# Management System using Smartphone and Sensor for Hydroponics Vegetables

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**บทคัดย่อ**—บทความนี้กล่าวถึงระบบควบคุมการจัดการผ่านอุปกรณ์สมาร์ทโฟนเพื่อใช้งานด้านการผลิตผักไฮโดรโปนิกส์ เป็นระบบที่ถูกพัฒนาเพื่อให้เกษตรกรหรือผู้ที่สนใจในการปลูกผักไฮโดรโปนิกส์ สามารถควบคุมและจัดการการทำงานผ่านอุปกรณ์สมาร์ทโฟน โดยใช้เซ็นเซอร์เข้ามาช่วยในการตัดสินใจการให้น้ำ สารอาหารพืช และการให้แสง แล้วทำการเก็บข้อมูลลงฐานข้อมูลเพื่อนำไปวิเคราะห์หาการเจริญเติบโตของพืชที่ดีกว่า การปลูกแบบให้เกษตรกรควบคุม

***คำสำคัญ: ผักไฮโดรโปนิก ,เซ็นเซอร์ ,สารอาหารพืช***

*Abstract*—In this research, the nutrient level in hydroponic cultivation will be automatically maintained by microcontroller and measured by sensor. The objective of this study was to create a working hydroponic management using smartphone and sensor, which is simple and real-time. It will monitor and control the key environmental ingredients needed such as water level, light and pH. The methodology in this project consists of hardware and software interfacing, analysis and troubleshooting, data and result collection.

***Keywords- software; monitoring; sensors; hydroponics***

## I. INTRODUCTION

Thailand is predominantly an agricultural country. However, the problems of arable land and resource shortage have not improved in spite of the fact that growth in agriculture has been increase. To tackle the cost-price squeeze, farmers must either improve their productivity by adopting new technology. Soilless culture or hydroponics is an alternative crop production system that might be one of many solutions to increase the output production. However, there is high cost for hydroponic set up system and requires constant supervision.

In hydroponic system, ensuring a good supply of nutrient is absolutely vital due to it is a major factor that affecting plant growth. Therefore, technical knowledge is required for growing plants through hydroponics.

### A. Diseaese and Insect Pathogenic Hydroponic

Fungal and disease problems are one of the biggest challenges hydroponic systems. Invasion of roots by pathogenic and other deleterious organisms infect the root function and development. Plants with *Pythium* root rot (Figure 1) are stunted and wilted. *Pythium* root rot, like most diseases, are difficult to control once the symptoms have begun. Therefore management should focus on a proactive preventive approach. Plant diseases occur when the pathogen is present, the crop is susceptible to the pathogen, and the environmental conditions are conducive to disease development.

Figure 1. Pythium Root Rot on Hydroponic

Moreover, the main problem is fungal and disease problems on the leaves. It appears as a water-soaked spot irregularly shaped brown to black in appearance as shown in Figure 2. Therefore, we should focus the management plan on preventing entrance or reducing pathogen inoculum and managing environmental conditions.

Figure 2. Leaf spot pathogens

### B. Hardware and Sensor

Arduino boards were constantly used with AVR microcontrollers due to it is open source computer hardware and software. The software consists of a standard programming language and the boot loader that runs on the board. In particular, the microcontrollers are typically programmed using the standard programming languages C and C++ which have various libraries for Input/Output connection. The startup is easy because there are the simply feature interfaces, including Universal Serial Bus (USB) on model, which is used for software installing to connect with microcontroller.

Raspberry Pi 3 is a new affordable small single-board computer for electronics and computer programming which can be connected to a monitor, keyboard and mouse. It can be used for many of the tasks that a desktop PC carries out, including spreadsheets, word-processing, game and high-resolution video playing. The Raspberry Pi has several Linux operating systems on SD card, including Raspbian (Debian), Pidora (Fedora), and Arch Linux. Raspberry Pi broad was designed to include with CPU, GPU and RAM in a chip. The broad also has GPIO access point that allow user to work with other electronic devices.

pH Sensor is a sensitive instrument that indicating the acidity or alkalinity of the solution and expressed as analog pH value on a scale of 0 to 14. This sensor can be continuously soaked in solution for 1 year. pH sensor is consist of sensor probes and interface circuits for microcontroller connection using optimal power supply and temperature at 5 volt and 25 ° C. The lifetime of a pH sensor has a significant impact on the accuracy value, high temperatures, high process pressure, or aggressive media and turbidity are also will reduce the lifetime of pH electrode. Moreover, there are the different function between the probes, ESEN251 Analog pH Meter Kit and ESEN288 Analog pH Meter Pro.

Figure 3. Sensor PH

The water level monitoring is important to maintain a suitable water level in hydroponic reservoir. Connecting a Grove-Water-Sensor to an Arduino is a great way to detect a leak, spill, flood, rain etc. It can be used to detect the the water situation such as presence, level, volume and/or the absence of water. This water sensor module composed of the several copper strips on the PCB to generate short circuit. This water sensor module works by having a series of exposed traces connected to ground and interlaced between the grounded traces are the sens traces. The sensor traces have a weak pull-up resistor of 1 MΩ. The resistor will pull the sensor trace value high until a drop of water shorts the sensor trace to the grounded trace.

