

Multiple Laser Alarm System using Arduino Uno

Prof. Manisha Vaidya, Abhishek lamture, Darshan Rakhade, Ayush warvanshi, Divesh Bante

¹ Prof. Manisha Vaidya, Artificial Intelligence, Priyadarshini J.L College of Engineering, Maharashtra, ² Abhishek lamture, Artificial Intelligence, Priyadarshini J.L College of Engineering, Nagpur, Maharashtra, India³ Darshan Rakhade, Artificial Intelligence, Priyadarshini J.L College of Engineering, Maharashtra, India

Ayush warvanshi, Artificial Intelligence, Priyadarshini J.L College of Engineering, Maharashtra, India

⁵ Divesh Bante Artificial Intelligence, Priyadarshini J.L College of Engineering, Maharashtra, India

ABSTRACT

Contemporarily, illegal activities such as theft, intrusion, and robbery are frequent in the community. Security systems identical to door locks and alarms are used to mitigate such crimes. In this paper, the researchers propose using a multi-laser alarm system by mainly using Arduino Uno board. Like laser systems common in action films, the project makes use of multiple lasers to detect motion on the location. The device is programmed to produce noise when all the LDR receive zero light from the lasers. The researcher thinks of using multiple lasers to increase the detection of human movement. For an instance, placing one laser in lower places and the latter to a higher height. Cats or rolling rubberball can trigger the lower laser, but humans can trigger both lasers at the same time. The details of the system and its code is described. Results show that the system works on a variety of objects.

In the face of rising security concerns, the development of advanced and cost-effective alarm systems is crucial. This paper presents a novel Multiple Laser Alarm System designed around the Arduino Uno platform, offering a multi-layered approach to intrusion detection. Utilizing a network of lasers and light-dependent resistors (LDRs), the system creates an invisible grid that, when breached, triggers an auditory alarm. The Arduino Uno serves as the central processing unit, interpreting signals from the LDRs to discern potential security breaches. The system's versatility allows for deployment in various settings, from residential to commercial spaces, providing a reliable deterrent against unauthorized entry. The simplicity of the Arduino Uno also ensures ease of programming and customization, making it accessible for security enhancements tailored to specific needs. This paper details the system's design, implementation, and operational efficacy, demonstrating its potential as a valuable asset in modern security measures.

Keyword : - Arduino Uno, laser, light dependent resistor, buzzer, LEDs

1. INTRODUCTION

Security is one of the most important factors to consider today. Every technology develops day by day in this world and some of the technologies are used to crimes. The team decided to create an alarm security system as the project to improve safety.

Alarm systems today are in the form of electronics and such systems are to detect, determine and deter criminal activities. It can detect invasions, fire, or any changes to its surrounding. Mostly it detects possible threats and notify the authorities about the events that take place.

The laser-alarm security system is a device designed to detect intrusion or unauthorized entry into an area. One of the major components used to create a security system is the sensor.

The sensor measured the action of the electrical equivalent and processes, and the signal can be sent and interpreted

quickly. The purpose of the sensor on the security is to detect the event or change in its environment and send the information to the other electronics components. Laser is also one of the major components in this project, without the laser the project will fail. The laser provides a protection to the area, and it works as a result to resonant effect. A laser alarm security system can be used in many ways; around the house, safety locker, and it can act as an additional layer of security. Aside from security purposes, it can be also setup to check if pets or babies crossed out of the boundary. Installing at home a laser alarm security system means to protect your home and valuables and to keep your family safe from break-in. Arduino Uno is a low-cost electronics device with a simple hardware and software. It is able to read inputs from a sensor, a finger on a button and turn into output – activating a motor, and publishing something online. Arduino Uno is made of a programmable board, and it allows us to write and upload code to the microcontroller. Nowadays, security systems can be considered as one of the most necessary things because of the increasing crimes on action. In this pandemic, there are a lot of crimes happening. These include stealing of things in some places like the business location, home equipment's and more. Security systems are a line of defense for keeping your property and valuables safe. This type of alarm system can alert you if something bad is going down, which it keeps both property and valuables safer. There are many types of security systems that are currently being used by most people like with the use of CCTV, alarm of the broken glasses, but this alarm system is visible to the naked eyes that will alert the intruders to deactivate them.

