PHARMACEUTICAL STORAGE MONITORING SYSTEM

# MINI PROJECT REPORT

***Submitted by***

**HARESH M (210701066)**

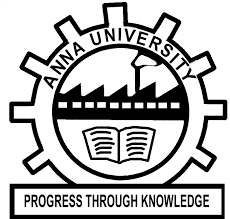
**HAYAGREEVAN V (210701080)**

**In partial fulfillment for the award of the degree**

**BACHELOR OF ENGINEERING**

***in***

**COMPUTER SCIENCE AND ENGINEERING**

**RAJALAKSHMI ENGINEERING COLLEGE**

**ANNA UNIVERSITY: CHENNAI 600 025**

**MAY 2024**

# BONAFIDE CERTIFICATE

Certified that this project **“PHARMACEUTICAL STORAGE**

**MONITORING SYSTEM**” is the bonafide work of “**HARESH M (210701066) and HAYAGREEVAN V (210701080)”** who carried out the project work under my supervision.

|  |
| --- |
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Submitted for the **ANNA UNIVERSITY** practical examination Mini-Project work viva voice held on \_

**INTERNAL EXAMINER EXTERNAL EXAMINER**

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**HARESH M (210701066),**

**HAYAGREEVAN V (210701080)**

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# LIST OF ABBREVIATION

|  |  |
| --- | --- |
| **ABBREVIATION** | **ACRONYM** |
| **IOT** | Internet of Things |
| **HTTP** | HyperText Transfer Protocol |
| **TEMP** | Temperature |
| **DHT** | Digital Humidity and Temperature |
| **SQL** | Structured Query Language |

# ABSTRACT

This project explores the significance of effective storage monitoring in the pharmaceutical industry and investigates the transformative potential of IoT technology in addressing storage-related challenges. The integration of IoT technology into storage monitoring systems enables real-time data collection and intervention, facilitating improved product quality assurance, enhanced supply chain visibility, and streamlined regulatory compliance. This project encompasses the warehouses / dispensaries which monitor the environment conditions like temperature, humidity and light intensity using IoT devices kept at specified locations. This smart device orchestra is controlled by a microcontroller which sends out required data to the management system. When there is a deviation from normal conditions, the system is expected to notify the change so that the data is interpreted by the concerned authorities to enable them to take quick actions to preserve the medicines. It provides effectiveness in maintaining optimal storage conditions and preventing product spoilage. Further research and collaboration can maximize the benefits of IoT-enabled storage monitoring systems in the pharmaceutical industry.

# CHAPTER 1

## INTRODUCTION

## 1.1 INTRODUCTION

In the dynamic landscape of the pharmaceutical industry, ensuring the integrity and efficacy of pharmaceutical products throughout their lifecycle is paramount. Deviations in factors like temperature, humidity, and light exposure can significantly impact product quality and safety. The integration of advanced technologies becomes imperative to meet the rigorous standards and regulatory requirements governing pharmaceutical storage.

The advent of Internet of Things (IoT) technology has heralded a new era in storage monitoring systems, offering real-time insights and actionable intelligence to pharmaceutical stakeholders. By leveraging IoT-enabled sensors and connectivity, stakeholders can proactively monitor storage conditions, detect deviations, and initiate timely interventions to mitigate risks. This enhances product quality assurance and regulatory compliance.

Through a comprehensive examination of existing literature, industry standards, and case studies, we elucidate the critical role of IoT-enabled storage monitoring systems in maintaining optimal storage conditions and safeguarding product integrity.

## 

## 1.2 SCOPE OF THE WORK

This project can benefit the pharmaceutical industry. For the Pharmaceutical Industry, it will collect real-time data, analyze it for deviations, and trigger alerts if conditions exceed acceptable thresholds. Key components include IOT sensor selection, software development for data analysis, providing real-time dashboard and alerting the management when there is an abnormality.

## 1.3 PROBLEM STATEMENT

Limited research has been conducted on the causes and economic impacts of expired medicine, yet medicine costs comprise a significant proportion of healthcare expenditure.The lack and wastage of essential medicine is still one of the most serious public health issues globally. The proposed solution is a system that monitors temperature, pressure, humidity and exposure to other gas compositions in medical warehouses or dispensaries and intimates the unfavorable condition of the environment and expiration of pharmaceutical products accordingly.

## 

## 1.4 AIM AND OBJECTIVES OF THE PROJECT

This project aims to create a pharmaceutical storage monitoring system with a real-time dashboard web application. Objectives are developing hardware and software for data collection, analysis, monitoring and alerting, as well as designing a user-friendly web interface. Additionally, ensuring compliance with regulations and notifying the administrators when there is a change in environment.

