INTI JOURNAL | Vol.2024:38
eISSN:2600-7320

# Design and Construction of an Arduino-Driven Weight-Based Fish Sorting Tool

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## Abstract

This research aims to design and develop a weight-based fish sorting tool that uses a strain gauge sensor under Arduino Uno control. We designed this tool to enhance the effectiveness and accuracy of the fish sorting process, focusing on three size categories: small, medium, and large. The system consists of a strain gauge sensor that measures the weight of the fish, an HX711 module that converts analog data to digital, a servo motor to move the fish, and a conveyor that moves the fish through the sorting process. We conducted testing to measure the accuracy of the system in determining the fish's weight and its success in classifying it based on its size. The test results show that this device has an average accuracy rate of 99.5%. However, minor differences in weight measurements suggest the need for further improvements. Overall, the fishing industry has enormous potential to implement this tool to increase productivity and reduce reliance on manual methods.

## Keywords

Fish sorting tool, strain gauge sensor, Arduino Uno, weight-based sorting

## Introduction

The global fish market, particularly in Indonesia, is significantly influenced by the size and weight of fish, as these attributes are critical indicators of both quality and selling price. Traditionally, sorting fish has been performed manually, especially on a commercial scale. While manual sorting can suffice in small operations, it becomes highly time-consuming, labor-intensive, and prone to inaccuracies when applied to larger-scale fish farming. These inefficiencies significantly limit the growth of the fish farming and distribution industries. Consequently, there is a growing need for automated fish-sorting technologies to enhance efficiency and accuracy in the sorting process.

Control systems in agricultural science, consisting of sensors and mechanics, automate tasks like sorting (Alif Naufal Allaudin & Aris Nasuha, 2023). Technology development underpins large-scale automation systems, like control machines in agricultural machinery, reducing human labor and improving sorting accuracy (Mohale et al., 2024).

**Submission**: 27 September 2024; **Acceptance:** 23 October 2024

## Literature Review

The advancement of sensor technology has revolutionized weight-based fish harvesting, enabling real-time monitoring and improved efficiency (Kuswantori et al., 2023). The integration of control systems and sensors can enhance sorting efficiency and reduce errors. The success of automated sorting systems depends on their mechanical design, which ensures the sorting of fish without harm, improves accuracy, and enhances product quality, making them a competitive tool in fish farming (Tran et al., 2017).

The research aims to develop an automated fish-sorting tool using strain gauge technology, enhancing efficiency and consistency in the sorting process for improved fish farming productivity (Wicaksono et al., 2020). Automated fish-sorting systems in aquaculture improve efficiency, reduce labor costs, and minimize human error by using computer vision and image processing techniques (Bellis et al., 2024). Weight-based fish grading systems enhance quality control in distribution and marketing, ensuring accurate size sorting for determining market value (Garavelli et al., 2019). Automated aquaculture systems enhance fish welfare and productivity by monitoring water quality, reducing stress and mortality rates, and enhancing product quality (Kannan et al., 2024).

The project proposes an automatic sorting tool using strain gauge-based weight sensors to enhance fish sorting accuracy and efficiency in Indonesia, benefiting the fish farming industry.

## Methodology

The design of electronic hardware in the form of a system block diagram as shown in Figure 1.

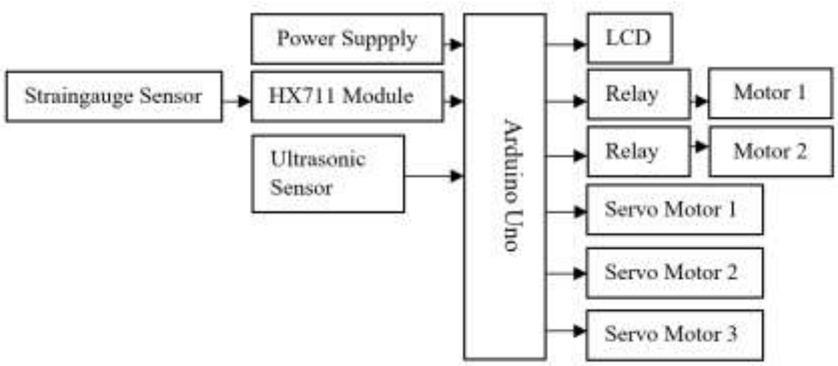



Figure 1. System design

The system uses a power supply to convert AC voltage into DC, a strain gauge sensor to measure fish weight, an HX711 module to convert analog data into digital, a vibrating motor to shake fish, a conveyor belt to move fish to sort, servo motors for large and small fish, an LCD to display weight, and a relay to control the DC motor. The system categorizes fish into small, medium, and large sizes using an Arduino Uno microcontroller and strain gauge sensor data. It uses servo motors to direct fish into separate paths, and a conveyor belt controls the movement. We test the strain gauge sensor for accuracy, ensuring efficient classification of fish based on their weight.

