Microcontroller based Smart Home Automation With Power Conservation System Including Remote Monitoring Facilities

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Abstract

A lot of energy is wasted in our daily lives by keeping the lights and appliances switched on when they are not needed. In many places, generally, the fans and the lights are switched on even in places where nobody is present. Thus, our project is a small step towards a better automatic way to save energy. Our project uses Wi-Fi-enabled microcontrollers, which allows us to conserve energy by stopping it where it is not needed. Sometimes we keep the lights on, not realizing the apt amount of sunlight already available in the room. This decreases the connection between us and nature as well as increases energy consumption. Thus, our system helps you save energy by keeping the lights off. Our system also has a Wi-Fi camera system to remotely monitor the room when you are not present in the room. This can be accessed from outside by using a website. Most of the time, while going out in a hurry, we forget to close the door correctly. The door sensor present in our system allows us to monitor the state of the door remotely. The cherry on top of the cake is the temperature and humidity sensor, which, in addition to a smart Air Condition system, can automatically regulate the temperature and save energy where it is not needed.

Keywords: *IoT, Microcontroller, power conservation, remote monitoring.*

1. Introduction

The amount of energy consumed is a major concern in our modern society. The more digitized the world gets, the shortage of energy increases day by day. Energy production from fossil fuels is both bad for the environment and exhausting. There are also various eco-friendly ways of producing energy, but those are not as efficient and easily available in the current scenario. Thus, we thought about limiting energy consumption from our homes. This, in the long run, can save a lot of energy and can make our daily lives more efficient. In the project made, we plan upon conserving energy primarily. As we leave the room the PIR sensor and ultrasonic sensors detect the presence of any being and turns the electronic devices completely. We have also included DHT 11 for finding out and displaying the humidity and temperature. In the room, we can supervise the action in the room with the help of an ESP32cam module, the output will be shown in a website and can be viewed remotely. The website will also display the time, humidity and temperature and will also show if the doors are open with the help of door sensors. The paper is divided into 9 sections. First we have the abstract that gives a background to the project and the problem we are working on. Then we have the Introduction that gives a brief note on the project and the implementation idea. Following that we have the Literature Survey, which helps us cite the papers from which we have gained the knowledge. Then following comes the Methodology which contains the list and brief details of the components used in the project. Then comes the circuit diagram and the workflow diagram which helps us understand the project better on the flowchart. Then comes the working principle which gives a detailed description of the working of the project. Then comes the results of the continuous experiments done on the project. This area gives the tables and the graphs done in order to ensure the accuracy of the system in real world. Then comes the conclusion and the references used in the project for our project work.

2. LITERATURE SURVEY

The robust and scalable architecture included in project conducted by Mr. A. Abdulrahman in 2016 [1] "Design, Specification and Implementation of a Distributed Home Automation System", a WebSocket and JSON based communication protocol that saves a great deal of bandwidth with terse messages exchanged and exhibits a very low latency needed for a real-time home automation operation saving time, money and space. Although, the actual link characteristics depend on the available Internet connection strength, even at relatively poor connection situations, the system performance is guaranteed.

In the system proposed by Asst. Professor Sudha Kousalya in 2018 [4] "IoT Based Smart Security and Smart Home Automation" they have implemented using Node MCU by overcoming all the drawbacks of previous existing methods in this project all the sensors are connected to the Node MCU board and the results can be seen in Smart phone. For every second it shows new value. If any gas leakage happens the value of air purity sensor shows the high value at that time, we can turn on the fan to send the gas out. The camera module is connected to the Arduino UNO board because in Node MCU board we have only one analog pin for camera module we will use more analog pins, so we are connecting camera module to Arduino UNO. When IR sensor detects the motion, the camera module will be turned on. The captured images will be stored in folder of our PC and, it sends Captured images to the user email.

