Automatic Lobster Feeder Based on Web Integrated with Internet of Things

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Abstract

Freshwater lobsters have a high mortality rate due to poor water quality or cannibalism between lobsters. In the lobster cultivation process, the process of monitoring water quality and feeding is done manually so that it has problems in the monitoring and feeding process that is carried out at night because lobsters are nocturnal animals. This study uses freshwater crayfish with the type of red claw with a total of 20 lobster seeds in 2 ponds with an Internet of Things-based system and integrated web monitoring and without an IoT system. This study aims to build a system that can increase the survival of freshwater crayfish using an IoT-based system called Smart Lobster Feeder. The analytical methods used include Observation, Literature Study, and Interview. The development method used is the waterfall method with 6 stages of the process, namely Planning, Analysis, Design, Implementation, Testing, and Verification. This research uses the ESP8266 microcontroller, ESP32 Cam, water salinity sensor, pH sensor, temperature sensor, ultrasonic, and website monitoring. The results in this study obtained a sensor error rate value of < 1.5%, UAT results of 94%, automatic feeding according to the specified hour, and a survival rate of 100%. From the study results, it can be concluded that the IoT system can increase the survival rate of freshwater crayfish, has a sensor error rate that is by established standards and is a feasible system to implement.

Keywords
Freshwater lobster, ESP8266, ESP32, IoT, dashboard monitoring

1. Introduction

IoT is a system architecture consisting of hardware, software, and the Web (Prihatmoko, 2016). and society to become more efficient. IoT is an important element to support the Indonesian government's roadmap of Making Indonesia 4.0 (Jamaludin, et al., 2020) IoT technology is one of the solutions made to restore the economy in Indonesia during the COVID-19 pandemic, especially in the fisheries sector. Based on data from the Central Statistics Agency (BPS) (Direktorat Jendral Perikanan Tangkap, 2021) the value of the Gross Domestic Product (GDP) of Fisheries in the Second Quarter of 2021 is IDR 188 trillion or 2.83 percent of the value of National GDP. This GDP value increased compared to the first quarter of Rp. 109.9 trillion or 2.77 percent of the value of the National GDP. One of the biggest contributors to the increasing value of fisheries GDP in Indonesia is freshwater crayfish aquaculture.

Freshwater lobster (genus Cherax) comes from Australia, Papua New Guinea, and Irian Jaya, with different species. One of the species with the highest economic value isCherax quadricarinatus (red claw) habitat Cherax is shallow freshwater, with a muddy substrate and plenty of crevices and cavities for hiding. Freshwater lobster has a high mortality rate. Deaths are mainly caused by poor water quality or being eaten by other lobsters during molting. As in other fish farming, disease prevention is carried out by keeping the water and ponds clean, providing adequate nutrition, and maintaining the cleanliness of equipment related to freshwater crayfish, such as hiding places, shelters, and the natural food provided by the lobsters.

Following the business opportunities for freshwater crayfish cultivation in Indonesia, the author wants to innovate by making freshwater crayfish cultivation based on the Internet of Things to provide convenience in monitoring water quality and the survival rate of freshwater crayfish. Currently, water quality monitoring is carried out by looking at the turbidity of the pond water, draining the pond according to a schedule every two weeks, and feeding manually, so that the existing water quality is not to the characteristics of freshwater crayfish and feeding is not by the lobster hours. activity because lobsters are nocturnal animals that are active at night so there are no employees on guard.

Departing from this problem, the author innovated a device called the Smart Lobster Feeder. Smart Lobster Feeder is a web-integrated IoT-based device for monitoring pond water quality, automatic feeding according to a specified schedule and monitoring pond conditions using cameras. The author hopes to contribute to the existence of a Smart Lobster Feeder that can make it easier for companies to monitor freshwater crayfish aquaculture. The Smart Lobster Feeder is equipped with various sensors that can help determine water conditions, such as water temperature conditions, water pH levels, and salinity and use ESP32CAM to view pond conditions using a camera. The condition of the lobster pond will then be monitored on the web to determine the appropriate treatment regarding the conditions displayed on the web dashboard.