2. PROBLEM DEFINITION

The prevalence of unauthorized entries and security breaches has necessitated the development of more sophisticated and reliable alarm systems. Conventional security measures often fail to provide comprehensive coverage or are easily circumvented by determined intruders. The challenge is to create an advanced yet cost-effective alarm system that can be implemented in various environments, from residential to commercial spaces.

The “Multiple Laser Alarm System using Arduino Uno” addresses this challenge by utilizing a network of lasers and sensors to form a protective grid. The system is designed to detect any interruption in the laser beams, indicating a potential intrusion. The Arduino Uno microcontroller acts as the brain of the system, processing input from the sensors and activating an alarm when a breach is detected.

3. LITERATURE REVIEW

The light emitted by a laser varies greatly from that produced by a torch. It is special in three aspects. To begin with, it is more practical. As a result, lasers can be used to cut through tough materials. Second, laser light has a much smaller spread than ordinary light. Surveyors may use the laser to draw straight lines and calculate distances. Finally, laser light has only one color or wavelength, whereas ordinary light has a range of colors [1].

LASER has a broad range of uses, according to Kant, Sharma, and Singh, including optical disk drives, laser printers, and barcode scanners; fiber-optic and free-space optical communication; laser surgery and skin treatments; cutting and welding materials; military and law enforcement devices for marking targets and measuring range and speed; and laser lighting displays in entertainment. Laser lighting displays in entertainment, as well as military and law enforcement equipment for marking targets and measuring range and speed [2].

According to Dong, Giakoumidis, Juma, Tretyakov and Mavridis, elderly people and people with disabilities have it hard to live encountering fast moving objects. Therefore, they made use of a Laser motion detection to alert people of an incoming object. In this case, they used vibration signal to the individual's neck [3].

Aside from detecting fast moving objects, laser can also be used to secure places where nobody is allowed to enter. A protection and warning system that uses laser light and a light sensor is known as a laser-based security system. Our homes, offices, banks, lockers, and other valuables are all secured by security systems from intruders and unauthorized entry. There are various types of security systems available, with laser-based security systems being one of the most important and successful. A laser security system may be used as a standalone system that emits a sound or creates a noise when it senses some suspicious behavior, or it can be incorporated into a wider security and home automation system that can send messages, call the owner etc. [4]

When an invisible LASER beam is disturbed, a Warning or SIREN works. This is a very typical scenario nowadays. The LASER beam protection device is used by many people to protect their homes, workplaces, stores, warehouses, and other places. Not only buildings and premises are protected with such invisible LASER beams, but many valuable objects such as watches, diamonds, valuable antique items in museums, and many other items are as well. A laser system consumes less power than the whole laser system, which is expensive. It can also be installed in homes

easily; you can install it yourself [6].

Like Singha's laser system, Ayad Mohammed's laser fence is a mechanism that can detect objects passing the line of sight between the laser source and detector. His alarm makes use of camera, which will focus to the sight of unauthorized entry. The system runs on a program using the C# language and visual basic to evaluate the system [7].

People do not have to worry about the cost of these laser security systems. They are affordable and easy to produce and install, they might be able to make it themselves. According to the team of Rai, it consists of few components and can be placed to small areas, yet it covers long distances. Crimes are imminent today which is why their team created this "Low-Cost Laser Light Security System in Smart Home" affordable by anyone [8].

4. PROPOSED WORK

The proposed work involves designing and implementing a Multiple Laser Alarm System using the Arduino Uno microcontroller. The system will utilize a series of lasers and light-dependent resistors (LDRs) to create a security grid. The primary objective is to detect any interruptions in the laser beams, which would indicate an intrusion.

The proposed system will be programmed to emit an audible alert when the LDRs fail to receive light from the lasers, suggesting that the laser beams have been obstructed. To enhance detection capabilities, the system will employ multiple lasers at varying heights. This configuration aims to differentiate between small animals or objects and human-sized intruders, reducing false alarms.

