University Of Information Technology, VNU-HCM
CS117.O21.KHTN - Computational Thinking

Vietnamese License Plate Recognition

Teacher Instruction: *PhD. Ngo Duc Thanh*

Tran Nhu Cam Nguyen 22520004

Tran Thi Cam Giang 22520361

Nguyen Huu Hoang Long 22520817

Tran Minh Quan 22521191

1 Introduction

We develop a Vietnamese license plate recognition model for smart parking systems

With the increasing number of vehicles in urban areas, traditional parking management systems face challenges such as inefficiencies, long wait times, and security issues. As cities expand, the demand for advanced parking solutions becomes crucial. This project tackles these challenges by developing a License Plate Recognition (VLPR) system specifically designed for Vietnamese vehicles.

Our goal is to create an LPR system that uses efficient deep learning algorithms to accurately and quickly recognize license plates. This solution effectively supports parking lots by shortening the entry and exit process, reducing waiting time, and minimizing human intervention.

2 Problem Identification

Input

An image of a vehicle containing a clearly visible license plate

Output

30G56789

52F6-4378

A string containing the content of the license plate

Constraints

- The license plate follows the standard format of Vietnamese vehicle plates.
- The image resolution is 1920x1080 (Full HD).
- The license plate occupies at least 5% of the image area.
- The license plate is clearly visible, not obscured, not overexposed, not poorly lit and not deformed.
- The image has in-plane rotations of the license plate no greater than 30 degrees along the x-axis.

Requirements

- The system must achieve at least 95% accuracy in recognizing Vietnamese license plates on the dataset provided by the customer.
- The processing time from receiving the image to outputting the license plate content must not exceed 5 seconds on the hardware configuration of the Apple MacBook Air with the M1 chip, released in 2020.

