# Project Progress Report on



**DEEP LEARNING BASED SMART SECURITY SURVEILLANCE SYSTEM FOR SAFETY ENHANCEMENTS**



**Submitted in partial fulfilment of the requirement for the award of the degree of BACHELOR OF TECHNOLOGY**

**IN**

**ARTIFICIAL INTELLIGENCE & MACHINE LEARNING**

**Submitted by:**

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***Under the Guidance of* Mr. PriyankPandey**

**Asst. Professor**

**Project Team ID: MP24ML010**



**Department of Computer Science and Engineering Graphic Era (Deemed to be University)**

**Dehradun, Uttarakhand December-2024**



**CANDIDATE’S DECLARATION**

I hereby certify that the work which is being presented in the project progress report entitled **“DEEP LEARNING BASED SMART SECURITY SURVEILLANCE SYSTEM FOR SAFETY ENHANCEMENTS”** in partial fulfillment of the requirements for the award of the Degree of Bachelor of Technology in Computer Science and Engineering **(Artificial Intelligence and Machine Learning )**in the Department of Computer Science and Engineering of the Graphic Era (Deemed to be University), Dehradun shall be carried out by the undersigned under the supervision of **Mr. Priyank Pandey, Assistant Professor**, Department of Computer Science and Engineering, Graphic Era (Deemed to be University), Dehradun.

Shristy Chaudhary 2019498

The above mentioned students shall be working under the supervision of the undersigned on the **“Deep Learning Based Smart Security Surveillance System For Public Enhancements”**

Signature Signature

**Supervisor Head of the Department**

**Examination**

**Name of the Examiners: Signature with Date**

1. Mr. Vivek Tomar
2. Mr. Navin Garg

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**Chapter 1**

# Introduction and Problem Statement

In the following sections, a brief introduction and the problem statement for the work has been included.

## Introduction

In today's world, security is paramount, and technology plays a crucial role in enhancing surveillance capabilities. The Smart Security Surveillance System leverages advanced machine learning techniques, specifically Mask R-CNN, to detect and segment objects in real-time from security camera feeds. This system aims to provide a comprehensive solution for monitoring and analyzing surveillance footage, offering enhanced security through automated detection and alert mechanisms. By integrating state-of-the-art computer vision models, the system can identify and track various objects, such as people and vehicles, in different environments, ensuring accurate and reliable surveillance.

The core of the Smart Security Surveillance System is its ability to process video feeds in real-time, using Mask R-CNN for precise object detection and segmentation. Mask R-CNN, a powerful convolutional neural network, enables the system to not only identify objects within a frame but also delineate their boundaries, providing a clear and detailed view of the monitored area. This capability is essential for distinguishing between different objects and understanding their interactions, which is crucial for detecting suspicious activities. The system's backend, developed using frameworks like Django or Flask, handles the video processing, alert generation, and data management, ensuring seamless integration and efficient performance.

The user interface, built with React.js, offers a responsive and interactive platform for monitoring live video feeds and reviewing detected events. Through real-time data transmission using WebSockets, users can receive instant alerts about potential security threats, allowing for timely responses. The system's ability to send notifications via various channels, such as email and SMS, ensures that users are always informed about critical events. By combining advanced machine learning models with robust web technologies, the Smart Security Surveillance System provides a reliable and efficient solution for modern surveillance needs, enhancing security and situational awareness in diverse environments.

## 1.2 Problem Statement

The problem at hand revolves around the Traditional surveillance systems rely heavily on continuous manual monitoring, which is labor-intensive, prone to human error, and often ineffective in real-time threat detection. There is a critical need for an advanced, automated solution that can accurately detect and segment objects in live video feeds, generate timely alerts for suspicious activities, and provide detailed visual insights to enhance security operations. The Smart Security Surveillance System addresses these challenges by leveraging Mask R-CNN for real-time object detection and segmentation, combined with robust web technologies to deliver a scalable, efficient, and cost-effective surveillance solution