# CHAPTER 2

## SYSTEM SPECIFICATIONS

## 2.1 IOT DEVICES

1. ESP8266-12E NODEMCU with Wi-Fi Module
2. DHT11 Sensor
3. BH1750 Sensor

## 2.2 SYSTEM HARDWARE SPECIFICATIONS

|  |  |
| --- | --- |
| PROCESSOR | Intel i5 11th Gen |
| MEMORY SIZE | 8 GB (Minimum) |
| HDD | 40 GB (Minimum) |

## 2.3 SOFTWARE SPECIFICATIONS

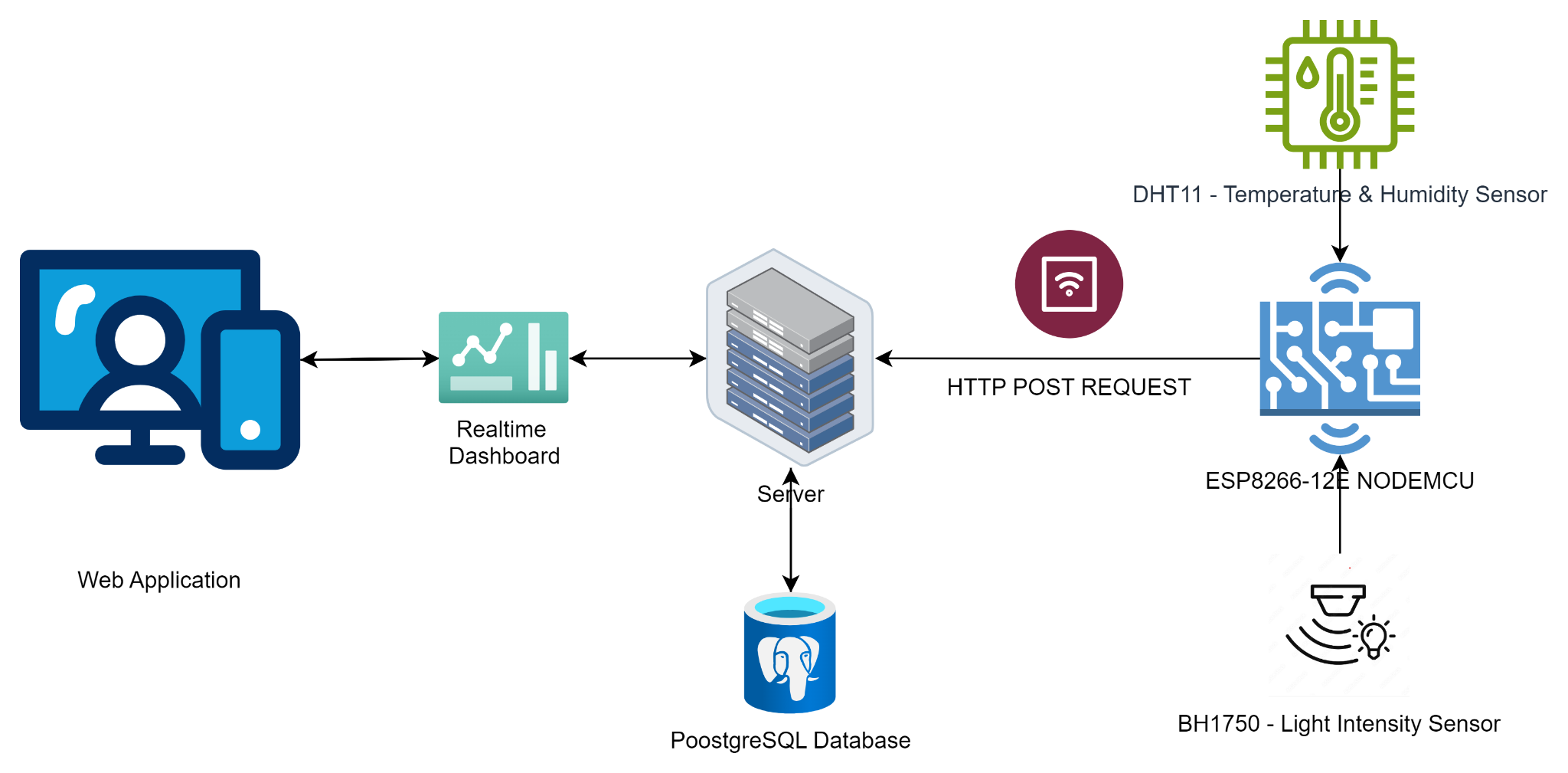
|  |  |
| --- | --- |
| Operating System | Windows 11 |
| Front – End | React JS |
| Back – End | PostgreSQL, Express and Node JS |
| Browser | Google Chrome |
| IDE | Visual Studio Code |

# CHAPTER 3

# SYSTEM DESIGN

## 3.1 ARCHITECTURE DIAGRAM

An architecture diagram is a graphical representation of a set of concepts, that are part of an architecture, including their principles, elements and components

