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IoT Based Food Monitoring System

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Abstract: *Nitrogen, Oxygen, Trace gases and other various mixtures of gases comprises the Earth's atmosphere. Trace gas is usually in small portion and is a mixture of gases include carbon monoxide, methane, carbon dioxide, hydrogen, argon, neon etc. The concentration of these trace has have increased in recent past and have a adverse effect on human health. So, it is very important to determine these gases. Over the last few decades, sensors have developed its applications in several fields of technology. In this paper, IoT framework is provided for food monitoring system for protection of food due to surrounding conditions with array of low cost sensors. The proposed work analyzes temperature, humidity and gas emitted by food as these parameters affect nutritional value of the food items and analyzed results will be displayed on LCD and message will be sent to android phone (or any device which access internet) by using application.*

Keywords: IoT, Sensors, Food Monitoring System, Android Phone, LCD

I. INTRODUCTION

Every industry has its own list of unique logistics challenges and issues can arrive from a multitude of sources – product type, mode, receiver, market conditions, etc. Working exclusively within the food, beverage, and consumer product sectors, the transportation professionals at Zip line Logistics know the ins-and-outs of these unique challenges. But what are some common food transportation issues most face. Here are we saw the food transportation issues and try to help by using our project. [1]

Our project aims to solve the problem in transportation of food and beverages due to environmental changes in location while transporting the raw material. Many consumer goods are subject to perishability or freeze ability and require temperature controlled transportation. Demand for this equipment has increased dramatically with the consumer preference for fresh and less processed products while the supply has seen little improvement due to the higher cost of ownership and a more challenging regulatory environment. This means significantly tighter capacity and often higher prices when compared to traditional truckload or dry van[2].

Our system uses temperature as well as humidity sensing of trucks trailer to keep track of vegetables and fruits in their appropriate quality. The sensors are connected to a microcontroller to track the status which is in turn interfaced to an LCD display as well as Wi-Fi connection in order to transmit alerts. If system detects any abrupt changes in trucks humidity or external temperature, the system automatically alerts the user about the trailers' status over IOT and also shows details of humidity and temperature level of environment inside the truck live over the internet. Thus IOT based food quality tracking system effectively uses internet to monitor the environment and start the heater or fogger to increase or decrease the temperature or humidity inside the trucks, to maintain the quality of food to be transport

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II. METHODOLOGY

Hardware Specifications:

- DHT11 Temp & humidity Sensor
- ESP32 Microcontroller
- Wi-Fi Modem
- Android phone
- LCD 16 x 2

Software Specifications:

- Arduino Compiler
- MC Programming Language: C
- Blynk Android App / Blynk Web Server

III. LITERATURE REVIEW

Introduction

In this chapter we discuss food quality monitoring systems that currently exist or have been proposed giving both their strengths and weaknesses. A study on our proposed system is done comparing it with these food quality monitoring systems focusing more on how our system addresses their weaknesses. We also do a comprehensive literature study of various components that are likely to be used in the realization of our proposed solution. The study of the components covers areas such as their mode of operation, features, specifications, uses, applications, advantages and disadvantages.[5]

Existing solutions

The following solutions that attempt to monitor food quality by monitoring related environmental factors currently exist;

Manual monitoring of atmospheric and environmental factors

Majority of food stores and warehouses still rely on this system of manual monitoring of the atmospheric factors related to food quality. This requires some personnel to routinely visit and check the conditions of the store by taking note of these conditions at some selected time intervals. Increase in labor by routine checkups, risk of injury or harm to the personnel by extreme conditions, delays or even human errors in measurements are among the shortcomings of this method.[10]

Smart Food Quality Monitoring System

This study suggests the systematic use of various sensors to perform quality monitoring and control of food materials. More precisely, this system consists of gas, temperature, light and humidity sensors, which provide the essential information needed for evaluating the quality of the packed or stored product. This information is transmitted wirelessly to a computer system providing an interface where the user can observe the evolution of the product quality over time using the Internet of Things technology. This system comes with the following key advantages;

Automation of daily tasks leading to better monitoring of devices.

