APPS - Autonomous Payload Perception Systems : A Technical Feasibility Exploration

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1 INTRODUCTION & PROBLEM STATEMENT:

- Addressing Long Loads (Pipes/Bars, etc.) in Racking for Autonomous Forklifts: An Assessment Report.

RQ What are the best Sensors/Algorithms for payload perception that can be used as the perfect solution for Long Load handling needs.?

Goals

- Develop suitable vehicle perception systems (sensors and algorithms) for high-fidelity perception of forklift loads including pallets and other non-uniform loads.

- Provide a real time load detection method/model that performs long-range and high accuracy object detection.

Challenges

- Shiny surfaces and metal edges pose some challenges with 3D camera technology.

Camera Sensor Kit Used

ToF /RGB sensor kit

2 METHODS, TECHNIQUES, & SOLUTIONS:

- State-of-the-art ToF sensor system evaluated for: range, field of view, accuracy and frame rates. Helios2+ Triton 3.2MP sensor kit selected for use in this project as the best solution for the target application.

- Comparison of Deep Learning Models for load detection such as YOLO v.8 and Faster-RCNN algorithms and object detections for different types of loads.

- Identifying the load length, height and depth.

- Identifying the gap between two loads.

- Identifying the distance between the camera sensor and the load.

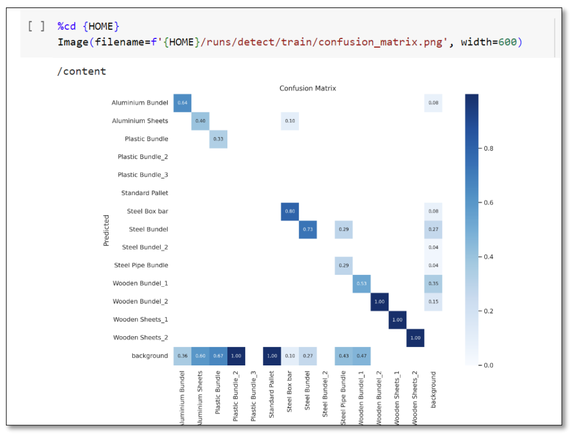
Research Area

- Machine Vision/Object Detection

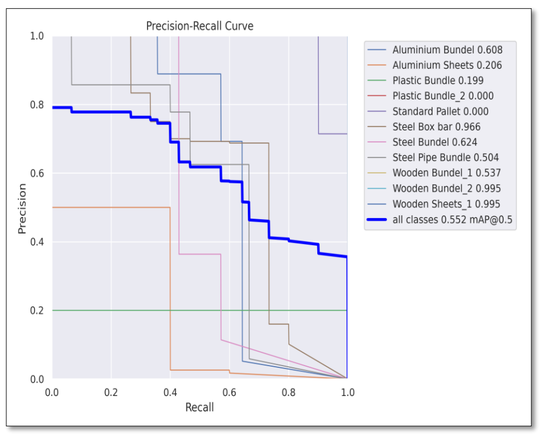
Segmentation Example of a Load in a Warehouse.

3 SOME RESULTS DURING TRIALS/EXPERIMENTS:

Training Custom Data via YOLOv8 snapshots

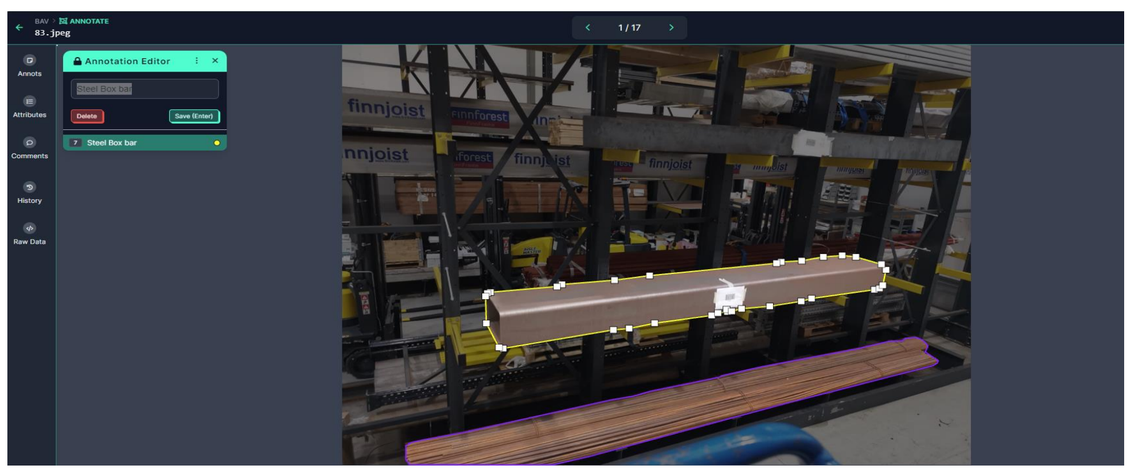


Confusion Matrix Produced by YOLOv8 for Our Model



Precision –Rrcall Curve /Running YOLOv.8

4 LABELLING EXAMPLE OF A LOAD IN A WAREHOUSE:



Potential Publications

Target to Publish in early 2024

- Autonomous Vehicle Machine Vision: State of The Art of Cutting edge Solutions: Sensors, Object Detection and Systems.

- An Autonomous Forklift for Different Types of Long Loads: Comparison of Implementation of Deep Learning Models Yolo.v8 and Faster-RCNN .

- ToF and RGB Combining for Autonomous Forklifts Handling Different Types of Long Loads via YOLO.v8 Machine Vision Model: A Proof-of-Concept Prototype for Autonomous Payload Perception.

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