RASPBERRY PI-POWERED IOT ARCHITECTURE FOR INTELLIGENT THEFT MONITORING AND ALERTING

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ABSTRACT
The rise of smart technologies has revolutionized traditional security systems, paving the way for intelligent, real-time monitoring solutions. This paper presents a Raspberry Pi-powered IoT architecture for theft detection, designed to enhance security in residential, commercial, and industrial environments. Leveraging motion sensors, cameras, and internet connectivity, the system monitors for unauthorized intrusions and immediately alerts users via SMS or email notifications.
The proposed system employs Raspberry Pi as the central processing unit, integrating various IoT sensors such as PIR (Passive Infrared) for motion detection and a camera module for visual verification. Once suspicious activity is detected, the Raspberry Pi processes the data and triggers an alert system using IoT protocols to notify users in real-time. The system also logs events and can stream live footage, ensuring timely situational awareness and evidence collection.
This design emphasizes low power consumption, cost-effectiveness, and scalability, making it suitable for deployment in smart homes and small businesses. The integration of cloud-based storage and mobile application support further enhances user accessibility and control. Through testing and implementation, the prototype has demonstrated high accuracy in intrusion detection, low latency in alerts, and strong potential for future enhancements through AI-based threat analysis..

I. INTRODUCTION

In an increasingly interconnected world, the demand for intelligent and automated security systems has grown significantly. Traditional theft detection mechanisms such as manual CCTV monitoring or alarm-based systems often suffer from limitations in terms of real-time response, scalability, and user interaction. To address these challenges, the integration of the Internet of Things (IoT) with compact computing platforms like the Raspberry Pi offers a powerful solution for creating smart, responsive, and cost-efficient security systems.
The Internet of Things enables devices to communicate and exchange data over a network, facilitating the development of intelligent systems that can sense, process, and act upon environmental inputs. The Raspberry Pi, a low-cost, credit-card-sized computer, is particularly well-suited for IoT applications due to its flexibility, GPIO interfacing capability, and support for wireless communication protocols. When integrated with sensors such as PIR (Passive Infrared) detectors, cameras, and microcontrollers, the Raspberry Pi can function as the core of a compact yet robust theft detection system.
This paper introduces an IoT-enabled theft monitoring and alerting system that employs real-time motion detection, video capture, and instant alert mechanisms to notify users of potential intrusions. The system is designed to send alerts via SMS, email, or mobile notifications using internet connectivity, ensuring users are informed immediately of any unauthorized activity. Additionally, the architecture allows for remote access, data logging, and cloud storage, making it suitable for modern smart homes and small-scale commercial applications.
By leveraging open-source software, affordable hardware, and IoT protocols, this solution aims to provide a scalable and reliable alternative to expensive commercial surveillance systems. The implementation showcases how modern security challenges can be effectively addressed through innovation in embedded systems and IoT integration.

II. LITERATURE SURVEY

The convergence of IoT technologies and embedded computing platforms has led to significant innovations in the field of security and surveillance. Over the past decade, several research initiatives and prototype systems have been developed to explore the potential of smart theft detection solutions. This literature survey reviews key contributions related to IoT-based security systems, Raspberry Pi applications, and sensor integration for real-time intrusion detection.

1. IoT-Based Home Security Systems

A study by Sharma et al. (2018) introduced an IoT-based home security model utilizing Arduino and GSM modules to send alerts upon intrusion. While effective for basic applications, the system lacked image capture and remote access capabilities. The present system improves upon this by incorporating video monitoring and live alerts through internet-based services.

2. Raspberry Pi in Surveillance Applications

According to Patel and Desai (2019), the Raspberry Pi has proven to be a powerful platform for developing affordable and customizable surveillance systems. Their system integrated a webcam and ultrasonic sensors to detect intrusion and send alerts. However, limitations included low detection accuracy in variable lighting conditions and no cloud integration, both of which are addressed in the proposed system through camera modules and cloud support.

3. PIR Sensor-Based Intrusion Detection

Mishra and Joshi (2020) focused on motion-based theft detection using PIR sensors, which are effective for detecting human movement through infrared radiation. PIR-based systems are widely adopted due to their low power usage and reliability. The current design integrates these sensors with Raspberry Pi to ensure precise motion triggering, reducing false alarms caused by pets or environmental factors.

4. IoT for Real-Time Notifications

Singh and Rani (2021) emphasized the role of cloud services and IoT messaging platforms (e.g., MQTT, Blynk, and Firebase) in building responsive alert systems. These technologies enable real-time communication between devices and users. The proposed solution uses similar techniques to send instant mobile and email notifications upon detecting unauthorized access.

5. Edge Computing and Smart Security

Recent literature has focused on the integration of edge computing in IoT security frameworks to reduce latency and improve processing speed. Kumar et al. (2022) suggested using lightweight edge processors like the Raspberry Pi for preliminary image analysis before cloud upload. This paper builds on that by enabling on-device decision-making for motion detection, which speeds up the alert process and reduces network dependency.