The biggest advantage of employing the IoT technology in this system is saving money.

Efficient and saves time

Temperature and Humidity Sensors

These sensors are used to sense the values of temperature and humidity in the air or particular surrounding

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DHT Temperature and Humidity Sensors

These sensors are very popular for electronics hobbyists because there are very cheap but still providing great performance. We have two versions of the DHT sensor, they look a bit similar and have the same pinout, but have different characteristics

DTH11 SENSOR

The DHT11 is a commonly used Temperature and humidity sensor. The sensor comes with a dedicated NTC to measure temperature and an 8-bit microcontroller to output the values of temperature and humidity as serial data. The sensor is also factory calibrated and hence easy to interface with other microcontrollers. The sensor can measure temperature from 0°C to 50°C and humidity from 20% to 90% with an accuracy of ±1°C and ±1%. So if you are looking to measure in this range then this sensor might be the right choice for you. The DHT11 sensor can either be purchased as a sensor or as a module. Either way, the performance of the sensor is same. The sensor will come as a 4-pin package out of which only three pins will be used whereas the module will come with three pins as shown above. The only difference between the sensor and module is that the module will have a filtering capacitor and pull-up resistor inbuilt, and for the sensor, you have to use them externally if required

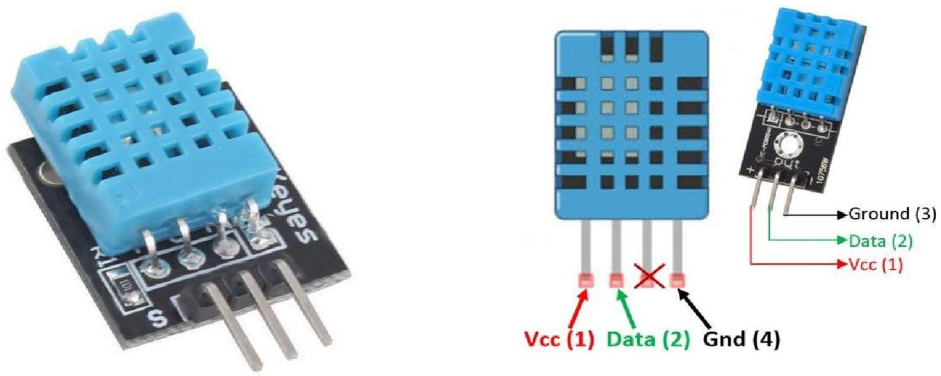

Fig: DTH11 (Humidity and temperature) sensor

DHT11 Pinout Configuration

No:	Pin Name	Description
For DHT11 Sensor		
1	Vcc	Power supply 3.5V to 5.5V
2	Data	Outputs both Temperature and Humidity through serial Data
3	NC	No Connection and hence not used
4	Ground	Connected to the ground of the circuit
For DHT11 Sensor module		
1	Vcc	Power supply 3.5V to 5.5V
2	Data	Outputs both Temperature and Humidity through serial Data
3	Ground	Connected to the ground of the circuit

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ESP32 Microcontroller

ESP32 is a low-cost System on Chip (SoC) Microcontroller from Espressif Systems, the developers of the famous ESP8266 SoC. It is a successor to ESP8266 SoC and comes in both single-core and dual-core variations of the Tensilica's 32-bit Xtensa LX6 Microprocessor with integrated Wi-Fi and Bluetooth.

The good thing about ESP32, like ESP8266 is its integrated RF components like Power Amplifier, Low-Noise Receive Amplifier, Antenna Switch, Filters and RF Balun. This makes designing hardware around ESP32 very easy as you require very few external components

ESP32 DevKit – The ESP32 Development Board

Espressif Systems released several modules based on ESP32 and one of the popular options is the ESP-WROOM-32 Module. It consists of ESP32 SoC, a 40 MHz crystal oscillator, 4 MB Flash IC and some passive components.

