

Anti-Theft Flooring Mat

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Abstract- Besides all that, there is the IoT-Based Anti-Theft Mat System. As it is evident from the name, the security system is intended for securing the property from any unauthorized access by means of a relatively inexpensive apparatus, which employs a principle of the pressure detection method. Different from the current devices which utilize motion sensors and often suffer from false alarm, this system will detect a person's footprint. This concept is based on the employment of the pressure sensor installed inside the mat, data about which will be forwarded to the microcontroller. Once someone steps on the mat, the device will immediately notify its user about it through Wi-Fi connection. Thus, users will be notified about intrusion instantly once it happens. Due to the IoT, users will be able to receive notifications independently from their location at that moment. There are several benefits offered by the proposed system such as its cost-effectiveness, easy operation and availability. It will be easy for users to install such a device either in their office or residence since no expenses will be required for installation and purchase of additional hardware.

Keywords- IoT, Anti-Theft System, Pressure detection, Microcontroller, Real-Time Alerts, Wi-Fi Connectivity, Smart Security System.

I. INTRODUCTION

In modern times, people want to be sure about the safety of their personal belongings in personal or professional settings. Security devices are needed to notify us when someone has entered into our premises without permission, particularly those who are used in sensitive or valuable locations. Although numerous security solutions have become accessible for people today, including surveillance cameras, alarm systems, and various motion sensors, they are costly, cumbersome to install, and generate unnecessary signals due to minor changes in the environment.

IoT-based Anti-theft mat is a unique security concept that offers easy-to-install and cost-effective security measures. Its working principle is based on the basic premise of footsteps detection that happens at every entrance point of a facility. The IoT system consists of a pressure-sensitive mat placed strategically close to doors or restricted locations.

Each time someone walks over the pressure mat, pressure detection sensor inside the mat detects the movement.

It then transfers data to the microcontroller in the form of a digital signal, which is processed by it to determine whether to generate an alert signal or not. Once an intrusion is detected, the IoT system generates an alert that is instantly notified to the user via Wi-Fi connectivity. This will ensure that the user remains updated even when they are physically absent from that particular spot.

The value of such a system lies in the simplicity and effectiveness of this method. In contrast to other detection techniques that respond to any small motion, this device detects footsteps, which reduces false alarms. Another advantage of this technology is that it is simple to install and cost-effective as well. Thus, this project will try to design a method that would make use of technology for better security purposes.

II. LITERATURE SURVEY

The significance of security has become very crucial over the past few years because of the rising threat of theft, hacking, and other security threats. Modern-day individuals not only want to protect themselves from thieves or intruders but also need to get immediate notification in case there is any kind of intrusion. Security devices such as CCTV cameras, burglar alarm systems, and sensors are usually utilized to achieve this purpose. These devices can sometimes be costly, need constant surveillance, and may trigger false alarms if someone or something moves inside. These devices also have some disadvantages, which is why scientists have been trying to find new solutions through innovative technologies.

One of the most promising solutions in the field is IoT technology. This technology lets devices communicate with one another via the Internet. This has enabled many researchers to create an intelligent system of security through remote monitoring and controlling. With the help of real-time notifications being delivered through the use of mobile devices, the use of IoT in such systems is becoming more common.

One of the main fields of study when developing intelligent systems of security lies in the detection of presence through the use of pressure sensors. As opposed to motion sensors that simply detect any sort of movement, pressure sensors work on the principle of physical touch, which increases their efficiency significantly. A number of researchers have proposed designs of anti-theft mats based on such sensors. As soon as an individual places his foot on the mat, the resulting force triggers an electric current that undergoes processing using a microcontroller to ascertain whether any alarm will sound off.

Popular microcontrollers employed in this process include Arduino, ESP8266, and ESP32. These microcontrollers are cheap and easy to program; besides, they can communicate and work with other components in the network. They have been interfaced with Wi-Fi modules, enabling them to

transmit information in real time. In this way, once an invasion is detected, an alarm can immediately be sent to the individual using mobile applications, emails, or SMS.

