

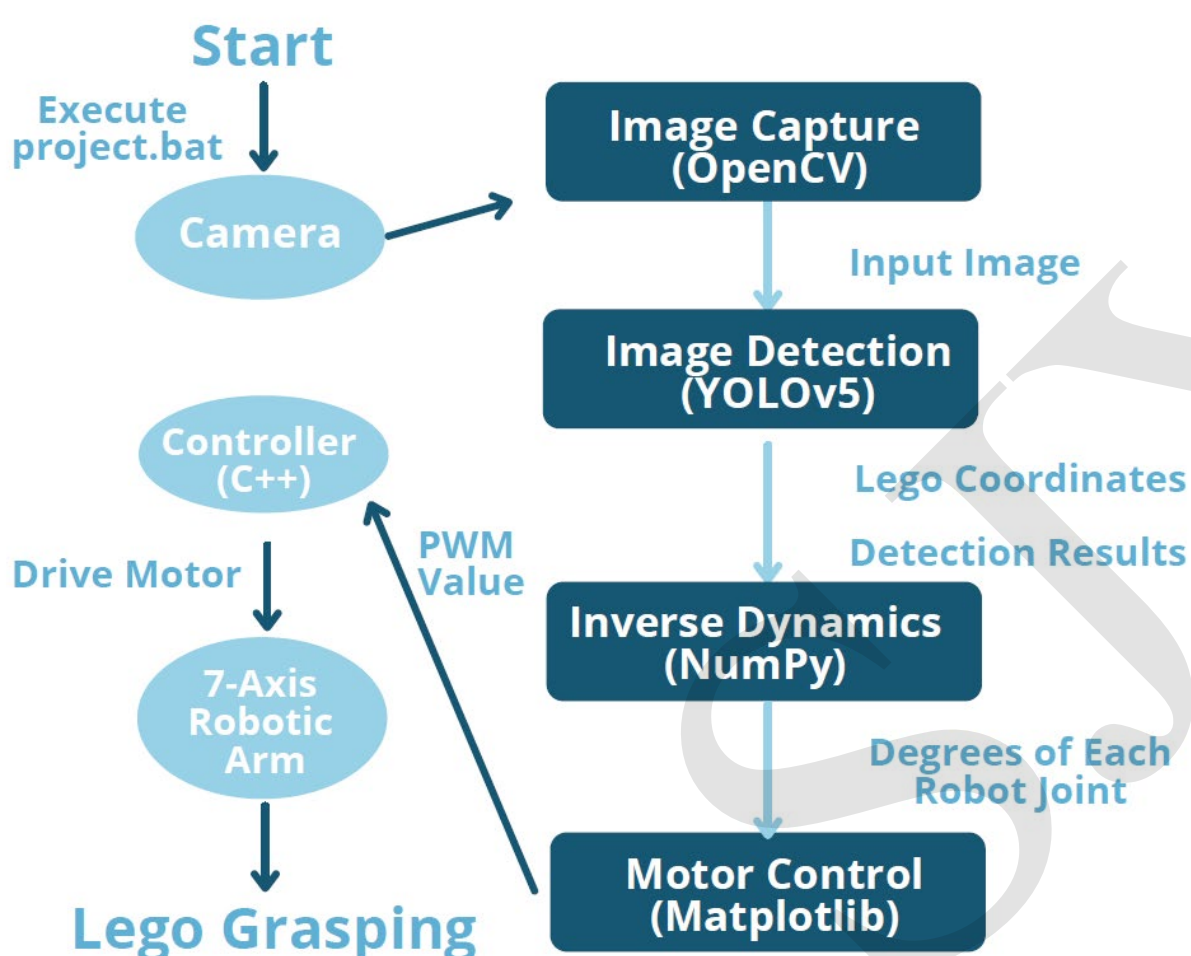
LEGO Color Recognition and 7-Axis Robotic Arm

Control System Based on YOLOv5

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Project Overview

This project integrates image recognition and motor control within the realm of industrial automation, driven by my enthusiasm for machine learning and programming. It attained 100% accuracy on the test set with a LEGO color recognition and robotic arm control system utilizing YOLOv5, trained on a dataset of 150 images, thereby enhancing my competencies in computer vision, deep learning, and programming in Python and C++.

