An Automation and Temperature Prediction on Smart AC System

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Submitted Date: September 2018

Daffodil International University
Dhaka, Bangladesh

APPROVAL

This **Thesis** titled "**A Smart Embedded System Model for the AC Automation with Temperature Prediction**", submitted by **F.M. Javed Mehedi Shamrat**, **143-35-777** to the Department of Software Engineering, Daffodil International University has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc in Software Engineering and approved as to its style and contents.

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DECLARATION

We hereby declare that we have taken this thesis under the supervision of **Dr. Shaikh Muhammad Allayear, Associate Professor, Department of Software Engineering, Associate Professor & Head, Department of Multimedia & Creative Technology, Daffodil International University.** We also declare that neither this thesis nor any part of this has been submitted elsewhere for award of any degree.

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Abstract

A model of an automated temperature prediction on smart AC system for a room has been designed, developed and implemented with an embedded system. In a room, temperature of object (like human being) with the environment is detected, identified and analyzed, with an ideal temperature. Based on data, a mathematical formula can be derived and an algorithm has been formed by using the mathematical formula of the predicted temperature data and the values of the two sensors, where sensors are used for object temperature detection and the AC perform automatically turned on or turned off. Python programming language with its default library has been used to code for the successful implementation of the algorithm. This proposed embedded system can be implemented in any smart AC room where anyone can utilize the AC system automatically switched on/off with the predicted temperature. Exploit this embedded system in all over the places including for disabled peoples, personal room, conference room, hall room, classroom and transports, where manually control of Air conditioner is not feasible.

Acknowledgments

Firstly, I might want to thank my supervisor, Dr. Shaikh Muhammad Allayear, Associate Professor, I owe such a great amount to his motivating direction over the span of this venture, for his recommendations on papers to peruse, and for his endless hours of accommodating exchanges and assessment. He gives me an opportunity to work in Smart Data Science Center (SDSC) for complete my research. SDSC is a computer research laboratory of Daffodil International University. I might likewise want to demonstrate appreciation to my committee, including Department of Software Engineering and my noteworthy our Department Head Professor Dr.Touhid Bhuiyan for their profitable instructions.

All the more by and large, I can't exaggerate the amount Daffodil International University's software engineering offices have helped me develop as an understudy. Uncommon much gratitude goes Imran Mahmud, Assistant Professor for putting me on the way to seeking after hypothetical software engineering research and for being a uniquely rousing coach and to lecturer Md. Mushfiq for filling in as my scholarly consultant. I might likewise want to thank lecturer Md Fahad Bin Zamal for teaching one incredible course that truly got me amped up for a few complex factors. I would also like to thank lecturer Ms. Rubaida Easmin for her incredibly extensive and important input on the evidence of my principle result. I'm particularly appreciative for Research Associate MD. Tahsir Ahmed Munna for being regular teammates on issue sets. I'm particularly thankful for my paper observers Lecturer Md. Motiur Rahman and lecturer Md. Habibur Rahman for being continuous collaborators on issue sets and their suggestions on research report to peruse or read.

Lastly, I might want to thank my parents for bringing me into this world and making everything conceivable. They were the reason I initially began to look all starry eyed at learning, and I am appreciative consistently for what they have done to raise me up to be simply the best form.

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Chapter 1

Introduction

Temperature prediction in Air conditioners is highly challenged in today's life. Automation in air condition is currently important topics in the area of IOT. It's extremely difficult to change the temperature haphazardly by physically for handicapped people groups, in sleeping hours, meeting time and in generally where a large number of people exist there must be issue for comfort temperature for all. For the most time, most of the researchers work with room environment not with the object temperature, so the result what is found is may more efficient if temperature prediction only depend on object temperature. If there are one or two people in environment, there can be possible to give an idle temperature for all but if there is more and more people so there is very complex situation to give comfort temperature depend on room temperature.

1.1 Overview

Automation in air condition is currently important topics in the area of IOT. It's extremely difficult to change the temperature haphazardly by physically for handicapped people groups, in sleeping hours, meeting time and in generally where a large number of people exist there must be issue for comfort temperature for all. For the most time, most of the researchers work with room environment not with the object temperature, so the result what is found is may more efficient if temperature prediction only depend on object temperature. If there are one or two people in environment, there can be possible to give an idle temperature for all but if there is more and more people so there is very complex situation to give comfort temperature depend on room temperature. This research report exhibits about one algorithm. The purpose of algorithm is receiving the temperature data from sensors and makes a decision to command the AC. The mathematical part is process the raw data and gives an output. Generally automation on Smart Ac system is fully a new topics and temperature prediction is highly effective and most challenging thing in smart AC system. Our analysis is to attempt to give some calculation which takes after a few exercises of this recent research. When we thought about the peoples with the problem with existing AC, like (handicapped peoples, oldest citizen, a conference room, sleeping peoples) where manually controlling of Ac is less important. Generally this recent research motivated us to doing our research.

The structures we are searching for are just thickness varieties in the computation. Then we build up a model that can work perfectly on an AC system and able to predict temperature. In future we are we hope that our model will be upgrade model rather than all. In this research, proposed a model to solve an automation and temperature prediction on smart AC system. Model is the approach for detecting human object temperature from an environment and predicts an idle temperature. A mathematical formula and algorithm has been proposed to find out the value of predict temperature, these value given by two sensors. AC automatically turned on or turned off, if object entered or exit in the room.

In the event that any protest discovered Ac will consequently turned on else it turned off. When it will turn on it will look through the protest, if question discovered it consequently recognize the temperature estimation of protest and pass it to the raspberry pi zero. The gadget forms the crude information with the qualities by the sensors. At that point pass it to the microcontroller and it directions the AC to change temperature.

we build up a model, which works with human temperature, AC will naturally turn on when sensors identify a man in the room and AC will consequently kill when sensors recognize a man an incentive for the room is invalid it identifies the temperature from human body by utilizing sensors and naturally predicts a solace temperature for every one of, those people are available in condition. No compelling reason to make new AC, the Algorithm is deal with existing AC, which has coordinated sensor.

1.2 Research Objectives

The main objective of this thesis is make fully automated embedded system for smart AC, which can predict temperature and automatic control the AC without human interruption. Embedded systems that can be detect the human temperature and predict a comfort temperature, so that we can maintain the AC easily.

This research report exhibits about one algorithm. The purpose of algorithm is receiving the temperature data from sensors and makes a decision to command the AC. The mathematical part is process the raw data and gives an output.

1.3 Research Questions

The thesis with titles showing that how detect object temperature and make a sense to predict a temperature. There have exactly some research questions and this will enable to understand some features of this thesis.

- Why need proposed algorithm?
- What is the advantage of embedded system on smart AC system?
- How embedded system works?
- Is it a new or modify approach?
- How much object can identify by the embedded system?
- Is it possible to build the proposed model of an embedded system?

1.4 Organization

In Chapter 1, we revolve our work around the thesis and quickly present about foundation overview and purpose of this algorithmic research.

In Chapter 2, we concentrate on a particular issue for building algorithm. In here we demonstrate which literature is audited. We at that point exhibit the evidence of our motivation, this chapter briefly foundation or background of thesis, past research of smart AC and on temperature.

