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Prototype Catfish Seed Calculator Using Arduino Uno in Cloudy Water

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Abstract

Since Indonesia is an archipelagic nation, the economic sector of fisheries, particularly catfish farming, is one that has a lot of potential. However, a lot of catfish breeders still count their fish seeds by hand, which is time-consuming, particularly in hazy water conditions. Therefore, an automatic catfish seed counter is required in order to make calculations simpler, quicker, and more precise even under hazy water situations. In order to address these objectives, the prototype of a catfish seed counting device in murky water is shown in this study. This tool's prototype was created and constructed utilizing an Arduino Uno as the processor, two different types of sensors as inputs, and an LCD and buzzer as outputs. The FC-51 proximity sensor is used to count the quantity of fish seeds, while the turbidity module sensor measures the amount of turbidity in the water. With a total sample size of 50 fish fry, the test was run under three conditions for the turbidity level of the water samples: 6.21 NTU, 11.10 NTUs, and 16.38 NTU. According to the test results, the catfish seed counter in murky water performed admirably and was fairly accurate. An average error value of 3.2% is achieved with a water turbidity value of 6.21 NTU. An average error value of 6.8% was discovered at the turbidity value of 11.10 NTU. Finally, an average error value of 18.8% was discovered at a water turbidity value of 16.38 NTU. In order for this catfish seed counter to be effective, water turbidity values below 13 NTU with a minor error of 10% are preferred, particularly water turbidity values below 8 NTU with a little error of 5%.

Keywords: *Fish Seed Counter, Turbid Water, Proximity FC-51 sensor*

Abstrak

Indonesia merupakan negara kepulauan sehingga sektor perekonomian dalam bidang perikanan menjadi salah satu yang sangat menjanjikan termasuk di antaranya peternakan ikan lele. Namun saat ini, masih banyak peternak ikan lele yang menghitung benih ikannya secara manual sehingga membutuhkan waktu yang cukup lama, terutama pada kondisi air keruh. Oleh karena itu, dibutuhkan alat penghitung benih ikan lele yang dapat bekerja otomatis agar proses perhitungan menjadi lebih mudah, cepat, dan akurat pada kondisi air yang keruh sekalipun. Makalah ini menyajikan prototipe alat penghitung benih ikan lele pada kondisi air keruh untuk memenuhi kebutuhan tersebut. Prototipe alat ini dirancang dan dibangun menggunakan Arduino Uno sebagai prosesor, dua jenis sensor sebagai perangkat input, serta LCD dan buzzer sebagai perangkat output. Sensor yang digunakan adalah sensor proximity FC-51 untuk mendeteksi banyaknya benih ikan dan sensor turbidity module untuk mendeteksi tingkat kekeruhan air. Pengujian dilakukan pada tiga kondisi tingkat kekeruhan sampel air yaitu pada 6,21 NTU; 11,10 NTU; dan 16,38 NTU dengan jumlah sampel benih ikan masing-masing 50 ekor. Dari hasil pengujian diperoleh bahwa alat penghitung benih ikan lele pada air keruh ini dapat bekerja dengan baik dan relatif akurat. Pada nilai kekeruhan air 6,21 NTU diperoleh nilai rata-rata eror sebesar 3,2%. Sedangkan pada nilai kekeruhan keruhan air 11,10 NTU diperoleh nilai rata-rata eror sebesar 6,8%. Terakhir pada nilai kekeruhan air 16,38 NTU diperoleh nilai rata-rata eror sebesar 18,8%. Sehingga alat penghitung benih ikan lele ini layak digunakan pada nilai kekeruhan air di bawah 12,51 NTU dengan error kecil dari 10% terutama pada nilai kekeruhan air di bawah 8,66 NTU dengan error kecil dari 5%.

Kata kunci: Penghitung Benih Ikan, Air Keruh, Sensor Proximity FC-51

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Introduction

Indonesia might have the right kind of land and climate for growing fish seeds. This is due to the fact that Indonesia is a marine nation with a sizable number of islands. Catfish are a cheap source of animal protein with a good nutritional value, hence humans have a very widespread habit of raising them (Lestari & Dewantoro, 2016). However, it is still common practice to manually calculate the quantity of catfish seeds to predict how much seeds will cost. This method's calculations take a very long time and frequently yield inaccurate answers, especially in hazy water circumstances. We therefore require a device that can swiftly and accurately calculate in murky water. Errors in counting catfish seeds are a result of a lack of quick and accurate calculation methods that save growers time (Wiguna, 2019).

