# REAL-TIME MONITORING SECURITY SYSTEM INTEGRATED WITH RASPBERRY PI AND E-MAIL COMMUNICATION LINK

## P. ABHISHEK[1], R. POOJITHA SINGH[2], S. SRILATHA[3], T. DIVYA[4]

[1]Assistant Professor, Department of ECE, Mallareddy Engineering College For Women

[2,3,4]UG Scholar, Department of ECE, MallareddyEngineering College For Women

**ABSTRACT-** The rapid rise in thefts and break-ins across the globe has become a significant concern for homeowners and businesses alike. Traditional security systems often fail to offer real-time surveillance and immediate action, especially when authorities are unable to respond swiftly. As a result, there is an increasing demand for smarter, more responsive security solutions. In this paper, we propose a Smart Door Lock Security System that leverages the capabilities of the Internet of Things (IoT) and Raspberry Pi to enhance the security of residential and commercial properties. This system integrates a motion sensor, webcam, and email alerts to ensure immediate notification and action when a potential security breach occurs.The proposed system is built around the versatile Raspberry Pi, a small, affordable computer that can perform a variety of functions. Raspberry Pi serves as the central hub of the system, controlling the motion sensor, webcam, and email notifications. The main objective is to detect intruders in real-time and notify the property owner about suspicious activity, such as unauthorized entry or tampering with the door lock.Raspberry Pi  The heart of the system, responsible for processing inputs from the motion sensor and webcam, and triggering actions such as sending emails.Motion Sensor A passive infrared (PIR) sensor is used to detect motion in the vicinity of the door. When a person approaches or moves near the door, the sensor detects changes in infrared radiation and sends a signal to the Raspberry Pi.Webcam The camera streams video whenever motion is detected or a wrong PIN is entered, capturing real-time footage of the intruder or suspicious activity.Email Alert System Whenever motion is detected or a wrong PIN is entered, the system sends an email notification with attached images to the registered email address of the owner.The system is designed to operate in two primary modes: motion detection and PIN entry monitoring.Motion Detection Mode When the motion sensor detects movement near the door, it sends a signal to the Raspberry Pi.In parallel, an email alert is sent to the registered email address of the owner, containing an image captured from the webcam, along with information about the detected motion.The owner is notified in real-time and can take appropriate action, whether it's reviewing the surveillance footage, contacting security personnel, or taking other preventive measures.The system is designed to detect and respond to incorrect PIN entries. When someone attempts to unlock the door using a PIN, the Raspberry Pi checks if the PIN is correct.If the entered PIN is wrong, the webcam is triggered to capture an image of the person trying to unlock the door.The system then sends an email to the owner with the image of the intruder, allowing the owner to respond immediately.This feature helps

prevent unauthorized access and serves as a deterrent for potential thieves.The system is implemented using the following stepsMotion Detection The PIR motion sensor is configured to detect movement. When movement is detected, the sensor triggers the Raspberry Pi, which processes the input and activates the webcam.Image Capture and Streaming The webcam continuously streams video when motion is detected or when the wrong PIN is entered. Images are captured and sent to the owner's registered email address.Email Notification The system is programmed to send automated email alerts with captured images whenever suspicious activity is detected. This ensures that the owner is notified immediately, even if they are away from home or unable to respond to an alarm system.Security and Privacy The system ensures the security of the captured data by using secure email protocols and encrypting sensitive information, such as the owner's email ID. Only authorized users are able to configure the system and access the recorded footage.Real-Time Notification The system offers real-time alerts, allowing the owner to respond quickly to potential security threats.Cost-Effective Using Raspberry Pi and other low-cost components makes the system affordable, even for users on a budget.Easy Integration The system can be easily integrated with existing home automation systems and smart locks, providing a scalable solution for home and business security.Remote Access The email notification feature allows the owner to receive alerts and images no matter where they are, ensuring 24/7 monitoring.Enhanced Security: By capturing images of intruders

