IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Intrusion Detection Laser Guard System For Security Purpose

[1] Dr. Sachin Sambhaji Patil, [2] Vaibhav Gawai, [3] Alok Dhawale, [4] Vedika Chavan, [5] Harsh Tendulkar

[1] Assistant Professor, [2, 3, 4, 5] Students

[1, 2, 3, 4, 5] Department of Electronics and Communication Engineering, School of Engineering and Sciences,

[1,2,3,4,5] MIT Art, Design and Technology University, Pune, India

Abstract: Modern security infrastructure must include intrusion detection systems (IDS) in order to prevent unwanted access to sensitive locations. Conventional IDS technology, such CCTV cameras, motion detectors, and infrared sensors, have drawbacks in terms of false alarms, sensitivity to environmental changes, and evasion vulnerability. The application of laser-based intrusion detection systems, which provide a more accurate, non-contact substitute for traditional techniques, is examined in this paper. The capacity of laser systems to provide extremely precise and dependable monitoring, especially under difficult environmental circumstances, has been researched. These systems use laser beams to build invisible detection boundaries.

***Index Terms* – Intrusion detection, Laser guard, Security etc.**

I. INTRODUCTION

As sensors and detecting methods have advanced over the years, intrusion detection systems (IDS) have become an increasingly important component of security technology. Conventional IDS frequently depend on physical barriers such as cameras, motion detectors, and fences. Despite offering a certain level of protection, these systems are not infallible and can be circumvented in a number of ways. Numerous cutting-edge strategies have been investigated over time to increase intrusion detection's effectiveness and dependability. Because of their capacity to erect imperceptible barriers and precisely identify incursions, laser-based systems have become one of the most promising technologies among them.
The potential of laser intrusion systems to provide high-resolution, non-contact security monitoring has been investigated. These systems employ laser beams and photo detectors to monitor certain locations.

II. LITERATURE SURVEY

M. A. Zainal Arifin et al.[1] This paper presents a development of a Home Automation Security with Laser Lights Alarm that interfaces with web pages and Mobile apps. This system is designed to improve the security of a large space area like the factory from the robbery. A new development system using Raspberry Pi controllers which interface with Windows Mobile users and web pages which comprised on design system, hardware and sensors connections with programmed coding. Laser beam module and passive infrared (PIR) sensor are installed at a selected area to be protected to detect the intruder.

D. Mizushima et al.[2] A laser microphone which is applying self-coupling effect of LD for sound wave detection is developed. It has flat and wide frequency response by utilizing the self-coupling effect. From experiment results, laser microphone has nearly flat frequency response from 40Hz to 50kHz.

Problem Definition

Traditional security systems, like locks, alarms, CCTV cameras, and motion sensors, often fail to detect intrusions until it's too late, leaving homes, offices, and industrial facilities vulnerable to unauthorized access. There is an urgent need for a more reliable, cost-effective, and low-maintenance solution that can proactively detect and prevent breaches in real-time.

III. OBJECTIVES

- Design and Develop a Laser-Based Intrusion Detection System.
- To create a functional system that uses laser sensors to detect interruptions in the beam and trigger alerts through the NodeMCU microcontroller.
- Integrate NodeMCU for Real-Time Notification.
- To leverage the Wi-Fi capabilities of NodeMCU to send real-time alerts (e.g., SMS, email, or mobile notifications) whenever an intrusion is detected.
- Optimize System for Accuracy and Sensitivity.
- To ensure the system accurately detects intrusions with minimal false alarms, even in varying environmental conditions.
- Develop a Scalable Security Solution:
- To design a system that can be easily expanded to cover larger areas by adding more laser sensors or integrating with other security devices.
- Ensure Low-Cost and Energy-Efficient Operation:
- To develop an affordable system using cost-effective components like NodeMCU and low-power laser sensors while optimizing energy consumption for longer operation.
- Implement Security Features for Data Privacy.

