Online and real-time environment monitoring system using ESP8266 and Wireless Sensor Networks

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ABSTRACT

According to the study, the major issue that affects on the field corn productivity in the planting period is found that most of the farmers do not measure the soil quality. In order to get the instant result, it is needed to have an experiment in a laboratory which takes at least 3-4 months to get the results. This is not a good option due to the fact that the soil quality. In the present day, there is an application of smart farm technology in agriculture to reduce that mentioned issue.

This research aims to develop a real-time soil quality measuring and notifying system. This study investigates users' problems and demands, analysis, and design of the model system software that is connected with temperature, humidity, and Potential of Hydrogen ion sensors, and the amount of nutrient in the soil. The measurement results will be transferred to the server and presented through a website in graphs and charts. The system also notifies the farmers through the LINE notification function within an appropriate environment. The developed system is based on a wireless sensor network (WSN), Internet of Things (IoT), and open coded software (FOSS4G), which supports the increasing tools in the future. The result of the system performance is found at a good level. In addition, farmers can also access the model measurement tool at a reasonable price. It can reduce the cost of the model tool and adapt to other kinds of plants

1. INTRODUCTION

Nowadays, Internet of Thing (IoT) has been applied to a lot of stuff all around the world, even to agriculture for the purpose of effective farm management and less human labor. This becomes the title Smart Farm in which employs RFID Sensors technology to connect agricultural tools so that they communicate with the main controller, for example weather station, soil sensor, plant disease sensor, yield monitoring sensor, etc. Those sensors can be set as wireless sensor network and set up in a field in order to collect data of soil humidity, temperature, light intensity, and chemical for the accurate problem solving.

Wireless Sensor Networks are the use of many small sensors to measure interested environment properties and to process the data for new knowledge about surroundings or automatic despondence to environmental surroundings. WSN is the integration between the embedded systems with wireless communication through node sensor in the platform of ad-hoc.

Mobile technology has been rapidly developed because of its benefits in several ways so that it has an important role for more convenient living. Therefore, consumers easily accept mobile technology as a part of daily life. In the present, the ability of smartphones is not only provide

convenience, it also supports farmers to work more effectively by applying mobile technology with agricultural works; for example, agricultural planning system, agricultural farm problem management, and agricultural products follow-up. Geographic information technology is the integration of knowledge with remote sensing (RS), geographic information system (GIS), and global navigation satellite system (GNSS), to apply with other tasks effectively. Geographic information technology is the important for many organizations to develop the country mission including agriculture, traffic and transportation, and natural disasters. The analysis results with information technology can be applied with decision-making planning accurately and fast.

Smart farming is the application of new technology with agricultural tasks to solve problems for farmers. It is in the concept of a modern farm called precision agriculture. The agricultural strategy is eco-friendly in which the farmers can adapt the resources to be mostly in accordance with area conditions, as well as to monitor effectively. This concept can be adapted with plant and animal farms. The smart farm differs from a general farm by its accurate resource usage for the needs of plants and animals. This decreases the resource loss and increases products based on the farmers' needs.

The purposes of this study are to develop the sensor system to verify the real-time soil properties in order to monitor and follow up the growth of corn in which is perhaps effected from the insufficient nutrient absorption, because the soil surface at the planting fields maybe too high or too low temperature and humidity.

2. METHEOLOGY

2.1 To investigate the problems and resolutions

The researcher investigates the problems of soil in the research field of Research Project of Growth and the Status of Nitrogen for applying fertilizers based on the potential of the corn production rate by Unmanned Aerial Vehicle (UAV), Tapho Sub-district, Muang District, Phitsanulok. This is to analyze the way and technical possibilities that solve the problems or demands as mentioned above. Then, the major question of the study is how to notify the farmers about the condition of soil in each spot in the cornfield conveniently and fast; and to identify the concepts and goals of the study framework, as well as necessary software and hardware tools for the model system development.

2.2 Microcontroller

The design of a measurement tool employs microcontroller model Wemos D1, which is an instant board including the connector between the board and other external tools. Even though there is a few connection ports, it can be used to connect with sensors sufficiently which is potential to evaluate data signal received from the sensor and to receive and send information through Esp8266 attached with the microcontroller. The Esp8266 is attached with Wi-Fi module so that is can connect with the network system to transfer information through protocol.

When the controller model Wemos D1 starts the work when the sensor system starts; this means that the system work begins. The sensor operates the serial port of each type of sensors that has been set up. When the sensor is active, it means that the sensor starts to read based on each sensor. The instruction is set that when the sensor reads the information, it will delay for 1 minute and then send to the database. On the other hand, if the sensor does not read the status of the soil, the process will be restarted. As a result, when it manifests that the temperature is higher than 25 degree Celsius, the system will notify through LINE Notify, and transfer the information to the database. This process is the acquisition of the 1-minute delayed information so that it will be transferred to the database.

2.3 The development of hardware system model

The model tool of system hard wear is designed to support the related sensors such as soil temperature measurement, soil humidity, soil's potential of Hydrogen ion (pH) sensor, and the amount of soil nutrients sensors. This depends on the budget of the farmers, for example farmers may needs to measure only the soil temperature so that it reduces the cost, as shown in Figure 1 showing the sensor model settings.

