IMPROVE DRIVABLE AREA SEGMENTATION AND LANE DETECTION BY TWINLITENET+

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What ?

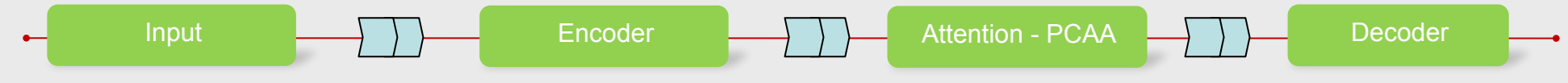
We introduce TwinLiteNet+, a lightweight model for real-time lane and drivable area segmentation

- Uses Depthwise ESP and PCAA to enhance feature learning.
- Multi-head Decoder tailored to each segmentation task.
- Focal Loss improves detection of small lane markings.
- Tversky Loss balances false positives and negatives in road segmentation.

Why ?

- Today's self-driving cars need accurate perception, but most models are too heavy and energy-hungry for real-time use.
- **TwinLiteNet+** solves this by combining lightweight design with competitive accuracy, reducing FLOPs while maintaining performance.
- This enables faster, greener, and more deployable perception for real-world self-driving applications.

Overview



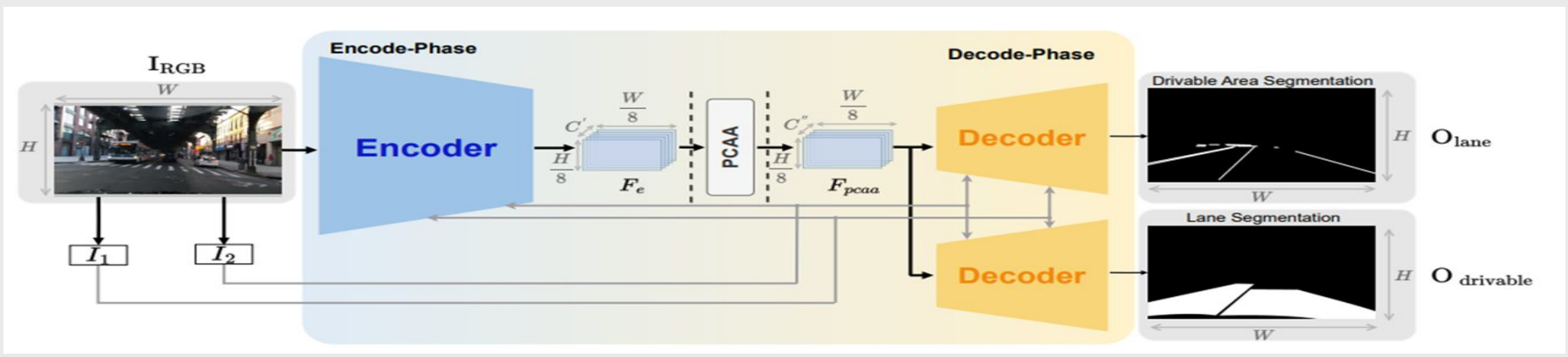


Figure 1. TwinLiteNet+ architecture for real-time drivable area and lane segmentation.

Description

1. Input

- The input is a street-level RGB image of resolution 640×384.
- Auxiliary binary edge maps can be added optionally.

Figure 2. Example of Input Image

2. Encoding with DESP

- Utilizes Depthwise Dilated Separable Convolution (DESP) blocks to efficiently capture multi-scale contextual information.
- Incorporates skip connections to preserve spatial details across layers.

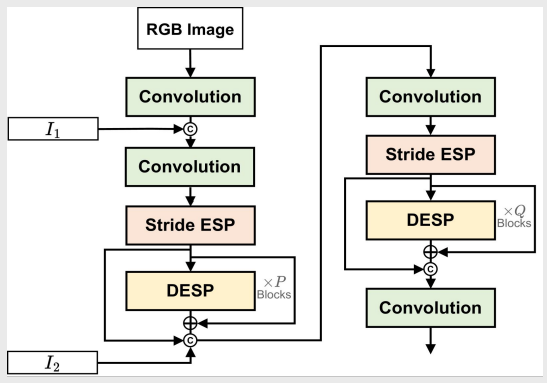


Figure 3. Comprehensive schematic of the Encoder in TwinLiteNet+.

3. Partial Class Activation Attention (PCAA)

- Enhances feature representations by focusing on class-specific regions.
- Combines local class activation maps with global context to improve segmentation accuracy, especially for thin structures like lane markings.

4. Multi-task Decoding

- Features a multi-task decoder with separate branches for:
  - ➔ Lane Segmentation
  - ➔ Drivable Area Segmentation
- Employs UpConvBlocks and skip connections to reconstruct high-resolution segmentation masks

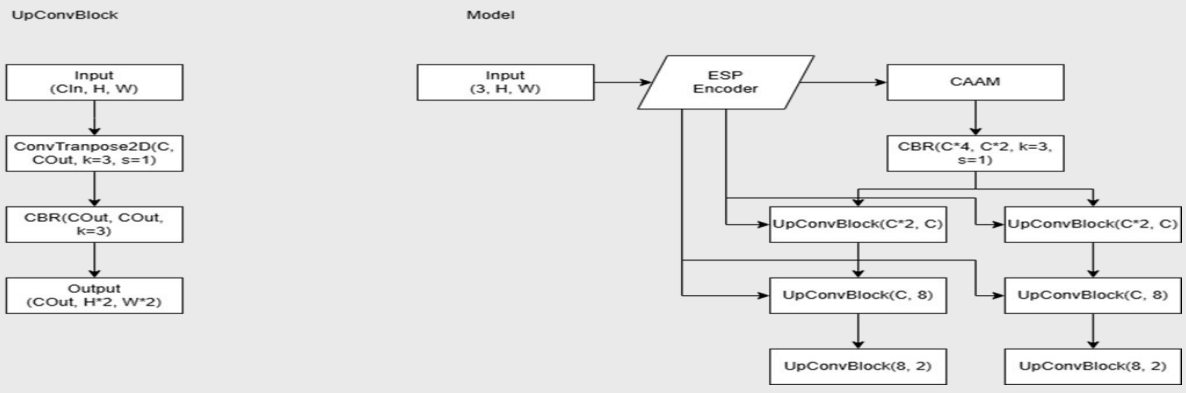


Figure 4. Decoder with UpConvBlocks, applied to both Lane and Drivable Area segmentation.

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