



Night Time Traffic Monitoring System

BOT FORGE

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Title:

Smart Low-Light Vehicle Detection, Tracking & Classification System

Problem Statement:

- Night-time traffic monitoring suffers from glare, shadows, and poor visibility.
- Difficult to differentiate between close-proximity vehicles (e.g., 2 bikes vs. 1 car).
- Affects urban traffic management, safety, and enforcement.

Goal:

Develop an AI-based computer vision system that reliably works in low-light conditions.

- Detect and classify vehicles (2W/4W) under poor lighting.
- Track moving vehicles consistently across frames.
- Extract number plates (if visible) using OCR.
- Handle glare, noise, shadows, and distortion.
- Build a web/desktop app for real-time visualization.
- Deliver a deployment-ready system with documentation.

- Dataset Preparation
 - Low-light traffic videos collected from public sources.
 - Preprocessing and noise reduction applied.
- Low-Light Enhancement
 - Contrast stretching, histogram equalization (future: GAN-based enhancement).
- Vehicle Detection
 - YOLOv8 used for detecting cars, bikes, trucks, etc.
- Multi-Object Tracking
 - Deep SORT algorithm for ID consistency across frames.
- Number Plate Recognition
 - EasyOCR applied on vehicle ROIs.
- System Integration
 - FastAPI backend with optional React-based UI.

