Analysis of the use of SEN0161 pH sensor for water in goldfish ponds

T H Nasution1*, S Dika1, E P Sinulingga1, K Tanjung1, and L A Harahap2

1Department of Electrical Engineering, Universitas Sumatera Utara, Medan Indonesia
2Department of Mathematics and Computer Science, Faculty of Science, Chulalongkorn University, Bangkok, Thailand

Correspondent Author: tigor.nasution@usu.ac.id

Abstract. Goldfish are considered economically important because they are popular with the community. Goldfish is an important type of freshwater aquaculture that is quite developed and can be cultivated in Indonesia. The pH value will affect the growth of fish. The acidity of water that is good for goldfish life is 7 to 8. The lowest limit that causes fish death is pH 4 and the highest at pH 11. Therefore, in this study, we will analyze the use of a SEN0161 pH sensor to measure the pH level of water in goldfish ponds. The pH measurement of fish pond water is compared with measurement data using a standard pH meter. Data collection and testing is done using two sensor nodes, where the first sensor node is connected to the LattePanda which also functions as a base station. LattePanda communicates simultaneously with a data speed of 9600 bps with a second node sensor that uses Arduino as a microcontroller. In communicating, 2 nodes use the Xbee radio module. From the results of testing and implementation that have been done, it can be concluded that the percent accuracy of the pH sensor reading SEN0161 at each node is ± 98.39% and ± 99.07%.

1. Introduction
Goldfish are considered economically important because they are popular with the community. Goldfish is one type of important freshwater aquaculture that is quite developed and can be cultivated in Indonesia[1]. Goldfish are freshwater fish that are usually sold alive. Goldfish production which is targeted to be 500,000 tons in 2013 has not been able to reach the target (68.17% of the target) as well as the production value which only reached 90.89% of the target[2]. Several things cause the achievement of these targets, including the emergence of disease and fish death. Live fish transportation techniques that can guarantee that the fish will come to consumers in a state of survival are urgently needed. These efforts have not been followed by efforts to increase fish survival and physiological studies of fish so there are still many problems faced. one of the physical factors that influence the physiological process of fish is temperature and is one source of stress that can affect the physiological changes in the fish body[3].

Another factor is the degree of acidity or pH, dissolved oxygen, and ammonia levels are some of the chemical parameters of water that has a great influence on the organisms that live in them[4]. Discrepancies in temperature, pH, DO and ammonia levels where goldfish live (the environment) will result in slow fish growth and can result in fish mortality. The pH value will affect the growth of fish. The acidity of water that is good for goldfish life is 7 to 8[1]. The lowest limit that causes fish death is
pH 4 and the highest at pH 11. Waters with a pH range of 4-6 result in slow growth for cultured fish[5,6]. Therefore, in this study, we will analyze the use of the SEN0161 pH sensor to measure the pH level of water in a goldfish pond.

2. Material and method

2.1. SEN0161 pH sensor

This sensor is one of the components in this system because it is used to measure the pH value of water[7]. These sensors are installed at each node to monitor water pH and calculate ammonia levels. The output from this sensor is in the millivolt (mV). So, to get the output in pH value, convert the output from pH millivolts to this formula:

$$Value\ of\ pH = \frac{7 - (output)}{(59.16\ mV) \times (2.2)}$$

The output of the sensor in millivolts will be automatically converted into a pH value after this formula is applied to programming[8]. The pH sensor display can be seen in Figure 1.

![Figure 1. SEN0161 pH sensor](image)

The specifications of this sensor are as follows:
- Measuring range: 0 ~ 14 pH
- Operating temperature: 0 ~ 60 °C
- Accuracy: ± 0.1pH (25 ℃)
- Response time: ≤ 1 m

The SEN0161 pH sensor is specifically designed for Arduino controllers and has simple connections and features. As for the schematic circuit, see Figure 2. This sensor can be used to measure pH with a range of 0 ~ 14, with an accuracy of ± 0.1pH (25 ℃).

![Figure 2. SEN0161 pH Sensor Circuit with Arduino](image)
2.2. Data collection and testing
Data collection and testing are done using two sensor nodes, where the first sensor node is connected to LattePanda which also functions as a base station[9,10]. LattePanda communicates simultaneously with a data speed of 9600 bps with a second node sensor that uses Arduino as a microcontroller[11,12]. In communicating, 2 nodes use the Xbee radio module[13–15].

The test location is done on Jl. Bunga Cempaka, Tj.Sari, Medan Selayang, Medan. Testing is done by placing the sensor node on the edge of the pool, because of limited access to the middle of the pool and the power supply for LattePanda is on the edge of the pool. The location of the test can be seen in Figure 3. and the location of the nodes can be seen in Figure 4.

![Figure 3. Goldfish pond location](image)

![Figure 4. Node 1 and node 2 at the test site](image)

Testing is done by uploading a pH reading program on LattePanda for node 1 and Arduino UNO for node 2. Testing the pH using a pH meter at the location of node 1 and node 2 can be seen in Figure 5. below this.
3. Results and Discussion
The pH measurement of fishpond water is compared with measurement data using a standard pH meter. The results of the measurement of pH at the node designed and the measurement of pH using a pH meter at node 1 can be seen in Table 1. The results of pH measurements at the nodes designed and pH measurements using a pH meter on node 2 can be seen in Table 2.

### Table 1. Measurement of pH on Node 1

| No. | pH measurements using the SEN0161 pH sensor in Node 1 (mg/L) | pH measurements using a pH meter on node 1 (mg/L) |
|-----|-------------------------------------------------------------|--------------------------------------------------|
| 1   | 8.17                                                        | 8.2                                              |
| 2   | 7.98                                                        | 8.2                                              |
| 3   | 8.22                                                        | 8.2                                              |
| 4   | 8.46                                                        | 8.2                                              |

### Table 2. Measurement of pH on Node 1

| No. | pH measurements using the SEN0161 pH sensor in Node 2 (mg/L) | pH measurements using a pH meter on node 1 (mg/L) |
|-----|-------------------------------------------------------------|--------------------------------------------------|
| 1   | 8.19                                                        | 8.3                                              |
| 2   | 8.19                                                        | 8.3                                              |
| 3   | 8.33                                                        | 8.3                                              |
| 4   | 8.36                                                        | 8.3                                              |

From Table 1 and Table 2 the accuracy values obtained from the measurement of the pH sensor SEN0161 for node 1 are ± 98.39% and ± 99.07% for node 2. Besides, there are also insignificant differences between the readings of the two sensor nodes, with a reading difference of 0.1 back digits comma, and the percent difference of accuracy is 0.68%. That is because the difference in the location of the sensor node reading on the sensor is not fixed.

4. Conclusion
From the results of testing and implementation that have been done in the previous section, it can be concluded that the percent accuracy of the reading of the SEN0161 pH sensor at each node is ± 98.39% and ± 99.07%. There was also an insignificant difference between the readings of the two sensor nodes, with a reading difference of 0.1 digits behind the comma, and a difference in percent accuracy of 0.68%. That is because the difference in the location of the sensor node reading on the sensor is not fixed.
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