Figure 4. Grove-Water-Sensor

BH1750 light sensor is an electronic device used to detect the current ambient light Light Dependent Resistor (LDR) in a voltage divider. Afterward, the Analog-to-Digital Converter (ADC) with microcontroller will measure the signal and display on LCD. Moreover, BH1750 is a calibrated digital light sensor IC that measures the incident light intensity and converts it into a 16-bit digital number.

Figure 5. BH1750 Light Sensor

## II. RESEARCH METHODOLOGY

### A. Diagram

Figure 6 showed a diagram of the smartphone controlling system for hydroponics vegetable production. In this research, we used an open source AVR microcontroller, Raspberry Pi 3, sensor and smartphone for real time observation to perform the automatic level controlling of water, pH and intensity of the light in hydroponic culturing.

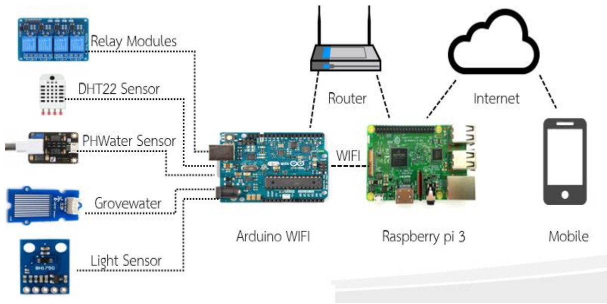



Figure 6. Diagram of Smartphone Controlling System For Hydroponics Vegetable Production

## B. *Hardware System*

Hardware system consisting of Arduino Wi-Fi, Sensor pH, Sensor Grove- Water- Sensor, DHT22 Digital Temperature and Humidity Sensor, Sensor BH 1750 Light by connected with Arduino Wi-Fi broad as shown in Figure 7.

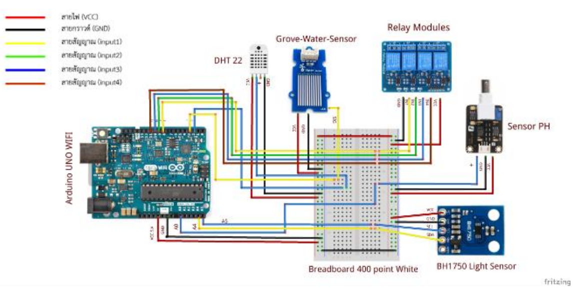
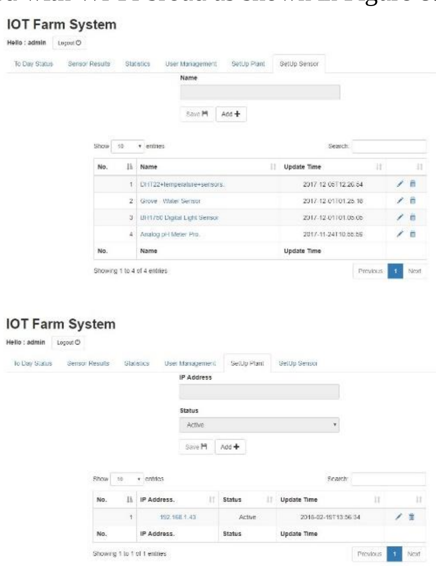



Figure 7. shows the hardware developed to control the hydroponic system

## C. *Application System*

Totally, Application system consisting of plant farm connected with Wi-Fi broad as shown in Figure 8.



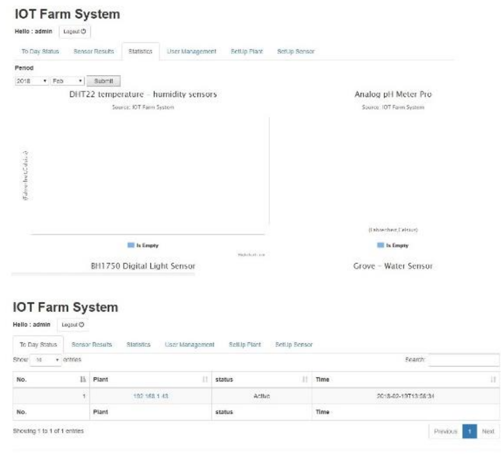




Figure 8. shows the hardware developed to control the hydroponic system

## D. Cultivation Methodology

- There were 2 culture experiment with 15 plant seedlings per plot
- Experiment 1 : Controlled cultivation using automate hardware controlling
- Experiment 2 Conventional cultivation

# III. RESULT AND SUGGESTION

According to the culture experiments, the results showed that the stem length of hydroponic plant that cultured with controlled experiment was higher than conventional cultivation, whereas it also depends on cultivation time as shown in Table I.

TABLE I. Growth of Hydroponic

| Days | System growth | Human growth |
|---|---|---|
| 10 | 5 cm. | 3 cm. |
| 20 | 12 cm. | 7 cm. |
| 30 | 2 cm. | 13 cm. |

# IV. CONCLUSION

This research has implemented an automated system using with Arduino board and Raspberry Pi 3. This project has introduced the real-time monitoring of the nutrients solution by control the level of water, pH and light culture system. The proposed algorithm has shown better performance in terms of growth and yield than the conventional system. A prototype for the automate cultivation of hydroponic plant has been developed and the results of the plant growth have been analyzed.

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