Vol.12, No.3, Jul.-Sept. 2018

ECTI *e*-magazine

In this Issue...

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Message from Editor

Dear authors, reviewers and readers of ECTI E-Magazine,

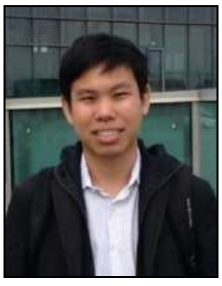
In the third quarter of this year, ECTI association lost one of its greatest former presidents, Dr.Somsak Choomchuay, on 27th August, 2018. The King Mongkut's Institute of Technology Ladkrabang professor made an incredible contribution to modern day telecommunication and electronics for Thailand and the Lao People's Democratic Republic, through his advanced research, book writing and inspirational teaching. His contribution to ECTI association is phenomenal, revolutionizing our activities towards international collaboration, especially in ASEAN communities. With his generous mind and good sense of humour, the legacy of Dr.Somsak Choomchuay will live on to inspire new generations for many years to come.

We are pleased to introduce an article entitled "A Fuzzy Logic-based Control in Wireless Sensor Network for Cultivation" written by Dr. Vitawat Sittakul and his team at King Mongkut's University of Technology North Bangkok. This article describes a prototype of wireless sensor networks with fuzzy logic control for cultivation. We highly recommend this article for readers who intend to learn how fuzzy logic can be efficiently applied to control sprinklers, lamps and fans to ensure suitable temperature, light and moisture for growing crops.

Three major conferences of ECTI was successfully complete, namely ITC-CSCC 2018 (Bangkok) in July 4-7, 2018, the ECTI-CON 2018 (Chiangrai) in July 18-21, 2018, ISCIT 2018 (Bangkok) in September 26-29, 2018. Many leading researchers, students and participants from different countries joined in these conferences. Accepted papers in conferences with exceptionally high quality have been extended for publication in two prestigious journals of ECTI, namely the ECTI Transactions on Computer and Information Technology (ECTI-CIT) and the ECTI Transactions on Electrical Engineering, Electronics, and Communications (EEC).

Finally, we wish to invite students, researchers and engineers to write one-page articles on interesting technology or findings in their own languages together with the corresponding English translation. The objective is to encourage international experts to express their interesting work for their own countries as well as to international community. This new section is referred to as "Unravelling Technologies in the Digital World". The article for this edition is to briefly unravel new technology in channel codes of 5G wireless communication.

Lunchakorn Wuttisittikulkij
ECTI E-Magazine Editor



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A FUZZY LOGIC-BASED CONTROL IN WIRELESS SENSOR NETWORK FOR CULTIVATION

V. Sittakul, S.Chunwiphat, P.Tiawongsombat

ABSTRACT

This paper presents a cultivation control system on wireless sensor network using fuzzy logic approach. The system controls sprinklers for moisture, lamps for sunlight and fans for temperature. The wireless sensor network consists of temperature sensor, sunlight sensor and moisture sensor, and they are directly connected to a microcontroller (Arduino). The signals obtained from these sensors are converted into the digital data by the microcontroller before transmitted on air via both X-bee radio modules (Compatible with ZigBee and IEEE 802.15.4) to a tiny computer (Raspberry Pi2) as a controller. Finally, the digital data is analyzed based on Fuzzy logic on the Linux Operation System (OS) of the Raspberry Pi2 and then the generated output signals are used to control the fan, sprinkler and lamp to decrease or increase the levels of temperature, moisture and sunlight respectively.

Keywords: Wireless sensor network, Fuzzy logic, IEEE 802.15.4, ZigBee

I.INTRODUCTION

Wireless Sensor Network (WSN) plays an important role in recent years for monitoring and tracking data. Most of wireless sensors are small, inexpensive and low power consumption, trading off with the limited processing and computer resources. Also, each sensor node has ability to detect, monitor and gather data from the environment and transmit them back to the user [1-3]. Most of mechanical, thermal, chemical, optical and magnetic sensors may be attached to a wireless sensor node to send the monitored data among the sensor node and finally to the base station such as a computer or server to store the data as a log file due to the limited memory of the sensor node [4]. Furthermore, each sensor node consumes very low energy, and this enables the portable battery to be used as the main power supply. This allows each sensor node to be independently placed close to the monitored point. As for agriculture countries, farmers are very concerned about the cultivation and farming, and consequently many wireless sensor network researches on agriculture technologies have been carried out. For example, in Egypt, the wireless sensor network has been used to save the resources for cultivation such as fertilizer and irrigation water [5]. In Ethiopia, it was used to monitor and control the farms via mobile phones [4]. In India, it was used to control the soil moisture via sprinkles [6]. However, all previous researches have to be manually accomplished and their systems cannot be self-controlled. Therefore, in this paper, the concept of Artificial Intelligence (AI) based on fuzzy logic is applied to the wireless sensor network. The system controls the use of sprinklers for moisture and lamps for sunlight and fans for temperature. The wireless sensor network consists of temperature, sunlight and moisture sensors directly connected to a microcontroller (Arduino). The signals obtained from these sensors are converted as the digital data by the microcontroller before transmitted on air via both X-bee radio modules (Compatible with ZigBee and IEEE 802.15.4) to a tiny computer (Raspberry Pi2). Finally, the digital data is analyzed based on Fuzzy logic on the Linux Operation System (OS) of the Raspberry Pi2 and the generated output signals are used to control the fan, sprinkler and lamp to decrease or increase the levels of temperature, moisture and sunlight respectively. Here the fuzzy logic-based algorithm can be varied by changing the fuzzy rules regarding the types of crops. The fuzzy logic parameters are collected from the experience in farming and cultivation.

The paper can be organized as follows. Section II shows the device characterization and section III shows the fuzzy logic theory. Section IV demonstrates the experimental setup and section V shows the experimental results. Finally, section VI summarizes all results.