2. Literature Review

Research results from (Oktafiana, 2021) use the Arduino UNO microcontroller and are equipped with a DS18B20 sensor to measure temperature, an MQ137 sensor to measure ammonia gas levels, Servo motors as actuators and relays. The value read by the sensor will be sent to *the Firebase database*. This research has a drawback, namely, the monitoring system that is carried out is only a tool and does not rely on seeing environmental conditions in *real-time*. In addition, the data displayed is also *real* without being able to see the data that was previously obtained by the sensor. The advantages of this study are the performance of the DS18B20 sensor is quite good because it is still below the tolerance value limit of 3% and temperature testing and automatic feeding 2 times a day are carried out for 7 days.

Research conducted by (Kurniatuty, 2019) uses an Arduino Mega microcontroller with a pH sensor to measure the pH level of dissolved water, an ultrasonic sensor to measure the amount of feed, and a DS18B20 sensor to measure the temperature of the water which will be sent to *database* MysqlHas the advantage of having a *website monitoring* to control the servo and the microcontroller is small, but has drawbacks in the form of not having a camera to monitor the lobster pond, there is no amount of feeding that is by the provisions, namely 2 times a day at night.

According to research (Ansyah, 2020) using an Arduino Uno microcontroller with a pH sensor, DS18B20, and a turbidity sensor. The data generated from the sensor is sent to the *firebase* as a *monitoring system* in *real-time*. This study has the advantage that the sensor data from the sensor is sent in real-time and is *multisensory*, but the disadvantage that the *protocol* used is MQTT without using a request first to the server used.

According to research (Afifah, Rosadi, & Hafiz, 2019) using a Raspberry Pi and Raspi Cam microcontroller with a DS18B20 sensor to measure temperature, and an ultrasonic sensor to measure pool water level. The value read by the sensor will be sent to *the firebase database* to then be displayed on the android application. It has an advantage. Having an android application for *monitoring* and having a camera to monitor the security of the fish aquarium, but has a disadvantage where the fish aquarium does not have a pH sensor so it can not monitor the pH of the water.

According to research (Nocheski & Naumoski, 2018) Fish and living, things that live in water have specific characteristics and require several appropriate environmental parameters so some fish cannot live in a certain environment. This will require more effort when moving their residence to a pond, starting from maintaining water quality such as temperature, turbidity, nutrients, and others. This can be overcome by maintaining water quality by the standards of each living creature. In addition, according to (Ramya, Rohini, & Ravi, 2019) in raising fish raised in different areas, there are problems when the feeding process. One example is an excess of feed or a difference in feed which causes the pond to become dirty which will cause the fish to die. This can be overcome by making an Arduino and Web-based IoT system to monitor the feeding system.

According to research (Putra, 2021)lobsters have a standard of living quality that affects water quality. Water quality has a function that affects the life of the lobster. Water quality is closely related to minerals in the rock, salt, dust and wind. Table 1 describes the standard standards of lobster water quality.

Table 1. Standards for Freshwater Lobster Pond Water Quality

Parameter	Value
Temperature	24 – 29 ºC
Salinity	25-80 ppm
pH	6.5-10

The results of the study will be carried out 3 trials to see the resistance of the system carried out and see whether the system created has answered the problem of the quality of life of the lobster used. The first test is to make sure whether the system variables used can function properly and as expected. Sensor test tests are carried out alternately and are carried out for each sensor used and the system used.