**Chapter 2**

# Objectives

1. To Implement a robust Mask R-CNN model to detect and segment objects in real-time from security camera feeds.
2. To Develop algorithms to identify and alert users about suspicious activities based on detected objects and predefined rules.
3. To Optimize the system for high-performance video processing to ensure smooth and efficient real-time surveillance.
4. To Create an intuitive web application interface for monitoring live feeds, reviewing alerts, and managing system settings.
5. To Implement a reliable data storage solution for saving video footage, detected objects, and alert logs.
6. To Incorporate machine learning techniques to detect anomalies in the video feed, enhancing the system's capability to identify unusual patterns or behaviors.
7. To Design the system to be scalable and flexible, allowing easy integration of additional cameras and sensors as needed.
8. To Develop a robust alert mechanism that notifies users through multiple channels (e.g., email, SMS, in-app notifications) in case of detected suspicious activities.
9. Implement comprehensive monitoring and logging to track system performance, detect issues, and ensure the system runs smoothly.
10. Ensure the system adheres to privacy and security standards, protecting sensitive data and complying with relevant regulations.

**Chapter 3**

# Project Work Carried Out

The development of the *Smart Security Surveillance* system is a complex, multi-stage process involving a combination of backend and frontend technologies, AI integration, dynamic routing, and user experience design. This section provides an overview of the work done so far, including the architectural design, objectives implemented, and the algorithms/pseudo code used.

## Architectural Design of the Project

The architecture of the Smart Security Surveillance System using Mask R-CNN is designed to be scalable, modular, and flexible, allowing for future enhancements and easy maintenance. The application is based on a full-stack architecture, consisting of the following key components:

* + - **Frontend (React.js)**: The user interface (UI) is built using React.js, ensuring an interactive and responsive design. It allows users to interact with the application, monitor live feeds, view detected objects, and receive real-time alerts about suspicious activities.
    - **Backend (Flask/Django)**: The backend, built with Flask or Django, handles user requests, communicates with the database, and integrates with the deep learning model for object detection and segmentation. It manages the video feeds and processes frames in real-time.
    - **Database (PostgreSQL/MongoDB)**: PostgreSQL or MongoDB is used for data storage, providing a reliable system to store video footage, detected objects, user data, and alert logs. The choice of SQL or NoSQL database depends on the specific requirements for structured or unstructured data.
    - **Deep Learning Model (Masked RCNN)**: The core of the system is the Mask R-CNN model, which is used for real-time object detection and segmentation. The model is pre-trained on a large dataset and fine-tuned with surveillance-specific data to improve accuracy.
    - **Real-Time Video Processing (OpenCV)**: OpenCV is used for capturing and processing video frames from security cameras. It ensures efficient handling of video feeds and integration with the Mask R-CNN model for object detection.
    - **Alert Mechanism**: The system includes a robust alert mechanism that notifies users through multiple channels such as email, SMS, and in-app notifications when suspicious activities are detected. This component ensures timely alerts and enhances security measure.
    - **Performance Monitoring and Logging:** Comprehensive monitoring and logging are implemented to track system performance, detect issues, and ensure smooth operation. Logging helps in maintaining records of activities and debugging any problems.
    - **Cloud Deployment (AWS/GCP):** The system is deployed on cloud platforms like AWS or GCP to ensure scalability, flexibility, and reliability. Cloud services provide the necessary infrastructure to handle high computational loads and storage requirements.
    - **Security and Privacy Compliance:** The architecture ensures compliance with privacy and security standards, protecting sensitive data and adhering to relevant regulations. Security measures include data encryption, access control, and secure communication channels.

This architectural design ensures that the Smart Security Surveillance System is robust, efficient, and capable of meeting the demands of real-time security monitoring and analysis.

## Implementation of Objectives

Several key objectives have been implemented in the development of the *Smart Surveillance System*:

1. **Real-Time Object Detection and Segmentation**: The Mask R-CNN model has been integrated into the system for real-time detection and segmentation of objects in security camera feeds. This is implemented using Python and TensorFlow, where the model processes video frames captured by OpenCV and identifies objects with high precision.
2. **Accurate Suspicious Activity Identification:** Algorithms for detecting suspicious activities based on the segmented objects have been developed. This involves defining specific rules and patterns, such as unusual movements or unauthorized access, which trigger alerts when detected by the model.
3. **High-Performance Video Processing:** Video processing is optimized using OpenCV and hardware acceleration with GPUs. This ensures that the system can handle multiple video streams simultaneously, providing real-time analysis without significant latency.
4. **User-Friendly Web Interface:** A responsive web application built with React.js allows users to monitor live feeds, review detected objects, and manage system settings. The interface is designed to be intuitive, enabling users to easily navigate and interact with the surveillance system.
5. **Data Storage and Management:** The system uses PostgreSQL for structured data storage and MongoDB for unstructured data, such as video footage and logs. The database schema includes tables for storing user information, detected objects, and alert logs.

