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Automatic Fish Feeder Control System Based on Arduino Mega, Integrated with Web and SD Card at BPPBAT

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The topic is gotten after doing some problem analyzing on BPPBAT. this controlling system use six metode analysing, designing, implemetation, testing, devolepment analysing and development. at every metode is done by detailed for apropriate result as needed.Automatic Fish Feeder Controller system need important component like arduino mega 2560, arduino ethernet Shield, Wireless Router, Real Time Clock (RTC), Liquid Crystal Display (LCD), Sd Card, Servo MG946R, Servo MG996R, Load Cell HX711, PSU Module LM2596S and Buzzer. the implementation automatic fish feeder controller system at bppat is to faccilitate cultivating freshwater fish on pond process. arduino mega will process the data when time for feeding the fish is come. fish feeding time is set automatically on arduino mega system. meanwhile servo is used for opening food container and load cell is used for wheigh the food for appropriate dose. result of the food weigh will be presented on lcd 16x2 and local web for monitoring system status and will be keep on sd card in xls format.

Keywords: Arduino Mega, servo, Arduino Ethernet Shield, web, Load Cell

INTRODUCTION

In fish farming activities, feed is a very important factor for fish growth (Mahyuddin, 2013; Simanjuntak et al., 2015). With proper and proportional feeding, farmed fish will grow to their full potential (Saparinto, 2014; H. Susanto, 2014). Conversely, choosing the wrong feed can result in suboptimal harvests and even losses. Quality fish feed is not only determined by quantity, but also by its nutritional value. The purpose of feeding is basically to provide nutritional needs for good health, growth, and optimal harvest.In practice at BPPBAT, the process of checking pond conditions and preparing fish feed is still largely done manually, which has a high potential for failure (Himawan & Yanu F, 2018). Manual, uncontrolled feeding is not only costly and inefficient, but also risks damaging the basic quality of the pond due to organic waste that reduces the redox potential of the sediment (Wiyoto et al., 2022). Cultivation systems that are not well managed or rely solely on manual monitoring have a high potential for failure; therefore, a system is needed that can simplify management steps and minimize the risk of failure (Siskandar & Kusumah, 2019).The integration of automatic controls greatly helps in maintaining optimal pool conditions and reducing the intensive physical workload of manual pool management (Jamiu, 2019; Siskandar et al., 2020).

To make it easier for BPPBAT agencies to monitor fish feeding in certain ponds, a tool is needed that has the ability to monitor and track feed conditions in ponds in real-time and automatically. This automated system will weigh and dispense fish feed that changes over time, and the results can be viewed on a 16x2 LCD screen (Barbosa Silveira, n.d.) and local network web.Today's IoT-based prototypes emphasize the importance of real-time data access via web

applications to increase ikan productivity (Jibon et al., 2024).Monitoring systems can provide an easy approach to obtaining accurate data or providing notifications on the status of the applied sensor measurement process (Siskandar et al., 2023). Changes in fish feed weight data are stored on an SD card in .xls (Ms. Excel) format. For long-term evaluation purposes, the system integrates an SD card for data storage. Using this external storage medium is considered far more efficient for continuous data recording than manual recording methods (A. Susanto et al., 2020).

METHODS

1 .Development Analysis

After testing the tool, its performance will be observed. If the tool works well and is in line with the objectives but there are still functions or developments that need to be added, this stage will be carried out. This stage will be the initial stage in the tool development process. This stage consists of analyzing the needs and designing the additional functions or developments (Lindgaard et al., 2006)

2. Development

This stage involves the creation of the tool in accordance with the additional functions or developments. This stage is the final stage in the development process and also the final stage in the field research methodology. This stage involves the creation of the tool as well as testing the results of the development (Muslihi, 2025).

RESULTS AND DISCUSSION

1.Development Analysis

Based on the methodology used in the Field Work Practice study, a development analysis was created as a follow-up to the tool created in the Field Work Practice. The analysis consists of a development analysis and an analysis of the tool development requirements. The development analysis of the tool created in the PKL study consists of the development of the tool's functions. The tool's functions will be added to the data storage section called the data logger and the display of feed weight measurement results on the web. The benefits of developing the data logger and feed weight measurement results on the web are to help secure data properly, avoid data loss, conduct real-time observations, help read feed weight measurement results on the web, and help streamline time.

