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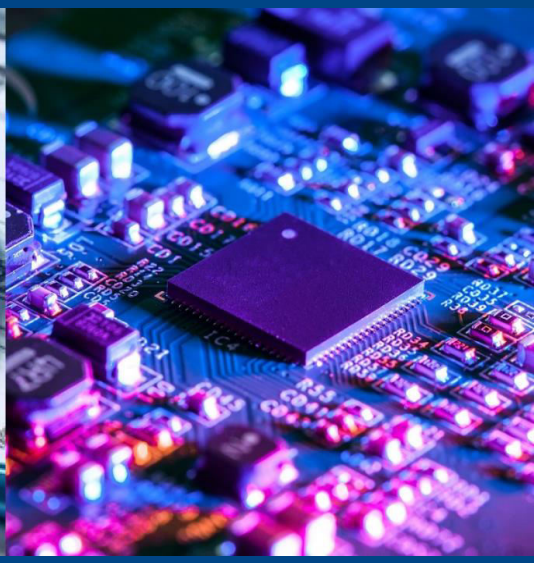

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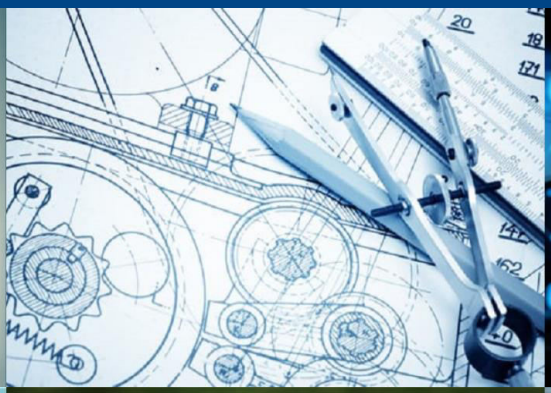

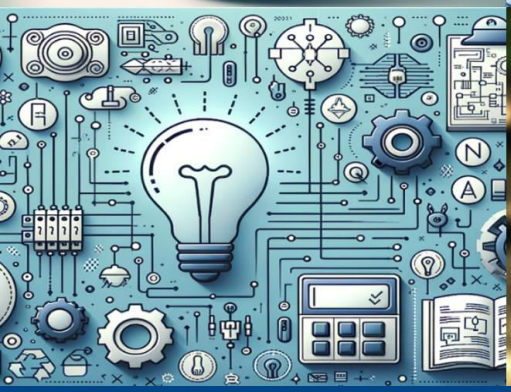

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Intruder Detection System using ML

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ABSTRACT: With the increasing need for intelligent surveillance systems, our web application integrates three essential modules: motion detection, face recognition, and face mask detection. These features work together to monitor environments, identify individuals, and ensure compliance with health guidelines. The system aims to enhance security and safety across various settings by offering real-time monitoring, recognition, and alerting capabilities. This application leverages advanced algorithms such as deep learning and computer vision to improve accuracy and efficiency. It provides a scalable solution adaptable to a range of environments, from public spaces to enterprises, addressing modern challenges like identity verification and pandemic management.

KEYWORDS: Motion Detection, Face Recognition, Face Mask Detection, Real-time Surveillance, Deep Learning, Flask Web Application, Security System, Health Compliance.

I. INTRODUCTION

Security and safety have become significant concerns in today's world, especially with increasing threats to physical spaces and public health. Conventional surveillance systems often rely on manual monitoring, which is prone to human error and delayed responses. There is a growing demand for automated solutions that can monitor spaces, identify individuals, and enforce safety protocols efficiently. Facial recognition has emerged as a key technology for security, helping organizations manage access control and monitor critical areas. However, many systems still struggle with environmental challenges like varying lighting and dynamic backgrounds. Integrating face recognition with advanced motion detection can significantly improve the efficiency of surveillance systems.

The COVID-19 pandemic has also introduced new health safety requirements, such as wearing masks in public spaces. Existing surveillance systems are not equipped to monitor compliance with these rules. Incorporating mask detection alongside other security features can ensure better public health management and compliance monitoring.

This project aims to build a web application that combines motion detection, face recognition, and face mask detection to deliver a comprehensive, intelligent surveillance system. With real-time alerts and analysis, this solution can help businesses, governments, and individuals manage security and health protocols more effectively.

II. LITERATURE SURVEY

Motion detection systems have evolved from traditional frame subtraction techniques to advanced deep learning- based approaches that reduce false positives and enhance accuracy. Wang and Zhang (2018) discuss the performance of such algorithms in modern surveillance systems. Face recognition technology has also seen significant advancements, with Zhao and Chellappa (2019) emphasizing the impact of deep learning models like CNNs in achieving high accuracy under challenging conditions.

