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IoT Smart Garden

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Abstract

In today's busy world, people forget to nourish and grow plant and having difficulities to monitor their plants condition. In addition, with unpredictable weather conditions, it is difficult to control the temperature and humidity of the soil to ensure the plants are fertile. With regard to this, we develop an IoT Smart Garden system to solve a problem related to controlling temperature and soil moisture and to monitor the plant are fertile. This project works as an automation system which is consists of fan and water pump. To make the system worked, it is merge with three sensors consist of humidity sensor, temperature sensor and soil moisture sensor. This system also attached a monitoring system by using a surveillance camera to monitor the condition of the plants. An IoT system was included to keep all information gathered from then sensors and plant condition updated through cloud technology. It worked thorugh NodeMCU where the real-time values from the sensors are uploaded to Node-RED. The Node-RED is integrated with mobile apps for control purpose. As the result, the data reading follow the plant condition which is temperature lower than 30°c, the cooling fan will operated automatically. Meanwhile when the soil moisture reading less than 50%, the water pump will automatically operated. All real time data can be archive through Cloud Technology. Generally, the automation of fan and water pump was successfully operated. By keeping updated all the information gathered from sensors through the IoT system, it will provide the convenience and comfort to the user to view the parameters in a real time without their physical presence.

Keyword: IoT, Smart Garden, Automation, Monitoring

Introduction

With the growth of the internet and Industry Revolution 4.0 technologies, Internet of Things (IoT) represents a basic concept of the ability of network devices to sense and collect data from around the world, then the data will send to the Internet where it can be processed and utilized for various purpose. Now a day's every persons are connected with each other using lots of communication way. Where the most popular communication way is internet so in another word, internet which connect peoples in the world. The essential idea of the Internet of Things (IoT) has been attracted many researcher and industries because of its great estimated.

So from the various kind of IoT development, this system was build. In today's busy world, people forget to nourish and grow plant and having difficulities to monitor their plants condition. In addition, with unpredictable weather conditions, it is difficult to control the temperature and humidity of the soil to ensure the plants are fertile. With regard to this, an IoT Smart Garden system was develop to solve a problem related to controlling temperature and soil moisture and to monitor the plant are fertile. This system works as an automation system which is consists of cooling fan and water pump. To make the system worked, it is merge with three sensors consist of humidity sensor, temperature sensor and soil moisture sensor. The operation is once the soil moisture sensor detect lack of water in the soil, the water pump will pump the water as soon the sensor detects the lacking of water. Other than the fan will works once the temperature and humidity sensor to detects raising in surrounding temperature as setting.

This system also attached a monitoring system by using a surveillance camera to monitor the condition of the plants. An IoT system was included to keep all information gathered from the sensors and plant condition updated through cloud technology which is can check on range of the sensor and conditions of plant. It can access via personal computer and smart phone as long as have internet. It worked thorugh NodeMCU where the real-time values from the sensors are uploaded to Node-RED. The Node-RED is integrated with mobile apps for control purpose.

For the other of IoT benefit, the system can check on range of the sensor and conditions of plant by accessing it anywhere and anytime as long they have internet on it via personal computer, laptop or mobile phone. So it does give the people more efficient and makes peoples life easier.

Problem Statement

There are few issues that might be arise to the people which is loved and interest on gardening area, they want to take care of their plants condition to make sure the plant is grow up. But in the certain condition, they can't make it. For example, some people who working need to go to the outstation for coupled of days or weeks, so they can't take care of the plant and flush the plants.

They also mostly having the problem to monitor their plants condition. When they can monitor, the plant can grow up and the productivities of the plant will increase specially the plant which is need to monitor 24/7 days of week like strawberry farm, the grass, vegetable farm etc. So if they can't monitor, it might be the plant goes to withered or dead.

With this system, the plant can monitor every time and everywhere. The data of the plant will send the cloud of internet called IoT. Additional benefit of this system, it can flush the plant when the soil become dry and on the fan when the temperature increase.

Objectives

1) To monitor temperature, humidity and moisture in the soil through IoT system.
2) To monitor the growth and condition of the plant by camera.
3) To make component such as fan and water pump automatically ON to solve the moisture humidity and temperature problem.

