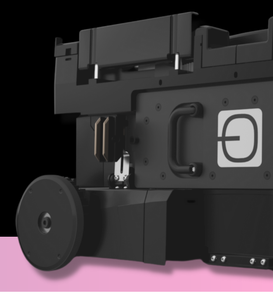
Attabotics: Improvement of Robotic Picking Mechanism

Adam Fraser, Mason Kendell, Adrian Keung, Owen Klassen, Edmond Heung, Samson Hua

Schulich School of Engineering, University of Calgary

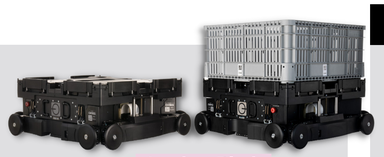


OUR SPONSOR

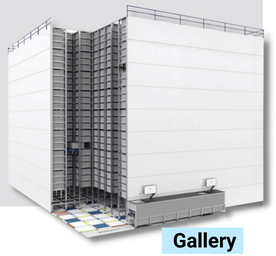
Attabotics is a local robotics company based in **Calgary, AB** that develops **robotic warehousing solutions** for automated storage and retrieval.

As a **leader in 3rd party logistics,** Attabotics offers their clients the ability to keep up with the **growing demand for fast and free delivery.**

Robots called Blades navigate through a **3D grid structure** called the Gallery to navigate, store, and retrieve bins to nodes where items can be retrieved.



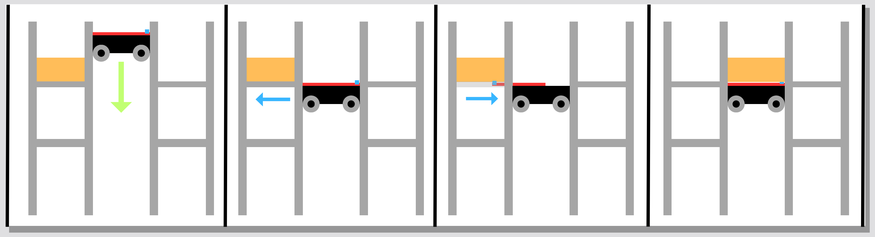
Attabot Blade



Gallery

THE PROBLEM

Attabotics identified an opportunity to improve a **sub-component; the pickarm.**

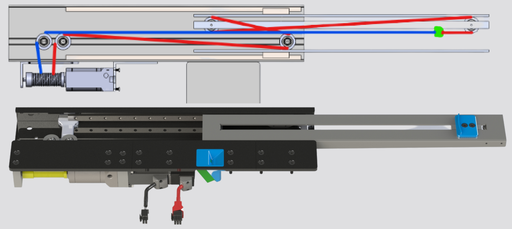


Three main opportunities for improvement with a new pickarm mechanism:

- Reduce the time it takes to pick and place a bin.
- Increase the load capacity of the mechanism.
- Increase the durability of the mechanism to increase the service life.

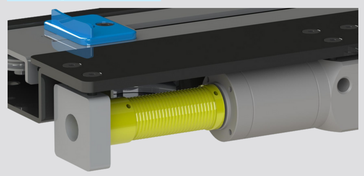
KEY FEATURES

Telescoping Chassis



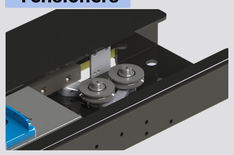
- 2:1 **Compact** telescopic mechanism
- **Linear rails** for accurate actuation
- Sheet metal DFM design
- Designed for **600N** pull load
- **Compact Design**

Compact Drum



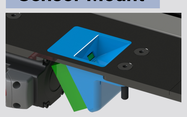
- Custom drum for **spooling and unspooling**
- Compact cable driven mechanism
- Integrated Servo Motor and 30:1 Gearbox

Tensioners



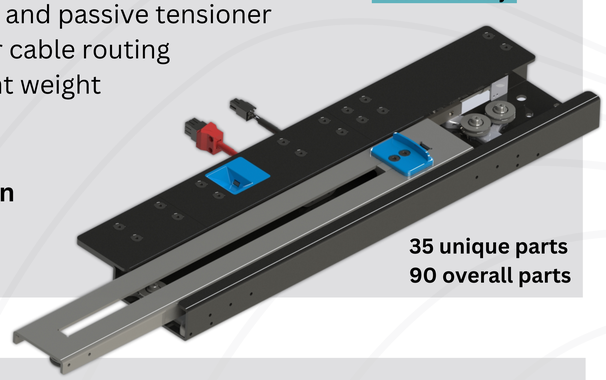
- **Adjustable** active and passive tensioner
- Easy and modular cable routing
- Optimized for light weight