The second test is to do a *User Acceptance Test* (UAT). According to (Pratama, 2018) UAT is a series of test steps of an application that has been made using a mutually agreed format to know the extent of user understanding and the effectiveness of the applications that have been used. And see if the application that has been made can meet user needs and can solve problems that occur. Each answer chosen from the respondents will be given a value according to the existing weight. The calculation is done by multiplying the total score of each assessment divided by the total highest score multiplied by 100. The formula for calculating the interval index is described in Equation 1

$$Interval\ Index = \frac{Total\ Questionnaire}{Value\ Maximum\ questionnaire\ value} x\ 100\% \tag{1}$$

The UAT process that has been carried out will later be concluded as the result of the feasibility test. The measurement scale used is the Likert scale. According to (Maryuliana, Subroto, & Haviana, 2017) the Likert scale is a measurement scale that has several questions that represent individual characteristics, such as knowledge, attitudes, and behavior. The Likert scale is a psychometric scale commonly used in questionnaires and the most widely used scale in research is in the form of surveys. The Likert scale is often used as a rating scale because it gives a value to the selected answer for quantitative analysis data, and the format of the answer can be given weight. The total score from the questionnaire results obtained is calculated according to Equation 1. The results of the calculation will be compared with the feasibility weight table as described in Table 1.

Table 2. UAT Assessment Weights Assessment

Description	Values	Weighted	Value (%)
5	SS	Strongly Agree	80 -100
4	S	Agree	60-80
3	N	Neutral	40-60
2	TS	Disagree	20-40
1	STS	Strongly Disagree	0-20

The next test is to calculate the *survival rate*. According to (Purnamasari, Erwan, Wiryawan, & Nurmaya., 2017) the *survival rate* is carried out to determine the survival rate of the object under study. The calculation is obtained by comparing the number of research objects at the beginning of the study compared to the number of objects at the end of the study. Survival rate calculation is described in Equation 2.

$$Survival\ Rate = \frac{Nr}{No} x\ 100\% \tag{1}$$

Description:
SR : *Survival Rate*
Nr : Number of research objects at the beginning of the research
Nt : Number of research objects at the end of the research

From the research that will be carried out has the aim of increasing the productivity of aquaculture in the field of fisheries, but from some studies, more emphasis is placed on *monitoring* water quality, research This emphasizes not only being able to monitor water quality but also emphasizes the hours of feeding freshwater crayfish, the survival rate of lobsters, and CCTV cameras for *monitoring* the state of the pond. Freshwater lobsters will still get fed automatically at night without the need for officers to feed manually. In this study, it is proposed to use ESP32CAM as CCTV to monitor the situation around the pond whether there are dead freshwater crayfish or lobster predators. In addition, this study also proposes the use of a controller with the ESP8266 type. This type of controller already has a wifi module so users can view the pool CCTV from the *website monitoring* that has been hosted and feeding using the schedule provided by *the website*.

3. Methods

The research method used is the waterfall method. This research stage begins with the identification of the problem, namely how to create a feeding system and a freshwater crayfish monitoring system that is automatically integrated on the website to increase the liveability of the freshwater crayfish and the quality of the pond water of the lobster. The next step is a literature review, the purpose of the literature review is to find out the problems that exist in the same research that has been done before and see the shortcomings of previous studies so that they can provide better solutions to these problems. After conducting a literature review, the next stage is to design an IoT system and monitoring website so that it is by the proposed model by using sensors that are to the existing problems. Next is the identification of the need to create an IoT system and monitoring website, begin to identify software and hardware needs in building the system, after making a Lo-Fi display design from the website and design the IoT system and its sensors, then coding on the controller so that IoT can work to capture and processing data and coding on the website so that the values read by the IoT sensors can be displayed in real-time on the website dashboard page. After the process of designing the IoT system is complete, testing is carried out, at the testing stage calibration will be carried out between sensors and measuring instruments sold in the market and the user interface from the website. If the test results are appropriate, the next stage is implementing the system in freshwater crayfish ponds and conducting observations, data collection, and evaluation of the survival rate of lobsters and pond water quality. After the observations and the results obtained from the observations were recorded as conclusions and reports on the results of research observations. The research stages are described in Figure 1.

