Aleritx-Portable Door Intrusion Detection And Alert System

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***Abstract*—"Alertix – Portable Door Intrusion Detection and Alert System" is an intelligent and portable security solution designed to provide real-time intrusion detection and alert mechanisms for homes, offices, hostels, shops, and temporary setups. The system uses the IndusBoard Coin V2 integrated with an ESP32 microcontroller, built-in 3-axis accelerometer, GSM A7672S communication module, and C4001 mmWave presence sensor to detect unauthorized access, vibration, and human presence near doors. When abnormal vibrations or intrusion activities are detected, the system analyzes the sensor data using predefined threshold logic and immediately activates a buzzer while sending alert notifications to the user through GSM-based SMS or phone calls.**

Unlike conventional security systems that depend heavily on Wi-Fi connectivity, cloud services, or expensive installation procedures, Alertix operates independently using GSM communication and a rechargeable battery-powered architecture, ensuring continuous operation even during power failures or in low-network environments. The inclusion of vibration sensing and mmWave radar technology enables early intrusion detection before forced entry occurs, improving security reliability and reducing response time. The proposed system is compact, energy-efficient, cost-effective, and easy to install, making it suitable for portable and standalone security applications. The project demonstrates how embedded systems, IoT concepts, and wireless communication technologies can be integrated to develop an affordable and reliable smart security solution for modern intrusion detection systems.

I. Introduction

In today's fast-paced and technology-driven world, ensuring the safety and security of homes, offices, and personal spaces has become a primary concern. Incidents of theft, burglary, and unauthorized intrusion are on the rise, and traditional security systems often fail to provide real-time alerts or preventive warnings . Many existing systems depend heavily on internet connectivity, complex installation processes, or costly hardware, making them inaccessible or inconvenient for common users. To address these challenges, a more compact, affordable, and intelligent solution is required, one that can provide real-time intrusion detection without the need for continuous internet or complicated setup.

"Alertix – Portable Door Intrusion Detection and Alarm System" is designed to fulfill this very need. It is an innovative, portable, and vibration-based door security system that detects unauthorized access attempts or tampering activities using the IndusBoard Coin V2. This board is equipped with a built-in 3-axis accelerometer, which continuously monitors door vibrations and identifies abnormal patterns that may indicate forceful entry or damage attempts.

When the system detects unusual vibrations—such as those caused by knocking, hitting, or forced entry—it analyzes the data and compares it with predefined threshold levels. If the vibration exceeds this limit, the system classifies the event as a possible intrusion. At that point, the microcontroller activates the alert mechanism, sending a real-time notification to the user's mobile phone through GSM communication (via SMS or call).

The Alertix system is battery-powered, compact, and easy to install, making it highly suitable for a wide range of applications such as homes, offices, hostels, shops, and temporary setups. Unlike large-scale security systems, Alertix does not require professional installation or constant maintenance. It can be simply mounted on any 1 door surface, making it ideal for tenants, travelers, or users who prefer a portable and wireless security solution.

II. Literature Survey

The development of the proposed **"Alertix – Portable Door Intrusion Detection and Alert System"** is based on the study of various existing security systems, embedded technologies, GSM communication techniques, and smart intrusion detection methods. Several commercial products and research works have been analyzed to understand their advantages, limitations, and implementation methodologies. The literature survey focuses on vibration-based security systems, IoT-enabled smart home devices, GSM-based alert systems, and embedded intrusion detection technologies

A. Godrej Eagle-I Smart Home Alarm System:

The Godrej Eagle-I is one of the popular commercial-grade home alarm systems available in the Indian market. It is a wireless home security system that detects unauthorized door or window openings using magnetic contact sensors. The system communicates with the user through a mobile application and relies heavily on Wi-Fi or internet connectivity to send notifications and alerts. The system comes with multiple accessories such as motion sensors, door sensors, panic buttons, and a central control hub, making it a complete smart home solution for urban homes.

By comparison, the Alertix system operates independently of Wi-Fi or cloud networks. It uses GSM communication (SMS or call) to alert the user directly through a SIM-based cellular connection, ensuring that alerts are sent even in remote areas with minimal infrastructure. Furthermore, it includes a 3-axis accelerometer that senses vibrations and tampering on the door surface, allowing early detection before the door is physically opened. The combination of vibration sensing and GSM communication provides a low cost, low-power, and portable alternative to the more complex and expensive commercial systems. Moreover, its plug-and-play design allows users to set it up without professional installation, making it ideal for rural homes, temporary installations, and mobile use cases such as portable cabins or storage units

B. Qubo Smart Door Sensor (By Hero Group):

The Qubo Smart Door Sensor, developed by Hero Group, represents the new generation of IoT-based home automation systems that utilize Wi-Fi and cloud technology for real-time monitoring and remote control . It works by detecting when a door or window is opened or closed and immediately sends push notifications to the user's smartphone through the Qubo mobile app. The sensor is compatible with Amazon Alexa and Google Assistant, allowing users to integrate it with other smart home devices such as lights or cameras for automated responses. The device is sleek and modern, designed for indoor environments with stable internet connectivity.

