J. Bangladesh Electron. 18 (1–3); 01–05, 2018

Implementation of a Smart AC Automation System with Room Temperature Prediction

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Abstract

Room Temperature prediction in Air Conditioners is highly challenged and ambiguous in today's life. To develop the system, some hardware like raspberry pi zero, thermal sensor, microcontroller, IR sensor and the room's AC with existing remote are used. The proposed system is implemented through an embedded system by using the Python programming language. Based on the data, a mathematical formula can be derived and an algorithm of the proposed system has been designed and developed for the predicted temperature data with the values of the two sensors. The sensors are used to detect temperature and the AC performs automatically turn on or turn off. This system can be implemented in any smart AC room where anyone can utilize the AC system automatically switched on/off with the predicted temperature. This also can used in all over the places including for disabled peoples, personal room, conference room, hall room, classroom and transports, where manually control of AC is not feasible.

Keywords: smart AC, Microcontroller, Automation, temperature prediction, thermal sensor, raspberry pi zero, IR sensor and IR remote.

1. INTRODUCTION

Temperature prediction in Air Conditioners is exceedingly challenged in the present life. Automation in air condition is as of now vital themes in the territory of IoT. It's to a really hard to change the temperature erratically by physically for debilitated people groups, in sleeping hours, meeting time and in for the most part where countless people exist there must be issue for comfort temperature for all. A large number of the researchers work with room environment not with the object temperature, so the outcome what is found is might be more productive if temperature prediction depends on object temperature. If there are one or two peoples in a place, there can be possible to give an comfort temperature for all but if there are huge peoples there is turmoil to give comfort temperature depend on room temperature.

2. LITERATURE REVIEW

In recent years some research paper has been published, where researchers have where researchers have demonstrated to lessen the utilization of power amid the utilization of air condition. But they have a few works on Smart AC system by predicting in AC temperature.

The System can distinguish the surface temperature of tenants by a non-contact recognition at the limit of 6 meters far. Separating human from other moving as well as static item by warmth variable is almost inconceivable since human, creatures and electrical apparatuses produce heat. The wild warmth properties which can change and exchange will add to the discovery issue. Coordinating the ease MEMS based warm sensor can comprehend the first of human detecting issue by its capacity to distinguish human in stationary [1].

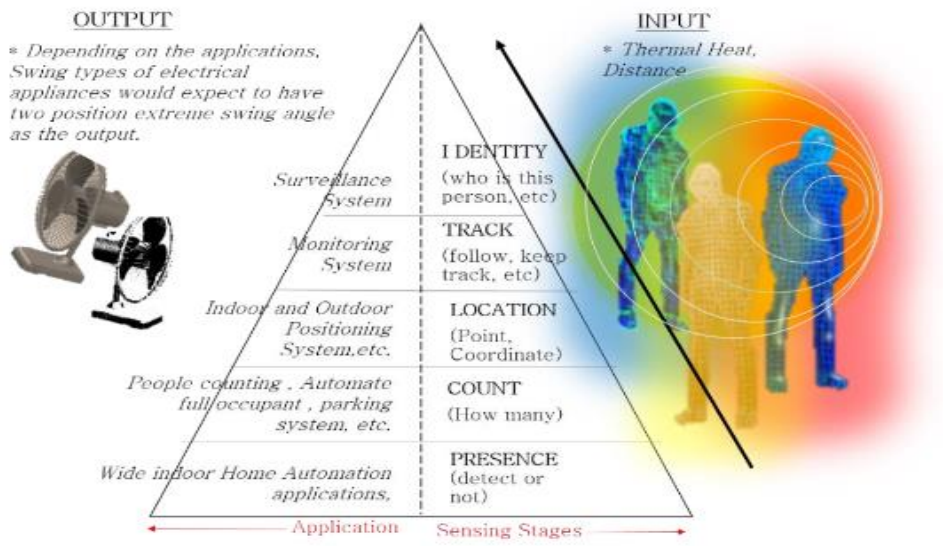

Fig. 1: Human-detecting from Nearness Identification to the Recognizing Character. Just Two Detecting Degree will be Required in this Undertaking which is Presence and Area

The system consequently controls cooling by methods for changing temperature settings in forced air systems. Inside gadgets of climate control systems accordingly, don't need to be supplanted. A versatile neuro fuzzy deduction framework and a molecule swarm calculation are received for unraveling a nonlinear multivariable backward PMV model in order to decide warm solace temperatures [2].

