Active Thermography System

Guangxun Zhai Supervisor: Yu Jiang

School of Electrical and Computer Engineering, Cornell University

Introduction

Prior research has demonstrated the need for innovative technology to assist crop farmers in accurately identifying whether their crops are thriving or failing, thereby avoiding unforeseen financial expenses.

Our research primarily focuses on two scenarios: firstly, determining the viability of grape branch buds; secondly, detecting insect infestations in seeds.

Figure 1. Grape bud (left); Seed with an insect hole (right)

Material and Methods

Our major materials:

- Thermal Camera (FLIR A700)
- Instruments (metal structure, lights, relay, platform)
- Software Interface (GUI)

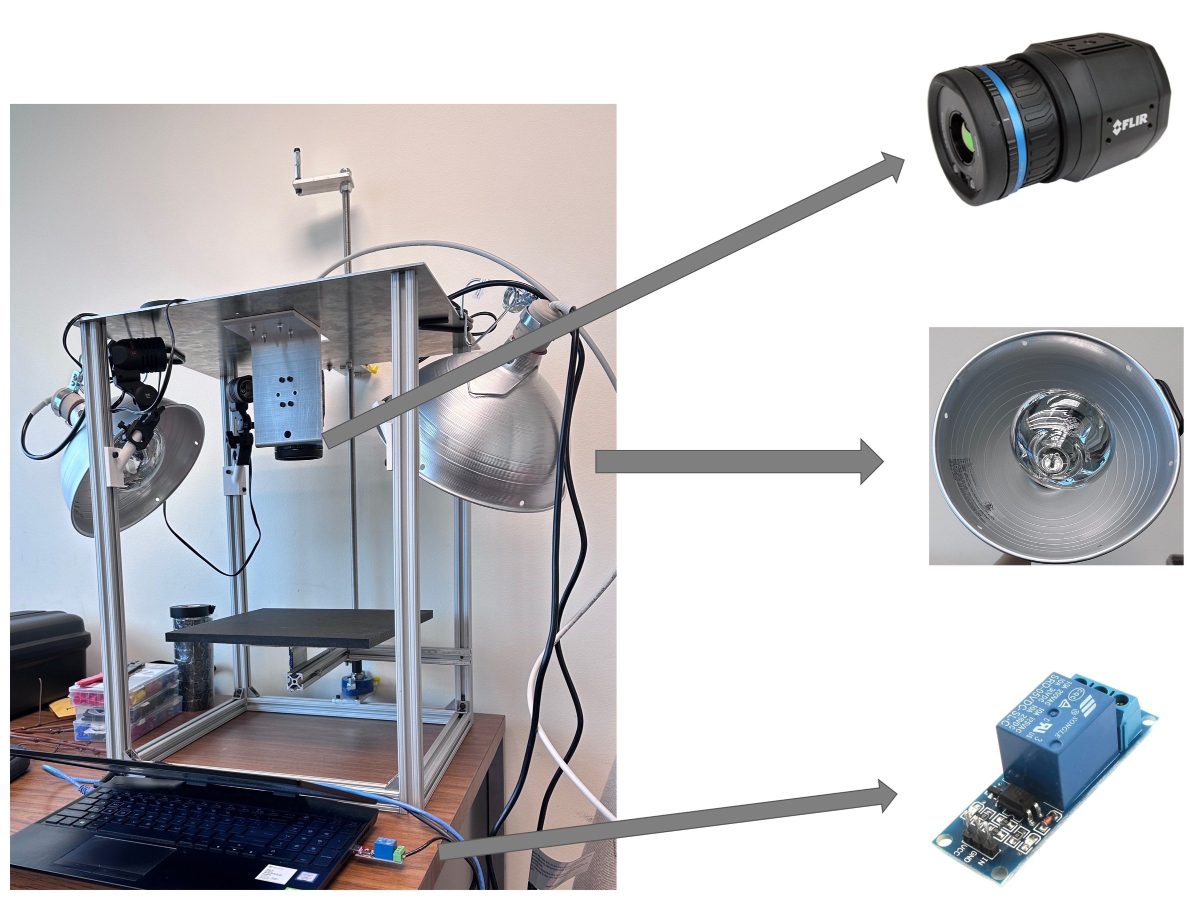

Figure 2. Experiment instruments.

