Smart IOT Agricultural Kit for Precision Farming

Murugan Krishnan
Politeknik Mersing
murugan@pmj.edu.my

Ruslaimi Abd.Kadir
Politeknik Mersing
ruslaimi@pmj.edu.my

Abstract
Technologies and IOT have the potential to transform agriculture in many aspects. The development of Intelligent Smart Farming ITT based devices is day by day turning the face of agriculture production by not only enhancing it but also making it cost-effective and reducing wastage. By using various smart agriculture gadgets, farmers have gained better control over the process of raising livestock and growing crops, making it more predictable and efficient. The aim of this paper is to propose a novel smart IOT gadgets which used in agricultural as weather stations, combining various smart farming sensors, collect various data from the environment and send it to the cloud in getting live data for efficient environment monitoring which will enable them to do smart farming and increase their overall yield and quality of products. The smart IOT agricultural kit being proposed via this paper is integrated with Arduino Technology, breadboard mixed with various sensors and live data can be obtained online from web based called Fabric.atilze.com. The product being tested as a pilot project on Live Agriculture Fields giving high accuracy over 98% in data feeds and save almost 40% of total fertilizer.

Keywords: precision farming, smart internet of thing (IOT), smart agriculture kit

1.0 Introduction

Farming is becoming more scientific, with remote sensing, GPS and data analytics all being added to farming equipment. Thousands of farmers all over are adopting the new equipment to make their farming more precise. The development of IOT is increasing day by day. Great potential also results from a combination of electronic and internet which will ultimately benefit human life. Although in our country we have not received such a comprehensive reform, in many developed countries the idea of smart and new technology has been introduced and practiced. IOT technology is new and smarter than the existing one. It is also included in the Fourth Industrial Revolution technology (IR 4.0), which current trend in automation and data exchange in technology include cyber-physical systems, IOT, cloud computing and cognitive computing. In the fourth industrial revolution, emphasizing the integration between the internet and the use of big data. Precision farming is about managing variations in the field accurately to grow more food using fewer resources and reducing production costs.

1.1 Precision farming

Precision farming is modern agricultural practice involving the use of technology in agricultural like remote sensing, GPS and Geographical Information System (GIS) for improving the productivity of agricultural. It is precise application of agricultural inputs with respect to soil, weather and

crop need in order to improve productivity, quality, and profitability in agricultural. Water and fertilizer resources will be utilized efficiently under the precision farming. It is enable farmers to use crop inputs more efficiently including pesticides, fertilizers, tillage and irrigation water. Currently precision agriculture techniques are still under development and requires to increases opportunities for skilled employment in the agricultural sector and also provides new tools for evaluating multifunctional aspect including non-market functions. To farmers and land owners who decide to use technology to manage their fields, precision farming seems to bring many benefits, and ultimately increase of profit.

1.2 Smart IOT agricultural

Intelligent Agricultural Revolution refers to the use and integration of the latest technology such as IOT more widely in agriculture with the aim of increasing the quantity and quality of harvests of domestic crops. Through this system, farmers can monitor and control agricultural activities from anywhere using a smartphone through a specially created application. Through IOT and smart agriculture we invite young farmers involved in agriculture as it does not involve the use of brute strength but entirely driven by the technology at our fingertips. For example, the drone can be used to spray insecticides, analyze and monitor the results of soil cultivation of plants quickly and without using manpower. In addition, sensors or sensor-based Internet of Things (IOT) can also be used to transmit data or information related to the plant immediate (real-time) for further action by the farmers.

1.3 Problem statement

All aspects of the environment such as soil, weather, vegetation, water are different from place to place. All these factors determine crop growth and farming success. Farmers have always been aware of this, but they lacked the tools to measure, map and manage these variations precisely. Most of plantations in Malaysia are still using traditional methods. Plants need proper care and neat. Things like temperature, humidity, light, nutrients, water and air must be constantly monitored by farmers from time to time to prevent the simple plants wilted, stunted or suffer from enlargement. In addition, farmers could not assess the current state of the plant with only a rough observation. Most of the problems occur only realized when it has damaged crops. Despite the problems discovered, farmers take time to work and find the cause of the problem. Agricultural productivity nowadays may seem to have reached a stationary point due to the global availability of fertilizers and pesticides which are used to improve crop yield. However, misuse of these products and lack of awareness of the field parameters can decrease our productivity and endanger the environmental balance in the cultivation area.

