ECE 490/491 Capstone Design Project

<Optimal Energy Management of a Mini Greenhouse>

Design Group Members	Client	Technical Advisor	Year
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Introduction & Background

In recent decades, the greenhouse market has expanded and there is an increasing demand for organic products. This project is a proof of concept of smart greenhouses.

For the COVID-19 scope update, the IOT devices, including humidifier, fan and temperature control systems are removed from this project.

Purpose

Our project aims to design a box-sized greenhouse that smartly controls the plant growth environment while efficiently managing energy. The plants in our greenhouse are grown in the most suitable growth environment utilizing artificial intelligence. In this project, the temperature, humidity, and CO2 density are monitored and can be adjusted according to the optimal growing conditions for our test subject (mushrooms). An android app is also developed for users' convenience to monitor the growth condition of our test subject.

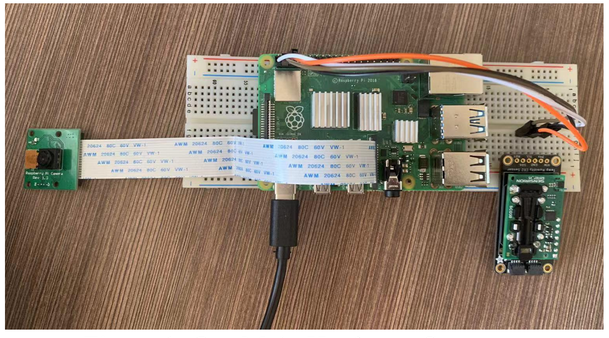


Figure 1: Our Main Hardware Setup

Raspberry Pi

- Using 64-bit Raspbian system with YOLO v5 for the convenience of possible future development
- Gets real-time image through the camera module
- Gets humidity, CO2 concentration, and temperature of the greenhouse from the SCD-30 sensor

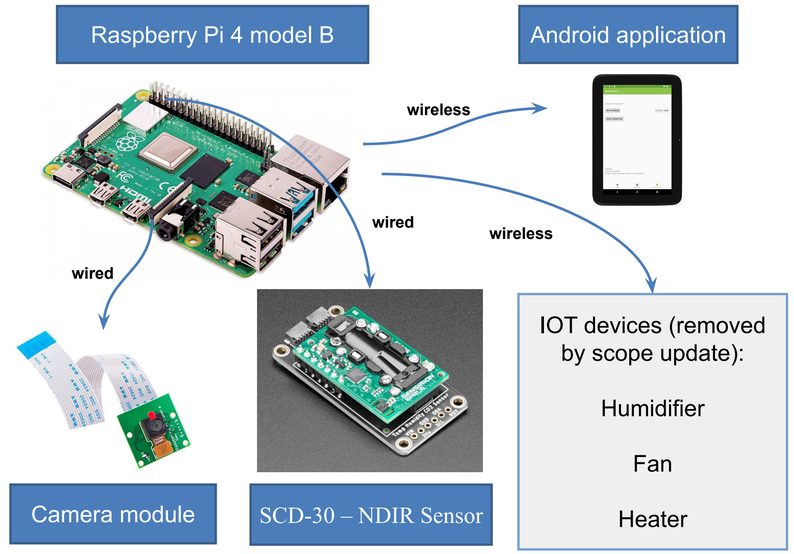


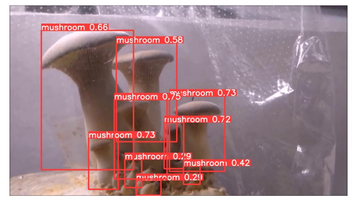
Figure 2: Layout of our design

Android Application

- For users' convenience to receive information about the greenhouse and the growing plant.
- The dashboard page displays the picture of the growing plant, as well as a text description of plant growth condition automatically generated by AI.
- On the user control page, users can see and control the current temperature, humidity, and CO2 values inside the greenhouse.
- A login page is also developed for the app's security.

Artificial Intelligence

- A self-trained mushroom detection model is developed using YOLO v5
- Sends images to the self-trained detection model to find mushroom numbers and sizes
- Automatically generates text descriptions of plant growth conditions based on plant sizes and numbers
- Gets data from the camera and sensors on a set frequency
- Adjusts the optimal environmental data based on different growth stages of the plant



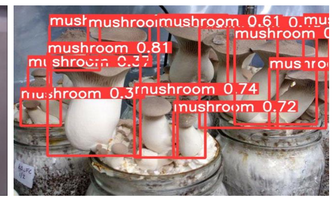


Figure 3, 4, 5: Mushroom detection image output

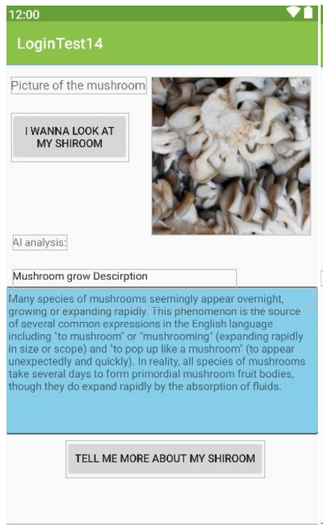


Figure 6: Dashboard

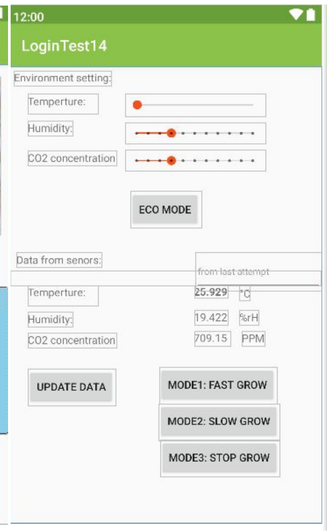


Figure 7: User control page

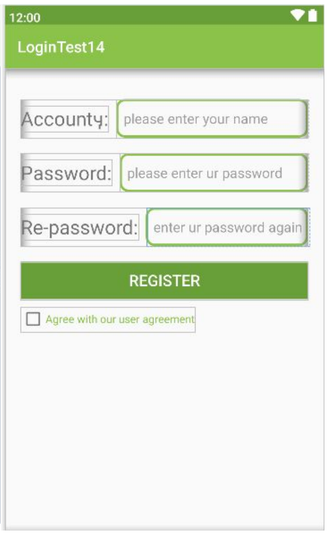


Figure 8: Login page