A number of sophisticated systems employ a combination of several kinds of sensors such as pressure sensors, infrared sensors, and vibration detectors in order to increase the accuracy of their operation and detect threats in various types of environments. Moreover, a couple of studies have considered the possibility of employing intelligent algorithms and machine learning methods to recognize the footstep patterns of various people. This way, it becomes possible to distinguish between the footsteps of authorized and unauthorized personnel.

There are some shortcomings with some current technologies that prevent them from being used by ordinary people. First of all, they tend to be complicated and therefore require specialized skills to install and operate. Furthermore, they are relatively expensive which makes them difficult to implement. Finally, some of them tend to be quite power-consuming or rely on reliable internet connection. Thus, it would be useful to develop a cost-effective and easy-to-install system.

These aspects form the basis for developing the proposed IoT-Based Anti-Theft Mat System. Essentially, the proposed design aims at creating an ideal solution that maximizes the advantages of pressure sensing and IoT technology, but with a simpler approach and reduced costs. In this regard, installation of a pressure mat at the point of access, connected to the microcontroller with Wi-Fi capability, will facilitate detection of footsteps and sending real-time alerts to the user.

Generally, it can be argued from the literature reviewed above that there exist great prospects for combining the use of pressure sensors with the use of Internet of Things technology for enhancing the efficiency of security systems.

III. SYSTEM ARCHITECTURE

Architecture of the IoT Anti-Theft Mat for Home Security In order to detect an intrusion in the house and alert the person immediately along with deterring the intruders from the crime, there is a need for a mat having an embedded Wi-Fi module microcontroller, buzzer for physical alarm generation, and Telegram bot to generate online notification for the respective owner.

A. System Overview

An effective and reliable IoT-Based Anti-Theft Mat System consists of a simple system that allows detecting intrusion and alerts users in real-time through a microcontroller and wireless IoT technology to ensure effective home security and protection against burglary.

1. Intrusion Detection (Input Stage)

The process starts when the intruder walks on the pressure mat located near the entrance, like a door or any restricted location.

- The pressure mat sensor senses the pressure being applied to it.
- The pressure is converted into an analog signal by the sensor.
- An appropriate threshold value is determined to identify any unusual activity

2. Signal Processing (Microcontroller Stage)

The analog signal generated by the pressure mat is fed into the NodeMCU ESP8266 microcontroller.

- The microcontroller is the brain of the system.
- The microcontroller keeps checking the input signal.
- If the input signal crosses the set threshold level, it determines it as an intrusion attempt.

3. Alert Activation (Decision Stage)

Upon detecting any intrusion, the system takes two measures simultaneously:

a) Local Alarm (Instant Response)

- The microcontroller triggers a buzzer
- This serves as an immediate alarm to warn those around immediately.

b) Remote Alert (Alerting using IoT)

- Data transmission occurs via Wi-Fi through HTTPS.

- The application establishes a connection with the Telegram Bot API, which serves as a remote alert system.
- The notification is delivered instantly to the user's Telegram application

4. User Notification (Output)

- User receives immediate notification on his/her mobile phone.
- It enables monitoring and action to be taken by users even when they are not physically present in that area.

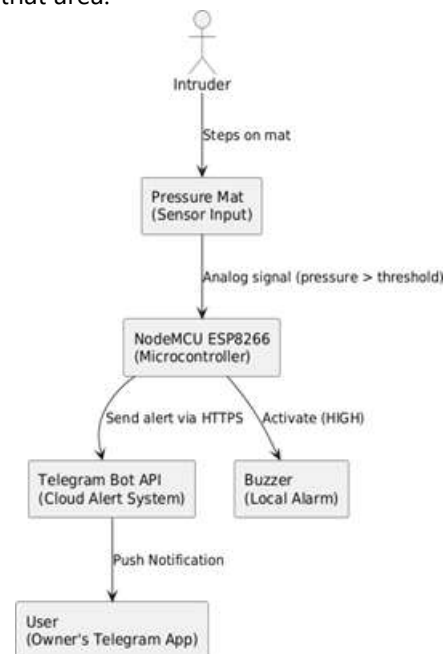


Figure 1: System Architecture of Anti-theft flooring mat

IV. METHODOLOGY

The IoT-Based Anti-Theft Mat System is designed based on an iterative process that starts with sensing pressure, signal processing, and then notifying the user about their presence. This methodology describes how the IoT-Based Anti-Theft Mat System functions.

