

IGEM Grant Report

☐ Progress (due January 1) ☐ Annual (due July 31) ☒ Final (due September 30)

IGEM Grant # __IGEM25-03__ Principal Investigators: Marco Schoen & Mary Hofle

Submission Date __September 30, 2025__ Primary Institution: Idaho State University

*Instructions: Complete each section of this report directly on this template. Completed reports must be limited to **1 page for Progress Reports and 2 pages for Annual or Final Reports in 12 pt Arial or similar font**, excluding the expenditure report. Simple and concise answers will be appreciated, and even bullet lists of information will be sufficient. Reports that do not follow these requirements will be returned for revision. Submit reports by the appropriate due date to HERC@edu.idaho.gov.*

Section 1: Summary of project accomplishments for the reporting period and plans for the upcoming reporting period.

- Established potato processing procedure, data collection process, and equipment acquisition.
- Successfully recorded sound and potato visuals for analysis.
- Successfully developed computer program to extract potato features to identify differences between potatoes with hollow heart and non-hollow heart.
- Statistical analysis shows, with accuracy in the mid-80%, hollow heart can be detected in potatoes using non-destructive methods.
- Datasets have been posted to public open-source platform – figshare.com
- Paper submitted to MDPI Data journal: “Comparative Data Analysis of Non-Destructive Testing for Hollow Heart in Potatoes.”
- Poster presentation at Idaho State University Research Symposium entitled “Non-Destructive Detection of Hollow Heart in Potatoes Using Artificial Intelligence.”
- Engaged three undergraduate students and one PhD student in the project.
- Established relationship with Double L - an Idaho potato equipment manufacturer for future work related to this project.
- Continued collaboration with Spudnik Equipment Company on Hollow Heart detection project.

Section 2: High-level summary of budget expenditures for the period just completed. If budget is underspent at time of report, explain why and plans for expending funds.

The requested funds of \$95,655.59 were utilized in support of the proposed activities. They included personnel cost such as partial summer support for the two PI's and student support (three undergraduate students and one PhD student): \$66,833.47 (budget was \$61,923.59), equipment: \$ 13,646.42 (budgeted for \$15,700), travel: \$384.64 (budget \$600), participant support: \$11,832 (budgeted \$11522) and materials and supplies: \$3,269.06 (budget \$5,600).

Section 3: Demonstration of economic development/impact, including the following as applicable: patents, copyrights, plant variety protection certificates received or pending; technology licenses signed, start-up businesses created, and industry involvement;

private sector engagement; jobs created; external funding; any other pertinent information.

Ongoing discussion of the project with Spudnik Equipment Company and Double L (both Idaho based potato equipment manufacturers). There is mutual interest in a) developing derivative technology based on the results of the project (Double L), b) further developing a prototype system (Spudnik Equipment Company). This includes applications on equipment for automated visual inspection such as AI based detection of potatoes during the harvesting process, online discernment of non-potato items in the harvest, extraction of foreign objects (dirt masquerading as potatoes) during the process, and seed potatoes delivery system improvement utilizing a developed vision system.

Section 4: Number of faculty and student participants as a result of funding, and brief description of student efforts.

A total of three (3) faculty members were involved in this project. Two were partially supported by the requested budget, and one volunteered his services. In addition, three undergraduate Mechanical Engineering students were part of this project for the entire duration of the project, while two additional students were temporarily helping. The primary three undergraduate students developed testing procedures that allowed for accurate feature extraction from potatoes. This included the development of computer programs that interfaced with various measurement devices and partially automated the data collection process. For the project, a large data set was required. The undergraduate students were tasked with making artificial hollow heart samples resulting in a data set of 1048 potatoes (hollow heart and non-hollow heart). Instrumentation specification, calibration, and networking was also accomplished by the three undergraduate students. At times, an additional undergraduate, as well as an additional graduate student, helped with the experiments. These tasks were very time consuming. The primary graduate student (PhD) developed the artificial intelligence-based algorithms to detect hollow heart in the data collected. This included feature engineering, data pipeline development, automated data cleaning algorithm, programming machine learning algorithms, and testing of the algorithms.

Section 5: Updated details and/or progress on the long-term sustainability plan for the project and description of future plans for project continuation or expansion. The team is currently in contact with two Idaho based potato equipment companies (Spudnik Equipment Company and Double L LLC). Both companies have specific and diverse interests in the developed technology. We plan to continue our work with these two companies.

Section 6: Expenditure Report – Attach an expenditure report as a separate document showing expenses toward the original budget submitted for this project. The expenditure report does not count toward the page limit. A written summary of budget expenditures should be provided in section 2 of this report.

