**Educational Administration: Theory and Practice**
2024, 30(2), 1539 - 1544
ISSN: 2148-2403
https://kuey.net/

**Research Article**

# Laser Fencing Surveillance System With Email Alert

Mamatha K R[1*], Thejaswini S[2], Rashmi N[3], Dr. Girish H[4]

[1*]Dept. of ECE, B M S Institute of Technology and Management Bengaluru, Karnataka, India
[2]Dept. of ETE, B M S Institute of Technology and Management Bengaluru, Karnataka, India
[3]Dept. of ECE, B M S Institute of Technology and Management Bengaluru, Karnataka, India.
[4]Professor, Department of ECE, Cambridge Institute of Technology, Bangalore, Karnataka, India.

***Citation:*** Mamatha K R, et al (2024), Laser Fencing Surveillance System With Email Alert, *Educational Administration: Theory and Practice, 30(2),* 1539 – 1544
Doi: 10.53555/kuey.v30i2.7919

**ARTICLE INFO**

**ABSTRACT**

This work presents an antitheft alert system that integrates multiple technologies to offer a high level of detection, monitoring, and barrier protection through cost-effective methods and equipment. It implements a virtual LASER fence framework, enabling individuals to establish real-time surveillance at locations such as homes, farms, or any other area of interest. The proposed system detects objects that cross the vision line between the laser source and optical detector. When the laser beam is interrupted, alert data—including an instant notification via email and recorded footage of the intrusion—is sent to the security provider's device using internet services like Gmail. The system is powered by a Raspberry Pi as the central processor, along with components like the Pi camera and laser modules. This solution addresses issues found in existing frameworks and ensures non-destructive consequences for the intruder.

**Keywords—**Laser fence; alarm system, Detection and Alert System, Field Surveillance

## I. INTRODUCTION

In recent times, while advancements have been made in various fields, the specific area concerning home and agricultural security against intruders remains underdeveloped. Traditional methods, such as high-voltage grids, electric pulse fences, or infrared electronic fences, are still commonly used but have proven inefficient in preventing unauthorized access. Additionally, these methods require substantial maintenance, manpower, and time. Therefore, a more innovative approach is necessary to address these issues effectively.
Intrusion detection is the cornerstone of any smart security system. Through such systems, unauthorized access can be identified in restricted areas, which is crucial to preventing theft and damage, whether on farms or in homes. Managing intruders is essential to avoid significant losses.
An effective intrusion detection system should be designed to detect unauthorized entry, and upon doing so, it should complement security measures by issuing warnings, such as capturing images, recording video, activating lights and alarms, and sending this data to the owner's device via various channels.
To create a robust protection system, we must integrate different technologies that enhance detection capability. By combining multiple detection methods, the system ensures a higher level of protection, even if one component fails.

## II. RELATED WORK

In previous years, several projects have been proposed and implemented based on laser-based security systems. Early designs focused primarily on detecting cattle intrusions in fields, utilizing cost-effective, high-end detection technologies to alert owners and monitor the area.
Subsequent systems evolved to combine laser technology with image processing algorithms to detect and compare images for potential intrusions. These systems prioritized monitoring over alerting the owner.
Recent works introduced intelligent anti-intrusion systems using laser fencing and wireless communication technologies. When the laser beam is interrupted, the system sends an alert with location information via IoT networks and short messages through GPRS, providing the user with timely and accurate data on the intrusion.

Building on these prior works, we propose a new methodology that emphasizes both detection and real-time

*Copyright © 2024 by Author/s and Licensed by Kuey. This is an open access article distributed under the Creative Commons Attribution License which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.*

user alerts, taking into account efficiency, cost, and system complexity.

## III. METHODOLOGY

The prototype is fully built around the Raspberry Pi model 3B+, where the Raspberry Pi board serves as the central processing unit (CPU) of the entire system. It includes a dedicated 15-pin MIPI Camera Serial Interface, simplifying the integration of the camera.
The core concept of this project is to automatically monitor and detect any laser beam interruptions and promptly alert the user. Figure 1 illustrates the system's interfacing setup.

