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**ECE3501**

**Internet of things**

**Temperature Monitoring and Alert system in Industries**

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**Index page:**

Topic	Page number
1) Abstract	3
2) Introduction	3
3) Motivation	4
4) Existing Systems	4
5) Proposed model	5
6) Design and modules	6
7) Architecture Diagram	9
8) Implementation details	10
9) Output	13
10) Result and discussion	16
11) Conclusion and future work	17

## **Abstract:**

The main purpose of this project is to detect the temperature fluctuations and notify the people if they are in trouble due to temperature and moisture without any manual alarms. The sensors send the temperature in real time and if the noted temperature or humidity is more than the ends of the threshold then people working there must be notified else pupils' lives are in danger so we made this project to read the real time temperature and notify people through their mobile messages if they are in danger. Now we have taken use cases from agriculture sector and nuclear industry so that they can be benefitted of no loss of money or lives of people.

## **Introduction:**

We have worked on NodeMCU to send the data and to process the inputs of DHT11 Temperature and humidity sensor. The sensor reads the temperature and humidity and we can parallelly upload the Arduino code and send it to NodeMCU the inputs and the code are worked in NodeMCU which is connected to Thingsboard cloud and the read outputs are viewed in Thingsboard. Then to send an alert message we worked on Blynk app which can support multiple users and can send emails and messages to phones which are registered on that application.

Uses case we worked on are Nuclear power plant, the nuclear reactor are used for the high electricity producers. The nuclear reactor produces electricity and as a byproduct a large of heat is also liberated. So the coolants (majorly water) is used to reduce the heat liberated. The major problem that occurs here in nuclear plant is the worst conceivable accident is a severe loss-of-coolant accident (LOCA) leading to the core melt down and explosion due to large amount of heat generated. i.e, the loss of coolants in nuclear reactors.

The Other Use case is Farmers who want to sell their crops but cannot sell it in a days so government has built the cold storage rooms which helps farmers to keep their goods there and sell them on the day next so that the goods doesn't get rotten but if any worker unknowingly opens the door and doesn't close it then the farmer and worker should be notified else the goods will be rotten due to humidity rise(moisture increase). The Use Cases we worked on has an better alerting system in Blynks app because blynks app reads the temperature and humidity and as per the requirement we set the thresholds and if the threshold is reached it would show the alerting message.

## **Motivation:**

The efforts of people working in nuclear power plants to keep lives in risk and work in the threat zone areas (i.e, nuclear power plant) and farmer who cannot sell the goods on the expected day and the next day would night mare if they wouldn't sell it, due to rotten of goods.

So these threats made us to think to work on this project to help people working in nuclear reactors and farmers in accordance to the threats.

## **Existing System:**

### **Surveillance in Nuclear Power Plant using Internet of Things**

On routine process of this type of nuclear power plant operations, the discharge of radioactive effluents from nuclear reactor causes hazardous impacts on its environment and affects the normal life of human beings, animals and plants. Hence it is essential to monitor the nuclear power plant and control the valves and devices to ensure the safety of the environment. Even many safety measures has already implemented at the power plant, the facility of monitoring and controlling from the remote location is better because the operator can be isolated from the environment. There are many companies which provide alerting system to the nuclear power plant. Some of them are Onsolve, Telegraphia. They provide sirens and notification message to all the citizens residing near to the power plant. They continuously monitor the status and condition of the entire warning system. The notification system automatically summons emergency services and informs the responsible staff of an emergency by sending a voice or text message.

### **Surveillance in Cold storages using Internet of Things**

In India we can hardly find alert system for cold storages. In small villages, we can say there are no alert systems according to sources. We have monitor systems in foreign countries, Sensaphone is one of it. They alert the security staff during Power failure, Temperature fluctuations and water shortage. But this type of equipment is costly and people in villages and Government can't afford it to install in India.

