SURVEILLANCE SYSTEM USING RASPBERRY PI

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0.1 Abstract

With the increasing need for cost-effective and efficient security and surveillance solutions, various IoT based systems utilizing Raspberry Pi have been developed to address challenges in intrusion detection, traffic monitoring, and automated surveillance. These systems integrate hardware components such as Raspberry Pi, PIR sensors, cameras, GSM modules, and infrared sensors, coupled with software tools such as Python, OpenCV, and cloud-basedased services for real-time monitoring and alert generation

Several projects have focused on intrusion detection, employing PIR sensors and image processing techniques to capture movement and trigger alerts via email or SMS, providing a cost-effective alternative to CCTV systems. Traffic surveillance systems have used IR sensors and edge detection algorithms to dynamically analyze road congestion, optimizing traffic signal timings. Smart robotic surveillance systems integrate motion tracking, IoT connectivity and AI-based recognition to enhance real-time monitoring capabilities

Each system presents advantages such as low power consumption, remote accessibility and affordability However, challenges remain, including dependency on stable internet connectivity, sensor calibration issues, and false alerts due to environmental conditions. Future improvements focus on AI integration for better accuracy, cloud-based storage for long-term monitoring, and enhanced mobility features in robotic systems.

This study highlights the versatility of Raspberry Pi in real-world security applications, demonstrating its potential for scalable, intelligent and cost-effective surveillance solutions across multiple domains, including home security, traffic management and autonomous monitoring. .

0.2 Research Problem Statement

Traditional security and surveillance systems, such as CCTV cameras and manual monitoring, have significant limitations in terms of cost, efficiency and real-time threat detection. These systems require continuous recording, high storage capacity and human intervention to analyze anomalies, making them expensive and inefficient for large scale applications. Additionally, intrusion detection and traffic surveillance systems often suffer from false alarms due to environmental factors, while embedded systems like Raspberry Pi face challenges related to processing power and real-time data handling. The need for an intelligent, automated and cost-effective surveillance solution has driven research into IoT based systems

that integrate motion detection, image processing, AI driven analytics and cloud based storage. However, optimizing these systems to enhance accuracy, minimize false positives and improve remote accessibility remains a key challenge that requires further investigations and technological advancements.

0.3 Research Objective

The objective of this research is to develop an intelligent, cost-effective and automated surveillance and security system using Raspberry Pi and IoT Technologies. This system aims to enhance real-time threat detection, reduce dependency on manual monitoring and optimize storage efficiency through motion based recording. By integrating AI driven image processing, PIR sensors and cloud based alert mechanisms, the research seeks to improve accuracy, minimize false alarms caused by environmental factors, and enable remote accessibility for real-time monitoring. Furthermore, the study aims to explore advancements in energy efficient embedded computing and smart automation to create a scalable solution for various security applications, including home surveillance, traffic monitoring and industrial safety.

0.4 Significance of the Research Study

The significance of this research lies in its potential to revolutionize surveillance and security systems by providing an intelligent, cost-effective, and automated solution using Raspberry Pi and IoT technologies.Traditional surveillance systems are often expensive, require constant human intervention and consume significant storage and power resources. This study addresses these limitations by developing a smart system that integrates motion detection, AI-driven image processing and real-time alerts to enhance security monitoring.

By reducing false alarms, optimizing storage through motion-based recording and enabling remote accessibility, this research contributes to making surveillance more efficient,affordable and scalable. Additionally, the implementation of low-power embedded systems ensures sustainability, making it suitable for application such as home security, traffic management and industrial monitoring. The findings of this study can serve as a foundation for future advancements in AI-based surveillance, autonomous threat detection and cloud-integrated security system,ultimately improving safely and security in various domains.

0.5 Literature Review

This section summarizes various research papers on smart surveillance system using Raspberry Pi.