CREATE TABLE detected\_objects (

id SERIAL PRIMARY KEY,

object\_type VARCHAR(50),

timestamp TIMESTAMP DEFAULT CURRENT\_TIMESTAMP,

location VARCHAR(100),

alert\_status BOOLEAN

);

CREATE TABLE alerts (

id SERIAL PRIMARY KEY,

detected\_object\_id INT,

alert\_message TEXT,

alert\_time TIMESTAMP DEFAULT CURRENT\_TIMESTAMP,

FOREIGN KEY (detected\_object\_id) REFERENCES detected\_objects(id)

);

1. **Anomaly Detection:** Machine learning techniques for anomaly detection are implemented to identify unusual patterns in video feeds. This includes clustering and statistical methods to detect deviations from normal behavior, enhancing the system’s ability to spot potential threats.
2. **Scalability and Flexibility:** The architecture is designed to be scalable, allowing easy integration of additional cameras and sensors. The backend services are containerized using Docker, enabling the system to scale horizontally as needed.
3. **Robust Alert Mechanism:** An alert mechanism that uses email, SMS, and in-app notifications is developed. This ensures that users receive timely alerts regarding any suspicious activities detected by the system. The alerts are generated based on predefined rules and are logged for future reference.
4. **Performance Monitoring and Logging:** Comprehensive monitoring tools like Prometheus and Grafana are used to track system performance. Logs are maintained using Elasticsearch and Kibana, providing a detailed view of the system's activities and performance metrics.
5. **Privacy and Security Compliance:** The system adheres to privacy and security standards, with data encryption, access control, and secure communication channels implemented. Regular security audits and updates are performed to ensure compliance with relevant regulations.

## Pseudo Code for Live CCTV Camera

BEGIN

IMPORT Tkinter library

IMPORT Image and ImageTk from PIL library

IMPORT record function from record module

// Initialize main window

SET window TO Tk()

SET window title TO "SMART SECURITY SURVEILLANCE SYSTEM"

SET window icon TO 'mn.png'

SET window size TO '1080x600'

// Create main frame

CREATE mainFrame AS Frame(window, bd=4)

// Add title label

CREATE label\_title AS Label(mainFrame, text="SMART SECURITY SURVEILLANCE SYSTEM", font=('forte', 40, 'bold'))

PLACE label\_title USING grid WITH padding (10,10) IN column 1

// Add first icon

OPEN icon\_1 AS Image('icons/24.png')

RESIZE icon\_1 TO (70,70) USING Image.LANCZOS

CONVERT icon\_1 TO ImageTk.PhotoImage

CREATE label\_icon\_1 AS Label(mainFrame, image=icon\_1)

PLACE label\_icon\_1 USING grid WITH padding (5,10) IN row 0, column 0

// Add second icon

OPEN icon\_spy AS Image('icons/spa.png')

RESIZE icon\_spy TO (180,180) USING Image.LANCZOS

CONVERT icon\_spy TO ImageTk.PhotoImage

CREATE label\_icon\_spy AS Label(mainFrame, image=icon\_spy)

PLACE label\_icon\_spy USING grid WITH padding (5,10) IN row 1, column 1

// Add record button

OPEN btn\_image AS Image('icons/recording.png')

RESIZE btn\_image TO (50,50) USING Image.LANCZOS

CONVERT btn\_image TO ImageTk.PhotoImage

CREATE btn AS Button(mainFrame, text="Video Record", font=('forte', 25, 'bold'), height=90, width=270, fg='blue', image=btn\_image, compound='left', command=record)

