Analysis Smart Class Method Fuzzy Logic Using Arduino Uno

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1. Introduction

1.1 Background

Internet of Things is a technology that allows us to connect the machinery, equipment, and other physical objects with a network of sensors and actuators to obtain data and manage their own performance, thus allowing the machine to collaborate and even act on new information obtained independently*(McKineyGlobal*Institute).National electrical energy needs continue to increase. This increase was caused by the use of electrical energy in buildings, industry and factories. On the other hand, electrical energy consumption is also very wasteful society. This is due to lack of attention to the size of power*(watts)*of electrical equipment used. Smart class room or smart rooms which objects in the room to be controlled easily and efficiently by users, in this case these objects are objects electronics commonly found in a room such as lights, fans, air conditioners, door , whiteboard, etc. Using control system in this project is to use arduino uno so that its use will allow users to control the electronic goods. Based on the above, then this study will analyze the automation *of air conditioner* by applying *fuzzy*logic.Title Research is -**Analysis of Smart Class Method *Fuzzy Logic* Using Arduino Uno**, is expected to use *fuzzy logic* to save and control the consumption of electrical energy efficient space.

2. Basic Theory

2.1Literature

To support this study used several relevant theoretical basis and related to the subject as follows:

2.1.1 System Settings Auto AC, Handry Khoswanto, Felix Pasila, Revelation Eka Cahyadi (2004).
The purpose of this research is to be able to control the *temperature, fan submode, on / off* based on the number of individuals who detected the timer sensors. If the number of individuals detected in the room empty then the air conditioner will automatically turn off. Results from the study showed that the pairing of the motion sensor, arranged parallel probably lies between *transmitter* and *receiver,*because if the distance difference of laying greater than 0.75 cm, then thesensor *motion* would be an *error* in reading data. The device further TX Results can work and respond well even made a shift in the form of angles and distances altered. *Error* will only happen if there is nothing blocking during do TX transmitting the signal to the air conditioner.

*2.1.2 Design of A Room Temperature And Humidity Controller Using FuzzyLogic,*Tarun Kumar Das, Yudhajit Das (2013). Computational Intelligence (CI) is a field of intelligent information processing related with different branches of computer sciences and engineering. The fuzzy systems are one paradigm of CI. The contemporary technologies in the area of control and autonomous processing are benefited using fuzzy sets. One of the benefits of fuzzy control is that it can be Easily implemented a on a standard computer.

2.1.3 Automation Air Conditioner ConditioningBased Microcontroller ATmega-16,Smith Fasudin (2013). The purpose of this research is on when the power supply is enabled, the input to the microcontroller in the form of temperature detected by the LM33. Output (output) will be displayed by the LCD microcontroller such as temperature, and the relay to turn on / off *Air Conditioner* (AC) in accordance with the room temperature which has the desired limit.

*2.1.4 Temperature Control System Using Fuzzy LogicTechnique,*Isizoh A. N, Okide S, Anazia AE, Ogu CD (2012). The system is intended to control the room temperature by adjusting the heating and fan speed, and Microcontroller aims to take a decision based on the external temperature conditions. Variable temperature is entered into the system is divided into ranges such as: very cold, cold, moderate, warm, hot, very hot. Logic *Fuzzy* can be non-linear control systems that are difficult or

impossible to model mathematically. This opens the door to the control system which is usually considered unfit automation.

3 Analysis

3.1 Analysis of Temperature Sensor DHT11

DHT11 has four pins, but only 3 pins are used, ie pin 1, 2, and 4. As already stated physical labeled DHT11, pin 1 will be connected to VCC of 3.5 V - 3.5 VDC and pin 4 will be connected to ground, while pin 2 is to get the data from DHT11. Here is a series of DHT11 to Arduino Uno:

Table 3.1 Circuit DHT11 to Arduino Uno

DHT11	ARDUINO UNO
VCC	5V
GND	GND
DATA	A0

Please note the output of the pin 2 is high or low, so to transfer data, DHT11 using a specially-based protocol with timing pulse or switching between high and low of the pin data. This protocol consists of three stages, which are:

A. Request

Arduino sends a signal to wake DHT11.

B. Response

DHT11 confirm that the request is received.

C. Data Reading

DHT11 transmit temperature data. Data sent will consist of five packets of 8 bits per packet. Once the response is received, DHT11 will pull the pin low and pull data into the data pin high to between 0 and 70 μs and re-drawn to low to get pegantian between bits. When the pin is pulled to a high of less than 24 μs, it can be recorded bits as 0, whereas when the pin is pulled high to more than 24 μs, it can be noted that bit as 1. This process is repeated until the received 40 bits will be divided into five packages. Here are five of the packages:

Angka Lembab	Pecahan Lembab	Angka Suhu (Celcius)	Pecahan Suhu (Celcius)	Checksum
00011000	00000000	00011010	00000000	00110010

Figure 3.1. 5 Data Package Reading DHT11

So with one pin can make a *request* or send data while reading data. Note also Arduino can change or read the voltage on a pin between high and low to unity μs (microseconds). 1 second = 1000 milliseconds 1 millisecond = 1000 microseconds So in 1 second Arduino can perform 1 million change in the status of high and low. Here is the code that is input to arduino to read the number of DHT1.

