Tech Expo, Spring 2026 – Team 48

2D LIDAR Storage

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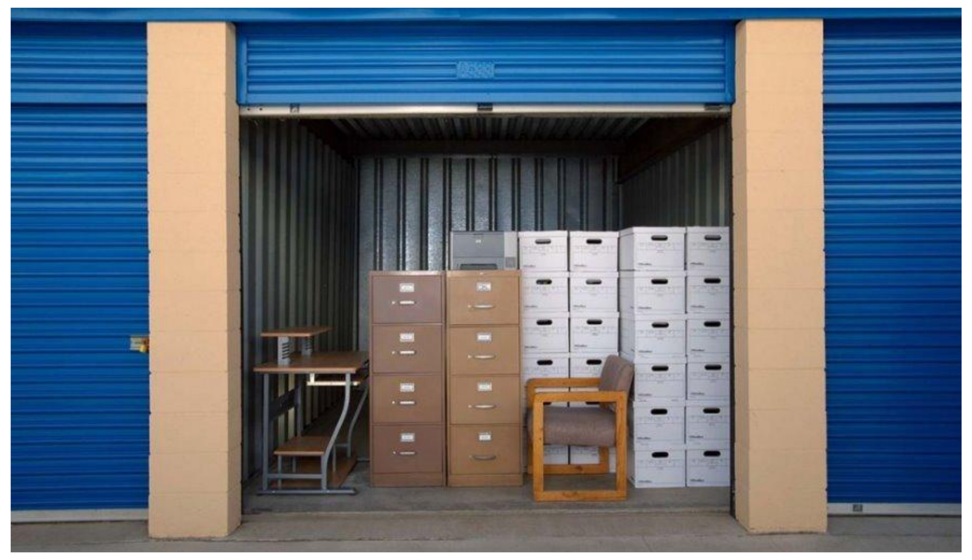
SICK Sensor Intelligence.

Problem Statement

Current storage estimation methods often rely on manual measurements and rough visual judgment, which can result in inaccurate storage planning and wasted space. This capstone project addresses that issue by developing a 2D LiDAR based scanning system capable of measuring object dimensions in the X, Y, and Z axes. Measurements are then converted into a digital model that supports storage capacity estimation and packing efficiency analysis.

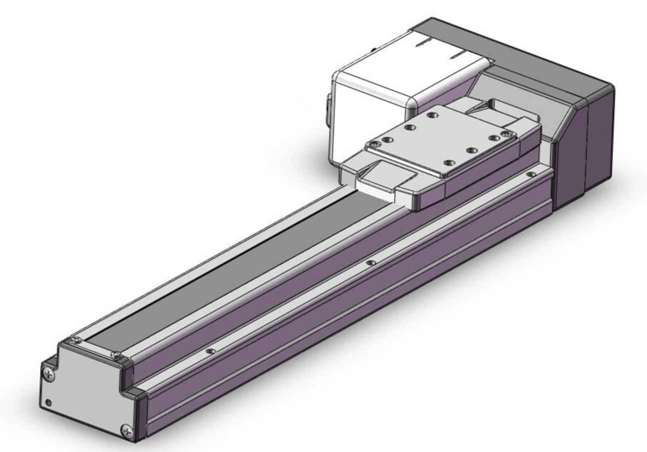
Project Background

- LiDAR provides accurate real-time distance measurements for automation and object detection.
- The SICK TiM561 was chosen as a cost-effective sensor for scanning box dimensions.
- Vertical motion and software processing convert the 2D scan data into a basic 3D model.
- The model is used to visualize box placement and reduce wasted storage space.



