DEVELOPMENT OF ADVANCED DRIVER ASSISTANCE SYSTEMS (ADAS) ON MOBILE DEVICES USING LIGHTWEIGHT CONVOLUTIONAL NEURAL NETWORKS FOR MOTOCYCLES.

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WHAT?

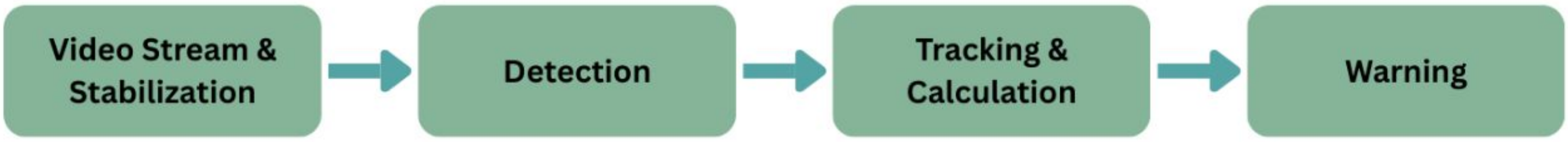
We propose a low-cost, real-time ADAS framework specifically designed for motorcycles using camera & smartphone, which includes:

- **Lightweight AI Engine:** Implementing YOLOv8-Nano optimized with INT8 Quantization for mobile deployment.
- **Safety Features:** Blind Spot Detection (BSD) and Rear Collision Warning (RCW) based on monocular vision.
- **Hardware Independence:** Works on standard smartphones without expensive sensors (LiDAR/Radar).

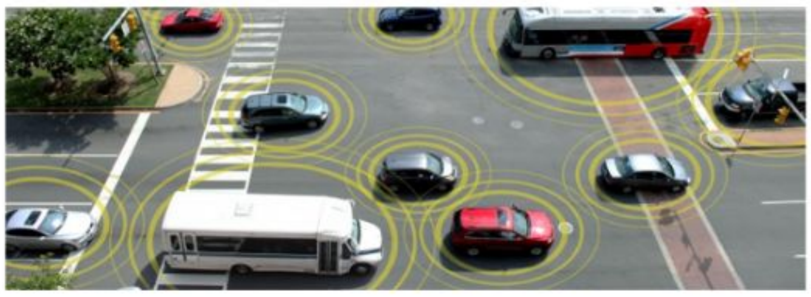
WHY?

- **Context:** Motorcycles are the primary vehicle in Vietnam, yet they lack the advanced safety features found in modern cars.
- **Problem:** High fatality rates due to blind spots and rear-end collisions. Existing ADAS solutions are too expensive or bulky for motorbikes.
- **Goal:** To democratize safety technology, turning a common phone into a life-saving device.

OVERVIEW


Video Stream & Stabilization → Detection → Tracking & Calculation → Warning

Camera


Vehicle's Detection

Phone

DESCRIPTION

1. Video Acquisition & Stabilization

Applying Optical Flow to crop and stabilize frames, reducing motion blur caused by helmet movement.

Raw, Shaky Footage

Stabilized Frame

2. Object Detection

- Utilizing YOLOv8-Nano as the backbone for high-speed inference.
- Applying Post-training Quantization (PTQ) to convert weights from FP32 to INT8, reducing model size by 4x.
- Inference Engine: TensorFlow Lite with NNAPI delegate for hardware acceleration.

3.Tracking & Risk Logic

- Blind Spot Detection: Dividing the camera frame into Safe Zone (Center) and Danger Zones (Left/Right margins). Using IOU-based tracking to monitor vehicle trajectory.
- Rear Collision Warning: Estimating Time-to-Collision (TTC) using the rate of bounding box expansion. Ignores static background, focuses only on approaching objects (Zooming effect).

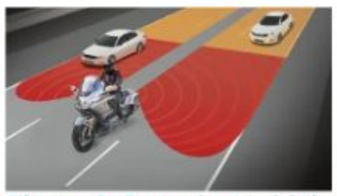


Figure 2. Detecing vehicle in blind spot (red zone).

Figure 3. calculating TTC based on bounding box expansion.

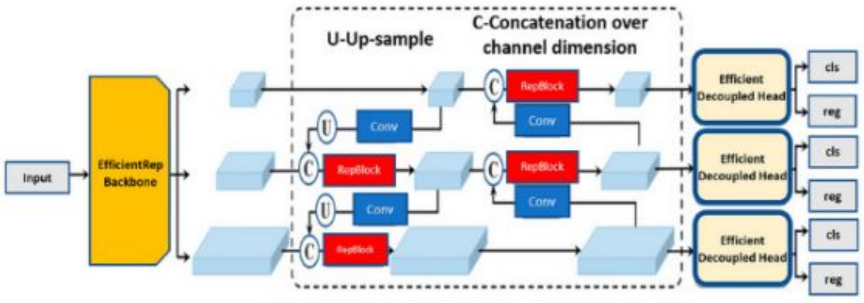


Figure 1. YOLOv8n (TFLite) model

4.Phone Warning

Generating directional audio alerts to ensure safety without visual distraction.

Figure 4. Using phone's speaker to notice the object's position (Left/Right/Danger)

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