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IoTs Smart Vertical Hydroponics with Microcontroller

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Abstract

- This research has been designed the automated control systems based on Raspberry Pi microcontroller for the vertical hydroponic systems. Technically, to control environmental factors of the vertical hydroponic greenhouse, the sensors such as Electrical Conductivity (EC), Potential of Hydrogen ion (pH), Air temperature, Relative humidity, Water temperature, and Dissolved Oxygen (DO) as well as Lighting system will install on the vertical hydroponic systems. Nevertheless, the measured value of sensors is processed by the microcontroller to monitor and control a motor, a humidifier, a water pump and a ventilator. And then, the measured value send via the wireless network to the smartphone of the farmer.

Introduction

- The vertical hydroponic is an alternative to grow vegetables for the limited space because it can also be stacked vertically to save the several times of space.

- Unsuitable environment hindrance the growth of such as labor shortage, limited of time, disease and insects.

- Therefore, this research is aiming to develop an automated control system based on Raspberry Pi microcontroller to monitor and control the factors of the environment related to the growth of the vegetables.
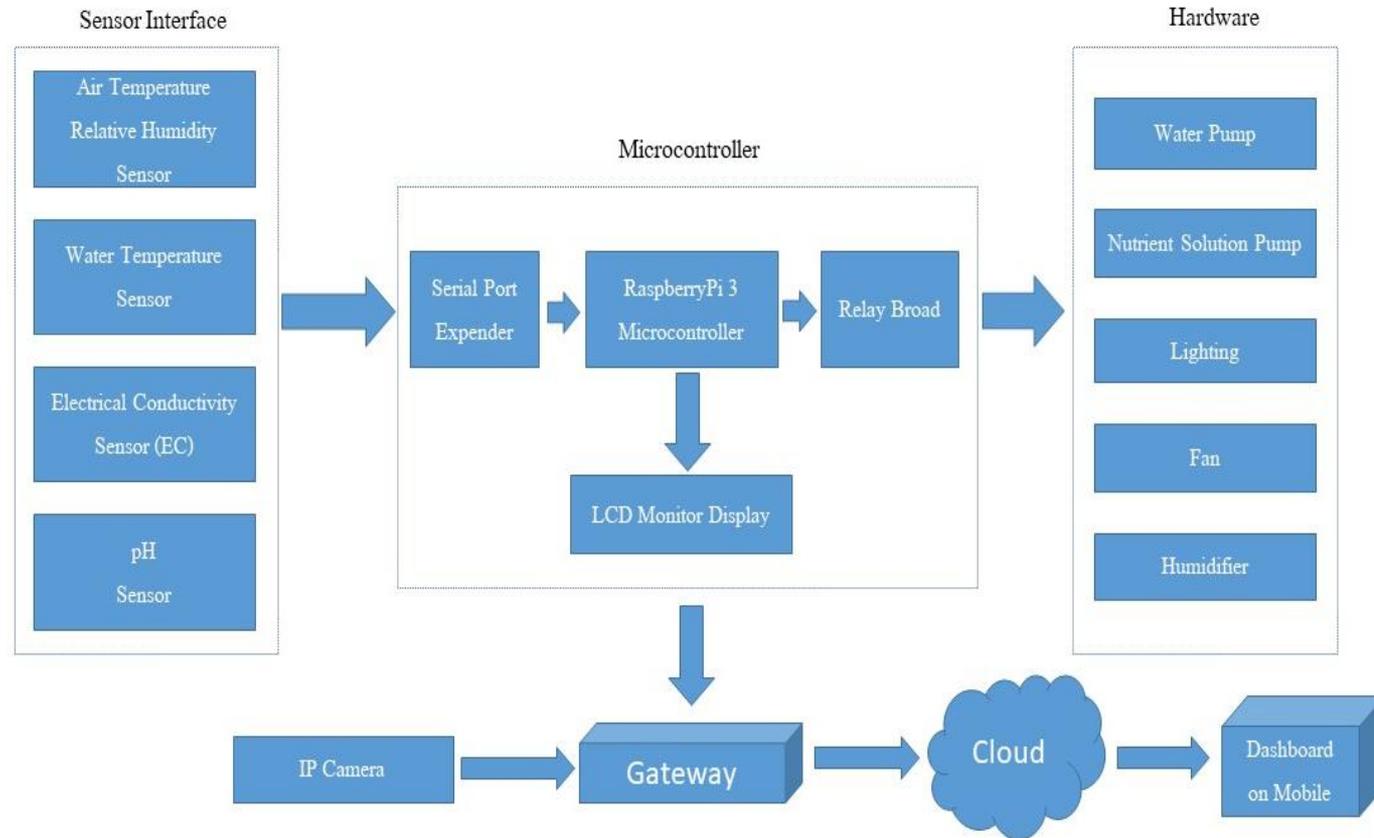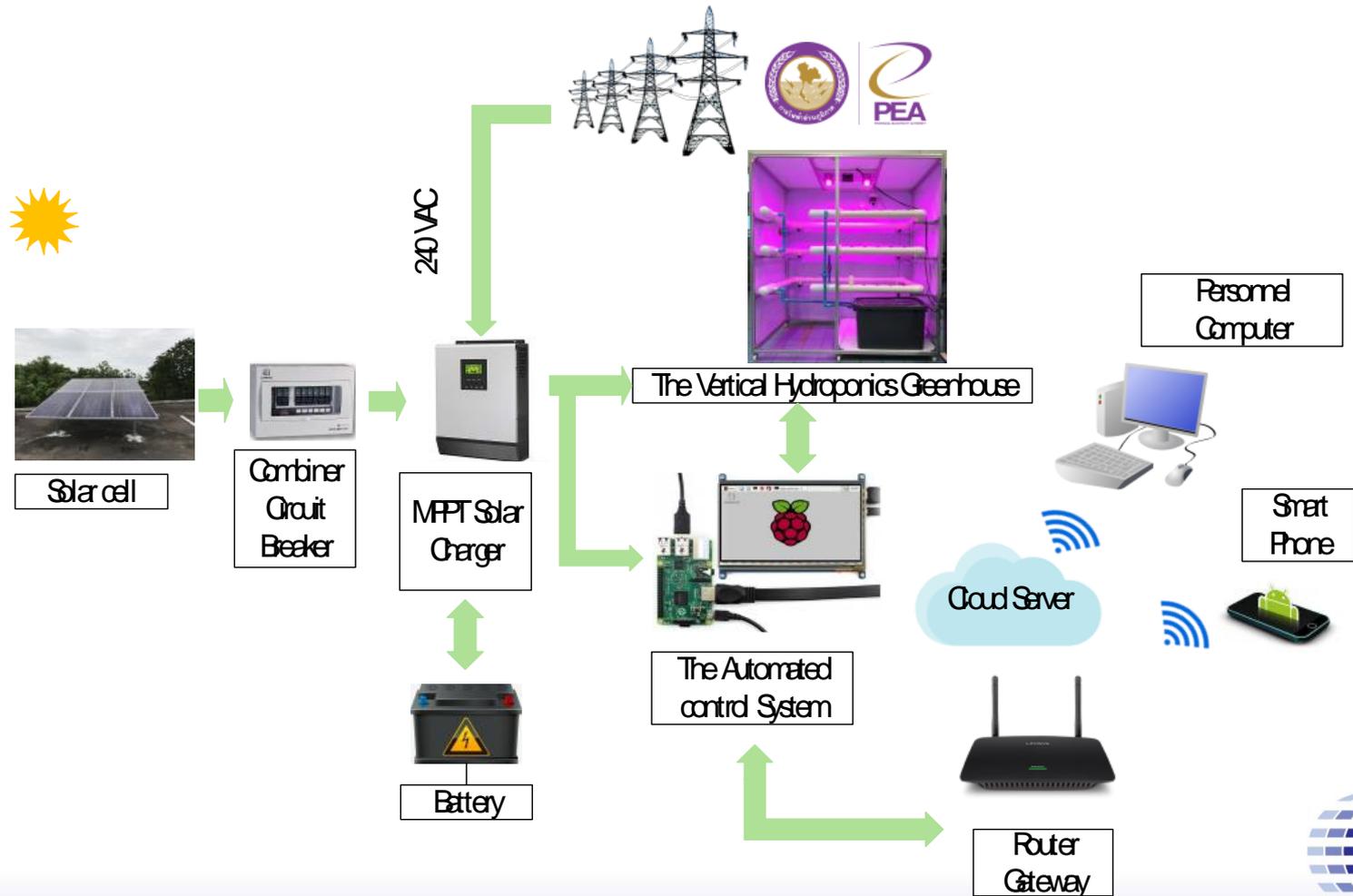
Objectives

- To design the automated control system for the vertical hydroponic greenhouse based on Raspberry Pi.

