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PYTHON–BASED FUZZY LOGIC SIMULATIONS FOR A SMART AIR CONDITIONING SYSTEM

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ABSTRACT

The temperature control, fan speed, and other features of the air conditioning system we use every day are all manually automated. Recent air conditioners offer automatic temperature control, variable fan speed, variable compressor speed, and more. However, using a Fully Logic Control System, we have refined it in this study to move automation one step further ahead. We count the number of people in the room using an IR sensor, and the temperature and fan speed are then adjusted accordingly.We estimate the room's size using sonar, and based on this data, we determine the fin's tilt position and maintain fan speed. We determine the inside temperature using an external temperature and humidity sensor. These are the three variables or ways by which we calculate the temperature, fan speed, and fin direction necessary to maintain the desired temperature.Python provides a straightforward answer to the fuzzy logic issue for the Air Conditioner context. Until now, MATLAB was used to construct fuzzy logic problems for Air Conditioner. However, Python logic is used in this, which mitigates the drawbacks of fuzzy logic in MATLAB.

Keywords: Python, Fuzzy Logic Control, Air conditioner, Sensor, FLC System.

1. INTRODUCTION

In our daily lives, the air conditioning system has grown in importance. It has evolved into the most prevalent and fundamental need for people everywhere in the planet. Reeds were hung fastened to the window side and trickling water was used to wet the air in the ancient Egyptian air conditioning system. The seed's evaporation caused the air blowing from the window to become cold.

The modern air conditioners use the fuzzy logic controller system to provide instructions to the conditioners when and what to do. There is a small electronic box holding all electronic components in which fuzzy logic has been coded into it**[1].**

In paper **[6]** it has been reviewed that the use of smart machines like air conditioner and washing machines makes use of fuzzy logic controller. It has been stated that, “Researchers are converting crisp phenomena to fuzzy”

Fuzzy logic was first introduced in the year 1965 by Professor LotfiA.Zadeh, University of California**[7].** It is used to develop control system using powerful design technology. It is used by engineers to implement complex systems by simple methods**[8]**.

It accepts various degree inputs in a particular amount of time and can develop a system in more natural ways**[9].** Fuzzy logic controllers are similar to the classical controllers which uses knowledge gained from human thoughts and operators**.** Using fuzzy logic behavioral model, gas heaters were also designed **[2].**

The performances of these fuzzy logic are controlled by the embedded automatic controller**[3]**. The fuzzy logic is a logic where when an input is given, it produces the output which already coded for the particular input.

The simulation of the fuzzy logic controller system is done using the software called MATLAB. It is a toolbox which can be used to design fuzzy logic controller**[4].** It is the most used simulation software for simulation of any kind of input and to read the output and we can compare it with our expected result. It is being used by many engineers and scientists across the world.

Fuzzy Logic is a mathematical system which is used to analyze the analog input in terms of fuzzy logic values**[5]**. According to the present-day technology, Fuzzy Logic has become a focused interest for both the industrial usage and fundamental perspectives**.**Using this technique [19], basic necessities of an agricultural land can be satisfied and is also useful for productive farming technique. The main concentration of this idea will be based on the cultivation of three different varieties of the Paddy.

The input given for the process is type of clothes, degree of dirt and mass of the cloth load and the output received is wash time, RPM, dry time, temperature. The simulation results show that the system provides a good wash quality [16]. The principle [18] of this process is to subject input to Fuzzy arithmetic which in turn returns the value of the temperature of water and washing time.

2. PROPOSED DESIGN

The fuzzy logic system can be determined by using inputs and outputs given. The main task of this air conditioner is to provide a cool temperature to the room with best possible current consumption with respect to room size, number of persons, atmospheric temperature and ton capacity of the air conditioner. There are 27 rules for input and output for smart air conditioning system which is produced to provide the proposed fuzzy logic. To achieve the best economical usage of air conditioner, the input parameters for the fuzzy logic are:

1. Number of Persons
2. Room size
3. Atmospheric temperature

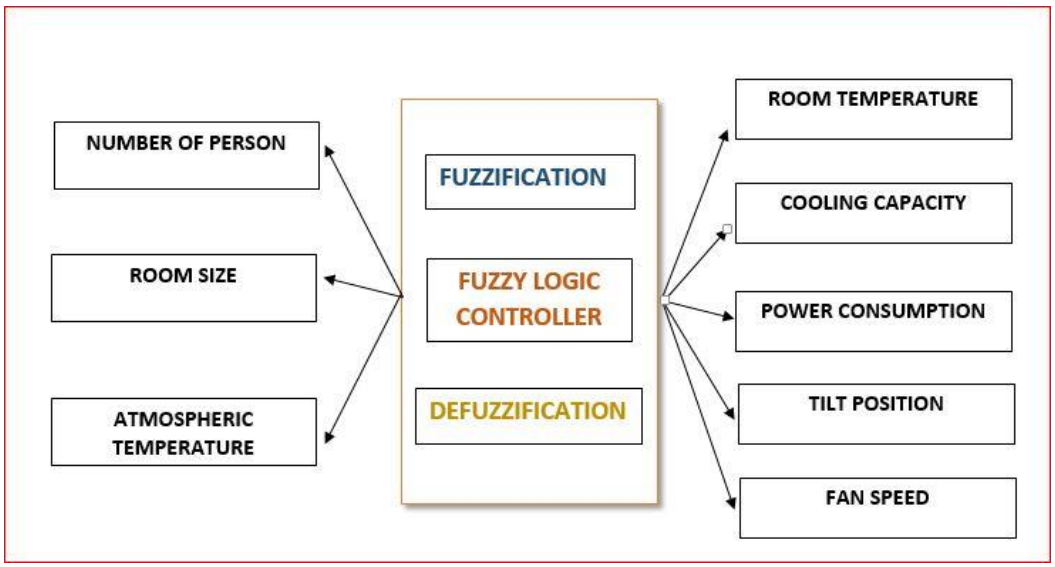

Figure 1:Fuzzy logic system of air conditioner

The fuzzy logic system processes the input and provides the outputs such as:

1. Room temperature
2. Cooling capacity
3. Power consumption
4. Tilt position
5. Fan speed

The input values are converted into corresponding fuzzy-set values by the process of fuzzification. The desired input derives the output for the rules applied to the machine by inference engine to obtain a crisp output. Defuzzification is carried out by the center of gravity method.