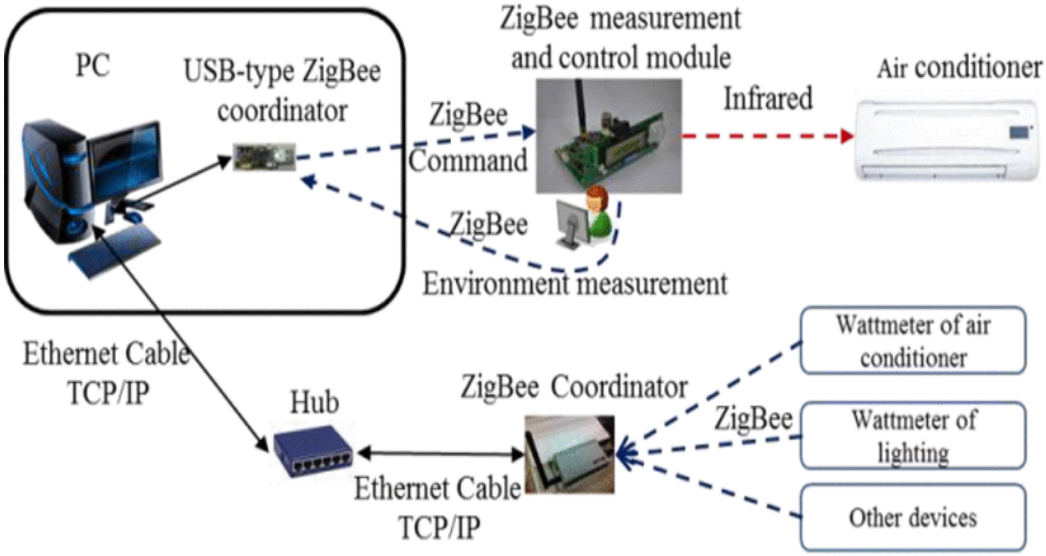

Fig. 2: Signal Transmission among Gadgets in the Remote Control Arranges

Most of the specialists worked for a Smart AC framework that can be constrained by remote gadgets. They considered a remote sensor sent in the objective zone for detecting the encompassing temperature. The remote sensor issues control directions to a remote cooling framework when the privately detected surrounding temperature surpasses a specific attractive temperature extend. There are a few issues considered in our sensor model [3].

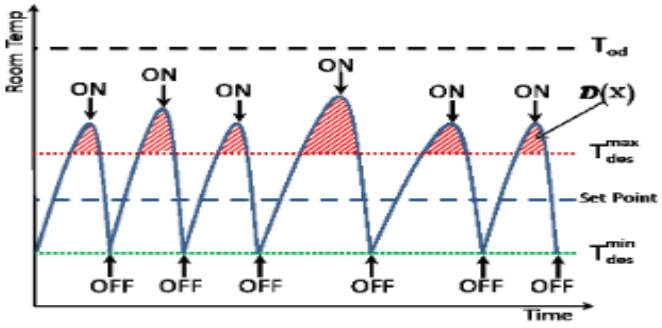

Fig. 3: A Representation of the ON/OFF Cycle of Cooling

The creators of [4] utilized a model-prescient control system to learn and adjust for the measure of warmth because of tenants and hardware. They utilized measurable techniques together with a numerical model of warm elements of the space to evaluate warming burdens because of occupants and hardware and control the AC likewise.

On the other hand, this paper presents a technique by methods for transmitting the temperature directions by means of a remote sensor organize [5] to control forced air system tasks for tenants' warm solace. The remote system is likewise used to acquire condition data including the temperature, moistness, and airspeed at spots around inhabitants. Along these lines, utilizing the proposed control setup does not need to change inside gadgets of existing climate control systems.