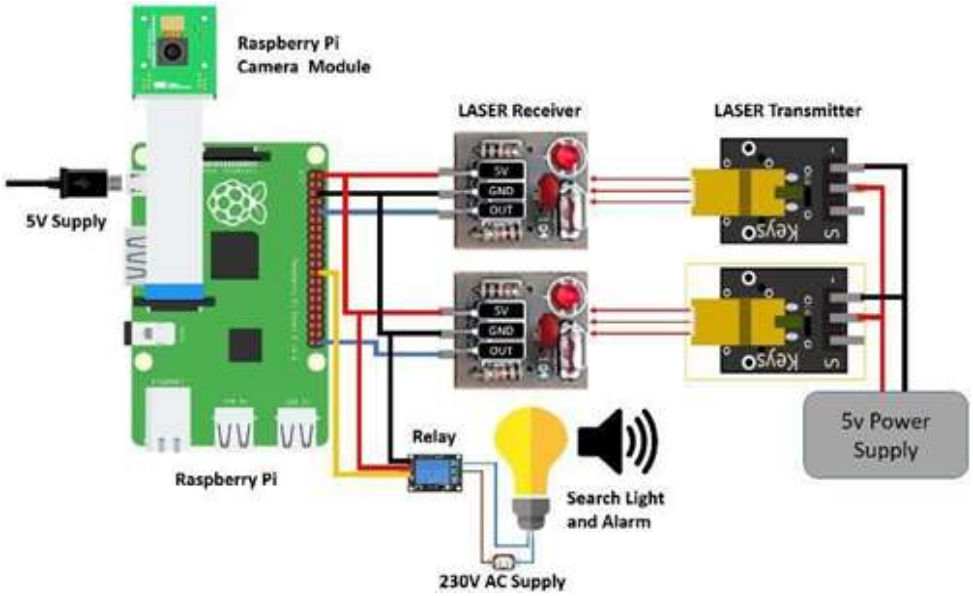


**Figure. 1 Interfacing Framework**

### *A. Laser Interface*

The laser interface operates by utilizing laser beams to detect any unauthorized entry. A laser fence serves as a detection system that triggers a warning signal when an intruder breaches a restricted or secured area. It consists of a laser generator that creates a virtual laser beam. Both the laser transmitter and receiver are powered by an external 5V DC source and can detect intrusions over a range of up to 30 meters. In this system, the signal pin of the laser receiver is connected to the GPIO pins of the Raspberry Pi to ensure efficient system functionality.

### *B. Raspberry Pi Camera Interface*

The camera interfacing is done using the Pi Camera module, which offers several key features, including crystal-clear 5MP resolution for images and 1080p HD video recording at 30fps. For still images, the camera supports resolutions up to 2592x1944 pixels and offers video recording options of 1080p at 30fps, 720p at 60fps, and 640x480p at 60/90fps. The module connects to the Raspberry Pi via a 15-pin ribbon cable to the dedicated 15-pin MIPI Camera Serial Interface (CSI), designed specifically for camera integration. The CSI bus supports very high data transfer rates, exclusively transmitting pixel data to the BCM2835 processor. Once connected, the camera is enabled to capture images or videos whenever an interruption occurs. The timing and duration of image capture can be configured based on the system's needs. Considering these features and the focus of this project on security monitoring, the Pi Camera module is the most suitable choice for the system

### *C. Onsite Search Lights and Alarm Interface*

The laser interface is used to trigger the alarm system and notify neighbors about any detected unauthorized entry. A 230V searchlight is connected to a Raspberry Pi, controlled by a single-channel 5V relay.

## PROGRAM ALGORITHM

As outlined in the program algorithm below, the process begins with turning ON the laser transmitter and receiver, creating a virtual laser fence. Initially, the laser receiver remains in a high state, indicating no intrusion. The output drops to a low state only when an interruption or illegal entry is detected. To prevent false alarms triggered by animals, birds, or infants, the system employs multiple horizontally stacked laser beams with a two-foot gap between each. The alarm system is activated only when one or more beams are interrupted simultaneously. Figure 2 illustrates the program algorithm.