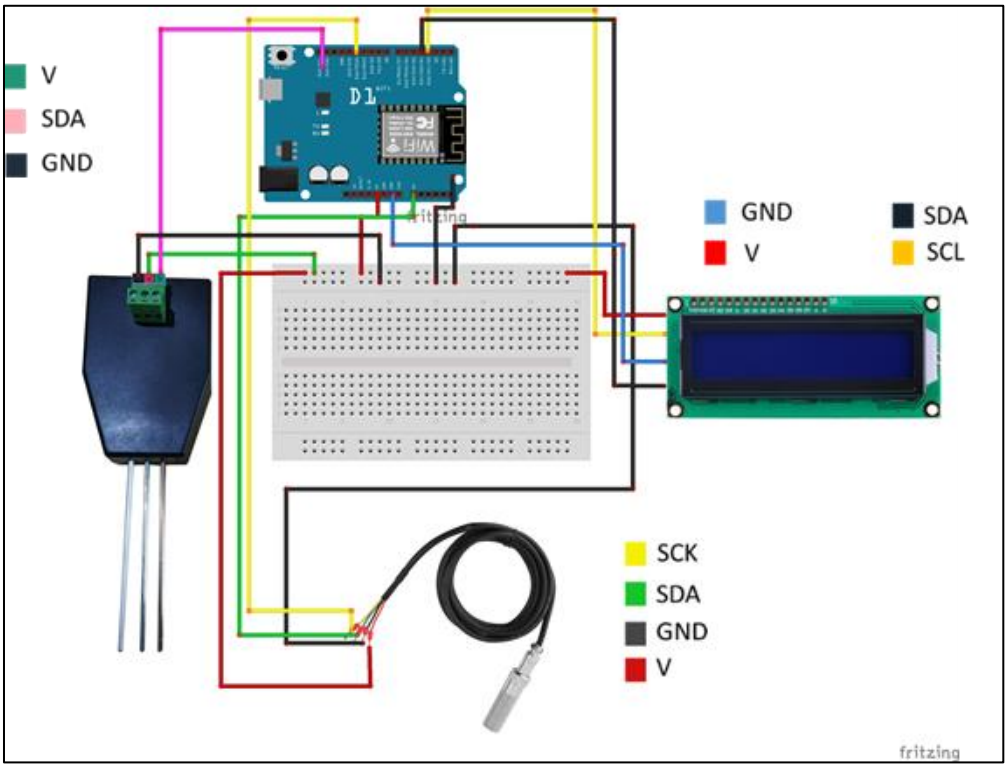

Figure 1 the sensor model

The energy resources used for the model tools can support solar energy. This study employs solar inverters to produce electric energy or solar cells. However, if the farms already have the electric providers, the tool can be applied with the house's electric energy through an electric transformer.

2.4 The development of Web Map Application

This study improves Web Map Application with Windows operation by applying Map Server for Windows (MS4W). MS4W is a free software designed to be applied with Map Server on Windows. In the past, users had to download and set up a lot of software, program by program, which resulted in difficulties. Therefore, there is the application of a software to work with Map Server together so that there will be no more difficulties, because the instant software helps the users work easier to create a web server even though they are not admins.

2.5 Mobile Application Development

The smartphone application with Android operation, version 8.0.0 with 17 level or above of API, has a major role to display and monitor sensor information from the soil measurement tool. Those information include temperature, humidity, potential of Hydrogen ion (pH), and the amount of nutrient, in which are displayed in real time at the location of the tool.

2.6 LINE Notifications

This study set the notification to LINE application directly through Wemos D1 board because the board ship ESP8266 that can transfer information when connected to the internet. The soil temperature is already identified and when the temperature is higher than 25 degree Celsius, it will be notified via LINE application.

3. RESULE

3.1 Results of system experiment

The measurement of the soil sensor consists of temperature, humidity, potential of Hydrogen ion (pH), and the amount of soil nutrient sensors. The data can be continuously transferred. The settings must be deep at least 15 centimeter from the surface, which is the advice from the Agriculture Academician. For this study, the setting location should be around the corn tree but it does not have to be set on all the corn trees, where the sample location can be chosen. However, if it is in need of accuracy, more tools can be set up.