The SHA proposed by Ms. Urvi Singh in 2019 [5] ("Smart Home Automation System Using Internet of Things"), has been working satisfactorily by using the ESP8266 Wi-Fi module and internet over mobile phones, tablets, and laptops. Also, the system is not only used in controlling of home appliances but it is also designed for monitoring purpose which is done with the help of the sensor used in it for safety and security purpose. So, in this way, it presents a prototype and implementation of "smart home automation" using Wi-Fi technology over mobile phones, laptops, and tablets. This whole system can be extended for controlling many other appliances of the home by using Smart Home Automation application and ESP8266 Wi-Fi module and data which are obtained with the help of sensors can also be expanded for monitoring purpose as well as for safety purpose of the home by analysing over the internet for future improvements.

In the paper, Shahram Nourizadeh and his associates in 2009, [7] "Medical and Home automation Sensor Networks for Senior Citizens Tele homecare", have presented a distributed system to support remote medical consultations and elderly management and homecare across global wide area networks and heterogeneous platforms. By using this system, MEDeTIC (www.medetic.com), a non-profit organization, offers a new concept of building smart homes by using telemedicine and home automation, named in French "Maisons Vill'Âge®". The first housing schemes are in building with implements of the system's components.

In this paper Jayeeta Saha in 2018,[8] "Advanced IOT Based Combined Remote Health Monitoring, Home Automation and Alarm System", has successfully proposed an advanced IOT based automated remote health monitoring system by offering alarm notification along with prescribed medicine name and dose display. The most important feature in this system is that the health condition of the patient could be monitored from the home as well and necessary action could be taken during semi-major ailment. The probability of human error while acquiring the data could be effectively reduced as sensors are used for health data measurement. The proposed system would also provide automatic appliance control which makes the environment comfortable for the patient. Another beneficial part is the alert notification to the respective authority of the patient, and health data monitoring through the website which allows performing their regular task.

RESEARCH METHODOLOGY

A. Hardware Requirements

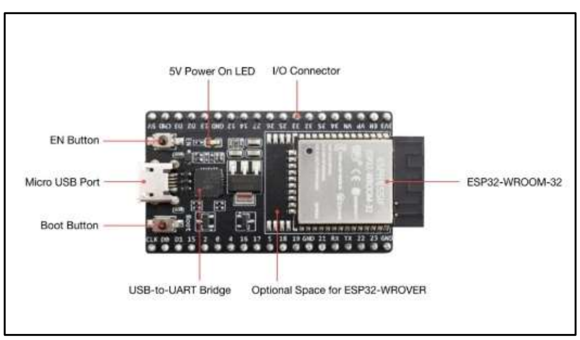

Fig 1: ESP32 Cam

- ESP32-CAM is a low-cost ESP32-based development board with onboard camera, small in size. It is an ideal solution for IoT application, prototypes constructions and DIY projects. The board integrates Wi-Fi, traditional Bluetooth and low power BLE , with 2 high- performance 32-bit LX6 CPUs.

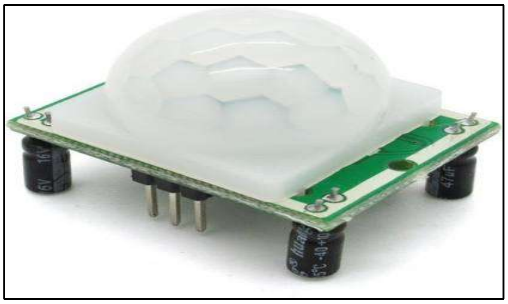

Fig 2: PIR sensor

- A PIR sensor also known as a passive infrared sensor, is used to measure infrared (IR) light emitting from a person or an object in its range. The main purpose of the PIR sensor is a motion detector. It detects various in the amount of IR light radiating upon it. This may vary depending on the temperature and surface of the object.