ESP-WROOM-32 Module

The good thing about ESP-WROOM-32 Module is the PCB has edge castellations. So, what third- part manufacturers do is take the ESP-WROOM-32 Module and design a break-out board for this module.

One such board is the ESP32 DevKit Board. It contains the ESP-WROOM-32 as the main module and also some additional hardware to easily program ESP32 and make connections with the GPIO Pins.

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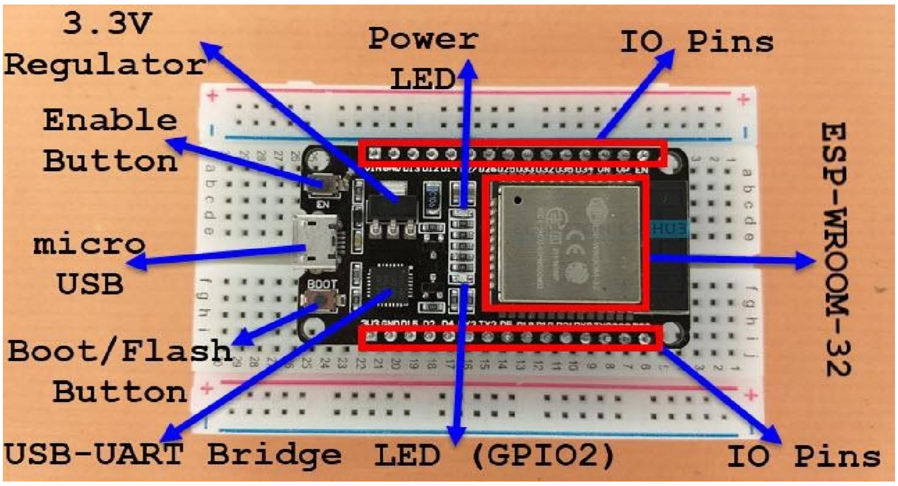
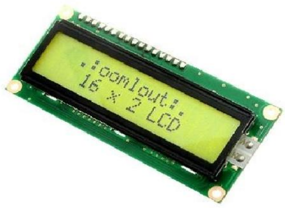


ESP32 Microcontroller

LCD 16×2 Display

The term LCD stands for liquid crystal display. It is one kind of electronic display module used in an extensive range of applications like various circuits & devices like mobile phones, calculators, computers, TV sets, etc. These displays are mainly preferred for multi-segment light-emitting diodes and seven segments. The main benefits of using this module are inexpensive; simply programmable, animations, and there are no limitations for displaying custom characters, special and even animations, etc.



LCD 16×2 Pin Diagram

The 16×2 LCD pinout is shown below.

Pin1 (Ground/Source Pin): This is a GND pin of display, used to connect the GND terminal of the microcontroller unit or power source.

Pin2 (VCC/Source Pin): This is the voltage supply pin of the display, used to connect the supply pin of the power source.

Pin3 (V0/VEE/Control Pin): This pin regulates the difference of the display, used to connect a changeable POT that can supply 0 to 5V.

Pin4 (Register Select/Control Pin): This pin toggles among command or data register, used to connect a microcontroller unit pin and obtains either 0 or 1(0 = data mode, and 1 = command mode).

Pin5 (Read/Write/Control Pin): This pin toggles the display among the read or writes operation, and it is connected to a microcontroller unit pin to get either 0 or 1 (0 = Write Operation, and 1 = Read Operation).

Pin 6 (Enable/Control Pin): This pin should be held high to execute Read/Write process, and it is connected to the microcontroller unit & constantly held high.

Pins 7-14 (Data Pins): These pins are used to send data to the display. These pins are connected in two-wire modes like 4-wire mode and 8-wire mode. In 4-wire mode, only four pins are connected to the microcontroller unit like 0 to 3, whereas in 8-wire mode, 8- pins are connected to microcontroller unit like 0 to 7.