Enhancement of Frame

Original Frame



Enhanced Frame

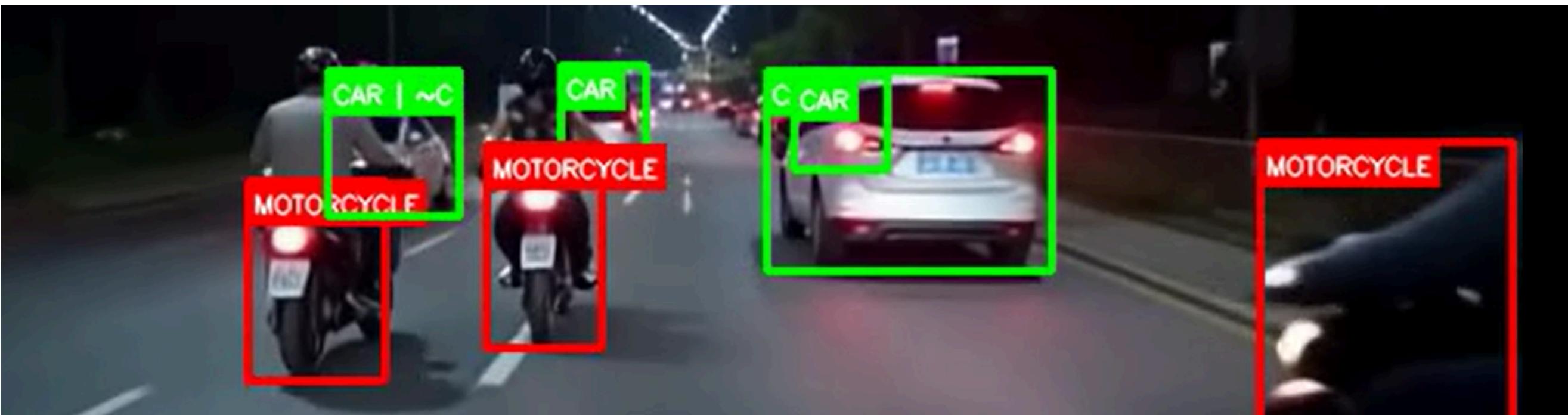


| 2 and 3 Wheeler Detection

Input Video Frame



Output Video Frame



Your paragraph text

|Plate Number Detection





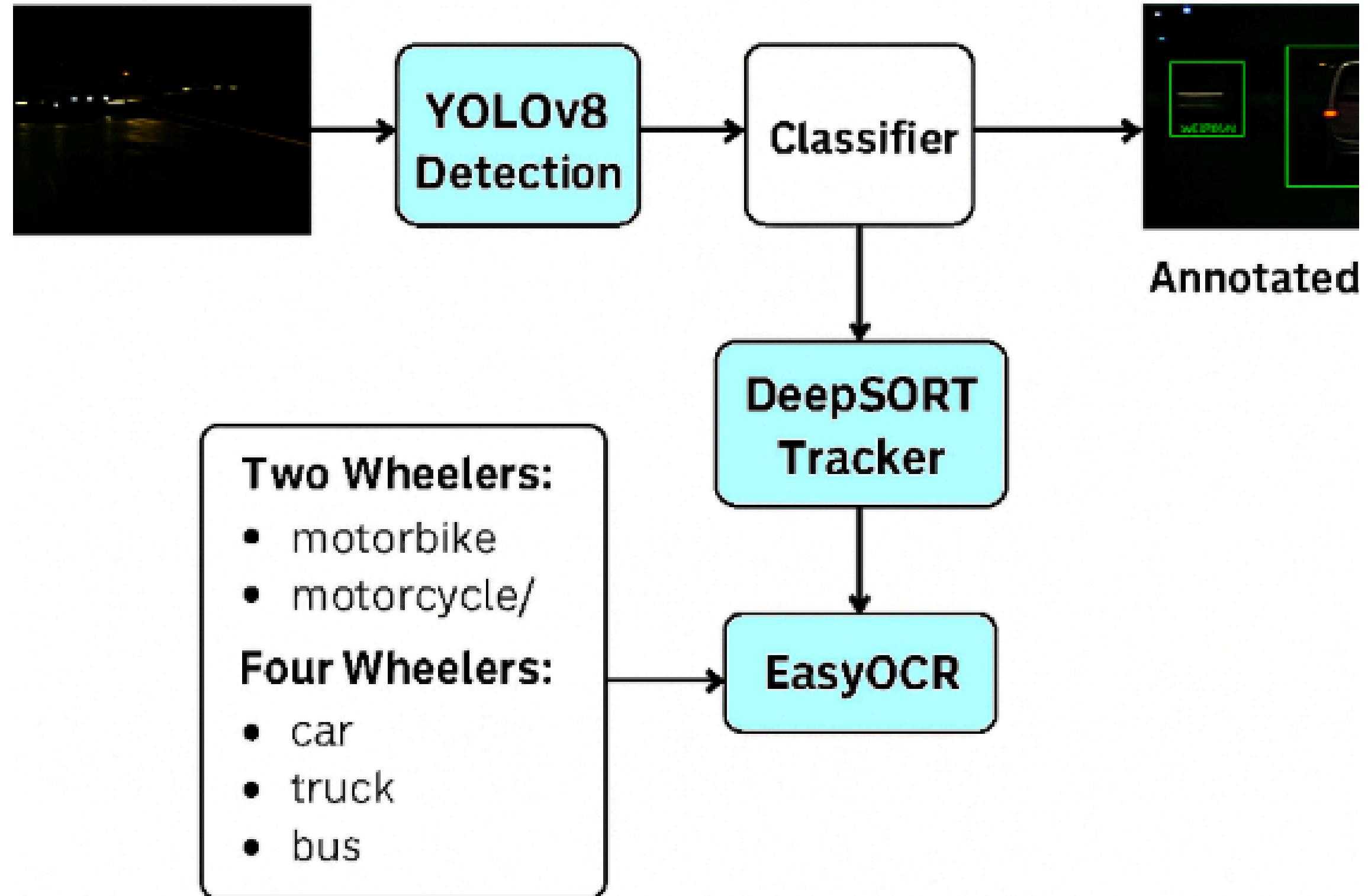
Night-Time Traffic Monitoring

Choose file 3087697-uh...0_30fps.mp4

Upload & Detect Vehicles

Built with ❤️ using FastAPI, YOLOv8, and DeepSORT

Architecture diagram-Low Light Vehicle Pipeline



Technology Readiness Level: TRL 6 (Prototype Demonstration in Real-World Environment)

- Low-light vehicle detection using YOLOv8
- Classification into 2W / 4W
- Deep SORT tracking for identity preservation
- Number plate detection via OCR
- App for video upload & result visualization
- Modular, documented Python codebase
- Runs on GPU with CUDA support

Comparison with State-of-the-Art

Feature	Existing Solutions	Our System
Low-light performance	Poor	Enhanced with preprocessing
Multi-object tracking	Often missing	Deep SORT integration
Plate recognition	Limited in night-time	OCR with region cropping
Classification (2W vs 4W)	Not fine-tuned	Tailored for traffic types
Real-time capability	Not real-time	Yes, supports GPU

Unique Selling Proposition (USP)

- Accurate Night-Time Vehicle Detection
 - Utilizes YOLOv8 with fine-tuned thresholds to maintain high detection accuracy even in low-light conditions.
- Smart Object Tracking
 - Integrates DeepSORT to assign consistent IDs across frames, enabling precise vehicle movement tracking over time.
- Real-Time OCR with EasyOCR
 - Extracts license plate numbers from vehicles using robust OCR, even under challenging lighting and motion blur.
- End-to-End Pipeline
 - From raw video input to annotated output with vehicle IDs and number plates—a seamless, automated solution.
- Lightweight & Deployable
 - Built with OpenCV, and efficient models—ready for deployment on edge devices or cloud infrastructure.
- Potential Use Cases
 - Ideal for smart surveillance, traffic law enforcement, and automated toll systems in urban or rural areas.

- Integrate deep-learning-based enhancement models (e.g., LLNet, EnlightenGAN).
- Improve number plate accuracy using region-specific OCR models.
- Dashboard with traffic analytics and violation reports.
- Deploy on edge devices (Jetson Nano, Raspberry Pi) for real-time roadside monitoring.
- Add anomaly detection for stalled vehicles or accidents.
- Extend to vehicle make/model recognition using fine-tuned CNNs.

Plan to take to Next Level

- Real-Time Dashboard Integration
 - Build a web-based interface showing live vehicle tracking, number plates, timestamps, and locations.
 - Use FastAPI + WebSocket for live video updates.
- Advanced OCR Accuracy
 - Improve accuracy using image enhancement (deblurring, contrast stretching) before OCR.
 - Train a custom OCR model on Indian license plates for better region-specific recognition.
- Night-Time Enhancement
 - Integrate infrared or low-light enhancement filters.
 - Use YOLOv8-Night fine-tuned on night surveillance datasets for higher detection rates.
- Threat Detection with AI
 - Add AI logic to detect suspicious behavior like:
 - Overspeeding at night.
 - Vehicle loitering near sensitive areas.
 - Multiple false plates on same vehicle.

- GPS and Edge Integration
 - Attach GPS module to enhance location tracking.
 - Deploy on edge devices (like Jetson Nano/Raspberry Pi) for real-time on-site processing.
- Searchable Database
 - Store all logs in a SQL/NoSQL database for search/filter by plate number, time, date, or location.
- Police/Authority Alert System
 - Auto-alert law enforcement via SMS/email if a blacklisted number plate is detected.
- Privacy & Encryption
 - Encrypt number plate data to ensure compliance with privacy laws and prevent misuse.
- Mobile App Interface
 - Build a mobile app for field officers to receive alerts, check vehicle logs, and access real-time footage.
- Deploy at Multiple Locations
 - Use cloud deployment and RTSP stream input to monitor multiple traffic points simultaneously.
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Thanks