1.4 Research objectives

i. To developed a novel smart IOT application kit which used in agricultural for efficient environment monitoring.
ii. To improve agricultural yield and reduce potential environmental risk by using smart agricultural kit.
iii. To monitor and control farming activities in real time data ensuring and provide correct information to farmer through smart application.

iv. To save time and cost of farming activities through smart IOT agricultural kit.

2.0 Methodology

This research has been conducted as a pilot project in Polytechnic Mersing in May 2019. In this project we have developed the smart agricultural kit which can control and monitoring activities in Chilli farm such as water irrigation system, temperature and humidity reading, EC monitoring, automatic fertilizer mixing, insecticide spray and cctv monitoring system. We have design Fabric Monitoring Portal Application system in this project to manage the farming activities through online using mobile phone. Data from sensor hub is sent to the Fabrick Monitoring Platform, where farmers are able to monitor information such as fertilizer concentration, tank capacity, and environmental information in a live dashboard. All information can also be viewed from smart phone.

2.1 Description of methodology

This research has been divided in to three section. First is develop prototype for smart Farming, second develop solar energy power to supply power for control devices and final one is develop smart agricultural kit for manage the precision farming.

2.2 Develop prototype for smart farming

The development of this prototype model is an innovative method of control and manage water irrigation system to the farm. In this section, the piping for irrigation system has to design together with farming devices such as drip irrigation pipe, pump, water tank and water control devices as shown in Figure 1.

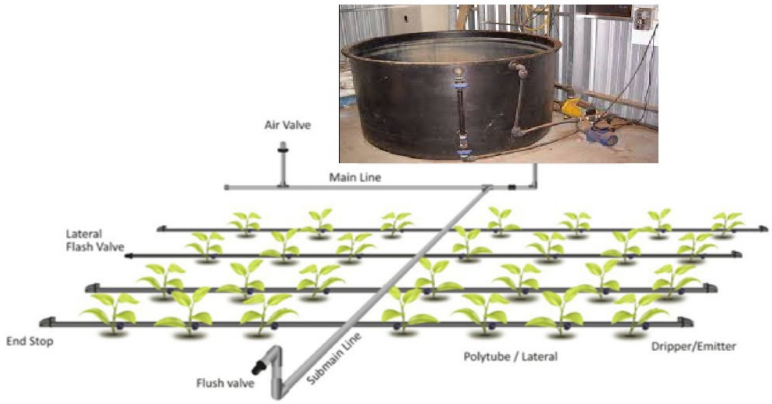

Figure 1: Prototype piping system for smart agricultural

This system using automation of water irrigation systems using IOT technology. In this method the pump will be activated by using the smart IOT agricultural kit to irrigate water and spray pesticides according to the prescribed schedule. The sensor will be used to detect the quantity of water in the main tank and to detect and control the ambient temperature of the crops area. The sprinkler system will be activated and water will be pumped throughout the plant to control the ambient temperature. In this design, pesticides work is also handled atomically when needed by just click to application in mobile phone. Main water tanks will be used for the purpose

of water irrigation system. Rain water harvesting method also has been build up in this system for harvesting rain water and resupply to farming activities through sprinkler when temperature is high. All this function will be control by smart agricultural application kit which has developed for farming purposed.

2.3 Develop solar energy power to supply power for control devices

This pilot project was design to use renewable energy as a source for operate the farming devices. The main focus is developed a solar system which will be used to supply electrical power for agricultural project using solar package devices such as solar panels, inverter (DC to AC), solar charger and battery. Safety aspect such as overload and short circuit are taking in consideration when developed this solar energy system as shown in Figure 2. Smart IOT kit will be used to send signals to the system interface to control all electric and electronic devices using electricity from solar energy which able to generate total power of 1000 watt.

