PURDUE UNIVERSITY

CAPSTONE/SENIOR DESIGN EXPERIENCE 2019

Introducing Drones to the Grain Industry

Agricultural & Biological ENGINEERING

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Problem:

The current methods of measuring grain temperature in stored ground piles have potential to involve dangerous human interaction with the grain. According to past trends, grain engulfment accounts for more than 10 fatalities per year. ADM was interested in a new and innovative way that would allow them to read surface temperature in ground storage piles in order to bring more accuracy in preventing grain spoilage while reducing human-to-grain interaction. This process should eliminate the need of removing thousands of square feet of tarp to discover spoilage.

Background:

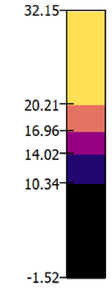
In grain storage, it is very important to continually monitor grain temperature as it is constantly changing due to respiration. With current methods, not all of the grain is able to be monitored, only a portion of it. With a drone, the entirety of the grain pile can be seen in one image.

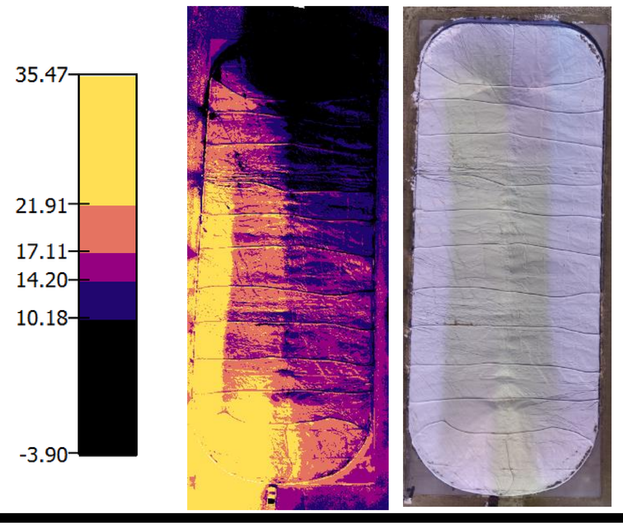
Purpose:

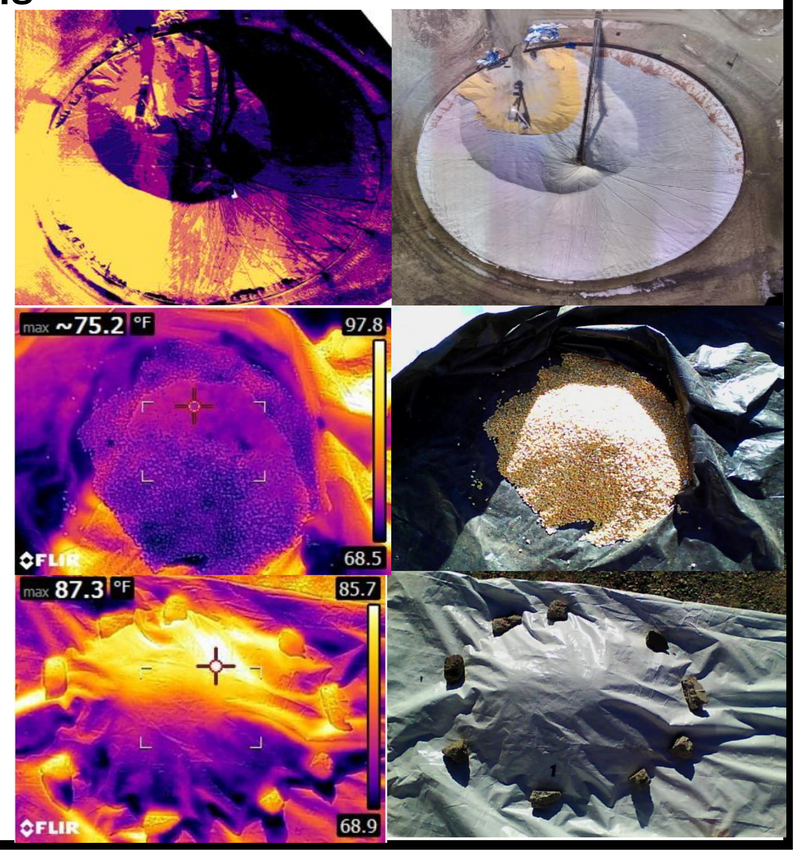
To determine the feasibility of implementing the use of a drone and thermal camera into grain facilities, which would give them the ability to efficiently monitor grain storage temperatures with accurate readings.

Final Solution and Qualitative Analysis

Our solution included going out to various ADM facilities and collecting data with a DJI Matrice 600 Pro drone and Flir DuoPro thermal camera. After collecting all the images the process included running the images through Flir Tools and Pix4D, an image processing software. These programs gave us the ability to pinpoint anywhere on the image and see the temperature.







Criteria:

- The tarp should not have to be taken off
- Fly multiple piles in one day
- Improve data accuracy
- Reduce human interaction
- Increase usability of data

Current Practices:

1. Heat gun
2. Temperature sensing cables
3. Exhaust fan temperatures

Impact, Feasibility, Conclusion

After preliminary research and data collection efforts, we conclude that the use of UAV for grain temperature assessment is time efficient, however, more data collection missions are recommended to validate temperature of grain through the tarp at multiple points.

Benefits

- Reduce human interaction
- Collect data quickly and efficiently
- Help prevent spoilage

Potential Issues

- Direct sunlight
- Outdoor weather conditions
- Quality of tarp

Factors

- Reduce physical contact with grain
- Tarp covers grain pile
- Internal temperature of ground pile
- Weather conditions based on location

Resource Analysis

Resource Analysis	
Drone	$ 4,100.00
Camera	$ 7,500.00
Gimbal	$ 1,500.00
Travel	$ 200.00
Accessories	$ 30.00
Thermal Heat Gun	$ 1,400.00
Total	$ 14,730.00

Recommendations

The amount of data that we have collected continues to tell us that the feasibility of reading surface temperature of the grain through the tarp cannot be done accurately, due to all the potential issues. By using a camera that is more sensitive we believe that this could be a probable solution with further research and analysis.

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