In Chapter 3, we introduced about proposed algorithm to build embedded system. In here we have also displayed the proposed model, steps of proposed algorithm, flowchart diagram of embedded system.

In Chapter 4, we talk about our embedded system components. We have showed the components and the feature of the components. This can easily define which component plays which types of role.

In Chapter 5, we analyses our algorithm, result. This part demonstrates explore examination and execution assessment with time and histogram. Different type of solving strategy analysis we exhibit in this section.

In Chapter 6, we endeavor to settle on a choice about embedded system, consist of summery, discussion, conclusion. This part indicates summary of this thesis and finishing.

In References, we try to show proper references which help for complete this research.

In Appendix, we incorporate audits of the fundamental many-sided quality classes, the portrayal of code, programming structure and evidences of some minor subtle elements specified in the body of the thesis.

1.5 Definitions

Embedded System: The electronic system which integrates the hardware circuitry with the Software programming techniques for providing project solutions is called as embedded systems. By using this embedded system technology the complexity of the circuits can be reduced to a great extent which further reduces the cost and size. Embedded system was primarily developed by Charles Stark for reducing the size and weight of the project circuitry.

Automation: The dictionary defines automation as “the technique of making an apparatus, a process, or a system operates automatically. “We define automation as "the creation and application of technology to monitor and control the production and delivery of products and services. “Using our definition, the automation profession includes “everyone involved in the creation and application of technology to monitor and control the production and delivery of products and services”; and the automation professional is “any individual involved in the creation and application of technology to monitor and control the production and delivery of products and services.”

Smart AC: In recent years, companies have added smart air conditioners to the mix; you can control these units using your smart phone, and they can also connect to other smart home systems. So, for example, you could program your smart home system to turn on the air conditioner, lower your shades and turn on your lights at a particular time or when the temperature inside gets too hot.

Human Temperature: Body temperature is measured by a clinical thermometer and represents a balance between the heat produced by the body and the heat it loses. Though heat production and heat loss vary with circumstances, the body regulates them, keeping a remarkably constant temperature. An abnormal rise in body temperature is called fever. Body temperature is usually measured by a thermometer placed in the mouth, the rectum, or the auditory canal (for tympanic membrane temperature). The normal oral temperature is 37° Celsius (98.6° Fahrenheit); rectally, it is 37.3° Celsius (99.2° Fahrenheit). The tympanic membrane temperature is a direct reflection of the body's core temperature. These values are based on a statistical average. Normal temperature varies somewhat from person to person and at different times in each person

1.6 Motivation of Research

Generally automation on Smart Ac system is fully a new topics and temperature prediction is highly effective and most challenging thing in smart AC system. Our analysis is to attempt to give some calculation which takes after a few exercises of this recent research.

When we thought about the peoples with the problem with existing AC, like (handicapped peoples, oldest citizen, a conference room, sleeping peoples) where manually controlling of Ac is less important. Generally this recent research motivated us to doing our research. The structures we are searching for are just thickness varieties in the computation. Then we build up a model that can work perfectly on an AC system and able to predict temperature. In future we are we hope that our model will be upgrade model rather than all.

Chapter 2

Background and Literature Review

In this research, proposed a model to solve an automation and temperature prediction on smart AC system. Model is the approach for detecting human object temperature from an environment and predicts an idle temperature. A mathematical formula and algorithm has been proposed to find out the value of predict temperature, these value given by two sensors. AC automatically turned on or turned off, if object entered or exit in the room. AC automatically detect object temperature and predict a comfort ratio temperature depend on variation of value. For implement this experiment, we have used python programming with its default library, proposed algorithm, Raspberry pi zero, Thermal sensors, IR sensors, IR remote and Micro controller (NodeMCU V-3 Development Kit). Thermal sensors are used to detect the value from temperature, raspberry pi process all of the mathematical terms depends on proposed algorithm and IR sensor command the AC. Utilize this embedded system in all over the place however including for disabled peoples, in personal room, conference room, hall room, classroom and transports, where manually control of Air conditioner is not feasible.

2.1. Previous Research Work

In recent years some research paper has been published, where researchers have shown how to reduce the use of electricity during the use of air condition. But they do not work with the prediction in AC temperature.

The system is able to detect the surface temperature of occupants by a non-contact detection at the maximum of 6 meters far. It can be integrated to any swing type of electrical appliances such as standing fan or similar devices. Differentiating human from other moving and or static object by heat variable is nearly impossible since human, animals and electrical appliances produce heat. The uncontrollable heat properties which can change and transfer will add to the detection issue. Integrating the low cost MEMS based thermal sensor can solve the first of human sensing problem by its ability to detect human in stationary [1].

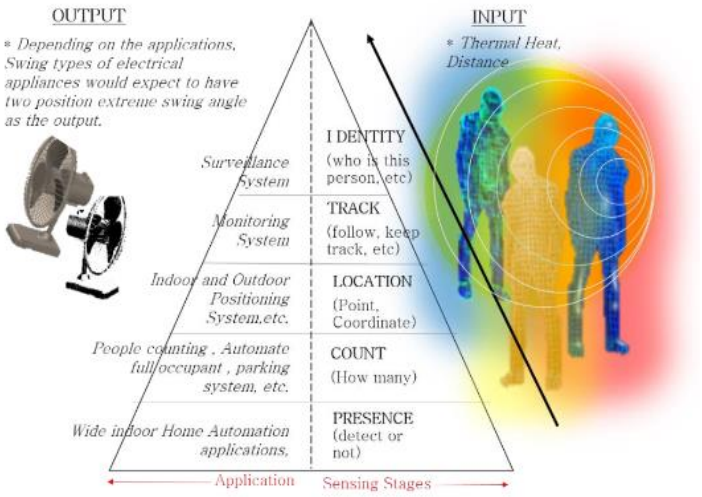

Figure 1. Human-sensing from presence detection to the identifying identity. Only two sensing scope will be needed in this project which are presence and location.

The network automatically controls air conditioning by means of changing temperature settings in air conditioners. Interior devices of air conditioners thus do not have to be replaced. An adaptive neurofuzzy inference system and a particle swarm algorithm are adopted for solving a nonlinear multivariable inverse PMV model so as to determine thermal comfort temperatures [2].

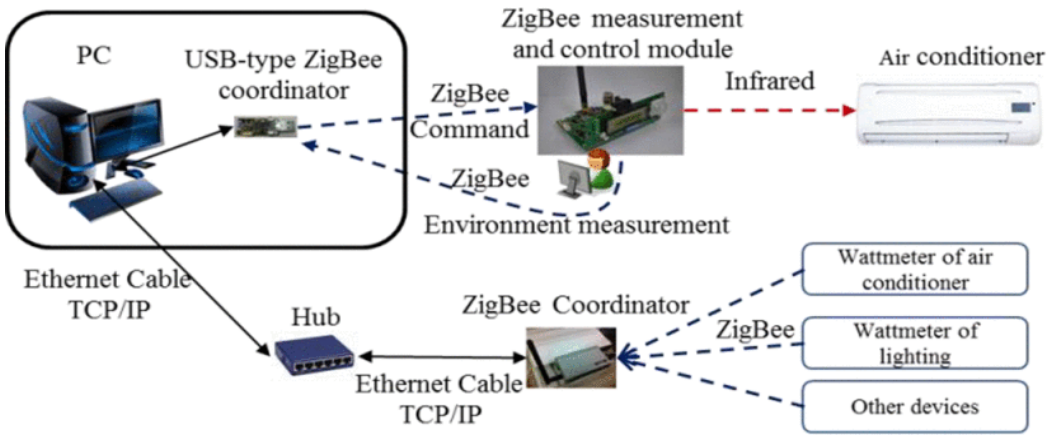

Figure 2. Signal transmission among devices in the wireless control network.