The input and output values are decided in advance to deal with the details of fuzzy logic controller. The crisp input values are mapped to the fuzzy values by the Membership function and after the suitable operation on them. The process which converts crisp value into Fuzzy value is known as Fuzzification.

2.1 Automation using IR sensor

We have the IR sensor placed inside the logic board. The IR sensor detects the number of persons present in the room. The fuzzy logic system takes the number of persons as the input and determines the temperature needed for the room.

For example: If the input is 2, (i.e.,) two persons, the room temperature is 24°C

If the input is 4, then the temperature reduces to 20°C,

Thus, maintaining the room temperature to be sufficient enough for the human body.

2.2 Automation using SONAR

Sonar is a device which detects the distance of any object from the source. It uses the ultrasonic waves to detect it. We use this in our system placed in the logic board which detects the size of the room and gives the input to the fuzzy logic as large, medium or small and produces the output of the tilt direction of the fin and fan speed.

For e.g. If the input is large, i.e., size of a room, then the tilt position and fan speed is high

If the input is small, then the output, i.e., the tilt position is low and the fan speed is dependent of the number of persons.

2.3 Automation using the atmospheric condition

We use the temperature and humidity sensor which is placed in the outdoor unit. These sensors detect the temperature and humidity of the atmosphere. This sensor output is given as an input to the fuzzy logic system in the logic board. This determines the temperature to be maintained in the room as low or high.

For e.g. If the input is low, i.e. the atmospheric temperature, then the temperature inside the room is slightly high. Consider the atmospheric temp to be 30°C, then the room temperature to be maintained is 24°C.

3. Algorithm for our Fuzzy logic system:

BEGIN < FUZZY LOGIC > (NO_OF_PERSON, ROOM_SIZE, ATMOSSPHERIC _TEMPERATURE)
IF NO_OF_PERSON=LESS AND ROOM_SIZE= SMALL AND ATMOSSPHERIC _TEMPERATURE = COLD THEN
PRINT WASH STASTICS
ELSE IF NO_OF_PERSON=LESS AND ROOM_SIZE= MEDIUM AND ATMOSSPHERIC _TEMPERATURE = WARM THEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=LESS AND ROOM_SIZE= LARGE AND ATMOSSPHERIC _TEMPERATURE = HOT THEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=NORMAL AND ROOM_SIZE= SMALL AND ATMOSSPHERIC _TEMPERATURE = COLD THEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=NORMAL AND ROOM_SIZE= MEDIUM AND ATMOSSPHERIC _TEMPERATURE = WARM THEN
PRINT WASH STATISTICS
ELSEIF NO_OF_PERSON=NORMAL AND ROOM_SIZE= LARGE AND ATMOSSPHERIC _TEMPERATURE = HOT THEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=MORE AND ROOM_SIZE= SMALL AND ATMOSSPHERIC _TEMPERATURE = COLD THEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=MORE AND ROOM_SIZE= MEDIUM AND ATMOSSPHERIC _TEMPERATURE = WARM THEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=MORE AND ROOM_SIZE= LARGE AND ATMOSSPHERIC _TEMPERATURE = HOTTHEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=LESS AND ROOM_SIZE= SMALL AND ATMOSSPHERIC _TEMPERATURE = COLDTHEN
PRINT WASH STATISTICS

ELSE IF NO_OF_PERSON=NORMAL AND ROOM_SIZE= SMALL AND ATMOSSPHERIC _TEMPERATURE = WARMTHEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=MORE AND ROOM_SIZE= SMALL AND ATMOSSPHERIC _TEMPERATURE = HOT THEN
PRINT WASH STATISTICS
13ELSE IF NO_OF_PERSON=LESS AND ROOM_SIZE= MEDIUM AND ATMOSSPHERIC _TEMPERATURE = COLD THEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=NORMAL AND ROOM_SIZE= MEDIUM AND ATMOSSPHERIC _TEMPERATURE = WARM THEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=MORE AND ROOM_SIZE= MEDIUM AND ATMOSSPHERIC _TEMPERATURE = HOTTHEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=LESS AND ROOM_SIZE= LARGE AND ATMOSSPHERIC _TEMPERATURE = COLDTHEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=NORMAL AND ROOM_SIZE= LARGE AND ATMOSSPHERIC _TEMPERATURE = WARMTHEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=MORE AND ROOM_SIZE= LARGE AND ATMOSSPHERIC _TEMPERATURE = HOT THEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=SMALL AND ROOM_SIZE= LESS AND ATMOSSPHERIC _TEMPERATURE = COLDTHEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=NORMAL AND ROOM_SIZE= MEDIUM AND ATMOSSPHERIC _TEMPERATURE = COLDTHEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=MORE AND ROOM_SIZE= LARGE AND ATMOSSPHERIC _TEMPERATURE = COLDTHEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=LESS AND ROOM_SIZE= SMALL AND ATMOSSPHERIC _TEMPERATURE = WARMTHEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=NORMAL AND ROOM_SIZE= MEDIUM AND ATMOSSPHERIC _TEMPERATURE = WARMTHEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=MORE AND ROOM_SIZE= LARGE AND ATMOSSPHERIC _TEMPERATURE = WARMTHEN
PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=LESS AND ROOM_SIZE= SMALL AND ATMOSSPHERIC _TEMPERATURE = HOT THEN
PRINT WASH STATISTICS

ELSE IF NO_OF_PERSON=NORMAL AND ROOM_SIZE= MEDIUM AND ATMOSSPHERIC _TEMPERATURE = HOT THEN
    PRINT WASH STATISTICS
ELSE IF NO_OF_PERSON=MORE AND ROOM_SIZE= LARGE AND ATMOSSPHERIC _TEMPERATURE = HOT THEN
    PRINT WASH STATISTICS

4. Python code for our Fuzzy logic system:

Fuzzy rules have been involved in the modeling of washing machines. The whole system which we have made is developed by using Python. The code for our FLC system is as follows:

```
list1=[]
def result():
#Silk
print("------")
print("OUTPUT")
print("------")
```

Rule 1:
```
if((list1[0]=="Less")and(list1[1]=="Small")and(list1[2]=="Cold")):#1
print("Room Temp  - Low")
print("Cooling Capacity      - Very Cold")
print("Power Consumption  - Low")
print("Tilts Position          - Low")
print("Fan Speed             - Low")
input("Press Enter key to exit...")
```