- To monitor and control the environment factors of the vertical hydroponic greenhouse via the smartphone such as Electrical Conductivity (EC), Potential of Hydrogen ion (pH), Air Temperature , Relative Humidity, and Water Temperature,

Overview of the Automated Control System

Overall of the vertical Hydroponic Control System

240 VAC

PEA

The Vertical Hydroponics Greenhouse

Personnel Computer

Solar cell

Combiner Circuit Breaker

MPPT Solar Charger

Battery

The Automated control System

Cloud Server

Smart Phone

Router Gateway

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Methodology of Research

- Design Greenhouse for the vertical hydroponics.
- Design and install the air circulation system and lighting system which the appropriate intensity to the growth of vegetables.
- Install the temperature & humidity sensor, EC sensor, and pH sensor to the Greenhouse.
- Design program of connection devices related to the growth of vegetables via the internet of things (IoTs).
- Set up the application to show the value of the sensors and observe the shape and size of vegetables via IP camera.
- Planting and controlling the factors that affect the growth of plants.
- Evaluate and summarize the automated control systems

The Automated Control System

LCD Display

Condition

Light 1, Light 2

Main pump

ON   6:00 am-18:00 pm

OFF 18:00 pm-6:00 am

Fan

ON   Air Temp. > 32 °C

OFF Air Temp. < 30 °C

RH

ON   RH. < 50 %

OFF RH. > 60 %

A-pump, B-pump

ON Value setting

OFF Value setting

11-11-2018 14:00:51

Vertical Hydroponic Control System

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Automatic   Manual

| RH | Fan-2 | B-Pump | Light-1 |

| Fan | A-Pump | M-Pump | Light-2 |

Air Temp.= 30.80 c RH.= 66.30 %   Fan: OFF   RH.: OFF
Water Temp.= 33.50 c   Fan-2: OFF
pH= 6.25   A-Pump: OFF
EC= 0.00 us/cm   B-Pump: ON
DO= 1.67 ppm   Light-1: ON   Light-2: ON
ORP= 79.30 mv   Main Pump: ON

Online

Config

Exit

The Automated Control System by Smartphone

Smartphone Display
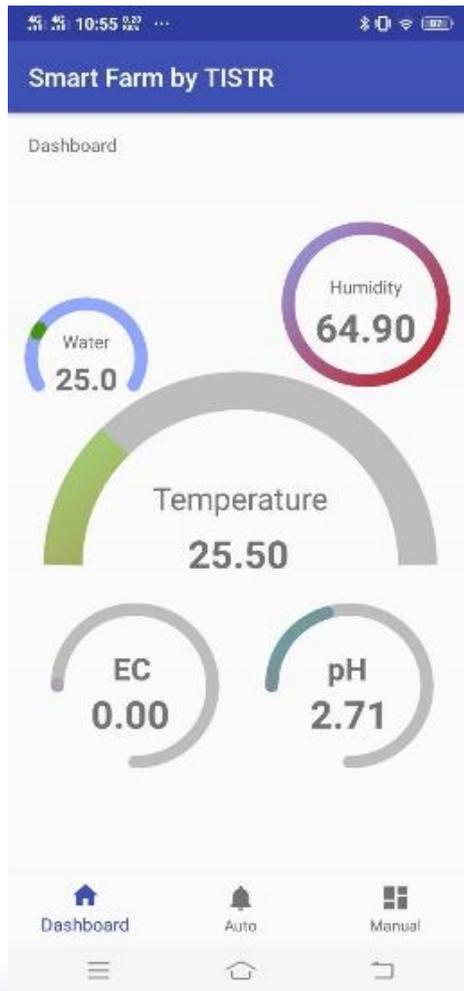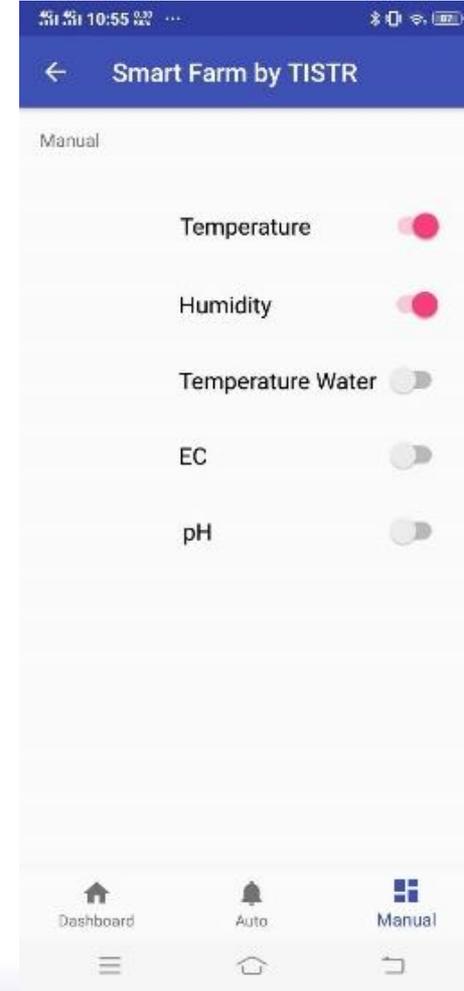
The Results

- The Vertical Hydroponic Greenhouse made up of Aluminum Profile:

Height 180 cm. × Length170 cm. × Width110 cm., and cover with the white Vinyl. The automated control system composed of;

- 240 VAC 200 Watts for the LED Lighting System

- 240 VAC 35 Watts for the Water Pump

- 240 VAC 65 Watts for the Ventilation Can Fan

- 12 VDC 1.4 Amp 17 Watts for Nutrient Solution Pump

- 12 VDC 1.5 Amp 18 Watts for Router

- 12VDC 1.5 Amp 18 Watts for IP Camera

- 240 VAC 60 Watts for The Automated Control System

- Solar Cell produce the power about 1800 watts charged in battery 12 VDC 100 Ampere × 4 unit

- The Total Power Consumption for the Vertical Hydroponic Greenhouse is 400 Watts, approximately.

