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Motion Sensing Security Camera

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ABSTRACT: The motion sensing security camera is a cutting-edge solution designed to enhance home and small business security. This project integrates an ESP32-CAM module, PIR sensors, and a servo motor to create an automated surveillance system. The PIR sensors detect motion in their respective directions, prompting the servo motor to rotate towards the detected motion. Simultaneously, the ESP32-CAM captures an image as soon as the servo motor adjusts its position. The captured image is then promptly sent and stored on a designated Google Drive account through the Google Drive API, providing a real-time security monitoring solution. This system offers a combination of motion sensing, image capture, and cloud integration, enhancing the capabilities of traditional security cameras for efficient and immediate response to detected motion events.

KEYWORDS: (ESP32 Cam Module , PIR sensor , Servo Motor , Google Drive API , Cloud Integration)

I. INTRODUCTION

Motion sensing security camera project represents a fusion of cutting-edge hardware and software technologies to create an intelligent surveillance system. leveraging the capabilities of the esp32-cam module, this project focuses on enhancing traditional security cameras by incorporating dynamic motion sensing and response mechanisms. passive infrared (pir) sensors serve as the system's eyes, detecting motion within their range. upon detection, a servo motor repositions the esp32-cam to capture images in the direction of the detected motion, providing an adaptive and responsive security solution as an integral part of this project, the esp32-cam module serves as the central processing unit, orchestrating the motion-sensing mechanism and facilitating real-time image capture. the servo motor, controlled by the esp32, dynamically adjusts the camera's orientation, ensuring that potential security breaches are captured with precision. additionally, the project integrates with google drive through the google drive API , enabling secure cloud-based storage of the captured images. this seamless cloud integration not only ensures data reliability but also facilitates remote access to the captured images, elevating the project's surveillance capabilities in essence, the motion sensing security camera project is at the forefront of modern security solutions, where responsiveness, adaptability, and cloud integration converge to redefine the landscape of surveillance technology. from motion detection to image capture and secure cloud storage, this project embodies a comprehensive approach to meeting the evolving needs of security and surveillance in a technologically advanced era.

II. RELATED WORK

The development of motion-sensing security systems has seen significant advancements in recent years, driven by the integration of various sensors, microcontrollers, and cloud services to enhance security and surveillance capabilities. This section reviews the current state of research and development in this domain, with a focus on technologies relevant to the project. The work in this paper is divided in two stages. 1) Text- Detection 2) Inpainting. Text detection is done by applying morphological open-close and close-open filters and combines the images. Thereafter, gradient is applied to detect the edges followed by thresholding and morphological dilation, erosion operation. Then, connected component labelling is performed to label each object separately. Finally, the set of selection criteria is applied to filter out non text regions. After text detection, text inpainting is accomplished by using examples based Inpainting algorithm.

- Motion Sensing and Image Capture

Previous research has extensively explored the use of Passive Infrared (PIR) sensors for motion detection in security applications. PIR sensors are widely recognized for their effectiveness in detecting motion based on infrared radiation emitted by warm objects, typically humans, which triggers subsequent actions in a security system. Studies have demonstrated the successful deployment of PIR sensors in home security systems, highlighting their reliability and low power consumption as key advantages .The ESP32-CAM module, equipped with a high-resolution camera, has been increasingly adopted in various surveillance and IoT projects due to its compact size, low cost, and integrated Wi-Fi capabilities. Research has shown that the ESP32-CAM can effectively capture and transmit images in response to motion detection events, making it a suitable choice for real-time monitoring applications . The module's integration

with cloud platforms enables remote access and storage of captured images, thus enhancing the accessibility and scalability of security systems.

- Servo Motor Integration

Servo motors play a crucial role in orienting cameras towards detected motion, thereby expanding the field of view and ensuring that relevant events are captured comprehensively. The combination of PIR sensors with servo motors has been explored in several studies, demonstrating that such systems can effectively track and respond to motion across multiple directions. This approach enhances the dynamic response capability of security systems, ensuring that no significant movement goes unnoticed.

- Cloud Integration

The integration of cloud services in security systems is a significant trend that leverages the benefits of remote storage, real-time access, and enhanced data management. The Google Drive API, for instance, provides a robust platform for storing and accessing security footage. Research has highlighted the advantages of using cloud-based storage for security applications, such as increased reliability, data redundancy, and the ability to access footage from any location.