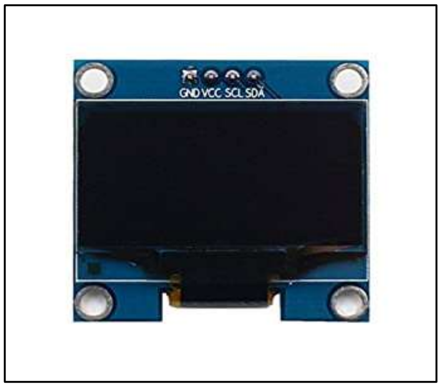

Fig 3: 0.96-inch OLED Display

- An organic light-emitting diode (OLED or organic LED), also known as organic electroluminescent (organic EL) diode, is a light-emitting diode (LED) in which the emissive electroluminescent layer is a film of organic compound that emits light in response to an electric current.

Fig 4: AC to DC converter

- AC/DC converters are electrical circuits that transform alternating current (AC) input into direct current (DC) output. AC/DC Converters are also called “rectifiers”; they convert the input AC voltage to variable DC voltage, then optimize it through a filter to obtain an unregulated DC voltage.

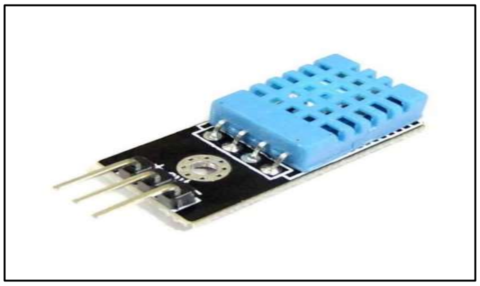

Fig 5: DHT11

- The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). Its fairly simple to use, but requires careful timing to grab data.

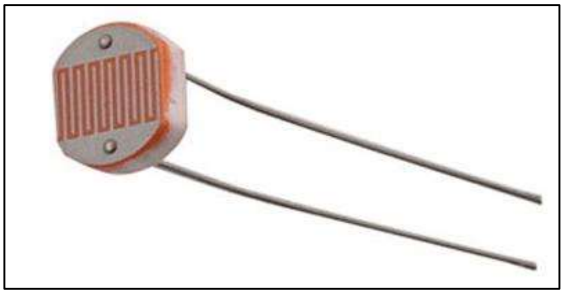

Fig 6: Photoresistor

– A photoresistor (also known as a Photocell, or light-dependent resistor, LDR, or photo-conductive cell) is a passive component that decreases resistance with respect to receiving luminosity (light) on the component's sensitive surface

Fig 7: ESP32 Cam

- ESP32-CAM is a low-cost ESP32-based development board with onboard camera, small in size. It is an ideal solution for IoT application, prototypes constructions and DIY projects. The board integrates Wi-Fi, traditional Bluetooth and low power BLE , with 2 high- performance 32-bit LX6 CPUs.

