

Motion Detection and Alarm Notification System: A Machine Learning Approach

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Abstract

This research proposes an automated safety system using Python for motion detection. Motion detection involves identifying any movement in front of a camera. OpenCV provides various methods for object detection and counting, but their performance may be insufficient for certain applications. This research utilizes computer vision and machine learning techniques to enhance motion detection and automatically capture visual data. Computer vision and image processing research are rapidly advancing to improve human lives. In this research, the system acts like a home-based surveillance security system. When unexpected motion is detected, it takes a snapshot, notifies the user, and sends an alert to their smart devices.

Keywords: Motion Detection, Surveillance Cameras, Real Time Video, Computer Vision, Face Detection, OpenCV, Machine Learning

1. Introduction

The objectives of this research are to create a motion detection system that can automatically capture screenshots and record video when motion is detected. The system should be able to create a bounding box around the person to accurately detect motion and capture images and videos only when necessary [1-5]. Additionally, the system should have a web interface that allows the user to start and stop the motion detection process and select

videos for motion detection. Finally, the system should be able to send SMS alert notifications to a provided number using the Twilio API when motion is detected in a selected video. These objectives aim to create a robust and user-friendly motion detection system that can be used for various purposes, such as home security and surveillance [6-10].

1.1 Scope of the Research

The scope of this research is to develop a motion detection system that automatically captures screenshots and records videos when it detects motion using the OpenCV library. Additionally, the system should allow the user to select a video from their device and detect motion in the selected video, taking screenshots and sending SMS alerts to a provided number through the Twilio API. The research also utilizes the Twilio API to send SMS notifications to a specified phone number when motion is detected. The system is designed to run on a computer with a webcam, making it suitable for use as a security system. The research includes the ability to save the recorded videos and screenshots to a specified directory on the computer for later review. Overall, the scope of the research is to provide a reliable and effective motion detection system that can be used for various applications, including home security and surveillance

2. Related Work

There are various existing motion detection systems available in the market. Some of these systems utilize specialized hardware components, such as motion sensors or cameras, while others rely on software-based solutions that can be run on standard computers and webcams [11-14]. While there are many existing motion detection systems available, each has its own set of strengths and weaknesses. The system developed in this research offers a flexible and customizable solution that can be easily modified to meet specific requirements. In the following Table.1, several papers have been explored that focus on real-time motion detection using OpenCV and Python [15-18].

Table 1. Related Work

Title	Authors	System Description	Limitations
Webcam Motion Detection in Real-Time Using Python	Amrit Pal Singh, Deepshikha Agarwal	Real-time motion detection system using OpenCV and Python. Detects multiple moving objects simultaneously.	Lack of comprehensive analysis of limitations, such as sensitivity to lighting changes or complex backgrounds.
An Intelligent Motion Detection Using OpenCV	Shubham Mishra, Mrs. Versha Verma, Dr. Nikhat Akhtar, Shivam Chaturvedi, Dr. Yusuf PerweJ	Real-time object detection and tracking system for intelligent video surveillance.	Challenges in handling complex scenes with multiple moving objects or occlusions.
Movement Detection Using OpenCV	Ankita Rameshwar Mahajan, Vinod Agrawal	Motion detection-based intrusion detection system for smart homes using Raspberry Pi and OpenCV.	Potential challenges in effectively working with scenes featuring complex backgrounds or varying lighting conditions.
Real Time Motion Detection in Surveillance Camera	-	Real-time vehicle detection and tracking system using OpenCV and Python.	Limitations in scenes with complex traffic patterns or occlusions.
Human Movement Detection using Recurrent Convolutional Neural Networks	M. Kusuma, M. Vijaya Lakshmi, K. Sai Krishna	Real-time motion detection using a webcam and OpenCV algorithms.	Potential accuracy challenges associated with using only a webcam for motion tracking.
Review on Motion Capture Technology	Rahul M	Intelligent motion detection system that sends an OTP to a smartphone as an alert notification.	Lack of capability to capture snapshots of the object when movement is detected.

