



Fuzzy logic to adjust room temperature depending on the number of people

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ABSTRACT

This study focuses on discussing how fuzzy logic can be used in temperature control systems. To avoid unsuitable and excessive performance as a result of the growing number of individuals entering the room, fuzzy logic is utilized to determine the amount of values provided. The effectiveness of the system in controlling the temperature and the quantity of individuals entering the space is its performance. When people enter the space, the sensor system counts them to establish the room's capacity. The ATmega328 microcontroller was used in the creation of this system. The quantity of people entering the room is forecast using PIR and ultrasonic sensors. To prevent system failure, the maximum number is restricted to 250 persons for calculating and evaluating system performance. In this case, the Tsukamoto fuzzy logic model was applied, with experimental results showing increased accuracy in determining how many rotations the dynamo and relay experience. The measured average value of the results obtained an accuracy of 54.11%, and the system shows that it is more stable than without applying the fuzzy logic model.

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1. INTRODUCTION

The advancement of technology keeps pace with the times, when technology can support whatever we undertake. We can now perform a variety of human actions more easily thanks to technology. It is currently possible to construct computer science applications where all tools will be entirely automated, particularly in the fields of soft computing and intelligent system computing (Furqon Siregar & Sihombing, n.d.). The subject of discussion will be soft computing, namely its computations in computer science, which seek to solve the issue of tolerance for ambiguity, error, and partial truth. Electronics that we now use in daily life, such air conditioners, refrigerators, washing machines, and many more electrical gadgets that use soft computing, have technology applications (Unger et al., 2019). A fuzzy logic algorithm has been included into the electronic device. Fuzzy logic is a subfield of Artificial Intelligence, which is the body of knowledge that enables computers and other electronic devices to carry out tasks that humans typically carry out (Jian-Guo & Jun, 2008). Genetic algorithms can be used to regulate fuzzy logic

controller design in order to further optimize the controller settings (Shishkin et al., 2019). A substitute for contemporary control systems with a steady system response is a fuzzy logic controller. Fuzzification, Rule evaluation, and defuzzification are the three steps in the fuzzy logic design of a control system (Wang et al., 2020). Each of these procedures will have an impact on how the controlled system reacts (Linh Nguyen, 2020). Fuzzy logic can be used to make decisions about temperature, which rises as more people enter the room. Particle swarm optimization (PSO), a parameter, is used to give the variable a variable depending on behavior and the number of people entering the room. The idea of a microcontroller can be used to apply fuzzy logic (Cherniy et al., 2019).

Soft computing methods can be used in conjunction with fuzzy logic functions to regulate the balance of a wheeled robot (Furqon Siregar, Muhammad Imam & Nasution, 2020). For robot prototype models, fuzzy logic on many microcontrollers can be created, where fuzzy logic is produced using a behavior-based methodology (Furqon Siregar & Sihombing, n.d.). When the communication between the microcontroller and the sensor is about the movement detected by the sensor, fuzzy logic commands may also be used to control the amount of human to the intensity of the number of people entering the room (Pekaslan et al., 2020). There is a fresh idea to build on earlier research in this area, where the goal is to develop a fuzzy logic method to regulate volume human based on the number of individuals entering. In order to prevent a human volume shortage when it is needed, this fuzzy logic must be applied in such a way that it can stabilize or outperform the amount of volume discharge. variables that fall within the categories of small, moderate, and big amounts (M. F. Siregar & Chairul Imam, 2022). The fuzzy logic method is intended to be applied to the PIR sensor and dynamo movement, in accordance with earlier research. The limits of the conditions that have been constrained and controlled in a system determine which sensors and dynamos operate. Which outcomes, when the fuzzy method was not applied to the control system, are anticipated to be better than previously.