The need for mask detection emerged with the COVID-19 pandemic. Loey and Manogaran (2021) introduced a real-time face mask detection system using CNN and MobileNet, demonstrating its effectiveness in enforcing health protocols. Singh and Anand (2020) discuss how AI- enhanced video surveillance can provide intelligent monitoring, combining motion detection and face recognition to improve system adaptability. These advancements form the basis for the development of this project.

The field of intelligent surveillance has evolved significantly with the advent of machine learning and computer vision

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technologies. **Wang and Zhang (2018)** conducted a detailed review of various motion detection algorithms, comparing traditional methods like background subtraction with modern approaches using deep learning. Their study highlighted that deep learning- based motion detection reduces false positives and increases accuracy, making it suitable for real-time applications.

Facial recognition has become a vital tool in security systems, offering precise identity verification. **Zhao and Chellappa (2019)** reviewed several face recognition algorithms, including Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), and deep learning models. They emphasized that convolutional neural networks (CNNs) significantly outperform traditional methods, especially under challenging conditions such as varying lighting and facial angles.

During the COVID-19 pandemic, mask detection became crucial for ensuring public health compliance. **Loey and Manogaran (2021)** developed a real-time face mask detection system using MobileNet architecture, achieving high accuracy in identifying individuals with and without masks. Their research demonstrated the effectiveness of deep learning models in real-world scenarios, particularly in crowded environments.

The integration of artificial intelligence in surveillance systems was explored by **Singh and Anand (2020)**, who discussed the role of AI in enhancing video surveillance. They emphasized that combining motion detection, face recognition, and analytics can significantly improve the adaptability and responsiveness of surveillance systems, paving the way for more intelligent monitoring solutions.

Finally, **Jain and Kumar (2017)** focused on the application of facial recognition in security. They discussed the benefits of facial recognition in access control and identity management while highlighting the importance of robust data protection measures to address privacy concerns.

Rishabh Paunikar, Shubham Thankare, Utharsh Abuse from Computer Engineering Bharati Vidyapeeth College of Engineering, Navi Mumbai. In April 2020 they made a complex project named “Action Recognition Using Surveillance System” the project was based on ideas in which the neural network with different datasets twice for computing an action. For object detection, the yoloV3 [3] will be used to detect humans and or any other objects and for activity recognition. The same neural network processing Yolo[2] weights will be used again which will be trained on a different dataset with human actions. They got the conclusion of the project demonstrating pattern matching, object detection, and action recognition.

Nandhini R, Duraimurugan N, S.P.Chokkalingam from International Journal of Engineering and Advanced Technology (IJEAT). In February 2019 they made a project named “Face Recognition Based Attendance System”. It was on Automatic face recognition (AFR) technologies have made many improvements in the changing world. Smart Attendance using Real-Time Face Recognition. They developed the “Fingerprint Based Recognition” later hours or before, the student needs to record the fingerprint on the configured device to ensure their attendance for the day. The problem with this approach is that during the lecture time it may distract the attention of the students then they implemented “Radio Frequency Identification” using a connection of RS232.

K.Govinda 1 K., Sai Krishna Prasad, Sai ram susheel SCSE, University, Vellore, India, SENSE, VIT University Vellore, India. They Created a nice project named “Intrusion Detection System for Smart Home using Laser Rays” In March 2014 whereas it is issued in vol. 2in IJSED (International Journal for Scientific Research & Development) it is based on the device that works based on the interaction between the sensor (which is LDR) and light source, preferably a LASER. When light is incident upon the LDR that is connected- the resistance would below, which directs a high input current through the base of the transistor, which in turn gives a low output which is accepted as an input in to the buzzer. The conclusion of the program is most occasions the security system was usually occupied or organized by big insurance companies or specific

Traditional motion detection systems rely heavily on background subtraction techniques and algorithms like Gaussian Mixture Models (GMM). Wang and Zhang (2018) highlight how modern approaches leverage deep learning architectures such as Convolutional Neural Networks (CNNs) to enhance accuracy and robustness under various lighting conditions

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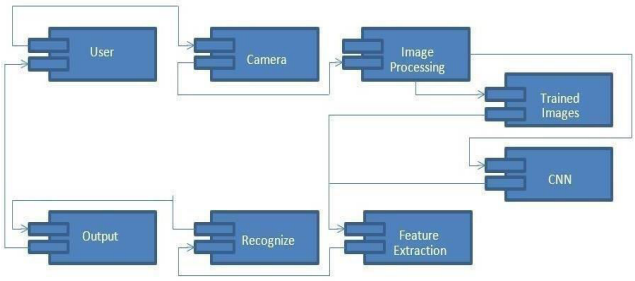
and environmental changes. These methods improve upon earlier systems that suffered from high false-positive rates in real-world scenarios.