Sr. No. and Paper Name	Hardware and Software	Advantage and Disadvantage	Novelty and Update	Conclusion
1.A Raspberry Pi based Smart Security Patrol Robot (IEEE)	***Hardware :*** Raspberry Pi 3B, Pi Camera, Sound Sensors, Neo-6 AGPS REceiver, L293D Motor Driver, DC Motors, Rechargeable Battery***Software :*** Raspbian OS, Python Programming, Mail Service for Communication	***Advantages :*** Reduces need for human security personnel ,real time surveillance with video anf GPS tracking, Can detect unusual sounds, cost-effective alternative to static CCTV***Disadvantage :*** Reuires stable internet connection , Limited movement range due to power constraints , May have false alarm due to background noise , Require maintenance and software updates	Integration of sound sensors for triggering movement towards suspicious activity, Combination of GPS and Video streaming for precise location tracking, Future improvements include better path planning, 360-degree coverage, and additional microphones for enhanced sound detection	The smart security patrolling robot enhances security by autonomously patrolling an area, detection unusual sounds, and transmitting live footage and GPS locations.
2.A Real-time Surveillance Mini-rover based on OpenCV-Python-JAVA using Raspberry Pi 2(IEEE)	***Hardware :*** Raspberry Pi 2 Model B, L298N H-Bridge Dual Motor controller, A4Tech USB mini webcam, Apacer 4400mAh Mobile Power Bank, 5 AA Battery Pack, Four-wheeled RC Toy-car Chasis ***Software :*** Raspbian OS, Python, OpenCV, JAVA, SSH, Putty, Xming	***Advantages :*** Real time video surveillance, Can be controlled remotely via the Internet, Low cost implementation ***Disadvantage :*** Latency issues when using the Internet for control, Limited movement on rough terrains due to chassis design, fixed camera angle limits field of view, Cannot carry extra payloads	This mini-rover can be controlled over a cloud server, allowing global access rather than limiting to a local Wi-Fi Network. For future work, Improve chassis design for better terrain handling, add more sensors for environment monitoring, implement solar-powered energy system, use rotating camera for better field of view	The project successfully developed a cost-effective, internet-controlled surveillance rover using Raspberry Pi 2 and openCV. However, improvements in mobility, payload capacity, and response time can further enhance its usability.
3.Advanced Raspberry Pi Surveillance (ARS) system(IEEE)	***Hardware :*** Raspberry Pi B+, GSM Module(SIM900), Camera, HDMI Display, Power Supply, GPIO-based sensors ***Software :*** Raspbian OS, Python, simpleCV, MPEG-streamer, AT commands	***Advantage :*** Provide real time surveillance with motion detection, Sends SMS notifications upon detecting movement, Reduces manual surveillance efforts, low power consumption compared to traditional CCTV systems ***Disadvantages :*** Requires stable internet and GSM network for notifications, limited processing power for advanced AI-based detection, False positives possible due to environmental changes, may need periodic maintenance of hardware components	Uses Raspberry Pi and SimpleCV for real time motion detection and SMS alerts, reducing dependency on high end surveillance systems. For future work, enhance Ai based motion detection for accuracy, implement cloud based remote access, integrate facial recognition for improved security, extend application to robotic surveillance systems	The ARS system is a cost-effective, automated surveillance solution that can replace manual monitoring in sensitive areas like banks, homes and industries. Future advancements can improve detection accuracy and enable more intelligent surveillance.
4.An enhanced Surveillance system for Gun and Knife Detection Using YOLOv8 and Raspberry Pi(IEEE)	***Hardware*** : Raspberry i board, Picam Camera Module, MicroSD Card, Power Supply ***Software :*** Raspbian OS, Python, OpenCV, YOLOv8, SMTP	***Advantages :*** Real time detection for firearms and knives, Immediate alerts via SMS and email, works in diverse lighting conditions ***Disadvantages :*** Limited processing power of Raspberry Pi for complex deep learning models, Dependent on stable internet connection for notification	Uses YOLOv8 for real time object detection of weapons, integrated with an automated alerting system for improved security response. For updates, Expanding dataset for improved model accuracy, Optimizing performance for edge-device deployment	The system effectively detects weapons in real-time, providing immediate alerts to authorities, making it a valuable tool for public safety enhancement. Future improvements will focus on increasing accuracy and extending its capabilities
5.Automated Surveillance system using Raspberry Pi(IEEE)	***Hardware :*** Raspberry Pi 3 Model B+, USB Web Camera, PIR Sensor, GSM 900 Module, MicroSD Card, Ethernet Cable, Power Supply Adapter, Display ***Software :*** Raspbian OS, Python, PuTTY, VNC Viewer, Balena Etcher, SD Card Formatter	***Advantages :***Can be accessed remotely via the internet, Reduces memory usage compared to continous CCTV recording, Sends instant notifications when motion is detected ***Disadvantages :*** Dependent on stable network conectivity for remote access, False alerts possible due to environmental factors	Uses PIR Sensors and IoT integration for efficient and cost-effective real-time surveillance with automated alerts, For future work,Improving cloud storage for better accessibility, Expanding system to detect and track specific objects or individuals.	The system provides an efficient, real-time surveillance solution that notifies users when motion is detected. It is cost effective and reliable for home and industrial security applications.

