Automatic Surveillance System & Efficient Recording (ASSER)

Minor Project Report

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In

Artificial Intelligence & Data Science

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UNDER THE SUPERVISION AND GUIDANCE OF

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माधव प्रौद्योगिकी एवं विज्ञान संस्थान, ग्वालियर (म.प्र.), भारत
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ABSTRACT

The “Automatic Surveillance System & Efficient Recording (ASSER) ” project aims to enhance traditional surveillance systems by intelligently capturing relevant footage from CCTV cameras. In many surveillance scenarios, continuous recording generates a large amount of data, leading to storage challenges and inefficiencies. Additionally, manually sifting through hours of footage during investigations can be time-consuming and unproductive. Our project addresses these issues by implementing an automated solution that detects motion in real-time CCTV streams and records short video clips when significant movement occurs. By doing so, we optimize storage utilization and facilitate efficient retrieval of relevant footage during crime investigations.

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CONTENT

Table of Contents

ACRONYMS

1. CCTV……Close Circuit Television

2. CV……..…Computer vision

3. AI……. Artificial intelligence

NOMENCLATURE

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1: INTRODUCTION

In today's security landscape, surveillance cameras play a crucial role in crime prevention, safety monitoring, and incident response. However, the sheer volume of continuous video footage generated by these cameras presents several challenges:

1. **Storage Overload**:
    - Storing every frame exhaust resources.
    - Traditional continuous recording consumes excessive space.
    - Investigators struggle to manage and sift through extensive data.
2. **Manual Review**:
    - Investigating incidents requires hours of manual review.
    - Most footage is uneventful, making the process inefficient.
    - Valuable time is wasted on irrelevant content.
3. **Relevance**:
    - Capturing meaningful events is essential.
    - Investigators need quick access to relevant footage.
    - Selective recording is the key to efficient surveillance.

Our project aims to enhance surveillance systems by automating scene capture and recording. By leveraging Python's OpenCV library, we achieve the following:

- **Motion Detection**:
    - Detect changes between consecutive frames.
    - Identify regions with significant movement.
    - Trigger recording when motion occurs.
- **Selective Recording**:
    - Record short video clips (e.g., 30 seconds) upon detecting motion.

- Efficiently store only relevant segments.
- Timestamp each clip for easy retrieval.

CHAPTER 2: LITERATURE SURVEY

Motion Detection Algorithms

- Various algorithms exist for detecting motion in video streams:
    - **Frame Difference**: Compares consecutive frames to identify changes.
    - **Background Subtraction**: Models the background and detects deviations.
    - **Optical Flow**: Tracks motion between frames.
- We have explored the pros and cons of each approach.

Selective Recording Techniques

- Our system records only relevant segments:
    - **Triggered Recording**: Initiates recording upon detecting motion.
    - **Dynamic Thresholding**: Adapts sensitivity to minimize false positives.
    - **Segmentation**: Divides continuous footage into meaningful clips.
- We discuss how these techniques optimize storage utilization.

Real-time Monitoring

- Our solution leverages existing surveillance apps that provide real-time access to CCTV streams.
- By processing the live feed using OpenCV, we detect motion and trigger recording.
- Real-time monitoring ensures timely response to incident.

CHAPTER 3: METHODOLOGY

CAMERA INPUT

- We connect to CCTV cameras via surveillance apps.
- The app streams live video to our Python code.
- Each frame becomes input for motion detection.

Motion Detection Algorithm

1. **Preprocessing**:
    - Convert frames to grayscale.
    - Apply Gaussian blur to reduce noise.
2. **Motion Detection**:
    - Calculate the absolute difference between consecutive frames.
    - Threshold the difference to identify regions with significant change.
    - Find contours to locate moving objects.
3. **Selective Recording**:
    - Record a 30-second video clip when motion is detected.
    - Efficiently store only relevant segments.

Recording Mechanism

- When motion occurs:
    - Start recording and timestamp the clip.
    - Save clips separately for easy retrieval.
    - Limit each clip to 30 seconds.
- Save the recording's name as real time timestamp:
    - It will help in identifying & sorting clips.

- Used Datetime library to get the current time.

- Efficient storage:
  - Only relevant segments are stored.
  - Clips are organized by timestamp.

Steps used for motion detection-

1. **Capturing the scene**
   - Capturing the live real-time CCTV footage
   - Converting the live CCTV screen to virtual camera using OBS in order to use it as a Virtual Camera in the project.

```
# Initialize the camera
cap = cv2.VideoCapture(1)
```

2. **Frame Differentiation**:
   - Set initial frame as Frame 0
   - Set next frame as frame 1.
   - Differentiate both frames and find the difference between both in order to identify the motion.
3. **Converting each frame to grayscale**:
   - Now all the frames are monochromatic.
   - It is easier to apply any method on this frame.
4. **Applying Gaussian Blur**:
   - Removing noise using gaussian blur.
   - Threshold the difference to identify regions with significant change.
5. **Find contours to locate moving objects.**
   - Detecting borders of an object.

- It helps in marking rectangles over the motion.

6. **Selective Recording**:
    - Record a 30-second video clip when motion is detected.
    - Efficiently store only relevant segments.

Other heavy motion detection algorithms are avoided because they very sensitive in nature and was detecting even the change in light as motion & hence frame differentiation is used which verified any change as motion only when there is a major change in the frame.