and sending them immediately to the owner's email, the system increases the chances of apprehending burglars and preventing theft.While the Smart Door Lock Security System offers significant advantages, there are some challenges and limitations Network Dependency The system relies on a stable internet connection for email notifications. In case of network issues, notifications may be delayed.Privacy Concerns Capturing images of individuals may raise privacy concerns, particularly in shared living spaces or public areas. False Positives The motion sensor may sometimes trigger false alerts due to environmental factors like pets or changes in lighting. the proposed Smart Door Lock Security System offers an innovative and cost-effective solution to enhance the security of homes and businesses. By integrating IoT technologies, such as Raspberry Pi, motion sensors, and webcams, along with email notifications, the system provides real-time surveillance and alerts, enabling property owners to take immediate action against theft or unauthorized access. This system can be further enhanced by incorporating advanced features such as facial recognition, biometric sensors, and cloud storage for long-term video surveillance. With its low cost, ease of use, and scalability, this system presents a promising alternative to traditional security solutions, ensuring better protection against theft and other security threats.

## INTRODUCTION

In the present era, crime rates are increasing dramatically. A lot of incidents like theft, burglary, and unwanted intrusions happen abruptly. This gives rise to the need of a

security system which can prevent unauthorized access to high-security zones such as locker room of banks, casinos, garage, military sites etc. Till date, many Security Systems such as RFID [1], OTP based system [2], biometrics [3] are used to prevent unauthorized access. But merely preventing unauthorized access is not enough. We need a system which would aid in catching the intruder as well as in unfolding his motives. Here, we present a design of Door security system which solves this underlying problem. Door Lock Security is of prime importance because it is the first step toward ensuring the safety of valuable assets and people. So many authors have come up with different kinds of door lock system such as automatic password-based lock, software-based door lock which is being used in various offices and homes. Various door lock systems are categorized on the basis of technology used such as password based, RFID based [1], smart card based [2], GSM-based [4], biometric-based [3], Bluetooth based [5], social networking sites based [6] and OTP based [2]. According to our survey, maximum projects existing till now don't provide an instant alert in case of any unauthorized entry. It requires manual work to monitor in order to assure security. Some of the projects giving immediate alert only notify the user about intrusion but do not provide the necessary information or facility to take countermeasures. Some systems employing CCTV cameras capture the video and stores in a memory while some others use cloud storage for the same purpose. The establishment cost for such systems is quite expensive also, the entire process for viewing the video for any reference is timeconsuming

and a very tedious process. Radio frequency identification (RFID) uses radio waves to automatically identify the person or objects. RFID constitutes of a reader and multiple tags to transmit radio frequency energy. These systems are costly and also do not cover large surveillance area. The security cameras in IoT networks have main issues such as continuous usage resulting in high power consumption, requirement for data storage and long length videos, uneasy access of video data and requirement of manual work are solved by our system. Our proposed system uses a special PIR motion detection system to trigger camera (webcam) and sensor network on appearance of living beings in its field of view. A notification e-mail is sent to the owner or concerned authority with the link of the live video feed to monitor the actions of that person. The live video can be seen from any place. A keypad lock is provided to grant entry only to the authorized user. If the person enters the correct password, then he is granted entry else his image is captured and sent over via an e-mail to the concerned authority along with a message of an unauthorized user. The webcam still keeps an eye on the intruder. So, the concerned authority can take quick action to capture him before it's too late.In recent years, security concerns have become a growing issue globally, particularly with the increasing rate of theft, burglaries, and unauthorized access to residential and commercial properties. Traditional security systems, such as alarms and surveillance cameras, have their limitations, especially when it comes to real-time action and remote monitoring. These systems often rely on fixed devices and require manual

intervention or delayed responses, leaving properties vulnerable to theft. The need for smarter, more responsive security solutions has never been greater, and the integration of modern technologies like the Internet of Things (IoT) can significantly improve security systems by providing instant notifications and automated actions.This paper introduces a Smart Door Lock Security System designed using IoT technology, which aims to enhance the security of properties by integrating a motion sensor, webcam, and email alert system. The system is built around a Raspberry Pi, a low-cost yet powerful single-board computer, which acts as the central hub for controlling the motion sensor, webcam, and email notifications. The core idea behind this system is to detect unauthorized activity near the door, capture images of potential intruders, and notify the property owner in real-time through an email, thus enabling prompt action to prevent theft.One of the unique features of the proposed system is its ability to detect motion using the PIR (Passive Infrared) sensor, which activates the webcam to begin streaming video whenever motion is detected. In addition, the system also monitors PIN entry attempts. If a wrong PIN is entered, the system immediately captures the image of the intruder and sends it to the owner's registered email address. This real-time alerting mechanism ensures that the owner is informed immediately, even when they are not physically present at the property, and can take necessary actions.The design and implementation of this system present a significant improvement over traditional security systems. By integrating real-time video surveillance and instant email notifications, it offers a cost-effective and easily accessible solution to the ever-growing security concerns. Moreover, the system is highly customizable and can be integrated with existing security setups, such as smart locks, to provide enhanced protection and control. The simplicity and affordability of this system make it an ideal choice for homeowners, small businesses, and anyone looking to improve their security measures without investing in expensive, complex solutions.