3. Proposed Work

1. **User Interface:** A web-based user interface will be created using HTML, CSS, and JavaScript. The user interface will consist of two buttons, "Start Tracking" and "Select Video," and a live video feed. When the "Start Tracking" button is clicked, the motion detection algorithm will be initiated, and the live video feed will display the video with a bounding box around the detected object.

2. **Object Detection:** The object detection algorithm will be based on OpenCV and Python. The algorithm will detect the object using a background subtraction technique and create a bounding box around the object. When the object moves, the algorithm will update the bounding box accordingly. The algorithm will also record a video of the object's movement and take screenshots at regular intervals.

3. **Video Recording:** When the "Start Tracking" button is clicked, the algorithm will begin recording a video of the detected object's movement. The video will be saved to the local machine, and a link to the video will be provided to the user.

4. **SMS Alert Notifications:** When the "Select Video" button is clicked, the user will be prompted to select a video from their local machine. The algorithm will then analyze the video for motion and send an SMS alert notification to a provided number using the Twilio API when motion is detected.

5. **Deployment:** The final step will be to deploy the research to a web server for public use. This will involve configuring the web server and making the necessary adjustments to the code to ensure it runs correctly on the server. The system architecture is depicted in Figure 1.

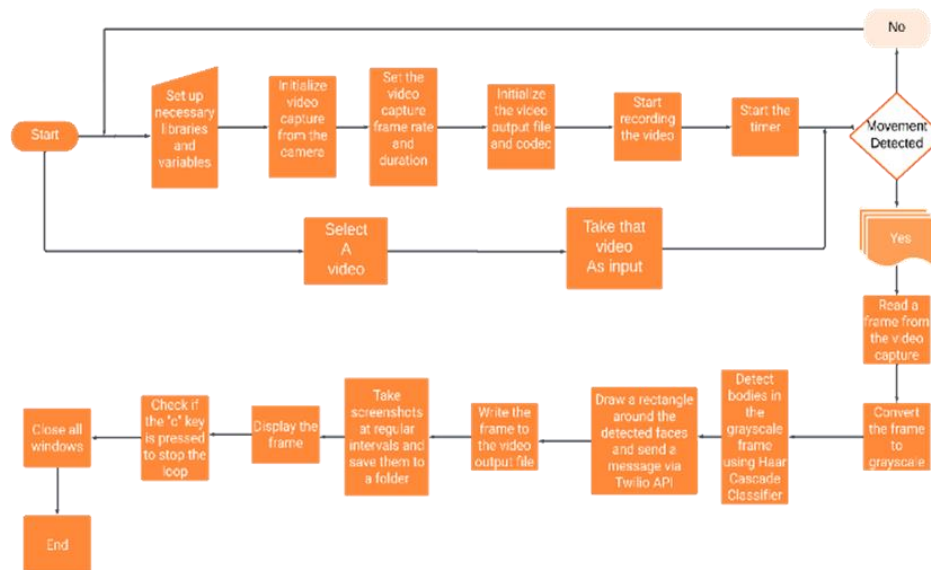


Figure 1. System Architecture

4. Results and Discussion

The process of the above research involves capturing video using the user's webcam for a specified duration and selecting a video as the input from the device and checking for any face detections using the OpenCV library. If a face is detected, a message is sent to a specified phone number using the Twilio API. Additionally, screenshots are taken at specified intervals during the video capture process using the PyAutoGUI library. The captured video and screenshots are stored in specified directories. The research involves using a combination of Python libraries, including OpenCV, PyAutoGUI, and Twilio, as well as integrating HTML for the web-based user interface. Overall, the research involves a combination of computer vision, web development, and API integration to accomplish its objectives. The results acquired through the website are depicted in Figure 2-7