Pin15 (+ve pin of the LED): This pin is connected to +5V

Pin 16 (-ve pin of the LED): This pin is connected to GND.

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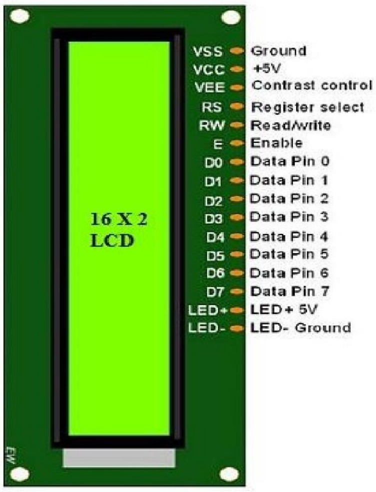


ARDUINO COMPILER

Compiling a program is the process of transforming high-level source code into a low-level object code (binary code) called machine language, which can be understood by the processor. In Arduino IDE AVR-GCC Toolchain is used for compiling the program.

MC PROGRAMMING LANGUAGE: C

MC language is a low-level code interpreted and converted from high-level source code and understood only by the machine. Machine code is transported to the system processor when a specific task, application or program executes even the smallest process. Machine code is also known as machine language (ML).

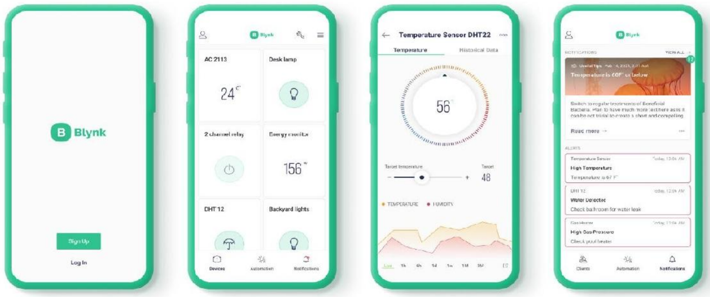
BLYNK FRAMEWORK

Blynk is an IoT platform for iOS or Android smartphones that is used to control Arduino, Raspberry Pi and NodeMCU via the Internet. This application is used to create a graphical interface or human machine interface (HMI) by compiling and providing the appropriate address on the available widgets.

Blynk was designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things.

There are three major components in the platform :

- Blynk App: – It allows you to create amazing interfaces for your projects using various widgets which are provided.
- Blynk Server: – It is responsible for all the communications between the smartphone and hardware. You can use the Blynk Cloud or run your private Blynk server locally. It's open-source, could easily handle thousands of devices and can even be launched on a Raspberry Pi.
- Blynk Libraries: – It enables communication, for all the popular hardware platforms, with the server and process all the incoming and outcoming commands.