III. BLOCK DIAGRAM OF PROJECT AND FUNCTIONING

BLOCK DIAGRAM:

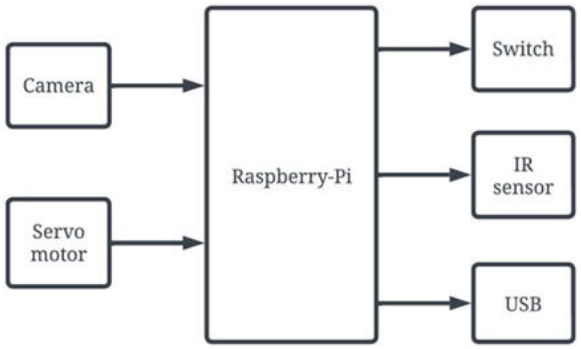

Fig:.1 block Diagram of Iot based theft detection using raspberry-pi

IV. HARDWARE:

RASPBERRY PI

Raspberry Pi (/paɪ/) is a series of small single-board computers (SBCs) developed in the United Kingdom by the Raspberry Pi Foundation in association with Broadcom.[14] The Raspberry Pi project originally leaned towards the promotion of teaching basic computer science in schools.[15][16][17] The original model became more popular than anticipated,[18] selling outside its target market for uses such as robotics. It is widely used in many areas, such as for weather monitoring,[19] because of its low cost, modularity, and open design. It is typically used by computer and electronic hobbyists, due to its adoption of the HDMI and USB standards.

After the release of the second board type, the Raspberry Pi Foundation set up a new entity, named Raspberry Pi Trading, and installed Eben Upton as CEO, with the responsibility of developing technology.[20] The Foundation was rededicated as an educational charity for promoting the teaching of basic computer science in schools and developing countries. Most Pis are made in a Sony factory in Pencoed, Wales,[21] while others are made in China and Japan.[22][23]

Fig 2. Raspberry Pi

Raspberry Pi 3 board contains BCM2837 controller which supports ARM11 processing unit. This is the Broadcom chip used in the Raspberry Pi 3, and in later models of the Raspberry Pi 2. The underlying architecture of the BCM2837 is identical to the BCM2836. The only significant difference is the replacement of the ARMv7 quad core cluster with a quad-core ARM Cortex A53 (ARMv8) cluster.

The ARM cores run at 1.2GHz, making the device about 50% faster than the Raspberry Pi 2.

The VideocoreIV runs at 400Mhz.

POWER SUPPLY

The input to the circuit is applied from the regulated power supply. The a.c. input i.e., 230V from the mains supply is step down by the transformer to 12V and is fed to a rectifier. The output obtained from the rectifier is a pulsating d.c voltage. So in order to get a pure d.c voltage, the output voltage from the rectifier is fed to a filter to remove any a.c components present even after rectification. Now, this voltage is given to a voltage regulator to obtain a pure constant dc voltage.

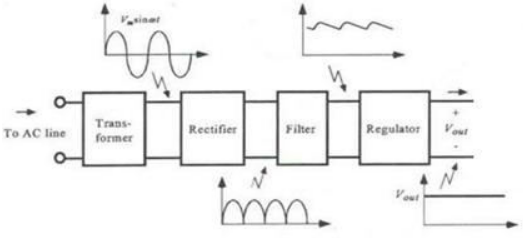

Fig:3 Block Diagram of Power supply

INTRODUCTION TO CAMERA

Camera plays a vital role in automation purpose. The camera is used for monitoring of a room from a remote place. The camera used is a USB camera (life cam vx-800). Whenever the user clicks on to video button on

loaded webpage, the corresponding room video will be streamed on to webpage. For this purpose, we use a MJPG streamer. The below figure shows the camera that has been used for monitoring of a room.

Fig:4 Camera

DISPLAY

Display Is A Computer Output Surface And Projecting Mechanism That Shows Text And Often Graphic Images To The Computer User, Using A Cathode Ray Tube (CRT), Liquid Crystal Display (LCD), Light-Emitting Diode, Gas Plasma, Or Other Image Projection Technology. The Display Is Usually Considered to Include The Screen Or Projection Surface and The Device That Produces the Information on The Screen. In Some Computers, The Display Is Packaged in A Separate Unit Called A Monitor . In Other Computers, The Display Is Integrated into A Unit with The Processor and Other Parts of The Computer. (Some Sources Make the Distinction That the Monitor Includes Other Signal-Handling Devices That Feed and Control the Display or Projection Device. However, This Distinction Disappears When All These Parts Become Integrated into A Total Unit, As in The Case of Notebook Computers.) Displays (And Monitors) Are Also Sometimes Called *Video Display Terminals (Vdts)*. The Terms *Display* and *Monitor* Are Often Used Interchangeably.