Face recognition has evolved significantly with the adoption of deep learning techniques. Early works used handcrafted features like Local Binary Patterns (LBP) and Principal Component Analysis (PCA), but newer systems incorporate CNNs and deep architectures like VGGFace and FaceNet, achieving higher precision (Geitgey, 2018). Recent studies focus on improving accuracy despite occlusions, lighting issues, and pose variations, ensuring reliable deployment for surveillance systems.

III. METHODOLOGY AND DISCUSSION

The web application integrates three core modules: motion detection, face recognition, and face mask detection. For motion detection, we employ frame- differencing algorithms enhanced by background subtraction to identify movement accurately. Face recognition uses a pre-trained convolutional neural network (CNN) model to detect and identify individuals. Mask detection is implemented using a deep learning model like MobileNet, trained on datasets containing images of people with and without masks.

Each module is deployed using a Flask backend, with a responsive web interface built using HTML, CSS, and JavaScript. The system captures video streams in real- time, processes the data, and provides alerts when motion is detected, a face is recognized, or an individual is found without a mask. This modular approach ensures scalability and allows seamless integration of additional security.



Objectives

a. Develop a real-time **motion detection module** with high accuracy.
b. Implement an efficient **face recognition system** for identity verification.
c. Integrate **mask detection** to ensure compliance with health regulations.
d. Provide a **user-friendly web interface** for seamless interaction.
e. Ensure **real-time alerts** and quick responses to security threats.

1. Advantages

a. **Enhanced Security**: Real-time monitoring and alerts for unauthorized access.
b. **Health Safety**: Ensures compliance with mask-wearing policies.
c. **Automation**: Reduces manual effort in surveillance.
d. **Scalable**: Adaptable to various environments, from homes to large enterprises.
e. **Integrated Solution**: Combines multiple functionalities in a single platform.

2. Algorithm

1. Motion Detection:

- Capture video frames continuously.
- Perform background subtraction to detect movement. Generate an alert if significant motion is detected.

2. Face Recognition:

- Capture the image of a person entering the frame.
- Compare with a pre-trained face dataset using a CNN model.

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- Identify the person or raise an alert forum recognized individuals.

3. Face Mask Detection:

- Extract the face region from the captured image.
- Use Mobile Net to classify whether a mask is present.
- Generate an alert if the person is maskless.

IV. PROPOSED SYSTEM

The proposed system is a robust web-based surveillance application with three key modules—Motion Detection, Face Recognition, and Face Mask Detection. Together, these modules ensure comprehensive monitoring in security-sensitive environments like offices, hospitals, or public spaces.

1. **Motion Detection Module**:This module continuously scans for movement in the camera's field of view. Using background subtraction techniques and machine learning models, it can detect motion and trigger alerts. The motion data helps in monitoring real-time activity and identifying potential security threats.
2. **Face Recognition System:** The face recognition module leverages deep learning models like CNNs to detect and recognize faces, allowing user identification. It builds upon pre-trained models (like VGGFace or FaceNet) for accuracy and speed. This module is beneficial in access control scenarios where only authorized personnel are allowed entry.
3. **Face Mask Detection Module:** This module addresses the need for compliance with health protocols by identifying individuals who are not wearing masks. By using architectures such as YOLO or MobileNet, it detects masked and unmasked faces accurately, even in crowded or challenging lighting conditions. It can trigger notifications when someone without a mask is detected, assisting in enforcing health and safety protocols.

V. FUTURE SCOPE

- **Integration with IoT devices** for enhanced automation and remote control.
- **Deployment on cloud platforms** for scalability and storage management.
- **Voice recognition and behavior analysis** for additional security.
- **Multi-camera support** to expand coverageacross large areas.
- **Mobile application** to provide remote alertsand controls.

VI. CONCLUSION

The Smart Surveillance Web Application combinesmotion detection, face recognition, and mask detection to offer a comprehensive security solution. By addressing the limitations of traditional surveillance systems, it enhances safety, ensures compliance with health regulations, and provides real-time alerts. The modular design ensures that the system can be easily adapted and scaled to different environments. This project represents a significant step toward intelligent surveillance, with the potential for further advancements in the future

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