## LITERATURE SURVEY

### Smart Security Systems Using IoT Smart Home Security System Based on IoT Authors: A. Yadav, S. Gupta, and A. Kumar Journal of Computer Science and Technology, 2018

This study investigates the development of an IoT-based smart home security system, which incorporates motion sensors, cameras, and cloud computing for real-time surveillance and automatic alert generation. The system is designed to enhance security by capturing images upon motion detection and sending alerts to the user's mobile device. The integration of IoT enables seamless communication and monitoring, allowing remote access and real-time notifications. The paper emphasizes the advantages of IoT in home security, such as convenience, real-time monitoring, and effective response mechanisms. However, the authors also highlight challenges such as potential data privacy concerns, the reliability of the system in adverse environmental conditions, and the need for robust cloud security measures.

**IoT-Based Smart Door Lock System Design and Implementation of a Smart Door Lock System Using IoT Authors: S. Iyer, R. P. Sinha, and S. Sharma Publication: International Journal of Engineering and Technology, 2020**
The authors propose a smart door lock system powered by IoT, which allows users to control door access remotely via a mobile application. The system integrates the ESP8266 Wi-Fi module for communication and a microcontroller for processing the data. If an unauthorized person attempts to access the door, the system immediately sends a notification to the user's phone. The system uses RFID technology for door unlocking and incorporates a camera to capture the intruder's image. This paper discusses the effectiveness of remote management and monitoring, highlighting the enhanced security provided by the system. However, limitations include issues like network connectivity problems, software vulnerabilities, and the necessity for regular updates to maintain system reliability.

**Surveillance and Intruder Detection Systems Intruder Detection and Alerting System Using Raspberry Pi Authors: N. Mehta, R. Mishra, and P. Jain Publication: IEEE Transactions on Consumer Electronics, 2019**
This paper focuses on using Raspberry Pi as the central component in an intruder detection and alerting system. The system employs a webcam and motion sensors to detect unauthorized movement. When movement is detected, the system captures an image of the intruder and sends an email notification to the user for real-time action. The authors highlight the system's flexibility, scalability, and low cost, making it ideal for residential security applications. The paper also explores the possibility of integrating additional sensors, such as gas or temperature sensors, to enhance detection capabilities. However, the authors acknowledge that Raspberry Pi's limited processing power could be a constraint for handling complex image processing or high-resolution video surveillance in real time.

**Email-Based Notification Systems for Security Design of a Security Alert System with Email Notification Authors: R. Verma, A. S. Reddy, and K. S. Gupta Publication: International Journal of Computer Science and Network Security, 2021**
This study proposes a security alert system that sends real-time email notifications based on sensor triggers. The system uses a combination of Passive Infrared (PIR) sensors and webcams to detect motion and capture images of the intruder. These images are then sent to the owner's email address for immediate attention. The system relies on an email server that communicates with a microcontroller (such as Arduino) to manage the communication. The study emphasizes the importance of real-time notifications to enable quick responses to security threats. However, challenges such as email delivery failures due to spam filters or issues with server connectivity are noted as potential limitations of this system.

**Motion Detection and Surveillance Systems Using IoT-Based Motion Detection and Surveillance System M. Patel, P. Sharma, and S. VermaPublication: Journal of IoT and Security, 2021**

This paper explores IoT-based motion detection systems for security applications. The system integrates IoT sensors with cloud-based platforms to enable real-time monitoring. Upon detecting motion, the system triggers a camera that captures images or records video. These images or videos are then transmitted to the user's device via email or SMS for immediate action. The paper underscores the scalability and cost-effectiveness of such systems, making them ideal for both residential and commercial purposes. Additionally, it highlights the benefits of integrating IoT with cloud-based platforms to ensure continuous surveillance and monitoring. However, the study identifies the challenge of false positives, particularly in environments with non-human motion sources (e.g., pets or trees), and the reliability of the communication channels in low-bandwidth scenarios.