Research Question

1) How to monitor the condition of the plant?
2) How to monitor the moisture, temperature and humidity of the plant?
3) How to make system work automatically to solve the moisture, temperature and humidity problem?

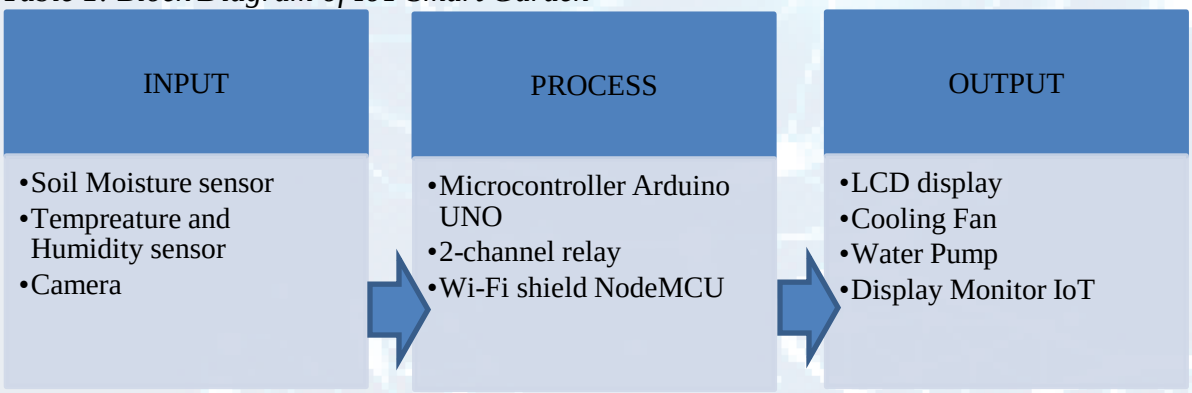
Importance of Research

This system mostly based on automation and IoT system. The most importance of the system is it can save time more efficiently. It also save energy for old age peoples and disabled people who cannot do heavy task. We can easily monitor the range of the sensors by remotely and can monitor the condition of plant via smartphone or personal computer.

Methodology

The method of this system was developed refer to the suited of carry out research and determine effective procedures for responding to the problems of study. This system is divide by three bock diagram which is input, process and output. The figure of block diagram is shown below:

Table 1: Block Diagram of IoT Smart Garden



1) Input

The input for this system is soil moisture sensor, humidity sensor, temperature sensors and camera. The Soil moisture sensor is use for detect the soil of moisture in the garden. If the sensor detect and its reading show the soil are too dry, so the water pump will be ON.

The temperature and humidity sensor is use for to check the temperature and humidity of the garden. If the sensor detect and its reading show the garden condition are too hot, so the cooling fan will be ON.

The surveillance camera is use for monitor the plant and the operation is 360°. It can be closed up, zoom in and zoom out when control at mobile phone apps. This IP Camera with 1/2.5" Color CMOS Sensor and 1,000k Pixels High-Quality Lens can send live video and sound through the Internet to a web browser anywhere in the world.

2) Process

The process of this system is use Arduino Uno as its microcontroller. Its important part because the microcontroller is use as a brain of this system which is this part need to embed with the coding to operation. This system use Arduino Uno because it easy and friendly microcontroller and capable with many sensors. The Arduino Uno will read the sensor reading and the data of sensor will convert to the digital signal. Because sensors are analog signal. So need to convert it to the digital for reading output. Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards are able to read inputs all the sensor and turn it into an output. It can tell what to do by sending a set of instructions to the microcontroller on the board. To do so, use the Arduino programming language (based on Wiring), and the Arduino Software (IDE) (based on processing).

2-channel relay needed and its function are for main switch that for open and close circuits electromechanically or electronically. Relays control one electrical circuit by opening and closing contacts in another circuit.

To get the internet, this system need setup the Wi-Fi. So this system use Wi-Fi shield NodeMCU. Because it's easy to setup with Arduino microcontroller compare the others microcontroller. It also suitable and flexible to leading the IoT platform.