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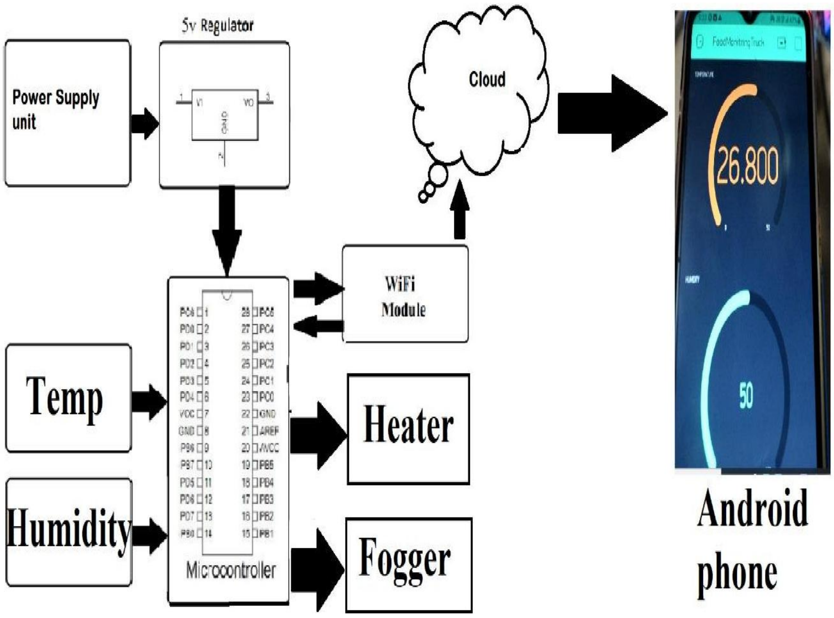
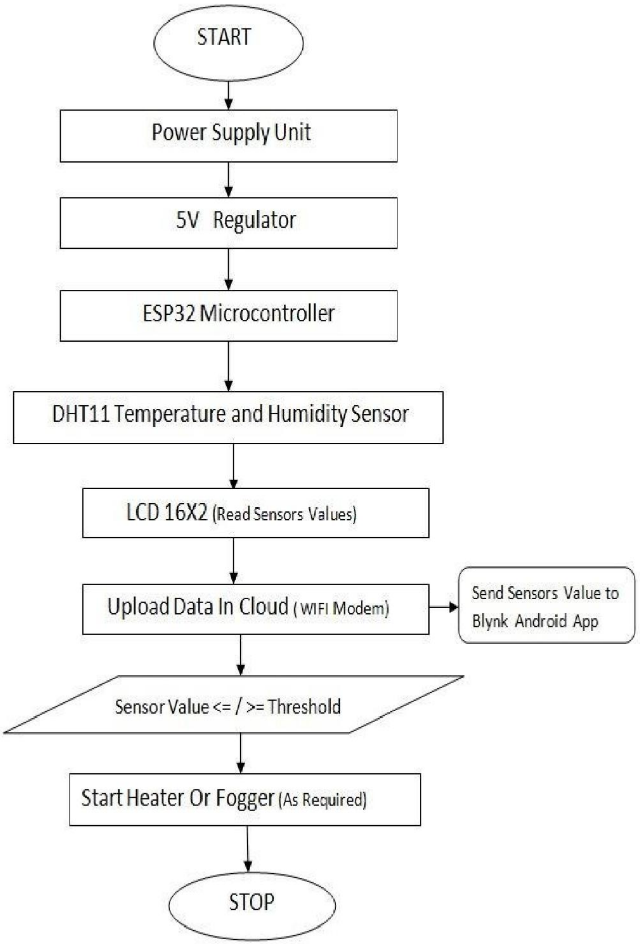
Block Diagram