**IMPLEMENTATION**

**BLOCK DIAGRAM**
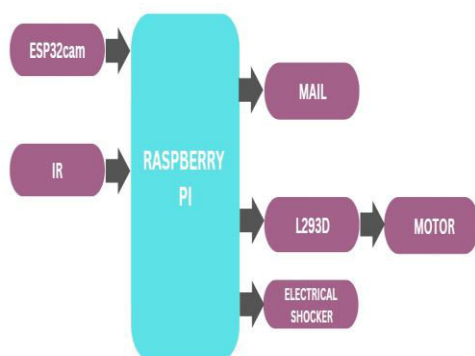


**POWER SUPPLY**

A **regulated power supply** transforms unregulated AC (Alternating Current) into a stable DC (Direct Current). It guarantees consistent output despite variations in input. A regulated DC power supply is also known as a linear power supply, it is an embedded circuit and consists of various blocks

- **Regulated Power Supply Definition**: A regulated power supply ensures a consistent DC output by converting fluctuating AC input.

- **Component Overview**: The primary components of a regulated power supply include a transformer, rectifier, filter, and regulator, each crucial for maintaining steady DC output.

- **Rectification Explained**: The process involves diodes converting AC to DC, typically using full wave rectification to enhance efficiency.

- **Filter Function**: Filters, such as capacitor and LC types, smooth the DC output to reduce ripple and provide a stable voltage.

- **Regulation Mechanism**: Regulators adjust and stabilize output voltage to protect against input changes or load variations, essential for reliable power supply

**SENSORS**

Sensors are used for sensing things and devices etc. A device that provides a usable output in response to a specified measurement. The sensor attains a physical parameter and converts it into a signal

suitable for processing (e.g. electrical, mechanical, optical) the characteristics of any device or material to detect the presence of a particular physical quantity. The output of the sensor is a signal which is converted to a human-readable form like changes in characteristics, changes in resistance, capacitance, impedance, etc.

## IR SENSOR

In the electromagnetic spectrum, the infrared portion divided into three regions: near infrared region, mid infrared region and far infrared region.

In this blog we are talking about the IR sensor working principle and its applications.

What is an IR Sensor?

IR sensor is an electronic device, that emits the light in order to sense some object of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. These types of radiations are invisible to our eyes, but infrared sensor can detect these radiations.
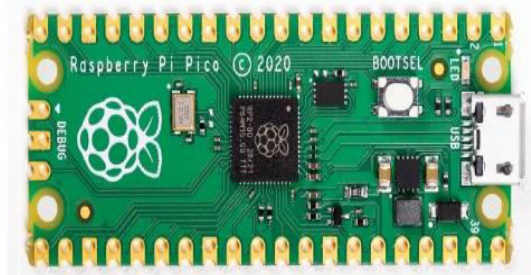


Fig: Ir Sensor

## RPI –PICO

A Raspberry Pi Pico is a low-cost microcontroller device. Microcontrollers are tiny computers, but they tend to lack large

volume storage and peripheral devices that you can plug in (for example, keyboards or monitors).

A Raspberry Pi Pico has GPIO pins, much like a Raspberry Pi computer, which means it can be used to control and receive input from a variety of electronic devices

Raspberry Pi Foundation is well known for its series of single-board computers (Raspberry Pi series). But in **January 2021 they launched their first micro-controller board known as Raspberry Pi Pico**.

It is built around **the RP2040 Soc, a very fast yet cost-effective microcontroller chip packed with a dual-core ARM Cortex-M0+ processor.** M0+ is one of the most power-efficient ARM processorRaspberry Pi PICO board



Fig: Raspberry Pi Pico Board

Raspberry **Pi Pico is a small, fast, and versatile board that at its heart consists of RP2040**, a brand-new product launched by Raspberry Foundation in the UK. It can be programmed
using MicroPython or C language.