Other researchers worked for a smart ac system that can be controlled by wireless devices. They considered a wireless sensor deployed in the target zone for sensing the ambient temperature. The wireless sensor issues control commands to a remote air-conditioning system when the locally sensed ambient temperature exceeds a certain desirable temperature range. There are several issues considered in our sensor model [3].

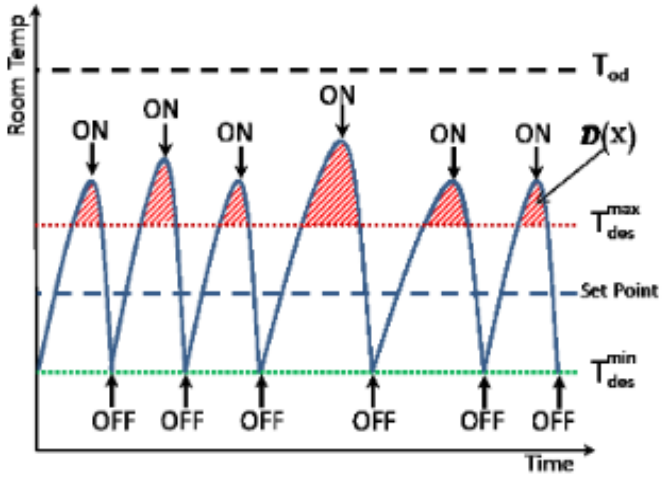

Figure 3. An illustration of the ON/OFF cycle of Air-conditioning.

The authors of [4] used model-predictive control technique to learn and compensate for the amount of heat due to occupants and equipment. They used statistical methods together with a mathematical model of thermal dynamics of the room to estimate heating loads due to inhabitants and equipment and control the AC accordingly.

By contrast, this paper presents method by means of transmitting the temperature commands via a wireless sensor network [5] to control air conditioner operation for occupants' thermal comfort. The wireless network is also utilized to obtain environment information including the temperature, humidity, and air velocity at spots around occupants. Therefore, using the proposed control setup does not have to change interior devices of existing air conditioners.

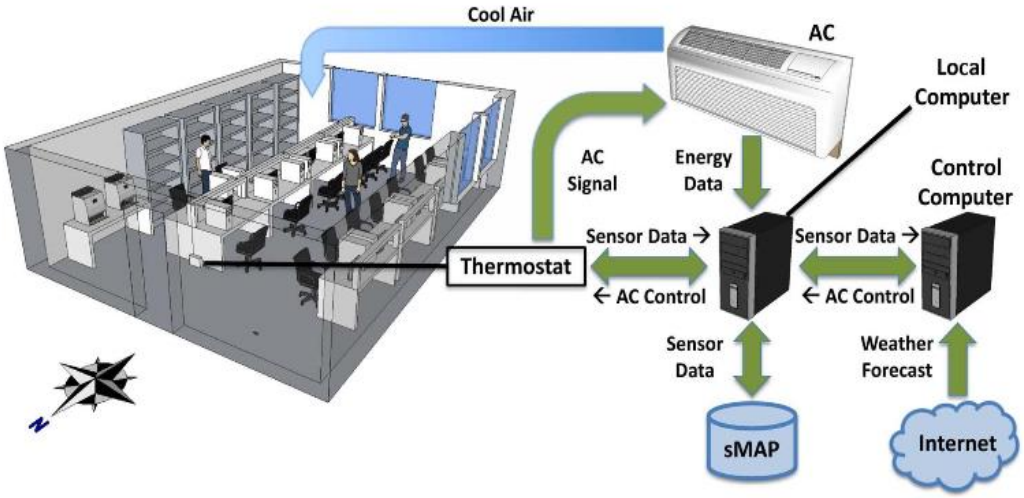

Figure 4. System built on the Berkeley campus that allows testing of different control strategies for controlling an AC in order to explore tradeoffs between energy consumption and tracking a temperature set point.

Warm solace and cooling vitality utilization are two imperative issues in places of business. This paper basically breaks down the connection between cooling vitality utilization and warm solace in various urban communities. Right off the bat, we present the meaning of in-entryway cooling load, and figure the normal office's indoor cooling load in thirteen urban areas; Secondly, in view of a basic condition for Predicted Mean Vote (PMV), a customized control optimizations technique for cooling control frameworks has been proposed in the paper; At last, we recreate the cooling vitality utilization under various warm solace extend. The outcomes demonstrate that cooling vitality sparing effectiveness is firmly related with the satisfactory comfort range and city's geographic area [6].

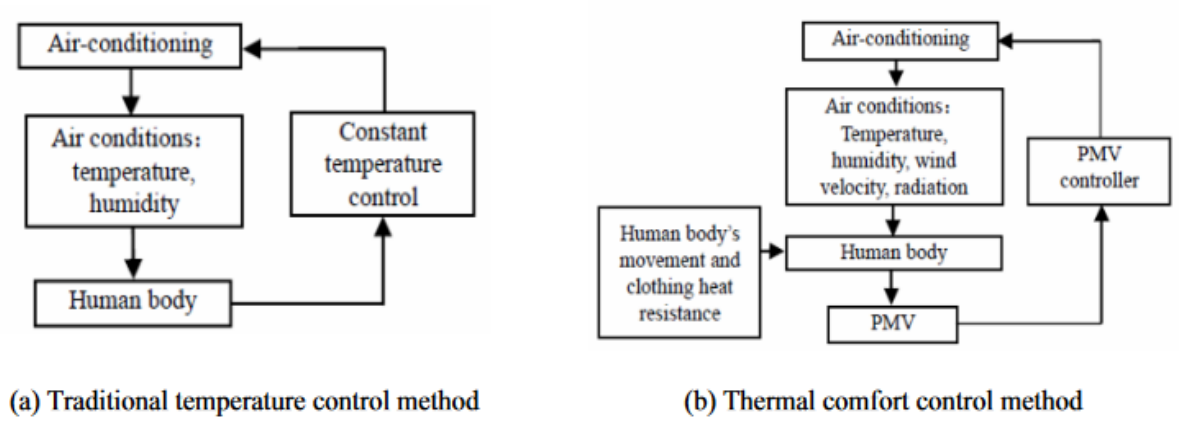

Figure 5. Traditional temperature control method and thermal comfort control method.

According to use research gap, an approach for detecting human object temperature from an environment and predict an idle temperature is proposed. For developing our experiment, we have used python programming with its default library, develop algorithm, Raspberry pi zero, Thermal sensors, IR sensors, IR remote. We have developed an embedded system by using these equipment’s, which works with object temperature and automatic on-off depend on either object is exist in room or not. Finally it produce result of temperature depend of the criteria of number of object, object value, environment temperature, object is in environment or not.

Chapter 3

Proposed Algorithm Model

Our research showed an embedded system which have displayed, how a system can detect object, and take the body temperature from the object and predict a comfort temperature for all and the system is fully automated not manually.