Key components of the system will include:

- **Arduino Uno:** Acts as the central processing unit, interpreting signals from the LDRs and controlling the alarm.
- **Lasers:** Create an invisible grid that, when interrupted, signals a potential security breach.
- **LDRs:** Detect the presence or absence of laser light, triggering the alarm system upon interruption.
- **Buzzer:** Produces an audible alarm when the system is breached.
- **LEDs:** Provide visual indicators of the system's status.

The proposed work will also explore the integration of additional features such as Wi-Fi connectivity for remote monitoring and control. The system's code and operational details will be thoroughly documented to facilitate replication and customization.

5. OBJECTIVES

Develop a comprehensive understanding of Laser Light Security Alarm Systems (LLSAS) by studying their operational principles, components, and capabilities.

Evaluate the performance of LLSAS in various environmental conditions to assess sensitivity, false alarm rates, and reliability.

Investigate methods to optimize LLSAS parameters and algorithms to enhance detection accuracy and response times.

Explore integration strategies to seamlessly incorporate LLSAS into existing security infrastructure, such as CCTV systems and access control platforms.

Assess interoperability between LLSAS and interconnected security systems to ensure effective data exchange and coordination.

Deploy LLSAS in real-world settings to evaluate practical utility, effectiveness in deterring intrusions, and facilitating rapid response by security personnel.

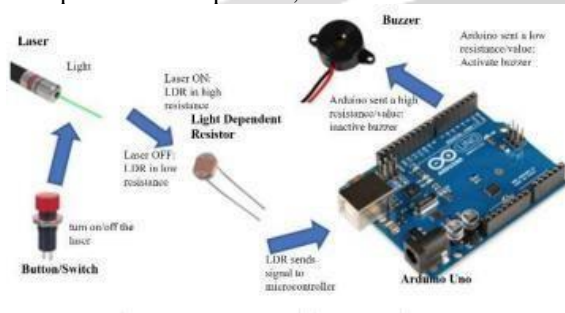
Solicit feedback from end-users and stakeholders to identify usability issues, operational challenges, and areas for improvement in LLSAS deployment and operation.

Explore emerging technologies, such as artificial intelligence and sensor fusion, to enhance LLSAS capabilities for advanced threat detection and behavior analysis.

6. METHODOLOGY

Input	Process	Output
LDR	<ul style="list-style-type: none"> • Detects continuous light from laser beams. • If light source is blocked, alarm will turn on. • LED 3 & 4 blinks rapidly. 	Laser Alarm Security System using Arduino.
Push Button Switch	<ul style="list-style-type: none"> • If not pressed, the device is on standby with LED 1 lit. • If pressed again, the device detects light and the LED 2 lit. • If the alarm turned on, press the button again to reset to standby. 	
Laser	<ul style="list-style-type: none"> • Laser emits light to the LDR when connected to power source. 	

The project’s inputs are Push Button Switch, LDR, and Laser. When the device connects to a power source, all the components connected to the device will activate except LED2. LED1 lights up green, which means the device is in neutral state. When LED 2 is red andblinking, it means an object blocked the light source and the alarm will turn on. When the pushbutton is pressed, the alarm and LED2 will turn off and the device is back to its neutral state.



This figure shows the process on how the whole system will work. The function of the switch is to turn on or off the prototype. The laser is directed to the LDR sensor where it can detect a high or low resistance. LDR sends a signal to the microcontroller and the Arduino sends a signal to the buzzer. When the laser is on, the LDR will detect a high resistance and the Arduino causes the buzzer to remain off state. But if there is no light directed to the sensor, or it is cut off by some object or people, the sensor will send a low resistance where the Arduino will detect, and the buzzer will activate.