Sensor Mount



- Flush **in-line design**
- Easily replaceable
- Clean aesthetic

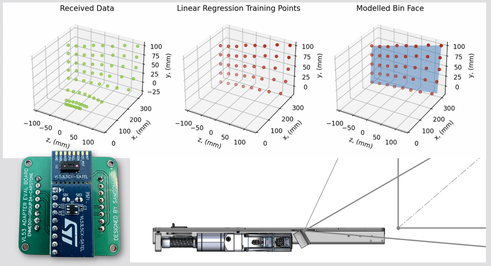
Full Assembly



35 unique parts
90 overall parts

CONTROLS

To better detect the bin location during the pick of a bin on the Attabot, we propose the **usage of sensors** to detect the distance and skew of the bin for accurate grasping.



Using the **VL53L5CX multi-zone lidar** sensor, with our **custom firmware**, we detect the bin within **~2.5mm accuracy** and **~2.5 degree accuracy.**

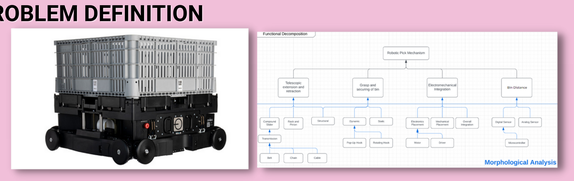
FUTURE IMPROVEMENTS

As with any engineering project, we identified two main areas of improvement:

- Further research and characterization of cable dynamics for routing design
- Continued optimization of DFM/DFA and cost optimization for parts

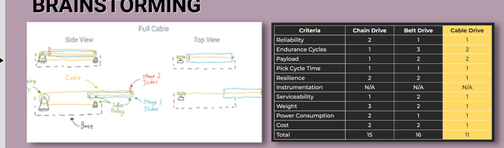
DESIGN PROCESS

PROBLEM DEFINITION



Determine Design Targets, Problem Constraints, Morphological Analysis, Engineering Analysis

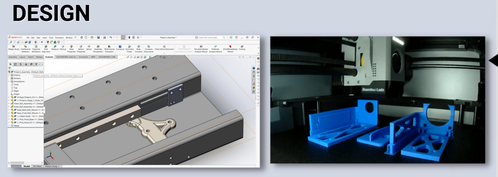
BRAINSTORMING



Criteria	Chain Drive	Belt Drive	Cable Drive
Reliability	2	1	1
Endurance Cycles	1	3	2
Payload	1	2	2
Pick Cycle Time	1	1	1
Resilience	2	2	1
Instrumentation	N/A	N/A	N/A
Serviceability	1	2	1
Weight	3	2	1
Power Consumption	2	1	1
Cost	2	2	1
Total	15	16	11

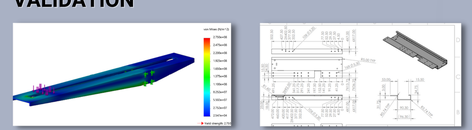
Creative Brainstorming
Design Matrix Evaluation

DESIGN



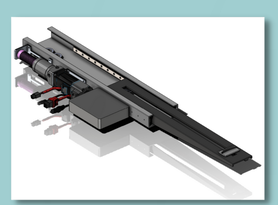
Solidworks Model & Rapid Prototyping

VALIDATION

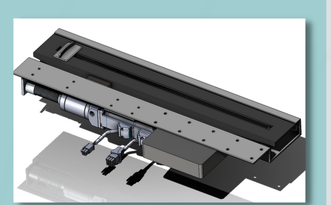


Test Simulations on Parts
DFM & DFA Revisions

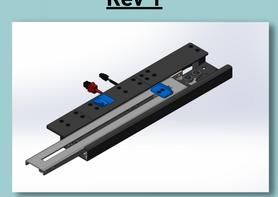
PROTOTYPING



Rev 1



Rev 2



Rev 3

Build and test designs using **iterative design** with technologies such as **additive manufacturing**

ACKNOWLEDGEMENTS

Sponsor

ATTABOTICS

Mentors

Corey Tracy (P.Eng, M.Sc.)
Jeff Smithanik (P.Eng, M.Sc.)
Conrad Bingham (P.Eng, M.Sc.)
Kevin Yergens (P.Eng)
Simon Zheng (E.I.T)
Dr. Peter Goldsmith
Malcolm MacDonald

Professors

Dr. Ramirez-Serrano
Dr. Joseph Thekinen