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Modeling and Simulink of Smart Agriculture Using IoT Framework

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***Abstract*—The purpose of this research also support involved for three agri-food such as fruit, vegetable, and organic delivery using the internet of things (IoT) framework. In Thailand, the effects of the ecosystem are also a problem such as water, soil, and bad weather conditions. A model tuning scheme is a test and control for smart agriculture using IoT framework. The process can monitor the environment via personal computer (PC) and mobile phone. Once have implemented the Fuzzy Logic Controller (FLC) and resolving the modeling and the Simulink in the system. Overall, the IoT framework developed will monitor to check all conditions and performance results as well as help the framers improved various operations of smart agriculture is discussed.**

Keywords—IoT techniques, smart agriculture, modeling and simulation, fuzzy logic controller

I. INTRODUCTION

The IoT is the current domain and a unique for technology to transform many smart agriculture in the world [2]. Smart agriculture is to provide farmers and to help sustainable agriculture techniques such as spaying, sensing, scaring, keeping, vigilance, weeding, moisture, humidity, bird, animal, etc [3]. They are effects and factors that relate the method of technological and smart agriculture requirements, monitoring environmental from various aspects and controlled by an automatic system. The "Smart" a major of IoT technology has attracted the various of network physical objects and connected to the internet of a global infrastructure of the network at very fast and applications link [9]. The word of "Smart" refers to the environment and communicate controlled such as smart home, smart agriculture, smart energy, smart grid, smart water, smart city, smart industry and so forth [11] includes cloud-based data, sensors, and a variety to identify and approach to support the system. Smart agriculture is the use of IoT technologies to control smart farming as need precision agriculture to ensure exact coverage of a field [8]. The paper aims organized as follows. Section II introduces the research methodology and software development and IoT design are described in Section III. Finally, simulation software and conclusions are presented.

II. METHODOLOGY

A. The smart agriculture

The applications for IoT are all manner of varied. They are used in firebase applications to monitor data via PC and give the order by mobile phone. All most electronics devices were connected to the PC, such as wired sensors and camera. Smart stations were installed indoor and outdoor to monitor and measure temperature, water, humidity, weather, and climate data for smart agriculture. Smart agriculture is shown in Fig. 1.

Fig. 1. Smart Agriculture.

B. Fuzzy Logic Controller

Smart agriculture developed a temperature control system using FLC. The DHT11 and LM35 temperature sensor detect current temperature after that an analog-to-digital is a system that converts analog value to the FLC. The plant is designed between input and output are related, including three triangular membership functions 3*3 fuzzy logic rule matrix. According to the membership function is converted into FLC triangular input and output.

Numbers as shown in Fig. 2-4. and the surface graph format will be shown in Fig. 5, respectively.

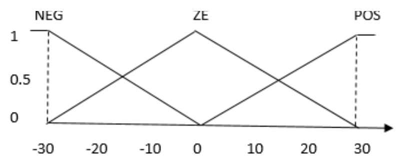

Fig. 2. Membership Function for Input1 (error).

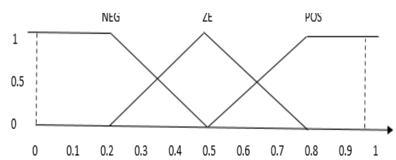

Fig. 3. Membership Function for Input2 (derror).

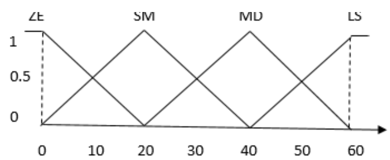

Fig. 4. Membership Function for Output.

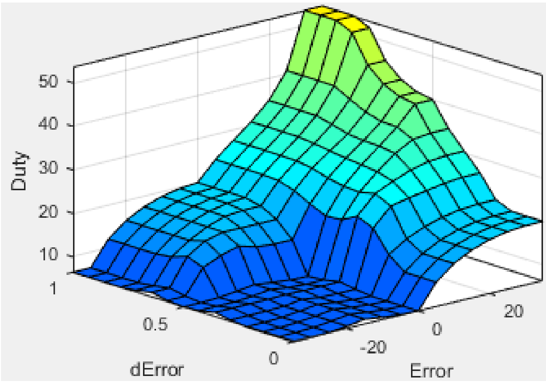

Fig. 5. Control Surface of the Fuzzy Logic Controller.