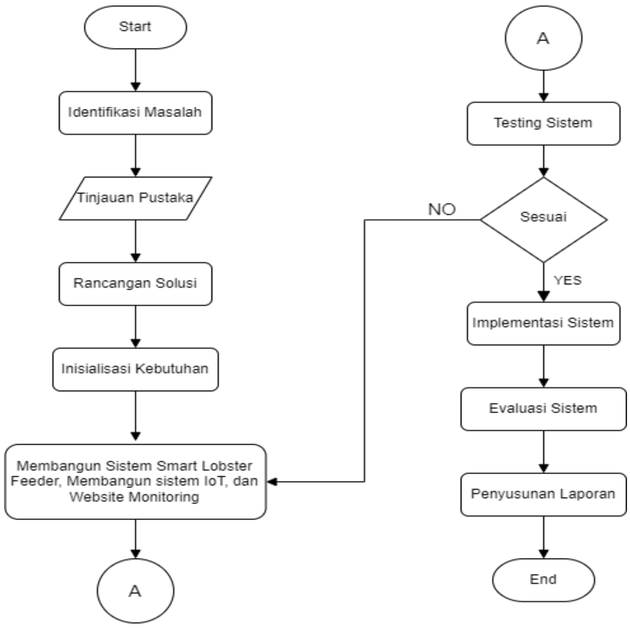


Figure 1. Research Stages

Parameters such as temperature, salinity, and pH that have been read on the sensor will be entered in *a database* that will be displayed on the web. In ade applied system also creates a *threshold* that has been previously set as a sign that the water used will exceed the standards set in Table 1. This sign is an alarm that will sound on the equipment used as a sign that the water used has exceeded set standards.

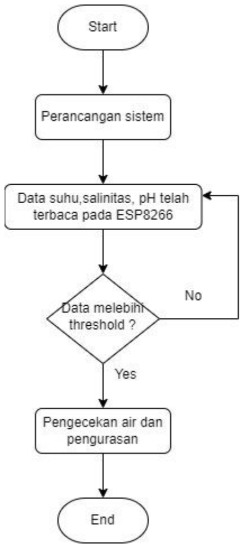


Figure 2. IoT Alarm System

3.1. Data Collection

There is a problem with lobster growth, namely the high mortality rate of lobsters caused by poor water quality and feeding that is not by the dose. One of the preventions that can be done is to maintain the cleanliness of the pond, maintain water quality and provide food according to the size of the lobster. Making a water quality monitoring system and automatic feeding can make it easier to maintain water quality because of the data such as temperature, pH, salinity, and how much food is available in the container.

The work system of the IoT that is made is the data of all sensors used that are connected directly to the database where the database will be connected to the web that has been created. In addition, on the web created there is also a video which is video streaming data from ESP32 which displays real conditions at the location through the camera. The feeding automation system is implemented by making a container that will provide food automatically with the help of a servo motor that will open the valve according to the set time. Lobsters are nocturnal animals or which means lobsters have more activities at night so feeding is done at night.

4. Results and Discussion

In the research conducted, the system created produced 2 types of products, namely an IoT hardware system containing sensors and cameras and a *dashboard* web *monitoring* for *monitoring* the entire system. The implementation of the IoT system and the IoT *Web Dashboard* is shown in Figures 3 and Figure 4.