3) Output

The Liquid-crystal display (LCD) display use for display the reading of the sensors. The system use 1602A LCD Display Module LED 1602 Backlight 5v for Arduino. This LCD capable with Arduino and the data will display when the sensor detect the reading. The data of sensor send to website by Wi-Fi shield through IoT. If the reading temperature sensor higher than 30°, the cooling fan ON automatically. If the soil moisture sensor show below than 50% the water pump will ON automatically. Node-RED is use for the server of IoT. It's a flow-based development tool for visual programming developed originally by IBM for wiring together hardware devices, APIs and online services as part of the Internet of Things. Node-RED provides a browser-based flow editor, which can be used to create JavaScript functions. The real-time values from the sensors are uploaded to Node-RED through NodeMCU. The Node-RED is integrated with mobile apps for control purpose.

Result

The automation of fan and water pump fully successful operation when the sensors detect the plant lack of water. The monitoring from the IoT system can monitor the real condition of the plant via personal computer or smart phone.

Figure 1: IoT Smart Garden fully successful

1) Automation system test

Humidity, temperature and soil sensor capability to measure the real time data from the plant. The data reading follow the plant condition which is temperature lower than 30°c, the cooling fan on automatically, meanwhile the soil moisture reading less than 50% automatically watering. Data can be archive through Internet cloud technology. The microcontroller Arduino Uno need to connect with WiFi Module ESP8266 to integrated TCP/IP protocol stack to access the WiFi network.

2) Monitoring system test

NodeMCU needed as a hub of IoT system. NodeMCU is an open source IoT platform. The real-time values from the sensors are uploaded to Node-RED through NodeMCU. The Node-RED is integrated with mobile apps for control purpose.