In this chapter, we present the proposed model, algorithm, and fundamental theory of object detection. We give a programming structure of proposed algorithm and draw the diagram of embedded system and process flowchart. We also give the components picture what we supposed to use for the implementation of proposed system.

3.1. Induction

Temperature prediction in Air conditioners is highly challenged in today's life. It's extremely difficult to change the temperature haphazardly by physically for handicapped people groups, in sleeping hours, meeting time and in generally where a large number of people exist there must be issue for comfort temperature for all. Generally, the most modern Air conditioners are work with environment temperature and make decision depend on environment temperature. But we developed a model, which works with human temperature, AC will automatically turn on when sensors detect a person in the room and AC will automatically turn off when sensors detect a person value for the room is null it detects the temperature from human body by using sensors and automatically predicts a comfort temperature for all, those humans are present in environment. No need to make new AC, the Algorithm is work on existing AC, which has integrated sensor.

3.2. Proposed Model

Our research showed an embedded system which have displayed, how a system can detect object, and take the body temperature from the object and predict a comfort temperature for all and the system is fully automated not manually.

We considered the value idle temperature 18°C for our research work. The World Health Organization recommends a minimum indoor temperature of 18 ºC, with a 2-3 ºC warmer Minimum temperature for rooms occupied by sedentary elderly, young children and the handicapped [6].

Below 16 ºC there is an increased risk of respiratory disease, while below 12 ºC the risk is of increased Cardiovascular strain [10].Our main motto predicts temperature with automation in AC, so that we can avoid manually operate to AC. We used some hardware or component to build up this embedded system. High difficult thing was that, to predict the precise esteem.

In Fig. 1 we have represented an algorithmic flowchart, In Fig. 2 we have a flowchart of our system. In Fig. 3 we have illustrated an algorithmic process of our experiment.

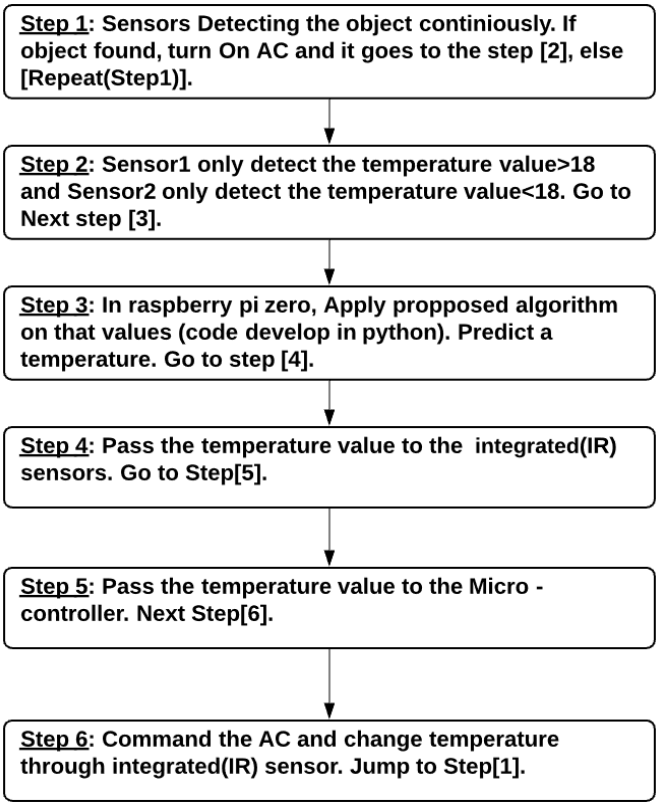

Figure 6.steps of our Proposed Model

In this algorithmic model, where we have shown of our total process of proposed model step by step. Sensor1 and sensor 2 detect the temperature, below and upper than ideal temperature [step1 and step 2]. Then total mathematical formula is done by the raspberry pi with the given value by two sensors. Process all of the values by the mathematical formula and proposed algorithm in Raspberry pi [step 3 and 4] and pass the value to the micro controller [step5] and microcontroller, at last microcontroller command the Ac to change the temperature depend on temperature prediction.

3.2.1. Flowchart of proposed model

In this flowchart, where we have appeared of our aggregate procedure of proposed show well ordered. Sensor1 and sensor 2 detect the temperature, beneath and upper than perfect temperature. At that point add up to numerical recipe is finished by the raspberry pi with the given an incentive by two sensors. Process the majority of the qualities by the numerical equation and proposed calculation in Raspberry pi and pass the incentive to the miniaturized scale controller and small scale controller, finally smaller scale controller order the Ac to change the temperature rely upon temperature expectation.

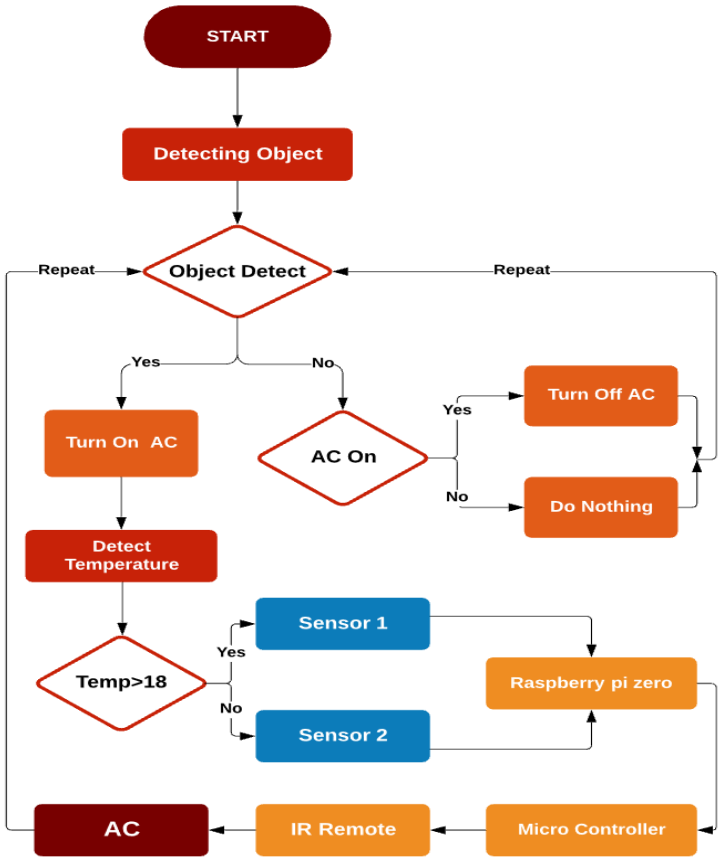

Figure 7: Flowchart of our Proposed Model.

If any object found Ac will automatically turned on otherwise it turned off. When it will turn on it will search the object, if object found it automatically detect the temperature value of object and pass it to the raspberry pi zero. The device processes the raw data with the values by the sensors. Then pass it to the microcontroller and it commands the AC to change temperature.