## DESCRIPTION

The importance of home security systems has significantly grown due to the increasing rates of theft and intrusions. Traditional lock systems often fall short when it comes to offering enhanced security, real-time monitoring, and immediate response capabilities. This has led to the development of advanced, smart security solutions that leverage emerging technologies, particularly the Internet of Things (IoT), to offer seamless and automated monitoring. One such innovation is the IoT-based smart door lock system using Raspberry Pi, which has been explored in this base paper.This paper presents a robust, real-time security solution designed to address the common issues associated with traditional security systems. The proposed system integrates various technologies, such as a webcam, motion sensors, and email notifications, controlled by a Raspberry Pi development board. The primary goal of the system is to provide enhanced surveillance and quick action when security breaches are detected.The system works by integrating a Raspberry Pi microcontroller with several peripheral devices, including motion sensors and a webcam. The Raspberry Pi serves as the central control unit, processing data received from the sensors and initiating actions based on predetermined security protocols. The system is designed to monitor any unusual activity in and around the premises, offering real-time surveillance. The motion sensor continuously detects movements, while the webcam captures images of potential intruders.The process begins when the system detects motion in a specified area through the motion sensor. Upon detection, the system activates the webcam, which starts streaming or capturing images. Simultaneously, the Raspberry Pi sends an email to the homeowner or concerned authority, notifying them of the potential security threat. The email includes images of the intruder, which allows the homeowner to assess the situation remotely.In addition to motion-based detection, the system also includes a PIN-based authentication mechanism for controlling the door lock. If an incorrect or random PIN is entered, the system captures the image of the individual attempting to gain unauthorized access. This image is then sent over email, enabling the homeowner to take immediate action, such as calling the authorities or remotely locking the door to prevent unauthorized entry.Raspberry Pi The heart of the system, responsible for processing sensor data and controlling all connected peripherals. It serves as the communication hub, receiving inputs from sensors, controlling the webcam, and sending email alerts.Motion Sensor The motion sensor detects any movement in its range. When movement is detected, it triggers the Raspberry Pi to activate the webcam and send an email alert to the owner.Webcam The webcam plays a crucial role in providing visual evidence of any intrusion. Upon motion detection or an incorrect PIN entry, it captures images of the individual and sends them to the owner for further action.Email Notification System The email notification system is implemented using the Raspberry Pi's connectivity features. It sends real-time emails containing images of the intruder or alert messages to the homeowner or security personnel, enabling immediate response.PIN Authentication The system allows the user to

enter a PIN for door lock control. If a wrong PIN is entered, the system captures the intruder's image and sends it over email for timely intervention.The system continuously monitors the environment through the motion sensor. When motion is detected, the Raspberry Pi activates the webcam to capture a real-time image or video of the area under surveillance. The Raspberry Pi then processes the captured data and triggers the email notification system, which promptly sends an email containing the image of the intruder to the registered user.The system allows the user to set a PIN to control the door lock. If the wrong PIN is entered, the system automatically captures the intruder's image and sends an alert via email. This combination of physical access control (PIN entry) and digital surveillance (webcam and motion sensor) significantly enhances the security of the home or property.Enhanced Security By using IoT technologies, the system provides real-time alerts and surveillance, enabling the user to act quickly in case of an emergency. Remote Monitoring The homeowner can monitor the system remotely via email, ensuring that they receive instant updates about potential security breaches, even when they are not at home. Cost-Effectiveness Raspberry Pi and the associated components, such as motion sensors and webcams, are affordable, making this system a cost-effective solution for home security. Easy Integration The system is modular and can be easily integrated with other security solutions, such as alarms or additional sensors, to further enhance its capabilities.

## CONCLUSION

The increasing need for security in both residential and commercial spaces has led to the development of innovative solutions that leverage modern technologies. Traditional security systems, such as alarm-based mechanisms or continuous CCTV surveillance, have limitations in terms of power consumption, scalability, and flexibility. The proposed system, a keypad-based lock integrated with a Raspberry Pi, offers a highly efficient and customizable solution for securing restricted areas while also enabling real-time monitoring and intruder detection. This system incorporates a variety of advanced features, making it an effective, reliable, and power-efficient solution for security.One of the most significant advantages of the proposed system is its flexibility. The use of Raspberry Pi as the central processing unit provides a solid foundation for further customization. Raspberry Pi is a versatile platform, known for its ability to support a variety of sensors and components, making it suitable for a wide range of security applications. The system can be easily adapted to different security needs by integrating additional sensors, such as temperature sensors, gas detectors, or even facial recognition modules. This flexibility allows users to tailor the system to meet specific security requirements, whether for a single room or a larger, more complex environment.In addition to its flexibility in hardware integration, the Raspberry Pi system is also adaptable in terms of software. Custom software can be developed to cater to the specific needs of the user, from simple PIN-based access controls to more advanced