## **Proposed Model:**

We have alert systems which cost high and normal farmers and small industries can't afford it. Alert system for cold storages in India is hardly to find. In nuclear power plant many security measures were already installed, but we can use our model with better sensors which costs low and easy to use.

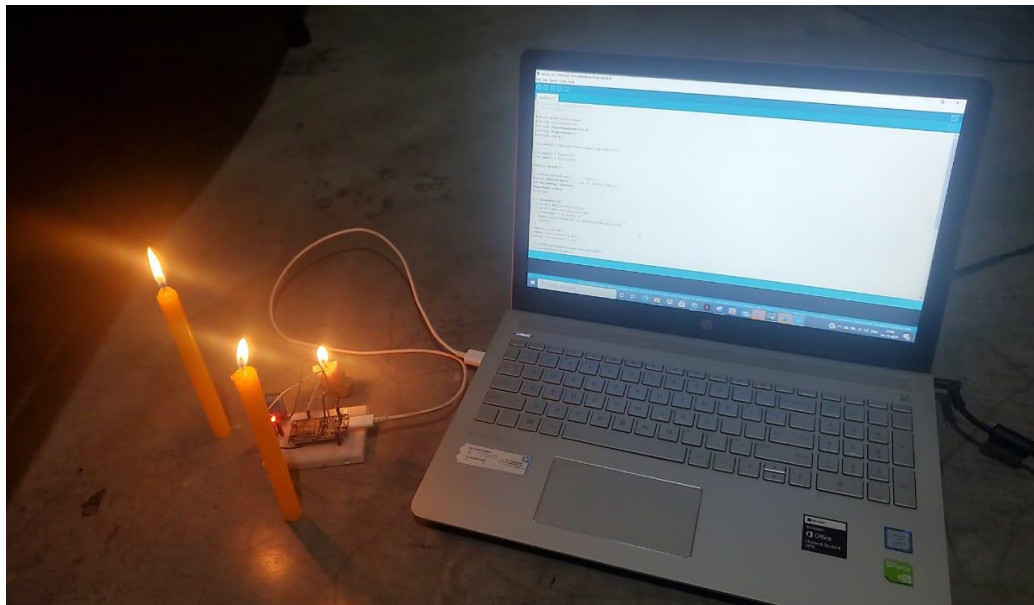
We used Nodemcu and DHT11 sensor to capture temperature and humidity in real time. Once the data is captured, we passed the data to ThingBoard to visualize the data. The data gets updated in real time and the administrator can analyze the data. Along with thingsboard, we used Blynk app to visualize the data. All the people and staff who are connected with the main account linked with sensor also can see the temperature and humidity. We wrote our code in Arduino IDE and compiled and submitted to Nodemcu. With the help of inputs given in the code, the data is captured by sensor and pass it to thingsboard and Blynk app. We made our model to detect sudden increase in temperature which is used in Nuclear Plants. The sensor data is captured for every 10sec and if we identify any sudden increment in temperature a notification message is passed through Blynk app to all the people and staff who are connected with it.

The second use case is to detect and alert if the humidity crosses threshold value. Since due to exposure to moisture the fruits and vegetables get spoiled, we are storing them in the cold storages. So, these fruits and vegetables should not expose to outside atmosphere. The only possibility they can expose is through opening and leaving the doors open. We observed through our experiments that the humidity levels getting increased when the doors are open. So we made our model to alert the security or farmers when the humidity goes over threshold value.

