IoT Hydroponics

Effective Control of Remote Growth

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ABSTRACT

In agriculture, plants are often cultivated in soil which requires large amounts of land and water. Hydroponics grows plants in water instead of soil. This saves space and water while increasing the yield at the same time if done correctly. In this project, hydroponics is used in addition to microcontrollers to show the benefits of the Internet of Things(IoT) in agriculture.

KEYWORDS

Internet of Things, hydroponics, water, agriculture, Arduino, ESP8266

1 Introduction

To implement IoT in hydroponics we designed a hydroponic growing module which would be fitted with microcontrollers to monitor the development and requirements of the plants growing in that module.

2 DESIGN

2.1 Hardware Components

In Figure 1 the model created is shown, it was created using a tray where the water to grow the plants is stored. Specially designed hydroponic growing modules can be created for each type of plant. In Figure 2 is all the hardware components used to connect the hydroponic module and control the system.

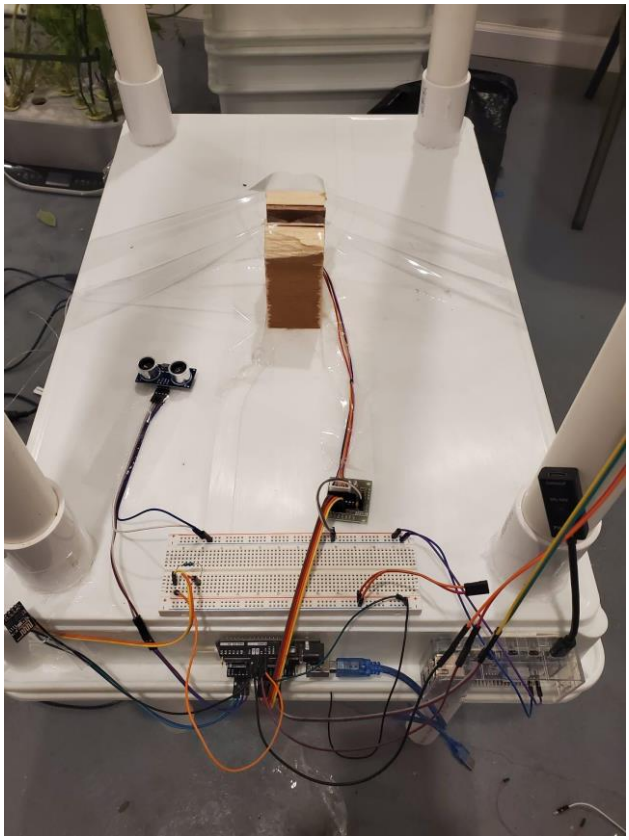

Figure 1: A hydroponic growing case

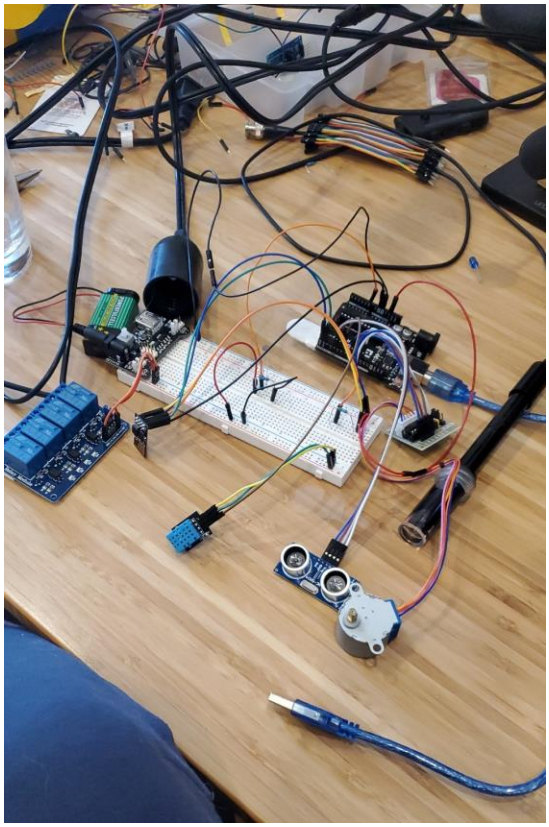

Figure 2: Microcontrollers and Sensors used.

2.1.1 **Arduino Uno R3**

Arduino Uno is a small microcontroller used to send commands to the rest of the hardware in the system.

2.1.2 **Ultrasonic Sensor**

The ultrasonic sensor is connected to the arduino and positioned on the hydroponic module to determine the height of the plants.

2.1.3 **pH Sensor with Adapter**

The pH Sensor with adapter is connected to the arduino to check the quality of the water in the system.

2.1.4 **4-Way Relay Module**

The relay sends signals from the arduino to the rest of the system. The relay controls other hardware by sending it a signal to turn off or to turn on.

2.1.5 **Humidity and Temperature Sensor**

The humidity and temperature sensor record the humidity and temperature of the

2.1.6 **Stepper Motor**

The stepper motor controls the height of the growing lights.

2.1.7 **Air Pump**

The air pump provides air flow to the hydroponic module.

2.1.8 **Submersible Pump**

The submersible pump ensures water is brought into the hydroponic module.

2.1.9 **Grow Light**

The grow light provides the plants with the necessary UV lights when grown indoors.

2.1.10 **ESP8266-01**

ESP8266-01 is a wireless module used to connect the arduino to the internet.

2.2 **Software Components**

2.2.1 **Arduino**

Arduino is an open-source electronics platform based on easy-to-use hardware and software.

2.2.2 **ESP8266 Network Stack**

The ESP 8266 module must be programmed to receive and return HTTP requests

2.2.3 **Python-Flask**

Python-Flask is a micro web framework written in Python.

3 **IMPLEMENTATION**

3.1 **Data Flow**

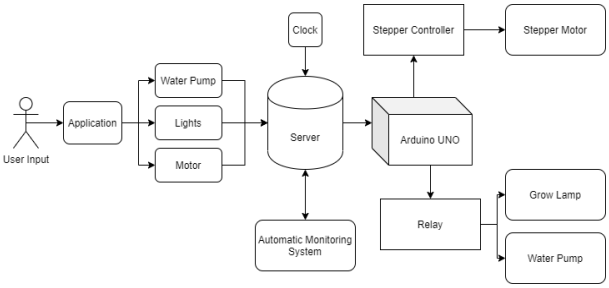

Figure 3: Data Flow Diagram

3.2 **Website**

The website showed the real-time information gathered from the module. It displays the humidity, temperature, plant height and equipment status. This allows for users

to monitor their plants status as well as the condition of the water in the hydroponic module.

3.3 **Module Control**

The hydroponic module is controlled by an arduino. The arduino controls the hydroponic module automatically using internal clocks and sensory information. This arduino sends signals to the relay to control the grow light clock to ensure the plants receive the correct amount of light and darkness. The relay also controls the air pump to provide sufficient air to the water so it is not stagnant.

4 **EVALUATION**

We successfully achieved the functionality as designed: 1. control the height of grow light, 2. control the grow light and air pump, 3. app displays live humidity, temperature, plant height, and equipment status, 4. server is able to automate control using timing and sensor input.

In future, larger plants could be supported to accommodate agricultural needs.

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