Intel Unnati Industrial Training 2024

VEHICLE MOVEMENT ANALYSIS AND INSIGHT GENERATION IN A COLLEGE CAMPUS USING EDGE AI

Team Techsmashers

PROBLEM STATEMENT

Managing vehicle movement and parking in a college campus can be a challenging task. An intelligent system that can analyse vehicle movement, monitor parking occupancy, and match vehicles to an approved database can significantly improve campus security and management. Our task is to develop an Edge AI-based solution that can analyse vehicle movement using data from cameras capturing vehicle photos and license plates. The solution should be capable of processing image data in real-time and provide insights on:

- Vehicle Movement Patterns: The solution should be able to analyse the frequency and timing of vehicle movement in and out of the campus. It should be able to identify peak times and patterns.
- Parking Occupancy: The solution should be able to monitor the occupancy of parking lots in real time. It should be able to identify which parking lots are frequently occupied and at what times.
- Vehicle Matching: The solution should be able to match captured vehicle images and license plates to an approved vehicle database. It should be able to identify unauthorized vehicles.

FEATURES 🧠:

01 - HYPER-FAST EDGE DEVICE INFERENCE:

Our models for License Plate processing and parking lot detection achive a combined average inference speed of just 59.38 ms on a Ryzen 5 CPU due to the use of specialized LPRNet and quantized YOLOv8 models, making them extremly fast compared to other alternatives.

02 - MODULAR DESIGN:

The license plate detection models, the parking occupancy monitoring models and the insights engine are modular and can be used separately or in conjunction with one another

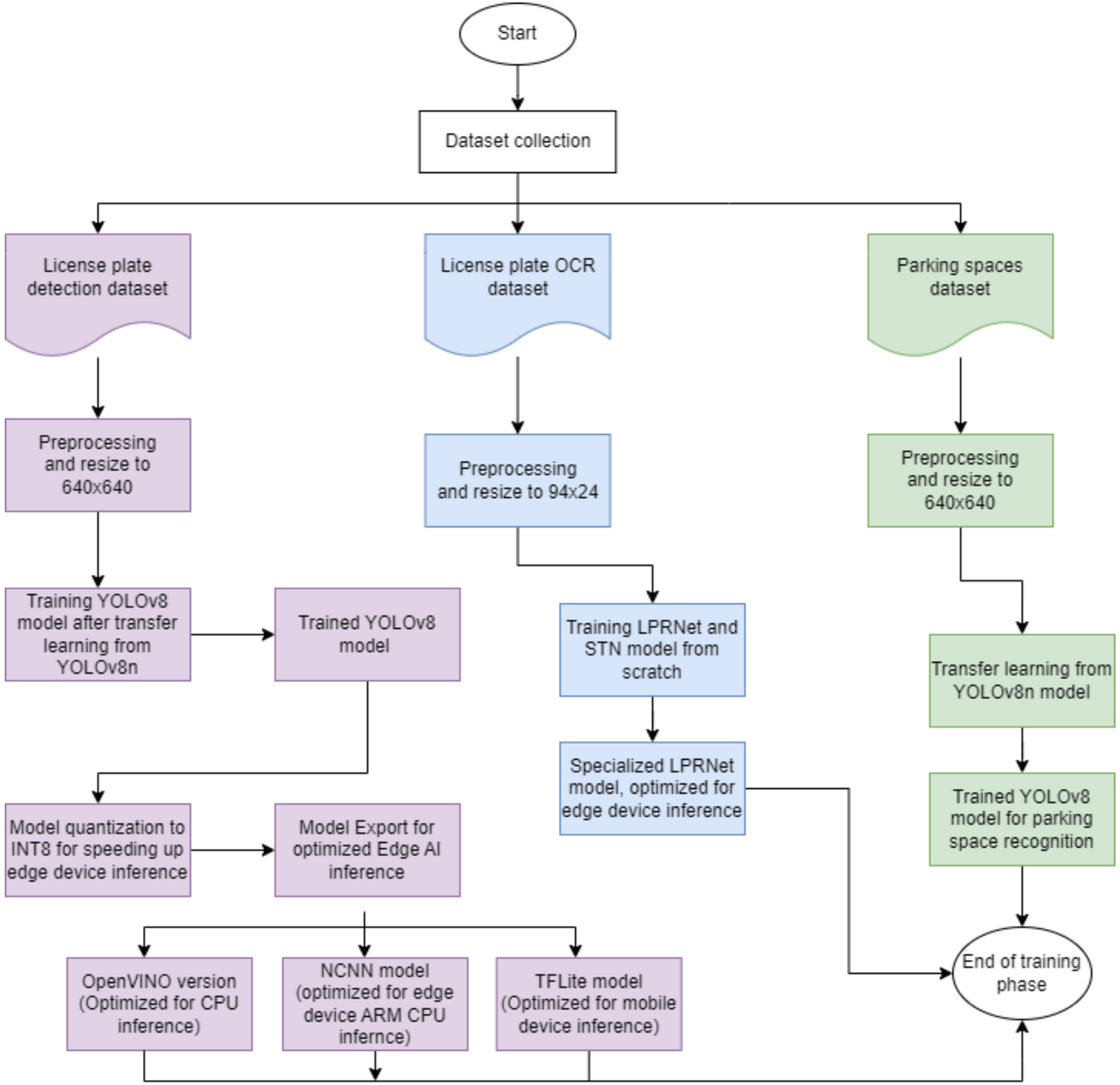
03 - LARGE VARIETY OF INSIGHTS:

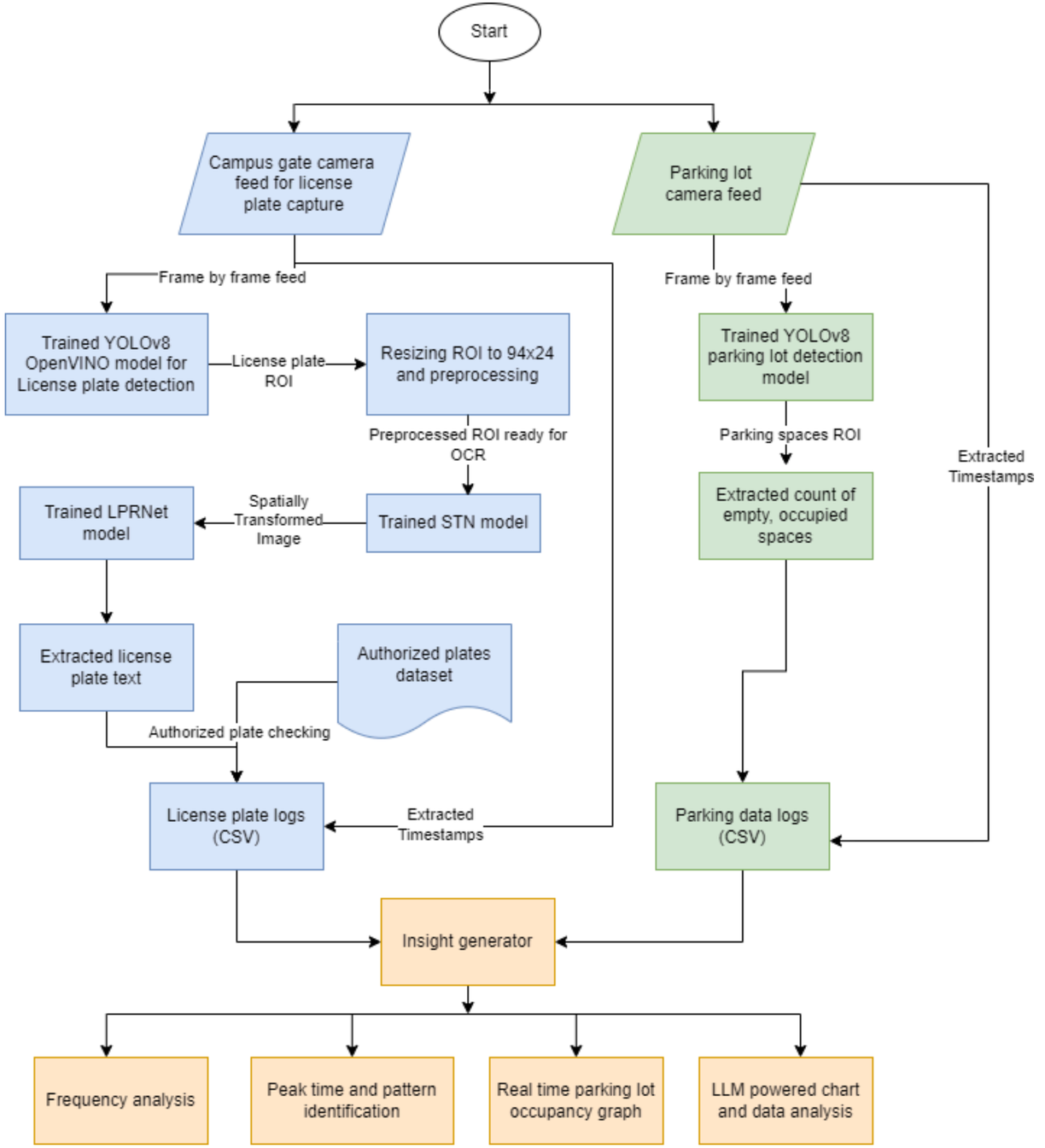
Our project delivers many different types of insights, including visualizations in the form of bar charts, line charts, etc., metrics for comparision and LLM-powered insights for interactive chat as well.

02 - MODULAR DESIGN:

The models were all trained on large and diverse datasets, each with upwards of ~20,000 images, making them robust and accurate in detecting even outliers.

ARCHITECTURE




Start
Campus gate camera feed for license plate capture
Parking lot camera feed
Frame by frame feed
Frame by frame feed
Trained YOLOv8 OpenVINO model for License plate detection
License plate ROI
Resizing ROI to 94x24 and preprocessing
Trained YOLOv8 parking lot detection model
Preprocessed ROI ready for OCR
Parking spaces ROI
Extracted Timestamps
Trained LPRNet model
Spatially Transformed Image
Trained STN model
Extracted count of empty, occupied spaces
Extracted license plate text
Authorized plates dataset
Authorized plate checking
License plate logs (CSV)
Extracted Timestamps
Parking data logs (CSV)
Insight generator
Frequency analysis
Peak time and pattern identification
Real time parking lot occupancy graph
LLM powered chart and data analysis

TEAM MEMBERS

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CONCLUSION

In this project, we implemented a vehicle movement and parking space detection module, which is used to detect incoming vehicles and parking spaces respectively. We also implemented an insights generation module, which uses the data collected from the vehicle movement and parking space modules, to provide meaningful insights in the form of visualizations, and interactive chat, using techniques such as aggregation. We also optimized the modules for low latency, on-device edge device inference, by using techniques such as export to fast inference formats and INT8 quantization.

THANK YOU

https://github.com/mopasha1/IntelUnnati2024TTS