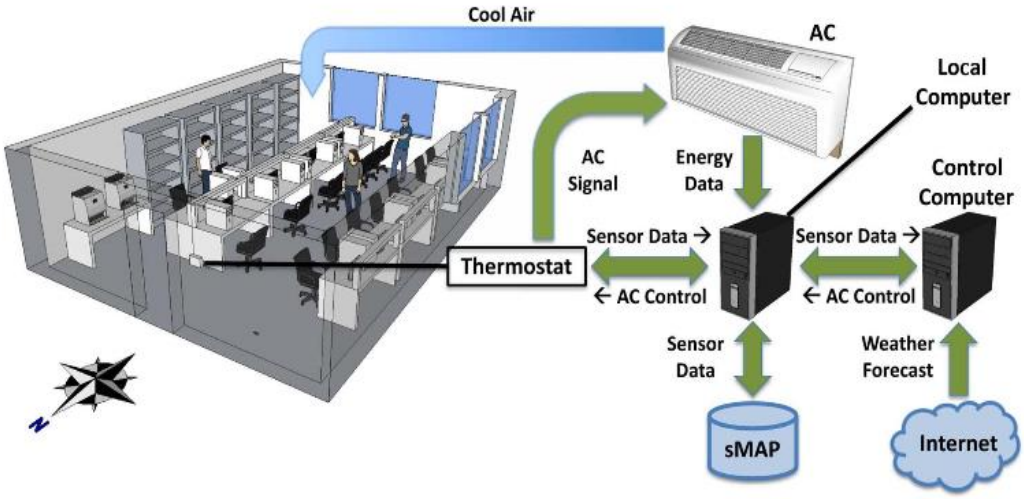

Fig. 4: System Built on the Berkeley Grounds that Permits Testing of Various Control Methodologies for Controlling an AC so as to Investigate Tradeoffs between Vitality Utilization and following a Temperature Set Point.

Warm comfort and cooling essentialness usage are two basic issues in spots of business. This paper fundamentally separates the association between cooling essentialness use and warm comfort in different urban networks. Directly off the bat, we present the significance of in-passage cooling burden, and figure the ordinary office's indoor cooling load in thirteen urban regions; Secondly, in perspective on a fundamental condition for Predicted Mean Vote (PMV), a tweaked control enhancements method for cooling control structures has been proposed in the paper; At last, we reproduce the cooling imperativeness use under different warm comfort expand. The results show that cooling essentialness saving adequacy is solidly related with the tasteful solace range and city's geographic region [6].

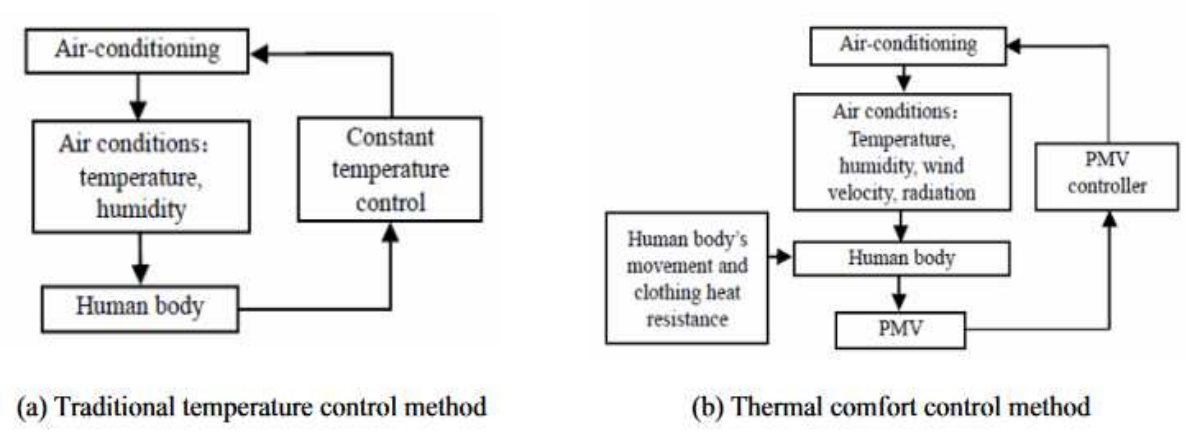

Fig. 5: Traditional Temperature Control Method and Thermal Comfort Control Method

According to use research gap, a methodology for recognizing human temperature from a situation and anticipate an ideal temperature is proposed. For building up our examination, we have utilized python programming with its default library, develop algorithm, Raspberry pi zero, Thermal sensors, IR sensors, IR remote. We have built up an implanted system by utilizing these types of gear, which works with object temperature and programmed on-off rely upon either object is exist in room or not. At long last it deliver consequence of temperature depend of the criteria of number of object, object value, environment temperature, object is in environment or not.

3. PROPOSED METHODOLOGY

The ideal value of the room temperature is considered as 18°C for the proposed research work. It is noted that the World Health Organization recommends a minimum indoor temperature of 18ºC, with a 2-3ºC warmer minimum temperature for rooms occupied by sedentary elderly, young children and the handicapped [6]. Below 16ºC temperature, there is an increased risk of respiratory diseases, while below 12ºC temperature the risk is of increased problem of the cardiovascular strain [10]. The main objective of this research is to set an ideal temperature that predicts temperature with automation of the AC system so that one can avoid manually operating the room AC. A set of hardware components is used here to develop the proposed embedded system. In Fig. 6 we shown our proposed model and Fig. 7 represents the flowchart of the entire system.