Rule 2:
```
elif((list1[0]=="Less")and(list1[1]=="Medium")and(list1[2]=="Warm")):#2
print("Room Temp- Medium")
print("Cooling Capacity      - Cold")
print("Power Consumption  - Medium")
print("Tilts Position- Centre")
print("Fan Speed- Medium")
input("Press Enter key to exit...")
```

Rule 3:
```
elif((list1[0]=="Less")and(list1[1]=="Large")and(list1[2]=="Hot")):#3
print("Room Temp- High")
print("Cooling Capacity      - warm")
print("Power Consumption  - High ")
print("Tilts Position          - High ")
print("Fan Speed             - Fast ")
input("Press Enter key to exit...")
```

Rule 4:
```
elif((list1[0]=="Normal")and(list1[1]=="Small")and(list1[2]=="Cold")):#4
```

```
print("Room Temp  - Low")
print("Cooling Capacity      - Very Cold")
print("Power Consumption  - Low ")
print("Tilts Position          - Low")
print("Fan Speed              - Low ")
input("Press Enter key to exit...")
```

Rule 5: elif((list1[0]=="Normal")and(list1[1]=="Medium")and(list1[2]=="Warm")):#5

```
print("Room Temp  - Medium")
print("Cooling Capacity      -  Cold")
print("Power Consumption  - Medium ")
print("Tilts Position          - Centre")
print("Fan Speed              - Medium ")
input("Press Enter key to exit...")
```

Rule 6:elif((list1[0]=="Normal")and(list1[1]=="Large")and(list1[2]=="Hot")):#6

```
print("Room Temp  - High")
print("Cooling Capacity      -  Warm")
print("Power Consumption  - High ")
print("Tilts Position          - High")
print("Fan Speed              - Fast ")
input("Press Enter key to exit...")
```

Rule 7:elif((list1[0]=="More")and(list1[1]=="Small")and(list1[2]=="Cold")):#6

```
print("Room Temp  - Low")
print("Cooling Capacity      -  Very Cold ")
print("Power Consumption  - Low ")
print("Tilts Position          - Low ")
print("Fan Speed              - Low ")
input("Press Enter key to exit...")
```

Rule 8:elif((list1[0]=="More")and(list1[1]=="Medium")and(list1[2]=="Warm")):#8

```
print("Room Temp  - Medium")
print("Cooling Capacity      -  Cold ")
print("Power Consumption  - Medium ")
print("Tilts Position          - Centre ")
print("Fan Speed              - Medium ")
input("Press Enter key to exit...")
```

Rule 9: elif((list1[0]=="More")and(list1[1]=="Large")and(list1[2]=="Hot")):#9

```
print("Room Temp  - High")
```

```
print("Cooling Capacity      -  Warm ")
print("Power Consumption  - High ")
print("Tilts Position          - High ")
print("Fan Speed              - Fast ")
input("Press Enter key to exit...")
```

Rule 10:elif((list1[0]=="Less")and(list1[1]=="Small")and(list1[2]=="Cold")):#10

```
print("Room Temp  - Low")
print("Cooling Capacity      - Very Cold ")
print("Power Consumption  - Low ")
print("Tilts Position          - Low ")
print("Fan Speed              - Low ")
input("Press Enter key to exit...")
```

Rule 11:elif((list1[0]=="Normal")and(list1[1]=="Small")and(list1[2]=="Warm")):#11

```
print("Room Temp  - Medium")
print("Cooling Capacity      - Cold ")
print("Power Consumption  - Medium ")
print("Tilts Position          - Centre ")
print("Fan Speed              - Medium ")
input("Press Enter key to exit...")
```

Rule 12:elif((list1[0]=="More")and(list1[1]=="Small")and(list1[2]=="Hot")):#12

```
print("Room Temp  - High")
print("Cooling Capacity      - warm ")
print("Power Consumption  - High ")
print("Tilts Position          - High ")
print("Fan Speed              - Fast ")
input("Press Enter key to exit...")
```

Rule 13: elif((list1[0]=="Less")and(list1[1]=="Medium")and(list1[2]=="Cold")):#13

```
print("Room Temp  - Low")
print("Cooling Capacity      - Very Cold ")
print("Power Consumption  - Low ")
print("Tilts Position          - Low ")
print("Fan Speed              - Low ")
input("Press Enter key to exit...")
```

Rule 14: elif((list1[0]=="Normal")and(list1[1]=="Medium")and(list1[2]=="Warm")):#14

```
print("Room Temp  - Medium")
print("Cooling Capacity      - Cold ")
print("Power Consumption  - Medium ")
print("Tilts Position          - Centre ")
print("Fan Speed              - Medium ")
input("Press Enter key to exit...")
```

Rule 15:elif((list1[0]=="More")and(list1[1]=="Medium")and(list1[2]=="Hot")):#15
print("Room Temp - High")
print("Cooling Capacity - Warm ")
print("Power Consumption - High ")
print("Tilts Position - High ")
print("Fan Speed - Fast ")
input("Press Enter key to exit...")

Rule 16:elif((list1[0]=="Less")and(list1[1]=="Large")and(list1[2]=="Cold")):#16
print("Room Temp - Low")
print("Cooling Capacity - Very Cold ")
print("Power Consumption - Low ")
print("Tilts Position - Low ")
print("Fan Speed - Low ")
input("Press Enter key to exit...")

Rule 17:elif((list1[0]=="Normal")and(list1[1]=="Large")and(list1[2]=="Warm")):#17
print("Room Temp - Medium")
print("Cooling Capacity - Cold ")
print("Power Consumption - Medium ")
print("Tilts Position - Centre ")
print("Fan Speed - Medium ")
input("Press Enter key to exit...")

Rule 18:elif((list1[0]=="More")and(list1[1]=="Large")and(list1[2]=="Hot")):#18
print("Room Temp - High")
print("Cooling Capacity - Warm")
print("Power Consumption - High ")
print("Tilts Position - High ")
print("Fan Speed - Fast ")
input("Press Enter key to exit...")

Rule 19:elif((list1[0]=="Less")and(list1[1]=="Small")and(list1[2]=="Cold")):#19
print("Room Temp - Low")
print("Cooling Capacity - Very Cold ")
print("Power Consumption - Low ")
print("Tilts Position - Low ")
print("Fan Speed - Low ")
input("Press Enter key to exit...")

