AQUARIUM FISH SMART FARMING ON INTERNET OF THINGS (IOT) AND MOBILE APPLICATION TECHNOLOGY

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ABSTRACT

Caring for fish raised in mini-aquarium fish farming is very important in keeping fish beautiful and reduce the mortality of fish. This paper aims to present a mobile application system with IoT and android application to control the aquarium water system. Android studio, Java, C, Arduino IDE, SQL and Firebase software ware used to develop in this study. Node esp28266 MCU V.2 board, Wemos-D1 boards and module ultrasonic hardware were used to create the control system. This system has been tested with real home mini-aquarium and performance data collection. Black Box testing is used to evaluate the performance of the system with users and experts. The result shows the mean and standard division by after users and experts explain on 4.21, 4.15 and 0.74, 0.72 respectively. Thus, this system can be used a main information tool for helpful users and prototype in others smart farmer.

Keywords: Aquarium smart farming, IoT, Mobile application

1. INTRODUCTION

Now a day, agriculture has begun to play a greater role in sustainable development of the country which corresponds to the government policy of Thailand 4.0. They focus on economy driven by innovation Value-Based Economy that makes it important of innovation to help drive the economy in the country. Due to Thailand economic structure has problems including the inequality extends further if we let this be the future, Thailand will definitely have problems. [1]

Thai farmers in Thailand era 4.0, they were started with a part of smart farmer that is not harming nature, use the resources as necessary and to be more comfortable. For example, the design of integrated and complementary crops by using appropriate technology. The smart farmer must be known world connection, product processing management, natural and new technology. [2] In addition, the application of IoT (internet of things) helps to manage the planting of agricultural crops. The farmer should have knowledge in agriculture and technology well that can be applied to use on the farm successful and reduce the worker cost problem. [3]

IoT technology is internet technology that is the device connection and tools such as computer, mobile, car, refrigerator, TV, et al. The user can easily order through the mobile system to environment that consists of various devices Transferring data together over the network. It is without the need to use the interactions between individuals and individuals or between individuals and computers [4] as shown in Figure 1 [5].

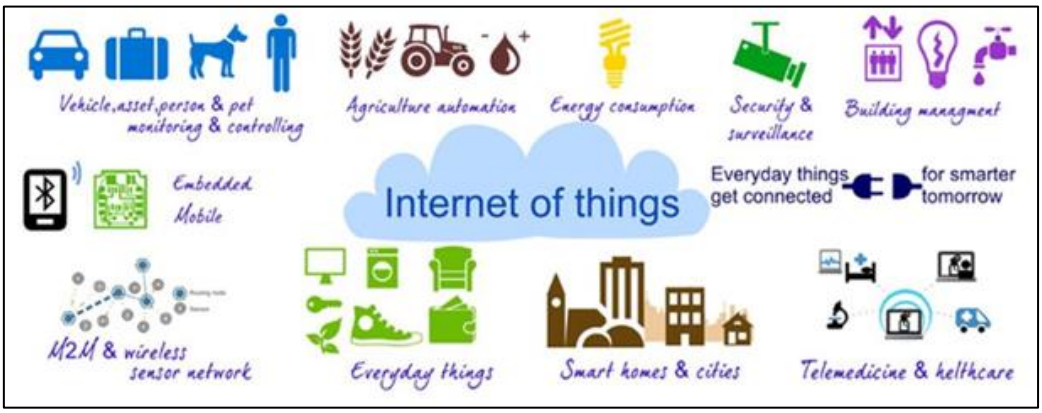

Figure 1 Internet of Things (IoT)

On the fish farm, controlling the environment is an extremely important obstacle, because it occurs from many factors such as water quality, type of fish, temperature, oxygen, food and waste disposal. It may cause damage to both the epidemic and the death of the fish. Thus, reducing losses from raising aquarium fish or beautiful end is absolutely necessary for aquaculture. The aim of works is to create a mobile application to control the water system in the aquarium based on IoT technology with android browser. The result was to benefit their aquarium fish and fish farmer group that supports their community economically and the nation. Furthermore, this mobile application also promotes to the prototype for other agriculture farm. [6 - 7]