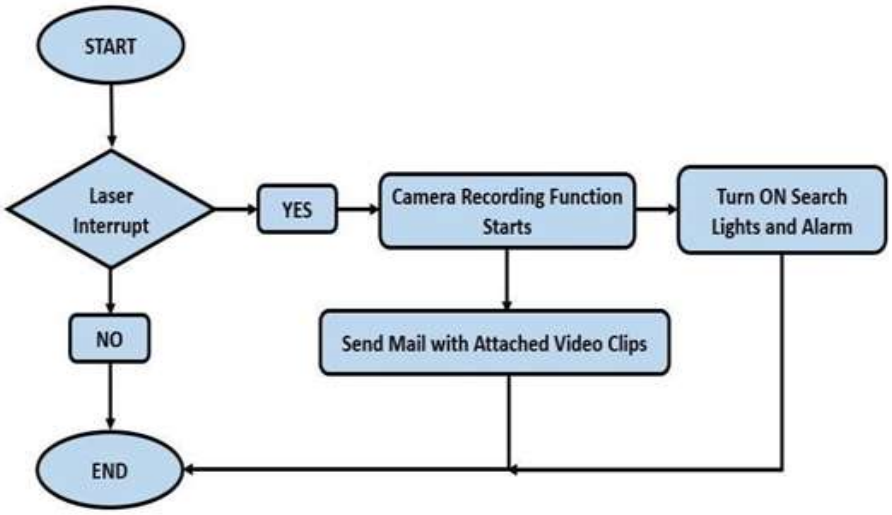


**Figure. 2 Program Algorithm**

The flowchart represents the process flow of a security system that triggers actions when a laser beam is interrupted, indicating potential intrusion. The process begins when the system is activated. The system continuously monitors for an interruption in the laser beam. If no interruption is detected, the process moves to "End," meaning the system remains idle. If an interruption is detected (e.g., an object or person breaks the laser beam), the system triggers a series of actions. The camera begins recording to capture footage of the area where the interruption occurred. Simultaneously, the searchlights and alarm are activated to alert about the intrusion and illuminate the area.

The system sends an email containing the video clips captured by the camera, likely to a predefined recipient such as the owner or security personnel. The process then loops back to monitor for further laser interrupts after the alarm and light system have been activated. If no laser interrupt is detected or once the alarm has been handled, the process ends, and the system resets, awaiting further instructions. This flow ensures real-time detection, alert, and documentation of any unauthorized entry by capturing video evidence and triggering alarms.

In this proposed system, when an interruption is detected, the Raspberry Pi processes the signal and initiates the following actions. First, it activates the camera module to begin recording the intrusion event. Once the footage is captured and converted to MP4 format, the videos are sent via Gmail to the defender's phone using the internet.

Simultaneously, onsite searchlights and the alarm system are activated. This alerts the neighbors about the unauthorized entry, drawing attention to the property and deterring the intruder, thereby enhancing security and protecting the premises.

## IV. RESULT

The designed prototype has been tested for its proper working and achieved its objective. Laser virtual fence is connected to the raspberry pi and a volunteer has been asked to work as intruder for the system. The interrupted laser beams have been detected by the Laser sensor. On detection of intruder warning email along with an intruder video was sent to the receiver (Figure 3) and also the onsite warning lights and alarmsystem switched ON. The results are shown in below Table 1.

