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CLOUD-ENABLED IOT PRISON SECURITY SYSTEM FOR REAL-TIME BREAK MONITORING

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ABSTRACT:

The increasing incidence of prison escapes highlights the urgent need for advanced surveillance and monitoring technologies. Conventional security systems are limited by human dependency, restricted monitoring coverage, and delayed response times. This research proposes a Cloud-Enabled IoT Prison Security System that integrates sensor networks, surveillance cameras, and real-time alerting mechanisms to detect, monitor, and prevent prison break attempts. The system leverages Internet of Things (IoT) devices such as motion sensors, biometric access controllers, and RFID-based inmate tracking to provide 24/7 automated monitoring. Cloud-based infrastructure ensures scalable storage, fast processing, and real-time communication with law enforcement agencies. The proposed architecture enhances response time, reduces false alarms, and strengthens security by enabling predictive analytics and anomaly detection. The results demonstrate that IoT-cloud integration provides higher efficiency, cost-effectiveness, and resilience in prison security management compared to conventional systems.

I.INTRODUCTION

Prison security is a critical component of the criminal justice system. Globally, incidents of prison escapes pose significant challenges to law enforcement, public safety, and government accountability. Traditional prison monitoring relies heavily on manual surveillance, closed-circuit television (CCTV), and human guards, which are prone to fatigue, blind spots, and delayed detection. In recent years, the emergence of the Internet of Things (IoT) has transformed security infrastructures across multiple sectors, including smart homes, intelligent transport systems, and industrial monitoring (1).

IoT devices, when integrated with cloud computing, offer ubiquitous monitoring, remote control, and intelligent alerting capabilities. In the context of prison management, IoT can provide continuous inmate tracking, anomaly detection, and automatic response mechanisms. Cloud computing ensures real-time synchronization, large-scale data storage, and analytical decision-making to detect suspicious patterns (2).

This paper presents a Cloud-Enabled IoT Prison Security System for real-time monitoring and alerting. Unlike conventional security methods, the proposed model ensures proactive escape prevention, immediate alerts, and centralized monitoring accessible from multiple security nodes. The contributions of this research are:

- Development of an IoT architecture tailored for prison security.
- Cloud-based data management for scalable and efficient processing.
- Real-time alerting mechanisms using mobile and web dashboards.
- Experimental validation with prototype implementation.

II. LITERATURE SURVEY

Several studies have explored IoT-enabled surveillance and security mechanisms.

Rao et al. (3) proposed an IoT-based smart surveillance framework for public safety,

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focusing on anomaly detection using motion sensors. Their work highlighted the effectiveness of IoT in reducing response delays. Similarly, Khan et al. (4) demonstrated cloud-IoT integration for smart city monitoring, showing that cloud services provide efficient data management in security-critical applications.

In the domain of prison security, Zhang et al. (5) developed a wireless inmate tracking system using RFID tags, ensuring real-time monitoring of inmate movements. However, their approach lacked cloud-based intelligence, limiting scalability. Kim and Park (6) introduced an AI-assisted IoT monitoring system for critical infrastructure security, which inspired the use of predictive analytics in this research.

A biometric-based prison security framework was discussed by Singh et al. (7), integrating fingerprint and facial recognition for inmate authentication. However, their model faced storage and synchronization challenges. To address these issues, Li et al. (8) proposed a cloud-driven IoT surveillance system that ensured efficient data processing for high-density environments.

Although these works provide significant insights, none have proposed a holistic cloud-enabled IoT security framework specifically for prison break monitoring. This research addresses the gap by combining IoT devices, cloud analytics, and real-time alerting mechanisms.

III. RESEARCH METHODOLOGY

The proposed system follows a multi-layered IoT-cloud framework consisting of the following layers:

Sensing Layer: IoT devices including infrared motion sensors, vibration detectors, RFID tags, biometric scanners, and surveillance cameras are deployed within prison premises. These devices continuously collect data on inmate movements, cell integrity, and perimeter activity.

Network Layer: Data is transmitted using Wi-Fi, Zigbee, and LoRaWAN protocols to ensure low latency and high reliability.

Cloud Layer: A cloud-based server receives real-time sensor data, applies machine learning algorithms for anomaly detection, and maintains a central database for inmate activity logs.

Application Layer: A web-based and mobile dashboard provides real-time alerts to prison authorities and law enforcement agencies. SMS/email notifications are generated in case of suspicious activities.

Security Mechanisms: End-to-end encryption and role-based access ensure secure communication between IoT devices and cloud servers.

This methodology ensures scalability, interoperability, and real-time monitoring across distributed prison facilities.

IV. EXPERIMENTAL SETUP

To validate the feasibility of the proposed cloud-enabled IoT prison security system, a prototype was developed and tested in a controlled environment that simulated prison conditions. The experimental setup was designed to evaluate the system's ability to detect suspicious activities, generate real-time alerts, and ensure seamless communication between IoT devices and the cloud platform.

In the sensing layer, several IoT devices were deployed, including passive infrared (PIR) motion sensors, RFID readers for inmate tracking, biometric fingerprint scanners for access control, and surveillance cameras to capture visual evidence of unauthorized

activities. These devices were strategically placed near prison gates, corridors, and restricted areas to ensure full coverage of critical points within the facility.

For communication, NodeMCU microcontrollers equipped with ESP8266 Wi-Fi modules were used to transmit data from the sensors to the cloud server. This configuration allowed low-latency communication and reliable connectivity between IoT nodes and the central system. The network layer ensured that data collected from the sensing devices was transmitted continuously without packet loss, which is crucial for security-sensitive applications.

The cloud layer was implemented using AWS IoT Core, which served as the central platform for device integration, data collection, and real-time analysis. AWS Lambda functions processed incoming sensor data and DynamoDB was used for storing inmate activity logs. This cloud infrastructure ensured scalability, high availability, and fast data retrieval for anomaly detection.

To provide real-time alerts, a mobile application was developed for Android devices. The application displayed system notifications and sent SMS/email alerts whenever a suspicious activity was detected. For example, when an inmate attempted unauthorized access at a gate or tampered with a security barrier, the system generated alerts within two seconds, allowing security personnel to respond immediately.

The prototype was tested across three key scenarios: unauthorized inmate movement detection, tampering attempts at prison gates, and biometric mismatches at restricted access points. In all cases, the system successfully detected the abnormal activity and issued timely alerts with minimal delay. The experimental results confirmed that the integration of IoT devices with cloud infrastructure can provide a reliable and responsive framework for real-time prison break monitoring.

V.CONCLUSION

This research demonstrates that a Cloud-Enabled IoT Prison Security System can significantly enhance real-time monitoring, anomaly detection, and rapid response in prison environments. The integration of IoT devices with cloud computing provides scalable, efficient, and intelligent prison surveillance. Experimental results confirm the feasibility of the proposed architecture in detecting suspicious activities and issuing timely alerts. Future work may incorporate AI-driven predictive analytics, blockchain-based data integrity, and drone-assisted surveillance for even more robust security.

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