In order to handle hazy water, it is required to create a catfish seed counter based on Arduino that can count accurately in murky or misty water. The use of an Arduino-based system will make it simpler for fish farmers to count catfish seeds in big amounts (Amri, 2020). Fish farmers find it challenging to switch the water while the computation is being done because there are numerous influencing factors that enable them to continue counting even in murky water conditions. For example, optical sensor-based fish seed counters (Purbowaskito & Handoyo, 2017), portable fish seed counter designs based on Arduino (Yutanto et al., 2018), and milkfish seed counters based on the Atmega 328 microcontroller (Afiyat & Rifqi, 2020) have all been proposed by various researchers. However, there isn't a fish fry counting device that takes the turbidity of the water into consideration, especially for catfish seeds, thus a long-lasting counter that can count in murky water conditions is required (Putra, 2017).

Literature Review

a. Catfish Seeds

Fish that have just been born or that have just hatched are referred to as fry; in scientific jargon, they are called larval fish or baby fish, respectively. For a fish to be considered a fingerling until its body length reaches 5 to 6 cm, this is the maximum size allowed. Early stages of catfish development are said to encompass a variety of stages beginning with eggs, larvae, and juveniles (Aldoni & Mukhaiyar, 2022). Some catfish fry body length measurements are shown in Figure 1.

Figure 1. Catfish Seeds

b. Water

Water is essential for all life on Earth, including humans, animals, and plants, to survive and go about their everyday lives. Since water covers 71% of the earth's surface, it is one of the necessities that is essential to daily living. Water is required for a variety of daily activities, such as producing electricity, warming water for drinking, growing fish, and many more (Irianto, 2015). Water is the only place where fish and fish seeds can ever exist.

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c. Arduino Uno

An open-source microcontroller board called Arduino Uno was created by Arduino.cc and is based on the ATmega328P microcontroller. The Arduino Uno board and all of its parts are depicted in Figure 2. The fact that Arduino UNO is simple to employ in electronic equipment and enables integrated control is one of its benefits. Currently, Arduino is used extensively in electronic devices for many different applications, such as gas control systems in enclosed spaces (Dianovita & Daud, 2016), testing clean water into hydrogen for alternative energy (Rimbawati et al., 2021), traffic light control devices (Rosyady et al., 2022), controlling the acidity of pool water (Gunadi & Daud, 2022), and various other applications.

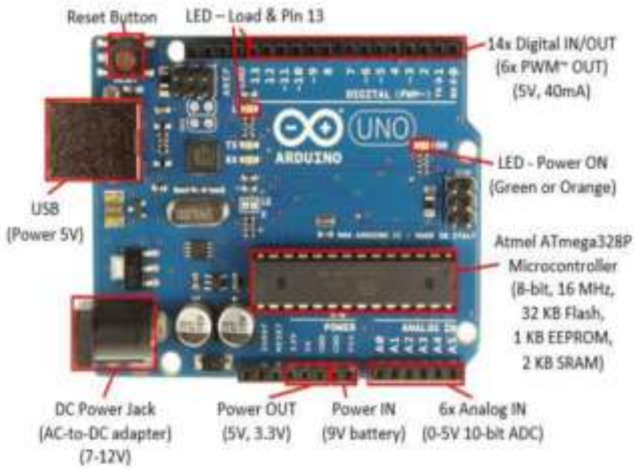

Figure 2. Arduino Uno

d. Sensor Proximity FC-51

A sensor module called the Proximity Sensor FC-51 consists of an electrical circuit that emits infrared light and records the reflection of that light in a work area. An infrared transmitter (IR transmitter) and an infrared receiver (IR receiver) are two parts used to send and receive infrared signals. A photodiode serves as an infrared signal receiver, and a light emitting diode (LED) that can emit infrared light serves as an infrared signal transmitter (Azahari et al., 2021). In Figure 3, an FC-5 proximity sensor is shown.

Figure 3. Sensor Proximity fc-51

e. Sensor Turbidity Module

A turbidity sensor, which can also be used to assess water quality, can measure the turbidity of water. To find suspended particles in water, this sensor monitors the amount of light that is transmitted and scattered, which varies with the number of suspended solids. Figure 4 depicts a sensor for a turbidity module.

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Figure 4. Turbidity Module Sensor

f. Liquid Crystal Display (LCD)

A display screen called a liquid crystal display (LCD) uses liquid crystals as its primary display. The LCD functions to reflect ambient light into the headlights using CMOS logic technology (Irfan, 2018). In the electronics sector, LCD screens are frequently used to show information such as clocks, schedules, running text, and other characters (Subagyo & Suprianto, 2017). The I2C dot-matrix display LCD used in this investigation is shown in Figure 5.