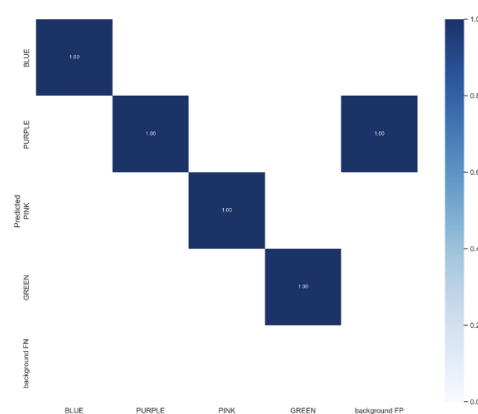


Technical Architecture

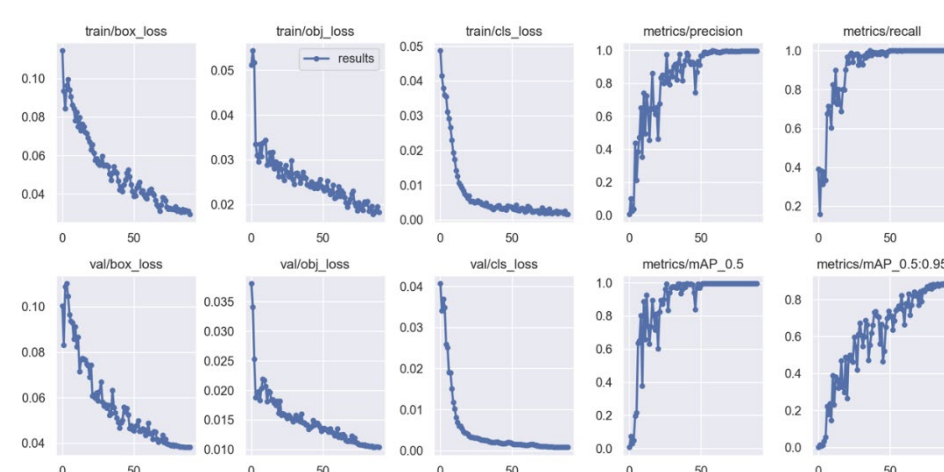
- **YOLOv5:** Detects LEGO position and color using image recognition.
- **Dataset:** 150 images (120 for training, 30 for testing).
- **Inverse Kinematics:** Computes joint angles for robotic arm movement using geometric methods.
 - Input: Target object position
 - Output: Required joint angles
- **Motor Control:** Generates and stores PWM values in a txt file for C++ controller

Discussion

The model's perfect accuracy is attributed to the dataset's simplicity, where each image consistently features all four colors with fixed shapes and lengths, aside from variations in lighting and camera distance. The convergence of training and validation loss curves indicates a stable training process without overfitting.