Rule 20:elif((list1[0]=="Normal")and(list1[1]=="Medium")and(list1[2]=="cold")):#20
print("Room Temp - Medium")

```
print("Cooling Capacity      -  Cold ")
print("Power Consumption  - Medium ")
print("Tilts Position          - Centre ")
print("Fan Speed              - Medium ")
input("Press Enter key to exit...")
```

Rule 21:
```
elif((list1[0]=="More")and(list1[1]=="Large")and(list1[2]=="Cold")):#21
print("Room Temp  - High")
print("Cooling Capacity      - warm ")
print("Power Consumption  - High ")
print("Tilts Position          - High ")
print("Fan Speed              - Fast ")
input("Press Enter key to exit...")
```

Rule 22:
```
elif((list1[0]=="Less")and(list1[1]=="Small")and(list1[2]=="Warm")):#22
print("Room Temp  - Low")
print("Cooling Capacity      -  Very Cold ")
print("Power Consumption  - Low ")
print("Tilts Position          - Low ")
print("Fan Speed              - Low ")
input("Press Enter key to exit...")
```

Rule 23:
```
elif((list1[0]=="Normal")and(list1[1]=="Medium")and(list1[2]=="Warm")):#23
print("Room Temp  - Medium")
print("Cooling Capacity      -  Cold ")
print("Power Consumption  - Medium ")
print("Tilts Position          - Centre ")
print("Fan Speed              - Medium ")
input("Press Enter key to exit...")
```

Rule 24:
```
elif((list1[0]=="More")and(list1[1]=="Large")and(list1[2]=="Warm")):#24
print("Wash Duration   - 2.10 h")
print("Temperature - 40c")
print("RPM         - 1000")
print("Dry Time    - Quick")
print("Quality     - Good")
input("Press Enter key to exit...")
```

Rule 25:
```
elif((list1[0]=="Less")and(list1[1]=="Small")and(list1[2]=="Hot")):#25
print("Room Temp  - High")
print("Cooling Capacity      -  Warm")
print("Power Consumption  - High ")
print("Tilts Position          - High ")
```

```
print("Fan Speed              - Fast ")
input("Press Enter key to exit...")
```

Rule 26:
```
elif((list1[0]=="Normal")and(list1[1]=="Medium")and(list1[2]=="Hot")):#26
print("Room Temp  - Medium")
print("Cooling Capacity      -  Cold ")
print("Power Consumption  - Medium ")
print("Tilts Position           - Centre ")
print("Fan Speed              - Medium ")
input("Press Enter key to exit...")
```

Rule 27:
```
elif((list1[0]=="More")and(list1[1]=="Large")and(list1[2]=="HotS")):#27
print("Room Temp  - High")
print("Cooling Capacity      - warm ")
print("Power Consumption  - High ")
print("Tilts Position           - High ")
print("Fan Speed              - Fast ")
input("Press Enter key to exit...")

def fun():
list1.append(str(input("Enter the No_of_Pesrson:").lower()))
list1.append(str(input("Enter the Room_Size:").lower()))
list1.append(str(input("Enter the Atmosspheric_Temp:").lower()))
print(list1)

   if(((list1[0]=="Less")or(list1[0]=="Normal")or(list1[0]=="More"))and
    ((list1[1]=="Small")or(list1[1]=="Medium")or(list1[1]=="Large"))and
      ((list1[2]=="Cold")or(list1[2]=="Warm")or(list1[2]=="Hot"))):
settings=str(input("Do you want to Change the Settings (YES OR NO):").lower())

if(settings=="yes"):
list1.clear()
fun()
elif(settings=="no"):
result()
else:
print("Given input is wrong try again")
list1.clear()
fun()
fun()
```

5. Resultant values of our Air Conditioner's FLC python code:

The decision of the fuzzy logic controller is made using previously stored data in the database. The principles which we use in this paper are derived from the logical thinking, data