CHAPTER 4: RESULT

Metric	Normal Recording (Avg Resolution = 720p)	ASSER ((Avg Resolution = 720p)) "Records only when there is a motion)
Storage Space per hour	800-900 MB	60MB
Total Data Consumed (GB)	1.35 GB	100 MB
Reduction in Data Usage (Times)	10 times less data is used after using ASSER	
Avg time consumed to verify any past recording.	30 mins (If surveillance is done after fast forwarding the recording	5-10 mins.

Table 1.1 Efficiency Difference between normal CCTV recording & Automatic Surveillance System & Efficient Recording (ASSER)

Our "Automatic Surveillance System & Efficient Recording (ASSER)" system demonstrates significant improvements in surveillance efficiency and data management:

1. **Storage Optimization:**
    - By selectively recording relevant segments, we reduce storage requirements.
    - Traditional continuous recording consumes excessive space, whereas our approach focuses on meaningful events.
    - Investigators no longer need to sift through hours of uneventful footage.
2. **Quick Retrieval:**
    - Relevant footage is readily accessible during investigations.
    - Timestamped video clips capture critical moments.

- Investigators can efficiently review specific incidents without wasting time on irrelevant content.

3. **Real-world Testing:**
   - We conducted extensive testing using real CCTV streams.
   - Performance metrics indicate successful motion detection and recording.
   - Case studies demonstrate the system's effectiveness in various scenarios.

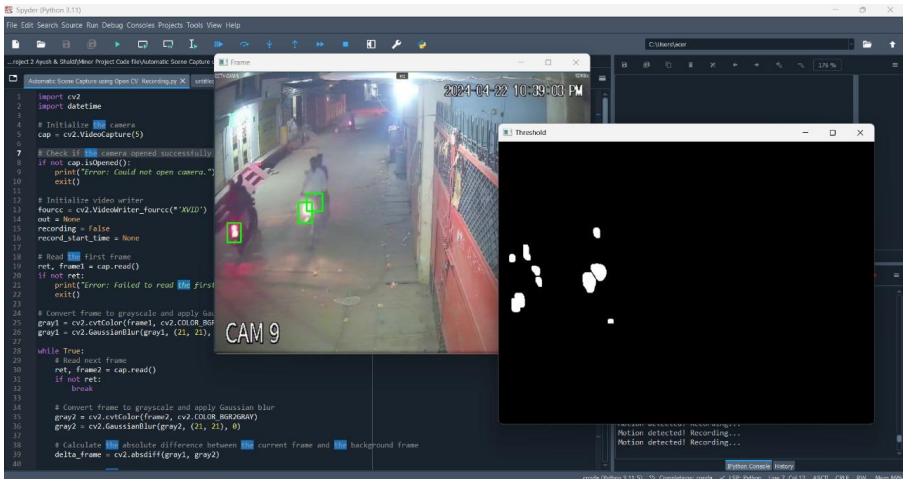

Figure 1. Motion Detection & Code.

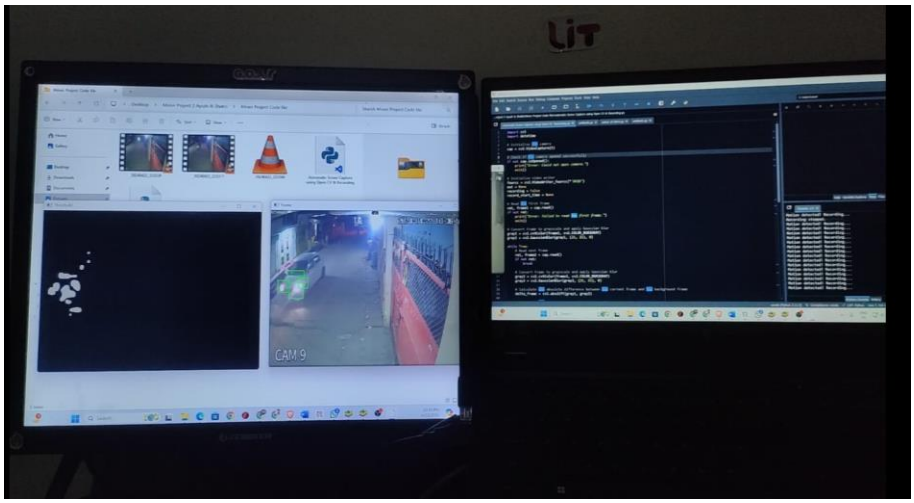

Figure 2. Automatic Scene Recording with files named as timestamps.

CHAPTER 5: CONCLUSION

Our “Automatic Surveillance System & Efficient Recording” project achieves the following objectives:

- **Efficient Surveillance**: By intelligently capturing scenes, we optimize storage and enhance system performance.
- **Crime Investigation**: Investigators can quickly access relevant footage, aiding criminal investigations.
- **Scalability**: The solution scales seamlessly to handle multiple cameras and diverse environments.

Future Enhancements

While our current implementation is robust, we envision further improvements:

- **Object Recognition**: Incorporating AI-based object recognition for advanced event detection.
- **Adaptive Parameters**: Dynamically adjusting recording parameters based on scene context.
- **Integration**: Integrating with existing surveillance systems for wider adoption.

In conclusion, our project bridges the gap between surveillance technology and practical usability, making surveillance smarter, more efficient, and responsive.

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