Internet of Things for Planting in Smart Farm Hydroponics Style

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Abstract **Recently, the farmers gain more profits by producing the quality product. The effects of the global warming make more difficult planning in uncontrolled environment. On the other hand, the yield does not match customers' needs. For these reasons, planting in a greenhouse is easy to maintain and to control important factors such as light, temperature, and humidity. Using of sensors coming in a greenhouse as Wireless Sensor Networks System are one efficiency of technology used in agricultural development by sending data to the cloud and controlling values such as temperature, light, etc. The results of this study will be useful for the farmer and related organizations applying in the farm.**

Keywords Internet of Things; Wireless Sensor Networks; Smart farm;

I. Introduction

The Internet of Things (IoT) refer to a network of objects, equipment, vehicles, buildings, and other electronic sensing devices including software for connecting into the network in order to information's exchanges. The IoT can make the subject perceiving the environment and controlling remotely via existed network infrastructure. We can merge the physical world with the computer systems and virtual resources-available on the Internet to provide both value-added information and functionalities for end-users [1].

The IoT's devices contain Radio Frequency Identification (RFID), various sensors, and computing node. The system needs to have an Internet connection so that these devices can send and receive data to communicate not only Internet network, but also with other IoT's devices. Sensor nodes create a number of different Wireless Sensor Networks (WSNs) connected to devices for detecting various phenomena (physical phenomena) on the network such as light, temperature, and pressure [2].

At present, farmers need agricultural information and pertinent knowledge to make decisions and to satisfy informational needs. In agriculture domain through the development of a knowledge management system, enquiries of farmers can be answered with the help of multimedia which is easily accessible the application of Information and Communication Technology (ICT) has proven for widening the opportunities

Promoting agriculture on several aspects in developing countries, technology has crossed hurdles by using wireless technology, networking, mobile, etc. to utilize energy and power consumption by equipment, which is helpful in the agricultural development, making more profit to the farmers. The development of ICT in various domains has driven substantial interest according to rising investments by private sectors towards the growth of ICT in agricultural research [3].

II. Related Research

A. *Water and nutrient use efficiency a low-cost hydroponic greenhouse for a cucumber crop: An Australian case study*

Planting tomato seedlings using a pipe recirculating water system is easy management system for IoT [4] as shown in Fig. 1.

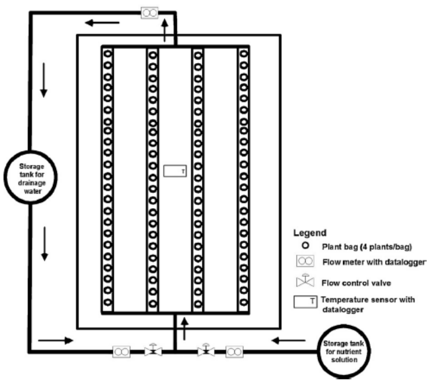

Fig. 1. Schematic of the hydroponic greenhouse system used in the case study.

B. *Bayesian networks for greenhouse temperature control*

Greenhouse crop production is directly influenced by climate conditions, mainly temperature and humidity, but where growers can also perform control actions independent on the automatic control system by wind made the greenhouses all the time [5].

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C. *Modifying folate and polyphenol concentrations in Lamb's lettuce by the use of LED supplemental lighting during cultivation in greenhouses*

The effecting of light-emitting diode (LED) supple-mental lighting on the folate and polyphenols content as well as antioxidant properties of Valerianella locusta (Lamb's lettuce) cultivated in greenhouse in autumn and winter seasons were used for evaluation. Six LED-lighting combinations were used. Four of them differed in percentage share of red (R) and blue (B) in emission either warm (4700K+2700K) or cool white light. Control plants were grown under high-pressure sodium (HPS) lamps [6].

D. *Smart greenhouse fuzzy logic based control system enhanced with wireless data monitoring*

The result [9] in this section uses sensors as follow:

- Temperature sensor
  The greenhouse is equipped with a temperature sensor (LM35DZ) whose output voltage is proportional to the measured temperature (°C). The typical accuracy is 0.4°C temperature of 25°C.
- Humidity sensor
  To measure the percentage of relative humidity. We installed a HIH 4000-001 sensor type from Honeywell Sensors [5].

Smart control greenhouse makes use such as electricity and water increased to 22% and 33%, respectively [8], as shown in Figs. 2 and 3.