The limitation of this tool's development is that the weighing data is stored every 5 seconds on an SD card in spreadsheet format (.xls). The data stored is real-time weighing data. A data logger is an automatic process of collecting and recording data from sensors for archiving or analysis purposes. Sensors are used to convert physical quantities into electrical signals that can be measured automatically and ultimately sent to a computer or microprocessor for processing. Data loggers can record data over time, either integrated with internal sensors and instruments or with external sensors and instruments. In short, a data logger is a tool for performing data logging. It is typically small in size, battery-powered, portable, and equipped with a microprocessor, internal memory for storing data, and sensors.

2.Development

The previous system, the Arduino Mega-based Web-Integrated Automatic Fish Feeder, used Arduino Mega 2560, MG946R Servo, MG996R Servo, HX711 Load Cell, LCD, Buzzer, and RTC components. The previous system focused on the performance of the device, with feeding carried out three times a day at 250 grams per feeding until the total weight reached 1 kg gradually, and monitoring of the device on the web during feeding times.

Journal of Applied Science, Technology & Humanities
Volume .., Issue .., Month, Year, Pages

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In this final project, the system will be enhanced with a default menu and web-based controls. The default menu displays the previously developed system's performance, where feeding is done three times a day with a weight of 250 grams until the total weight reaches 1 kg gradually. Then, the control menu displays a form for the desired weight with a maximum weight of 400 grams per stage. In addition, an SD card will be added as a data storage medium. The results of the weighed weight will then be displayed on the web as history and can be downloaded in Excel format.

2.1.Hardware Development Design Stage

After development, a block diagram design was carried out, and program code was created based on the block diagram. Then, the entire tool was created. The creation of the tool began by replacing the existing program code in Arduino Mega with new program code (Kadir, 2013). The block diagram design can be seen in Figure 1. The tool's workflow in the form of a development flowchart can be seen in Figure 2.

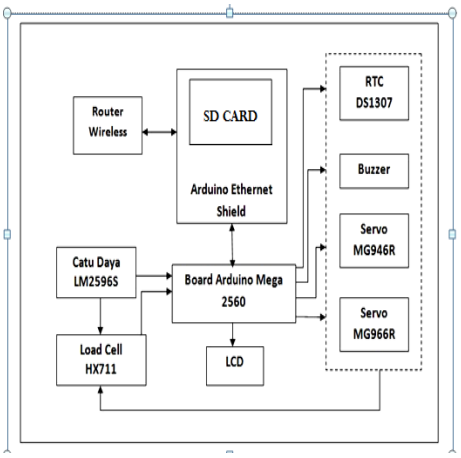

Figure 1 Development Block Diagram

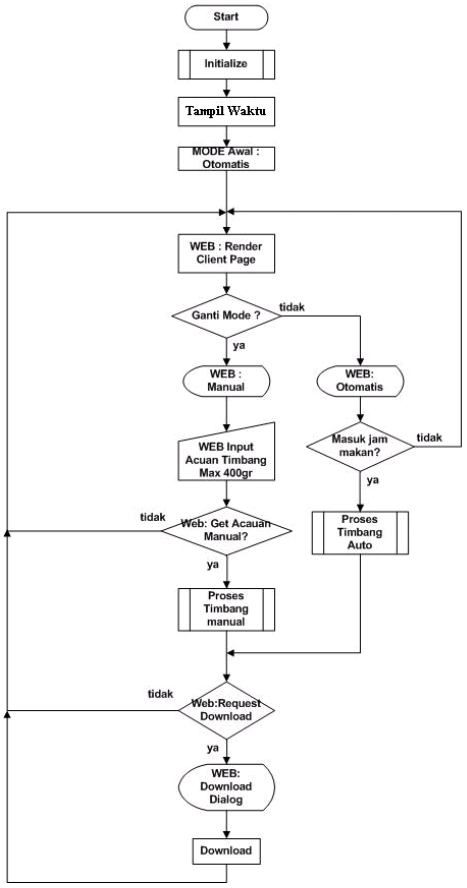

Figure 2 Development Flowchart

2.2 Development of a Fish Feeding Device Control System

Several developments have been made to the automatic fish feeding system controller, namely:

1.Turn on and run the fish feeding device with an adequate power supply.