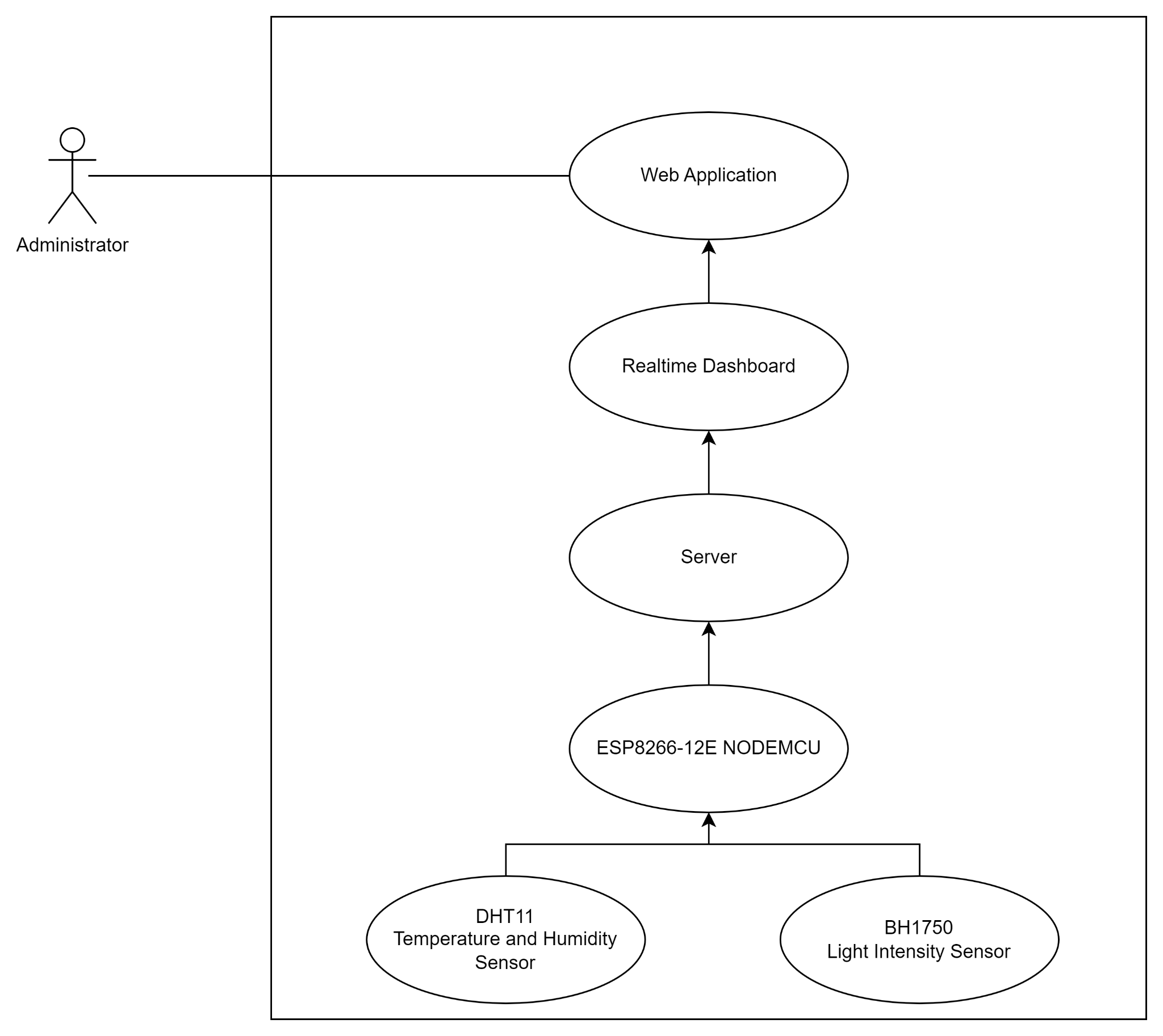


**Figure 3.1** Architecture Diagram

From the above Figure 3.1, the architecture of the system is well understood.

## 3.2 USE CASE DIAGRAM

A use case is a list of actions or event steps typically defining the interactions between a role (known in the Unified Modelling Language as an actor) and a system to achieve a goal. The actor can be a human or other external system.

