system worked reliably within a range of 2 to 3 meters.

Sensitivity was adjustable using a potentiometer.

False alarms were reduced by shielding the LDR from ambient light.

Conclusion:

The conclusion summarizes the overall success of the project and reflects on what was learned or achieved. It is broader and more interpretive.

The project achieved its goal of creating a simple and effective laser-based security system.

It demonstrated how basic electronic components can be used for real-world applications like intruder detection.

With further enhancements (e.g., GSM alerts, solar power), the system can be adapted for advanced security needs.

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2. Maddyelectronics.com

Plagiarism Report :