

Smart Farming Monitoring Towards IR 4.0 Implementation

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ABSTRACT

The Internet of Things is the current and future of every field that effects everyone's life by making everything smart. The development of Smart Farming Monitoring with the use of the Internet of Things, changes conventional farming methods by not only making them optimal but also effective for farmers and reducing crop wastage. Therefore, Smart Farm Monitoring of IR 4.0 Implementation is designed to provide a system for monitoring environmental factors in farming in real time. This product will help farmers by creating an easy-to-use user view so users can view data. By implementing various types of sensors and applications such as Raspberry Pi 4B as its main controller, Temperature & Humidity sensor(DHT22), Capacitive Soil Moisture sensor, ThingSpeak and ThingView, farmers will can monitor parameters and this data will be sent to the database for real-time display and storage purposes. The project is expected to create a smart environment conducive to agriculture and reduce labour costs and water wastage and increase productivity and efficiency.

Keywords: Temperature & Humidity (DHT22); Capacitive Soil Moisture sensor; ThingSpeak; Real – time display

1. INTRODUCTION

Agriculture helps people and societies meet their basic needs by providing food, clothing, shelter, medicine, and entertaining activities. Consequently, agriculture is the most important industry in the world. In developing countries, agriculture is an important issue because it can help improve human resources and provide food security, which has become a basic human right that must be met to stay alive. One of the conditions for improving agriculture is the use of technology, because the data required can be produced in greater quantities, allowing for better and more accurate analysis. Internet of things is a concept in which an object can send data over a network without requiring interaction between a person and a computer or a person and another person. The data is created by sensors that are attached to the chosen object. Therefore, Smart farming monitoring system with implement IR 4.0 is a technique of farming which integrates internet of things to help with the increase in yield. Smart farming helps farmers figure out when to use the right fertilizers and other tools to increase production. In order to implement IR 4.0, this project suggests a smart farming monitoring technique using the Internet of Things (IoT) concept. The project system is supposed to perform some automatic processes, like keeping track of soil moisture and show the user the environment situation.

2. PROBLEM STATEMENT

Traditional farming has few restrictions where it cannot meet the requirements of modern agriculture in aspects of needs the high crop yields, the good quality and the efficient output. Thus, it is very important to use IR 4.0 to update the ways things are done now and use the information to predict the best crop and productivity for a certain land area.

The traditional agriculture may be at serious risk of a shortage of food. This is because farmers used to be able to predict the state of their crops, the time of harvest, and other important things based on their years of work. But these working experiences and predictions don't always turn out to be right. Lastly, every plant has its own set of requirements for its living environment and these needs can affect the food supply in the long run. The reason is that climate change will change the ideal temperature for crops to grow, which will cause crop yields to go down. Refer to Food Security Update, World Bank Group (2022), Domestic food price inflation continues to remain high in almost all countries and High fertilizer prices have become a significant obstacle to food production in many low-income countries as shown in Figure 1 and 2. From this statement means that system that provide the real-time monitoring is much recommended to counter this problem.

