

AI Based Quality Control for Potato Harvesting

- PI/Co-PI: Marco Schoen and Mary Hofle
- Grant #: IGEM25-003
- Reporting Period:
7/1/24 –12/31/24



Summary of progress towards proposed milestones

| | | | |
|---------------------------|--|---|---|
| <p>Milestone 1</p> | <p>Status: COMPLETED</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Student researchers hired and project scope reviewed <input checked="" type="checkbox"/> Data collection system requirements identified, and components purchased <input checked="" type="checkbox"/> AI hardware system requirements identified and procured | | |
| <p>Milestone 2</p> | <p>Status: COMPLETED</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Data collection criteria and FES (Feature Enhancement System) established <input checked="" type="checkbox"/> Database setup completed for experiment tracking for Acoustic & Camera-based experiments. <input checked="" type="checkbox"/> Data collection systems installed and tested <input checked="" type="checkbox"/> Initial potato supply acquired from partners <input checked="" type="checkbox"/> Potato pre-processing and storage procedures implemented <input checked="" type="checkbox"/> AI algorithm development initiated | | |
| <p>Milestone 3</p> | <p>Progress: Multi-Method Detection Development</p> | | |
| | <p>Acoustic Testing (90%)</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> 334 potatoes processed. <input checked="" type="checkbox"/> Acoustic feature extraction completed for initial sample set <input checked="" type="checkbox"/> AI model validation with 87% accuracy <input checked="" type="checkbox"/> Feature importance analysis completed for acoustic data <input type="checkbox"/> Additional potato samples processing pending | <p>Camera-Based Experiment (60% Complete)</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> Motion capture testing procedure established <input checked="" type="checkbox"/> High-speed camera integrated <input checked="" type="checkbox"/> Database structure established and populated with initial data <input checked="" type="checkbox"/> MATLAB analysis pipeline implemented <input type="checkbox"/> Potato samples processing pending <input type="checkbox"/> Feature extraction implementation pending <input type="checkbox"/> AI algorithm implementation on extracted raw data pending | <p>Ultrasound Experiment (10% Complete)</p> <ul style="list-style-type: none"> <input type="checkbox"/> Equipment procurement in process <input type="checkbox"/> Testing protocols in development |
| <p>Milestone 4</p> | <p>Initiated (30%)</p> <ul style="list-style-type: none"> <input type="checkbox"/> Compare effectiveness across all three methods <input type="checkbox"/> Identify optimal combination of techniques <input type="checkbox"/> Scale up testing for best-performing methods <input type="checkbox"/> Validate results with large sample sets | | |
| <p>Milestone 5</p> | <p>Final Phase Planning: (Pending)</p> <ul style="list-style-type: none"> <input type="checkbox"/> Integration of all successful methods <input type="checkbox"/> Large-scale validation testing <input type="checkbox"/> Results compilation and reporting <input type="checkbox"/> HERC final report preparation | | |

Summary of expenditures and budget performance

Key Insights

- Spending is ON TRACK with proposal.
- Major expenditures included
 - student support
 - Computers
 - and testing equipment

Challenges/Changes

- Ultrasonic equipment no longer available at costs projected.

| | Budgeted | Spent | +/- |
|--|----------|-------------------|--------|
| Personnel (Faculty and students) | \$61,924 | \$29,783 | 0 |
| Equipment | \$15,700 | \$5,085.51 | 0 |
| Travel | \$600 | \$35.13 | -\$250 |
| Participant Support | \$11,832 | \$5,761 | 0 |
| Other Direct Costs | \$5,600 | \$1,142.9 | 0 |
| Total | \$95,656 | \$41,807.54 (44%) | -\$250 |

Projection of work in next reporting period

1. Complete Current Testing Phases

- Expand acoustic testing dataset beyond current 334 potatoes
- Finalize camera-based motion capture system integration (40% remaining)
- Set up ultrasound testing system once equipment arrives

2. AI and Data Analysis Development

- Continue optimizing AI models based on acoustic success (currently 87%)
- Implement cross-validation across multiple detection methods
- Expand feature engineering to incorporate new data streams

3. System Integration and Validation

- Validate AI performance across different testing approaches
- Scale up testing for most promising methods
- Prepare for comprehensive system evaluation

4. Documentation and Reporting

- Complete milestone 4 validation documentation
- Begin preparation for milestone 5 deliverables
- Update technical specifications for each method
- Plan final HERC report structure