IV. .METHODOLOGY USED

- **Components Used**: NodeMCU, laser sensors, resistor, power supply, LDR module, Buzzer.
- **Block Diagram**

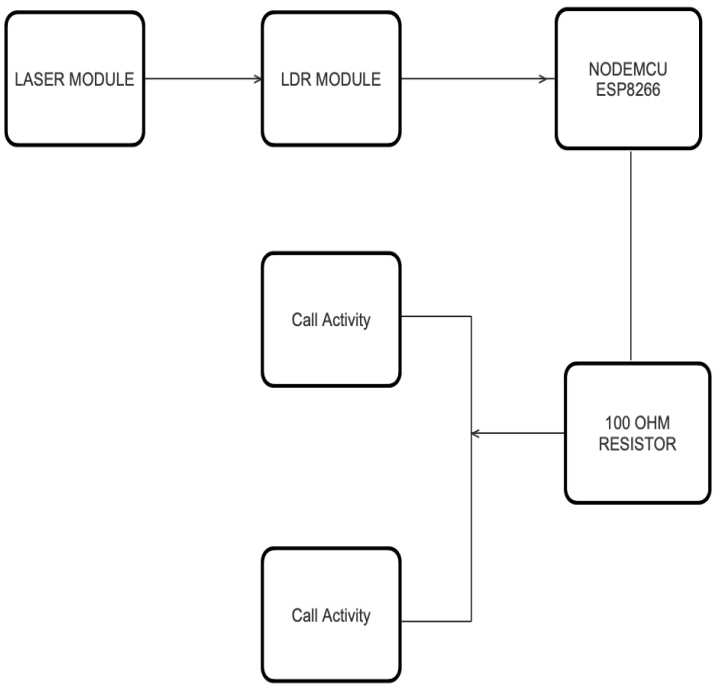

Fig. 1 Block diagram of Intrusion detection Laser Guard System

- Fig. 1 represents block diagram of Intrusion detection Laser Guard System which consist of Laser Module, LDR Module, Node MCU 8266 etc.

- **Circuit Diagram**:

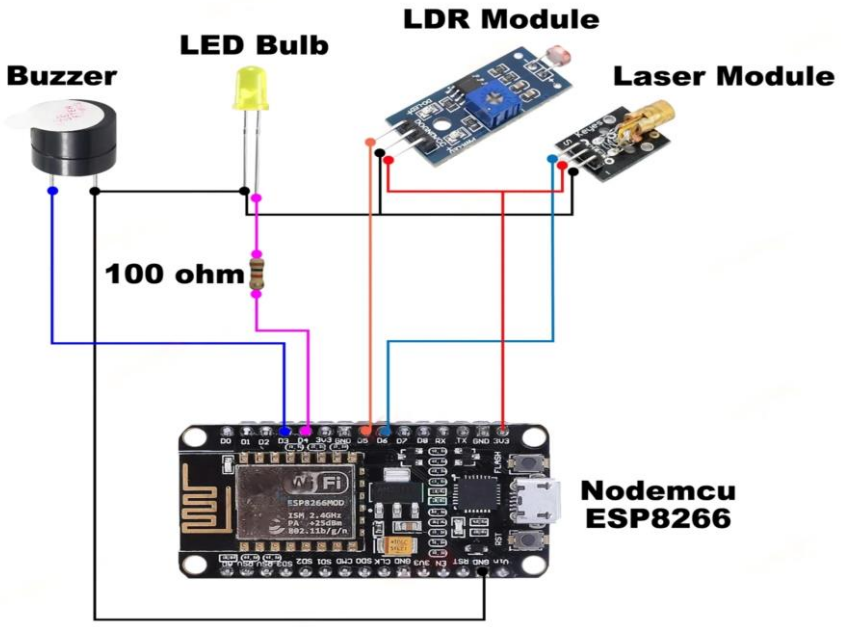

Fig. 2 Circuit diagram of Intrusion detection Laser Guard System

Fig 1 shows circuit diagram of Intrusion detection Laser Guard System which consist of LDR module , Laser module , Nodemcu ESP8266, Buzzer , LED etc.

