Title: John Deere Automated Grain Sorting

PURDUE UNIVERSITY

Agricultural & Biological ENGINEERING

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Background/Problem:

John Deere's current grain testing procedure used in the field during combine testing is time consuming. The method involves weighing a 250 gram sample of grain and remove the fines using a 12/64 inch sieve. After cleaning, a timer is set for 10 minutes to sort out the damaged grain on a flat metal pan. The overall process is limiting to field testing.

Goals:

- Cut testing time in half while maintaining accuracy
- Automate the sorting process
- Must remain portable

Alternative Solutions:

Initial Options Considered-

- Camera Sorters
- Seed Dye (Manual Sorting)
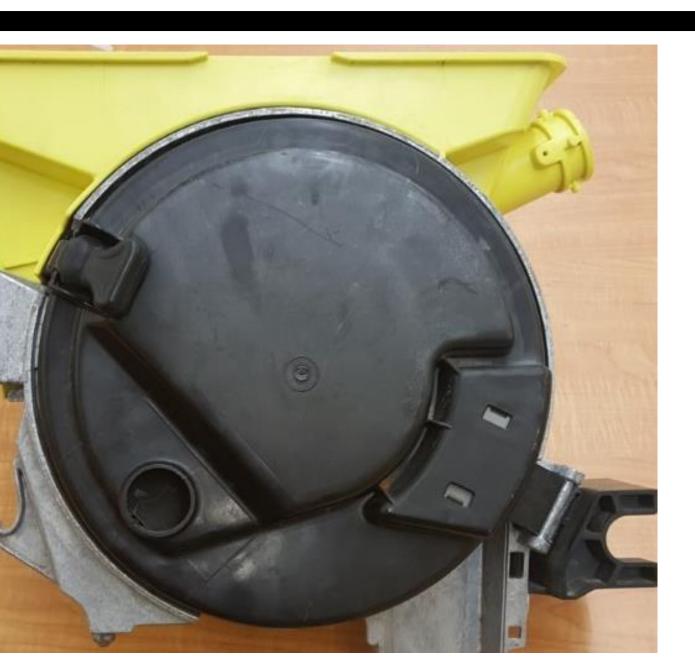- Seed Dye (Automated Sorting)
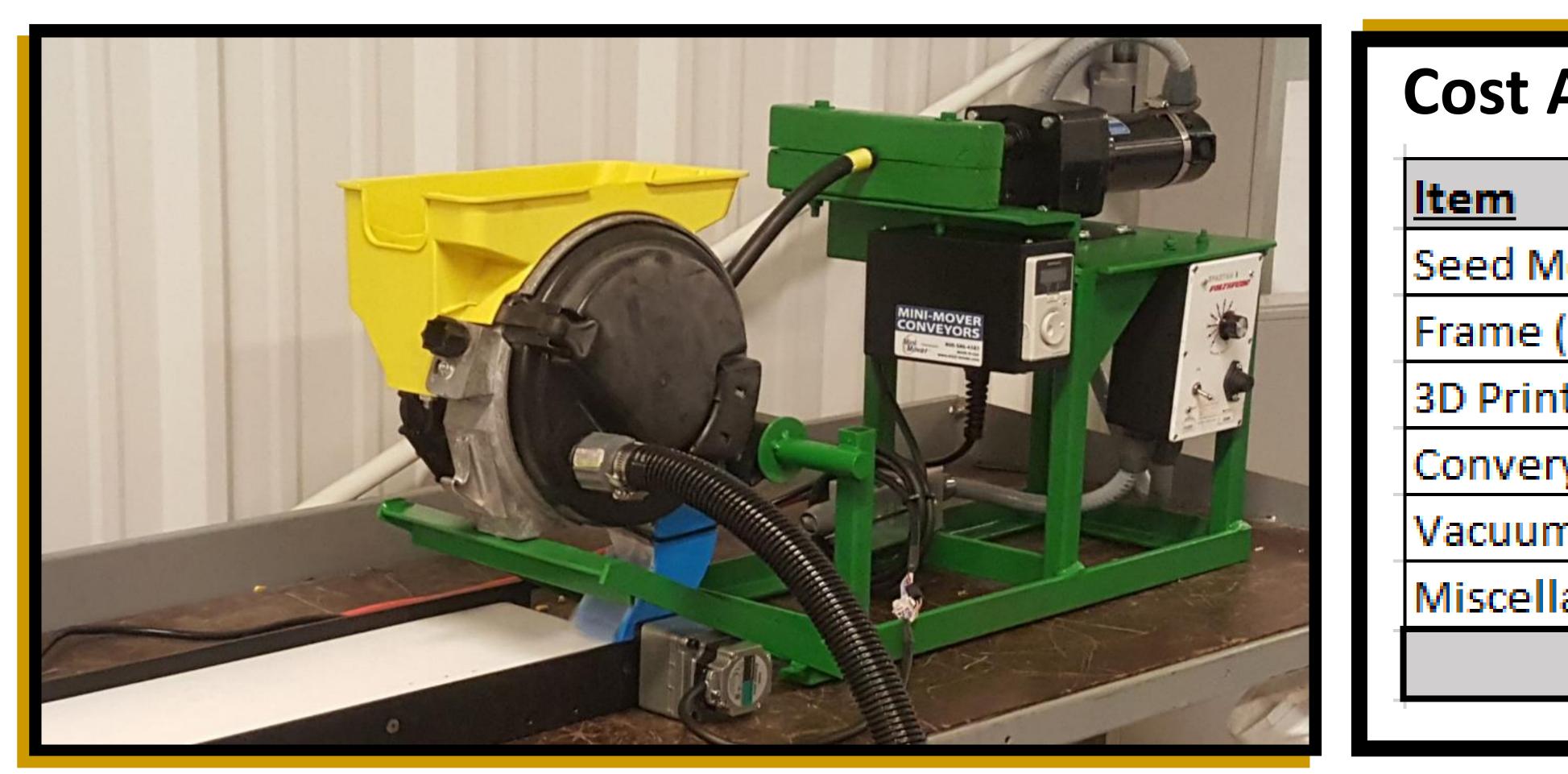- Infrared light Sorting