Figure 5. Liquid Crystal Display

Methodology

a. Research Stages

Making a concept in the form of a flowchart is the first step in doing research on the design of a catfish seed counter in murky water so that what is investigated is consistent with expectations. The next step is to design a system that illustrates the interactions between the various parts and the operation of the built-and-designed calculator. Block diagrams, flowcharts of the tool's operation, electronic designs, and mechanical designs serve as the current iteration of the calculating device's design. The creation of a prototype, or the physical realization of the design from the previous stage, is the following stage. The tool is then tested, specifically the built-prototype calculator is put to the test and data is gathered from the test results. The last step in the tool testing process is to examine and make conclusions from the data gathered earlier.

b. Block Diagram System

The link between input devices, processing devices, and output devices, as well as the signal flow in each, is depicted in the system block diagram. A system block diagram of the counter that was created and built in this study is shown in Figure 6.

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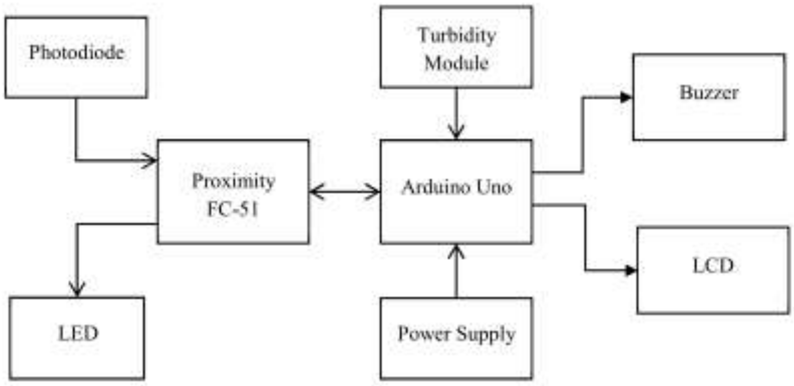

Figure 6. Block Diagram System

As shown in Figure 6, the parts of the system in the form of blocks representing the components and their respective functions are as follows:

1. A counter for the quantity of catfish seeds is built into the FC-51 proximity sensor. The sensor has two diodes: a photodiode to catch the reflected infrared signal and an LED to emit infrared signals;
2. The turbidity sensor module measures the amount of turbidity in the water;
3. The FC-51 proximity sensor and turbidity sensor module input data are processed by the Arduino Uno, which also activates the buzzer to alert the operator and sends the processed data to the LDC for display;
4. The LCD can show data, test results, or calculating results.

c. Electronics Design

The FC-51 proximity sensor, turbidity sensor module, Arduino Uno, power supply, I2C LCD, and buzzer make up the electronic design of an Arduino-based catfish seed counter. Figure 7 displays the electronic design.

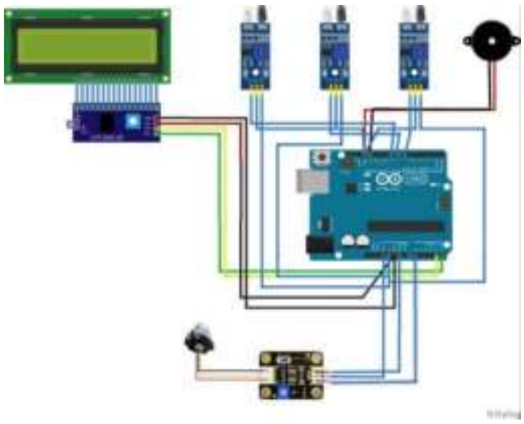

Figure 7. Electronics Design Flowchart

d. Mechanical Design

Figure 8 shows the mechanical layout of the Arduino-based catfish seed counter. The top portion has the shape of an open water-filled container where the catfish seeds will be poured and counted. This container also has a turbidity module sensor attached to measure the turbidity of the water. Three channels are located in the center of the counter, where catfish seeds will be tallied as they descend through them. An FC-51 proximity sensor is inserted in

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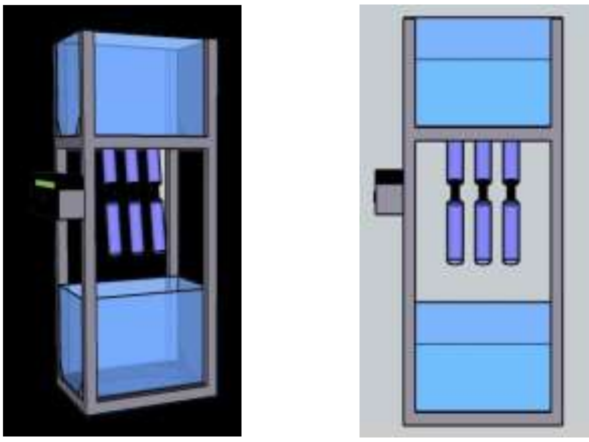
each of these channels, and it counts the fish fry that pass through it. The fish seeds that have undergone the counting procedure are contained in an open container at the bottom of the counter.



