CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

Ainesh Arumugam

Project Number

36838

Project Title

Smart Irrigation Controller Using Computation and Analysis of DGCI of Plants by Image Processing for Water Conservation

Abstract

Objectives/Goals

With the water crisis in California and other places in the world, I started this project with a goal to develop a low cost smart irrigation controller able to significantly reduce water usage, maintain and improve plant health, intelligently adapt, and be efficient. This device should be able to replace standard irrigation controllers and can be applied to both residential and farming applications.

Methods/Materials

The project uses a processing and controlling unit, a camera, and relays to control the irrigation system. To build the prototype, I used a Raspberry Pi B2 and a Raspicam as the main systems. The camera was used to take an image of the vegetation. The processing and control unit was used to segment it, process each pixel in the segment to calculate the DGCI (Dark Green Color Index), a value to measure vegetation health. This generated DGCI value is compared with the THRESHOLD DGCI value, a value corresponding to a level where the vegetation is considered healthy, to generate a watering schedule that will maintain and improve vegetation health. This schedule will be used to control the irrigation system’s start time, duration, and end time through the relay system.

Results

According to my tests and analysis of data, the Smart Irrigation Controller had reduced the water applied for healthy turfgrass and increased the water for dehydrated turfgrass. As the dehydrated turfgrass returned to a normal healthy state in 15 days, the controller reduced the watering schedules according to the DGCI values measured. This resulted in overall healthy vegetation while using 34.17% less water when compared to a timer based standard irrigation controller.

Conclusions/Discussion

The objectives of this project were to develop the necessary hardware and implement the image processing and control software to maintain plant health and have a greater efficiency when watering turfgrass and other vegetation. It was able to detect healthy and dehydrated grass by segmenting and processing the image, and accordingly adjusted the watering schedules. Both objectives were met. Most importantly, the Smart Irrigation Controller was able to save water compared to a standard irrigation controller. In conclusion, my project was able to meet my design criteria.

Summary Statement

By using image processing to measure the health of a plant, the device generates a schedule that will maintain or improve plant health and conserve water significantly.

Help Received

I would like to thank Mr. Tinh Tran of University High School for helping me 3-D print a camera case for my model.

Preliminary