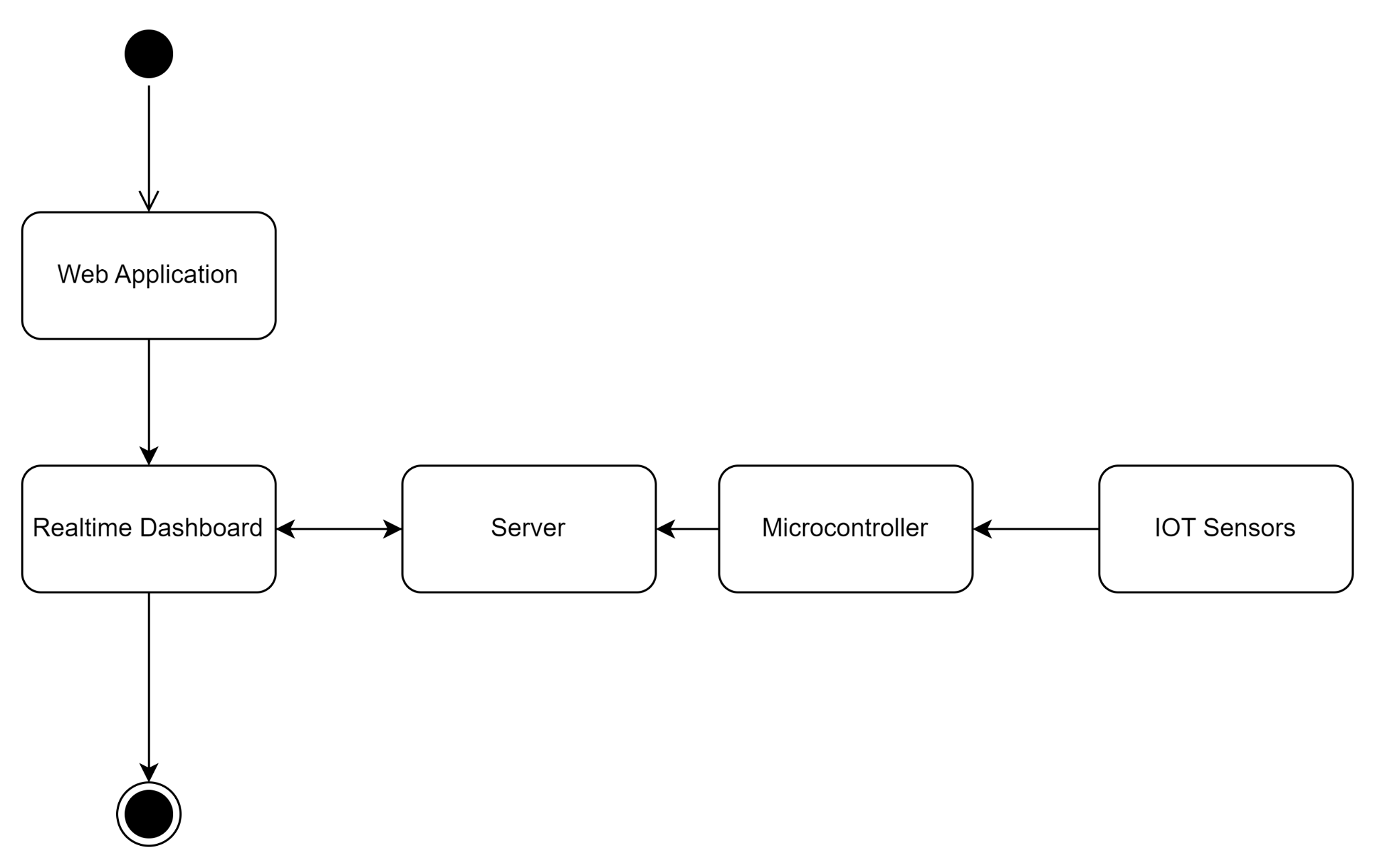


**Figure 3.2** Use case diagram

From the above figure 3.2, the interactions between a role in the system is shown

**3.3 ACTIVITY DIAGRAM**

An activity in Unified Modelling Language (UML) is a major task that must take place in order to fulfill an operation contract. Activities can be represented inactivity diagrams. An activity can represent: The invocation of an operation. A step in a business process.