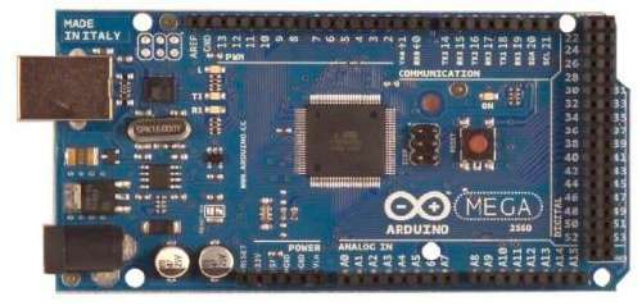

Figure 1: Microcontroller (Arduino Mega 2560).

II DEVICE CHARACTERIZATION

A. Microcontroller

The microcontroller (Arduino Mega 2560) as shown in Figure 1, functions as a receiver to receive the data from the sensors and a converter to convert the digital data before transmitting them to a computer or server.

B. Moisture sensor

The moisture sensor with model No. sku: SEN92355P manufactured from Seeed Studio Company is used to measure the soil moisture through its conductance. The moisture sensor transmits the measured data as 10-bit output to the pin#10 of microcontroller as shown in Figure 2.

C. Temperature sensor

The temperature sensor with model No. DHT11 manufactured from D-Robotics UK Company is used to measure the temperature by means of thermister principle as shown in Figure 3. Its accuracy is +/- 2ºC with measured data of 8-bit output.

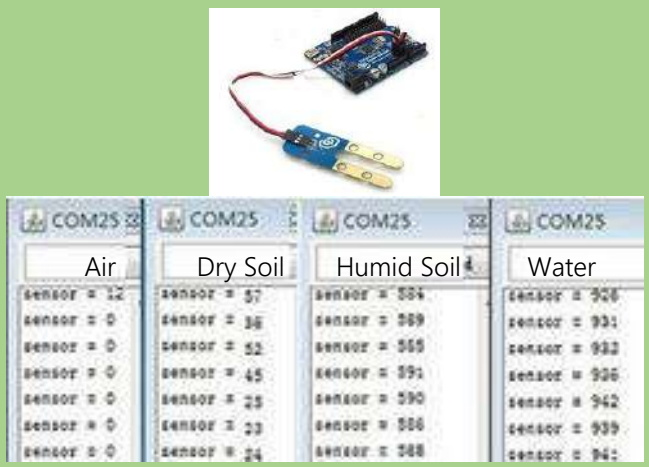

Figure 2: Moisture sensor module and display of the measured data.

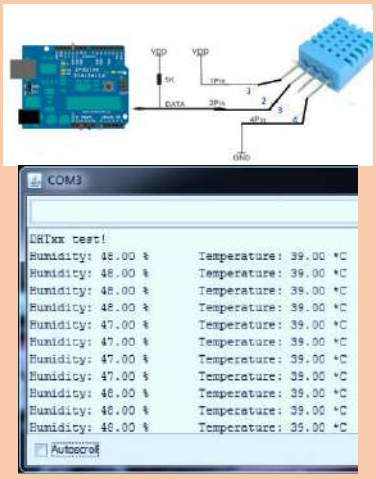

Figure 3: Temperature sensor module and display of the measured data.

D. Light sensor

The light sensor manufactured from Szhaiwang Company is used to measure the sunlight by means of light independent resistor as shown in Figure 4. The light independent resistor is made by CdS placed on the ceramic base.

III FUZZY LOGIC THEORY

Fuzzy logic theory was proposed by [7-8] based on the fuzzy probability. The membership of an element is not only strictly false or true {1,0}as same as Boolean logic, but rather gradual as shown in Figure 5.

The degree of its membership in fuzzy logic can be any real number in the interval [*0,1*] whereas those in Boolean logic can be only *0* or *1*. This is to deal with the vagueness and imprecision of many reality and it can be used to simulate the human ability of making decision based on not so precise information. A formal definition of fuzzy sets (A) in universe (U) can be written as:

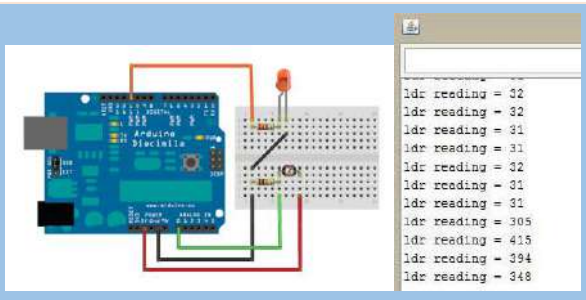

Figure 4: Light sensor module and display of the measured data.

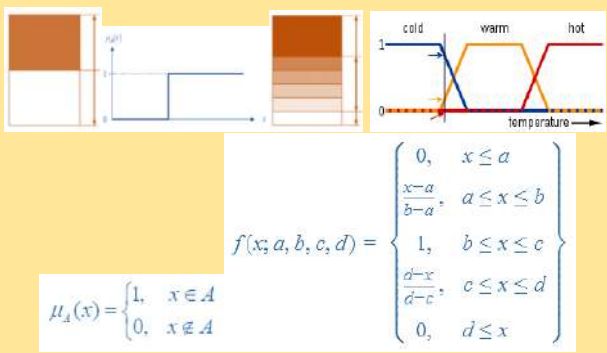

Figure 5: Boolean (left) and Fuzzy logic (Right)

$$A \equiv \{< x, \mu_A(x) > | x \in U\} \qquad (1)$$

Where $\mu_A(x)$ is called the membership function for the set of all objects x in U. There are four common member functions as shown in Figure 6.

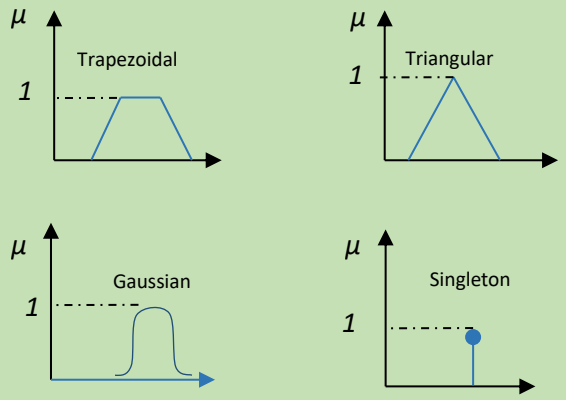

Figure 6: Four common membership functions

The fuzzy set operations of the union, intersection and complement can be expressed in terms of logical operations; disjunction, conjunction and complement as follows [9]:

Disjunction (OR): $\mu_A(x) \vee \mu_B(x) = max\{\mu_A(x), \mu_B(x)\}$

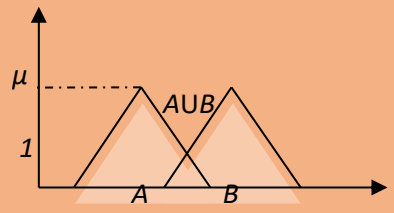

Figure 7: Disjunction (OR) property of $\mu_A(x)$ and $\mu_B(x)$.