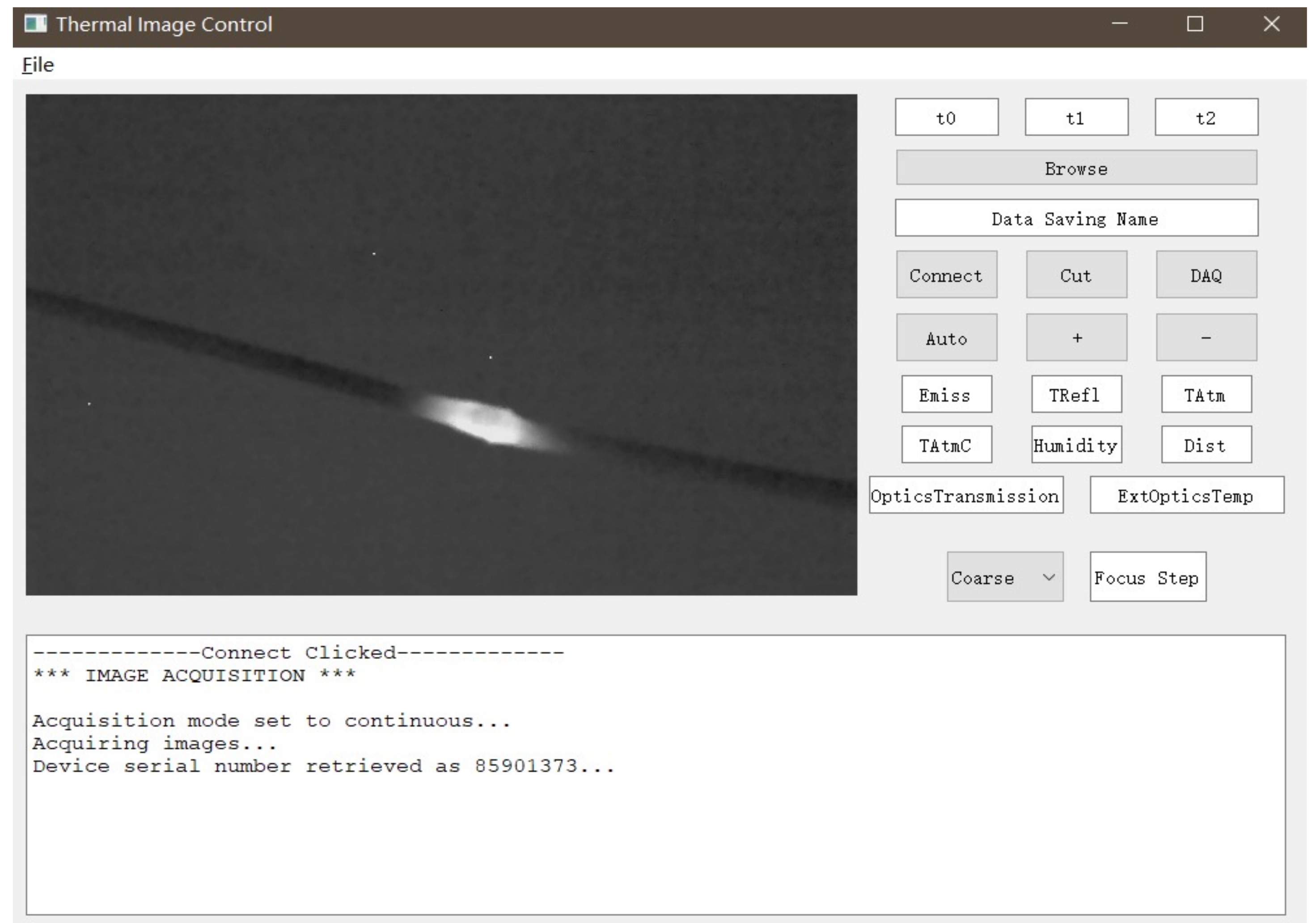

Figure 3. Basic software GUI in the streaming thread. (Here I have just touched the grape bud to warm its up, so could see the bud part is whiter than other places since it generally has a higher temperature).