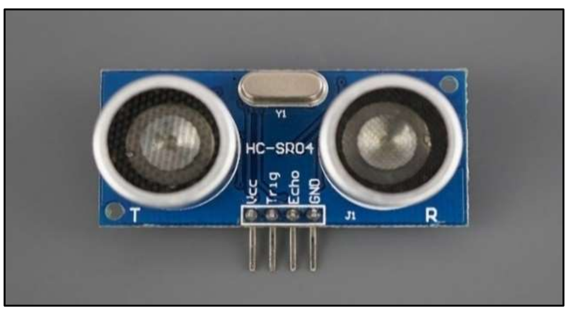

Fig 8: Ultrasonic Sensor

B: **Working Principle**

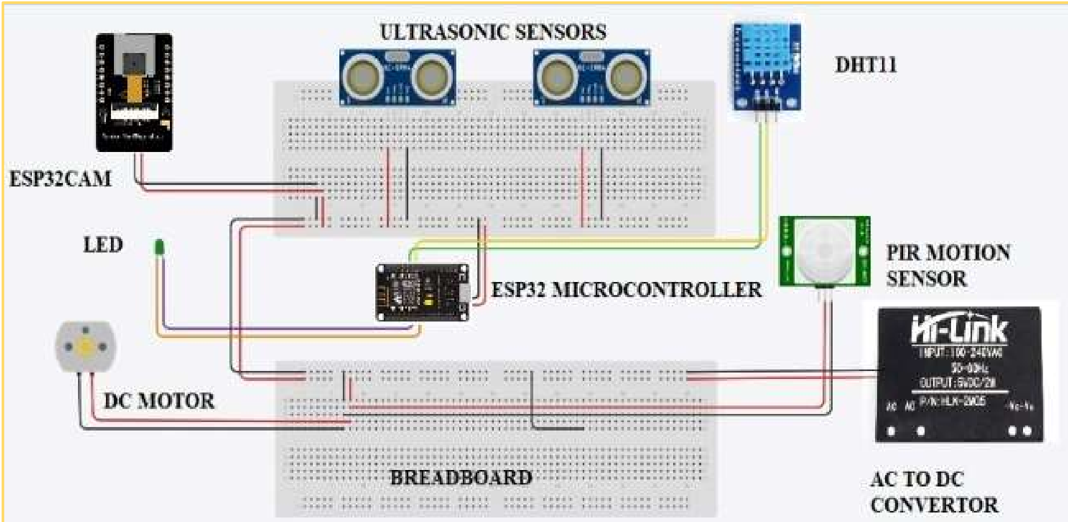

Fig 9: Circuit Diagram of the Prototype

The system assembled here is a fairly simple system. We are using two ultrasonic sensors here in order to detect people going in and out of the room. Thus, when the room is empty, the lights and other appliances will be switched off in the room. The PIR sensor is present to detect any movements in the room. These values from the sensors will be sent to the ESP32 microcontroller which will act as the server here. The ESP32 will host a website which will be available at our devices. This website will show the camera footage, the state of the door, the presence of any movements in the room and other necessary details. The LDR sensor present in the system will detect the amount of light present in the room in order to regulate the use of the light bulbs. The door sensor will detect the state of the door and the DHT11 will detect the temperature and the humidity of the room. There is also an OLED screen present in order to show the details manually. The ESP32 Cam contains a physical switch which can be used to turn off the camera completely in case of privacy issues.