PLACE btn USING grid WITH padding (20,10) IN row 2, column 1

// Add exit button

OPEN btn\_image1 AS Image('icons/exit.png')

RESIZE btn\_image1 TO (50,50) USING Image.LANCZOS

CONVERT btn\_image1 TO ImageTk.PhotoImage

CREATE btn\_exit AS Button(mainFrame, text="Exit", font=('forte', 25, 'bold'), height=90, width=270, fg='blue', image=btn\_image1, compound='left', command=window.quit)

PLACE btn\_exit USING grid WITH padding (20,10) IN row 3, column 1

// Pack the main frame

mainFrame.pack()

// Run the main event loop

window.mainloop()

END

PLACE label\_title USING grid WITH padding (10,10) IN column 1 // Add first icon

OPEN icon\_1 AS Image('icons/24.png')

RESIZE icon\_1 TO (70,70) USING Image.LANCZOS CONVERT icon\_1 TO ImageTk.PhotoImage

CREATE label\_icon\_1 AS Label(mainFrame, image=icon\_1) PLACE label\_icon\_1 USING grid WITH padding (5,10) IN row 0, column 0

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CREATE btn\_exit AS Button(mainFrame, text="Exit", font=('forte', 25, 'bold'), height=90, width=270, fg='blue', image=btn\_image1, compound='left', command=window.quit)

PLACE btn\_exit USING grid WITH padding (20,10) IN row 3, column 1

// Pack the main frame

mainFrame.pack()

// Run the main event loop

window.mainloop()

END

BEGIN

IMPORT cv2

IMPORT datetime

FUNCTION record()

// Initialize the camera SET cam TO cv2.VideoCapture(0)

// Set up video writer

SET fourcc TO cv2.VideoWriter\_fourcc(\*'XVID')

SET storage TO cv2.VideoWriter('recordings/' + CURRENT\_DATETIME + '.avi', fourcc, 20.0, (640, 480))

// Get current timestamp

SET timestamp TO CURRENT\_DATETIME

// Start recording loop

WHILE True

// Capture frame from camera

SET ret, frame TO cam.read()

// Overlay timestamp on frame

cv2.putText(frame, timestamp, (50, 50), cv2.FONT\_HERSHEY\_COMPLEX, 0.6, (255, 0, 255), 2)

// Save frame to video

file storage.write(frame)

// Display frame in a window

cv2.imshow('Recording', frame)

// Check for exit condition (ESC key)

IF cv2.waitKey(1) EQUALS 27

THEN

// Release resources

cam.release()

cv2.destroyAllWindows()

BREAK END

WHILE END

FUNCTION END

**Chapter 4**

**Future Work Plan**

The future work plan of our project are as follows:

|  |  |  |
| --- | --- | --- |
| **Sl. No.** | **Work Description** | **Duration in Days** |
| 1 | Integrate Mask R-CNN for Object Detection and Segmentation | 10 |
| 2 | Set Up Real-Time Video Streaming and Alert Mechanism | 12 |
| 3 | Develop Backend and Database Integration | 8 |
| 4 | Frontend Enhancement and Integration | 14 |
| 5 | Testing and Debugging | 10 |
| 6 | Deployment and Monitoring | 7 |

**Chapter 5**

# Weekly Task

The report of project work allocated by the supervisor is as follows:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Week No.** | **Date: From-To** | **Work Allocated** | **Work Completed**  **(Yes/No)** | **Remarks** | **Guide Signature** |
| 1 | 15th Nov - 21st Nov | Overview of the Project and Features Setup and  GUI Design and Setup | Yes | Basic window structure and user interface for video recording are in place, ready for additional functionality. |  |
| 2 | 22nd Nov - 28th Nov | Video Recording Functionality | Yes | Video capture, timestamping, and saving features are operational. System can now record video footage with timestamp overlays. |  |
| 3 | 29th Nov - 5th Dec | Finalizing GUI and Button Functionality | Yes | The main functionality of the "Video Record" and "Exit" buttons are operational, and the interface is polished. |  |
| 4 | 6th Dec - 7th Dec | Testing and Bug Fixing | Yes | All components are thoroughly tested and optimized for smooth operation. The project is now ready for further integration or deployment. |  |

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