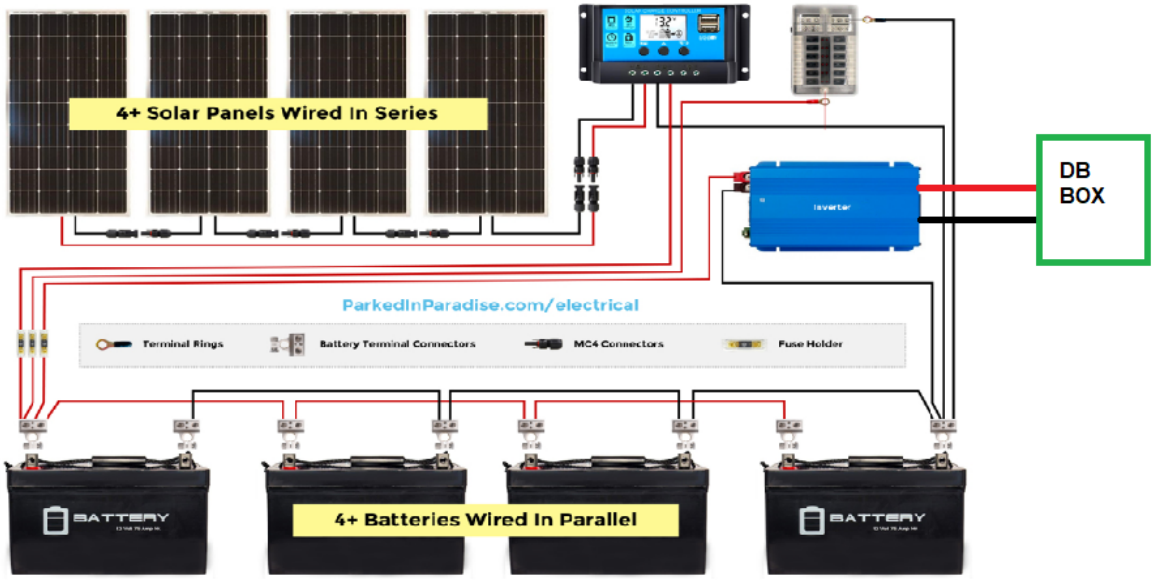

Figure 2: Solar energy power supply

2.4 Develop smart agricultural kit for manage the precision farming

Smart IOT agricultural kit is one of the smart farming solutions provide an integrated IOT platform that allows farmers to leverage sensors, smart gateways and monitoring systems to collect information, control various parameters on their farms and analyze real-time data in order to make informed decisions. These smart farming solutions as shown in Figure 3 is to ensure crops are well nourished and watered without human intervention. Smart irrigation helps farmers to avoid water wastage and improve the quality of crops growth in the field, by irrigating at the correct time, minimizing runoffs and other wastage as well as determining the soil moisture levels accurately. The data collected from sensors are stored in the cloud and can be easily accessed using a phone, tablet or laptop. The solutions are aimed at increasing farming productivity and quality, reducing labour costs and maintaining the sustainability of value chain.

