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DEPARTMENT OF INFORMATION TECHNOLOGY

IT3811 – Project work

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PEOPLE COUNTING SYSTEM USING MOBILENET, SSD ALGORITHM BY DEEP LEARNING

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Abstract:

- This project presents a real-time people counting system leveraging the MobileNet-SSD (Single Shot MultiBox Detector) algorithm, a lightweight and efficient deep learning-based object detection model. Designed for applications in smart surveillance, crowd analytics, and public space monitoring, the system utilizes MobileNet as the backbone for feature extraction, enabling fast and accurate detection on resource-constrained devices. By integrating the SSD framework with MobileNet, the model achieves a balance between speed and precision, making it ideal for edge computing scenarios. The system processes video streams to detect and count individuals frame-by-frame, employing Non-Maximum Suppression (NMS) to eliminate redundant detections. Experimental results demonstrate that the proposed method performs with high accuracy in diverse environments, including both indoor and outdoor scenes, while maintaining low computational overhead. This project highlights the potential of lightweight deep learning models for practical, real-time crowd analysis applications.

Introduction:

- Traditional methods of people counting, such as manual counting or sensor-based systems (e.g., infrared or ultrasonic sensors), often suffer from **inaccuracy**, **limited coverage**, and **high maintenance costs**, especially in dynamic or crowded environments. To overcome these limitations, modern approaches have shifted toward **computer vision and deep learning techniques**, which offer higher flexibility, accuracy, and scalability.
- This project presents a **real-time people counting system** based on the **MobileNet Single Shot MultiBox Detector (SSD)** deep learning model. MobileNet, a lightweight and efficient convolutional neural network, is optimized for devices with limited computational power, making it suitable for embedded and real-time applications. SSD enhances detection speed by eliminating the need for a region proposal network, allowing for rapid object detection in a single pass.
- The integration of **MobileNet SSD** with **OpenCV** and Python creates a cost-effective, scalable, and efficient solution that demonstrates the power of deep learning in solving real-world problems related to crowd analysis and intelligent surveillance.

Future work:

•**Improved Accuracy in Crowded and Occluded Scenes**
Future work could focus on developing advanced post-processing
•techniques or combining MobileNet-SSD with tracking algorithms
•(e.g., SORT, DeepSORT) to handle heavy crowd occlusion, overlapping
•individuals, and motion blur more effectively.

•**Model Optimization for Edge Devices**
To better deploy on low-power edge devices (e.g., Raspberry Pi, Jetson Nano), further optimization techniques such as **model quantization**, **pruning**, and **knowledge distillation** could be applied to significantly reduce the model size and inference time without sacrificing much accuracy.
•**Integration with Temporal Information**
Incorporating video frame temporal information using Recurrent Neural Networks (RNNs) or Long Short-Term Memory (LSTM) layers could help improve the system's robustness, especially during partial visibility or sudden lighting changes.

Documentation:

This project, titled "People Counting System Using MobileNet-SSD Algorithm by Deep Learning," presents the design and implementation of an intelligent system capable of detecting and counting people in real-time video streams. The system leverages the MobileNet architecture, a lightweight convolutional neural network optimized for mobile and embedded vision applications, combined with the Single Shot MultiBox Detector (SSD) framework for efficient object detection.

