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A Waterproof Ultrasonic Sensing System For Locating Fish In Underwater Area

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ABSTRACT

A waterproof ultrasonic sensing system for locating fish using geometric analysis of the position of the fish against the observer. The prototype is a system designed to detect fish and sea depth, the system is integrated with a smartphone hence fish location coordinates can be determined. The system uses sensors ultrasonic waterproof, namely transducer sensor with waterproof specially designed to work under water with the frquency of 200 KHz. The system uses Arduino MEGA2560 as the central performance control system by an additional HC-05 Bluetooth Shield that enables Arduino MEGA2560 communicate with Android smartphones. Android 2.3 smartphone use a GPS device that is connected directly with Google Maps and as an additional display for monitoring the presence of fish and the depth of the sea.The system is designed using the C Arduino programming language and JAVA Android. The experimental results showed the prototype system detects the presence of fish with an accuracy of 84%, and the measurement of ocean depths by percentage error ranges from 5.5% and the smartphone can display the fish location coordinates.

***Keyword**:* Waterproof ultrasonic sensor, microcontroller, Bluetooth shield, Android Smartphone.

1. INTRODUCTION

Waterproof ultrasonic sensing system for locating fish utilizes underwater detection technology with using acoustic devices (acoustic instruments) and operates with using SONAR (Sound Navigation, and Ranging). This technology use voice or sound for detection. It is known that the speed of sound in underwater is 1500 m / sec, while the speed of sound in free space is only 340 m / sec so the technology is very effective for detection under water [1].

The operation of underwater detection is performed by the transmitter that produces electricity with a certain frequency and then distributed to the transducer that will convert electrical energy into sound, then the sound emitted in the form of sound pulses.

The study of fish detection using ultrasonic sensors previously conducted by simulating a ball as visualization of fish as well as using manual calculations at a depth position detection fish [2]. Determining the presence location of fish with a centralized system is done with Garmin 240 fish finder [3].

Distance measurement of an object in front or by the side of a moving entity is describe in [4] which uses ultrasonic transmitter and receiver units mounted at a small distance between them and a Phillips P89C51RD2 microcontroller based system. The study in [5] was to develop and evaluate an ultrasonic sensing system for automatic monitoring of liquid levels in agricultural applications.

In this study a sensor system for locating fish was made using a microcontroller. The

ultrasonic sensor as a detector of the presence of fish that are integrated with smartphone as a display that displays the detection position in the form of fish location coordinates.

2. RESEARCH METHOD

The waterproof ultrasonic sensing system for locating fish prototype system (see Figure 1) consists of a number of circuit in which the main controller is the microcontroller ATMega2560. Microcontroller consists of input and output circuit. Microcontroller in the system is connected to a smartphone using Bluetooth as a communication medium.

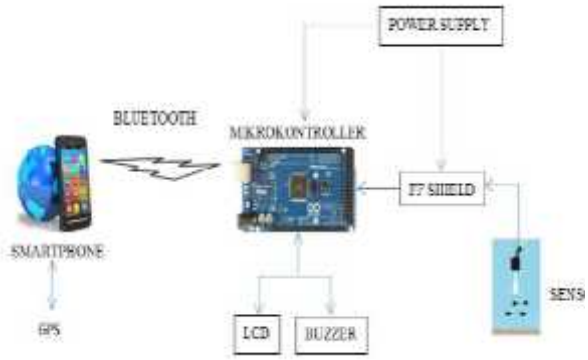

Figure 1. Block diagram of the waterproof ultrasonic sensing system for locating fish.

The design of the hardware in this study include the microcontroller circuit design, input and output circuits (see Figure 2). Input circuits consist of :

- Ultrasonic Sensor Waterproof 200KHz

As for the output circuit includes:

- LCD (Liquid Crystal Display)
- Buzzer
- Bluetooth

Ultrasonic sensor is also called transceiver because it can send and receive signals. The sensor emits ultrasonic waves to an object then will be reflected back to the sensor and the sensor will receives these waves. Then the sensor will turn them into an analog voltage. System uses a transducer that converts electrical energy into sound energy when transmitting and transforms the sound energy into electricity when it receives the reflected sound.

