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INTERNET OF THINGS (IOT) BASED ANTITHEFT STRATEGY (ATS), ENHANCEMENT IN THE THEFT IMAGE NOTIFICATION

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ABSTRACT: *Safety and security are paramount in today's society, increasing the need for effective antitheft measures. This paper presents an Antitheft Strategy (ATS) based on the Internet of Things (IoT), which focuses on improving visual theft image notification systems using IoT technology and advanced image processing. The ATS system aims to improve the accuracy of theft detection and reduce risk. It covers design, implementation, and evaluation and demonstrates the potential of IoT-based solutions to strengthen security measures. Safety and security considerations require effective antitheft measures. In this regard, the paper proposes ATS using Raspberry Pi (RP) and required image enhancing for real-time theft detection and notification. The system uses the camera and PIR (passive infrared) sensor, which detects movement. Additionally, a cost-effective intrusion detection system notifies owners and neighbors regardless of unauthorized activity, thus improving security. The need for security frameworks cannot be overstated.*

In this paper we offer a security investigation system capable of conducting intrusion investigation and notifying owners via a mobile application. Our system autonomously detects motion and sends instant notifications and images of intruders. This study introduces an economical intrusion detection system employing human detection algorithms and IoT-based applications for remote monitoring and notification via three mediums: text message, alarm/lighting, and theft image notifications or transformations on the web. The researcher concentrated on enhancing image quality for effective detection, with detailed analysis to be conducted by the antitheft agency or security personnel. Traditional surveillance systems lack scalability and require continuous monitoring. However, an IoT-based theft detection system using Raspberry Pi (RP) includes real-time image capturing and its processing to detect thieves by movement. Images are transmitted over the Internet for online viewing and stored for later review. The system improves the accuracy of theft detection and reduces risks ultimately by means of image processing using Matlab IP tools. Additionally, in this research study, open-source platforms like Python and PHP are also utilized to complement the building blocks of the ATS-IoT system, which is applied in various places like offices, homes, and ATM shops for security.

Keywords: *Matlab, Motion Detection, Image Processing, Burglar Detection, Android Notification, Buzzer, Alarm.*

I. NTRODUCTION

This particular research paper discusses the today's technology-driven era focuses towards the securing our homes, banks, ATMs and businesses places. The goal of this research is to create a system that uses Raspberry Pi controlled cameras to detect and prevent intruders. Sensors trigger the camera when motion is detected and send images to the owner via Wi-Fi to quickly counter potential thefts.

Ensuring security is increasingly important in today's society in various areas, including housing, business and public spaces. The increase in thefts and unauthorized intrusions highlights the need for effective anti-theft measures that not only detect incidents, but also provide timely notifications to effectively mitigate risks. This research paper presents an innovative anti-theft strategy (ATS) based on the principles of Internet of Things (IoT) technology to address these challenges. The IoT paradigm has emerged as a transformative force that brings connectivity and intelligence to everyday objects and

environments. Using this technological framework, the proposed ATS aims to transform traditional theft detection and notification systems by using advanced image processing techniques and real-time communication capabilities. By integrating IoT-enabled devices such as Raspberry Pi (RP) and related sensors, an ATS system aims to improve the accuracy and efficiency of theft detection and minimize false alarms and security breaches [4].

The keystone of an ATS system is its capability to combines hardware and software components to create a complete Anti-theft solution. Using the Raspberry Pi as a versatile computing platform with motion sensors and high-resolution cameras, the system can detect intrusions and capture relevant visual data in real time. Then, advanced image processing algorithms implemented with tools such as Matlab analyze the captured images to accurately identify potential threats.

In addition, the ATS system prioritizes seamless communication and notification mechanisms to ensure rapid response and intervention in the event of a security. The integration of mobile applications and web interfaces, the system facilitates immediate alerts and notifications to owners, security personnel and relevant stakeholders. Using various communication channels such as text messages, alerts and visual alerts, the ATS system maximizes situational awareness and enables proactive security measures. In addition, the study emphasizes the importance of cost-effectiveness and scalability when implementing anti-theft solutions in various areas. Environments using open source platforms and using readily available IoT components, the proposed ATS system provides an economical and adaptable alternative to traditional security systems. This scalability ensures that the ATS framework can be used in various environments such as residential, commercial enterprises and public infrastructures to effectively respond to evolving security challenges [3]

In conclusion, this research presents an innovative approach to anti-theft strategies by exploiting the power of IoT technology. Combining hardware innovations, advanced image processing algorithms and seamless communication protocols, the offered ATS system promises to improve security measures, reduce risks and protect assets in today's dynamic and interconnected world.