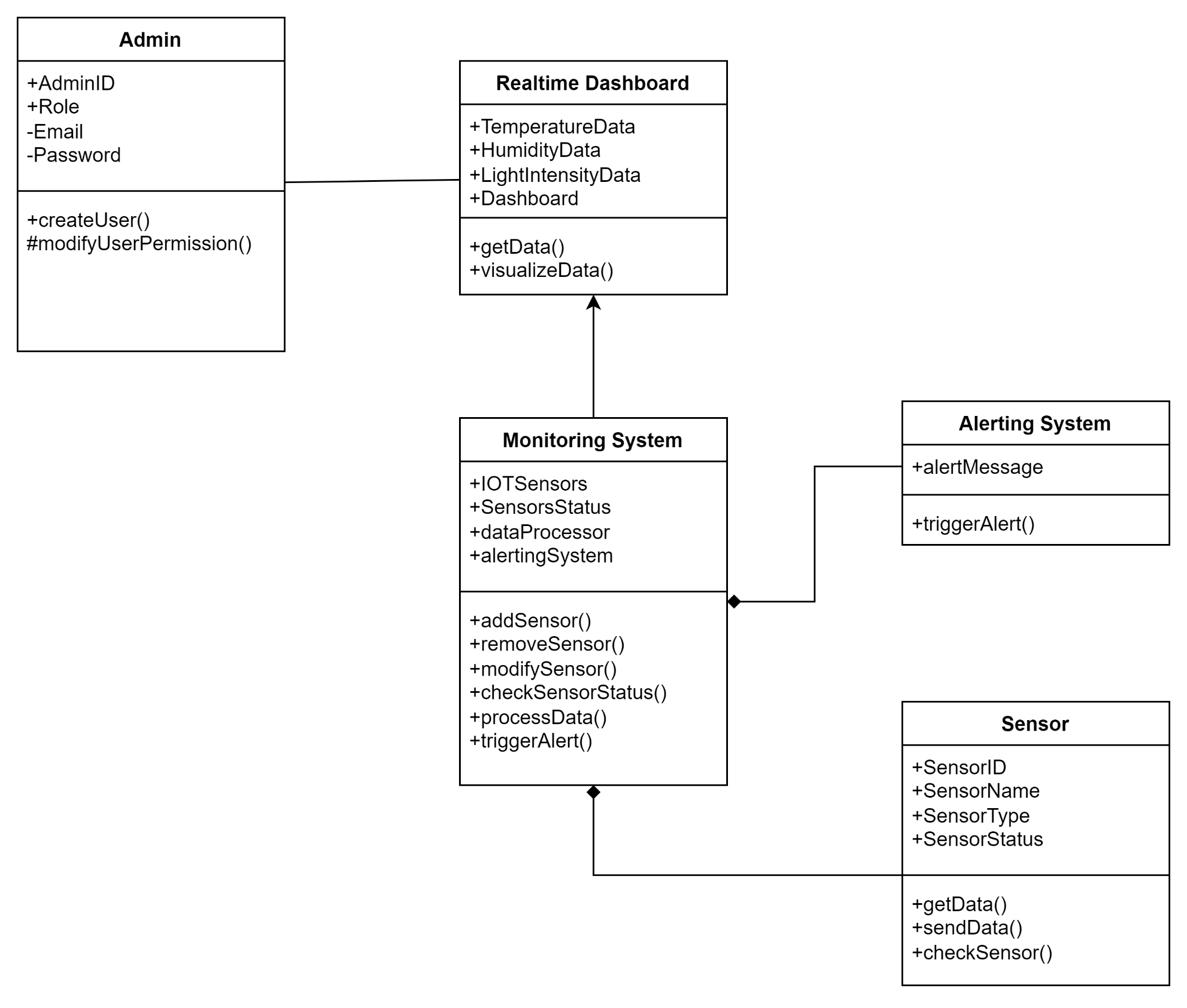


**Figure 3.3** Activity Diagram

From the above figure 3.3, the activities of the system are shown

## 3.4 CLASS DIAGRAM

A class diagram is an illustration of the relationships and source code dependencies among classes in the Unified Modelling Language (UML). In this context, a class defines the methods and variables in an object, which is a specific entity in a program or the unit of code representing that entity.

Online Food Ordering System - Class Diagram

**Figure 3.4** Class Diagram

The above Figure 3.4 is the class diagram for the system.

# CHAPTER 4

# MODULE DESCRIPTION

## 4.1 HARDWARE MODULE:

This module comprises temperature, humidity, and light intensity sensors along with the microcontroller (ESP8266-12E) for data acquisition. The sensors are responsible for continuously monitoring the environmental conditions in the pharmaceutical storage facilities.

## 4.2 DATA COLLECTION AND PROCESSING MODULE:

Responsible for interfacing with the hardware module to collect real-time data from the sensors and storing the data into the database. Utilizes http communication protocols to ensure accurate and reliable data transmission. Implements algorithms to analyze the data and identify deviations from predefined thresholds.

## 4.3 ALERTING MODULE:

Monitors processed sensor data for any deviations from acceptable ranges. Triggers alerts (e.g., email, push notifications) to notify administrator when deviations are detected, ensuring timely intervention to prevent damage to pharmaceutical products.

## 4.4 WEB APPLICATION MODULE:

Develops a user-friendly web interface with a real-time dashboard for visualizing sensor data. Provides stakeholders with access to real-time monitoring of storage conditions, enabling remote management and decision-making.

## 4.5 INTEGRATION MODULE:

Integrates the data processing and alerting functionalities with the web application to ensure seamless communication and data display. Enables synchronization between the monitoring system and the dashboard for immediate updates.

# CHAPTER 5

**TABLE**

## 5.1 MEDICINE TABLE

|  |  |  |
| --- | --- | --- |
| **S.NO** | **ATTRIBUTE** | **TYPE** |
| 1 | MED\_ID | NUMBER(5) |
| 2 | MED\_NAME | VARCHAR(45) |
| 3 | MANUFACTURER | VARCHAR(45) |
| 4 | PREF\_MIN\_TEMP | NUMBER(5,2) |
| 5 | PREF\_MIN\_HUM | NUMBER(5,2) |
| 6 | PREF\_MIN\_LIGHT | NUMBER(7,2) |
| 7 | PREF\_MAX\_TEMP | NUMBER(5,2) |
| 8 | PREF\_MAX\_HUM | NUMBER(5,2) |
| 9 | PREF\_MAX\_LIGHT | NUMBER(7,2) |

## 5.2 STORAGE TABLE

|  |  |  |
| --- | --- | --- |
| **S.NO** | **ATTRIBUTE** | **TYPE** |
| 1. | STORAGE\_ID | NUMBER(5) |
| 2. | MED\_ID | NUMBER(5) |
| 3. | MFD | DATE |
| 4. | EXPIRY\_DATE | DATE |

## 5.3 HISTORY TABLE

|  |  |  |
| --- | --- | --- |
| **S.NO** | **ATTRIBUTE** | **TYPE** |
| 1. | HISTORY\_ID | NUMBER(5) |
| 2. | STORAGE\_ID | INTEGER |
| 3. | TIME | TIMESTAMP WITHOUT TIMEZONE |
| 4. | TEMP | NUMBER(5,2) |
| 5. | LUX | NUMBER(7,2) |
| 6. | HUMIDITY | NUMBER(5,2) |

## 5.4 CURRENT DATA TABLE

|  |  |  |
| --- | --- | --- |
| **S.NO** | **ATTRIBUTE** | **TYPE** |
| 1. | TEMP\_IN\_C | NUMBER(5,2) |
| 2. | TEMP\_IN\_F | NUMBER(5,2) |
| 3. | LIGHT | NUMBER(7,2) |
| 4. | HUMIDITY | NUMBER(5,2) |

# CHAPTER 6

# SAMPLE CODING

**ESP8266-12E NODEMCU Program**

#include <ESP8266WiFi.h>

#include <ESP8266HTTPClient.h>

#include "DHT.h"

#include <BH1750.h>

#include <Wire.h>

#define DHTPIN 2

#define DHTTYPE 11

const char\* ssid = "FTTH\_Hex";

const char\* password = "03031204";

