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Automatic Inventory Management and Tracking by Deep Learning in Industrial Environments

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1. INTRODUCTION

Inventory management for large-scale warehouses has become one of the main challenges in the industry, due to the high demand for consumer products from online and local markets. Therefore, technology must be included to automate inventory management. In this thesis, we will focus on the acquisition and processing of images in an industrial environment. This will include new solutions for the industry. It will include in-depth learning about embedded systems using sensors and wireless equipment.

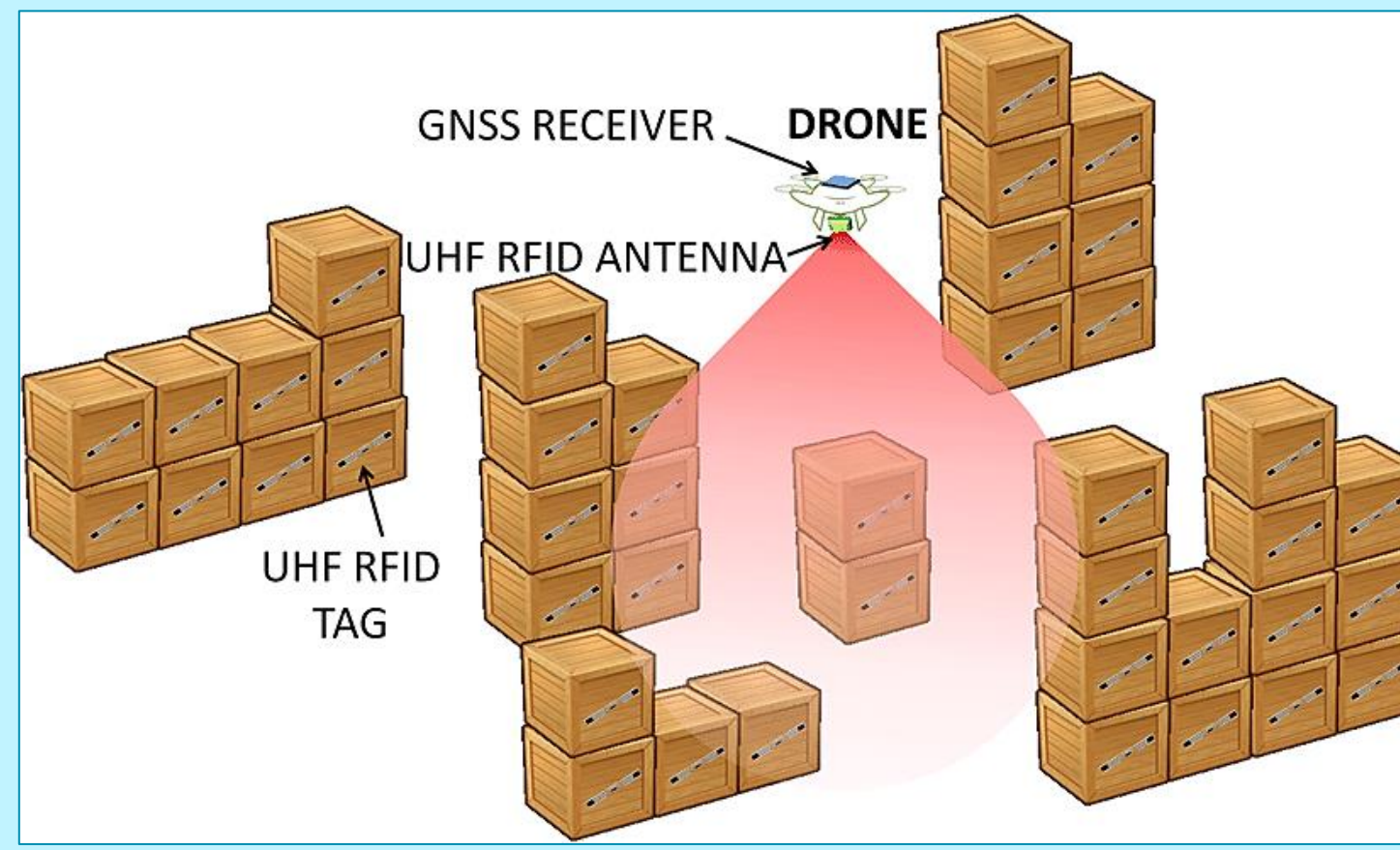
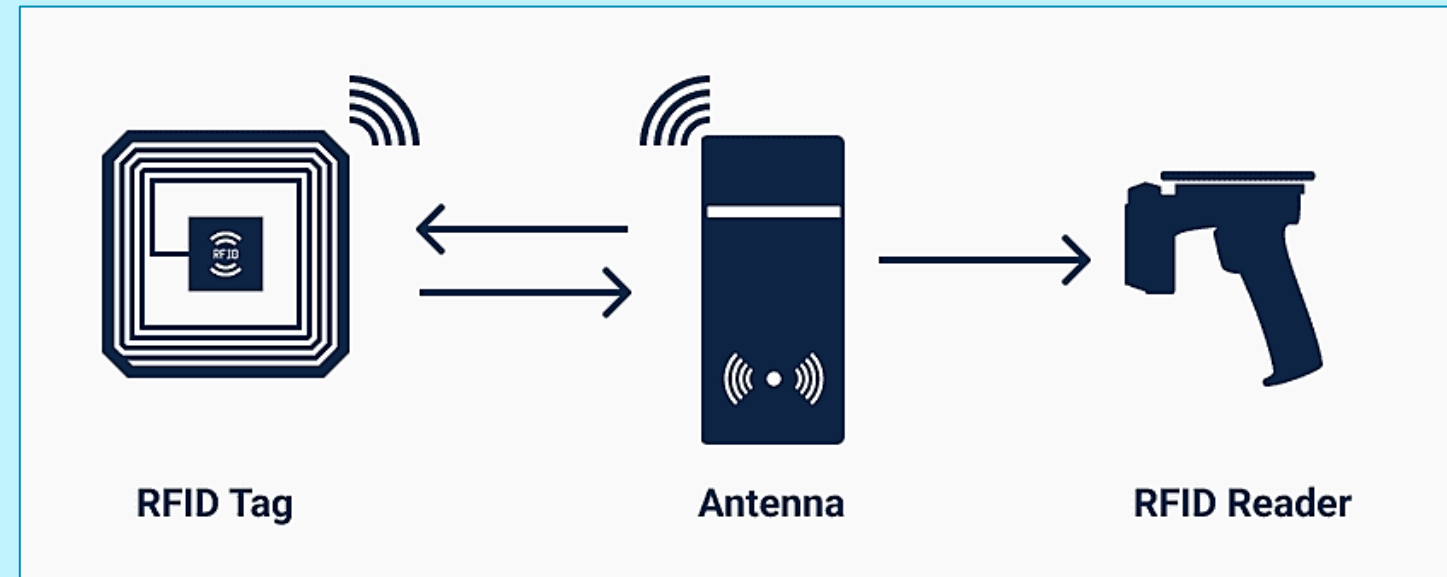


