A Laser and Computer Vision-Based Security System

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ABSTRACT

In the modern age, Security is one important factor for the betterment of society. With the advancement in technology in embedded and computer vision, many algorithms were developed for the security of the premises. In this approach, the LASER and computer vision-based security system have been presented. LASER rays are invisible and go through long distances. The rays are invisible hence invisible boundaries can be possible. LDR is used to detect the LASER ray placed exactly opposite to the LASER. When the person cuts the LASER rays, the system will produce an alarm and automatically camera start video recording of the trespassing event. At the same time, calling to the authority.

The proposed system is developed using the Raspberry Pi 3B model. The computer vision-based system is implemented using the OpenCV library and python language.

Keywords—Computer Vision, Embedded System, Laser Security, Raspberry Pi, Video Surveillance.

ARTICLE INFO

I. INTRODUCTION

Security is the most crucial factor in today's modern world. Technology is being developed day by day for the betterment of human life. But on another side,the tendency of criminal behavior is also at its peak. So the technology for security should be modernized and be more efficient. Hence we have decided to implement and test the performance of a security system as our project.

In this project, we are using a LASER light to cover a large area. We know that LASER light goes through a very long distance without scattering. The camera is also used in this project for live surveillance. It also records and stores video when trespassing event occurs. The laser is a concentrated light source that travels for a long distance. A detector is sensitive to light and set to detect LASER light. When a person or object crosses over the LASER light, the detector changes its output state. The microcontroller senses this change and generates a sequence of actions like turning on the siren.

Siren is a device that produces a loud noise. A siren can be seen on many emergency vehicles and an alarming system like ambulance, police cars of fire warning systems. It also starts camera recording and storing the video footage for analyzing the trespassing later on. System and establishing automatic calling to authorities like the police station, curators of the museum, etc. by means of communication protocols implemented using IoT. This project can be implemented for many other applications like surveillance on LOC for military, child security, etc.

The purpose is the need to stop the modern era crimes and hence the protection system should be modernized in every way to stop criminal activities and on every attempt of the system should be updated likewise.

The project is easy to install and functional at both insides as well as outside houses. The output can be used as an effective perimeter alarm system for individual properties and establishments. The circuit is at a size unnoticeable at first glance. Outside, it can easily be hidden behind shrubs or plants without causing any damage.

This paper is organized as, In section II, different approaches for the museum security system have been presented. In section III, the proposed system using the LASER and Computer Vision algorithm is explained. The software flow and algorithm are presented in section IV.Results are discussed in Section V and Finally, the approach is concluded in section VI.

II. Literature Survey

SumanSingh et al.[1] presented a Laser security system. This system is a manual switch dependant sensor and alarm

unit. LASER beam is projected on the photodiode placed opposite to the laser when the person cuts the laser, the P-N triggers the alarm.

V. Karri et al. [2] proposed a home network including three wireless sensor nodes and GSM/GPRS gateway. The system responds to the anomaly and quickly generates the alarm.

Y. Zhao et al. [3] present the vision-based approach for intruder detection. In this method, the moving object is detected by the combination of pixel illumination and chroma in YUV colorspace. The algorithm is maintained by three key values. Z. Bing et al. [4] proposed the methodology to detect the moving object and description based on its orientation and multi-feature analysis.

M. Meyer et al. [4] presented a vision-based object detection by moving cameras. This approach helps to increases the efficiency of the system by eliminating the blind spot. The mobile manipulator is also developed and equipped with cameras for monitoring from a distance place.

Parmita Mondal et al [5] presented Laser based security system using Arduino. This system is mainly implemented for detection of intruder. This system consist of Arduino as a controller, LASER emitter module, LDR module and ESP WIFI module. In this approach emitter emits the LASER line and LDR received the light striking on it. When an intruder cuts the laser beam, the alert will be generated and Camera will be initiated and capture the stream.

In another approach, Arianne B. Arjona et. al.[6] presented Arduino based Laser security system. The system will be start once switch is press. When anintruder crosses the laser line and light dependant resistor, the buzzer will be sounded. This system shows 80% accuracy. The system is implemented using Arduino microcontroller.

Sagar R. N. et al. [7] introduced "Smart Home Intruder Detection System" using surveillance camera and GSM based system. This system provide live feed with warning system. They found that simple surveillance system needs some intelligent mechanism. They developed the robotic home security system using image processing technique for anomaly detection. Robot movement, signboard recognition and face detection are key techniques are used.

Sachin Patidar et al. [8] proposed "Real Time Vision Based low cost implementation of a system for change detection in a closed monitored area. The system used camera and processor BCM2835 based ARM11 processor. In this system, the webcam capture the frame, followed by background subtraction, thresholding and morphological operations to create blob. The area of biggest blob is compared with the calculated values. This system has been texted over video of different environment and got 86% detection rate.