Rule1: If Δe is NEG and Δde is NEG, the Δo is ZE

$$\left[(\Delta e = NEG, \Delta de = NEG)\, then : \Delta o = ZE \right]$$

Rule2: If Δe is NEG and Δde is ZE, the Δo is ZE

$$\left[(\Delta e = NEG, \Delta de = ZE)\, then : \Delta o = ZE \right]$$

Rule3: If Δe is NEG and Δde is POS, the Δo is ZE

$$\left[(\Delta e = NEG, \Delta de = POS)\, then : \Delta o = ZE \right]$$

The membership function is used in fuzzification and defuzzification by applying the rule of the fuzzy algorithm between the error and derror of inputs and the duty of output, which are given in Table I.

TABLE I. THE RULES MATRIX FOR A FUZZY LOGIC CONTROLLER

e\de	NEG	ZE	POS
NEG	ZE	ZE	ZE
ZE	ZE	ZE	SM
POS	SM	MD	LS

The aims of Modeling and Simulink was as smart agriculture, which was a representative of the water, soil humidity, and weather control. A simulation of the Matlab and Simulink are studied to evaluate the performances of the plant model. The Matlab/Simulink as shown in Fig. 6.

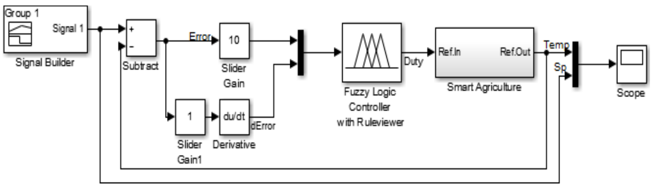

Fig. 6. Matlab Simulink Model.

III. IoT TECHNOLOGY AND SMART AGRICULTURE

A. *IoT Technology and Software Development*

As smart agriculture-based research and development in the IoT and cloud-based. The IoT based device consists of various enabling technologies such as the internet and search engines, cloud-based, big data, wireless sensors etc. The evolution of smart agriculture IoT based devices is assisting farmers for systematic environment monitoring and real-time information and includes to inspect the product for quality issues.

In IoT, the devices of networking and communication technology are able to connect with the firebase client. The firebase client aims automatically and created database URL in real-time. Various strategies used for firebase client and also firebase client library allows to build for any language such as HTML, CSS, and JavaScript for implementation.

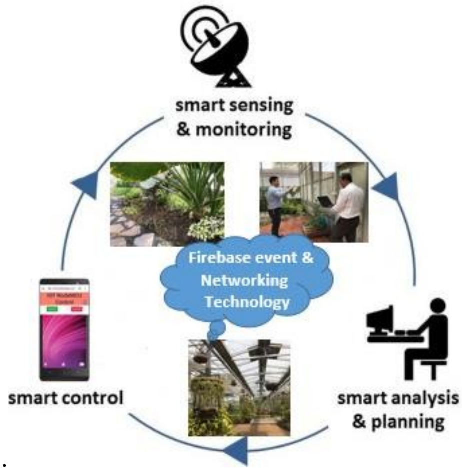

Fig. 7. Smart Agriculture Enhanced by Cloud-Based and Networking Technology.

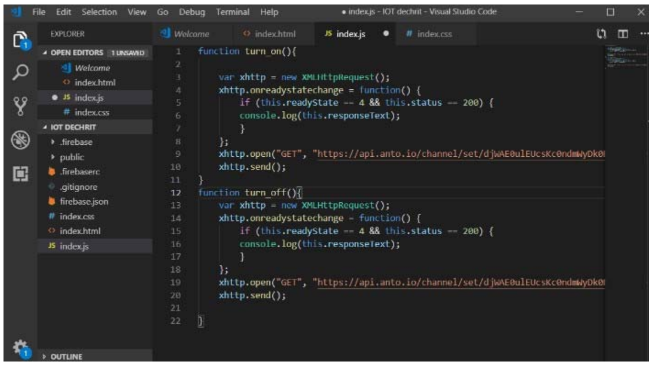

Fig. 8. HTML, CSS and JavaScript Software.