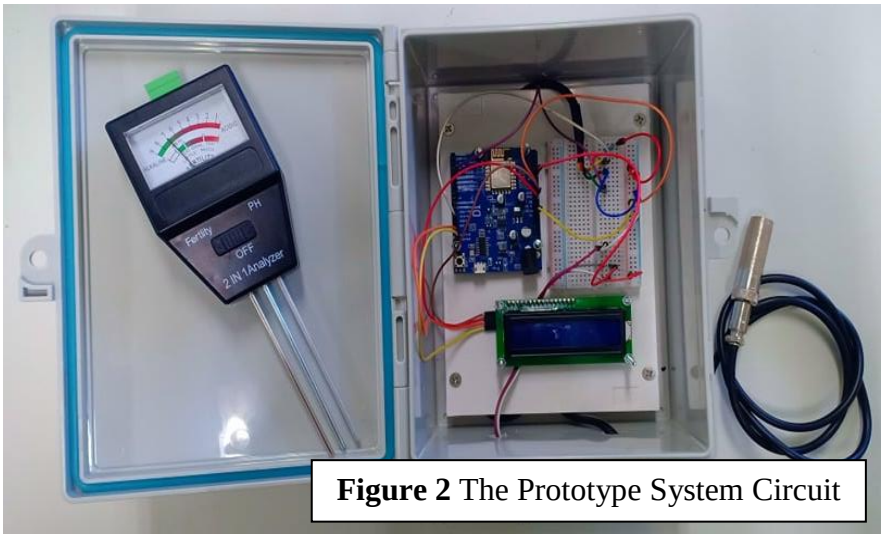

Figure 2 The Prototype System Circuit

3.2 Results of application test

The pattern on Android operation can function with every section, including 1) user identification, 2) overall information from the measurement tool, 3) notification, and 4) graphs.

3.3 Results of Web Map Application test

When the data are tansferred into the system, they are displayed on a parameter for sensor reading and graphs of measurement. The graphs include 2 characteristics, graphs for displaying each value of each sensor, graphs for displaying every sensor, and the 10-minute-back value.

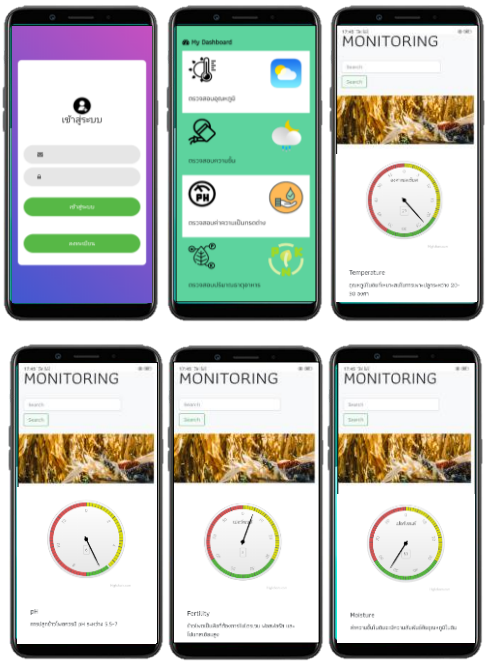

Figure 3 Mobile Application

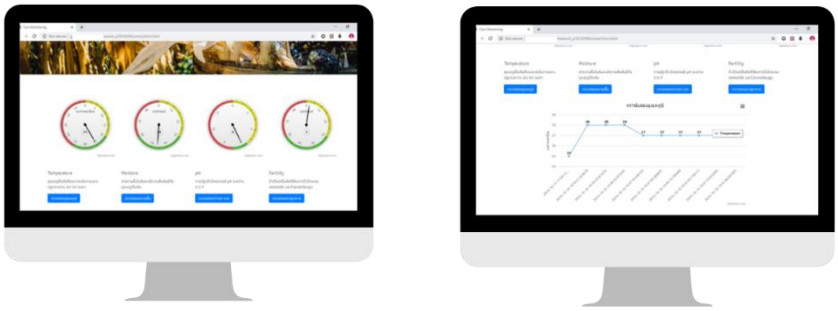

Figure 4 Web Application

3.4 Results of the expanses of the model measurement tools

Because the target of the researcher is a farmer, to apply the tools needs expenses as shown in Table. The basic system and sensor set are not more expensive than 1,600 baht. If the farmers already have their internet network transmitter and energy supplier, the price is acceptable. Moreover, only important sensors can be chosen, such as a temperature sensor, etc.

4.DISCUSSION AND CONCLUSION

From the purpose of the study to develop the real-time soil sensor system for monitoring the growth of corns, which may be affected from inappropriate nutrient, it reveals that the sensor actually works and can be tracked real time via both Web Application and Mobile Application. Furthermore, the system also notifies when the soil properties are not appropriate based on the conditions.

According to the development of soil properties measurement sensor tools, there is the usage of soil employing with Internet of Things to transfer information from the sensor and store as database through phpPgAdmin. Those mentioned development processes of soil properties tracking system are in accordance with the study of Pongpon N., et al (2021), which develops the soil monitoring and notification system in a durian farm and has a field study with minor group of farmers to solve the problems. The study investigates the problems and demands of the users, analyzes and designs the system, develops the model system in both integrated software with system database, and integrated hardware with potential of Hydrogen ion (pH), humidity, and soil and light intensity, as well as the system installation and technology transfer to the target groups. The study reveals that the model system installation that works well. Farmers can adjust the notifications of humidity and potential of Hydrogen ion (pH) as appropriate as the special equation directly through the application. The results of potential evaluation of the system and application users' satisfactions is scored 4.31 out of 5.00, which is ranked as Very Good. Furthermore, the minor group of farmers also access the model measurement tools with an acceptable price. In the future, the costs of the model tool will be reduced and can be integrated with the Smart Farming system with other kinds of plants.

5. REFERENCE

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