## **Design and modules:**

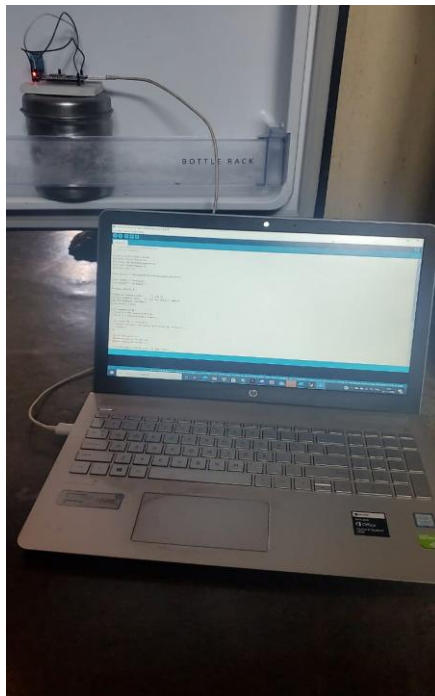
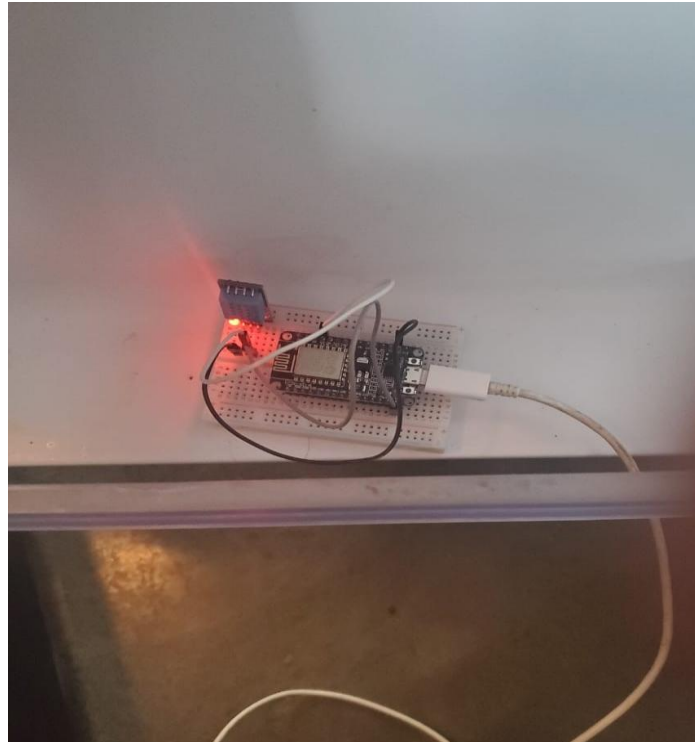
### **1. Design for usecase1, Nuclear power plant:**

Using Candles to show sudden increase in Temperature



## 2. Design for usecase2, Cold Storage Monitoring:

Using Fridge as Cold Storage and if Fridge door open we get a notification



## Modules:

**1) ESP8266 Wifi Module:** This module has on-board processing and storage capability that allows it to be integrated with the sensors and other application specific devices through its GPIOs with minimal development up-front and minimal loading during runtime. In this project node MCU is used to read the temperature and make them as Inputs and process to the code as Inputs so that it ensures to which inputs does the code need to work on.

**2) DHT11 Sensor:** This sensor is used to measure Temperature and Humidity. It can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of  $\pm 1^\circ\text{C}$  and  $\pm 1\%$ .

**3) Arduino IDE:** The Arduino Integrated Development Environment is a coding platform written in functions from C and C++. We can code and upload programs to Arduino compatible boards. We wrote our ThingsBoard and Blynk App in the Arduino IDE.

