Problem Statement

Intel® Unnati Industrial Training Program

Team: Intellidians

PS-13: Vehicle Movement Analysis and Insight Generation in a College Campus using Edge AI

Unique Idea Brief (Solution)

The objective of this project is to develop and deploy intelligent transportation and surveillance systems using deep learning and computer vision techniques.The project aims to:

1.Classify Vehicle Types: Implement and evaluate CNN architectures such as VGG16 and ResNet for accurate vehicle classification using the Stanford Cars dataset.

2.Detect Number Plates: Utilize Haar cascade classifiers for precise vehicle number plate detection and integrate EasyOCR for character recognition.

3.Analyze Vehicle Movement: Combine EasyOCR and Haar cascade models to identify vehicle number plates and timestamp movements for effective surveillance.

4.Monitor Parking Lots: Deploy the YOLOv5 model for real-time detection of parking lot occupancy using the Pklot dataset.

5.Edge Deployment: Optimize and deploy vehicle classification, movement analysis, and parking lot monitoring models on edge devices for low-latency and resource-efficient real-time applications.

Features Offered

- **Integrated Approach:** Our work combines state-of-the-art CNN architectures (VGG16, ResNet) with robust OCR (EasyOCR) and object detection models (YOLOv5), offering a comprehensive solution for intelligent transportation systems.

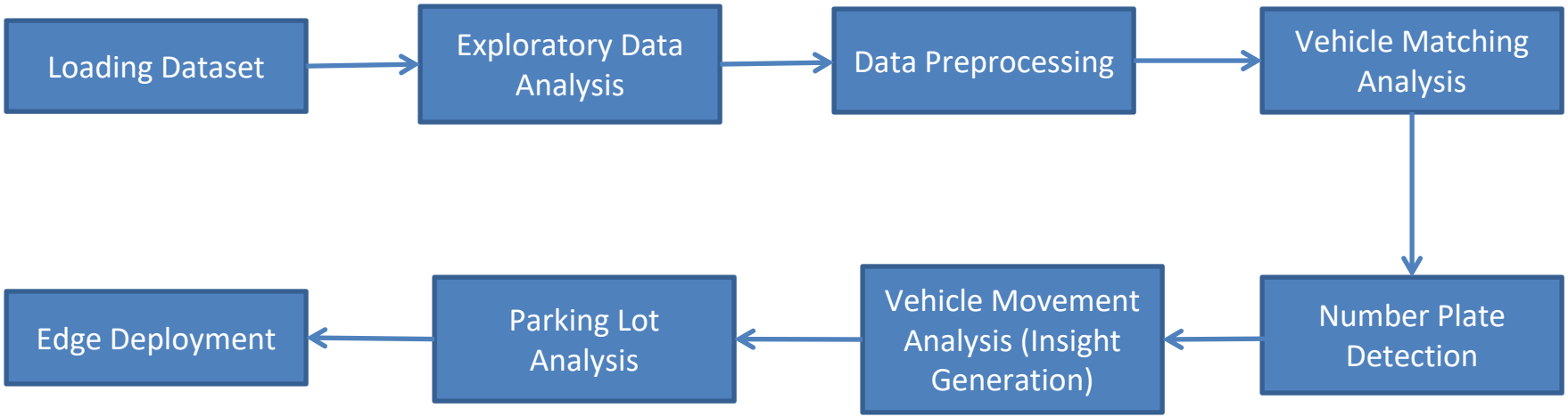
- **Edge Deployment:** Optimized models for edge devices ensure low-latency, real-time processing, and decision-making, reducing dependency on cloud infrastructure.

- **Enhanced Accuracy:** Advanced data preprocessing and augmentation techniques improve accuracy in vehicle classification, number plate recognition, and parking lot monitoring.