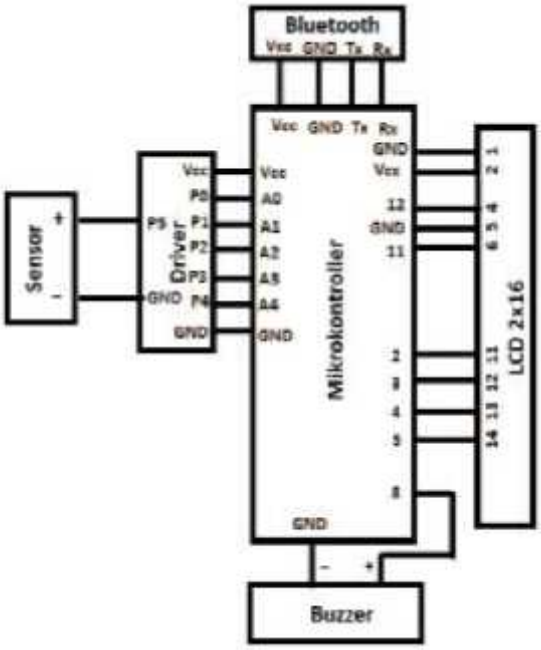

Figure 2. Input and output circuit at the microcontroller.

By measuring the time needed for the reflected wave reaching the sensor then the ocean depths can be calculated. If the transmitted waves

miss the object in this case the fish, the signal will have a constant voltage, which will be different if there are fish that reflects the value of the wave, the voltage value will vary. This will be processed by the microcontroller that can distinguish between fish detection and

depth measurement. Microcontroller will process the information from the data transmitted by the sensor on the ADC pin which will be converted into digital form for further processing and display them on the LCD.

Bluetooth serves as a communication medium that will link the smartphone with microcontroller so that we can read the results of sensor detection on a smartphone.

The software of the microcontroller is based on the main controller ATMega2560. The programming languages used is AVR C programming language. Set of command lines to be written, usually saved with the extension [* .ino or * .pde] . This is due to that ATMega2560 is a part of the MEGA Arduino microcontroller that has its own compiler called Arduino IDE. The file is then compiled and uploaded to the microcontroller Arduino MEGA by using a USB cable so that the microcontroller can work as a system controller for desired performance.

The principle of this sensor system is to function as an ultrasonic sensor transducer that will emit a sound wave and when the sound wave hit an object, it will be reflected back and subsequently microcontroller will process the information and translate them into string data form which the results will be displayed on the LCD (Liquid Crystal Display). In addition, the information obtained is also can be noticed from the sound of the buzzer alarm. By using Bluetooth-based point to point communication the microcontroller can be connected to the smartphone that also serves as an additional display that is integrated with GPS (Global Positioning System). In this system, the sensor is not yet able to distinguish between fish and moving objects so that if there is a moving object other than fish, the sensor will detect the presence of fish below water level. The depth measurement is done when reflection waves emitted by the sensor has a constant voltage value.

The GPS application with App Inventor is the main feature on smartphone, whereas the Android operating system also has GPS feature by default. In the design of the prototype sensor system GPS application is made by using App Inventor and use activity starter (intens)to call a Google Map. For this application it is required Android phones, because the emulator does not have the GPS facility.

Android applications that are made on this study are stored in file form * .apk, therefore these files can be used directly in the smartphone. This application enables a smartphone that acts as the display to receive information from the microcontroller, show GPS data such as location address, latitude, longitude, and depth of the sea and also get the fish information according to the LCD display.

Installation of the prototype casing is for compactness and also helps to protect components. The prototype casing is made of fiber acrelic for its amenable and also very light. Picture of prototype of fish locating sensor system can be seen in Figure 3.