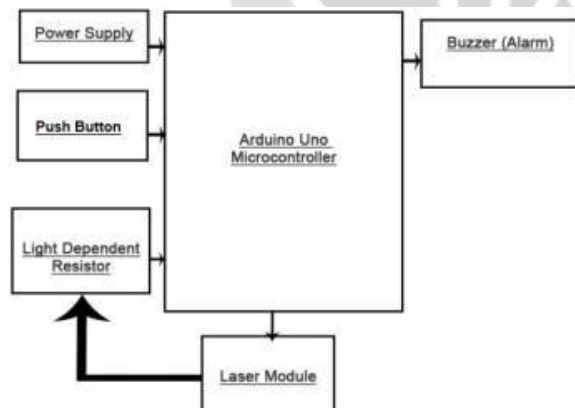


Figure 3 shows the Block Diagram of the device. The power supply will give power to the Arduino to run the other electronic components such as the laser beam module, the LDR, Push Button Switch, LEDs, and Buzzer. Therefore, all the components are powered on and the buzzer is beeping. However, it is off when the laser beam points toward the Light Dependent Resistor. If someone passes the laser beam removing the light to the LDR, it will result to the buzzer beeping. This is when the push button comes in use. You must press the push button to turn off the alarm.

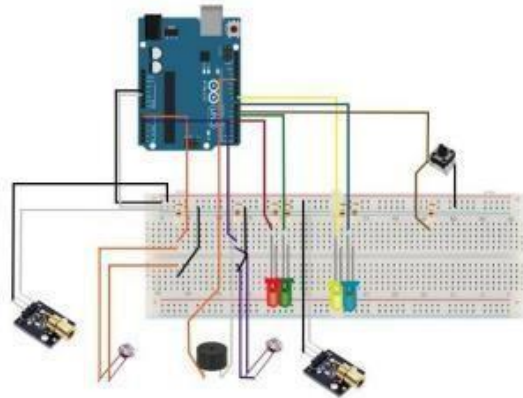


Figure 4 presents the schematic diagram of the system. It shows the connection of wirings in the system. The black wire connects to 5v and board, which connects the components to the power source. The white wire is the ground. Red wire for Red LED, which connects to Digital Pin 4, green to pin 5, yellow to pin 8, Blue to pin 7, and brown to pin 6 which is connected to the pushbutton. The buzzer is connected to pin 12. The LEDs and LDRs have resistors used in between the connections.

WORKING

A lease security alarm system integrated with IoT (Internet of Things) involves several components and technologies working together to provide enhanced security and monitoring capabilities for leased properties. Here's a detailed breakdown of how such a system works:

Components of an IoT-based Lease Security Alarm System

1. Sensors:

- *Motion Sensors*: Detect movement in specific areas.
- *Door/Window Sensors*: Detect if doors or windows are opened or tampered with.
- *Glass Break Sensors*: Detect the sound or vibration of breaking glass.
- *Cameras*: Provide visual monitoring and can be set to record or alert on detecting movement.

2. Control Panel:

- The central hub that connects all sensors and devices. It processes data, triggers alarms, and communicates with users and monitoring services.

3. Connectivity:

- *Wi-Fi*: Common for connecting sensors and control panels to the internet.
- *Cellular Networks*: Provide backup connectivity if Wi-Fi is unavailable.
- *Bluetooth/Zigbee/Z-Wave*: Used for short-range communication between devices.

4. Cloud Platform:

- Stores data, manages device communication, and runs analytics. Provides remote access to the system via apps or web interfaces.

5. Mobile App/Web Interface:

- Allows users to monitor and control the system remotely. Provides real-time alerts and notifications.

6. Alarm Mechanisms:

- Audible Alarms: Sirens or bells that sound when an intrusion is detected.
- Silent Alarms: Notify monitoring services or users without sounding an audible alarm.

7. Monitoring Service (optional):

- A professional service that monitors alerts and can dispatch emergency services if needed.

Laser Emitters: These devices emit a narrow beam of laser light. They are usually low-powered to ensure safety but are intense enough to be detected by the receiver.

Receivers: Receivers are placed opposite the emitters and are designed to detect the laser beam. When the beam is interrupted, the receiver triggers an alarm.

Alarm Systems: Alarms can vary depending on the application. They may include sirens, lights, notifications to a

security system, or alerts sent to a monitoring center.

Power Supply: Both the emitters and receivers require power, which can be provided through batteries or a wired connection.