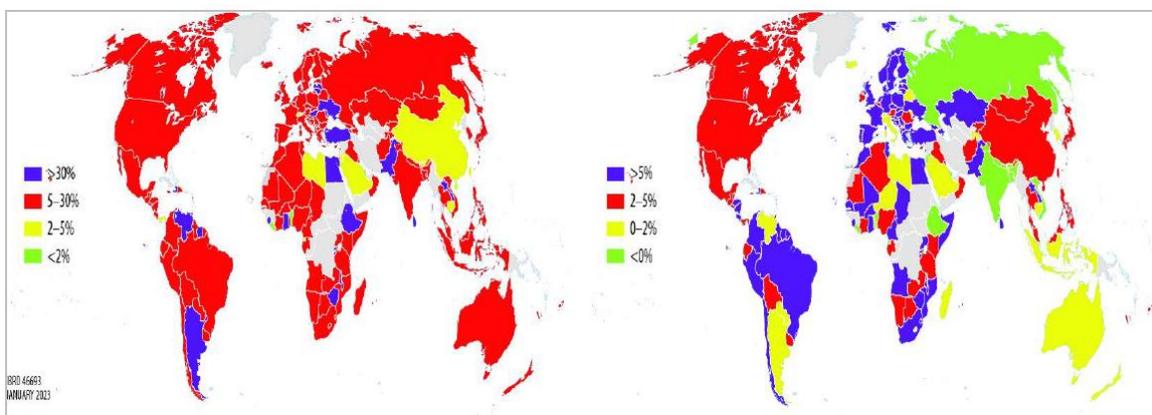


Figure 1. Food Inflation Heat Map

Figure 2. Real Food Inflation Heat Map

Source: International Monetary Fund, Haver Analytics, and Trading Economics.

3. METHODOLOGY

This sub-section illustrates and describes the methodology and material involved in this study. Also contains a project overview and project overflow for a better understanding of the project's progress.

3.1 Project Overview

The main purpose of this project is to implement a smart farming monitoring towards IR 4.0 implementation which is useful to real - time monitoring on crops and farming environment parameter. Project development begins with system design, hardware and software implementation, software and hardware implementation combination, testing and debugging.

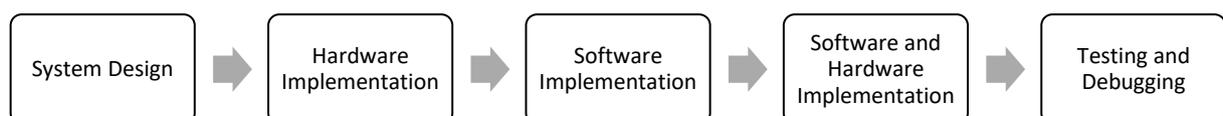


Figure 3. Project Development Step

3.2 Sensor Data Acquisition System

In order to visualize sensor data, the data has to first be provided by the sensors. To achieve the goal of this project, various hardware and software are required. This section will explain on all the components used in the process of getting and preparing sensor data needed by the smart farming monitoring system.

3.3 System Flowchart

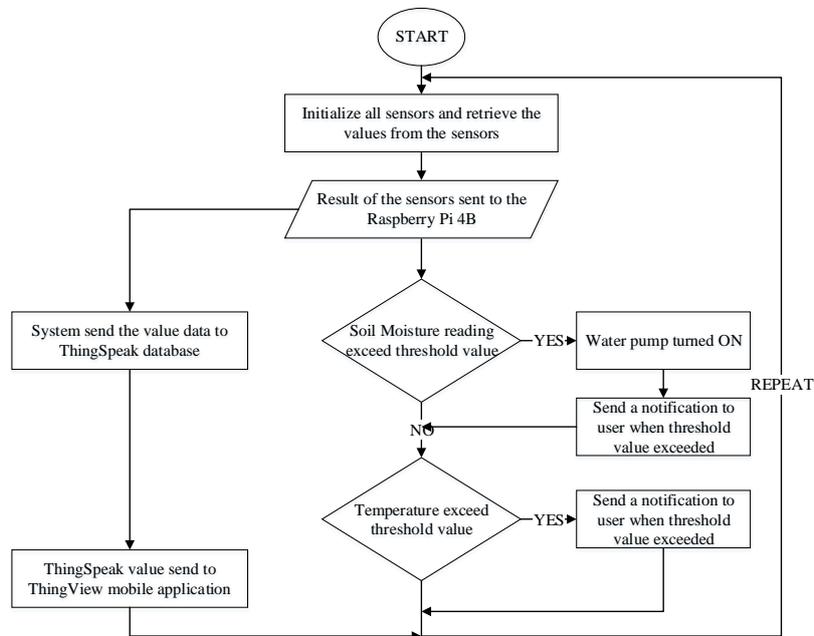


Figure 4. Smart Farming Monitoring System Flowchart

The flowchart for the entire Smart Farming Monitoring System process, which it can be sort into fundamental steps shown in Figure 3.