Conjunction (AND): $\mu_A(x) \wedge \mu_B(x) = min\{\mu_A(x), \mu_B(x)\}$

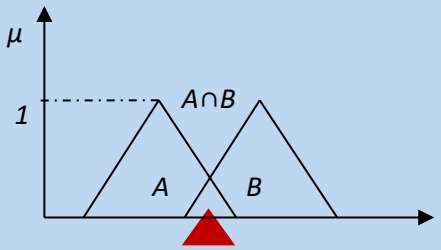

Figure 8: Conjunction (AND) property of $\mu_A(x)$ and $\mu_B(x)$.

Complement (NOT): $\mu \neg_A(x) = 1-\mu_A(x)$

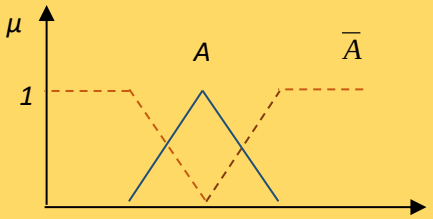

Figure 9: Complement (NOT) property of $\mu_A(x)$.

IV. EXPERIMENTAL SETUP

In this section, all components from Section II are now combined as a system as can be seen in Figure 10. All sensors (Temperature, Light and Moisture) are connected to the input ports of Arduino. Arduino now converts a parallel-data inputs into a serial-data output and it is then transmitted to a tiny computer (Raspberry Pi2) via X-bee radio modules on air.

It can be noted that Raspberry Pi2 has been used to reduce the size and the cost of the remote unit. In reality, this unit has to be placed close to the

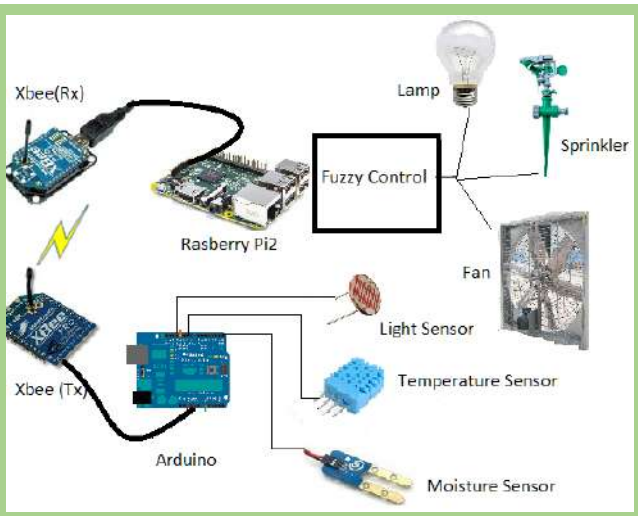

Figure 10: Experimental Setup.

controlled devices (Lamp, Sprinkler and Fan) where the size and cost are very critical. The received data from the X-bee (Rx) is now computed by a Java program (based on fuzzy logic) to generate control output signals. Finally, the control signals are used to control the lamp, sprinkler and fan to adjust the light intensity, moisture and temperature for cultivation.

A. Design of Fuzzy control

In order to achieve the fuzzy control, it is important that the inputs and outputs of the system have to be assigned. The inputs of the system are temperature, moisture and light intensity obtained from the sensors. The level of temperature, moisture and light intensity in this work are divided into three triangular memberships as shown in Figure 11, which are Negative (*N)* from -50% to 50%, No Change (*NC)* from 0% to 100% and Positive (*P)* from 50% to 150% respectively. The triangular memberships are chosen here to reduce the complexity of the calculation. Since the level of the parameters is defined within the range of 0-100%, the maximum and minimum values of the measured data have to be normalized [9].

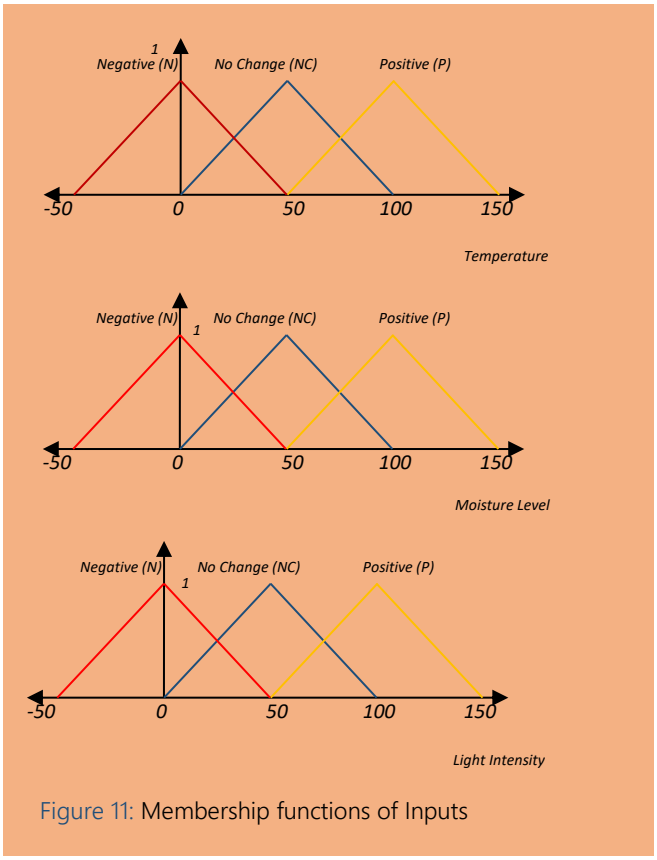

Figure 11: Membership functions of Inputs

The outputs of the system are used to control the fan, the pump of sprinkler and the lamp respectively. The output levels of fan, pump of sprinkler and the brightness of lamp are divided into five triangular memberships as shown in Figure 11 which are *B2* (0% to 39%), *B1* (30% to 49%), *CE* (41% to 60%), *S1* (50% to 69%), *S2* (61% to 100%) respectively as shown in Figure 12.