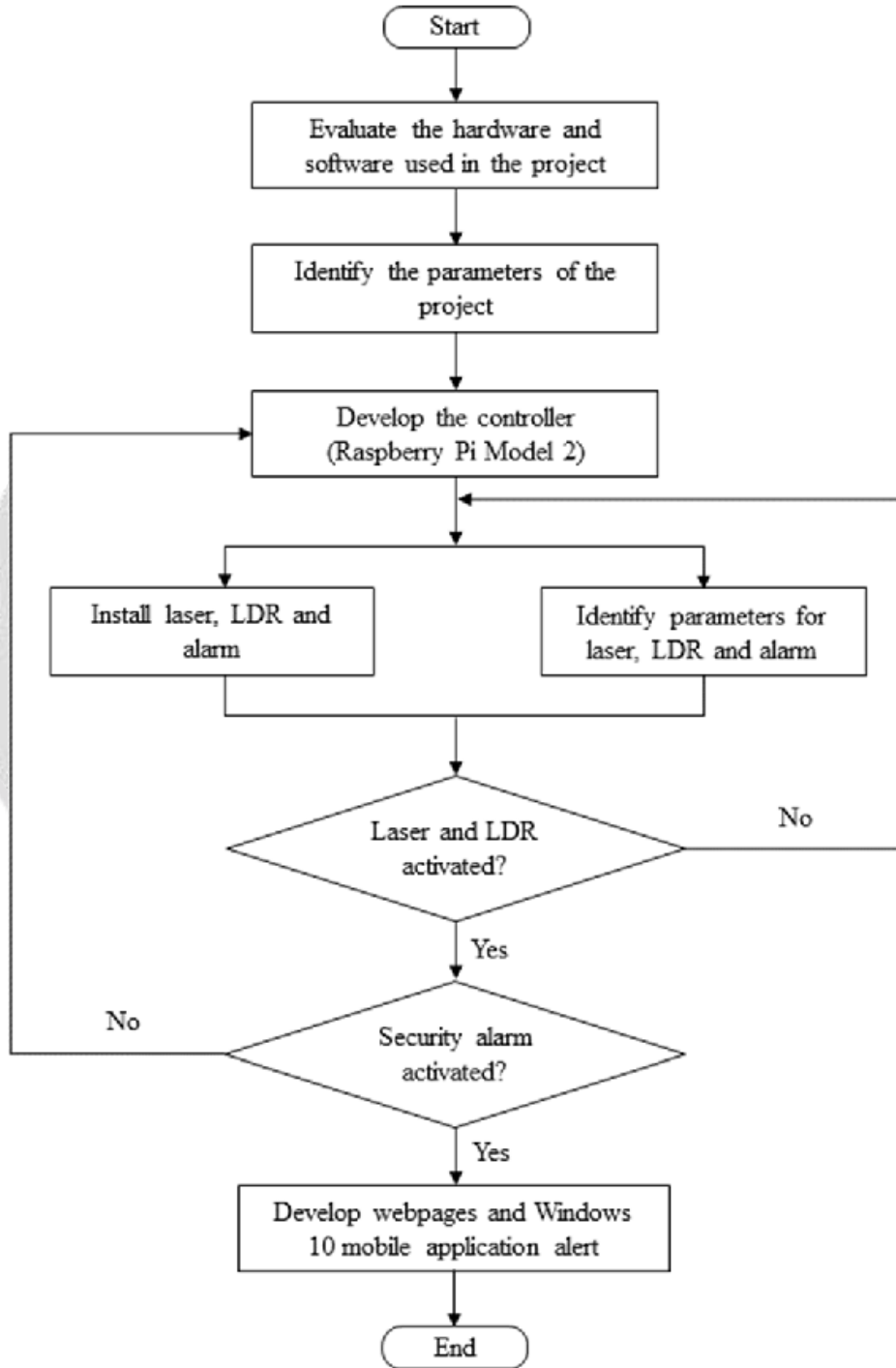
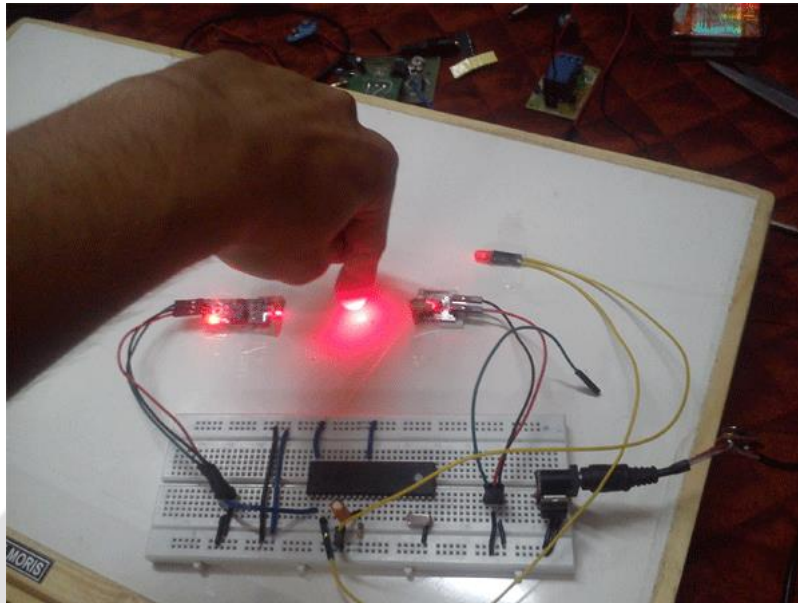