3.2 Analysis of Fuzzy Logic

Insystem design *Fuzzy Logic* has several major part in making the basic structure of thecontrol *fuzzy*system,namely:

1) Fuzzyfication

That is the process for changing the input value system that has firmly become linguistic variables using membership functions stored in *knowladge*base.

2) *Knowladge base*

That the establishmentof fuzzy knowledge base (in the form of IF THEN Rule).

3) Defuzzyfication

That is the process to change the output obtained from the fuzzy inference engine into a firm value using the membership function in accordance with the time fuzzyfication. Fuzzy input variable to control the Air Conditioning (AC) is based on the air temperature. Fuzzy set to air temperatures are: Cold, Normal, Heat. Fuzzy set for Many People namely: Few, Many. As for the fuzzy output variables consist of Temperature Air Conditioner (AC). Fuzzy set to a temperature of Air Conditioner (AC), namely: Cold, Cool, Heat. In the fuzzy logic first thing is to determine the domain on fuzzy set of each variable and its membership function with the following conditions:

a) Variable air temperature is composed of three fuzzy sets are: COOL, NORMAL, HOT.
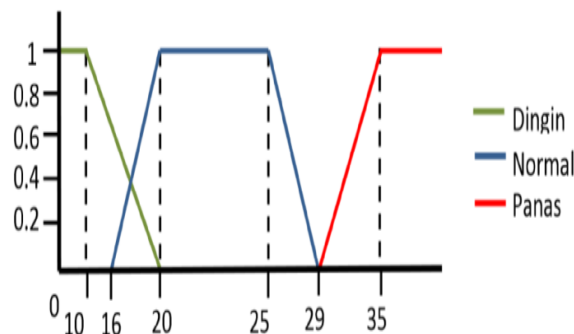
Figure 3.2. Variable Air Temperature

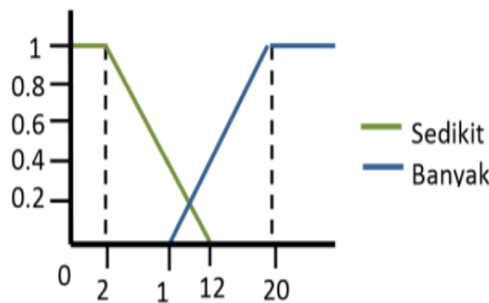b) Variable Number of People consists of two fuzzy sets are: BIT and LOT.

Figure 3.3. Variable Many People

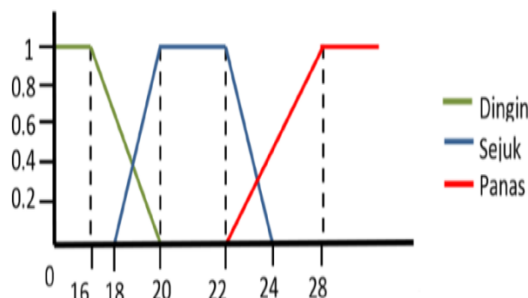c) Variable temperature Air Conditioner (AC) consists of three fuzzy sets are: COOL, NORMAL, HOT.

Figure 3.4. Variable Temperature Air Conditioner (AC)

Knowladge Base can be formed as follows:
1. IF Number of People = 'LITTLE' and Air Temperature = 'COLD' THEN Temp_AC = HOT.
2. IF Number of People = 'LITTLE' and Air Temperature = 'NORMAL' THEN Temp_AC = COOL.
3. IF Number of People = 'LITTLE' and Air Temperature = 'HEAT' THEN Temp_AC = COOL.
4. IF Number of People = 'LOT' and Air Temperature = 'COLD' THEN Temp_AC = COOL.
3. IF Number of People = 'LOT' and Air Temperature = 'NORMAL' THEN Temp_AC = COLD.
6. IF Number of People = 'LOT' and Air Temperature = 'HEAT' THEN Temp_AC = COLD.

So we can conclude that for controlling the temperature of *Air Conditioner* (AC), is influenced by the number of people in the room and the air temperature at the time. If more people in the room and hot air temperature, then the temperature will be regulated more cold air conditioning. However, if the number of people a little bit in the room and the air temperature in cold conditions the temperature of the AC will be set higher.