To allow the system making a decision correctly, the fuzzy rules have to be created as shown on Tables 1, 2 and 3, based on computer programming like if-then statements [9, 10]. The rules as in this work have been generated from the survey of farming of lettuces in the central region of Thailand and from the experts and they may be varied depending on the types of crops, regions and countries. However, these rules can be easily changed inside the rule tables on the software and this allows the possibility to change the types of crops regarding the seasons.

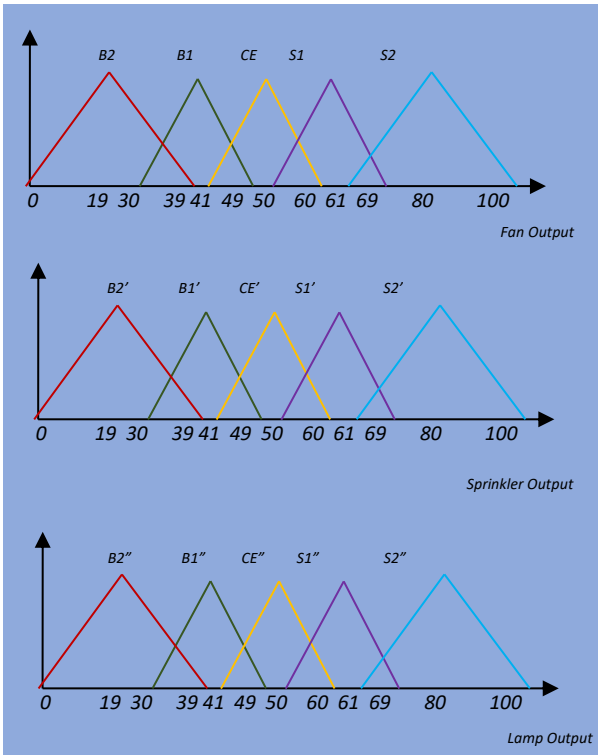

Figure 12: Membership functions of outputs.

Table 1 displays the rules of fuzzy logic for fan control. There are 27 rules being used here to create the fan control output (Output1). For instance, if the inputs from temperature sensor (Temp), moisture sensor (Moisture) and light sensor (Light) are positive

Table 1: Rules of the fuzzy logic for Fan control

Rule #	IF	Temp	Operator	Moisture	Operator	Light	Operator	Output1
1	IF	*P*	AND	*P*	AND	*P*	THEN	*S2*
2	IF	*P*	AND	*P*	AND	*NC*	THEN	*S2*
3	IF	*P*	AND	*P*	AND	*N*	THEN	*S1*
4	IF	*P*	AND	*NC*	AND	*P*	THEN	*S2*
5	IF	*P*	AND	*NC*	AND	*NC*	THEN	*S1*
6	IF	*P*	AND	*NC*	AND	*N*	THEN	*S1*
7	IF	*P*	AND	*N*	AND	*P*	THEN	*S1*
8	IF	*P*	AND	*N*	AND	*NC*	THEN	*S1*
9	IF	*P*	AND	*N*	AND	*N*	THEN	*CE*
10	IF	*NC*	AND	*P*	AND	*P*	THEN	*S1*
11	IF	*NC*	AND	*P*	AND	*NC*	THEN	*CE*
12	IF	*NC*	AND	*P*	AND	*N*	THEN	*CE*
13	IF	*NC*	AND	*NC*	AND	*P*	THEN	*CE*
14	IF	*NC*	AND	*NC*	AND	*NC*	THEN	*CE*
15	IF	*NC*	AND	*NC*	AND	*N*	THEN	*B1*
16	IF	*NC*	AND	*N*	AND	*P*	THEN	*CE*
17	IF	*NC*	AND	*N*	AND	*NC*	THEN	*B1*
18	IF	*NC*	AND	*N*	AND	*N*	THEN	*B1*
19	IF	*N*	AND	*P*	AND	*P*	THEN	*B1*
20	IF	*N*	AND	*P*	AND	*NC*	THEN	*B1*
21	IF	*N*	AND	*P*	AND	*N*	THEN	*B2*
22	IF	*N*	AND	*NC*	AND	*P*	THEN	*B1*
23	IF	*N*	AND	*NC*	AND	*NC*	THEN	*B2*
24	IF	*N*	AND	*NC*	AND	*N*	THEN	*B2*
25	IF	*N*	AND	*N*	AND	*P*	THEN	*B1*
26	IF	*N*	AND	*N*	AND	*NC*	THEN	*B2*
27	IF	*N*	AND	*N*	AND	*N*	THEN	*B2*
Fan scale						Fan Control Signal		
S2 = 61 – 100 %						7.32 V – 12.00 V		
S1 = 50 - 69 %						6.00 V - 8.28 V		
NC = 40 - 60 %						4.80 V - 7.20V		
B1 = 30 - 49%						3.60 V - 5.88 V		
B2 = 0 - 39 %						0 V - 4.68 V		

Table 2: Rules of the fuzzy logic for pump control (Sprinkler)