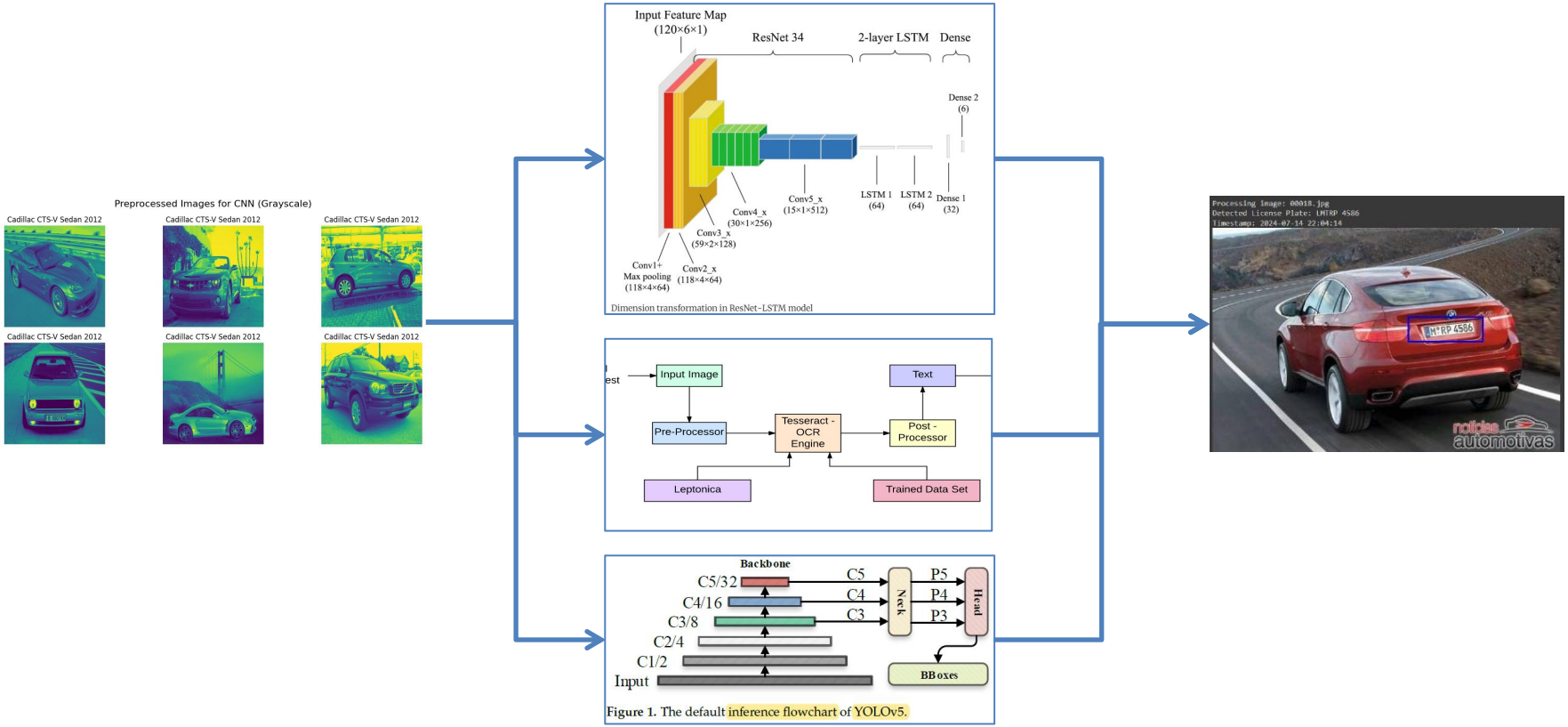
- **Scalability and Flexibility:** Our system is designed to be scalable and adaptable, suitable for various applications including traffic management, surveillance, and parking optimization.

- **User-Friendly Integration:** Seamless integration with Google Drive facilitates easy access to datasets, storage, and project file management, enhancing usability and efficiency.

Process flow



Architecture Diagram



Technologies used

Python: Primary programming language for implementing machine learning algorithms, data processing, and application development.

Libraries and Frameworks:

- TensorFlow / Keras: Deep learning frameworks for building and training neural networks, including CNNs for image classification (e.g., VGG16, ResNet).
- OpenCV: Open Source Computer Vision Library for image and video processing tasks such as image preprocessing, object detection, and feature extraction.
- Pandas: Data manipulation and analysis tool, particularly useful for creating dataframes and performing statistical analysis.
- NumPy: Fundamental package for numerical computing in Python, essential for handling arrays and matrices.
- Matplotlib and Seaborn: Visualization libraries for generating plots, charts, and graphs to visualize data distributions and model performance.
- EasyOCR: Optical Character Recognition library for extracting text from images, crucial for number plate recognition.
- YOLOv5: State-of-the-art object detection model for real-time detection and tracking of objects in images and video streams.
- Google Drive: Cloud storage and synchronization service used for storing datasets, trained models, and project files, enabling collaboration and easy access.
- Haar Cascade Classifiers: Pre-trained models for object detection based on Haar-like features, employed for vehicle number plate detection.
- Edge Computing: Strategies for optimizing models (vehicle classification, number plate detection, etc.) for deployment on edge devices, ensuring low latency and efficient real-time performance.

Team members and contribution:

1. Arunya Paul (Team Leader):
As team leader, I spearheaded the project with innovative ideation, ensuring all aspects of machine learning model development, including car classification, number plate detection, timestamp marking, and parking lot occupancy, were meticulously optimized using TensorFlow and PyTorch. Additionally, I took charge of revising the project documents and editing the presentation slides, ensuring clarity and coherence throughout. This comprehensive approach contributed to a robust final deliverable that aligned closely with project goals and stakeholder expectations.

2. Naureen Hassan:
I skillfully created the project document and PowerPoint presentation, meticulously organized technical details and findings into clear, documents, ensuring thorough documentation of the project's aspects. The structured approach and attention to detail significantly improved the clarity and professionalism of our deliverables. The expertise in document preparation played a vital role in presenting our project effectively, highlighting our team's achievements and insights with clarity and precision.

Conclusion

In conclusion, our study highlights the significant advancements made in intelligent transportation systems through the integration of deep learning and computer vision techniques. By leveraging state-of-the-art CNN architectures, robust OCR tools, and advanced object detection models, we have demonstrated improved accuracy and efficiency in vehicle classification, number plate detection, and parking lot analysis. Our approach not only enhances real-time performance and scalability but also underscores the importance of optimizing models for edge deployment, thereby enabling effective decision-making in dynamic traffic and surveillance environments.