2.Initial Mode The device operates in automatic mode. The web can be monitored; if the web server is accessed, the button status will read AUTOMATIC.

3.In both automatic and manual modes, the fish feeding status will be displayed according to whether it is feeding time or not.

4.If you want to switch to manual mode, press the button labeled “AUTOMATIC” and the mode will change to manual, but the word ‘MANUAL’ will appear instead of “AUTOMATIC” on the button after 5 seconds, because the website uses HTML technology. The browser will then refresh according to the HTML header script that is sent.

Journal of Applied Science, Technology & Humanities
Volume .., Issue .., Month, Year, Pages

ISSN 3032-5765
DOI:

5.In manual mode, users can input feed weight without feeding time restrictions, with a weighing limit based on text data submitted to the server, up to a maximum of 400 grams.
6.The weighing data will appear in the table as stored in the server memory, so if it is turned off, the data in the table will be lost. The assumption is that the device is on 24 hours a day, and after 11:59 p.m. WIB, the data in the table will be deleted and stored on the microSD card.
7.The weighing results will be recorded in the ikan.xls file located on the microSD card. To download, press the download button and then save.
8.The weighing results are stored on an SD card in .xls (Ms. Excel) format. Data is stored every 5 seconds.
9.How to access the web by activating the wireless router with the ID “tekom” and password “tekkom49”. Enter the IP address 192.168.1.83. This can be seen in Figure 3.

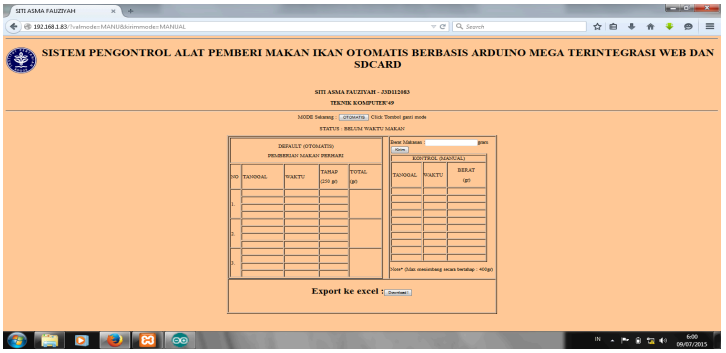

Figure 3 Development Web View

2.3 How the Fish Feeder Control System Works Development Stage

The device works by using a power supply that provides 12 volts to the wireless router and Arduino Mega 2560 microcontroller. The microcontroller reads the system that has been created, then the RTC regulates the time. The HX711 Load Cell sensor and Servo are automatically activated. In the construction of the automatic fish feeder, the LM2596S Power Supply is used to provide current and stabilize the voltage to the MG946R Servo, which is used to open and close the food dispenser. The MG996R Servo is used as a drive to dispense food into the pond. The ATMega 2560 microcontroller controls the operation of the device, and the HTML web storage media provides remote network access for users by utilizing the local host IP. The IP owned by the Ethernet shield is 192.168.1.83. The DS1307 RTC (real-time clock) provides real-time timing. The HX711 load cell is used to weigh the fish food according to its measurement. When the device starts operating, the time and weighing results can be viewed on the 16x2 LCD. Additionally, it can be accessed remotely via the local network to monitor the device's operational status, and the weighing history is stored on the SD Card.

3.Potential for Freshwater Fish Farming

The best feeding techniques need to be applied to ensure more efficient use of fish feed and maintain an optimal living environment for the fish. In principle, the purpose of applying feeding techniques is to minimize the possibility of wasted feed so that greater profits can be obtained. Several applications of potential for improving the efficiency of fish feeding in freshwater fish farming are as follows:

1.Fish feed efficiency

Feed efficiency can affect profits. The more efficient the fish feed is, the higher the yield at harvest time. Feed efficiency includes how to feed correctly, the type of feed that is appropriate, and the nutritional content of the feed given for fish growth. Feed that contains the substances and

nutrients needed by fish during their growth process will affect the harvest yield. The feed given to fish is pellet feed, but feeding must also take into account the growth phases of the fish. This feed is also divided into two types, namely sinking feed and floating feed. Feeding must also take into account the needs of the fish, because overfeeding will result in losses. If the feed is not eaten by the fish, it will settle and make the pond dirty.