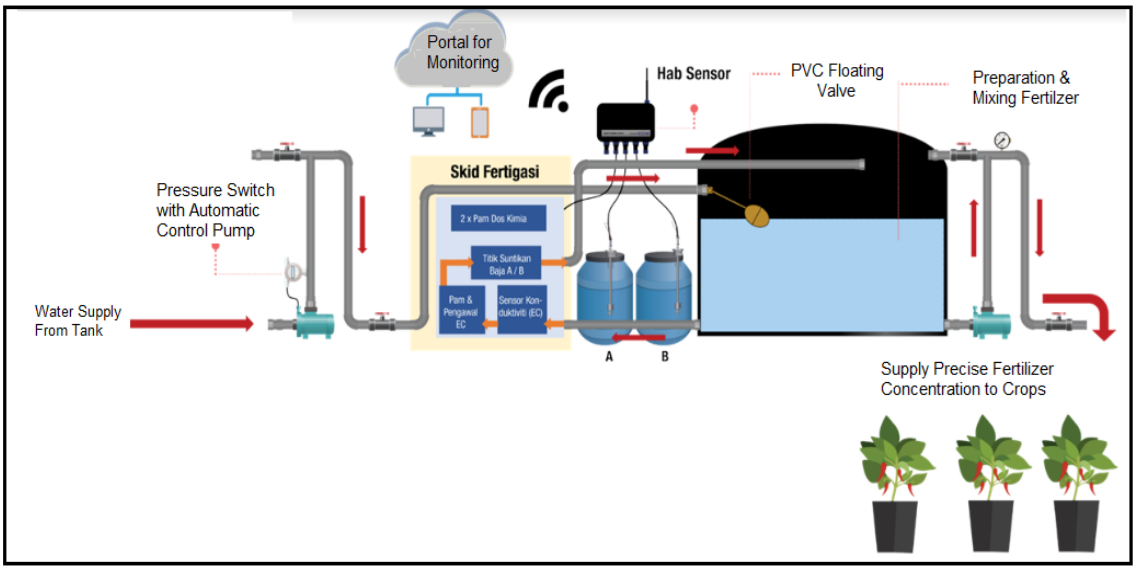

Figure 3: Smart agricultural kit for precision farming

3.0 Results and discussions

3.1 Smart agricultural kit application

This section discusses on how to setup the application and the results obtained from the farming activities study. The application software developed from Fabric.atilze.com and this software need to subscribe from internet service provider in order to access cloud data storage and internet access. The schedule for farming activities will be create according to type of crop or vegetables. The farming schedule need to setup in order to monitor and get the actual data from devices. The smart application web developed combined with the sensor Hub to enable more advanced functionality and crop performance. The function which setup in this system will display the whole information of farming activities as shown in Figure 4.

Figure 4: Setup for farming activities and display

The function of each setting will be display and farmer able to monitor the activities accordance with feedback received from smart kit system as shown in Table 1.

Table 1: Data reading for farming activities

No	Item	Function
1.	EC Reading	Strength of nutrient (1.6 – 2.2)
2.	Fertilizer Tank A	Nutrition Fertilizer Type A
3.	Fertilizer Tank B	Nutrition Fertilizer Type B
4.	Irrigation Pump	To spraying water for crop
5.	Mixing Pump (Dosain Pump)	To mixing up fertilizer with water
6.	Temperature (^{0} C)	Surrounding temperature
7.	Humidity Percentage %	Content of humidity in air
8.	Fertilizer Schedule	Time to deliver fertilizer

3.2. Result through monitoring system for farming activities

The output for each function will be display and record in this system. Farmer will be received the SMS alert through mobile phone to notify the functions and also alert if there is any error or malfunction as shown in Figure 5.

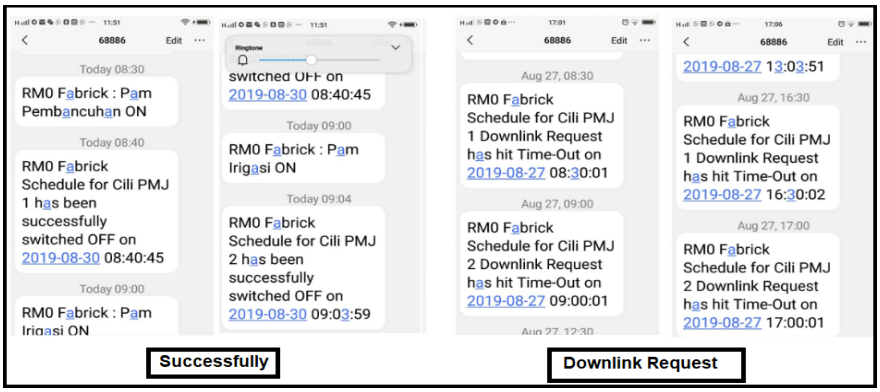

Figure 5: SMS Alert to through phone

i. Notify alert and function

a. EC Reading

The electrical conductivity of water estimates the total amount of solids dissolved in water. Full-strength nutrient formulas usually have a target EC of about 1.8- 2.0. During the vegetative growth stage, it's best to keep the EC in the 1.6-2.0 range for most vegetables. If the EC rises above 2.0 during the vegetative growth stage, just add more water to the reservoir to lower the EC. If the EC reading is high, then it will show in display system as shown in Figure 6 and same time will send notification alert to farmer.

