The Cultivators: AutoRock TP2.0

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Objective

- General Need
  - Increasing population, decreasing arable land
  - Hydroponics
    - Control resources, year-round crop production, and can be located in cities
    - High labor cost

- Market Size
  - Sell 100/year

- Customer Requirements
  - Plant not harmed
  - Low energy consumption
  - High speed translation
  - Low human interaction

Constraints

- Transplant to PVC pipe with 2’ hole
- Run on 12V
- Weather & corrosion resistant
- Use common materials

Engineering Characteristics

- Heat and vibration output
- Speed of system
- Accuracy
- Power to system

Physics of Task

- Force to Cut = 5.31N
- Force to Lift = 0.196N

Concept Generation

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>[W]</th>
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<tbody>
<tr>
<td>Ease of Design</td>
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<tr>
<td>Cutting Ability</td>
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<tr>
<td>Speed</td>
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<tr>
<td>Low Energy Consumption</td>
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<tr>
<td>Cost</td>
<td>0.21</td>
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<td>Plant is not harmed</td>
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<tr>
<td>Total</td>
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</table>

Final Concept: individual claw cut and grab

- Plant is not harmed
- Low cost
- Easy to design

Design

- Meeting Customer Requirements
  - Plants are not harmed
  - Materials are recycled and costless
  - Input Voltage 6V

- Functions
  - cut, grab, lift, transport & release plant

- Trade Offs
  - Range of motion limited
  - Focus on designing grabber and lifter

Prototype and Testing

- Completed Tests
  - Grabbing force applied by grabber
  - Cutting pressure of blade
  - Lifting force of arm assembly

- Future Tests
  - Accuracy of arm and grabber
  - Ability to cut, grab and transport
  - Percentage of plants damaged in process

- Prototyping
  - Constructed using scrap materials
  - Old printers
  - Scrap metal and wood

Test Results and Future Work

- Design Process
  - Automated transplanter needed for hydroponics farm
  - Generate overall system concepts
  - Design and build grabbing and cutting mechanism
  - Construct final prototype with translating system

- Recommendations
  - Use sensors to verify position and possession of Rockwool
  - Integrate prototype with complete overhead transplanting system

- Reflection
  - Focus on small part while keeping overall system in mind
  - Often better to test usefulness of available parts rather than custom order

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