2. LITERATURE REVIEW

Agriculture is an important foundation of living in every country that is the science and art of cultivating plants. It is performed manually from ages to trending into new technologies and implementations as a necessary goal to trend up with agriculture. IOT is a very important tool in smart agriculture, which the sensors are capable of providing information about agriculture fields. The smart agriculture system played with an automation system and monitoring system based on wireless sensor networks. It can collect data from different sensors deployed at various nodes and sends it through the wireless protocol. In smart agriculture, Arduino mainboard of IOT system consists of temperature sensor, moisture sensor, water level sensor, DC motor and GPRS module. [8]

Agriculture in Australian has historically been defined by long droughts and irregular rainfall. The farmer harsh conditions leave small margins for grueling work on the paddock. It is not necessarily translating to healthy stock or strong crop harvests. However, the farmers have adapted to use Internet of Things (IoT) devices and sensors that is slowly development when compared with other sectors. Because, these technology concerns surrounding the cost of implementation and ongoing service. [9]

Smart farming has become an increasingly attractive technology for farmers that refers to reducing production costs and farm management. In addition, many technology devices were used to apply for managing farms such as IoT, robotics, drones and AI which focus on increase the quantity and quality of products. In Ukrainian, a smart farm would sound like a fairy tale that consist of Sensors (soil, water, light, humidity and temperature management), Software solutions for specific farm like IoT platforms, Connectivity with internet system, location (GPS or Satellite), Robotics and data analytics both standalone analytics solutions and data pipelines for downstream solutions. [10]

Jirapond Muangprathub et al. [11] propose an IoT in agriculture data analysis for smart farm that were developing a system optimally watering agricultural crops based on a wireless sensor network. The goal of this work to design and develop a control system based on node censors in the crop field with data management on mobile and web application that consist of three components such as hardware, web application, and mobile application. The results showed the implementation system can be to be useful in agriculture. Especially, soil moisture data are very useful for the growth of vegetables, cost reduction and increasing productivity. Furthermore, the system can send notifications through LINE API for the LINE application.

Karim Foughali, et al. [12] present a new prototype of late blight prevention decision support system based on sensor network and cloud IOT based on the application of decision support system (DSS) for potato late blight disease prevention has proven its benefit. They have estimated the exact requirement fungicide quantity effect to minimize cost and environmental impact. The huge number of low cost and low power sensor nodes can be used in farmlands forgather a precise climate data. The application of an IOT platform can collect the images of the plants and analyzes that the fungus leaves brown spots and collected data from Internet connection.

3. ANALYSIS AND DESIGN

In order to perform this study, the author investigated by collecting data from the related works and the expert group. All information was used in the analysis and design state that perform to manage the mobile application and database. It also was helpful the researcher to make the system fast and works easily. This mobile application must be compatible to use all international mobile browsers. In this study, the technique to use for analysis and design that can be divided into 2 steps as follow: system overview, use-case diagram of the system of the mobile application as shown in Figure 2-3 consequently.