2.Improving feed efficiency by improving feed quality

Better feed quality will improve fish quality. Usually, fish feed quality can be improved by mixing the feed with hormonal feed to enhance the fish's growth and appetite. This hormonal feed aims to increase the fish's hormones. The administration of these hormones is also intended to not increase the price of fish feed. The purpose of providing this mixed feed is to improve the physical condition of the fish.

4.Testing in the Development Stage

Figure 4 shows the results of weighing fish feed in manual mode with a maximum weight of 400 grams per stage. The purpose of this is to feed the fish directly without the default procedure and without any restrictions on the time of feeding.

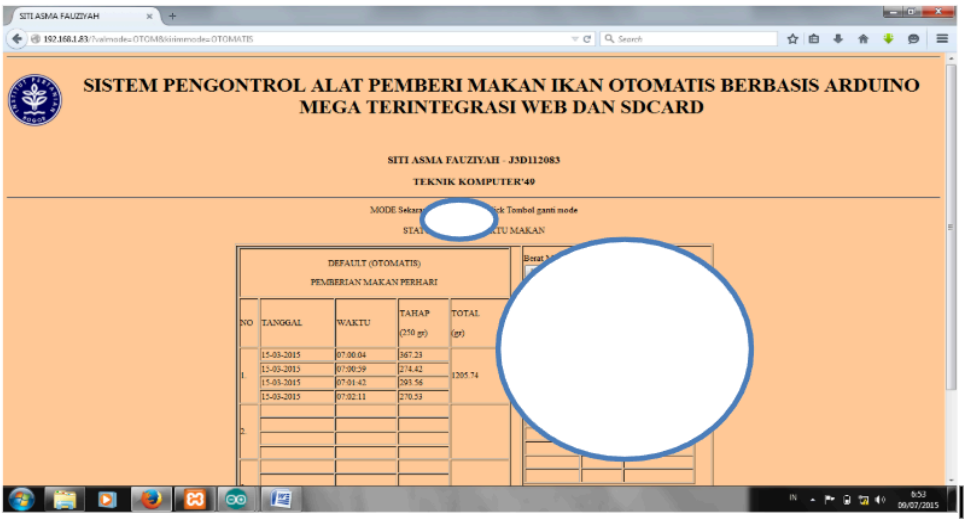

Figure 4 Web View with Manual Weighing Result Data

Journal of Applied Science, Technology & Humanities
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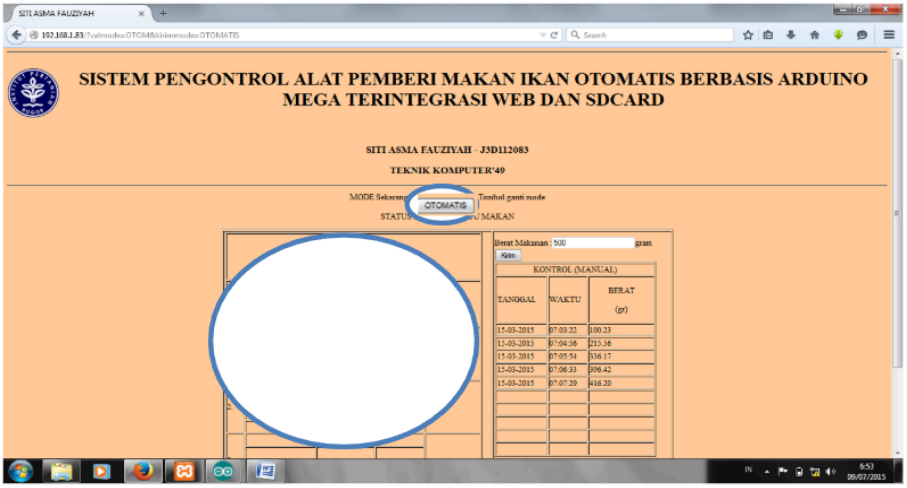

Figure 5 Web View with Automatic Weighing Result Data

Figure 5 shows that the results of weighing fish feed in automatic mode (default) at this stage are based on the operation of the device prior to development.

