

Motion-Activated Surveillance System Using Raspberry PI

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Abstract: This research presents the development of a motion-activated surveillance system using a Raspberry Pi microcontroller. The primary motivation is to provide an affordable, real-time monitoring solution for security applications in residential or small-scale commercial settings. The system integrates a PIR (Passive Infrared) sensor to detect motion and instantly activates a camera to stream and record video footage. An audio alert via a buzzer is triggered simultaneously to notify occupants. Captured videos are stored on USB for offline viewing. Testing showed that the system responded within one second of motion detection and performed reliably under indoor and low-light conditions. This approach demonstrates a cost-effective and efficient way to enhance security infrastructure using open-source hardware.

Keywords: Raspberry Pi; PIR Sensor; Motion Detection; Surveillance System; Real-Time Monitoring

I. INTRODUCTION

Security has become a growing concern in urban and semi-urban areas. Traditional CCTV systems are often costly and power-intensive, especially when required to operate 24/7. The goal of this research is to develop a low-power, real-time surveillance system that activates only when motion is detected. By using a Raspberry Pi along with a PIR sensor, camera module, and audio alert mechanism, the proposed system achieves significant energy savings and improves recording efficiency.

II. RELATED WORK

Several researchers have explored motion-triggered systems using microcontrollers. Himani Shah et al. [3] proposed a Raspberry Pi-based real-time video surveillance system. Similarly, Sumathi et al. [1] demonstrated a motion-activated recording camera. However, many prior solutions lacked effective storage options or alerting systems. Table 1 presents a comparison:

Reference	Real-Time Video	USB Storage	Audio Alert
[1]	No	No	Yes
[3]	Yes	No	No
This Work	Yes	Yes	Yes

Key Contribution

- Integration of multiple low-cost components to form a cohesive surveillance system
- Real-time streaming and recording on motion trigger
- Buzzer alert for immediate notification
- Reliable performance in low-light and indoor conditions
- Easy-to-access video storage on external USB drive

Method, Experiments and Results

The system was built using:

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- Raspberry Pi 4
- PIR Motion Sensor
- USB Webcam or Pi Camera
- Buzzer
- USB Flash Drive

Upon motion detection by the PIR sensor, the Raspberry Pi triggers a Python script that begins recording, streams the video, and activates the buzzer. Test conditions included varying light environments and motion distances from 1 to 5 meters.

III. RESULTS

Response time: < 1 second

Video file size per 15-sec clip: ~3.5MB

Recorded over 30 motion events during 2-day test

Figure 1: Hardware Setup

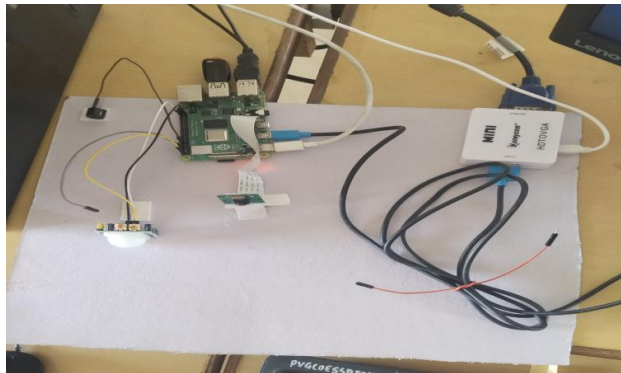


Figure 2: Software Interface

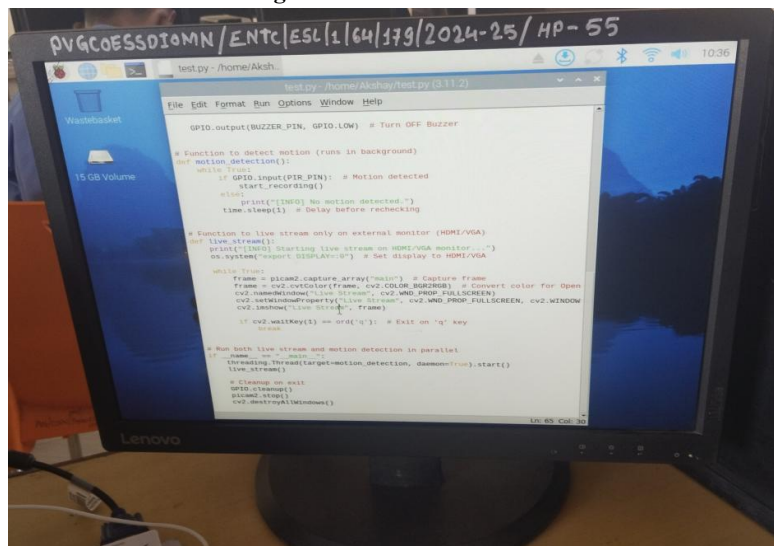


Table 2: Sample Motion Events

Event No.	Date	Time	Motion Detected	Video File Name
1	2025-04-10	10:05:32 AM	Yes	motion_20250410_1005.mp4
2	2025-04-10	11:47:08 AM	Yes	motion_20250410_1147.mp4
3	2025-04-10	01:12:45 PM	Yes	motion_20250410_1312.mp4
4	2025-04-11	09:34:21 AM	Yes	motion_20250411_0934.mp4
5	2025-04-11	10:56:59 AM	Yes	motion_20250411_1056.mp4

IV. DISCUSSIONS

The system demonstrated practical feasibility, performing well under constrained lighting and space conditions. Unlike continuously recording CCTV systems, it conserved power and storage. However, it could falsely trigger in environments with high thermal variation (e.g., sunlight or heating vents).

V. CONCLUSIONS

- **Motivation:** Affordable motion-based surveillance
- **Method:** Raspberry Pi + PIR sensor triggering real-time video capture
- **Findings:** Fast response, low power, storage-efficient
- **Limitations:** May need additional filters to reduce false positives
- **Future Work:** Add cloud storage support, push notifications, and face recognition