Current Stage

I have configured the data acquisition setup and developed a GUI that can support multiple threads. The Data Acquisition Thread (DAQ) is responsible for collecting data. The DAQ thread is initiated after the tested plant is cooled down completely. At t0s, the plant is exposed to light to induce heating, and at t1s, the light is turned off. The DAQ is terminated at t3s after the plant has cooled down to room temperature.

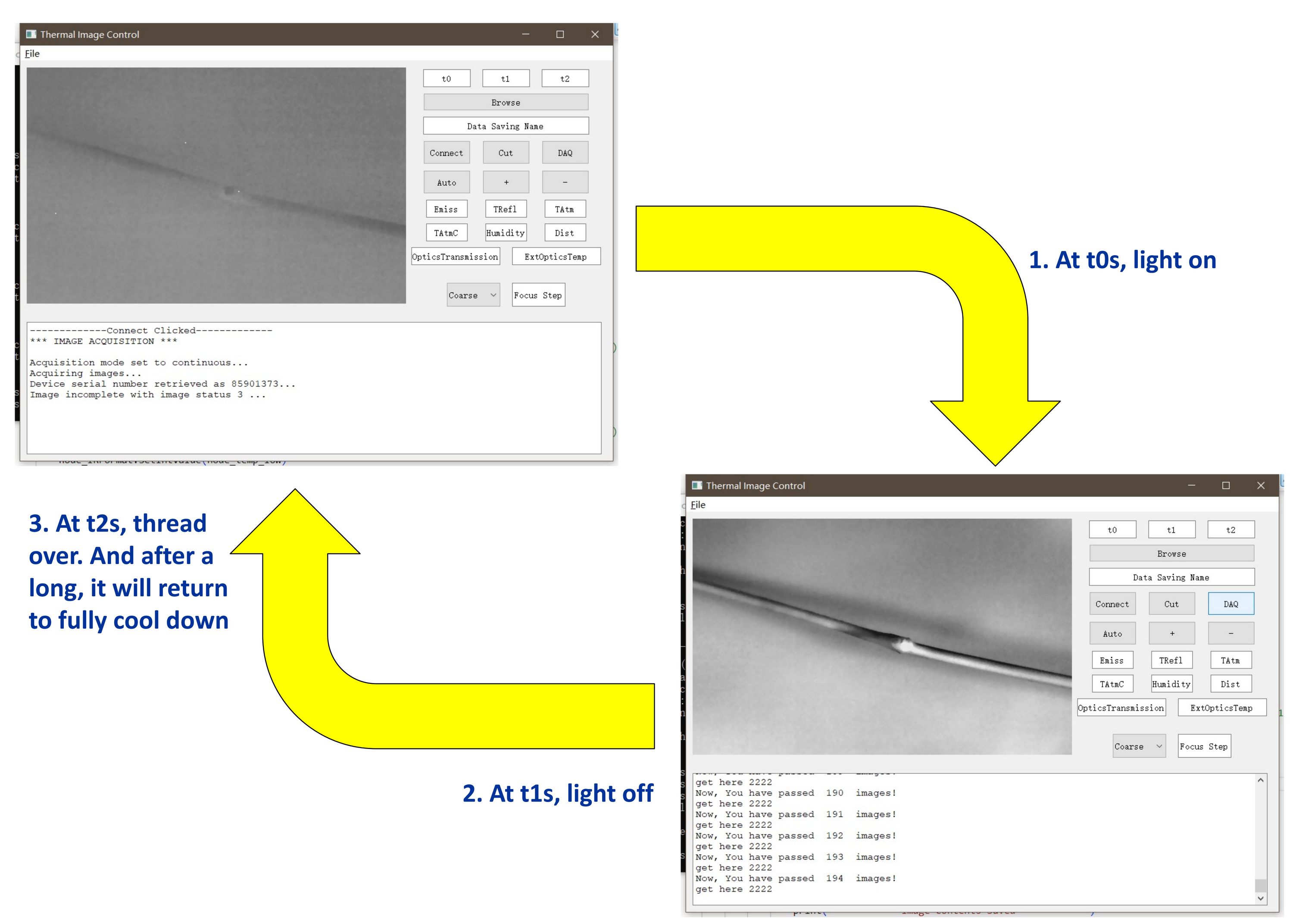

Figure 4. data acquisition thread process.

Furthermore, we conducted experiments to demonstrate the correlation between seed quality and its thermal properties. We arranged 10 seeds, five healthy and five unhealthy, into two columns. Using computer vision techniques, we separated the seeds from the background, applied labels to them, and graphed their thermal readings over time as curves.