Table 1. List of input and output address allocations for Arduino Uno

| Arduino Port | Input and Output |
|---|---|
| Ultrasonic ECHO Pin | D6 |
| Ultrasonic TRIGGER Pin | D7 |
| Small Fish Servo | D8 |
| Big Fish Servo | D9 |
| Scale Servo | D10 |
| Vibration Relay Pin | D11 |
| Conveyor Relay Pin | A0 |
| Scale HX711 Pin | A1, A2 |
| LCD Pin | SDA, SCL |

The allocation list determines the input and output equipment from the Arduino Uno to ensure the system operates as expected.

Flowchart for software design as shown in Figure 2.

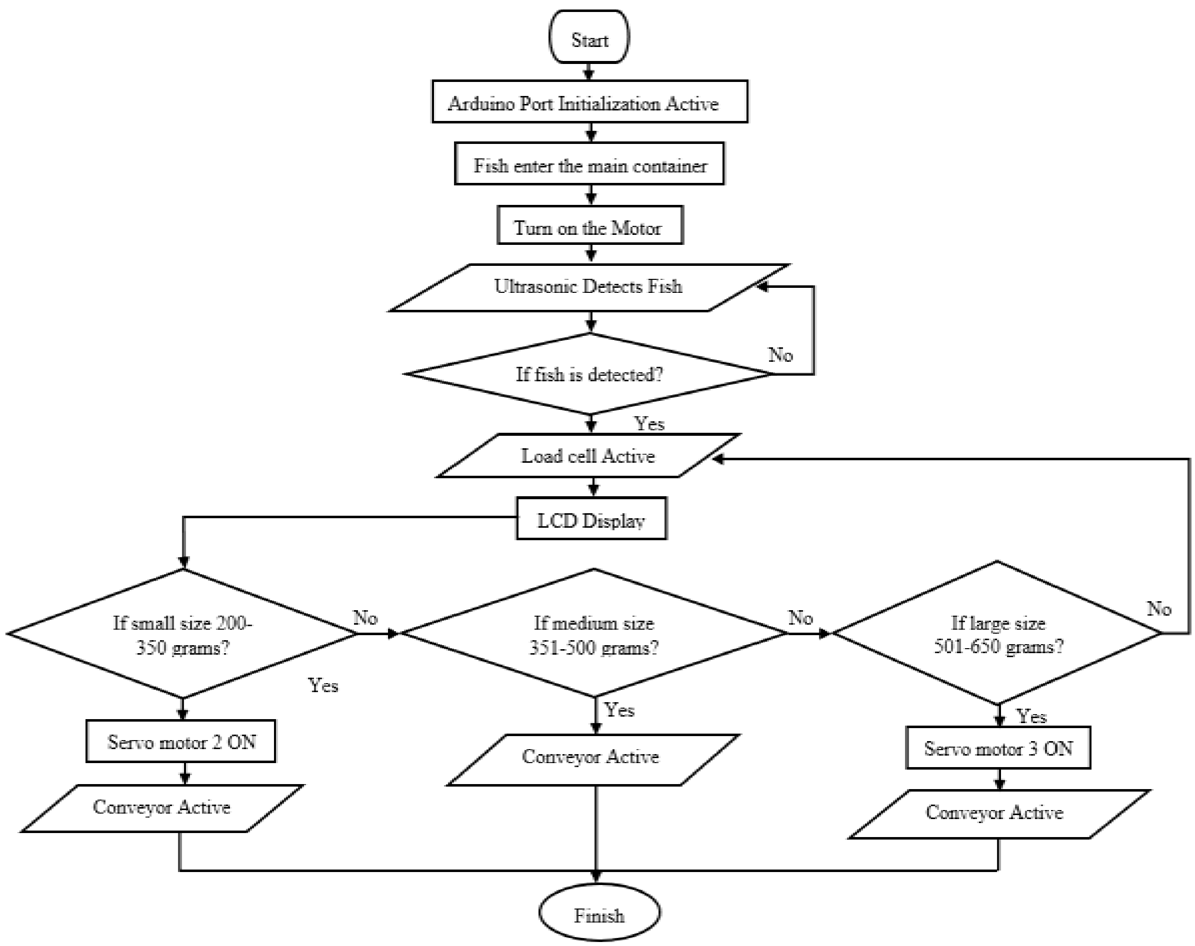
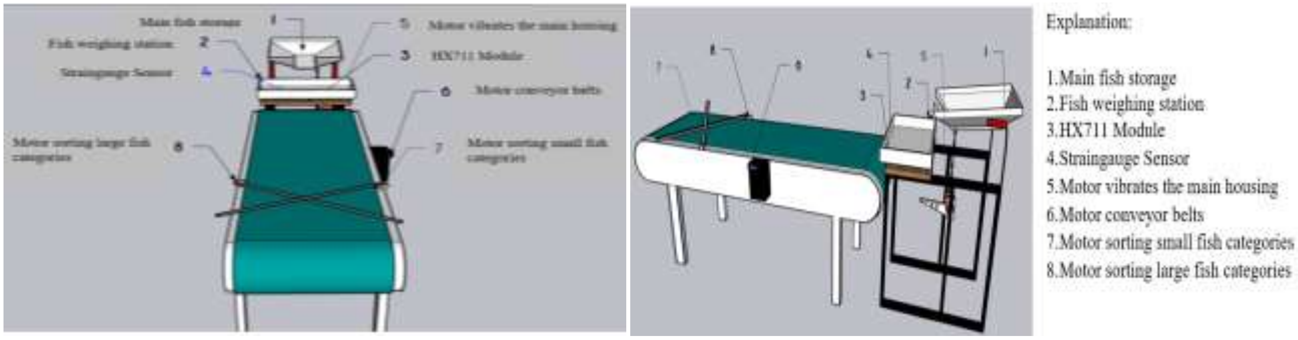