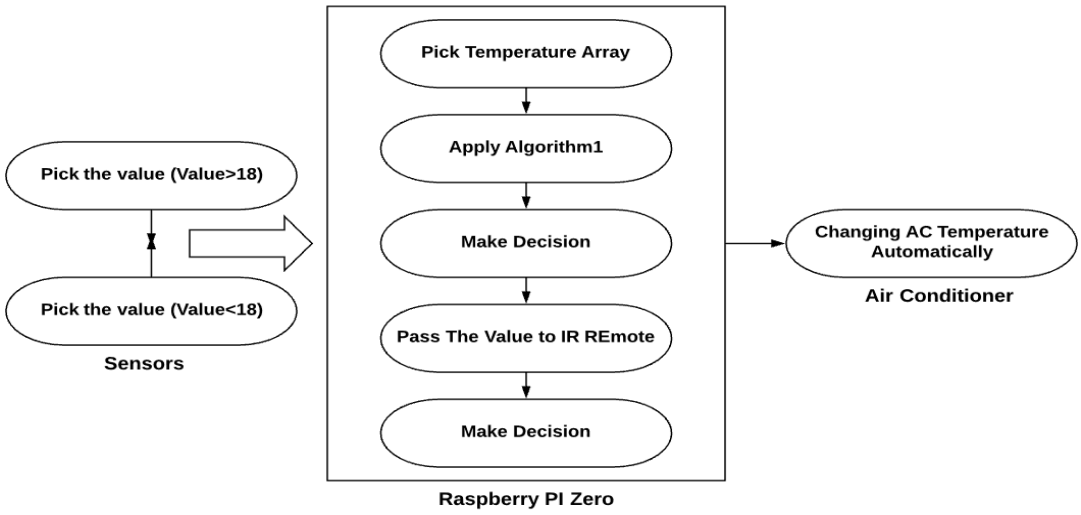

Fig. 6: Process of the Proposed Model.

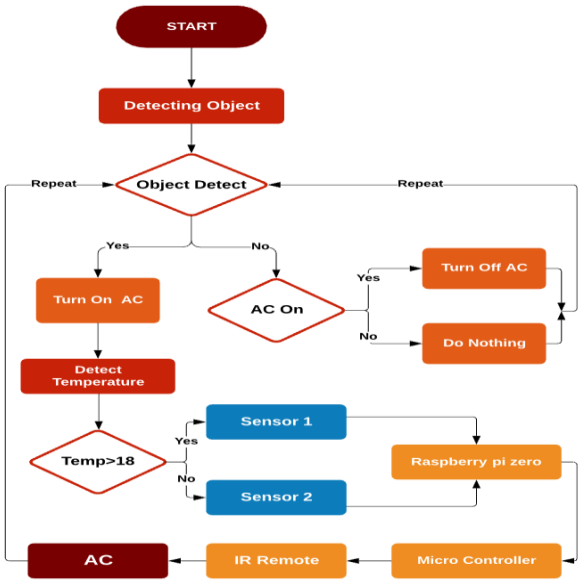

Fig. 7: Flowchart Diagram of the Entire System

Mathematical Exploration: To develop the algorithm of proposed entire embedded system, first temperature data and object data are gathered by utilizing thermal sensors1 and sensor2 to set up an anticipated temperature. The sensors play the role of distinguishable sorts of momentous worth. Sensor 1 is utilized to detect the temperature upper than 18 (temp>18) and sensor 2 is utilized to identify the temperature below (temp<18). Here, the ideal temperature is deliberated as 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
$\sum$s1= x1.t + x2.t + x3.t + x4.t + x5.t + x6.t+…+xn.t /n
$\sum$s2= x1.t + x2.t + x3.t + x4.t + x5.t + x6.t+…+xn.t /n
Predict Temperature (PT) = ($\sum$s1 + $\sum$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 then 10 and less than 20 (10<CT<20)
PT = CT – 2.
# If CT value more then 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 ()]

Description of used component: Building up the proposed embedded smart AC system, following equipment segments are used. Here, the segments with their figures and portrayal are introduced.