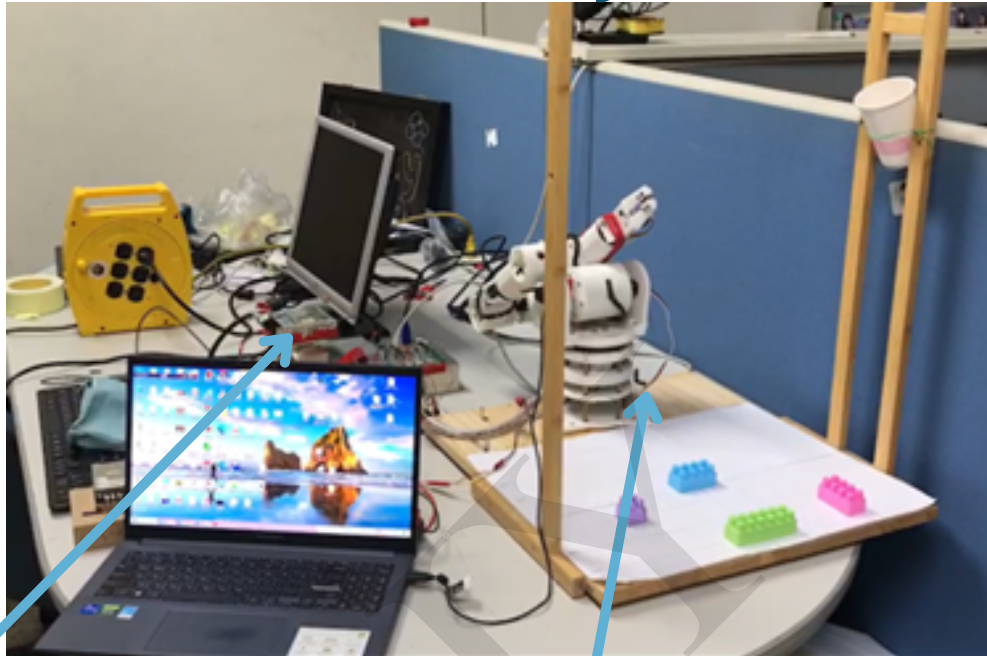


Confusion matrix

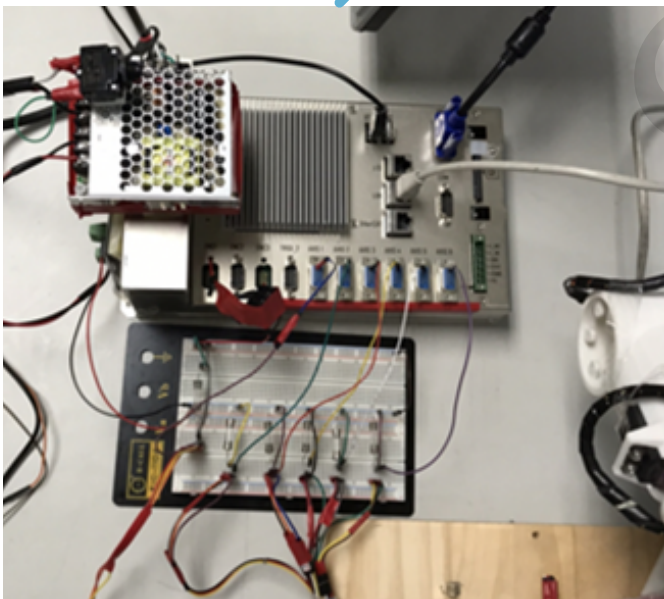


Train/valid loss

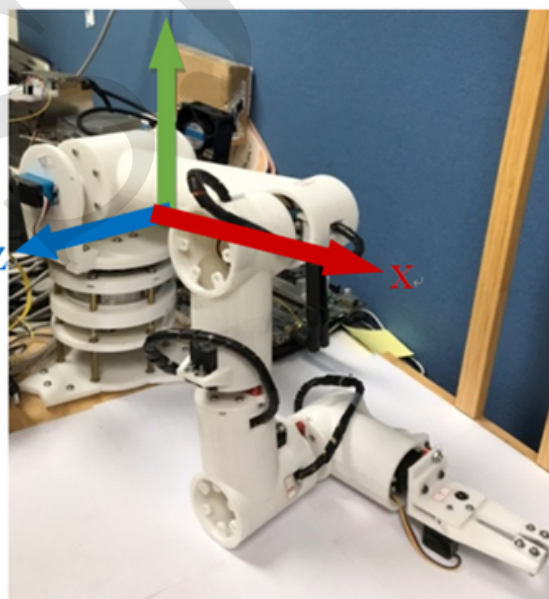
Hardware System



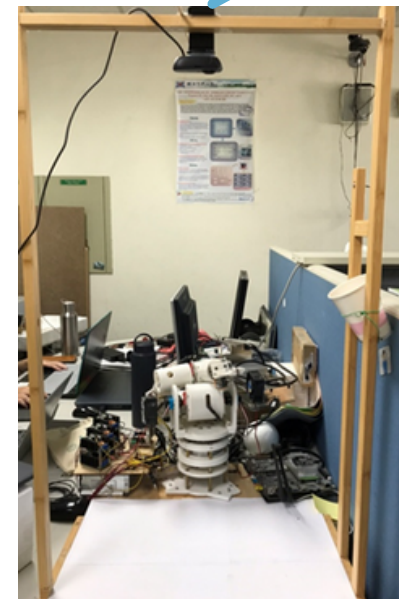
**Camera
(Logitech C310)**



**Controller &
Circuit Wiring**



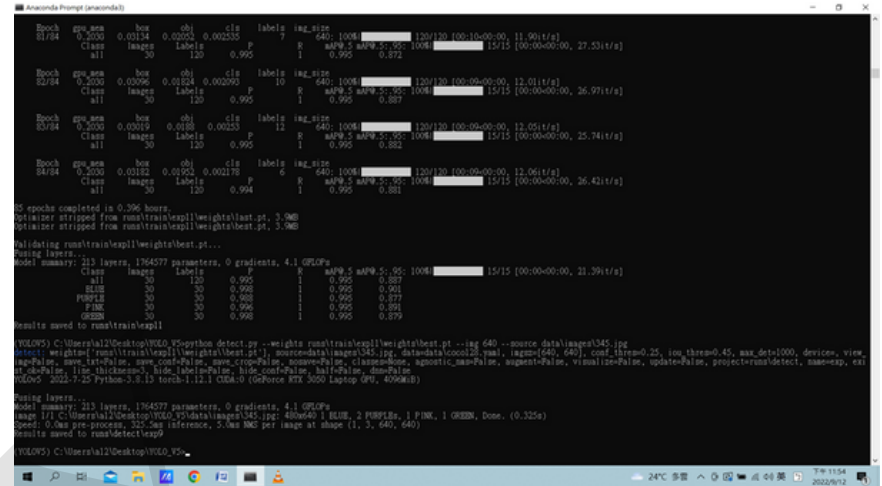