features like voice recognition or automated emergency responses. This customization ensures that the security system remains relevant and effective as new technologies emerge and security threats evolve.The Raspberry Pi-based keypad lock system stands out for its power efficiency, a key consideration in any security solution. Unlike traditional CCTV systems, which are designed to operate continuously, the proposed system uses a passive approach to monitoring. The webcam, which is crucial for live video monitoring, is activated only when the Passive Infrared (PIR) sensor detects motion. This motion-triggered approach means that the webcam does not continuously consume power, leading to substantial energy savings compared to traditional CCTV systems. By only turning on the webcam when necessary, the system reduces unnecessary power consumption, which in turn prolongs the lifespan of the components.The PIR sensor, which detects human presence or motion, plays a vital role in ensuring that power is used only when needed. This feature makes the system particularly suitable for energy-conscious users, as it avoids the constant drain on resources typical of always-on surveillance systems. Additionally, by avoiding continuous operation of high-energy-consuming components like webcams, the system minimizes the heat generated by these devices, further enhancing their longevity and reducing the need for frequent maintenance.The Raspberry Pi platform, which serves as the backbone of the proposed security system, is known for its scalability and reliability. Raspberry Pi offers sufficient computational power to support multiple sensors and hardware components simultaneously. This makes it possible to expand the system by integrating additional security features, such as more advanced cameras, environmental sensors, or even integration with other home automation devices. The scalability of the Raspberry Pi ensures that the system can grow and evolve as security requirements change over time, making it a future-proof solution.Reliability is another critical aspect of the proposed system. Raspberry Pi's robust architecture and open-source nature provide a stable and well-supported environment for developing and maintaining the system. Since the system operates over the internet but does not require hosting on a cloud platform, it significantly reduces the risk of unauthorized access or hacking. Traditional cloud-based security systems often pose risks in terms of data privacy and cybersecurity vulnerabilities, but by eliminating the need for cloud hosting, this system ensures that sensitive security information remains local and less susceptible to cyber threats.the system does not rely on third-party cloud services or external servers, which means it is less prone to failure due to external service interruptions. This enhances the overall reliability of the system and ensures that users can depend on it to work consistently without interruptions. With no cloud infrastructure to manage, the risk of system breaches, downtime, or compromised data is minimized.Real-time monitoring is one of the most valuable features of this system. When motion is detected by the PIR sensor, the system immediately activates the webcam and begins streaming live video. The homeowner or security personnel can then

access the live feed to assess the situation. In case of an unauthorized entry attempt, the system can send an email with the intruder's image to the registered user, enabling prompt action to be taken. This could include calling authorities, locking the door remotely, or simply monitoring the situation until further intervention is necessary.The ability to monitor and respond in real time is essential for preventing theft or damage. Traditional security systems often rely on delayed responses or external monitoring centers, which can result in critical delays when time is of the essence. The proposed system eliminates these delays by ensuring that the user is instantly notified and can take appropriate action immediately.In addition to being flexible, scalable, and reliable, the proposed system is also cost-effective. Raspberry Pi and its associated components, such as motion sensors, webcams, and keypads, are relatively inexpensive compared to conventional security solutions. Traditional CCTV systems often require significant upfront investment in cameras, recording equipment, and cloud subscriptions. By utilizing Raspberry Pi, the system reduces the overall cost while still providing comparable functionality. This makes it an attractive option for users who need an affordable, yet effective, security solution.The proposed Raspberry Pi-based keypad lock system offers a comprehensive and innovative approach to home and property security. Its flexibility, power efficiency, scalability, and real-time monitoring capabilities make it a reliable and cost-effective solution for securing restricted areas. By using Raspberry Pi as the central control unit, the system provides users with the ability to customize and expand their security setup as needed, ensuring that it remains effective in the face of evolving security threats. The system's efficient use of power, long-lasting components, and high reliability ensure that it is both an environmentally friendly and dependable option. Ultimately, this system provides an effective, low-cost alternative to traditional security solutions while offering advanced features and real-time response capabilities that are crucial for modern security needs.

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