3.2.2. Process of our proposed model

In this model, where we have showed up of our total technique of proposed demonstrate all around requested. Sensor1 and sensor 2 detect the temperature, underneath and upper than impeccable temperature. By then indicate numerical formula is done by the raspberry pi with the given a motivation by two sensors. Process most of the characteristics by the numerical condition and proposed computation in Raspberry pi and pass the motivator to the scaled down scale controller and little scale controller, at long last littler scale controller arrange the Ac to change the temperature depend upon temperature desire**.**

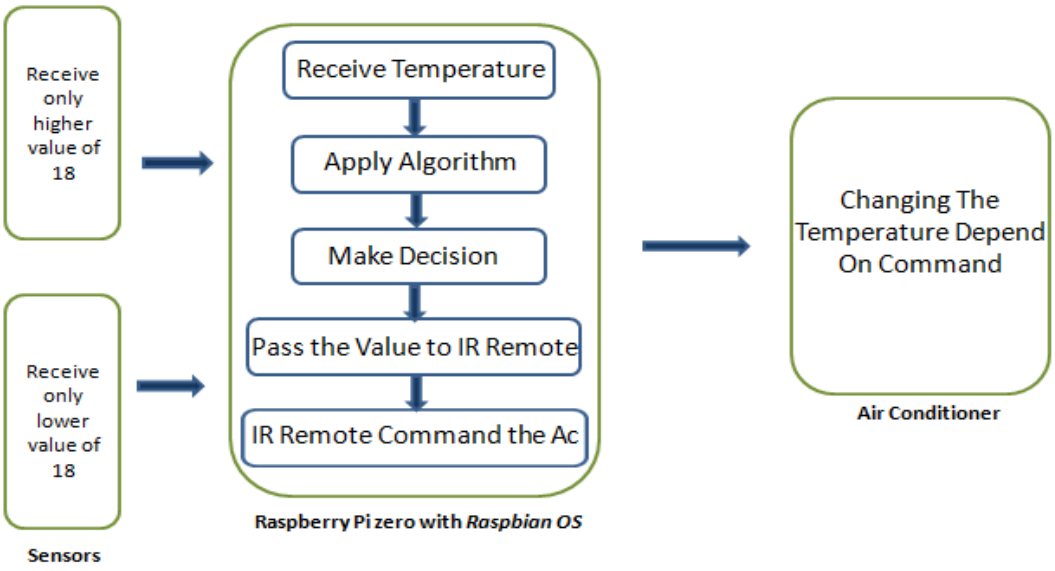

Figure 8. Process of our Proposed Model.

In the event that any protest discovered Ac will consequently turned on else it killed. When it will turn on it will look through the protest, if question discovered it consequently recognize the temperature estimation of protest and pass it to the raspberry pi zero. The gadget forms the crude information with the qualities by the sensors. At that point pass it to the microcontroller and it directions the AC to change temperature.

3.3. Mathematical Exploration

In our research we proposed an algorithm depend on mathematical solution that work along with an embedded system and will predict a temperature using thermal sensors1 and sensor2. Also, the sensors get distinctive sorts of significant worth. Sensor 1 identify the temperature more than 18 (temp>18) and sensor 2 recognize the temperature under (temp<18). We considered the idle temperature 18°C [6].

Let,

Sensor1 = s1.

Sensor2 = s2.

Object = x.

Temperature = t.

No of object in environment = n.

Read the value from s1 (t.value>18).

Read the value from s2 (t.value<18).

S1.value = x1.t, x2.t, x3.t, x4.t, x5.t, x6.t,……,xn.t

S2.value = x1.t, x2.t, x3.t, x4.t, x5.t, x6.t,……,xn.t

∑s1= x1.t + x2.t + x3.t + x4.t + x5.t + x6.t+……+xn.t /n

∑s2= x1.t + x2.t + x3.t + x4.t + x5.t + x6.t+……+xn.t /n

Predict Temperature (PT) = (∑s1 + ∑s2) /2.

Compare Temperature (CT) = PT – 18°C.

#If CT value is equal or more then 20 (CT>=20)

PT = CT – 5.

#If CT value more than 10 and less than 20 (10<CT<20)

PT = CT – 2.

If CT value more than 1 and less than 10 (1<CT<10)

PT = CT – 1.

If CT value is equal or more then -5 (CT>= -5)

PT = CT + 3.

If CT value is equal or more then -5 (-1 <CT< -5)

PT = CT + 1.

If CT value is 0

PT = 18 °C

After a couple of sec.

Repeat [process ()]

3.4. Structure of Algorithm

In this segment, we expressed the programming idea and structure of our algorithm. The

algorithm was implemented by Python programming language. The idea of the algorithm (See Algorithm 1) in programming perspective is as follows:

Step1: Create an object class to find the object.

- Checks the object from the environment through thermal sensors.

Step2: Create turn on/off function () and call the function.

- Presenting of any object it automatically turn on otherwise it continue searching function ().

Step3: Create the temperature read function () and call the function.

- After turned on, sensors read () the temperature of the object and categorize the value depend on idle value [see 2.1.Mathematical Exploration].

Step4: Make a mathematical function () [That work with the proposed algorithm]

- Deploy the Algorithm on the categorized value, detects using sensors.

Step5: Take decision to command the AC.

- Get a decision from the processing of the mathematical function().

Step6: Passing the value through the parameter.

- Pass the value to the microcontroller [See fig.8].

Step7: Apply command.

- Microcontroller commands the AC to change the temperature.

Step7: Repeat.

- Repeat all these steps begin to end after a certain time [See Fig.1].

We present a pseudo code which in view of objects oriented programming (OOP) formation that recognizes temperature detection algorithm along with the mathematical formula. The pseudo code of the proposed algorithm is given below:

Algorithm 1: Temperature Detection & Automation Algorithm

```
1: import library;
2: Scanning  Search Object;
3: While(Scanning until object found )
4:         If(Scanning == object)
5:             Turn on air condition;
6:              Break;
7:         Else
8:              Turn off air condition  when ac power(1);
9:              Continue;
10:     end while
11:     If(Object(true)){
12:        Sensor1 scan  Detect Object Temperature;
13:        Sensor2 scan  Detect Object Temperature;
14:        If(object temperature >18°C){
15:           Read by Sensor1[];
16:        Else
17:           Read by Sensor2[];
18:           S1 = Sensor1[].value  Object[x1.t, x2.t, x3.t, x4.t, x5.t,  x6.t,……, xn.t];
19:           S2 = Sensor2[].value  Object [x1.t, x2.t, x3.t, x4.t, x5.t, x6.t,……, xn.t];
20:           sumOfS1= ∑S1  Object [x1.t + x2.t + x3.t + x4.t + x5.t +   x6.t+……+xn.t /n];
21:           sumOfS2= ∑S2  Object [x1.t + x2.t + x3.t + x4.t + x5.t + x6.t+……+xn.t /n];
22:           Predict Temperature (PT) = (∑S1 + ∑S2) /2;
23:           Compare Temperature(CT) = [PT – 18°C]  Idle value 18°C;
24:         While (CT !=0)
25:                 If (CT >= 20){
26:                 PT= (CT – 5) °C;
27:                 Set.Tmp(PT);
28:                 }
29:                 Else If(CT >10 && CT<20){
30:                 PT= (CT – 2) °C;
31:                 Set.Tmp(PT);
32:                 }
```

```
33:             Else If (CT<10 && CT>1){
34:             PT = (CT – 1) °C;
35:             Set.Tmp(PT);
36:             }
37:             Else If(CT>=-5){
38:             PT = (CT +  3) °C;
39:             Set.Tmp(PT);
40:             }
41:             Else If(CT>-1 && CT<-5){
42:             PT= (CT + 1) °C;
43:             Set.Tmp(PT);
44:             }
45:             end while
46:         While(CT == 0)
47:         PT = 18°C
48:         Set.Tmp(PT);
49:       }}
50:       Else
51:       Scanning  Search Object;
52:     Repeat(Process())  After every 10 sec delay;
```

Chapter 4

Components

In our research for developing the embedded system we use some hardware, according to that I hare by declare some of the major component of them.