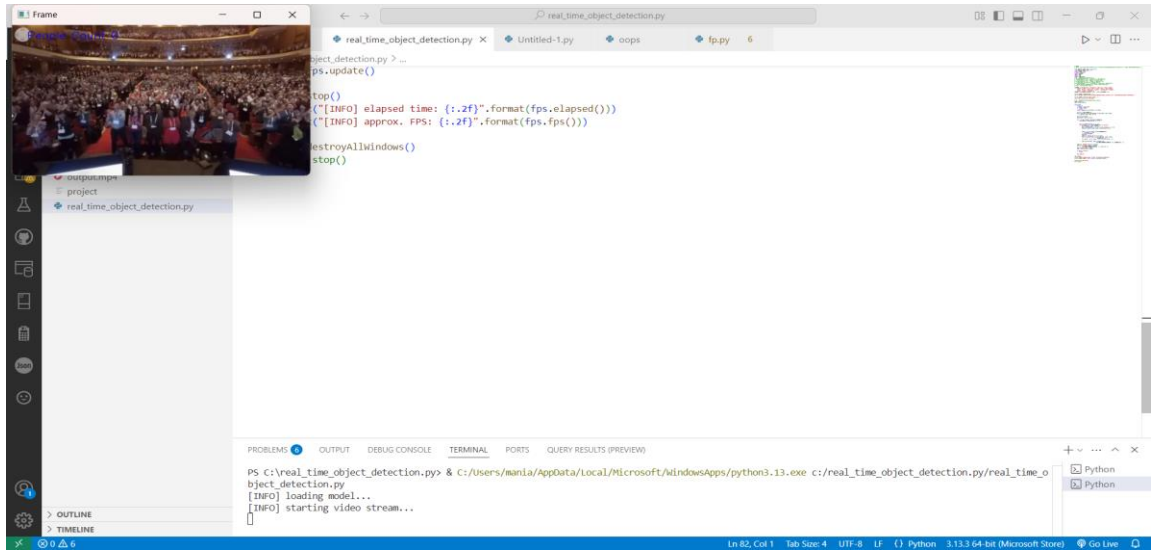
Using deep learning-based techniques, the model processes live video feeds, identifies instances of the "person" class, and dynamically counts the number of individuals in each frame. The MobileNet-SSD model offers a practical balance between computational speed and detection accuracy, enabling deployment even in environments with limited hardware resources.

- This documentation provides a comprehensive overview of the project's objectives, system design, methodology, software and hardware requirements, implementation details, and evaluation results. It demonstrates how deep learning and computer vision can be effectively utilized to develop a robust people counting system for applications in surveillance, crowd management, retail analytics, and smart environments.

Project scope:

- Incorporating tracking algorithms such as **Deep SORT** or **Kalman Filters** can ensure continuous identification of individuals across multiple frames, minimizing errors caused by duplicate or missed counts, especially in crowded environments.
- Further optimization can allow the system to be deployed on low-power edge devices such as **Raspberry Pi**, **Jetson Nano**, or **Google Coral TPU**. Model quantization and pruning techniques can be employed to reduce the computational load.
- Extending the system to work across multiple camera feeds can help in monitoring large areas like shopping malls, stadiums, and airports, providing an aggregated people count with spatial distribution analysis.
- Beyond simple counting, the system can be enhanced to estimate crowd density, detect overcrowding, and trigger alerts, making it useful for public safety and emergency management.
- Fine-tuning or retraining the MobileNet-SSD model on domain-specific datasets (such as factory floors, classrooms, or transportation hubs) can improve detection accuracy under diverse conditions.

Output:



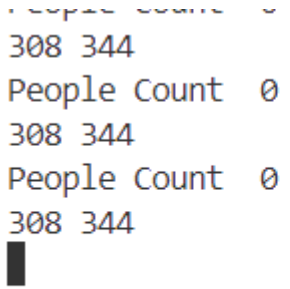


Figure: 1.1 Project output screenshots

SUMMARY:

ZEROTH REVIEW:

- Introduction
- Literature Review
- Problem Statement
- Project Objective

FIRST REVIEW:

- Abstract
- Methodology
- Diagrams
- Output

SECOND REVIEW:

- Introduction
- Objectives
- Result And Analysis
- Testing And Validation

THIRD REVIEW:

- Abstract
- Documentation
- Future Work
- Prototype Output Screen
- Conclusion

Conclusion:

- In this project, we successfully designed and implemented a real-time **People Counting System** utilizing the **MobileNet-SSD algorithm** powered by deep learning. The system demonstrated the ability to accurately detect and count individuals in video streams, achieving a strong balance between detection accuracy and computational efficiency. By leveraging the lightweight MobileNet architecture and the Single Shot MultiBox Detector framework, the system operated effectively even on hardware with limited processing capabilities.
- This project highlights the potential of deep learning in solving practical problems related to surveillance, crowd management, and smart environment monitoring. Although the model performs well under standard conditions, challenges such as heavy occlusion, varying lighting, and crowded scenes present opportunities for further enhancement.
- The work lays a solid foundation for future developments, including the integration of tracking algorithms, deployment on edge devices, and real-time analytics. Overall, this project illustrates how deep learning-based object detection models can be effectively utilized to build intelligent, real-world applications.

Thankyou