Automated Scanning of Bins for Warehouse Inventory

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INTRODUCTION

Attabotics is a Calgary-based robotics company that specializes in robotic warehousing systems, using a 3D storage design with robotic shuttles for efficient storage and retrieval. Their technology optimizes space, enhances operational efficiency, and improves order fulfillment speed and accuracy, particularly beneficial for industries like e-commerce and retail.

PROBLEM

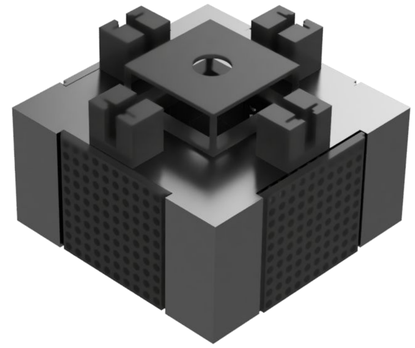
- With numerous bins and transactions, database errors can occur, leading to incorrect bin picking or attempted placement on occupied shelves.
- In the warehouse setting, some bins could be misplaced, leading to difficulties in locating them accurately.
- Additionally, missing **QR/Data Matrix codes** on bins can result in them being unidentifiable.

SOLUTION

- This project aims to create a solution that securely attaches to a bin that sits on top of the Attabotics Blade robot. The robot along with the **SatHat** (Scanning Acceptance Test Hat) is sent in the structure to scan every location. The SatHat must have enough energy to be powered for minimum of **4 hours**.
- Each column in the structure will be scanned to correctly identify the total number of bins present, along with the QR/Data Matrix code of each bin. The scan results are then uploaded to our server and displayed on a web application.
- This data will then be uploaded to Attabotics' servers and analyzed to **verify/update** the existing database.

METHODS & MATERIALS

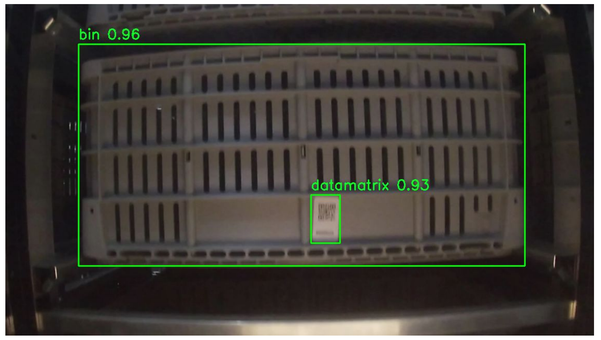
- The SatHat uses **4x 1080p@60FPS cameras** to optically scan every possible bin location in a column, covering all four sides. The SatHat illuminates the surroundings with an **LED light bulb** on top, along with an **LED strip** around the SatHat perimeter.
- There are **2 NVIDIA Jetson Nano's**, each controlling 2 cameras.
- We have trained a **YOLOv8** model for the task of object detection.
- The Jetson Nano performs inference using **OpenCV** and our custom YOLOv8 model on the videos captured from the cameras in order to detect **bin presence** and their QR/Data Matrix values.
- This information is then uploaded to our **backend server** and displayed on a **web application**. Additionally, we supply Attabotics with **bin position** in the structure (x, y, z), along with information about bin presence, and QR/Data Matrix value, presence and readability.



DISCUSSION & RESULTS

- We conducted unit and simulation tests in which the SatHat was given video recordings of the Blade robot navigating through a storage facility. The SatHat was able to **accurately detect** and **identify** the bins and the QR/Data Matrix labels. The SatHat was able to create an inventory map of the facility, with information such as bin presence, bin identifier, and images of the corresponding bin and label at each location.

- We also performed live testing at Attabotics HQ, where we mounted the SatHat on the Blade Robot. The robot was then sent in the structure to scan a column, and the SatHat was able to recognize the bins. One challenge we encountered was that the robot was moving at a speed much faster than what the SatHat was designed for, resulting in camera motion blur that hindered QR code readability.



CONCLUSION

- Our SatHat prototype was able to accurately determine bin and QR/Data Matrix presence and offload this information for Attabotics to consume.
- This will help the structures that the robot of Attabotics look after have fewer mishaps, leading to improved efficiency and accuracy.
- Additionally the SatHat is able to operate while the structure are live **saving** Attabotics **time** on downtime for any checks they might have.

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