B. *IoT Technology and Hardware Design*

In this section, Smart agriculture IoT based developed for help framers monitoring of water, soil, and weather conditions by using Arduino Microcontroller, firebase client, and cloud computing technology.

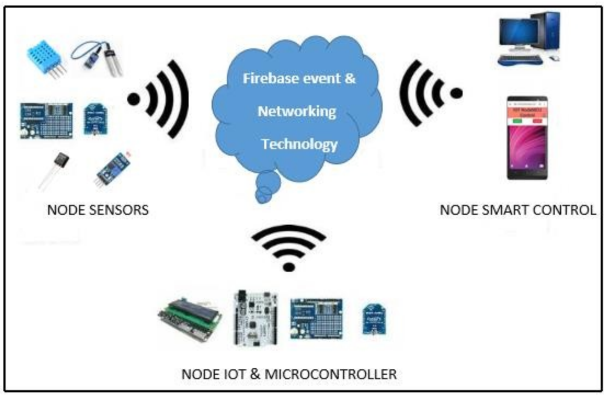

Fig. 9. IoT Technology and Hardware Design.

IoT interface with sensors based device consists of components as follows:

- Arduino Mega 2560
- Node MCU8266
- Temperature Sensor

- Soil Moisture Sensor
- Light Sensor
- Liquid Crystal Display
- Pushbutton and Switch
- Inverter and Driver
- Camera, interface for Audio and Video

IV. Experimental And Validation

The following diagram shows the experimental and the validation details, as shown in Fig. 10-15. In addition, this monitoring interfaces the validation of the different values in real-time between the parameters of the soil moisture, the temperature, the humidity, and the light or illumination as discussed.

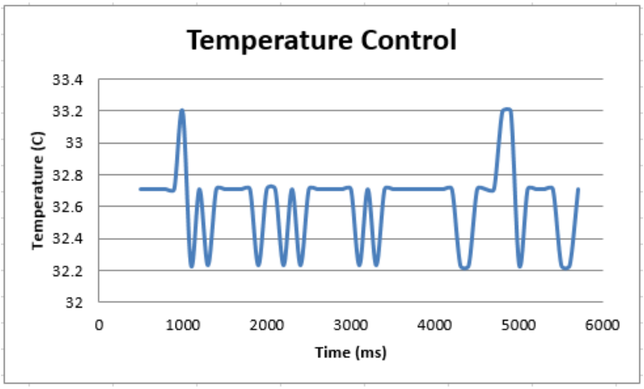

Fig. 10. Illustration of indoor temperature control for smart agriculture.

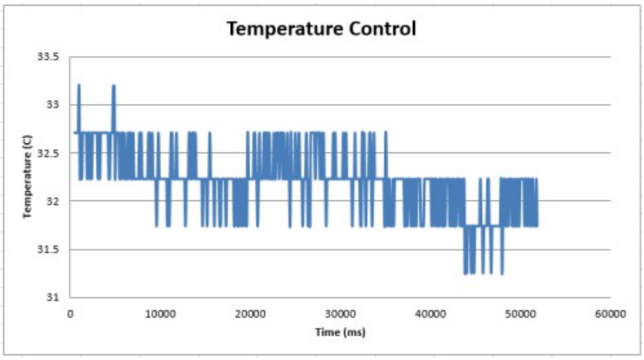

Fig. 11. Illustration of outdoor temperature control for smart agriculture.