3 Decomposition

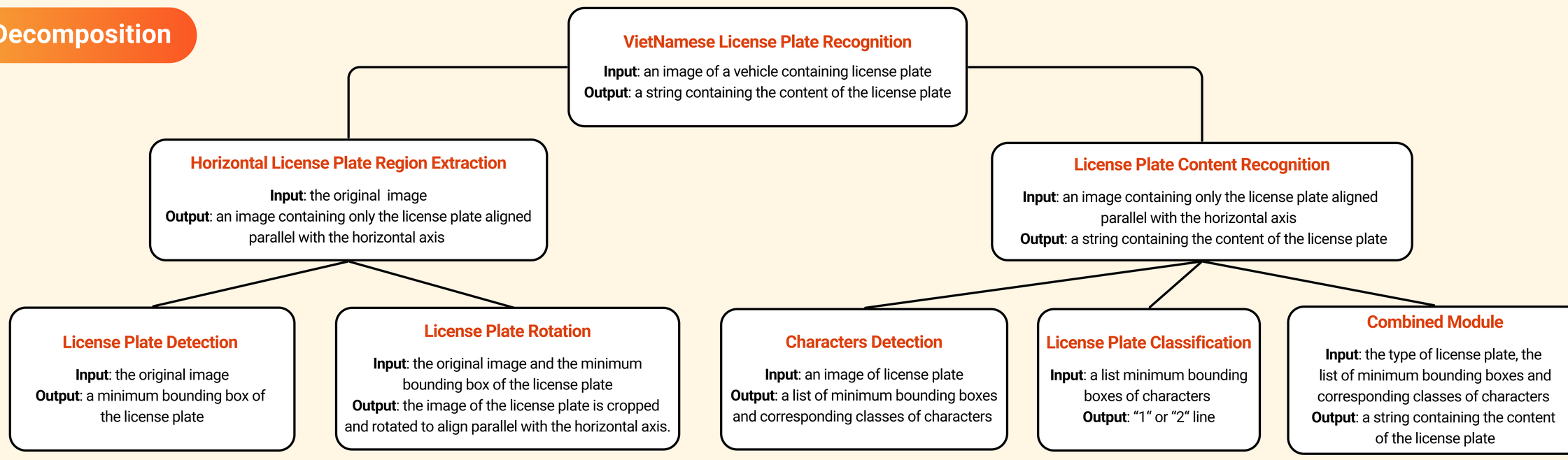

Fig 1. Decomposition tree

4 Algorithms

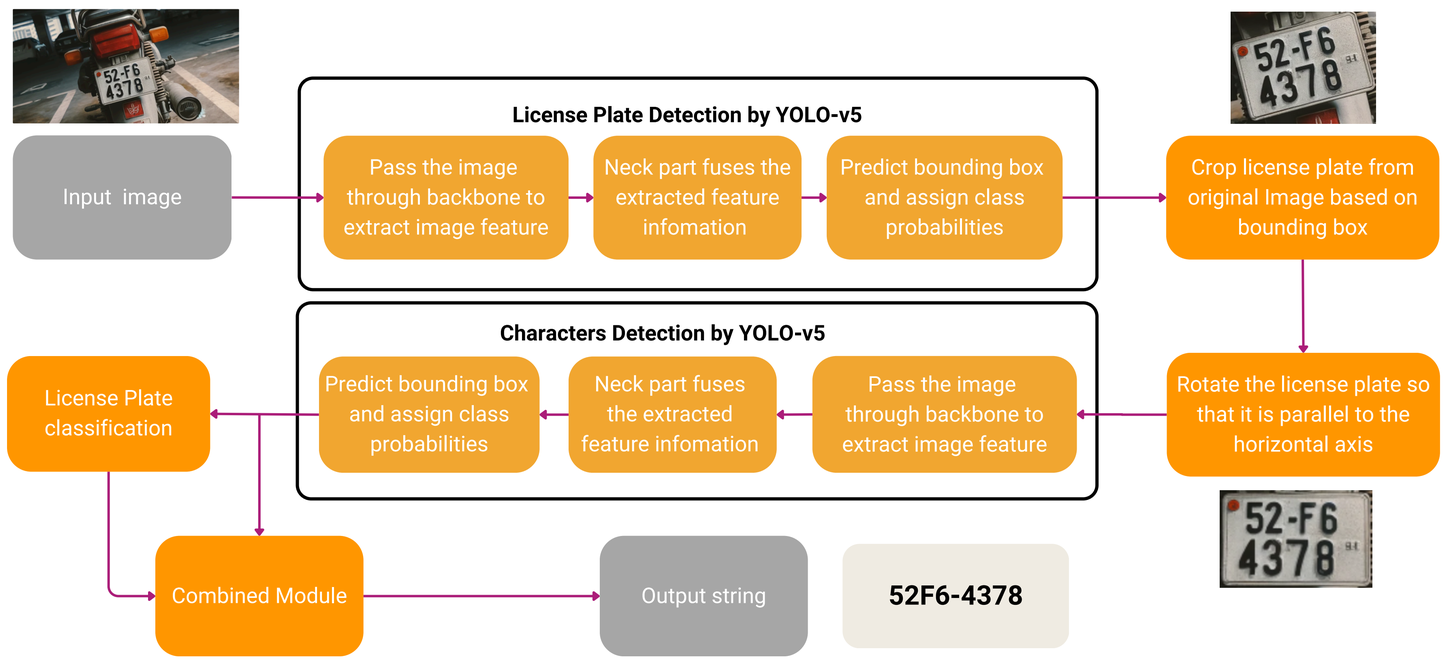

Fig 2. Algorithm flowchart

Yolov5

- Introduced by Ultralytics in 2020, YOLOv5 is an object detection method belonging to the YOLO family and classified as a One-stage Detector. It is widely employed in various real-time applications due to its ability to swiftly process images and accurately detect objects.
- Its architecture comprises 3 main components
  - **The backbone** for feature extraction.
  - **The neck** for feature aggregation.
  - **The head** for predicting bounding boxes and class probabilities.

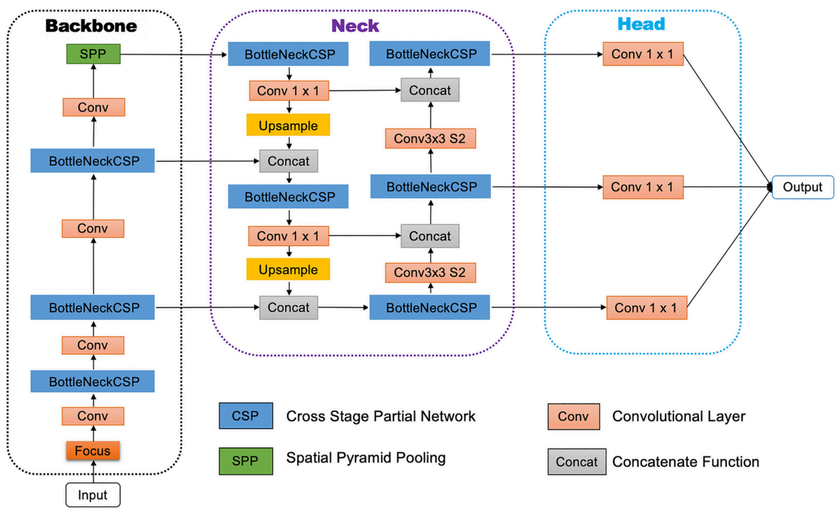

Fig 3. Yolov5 architecture

5 Datasets & Metrics

Datasets

1. **The Character Detection Dataset** consists of 3066 training images and 767 validation images, each containing a license plate. This dataset is annotated with a list of bounding boxes and corresponding classes of characters present on this image.
2. **License Plate Detection Dataset** comprises 6607 train images and 1652 validations images.
3. **License Plate Recognition Dataset** comprising 400 images, is a dataset collected by our team for final evaluation purposes. The labels for each image consist of the license plate content provided as a string, allowing us to evaluate the accuracy of our system in recognizing license plate.

Metrics

For character and license plate detection:

- **Recall** - **Precision** - **mAP**

For final license plate recognition:

- **Accuracy** - **Time**

Evaluation

Number of test	Correct Prediction	Accuracy	Average Time
400 (images)	384 (images)	0.96	1.33s

Table 1. Experiment on the License Plate Recognition Dataset

6 Conclusion

Through this project, we have learned how to apply computational thinking to solve specific real-world problems, such as Vietnamese license plate recognition. By using the YOLOv5 model, our team has found that this approach meets the initial requirements set by our team. However, for effective integration into real-world systems, we need to overcome several challenges such as poor image quality, low resolution, etc. and implement state-of-the-art methods to ensure the system performs optimally.