Rule #	IF	Temp	Operator	Moisture	Operator	Light	Operator	Output2
1	IF	*P*	AND	*P*	AND	*P*	THEN	*CE'*
2	IF	*P*	AND	*P*	AND	*NC*	THEN	*CE'*
3	IF	*P*	AND	*P*	AND	*N*	THEN	*B2'*
4	IF	*P*	AND	*NC*	AND	*P*	THEN	*B1'*
5	IF	*P*	AND	*NC*	AND	*NC*	THEN	*B2'*
6	IF	*P*	AND	*NC*	AND	*N*	THEN	*CE'*
7	IF	*P*	AND	*N*	AND	*P*	THEN	*S2'*
8	IF	*P*	AND	*N*	AND	*NC*	THEN	*S2'*
9	IF	*P*	AND	*N*	AND	*N*	THEN	*S1'*
10	IF	*NC*	AND	*P*	AND	*P*	THEN	*CE'*
11	IF	*NC*	AND	*P*	AND	*NC*	THEN	*CE'*
12	IF	*NC*	AND	*P*	AND	*N*	THEN	*CE'*
13	IF	*NC*	AND	*NC*	AND	*P*	THEN	*B2'*
14	IF	*NC*	AND	*NC*	AND	*NC*	THEN	*CE'*
15	IF	*NC*	AND	*NC*	AND	*N*	THEN	*CE'*
16	IF	*NC*	AND	*N*	AND	*P*	THEN	*S1'*
17	IF	*NC*	AND	*N*	AND	*NC*	THEN	*S1'*
18	IF	*NC*	AND	*N*	AND	*N*	THEN	*S1'*
19	IF	*N*	AND	*P*	AND	*P*	THEN	*CE'*
20	IF	*N*	AND	*P*	AND	*NC*	THEN	*CE'*
21	IF	*N*	AND	*P*	AND	*N*	THEN	*CE'*
22	IF	*N*	AND	*NC*	AND	*P*	THEN	*CE'*
23	IF	*N*	AND	*NC*	AND	*NC*	THEN	*CE'*
24	IF	*N*	AND	*NC*	AND	*N*	THEN	*CE'*
25	IF	*N*	AND	*N*	AND	*P*	THEN	*CE'*
26	IF	*N*	AND	*N*	AND	*NC*	THEN	*CE'*
27	IF	*N*	AND	*N*	AND	*N*	THEN	*S1'*
Sprinkler scale %						Sprinkler Control Signal		
S2' = 61 – 100 %						0 V		
S1' = 50 - 69 %						0 V		
NC' = 40 - 60 %						0 V		
B2' = 30 - 49 %						1 V – 9.5 V		
B1' = 0 - 39 %						7.3 V – 12 V		

(50%-150%), the output1 is set to *S2*. The *S2* now is referred to the output power of fan 61-100%.

Table 2 displays the rules of fuzzy logic for pump control (sprinkler). Similarly, it can be seen that there are 27 rules being used to create the pump control output (Output2). For instance, if the inputs from temperature sensor (Temp), moisture sensor (Moisture) and light sensor (Light) are positive (50%-150%), the output2 is set to *N/C*'. The *N/C*' is referred to the output power of the pump to sprinkler 40-60%.

Table 3 displays the rules of fuzzy logic for lamp control. It can be seen that there are 27 rules being used here to create the lamp control output (Output3). For instance, if the inputs from temperature sensor (Temp), moisture sensor (Moisture) and light sensor (Light) are positive (50%-150%), the output3 is set to *B2*". The *B2*" is referred to the output power of lamp 0-39%.

V. EXPERIMENTAL RESULTS

To configure the parameters of the fuzzy logic on Raspberry pi2, java software is written and run on the Linux OS as shown in Figure 13. It is necessary here to validate if the software can function correctly. Therefore, the simple test inputs can be used here to check the results.

Figure 13: User Interface of Java software on Raspberry Pi2.

Table 3: Rules of the fuzzy logic for Lamp control

Rule #	IF	Temp	Operator	Moisture	Operator	Light	Operator	Output3
1	IF	*P*	AND	*P*	AND	*P*	THEN	*B2"*
2	IF	*P*	AND	*P*	AND	*NC*	THEN	*B1"*
3	IF	*P*	AND	*P*	AND	*N*	THEN	*NC"*
4	IF	*P*	AND	*NC*	AND	*P*	THEN	*B1"*
5	IF	*P*	AND	*NC*	AND	*NC*	THEN	*CE"*
6	IF	*P*	AND	*NC*	AND	*N*	THEN	*CE"*
7	IF	*P*	AND	*N*	AND	*P*	THEN	*B2"*
8	IF	*P*	AND	*N*	AND	*NC*	THEN	*B1"*
9	IF	*P*	AND	*N*	AND	*N*	THEN	*B1"*
10	IF	*NC*	AND	*P*	AND	*P*	THEN	*B1"*
11	IF	*NC*	AND	*P*	AND	*NC*	THEN	*CE"*
12	IF	*NC*	AND	*P*	AND	*N*	THEN	*CE"*
13	IF	*NC*	AND	*NC*	AND	*P*	THEN	*B1"*
14	IF	*NC*	AND	*NC*	AND	*NC*	THEN	*CE"*
15	IF	*NC*	AND	*NC*	AND	*N*	THEN	*CE"*
16	IF	*NC*	AND	*N*	AND	*P*	THEN	*CE"*
17	IF	*NC*	AND	*N*	AND	*NC*	THEN	*CE"*
18	IF	*NC*	AND	*N*	AND	*N*	THEN	*CE"*
19	IF	*N*	AND	*P*	AND	*P*	THEN	*B1"*
20	IF	*N*	AND	*P*	AND	*NC*	THEN	*NC"*
21	IF	*N*	AND	*P*	AND	*N*	THEN	*S1"*
22	IF	*N*	AND	*NC*	AND	*P*	THEN	*B1"*
23	IF	*N*	AND	*NC*	AND	*NC*	THEN	*NC"*
24	IF	*N*	AND	*NC*	AND	*N*	THEN	*B1"*
25	IF	*N*	AND	*N*	AND	*P*	THEN	*B1"*
26	IF	*N*	AND	*N*	AND	*NC*	THEN	*S1"*
27	IF	*N*	AND	*N*	AND	*N*	THEN	*S2"*

Lamp scale	Lamp Control Signal
S2" = 61 – 100 %	0 V – 4.68 V
S1" = 50 - 69 %	3.6 V – 5.88 V
NC" = 40 - 60 %	4.8 V - 7.2V
B1" = 30 – 49 %	6 V - 8.28 V
B2" = 0 - 39 %	7.32 V - 12 V

As shown in Figure 13, the received data of temperature, moisture and light are set to 25ºC (25%), 0 RH (0%) and 0 Lux (0%) respectively. This can be graphically explained by Figure 14. At the temperature of 25%, the levels of membership function can be divided into 0.5 of triangular memberships *N* and *NC* respectively. Since the moisture and light has been set to 0%, their memberships are 1.0 of triangular membership *NC*. To calculate the fan output (output1), the rules #14 and 23 in Table I are applied.