3.4 Hardware and Software

- a) Raspberry Pi 4B
- b) Capacitive Soil Moisture
- c) DHT 22 (Temperature & Humidity)
- d) Analog - to - Digital Converter
- e) Raspbian Operating System
- f) ThingView
- g) ThingSpeak

3.5 Hardware Implementation

There are few hardware components involves in the hardware implementation of the project. The architecture and functionality of each component used in the project will be covered in this part.



Figure 5. Hardware implementation process

3.5.1 Connection of Capacitive Soil Moisture with Water Pump

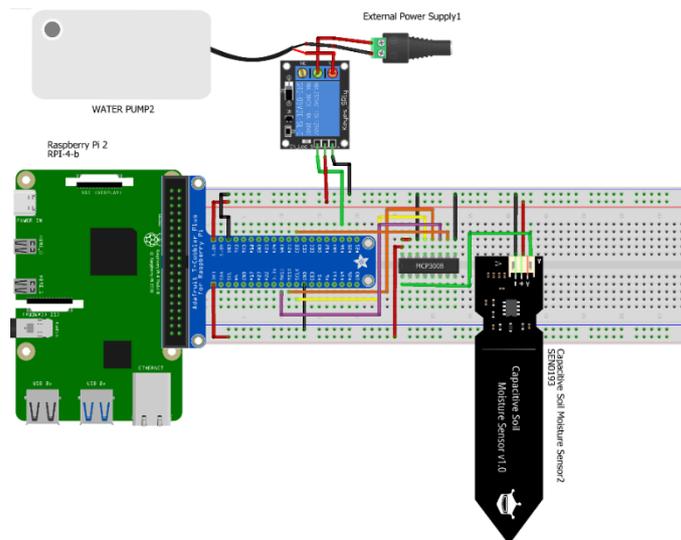


Figure 6. Connection of Capacitive Soil Moisture with Water Pump

The capacitive soil moisture sensor is an analog device that measures soil moisture by capacitive sensing. Since this sensor only records analog values, MCP3008 have to be used to convert analog value to digital value. The red, black, and green cable pins are connected to the 5V pin, the GND pin, and CH0 (pin 1) of the MCP3008.

For connection, the relay's IN connected to GPIO16 Raspberry Pi. The COM connector of the relay is connected to positive wire of the external power supply. The negative wire of the water pump is connected to negative wire of the external power supply. The normally open (NO) connector of the relay is connected to the positive wire of the water pump.

3.5.2 Connection of DHT22

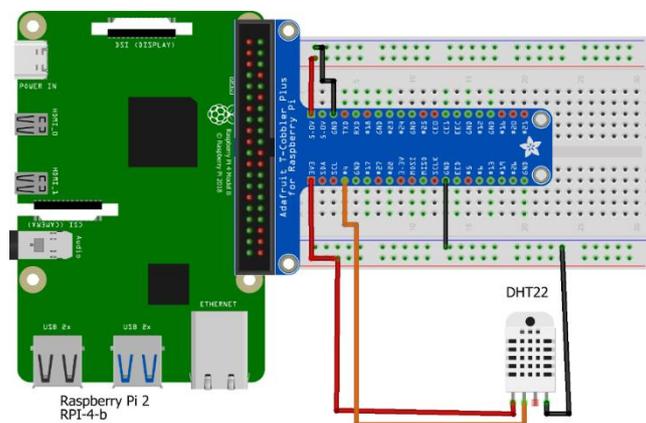


Figure 7. Connection of DHT 22

DHT 22 is a digital sensor, it measures the humidity in the air using a thermistor and a capacitive humidity sensor. GND will be connected to GND board, VCC to 5V pin board and Signal pin (orange) to GPIO 4. Figure 6 shows the connection of DHT 22.