The Wave Length of the Lighting System in Used
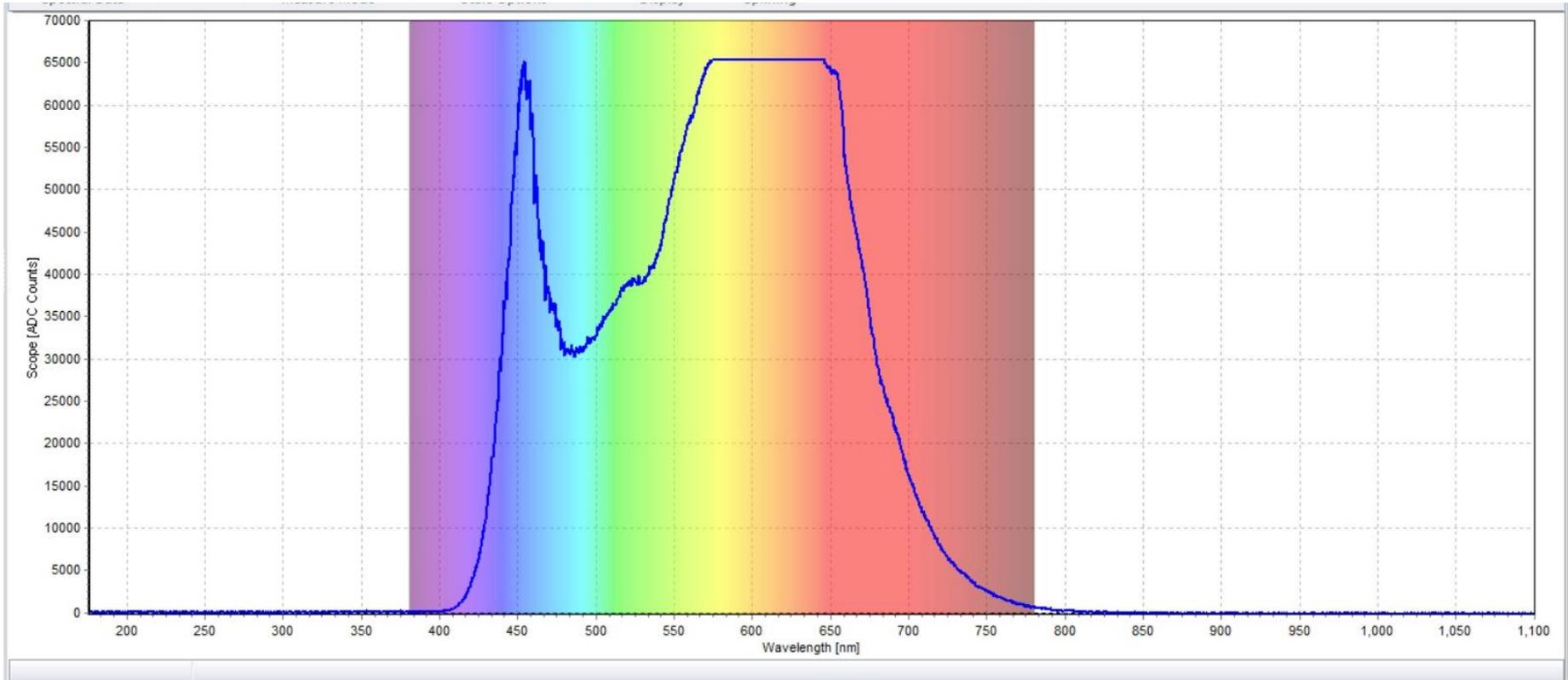
380-780nm

The Results

The First Crop for 6 Weeks

The Quantity of Vegetable is about 6 Kilogram.

The Results

The Second Crop for the another vertical Greenhouse.

Conclusion

- The Automated Control System can work smoothly on each environmental factors.

- The smart vertical hydroponic Greenhouse has been showed the good performance under the setting condition.

- To improve this system, its necessary to increase 200 Watts of lighting system and feeding CO_2 in order to accelerate the growth of the vegetables.

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Thank you

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