This results in the memships output *B1* and *B2*. To calculate the fan output level, the areas of *B1* and *B2* are now averaged and the average point of fan output of 25.5% has successfully been found.

Finally, the test inputs are now replaced by the real sensors inputs from the system in Figure10. Here, the temperature of 24ºC (24%) , moisture of 46RH (46%) and light of 600 Lux (13.3%) are measured as shown in Figure 15. By using the fuzzy logic control theory, the outputs of fan, pump of sprinkler and lamp of 34.6%, 36.8% and 50.6% can be calculated (Figure 16). The output signal in Figure 15 can now be converted to the controlled signals in voltage. Compared with the data in Tables 1, 2 and 3, the output signals in voltage are in the range of (3.6-5.88V) for fan output, (1-9.5V) for pump output and (4.8-7.2V) for lamp output respectively.

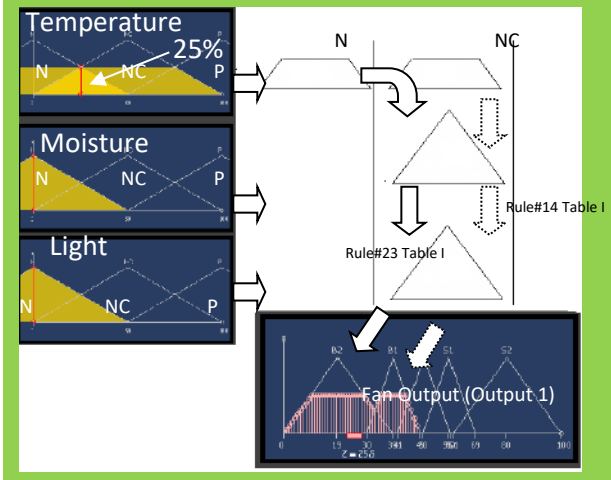

Figure 14: Conceptof fuzzy logic control

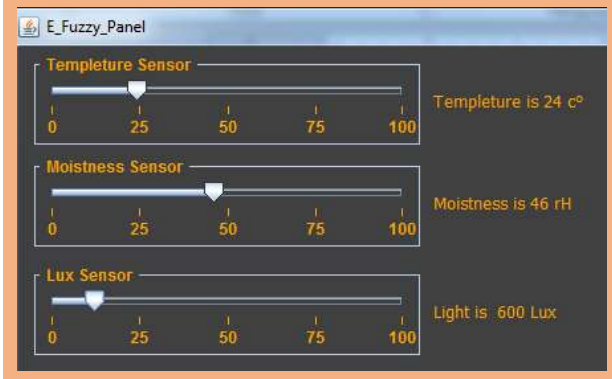

Figure 15: Measured sensor data of the Java software on Raspberry Pi2.

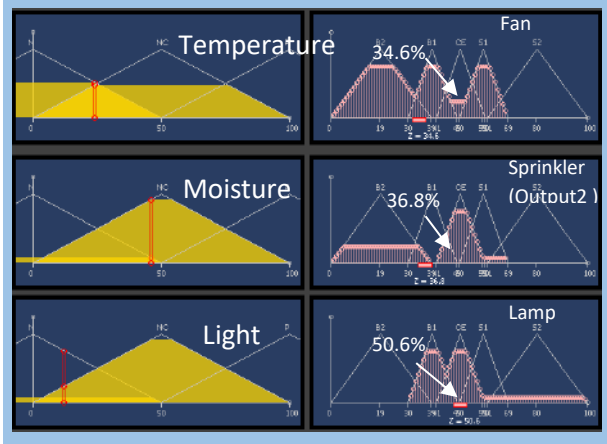

Figure 16: Control signal outputs of the system

VI. CONCLUTION

The fuzzy logic-based control in wireless sensor network for cultivation has been successfully demonstrated. Temperature, moisture and light sensors can be used to monitor and control the growth of the crops such as lettuce. The concept of fuzzy logic can be suitably applied to the wireless sensor network to enhance the ability to control the crop environment. This system is also achieved a low-cost design since all inexpensive devices can be used. Moreover, it is very flexible for changing fuzzy logic rules for different types of crops in future.

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UNRAVELLING TECHNOLOGIES IN THE DIGITAL WORLD

New Technology in channel codes of 5G wireless communication

Watid Phakphisut and Lunchakorn Wuttisittikulkij

Since Shannon's theorem proved the existence of channel codes which information can be reliably transmitted over a noisy channel, a large number of channel codes had been proposed. However, none of these had been demonstrated to closely approach Shannon's limit. The first breakthrough came in 1993 with the discovery of turbo codes by Berrou, Glavieux and Thitimajshima. This channel codes can show, for the first time, the performance approaching Shannon's limit. Nowadays, the turbo code [1] is adopted in the fourth generation (4G) mobile communication system [2]. A second breakthrough came in 1996 with the rediscovery of LDPC codes [3], originally invented by Gallager. These codes can also be shown to have near Shannon's limit and have been successively adopted in IEEE 802.11n standards [4], hard disk drive [5] and flash drive technologies [6]. The essential ideas behind the turbo code and LDPC codes are the efficient decoding whereby the turbo codes employ the iterative BCJR algorithm and the LDPC codes employ the belief propagation algorithm. Unfortunately, these codes cannot assert the joint asymptotic equipartition property (AEP) that is one of the channel coding theorem proved by Claude Shannon.

The situation changes due to the invention of polar codes proposed by Arikan [7]. This code shows the AEP which can reach the Shannon's limit. The key idea of polar codes is that any statistically independent noisy channel can be transformed into the equivalent channel consisting the extreme noisy channel and the almost free of noise. Therefore, the encoding strategy is to transmit the information bits over the noiseless channels while assigning the parity bits to the extreme noisy channel. Intuitively, the polar codes are a constructive instance of the AEP. Recently, the 3GPP agreed to adopt polar codes for the eMBB (enhanced mobile broadband) control channels for the 5G mobile communication system [8].