The steps of the prototype test using a fish locating ultrasonic sensor and a microcontroller Arduino MEGA2560 is as follows :

1. Connect the ultrasonic sensors to prototype

2. Turn on the power supply, buzzer switch, and bluetooth switch.
3. Open fish finder application on the smartphone, the display can be seen in Figure 4.
4. Insert ultrasonic sensor into the water.
5. Connect the smartphone to the fish locating device through HC-05 bluetooth on the option menu "Connect".
6. Choose the menu "Monitoring" on the Smartphone display to see the response of the fish locating sensor in the form of the ocean depths and the fish existence in accordance with the LCD display.
7. To display the location and GPS coordinates then enable the GPS or packet data on a smartphone therefore it will automatically appear on the application screen
8. Choose the menu " Simpan Lokasi Sekarang " so that previous data are visible.
9. Conduct an experimental procedure (step 6) for retrieval of data which are depth, indicators of fish existence (Figure 5 and 6) as well as coordinates position.

Figure 3. Prototype of the fish locating sensor system.

Figure 4. Initial display of Android's fish finder application.

Figure 5. Smartphone display in condition of fish detection.

Figure 6. Smartphone display in condition of water depth measurement.

3. RESULTS AND DISCUSSION

For depth measurement, testing was conducted by comparing the sensor readings and manual measurement while testing for fish locating is done by comparing the LCD display indicator and smartphone display in realtime. The purpose of this test is also to obtain the accuracy of the system. From Table 1 it can be concluded that both the result shows only a small difference with average of 5.5 % error readings.

In testing fish locating system for detecting the fish, there are 25 experimental testing. All the experiments are carried out in the fish pond (3x4 m wide) at a varied depth of 50 cm to 150 cm. This testing is done by adjusting the movement of the fish existed in the pool and then observing the response of the sensor as shown on the display when the fish move pass and leave the sensor.

Table 1. Test Result of Sensor Performance.

Depth measured manually (m)	Depth on LCD and Smartphone display (m)	Error (%)
1.2	1.1	8.3
2.5	2.3	8
2.7	2.6	3.7
4.5	4.2	6.7
5.3	5	6
5.7	5.5	3.5
6.2	6.1	1.6
6.9	6.6	4.3
7.3	6.8	6.8
9.4	8.8	6.4

Figure 7. Sensor testing at a fish pond.

This test detects the presence of fish by comparing readings from LCD display and smartphone display in realtime (see Figure 7). The procedure steps for data collection in this test:

1. Connect the sensor with the prototype.
2. Turn the power supply switch, buzzer switch, and bluetooth switch.
3. Open fish location application on the smartphone.
4. Insert ultrasonic sensor into the water.
5. Connect the smartphone to the device through the fish locating system via HC-05 bluetooth on the option menu "Sambungkan".

6. Choose the menu "Monitoring" on the smartphone display to see the response of the sensor when it locates a fish.
7. Observe the movement of the fish as it move pass and leave the sensor.

After conducting this test it can be stated that there is a minor difference between the display reading and the real situation where sometimes the display cannot detect the fish while there is fish due to the delay of microcontroller response to the data sent by the sensor, previous data is still being processed by the microcontroller, while the movement of the fish is too fast and difficult to predict. Overall, based on data obtained, it can be seen that an ultrasonic sensor that is used as a tool to detect fish can work well because nearly 84% indicate accuracy.

4. CONCLUSION

An ultrasonic sensing system for locating fish had been constructed which can be used for detecting fish under the sea because this prototype system can detect and locate moving objects under water and also can measure water depth. After testing the sensor system, the ultrasonic sensor can function well to measure the depth of the sea with a percentage error 5.5%. The sensor system also can locate the fish at a pond, with nearly 84% of accuracy.

The fish finder application on a smartphone that is used as a display had been operated well, due to the data shown in smartphone display is identical to the data on the LCD prototype.

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