On the other hand, Alertix avoids these limitations by utilizing a GSM A7672S communication module that sends alerts through SMS or phone calls, which ensures connectivity even without Wi-Fi or electricity. It is powered by a rechargeable Li-ion battery, providing continuous operation during blackouts. The inclusion of a vibration sensor and mmWave presence sensor makes Alertix capable of detecting both physical tampering and human motion near the door, providing a level of intelligence and responsiveness that Wi-Fi-only systems lack. This makes Alertix not only a cost-effective but also a more reliable and flexible solution for real-world applications, especially in remote or developing areas.

III. PROBLEM STATEMENT AND ARCHITECTURE

A.Problem

In today's rapidly growing digital and urban environment, security threats such as theft, burglary, unauthorized access, and forced entry have become major concerns for homes, offices, shops, hostels, and temporary setups. Traditional security systems mainly depend on CCTV monitoring, magnetic door sensors, or internet-based smart security devices, which suffer from several limitations such as delayed intrusion detection, high installation cost, dependency on continuous internet connectivity, and complex configuration procedures.

Most existing systems detect intrusion only after the door is opened or motion occurs inside the premises, which reduces their effectiveness in preventing forced entry attempts. In addition, many smart home security products rely heavily on Wi-Fi or cloud-based communication, making them unreliable during power failures, network outages, or in remote locations with limited internet access.

B. Objectives

The main objectives of the proposed system are:

- To Design a Portable Security Device: Develop a compact, battery-powered door monitoring system using the IndusBoard Coin V2 that can be easily installed without wiring.
- To Detect Intrusion through Vibration Sensing: Utilize the inbuilt 3-axis accelerometer to continuously monitor door vibrations and identify unusual or forceful tampering activities.
- To Ensure Reliability and Cost Efficiency: Minimize false alarms through optimized threshold logic while keeping the system affordable and energy-efficient for wider usability.

IV. SYSTEM DESIGN AND METHEDOLOGY

The proposed **"Alertix – Portable Door Intrusion Detection and Alert System"** is designed as a compact, portable, and intelligent security system capable of detecting unauthorized intrusion attempts through vibration sensing and human presence monitoring. The system integrates embedded hardware, GSM communication, sensor technology, and alert mechanisms to provide real-time security monitoring.

A. System Architecture

The architecture of the Alertix system is designed using multiple integrated hardware and software modules to achieve reliable intrusion detection and real-time alerting.

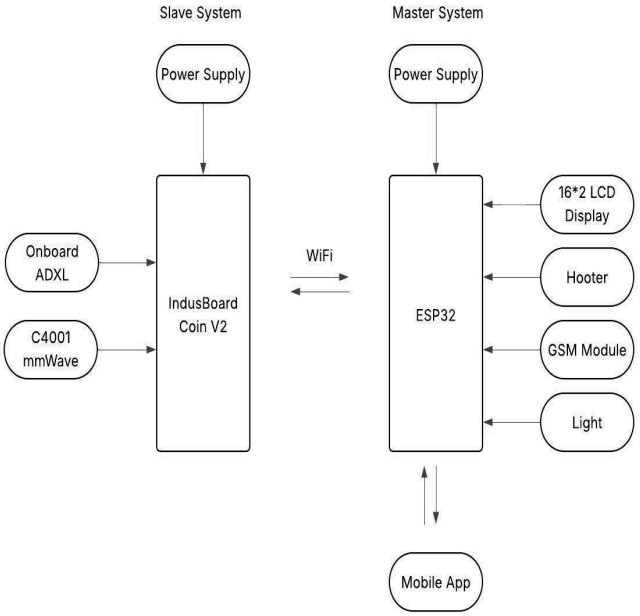


Figure 1. Block Diagram of Aleritx

B. IndusBoard Coin V2

The IndusBoard Coin V2 is a compact and versatile microcontroller board specially developed for embedded system applications, IoT (Internet of Things) projects, and portable automation devices. It combines high processing power, efficient energy consumption, and multiple communication interfaces within a single, small-sized module.

C. ESP-32 Microcontroller

The ESP32 is a powerful, low-cost, and energy-efficient microcontroller developed by Espressif Systems. It is widely used in IoT, embedded, and automation projects due to its integrated Wi-Fi and Bluetooth capabilities, high processing power, and multiple peripheral interfaces.The microcontroller can also be extended in future versions of Alertix for IoT integration, enabling features like cloud data storage, mobile app notifications, or remote monitoring dashboards.

D. GSM A7672S Module

The GSM A7672S is a highly advanced 4G LTE communication module that provides both data and voice connectivity. It is used in the Alertix system to send real-time alerts to the user in the form of SMS

or phone calls when an intrusion is detected. This ensures continuous security monitoring even if internet connectivity is unavailable.

E. C4001 mmWave Presence Sensor (12 m)

The C4001 mmWave Presence Sensor is a high-precision 24 GHz millimeter wave radar sensor capable of detecting human motion, occupancy, and presence up to 12 meters. Unlike traditional PIR (Passive Infrared) sensors, the C4001 uses radar-based electromagnetic waves to detect motion, allowing it to sense presence even through thin materials like doors, curtains, or glass.