taken from daily usage, and experimentation of the system in a controlled environment. The set of principles used here to derive the output are based on the Fuzzy logic system using python code are given below:

```
Enter the No_of_Pesrson:Less
Enter the Room_Size:Small
Enter the Atmosspheric_Temp:Cold
['less', 'small', 'cold']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - Low
Cooling Capacity   - Very Cold
Power Consumption - Low
Tilts Position     - Low
Fan Speed          - Low
Press Enter key to exit...
```

```
Enter the No_of_Pesrson:lESS
Enter the Room_Size:MEDIUM
Enter the Atmosspheric_Temp:WARM
['less', 'medium', 'warm']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - Medium
Cooling Capacity   - Cold
Power Consumption - Medium
Tilts Position     - Centre
Fan Speed          - Medium
Press Enter key to exit...
Enter the No_of_Pesrson:Less
Enter the Room_Size:Large
Enter the Atmosspheric_Temp:Hot
['less', 'large', 'hot']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - High
Cooling Capacity   - warm
Power Consumption - High
Tilts Position     - High
Fan Speed          - Fast
Press Enter key to exit...
```

```
Enter the No_of_Pesrson:Normal
Enter the Room_Size:Small
Enter the Atmosspheric_Temp:Cold
['normal', 'small', 'cold']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - Low
Cooling Capacity   - Very Cold
Power Consumption  - Low
Tilts Position     - Low
Fan Speed          - Low
Press Enter key to exit...
```

```
Enter the No_of_Pesrson:Normal
Enter the Room_Size:Medium
Enter the Atmosspheric_Temp:Warm
['normal', 'medium', 'warm']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - Medium
Cooling Capacity   -  Cold
Power Consumption  - Medium
Tilts Position     - Centre
Fan Speed          - Medium
Press Enter key to exit...
```

```
Enter the No_of_Pesrson:Normal
Enter the Room_Size:Large
Enter the Atmosspheric_Temp:Hot
['normal', 'large', 'hot']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - High
Cooling Capacity   -  Warm
Power Consumption  - High
Tilts Position     - High
Fan Speed          - Fast
Press Enter key to exit...
```

```
Enter the No_of_Pesrson:More
Enter the Room_Size:Small
Enter the Atmosspheric_Temp:Cold
['more', 'small', 'cold']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - Low
Cooling Capacity   -  Very Cold
Power Consumption - Low
Tilts Position     - Low
Fan Speed          - Low
Press Enter key to exit...
Enter the No_of_Pesrson:More
Enter the Room_Size:Medium
Enter the Atmosspheric_Temp:Warm
['more', 'medium', 'warm']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - Medium
Cooling Capacity   - Cold
Power Consumption - Medium
Tilts Position     - Centre
Fan Speed          - Medium
Press Enter key to exit...
Enter the No_of_Pesrson:More
Enter the Room_Size:Large
Enter the Atmosspheric_Temp:Hot
['more', 'large', 'hot']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - High
Cooling Capacity   - Warm
Power Consumption - High
Tilts Position     - High
Fan Speed          - Fast
Press Enter key to exit...
```

```
Enter the No_of_Pesrson:Less
Enter the Room_Size:Small
Enter the Atmosspheric_Temp:Cold
['less', 'small', 'cold']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - Low
Cooling Capacity   - Very Cold
Power Consumption  - Low
Tilts Position     - Low
Fan Speed          - Low
Press Enter key to exit...
```

```
Enter the No_of_Pesrson:Normal
Enter the Room_Size:Small
Enter the Atmosspheric_Temp:Warm
['normal', 'small', 'warm']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - Medium
Cooling Capacity   - Cold
Power Consumption  - Medium
Tilts Position     - Centre
Fan Speed          - Medium
Press Enter key to exit...
```

```
Enter the No_of_Pesrson:More
Enter the Room_Size:Small
Enter the Atmosspheric_Temp:Hot
['more', 'small', 'hot']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - High
Cooling Capacity   - warm
Power Consumption  - High
Tilts Position     - High
Fan Speed          - Fast
Press Enter key to exit...
```

```
Enter the No_of_Pesrson:Less
Enter the Room_Size:Medium
Enter the Atmosspheric_Temp:Cold
['less', 'medium', 'cold']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - Low
Cooling Capacity   - Very Cold
Power Consumption  - Low
Tilts Position     - Low
Fan Speed          - Low
Press Enter key to exit...
```

```
Enter the No_of_Pesrson:Normal
Enter the Room_Size:Medium
Enter the Atmosspheric_Temp:Warm
['normal', 'medium', 'warm']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - Medium
Cooling Capacity   -  Cold
Power Consumption  - Medium
Tilts Position     - Centre
Fan Speed          - Medium
Press Enter key to exit...
```

```
Enter the No_of_Pesrson:More
Enter the Room_Size:Medium
Enter the Atmosspheric_Temp:Hot
['more', 'medium', 'hot']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - High
Cooling Capacity   -  Warm
Power Consumption  - High
Tilts Position     - High
Fan Speed          - Fast
Press Enter key to exit...
```

```
Enter the No_of_Pesrson:Less
Enter the Room_Size:Large
Enter the Atmosspheric_Temp:Cold
['less', 'large', 'cold']
Do you want to Change the Settings (YES OR NO):NO
------
OUTPUT
------
Room Temp          - Low
Cooling Capacity   - Very Cold
Power Consumption  - Low
Tilts Position     - Low
Fan Speed          - Low
Press Enter key to exit...
Enter the No_of_Pesrson:Normal
Enter the Room_Size:Large
Enter the Atmosspheric_Temp:Warm
['normal', 'large', 'warm']
Do you want to Change the Settings (YES OR NO):nO
------
OUTPUT
------
Room Temp          - Medium
Cooling Capacity   - Cold
Power Consumption  - Medium
Tilts Position     - Centre
Fan Speed          - Medium
Press Enter key to exit...
Enter the No_of_Pesrson:More
Enter the Room_Size:Large
Enter the Atmosspheric_Temp:Hot
['more', 'large', 'hot']
Do you want to Change the Settings (YES OR NO):no
------
OUTPUT
------
Room Temp          - High
Cooling Capacity   - Warm
Power Consumption  - High
Tilts Position     - High
Fan Speed          - Fast
Press Enter key to exit...
```

```
Enter the No_of_Pesrson:Less
Enter the Room_Size:Small
Enter the Atmosspheric_Temp:Cold
['less', 'small', 'cold']
Do you want to Change the Settings (YES OR NO):no
------
OUTPUT
------
Room Temp          - Low
Cooling Capacity   - Very Cold
Power Consumption  - Low
Tilts Position     - Low
Fan Speed          - Low
Press Enter key to exit...
Enter the No_of_Pesrson:Normal
Enter the Room_Size:Medium
Enter the Atmosspheric_Temp:Cold
['normal', 'medium', 'cold']
Do you want to Change the Settings (YES OR NO):no
------
OUTPUT
------
Room Temp          - Medium
Cooling Capacity   - Cold
Power Consumption  - Medium
Tilts Position     - Centre
Fan Speed          - Medium
Press Enter key to exit...
Enter the No_of_Pesrson:More
Enter the Room_Size:Large
Enter the Atmosspheric_Temp:Cold
['more', 'large', 'cold']
Do you want to Change the Settings (YES OR NO):no
------
OUTPUT
------
Room Temp          - High
Cooling Capacity   - Warm
Power Consumption  - High
Tilts Position     - High
Fan Speed          - Fast
Press Enter key to exit...
```

```
Enter the No_of_Pesrson:Less
Enter the Room_Size:Small
Enter the Atmosspheric_Temp:Warm
['less', 'small', 'warm']
Do you want to Change the Settings (YES OR NO):no
------
OUTPUT
------
Room Temp          - Low
Cooling Capacity   - Very Cold
Power Consumption  - Low
Tilts Position     - Low
Fan Speed          - Low
Press Enter key to exit...
Enter the No_of_Pesrson:Normal
Enter the Room_Size:Medium
Enter the Atmosspheric_Temp:Warm
['normal', 'medium', 'warm']
Do you want to Change the Settings (YES OR NO):no
------
OUTPUT
------
Room Temp          - Medium
Cooling Capacity   -  Cold
Power Consumption  - Medium
Tilts Position     - Centre
Fan Speed          - Medium
Press Enter key to exit...
Enter the No_of_Pesrson:More
Enter the Room_Size:Large
Enter the Atmosspheric_Temp:Warm
['more', 'large', 'warm']
Do you want to Change the Settings (YES OR NO):no
------
OUTPUT
------
Room Temp          - High
Cooling Capacity   - Warm
Power Consumption  - High
Tilts Position     - High
Fan Speed          - Fast
Press Enter key to exit...
```

```
Enter the No_of_Pesrson:Less
Enter the Room_Size:Small
Enter the Atmosspheric_Temp:Hot
['less', 'small', 'hot']
Do you want to Change the Settings (YES OR NO):no
------
OUTPUT
------
Room Temp          - Low
Cooling Capacity   - Very Cold
Power Consumption  - Low
Tilts Position     - Low
Fan Speed          - Low
Press Enter key to exit...
Enter the No_of_Pesrson:Normal
Enter the Room_Size:Medium
Enter the Atmosspheric_Temp:Hot
['normal', 'medium', 'hot']
Do you want to Change the Settings (YES OR NO):no
------
OUTPUT
------
Room Temp          - Medium
Cooling Capacity   - Cold
Power Consumption  - Medium
Tilts Position     - Centre
Fan Speed          - Medium
Press Enter key to exit...
Enter the No_of_Pesrson:More
Enter the Room_Size:Large
Enter the Atmosspheric_Temp:Hot
['more', 'large', 'hot']
Do you want to Change the Settings (YES OR NO):no
------
OUTPUT
------
Room Temp          - High
Cooling Capacity   - Warm
Power Consumption  - High
Tilts Position     - High
Fan Speed          - Fast
Press Enter key to exit...
```