Thermal Sensor: This sensor is an 8x8 exhibit of IR warm sensors from Panasonic. When it is associated with the microcontroller (or Raspberry Pi) it will restore a variety of 64 singular infrared temperature readings over I2C. It is as like as those of extravagant warm cameras, sufficiently straightforward for simple reconciliation. This part will quantify temperatures going from 0°C to 80°C (32°F to 176°F) with an exactness of ± 2.5°C (4.5°F). It can distinguish a human article present in the room from a separation of up to 7 meters or 23 feet. Program codes are created for utilizing this breakout on an Adriano or a perfect or on a Raspberry Pi with Python. On the Pi, with a touch of picture handling help from the SciPy python library by which it can introduce the 8x8 networks and get some truly decent outcomes. The AMG8833 is the up and coming age of 8x8 warm IR sensors from Panasonic and offers higher execution than its forerunner the AMG8831 [18]. Fig. 8 is a warm sensor that is utilized for the framework.

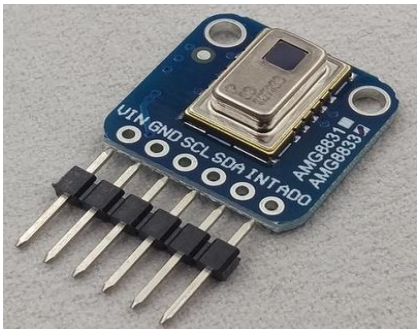

Fig. 8: Thermal Sensor

Raspberry pi zero: The Raspberry Pi is ease, MasterCard estimated PC that connects to a PC screen or TV, and utilization a standard console and mouse. It is a competent little gadget that empowers individuals of any age to investigate registering, and to figure out how to program in dialects like Scratch and Python. The Raspberry Pi Zero is a large portion of the span of a Model A+, with double the utility. A modest Raspberry Pi that is moderate enough for any task. It contains 1GHz single-center CPU, 512MB RAM, Mini HDMI port, Micro USB OTG port, Micro USB control, HAT-perfect 40-stick header, Composite video and reset headers, CSI camera connector [19]. Fig. 9 is an image of Raspberry pi zero.

Fig. 9: Raspberry pi zero

IR Sensor: An infrared sensor is an electronic instrument that is used to identify certain characteristics of its condition. It does this by either creating or recognizing infrared radiation. Infrared sensors are in like manner prepared for assessing the glow being released by an inquiry and perceiving development [20]. In Fig. 10 we demonstrated the IR sensors which pass the esteem and get the incentive for the direction the air conditioner.

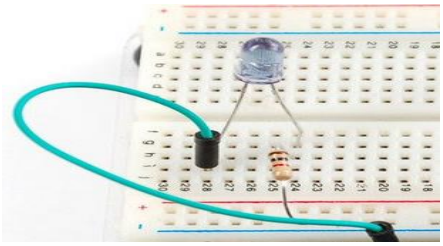

Fig. 10: Infered Sensor

IR Remote: Infrared remote control a handheld, a remote gadget used to work sound, video and other electronic hardware inside a room utilizing light flags in the infrared (IR) run. Infrared light requires a viewable pathway to its goal. Low-end remotes utilize just a single transmitter toward the finish of the unit and must be pointed legitimately at the hardware. Excellent remotes have three or four ground-breaking IR transmitters set at various edges to give the room signals [21]. In Fig. 11 we showed the image of an IR remote.

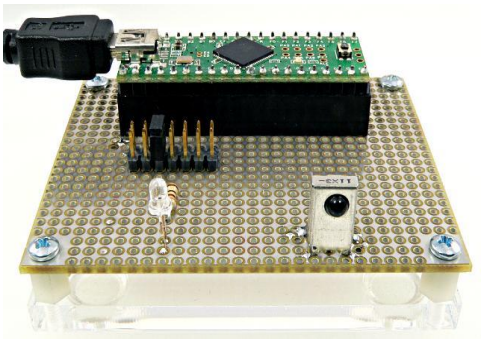

Fig. 11: IR Remote

Microcontroller (NodeMCU V-3 Development Kit): The NodeMCU is an open-source firmware and advancement pack that causes us to Prototype our IOT item inside a couple of Lua content lines. Open-source, Interactive, Programmable, Low cost, Simple Smart, and WI-FI empowered. The Development Kit dependent on ESP8266 incorporates GPIO, PWM, IIC, 1-Wire, and ADC across the board. Power your improvement in the quickest manner mixes with NodeMCU Firmware! USB-TTL included, plug and play, 10 GPIO, each GPIO can be PWM, I2C, 1-wire, FCC CERTIFIED WI-FI module, PCB radio wire [22]. In Fig. 12 we demonstrated the image of the microcontroller.