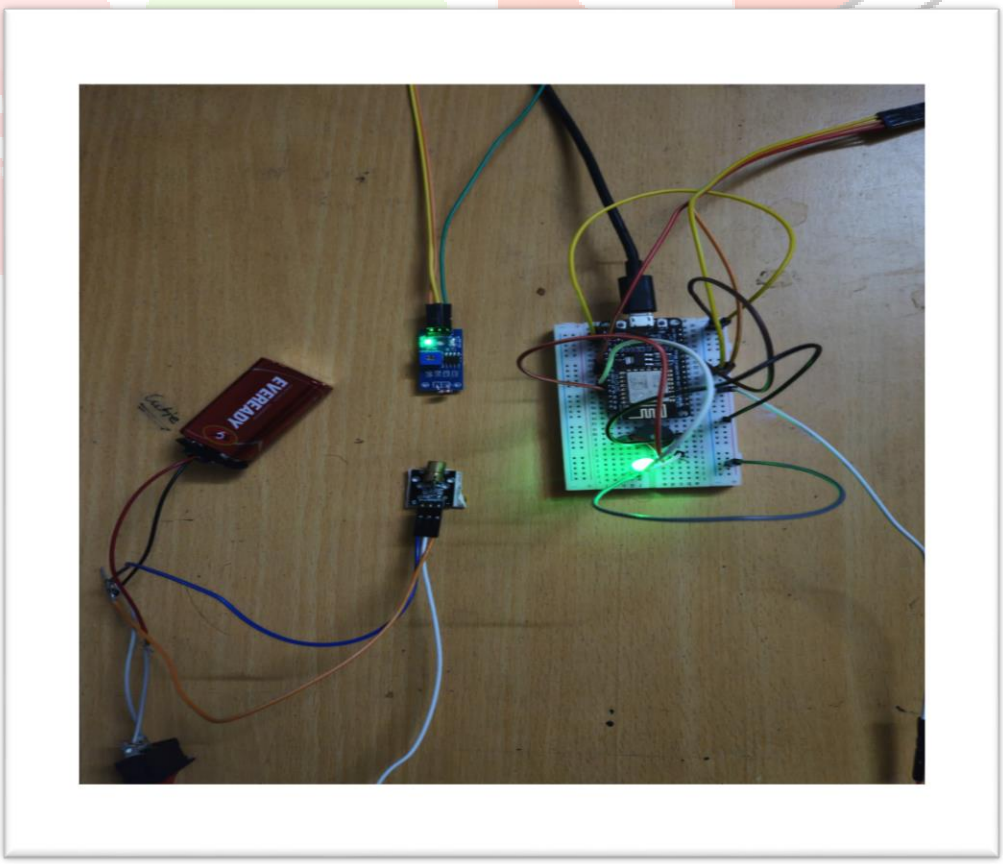

Fig. 2 Intrusion detection Laser Guard System

The methodology for implementing a laser-based intrusion detection system involves multiple steps, including the design of the hardware setup, calibration, programming, testing, and validation. Below is a detailed description of the methodology:

1. System Design and Hardware Setup

The system consists of several core components: the **laser emitter (laser diode)**, the **light receiver (photodiode)**, the **microcontroller (NodeMCU)**, and the **alert mechanism**.

Laser Diode: The laser diode emits a focused laser beam that will be interrupted when an object crosses its path.

Photodiode: Positioned opposite the laser diode, the photodiode detects the laser beam and senses any interruption caused by an object blocking the beam.

NodeMCU: This microcontroller processes the signal from the photodiode and triggers an alert or system response when an interruption is detected.

Alert Mechanism: Upon detecting an interruption, the NodeMCU triggers an alarm or sends a notification (e.g., via email or an app).

Component Selection:

Choose an appropriate **infrared laser diode** for minimal environmental interference.

Select a **photodiode** or **light sensor** with high sensitivity to detect even slight interruptions in the laser beam.

NodeMCU (ESP8266) is used for its Wi-Fi capability and ease of integration with sensors.

2. Placement and Alignment of Sensors

Laser Emitter (Diode): Position the laser diode to emit a focused beam across the area you want to monitor. Ensure the beam is stable and directed towards the photodiode.

Photodiode (Receiver): Place the photodiode on the opposite side of the laser beam path, ensuring it is aligned precisely to detect any changes in light intensity when the beam is blocked.

Alignment:

Ensure the laser beam is tightly focused to avoid divergence and false readings.

Align the photodiode to be sensitive only to the laser beam, minimizing the influence of ambient light.