III. Proposed Laser Security System

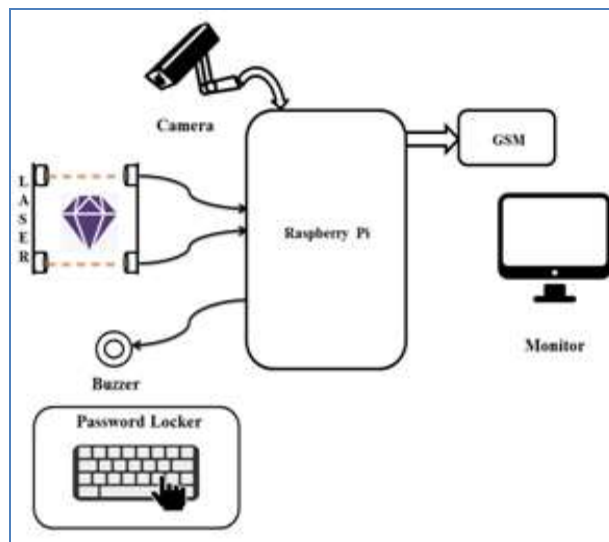The block diagram of the proposed LASER security system is as shown in Fig. 1.

Figure 1. Block Diagram of the proposed system

The project is based on the Raspberry Pi model 3 B.Raspberrypi 3B model is an upgrade to a next-generation main processor and improved connectivity with Bluetooth low energy(BLE) and BCM43143 Wi-Fi on board. Additionally, the raspberry pi 3 has improved power management, with an upgraded switched power source upto 2.5 A, to support more powerful external USB devices.

In this project, there are eight laser modules used to cover a specific area. As explained earlier the laser module produced a very sharp and focused laser ray that travels a very long distance without scattering effect. The laser ray is focused on the LDR module which works on the principle that when the intensity of the light changes its resistance also changes. When the laser ray focused on the LDR is interrupted then the LDR changes its resistance and the output is changed. All eight outputs are applied to AND gate and only one single output are obtained. The output obtained from the AND gate is applied to the raspberry pi as an input.

Whenever the intruder crosses the laser ray then raspberry pi indicates the intruder and then the buzzer is ringing. The buzzer makes the loud noise and forces the security personnel to have a notice on the event. The camera is used for live video surveillance of the event and also when the intruder is introduced in the system then the recording of the even with appropriate date and time is recorded which can be further used for the investigation purpose for the officials, owners, policemen, and higher authorities, etc.

SIM800C is a quad-band GSM/GPRS module, its performance very stable, with a small appearance and high cost-performance, to meet the various needs of customers. The operating frequency of SIM800C is GSM/GPRS 850/900/1800/1900MHz, can be used worldwide, you can achieve low power consumption of voice, SMS and data transmission, can be applied to a variety of design requirements of a compact product. Whenever the intruder is detected then the GSM module is used to call the higher authorities, police personnel, and the owner also. The module can also be used to send the SMS to the authorities to provide an extra indication method for security. This project is made with low cost and the maintenance of the project is not that much costly. The performance of the project is very

fast and hence a fully automatic security system can be used to minimize human error.

IV. Hardware and Software Specification

Hardware specification

- Raspberry Pi 3B

Raspberry Pi 3B is a modern upgraded processor with improves connectivity with Bluetooth and Wi-Fi (BCM43143) technology on the board. It is a small, cheap, credit card size, portable board. It has advanced power management with upgraded switch power supply upto 2.5Amps for external USB devices. The computer vision algorithm can be implemented with python language.

Figure 2.   Raspberry Pi 3B model

- LASER module

The laser module is the electronic component that produces a sharp focus infrared light ray which can travel a very long distance without having scattering effect.
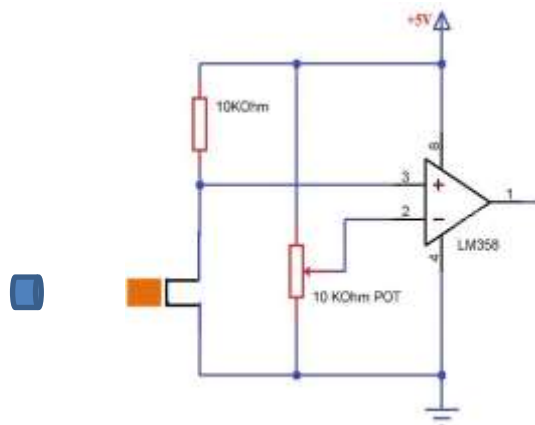
Figure 3.   LASER Module

- LDR

As the name suggests the light-dependent resistor works on the principle that the resistance of the component changes depending upon the light intensity falling on it.