Flow of the project



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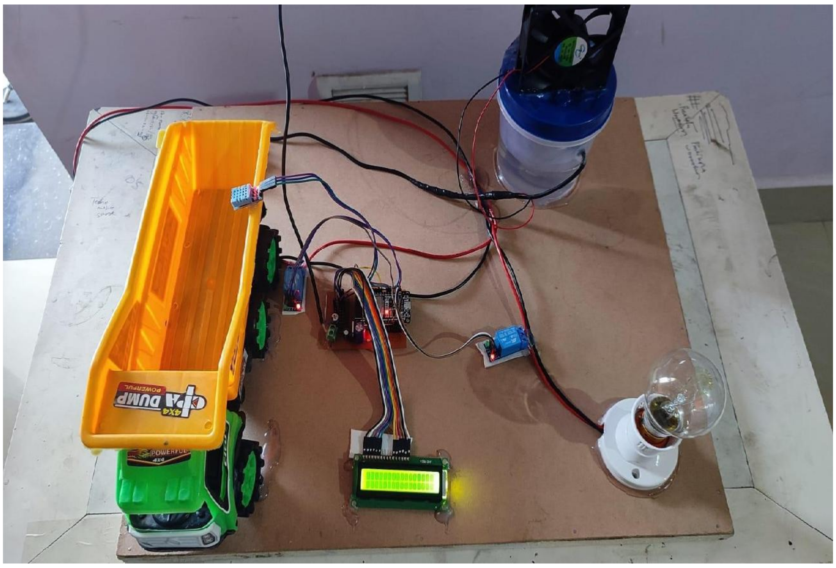
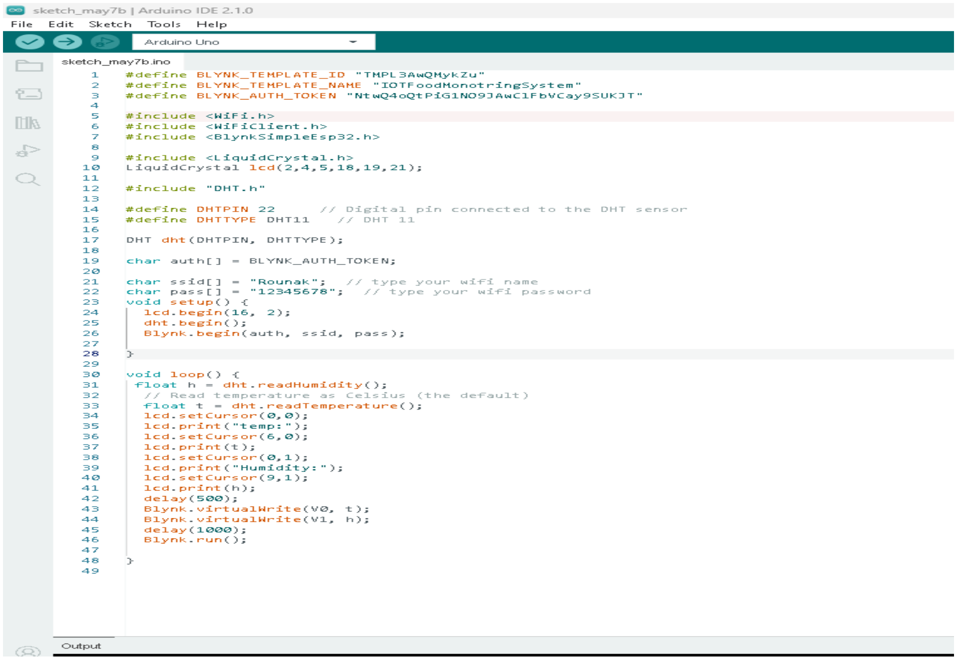
IV. OUTPUT