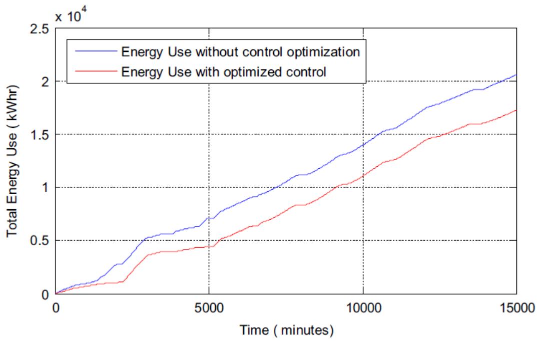


Fig. 2. Total energy used.

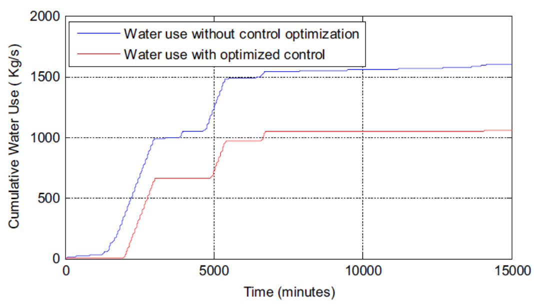


Fig. 3. Cumulative water used.

E. *Spatial variability of soil temperature under greenhouse conditions*

Despite erratic fluctuation of the soil temperature, preliminary analysis of data revealed that the coefficient of variation is relatively high (12.11%). The soil temperature had a range of ±6 °C with variance of 5.71 °C. The frequency distribution for soil temperature [7].

III. SYSTEM DESIGN AND REALIZATION

Data collection, monitoring and evaluation of the system results in determining which approach is effective.

These adaptations are most needed. Therefore, ICT engaged interventions in agricultural sector are more productive. The control greenhouse apps using the name Blynk. We can control the house using Internet of Thing.

Where you can control your device via the API given by Blynk control sensor information.

TABLE 1.
Deployment parameters

Parameter	Value	Working voltage
Temperature and humidity	DHT-11	3V DC
Ultrasonic Sensor Module	HC-SR04	5V DC
Relay Board	8 Channel	12V DC
Architecture	greenhouse	-

A. *Monitor Interface*

1) *Hardware Requirements:*

NodeMCU is used to implement the monitoring modules. The following sensors and other peripherals are used to collect real time data from the field [8,9]:

- DHT11 is a relatively cheap sensor for measuring temperature and humidity
- Soil Moisture Sensor (KG003) - Output is high when there is deficit in soil moisture (i.e. the field is dry), or output is low.
- An Eight Channel Relay Board (5V) for switching AC/DC is used to trigger a AC motor (220V) to operate the valves.
- Ultrasonic Sensor Module (HC-SR04) includes an ultrasonic transmitter, a receiver and a circuit. There are four pins.

2) *Software Requirements*

Blynk is an open-source electronics prototyping platform which is a modified version of wiring/Arduino IDE with iOS and Android apps to control Arduino and the likes over the Internet. It's a digital dashboard where a graphic interface for any project can be built by simply dragging and dropping widgets as shown in Fig. 4. and cloud data in ThingSpeak™ [5].

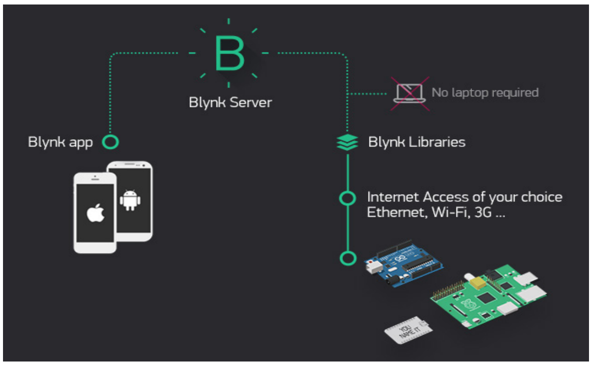


Fig. 4. Blynk platform.

B. *Greenhouse Specification*

1) Area: The greenhouse is mounted on the roof of the building with the size of 2.4 * 5.3 * 2.0 (length * width * height: m).

2) Plants: The plants used in this study Cantonese. Season pale green succulent stems, petioles 25-40 cm wide, 5-15 cm long, 15-30 cm. Vegetable consumption is growing very fast. Just harvested 35-45 days, it can be harvested. We acknowledge the seeds coming from Mae Jo University as an organic grain.

