



International Journal of Recent Development in Engineering and Technology
Website: www.ijrdet.com (ISSN 2347-6435 (Online) Volume 15, Issue 08, August 2026)

Smart Border Security and Intrusion Detection System

Prof. Amit Kumar Patil¹, Diyarani Dhauskar², Hritika Rai³, Vishwajeet Singh⁴, Aayush K. Kulhade⁵

Department of Electronics and Communication Engineering, SOES, MIT Art, Design and Technology University, Pune, India

Abstract— Border Security is very much important for any country, if any illegal movement is happening near the border it can cause serious threats to safety. Normally, border monitoring is depend on human petrol, in which can happen any dangerous situation. So, the main aim of our project is to solve this problem using sensors and embedded systems. In this project, if any unauthorized movement is happening near the border then sensors will detect it and sends signal to the microcontroller and the cameras will capture the illegal movement happening around the border. Alerts will sends through wi-fi and then buzzer will send the notification to security and then security will take the actions. Finally, by doing this project we can easily detect the unauthorized or illegal movement happening near the border. It can also reduce human efforts and can give the quick response.

Keywords— Raspberry Pi, LCD Display , Sensors, Cameras, Communication module , Alerts

I. INTRODUCTION

Border Security is very important to prevent illegal movement or unauthorized movement happening around the border. If we saw many border securities are depend on only humans. It can be time consuming and dangerous, so there is need of modern technologies which can help to prevent such conditions. So, by using sensors and embedded systems we can protect our border areas. By using, detection system we can that can automatically detect and sends alerts. This system can continuously monitor the border area and if any abnormal activity is happening around the border it can sends real-time alerts with less human interaction.

The Smart Border Security and Intrusion Detection System is an intelligent surveillance solution designed to enhance the safety and security of sensitive border areas through advanced sensing, communication, and artificial intelligence technologies. The proposed system integrates multiple sensors such as PIR, infrared, vibration, magnetic, and motion sensors to detect unauthorized human movement, fence tampering, digging, or suspicious activities. Cameras, including night-vision or thermal imaging systems, can be incorporated to capture visual information and support reliable identification of intruders under different environmental conditions.

II. BACKGROUND OF BORDER SECURITY

Border areas are very large so it becomes difficult to continuously detect border areas by humans. Many countries used modern technologies to resolve such problems and to reduce human efforts. Humans can monitor the area continuously but it not always effective because humans can make mistakes. Because it is defficult to detect large areas. So, nowadays there are many technologies used to prevent border areas. Using sensors, cameras and communication module. But using all this technologies there are still some problem of network issue, bad weather so, by looking all this problems there is need of better system which can work efficiently and provide security.

III. PROBLEM STATEMENT

A. Problem Statement

We already cover the main introduction of our project. So, let me give few seconds to problem statement. In many cases, unauthorized movement may not detected on time and for real-time alerts is most important to design and develop smart automated system that can detect any unauthorized or illegal movement correctly happening near the border and send real-time alerts so, the security can take quick actions. Also, system should be cost-effective and easy to handle and also capable to work in different weather conditions. Manual border monitoring is slow and not very efficient. Existing system do not provide real-time alerts when any illegal movement is happening. So, a smart automated system is needed for faster detection and quick response.

B. Objectives

To detect any illegal movement happening around the border. If any such movement is happened sensors will detect and cameras to capture the videos or images. To reduce human efforts by providing automated system and to capture live images or videos to sends the real-time alerts. For determining the exact location of illegal movement GPS module is used. The main objective is to provide cost-effective, reliable solution to improve border security.

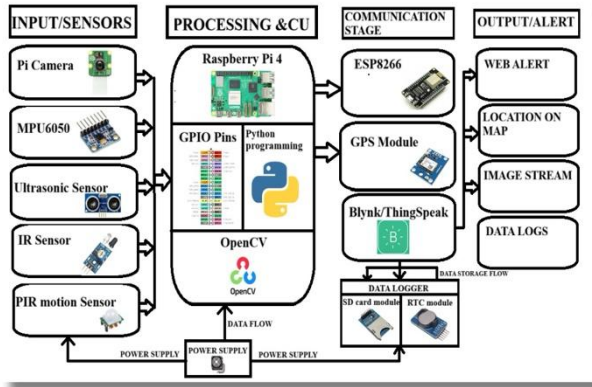


Fig 1: Block diagram of smart border security

Above is the basic block diagram of smart border security which represent the overall working of system. Basically, the system is divided into four stages: sensing, processing, Decision-making and reporting. In the input section we can see different sensors PI Sensors, MPU6050, Ultrasonic Sensor, IR Sensor, PIR motion sensor are used to collect the information from the surrounding. Now all the collected information is sent to the processing unit in which Raspberry pi is act as the main controller to detect any abnormal or illegal activity, Raspberry pi used python programming. The next stage is the communication stage in which module like ESP8266 is connected. In this, GPS module is used to provide exact location to detect unauthorized movement. Last is the output section, in which system generate alerts like web alert, location on map, image stream and data log.

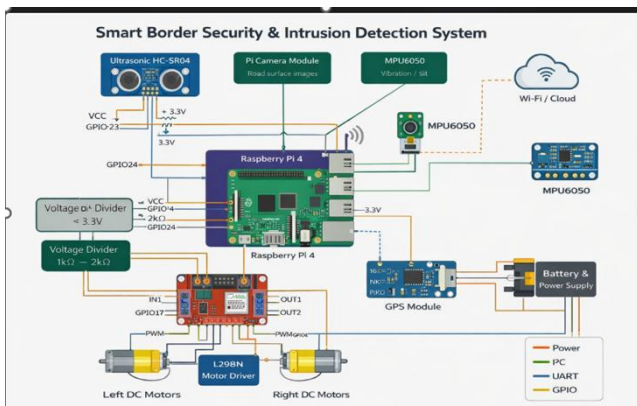


Fig 2: Circuit Diagram of smart border security

In this above picture, we can see the circuit diagram of smart border security system. This actual shows the hardware hardware connection of components which are used the Raspberry Pi is interfacing with all components.