Requirements

- The technical requirements for the design include using the TiM561 2D LiDAR and to apply this sensor in a new application in a new industry
- The TiM561 has a 10m range, 0.03° angular resolution, and a FOV of 270°
- The linear stage has a range of 700mm and a maximum speed of 50mm/s
- The software requires a strong Internet connection and an Ethernet adapter



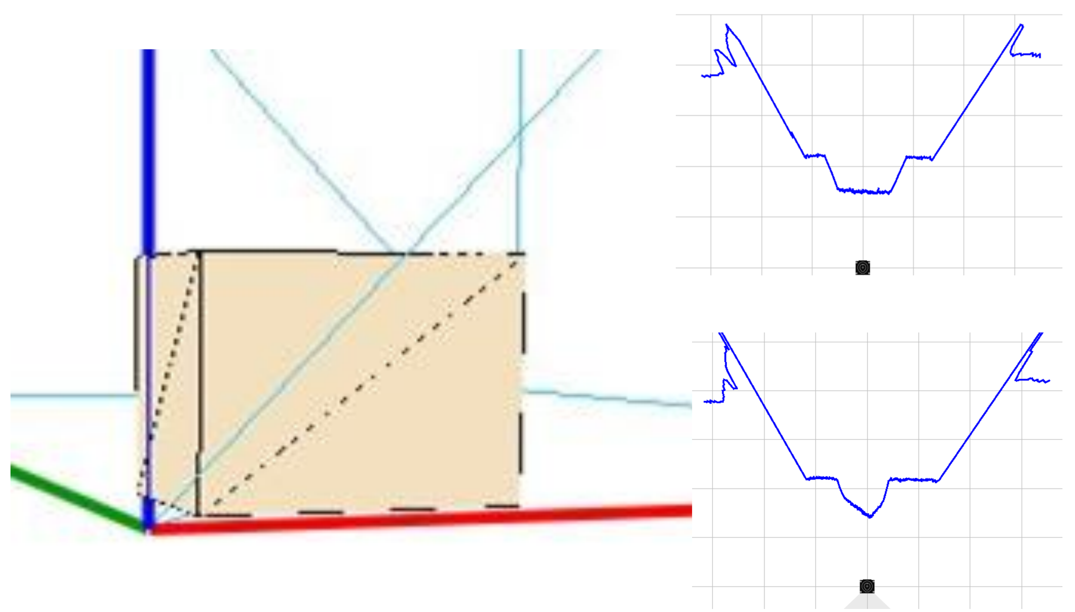
Concepts and Evolution

Step 1: Width using Box Edge Detection

Step 2: Length Dimensioning

Step 3: Height using Linear Actuator

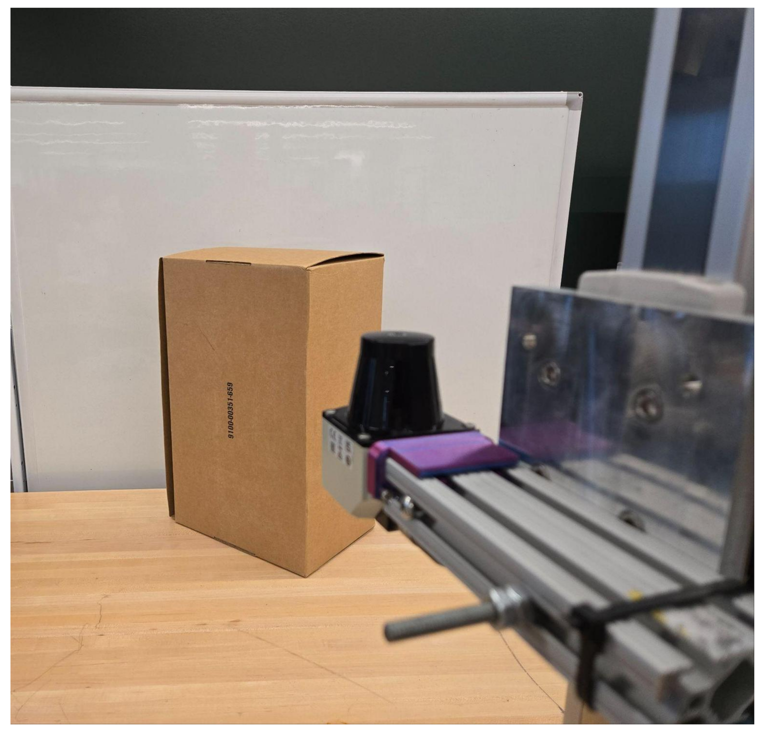
Step 4: Calculate Volume & Visualize



Final Design

- A SICK TiM561 2D LiDAR sensor is mounted on a vertical linear stage to scan box dimensions
- LiDAR unit scans box from the side, can use a backboard as a reference to help determine box length
- Linear stage moves LiDAR upward until the box is not detected, allowing the system to find box height
- Depth can be found either using a backboard or measuring a second side simultaneously
- Measured dimensions are then sent to a laptop software interface