N0	TANGGAL	JAM	BERAT PAKAN	KETERANGAN
1	15/03/2015	7:00:04	367.23 gram	367.23 gram
2	15/03/2015	7:00:59	274.42 gram	641.65 gram
3	15/03/2015	7:01:42	293.56 gram	935.21 gram
4	15/03/2015	7:02:11	270.53 gram	1205.74 gram
1	15/03/2015	7:03:22	100.23 gram	
2	15/03/2015	7:04:56	215.56 gram	
3	15/03/2015	7:05:54	336.17 gram	
4	15/03/2015	7:06:33	396.42 gram	
5	15/03/2015	7:07:29	416.20 gram	

Figure 6 Ms. Excel Display

Figure 6 shows that the results obtained from weighing fish feed can be downloaded in Ms. Excel format. In Manual mode, this is indicated by the word Manual written on Total Weight.The weighing results table can be seen in Table 1, which contains a comparison of fish feed weighing results using a load cell with fish feed weighing results using a calibration tool, namely an analog scale with units of grams (gr). The fish feed weighing results between the load cell and the calibration tool are stated to be the same with an accuracy of 98.7%.

Tabel 1 Results of Weighing Fish Feed at the Development Stage

Time	Mode	Weighing with Load Cell Sensor (gr)	Weighing with Analog Scales (gr)

7:00:04	Otomatis	367.23	367
7:00:59	Otomatis	274.42	274
7:01:42	Otomatis	293.56	293
7:02:11	Otomatis	270.53	270
7:03:22	Manual	100.23	100
7:04:56	Manual	215.56	215
7:05:54	Manual	336.17	336
7:06:33	Manual	396.42	396
7:07:29	Manual	416.20	416
		$\bar{x}$ sensor = 296.7 gr	$\bar{x}$ kalibrasi = 296.3 gr

Based on the weighing accuracy calculation results, the accuracy value was obtained from the formula below:

$$\text{Weighing accuracy} = 1 - \left[\frac{\Delta x}{\bar{x}}\right].100\%$$

$$\Delta x = x_i - \bar{x}$$

- Xi, measurable value to i
- X, average
- Δx adalah result of $\bar{x}kalibrasi$ minus the result $\bar{x}sensor$ to find the error value or deviation from the weighing results of the HX711 sensor.

Accuracy is the conformity between the measurement result (average) and the actual value. The closer the measurement or weighing result (average) is to the actual result, the smaller the error, and the more accurate it is. To find the error value or deviation from the HX711 sensor weighing, the value can be calculated as follows:

$$\bar{x}sensor = \frac{2670.3}{9}$$

$$\bar{x}sensor = 296.7gr$$

$$\bar{x}kalibrasi = \frac{2667}{9}$$

$$\bar{x}kalibrasi = 296.3gr$$

$$\Delta x = 296.3 - 296.7 = 0.04gr$$

Journal of Applied Science, Technology & Humanities
Volume .., Issue .., Month, Year, Pages

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Weighing accuracy

$$1-\left[\frac{\Delta x}{\overline{x}}\right].100\% = 1-[\frac{0.04}{296.3}].100\% = [1-0.013].100\% = 0.013.100\% = 98.7\%$$

CONCLUSION

The conclusion from the results of creating an Arduino Mega-based Automatic Fish Feeding Control System integrated with the web and SD card is:

1.Automatic fish feeders can help increase production and reduce the burden of fish farming.

2.With this tool, errors in the amount and timing of fish feeding can be reduced according to the type and weight of the fish.

3.It facilitates users in monitoring the status of the fish feeder through a local web network.

4.Controlling the device via the web facilitates the performance of fish farmers in feeding various types of fish.

The shortcomings of the system are that the casing design should be closed and neat to avoid exposure to sunlight and water. Furthermore, the accuracy of the scale depends on pressure, meaning that the stronger the pressure, the better the accuracy of the scale.

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