In this, Ultrasonic sensor is connected using trigger for safe operation, The GPS module is also connected for location tracking. The Pi camera module is connected through the Raspberry Pi is used to capture the images or videos. To detect any unusual activity MPU6050 is connected. The L298N motor driver is connected to move the of robot. It also controls two DC motors. GPS module is connected using UART communication to provide real-time location.so any illegal movement happening around the border can detected quickly.

C. System Architecture

Basically, the system architecture is consists of both hardware and software working together. As we saw in figures. The overall architecture is shown in fig1. As it consists of four stages: input, processing, communication and output, AS we saw in input stage many sensors are used to collect the information and for measuring distance. The MPU6050 sensor used to detect vibration. Other sensors are also used to detect any human movement happening around the border. The Raspberry Pi act as the main component of the system. It perform data processing and decision-making, for measuring distance ultrasonic sensor is used. The pi camera module is used to capture the real-time images or videos. This image are used to detect any illegal or unauthorized movement is happening around the border. In the communication stage, GPS module comes, GPS module is used to track real-time location. This helps in identifying where the real intrusion is happening. So once the intrusion is detected then security can take quick actions. All components are using battery supply.

D. Construction

In this project, we are going to design a smart border system which can detect any unauthorized movement happening around the border, sensors are connected. In the hardware section, all the sensors PIR Sensors, Ultrasonic Sensor, IR sensors are used and all this sensors are connected to the Raspberry Pi. These all sensors help system to work they provide distance, object presence, motion, vibration. Camera module is connected which capture real-time images or videos which also help system to detect illegal activities. The hardware connection is shown in the Fig.2

E. Working

In this, sensors will continuously monitor the border area, if sensors detect any unauthorized or illegal movement happening around the border it sends signal to the microcontroller. The microcontroller processes the signals and cameras will capture the real-time images or videos.



In this system ultrasonic sensor is used, which help system to detect the object or movement. All the collected data is sent to Raspberry Pi which act as the main component. It checks for any abnormal activity or illegal movement happening or any object detected around the border. Based on the received data, system makes decision if no abnormal activity is detected then system normally continuous monitoring. If any unauthorized movement is detected it capture images, identifies the location and sends the real-time alerts. And system take immediate action after detection. GPS module is used to provide the exact location. This helps in taking illegal actions. at the same time, the system also generates alerts which can sends information quickly.

IV. CONCLUSION

In this paper, we design and implemented smart border security and intrusion detection system using Raspberry Pi, sensors and camera modules. So, we notice that system is now capable of monitoring the border areas continuously and providing real-time alerts. In system, many sensors are used which helps to detect movement the system also capable to capture image or videos, identify abnormal activities. GPS module also detect live location information. For sending alerts wireless communication is used. This system successfully reduces the human efforts because human petrol is not possible 24/7 and human can make mistakes. So this system will solve this problem. This system is flexible so we can use this system in many other areas such as military zones, airports and restricted areas. For future analysis, we can also add data logging for records. So, as we saw advantages of this system there are also some limitations of this system. Main limitation is that it depend on network connectivity and performance issue under poor environment condition. Sometimes this system can also provide some false detection.

Despite all this challenges, system perform effectively and sends real-time alerts. Overall, the system is efficient and helpful for security. For future improvement we can used Ai, better sensors and modern communication technologies so the system can work developed into more advance.

REFERENCES

- [1] A. Kumar and S. Patel, "Smart Surveillance System Using IoT for Border Security," IEEE International Conference on Smart Computing, pp. 112–117, 2022.
- [2] R. Sharma and P. Singh, "Intrusion Detection System Using Raspberry Pi and Image Processing," IEEE Access, vol. 9, pp. 45678–45685, 2021.
- [3] M. Verma, K. Gupta, and S. Tiwari, "Wireless Sensor Network Based Border Monitoring System," IEEE Sensors Journal, vol. 20, no. 5, pp. 2345–2352, 2020.
- [4] D. Mehta and A. Joshi, "Autonomous Surveillance Robot Using Raspberry Pi and Camera Module," IEEE International Conference on Robotics and Automation, pp. 876–881, 2021.
- [5] S. Nair and V. Menon, "IoT-Based Intrusion Detection System for Smart Security Applications," IEEE Internet of Things Journal, vol. 8, no. 3, pp. 1456–1463, 2021.
- [6] P. Reddy and L. Kumar, "Cloud-Based Smart Surveillance System Using IoT," IEEE International Conference on Cloud Computing, pp. 210–215, 2022.
- [7] T. Das and R. Roy, "Vision-Based Motion Detection Using Image Processing Techniques," IEEE Conference on Image Processing, pp. 567–572, 2020.
- [8] H. Ali and M. Khan, "Energy Efficient Wireless Sensor Network for Border Surveillance," IEEE Transactions on Wireless Communications, vol. 19, no. 7, pp. 4789–4796, 2020.
- [9] Y. Chen and X. Li, "Deep Learning-Based Intrusion Detection for Smart Environments," IEEE Access, vol. 10, pp. 9987–9995, 2022.
- [10] R. Gupta and N. Sharma, "GPS-Based Tracking System for Security Applications," IEEE International Conference on Communication Systems, pp. 145–149, 2021.
- [11] S. Kulkarni and A. Deshmukh, "Low-Cost Smart Security System Using Raspberry Pi," IEEE International Conference on Electronics and Communication Engineering, pp. 98–102, 2020.