2. RESEARCH METHOD

The authors use the fuzzy logic approach method in this investigation. What can you do to maintain stability while adjusting the volume to the number of visitors? The sensor is tasked with sending a signal of input to the microcontroller. Once the input has been received, each input is relayed, and each relay process is tested for fuzzification. The use of this fuzzy logic system is intended to be able to overcome temporality in situations where there are growing numbers of people. On the microcontroller, fuzzy logic control is applied to relay contacts. A functioning flowchart is created as shown in order to implement the suggested system.

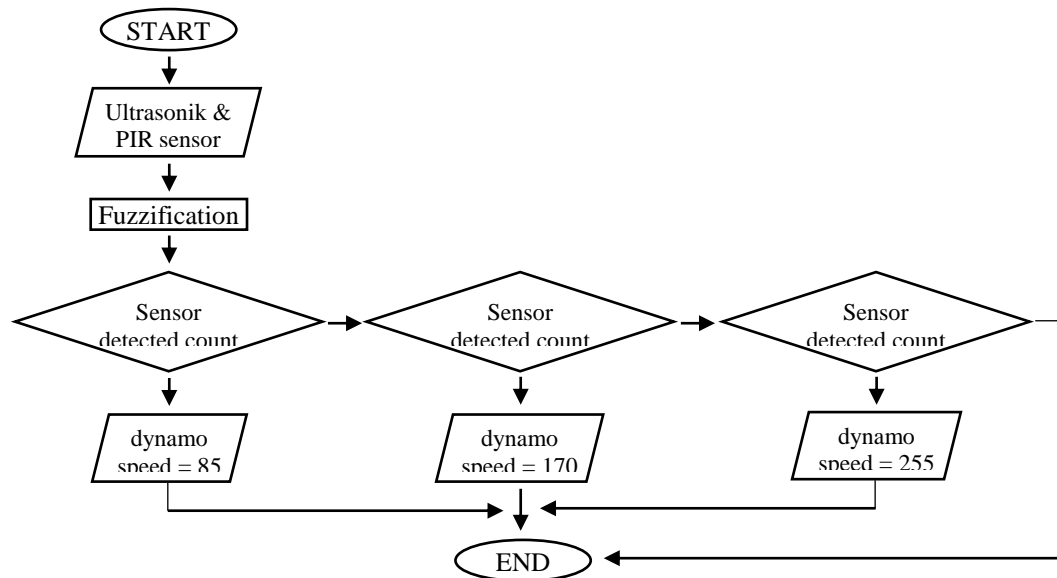


Figure 1. System Flowchart For Process Sensors And Relay Dynamo Speed

a. System Work

Ultrasonic and PIR sensors are used to assess the mass of items when the system is turned on. Within the microcontroller software, fuzzy logic is used to interpret sensor data. The relay and dynamo are activated following the analysis of the load data. Relay and dynamo motors are interconnected.

b. Microcontroller Arduino Uno

Only the clocking system and input/output interfaces are needed for the bare minimum system. The scratch software system, which is text-based, can be used to program the microcontroller when it is linked to a computer through a USB cable. The popular microcontroller chip for the Arduino system is ATmega328 (Kamide, 2020).

c. Fuzzy Logic

Uncertain problems can be certified using fuzzy logic. own a membership degree between 0 (zero) and 1 (one). The part that the programmer has provided then is represented by the value in the classification. This study examines each object to be deleted using fuzzy logic. The control system will be processed using a number of output values (Zulkifli et al., 2020).

d. Inference Process

The inference process is used to trace the reasoning of decision-makers. This section uses a fuzzy associative map (FAM) table as an illustration. The operator who creates the fuzzy logic makes the decisions for the output that is fuzzy (Soeharwinto et al., 2019). This procedure is a "IF-Then Rules" declaration of implications.

e. Membership Functions

The membership function, which has a value between 0 and 1, is a curve that depicts the conversion of data input points into membership degrees. The function technique is the way membership values are obtained (Todorovic & Simic, 2020).

f. Fuzzy Sets

A fuzzy set is a collection of x objects where each item has a membership function, commonly known as the "frith value." Fuzzy sets of A in X are sets with two members or can be expressed as: If X is a set of objects and its members are expressed as x , then X is a set of object (Gencer, 2019).

