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Plant Nutrition Monitoring System for Water Spinach Based on Internet of Things

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ABSTRACTS

The concept of plants using a hydroponic system has been widely used. Currently, the weakness in the management of the hydroponic system is the difficulty in managing the nutritional needs of plants. Nutrition is the main requirement for plants with the concept of a hydroponic system. In this research, a system will be proposed that can monitor the nutritional needs of hydroponic plants with a concentration of water spinach plants. The use of internet of things technology is proposed to be able to monitor in real time. With the existence of a monitoring system in real time, it can make it easier to monitor and control the nutritional needs of kangkong plants using a smartphone.

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1. INTRODUCTION

Agriculture is currently implementing the Industrial Era 4.0. The application of technology in agriculture is currently widely used by using the Internet of Things (IoT). IoT is able to provide convenience for monitoring and control in real time to users (Pamungkas *et al.* 2021). IoT is a system that can facilitate autonomous monitoring, control, and management of functions. This concept connects objects, sensors, and devices that enable data exchange (Kurniawan *et al.* 2022). Hydroponics is one of the plant cultivations using water without the use of soil. The amount of water needed in hydroponic cultivation is less than using soil media. In hydroponics, the need for nutrients is the

main thing. A mismatch in the nutrients provided will have an impact on plants such as non-optimal growth, to the death of plants (Wibowo *et al.* 2022).

The cultivation of water spinach plants using hydroponics needs to be monitored for the need and use of the amount of nutrients. Water spinach requires a pH value of 6.0 with a total dissolved solid (TDS) value of 1500 ppm. Providing nutrients with a conventional system can affect the height and number of water spinach leaves (Lestari & Putri 2022). The process of monitoring hydroponic water spinach plants periodically changes the pH value, temperature, and concentration of the nutrient solution. This can cause the pH value to drop and keep changing (Ayudyana & Asrizal 2019; Maulady *et al.* 2022). So, a monitoring system is needed for water spinach plants using hydroponics to be able to determine changes in parameters that affect nutritional needs in real time.

2. METHOD

In this research, two stages of research were carried out, namely the stages in the data collection process and the stages of application design and prototype models. The approach model used is a descriptive model which aims to provide an explanation of the initial stages in the research. Then, the stages of problem design and problem analysis are continued with the development of applications and prototypes to be used.

2.1. Research Stages

The stages of research carried out are shown in Figure 1. The stages begin with problem identification, data collection, design analysis, software development, testing, and conclusions and suggestions.

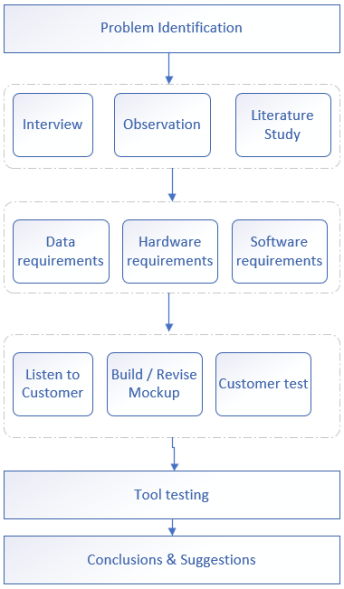

Fig. 1. Research stages

2.2. Software Development

The software development model refers to the stages in the prototyping model. The initial stage begins with the identification of needs with exposure from consumers, design and formation of software, and the final stage is testing the system on consumers. The complete stages and flow are depicted in Figure 2.

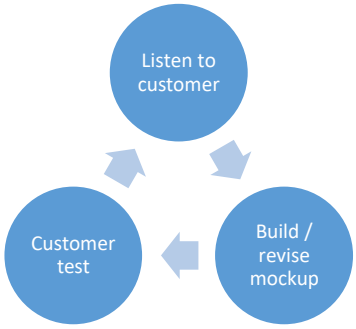

Fig. 2. Prototype model

3. RESULTS AND DISCUSSION

The hydroponic model made in this research consists of 10 netpot holes with 2 levels of water gutters. The plants that become the case study in this research are hydroponic kangkong plants. The

hydroponic is then equipped with the placement of several sensors such as pH, TDS, altitude sensors, microcontrollers, and relays to control nutritional needs. The hydroponic model built is shown in Figure 3.

Fig. 3. Model hidroponic

3.1. Software Implementation

The monitoring process proposed in this research uses a smartphone as a monitoring medium. The application is built with the need for the process of monitoring the nutritional conditions needed in water spinach plants. The results of the implementation of the smartphone application built are in Figure 4.

There are several features in the application that are used to monitor water spinach plants using IoT. In monitoring, there is a process to monitor temperature, pump and TDS conditions. In the data section there is also a history of data that has been monitored. This makes it easier to monitor and control the condition of water spinach plants.

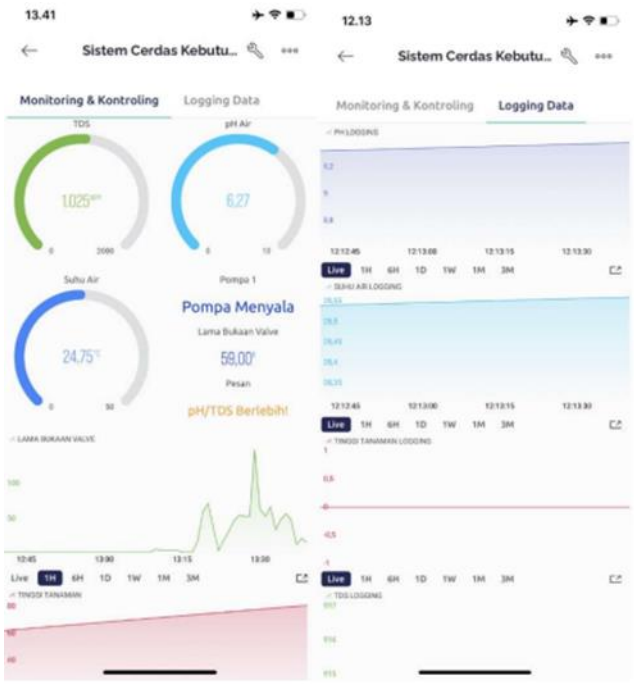

Fig. 4. Application implementation.

