খুলনা প্রকৌশল ও প্রযুক্তি বিশ্ববিদ্যালয়
KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY

Course no: EE 2110

Department of Electrical and Electronic Engineering

Project Title: **Laser Security System**

Submitted to:	Submitted by
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Date of Submission: 10/02/2025

Remarks:

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Objectives: The purposes of this lab project are to

1. develop a laser-based security alarm system.
2. understand the working principles of an LDR and transistor.
3. increase security by detecting interruption in the laser beam.

Introduction: The Laser Security System is a simple and effective method for safeguarding a restricted area. It uses a laser beam directed at a Light Dependent Resistor (LDR) to monitor access. If the laser beam is interrupted, an alarm (buzzer) is triggered. A laser security system is designed for security purposes. It has a wide range of applications, from protecting household items to safeguarding high-value materials in organizations.

In a Laser Security System, the **transistor** acts as a switch that controls the buzzer based on the LDR's resistance. The LDR is connected to the base of the transistor. When the laser light continuously falls on the LDR, its resistance remains low and absorbs most of the input current from the emitter, preventing the transistor from conducting to the collector, where the buzzer is located. As a result, the buzzer remains off. However, when the laser beam is interrupted, the LDR's resistance increases, causing a voltage change that turns the transistor's collector path on. This allows current to flow through it, activating the buzzer and generating an alarm signal. The transistor also amplifies the signal, ensuring reliable alarm activation.

Lasers differ from other light sources in significant ways, with two features being particularly important for security systems. Unlike a light bulb or flashlight, laser light does not spread out; it remains a narrow beam. Additionally, laser light is essentially a single color.

Because laser light does not spread much, it can travel long distances and still retain enough energy in a small area to trigger a security system detector. Its single wavelength allows for the use of a blocking filter on the detector, which lets laser light through while blocking background light.

The laser is a concentrated light source that puts out a straight line, 'pencil beam', of light of a single color. The LDR is sensitive to light and permits high current flow when the laser light hits it. When the laser light is interrupted, the LDR displays high resistance and current has to pass through elements connected in parallel with it. So, if we connect a buzzer in parallel to the LDR, if the laser is interrupted from an intruder, current will flow in the parallel buzzer, producing a warning alarm.

An **LDR** (Light Dependent Resistor), also known as a photoresistor or light sensor, is a special resistor that operates on the principle of photoconductivity, meaning its resistance changes with the intensity of light. Made from semiconductor materials like cadmium sulfide (CdS), its resistance decreases when exposed to light and increases in darkness. When photons strike the LDR, they excite electrons to the conduction band, increasing conductivity. In a circuit, when a laser beam falls on the LDR, its resistance stays low, preventing current from activating other components like a buzzer. On the other hand, when the beam is blocked, the LDR's resistance rises, causing a voltage drop that activates a transistor, completing the circuit and turning on the buzzer.

A **thermistor** is also used in this system. It is a type of resistor whose resistance changes with temperature. There are two main types:

NTC (Negative Temperature Coefficient): Resistance decreases as temperature increases, commonly used in temperature sensing and compensation.

PTC (Positive Temperature Coefficient): Resistance increases with temperature, often used in circuit protection and current limiting.

The uses of Thermistor in a Laser Security System are:

1. **Temperature Compensation**: Laser diodes and photodetectors (LDRs or photodiodes) are sensitive to temperature changes. A thermistor can help compensate for temperature variations by adjusting circuit parameters accordingly.

Compensation: Adjusts circuit parameters to counteract temperature effects on laser diodes and photodetectors.

2.**Overheating Protection:** Monitors heat levels and prevents damage by triggering alerts or shutting down the system if necessary.

3.**Stabilizing Sensor Readings:** Helps maintain accurate sensor performance despite temperature variations.

4. **Environmental Adaptation:** Ensures consistent functionality in outdoor conditions by adapting to temperature fluctuations.

5. **Power Control & Efficiency:** Regulates power to the laser diode, preventing excessive heating and improving energy efficiency.

Apparatus required:

Serial no.	Apparatus name	Ratings	Quantity
01	AC Power Supply	3-phase, (0-220) V	01
02	Light Dependent Resistor (LDR)	Dark resistance: (1Ω -20MΩ)	01
03	NPN Transistor	BC547	01
04	Resistor	10kΩ, 1kΩ	02
05	Laser pointer	-------	01
06	Buzzer	(5-12) V	01
07	Thermistor	10KΩ	01
08	Breadboard	-------	01
09	Connecting wires and probes	______	As required

Experimental setup:

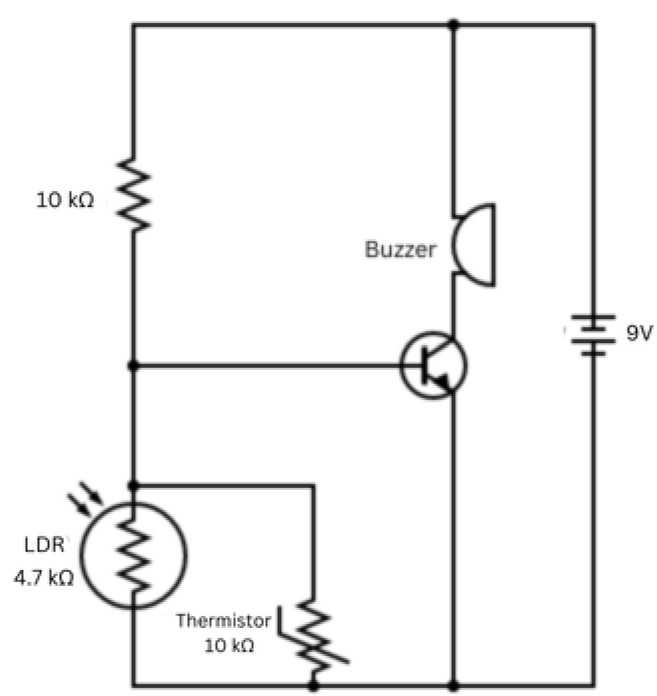

Fig10.1: Light sensor circuit using LDR

Discussion: The Laser Security System functioned based on the variation in resistance of the LDR due to changes in light exposure. When the laser beam was uninterrupted, the LDR's resistance remained low, causing minimal current to flow. As a result, the voltage across the transistor remained below 5V, preventing the buzzer from being activated. But when the laser beam was obstructed, the LDR's resistance increased significantly. This led to a higher voltage drop, allowing sufficient current to flow through the transistor to the buzzer, which produced an alarm sound. It was noticed that in the presence of light, very little current was allowed to pass, preventing the buzzer from ringing. Contrarily, in darkness, an increased current was allowed to flow to the buzzer, activating the alarm. The system's sensitivity could be adjusted by modifying the resistance values or transistor parameters to ensure the desired threshold voltage for activation.

Conclusion: The Laser Security System has been identified as a cost-effective and efficient method for intrusion detection. The integration of an LDR and a transistor enables a reliable security alarm mechanism. The system can be further enhanced by incorporating features such as a microcontroller-based logging system or a wireless notification mechanism.

References:

[1] https://www.electronicsforu.com/technology-trends/learn-electronics/ldr-light-dependent-resistors-basics

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