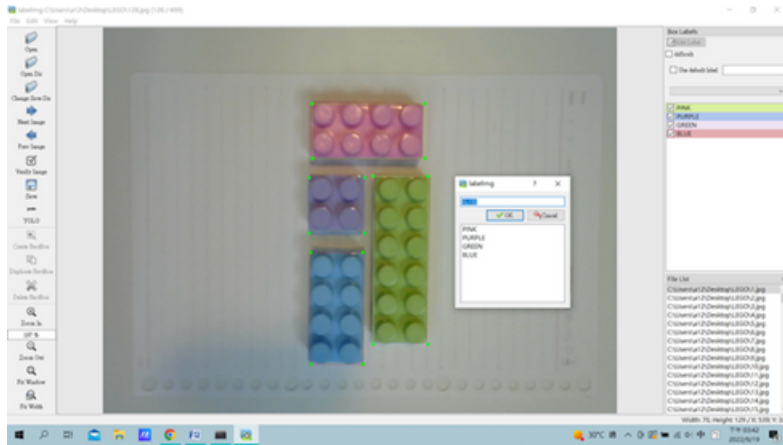
**Robot Arm
Coordinate Definition**



**ObjectView Platform
(Size: 50x39 cm)**

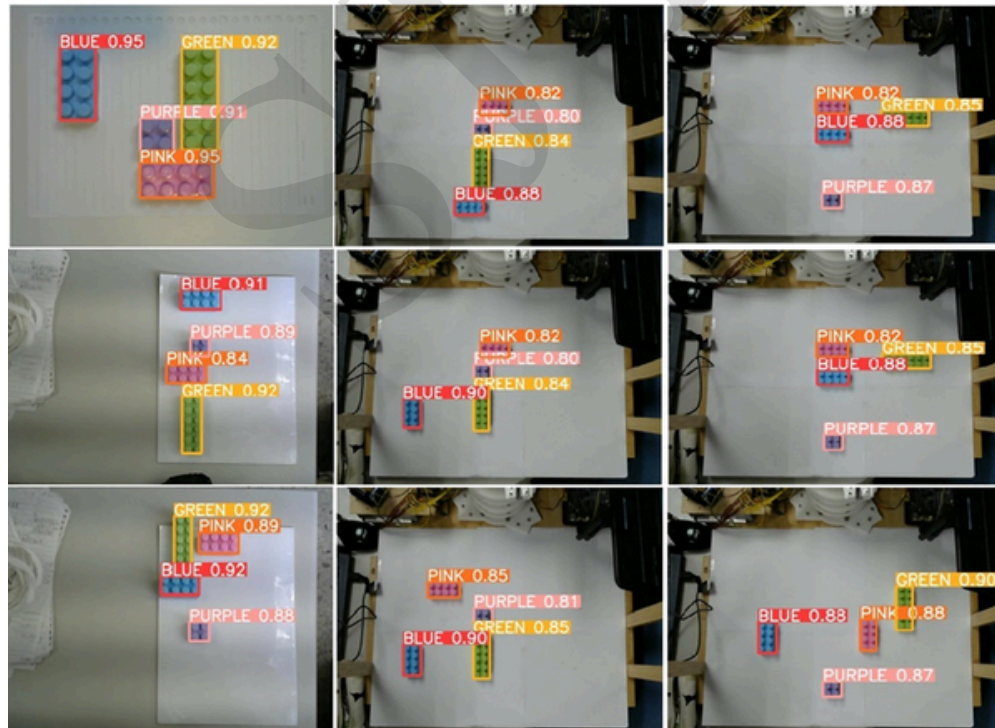
90 cm

Training, Labeling, and Results



Label Process
(**'BLUE'**, **'PURPLE'**, **'PINK'**, **'GREEN'**)

Training Process



Detection Results