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Design and Development of Watering Cassava Crop Systems using Solar Energy by Control through Smartphone for Community in Kampang Phet, Thailand

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Abstract:- In this paper, design and development of the watering cassava crop systems using solar energy by control through smartphone for community in Kampang Phet, Thailand. That was present the structure of the system prototype used Arduino Uno board to control the operation of the system and connect with wireless network via Wi-Fi module. The design and development of the prototype watering cassava crop system with controlled via smartphones and wrote program command code for control systems by using blynk applications. This research studied the experiment of temperature, humidity and soil moisture by control through smartphone. From the measurements results of the watering cassava crop systems by using solar through smartphone were average ambient temperature of 36C°, average ambient humidity of 65% and average soil moisture of 56%, respectively. The watering systems open for cassava plant used average time of 96 hours per session and the system will work to water an average of every 4 days, which can save water for about 3 days. The average satisfaction at 4.56 was the best level from watering systems users. Moreover, the watering cassava plants system can control via smartphones can well. Therefore, the watering system can apply for the community sustainably.

Keywords:- *Arduino UNO; Cassava Crop; Watering Systems, Solar Cell, Blynk Apps.*

I. INTRODUCTION

In Thailand, the planting area of cropping cassava of 6.5 million rai in 2020. Nowadays, technology internet of thing (IoT) is very important technology for help management of thing. The mainly benefits that farmers get from IoT application in agriculture such as, increase in the yielding, benefit is the cost of production, reduces the wastage coming from the production and automates the most of the processes, respectively. The water is a mainly factor to helping in the growth of cassava crop plant. In the summer season, the cassava crop plant need water for help watering of the plant. Since water in Thailand have the water limited. Therefore, if have the watering systems for management of the water. Therefore, several researcher are design and development systems for agriculture plant such as designed a system by using wireless sensor based crop monitoring [1], designed a system by using GSM activated watering system [2], arduino and GSM module [3], wireless agricultural sensor network [4]-[5], and design systems by using a fuzzy logic controller algorithm [6], respectively. Moreover, the researcher developed automatic watering using solar PV tracking to the longa [7], automatic watering system via wireless network based on Arduino Uno R3 microcontroller and Xbee wireless module [8], and using microcontrollers based irrigation systems [9]-[10]. However, all these research design and development the watering systems by using IoT devices help in watering for crop plant. If consider that those of the systems may also improve the growing up of vegetables and provide more agricultural outputs. The watering system should be modifying for increase performance and more control by using smartphone and use solar energy for support systems in the area without electricity. Therefore, it should be improving system for support solar energy watering cassava crop systems with control systems by smartphone.

In this paper, we present a design and development of the watering cassava crop systems using solar energy by control through smartphone for community in Kampang Phet, Thailand. The structure of the system prototype used Arduino Uno board to control the operation of the system and connect with wireless network via Wi-Fi module. The design and development of the prototype watering cassava crop system with controlled via smartphones and write program command code for control systems by using blynk applications. This research study the experiment of temperature, humidity and soil moisture by control through smartphone. Detail the experiment results and discussion show in next section.

II. METHODS

The watering cassava crop systems by using solar through smartphone for community in Kampang Phet, Thailand. This research investigated the use of a soil moisture sensor as a determinant of the time when the plants need water to water them control though smart phone. The diagram of watering cassava crop systems through smartphone as shown in figure 1.

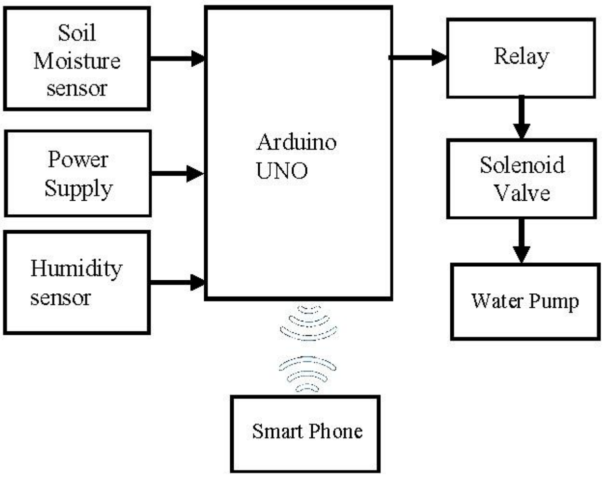

Fig .1. Diagram of watering cassava crop systems through smart phone

From figure 1, show a diagram of watering cassava crop systems through smart phone. This systems design principles and implementation for the community in Kampang Phet, Thailand, as follow:

1. The power supply is composed of a power supply system by connecting the solar panel to the controller charger from the battery to store energy and power the system.
2. Microcontroller compose the arduino Uno, and ESP8266EX as an integrated Wi-Fi module. In this prototype for controls other electronic components such as soil moisture sensor, relay, solenoid valve and water pump. The ESP8266EX as the Wi-Fi module built-in the board, serve to connect the watering device.
3. Soil Moisture sensor is to detect soil moisture or can be used to determine whether moisture in the soil around the sensor. The soil moisture sensor is the sensor used to the soil to detect moisture and send order to relay. Relay is a switch that operates electrically with can be on-off electric current.
4. When there is an electric current flowing through to solenoid valve, water pump is on for watering cassava plants and control by using smart phone.

After the design and development of watering cassava crop systems by using solar through smartphone. We make the prototype and test the watering systems to meet the objective. The system was used to test operate efficiency in Khlong Lan Phatthana Sub-district, Khlong Lan District, Kamphaeng Phet Province. In addition, the satisfaction survey of the cassava farmers group was also conducted. By using descriptive statistics such as mean and standard deviation, the questionnaire's answer score was determined as follows [11]

The highest satisfaction level	5 points.
High satisfaction level	4 points.
Middle satisfaction level	3 points.
Less satisfaction level	2 points.
The least satisfaction level	1 points.

The scores obtained are calculate to find the mean and set the criteria for interpreting the mean as follows:

The average of 4.51-5.00	the satisfaction was the highest
The average of 3.51-4.50	the satisfaction was high
The average of 2.51-3.50	the satisfaction was middle
The average of 1.51-2.50	the satisfaction was less
The average of 1.00-1.50	the satisfaction was least

III. DEDIGN AND IMPLEMENTATION

All this system some hardware components use for sensing the inputs signal and operate accurately to get the exact outputs. Arduino Uno are control the components by programming the software code. This research is Arduino Uno [11]-[12], Soil Moisture Sensor, relay modules ESP8266[13], water power pump, solar panels of DC 12V, 150 W and 330W, Battery 12V DC, 20 Ah, smartphone and Blynk applications[14], respectively. The System workflow of the proposed design as shown in figure 2.

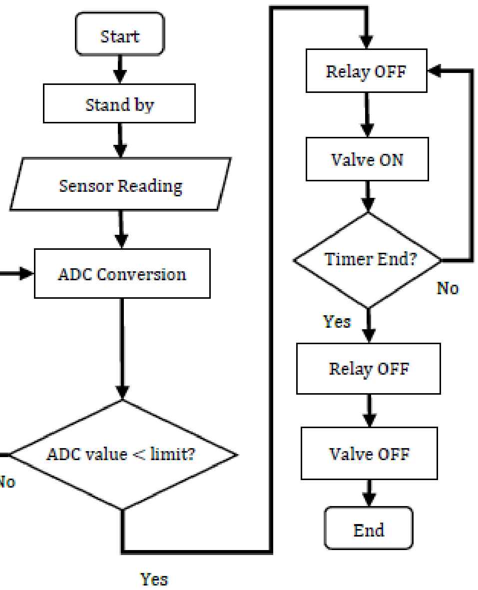

Fig.2. System workflow

Figure 2 shows the working process of watering cassava crop systems by using solar through smartphone in Baan Pangsi, Klong Lan Phatthana Subdistrict, Khlong Lan District, Kamphaeng Phet Province, Thailand. The program commands are written on the blynk applications that installed on the computer and set initial command of percentage moisture. Defined of soil moisture sensor >50%, the systems directs the relay to run, solenoid valve and water power pump to operated watering the cassava crop plant. The soil moisture sensor >80%, the systems order the relay to stop working for watering the cassava crop plant. In addition, the watering systems can control through smartphone.

