Pool Water Acidity Gauge Using Fuzzy Mamdani Method

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Abstract. Swimming pool is one of the means of sports and play that is fun. Swimming pools must also be considered clean. In order to be replaced with new water. The goal is so that pool users are not infected with infectious diseases due to the dirty water inside the pool. The Mamdani method is the most common method when discussing fuzzy methodology. It was Ebrahim Mamdani who first proposed this method in 1975 when building a steam engine and boiler control system. Mamdani uses a collection of IF-THEN rules obtained from experienced operators / experts. Mamdani's work is actually based on the article "The Father of Fuzzy, Lotfi A. Zadeh: fuzzy algorithms for complex systems and decision processes.

1. Introduction

Clarity of water in swimming pools is an important factor for skin health. The cause of the occurrence of turbid water is due to the use of ponds together, which causes discomfort to swim. The level of water PH must be considered so that the water is not too acidic and not too alkaline. To overcome this problem, in this study we will examine a tool for draining and replenishing water in the swimming pool automatically. Turbid water will cause the intensity of light entering into it to decrease. This is because light passing through turbid water absorbs or reflects, so little is passed. The pH level of pond water must also be monitored so as not to cause skin diseases and not endanger the health of the body. Pool water is too acidic and can damage the base of the ceramic and accelerate the growth of moss, the pool water is too alkaline to make the water cloudy and cause irritation to the eyes, the skin becomes dry and itchy.

The tool that will be made must be able to determine when the right time to do the drain automatically by comparing the PH value and Turbidity of Water which is good for use in swimming pools. So that the water in the pool still looks clear and has safe water quality. Therefore the author must use a method that can determine the PH level and the quality of the water that is appropriate for automatic draining. The method that I use is the Fuzzy Mamdani method, the author chooses this method because the pH level and the value of turbidity of the water must change and it is difficult to determine the right time for draining. While the fuzzy hamdani method evaluates the degree of membership which includes the value of a variable based on the level of linguistic relativity.
2. Methode Mamdani Fuzzy Logic

The Mamdani method is the most common method when discussing fuzzy methodology. It was Ebrahim Mamdani who first proposed this method in 1975 when building a steam engine and boiler control system. Mamdani uses a collection of IF-THEN rules obtained from experienced operators / experts. Mamdani's work is actually based on the article "The Father of Fuzzy, Lotfi A. Zadeh: fuzzy algorithms for complex systems and decision processes.

1) Application Function Implication

The stage where the process of getting the conclusion of an IF-THEN rule is done based on the degree of truth. Function The implication used in this method is a minimum function, meaning to set the smallest function between two or more numbers.

2) Composition or Aggregation

A process for combining all IF-THEN output into a single conclusion. If there is more than one statement in the conclusion section, the aggregation process is carried out separately for each variable output from the IF THEN rule. This kind of aggregation is run by fuzzy OR logic. If the system consists of several rules, then inference is obtained from a collection and correlation between rules.

There are 3 methods used in doing fuzzy system inference, namely:

a. Max Method (Maximum)

In this method, fuzzy set solutions are obtained by taking the maximum value of the rule, then using that value to modify the fuzzy region and apply it to the output using the OR (combined) operator. If all proportions have been evaluated, the output will contain a fuzzy set that reflects the contribution of each proportion. In general it can be written:

\[ \mu (Xi) = \max (\mu Xxf (Xi), \mu Xkf (Xi)) \]

with:

\[ \mu Xxf (Xi) = \text{membership value of fuzzy solutions to i-rule} \]

\[ \mu Xkf (Xi) = \text{consequent value of the fuzzy rule of the i} \]

b. Additive (Sum) Method

In this method, fuzzy set solutions are obtained by summarizing all fuzzy region outputs

c. Probabilistic (probar) method

In this method, fuzzy set solutions are obtained by multiplying towards all fuzzy area outputs

3) Affirmation (defuzzification)

The stages in which fuzzy quantities are the result of inference systems, are transformed into firm quantities. The input of defuzzification is a set obtained from the composition of fuzzy rules, while the output produced is a number in the fuzzy set domain.