Table 1: The rules for set of inputs and outputs for Air Conditioner

S. NO	LINGUISTIC INPUTS			LINGUISTIC OUTPUTS				
	NUMBER OF PERSON	ROOM SIZE	ATMOSSPHERIC TEMPERATURE	ROOM TEMPERATURE	COOLING CAPACITY	POWER CONSUMPTION	TILTS POSITION	FAN SPEED
1	Less	Small	Cold	Low	Very cold	Low	Low	Low
2	Less	Medium	Warm	Medium	Cold	Medium	Centre	Medium

3	Less	Large	Hot	High	warm	High	High	Fast
4	Normal	Small	Cold	Low	Very cold	Low	Low	Low
5	Normal	Medium	Warm	Medium	Cold	Medium	Centre	Medium
6	Normal	Large	Hot	High	warm	High	High	Fast
7	More	Small	Cold	Low	Very cold	Low	Low	Low
8	More	Medium	Warm	Medium	Cold	Medium	Centre	Medium
9	More	Large	Hot	High	warm	High	High	Fast
10	Less	Small	Cold	Low	Very cold	Low	Low	Low
11	Normal	Small	Warm	Medium	Cold	Medium	Centre	Medium
12	More	Small	Hot	High	warm	High	High	Fast
13	Less	Medium	Cold	Low	Very cold	Low	Low	Low
14	Normal	Medium	Warm	Medium	Cold	Medium	Centre	Medium
15	More	Medium	Hot	High	warm	High	High	Fast
16	Less	Large	Cold	Low	Very cold	Low	Low	Low
17	Normal	Large	Warm	Medium	Cold	Medium	Centre	Medium
18	More	Large	Hot	High	warm	High	High	Fast
19	Less	Small	Cold	Low	Very cold	Low	Low	Low
20	Normal	Medium	Cold	Medium	Cold	Medium	Centre	Medium
21	More	Large	Cold	High	warm	High	High	Fast
22	Less	Small	Warm	Low	Very cold	Low	Low	Low
23	Normal	Medium	Warm	Medium	Cold	Medium	Centre	Medium
24	More	Large	Warm	High	warm	High	High	Fast
25	Less	Small	Hot	Low	Very cold	Low	Low	Low
26	Normal	Medium	Hot	Medium	Cold	Medium	Centre	Medium
27	More	Large	Hot	High	warm	High	High	Fast

6. SURFACE VIEWER FOR FUZZY LOGIC SYSTEM OF AIR CONDITIONER

The fuzzy logic system has been implemented to provide output for the given input of the air conditionerThe surface viewer helps us to represent the relation between the input and the output parameter of the membership function. The 3D surface viewer for the input and output are graphed in the figure 2.

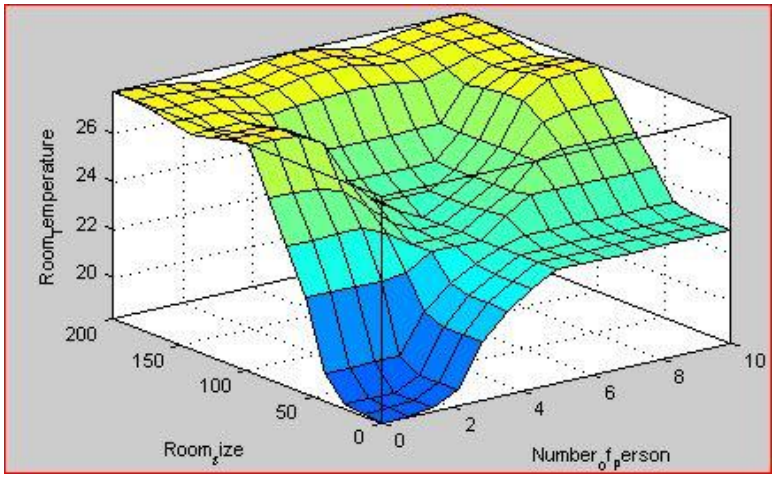

Figure 2: Surface viewer for Number of person vs Room size for Room temperature

According to the surface viewer shown in the figures from3 to 5, as the number of persons increase, the room temperature also increases. Simultaneously, as the room size increases, room temperature decreases. Eventually, when both increase, the temperature is at the peak. So to maintain the room temperature cool, fuzzy logic used in the air conditioner, senses the temperature using sensor and to maintain it.

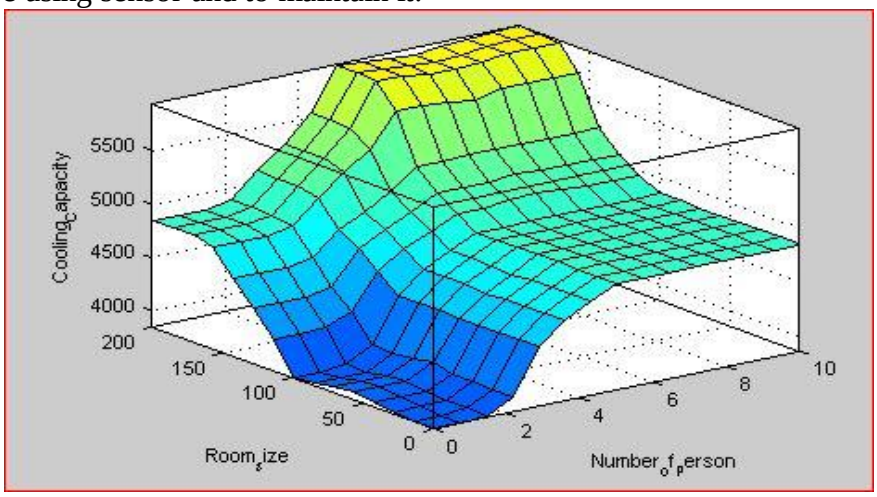

Figure 3: Surface viewer for Number of person vs Room size for the Cooling capacity

