

SPATIAL ORGANIZATION ASSISTANT

Development of a Logistics Warehousing Item Placement Application
Based on the 3D Rotation-Aware Greedy Packing Algorithm

Capstone Project Advisor: Hsien-Tsung Chang.

Project Participant: Chen, Wei An. Wu, Xu Cheng. Chen, Chuan.

Innovation Motivation

Pain Points

Traditional manual methods are time-consuming and struggle to handle varying item dimensions and packaging constraints.

Smart Solution:

Our system leverages **AI-powered 3D modeling** and a **rotation-aware greedy algorithm** to optimize packaging space and improve logistics efficiency.

System Features

The smart space organization application includes camera capture, item recognition and classification, and placement suggestions to help users efficiently utilize space.

By determining the minimum space required after organizing and packing the items, the system can find combinations of available space options that can accommodate everything without wasting space.

Through destination settings before each packing session, the system automatically checks the customs regulations or postal restrictions of the country, then reminds the user of relevant limitations.

Technologies and Approaches



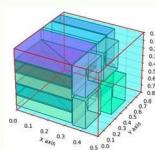
LiDAR

Compared to traditional methods that require taking photos from multiple angles and using reference objects to obtain dimensions, LiDAR technology allows us to capture both the size and shape of items simultaneously by simply scanning around them.

Capture



The surfaces of item models are marked with densely distributed vertices, which are used to form faces. These faces construct a space where no intersections or conflicts are allowed.



Using three-dimensional rotation placement, start by positioning the largest and most complex items first. Then calculate arrangements that allow all items to fit within the storage space. Finally, visualize the arrangement through item models.

Create 3D Models



LiDAR

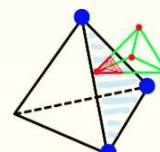
After obtaining the dimensions and shape of an item using LiDAR, a 3D model of the item is created.

Mask R-CNN

Apply Mask R-CNN to label item surfaces and reconstruct accurate 3D models.

Calculate Occupied Space

Analyze Object Conflicts



Perform sorting: if the space constructed by all vertices of one item overlaps with the space of another item, the arrangement is invalid, and the sorting order must be adjusted.

Space Visualization