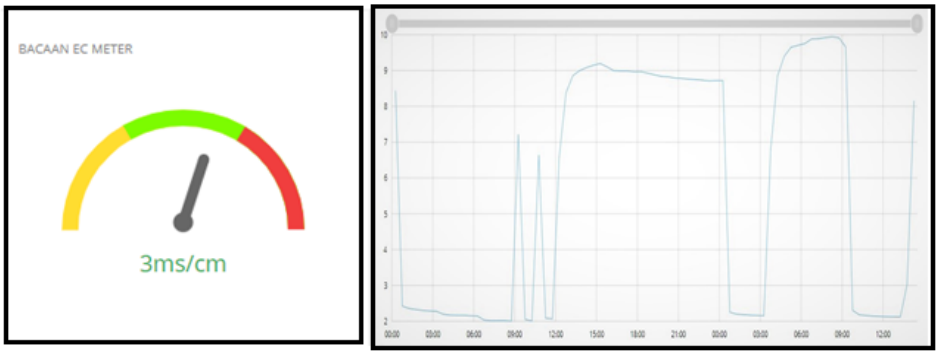

Figure 6: EC reading display

b. Fertilizer type A and type B

The mount of fertilizer Type A and Type B will be fill up in two different drums to mixing up with water irrigation system using Dosain Pump. Sensor will be used to detect the amount of water in both drums. If the level of water below the setting point, then the sensor light will be in OFF status and system will be notify through display as shown in Figure 7.

Figure 7: Status of fertilizer level

c. Irrigation pump

The irrigation pump has been setup to ON and OFF according to time required by type of crop. Normal setting is 3@4 times a day to supply water to crops. The system will send SMS notification to farmer when the pump is ON and OFF (Figure 5). If there is no notification received, then the farmer should alert and check the status of water level or pump.

d. Mixing pump

The function of mixing pump is to mixed up the fertilizer concentration with water in order to get correct EC reading. If the EC level is high, then the pump will not be ON and same time system will notify the farmer through SMS. Then farmer could ON the pump manually by using his mobile phone if necessary.

e. Temperature ^{0}C and humidity

The temperature on farming area always be monitor through this system. If the temperature is high, notification will be send to farmer through SMS. Then farmer can manually on the sprinkler which is connected to rain harvesting tank in order to reduce the temperature. The humidity also should be monitor from this system as shown in Figure 8.

Figure 8: Temperature and humidity reading

f. Fertilizer schedule

In this system, activity of water irrigation process has been setup according to type of crops. This setting always be changeable according to progress on growing and the irrigation schedule will display in system as shown in Figure 9.

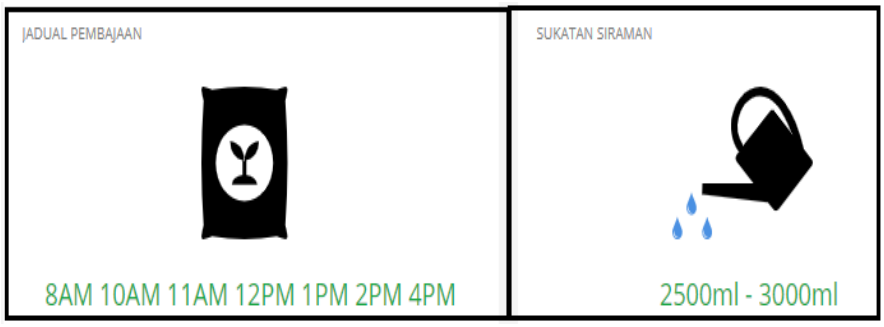

Figure 9: Irrigation schedule and water measurement

4.0 Conclusions and recommendation

Precision farming will optimize use of water and pesticides however data and automation can help farmers address the many challenges of the future. In the past, precision agriculture was limited to larger operations only. Today, however, mobile apps, smart sensors, drones and cloud computing makes precision agriculture possible for farming cooperatives and even small family farms. To raise awareness among farmers of the benefits of new farming technology. It is particularly challenging due to lured by the promise of employment and a modern lifestyle, many rural youths have relocating to urban area. It is pertinent to attract and retain youths within the farming industry, particularly those who are technology-savvy, by providing suitable employment opportunities in rural areas.

Changing the old practices to incorporate the new, we can attract the youth who are tech-savvy with employment opportunities in the form of a modern, hi-tech farm. IR 4.0 is probably the best platform to drive changes in increasing productivity and support the shift towards an innovation- and knowledge-based economy. With youth involvement, it would be easier to incorporate new farming technology and change farming culture. By creating modern high-tech farms, establishing permanent food parks, building learning institutions for modern farming and forming an agriculture outsourcing service (AOS) such job opportunities can be created. Favourable financial schemes have to be expanded to enable farmers to upgrade and modernise their farms and the government has to encourage the establishment of AOS to help farmers put smart farming into practice.

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