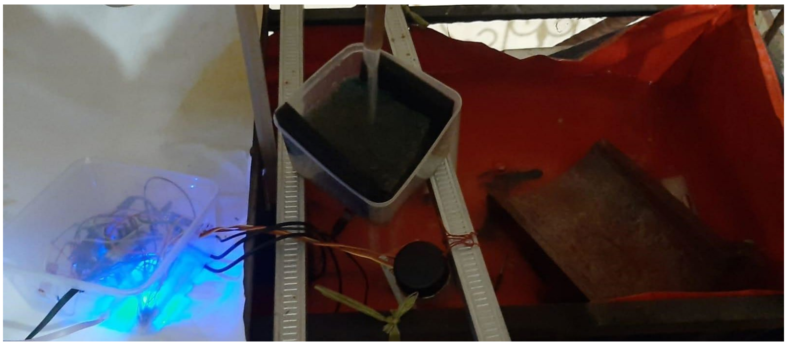


Figure 3. Implementation of the IoT System

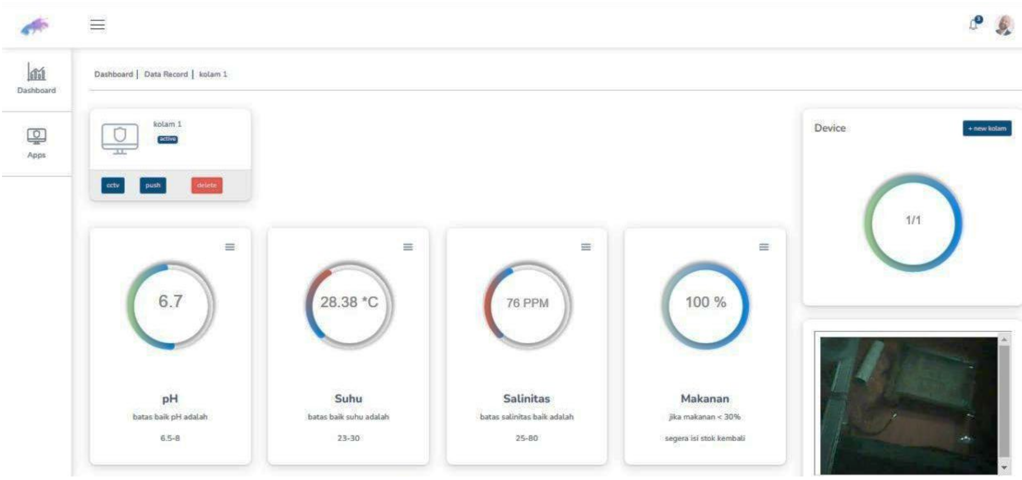


Figure 4. Implementation of *Dashboard Monitoring* IoT

The implementation of the IoT system that has been implemented, will be carried out in several stages to conduct system testing to ensure the system used is by the research objectives or not.

4.1. Sensor and web testing based on scenarios

Sensor test testing are used to ensure whether the *variables* used can function properly and as expected. Sensor test tests are carried out alternately and are carried out for each sensor used and the system used. This trial was carried out based on several predefined scenarios to see whether the system built had achieved the desired expectations from the existing goals. Table 3 describes the process of system testing stages based on scenarios.

Table 3. Testing System Based on Scenario

No.	Testing	Expectations	Appropriate	
			Yes	**No**
1	Dallas Sensor	Can display temperature data from sensor	✓	
2	pH sensor	Can display pH data from sensor	✓	
3	TDS sensor	Can display salinity data from sensor	✓	
4	Automatic feeding system	Can provide automatic feed	✓	
5	*Dashboard* Web *Monitoring*	Can display sensor data in real-time	✓	
6	video display system	Can display the situation and condition of the pool in real time	✓	

4.2. Sensor testing with the web

This test is carried out to determine whether the value read on the measuring instrument is the same as the value read on the sensor, the value that has been obtained by sensors can be sent and displayed in *real-time* by *dashboard monitoring* and automatic feed system every 12 hours.

(a) (b)

(c) (d)

Figure 5. Measurement of the state of the lobster pond with measuring instruments

Figure 5 describes the measurement process with measuring instruments. Figure 5. a is a pH measurement with a pH meter. Figure 5. b is a measurement of Salinity with a TDS Meter. Figure 5. c is a measurement of temperature with a thermometer and Figure 5.d is a measurement of a lot of what's wrong with a ruler. After measuring with the measuring instrument in the picture above, the results of the measurement of the water pH measuring instrument are 7.8, the TDS meter is 78ppm, the digital thermometer is 29.8^{o}C and the ruler is 3cm. The values that have been obtained on this measuring instrument will be compared with the sensor values displayed on the web *dashboard monitoring*.