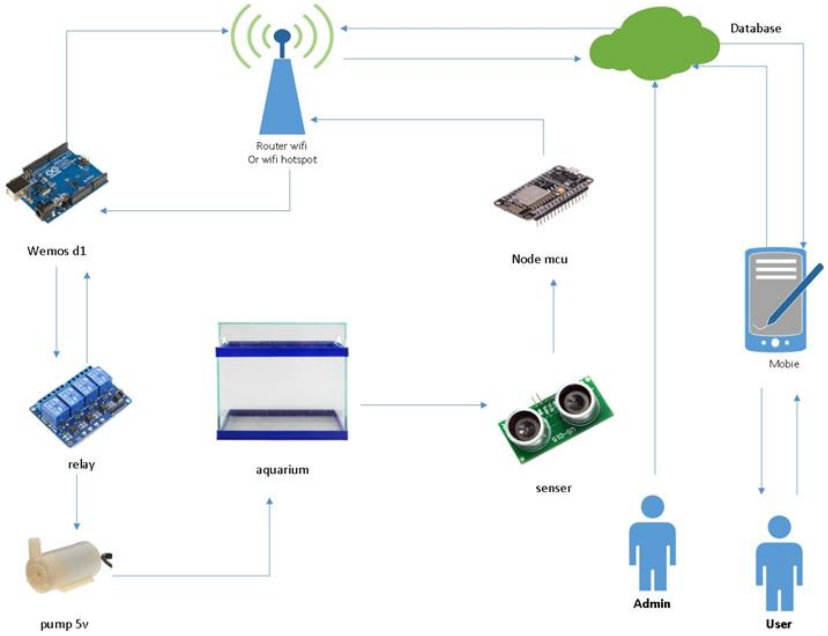

Figure 2 System overview

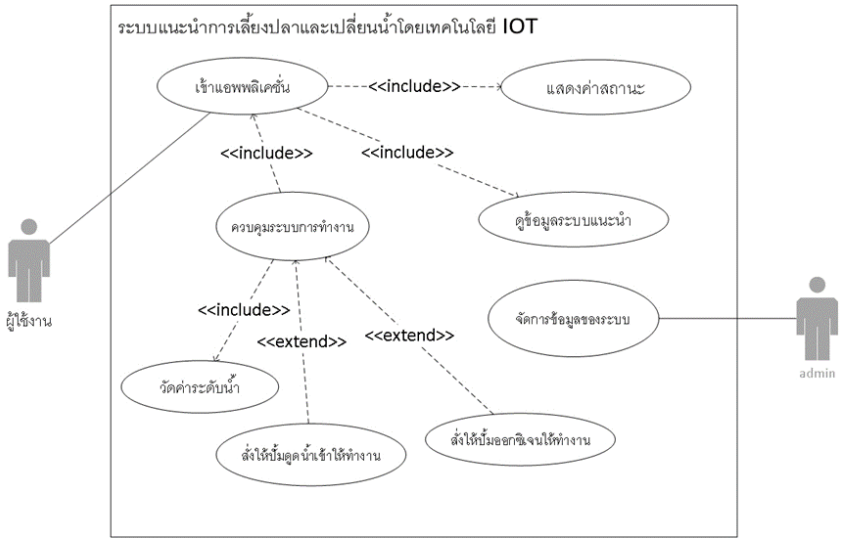

Figure 3 Use-case diagram of the system

4. RESULTS AND DISCUSSION

In this study, the result was divided in 2 parts: development of mobile application and evaluating performance and satisfaction of mobile information about aquarium fish smart farming.

4.1 Developing of mobile Application

The state of development the mobile application for an aquarium fish smart farming, android studio, Java, C, Arduino IDE, SQL and Firebase software ware used to develop in this study. Node esp28266 MCU V.2 board, Wemos-D1 boards and module ultrasonic hardware were used to create the control system. This system has been tested with real home mini-aquarium that was built by researchers. The home page is displayed the menu keys such as location name search, arrow selection show, main menu and details that depend on the user selection. Besides, the user can click on the text box and fill in the form to set up the system that can be adapted or change the parameter by themselves. For a backend, the system administrator used to manage the policy such as log-in name and password. This system also offers the administrator to edit or updating more information any time that corresponded to the related information in the database as shown in Figure 4-10.