Figure 2. Work Flow Chart of Tools

The mechanical design can be presented in its entirety. Figure 3 shows (a) front- and (b) side-view drawings.




(a) (b)

Figure 3. Dimensions of the Tool, as seen (a) from the front (b) from the side

## Results and Discussion

Sensors, actuators, and the accuracy of the device's success are tested. Strain gauge sensors are used as mass control for fish weights. The strain gauge sensor testing is conducted to determine the precision in weighing within the developed system. The accuracy in carrying out this weighing affects the system's performance. Table 2 displays the results of the strain gauge sensor testing.

Table 2. Results of the strain gauge sensor testing

| No | Scale digital (gr) | Strain gauge (gr) | Difference (gr) |
|---|---|---|---|
| 1 | 315 | 312.4 | 2.6 |
| 2 | 341 | 339.3 | 1.7 |
| 3 | 400 | 398.2 | 1.8 |
| 4 | 374 | 372.2 | 1.8 |
| 5 | 529 | 527.6 | 1.4 |

Table 3. Servo motor angles

| Size | Direction | Servo motor angle 2 (°) | Servo motor angle 3 (°) |
|---|---|---|---|
| Small | Right | 90 | 0 |
| Large | Left | 0 | 90 |

Table 4. Results of rain sensors testing

| Test No. | Digital scale (gr) | Strain gauge (gr) | Difference (%) | Remarks | Size | Remarks |
|---|---|---|---|---|---|---|
| 1 | 315 | 312,4 | 99.17 | Successful | Small | Successful |
| 2 | 341 | 339,3 | 99.50 | Successful | Small | Successful |
| 3 | 400 | 398,2 | 99.55 | Successful | Medium | Successful |
| 4 | 374 | 372,2 | 99.52 | Successful | Medium | Successful |
| 5 | 529 | 527,6 | 99.74 | Unsuccessful | Large | Unsuccessful |

Table 3 shows the actuator being tested to determine the servo motor's performance as a fish sorting actuator and to obtain the desired servo motor angle. We are testing the accuracy of the system's success five times with a load to determine the system's precision in reading load values and the accuracy in determining the fish category, as shown in Table 4.

## Conclusion

The design and development of a fish sorting device based on weight using Arduino has successfully facilitated sorting fish by weight, thereby increasing time effectiveness and reducing reliance on manual methods. Nevertheless, the test results show that the accuracy level of this tool reaches an average of 99.5% from the comparison results of the Strain gauge with digital scales, which means there is still room for improvement, particularly in determining the weight of the fish. Overall, this tool has great potential to be implemented in the fisheries sector.

## Acknowledgements

The author expresses their deepest gratitude to all parties who have supported and contributed to completing this research.

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