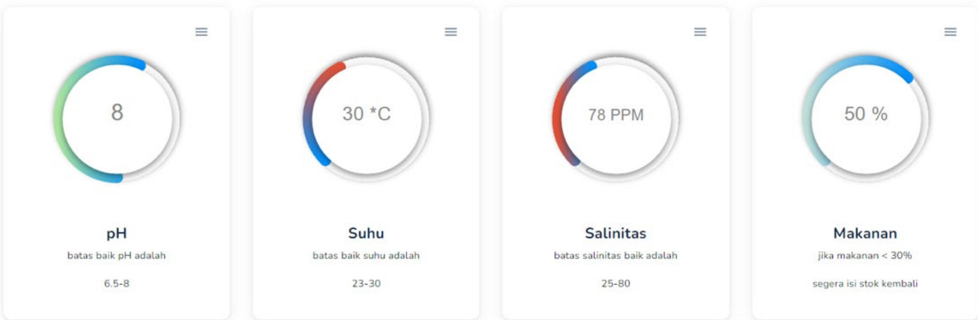
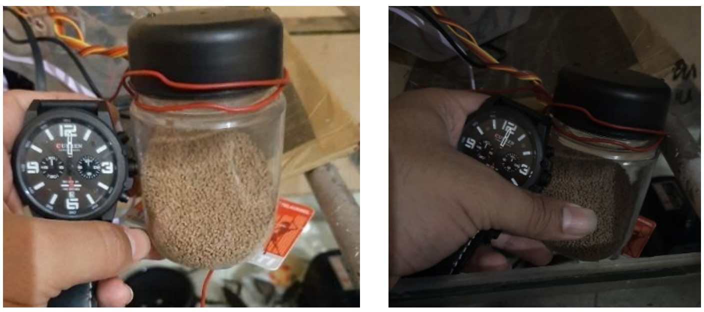


Figure 6. displays sensor values on the *dashboard monitoring*

The next test is the automatic feeding system. This system is made with a network that has been integrated with *the database* using the system will get input in the form of commands that will be given automatically according to a predetermined hour. *the server* will automatically provide input to servo.php every 12 hours starting when the edit line button is clicked. This mebyta in *the database* changes, the valve on the servo motor will move automatically and the command will repeat itself according to a predetermined hour.



(a) (b)

Figure 7. Automatic Feeding

Figure 7.a describes the data collection process for automatic feeding at 12:00 WIB and Figure 7.b describes the automatic feeding data collection process at 00:00 WIB. The picture shows that the servo valve will open once every 12 hours starting at 00:00 WIB and will open again at 12:00 WIB. The selection of working hours for automatic feeders is 00:00 WIB and 12:00 WIB according to the freshwater crayfish feeding hours, namely during the day and at night.

4.3. User acceptance test

User acceptance test is carried out using the questionnaire method. The questionnaire was conducted using an *online* via google form. The number of respondents from the questionnaire conducted was 10 people. The questionnaire was conducted to ascertain whether the IoT and web systems that have been used are in accordance with the wishes of potential users. The results of this questionnaire will be used to measure several indicators such as the ease of use of the application, the beauty of the design and the suitability of the concept and purpose of making the application. To find out the responses from respondents to the web that has been made, then the questions are given to 10 respondents with a total of 10 questions with each question having an answer that has a different weight value. UAT results are shown in Table 4

Table 4. UAT test results

No	Questions	Answers				
		SS	S	N	ST	STS
1	Attractive web display	6	4			
2	Features on the web are easy to use	5	5			
3	existing features are complete	3	7			
4	Display of *realtime* sensor data on the web is easy to understand	7	3			
5	Display analytics data from sensors on the web is easy to understand	7	3			
6	Display data from the TDS sensor appears on the web	7	3			
7	Display data from the ultrasonic sensor to generate data on the amount of food to appear on the web?	6	4			
8	Display data from the temperature sensor appears on the web	7	3			
9	Display data from the pH sensor appears on the web	6	4			
10	display of pool conditions *appears* on the web	6	4			

Based on the data obtained from the results of the questionnaires that have been distributed and calculated using the linkert scale, the results obtained are in accordance with Equation 1

$$Index\ Interval\ = \frac{Total\ Value\ of\ Questionnaire}{Maxim5\ categories\ areonnaire} x\ 100$$

$$Index\ Interval\ \frac{460}{500} \times 100$$

$$Interval\ Index\ =\ 94\%$$

Based on the data obtained from the results of the questionnaires that have been distributed and calculated using the Linkert scale, the results obtained in accordance with Equation 1 are 94%. These results explain that the user strongly agrees if the system is implemented. When compared with Table 2, the UAT results can be concluded to mean that prospective users strongly agree with the results of making the