String deviceID = "Hex";

DHT dht(DHTPIN, DHTTYPE);

BH1750 lightMeter;

void setup() {

Serial.begin(9600);

Serial.println();

dht.begin();

Wire.begin();

lightMeter.begin();

Serial.println(F("BH1750 Test begin"));

Serial.print("Connecting to ");

Serial.println(ssid);

WiFi.begin(ssid, password);

while (WiFi.status() != WL\_CONNECTED) {

delay(500);

Serial.print(".");

}

Serial.println("");

Serial.println("WiFi connected");

Serial.println("IP address: ");

Serial.println(WiFi.localIP());

}

void loop() {

delay(2000);

float h = dht.readHumidity();

float t = dht.readTemperature();

float f = dht.readTemperature(true);

if (isnan(h) || isnan(t) || isnan(f)) {

Serial.println(F("Failed to read from DHT sensor!"));

}

float hif = dht.computeHeatIndex(f, h);

float hic = dht.computeHeatIndex(t, h, false);

Serial.print(F("Humidity: "));

Serial.print(h);

Serial.print(F("% Temperature: "));

Serial.print(t);

Serial.print(F("°C "));

Serial.print(f);

Serial.print(F("°F Heat index: "));

Serial.print(hic);

Serial.print(F("°C "));

Serial.print(hif);

Serial.println(F("°F"));

float lux = lightMeter.readLightLevel();

Serial.print("Light: ");

Serial.print(lux);

Serial.println(" lx");

delay(1000);

HTTPClient http;

String URL = "http://192.168.1.6:3001";

WiFiClient client;

http.begin(client, URL);

http.addHeader("Content-Type", "application/x-www-form-urlencoded");

String postData = "StorageID=1&TemperatureInC="+String(t)+"&TemperatureInF="+String(f)+"&Humidity="+String(h)+"&Light="+String(lux);

int httpCode = http.POST(postData);

Serial.println(httpCode);

if (httpCode > 0) {

String payload = http.getString();

Serial.println(payload); // Print response

}

http.end();

Serial.println("END");

delay(2000);

}

**Web Application**

# index.js

const express = require("express")

const app = express()

const PORT = 3001

const cors = require('cors');

const morgan = require('morgan');

const bodyParser = require("body-parser");

const corsOptions = require('./config/corsOptions')

const db = require('./config/DBConnect')

const medStorageRoute = require('./routes/med\_storage.route');

const historyRoute = require('./routes/history.route');

app.use(bodyParser.urlencoded({ extended: false }));

app.use(cors(corsOptions));

app.use(express.json());

app.use(morgan('tiny'));

db.connect().then(()=>{

console.log("Postgres is connected");

})

app.get("/getSensorData", async(req, res) => {

res.send(response)

})

let StorageID, TemperatureInC, TemperatureInF, Humidity, Light;

let currentData;

app.post('/',async(req,res)=>{

console.log(req.body);

currentData = req.body;

StorageID = req.body.StorageID;

TemperatureInC = req.body.TemperatureInC;

TemperatureInF = req.body.TemperatureInF;

Humidity = req.body.Humidity;

Light = req.body.Light;

if(TemperatureInC !='nan' && Light>0){

await db.query("INSERT INTO HISTORY(STORAGE\_ID, TEMP, LIGHT, HUMIDITY) VALUES($1,$2,$3,$4)",[StorageID,TemperatureInC,Light,Humidity]);

await db.query("UPDATE CURRENT\_DATA SET TEMP\_IN\_C = $1, TEMP\_IN\_F = $2, LIGHT = $3, HUMIDITY = $4",[TemperatureInC,TemperatureInF,Light,Humidity]);

console.log("Inserted with Light");

}else if(TemperatureInC !='nan'){

await db.query("INSERT INTO HISTORY(STORAGE\_ID, TEMP, HUMIDITY) VALUES($1,$2,$3)",[StorageID,TemperatureInC,Humidity]);

await db.query("UPDATE CURRENT\_DATA SET TEMP\_IN\_C = $1, TEMP\_IN\_F = $2, HUMIDITY = $3",[TemperatureInC,TemperatureInF,Humidity]);

console.log("Inserted without Light");

}

res.status(200).send("POST Request Received");

})

app.get('/currentData',async(req,res)=>{

const result =await db.query("Select \* from current\_data");

res.status(200).send(result.rows[0]);

});

app.use('/meds-storage',medStorageRoute);

app.use('/history',historyRoute);

app.listen(PORT, () => {

console.log("Server is online")

})

# Dashboard.jsx

import \* as React from 'react';

import { styled, createTheme, ThemeProvider } from '@mui/material/styles';

import CssBaseline from '@mui/material/CssBaseline';

import MuiDrawer from '@mui/material/Drawer';

import Box from '@mui/material/Box';

import MuiAppBar from '@mui/material/AppBar';

import Toolbar from '@mui/material/Toolbar';

import List from '@mui/material/List';

import Typography from '@mui/material/Typography';

import Divider from '@mui/material/Divider';

import IconButton from '@mui/material/IconButton';

import Badge from '@mui/material/Badge';

import Container from '@mui/material/Container';

import Grid from '@mui/material/Grid';

import Paper from '@mui/material/Paper';

import Link from '@mui/material/Link';

import MenuIcon from '@mui/icons-material/Menu';

import ChevronLeftIcon from '@mui/icons-material/ChevronLeft';

import NotificationsIcon from '@mui/icons-material/Notifications';

import { mainListItems, secondaryListItems } from './listItems';

import Chart from './Chart';

import Deposits from './Deposits';

import Orders from './Orders';

function Copyright(props) {

return (

<Typography variant="body2" color="text.secondary" align="center" {...props}>

{'Copyright © '}

<Link color="inherit" href="https://mui.com/">

Your Website

</Link>{' '}

{new Date().getFullYear()}

{'.'}

</Typography>

);

