Smart Leaf

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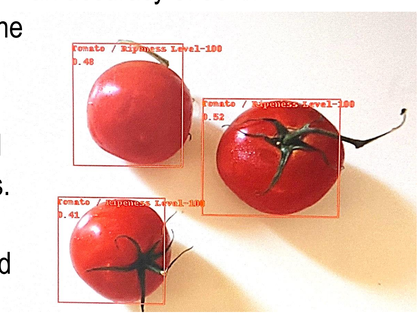
Problem

Due to drastic and unexpected changes in climate, many farmers struggle to yield desired number of crops from greenhouses. That is due to the fact that many of them fail to closely monitor and control important parameters like temperature, light level and water level. The manual mechanism used in traditional greenhouses often are not efficient due to the energy loss and increased labor cost.

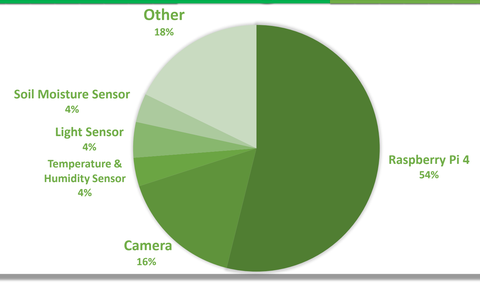
https://ask.extension.org/uploads/question/images/attachment

Machine Learning

This project required three distinct machine learning models, to tackle the problems of tomato detection, image classification to identify the ripeness level of the tomato, and disease detection based on tomato leaves. For object detection SSD Mobilenet, an optimized model for Raspberry Pi was used, however, the mentioned model is not trained to detect tomatoes, thus a technique called transfer learning was applied on manually labeled tomato images. Moreover, KNN an unsupervised machine learning model was utilized to identify distinct clusters for ripeness levels. Three clusters were successfully identified: unripe, medium, and ripe. For disease detection, Convolutional Neural Networks were employed on the dataset provided by plant village organization and the model achieved an accuracy of 90%.

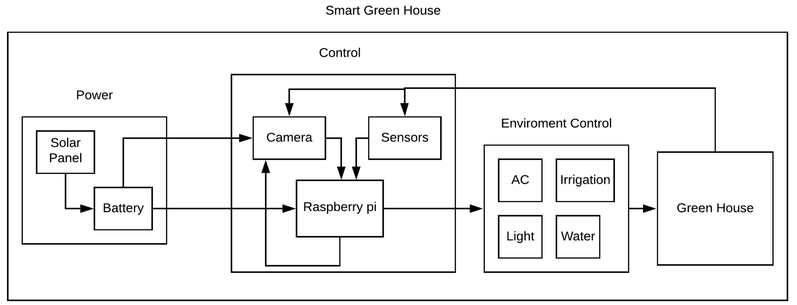


Budget

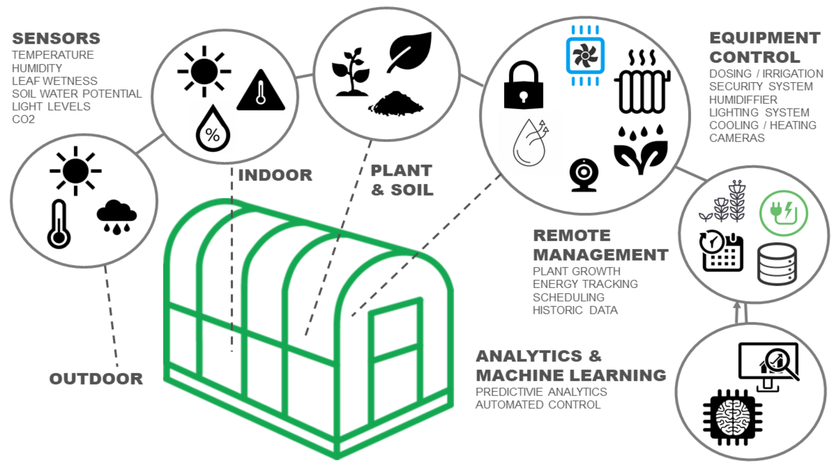


Our Solution

The goal of the project is to create a fully autonomous greenhouse to avoid such losses. With the correct implementation of new technologies like Internet of Things (IoT) and machine learning (ML), we were able to overcome the challenges of an automated greenhouse. The automated greenhouse takes into consideration every possible factor such as the security of the greenhouse, the outdoor factors and their effect on the indoor parameters, remote management and the efficiency of the over all project in regards to cost and power consumption.



Product Overview



The Greenhouse project has taken every possible element into consideration from security to power efficiency. The control unit monitors every element including light, temperature, humidity and soil moisture level and provides the best possible condition based the ripeness level of the tomatoes using the systems implemented such as irrigation and air conditioning. Using the machine learning algorithms, all the possible diseases and the ripeness level of the tomatoes are detected to help the user, achieve the best possible outcome by having a 100% awareness of the overall environment in real time. The greenhouse is designed so it fully runs using solar panels to make the project more efficient and green.

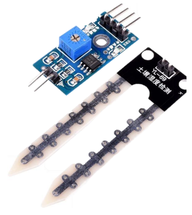
Key Hardware Components

High Dynamic Range Digital Light Sensor

The light sensor measures the lux in a local area. By knowing the lux, we can safely correlate how much sun light the plant is receiving. Therefore, we can provide the plant the optimal amount of sun light.

Temperature & Humidity Sensor

This sensor provides the ability to record the environment's temperature and humidity. With this information the Raspberry Pi can reactively alter the environment to desired values.

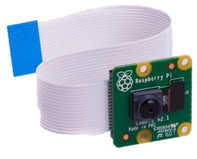


Soil Moisture Sensor

With the soil moisture sensor, we can limit how much water goes into the plant. The soil moisture sensor is calibrated to a desired moisture and if it reads anything over it will notify allowing the user to reduce the amount of water given to the tomato plant.

Raspberry Pi 4

The Raspberry Pi 4 is the main processor and was a suitable choice due to the its support of Google's TensorFlow. The machine learning aspect of this project which is the most essential one, determines the purpose of all the systems implemented in the green house.



Raspberry Pi Camera Module V2-8

One of the key elements of this project is the Module V2-8 camera. The camera is highly used in regards to the machine learning aspect of the project. Using the camera, the images of tomato and leaves are transmitted to the control unit and by applying the appointed algorithms the required values for temperature, light level and soil moisture level are determined.

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http://www.thesmartleaf.com/

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