4.4. Survival Rate Testing

Survival Rate testing is done by comparing the survival rate of lobster ponds using an IoT system with lobster ponds without an IoT system. The testing process is also carried out by monitoring the system for 2 weeks. The condition of the pond is in the same location, the same type of water, and with the same age of lobster seeds, which is 2 months. One of the objectives of this research is to maximize the survival of lobsters. After 2 weeks of observation, it will be seen how many lobsters survive and a comparison will be made between lobsters monitored using the IoT system and without using the IoT system. Parameters to see the survival of lobsters will be calculated *Survival Rate* from 2 pond conditions, without using the IoT system. The calculation of the survival rate is described in Equation 2.

In existing ponds, water quality measurements are taken every morning around 08:00-09:00 WIB to see the quality of the pond water and whether there are dead lobsters. In addition, they also provide feed around 17:00 WIB because more than 17:00 WIB the office conditions have begun to be quiet and there are no employees to supervise and *monitor* the pond. Feeding at 17:00 WIB is not effective because lobsters are *nocturnal* animals or animals that are active at night so the food provided will not be eaten by lobsters and will become sediment which makes the pond dirty.

The process of measuring water quality is carried out every morning by taking manual measurements using measuring instruments such as thermometers, pH meters, and TDS meters. The results of manual measurements using measuring instruments are shown in the following Table 5.

Table 5. Results of Measurement of Water Quality and Number of Lobsters Without IoT

Week 1 (25 March 2022-31 March 2022)								
	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Average
Temperature	28.3	28	28.4	28.8	28.4	29.1	28.1	28.45
Salinity	76	77	77	79	81	83	86	79.857
pH	7.6	7.6	7.7	7.8	7.8	7.8	7.8	7.728
Number of Lobsters	20	20	20	20	20	20	20	20

Week 2 (1 April 2022 – 7 April 2022)								
	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Average
Temperature	29.5	27.9	28.6	28	28.4	28.6	28.1	28.442
Salinity	88	91	92	95	100	113	136	102.142
pH	7.9	7.9	7.9	8	8	8.1	8.3	8.014
Number of Lobsters	20	20	20	19	19	19	17	19.142

Table 5 is the result of measuring the quality of lobster pond water without an IoT system. There are 5 categories that are measured to determine the level of quality of life of lobsters, namely: Temperature, salinity, pH, and number of lobsters. Measurements were carried out for 14 days with a total of 20 lobster seeds. In the first week of measurement, the temperature had an average value of 28.45, salinity had an average value of 79.857, pH had an average value of 7.728, and the number of lobster seeds was 20. In the second week the temperature measurement had an average value of 28.442, salinity had an average value of 102.142, pH had an average value of 8.014, and the number of lobster seeds was 19.142. Based on observations, the number of lobsters decreased due to mortality caused by high levels of salinity and pH increased at the end of the week of observation. Figure 8 shows a lobster that has died during the observation process

Figure 8. Lobster died during the observation process

Observations using IoT were carried out for 2 weeks by *monitoring* the *dashboard* to ensure the availability of lobster food capacity and the value of the sensor. Monitoring of water quality in pools using the IoT system is carried out automatically and sensor values will be sent every 10 minutes. This means that in the *monitoring* carried out, different data will be obtained every 10 minutes in 1 day. Calculation of sensor data per day is done by calculating the average value that is read so that the data shown in the following table is obtained.