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My Research and Life Experience

Sanika Wijayasekara, Sri Lanka

Ever since I was a little girl, if someone asked about my future ambition, my obvious reply was becoming a teacher. The academic field and educational aspects have always inspired me as a profession and as well as a social service. Later, when I became a university lecturer, I realized that there is room for improvements in the teaching. Applying state of the art technologies in learning process can be stimulus both for students and teachers. This motivation compelled me to look into new aspects and concepts of technology that could be involved in education to improve the quality, while enhancing my awareness and knowledge on those aspects.

After completing bachelor's degree from Sri Lanka, I applied for admission at the Asian Institute of Technology (AIT), Thailand for continuing studies in Master of Science (MSc) in the field Telecommunications and I was awarded AIT fellowship to pursue my MSc degree. This lifetime opportunity leads me to meet well qualified professors and lots of researchers, which augmented my motivation to conduct research in order to broaden my knowledge horizon and to learn new concepts. AIT is one of the unforgettable places in my life since it is made up of the people who lived there. People from different countries having different social, cultural and ethnic backgrounds, work together for a single goal i.e. to gain knowledge and serve a higher purpose by making the world a better place. I was voluntarily involved in the Student Union for three semesters and was an active member in Sri Lankan Association in AIT. Being involved in extracurricular work, I developed invaluable skills like leadership, problem solving and time management skills that greatly helped me achieving excellence in academic activities. The greatest lesson I have learned is never to give up and realized the dreamed journey had just begun.

As a result of my enduring enthusiasm on research, I was determined to continue my higher studies towards PhD and I selected Chulalongkorn University (CU), Thailand. I was fortunate to gain the PhD admission in Faculty of Engineering, Chulalongkorn university which is the Thailand's

oldest and best engineering school. Due to my consistent excellent academic performance and outstanding research work, Chulalongkorn university has awarded me with the prestigious 100th Anniversary Chulalongkorn University for Doctoral Scholarship along with the Electrical Engineering Chulalongkorn University PhD (EECU-PhD) Honors Program Scholarship. These scholarships supported me to make one of my lifetime goal achievable, which is to obtain a doctoral degree in the field of Telecommunications.

PhD program at Electrical Engineering department, Chulalongkorn university offers two distinct PhD programs to student which are only the research based and the coursework along with the research. I selected the program which combine the coursework with research so that I can obtain more knowledge through the well qualified Professors associated with Electrical Engineering department. They provide necessary and useful background knowledge to understand the difficult engineering theories and concepts in an easy fashion. Currently, I am successfully applying this knowledge in my rigorous PhD research work.

I got an opportunity to spent valuable time at Tanabe (Thailand) Co.Ltd for three weeks of internship funded by University of Niigata, Japan. I was responsible for evaluating the current situation of the company and forecast the future market and strategies. This was a challenge for me and I enjoyed

the work since I could forget my research work stress for a short period time.

Throughout this higher education journey in Thailand, I realized that the university professors are very supportive, and kind hearted. The best thing is that the advisor has a substantial commitment in student's research and sometime experience more pressure than the student in order to have a fruitful research. This creates confidence to student in a well guided and friendly environment.

Apart from foreign student, as a foreigner, I truly love the country and the people of Thailand. Thailand is a pretty safe place and I respect the freedom I experience in Bangkok. Particularly, the main practice I learnt from the culture of Thailand is of being grateful. As a follower of Theravada Buddhism, I admire the daily alms rounds of Thai monks after dawn. I practice this as a special daily ceremony to get blessing and make merit for my good karma. The gorgeous Lord Buddha statues and the sacred Buddhist temples in Thailand help me to get through the times when I feel homesick and it is now my second home.

Currently, I am studying as a research visiting student at TONIC Research group, Department of Electrical Engineering, National Taiwan University, Taiwan with funds of the Overseas Research Experience Scholarship for Graduate Student from Graduate School of Chulalongkorn University, Thailand. This is a good opportunity for me to learn new things in my research field not only theories but also more advanced experiments. Finally, most important thing is that my higher education studies built me strong and confident to serve more students in the world and to face the society.

More about the Author

Sanika Wijayasekara is was born in Colombo, Sri Lanka. She received her B.Sc in Computer System and Networking from Sri Lanka Institute of Information Technology (SLIIT), Sri Lanka in 2010 and M.Sc in Telecommunications from Asian Institute of Technology (AIT), Thailand in 2012. Since 2015 August, she pursues the Doctoral Degree in Department of Electrical Engineering, Chulalongkorn University, Thailand with the support of the 100th Anniversary Chulalongkorn University for Doctoral Scholarship. Bangkok, Thailand. He is under the EFS-SIIT scholarship.

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กลุ่มที่ 3: การประหยัดพลังงาน การจัดการพลังงาน บ้านอัตโนมัติ
กลุ่มที่ 4: การเรียนการสอนทางไกล การศึกษาบันเทิง คอมพิวเตอร์แอนิเมชัน
กลุ่มที่ 5: การกู้ภัย ระบบเตือนภัย และพยากรณ์
กลุ่มที่ 6: การสื่อสาร การสนับสนุนผู้ใช้ตามบ้าน เครือข่ายสังคม เครือข่ายไร้สาย
กลุ่มที่ 7: การขนส่ง การควบคุมจราจร การจัดการอุตสาหกรรม
กลุ่มที่ 8: ธุรกิจการธนาคาร การท่องเที่ยว และการโรงแรม
กลุ่มที่ 9: ระบบความปลอดภัย การควบคุมการเข้าถึงการยืนยัน ตัวตน ระบบตรวจจับ
กลุ่มที่ 10: มาตรวิทยา การวัดและควบคุม
กลุ่มที่ 11: วิศวกรรมและเทคโนโลยีอุตสาหกรรม
กลุ่มที่ 12: STEM เทคโนโลยีการศึกษา
กลุ่มที่ 13: หัวข้ออื่นๆ ที่เกี่ยวข้อง