}

const drawerWidth = 240;

const AppBar = styled(MuiAppBar, {

shouldForwardProp: (prop) => prop !== 'open',

})(({ theme, open }) => ({

zIndex: theme.zIndex.drawer + 1,

transition: theme.transitions.create(['width', 'margin'], {

easing: theme.transitions.easing.sharp,

duration: theme.transitions.duration.leavingScreen,

}),

...(open && {

marginLeft: drawerWidth,

width: `calc(100% - ${drawerWidth}px)`,

transition: theme.transitions.create(['width', 'margin'], {

easing: theme.transitions.easing.sharp,

duration: theme.transitions.duration.enteringScreen,

}),

}),

}));

const Drawer = styled(MuiDrawer, { shouldForwardProp: (prop) => prop !== 'open' })(

({ theme, open }) => ({

'& .MuiDrawer-paper': {

position: 'relative',

whiteSpace: 'nowrap',

width: drawerWidth,

transition: theme.transitions.create('width', {

easing: theme.transitions.easing.sharp,

duration: theme.transitions.duration.enteringScreen,

}),

boxSizing: 'border-box',

...(!open && {

overflowX: 'hidden',

transition: theme.transitions.create('width', {

easing: theme.transitions.easing.sharp,

duration: theme.transitions.duration.leavingScreen,

}),

width: theme.spacing(7),

[theme.breakpoints.up('sm')]: {

width: theme.spacing(9),

},

}),

},

}),

);

const defaultTheme = createTheme();

export default function Dashboard() {

const [open, setOpen] = React.useState(true);

const toggleDrawer = () => {

setOpen(!open);

};

return (

<ThemeProvider theme={defaultTheme}>

<Box sx={{ display: 'flex' }}>

<CssBaseline />

<AppBar position="absolute" open={open}>

<Toolbar

sx={{

pr: '24px', // keep right padding when drawer closed

}}

>

<IconButton

edge="start"

color="inherit"

aria-label="open drawer"

onClick={toggleDrawer}

sx={{

marginRight: '36px',

...(open && { display: 'none' }),

}}

>

<MenuIcon />

</IconButton>

<Typography

component="h1"

variant="h6"

color="inherit"

noWrap

sx={{ flexGrow: 1 }}

>

Dashboard

</Typography>

<IconButton color="inherit">

<Badge badgeContent={4} color="secondary">

<NotificationsIcon />

</Badge>

</IconButton>

</Toolbar>

</AppBar>

<Drawer variant="permanent" open={open}>

<Toolbar

sx={{

display: 'flex',

alignItems: 'center',

justifyContent: 'flex-end',

px: [1],

}}

>

<IconButton onClick={toggleDrawer}>

<ChevronLeftIcon />

</IconButton>

</Toolbar>

<Divider />

<List component="nav">

{mainListItems}

<Divider sx={{ my: 1 }} />

{secondaryListItems}

</List>

</Drawer>

<Box

component="main"

sx={{

backgroundColor: (theme) =>

theme.palette.mode === 'light'

? theme.palette.grey[100]