Table 6. Results of Measurement of Water Quality and Lobster Number with IoT

Week 1 (25 March 2022-31 March 2022)								
	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Average
Temperature (^{0}C)	26.531	26.442	26.564	26.321	26.443	26.556	26.541	26.485
Salinity	77.688	77.503	77.545	77.333	77.535	77.375	77.375	77.479
pH	6.773	6.741	6.771	6.750	6.742	6.733	6.741	6.750
Feed (%)	100	100	83.33	83.33	83.33	66.66	66.66	83,33
Number of Lobsters	20	20	20	20	20	20	20	20

Week 2 (1 April 2022 – 7 April 2022)								
	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Average
Temperature (^{0}C)	26.492	26.913	26.788	27.083	26.933	26.445	26.810	26.781
Salinity	77.215	77.615	77.366	82.160	77.597	77.493	77.597	77.720
pH	6.745	6.741	6.759	6.917	6.739	6.770	6.756	6.775
Feed (%)	66.66	50	50	50	33.33	33.33	100	100
Number of Lobsters	20	20	20	20	20	20	20	20

Table 6 is the result of quality measurement s lobster pond water using an IoT system. 5 categories are measured to determine the level of quality of life of lobsters, namely: Temperature, salinity, pH, p, and number of lobsters. Measurements were carried out for 14 days with a total of 20 lobster seeds. In the first week of measurement, the temperature had an average value of 26,485, salinity had an average value of 77,479, pH had an average value of 6,750, and the number of lobster seeds was 20. In the second week, the temperature measurement had an average value of 26,781, salinity had an average value of 77,720, pH had an average value of 6.775, and the number of lobster seeds was 20. The results of these measurements will be used for *survival rate* and to compare whether the existing water quality is to the lobster water quality standard.

Based on Table 6, lobster ponds that use the IoT system have much better quality because in the *monitoring* there is an indicator value that will be a benchmark if the sensor value that is read exceeds a predetermined standard, then the pond needs to be drained. In addition, the *monitoring* also makes it easier for employees to automatically feed.

To see the level of comparison of *survival rates* between systems with IoT and without IoT, look at the comparison between the number of lobsters that survived until the end of the study from each system used. The comparison of Survival Rate between systems with IoT and without IoT is described in Table 7.

Table 7. Comparison of Survival Rate with IoT and Without IoT

Week	With IoT	Without IoT
1	20	20
2	20	17
Survival Rate (%)	100	85

Table 7 is the result of the calculation of the *Survival Rate* of lobster seeds that use the IoT system with no IoT system. calculation of *Survival Rate* is done by observing the number of lobsters in the first week of the study and the second week of the study and then a comparison is made between systems using IoT and without IoT. The calculation of the *Survival Rate* described in Equation 2 shows that the *Survival Rate* from lobster ponds that use the IoT system has a better level of 100% compared to systems without IoT, which is 85%. One of the influencing factors is that the system using IoT will be drained when the paraWednesdayvalueThursdays is the standard that has been set according to the lobster pond water quality standard in table 1. while for systems without IoT, the drain is carried out according to a predetermined schedule, which is every 2 weeks.

5. Conclusion

Based on the results of the analysis of the research conducted, the design and implementation of the Smart Lobster Feeder can Wednesdayse the effectiveness and efficiency of freshwater crayfish cultivation by helping field officers to feed automatically at night and during the day. This system also helps officers to monitor the water quality of the lobster pond to determine the schedule for draining the pond following the freshwater crayfish pond water quality standards. Smart Lobster Feeder works by displaying the data read on the sensor to the dashboard IoT monitoring that has been made, starting from the DS18B20 sensor, TDS sensor, pH sensor, an ultrasonic sensor. the dashboard that has been created will also display the state of the pool directly using the ESP32-CAM that has been set to view the condition of the pool in real time. The results of the system implementation carried out for 2 weeks also showed the Survival Rate of lobster ponds using the IoT system had a higher level of 15% when compared to the Survival Rate from lobster ponds without an IoT system. This shows that ponds with IoT systems have maintained water quality because draining is carried out if the existing parameters increase and the scheduled lobster feeding hours every 00:00 WIB and 12:00 WIB helps to prevent the occurrence of feed deposits in the lobster pond.

Based on this research, the author has several suggestions such as using an ESP32 CAM which only has VGA resolution so that the results of the video displayed have poor quality. The suggestion from this is to use an IP Camera or IP CCTV that is connected to the internet to produce much better video quality.

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