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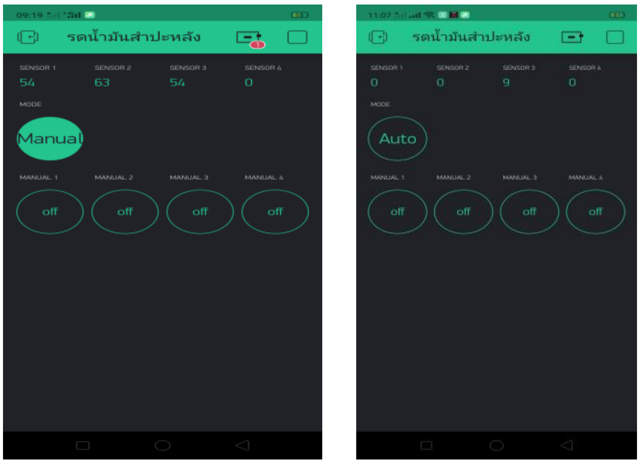

(a) The display watering cassava crop systems by using solar through smartphone

(b) Systems of watering cassava crop by using solar through smartphone.

(c) Solar water pumping system

(d) Watering system for cassava plants

Fig. 3. Prototype of watering cassava crop systems by using solar through smartphone

From figure 3 (a), a display of watering cassava crop by using solar through smartphone programmed in the Blynk applications, displayed on a mobile phone for use ON-OFF systems. The watering system will connect Arduino Uno, Soil moisture sensor, relay modules ESP8266, water power pump, solar panels, control charger and battery respectively and assembled in a box as shown in figure 3 (b). Figure 3(c) shows the water pumping system by using solar three panels (330W) for pump water (1Hp) use to suck water to a central storage tank. The area in Baan Pangsi, Klong Lan Phatthana Subdistrict, Khlong Lan District, Kamphaeng Phet Province, Thailand as shown in figure 3(d), respectively.

IV. EXPERIMENT RESULTS

The experiment results of the solar watering cassava crop systems through smartphone in Baan Pangsi, Klong Lan Phatthana Subdistrict, Khlong Lan District, Kamphaeng Phet Province, Thailand. This section show measured of temperature, humidity and soil moisture, respectively.

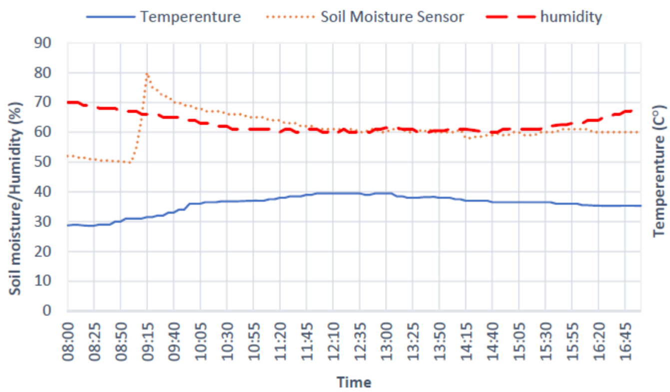

Fig. 4. Measured of temperature, humidity and soil moisture in first day

First, the measurements of soil moisture and weather conditions. By collecting data on March 1, 2020 from 8.00-17.00 hours. The measurement results as shown as in figure 4.

From figure 4 shows the measured results of humidity, temperature and soil moisture in first day. The experiment results of watering cassava crop systems through smartphone. It can be seen that the watering cassava crop systems by control via smartphone, and the watering systems is off when soil moisture >80%. The measurements results are average ambient temperature of 37C°, average ambient humidity of 65% and average soil moisture of 65%, respectively.

Second, the measurements result of soil moisture and weather conditions. By collecting data on March 2, 2020 from 8.00-17.00 hours. The measurement results as shown as in figure 5.

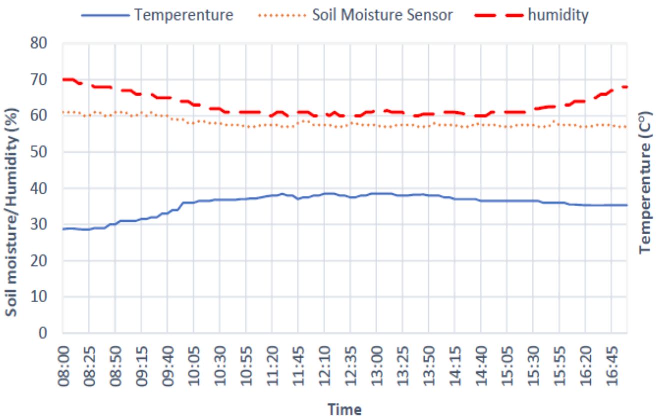

Fig 5. Measured of temperature, humidity and soil moisture in second day

From figure 5 shows the measured results of humidity, temperature and soil moisture in second day.