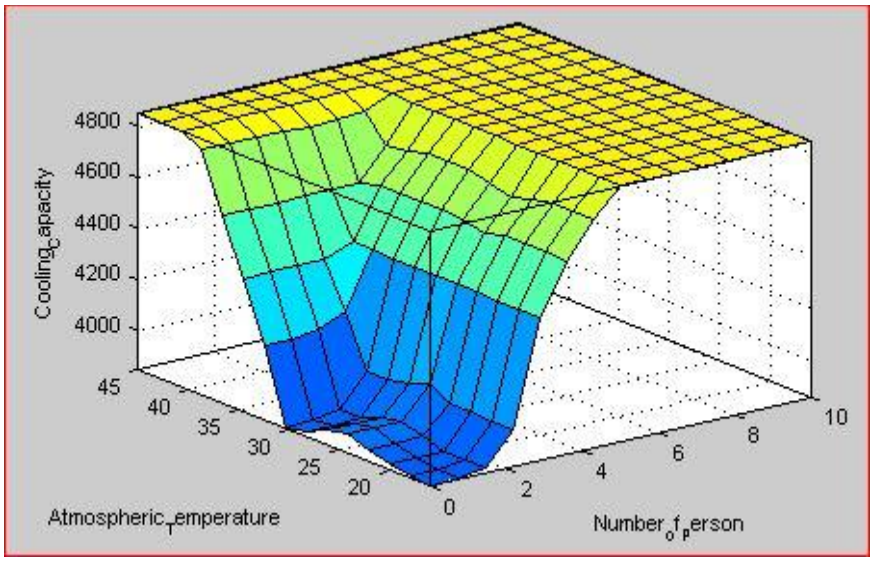

Figure 4: Surface viewer for number of person vs atmospheric temperature for cooling capacity

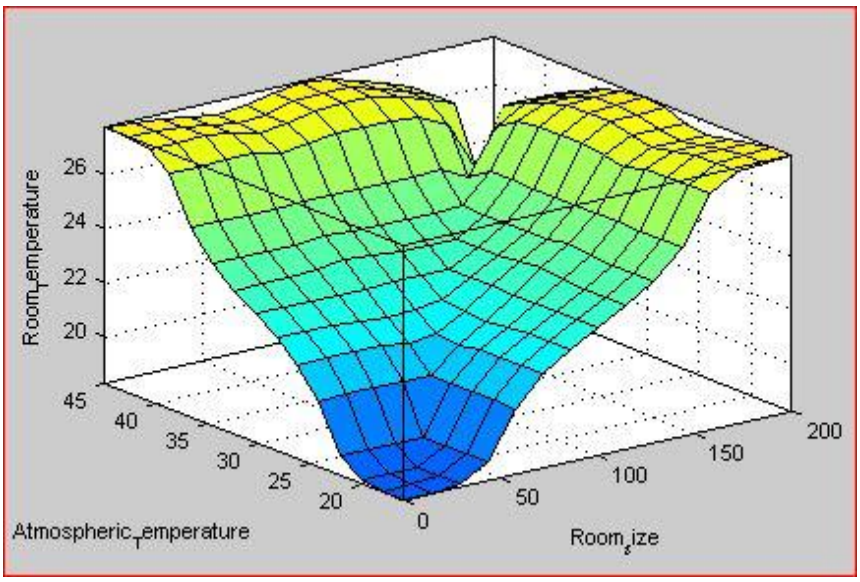

Figure 5:Surface viewer for room size vs atmospheric temperature for room temperature

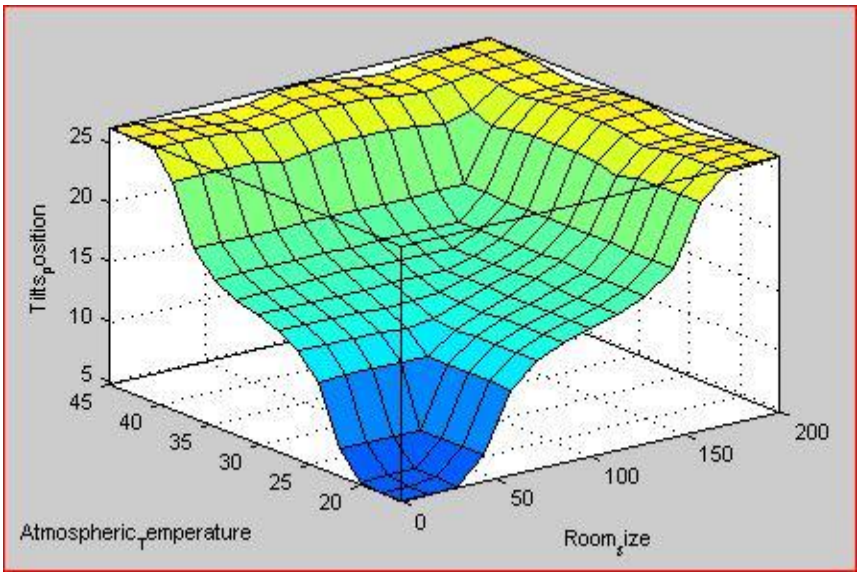

Figure 6:Surface viewer for room size vs atmospheric temperature for tilt position

