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CONTENTS

Prototyping Model for Hydroponic Plant Monitoring System on Pandemic and Quarantine Environment

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Abstract

In the era of the pandemic and quarantine environment due to the coronavirus, we must consider a paradigm shift in many aspects of society. On isolated from society and the case of airborne infection worsens, it is difficult to expect a smooth supply of fresh food ingredients with transportation delivery problem. In particular because agricultural technologies and information are not evenly distributed to the normal people. To solve this problem, we propose a prototyping model of hydroponic growing environment monitoring system to get fresh crops in any house without having any knowledges of the farming techniques. We expect to spread the in-house farming with our model in quarantine or normal environment for new farmers.

Keywords: *Hydroponics, Plant Environment Measuring System, Arduino, Raspberry Pi.*

1. Introduction

Worldwide, rural populations are declining, and the average age of farmers is also increasing. This is because terrestrial cultivation requires tremendous physical labor. In addition, there are increasing cases of returning farmers who are unable to adapt to the new rural environment, do not know how to start farming, and give up farming due to repeated failures. Moreover, farmers are learning agricultural technology through various specialized institutions such as agricultural technology centers, but the supply is absolutely insufficient. Most farmers rely on experience through farming, so there is a disadvantage in that the crop harvest is not constant and the minimum crop cannot be guaranteed.

This paper proposes the prototype of open source based hydroponic plant environment monitoring system to improve these problems. the prototype of open source based hydroponic plant environment monitoring system is specialized for hydroponic cultivation and measures and collects growth environment values required for hydroponic cultivation of crops. Chapter 2 introduces related research and Chapter 3 explains the process of implementing a growth environment measurement device. Chapter 4 remarks the conclusions and future research directions.

2. Related Studies

Currently, the Rural Development Administration (RDA) is conducting experiments by making a test bed for a plant factory system which includes solar-powered and Artificial light plant factory systems. Yet, although other research institutes including the Rural Development Administration are continuing research on plant growth and environment control, the technology is rarely spread to farmers. Therefore, we expect that the open source-based plant growth environment devices can be quickly spread to farmers.

There are there are several elements are very essential for plant growth such as light, carbon, and nitrogen are required, and essential elements for the cultivation environment include nutrient solution, crops, wind, and

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electric energy. In particular, nutrient solution is very important because it is the only nutrient to supply nutrients to the roots floating in the air. The nutrient solution measure device consists of an EC(Electric Conductivity Sensor) or Total Dissolved Solid (TDS) meter, a pH meter, and a waterproof temperature sensor, and the EC and pH values vary according to the ratio of the nutrient solution[1]. Figure 1 is the Arduino Circuit Diagram of Nutrient Solution measure device.

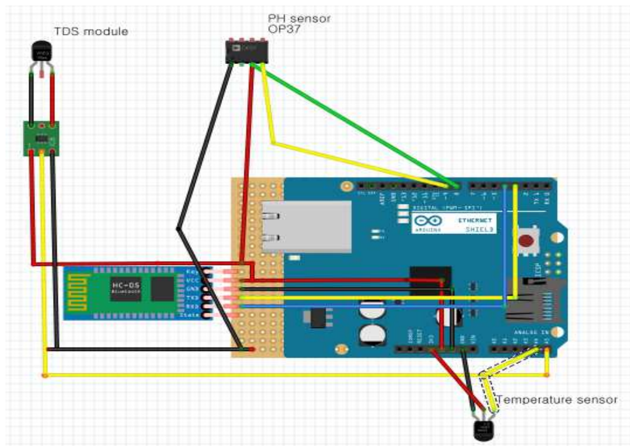

Figure 1. Arduino Circuit for Nutrient Solution Measure Device

3. Hydroponic Growing Environment Measuring System

We implement the plant growth environment device by researching and combining various sensors compatible with Arduino. We use Arduino Uno, MariaDB, MySQL, C++, PHP, HTML, Python, Raspberry Pi, Bluetooth, etc. as open source-based technologies. Figure 2 is a relationship diagram of Hydroponic Growing Environment Monitoring System (HGEMS).

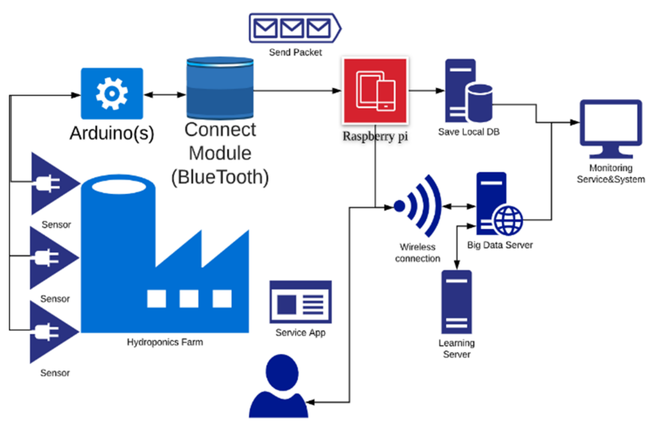

Figure 2. Relationship Diagram of HGEMS

First, in order to collect growth data, we install Plant Environment Sensing Device (PESD). It is composed of TDS sensor, pH sensor, and waterproof temperature sensor based on Arduino Uno. When the temperature is measured by the waterproof temperature sensor, the temperature is received, and the electrical conductivity is measured by the TDS sensor to quantify the concentration of the nutrient solution. In addition, the pH value is measured in real time through a pH sensor. TDS is a measurement of inorganic salts, organic matter and other dissolved materials in water[2]. Therefore, although the TDS concentration does not indicate which mineral is composed of, It is used for monitoring purpose of Nutrient solution.

Collecting information and creating packets through sensors in Arduino is implemented using C++, which is fast and modular, relatively easy. Then, the data collected through the sensors is packetized by the Arduino. Packetized data is transmitted to the Raspberry Pi through the Bluetooth module. Raspberry Pi stores the data transmitted through the Bluetooth module in a local DB and records it in the Big Data server through the Internet[3]. From Raspberry Pi, python is used to handle code, MariaDB is used to create a local DB, and MySQL is used to write Query statements to process data. We use PHP to display the data as a graph for real-time monitoring by users. The following figure shows a graph that monitors the TDS concentration, pH, and temperature of the nutrient solution in real time. Figure 3. Shows the prototype of real time monitoring system. User can check TDS, pH, Nutrient Solution temperature by minutes, hour, day, week, and Month.

Figure 3. Real Time Monitoring System Prototype

4. Conclusion

We propose a prototype of an open source based hydroponic growing environment monitoring system on this paper. There are various plant growth factors depending on the crop as well as TDS, PH, and temperature. Measuring the growth factors of crops and accumulating data is essential to extracting optimization data for crops. Future research is expected that the environment where plant growth environment data for various crops and varieties that are difficult to grow will be accumulated, a predictive model will be developed through artificial intelligence learning, and an environment in which difficult crops can be easily grown if conditions are met anywhere. In addition, by studying the automation method of all systems, it is expected to increase the yield while reducing the physical burden of farmers.

5. Acknowledgement

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