One of the main issues is the need for innovative solutions to battle the ever-increasing theft and unauthorized use. In this sense research paper aims towards development of an IoT-based Anti-Theft System (ATS). The goal is to use the capabilities of Internet of Things technologies to create a strong and intelligent information security framework. In today's technologically advanced world, the Internet of Things (IoT) has emerged as a revolutionary force that connects devices and enables their seamless communication. One area where IoT can have a significant impact is security, specifically the development of anti-theft systems (ATS). Growing theft and security challenges require innovative solutions that can harness the power of the Internet of Things to improve protection and accountability [1].

II. RESEARCH METHODOLOGY

Designing an Antitheft System (ATS) using IoT involves mixing various sensors, communication devices, and smart technologies to create a robust security solution. This section follows the general guide on the architectural design of an anti-theft system using IoT. By carefully designing the architecture of the anti-theft system (ATS) using IoT, we can create a comprehensive and efficient solution for protecting assets and properties. Regular

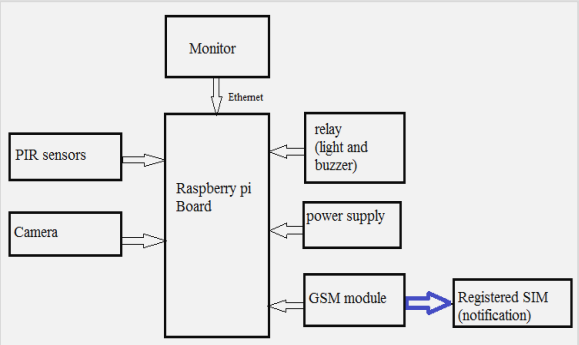

Fig. (1) : Block Diagram of ATS-IOT

updates and improvements based on evolving technologies and threat landscapes are crucial for maintaining the system's effectiveness. With the help of block diagram which is as shown in the Figure (1) the following section describes the architectural design procedure of each part of the ATS:

-Server Module:

Server module is nothing but the Raspberry pi module which acts as server; the radiations are received from PIR sensors which is nothing but input. Then it is activated in the relay module. When image is captured it is stored in Raspberry pi. It is also responsible for activating GSM module for notification purpose.

-GSM Module:

When GSM Module is triggered it will send the notification through SMS to owner of the system. This module contains the registered SIM. This module works from 850 MHz to 1900 MHz frequency band. For working of GSM model signal range is required for SIM which we are using. Such single range is depends up on the place to place.

-Instrumentation and Components:

The entire system instrumentation is based on the IoT and its devices with required platform. In this instrumentation section the following major components / hardware equipment have been used:

1. The Raspberry Pi 3, Model B+, 1GB RAM.
2. The camera module V2.
3. PIR Sensor (Motion detector)
4. GSM (Global System for Mobile Communication)

For the design and development purpose the above mentioned components/hardware are used to integrate the ATS-IoT (Antitheft system-Internet of Things).

-The Raspberry Pi 3:

In this ATS-IOT diagram the Raspberry Pi 3 serves as the most crucial component. Functioning akin to a mini desktop computer with Linux-based operating systems, it boasts various models, yet in this scenario, the Raspberry Pi 3 Model B is employed. Key features of the Model B include an Ethernet port, four USB 2.0 ports, audio input/output, HDMI output, and general-purpose input/output (GPIO).

The general outer structure of the Raspberry Pi is depicted on its board, as shown in Figure (2) A standout feature of the Raspberry Pi is the row of GPIO (general-purpose input/output) pins along the top edge of the board. It is low-cost, roughly the size of an ATM card.

These pins facilitate physical interfacing between the Pi and external IoT devices. They are utilized for input and output purposes, enabling the Pi to toggle between on and off states. Out of the 40 pins, 26 are GPIO pins, while the others are power or ground pins, with two ID EEPROM pins. Additionally, it features an easy-to-use micro SD version with a push-push facility. In this specific instrumentation, it functions as a server, capable of capturing and storing images.

The GPIO pins on the Raspberry Pi support three communication protocols, initially disabled in standard mode. Enabling the RPi protocol configuration is vital for utilizing these communication channels, thereby expanding the Pi's capabilities. One such protocol is the Serial Peripheral Interface (SPI), developed by Motorola in the late 1980s and subsequently adopted as a universal standard. SPI facilitates serial communication with digital devices, commonly utilized for short-distance communication within embedded systems.