Sr. No. and Paper Name	Hardware and Software	Advantage and Disadvantage	Novelty and Update	Conclusion
6.Automatic Door Unlocking and Security system using Raspberry Pi(IEEE)	***Hardware :*** Raspberry Pi 3, Pi Camera, MLX temperature Sensor, GSM Module, Relay Module, Solenoid Lock, Buzzer, LED, LCD Display ***Software :*** Raspbian OS, Python, OpenCV, VNC Viewer, Adafruit IO Cloud Service	***Advantage :*** Sends alerts via SMS and email if an unauthorized person is detected, Integrates temperature measurement for additional safety, Remote access via Adafruit IO for unlocking from anywhere ***Disadvantage :*** Limited accuracy under poor lighting conditions, Requires periodic updates and traning for face recognition database	The system integrates face recognition with temperature sensing and IoT based remote control, enhancing security and convenience. For future work, adding motion sensors to turn lights off when no activity is detected, Using high-resolution cameras for better detection	The project successfully implements an intelligent, real-time door unlocking system using Raspberry Pi and face recognition.
7.Crossroad accident prevention system using real-time depth sensing(IEEE)	***Hardware :*** Raspberry Pi, Logitech C270 Webcams, RGB LEDs ***Software :*** Python, OpenCV, YOLOv7 for object detection, Google collab for training and testing	***Advantage :*** Prevents crossroad accidents in real-time, use machine learning for accurate vehicle detection and speed estimation, works in both daytime and nighttime conditions using headlight detection ***Disadvantages :*** Dependent on hardware installation at every crossroad, accuracy may be affected by poor weather condition, potential latency in real-time processing due to raspberry pi's limited computational power	Uses real-time depth sensing and machine learning to dynamically change signal lights at crossroads, preventing accidents without requiring traditional traffic signals, For future work, enhancing accuracy of speed and distance estimation, Expanding deployment for large-scale traffic management, Integrating with smart city infrastructure for automated accident prevention	The system offers a novel approach to accident prevention at crossroads by using AI and IoT. t effectively reduces collision risks and can be scaled for future smart traffic management systems.
8.Design of IoT based Agricultural Farm Protector Drone Using Raspberry Pi(IEEE)	***Hardware :*** Raspberry Pi, Drone with Camera, GSM Module, GPS Module, Speaker ***Software :*** Python, openCV, IoT based alert system, SMTP for email notification, Telegram API for security alerts	***Advantage :*** Provides real-time surveillance of agricultural fields, Detects and alerts farmers and forest officers about intruding animals, Uses loudspeaker sounds to deter animals, Reduces Huamn effort in farm security and monitoring ***Disadvantage :*** Dependent on stable internet and GPS connectivity, Limited battery life of the drone may require frequent recharging, False alarms possible due to environmental factors like wind or shadows, Requires periodic maintenance of drone components.	Integrates drone-based surveillance with IoT technology for farm protection, using AI driven image processing to detect intruding animals and send real-time alerts, For future work, Enhancing AI model accuracy for better animal detection, Implementing automated flight path adjustments based on farm layout, Integrating thermal imaging for night surveillance, Expanding system for pest detection and crop monitoring	The project successfully implements an IoT based drone surveillance system for protecting agricultural farms from animal intrusions. Future improvements could enhance detection accuracy, expand its applications, and improve energy efficiency.
9.Embedded Surveillance system using Background Substraction and Raspberry Pi(IEEE)	***Hardware :*** Raspberry Pi, RGB Camera, Motion Sensors ***Software*** : Python, OpenCV, Background Substraction Algorithm	***Advantage :*** Efficient motion detection using background subtraction, Low power consumption and cost-effective, Suitable for real-time surveillance in various environments, Can be integrated with IoT based alert systems ***Disadvantage :*** Accuracy may decrease in low-light conditions, Requires periodic calibration to prevent false detections, Limited processing power of Raspberry Pi affects real-time performance	Utilizes a background subtraction approach for motion detection, which improves efficiency and reduces false alarms in surveillance systems, For future work,Implementing deep learning models for better object recognition, Enhancing low-light performance with infrared sensors, Expanding system for multi-camera setups.	The system efficiently detects motion using background subtraction, making it a reliable and cost-efffective surveillance solution. Future enhancements can further improve accuracy and expand its applications.