3. Calibration of the Sensors

Threshold Calibration: The system must be calibrated to detect a significant reduction in light intensity when the laser beam is blocked by an object. A threshold value is set in the software, which determines the amount of light loss that will trigger an alert.

Sensitivity Adjustment: Adjust the sensitivity of the photodiode to detect small obstructions, ensuring that the system responds to human-sized objects but not to trivial disturbances like small movements in the environment.

Ambient Light Compensation: Implement software compensation to adjust the sensitivity based on changing environmental lighting conditions (e.g., sunlight or room lights).

4. Software Development and Programming

NodeMCU Programming: Write the code to monitor the photodiode's output and trigger an alert when the signal falls below the set threshold. The software reads the photodiode's voltage and compares it with the pre-calibrated threshold.

Signal Processing: The software processes the signal from the photodiode, filtering out noise or minor fluctuations in light. When a significant change is detected, indicating that the laser beam is interrupted, an alarm is triggered.

Alert Mechanism: Once the interruption is detected, the system can send an alert in various forms:

Sound Alarm: A buzzer or siren is activated.

Notification: The system can send an email or app notification through the Wi-Fi module of the NodeMCU.

5. Testing and Validation

System Testing: Perform testing under various conditions:

Test the system with different objects (e.g., hands, boxes) moving through the laser beam.

Test in different environments (e.g., varying ambient light conditions) to ensure the system responds correctly.

False Alarm Reduction: Adjust the threshold and sensitivity settings to ensure the system does not trigger false alarms due to minor environmental factors such as small shadows or changes in ambient light.

Performance Evaluation: Measure the system's response time and detection accuracy. The goal is to minimize detection delays and ensure reliable performance.

IV. Future Scope

In future scope the long range application and use of cloud platform. In future The use of Long-Range Wireless Communication: Enhance the range and reliability of wireless communication (Wi-Fi or LoRa) for large or outdoor areas. Another future scope is Cloud Integration and Data Analytics: Enable cloud-based storage and analytics for real-time monitoring, management, and performance tracking.

V. CONCLUSION

The Laser Intrusion System using NodeMCU provides an efficient, cost-effective, and reliable solution for security applications. By integrating laser sensors with NodeMCU, a microcontroller with built-in Wi-Fi capabilities, this system can detect unauthorized access or intrusion in real-time. The system works by detecting interruptions in a laser beam, triggering a response such as sending notifications or activating an alarm.

REFERENCES

[1] M. A. Zainal Arifin, M. Kassim, A. R. Mahmud and S. Izwan Suliman, "Automation Security System with Laser Lights Alarm on Web Pages and Mobile Apps," *2019 IEEE 9th Symposium on Computer Applications & Industrial Electronics (ISCAIE)*, Malaysia, 2019, pp. 287-292, doi: 10.1109/ISCAIE.2019.8743998.

[2] D. Mizushima, N. Tsuda and J. Yamada, "Study on laser microphone using self-couping effect of semiconductor laser for sensitivity improvement," *2016 IEEE SENSORS*, Orlando, FL, USA, 2016, pp. 1-3, doi: 10.1109/ICSENS.2016.7808478.

[3] SACHIN SAMBHAJI PATIL, Snehasish Paul, Mohnish Shandilya, Sanika Gadhave, Sakshi Sudhrik, "Automatic Room Light Controller Using PIR Sensor", International Journal of Creative Research Thoughts (IJCRT), ISSN:2320-2882, Volume.12, Issue 12, pp.a537-a539, December 2024, Available at : https://www.ijcrt.org/papers/IJCRT2412062.pdf.

Corresponding Author details:-

Dr. Sachin Sambhaji Patil, Assistant Professor, School of Engineering and Sciences, Department of Electronics and Communication Engineering, MIT Art, Design and Technology University Rajbaug, Loni Kalbhor, Pune. He has completed B.E. E&Tc in 2008, M.E. Electronics in 2012 and Ph.D in the subject of Electronics Engineering from Shivaji University Kolhapur in the year of July 2024. He has good publications record near about 54 papers published in international journals. He has total 16 years of teaching experience since 2008 to 2024.