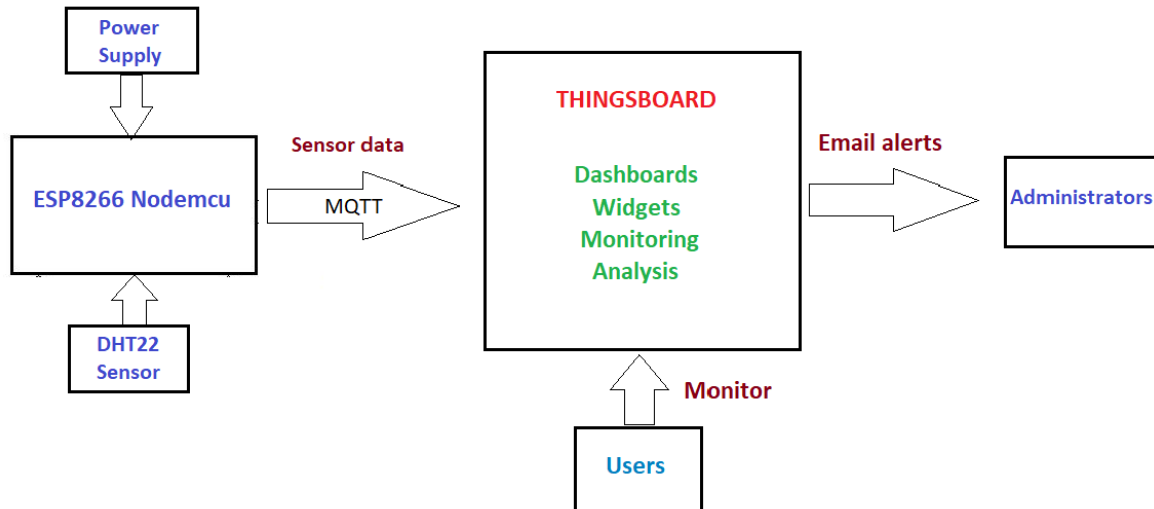
**4) ThingsBoard:** ThingsBoard is an open-source IoT platform for data collection, processing, visualization, and device management. We created an account in ThingsBoard and connected with it to pass the sensor data. We visualized the Temperature and Humidity.

**5) Blynk App:** It is a mobile application where we can pass our sensor data to the app and we can visualize and operate data. Using Blynk app we can send alert or notification any number of people who are connected to the main account. So it useful in our Nuclear power plant use case to notify people around the plant.

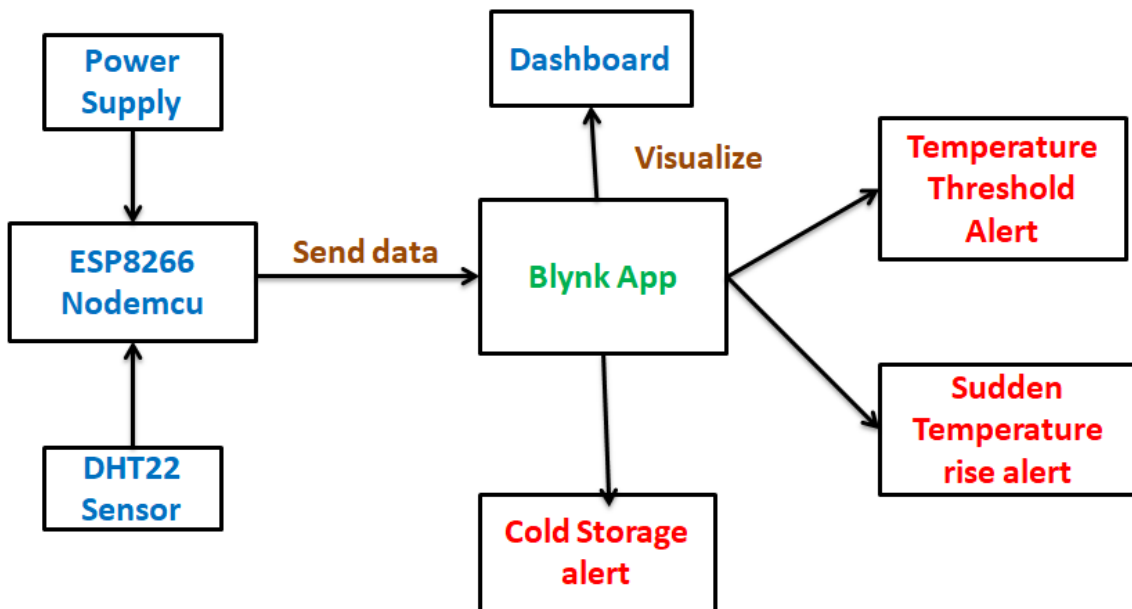


## Architecture Diagram:

### Thingsboard:



### Blynk App:



## **Implementation details:**

### **1. ESP8266 and Arduino IDE setup.**

We need to install all the required libraries in Arduino IDE to work with ESP8266. And now select the preference in files menu and add this URL address in additional boards managers.