Figure 1: Methods Used in Inventory Management

2. VISION BASED CHALLENGES AND FEATURES

The objective of this project is to apply the detection and classification of objects with the recognition of barcodes, QR codes, optical characters (OCR) and the detection of packages and pallets inside warehouses. We will create new deep learning models implemented on custom developed hardware that will be compatible with the industry domain.



Figure 2: Pallets Inside the Warehouse



Figure 3: Pallets and tags detection

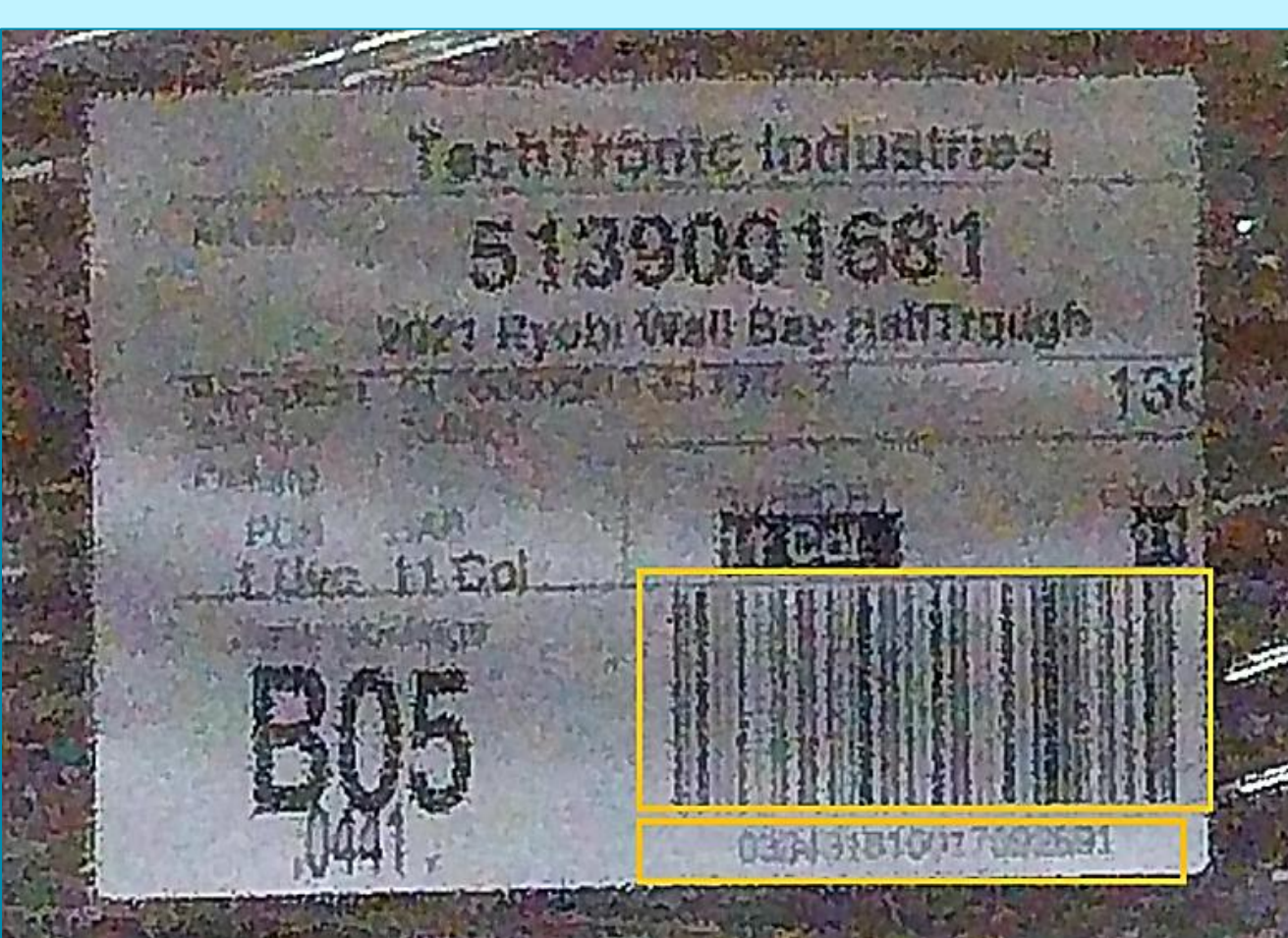


Figure 4: Palette tag need to recognize its barcode



Figure 5: Liquid leakage that must be recognized using AI

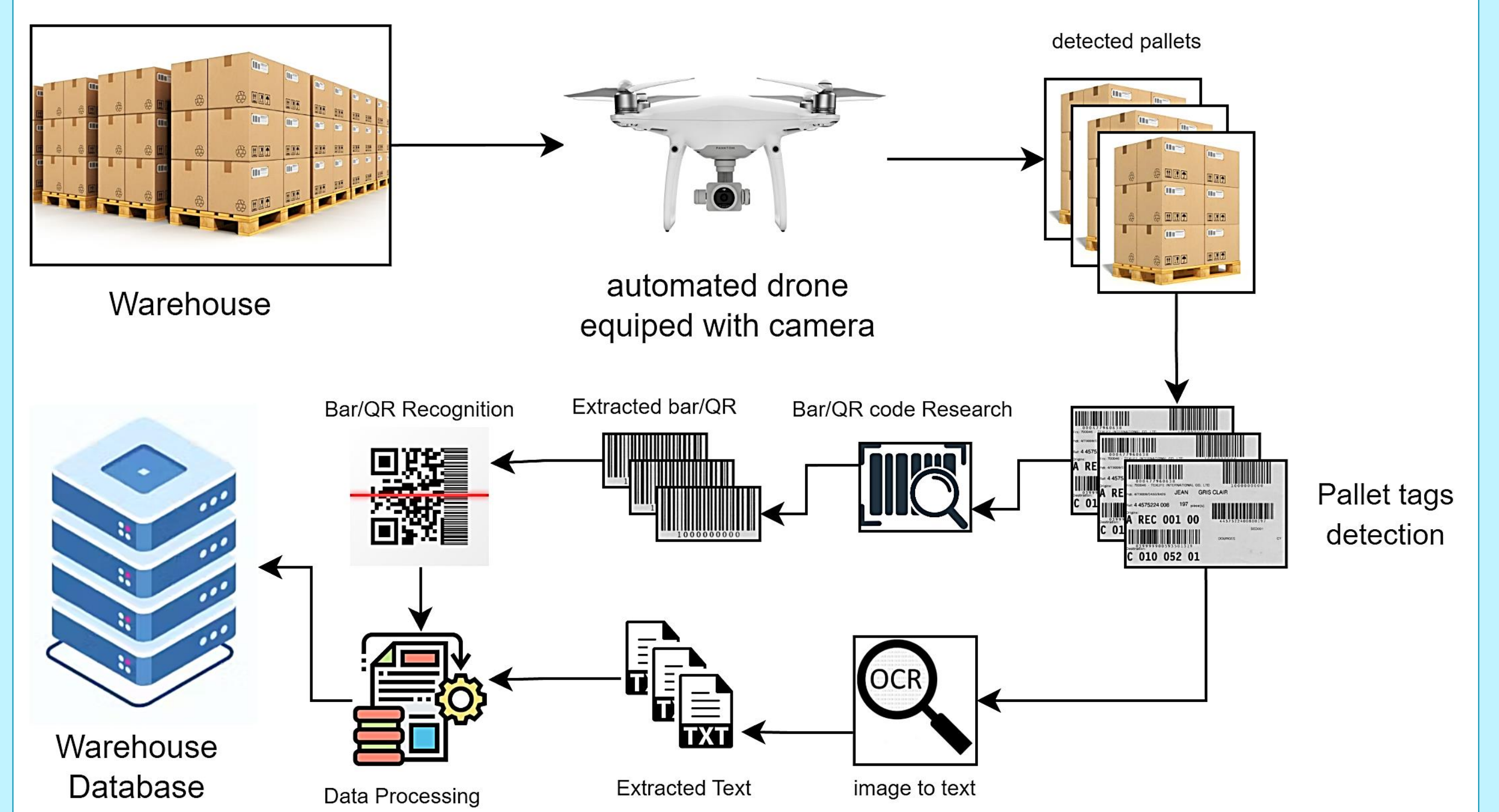
Challenges:

- 1- Choosing the best camera model that can be stable enough to capture pallet tags with high resolution in a drone for industry.
- 2- Detecting all the content of the pallet 2 meters long from a close distance. (Camera FoV challenge, Camera Stabilization Challenge, Lighting Challenges).

Pros of the next generation solution:

- Better in health care for warehouse agents (more radiation of RFID means more cancer risks)
- Better way of using semiconductor to produce more sustainable devices instead of RFID tags

3. OUR METHOD



During our research on the state of art for pallets detection in logistics we found public dataset and tried to replicate the work. We successfully replicated the work and we contributed to get better results in accuracy using YoloV4 model.

Model	2020	2022	ours
YoloV4 (mAP@0.50)	41.0%	64.54%	75.63%*
YoloV4-Tiny (mAP@0.50)	22.1%	49.98%	60.60%*

For YoloV4/YoloV4-tiny, we got this Results after taking more than 40 training sessions.