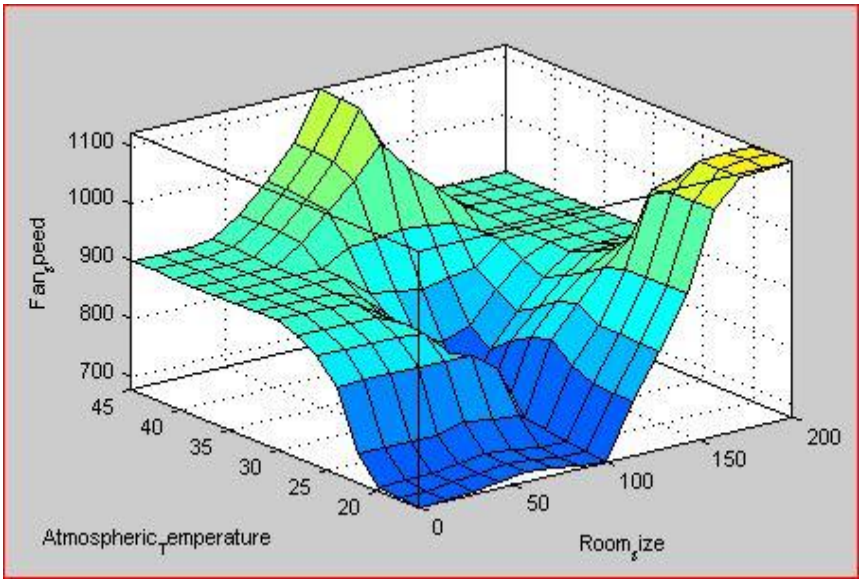

Figure 7: Surface viewer for room size vs atmospheric temperature for fan speed

According to the surface viewer shown in the figures 6 and7, as the atmospheric temperature increases, the fan speed also increases. Simultaneously, as the room size increases, fan speed also increases. Eventually, when both increase, the temperature is at the moderate. So to maintain the room temperature cool, fuzzy logic used in the air conditioner senses the temperature using sensor and maintains it.

CONCLUSION

From the above work, we conclude the following results:

i.) Using these smart systems like prediction of number of persons to maintain room temperature, tilt position to find the best distance coverage, fan speed for appropriate temperature, number of persons to maintain room temperature, room size for maintaining tilt position and fan speed etc.

ii.) These smart prediction techniques may reduce the usage of current and may increase the efficiency of the air conditioner.

iii.) The usage of fuzzy logic to assign actions to the various operations of the air conditioner has made easy to calculate the need of temperature maintenance and fan speed with tilt position and prediction of best temperature to maintain using the atmospheric temperature.

iv.) All these advantages and uses of the smart air conditioning system is a great economical and advanced technological system for daily usage in all areas.

Thus, Fuzzy logic control systems in Python provides great advantages and provides more solutions for problems that cannot be solved by MATLAB environment by reducing the disadvantages such as time management, processing speed and restricted number of input values and etc. So, Python would be the best solution to solve these problems.

Ethical Approval

Any of the authors' investigations with human participants or animals are not included in this article.

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Conflict of Interest

The authors have no applicable financial or non-financial interests to expose this article.

Informed Consent

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REFERENCES

[1]. Alshammari. A, Al-Smadi., M, Omar Abu Arqub, IshakHashim, and Mohd Almie Alias, **(2020)** Residual Series Representation Algorithm for Solving Fuzzy Duffing Oscillator Equations,*Symmetry* , *12*(4), 572.

[2]. Arqub, OA (2017), Adaptation of reproducing kernel algorithm for solving fuzzy Fredholm–Volterraintegro differential equations, Neural Computing and Applications volume 28, pages1591–1610.

[3]. George J. Kilr and Bo Yuan, Fuzzy Sets and Fuzzy Logic (India: PHI, 1995)

[4]. Hetland, M. L., (2010), Python Algorithms, Mastering Basic Algorithms in the Python Language, A press Learning Python, Third Edition, O'Reilly Media.

[5].KalyaniAdawadkar1., (2017) Python Programming-Applications and Future, International Journal of Advance Engineering and Research Development, Special Issue Section- 2017.

[6]. More Control Flow Tools. Python 3 documentation Python Software Foundation. 2015.

[7]. Omar Abu Arqub, Jagdev Singh, BananMaayah and Mohammed Alhodaly, (2021), Reproducing kernel approach for numerical solutions of fuzzy fractional initial value problems under the Mittag–Leffler kernel differential operator,*Mathematical Methods in the Applied Sciences*.

[8]. Omar Abu Arqub, Jagdev Singh and Mohammed Alhodaly., (2021), Adaptation of kernel functions-based approach with Atangana–Baleanu–Caputo distributed order derivative for solutions of fuzzy fractional Volterra and Fredholmintegro differential equations, *Mathematical Methods in the Applied Sciences*.

[9]. Patel N., (2019) Python: An open source programming language, International Journal of Engineering in Computer Science; 1(1): 12-15.

[10]. Peterson Benjamin. Python 2.7.14 released. Python Insider. The Python Core Developers, 2017. Retrieved 17 September 2017.

[11]. Python legal statements. Python Software Foundation, 2012. Retrieved January 28 Kuhlman Dave. A Python Book: Beginning Python, Advanced Python, and Python Exercises, 2012. On 23 june.

[12]. Raja, K., and Dr. S. Ramathilagam.,(2021), Automation on washing machine using fuzzy logic controller provided with three inputs and two outputs for setting the temperature of water, *Proceedings of the IEEE*, ISBN: 978-1-6654-1570-5 Page 1753-1759 (2021). ISSN NO: 0018-9219.

[13]. Raja, K., and Dr. S. Ramathilagam., (2019), Paddy growth analysis and disease prediction using fuzzy logic controller system,*Turkish journal of computer and mathematics education,*Vol. 10(02) 573-595 (2019). ISSN NO: 1309-4653.

[14].Raja, K., and Dr. S. Ramathilagam., (2021), Smart air conditioning system using fuzzy logic system and simulation using Matlab, *Malaya journal of Matematik*, Issue 1, 331-333 (2021). ISSN NO: 2321 – 5666.

[15]. Raja, K., and Dr. S. Ramathilagam., (2021), Washing machine using fuzzy logic controller

to provide wash quality, *Soft computing*, Vol. 24 issue 15, 9957-9965 (2021). ISSN NO: 1433-7479.
[16]. Raja, K., (2023), Python-based fuzzy logic in Automatic Washer control system, *Soft computing*, Vol. 27,6159-6185 (2023). ISSN NO: 1433-7479.
[17].Srinath., K. R. (2017) Python – The Fastest Growing Programming Language, International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056.
[18]. Van Rossum Guido. A Brief Timeline of Python.The History of Python.Google, 2009. Retrieved 20 January 2009.
[19]. Workman,M.,(1996)Hardware requirement for Fuzzy Logic Control Systems.Lubbock,TX: Texas Tech University.
[20]. Zadeh, L.A., Fuzzy Sets, Information and Control, 338–353, (1965)
[21]. Zhen. A. and Feng R. G., "The design of neural network Fuzzy controller in washing machine," in Proc. 2012 International Conference on Computing, Measurement, Control and Sensor Network (CMCSN), Shanxi,China, 136-139, 2012.