Fig -2 : Model Photo



8.3 Advantages

High Sensitivity: Laser light security systems offer high sensitivity, capable of detecting even slight disturbances in the laser beam. This makes them effective for detecting intrusions with precision, minimizing false alarms.

Wide Coverage: These systems can cover large areas, making them suitable for securing expansive perimeters such as those found in industrial facilities, military installations, and wildlife reserves.

Quick Response Time: Laser light security systems provide rapid response to intrusions, triggering alarms or alerts instantly when the laser beam is interrupted. This allows for timely intervention by security personnel or automated security measures.

Versatility: Laser light security systems can be customized to suit various environments and security requirements. They can be configured with different sensitivity levels, detection patterns, and alarm mechanisms to adapt to specific applications.

Deterrent Effect: The presence of visible laser beams acts as a deterrent to potential intruders, dissuading them from attempting unauthorized entry or criminal activities. This proactive approach helps prevent security breaches before they occur.

Low Maintenance: Once installed, laser light security systems require minimal maintenance compared to other security solutions. They have fewer moving parts and are less susceptible to wear and tear, resulting in lower long-term maintenance costs.

Integration Capabilities: Laser light security systems can be integrated with other security technologies such as surveillance cameras, motion sensors, and access control systems for enhanced functionality and comprehensive threat detection.

8.4 Disadvantages

Vulnerability to Weather Conditions: Laser beams can be affected by adverse weather conditions such as fog, rain, snow, or dust, which may scatter or block the beam, leading to false alarms or reduced detection sensitivity.

Potential for False Alarms: Laser light security systems may trigger false alarms due to environmental factors such as moving vegetation, small animals, or airborne debris that interrupt the laser beam, leading to unnecessary disruptions and security alerts.

Limited Coverage in Outdoor Environments: In outdoor environments with uneven terrain or obstacles, achieving

consistent coverage with laser beams can be challenging, especially over long distances. This may require additional adjustments or the use of multiple laser modules to ensure comprehensive perimeter protection.

Risk of Interference: Laser beams emitted by security systems can be susceptible to interference from external sources such as other light sources, reflective surfaces, or electromagnetic radiation, which may compromise the system's reliability and accuracy.

Cost of Implementation: Laser light security systems may involve significant upfront costs for purchasing and installing the necessary equipment, including laser modules, photodetectors, amplifiers, and alarm mechanisms. Additionally, ongoing maintenance and calibration expenses should be factored into the total cost of ownership.

Safety Concerns: Laser beams used in security systems can pose potential safety hazards to humans and animals if not properly controlled or contained. Exposure to high-intensity laser light may cause eye injuries or skin burns, necessitating adherence to safety regulations and precautions during installation and operation.

APPLICATION

Residential Security: Laser light security systems are commonly used to protect residential properties such as homes, apartments, and gated communities. They can be installed along fences, gates, or windows to detect intrusions and deter unauthorized entry.

Commercial and Industrial Facilities: Businesses, warehouses, factories, and other commercial or industrial facilities utilize laser light security systems to safeguard valuable assets, equipment, and inventory. These systems help prevent theft, vandalism, and unauthorized access to restricted areas.