URL: [http://arduino.esp8266.com/stable/package\\_esp8266com\\_index.json](http://arduino.esp8266.com/stable/package_esp8266com_index.json)

Install ESP8266 module in Arduino.

### **2. Install required libraries**

Now go to sketch and go to Include libraries and manage libraries

Add the following packages.

#### **I. PubSubClient by Nick O’Leary**

A client library for MQTT messaging. This library used to send and receive MQTT messages. It supports the latest MQTT 3.1.1 protocol and can also be used to the older MQTT 3.1 if needed. It supports all Arduino client compatible hardware, including the Intel Edison, ESP8266 .

#### **II. Adafruit Unified Sensor by Adafruit**

Required for all Adafruit Unified Sensor based libraries. A unified sensor abstraction layer used for so many Adafruit sensor libraries. This library is compatible with all of the existing architectures so it could be able to use it on all the Arduino boards

#### **III. DHT sensor library by Adafruit**

This supports for sensing the temperature and to shows the output in serial monitor.

#### **IV. Arduino ThingsBoard SDK by ThingsBoard**

ThingsBoard is an open-source server-side platform which allows you to monitor and control IoT devices. It is free for both personal and commercial usage and you can work on it anywhere. The application that is running on ESP8266 is written using ThingsBoard Arduino SDK.

## **V. ArduinoJSON by bblanchon**

ArduinoJson is a C++ JSON library for Arduino. Supports single quotes as a string delimiter. Compatible with NDJSON and JSON Lines

## **VI. Arduino Http Client**

It connects to the internet and downloads content.

### **3. Upload the sketch/code in the IDE**

- WIFI\_AP - name of your access point
- WIFI\_PASSWORD - access point password
- TOKEN - the \$ACCESS\_TOKEN from ThingsBoard configuration step.

Now connect with laptop or any power source to make the sensor to work and upload the code in ESP8266

So the outputs are visualized in thingsboard demo.

### **4. Visualizing in thingsboard:**

First we need to create an Asset in the Thingsboard. In the Asset give the device name. In the devices panel we can see our device name. The real time temperature and humidity are updated in the “last telemetry” along with the timestamp. In the dashboard panel create a new dashboard and give the device name. In the dashboard, select the widgets to visualize the real time temperature and humidity.

### **5. Connecting to Blynk App:**

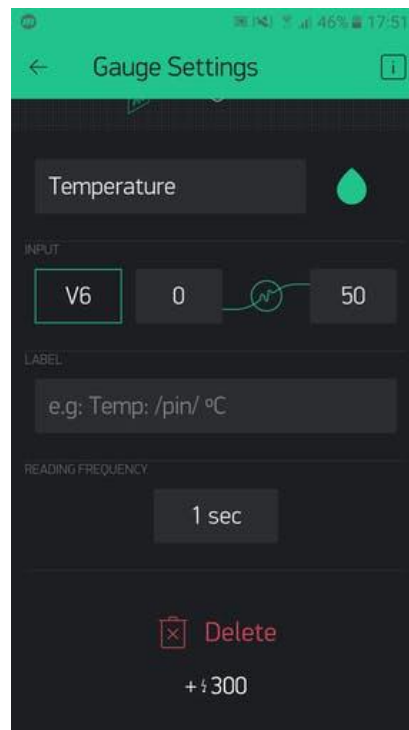
Blynks app is a platform that allows you to build interfaces easily for controlling and monitoring our project on any os

We have used blynk app because it allows us to send us mails and notifications simultaneously and it can be used for multiple user use because we our use cases are for multiple users working in industries so this is the best platform to use for its properties for multiple users

**Software serial** library is used as a serial communication with a digital pin other than the serial port and it is possible to have many software serial ports with speed 115200bps

And **Blynk library** for embedded hardware is used for arduino and esp8266 raspberry and many.