(a) (b)

Figure 8. Mechanical Design System; (a) 3D Fasade (b) Side Fasade

Results and Discussions

a. System Realization

A prototype of a system for counting catfish seeds in murky water that is powered by an Arduino Uno was created. Mechanical and electronic circuit realizations (hardware and software) make up system realization. As seen in Figure 9, the device is depicted in its entirety on the left in image (a), and the electrical circuit, which serves as the system control device, is depicted on the right in image (b). A power supply, Arduino Uno, turbidity sensor module, FC-51 proximity sensor, buzzer, and I2C LCD make up the electronic circuit.

(a) (b)

Figure 9. Realization of the Calculator Prototype (a) Overall tool (b) Electronic Circuit

b. System Performance Testing

Testing the effectiveness of the catfish seed counter was done with three different turbidity levels of water samples: 6.21 NTU, 11.10 NTU, and 16.38 NTU, each with a sample size of 50 fish. Figure 10 depicts the testing procedure for counting catfish seeds. Five tests were conducted for counting in each case of murky water. The commentary that follows provides an explanation of the computation findings.

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(1) Tests on 6.21 NTU Turbid Water Samples

In a sample of turbid water with a turbidity value of 6.21 NTU and a total sample of 50 fish, the test for counting fish fry was performed five times. In Table 1, the test's outcomes are displayed. As can be observed, the calculation's results are relatively accurate, with an average error value of 3.2% in the case of turbid water with a value of 6.21 NTU.

Figure 10. System Performance Testing

Table 1. Test Results on Turbid Water Samples 6,21 NTU

Test	Water Turbidity	Fish Samples		Erorr Value
		Manual	Counter	
1	6,21 NTU	50	50	0%
2	6,21 NTU	50	53	6%
3	6,21 NTU	50	52	4%
4	6,21 NTU	50	52	4%
5	6,21 NTU	50	51	2%
Erorr Mean				3,2%

(2) Testing on Cloudy Water Samples 11,10 NTU

In a sample of turbid water with a turbidity value of 11.10 NTU and a total sample of 50 fish, the test for counting fish seeds was performed five times. Table 2 displays the outcomes of this exam. As can be observed, the calculation results are produced with a comparatively low average error value of 6.8% when the turbidity of the water is 11.10 NTU.

Table 2. Results of Tests on Samples of Turbid Water 11,10 NTU

Test	Water Turmidity	Fish Sample		Eror Value
		Manual	Counter	
1	11,10 NTU	50	55	10%
2	11,10 NTU	50	53	6%
3	11,10 NTU	50	54	8%
4	11,10 NTU	50	53	6%
5	11,10 NTU	50	52	4%
Eror Mean				6,8%

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(3) Examining Samples of Cloudy Water 16,38 NTU

In a sample of turbid water with a turbidity value of 16.38 NTU and a total sample of 50 fish, the test for counting fish seeds was performed five times. The outcomes of this examination are displayed in Table 3. As can be seen, the calculation produced results with a rather high average error value of 18.8% in the case of the turbid water value of 16.38 NT

Table 3. Results of Tests on Samples of Turbid Water 16,38 NTU

Test	Water Turmidity	Fish Sample		Error Value
		Manual	Counter	
1	16,38 NTU	50	59	18%
2	16,38 NTU	50	60	20%
3	16,38 NTU	50	61	22%
4	16,38 NTU	50	58	16%
5	16,38 NTU	50	59	18%
Error Mean				18,8%

(4) Analysis and Discussion

A brief summary of the test findings from each system performance test that has been performed is provided in Table 4 and the graph is shown in Figure 11. As can be seen, the computation error value increases with increasing water turbidity values. If linear interpolation is used, a 10% error value at a water turbidity value of 12.51 NTU and a 5% error value at a water turbidity value of 8.66 NTU will be achieved. The catfish seed counter is therefore appropriate for use at water turbidity values below 12.51 NTU with a small error of 10%, and in particular for water turbidity values below 8.66 NTU with a little error of 5%.

Table 4. Recapitulation of System Performance Test Results

No.	Water Turbidity	Test Frequency	Error Mean
1	6,21 NTU	5x	3,2%
2	11,10 NTU	5x	6,8%
3	16,38 NTU	5x	18,8%

Figure 12. System Testing Results

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Conclussion

The prototype of the equipment for computing catfish seeds in murky water has been successfully conceived and realized. According to the test results, the catfish seed counter in murky water performed admirably and was fairly accurate. An average error value of 3.2% is achieved with a water turbidity value of 6.21 NTU. An average error value of 6.8% was discovered at the turbidity value of 11.10 NTU. Finally, an average error value of 18.8% was discovered at a water turbidity value of 16.38 NTU. In order for this catfish seed counter to be effective, water turbidity levels below 12.51 NTU with a little error of 10% and, in particular, water turbidity values below 8.66 NTU with a small error of 5% must be considered.

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