4.1. Thermal Sensor 8*8

This sensor from Panasonic is an 8x8 array of IR thermal sensors. When connected to your microcontroller (or raspberry Pi) it will return an array of 64 individual infrared temperature readings over I2C. It's like those fancy thermal cameras, but compact and simple enough for easy integration. This part will measure temperatures ranging from **0°C to 80°C (32°F to 176°F)** with an accuracy of +- 2.5°C (4.5°F). It can detect a human from a distance of up to 7 meters (23) feet. With a maximum frame rate of 10Hz, It's perfect for creating your own human detector or mini thermal camera. We have code for using this breakout on an Adriano or compatible (the sensor communicates over I2C) or on a Raspberry Pi with Python. On the Pi, with a bit of image processing help from the SciPy python library we were able to interpolate the 8x8 grid and get some pretty nice results! The AMG8833 is the next generation of 8x8 thermal IR sensors from Panasonic, and offers higher performance than its predecessor the AMG8831. The sensor only supports I2C, and has a configurable interrupt pin that can fire when any individual pixel goes above or below thresholds that you set [18]. In Fig. 4 we provide a picture of the thermal sensor that we use for our system.

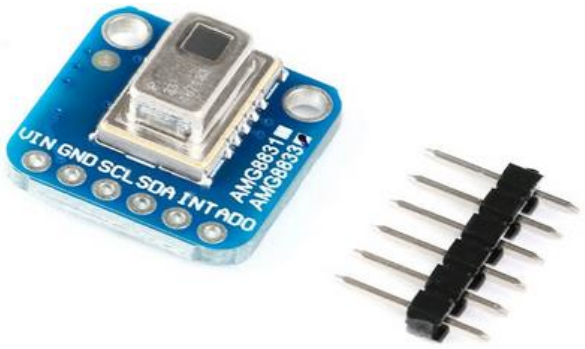

Figure 9.AMG8833 Thermal camera sensor.

4.2. Raspberry pi Zero

The *Raspberry Pi* is a low cost, credit-card sized computer that plugs into a computer monitor or TV, and uses a standard keyboard and mouse. It is a capable little device that enables people of all ages to explore computing, and to learn how to program in languages like Scratch and Python. The Raspberry Pi Zero is half the size of a Model A+, with twice the utility. A tiny Raspberry Pi that's affordable enough for any project. It contains 1GHz single-core CPU, 512MB RAM, Mini HDMI port, Micro USB OTG port, Micro USB power, HAT-compatible 40-pin header, Composite video and reset headers, CSI camera connector [19]. In Fig. 5 we showed a picture of Raspberry pi zero.

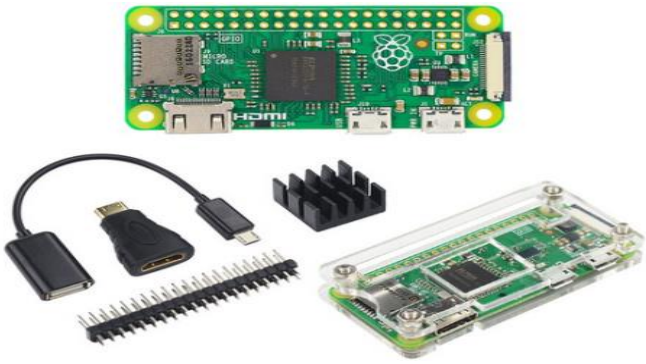

Figure 10. Raspberry pi zero.

4.3. IR sensors

An infrared sensor is an electronic instrument that is utilized to detect certain attributes of its environment. It does this by either producing or identifying infrared radiation. Infrared sensors are likewise equipped for estimating the warmth being discharged by a question and recognizing movement [20]. In Fig. 6 we showed the IR sensors which pass the value and receive the value for command the ac.

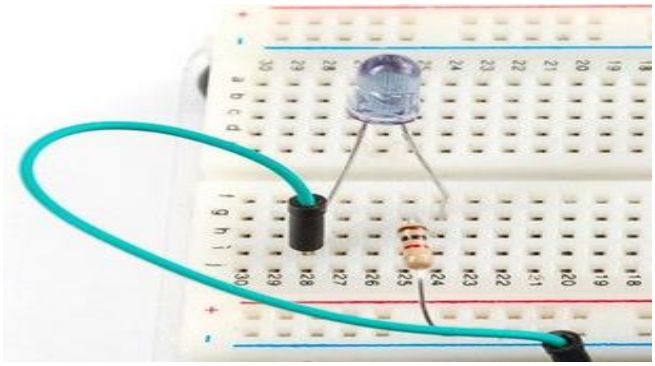

Figure 11.IR sensor.

4.4. IR remote

Infrared remote control a handheld, wireless device used to operate audio, video and other electronic equipment within a room using light signals in the infrared (IR) range. Infrared light requires line of sight to its destination. Low-end remotes use only one transmitter at the end of the unit and have to be aimed directly at the equipment. High-quality remotes have three or four powerful IR transmitters set at different angles to shower the room with signals [21]. In Fig. 7 we displayed the picture of an IR remote.

Figure 12: IR remote.

4.5. Microcontroller (NodeMCU V-3 Development Kit)

The NodeMCU is an open-source firmware and development kit that helps us to Prototype our IOT product within a few Lua script lines. Open-source, Interactive, Programmable, Low cost, Simple Smart, and WI-FI enabled. The Development Kit based on ESP8266, integrates GPIO, PWM, IIC, 1-Wire and ADC all in one board. Power your development in the fastest way combinations with NodeMCU Firmware! USB-TTL included, plug & play, 10 GPIO, every GPIO can be PWM, I2C, 1-wire, FCC CERTIFIED WI-FI module, PCB antenna [22]. In Fig. 8 we showed the picture of microcontroller.

Figure 13. NodeMCU V-3 Development Kit.

Marge these entire components we developed our embedded system based on the proposed model. In Fig. 9 we have shown the process of entire system using a picture diagram.