In the Blynk app, we need to create gauges to visualize the data. In widget box add the required gauge to monitor temperature and humidity data. Provide the name to the gauge and pin number. This pin number we need to give in the code to pass the data to the gauge.



## 6. Passing data to Blynk app:

- Blynk.virtualWrite(V5, h);
- Blynk.virtualWrite(V6, t);

The above commands helps to pass the humidity and temperature to the Blynk app.

## 7. Alert to mail and notification

```
if(t > 28){  
    Blynk.email("maruthi.palevela@gmail.com", "ESP8266 Alert", "Temperature over 28C!");  
    Blynk.notify("ESP8266 Alert - Temperature over 34C!");  
}
```

}

## 8. Use case 1:

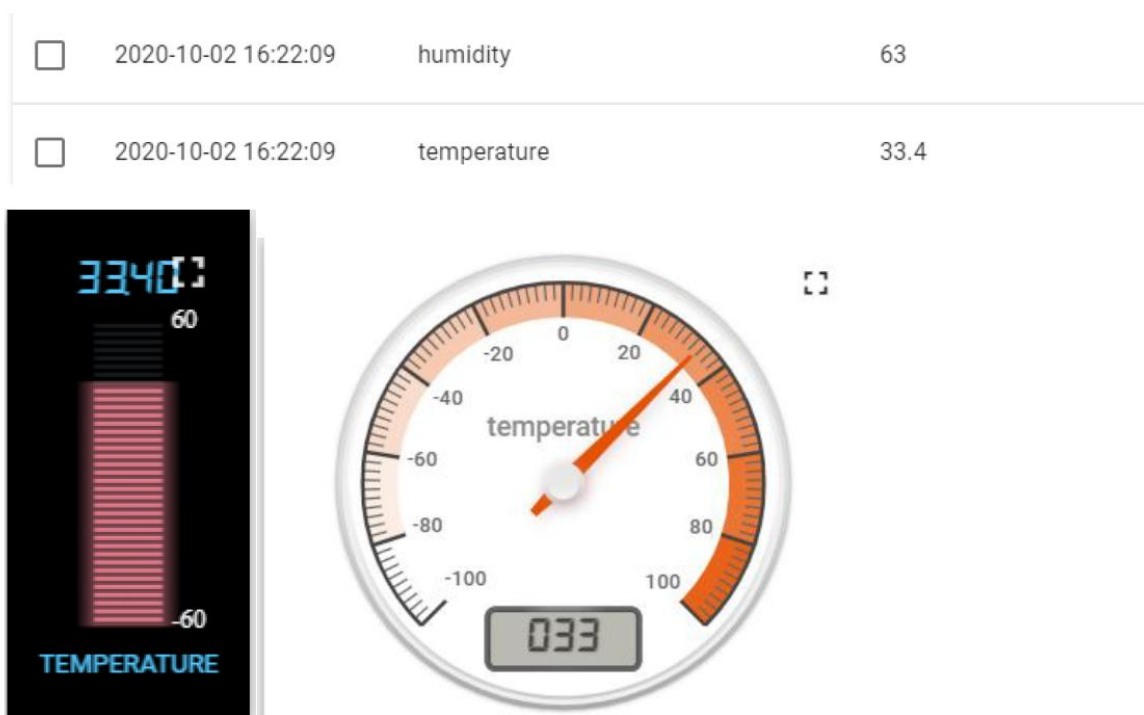
We have implemented these use cases on Blynk app and as the problem statement indicates that nuclear power plant's issue due to quick raise in temperature to do this demo we cannot show as demo from nuclear power plant so we made a setup using candles as nuclear power plant and made threshold as 1 degree centigrade so if the temperature is raised higher than threshold then it indicates warning.