3.3 Analysis Arduino Uno

Microcontroller system more for simple tasks but it is important, such as controlling the motors, the control switch, variable resistor setting, or other electronic devices (Son, 2010). The existence of the microcontroller to work these jobs, the microcontroller has to contain a minimum requirement in order as a microprocessor system, namely memory for data and program and system interface*(interface)*input / output (input / output, I / O unit) is simple, so the microcontroller does not always require external memory (Son, 2010).

3.1.1 How it WorksArduino Uno

Whenmicrocontroller as thesystem, *embedded*the microcontroller has the principal function does not compute, but as something that is controlled by a computer embedded in it (Abandah, 2013). For conditions where the dysfunction as anmicrocontroller *embeddedproduct,*then the steps of operation, namely:

1. The first step is the value contained in the program *counter register* within the microcontroller retrieve data in ROM at the address indicated on the program *counter*register,then the contents of the program *counter register* plus one*(increment)*automatically, so that the data taken at the ROM is a sequence of program instructions that have been created and filled previously by the user.

2. The second step is the instruction that has been taken is processed and operated by a microcontroller, wherein the process depends on the type of instruction, can read, change the values in registers, RAM, fill port, or perform readings and proceed with the conversion data.

3. The third step is the program *counter register* has changed its good value for automatic addition in the first step, or because changing-conversion in the second step, then the microcontroller will looping the cycle in the first step to supply power to microcontroller interrupted or disconnected.

3.3.2 Programming AlgorithmArduino Uno

Programmingto the Arduino Uno to the operation of the temperature conditioning system use the Arduino IDE*(IntegratedDevelopment*Environment).The main function of the Arduino IDE, as *comfile* program code into *hex-decimal* (machine language). Flowchart for programming Arduini Uno consists of a number of stages, namely:

1. Thepin configuration
   Pin configurationis the determination ports / pins are used either as input or output. Port / pin is used as a parameter in each addressing a program for the determination of the pins on the Arduino Uno good for DHT11 sensor and LCD 2x16.

2. Variable declaration
   Variable declaration made to the declaration of the type of data that should be done.

3. Declarationconstants
   Declaration of constants aregiving constant values in the program based on *datasheet.* the sensor In constant declarations immediately called value, do not use a colon (:) as the declaration of variables but use the equal sign (=).

4. Initialization

Initialization is giving the initials of the program are made to determine the status of each command in the program. The existence of the initialization is expected to shorten the command on the next program.

5. The main program

Main program is the source of the control program, because all the commands in the program are sorted from the initial display, data retrieval, data on the appearance of the LCD and the reaction or the output of the program.

6. Check the temperature of the temperature display is performed to determine any changes that occur in a room or area.

7. Retrieve and send the data displayed temperature data must be subjected to getter data from sensors used with orders or regulations in accordance with the *datasheet* sensor used. Having obtained the data, then the data is sent to and then displayed on the LCD.

8. Output

Output due to the existence of the program syntax is a reaction to the feedback from the input source or sensor. Program for are affected output of any changes detected by the sensor.

3.3.3   SyntaxProgram

SyntaxC language-based program for Arduino Uno microcontroller following is the syntax:

```
#include "LiquidCrystal.h";
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
float tempC;
int tempPin = 0;
void setup() {
        pinMode (13, OUTPUT);
        lcd.begin(16, 2);
        lcd.print("Temp BLF");
        Serial.begin(9600);
}
Void loop () {
        lcd.setCursor (9, 0);
        tempC = analogRead (tempPin);
        tempC = (5.0 * tempC * 100.0) / 1024.0;
        lcd.print (tempC);
        lcd.print (" C");
        Serial.print(tempC);
        Serial.print(" C Suhu");
        if (tempC >=30)
        digitalWrite(13,HIGH);
        else digitalWrite(13,LOW);
delay(2000);
}
```

4. **Conclusions and Recommendations**

4.1 Conclusions

From the analysis that has been done, there are some conclusions include the following:

1. The analysis is made in order to facilitate human tasks and make the power output efficiency is not wasted unnecessarily.

2. DHT11 temperature sensor is a temperature sensor that is good and suitable for use in monitoring the temperature of the room.
3. Microcontroller Arduino Uno is anmicrocontroller *open source* can be used to process the analog data from the sensors.
4. For the application ofcontrol system *fuzzy logiccontrol* does not require a mathematical model and optimum control of non-linear because the decision issued only uses human logic.
5. The weakness of this tool is require maintenance and periodic checks on the vital parts, especially checking that the power supply remains output 5 Volt, so it does not damage the IC (chip) digital.

4.2 Suggestions

Results of the analysis of scientific writing title Analysis of Smart Class Method *Fuzzy Logic* UsingArduino Uno, still has many shortcomings, so it needs further development, several things need to be done, namely:
1. Using another microcontroller for example Raspberry pi.
2. Researchers aware of the time constraints and the ability to make the *rule base* of *fuzzy logic* is recommended for those interested in developing to create a more perfect degree of membership so that the setting of *fuzzy logic* better.

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