Arduino IDE code




```
#define BLYNK_TEMPLATE_ID "TMPL3AwQMykZu"
#define BLYNK_TEMPLATE_NAME "IOTFoodMonotringSystem"
#define BLYNK_AUTH_TOKEN "NtwQ4oQtPiG1NO9JAwC1FbVCay9SUKJT"

#include <WiFi.h>
#include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>

#include <LiquidCrystal.h>
LiquidCrystal lcd(2,4,5,18,19,21);

#include "DHT.h"

#define DHTPIN 22      // Digital pin connected to the DHT sensor
#define DHTTYPE DHT11   // DHT 11

DHT dht(DHTPIN, DHTTYPE);

char auth[] = BLYNK_AUTH_TOKEN;

char ssid[] = "Rounak";  // type your wifi name
char pass[] = "12345678";  // type your wifi password
void setup() {
  lcd.begin(16, 2);
  dht.begin();
  Blynk.begin(auth, ssid, pass);

}

void loop() {
 float h = dht.readHumidity();
  // Read temperature as Celsius (the default)
  float t = dht.readTemperature();
  lcd.setCursor(0,0);
  lcd.print("temp:");
  lcd.setCursor(6,0);
  lcd.print(t);
  lcd.setCursor(0,1);
  lcd.print("Humidity:");
  lcd.setCursor(9,1);
  lcd.print(h);
  delay(500);
  Blynk.virtualWrite(V0, t);
  Blynk.virtualWrite(V1, h);
  delay(1000);
  Blynk.run();

}
```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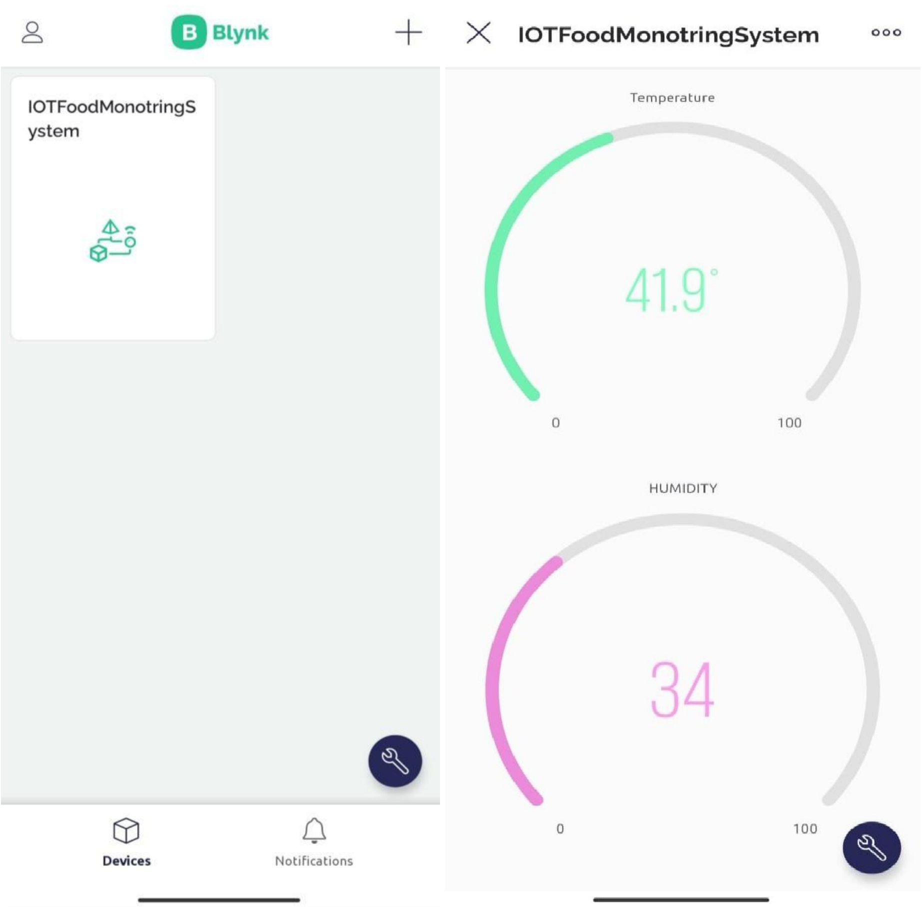
Atmospheric Factor chart

COMMODITY	STORAGE TEMPERATURE (°C)	RELATIVE HUMIDITY (%)	SHELF LIFE
Asparagus	0-2	95	2-3 weeks
Beans (green)	5-7	90-95	7-10 days
Carrot	0	90-95	2-5 months
Cauliflowers	0	90-95	2-4 weeks
Cucumbers	7-10	90-95	10-14 days
Cabbage	0	90-95	3-6 weeks
Pepper	7-10	90-95	2-3 weeks
Couregettes,	0-10	90	5-14 days
Eggplants, Brinjals	7-10	90	1 week
Melons	0-4.4	85-90	5-14days
Okra	7-10	90-95	7-10 days
Onion (dry)	0	65-70	1-8 months
Potatoes (white)	5-10	93	2-5 months
Potatoes (sweet)	12-16	85-90	4-6 months
Tomatoes (ripe)	7-10	85-90	4-7 days
Tomatoes (green)	12-20	85-90	1-3 weeks
Watermelons	4.4-10	90	2-3 weeks
Apples	1-4.4	85-90	3-8 months
Avocados	4.4-12.5	85-90	2-4 weeks
Mangoes	12	85-90	2-3 weeks
Pineapples	7-12.5	85-90	2-4 weeks
Pawpaw	7.0	85-90	1-3 weeks
Carnations	0-2	90-95	3-4 weeks