Critical Infrastructure Protection: Laser light security systems play a vital role in protecting critical infrastructure such as power plants, water treatment facilities, telecommunications centers, and transportation hubs. By monitoring perimeters and detecting intrusions, these systems help ensure the continuous operation of essential services.

Military and Defense: Military installations, border checkpoints, and high-security government facilities employ laser light security systems to enhance perimeter security and protect sensitive areas from unauthorized access. These systems may be integrated with surveillance cameras, motion sensors, and other advanced technologies for comprehensive threat detection.

Retail Loss Prevention: Retail stores, shopping malls, and commercial establishments use laser light security systems to prevent shoplifting, burglary, and vandalism. These systems can be discreetly installed to monitor entrances, exits, and high-value merchandise areas.

Outdoor Events and Festivals: Laser light security systems are deployed at outdoor events, concerts, festivals, and sporting venues to ensure crowd safety and security. They help monitor perimeters, control access points, and detect any unauthorized individuals attempting to enter restricted areas.

Border Security: Border patrols, customs agencies, and law enforcement agencies utilize laser light security systems to monitor and secure international borders, seaports, and airports. These systems help detect illegal border crossings, smuggling activities, and other security threats.

Wildlife Conservation: Laser light security systems are employed in wildlife reserves, national parks, and conservation areas to protect endangered species from poaching and illegal hunting. They can be used to create virtual barriers and alert park rangers of any unauthorized intrusions into protected areas.

FUTURE SCOPE

Integration with Smart Home Technology: Future systems could integrate with smart home ecosystems, allowing users to monitor and control their security systems remotely using smartphone apps or voice commands. This integration could also enable features such as notifications to mobile devices in case of breaches and the ability to disarm the system remotely.

Enhanced Sensing Technology: Advancements in sensing technology could lead to more sensitive and accurate detection of intrusions while minimizing false alarms. This could include the use of advanced photodetectors with higher resolution and improved signal processing algorithms to distinguish between legitimate disturbances and false triggers caused by environmental factors.

Multi-Layered Security Systems: Laser light security systems may be integrated as part of multi-layered security setups, combining different technologies such as motion sensors, surveillance cameras, and access control systems. This approach provides comprehensive coverage and redundancy, making it more difficult for intruders to bypass security measures.

Energy-Efficient and Sustainable Solutions: Future systems could prioritize energy efficiency and sustainability by employing low-power components, renewable energy sources, and eco-friendly materials. This not only reduces operational costs but also aligns with broader environmental goals.

11. CONCLUSION

In conclusion, a laser light security alarm system offers a reliable and effective solution for perimeter security in various settings. By emitting a laser beam and detecting interruptions in that beam, the system can quickly identify intrusions and trigger an alarm or alert. Key components of the system include a laser module, photodiode or phototransistor, amplifier and comparator circuits, and an alarm mechanism.

While building a laser light security alarm system, it's essential to carefully design and assemble the circuitry, ensuring proper functionality and sensitivity. Testing the system in different conditions helps verify its reliability and accuracy, while fine-tuning adjustments may be necessary to avoid false alarms. Integration of an alarm or alert mechanism, such as a buzzer or LED, enhances the system's effectiveness in notifying of breaches.

12. REFERENCES

1. [Laser Security System Project Report¹](#): This document describes a project created by students Chirag, Mohit Jangra, and Shubham for their computer science engineering diploma. It details the use of a laser, light-dependent resistor sensors, buzzer, and Arduino board to create a security system that triggers an alarm when the laser path is interrupted.
2. [A Project Report on Laser Security Alarm System²](#): This report by DADI TIRUMALA TARUN from 2020 discusses a model of laser security alarm system design. It covers the working principle, objectives, block diagram, circuit diagram, components description, and advantages and disadvantages of the system.
3. [Design and Analysis of LDR Based Laser Security System³](#): This abstract provides information on the key components and working of a Laser Security Alarm System, including a laser emitter, receiver, LDR, and an alarm unit.

These references should provide you with a comprehensive understanding of laser alarm systems, including their design, components, and functionality.