การส่งบทความ

- ❑ รูปแบบ บทความวิจัย เป็นบทความเต็มรูปแบบภาษาไทย หรือภาษาอังกฤษไม่เกิน 2 หรือ 4 หน้ากระดาษ A4 ในรูปแบบมาตรฐาน 2 คอลัมน์ของ IEEE โดยต้องกล่าวถึงที่มาและผลที่ได้รับ รายละเอียดและ/หรือการนำไปใช้งานซึ่งเกี่ยวข้องกับหัวข้อใดหัวข้อหนึ่งหรือมากกว่าจากกลุ่มต่าง ๆ ที่ได้กำหนดไว้
- ❑ รูปแบบ สิ่งประดิษฐ์และนวัตกรรม เป็นบทความเต็มรูปแบบ ภาษาไทย หรือภาษาอังกฤษ ไม่เกิน 2 หน้ากระดาษ A4 ใน รูปแบบมาตรฐาน 2 คอลัมน์ของ IEEE โดยผู้เขียนบทความ อาจนำผลงานหรือสิ่งประดิษฐ์มาร่วมจัดแสดงในงานประชุมได้

กำหนดการ

ส่งบทความฉบับสมบูรณ์	วันที่ 15 มกราคม 2562
ประกาศผลการพิจารณาบทความ	วันที่ 18 มีนาคม 2562
ส่งบทความต้นฉบับเพื่อตีพิมพ์	วันที่ 10 เมษายน 2562
วันจัดประชุมวิชาการ	วันที่ 5 - 7 มิถุนายน 2562

ติดต่อประสานงาน

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ร่วมจัดประชุมโดย: ECTI Association

ITC-CSCC 2019

The 34th International Technical Conference on Circuits/ Systems, Computers and Communications

June 23 - 26, 2019 / Jeju Shinhwa World, Republic of Korea

Welcome to ITC-CSCC

The 34th International Technical Conference on Circuits/Systems, Computers and Communications (ITC-CSCC 2019) will be held on June 23-26 at Jeju Shinhwa World, Republic of Korea.

Topics

The conference is open to researchers from all regions of the world. Participation from Asia Pacific region is particularly encouraged. Proposals for special sessions are welcome. Papers with original works in all aspects of Circuits/Systems, Computers and Communications are invited. Topics include, but not limited to, the followings:

- **Circuits & Systems**
  - Computer Aided Design
  - Analog Circuits
  - Modern Control
  - Semiconductor Devices & Technology
  - Sensors & Related Circuits
  - Power Electronics & Circuits
  - RF Circuits
  - Medical Electronics & Circuits
  - VLSI Design
  - Intelligent Transportation Systems & Technology
  - Linear / Nonlinear Systems
  - Neural Networks
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- **Computers**
  - Artificial Intelligence
  - Internet Technology & Applications
  - Multimedia Service & Technology
  - Face Detection & Recognition
  - Watermarking
  - Image Processing
  - Computer Systems & Applications
  - Computer Vision
  - Security
  - Biocomputing
  - Motion Analysis
  - Object Extraction & Technology
  - Image Coding & Analysis
- **Communications**
  - Antenna & Wave Propagation
  - Audio / Speech Signal Processing
  - Circuits & Components for Communications
  - IP Networks & QoS
  - Ubiquitous Networks
  - Visual Communications
  - Network Management & Design
  - Optical Communications & Components
  - Radar / Remote Sensing
  - Communication Signal Processing
  - Multimedia Communications
  - Future Internet Architectures
  - MIMO & Space-Time Codes
  - UWB - Mobile & Wireless Communications

PROCEEDINGS

All registered participants are provided with conference proceedings. Authors of the accepted papers are encouraged to submit full-length manuscripts to IEIE JSTS (Journal of Semiconductor Technology and Science) or IEICE Transactions. Papers passed through the standard editing procedures of the IEIE JSTS or IEICE Transactions will be published in regular issues. The authors (or their institute) are requested to pay the publication charge for the IEIE JSTS or IEICE Transactions when their paper is accepted.

SUBMISSION OF PAPERS

Prospective authors are invited to submit original papers (1~4 pages) of either MS Word or PDF format written in English. Paper submission procedures are availabe at www.itc-cscc2019.org

AUTHOR'S SCHEDULE

- Submission of Paper : March 22, 2019
- Notification of Acceptance : April 19, 2019
- Submission of Final Paper : May 10, 2019

Hosted by

The Institute of Electronics and Information Engineers (IEIE), Korea
The Institute of Electronics, Information and Communication Engineers (IEICE), Japan
The Electrical Engineering/Electronics, Computer, Telecommunications and Information Association, Thailand

Contact Point

- E-mail : inter@theieie.org
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ECTI-CON 2019 INTERNATIONAL CONFERENCE

July 3-5, 2019, Pattaya, Thailand

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The 16th International Conference on Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology or ECTI-CON 2019 (IEEE Conference Record) is the sixteenth annual international conference organized by Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI) Association, Thailand. The conference aims to provide an international platform to present technological advances, launch new ideas and showcase research work in the field of electrical engineering, electronics, computer, telecommunications and information technology. Accepted papers will be published in the Proceedings of ECTI-CON 2019 and will be submitted for inclusion in the IEEE Xplore. Acceptance will be based on quality, relevance and originality.

Technical Tracks

1. Devices, Circuit and Systems
2. Computers
3. Information Technology
4. Communication Systems
5. Controls, Instrumentation and Measurements
6. Electrical Power Systems
7. Power Electronics
8. Signal Processing
9. Other Related Areas

Special Sessions

A proposal for a special session can be submitted to the special session chair. The session topic can be varied upon one's interest but still relate to Electrical Engineering/ Electronics, Telecommunication, Computer and IT.

Supports and Scholarship

Post graduate student whose paper is outstanding and has applied for the scholarship will be nominated for a partially supported scholarship. The grant is neither transferable nor claimed in other forms.

Best Paper Award

Paper with highest score will be nominated "Best Paper Award"

Important Dates

Deadline for Special Session Proposal	8 December 2018
Deadline for Submission	11 January 2019
Notification of Acceptance	19 April 2019
Deadline for Final Manuscript Submission	17 May 2019
Deadline for Early Registration	17 May 2019
Conference Dates	3-5 July 2019

More Information

Available at http://www.ecticon2019.org

ECTI Who's Who

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