Fuzzy sets have two features, such as: (a) Linguistic features, such as the ability to name conditions like Little, Medium, and Many. (b) Numerical, meaning that the value (number) reflects the variable's size, such as: 75, 125, 225.

g. Load Variables

As shown in Figure 2, the design of fuzzy membership functions for load variables consists of three linguistic attributes with values L(Little) (0-125), M(Medium) (75-225), and H(Many) (175-250).

h. Fuzzy Rules

The fuzzy rules that are used in this study are those that Tsukamoto's fuzzy inference system has defined. Each Relay and dynamo has three rules, which are listed in Table 1.

3. RESULTS AND DISCUSSIONS

To begin the calculation, we need to create a membership function table, which entails declaring each movement point for the sensor and relay dynamo. The membership function of variable input can be calculated by the following formula set:

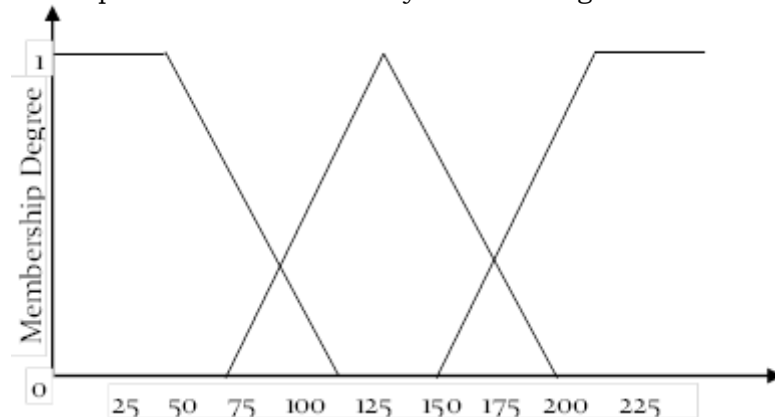


Figure 2. Membership Functions.

Set for variable than sensor_(little):

$$\mu_{\text{Load}_{L[x]}} = \begin{cases} 1, x \leq 75 \\ \frac{125-x}{125-75}, 75 \leq x \leq 125 \\ 0, x \geq 125 \end{cases} \quad (1)$$

Set for variable than sensor_(medium):

$$\mu_{\text{Load}_{M[x]}} = \begin{cases} 1, x = 150 \\ \frac{x-75}{150-75}, 75 \leq x \leq 150 \\ \frac{225-x}{225-150}, 150 \leq x \leq 225 \\ 0, x \leq 75, x \geq 225 \end{cases} \quad (2)$$

Set for variable than sensor_(many):

$$\mu\text{Load}_{H[x]} = \begin{cases} 1, x \geq 225 \\ \frac{x-175}{225-175}, 175 \leq x \leq 225 \\ 0, x \leq 175 \end{cases} \quad (3)$$

Table 1. Fuzzy Rules On Ultra Sonic - PIR And Relays — Dynamo

Rules	Ultrasonic sensor & PIR sensor	Relays & Dynamo
1	IF Little	THEN Low
2	IF Medium	THEN Middle
3	IF Many	THEN High

The rule for the sensors percentages are: (a) Little : 33% (b) Medium : 68%, (c) Many : 100%

Rule for Sensor To Relay & Dynamo

[R1] IF sensor = Little THEN Relay & Dynamo = Low

$$\begin{aligned} \alpha\text{-predicate1} &= \min \mu\text{Low} \\ &= \min(1) = 1 \end{aligned}$$

[R2] IF sensor = Medium THEN Relay & Dynamo = Middle

$$\begin{aligned} \alpha\text{-predicate2} &= \min \mu\text{Medium} \\ &= \min(0) = 0 \end{aligned}$$