Sr. No. and Paper Name	Hardware and Software	Advantage and Disadvantage	Novelty and Update	Conclusion
10. Implementation of Spy Robot for A surveillance system using Internet Protocol of Raspberry Pi(IEEE)	***Hardware :*** Raspberry Pi 3 Model B, PIR Sensor, Pi Camera, L298N Motor driver, DC Geared Motors, Robot chassis ***Software :*** Raspbian OS, Python, HTML, Javascript, IoT-based Web server	***Advantage :*** Provides real-time surveillance with remote access, Detects human presence using PIR sensors, Controlled via IoT and Internet protocol for global accessibility, Cost-effective compared to traditional surveillance system ***Disadvantage :*** Limited movement on rough terrains due to wheeled chassis, Requires stable internet connectivity for remote monitoring, dependent on Raspberry Pi's processing power, which may limit advanced AI features, PIR sensors may trigger false alarms due to environmental factors.	Uses IoT and Raspberry Pi based real-time surveillance with remote access, integrating PIR sensors for intelligent motion detection. For future work, Integrating AI based facial recognition for better security, Upgrading to a quadcopter design for broader surveillance coverage, Enhancing night vision capabilities with infrared sensors, Improving obstacle detection for autonomous movement.	The spy robot successfully implements a real-time surveillance system using raspberry Pi and IoT. It is a cost-effective, efficient, and remotely controlled security solution, with potential improvements in mobility, AI integration, and obstacle detection.
11. Indoor Intrusion Detection and Filtering System Using Raspberry Pi(IEEE)	***Hardware :*** Raspberry Pi, Camera Module, PIR Motion Sensor, Buzzer, SD Card ***Software :*** Raspbian OS, Python, OpenCv, HTML	***Advantage :*** Real-time motion detection with alert system, Captures images and records video for evidence, Low-cost and energy-efficient compared to traditional CCTV systems, Can be remotely accessed via the internet ***Disadvantage*** : Requires a stable network connection for remote monitoring, False alarms may occur due to environmental changes, Limited detection accuracy in low-light conditions, May need regular maintenance and software updates.	Integrates Raspberry Pi with PIR motion sensors and video recording to provide an automated, real-time home security system. For future work, Improving Ai based intrusion detection for higher accuracy, Enhancing night vision capabilities with infrared sensors, Expanding storage for longer video recordings, Adding multi-user authentication for better security.	The system effectively detects and records intrusions, providing a cost-effective home security solution. Future improvements will enhance its reliability, accuracy and usability.
12.IoT based Surveillance System using Comparative Analysis of Different Threshold Algorithms for Motion Detection(IEEE)	***Hardware :*** Raspberry Pi, Pi Camera, Internet Connectivity Module, Storage Device (SD Card), Power Supply ***Software :*** Raspbian OS, Python, OpenCV, IoT Cloud	***Advantage :*** Efficient motion detection reduces unnecessary storage consumption, Cloud based storage allows remote access to surveillance data, Uses IoT for automated data transfer without human intervention, works effectively in both indoor and outdoor environments ***Disadvantage :*** dependent on internet connectivity for reltime cloud storage, False alarms may occur due to environmental changes, Requires proper calibration for optimal thresholding in different conditions, Limited processing power of Raspberry Pi may impact real-time performance	Compares different thresholding algorithms, Otsu's method to determine the most effective motion detection approach for surveillance systems. For future work, Enhancing accuracy using AI based object detection, Implementing real-time video streaming instead of image based capture, Improving detection reliability in low light conditions, Expanding system compatibility with multi-camera setups.	The project successfully develops an IoT enabled motion detection surveillance system that efficiently detects movements and stores data on the cloud. The evaluation of different thresholding methods helps in optimizing the accuracy of motion detection. Future enhancements could further improve reliability, accuracy and scalability.