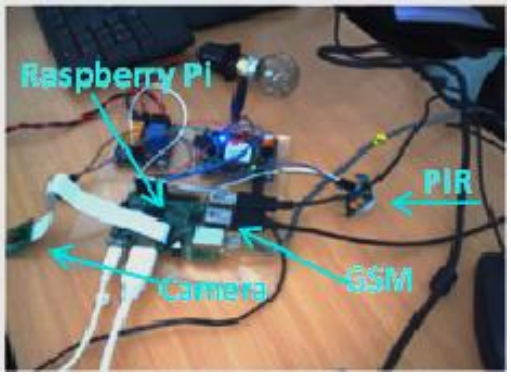

Fig.(2): ATS-IoT- Raspberry Pi, GSM, PIR

-PIR (Passive Infrared):

Passive Infrared (PIR) sensors, also called Pyroelectric Infrared sensors, detect motion by sensing changes in infrared radiation. They use a Pyroelectric sensor that generates electric charge in response to temperature changes. Components include the sensor divided into sections for different detection areas, a lens to focus infrared radiation, and optionally a filter to limit detected radiation. Housed in a protective casing, PIR sensors can adjust their field of view its adjustable position is shon in the Figure (2)

-GSM-SIM (Global System for Mobile Communication):

This particular system is used over any telecommunication network. Here GSM is used to send and receive text message which helps to alert message to avoid the theft. Thus for configuration the entire systems the design procedure starts from its architecture and block diagram and ends to its actual connections and installation of the all components. Entire developed system prototype is as shown in the Figure (2). This uses the knowledge of basic principles and of physical characteristics of each component. In this way the system is developed and kept ready for the operational use of it in actual application. The next section focuses on the execution, testing of the designed and developed system by means of software development using python software on the IoT platform [8].

III. ATS-IoT IMPLEMENTATION

The ATS system is implemented using Raspberry Pi and various sensors. The process involves configuring the Raspberry Pi with Raspberryian Software, connecting components like the Pi camera, SD card, display, keyboard, mouse, LAN, and power adapter. Operational

steps include connecting the camera, inserting the SD card, booting the Pi, and performing initial configuration without automatically starting the graphical interface. Tools and techniques utilized include enabling the camera through the Pi Software Configuration Tool Menu, installing motion detection software via the command line, and programming in Python to control the PIR sensor and trigger the camera for image capturing, is presented in the operational and processes disarm *(ref. Fig.(3,4))*.

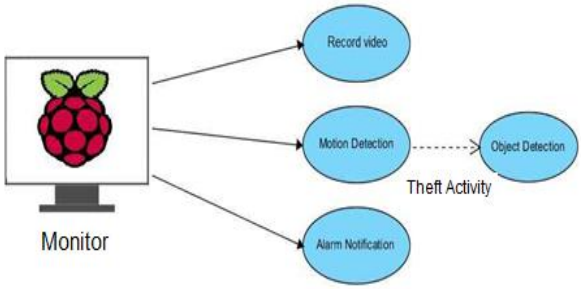

Fig.(3): ATS Process Diagram

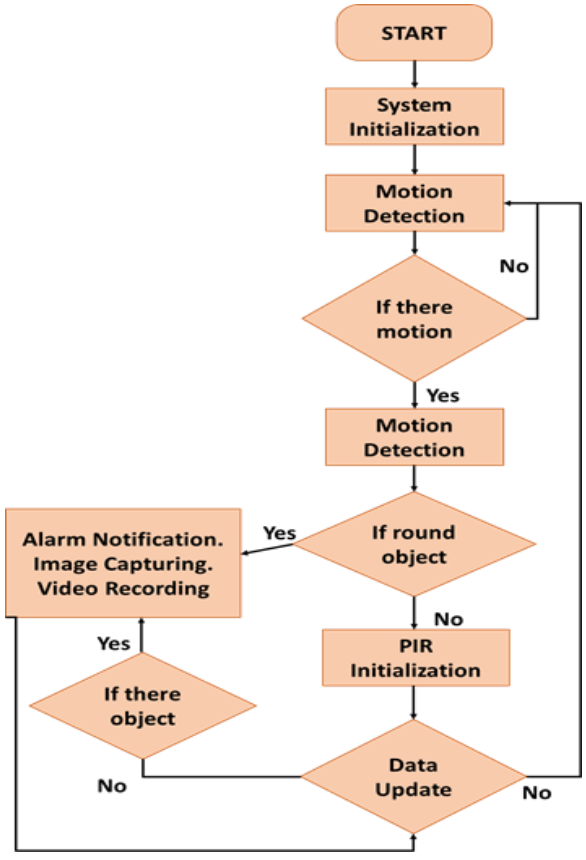

Fig. (4): System Flow Diagram (ATS-IoT)