Figure 5. left is the original data that was retrieved from the GUI DAQ; right is the image of the seeds after segmentation

Conclusion

From our experiments, there appears to be a discernible correlation between the viability of a plant and its temperature fluctuations. Specifically, non-viable seeds, possess a greater quantity of air within their internal composition and experience a more rapid dissipation of thermal energy.

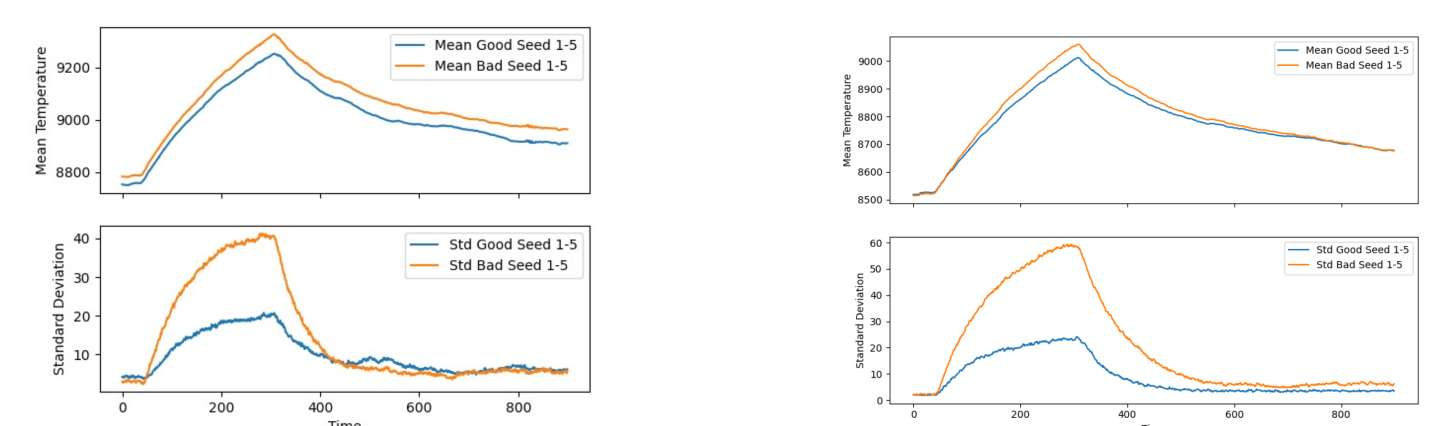

Figure 6. Seed group thermal data versus time with different placement orders. The left plot is 5 bad seeds left in a column and 5 good seeds right in a column; while the right plot is the opposite.

Acknowledgments

Special thanks to Yu Jiang, advisor of this Master of Engineering Design project. For providing guidance and instruments funding.

Literature References

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