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13. IoT enabled Video surveillance system using Raspberry Pi(IEEE)	***Hardware :*** Raspberry Pi, USB Camera, Internet connectivity module, storage devise, Power supply ***Software :*** Raspbian OS, Python, OpenCV, AWS for notification and storage, Google drive, Flask for web based monitoring	***Advantage :*** Real-time motion detection with automated cloud storage, Provides remote access through IoT integration, Sends instant email notifications upon motion detection, Cost-effective compared to traditional CCTV systems ***Disadvantage :*** Dependent on stable internet connectivity for real-time cloud updates, False alarms may occur due to sudden light changes, Limited processing power of Raspberry Pi may introduce slight delays, Cloud storage dependency may incur costs for long-term storage.	Uses a combination of IoT, Cloud computing and real-time motion detection for a fully automated surveillance system with minimal latency. For future work, Improving AI based motion recognition to differentiate between human and non-human movement, Enhancing low-light performance with infrared sensors, Reducing system latency for quicker alerts, Developing a more lightweight algorithm to optimize performance on Raspberry Pi.	The system successfully integrates IoT for real time surveillance, cloud storage and automated notifications, making it a cost effective anf efficient security solution. Future improvements will focus on enhancing AI based recognition and reducing processing delays.
14. License Plate detection using OCR method with Raspberry Pi(IEEE)	***Hardware :*** Raspberry Pi, Raspberry Pi Camera, SD Card, Power Supply ***Software :*** Raspbian OS, Python, OpenCV, Tesseract OCR, Canny edge Detection, Otsu Thresholding	***Advantage :*** Automates vehicle license plate recognition, reducing manual errors, Cost-effective compared to high end ANPR systems, Works in various lighting conditions, Can be integrated with smart parking and toll systems. ***Disadvantage :*** Accuracy depends on license plate quality and environmental lighting, Plates with low contrast or damaged surfaces may not be detected, False detections occur if the plate lacks a clear boundary, Dependent on stable camera positioning for proper recognition.	Compares two segmentation techniques to enhance OCR based license plate recognition and improve accuracy. For future work, Improving OCR accuracy with deep learning models, Enhancing performance for real time processing on Raspberry Pi, Integrating cloud based storage for remote access to detected license plates, Expanding detection to multiple vehicle types and plate formats.	The system effectively detects and recognizes license plates using OCR and Raspberry Pi. Future improvements will focus on increasing recognition accuracy and adapting to real-world conditions.
15. Pibot : The Raspberry Pi Controlled Multi-Environment Robot for Surveillance and Live Streaming(IEEE)	***Hardware :*** Raspberry Pi Model B, Pi camera module, Infrared Sensor, Servo motors, Micro-controller, Relay switch, Batteries, Power Bank ***Software :*** Raspbian OS, Python, MJPEG streamer, Java, Web GUI for control	***Advantage :*** Cost-effective alternative to traditional surveillance systems, Provides real-time live streaming within a local network, Can be controlled remotely via a Web GUI, Infrared sensor prevents collisions during movement. ***Disadvantage :*** Requires a separate Wi-Fi adapter for wireless connectivity, Limited to a local network, cannot connect via the internet, Requires system access for configuration, making setup less user-friendly, Not compatible with Windows OS for direct installation.	Uses Raspberry Pi as a central control unit to provide an affordable and flexible alternative to Ip based surveillance systems, with platform-independent Java-based Control. For future work, extending accessibility via the internet for global control, Implementing SLAM for autonomous navigation, Adding facial recognition for enhanced security, Developing mobile apps for Android/iOS for easy control.	The Pibot robot successfully demonstrates the use of Raspberry Pi for real-time surveillance and live streaming. Future improvements aim to make it more autonomous, internet-accessible and feature-rich for better security applications.