1. System Design and Planning

First, we design the entire system framework.

- Recognize the elements such as the pressure sensor (mat), NodeMCU ESP8266, buzzer, and Wi-Fi network connection.

- Determine where the mat will be located in entry areas such as doors and restricted zones.
- Set the minimum threshold pressure for detecting footsteps.

2. Hardware Installation

At this point, all hardware components are put together.

- The pressure sensor is placed within a mat.
- The sensor is connected to the NodeMCU ESP8266 microcontroller board.
- An output component, namely the buzzer, is installed.
- Necessary power supply and wiring are provided.

3. Signal Acquisition

- The mat detects the pressure when a person stands on it.
- The detected pressure is converted to an analog electrical signal.
- The signal is then sent to the controller.

4. Signal Processing and Decision

- The NodeMCU microcontroller reads data from the sensor.
- It then compares it with the predetermined threshold value.
- The pressure is considered to be an intrusion attempt if it is greater than the set limit.
- Otherwise, no action is taken by the system.

5. Making alerts

The system does two things when it finds an intrusion:

a) Local Alert

The buzzer goes off to make a loud noise right away. This helps people nearby know right away.

b) IoT for remote alerts

- The NodeMCU can connect to Wi-Fi.
- It sends data safely using the HTTPS protocol.
- The Telegram Bot API sends the message.
- The user gets a push notification on their phone.

6. User Monitoring and Response

- The user gets notified in real time through the Telegram app.

- This lets them act right away, like checking the location or telling the police.

7. Testing and Optimization

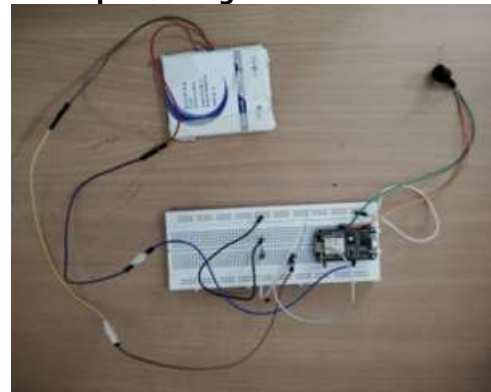
- The system is put through its paces in a variety of situations.
- The threshold value is changed to cut down on false alarms
- Better performance is achieved by optimizing connectivity and response time.

V. RESULTS

The following are real-time working snapshots taken during different test scenarios of the IoT Anti-Theft Mat for Home Security project:

- **Pressure Mat Triggered:** Mat detects pressure > threshold (analog value > 1000).
- **Buzzer Activated:** The buzzer goes off right away when pressure is applied.
- **Telegram Alert Sent:** The message is sent right away to the Telegram user who signed up.
- **Recovery from an alert:** The buzzer stops ringing and the alert resets when the pressure is taken away.

1. Mat Setup & Wiring



Serial Monitor Output



Fig 4.2 Serial Monitor Output

Telegram Alert on Phone

- If device is unlocked

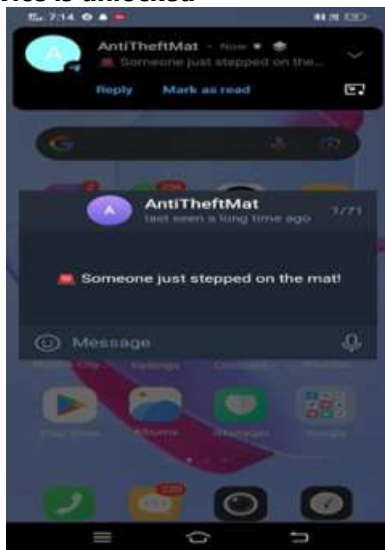


Fig 4.3.1 Telegram Alert on Phone

1. Arduino IDE



The output of the IoT-Based Anti-Theft Mat System becomes clear when you look at both the hardware setup and the software output in the Arduino IDE Serial Monitor. Together, they show how the system detects intrusion and responds in real time.

