Rice Cake Waste Stream Optimization

Final Design Presentation
May 8, 2012
The Team

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Background

- High volume
- Manual inspection
- Repetitive stress injuries
- Human inconsistencies
- High Cost
Need and Goal

• Need
  • Reduce resources required
  • Limit amount of defective product
  • Reduce repetitive stress injuries

• Goal
  • Design and fabricate an automated rice cake inspection device to reject defective product
Primary Customer Requirements

• **Must do**
  • Eliminate at least one of the most common rejection modes
  • Operate at or faster than current conveyor speeds
  • Document how rice cakes fail (for statistical analysis)
  • Complete a cost benefit analysis of the full implementation

• **Should do**
  • Reject more than one of the frequent defect modes

• **Would be nice**
  • Reduce physical volume of the rejected rice cakes
  • Devise a new method to test the structural integrity of rice cakes
# Engineering Specifications

<table>
<thead>
<tr>
<th>Priority</th>
<th>Requirement</th>
<th>What is being measured</th>
<th>Units</th>
<th>Method of measurements</th>
<th>Target numbers</th>
<th>Tolerance</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Must Do</td>
<td>Must reject certain percentage of defective rice cakes</td>
<td>Number of rejected vs. total number of defective rice cakes</td>
<td>Machine rejected vs. Reference</td>
<td>Counter &amp; Comparison</td>
<td>50%</td>
<td>±10%</td>
<td>200 rice cakes</td>
</tr>
<tr>
<td>Must Do</td>
<td>Operate at or faster than current throughput</td>
<td>Rice cakes per second</td>
<td>Rice cakes per second</td>
<td>Counter and stop watch</td>
<td>≥2 Cakes/sec</td>
<td>+3 -1</td>
<td>Continuous operation for 1 minute</td>
</tr>
</tbody>
</table>
Sensor

- x: Horizontal laser displacement
- y: Vertical laser displacement
- α: Laser mounting angle

\[ y = x \cdot \tan(\alpha) \]
Statistical analysis

- Average heights
- Significant difference
MatLab Analysis
Electronics
Pneumatic rejection

- High Pressure regulator
- 60-80 psi for consistent rejection
Programming

- C++
- Libraries
  - CLEMultiCam
  - OpenCV
  - Boost
- Performance dependent on computer
Fabrication

- Purchased raw material from Valin Corporation
  - College of ECC Tech shop cut material to specified lengths
- Misc. Parts fabricated in Plumas machine shop
- Pacific Water Jet
  - Laser cut small brackets
- Cody Leuck
  - Machine laser mount parts
- Design changes
  - Increase laser adjustability
  - Increase camera adjustability
Laser Mount

- Adjustable angle
- Adjustable location
- Adjustment of laser line orientation
Camera Mount

- Adjustable height
- Added extra support to keep from tilting
- Closer distance allows for higher resolution
Working Prototype
Testing

- Effective speed of rice cake rejection
  - Measure the speed a rice cake can be analyzed at
- Repeatability at effective speed
  - Determine percentage good rice cakes rejected
  - Determine percentage bad rice cakes not rejected
- Minimum distance between rice cakes
## Final Budget

### Total cost

<table>
<thead>
<tr>
<th>Material</th>
<th>$801.03</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchased parts</td>
<td>$916.60</td>
</tr>
<tr>
<td>Tooling</td>
<td>$399.54</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$2,117.17</strong></td>
</tr>
</tbody>
</table>

### Sources of funding

- Industrial Sponsor
- Donations

### Estimated Labor Cost

| Estimated Labor Cost | $80,677.31 |
Reflection

• Suggestions for future
  • Event based programming
  • Embedded system
  • Parallel processes running independent of each other
  • Use 2D laser displacement sensor
  • Eliminate reading and writing to hard drive
Conclusion

• On time and under Budget!

• Acknowledgments
  • Lundberg Family Farms: Conveyor donation
  • Nate Priddy and professor Dale Word: Programming consultation
  • ECC Tech Shop: For cutting the materials needed
  • Dr. Jimmy Tan-atichat: Warning us how hard programming would be
Questions?