The Python programming techniques are employed for efficient execution on its platform. Theft processes are thoroughly studied, and the utilization of these programming features is guided by logic. Hardware utilized in these projects is optimized for efficient functionality. The algorithmic outcome operates automatically, minimizing human intervention in the antitheft process. The integration of Python code and PHP-designed web pages into IoT platforms fulfils the research objectives. Raspberry Pi serves as a cost-effective minicomputer, streamlining hardware and software networking for optimal system performance, as illustrated in the system of ATS-IOT's process flow *(ref. figure (3))* and flow diagram as shown in the Figure (4).

The program is excited and code and system automatically retrieves required outputs. The ATS system, as depicted in the process flow diagram, extracts theft-related information for further action, as outlined in the Raspberry Pi manual we have standardized operating procedures includes:

- Motion detection using the PIR sensor.
- ✓ **Text message alerts via GSM to notify property owners.**
- ✓ **Alarm notifications to deter theft.**
- ✓ **Theft Image generation, Video recording of disturbances or object movements.**

Result: The theft/thief image capturing process involves the USB camera receiving triggers from the ATS, activating its imaging components, and capturing a series of still images or video clips. High resolution, low-light capabilities, and a wide field of view ensure clear images even in challenging conditions, aiding in theft identification. In this case, the important output is capturing the theft activity images. However, sometimes the number of captured images lacks quality, leading to difficulties in detecting and identifying theft activities at the time of the incident.

To overcome this crucial problem, this research paper aims to utilize image processing techniques, where the processed images are then sent for further analysis. Theft image enhancement is introduced using Matlab's Image processing tools.

Here it is important to observed that the ATS-IoT system noticing the theft alert to the neighbor by ringing alarm (abbot theft) at the same time text message send to the owner of the property (house, shop, ATM etc.) and also security authority get the theft images for theft identification and detection place and Burglar's activity (motion).

IV. THEFT IMAGE ENHANCEMENT

A high-contrast and bright image is referred to as a fine-quality image; on the other hand, low contrast and poorly defined edge boundaries indicate a poor-quality image. Image enhancement is the process of transforming a low-

quality image into a high-quality one so that computer analysis or human perception can better understand it. To implement theft image processing techniques for making the theft image superior to the original theft image captured by ATS-IOT. Therefore, the research discussed in this section focuses on employing the technique to enhance the damaged theft image (image processing) to improve image quality for clearer identification of theft, thus achieving the research target of theft prevention which is as shown in Figure (5). In this case evaluation of the theft images is carried out by using Matlab Image Processing Technique (MIPT). The algorithm is developed and tested.

Algorithm (Theft Image Processing):

1. Input metrics for original and enhanced images.
2. Compare mean intensity, MSE, MLI, and PSNR between the original and enhanced images.

(a) Original theft Image **(b) Enhanced image**

Fig. (5): Result: Image Processing of Theft Images

3. If any metric shows significant differences, indicate potential alterations.
4. Otherwise, conclude no alterations detected.

The program is executed and gives the results which are tabulated in the Table (1).

Table (1): Comparison of Ordinal and Enhanced Image

Image type	Mean	MSE	MLI	PSNR
Original	108.8707	0	1	0
Enhanced	127.517	760.0806	0.85377	19.3222

On the basis of above results and considering these metrics, it seems that the enhanced image exhibits significant differences compared to the original, including changes in mean intensity, MSE, MLI, and PSNR. These differences strongly indicate potential theft or unauthorized alterations in the enhanced image. Further analysis and possibly image processing techniques would be advisable to confirm and identify the specific alterations made to the particularly in theft image.

V. CONCLUSION

The paper presents an IoT-based anti-theft strategy (ATS) that uses Raspberry Pi and sensors for automatic theft detection and notification. It addresses the problem of low-quality stolen images by providing suggestions for improvement using Matlab's image processing tools. Using an algorithmic comparison, significant differences between the original and enhanced images indicate possible theft. ATS system demonstrates efficiency by providing accurate results and quickly informing users and security agencies, improving security measures.

VI. FUTURE SCOPE

Overall, the future scope of the proposed ATS system involves leveraging emerging technologies, enhancing system capabilities, and fostering collaboration with stakeholders to create more robust and intelligent solutions for theft prevention and security enhancement.

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