In addition to the monitoring process, another important aspect of this research is the process of controlling the nutrients used. The pump application that delivers nutrients can automatically provide nutritional treatment according to the needs and conditions of the plants. In addition, there is also a warning if the pH or TDS value is excessive

3.2. System Evaluation

3.2.1. Sensor Testing of pH, Temperature, TDS, and Nutrient Controls

To test the system that has been built to run as needed, testing of several sensors is carried out. The pH sensor is used in monitoring the concentration value of the nutrients used. To ensure the accuracy of the pH measurement, a comparison of testing the pH sensor using the sensor and using a pH meter is carried out. The test results are presented in Table 1.

Table 1. pH sensor testing

Time (second)	pH meter	pH sensor
5	5,4	4,04
10	5,4	4,11
15	5,4	4,42
20	5,4	4,58
25	5,3	4,08
30	5,3	4,82
35	5,3	3,64
40	5,3	4,34
45	5,3	3,93
50	5,3	3,99

The next parameter test is the use of a temperature sensor using a DS18B20 sensor. The temperature sensor is used to measure the temperature in water and as a reference for the TDS sensor in getting the optimal value. The test results were carried out by manually measuring the temperature and using the sensor. The test results are in Table 2. With the help of applications in monitoring, it is easier to control the process and the need for data analysis (Alviana *et al.* 2023).

Table 2. Temperature sensor testing

Time (second)	Temperature meter	Temperature sensor
5	21,19	21,69
10	21,19	21,69
15	21,19	21,69
20	21,19	21,69
25	21,19	21,69
30	21,19	21,69
35	21,19	21,69
40	21,19	21,69
45	21,19	21,69
50	21,19	21,69

The next test is testing the TDS sensor to measure the liquid concentration value. This test was carried out by comparing the use of sensors and TDS meters. The results are presented in Table 3.

Table 3. TDS sensor testing

Time (second)	TDS meter	TDS sensor
5	962	1020
10	964	1019
15	964	1012
20	965	1015

25	965	1019
30	1340	1020
35	1350	1020
40	1390	1018
45	1390	1021
50	1390	1015

The last test is nutrient control testing for water spinach plants which is used to control nutrient needs automatically. Nutrient control testing is contained in Table 4.

Table 4 Nutritional control

pH before control	TDS before control	pH after control	TDS after control
9,8	931	8,9	1004
9,37	1006	8,98	1009
8,94	1008	8,93	1007
9,61	1013	6,74	1011
8,98	1009	5,99	1008

4. CONCLUSION

The use of nutrient control in water spinach plants using the internet of things can help monitor in real time. Any changes in parameters that occur can be monitored directly and provide convenience in the process of controlling nutrition. With nutrient control, the pH value and concentration can be in accordance with the needs of plants and can provide better growth and development of plants.

REFERENCES

Alviana, S., Ibrohim, Y. M., & Kurniawan, B. (2023, October). Pollen harvest monitoring system using internet of things. In *AIP Conference Proceedings*, 2510(1). AIP Publishing.

Ayudyana, V. (2019). Rancang bangun sistem pengontrolan pH larutan untuk budidaya tanaman hidroponik berbasis internet of things (Solution pH control system fabrication design for the cultivation of hydroponic plants based on the internet of things). *Pillar Of Physics*, 12(2).

Kurniawan, B., Haq, A. H., & Alviana, S. (2022). Nata De Coco Material Monitoring System Using Internet of Things. *Journal of Engineering Science and Technology*, 17(1), 0267-0274..

Lestari, I. P., & Putri, D. N. (2022, June). Efikasi Aplikasi Komposisi AB Mix, Eco Enzyme dan Pupuk Hayati Terhadap Pertumbuhan dan Hasil Kangkung pada Sistem Hidroponik Statis. In *Prosiding Seminar Nasional Hasil Penelitian*

Agribisnis, 6(1), pp. 248-254.

Maulady, A., & Tohir, T. (2022, August). Pengendalian Nilai pH Pada Sistem Hidroponik Nutrient Film Technique Menggunakan Metode Fuzzy Logic Berbasis IoT. In *Prosiding Industrial Research Workshop and National Seminar,* 13(01), pp. 509-516.

Nugroho Setyo Wibowo, S. W., Muknizah Aziziah, A., I Gede Wiryawan, W., & Eva Rosdiana, R. (2022). Implementasi metode regresi linier pada rancang bangun sistem informasi monitoring nutrisi tanaman hidroponik kangkung. *Jurnal Teknologi Informasi dan Multimedia*, 4(1), 13-24.

Pamungkas, L., Rahardjo, P., & Agung, I. G. A. P. R. (2021). Rancang Bangun Sistem Monitoring Pada Hidroponik Nft (Nurtient Film Tehcnique) Berbasis Iot. *Jurnal SPEKTRUM Vol*, 8(2).