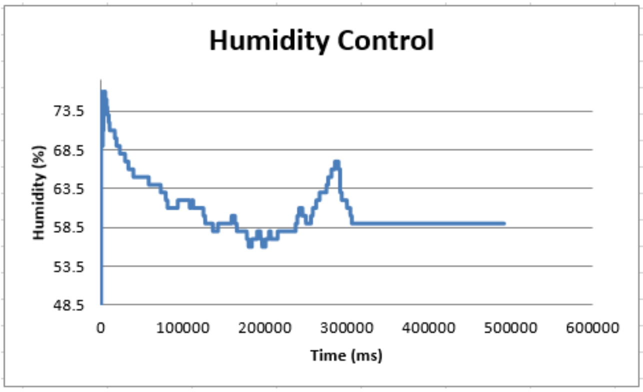

Fig. 12. Illustration of indoor humidity control for smart agriculture.

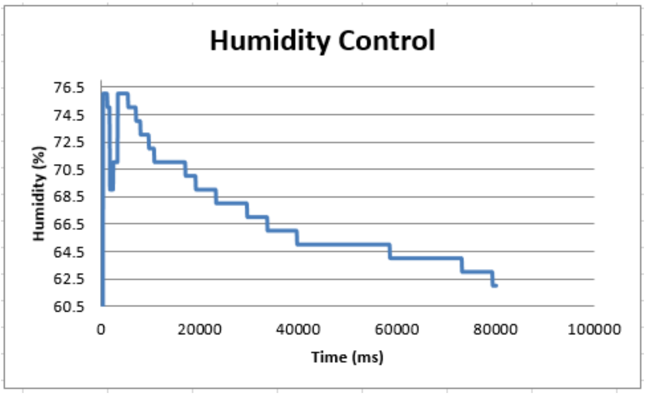

Fig. 13. Illustration of outdoor humidity control for smart agriculture.

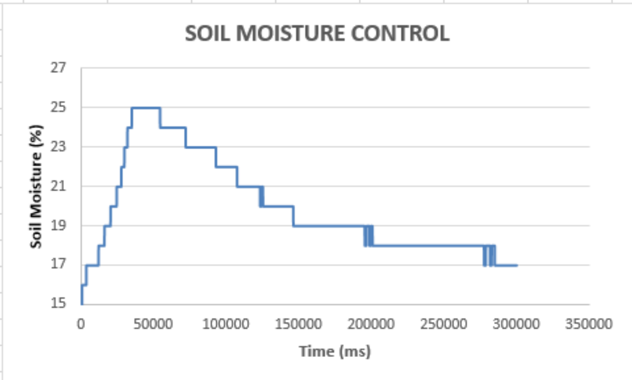

Fig. 14. Illustration of indoor soil moisture control for smart agriculture.

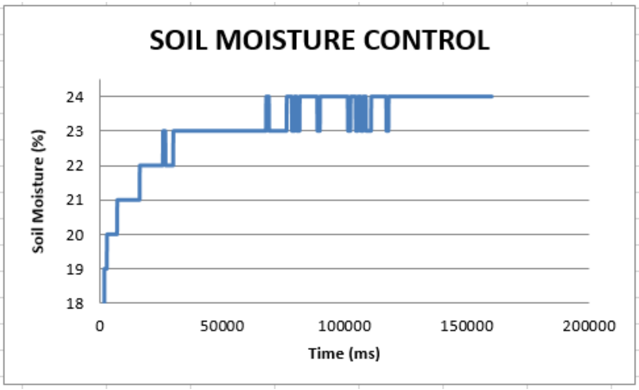

Fig. 15. Illustration of outdoor soil moisture control for smart agriculture.

V. Conclusion And Future Work

IoT to better support the smart agriculture and sustainable agriculture development. One the other hand, IoT and networking communication applications to achieve the different nodes in intelligent and automatic control. An FLC and MATLAB SIMULINK technique are provided to set the temperature of smart agriculture and humidity related around 32.5 C^0 and 58.5 % and soil moisture by comparing with indoor and outdoor that indoor soil moisture is to fix atmospheric moisture lower than outdoor soil moisture at 17% and 24%, respectively.

Farther research work plans include the cooling system control and to adjust the environmental higher conditions such as the speed of the fan motor, the air volume, the flow rate, the vibration and various energy of smart agriculture.

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