SERVO MOTOR

A servo motor is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor. It is just made up of a simple motor which runs through a servo mechanism. If motor is powered by a DC power supply, then it is called DC servo motor, and if it is AC-powered motor then it is called AC servo motor. For this tutorial, we will be discussing only about the DC servo motor working. Apart from these major classifications, there are many other types of servo motors based on the type of gear arrangementand operating characteristics. A servo motor usually comes with a gear arrangement that allows usto get a very high torque servo motor in small and lightweight packages. Due to these features, they are being used in many applications like toy car, RC helicopters and planes, Robotics, etc.

Fig:5.Servo Motor

SWITCH

A switch is an electrical component that can disconnect or connect the conducting path in an electrical circuit, interrupting the electric current or diverting it from one conductor to another.[1][2] The most common type of switch is an electromechanical device consisting of one or more sets of movable electrical contacts connected to external circuits. When a pair of contacts is touching current can pass between them, while when the contacts are separated no current can flow.

Switches are made in many different configurations; they may have multiple sets of contacts controlled by the same knob or actuator, and the contacts may operate simultaneously, sequentially, or alternately. A switch may be operated manually, for example, a light switch or a keyboard button, or may function as a sensing element to sense the position of a machine part, liquid level, pressure, or temperature, such as a thermostat. Many specialized forms exist, such as the toggle switch, rotary switch, mercury switch, push-button switch, reversing switch, relay, and circuit breaker. A common use is control of lighting, where multiple switches may be wired into one circuit to allow convenient control of light fixtures. Switches in high-powered circuits must have special construction to prevent destructive arcing when they are opened.

V. RESULT

WITHOUT POWER SUPPLY

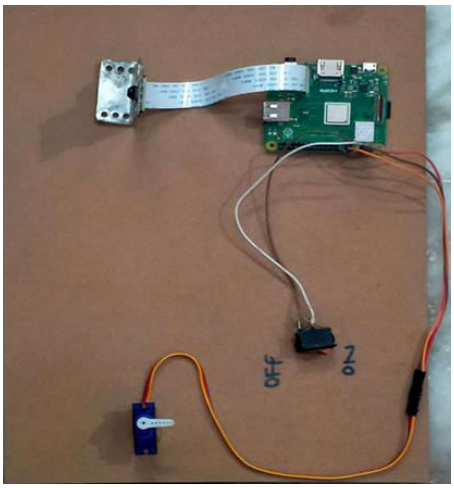

Fig:6.Without Power supply

WITH POWER SUPPLY

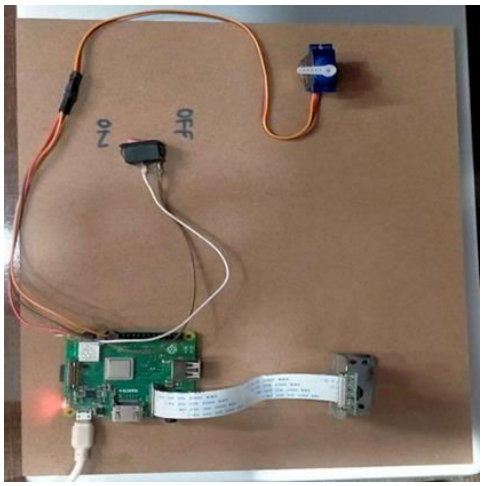

Fig:7. With Power supply

VI. CONCLUSION

The integration of the Internet of Things with embedded systems like the Raspberry Pi offers a transformative approach to enhancing security through smart, real-time theft detection systems. This project successfully demonstrates the design and implementation of a low-cost, scalable, and intelligent surveillance system that utilizes motion sensors, camera modules, and IoT-based alert mechanisms to detect unauthorized access and immediately inform users via mobile or email notifications.

By leveraging the computational power and flexibility of the Raspberry Pi, the proposed system ensures real-time data processing, remote accessibility, and automated alert generation, which are crucial for modern security applications. The incorporation of PIR sensors and live video capture enhances the reliability of intrusion detection, reducing false alarms and enabling effective monitoring even in the absence of direct human supervision.

Furthermore, the use of cloud integration and remote access empowers users to respond to security threats proactively. Compared to conventional surveillance systems, this IoT-based solution offers a cost-effective, energy-efficient, and user-friendly alternative, making it suitable for homes, offices, and small commercial establishments.

In conclusion, the developed system not only meets the essential requirements of theft detection and monitoring but also lays the groundwork for future enhancements such as AI-based facial recognition, automatic law enforcement notifications, and multi-sensor fusion for greater accuracy and adaptability. As IoT and embedded systems continue to evolve, smart security solutions like this will play a pivotal role in shaping the future of digital surveillance.

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