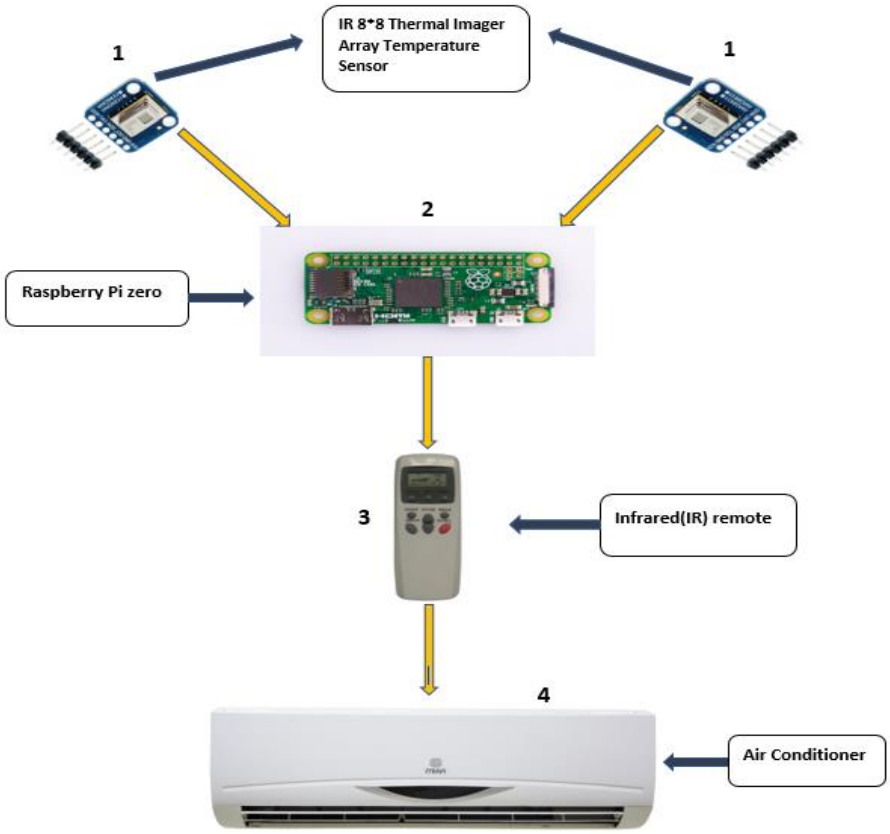

Figure14. Diagram of Entire System.

In this embedded system diagram we demonstrate that how the whole framework functions. If any dissent found Ac will subsequently turned on else it slaughtered. When it will turn on it will glance through the challenge, if question found it therefore perceive the temperature estimation of dissent and pass it to the raspberry pi zero. The device shapes the unrefined data with the characteristics by the sensors. By then pass it to the small scale controller and it bearings the AC to change temperature.

Chapter 5

Results and Analysis

The proposed technique was developed in default IDE and also can build up Anaconda application. For test the model and system we selected a small conference room, where 12 persons were available. They all had different temperatures that we detect by two thermal sensors (Sensor1, Sensor2). Then we make a data table what exactly the sensor was provide us, in there we skipped the fracture value like (28.5 to 29, 28.3 to 28). Here we done a few experiments to test the algorithm of our proposed system and compare these experiments with another and the result are as expected.

5.1. Experiment 1

Table 1
Object with temperature by implemented sensors.

No Of Object	Object Temp In °C	Predict Temp
1	19	20°C
2	20	
3	28	
4	30	
5	17	
6	25	
7	16	
8	22	
9	20	
10	19	
11	17	
12	29	

In figure. 15 we showed the Line chart of the tabular 2 data and output. Utilizing the estimation of the table distinguishes by the sensors and the output gets by the utilizing of our calculation. In fig. 15 we demonstrated the Line graph of the unthinkable information and Output.

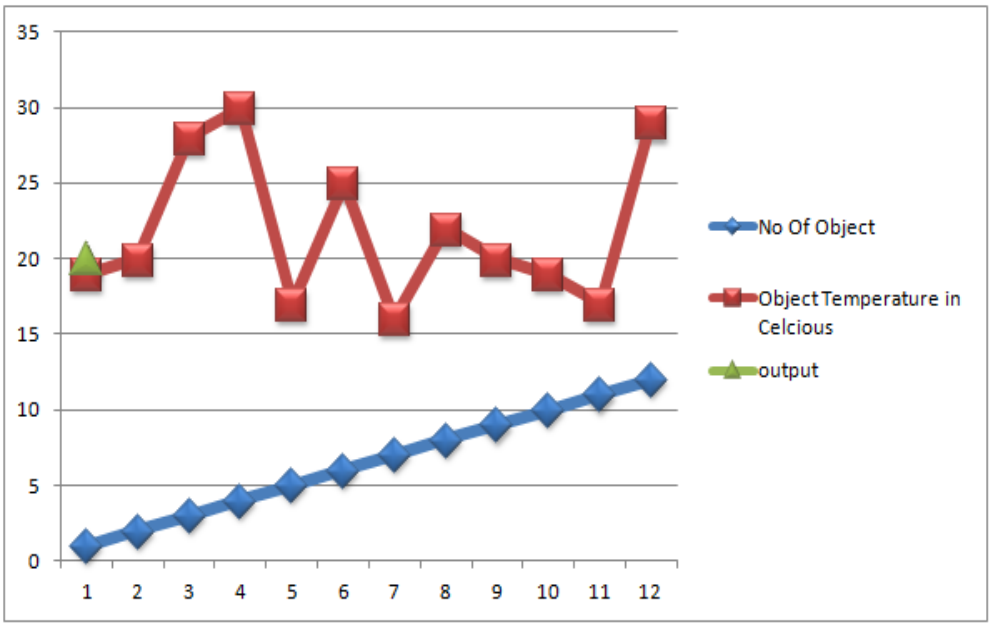

Figure 15. Line Chart Diagram of Table1 Data.

In experiment 1we took some value by the use of thermal sensors and deploy the proposed algorithm on it and get output from the data that shown in Fig. 15. The predict temperature is 20°C. All overall temperature of data, this predicts temperature is comfort for all that we can see from Fig. 15.

5.2. Experiment 2

Table 2
Object with temperature by implemented sensors.
Using the estimation of the table recognizes by the sensors and the yield gets by the using of our figuring. In figure. 16 we showed the Line chart of the unimaginable data and Output.

No Of Object	Object Temp In °C	Predict Temp
1	19	19°C
2	20	
3	23	
4	25	
5	18	
6	22	
7	17	
8	21	
9	19	
10	18	
11	19	
12	24	

In figure. 16 we showed the Line chart of the tabular 2 data and output. In experiment 2 we use another qualities from same protest by the utilization of warm sensors and send the proposed calculation on it and get yield from the information that appeared in Figure. 16. The anticipate temperature is 19°C. All general temperature of information, this predicts temperature is comfort for everyone.