[R3] IF sensor = Many THEN Relay & Dynamo = High

$$\begin{aligned} \alpha\text{-predicate3} &= \min \mu\text{Many} \\ &= \min(0) = 0 \end{aligned}$$

$$\begin{aligned} [Z1] Z\text{Max} - \alpha p1 \cdot (Z\text{max} - Z\text{min}) \\ &= 100 - 1 \cdot (100 - 33) \\ &= 100 - 67 = 33 \end{aligned}$$

$$\begin{aligned} [Z2] Z\text{Max} - \alpha p2 \cdot (Z\text{max} - Z\text{min}) \\ &= 100 - 0 \cdot (100 - 68) \\ &= 100 - 0 = 100 \end{aligned}$$

$$\begin{aligned} [Z3] Z\text{Max} - \alpha p3 \cdot (Z\text{max} - Z\text{min}) \\ &= 100 - 0 \cdot (100 - 100) \\ &= 100 - 0 = 100 \end{aligned}$$

Defuzzification Proccess in Relay & Dynamo, The defuzzification process uses the Tsukamoto model inference in testing Relay & Potensiometer as follows

$$\begin{aligned} Z \text{ Total} &= \frac{(\alpha p1 * z1) + (\alpha p2 * z2) + (\alpha p3 * z3)}{(\alpha p1 + \alpha p2 + \alpha p3)} \\ &= \frac{(1 * 33) + (0 * 100) + (0 * 100)}{(1 + 0 + 0)} \\ &= 33 \end{aligned}$$

To acquire the best results in terms of success and time accuracy, test the defuzzification procedure ten (10) times.

Relay & Dynamo beginning speed rise as dynamo for PIR & ultrasonic increases. The percentage of the relay and Potensio against the provided sensor input was determined from the test that was run ten times. Which picture is seen in Figure 3. In this section, the research findings are discussed while also providing a thorough discussion. Results can be shown in tables, graphs, figures, and other formats that are simple for the reader to understand. Multiple sub-chapters can be used to discuss the topic.

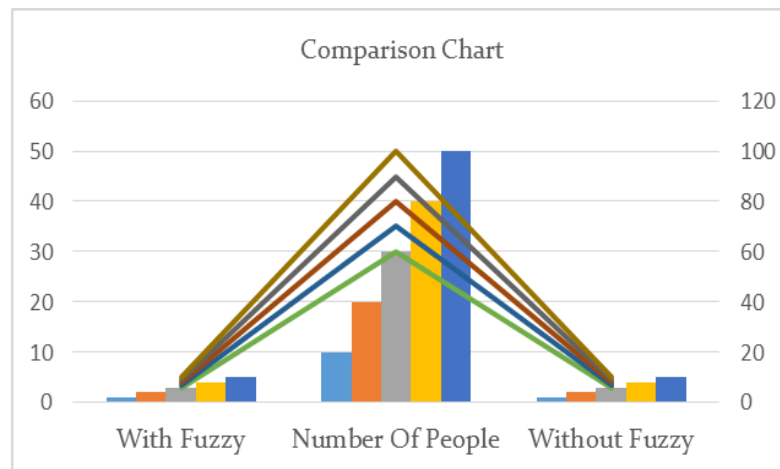


Figure 3. Testing of 10 Data Sensor Inputs

Figure 3 shows that human movements toward the relay and dynamo are stable when compared to the input from the provided sensor. The percentage will increase along with an increase in load, and this increase is always constant for relay and dynamo applications. By adding each percent of the test and dividing by the total number of inputs, the average value of each percent degree may be calculated from the relay and dynamo. the average yield of the relay and dynamo is thus 54.11%.

4. CONCLUSION

According to the test results, it seems that the system's increased function looks more ideal. This is because the Tsukamoto fuzzy logic model's sensor readings and the shift from the dynamo have a higher level of accuracy in estimating the volume of the number of people in the room. These findings demonstrate that fuzzy logic can increase the capacity to regulate the stability of movement. The sensor to dynamo percentage number, which has increased by 54.11%, can show that the system is becoming more stable. If fuzzy logic is applied to the intended module, it can be concluded that there is an improvement in the system

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