: theme.palette.grey[900],

flexGrow: 1,

height: '100vh',

overflow: 'auto',

}}

>

<Toolbar />

<Container maxWidth="lg" sx={{ mt: 4, mb: 4 }}>

<Grid container spacing={3}>

{/\* Chart \*/}

<Grid item xs={12} md={8} lg={9}>

<Paper

sx={{

p: 2,

display: 'flex',

flexDirection: 'column',

height: 240,

}}

>

<Chart />

</Paper>

</Grid>

{/\* Recent Deposits \*/}

<Grid item xs={12} md={4} lg={3}>

<Paper

sx={{

p: 2,

display: 'flex',

flexDirection: 'column',

height: 240,

}}

>

<Deposits />

</Paper>

</Grid>

{/\* Recent Orders \*/}

<Grid item xs={12}>

<Paper sx={{ p: 2, display: 'flex', flexDirection: 'column' }}>

<Orders />

</Paper>

</Grid>

</Grid>

<Copyright sx={{ pt: 4 }} />

</Container>

</Box>

</Box>

</ThemeProvider>

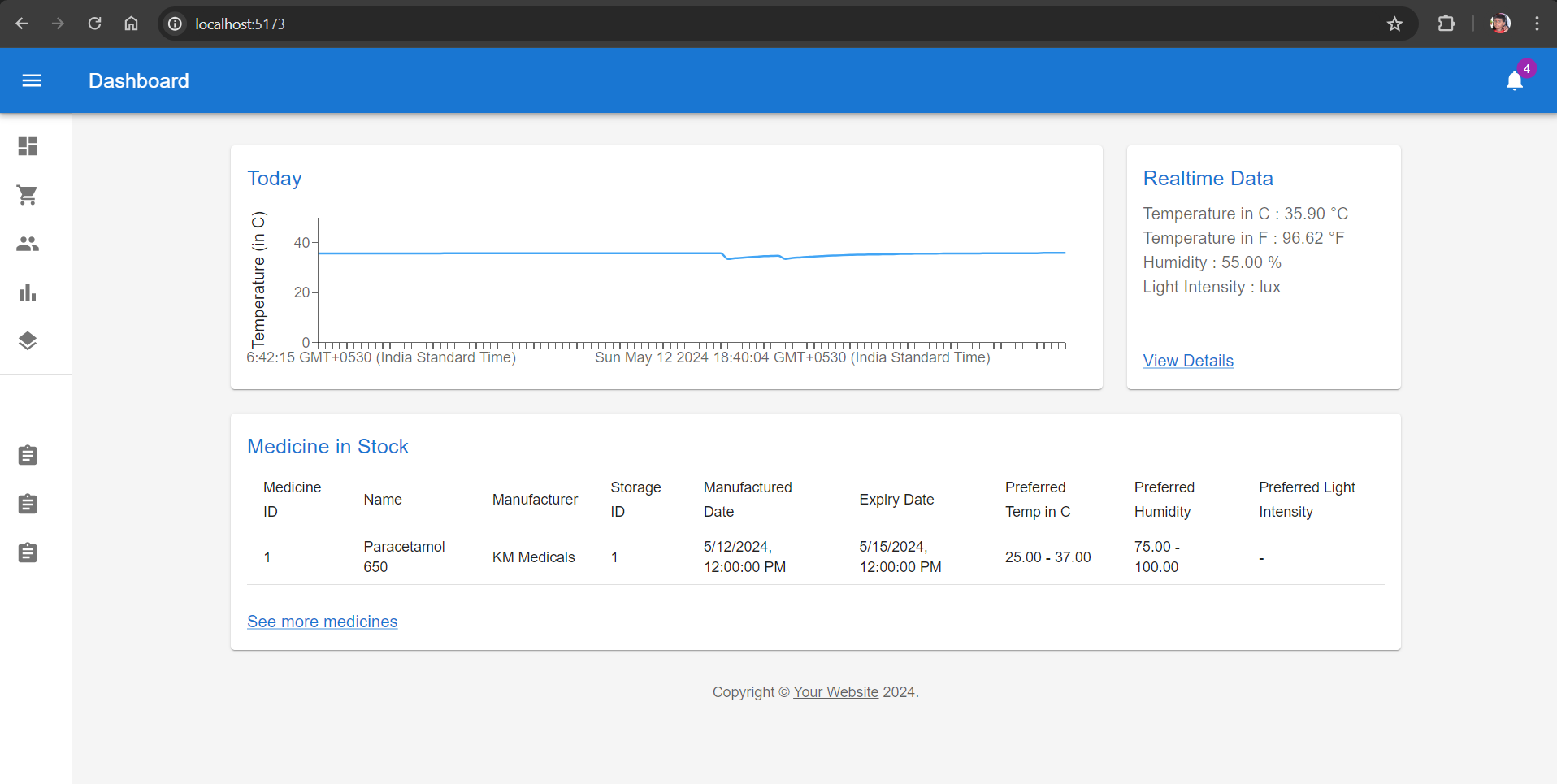
);

}

# CHAPTER 7

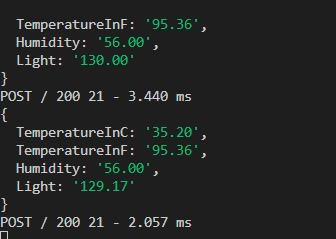
# SCREEN SHOTS

### Dashboard Page



**Figure 7.1** Responsive Dashboard

**2. Data Sent from ESP8266-12E Nodemcu to Server**



**Figure 7.2** Data Received by Server from ESP8266-12E Nodemcu

# CHAPTER 8

## CONCLUSION AND FUTURE ENHANCEMENT

The pharmaceutical storage monitoring system with its real-time dashboard web application stands as a revolutionizing advancement in pharmaceutical storage management, ensuring the integrity and efficacy of stored medications. Through the integration of hardware sensors, data processing algorithms, and a user-friendly interface, the system provides stakeholders with unprecedented insight into storage conditions, enabling swift detection and response to deviations. Further improvement in pharmaceutical storage facilities signifies a paradigm shift in storage management practices, promising enhanced operational efficiency and risk mitigation.

Future enhancements can be directed towards several key areas. Enhanced data analytics techniques can unlock deeper insights into storage condition trends, informing proactive management strategies. Predictive maintenance algorithms can be developed to anticipate equipment failures and ensure uninterrupted monitoring operations. Integration with inventory management systems can streamline product tracking and monitor supply chains. Expanding the web application's capabilities for remote monitoring and control can provide stakeholders with greater flexibility and accessibility. Additionally, the integration of additional IoT devices and sensors, coupled with Artificial Intelligence, can enhance the system's intelligence and adaptability, ensuring compliance with evolving regulatory standards and facilitating seamless adherence to compliance requirements.

# REFERENCES

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