IV. Results

A. *Productivity receive*

1) Productivity: Due to the high temperature of the plant 48 trees dying in the first week. Maximum temperature is 44°C measured from the sensor via the IoT. The DHT11 sensor is used to measure in the survival rate 0% as shown in Fig. 5.

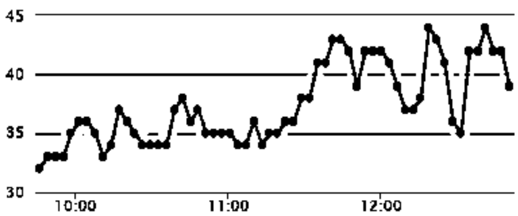


Fig. 5. Temperature in the first week.

Next step, we install SLAN filter mesh filter UV 50% black on-off the user to reduce the heat as shown in Fig. 6.

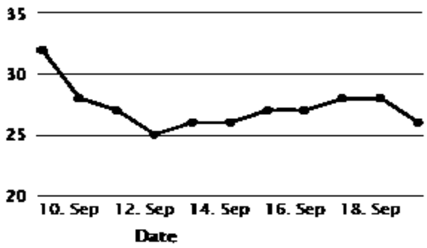


Fig. 6. Temperature after installing filter UV 50%.

2) Second generation: After cooling in greenhouse number, 48 seed planted 22 trees survived the survival rate of 45.83%.

Ultrasonic sensor monitors the amount of water in the tank if it is lower than normal. Solenoid is working to add water as shown in Fig. 7.

Fig. 7. Solenoid controlled by ultrasonic sensors.

Ultrasonic sensor sent the up-to-date data as we can desired the duration time for collecting data into ThingSpeak™ to simulate the water level's graph as shown in Fig. 8.

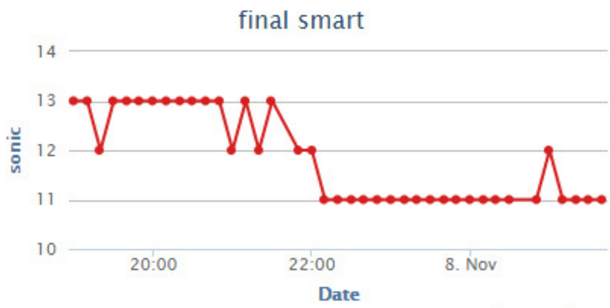
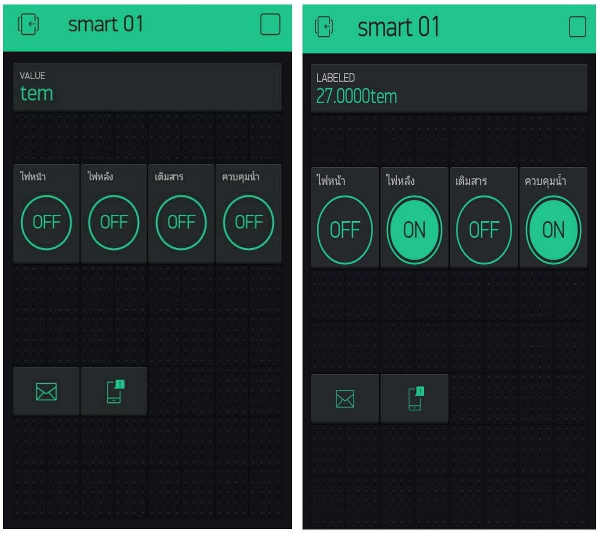


Fig. 8. Water level's graph on ThingSpeak™

Electronic devices, such as solenoid and UV light, is controlled by nodeMCU which makes connection with sensor and sends data to ThinkSpeak™ for processing devices' work of vegetales' growing. The vegetable's growing is very well as shown in Fig. 9.

Fig. 9. Vegetable growing technology in the greenhouse.

The greenhouses can work automatically and control via the Applications controlled by mobile device. The connections were able to control by nodeMCU. Freely, no matter where we are on the worldm, you can control via mobile device which is called *Blynk* as shown in Fig.10.