3.6 Hardware and Software Implementation

After the completion of the hardware and software component of the project, the integration of software and hardware is required to synchronize the functionality of all parts of the project. The ThingView serves as a medium to real – time monitoring the reading value or data from sensors. Figure 7 shows the integration between software and hardware system.

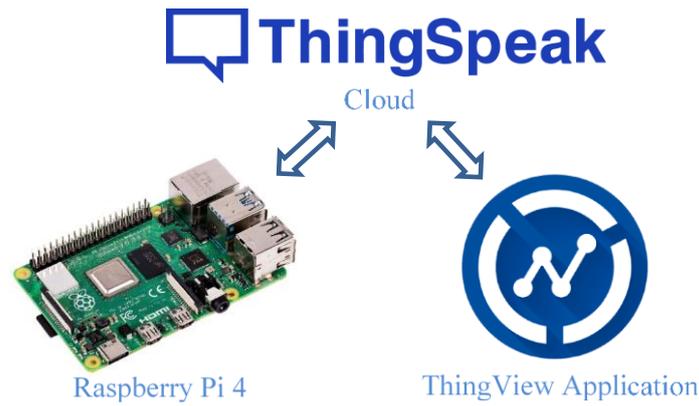


Figure 8. Hardware and Software Integration

4. RESULTS

The sensor data is first obtained by Raspberry pi as the code is executed by using Thonny IDE which are contain four types of sensors such as capacitance soil moisture and dht22. The output that will be displayed are the real – time surrounding which is the temperature in unit Celsius, humidity in unit percentage. After running the code, the related output was observed in the serial monitor to make sure the code is successfully executed.

```
2023-01-13 22:53:10=====DHT22 SENSOR=====
Temp: 27.7 C
Humidity: 88.3%
2023-01-13 22:53:10=====CAPACITIVE SOIL MOISTURE SENSOR=====
Capacitive Soil ADC Value: 768
Capacitive Soil ADC Voltage: 2.48V
DRY SOIL
```

Figure 9. Output sensor data in serial monitor

4.1 ThingView and ThingShow Application

ThingView and ThingShow mobile application displays the real – time data that obtained by each of sensor and able to viewed by user.

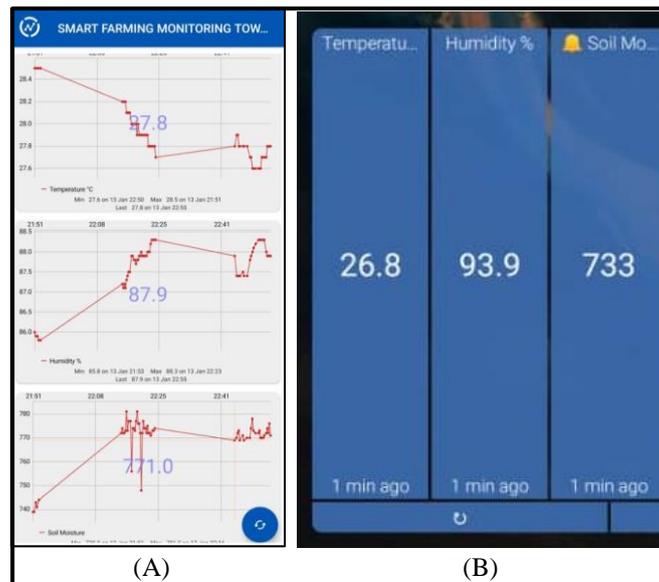


Figure 10. (A) ThingView, (B) ThingShow Application

4.2 Real - Time Clock and Date

Real time and date is obtained by importing the library in python code. Upon executing the code, an output of the current time and date will be printed for each of sensor category.

```

2023-01-14 01:27:29=====DHT22 SENSOR=====
Temp: 28.1 C
Humidity: 85.7%
2023-01-14 01:27:29=====CAPACITIVE SOIL MOISTURE SENSOR=====
Capacitive Soil ADC Value: 751
Capacitive Soil ADC Voltage: 2.43V
DRY SOIL
WATER PUMP in ON
    
```

Figure 11. Output of Real Time Clock

4.3 Notification in ThingShow Widget

Every time the reading of the sensors exceeds the respective threshold, a push notification is sent to the user to inform user.