- User then enters the size of the storage space, such as a storage unit, trunk, or moving container
- The software creates a virtual layout of the scanned boxes and then the user can arrange them to reduce wasted space
- User interface shows the user the box orientation, layout, and remaining storage volume

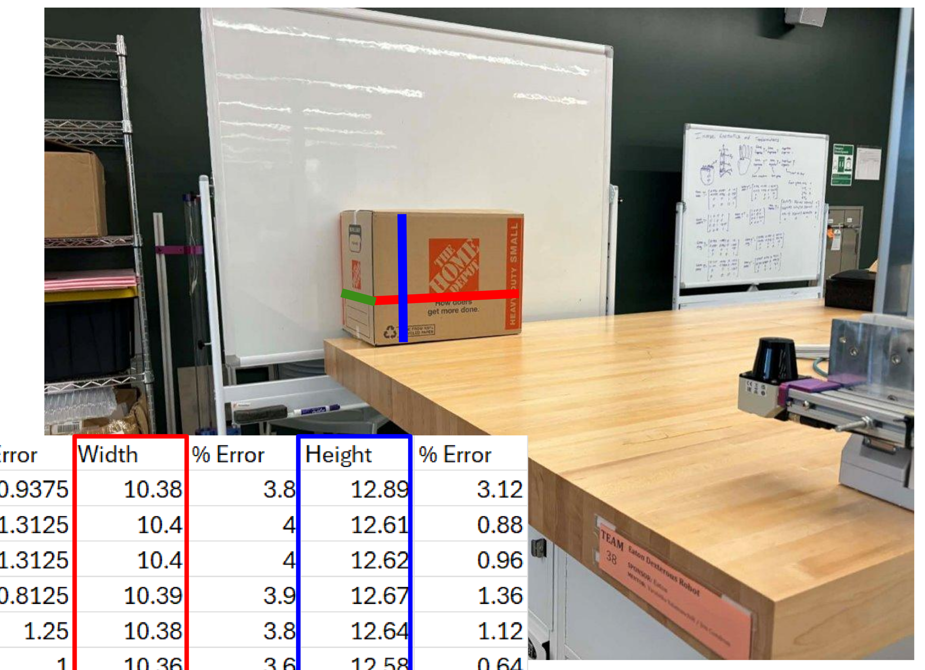
Start of scan - bottom of box



Ending position - top of box

Height of box can be found by finding difference of scanner height

Testing and Results



Length	% Error	Width	% Error	Height	% Error
16.15	0.9375	10.38	3.8	12.89	3.12
16.21	1.3125	10.4	4	12.61	0.88
15.79	1.3125	10.4	4	12.62	0.96
16.13	0.8125	10.39	3.9	12.67	1.36
16.2	1.25	10.38	3.8	12.64	1.12
16.16	1	10.36	3.6	12.58	0.64
16.15	0.9375	10.43	4.3	12.69	1.52

Volume Measurement System

Dimensional Accuracy - Common Boxes

Length, Width, and Height ±5% error

Positional Variance - Adjust before each scan

Repeatability Test - Scanning the same box x3-5

Box Visualizer Python GUI

Dimension Array Fields - Manual Input

Box Movement - Movement along Axis keys

Boundary Detection - Update Storage Efficiency

Quality of Life Features:

Volume Color Coding | Rename/Update/Delete