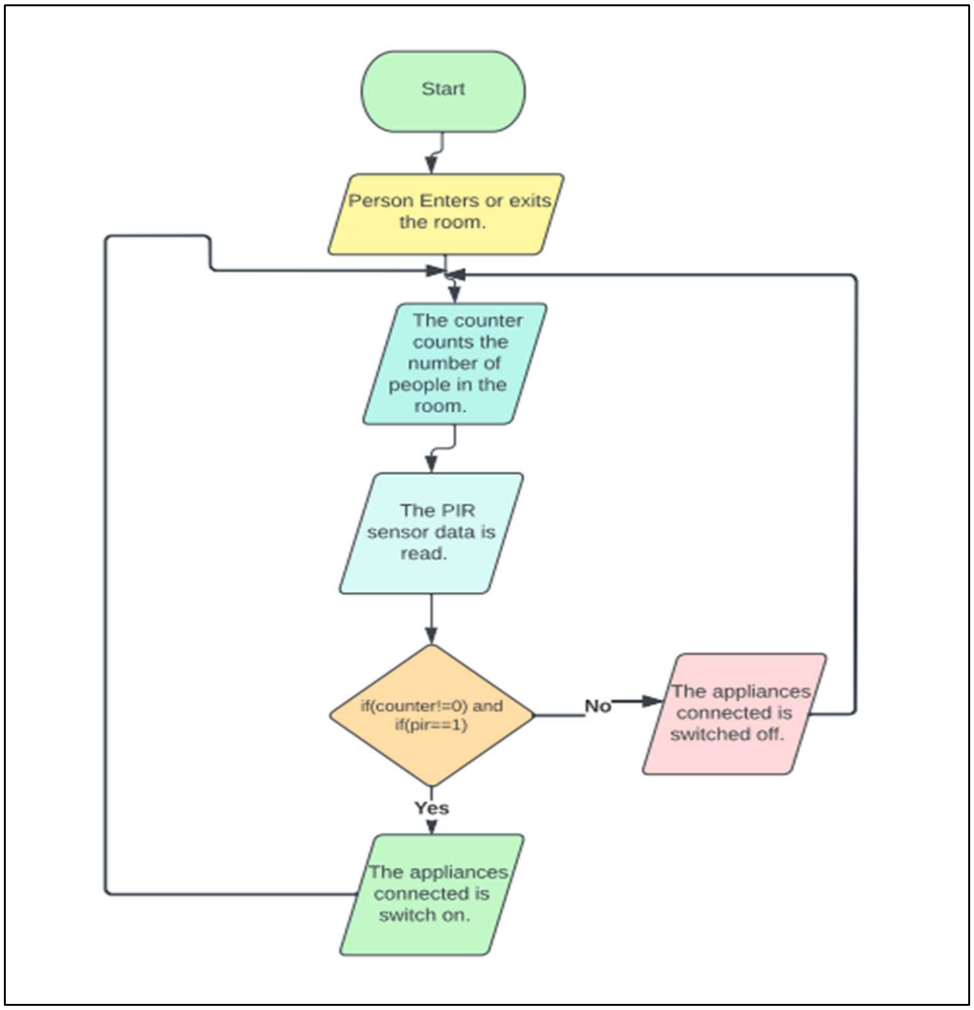

Fig 10: Flowchart of the energy conserver

3:RESULTS AND DISCUSSION

When the person enters the room, the counter in our system adds the number to the counter present in our system. When the person exits the room , the counter subtracts the number from our system. Thus, when the counter in our system becomes zero, the light and the fan turns off. Also the PIR sensor present in the room, on detection of any movement, turns on the light and the fan. The LDR sensor in the room detects if any light is needed. We have tested the counter system about 100 times. The accuracy of the system is about 98%. We have also tested the DHT11 sensor in all types of regions, and it gives the correct result all the time.

C. Testing of counter

Inward Movement is denoted by 1 and outward movement is denoted by 0.

Count Addition is denoted by 1 and subtraction is denoted by -1 and when nothing happens, it is denoted by 0.).

Table 1: Counter testing table

Serial No.	Movement direction	Count Addition or Subtraction
1	1	1
2	1	1
3	1	1
4	1	1
5	1	1
6	1	1
7	1	1
8	1	1
9	1	1
10	1	1
11	1	1
12	1	1
13	1	1
14	1	1
15	1	1
16	1	1
17	1	1
18	1	1
19	1	1
20	1	1
21	1	1
22	1	1
23	1	1
24	1	1
25	1	1
26	1	1
27	1	1
28	1	1
29	1	1
30	1	1
31	1	1
32	1	0
33	1	1
34	1	1
35	1	1
36	1	1
37	1	1
38	1	1

39	1	1
40	1	1
41	1	1
42	1	1
43	1	1
44	1	1
45	1	1
46	1	1
47	1	1
48	1	1
49	1	1
50	1	1
51	0	-1
52	0	-1
53	0	-1
54	0	-1
55	0	-1
56	0	-1
57	0	-1
58	0	-1
59	0	-1
60	0	-1
61	0	-1
62	0	-1
63	0	-1
64	0	-1
65	0	-1
66	0	-1
67	0	-1
68	0	-1
69	0	1
70	0	-1
71	0	0
72	0	-1
73	0	-1
74	0	-1
75	0	-1
76	0	-1
77	0	-1
78	0	-1
79	0	-1
80	0	-1
81	0	-1
82	0	-1
83	0	-1

84	0	-1
85	0	-1
86	0	-1
87	0	-1
88	0	-1
89	0	-1
90	0	-1
91	0	-1
92	0	-1
93	0	-1
94	0	-1
95	0	-1
96	0	-1
97	0	-1
98	0	-1
99	0	-1
100	0	-1

In this Table we, have tested the counter system present in our prototype 100 times. We have listed the values from the experiment and also plotted a graph for the experiment. We have found that out of 100, the system is giving current result for 98 times, which gives 98% accuracy.