Blynk Application



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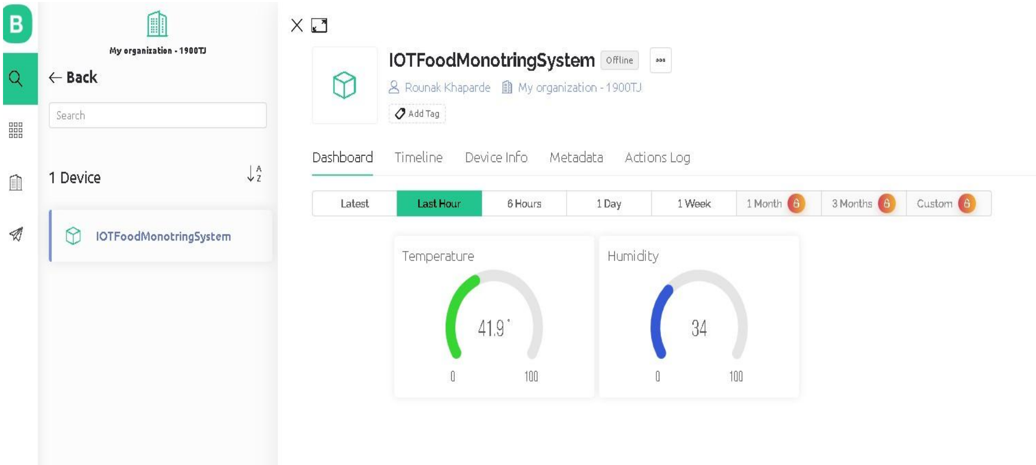
Blynk Webpage



Advantages

- Easy to monitor and control
- Real time data can be monitor
- Easy to install like GPS system
- Multiple users can access data at same time

Applications

- It can used in medicinal transportation trucks
- It can be used in chemical transport system where temp and other environmental factors affect the quality of product.

V. CONCLUSION

The proposed food monitoring system using IoT has a wide range of applications in food processing industry. This addresses the critical issues like food waste, food contamination etc. The threshold value of the device is maintained according to the food sample as each food has its own different threshold value. The array of gas sensors helps in reducing the chances of inaccurate readings. The device can be customized and can be used for different other applications. This project uses many low-cost sensors which will reduce the cost and improves the efficiency

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Annexure: Coding

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#define BLYNK_TEMPLATE_NAME "IOTFoodMonotringSystem"
#define BLYNK_AUTH_TOKEN "NtwQ4oQtPiG1NO9JAwClFbVCay9SUKJT"

#include <WiFi.h> #include <WiFiClient.h>
#include <BlynkSimpleEsp32.h>

#include <LiquidCrystal.h> LiquidCrystal lcd(2,4,5,18,19,21);
#include "DHT.h"
#define DHTPIN 22          // Digital pin connected to the DHT sensor #define DHTTYPE DHT11 // DHT 11
DHT dht(DHTPIN, DHTTYPE);
char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = "Rounak"; // type your wifi name
char pass[] = "12345678"; // type your wifi password
void setup()
{
lcd.begin(16, 2);
dht.begin(); Blynk.begin(auth, ssid, pass);
}
void loop()
{
float h = dht.readHumidity();
// Read temperature as Celsius (the default) float t = dht.readTemperature(); lcd.setCursor(0,0);
lcd.print("temp:"); lcd.setCursor(6,0); lcd.print(t); lcd.setCursor(0,1); lcd.print("Humidity:"); lcd.setCursor(9,1);
lcd.print(h); delay(500);
Blynk.virtualWrite(V0, t); Blynk.virtualWrite(V1, h); delay(1000);
Blynk.run();
}
```