SENIOR CAPSTONE/
SENIOR DESIGN EXPERIENCE

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In-Line Seed Counter

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Executive Summary

The In-line Seed Counter is an automated system developed for Bayer Crop Science to improve the speed and accuracy of measuring corn seed unit weight. Since corn is sold by seed count but bagged by weight, accurate unit weight is critical. Currently sampling is done manually and requires an operator to frequently collect and measure samples The system is OSHA compliant, cost-effective, precise, and gentle on seeds. It has the potential to reduce bagging error from 2% to 1% by increasing the frequency of testing.

Project Research/Context

In industry many types of tabletop counters are used. While these counting machines are accurate, they require an operator to collect, sample, and run it through these machines. Companies like Seedburo and CGOLDENWALL produce these tabletop counters as shown in Figure 1, however they are costly and inefficient. For specialty crops in industry like oranges and tomatoes conveyors are used throughout processing facilities. Counters exist in on a much larger scale for these items.

Figure 1: Seedburo 901

Figure 2: Gamet B-310 Sampler

Characteristics/Limits

Our constraints and criteria are based off the project characteristics and limits. These are essential in giving Bayer metrics of how an efficient seed counting system should perform.

Constraints:
- 1 lb. of seed
- Automated/Efficient
- OSHA Complaint
- Compatible with existing system
- Less than 1 minute per cycle

Criteria:
- Cost
- Precision
- Reliability
- Gentle
- Returns to the system
- Pulls a representative sample

Codes/Patents/Standards:
- US6706989B2 (Pioneer Seed Processing System)
- US12063885B2 (Deere & Co Camera Imaging)

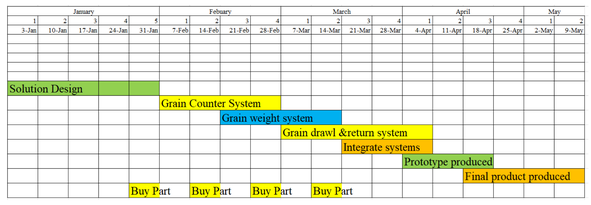

Figure 2: Capstone Project Timeline

Project Solution Ideas

Different design solutions were broken up into three distinct parts. The drawing of the grain from the bin, the counting of seed, and the weighing of seed. The design solutions were weighed evenly based on the constraints and criteria.

Seed Counting Solutions:
- Laser counter
- Optical Counter
- Totalize 750-2C Mechanical Counter

Seed Input Solutions:
- Side draw
- Gambet B-310 Sampler (Figure 2)
- Core Sampler

Seed Weighing:
- Bucket with scale before counter

Prototype Testing/Feedback

Figure 3: Prototyping and Testing of the Seed Counter

The final prototype is displayed in Figure 3. The frame consists of a Kinze frame, seed meter, and seed box. To power the meter, we used a Dayton 1/3 HP 3 phase motor with a VFD. To read, sense, and weigh the seed we used an Arduino, John Deere sensor, and load cells. A 3D printed hopper was used to hold the 1 lb of seed. The simple design proves a seed counter can be made inexpensive.

Table 1: Testing Results

Seed Counter Testing Data			
Time (sec)	1 lb of seed	Seed Counted	% Error
80	1768	1765	0.17%
81	1768	1739	1.64%
83	1768	1722	2.60%
81	1768	1733	1.98%
79	1768	1714	3.05%

Testing included five replications of counting out our test seed. The testing variables were # of seeds in the allotted time (sec), percent error, weight (oz), motor speed, and accuracy of the seed sensor. We tested at varying RPMs from 116-140 and different types of seed. Final results are shown in Table 1. After reviewing the final data our sponsors were pleased with the prototype as a proof of concept.

Project Design and Development

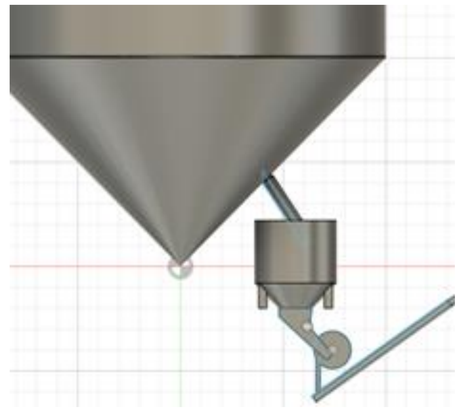

Figure 4: Seed counter as a part of in-line process

The final model of our seed counter would pull a sample from the hopper directly before the bagging unit. Data would be sent a main control room and sampling could be initiated by an operator from the main control center, integrating seamlessly with the current system already being used at Bayer sites.

Value Proposition

The value of the seed counter can be summarized by who benefits, why they benefit, and how they benefit. Seed companies and farmers are the main target audience for this project. Combined these attributes help derive the most cost effective, efficient, and ethical solution. The final solution can see a return on investment in 1 hour and 17 minuets of operation by producing 1,769 units.

Project Impact in the Future

This project will improve seed bag accuracy, reduce waste, and lower labor costs by tracking seed weight more precisely, benefiting seed producers, farmers, and the Agricultural industry amid labor shortages.

Sponsor: Jacob Taylor: Process Engineer at Bayer

Purdue University and the ABE department for sponsoring/supporting the project