

PestBuster AI IoT

Mentor: [REDACTED]

Student: [REDACTED]

Project Description

Pest management is one of the biggest challenges facing agriculture in all settings, from large industrial farms down to home gardeners. A wide range of techniques have been developed to help deter or eliminate pests, including physical barriers for larger pests (e.g. rabbits) and pesticides for insects or other small pests (e.g. grasshoppers).

Completely eliminating agricultural pests is too costly and may have serious consequences for the environment so a more balanced approach is necessary. To help address this problem, agriculturalists have turned to recent technologies such as Internet of Things (IoT) devices and artificial intelligence (AI) to reduce costs and provide more accurate deterrence [1].

Last summer, [REDACTED] and I worked on a PURE project that aimed to create a self-contained IoT system for home gardeners to automatically identify and deter common pests. This system, PestBuster AI, used motion sensors, a Raspberry Pi, and image recognition software to identify pests. I am proposing to work with [REDACTED] again this summer to further develop this system. In particular, the following features are needed to create a viable system prototype: integration of an infrared camera and object recognition software to identify pests in a variety of environments (including low-light); development of a web server to display data and allow for control of the device; developing packaging that allows for standalone usage in a wet environment; and integration of pest deterrent devices such as sprayers.

Mentorship Plan

Having already worked on a project with [REDACTED], I have come to understand some of her strengths and weaknesses. My goal over the summer is to help her leverage those strengths while achieving growth in her areas of weakness. For example, her excitement to get things working leads her to favor quick solutions; during the summer we will work on carefully researching options before jumping into implementation.

Being a first year student, [REDACTED]'s classroom experience has been limited and focused on small scale computational problems. During this experience, one of my goals for [REDACTED] will be to give her a more realistic view of software development, including processes that enable easier collaboration and testing frameworks that increase software/hardware reliability.

More generally, my mentoring will focus on three areas, based on my previous experience with novice research students.

1. Setting clear goals. Inspired by Agile software development, I work together with students to come up with a set of tasks that will be completed over a 1-2 week period of time called a *sprint*. The goal is to have a clearly defined product that the student will demonstrate at the end of the sprint. I'll encourage [REDACTED] to ask clarifying questions and work towards helping him develop his own goals later in the project.
2. Frequent Communication. During the PURE experience, [REDACTED] and I were able to build a strong rapport and had frequent (often daily) communication, both in person and through Slack. For this project, we will continue that model. She will also be part of a community of CS faculty and students working on research over the summer.
3. Provide Professional Development Opportunities. [REDACTED] will have many opportunities to develop her technical and social skills. I will be curating resources on relevant technologies for her and doing code reviews to help improve her coding. She will also have to present her work regularly to me and other CS faculty/students.

Logistics

The project will proceed in three general phases.

Phase 1: (3 weeks) In this phase, we will revisit our work from last year and implement features that were partially implemented but never completed, including the use of a live camera sensor, developing a website for viewing pest activity, and training object classification software to accurately differentiate pests from beneficial insects. I will provide tutorials and other reference materials to [REDACTED] to guide her learning during this phase and will meet 3+ times per week.

Phase 2: (3-4 weeks) [REDACTED] will work towards making the system operable in an environment resembling that of a garden. This will require research into waterproofing, battery or solar power integration, and low-power communication, which I will aid in by providing some reference materials. Testing will be an important part of this phase so I will provide resources on setting up software and hardware testing environments and learning about their importance.

Phase 3: (3-4 weeks) [REDACTED] will focus on adding capabilities for not only detecting and identifying pests, but also deterring them. This will require research into existing options and how to integrate mechanical components into a sensor-based system. She will also be investigating communication options for environments where wifi is not available. At the end, [REDACTED] v[REDACTED]nal demonstration that will be open to others.

References

[1] Vilani Sachithra, L.D.C.S. Subhashini, *How artificial intelligence uses to achieve the agriculture sustainability: Systematic review*, Artificial Intelligence in Agriculture, Volume 8, 2023, Pages 46-59, <https://doi.org/10.1016/j.iiia.2023.04.002>.