(A) (B)

Fig. 10. Home Applications control devices: (A) Applications run control devices and shows the temperature in the upper left (B)

Blynk is a Platform with iOS and Android apps to control Arduino, Raspberry Pi, and the likes over the Internet. It is a digital dashboard where you can build a graphic user interface for your research by simply dragging and dropping widgets. That is really simple to set up everything and you will start tinkering less than 4 minites. Blynk is not tied to some specific board or shield. Instead, it's supporting hardware of your choices. Whether your Arduino is linked to the Internet over Wi-Fi, Ethernet, or this new ESP8266 chip, Blynk will get you online and ready for the IoT, the sensor data including temperature and relative humidity were recorded to the ThingSpeak™ clouding service with the frequency of every 3 minutes of data collection (see Figs. 11-12). The location of this study was shown in Fig. 13.

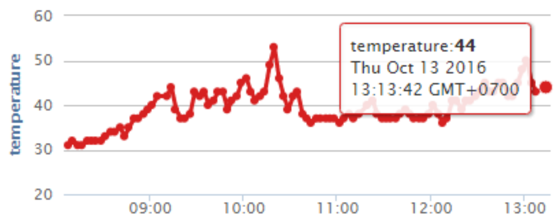


Fig. 11. The real-time visualization of temperature at the study site.

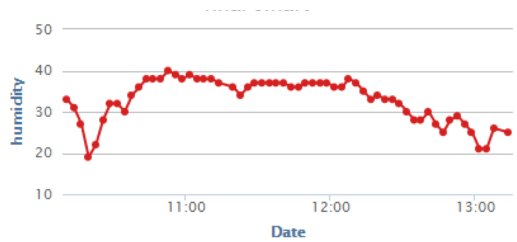


Fig. 12. The real-time visualization of relative humidity at the study site.

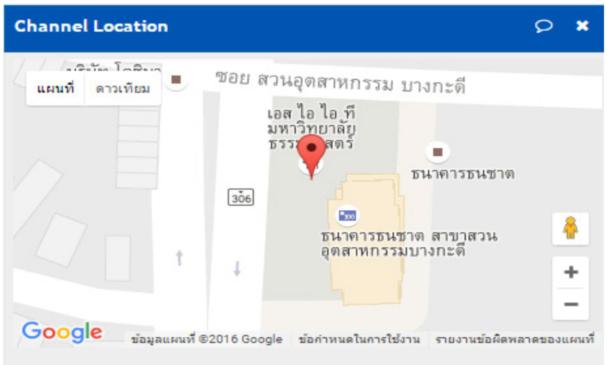


Fig. 13. Location of study site show in ThingSpeak™.

B. Testing

In our evaluation, We tested 10 times On 11/15/56 at 16:00 for checking the efficiency of delay controlling. The Statistical tool is mean or average (AVG). Hence, the result as shown in Table.2. is not significant. This means that both testing control inside and outside the LAN Delay are equated.. The result is not significant. This means that both testing control inside and outside the LAN Delay are equated.

TABLE 2.
Testing Control with Mobile via Blynk

NO	Inside the LAN Delay(s)				Outside the LAN Delay(s)			
	LED		Solenoid		LED		Solenoid	
	Turn on	Turn off	Turn on	Turn off	Turn on	Turn off	Turn on	Turn off
1	5	5	4	0*	6	10	8	0*
2	5	5	6	0*	5	9	6	0*
3	4	7	4	0*	6	10	7	0*
4	5	6	5	0*	4	10	7	0*
5	6	7	5	0*	5	8	8	0*
6	6	8	3	0*	6	7	9	0*
7	7	10	6	0*	7	9	10	0*
8	8	14	4	0*	8	6	14	0*
9	10	12	8	0*	9	7	19	0*
10	14	13	3	0*	10	9	14	0*
AVG	7	8.7	4.8	0	6.6	8.5	10.2	0

* The sensor stops the water to overflow the tank makes Solenoid stop working.

V. CONCLUSION AND FUTURE

Sensor technology are intended for the automatic control devices via mobile accurated correctly. This technology will save time to look for vegetables which people can eat healthy. Farmers need some helps in the different stages of crop growth and the guidance should be given at the right time. Farmers are suffering a lot of problem; economy, social, and politics. Various challenges in agricultural domain are identified. The architecture of the challenges mentioned above, knowledge-based structure have various details about agriculture, flow, various input such as market availability, geospatial information and weather prediction. Monitoring system contains modules like remainder, monitoring plant growth in various stages, irrigation planner, and the water need of a plant per day with devised algorithm's help. The futuer work of this study will be developed the sensor for using in public actually.

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