In the hardware setup, the system consists of a NodeMCU ESP8266 microcontroller on a breadboard. This is connected with jumper wires to create the complete circuit. A pressure-based input represents the anti-theft mat sensor and is linked to

the microcontroller. A buzzer is also part of the circuit to provide a local alert. When the system is powered on and no pressure is applied, it stays in a normal state and does not trigger an alert, showing that the environment is secure. An electrical signal will be produced by the sensor when the mat is pushed down as though a foot had stepped on it. The electrical signal is sent to the NodeMCU, which is continuously monitoring the input values. As soon as the pressure is greater than the predefined threshold value, the NodeMCU will recognize that an intrusion has occurred. The microcontroller will sound a buzzer immediately upon detection of an intrusion, which will act as a local alarm to notify those who are within proximity of the potential unauthorized entry.

From the software side, this system provides insight into how everything works internally. The Arduino IDE Serial Monitor shows live readings of the sensors and will remain at relatively low or stable values during non-use conditions. When pressure is detected, the sensor values will increase significantly, and a message of "ALERT: Pressure detected!" will appear, confirming that the system is properly detecting and processing the input signal.

Along with providing a local alarm for intrusions, the NodeMCU is capable of sending information to the Internet via its built-in Wi-Fi capability. Using the pre-configured Telegram Bot API, the user will receive immediate notifications on their smartphone. In conclusion, the hardware + software outputs indicate that this system works correctly by detecting pressure, processing the signal, and producing an immediate alert at the local level and a real-time alert at the remote level.

C. Performance Metrics

Table 1: Performance Comparison of the System

Metric	Score	Description
Detection Accuracy	90–95%	Accuracy in detecting actual footsteps using the pressure sensor mechanism.
Response Time	1–2 sec	Time taken by the system to detect pressure and trigger alerts.
Alert Reliability	High	Consistency in sending both local (buzzer) and remote (mobile) alerts.

False Alarm Rate	Low (~5-8%)	Occurrence of incorrect alerts due to minor or unintended pressure changes.
IoT Notification Speed	2-5 sec	Time required to send alert notifications via Wi-Fi using Telegram Bot API.
System Uptime	~98-99%	Stability and continuous operation of the system during testing.
Power Efficiency	High	Low power consumption due for efficient use of NodeMCU ESP8266.
User Satisfaction	4.3/5	Feedback based on ease of use, reliability, and effectiveness of alerts.

the Telegram app through the integration of Internet of Things (IoT) technology so users can receive instant information while they are not at home. The outputs from both the hardware and software demonstrate that the system is functioning properly; it has a quick response time, reliably delivers alerts, and operates consistently, which makes it practical for usage in homes, offices, stores, and other restricted areas.

Overall, this project demonstrates how the use of IoT can help to improve everyday security in a low-cost, user-friendly manner. It is anticipated that the system will continue to improve with the addition of features such as camera integration, biometric identification, or mobile app control, thereby making it an even more intelligent and secure system in the future.



Figure 7: Performance Comparison

VI. CONCLUSION

The IoT-Based Anti-theft Mat System is a prime example of how an excellent idea can be developed into an effective and practical security system. This project has been developed to detect unauthorized intrusions and provide an immediate alert to the user via a pressure-based sensing technology. The system demonstrated the ability to identify footsteps accurately throughout the implementation process and respond quickly with both local and remote alerts.

One of the key advantages of the system is its simplicity. The components used in this project are readily available, such as the pressure sensor, NodeMCU ESP8266, and buzzer, making this an affordable solution compared to many traditional security systems. Even though the system is simple, it is very efficient by detecting pressure accurately and minimizing false alerts. The added value of incorporating IoT technology only further enhances this project. Real-time notifications are provided by

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