4. HARWARE SYSTEM

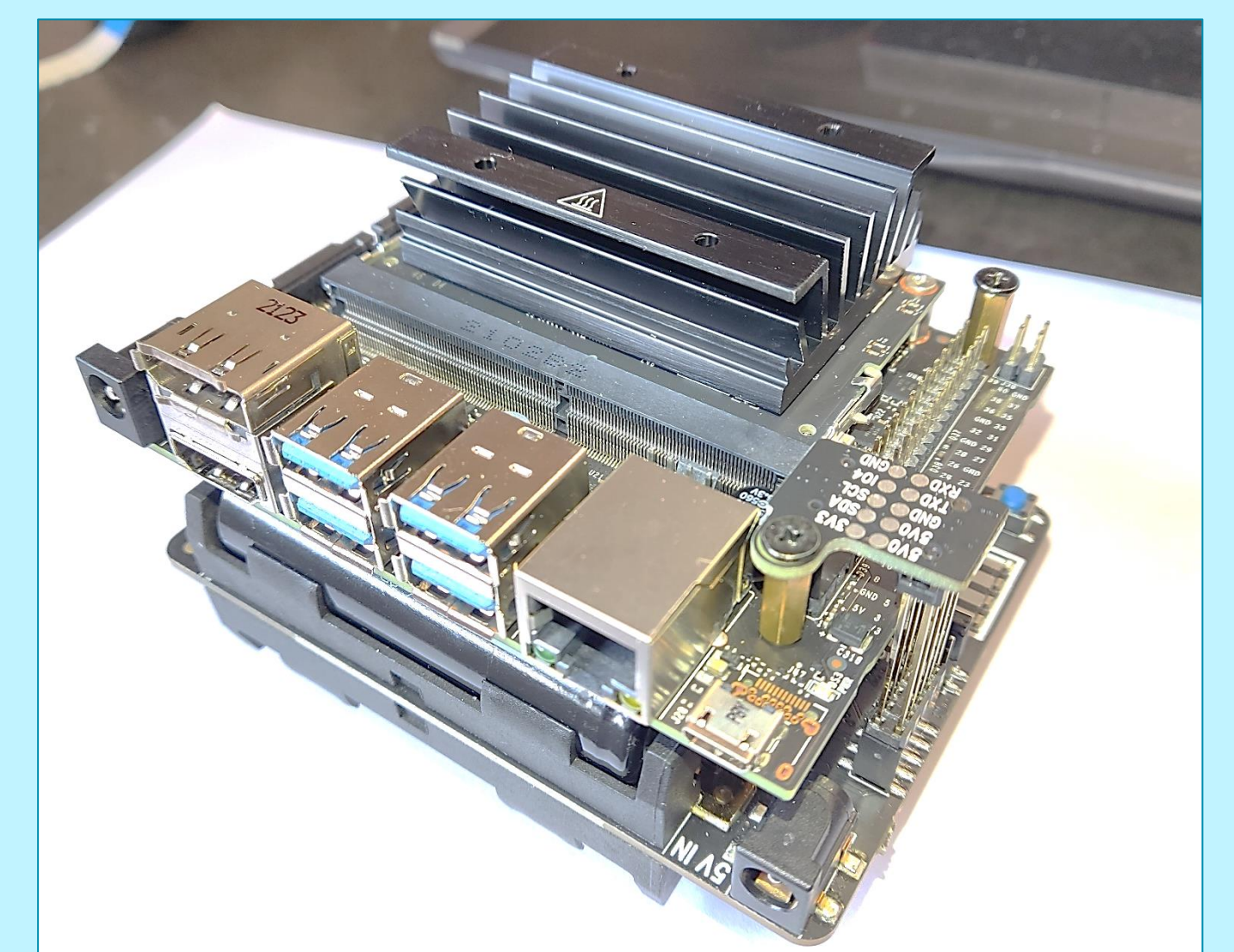
We tried to integrate the yolov4 model in our SBC. We tested it to predict objects in video sequence, and we reached from 9FPS to 21FPS by tweaking hyperparameters of YoloV4 models.

Challenge:

More FPS = Less Accuracy

Goal:

Get best FPS for highest accuracy score.



The DJI Matrice 100 drone is fully customizable and programmable. Equipped with Easy To Fly technology and optimized for easy programming via the DJI SDK, the Matrice 100 is ready to carry sensors, devices. It can carry up to 3.4 kg additional weight.

Challenge

Install SBC with camera and try to capture videos with best stabilization

5. CONCLUSIONS

- Now we still working on development and optimization of our prototype.
- We may think to find logistics Warehouse in order to adjust our approaches to be more integrable for this application.
- We are happy to find any researchers or partners interested in boosting this research approaches.

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