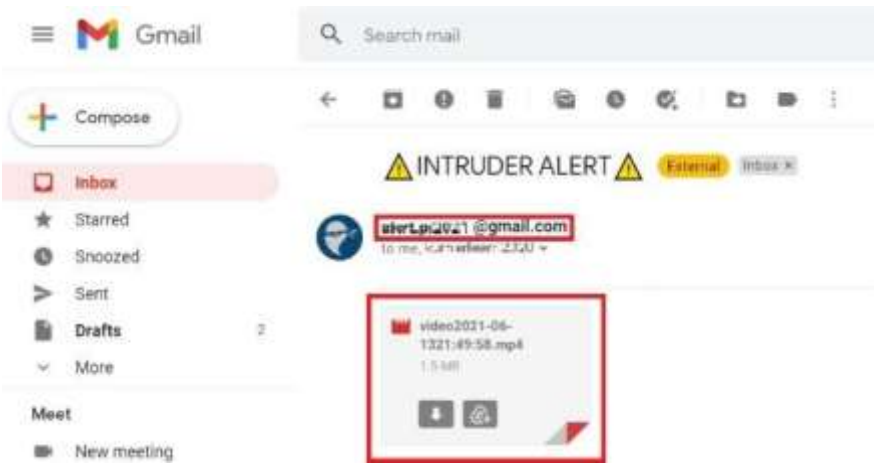


**Figure. 3 Snippet of received Email**

**Table. 1 Accuracy Evaluation Result**

| Sl. No. | Height of Laser 1 | Height of Laser 2 | Height of Intruder | Detection of intrusion |
|---|---|---|---|---|
| 1 | 2 feet | 4 feet | 1 foot | No |
| 2 | 2 feet | 4 feet | 1.5 feet | No |
| 3 | 2 feet | 4 feet | 2 feet | No |
| 4 | 2 feet | 4 feet | 2.5 feet | No |
| 5 | 2 feet | 4 feet | 3 feet | No |
| 6 | 2 feet | 4 feet | 3.5 feet | No |
| 7 | 2 feet | 4 feet | 4 feet | yes |
| 8 | 2 feet | 4 feet | 4.5 feet | yes |

## V. CONCLUSION

The developed virtual fence is designed to detect intruders, send an alert to the defender's phone, and activate onsite lights and alarms to notify neighbors. The results demonstrate several advantages, including high security, low energy consumption, minimal maintenance, portability, reduced manpower, low false negatives, and ease of use and installation. With minor modifications, the proposed system can be applied to secure large-scale restricted areas such as airports, railway stations, military bases, and residential complexes where large crowds gather. This system has broad application potential and can provide significant social and economic benefits, helping to alleviate farmers' security concerns and enhancing the quality of life for security personnel.

## FUTURE SCOPE

To improve the system's accuracy, the property should be divided into separate regions to pinpoint the exact area of a breach. This way, only the camera in the affected region is activated for surveillance, rather than turning on all cameras, making the system more cost-effective. This setup also helps notify security personnel about the breach location. In the meantime, they can monitor the area through the camera and use an external audio system to communicate with the intruder, informing them that they are in a restricted or unauthorized area without access rights.

## REFERENCES

[1] Sidhu, S. K. and T. Singh. "Design and Development of Virtual Fence System for Agriculture Field using Laser and GSM Technology." (2015).
[2] Fondazione Giorgio Ronchi. "Design and Construction of a Smart Security System by Laser Fence Technique" (2015)
[3] Chunjuan Wei, Junjie Yang, Wu Zhu and Jian Lv, "A design of alarm system for substation perimeter based on laser fence and wireless communication," 2010 International Conference on Computer Application and System Modeling (ICCASM 2010), Taiyuan, (2010).
[4] Z. Butler, P. Corke, R. Peterson, and D. Rus."Virtual fences for controlling cows". In Proc. IEEE Conf. on Robotics andAutomation, april- mayy, 2004, pages (4429-4436) vol 5.
[5] Varun Goyal, Mr. Ajay Mudgil, "Design and Implementation of Virtual Fencing using RF Module" International Journal of Engineering Research & Technology (IJERT) Vol. 1 Issue 3, May – 2012, ISSN: 2278-0181.
[6] IoT based home automation using Blynk cloud, J. Chetan Naik, B. S. Deeksha, H. Girish, Gurusharan Kashetty, T. G. Shivapanchakshari, Manohar Sai Polakam, Journal: AIP Conference Proceedings, AIP Conf. Proc. 2965, 020006 (2024), https://doi.org/10.1063/5.0215427, Published: July 2024
[7] IoT based fire alarm system using Blynk app, T. Bhargava, H. Kishor Kumar, Pramod Mahalingappa Godi, H. Girish, J. Chetan Naik, Journal: AIP Conference Proceedings, AIP Conf. Proc. 2965, 020007 (2024), https://doi.org/10.1063/5.0212325, Published: July 2024
[8] Dr. GIRISH H et. al., "Design and Analysis of a Machine learning based Agriculture bot", Tuijin Jishu/Journal of Propulsion Technology ISSN: 1001-4055 Vol. 44 No. 6 (2023)
[9] Dr. GIRISH H et. al., "Integrating Disaster Data Clustering with Neural Networks for Comprehensive Analysis", Tuijin Jishu/Journal of Propulsion Technology ISSN: 1001-4055 Vol. 45 No.1 (2024).
[10] Dr. GIRISH H et. al., "ROBOTIC INNOVATION IN E-DELIVERY SYSTEMS: A DESIGN AND MODELING APPROACH", The Seybold report ISSN 1533-9211, 2023.
[11] Dr. GIRISH H et. al., "Machine Learning based Agriculture Bot", International Conference on Smart Technologies, Communication and Robotics [ ICSCR-2023 ] in association with IJSRSET Print ISSN: 2395-1990 | Online ISSN : 2394-4099 (www.ijsrset.com) doi : https://doi.org/10.32628/IJSRSET
[12] Dr. GIRISH H et.al., "A GSM-Based System for Vehicle Collision Detection and Alert". International