The measurements results are average ambient temperature of 37C°, average ambient humidity of 62% and average soil moisture of 58%, respectively.

Third, the measurements result of soil moisture and weather conditions. By collecting data on March 3, 2020 from 8.00-17.00 hours. The measurement results as shown as in figure 6.

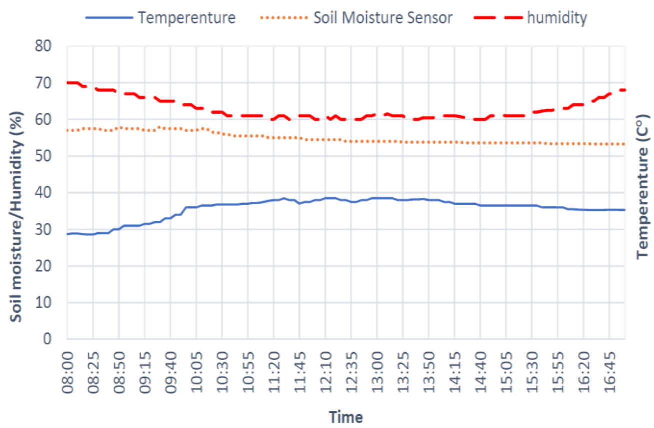

Fig 6. Measured of temperature, humidity and soil moisture in third day

From figure 6 shows the measured results of humidity, temperature and soil moisture in second day.

The measurements results are average ambient temperature of 37C°, average ambient humidity of 61% and average soil moisture of 54%, respectively.

Final, The measurements of soil moisture and weather conditions. By collecting data on March 1, 2020 - March 15, 2020 from 8.00-17.00 hours. The measurement results as shown as in figure 7.

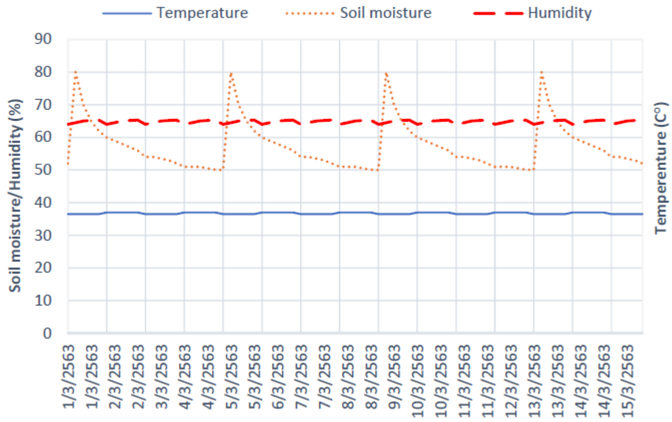

Fig 7. Measured of temperature, humidity and soil moisture in 15 day

From figure 7 shows the measured results of humidity, temperature and soil moisture in 15 days. The measurements results are average ambient temperature of 36.5C°, average ambient humidity of 65% and average soil moisture of 60%, respectively.

Based on the results of adopting watering cassava crop systems by using solar through smartphone for community in smartphone in Baan Pangsi, Klong Lan Phatthana Subdistrict, Khlong Lan District, Kamphaeng Phet Province, Thailand. The measurements results are average ambient temperature of 36C°, average ambient humidity of 65% and average soil moisture of 56%, respectively. The watering systems open for cassava plant used average time of 96 hours per session and the system will work to water an average of every 4 days, which can help save water for about 3 days. Moreover, the watering cassava plants system can control via smartphones can well. After that, the watering cassava crop systems by using solar through smartphone was used for community in Kampang Phet, Thailand and survey on the satisfaction of the use of watering cassava crop systems.

From the survey on the satisfaction of the use of watering cassava crop systems by using solar through smartphone. It was found that the average satisfaction at 4.56 was the best level. Therefore, this system can be effectively applied to the community.

V. CONCLUSIONS

The watering cassava crop systems by using solar through smartphone for community in smartphone in Baan Pangsi, Klong Lan Phatthana Subdistrict, Khlong Lan District, Kamphaeng Phet Province, Thailand. The measurements results are average ambient temperature of 36C°, average ambient humidity of 65% and average soil moisture of 56%, respectively. The watering systems open for cassava plant used average time of 96 hours per session and the system will work to water an average of every 4 days, which can help save water for about 3 days. The average satisfaction at 4.56 was the best level from watering systems users. Moreover, the watering cassava plants system can control via smartphones can well. Therefore, the watering system can apply for the community.

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