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16.Raspberry Pi-based Android-Thermal Surveillance Robot(IEEE)	***Hardware :*** Raspberry Pi 4, MLX-90640 Thermal Camera, Touch Display, Infrared Proximity sensors, Ultrasonic Sensors, Actuators, DC Motors ***Software :*** Raspbian OS, Python, OpenCV, Fritzing for circuit design, SolidWorks 2019 for 3D design	***Advantages :*** Provides real-time thermal surveillance and facial recognition, Mobile robot can navigate autonomously, Can be used for security, health monitoring and industrial applications, Energy-efficient design with rechargeable battery. ***Disadvantage :*** Requires significant processing power for real-time facial recognition and thermal analysis, Limited range of movement based on battery life, Accuracy can be affected by environmental conditions like lighting and obstacles, May require internet connectivity for remote monitoring.	Combines real-time thermal imaging with facial recognition on a mobile sureillance robot, making it suitable for security and health monitoring applications. For future work, Enhancing AI based recognition models for more accurate identification, Integrating clousbased monitoring for remote access, Adding improved obstacle detection and autonomous path planning, Optimizing power management for extended operational time.	The system successfully integrates thermal surveillance, facial recognition and autonomous movement into a single mobile unit, making it a versatile solution for security and monitoring applications, Future improvements aim to enhance accuracy, battery life and remote accessibility.
17. Remote Monitoring System based on a WiFi Controlled Car using Raspberry Pi(IEEE)	***Hardware :*** Raspberry Pi, Servo motors, Infrared sensor, Micro-controller IC AT89c51, Relay switches, Batteries, power bank ***Software :*** Pre-installed utilities for live streaming and surveillance, Python, Raspbian OS, HTML, Javascript	***Advantage :*** Cost-effective surveillance solution, Fully dependent on Raspberry Pi, covers large areas, user-friendly with pre-installed software. ***Disadvantage :*** Requires external WiFi adapter, Operates only in a local network, configuration requires direct system access, incompatible with Windows OS	Can be extended for internet access via mobile apps, potential implementation of SLAm, face detection for security enhancement, autonomous movement for routine surveillance	Demonstrates Raspberry Pi's superiority over Arduino in surveillance applications, provides a low-cost, efficient alternative to traditional systems, future improvements could include onlone access, better mapping and AI powered detection.
18. Road Traffic Density Surveillance System using IP sensor, Image processing and Raspberry Pi(IEEE)	***Hardware :*** Raspberry Pi, IP sensors, Raspberry Pi Camera, Power Supply ***Software :*** Raspbian OS, Python, OpenCV, Background Subtraction Algorithm, Canny Edge Detection	***Advantage :*** Provides real-time traffic density monitoring, Uses IR sensors and image processing for accurate vehicle detection, Helps in dynamic traffic signal control to reduce congestion, Cost-effective and energy-efficient solution. ***Disadvantage :*** Accuracy may be affected by environmental conditions, Requires periodic calibration of IR sensors, Limited processing power of Raspberry Pi may show down rral-time computations, May not work efficiently in highly congested area with overlapping vehicles.	The system integrates IR sensors with real-time image processing to optimize traffic light timings dynamically. For future work, Implementing Ai based object detection for more accurate vehicle counting, Integrating with cloud based traffic monitoring systems, Expanding the system to cover multiple intersections for s smarter traffic management networks, Improving detection reliability in low-light and adverse weather conditions.	The project successfully develops a smart traffic management system using Raspberry Pi, IR sensors, and image processing techniques. It helps in reducing congestion through dynamic traffic control. Future enhancements will focus on AI integration and large scale deployment.