## 9. Use case 2:

In the other use case also to show the demo of it we have kept the sensor in the fridge so it is shown as the cold storage and as shown in the problem statement as door open and humidity increases more than 65 then there would be warning through Blynk app notification.

## Outputs:

### 1) Visualizing Temperature and Humidity in real time through ThingsBoard



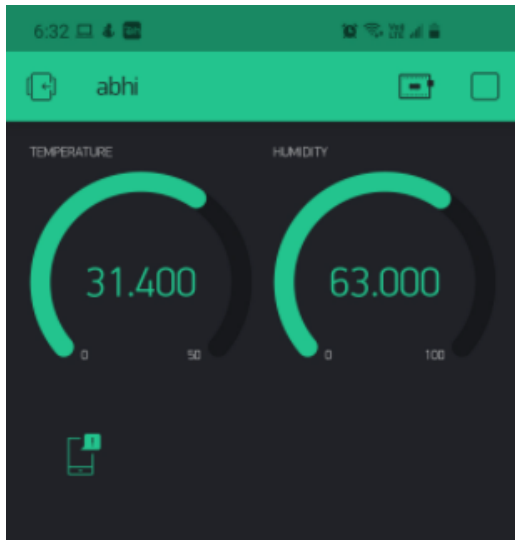
## 2) Visualizing Temperature and Humidity in Blynk App



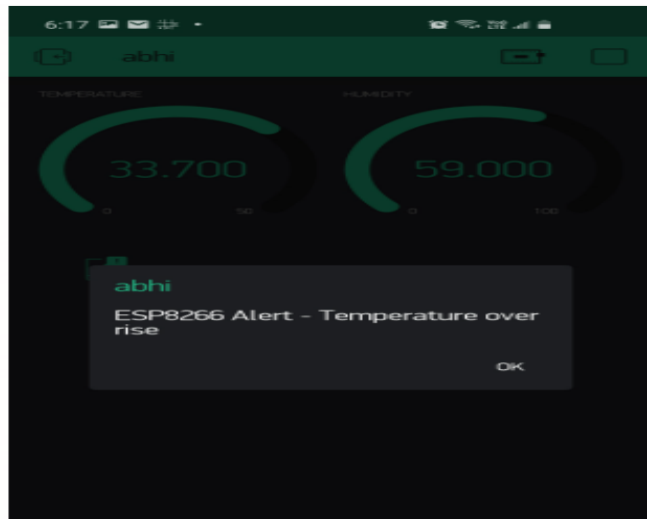
## 3) Email Alert when temperature exceeds Threshold