- Comparative Systems

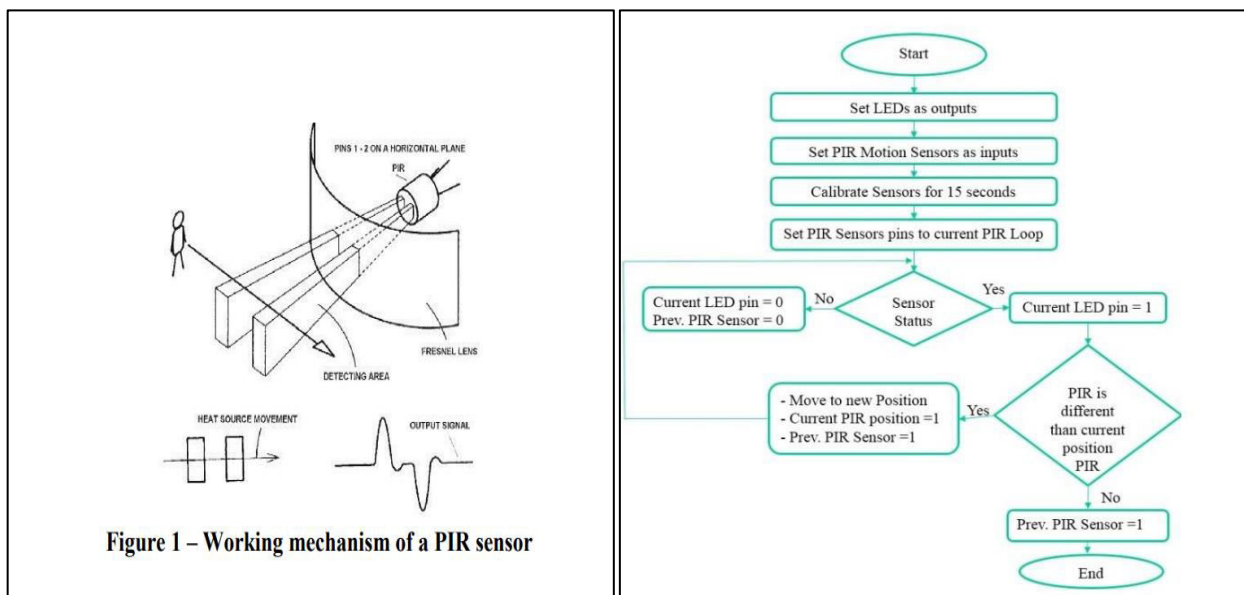
Several existing systems combine motion sensing, image capture, and cloud integration, but they often rely on more complex and expensive hardware. For instance, commercial solutions like Ring and Nest provide comprehensive security monitoring with advanced features such as facial recognition and two-way audio. However, these systems can be cost-prohibitive for small businesses and home users. The proposed project, which utilizes the cost-effective ESP32-CAM and PIR sensors, offers a more affordable alternative without compromising on essential security features.

III. METHODOLOGY

A. Working principle (PIR sensor) PIR Sensor :

The PIR sensor is the core component of the system. The working principle is based on infrared (IR) radiation. The PIR sensor has two slots with each slot made of a special material that is sensitive to IR. When a warm body like a human or animal passes by on front of the sensor, it first intercepts one half of the PIR sensor, which causes a positive differential change between the two halves. When the warm body leaves the sensing area, the reverse happens, whereby the sensor generates a negative differential change. These differential pulses are the signals being detected. Figure 1 describes the working mechanism of the PIR sensor. The sensor (Figure 2) is widely used in security system to detect the motion of human.

Flowchart:



PIR sensor Code :

```

For(int count = 0; count < 100; count++ ){
  pirVal 1 = digitalRead(PIR1);
  ... (do the same for other PIR sensors)

  if(pirVal_1 == HIGH){
    count1 = count1 + 1;
    ave1 = 7*ave1/10 + 3*count1/10;
    ... (do the same for other PIR sensors)

    if(ave1 > (ave2 && ave3 && ave4)){
      Serial.println("Motion Detected on PIR 1");
      pos = pos1;
      ... (do the same for other PIR sensors)
    }
    servo.write(pos); //turns the servo motor to the defined angle of
    rotation
  }
}

```

IV. EXPERIMENTAL RESULTS

The motion-sensing security camera project has yielded positive results, demonstrating effective motion detection and tracking capabilities. the pir sensor accurately detects motion, triggering the esp32-cam to capture images or record video. the servo motor-driven pan and tilt functionality enables the camera to actively follow and track detected motion, providing comprehensive coverage of the monitored area. the system's wireless connectivity facilitates real-time monitoring and remote access, enhancing its usability. overall, the project successfully combines hardware and software components to create a reliable and user-friendly motion-sensing security camera system with the potential for further enhancements and applications in smart security solutions.



V. CONCLUSION

In conclusion, the integration of the ESP32-CAM module, PIR sensor, and servo motor in motion-sensing security cameras represents a cutting-edge solution that combines wireless connectivity, accurate motion detection, and dynamic tracking capabilities. This system not only enhances security with real-time alerts and reduced false alarms but also offers the flexibility of remote monitoring. The inclusion of a servo motor enables active surveillance through pan and tilt functionality, providing a comprehensive view of the surroundings and acting as a deterrent to potential intruders. This innovative combination signifies a significant advancement in smart security technology, offering both efficiency and user-friendly features for diverse applications in home, office, or industrial settings.

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