Figure 4 Aquarium device

Figure 5 The system testing

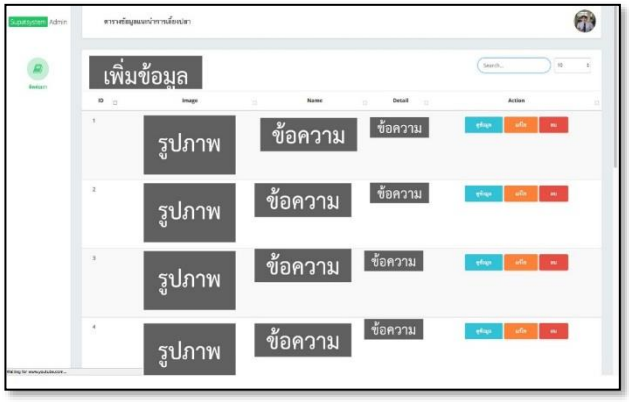

Figure 6 The Backend page

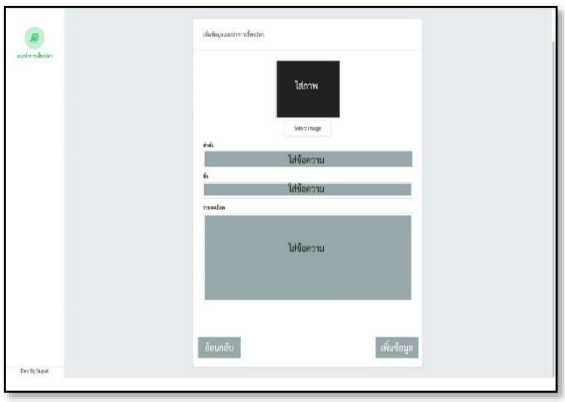

Figure 7 The Fill form page

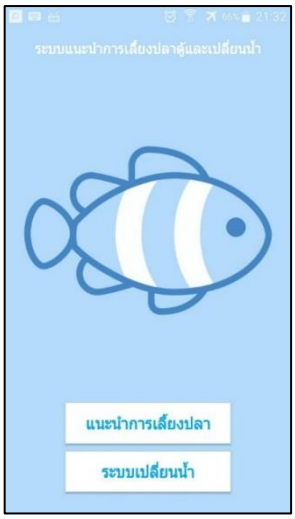

Figure 8 Homepage of mobile application page

Figure 9 The setup page

Figure 10 The recommendation

5.2 Evaluating the performance and satisfaction of mobile application

In the step of evaluating the performance and satisfaction of the web application, we tested and evaluated the performance of the system by using the Black Box Testing and Questionnaires. There are 10 experts and 30 users that were used to test this web application. Black Box testing was estimated in the error of the project as follows: functional requirement test, Function test, Usability test, Performance test and Security test. The functional Requirement test was evaluated the ability of the system to support the requirements of the users and Functional test was used to evaluate the accuracy of the system. The suitability of the system was tested by the Usability test. Performance test was estimated the processing speed of the system. Lastly, Security test was applied to evaluate the security of the system that proposed in Laurie Williams [13] as shown in Table 1 and Figure 10.

Table 1 The results of the Black Box testing of the system

	Experts		Users	
	$\bar{x}$	SD	$\bar{x}$	SD
1. Function Requirement Test	4.31	0.75	4.50	0.76
2. Functional Test	4.05	0.74	4.10	0.67
3. Usability Test	3.95	0.69	3.94	0.68
4. Performance Test	4.43	0.75	4.21	0.74
5. Security Test	4.32	0.76	3.98	0.76
Summary	4.21	0.74	4.15	0.72

The results of the Black Box testing of the system as shown in Table 1 and the chart is Figure 11 that a quality assessment of the system is good in all aspects and Mean were 4.01 and 3.96 and standard deviations were 0.67 and 0.59. In addition, the authors also test the system in real home mini-aquarium in a period of 10 times. The result shows the performance of this design system as well. Thus, it can be concluded that this mobile application is a good use for control an aquarium fish smart farming with IoT and in other fish farming.

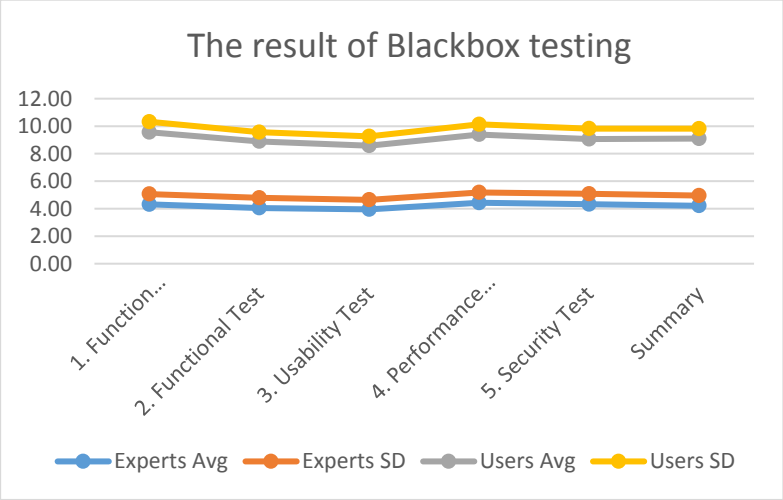

Figure 11 The result of Black box testing

5. CONCLUSION

The work of an aquarium fish smart farming based on the internet of things (IoTs) and mobile application, the system was implemented by using Android studio, Java, C, Arduino IDE, SQL and Firebase software ware used to develop in this study. Node esp28266 MCU V.2 board, Wemos-D1 boards and module ultrasonic hardware were used to create the control system. This system has been tested with real home mini-aquarium that can display system performance as well and easy to use on mobile application. Black Box Testing and Questionnaires were used to evaluate the system that estimated both 10 experts and 50 users. The result showed a statistically significant difference of quality assessment of the system is well in all research objectives. It can be concluded that an aquarium fish smart farming on IoT with the mobile application is a good way and appropriate to apply in other sectors of agriculture of Thailand product.

6. ACKNOWLEDGMENT

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