Sr. No. and Paper Name	Hardware and Software	Advantage and Disadvantage	Novelty and Update	Conclusion
19. Security system using Raspberry Pi(IEEE)	***Hardware :*** Raspberry Pi Model B, HD camera, GSM modern, VGA converter, Monitor, Power Supply ***Software :*** Raspbian OS, Python, OpenCV, Secure Shell for remote access	***Advantage :*** Reduces video storage requirements by rcording only when motion is detected, Sends real-time alerts via SMS and email using GSM modern, Cost-effective and power-efficient compared to traditional CCTV systems, Can be remotely accessed for monitoring. ***Disadvantage :*** Dependent on a stable GSM network for alert notifications, Limited processing power of Raspberry Pi may affect rral-time detection speed, May trigger false alarms due to lighting changes or environmental factors, Lacks built-in cloud storage for long-term video retention.	Uses OpenCV based motion detection to trigger video recording and alerts, reducing unnecessary storage usage and improving surveillance efficiency. For future work, Adding cloud storage for remote access to recorded footage, Enhancing night vision capabilities with infrared sensors, Implementing a mobile app for real-time alerts and live video streaming.	The system provides an effective and low-cost security solution using Raspberry Pi and OpenCV. By optimizing storage and sending real-time alerts, it reduces manual monitoring efforts. Future updates will focus on AI based recognition and clous integration for improved functionality.
20.Smart Buggy: An IoT based smart surveillance Robotic Car using Raspberry Pi(IEEE)	***Hardware :*** Raspberry Pi 3B+, Pi camera, Servo motors, L293D Motor Driver, DC motors, Power Bank, Infrared LEDs ***Software*** : Raspbian OS, Python, OpenCV, Flask, HTL, Background Subtraction Algorithm	***Advanatge :*** Provides real-time surveillance and remote monitoring via IoT, Uses motion detection to optimize storage and alert users of movement, Web based control allows operation from anywhere in the world, Pan and tilt mechanism improves field of view. ***Disadvantage :*** Motion detection may trigger false positives due to lighting changes, Dependent on a stable internet connection for remote operation, Limited battery life due to power consumption from motors and camera, Requires fine-tuning of the background subtraction model to filter unnecessary motion.	Integrates a robotic surveillance system with IoT based global control and motion detection, making it suitable for security, rescue and Indstrial applications. For future work, Improving motion detection by incorporating AI based object recognition, Adding autonomous navigation with obstacle detection for better movement, Enhancing battery efficiency to increase oprational time, Integrating cloud based storage for recorded surveillance footage.	The smart Buggy effectively combines Raspberry Pi, IoT and motion detection to provide a mobile surveillance solution. Future improvements will enhance detection accuracy, energy efficiency and automation capabilities.
21.Surveillance and monitoring system using Raspberry Pi and SimpleCV(IEEE)	***Hardware :*** Raspberry Pi Model B+, USB Camera, Storage Device, Power Supply ***Software :*** Raspbian OS, Python, SimpleCV, MJPEG streamer	***Advantage :*** Real-time motion detection and tracking, Low-cost and portable surveillance solution, Streams live video online, allowing remote monitoring, Automated alerts via message, email or alarm. ***Disadvantage :*** Motion detection accuracy may be affected by environmental factors like shadows and lighting changes, requires stable internet connectivity for remote access, Limited Computational power for advanced AI based surveillance, Storage constraints if video data is not optimized.	Uses Raspberry Pi with SimpleCv for efficient motion tracking and online streaming, eliminating the need for expensive surveillance hardware. For future work, Integrating Ai based object detection to reduce false alarms, Implementing cloud based storage for long term data retention, Enhancing night vision capabilities with infrared sensors, Developing a mobile app for remote surveillance system.	The proposed system successfully implements a cost-effective surveillance solution using Raspberry Pi and SimpleCV. It provides real-time monitoring and remote access, making it suitable for homes, offices and restricted arras. Future updates will focus on AI integration, better storage solutions and improved detection accuracy.