3. Result And Discussion

- Turbidity Sensor

Turbidity sensor is a sensor that uses the workings of the principle of light transmission, where the level of turbidity determines the amount of light that will be received by the sensor, the clearer the water it consumes, the more light is caught by the sensor, the more turbid the light caught by the sensor. Turbidity Sensor detects the level of turbidity of water that occurs, after the level of turbidity has been detected, an assessment of the level of turbidity that occurs will be carried out.
Sensor PH

PH meter is a tool used to determine the hydrogen ion concentration of a solution. A pH value of 7 states that the solution is neutral. A pH value below 7 indicates an acidic solution and a pH value above 7 indicates an alkaline solution. The scale used ranges from 1 to 14. The PH meter works digitally, how to use this sensor by dipping it into water that will be measured (approximately 5cm deep) and automatically measuring the working tool. A pH meter consists of an electrode (measuring probe) connected to an electronic device that measures and displays the pH value. The main working principle of the pH meter is located on the sensor probe in the form of a glass electrode by measuring the number of H3O+ ions in the solution. The tip of the glass electrode is a 0.1 mm thick layer of glass that is round (bulb). This bulb is paired with a non conductor glass or plastic elongated cylinder. The core pH sensor is on the surface of the glass bulb which has the ability to exchange positive ions (H+) with a measured solution.

Arduino Uno

Arduino is an electronic kit or open source electronic circuit board in which there are main components, namely a microcontroller chip with an AVR type from Atmel company. The microcontroller itself is a chip or IC (integrated circuit) that can be programmed using a computer. The purpose of embedding the program on the microcontroller is that the electronic circuit can read the input, process the input and then produce the output as desired. So the microcontroller serves as a "brain" that controls the input, process and output of an electronic circuit.
3.1. Block Diagram

The functions of each of these blogs are:

1) Arduino Blog: This section of the blog functions as a source of control and giving commands to Ph sensors, Turbidity sensors, Level 1 and 2 Water sensors, LDC, Drivers and water pumps.
2) Sensor PH: This section of the blog serves as a source of information on the state of ph water detected at any time.
3) Turbidity Sensor: This section of the blog serves as a detector of the state of turbidity that is detected at any time.
4) LCD: This section of the blog serves to display the results of detection of ph sensors and turbidity sensors, so that it is easier to know the state of ph and the level of turbidity of water.
5) Water Level 1: This section of the blog serves as a detection container in a state of water filling. So that when filling water it does not overflow over the container. This sensor lights up when the water pump has finished draining.
6) Water Level 2: This section of the blog serves as a detection container in a state of water drainage. So that when the water in the container has run out, the water pump will be turned off automatically and turn on the other water pump for charging.
7) Driver: This section of the blog functions to turn on the water pump and change the voltage from the water pump to Arduino.
8) Water Pump 1: This section of the blog serves to drain water in the container, the water pump 1 lights up when the system is finished comparing the ph condition of the water with turbidity of water. Water Pump 2: This section of the blog functions to fill water in the container, the water pump 2 lights up when the water level 2 sensor detects that the water is empty.

3.2. Design of a pool water acidity detection device

Test and measurement in simulation to prove whether the circuit has been designed and works in accordance with specified specifications. Every measurement will be carried out to analyze the hardware and software. Testing is done 1 per 1 both measuring the voltage and experiments in the software.
Fig 5. Simulate Device

3.3. Software and Hardware

The design uses several hardware components including: Turbidity sensor, PH sensor, Relay, LCD and Arduino. And some other components. As for software, use Arduino in C.

3.4. Detail Implementation

Testing is done by analyzing each system working properly. The test consists of testing the power supply, LM 2596 output, water level sensor, Arduino to the inlet pump relay, Arduino to the exhaust pump relay, turbidity sensor, pH sensor, LCD. In this system, the water level sensor used is 2 sensors including: low water level sensor and full water level sensor. Low water level sensor is enabled to check the condition of the water being drained and full water level sensor is enabled to check the condition of the water being filled. In this system, the water level sensor used is 2 sensors including: low water level sensor and full water level sensor. Low water level sensor is enabled to check the condition of the water being drained and full water level sensor is enabled to check the condition of the water being filled. In the absence of a full water sensor the voltage is 4.73 volts. This sensor is used to detect the volume of water during the filling process so that when the water has reached the filling volume it will stop automatically, so there is no excess volume.

Fig 6. Implementation Device

Clear turbidity and neutral pH conditions. Evidence that the detection results of the two sensors can be seen on the LCD

4. Conclusions

This system works by determining the pH level of the water and the level of turbidity of the water that is appropriate for draining. Determining the right pH and turbidity level using the fuzzy logic mamdani method. The tool is successfully run properly and is able to know the pH level and the clarity of water every time.
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