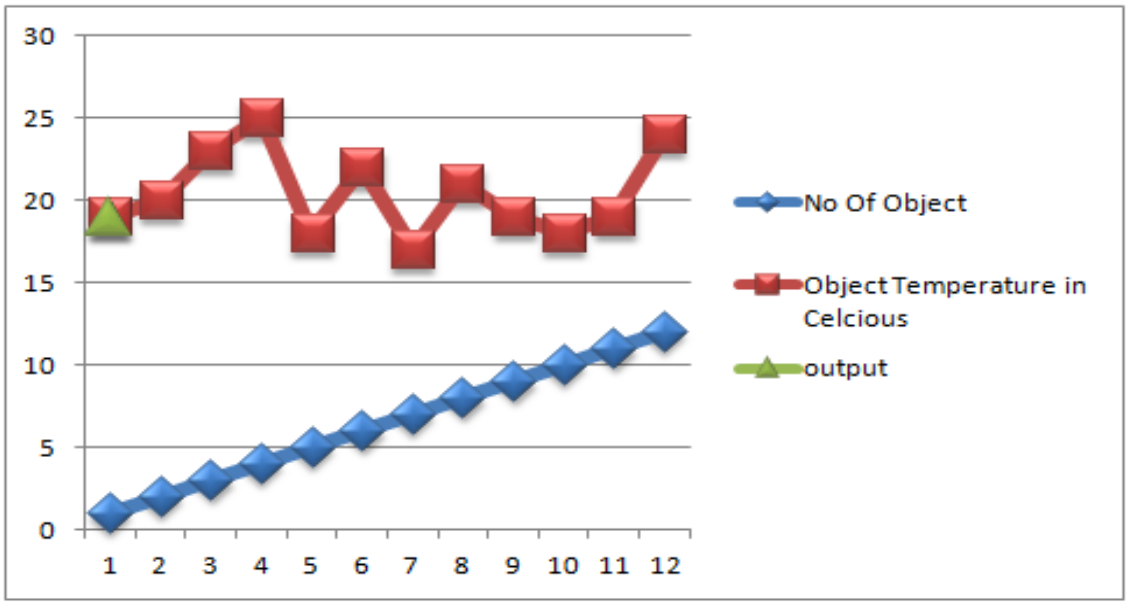

Fig. 16: Line Chart diagram of table 2 data.

In experiment 2we took another values from same object by the use of thermal sensors and deploy the proposed algorithm on it and get output from the data that shown in Figure. 16. The predict

temperature is 19°C. All overall temperature of data, this predicts temperature is comfort for all that we can see from Figure. 16. And from the Figure.15 and Figure.16 we can see the variation of data.

5.3. Experiment 3

Table 3
Object with temperature by implemented sensors.

No Of Object	Object Temp In °C	Predict Temp
1	19	18°C
2	19	
3	21	
4	22	
5	18	
6	20	
7	18	
8	20	
9	19	
10	18	
11	19	
12	21	

In figure. 17 we showed the Line chart of the tabular3 data and output.

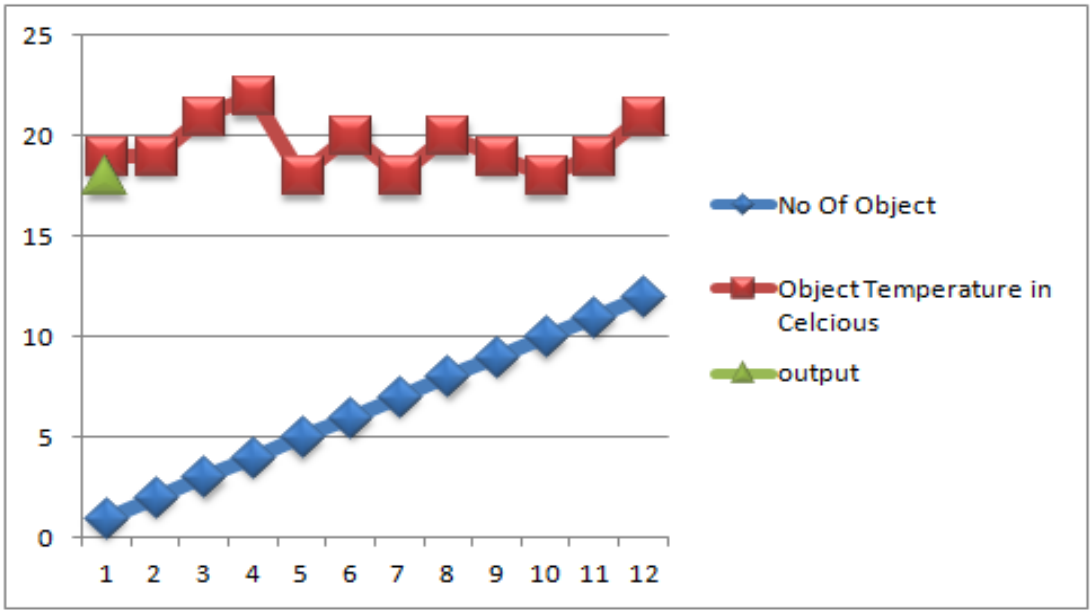

Figure 17. Line Chart Diagram of Table3 Data.

In experiment 1 we get temperature data from objects by using sensors from a small conference room and save it in a table1 and deploy our proposed algorithm1 on it, we found a predict temperature 20°C from experiment 1, then after 20-30 sec we again collect data and save it to a table2 in experiment2, by use algorithm1 we get predict temperature 19°C, we again collect data from room objects in experiment3 and deploy algorithm1 on it and get a predict temperature 18°C. If we concentrate on the Figure.15, Figure.16, Figure.17 we can easily judge that the temperature of object is changing dynamically, after experiment1 system predict a temperature (20°C) and deploy it, then after 20 to 30 sec when we collect data in experiment2 there we can see the changing ratio of temperature of the object in Figure.16 and again when we collect data in experiment3 we can also see the difference between the table2 and table 3 data. Generally what temperature predict by the system using algorithm1 that is comfort temperature for all we can easily see it from figure.15, figure.16, figure.17. Every predict temperature is near to close of comfort temperature 18°C.

Chapter 6

Discussion

This experiment depended on a greatly rich thought. By setting up a algorithm to keep running out of sight of the relative direction learning purpose, we could accomplish uncertain measures of watching time. This enabled us to endeavor a more profound hunt than would have been conceivable in a period apportioned circumstance. With an exceptionally restricted spending we assembled and introduced a beneficiary, spectrometer and control programming, all of which have performed honorably.

6.1. Summary

In this exploration, proposed a model to illuminate a automation and temperature expectation on savvy AC framework. Demonstrate is the methodology for identifying human question temperature from a situation and predicts a sit still temperature. A scientific equation and calculation has been proposed to discover the estimation of foresee temperature, these esteem given by two sensors. Air conditioning consequently turned on or killed, if question entered or exit in the room. Air conditioning consequently identify question temperature and foresee a solace proportion temperature rely upon variety of significant worth. For actualize this investigation, we have utilized python programming with its default library, proposed calculation, Raspberry pi zero, Thermal sensors, IR sensors, IR remote and Micro controller . Warm sensors are utilized to recognize the incentive from temperature, raspberry pi process the majority of the scientific terms relies upon proposed calculation and IR sensor direction the AC. Use this implanted framework in everywhere anyway including for crippled people groups, in close to home room, gathering room, lobby room, classroom and transports, where physically control of Air conditioner isn't achievable.

6.2. Conclusion

Automation and temperature prediction of a room is very much demanding issues in the current

era for many reasons. Several approaches are working in this purpose. A smart AC system room by automation and temperature prediction has been designed, developed and implemented by the python programming language. Several experiments have been performed to analyses the approach and found at satisfactory level. It can be applied in any manual AC system room to convert it into smart AC system environment by using machine learning, artificial intelligence and expert system.

6.3. Future Work

Automation in every sector or machines has been a most important research topic. This paper we worked on that, we actually tried to get a good feedback and automation with comfort temperature from the AC. There we used to propose an embedded system that can work efficiently with the existing AC systems. The entire concepts can be changed into a scholarly model by various learning calculations (Machine learning, Artificial intelligence).
In our coming exploration, we are hopeful to apply Artificial Intelligence and Machine Learning approach in AC with merge of current proposed model.

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