Sr. No. and Paper Name	Hardware and Software	Advantage and Disadvantage	Novelty and Update	Conclusion
22.System for detecting Intrusions using Raspberry Pi(IEEE)	***Hardware :*** Raspberry Pi 4, PIR sensor, USB Webcam, Magnetic Sensor, Power Supply ***Software :*** Raspbian OS, Python 3, OpenCV, IoT based alert system	***Advantage :*** Real-time intrusion detection with minimal power consumption, Sends instant alerts via email with captured images, Cost-effective and suitable for home security applications, Works effectively in small and restricted areas like bank restrooms and offices. ***Disadvantage :*** Accuracy depends on sensor positioning and environmental conditions, Limited functionality for large scale security applications, Requires stable internet connectivity for email notifications, PIR sensors may trigger false alerts due to temperature fluctuations.	Uses Raspberry Pi with IoT integration to provide an automated intrusion detection system with remote monitoring, replacing costly CCTV based surveillance. For future work, Implementing AI based object recognition to differentiate between humans and animals, Integrating cloud based storage for long term intrusion records, Enhancing sensor accuracy to minimize false alarms, Developing a mobile app for real-time intrusion monitoring.	The system successfully detects intrusions using PIR and magnetic sensors, triggering real-time alerts via IoT. It is a cost effective alternative to traditional security systems. Future improvements will focus on AI based recognition, cloud storage and enhanced sensor accuracy.
23.Web controlled raspberry Pi Robot Surveillance(IEEE)	***Hardware :*** Raspberry Pi, USB camera, DC motors, L298N motor driver, WiFi module, Battery, Robot chassis ***Software :*** Python, OpenCV, Flask, Raspbian OS, HTML/CSS/Javascript	***Advantage :*** Remote surveillance, Live streaming, cost-effective, portable, low power consumption ***Disadvantage :*** Internet dependent, limited battery life, security risks, restricted camera view	Web controlled robot, real-time video, Raspberry Pi as processing and communication unit. For future work, Ai based object detection, cloud storage, encrypted communication, autonomous navigation	Efficient, low-cost surveillance robot with live streaming, ideal for security and monitoring applications
24.Webcam based Secure Surveillance system for smart agriculture using Raspberry Pi(IEEE)	***Hardware :*** Raspberry Pi, Webcam, Soil moisture sensors, DHT sensor, ESP8266 WiFi module, Arduino Uno, Relay, Water Pump, Power Supply ***Software :*** Python, SMTP protocol, Raspbian OS, Mobile App, TCP/UDP sockets	***Advantage*** : Remote monitoring via webcam, automated irrigation, secure access with authentication, real-time alerts, cost-effective solution for smart agriculture. ***Disadvantage :*** Dependent on internet connectivity, limited webcam field of view, authentication delays in case of failed login attempts, potential power limitations	Webcam based secure surveillance, automatic irrigation based on soil moisture, email based authentication and alerts, integration of security layers for IoT based farming. For future, Integration with fire and IR sensors for better security, AI based image processing for enhanced monitoring, cloud storage for data logging, improved real-time decision making features.	Successfully implemented a secure smart agriculture surveillance system, providing real-time monitoring and automated irrigation, with scope for further enhancements in security and AI integration.
25.WiFi enabled Home Security Surveillance system using Raspberry Pi and IoT module	***Hardware :*** Raspberry Pi, USB Webcam, NodeMCU, PIR Motion sensor, Fire detection sensor, GSM modem, Buzzer, Relay, Power Supply ***Software :*** Python, OpenCV, Raspbian os, SMTP Protocol, Arduino IDE, Web server, Motion software	***Advantage :*** Low-cost, real-time remote surveillance, intruder and fire detection,worldwide monitoring via WiFi, SMS/Calll/Email alerts, compact and portable system ***Disadvantage :*** Requires constant WiFi connectivity, GSM dependent alerts, limited field of view of the camera, delay in response time due to internet dependency	Integration of WiFi enabled IoT modules for security, automatic fire detection with relay-controlled safety activation, live video streaming accessible globally, cost-effective alternative to commercial systems. For future work, AI based image recognition for better intruder detection, cloud storage for logs and video footage, enhanced encryption for security, additional sensors for improved surveillance	Successfully implemented a low cost, reliable and globally accessible smart home surveillance system, combining IoT, WiFi, and GSM for enhanced security, with scope for further AI integration and cloud based features.

0.6 Conclusion

In conclusion, Raspberry Pi powered IoT surveillance system offered a versatile, low-cost and efficient approach to modern security challenges. By integrating AI, automation and cloud computing. These solutions have the potential to revolutionize security and monitoring application in homes, industries and public spaces. Future advancement will continue to refine these technologies, making them more robust, accurate and widely deployable

The studies highlight the advantage of using PIR sensor, IR camera, GSM modules and IoT connectivity to improve detection accuracy. optimize storage and enable real-time notifications. However, limitations such as false positives due to environmental factors, dependency on stable internet connectivity and limited processing power remain key challenges that require further optimization.

A surveillance system using Raspberry Pi is a cost-effective and customizable solution for security monitoring in homes, offices, or remote locations. It offers affordability compared to traditional CCTV systems while allowing flexibility through open-source software like MotionEyeOS and OpenCV. With remote access capabilities, users can monitor their surroundings from anywhere via cloud storage or web interfaces. Additionally, integrating AI features such as facial recognition and motion detection enhances security. The system is energy-efficient, consuming less power than conventional alternatives, and can be scaled by connecting multiple Raspberry Pi units for broader coverage. However, challenges such as limited processing power, network dependency, and camera quality may arise. Despite these limitations, a Raspberry Pi-based surveillance system is a viable and innovative option for those seeking a DIY approach to security, providing an effective balance between affordability, functionality, and customization.

The reviewed research studies demonstrate the effectiveness of Raspberry pi based IoT surveillance and security systems across various applications, including intrusion detection, smart traffic monitoring, automated surveillance robots and facial recognition based security solutions. These systems provide cost-effective, energy-efficient and remotely accessible alternatives to traditional security mechanisms such as CCTV cameras and manual monitoring.Each project successfully integrates motion detection, Ai driven image processing and cloud based alert mechanisms to enhance real time monitoring and security automation.