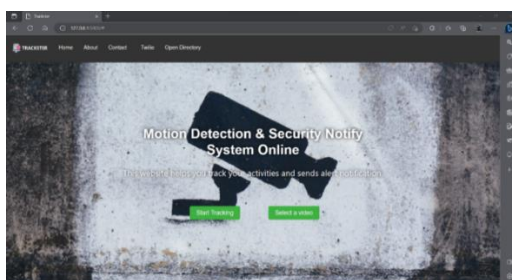


Figure 2. User Interface Webpage



Figure 3. Realtime Motion Tracking

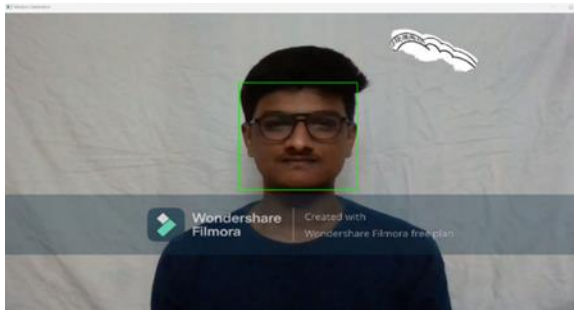


Figure 4. Motion Tracking from Prerecorded Video

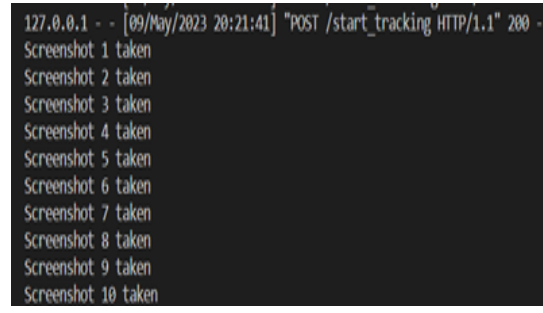


Figure 5. Taking Screenshots of the Motion Detected

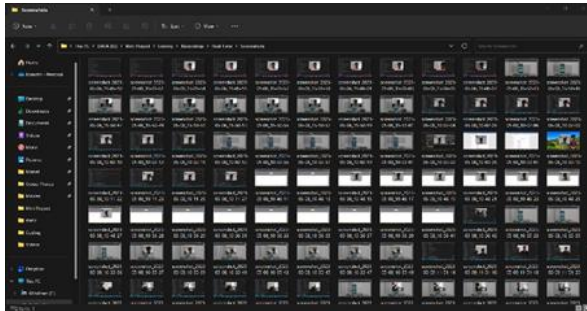


Figure 6. Saving Screenshots in a User Defined Location

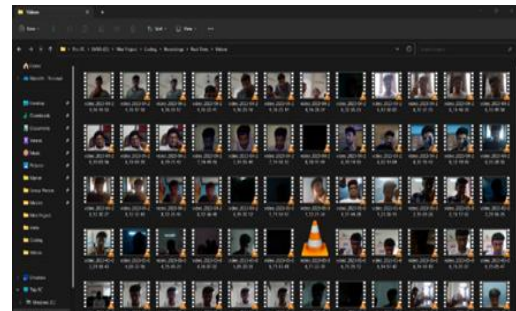


Figure 7. Saving Recorded Video in a User Defined

5. Conclusion

In conclusion, the Motion Detection and Security Notify System research is a valuable tool for enhancing security and automation in various applications. It utilizes motion detection technology and computer vision techniques to detect motion, capture screenshots, and record videos automatically. The system offers a user-friendly web-based interface that allows users to remotely access and monitor the captured data. Throughout the research, we have discussed the objectives, scope, and advantages of the system. The proposed methodology involves using Python, Flask, and OpenCV for motion detection and image processing. Twilio API is used to send SMS alert notifications to a provided number. The implementation process includes developing different modules, such as motion detection, screenshot capturing, video recording, and SMS notifications.

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