Final Solution-

- John Deere seed meter singulates kernels onto conveyor belt where it is sorted manually, separating the damaged and whole grain

Final Design:

- Electric motor mounted to steel frame
- Motor Speed is adjustable from 0-10 rpm
- Meter mounts to frame above conveyor belt
- Seed dropped through 3D printed chute
- Adjustable belt speed: 0-80 ft/min
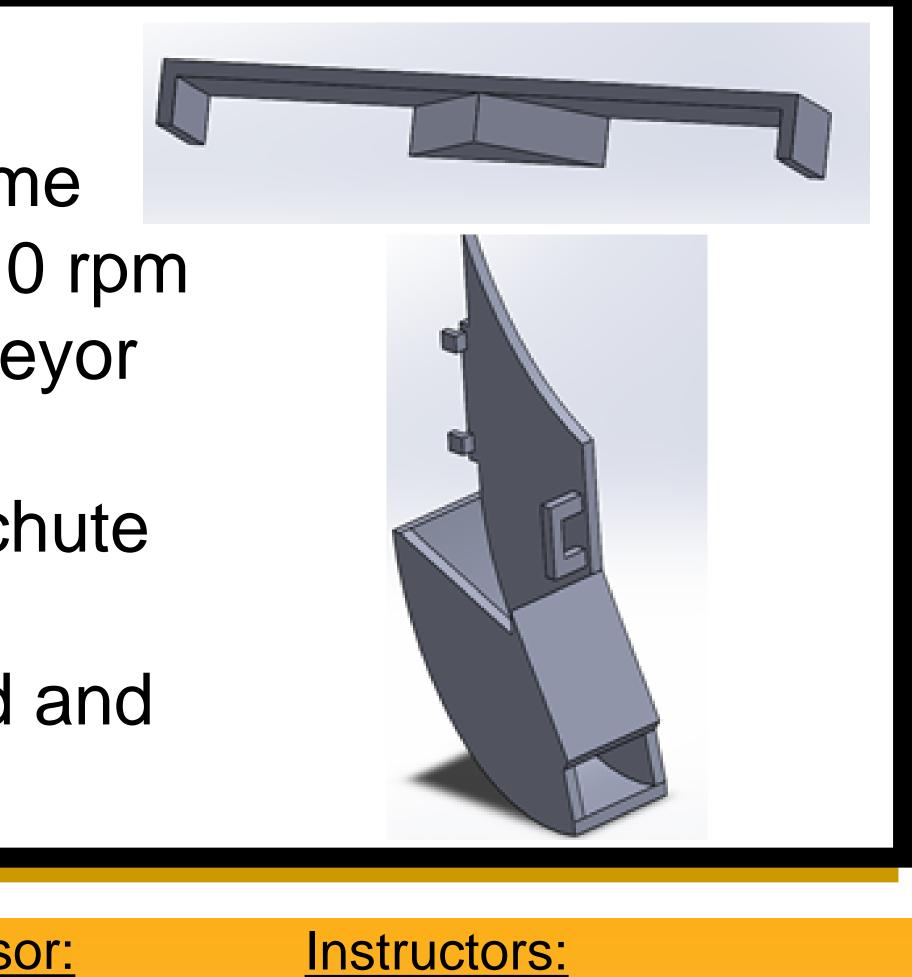- 3D printed splitter divides damaged and whole kernels

Cost Analysis

Item	Cost
Seed Meter (Donated by John Deere)	$ -
Frame (Donated by Purdue ABE)	$ -
3D Printed Parts (Donated by Purdue ABE)	$ -
Converyor Belt	$1,300.00
Vacuum	$ 20.00
Miscellaneous Parts	$ 25.00
Total	$1,345.00

Corn Damage Testing

Performance Evaluation:

- 3 tests were performed on 3 different 250g samples with known damage
- The known damage was found by using the seed dye method in a lab setting, making it highly accurate
- Automated grain sorting test results were very consistent, but were only a fraction of the known damage because John Deere's criteria for damage is less stringent than the lab criteria

Estimated Run Time vs. Motor Speed

- This graph represents an estimated testing time in minutes for various motor speeds for a 250 gram sample
- Determined by fitting a trend line to known testing times and known motor speeds from the various tests performed
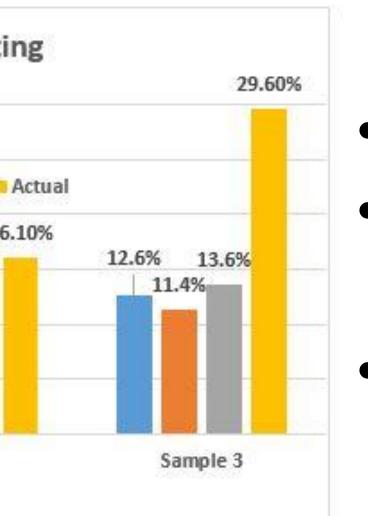- Motor speed is the number one factor that determines testing time

Impact and Future Possibilities:

- Singulation resulted in increased accuracy
- Reduced testing time increases the amount of tests performed per work day
- This will lead to additional and improved data, resulting in enhanced John Deere combine performance analysis.
- Possibility of complete automation with this design by adding camera sorting. Elimination of human error with better accuracy

Unsolved Issues/Improvements:

- Approximately 40-50 grams of samples were not picked up by the meter plate
- Chute design could be improved to achieve better seed placement on conveyor belt
- Mechanism to orient kernels in the same direction would increase accuracy
- More permanent solution for seed chute flap to slow seeds coming from the meter

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