Fig. 12: Microcontroller

By assembling all these segments, proposed embedded system has been structured and created. Fig.13 represents the proposed diagram of entire smart AC system.

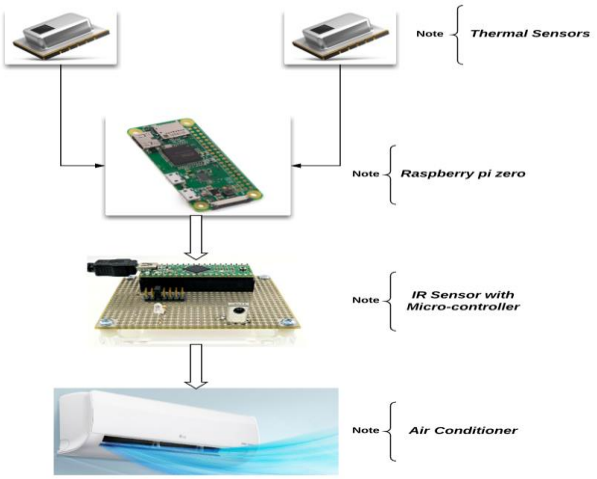

Fig. 13: Diagram of the Entire Syst

4. RESULT AND ANALYSIS

The proposed strategy has been structured and created in default IDE and furthermore can develop Anaconda application. A small conference room is selected for test the system, where 12 persons were available in the room. They all are of different temperatures, and the temperatures are detected by two thermal sensors (Sensor1, Sensor2). Then a data table is prepared by what exactly the sensor has provided. The fracture values like 28.5 to 29, 28.3 to 28 are skipped in this case. Several experiments have been observed to test the algorithm of the proposed system. But we have shown one experiment there one of them. Compare these results of the experiments with another, the result of the proposed system is found in the expected range.

Total 12 objects are measured for the temperatures that are presented in Table 1 and the corresponding graphical representations are presented as line chart and are shown in Fig. 14.
TABLE1: Object with Temperature by Implemented Sensors.

Utilizing the estimation of the table distinguishes by the sensors and the output gets by utilizing of our calculation.

Table 1. Object Temperature and Predicted Temperature

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

In Fig. 14 we showed the Line chart of the Tabular 3 data and output.

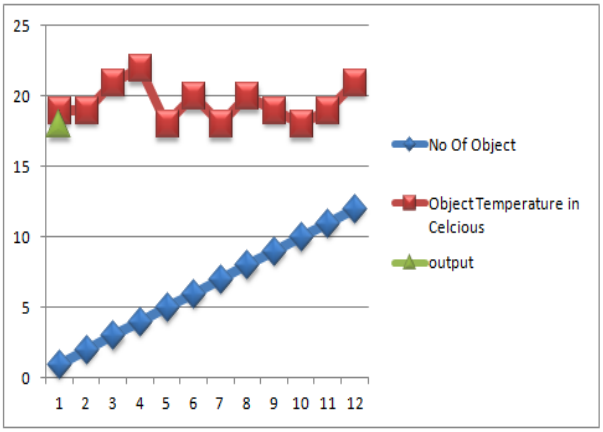

Fig. 14: Diagram of Table 1 Data

In several experiments, temperature data is found from objects by using sensors from a small conference room and save it in a table and deploy our proposed algorithm1 on it, we have found a predict temperature 20°C from experiment, then after 10 sec we again collected data and stored raw data in the another table and deploy algorithm1 on it and get a predict temperature 19°C. If we concentrate on the past predict temperature, we can easily judge that the temperature of object is changing dynamically. As not unlike that experiment we again collect temperature from object and store it to table and this one is last and final experiment. Deploy algorithm on the table that have shown in table1 and get predict temperature 18°C. Generally what temperature predict by the system using algorithm1 that is comfort temperature for all we can easily see it from fig.14. Every predict temperature is near to close of comfort temperature 18°C.

5. CONCLUSION

Automation and temperature prediction of a room is very much demanding issues in the present period for some reasons. A few methodologies are working in this purpose. A smart AC system room by mechanization 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 dimension. It can be applied in any manual AC system room to convert it into smart AC system environment by utilizing machine learning, artificial intelligence and expert system.

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