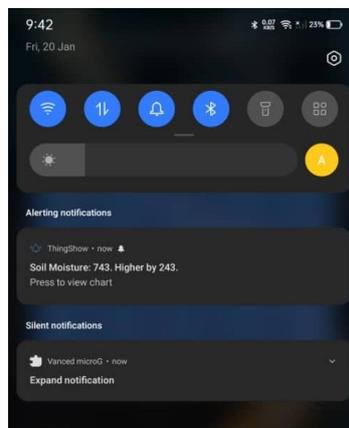


Figure 12. Push Notification of Threshold Level of Soil Moisture

4.4 ThingSpeak Cloud

The real time sensor data will be displayed on the ThingSpeak chart. The system is set with a 15 second delay for data to be saved or sent to thingspeak. The chart will display data of sensors over time. The data sensors able to viewed in Excel which is had been stored while the system is running. Other than live data sensor chart, the data can be viewed anytime and anywhere.

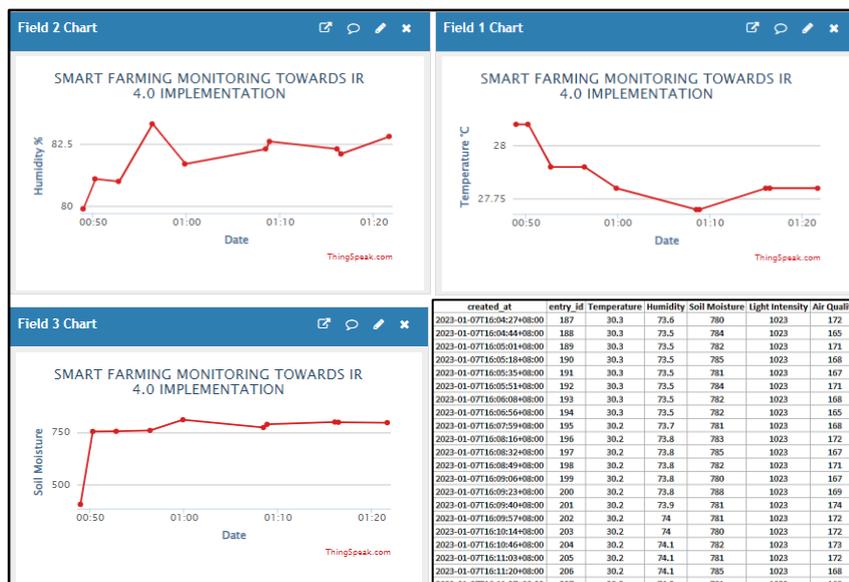


Figure 13. Sensor Data Chart in ThingSpeak

5. CONCLUSION

The project "Smart Farming Monitoring Towards IR 4.0 Implementation" was successfully designed, implemented and tested. All related studies and literature reviews were conducted to select the most suitable and efficient workflow for the project. In this project, a Raspberry Pi 4B is able to support and control all the functions and hardware of the system. The designed project considers the need for continuous real-time monitoring without missing any data to the user. Therefore, the ThingSpeak database was used to allow the user to monitor and show the real-time values in a table and an Excel file. After the completion of the project, the system was tested to ensure its full functionality and an analysis of the system was performed. Several problems were encountered during the implementation of the project. However, through perseverance, all obstacles were successfully overcome. The objectives of the system are thus achieved, as the intelligent monitoring of agriculture allows real-time monitoring.

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