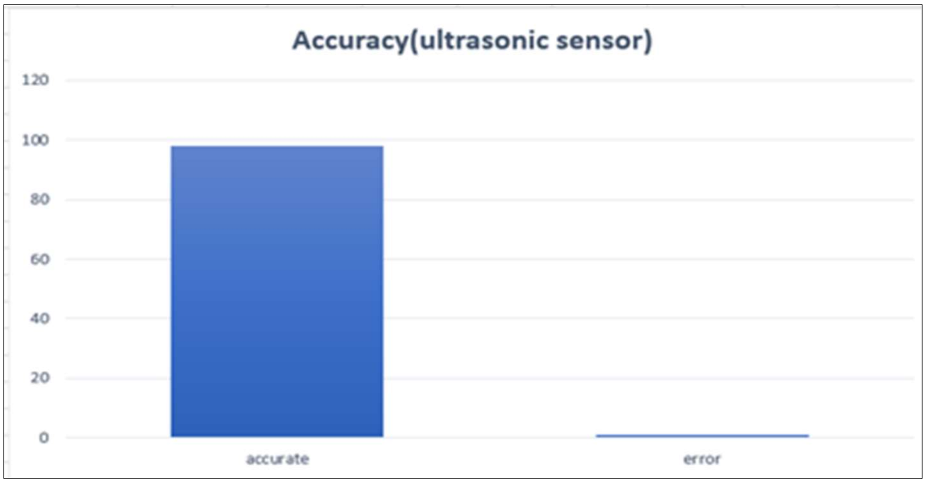

Fig 11: Graph of accuracy of counter

D. ***Testing of PIR sensor***

In the PIR table, any motion detected in the PIR sensor is denoted by 1 and if it detects no motion, it is denoted by 0.

Table 2: PIR sensor testing table

SL no	Movement direction	PIR
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0
17	0	1
18	0	0
19	0	0
20	0	0
21	0	0
22	0	0
23	0	0
24	0	0
25	0	0
26	0	0
27	0	0
28	0	0
29	0	0
30	0	0
31	0	0
32	0	0
33	0	0
34	0	0
35	0	0

36	0	0
37	0	0
38	0	0
39	0	0
40	0	0
41	0	0
42	0	0
43	0	1
44	0	0
45	0	0
46	0	0
47	0	0
48	0	0
49	0	0
50	0	0
51	1	1
52	1	1
53	1	1
54	1	1
55	1	1
56	1	1
57	1	1
58	1	1
59	1	1
60	1	1
61	1	1
62	1	1
63	1	1
64	1	1
65	1	1
66	1	1
67	1	1
68	1	1
69	1	1
70	1	1
71	1	0
72	1	1
73	1	1
74	1	1
75	1	1
76	1	1
77	1	1
78	1	1
79	1	1
80	1	1

81	1	1
82	1	1
83	1	1
84	1	1
85	1	1
86	1	1
87	1	1
88	1	1
89	1	1
90	1	1
91	1	1
92	1	1
93	1	1
94	1	1
95	1	1
96	1	1
97	1	1
98	1	1
99	1	1
100	1	1

In this table, we have tested the PIR motion sensor present in our system 100 times. We have listed the readings from the experiment and listed a similar table. Also, in this case our of 100 times, 98 times the readings are correct. This gives 98% accuracy.