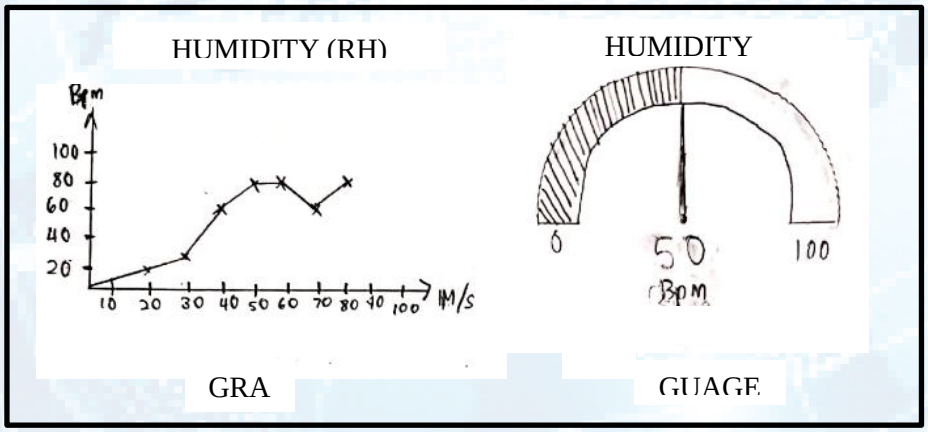


Figure 2: Graph and Gauge data for Humidity Sensor Reading

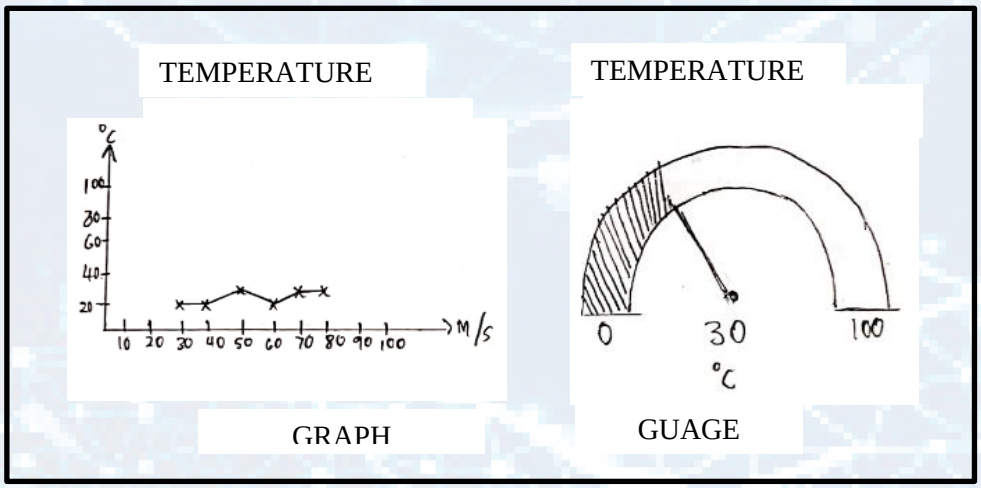


Figure 3: Graph and Gauge data for Temperature Sensor Reading

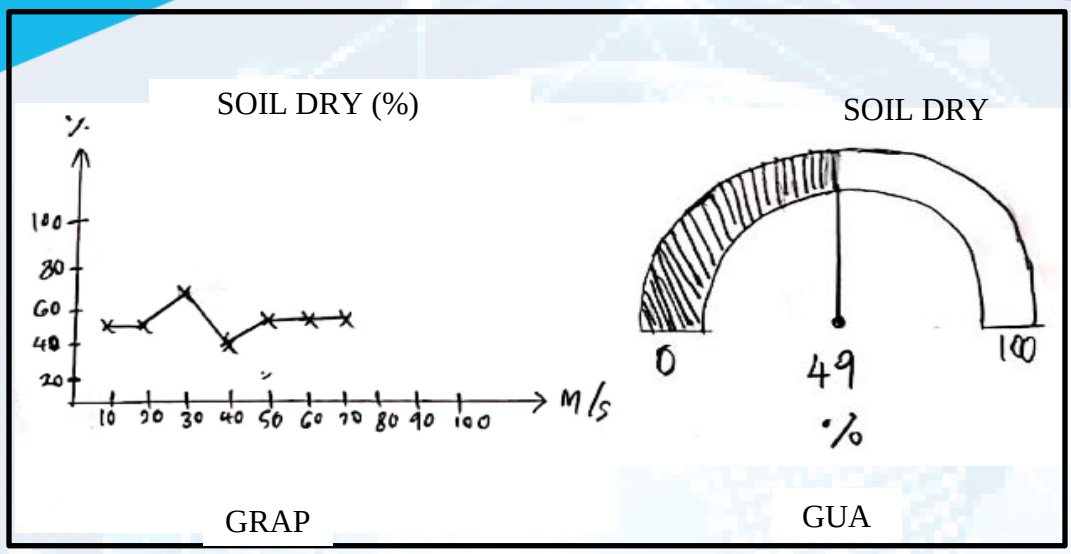


Figure 4: Graph and Gauge data for Soil Sensor Reading

Discussion

From the result, the implementation of Smart Garden system using the IoT has been verified to satisfactorily work by connecting different parameters of the soil to the cloud and was successfully controlled remotely through a mobile application. The system designed not only monitors the sensor data, like moisture, humidity, temperature. It also monitor condition of plants by IP camera.

For the future, this system might be implement for the various applications of temperature sensors or others sensor. The digital thermometers also can use to additional function to this system. The future enhancements in this system are plant type and soil type can be used to suggest the user about the fertilizers, water level for each type. An additional feature of monthly growth analysis can be added. The user can be provided a prior alert about the level of water tank. We can provide SMS alerts.

From the development of IoT Smart Garden system, the parameter of sensor value to automatic watering easily setup and implement. Before doing this system, many people declare wrong about parameter value, so that the pump was over watering. With the some of research, can learnt about the air, water and light makes a plant grow up. So that, this system model has built based on that.

Conclusion

The project deals with the automated temperature and humidity control. The proposed hardware configuration allows for a relatively simple and capable method for automation of indoor garden monitoring. The results show that the proposed system has good feasibility. It reduces the cost of monitoring system at the same time. The IoT system help to monitor from anywhere. The IP camera help to monitoring the condition of plant.

The impact of this system can save time, save cost, user friendly and also environmentally friendly to the gardening style.

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