- Buzzer:

The buzzer is a device that produces a loud noise. It is used to produce loud noise to indicate security management and authorities.

- GSM SIM 800

GSM SIM800 module is the quad-band module. The operating frequency of this model is 850/900/1900 MHz on which the GSM technologies work worldwide. This model can be used for voice, SMS and data transmission.

Figure 4.   GSM 800 Module

- Camera

The camera is used for live video surveillance as well as for the recording of the specific event. The camera used in this approach is VGA with 0.3 MP (640x480 pixels).

Figure 5.   USB Camera

- Micro SD card: 16 GB SD card.

Software specification

- Eagle

Autodesk EAGLE is a PCB design software that aims to design electronic circuits. The designer can seamlessly connect the schematic, place the component, routing PCB and comprehensive library content.

- Python 3 IDLE

IDLE is an Integrated Development Environment for Python. IDLE can be used to execute the program by the

statement. It provides text editor to develop python scripts including syntax highlighting, auto-completion, smart intending and debugger with breakpoint features.

V. Results

The pictures given below represents the results of the project work.

(a) (b)

(c) (d)

(e) (f)

(g) (h)
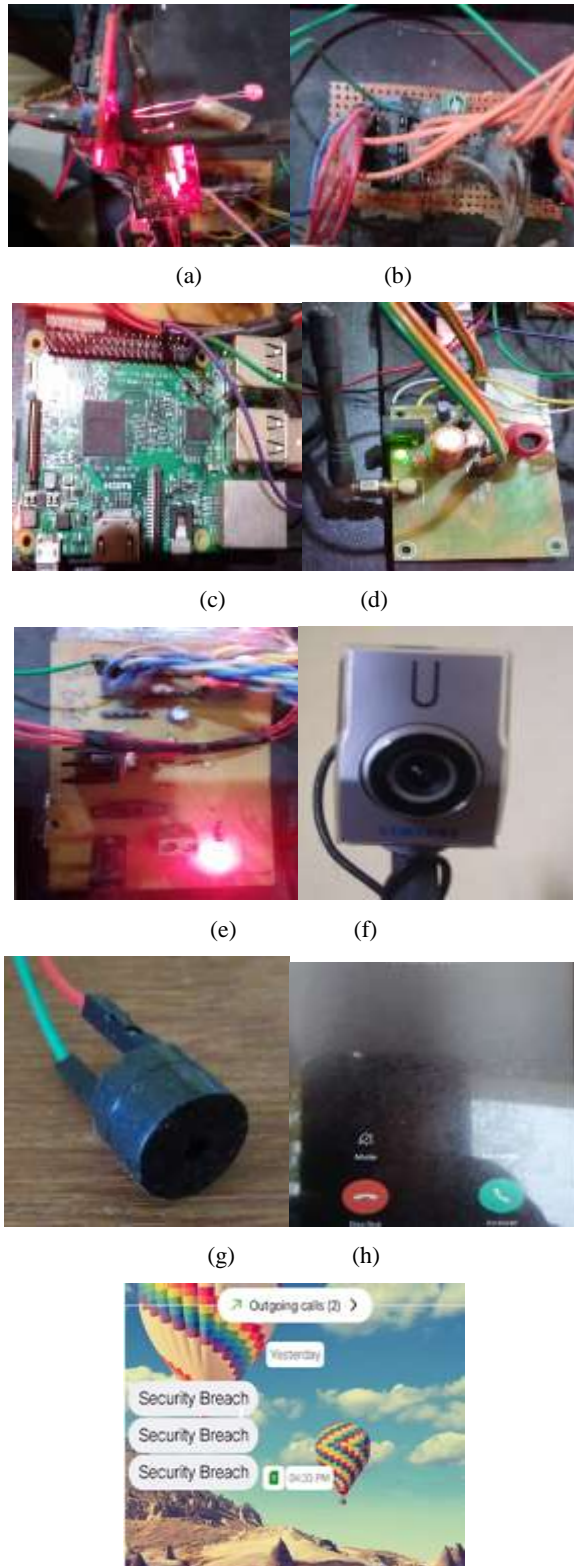
(i)

Figure 6. Results of the proposed system (a) LASER module and LDR(b) AND gate for single-output (c) Raspberry Pi model 3B (d) GSM module (e) power supply for system (f) camera (g) buzzer (h) call received after security breach (i) SMS received after security breach

VI. Conclusion

The system is developed with the laser module and the LDR which are able to detect the light variations and hence using invisible security we can secure the valuable things and hence we can develop a security system with the highly upgraded raspberry pi and the systems like security surveillance with the video camera and automatic recording. The data can be used for evidence against the criminal and hence the judicial process can go without any lack of proof. High precision and low-cost hardware make the system affordable to anyone and hence the security can be increased to stop any criminal activity.

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