#### 4) Usecase1: Blynk App Alert for sudden increase in Temperature (1 degree)

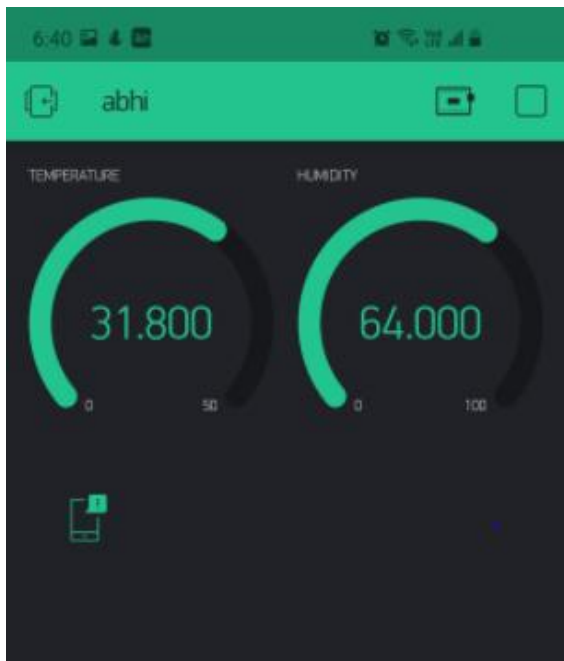


Initial temperature



Warning and raised temperature

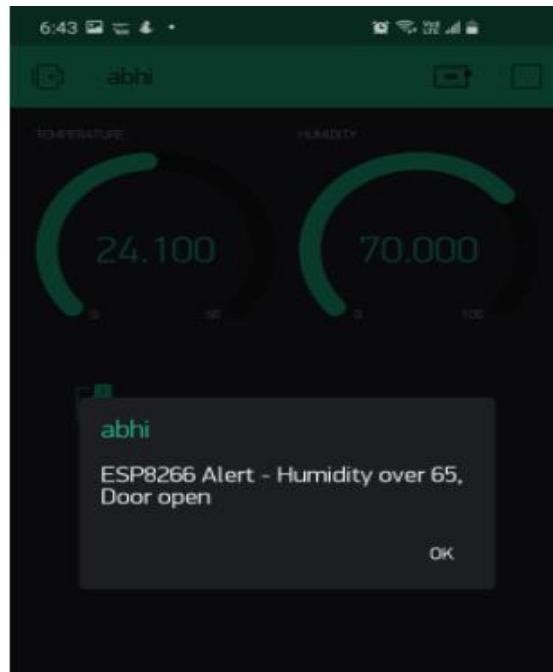
#### 5) Usecase2: Blynk App Alert for increase in Humidity when door opens



Room Temperature



Cold Storage Temperature



Alert when door opens

## **Result and Discussion:**

### **Temperature monitoring Threshold Temperature:**

Using ThingsBoard and Blynk app we visualized the sensor data. Output no. 1 and 2 describes the dashboards to visualize the sensor data in real time. The data in dashboard is updated every 3sec. We kept 34 degree centigrade as threshold temperature, Output no.3 describes the email alert when the temperature exceed 34.

### **Use case 1:**

The temperature is captured for every 10sec. We store the reading of temperature and if the present captured temperature is more than the previous temperature, we can consider it as a sudden increment and using Blynk app we sent a notification to all the people who are connected to it. In our case, we used candles to show sudden increment of temperature (more than 1 degree centigrade). In the output no.5, the initial temperature is 31.4 degree centigrade and after 10sec the temperature is 33.7 degree centigrade, which is an increase of 2.3 degrees and we can see a notification is popup showing “Temperature over Rise”.



## **Use case 2:**

In this use case we used Humidity to alert when the cold storage doors were kept open. In cold storages or fridges usually we have less humidity than outside atmosphere. The sensor is kept at someplace near to the door, if the doors are kept open the humidity in the cold storage room gets high and due to moisture fruits and vegetables gets spoiled. We used fridge in place of cold storage. In the output no.5, we can see that the humidity inside the fridge is 47 and outside is 64. When the door is kept open the humidity crossed the threshold value 65 and we got the notification “Humidity over 65, door open”.

## **Conclusion and future work:**

We were able to connect the circuit and pass the real time real time temperature and humidity to ThingsBoard and Blynk app. Using Blynk app we were able to send alert messages through app notification and email. We were able to send notification to all the accounts linked to it. We made alert system two use cases which are useful in Nuclear power plant and food cold storages. We pass a notification to all the connected people when we identify sudden increase in temperature to alert them. We also pass a notification when we identify increment of humidity due to opening of doors. Future work includes adding of more parameters along with temperature and humidity to identify the explosive nuclear matter and moisture levels to preserve the food. We can also add more features for food safety and monitor according to the type of food stored, since different food items suits different atmospheric conditions.

## References:

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- 3) <https://www.biz4intellia.com/blog/temperature-monitoring/>
- 4) <https://www.electronicsforu.com/electronics-projects/humidity-temperature-monitoring-using-arduino-esp8266>
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- 6) <https://www.rotronic.com/en/humidity-measurement-feuchtemessung-temperaturmessung/temperature.html>