Conference on Smart Technologies, Communication and Robotics [ ICSCR-2023 ] in association with IJSRSET Print ISSN: 2395-1990 | Online ISSN : 2394-4099 (www.ijsrset.com) doi : https://doi.org/10.32628/IJSRSET

[13] H. Girish, T. G. Manjunat and A. C. Vikramathithan, "Detection and Alerting Animals in Forest using Artificial Intelligence and IoT," 2022 IEEE Fourth International Conference on Advances in Electronics, Computers and Communications (ICAECC), 2022, pp. 1-5, doi: 10.1109/ICAECC54045.2022.9716679.

[14] A. Devipriya, H. Girish, V. Srinivas, N. Adi Reddy and D. Rajkiran, "RTL Design and Logic Synthesis of Traffic Light Controller for 45nm Technology," 2022 3rd International Conference for Emerging Technology (INCET), 2022, pp. 1-5, doi: 10.1109/INCET54531.2022.9824833.

[15] S. Vaddadi, V. Srinivas, N. A. Reddy, G. H, R. D and A. Devipriya, "Factory Inventory Automation using Industry 4.0 Technologies," 2022 IEEE IAS Global Conference on Emerging Technologies (GlobConET), 2022, pp. 734-738, doi: 10.1109/GlobConET53749.2022.9872416.

[16] T G Manjunath , A C Vikramathithan , H Girish, "Analysis of Total Harmonic Distortion and implementation of Inverter Fault Diagnosis using Artificial Neural Network", Journal of Physics: Conference Series, Volume 2161, 1st International Conference on Artificial Intelligence, Computational Electronics and Communication System (AICECS 2021) 28-30 October 2021, Manipal, India. https://iopscience.iop.org/issue/1742-6596/2161/1

[17] GIRISH H , "Internet of Things Based Heart Beat Rate Monitoring System", © September 2022 | IJIRT | Volume 6 Issue 4 | ISSN: 2349-6002 IJIRT 156592 INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN TECHNOLOGY 227

[18] Dr Girish H, Dr. Mangala Gowri , Dr. Keshava Murthy , Chetan Naik J, Autonomous Car Using Deep Learning and Open CV, PAGE NO: 107-115, VOLUME 8 ISSUE 10 2022, Gradiva review journal, ISSN NO : 0363-8057, DOI:10.37897.GRJ.2022.V8I8.22.50332

[19] Girish H. "Intelligent Traffic Tracking System Using Wi-Fi ." International Journal for Scientific Research and Development 8.12 (2021): 86-90.

[20] Girish H, Shashikumar D R, "Emission monitoring system using IOT", Dogo Rangsang Research Journal, UGC Care Group I Journal, ISSN: 347-7180, Vol – 8 Issue-14, No.6, 2020.

[21] Girish H, Shashikumar D R, "Display and misson computer software loading", International journal of engineering research & Technology (IJERT), ISSN: 2278-0181, Vol – 10 Issue-08, No.13, August 2020.