E. Humidity and Temperature

Table 3: Temperature sensor testing table

SL No.	**Temperature (C)**
1	33
2	31
3	28
4	31
5	29
6	27
7	28

8	29
9	30
10	30
11	32
12	33
13	33
14	34
15	32
16	31
17	30
18	25
19	28
20	26
21	24
22	22
23	23
24	26
25	31
26	30
27	34
28	32
29	33
30	29
31	30
32	28
33	27
34	30

35	34
36	99
37	34
38	34
39	32
40	29
41	31
42	31
43	34
44	33
45	32
46	33
47	30
48	29
49	29
50	28

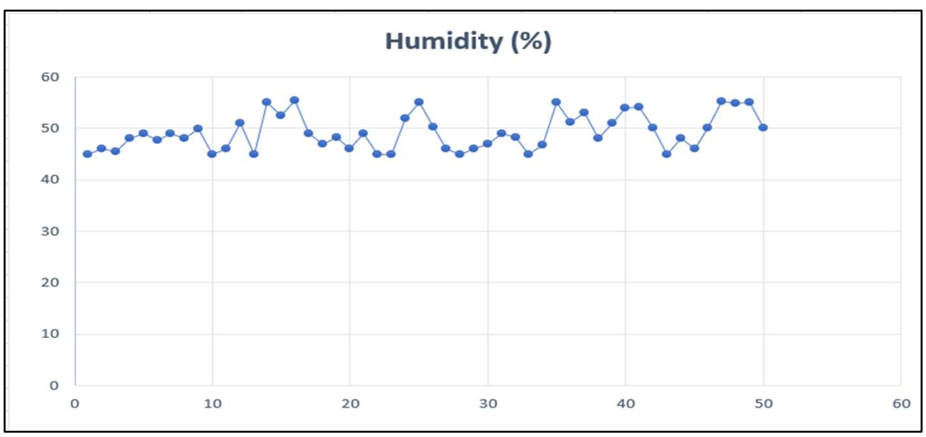

Fig 13: Humidity Testing Graph

SL No.	Humidity (%)
1	45
2	46
3	45.5
4	48
5	49
6	47.6
7	49
8	48
9	49.8
10	45
11	46
12	51
13	2
14	55
15	52.5
16	55.5
17	49
18	47
19	48.2
20	46
21	49
22	45
23	45
24	52
25	55

26	50.2
27	46
28	75
29	46
30	47
31	49
32	48.2
33	45
34	46.8
35	55
36	51.2
37	53
38	48
39	51
40	54
41	54.2
42	50
43	45
44	48
45	46
46	50
47	55.2
48	54.9
49	55
50	50

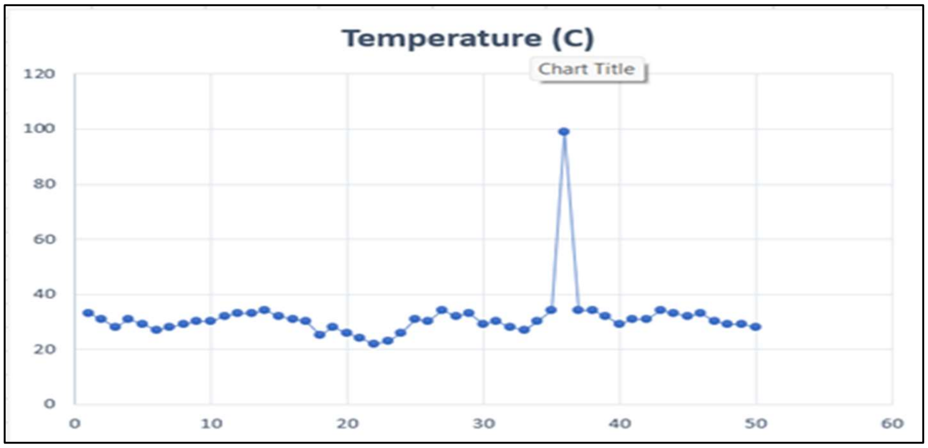

Fig 14: Temperature testing graph

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