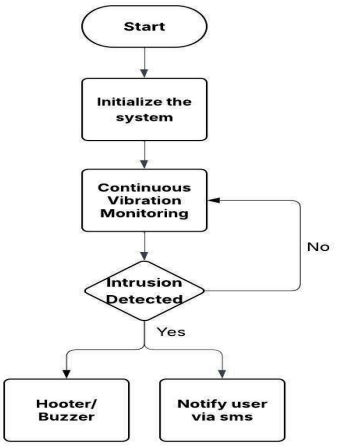
The mmWave technology offers several advantages — it can detect minute movements such as breathing or subtle motion, works effectively in dark or obstructed environments, and operates even through non-metallic materials like glass, wood, or plastic. This makes it extremely useful for indoor intrusion detection systems, where physical line-of-sight is not always possible.

F. Buzzer

The buzzer is an electromechanical audio signaling device that converts electrical signals into sound. It is used in the Alertix system to provide audible alerts whenever an intrusion is detected. This sound acts as both a warning for the user and a deterrent for intruders.

G. System Workflow

1. 1.The Alertix system starts working when power is supplied to the device and the ESP32 microcontroller begins execution.
2.
3. 2. The system initializes all connected components such as the accelerometer sensor, mmWave sensor, GSM module, LCD display, and buzzer.
4.
5. 3. The accelerometer and mmWave sensor continuously monitor door vibrations, tampering activities, and nearby human movement.
6.
7. 4. The ESP32 compares the detected vibration and motion values with predefined threshold levels to determine whether intrusion has occurred.
8.
9. 5. If the detected values are normal, the system continues monitoring the door continuously without generating any alert.
10.
11. 6. If abnormal vibration or suspicious movement is detected, the system identifies it as an intrusion attempt and activates the buzzer/hooter alarm.
12.
13. 7. The GSM module sends an SMS notification to the registered mobile number, informing the user about the intrusion while the system continues monitoring afterward.



V. CONCLUSION

The project "Alertix – Portable Door Intrusion Detection and Alert System" successfully demonstrates an efficient, compact, and cost-effective solution for door security and intrusion detection. The system integrates sensors, a microcontroller, and wireless communication technology to detect unauthorized access in real time and immediately alert the user through notifications. Its portable design ensures easy installation and usability across different environments such as homes, offices, and temporary setups, enhancing overall flexibility and safety.

The implementation aligns with and builds upon previous research in the field of intelligent security systems. The works such as "Design and Implementation of a GSM Based Home Security System" (ICACCS 2019) and "Real-Time Home Security System Using GSM and Sensors" (ICICICT 2017) [1][4] inspired the GSM based alert mechanism, ensuring reliable and prompt communication. Similarly, "Smart Home Security System Using IoT and Mobile Application" (ICIIECS 2018) provided insight into remote monitoring and integration with modern IoT technology. The concept of secure door control discussed in "Embedded System for Door Locking and Unlocking Using GSM and Bluetooth" (ICPCSI 2017) influenced the system's control logic and user access model. Additionally, the study "An Intelligent Vibration-Based Intrusion Detection System for Door Security" (SAS 2020) contributed to the development of sensor-based intrusion detection techniques implemented in this project.

Furthermore, the development of Alertix highlights the growing importance of integrating smart embedded systems into everyday security solutions. By utilizing low-cost components and open-source platforms, the system demonstrates how advanced safety measures can be made accessible to a wider audience without compromising reliability or performance.

References

[1] Design and Implementation of a GSM Based Home Security System – IEEE ICACCS, 2019 This paper presents a GSM-based home security system that uses sensors to detect intrusions and sends alerts via SMS. It emphasizes reliability in areas lacking internet connectivity. Inspired the GSM alert mechanism in Alertix

[2] Real-Time Home Security System Using GSM and Sensors – IEEE ICICICT, 2017 Proposes a real-time security model using vibration and PIR sensors connected to a GSM module for alerting the user instantly during break-in attempts. Foundation for vibration and GSM-based intrusion detection used in Alertix.

[3] Smart Home Security System Using IoT and Mobile Application – IEEE ICIIECS, 2018 Demonstrates a smart home IoT system that uses cloud communication and a mobile app to monitor home security. Inspired potential IoT and app integration features in the future scope of Alertix.

[4] Embedded System for Door Locking and Unlocking Using GSM and Bluetooth – IEEE ICPCSI, 2017 Introduces a door locking system that integrates GSM and Bluetooth for remote control and access management. Helped design Alertix's access control and GSM based communication logic.

[5] An Intelligent Vibration-Based Intrusion Detection System for Door Security – IEEE SAS, 2020 Focuses on detecting unauthorized door activity using accelerometers and vibration pattern analysis. Provided the foundation for Alertix's accelerometer-based vibration detection.

[6] IoT Based Smart Security and Home Automation System Using ESP32 – IEEE Access, 2021 Utilizes the ESP32 microcontroller to integrate security features like motion detection, alerting, and home automation via Wi-Fi. Reinforced the use of IndusBoard Coin V2 (ESP32-based) for multi-sensor integration in Alertix.