[22] Girish H, Shashikumar D R, "A Novel Optimization Framework for Controlling Stabilization Issue in Design Principle of FinFET based SRAM", International Journal of Electrical and Computer Engineering (IJECE) Vol. 9, No. 5 October 2019, pp. 4027~4034. ISSN: 2088-8708, DOI: 10.11591/ijece.v9i5.pp.4027-4034

[23] Girish H, Shashikumar D R, "PAOD: a predictive approach for optimization of design in FinFET/SRAM", International Journal of Electrical and Computer Engineering (IJECE) Vol. 9, No. 2, April 2019, pp. 960~966. ISSN: 2088-8708, DOI: 10.11591/ijece.v9i2.pp.960-966

[24] Girish H, Shashikumar D R, "SOPA: Search Optimization Based Predictive Approach for Design Optimization in FinFET/SRAM", © Springer International Publishing AG, part of Springer Nature 2019 Silhavy (Ed.): CSOC 2018, AISC 764, pp. 21–29, 2019. https://doi.org/10.1007/978-3-319-91189-2_3.

[25] Girish H, Shashikumar D R, "Cost-Effective Computational Modelling of Fault Tolerant Optimization of FinFET-based SRAM Cells", © Springer International Publishing AG 2017 R. Silhavy et al. (eds.), Cybernetics and Mathematics Applications in Intelligent Systems, Advances in Intelligent Systems and Computing 574, DOI 10.1007/978-3-319-57264-2_1.

[26] Girish H, Shashikumar D R, "A Survey on the Performance Analysis of FinFET SRAM Cells for Different Technologies", International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-4 Issue-6, 2016.

[27] Girish H, Shashikumar D R, "Insights of Performance Enhancement Techniques on FinFET-based SRAM Cells", Communications on Applied Electronics (CAE) – ISSN: 2394-4714, Foundation of Computer Science FCS, New York, USA .Volume 5 – No.6, July 2016 – www.caeaccess.org

[28] Girish H, Shashikumar D R, "DESIGN OF FINFET", International Journal of Engineering Research ISSN: 2319-6890) (online), 2347-5013(print) Volume No.5 Issue: Special 5, pp: 992-1128, doi: 10.17950/ijer/v5i5/013 2016.

[29] Dr. MANGALA GOWRI S G, Dr. SHASHIDHAR T M, Dr. SUNITHA R, SHYLAJA V, Dr. GIRISH H, "DESIGN OF 3-BIT CMOS WALLACE MULTIPLIER" , Seybold report, ISSN 1533-9211, Volume 18, Page No: 1260-1271 DOI: 10.5281/zenodo.8300481

[30] Dr. Mangala Gowri S G, Dr. Girish H, Ramesh N, Dr. Nataraj Vijaypur, "IOT based plant monitoring system and smart irrigation using new features" ResMilitaris, vol.13, n°2, January Issue 2023 https://resmilitaris.net/menu-script/index.php/resmilitaris/article/view/3312/2608

[31] Girish H.2023, Smart Theft Securityvehicular System Using Iot. Int J Recent Sci Res. 14(02), pp. 2881-2884. DOI: http://dx.doi.org/10.24327/ijrsr.2023.1402.0591

[32] Dr. Mangala Gowri S G, Dr. Girish H, Dr. Santosh Dattatray Bhopale, Weed Detection based on Neural Networks, International Journal of All Research Education and Scientific Methods (IJARESM), ISSN: 2455-6211 Volume 11, Issue 3, March-2023, Impact Factor: 7.429, Available online at: www.ijaresm.com DOI: https://doi.org/11.56025/IJARESM.2023.11323351

[33] Shashidhara, K.S., Girish, H., Parameshwara, M.C., Rai, B.K., Dakulagi, V. (2023). A Novel Approach for Identification of Healthy and Unhealthy Leaves Using Scale Invariant Feature Transform and Shading Histogram-PCA Techniques. In: Shetty, N.R., Patnaik, L.M., Prasad, N.H. (eds) Emerging Research in Computing, Information, Communication and Applications. Lecture Notes in Electrical Engineering, vol 928. Springer, Singapore. https://doi.org/10.1007/978-981-19-5482-5_47

[34] Mamatha K R, Hariprasad S A, Thippeswamy G, & Girish H. (2023). Real-time Animal Detection and Alert System using IoT and Deep Learning. Educational Administration: Theory and Practice, 29(4), 1050–1054. https://doi.org/10.53555/kuey.v29i4.5982