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IOT Based Weather Analysis System Using ESP8266

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Abstract: ***Our proposed system offers a smart internet weather system that makes it possible to report meteorological parameters on the Internet. It allows people to directly check weather statistics online without the need of a weather forecast agency. The system uses temperature, humidity as well as rain sensor to monitor weather conditions and provide live reports of weather statistics. The system continuously monitors temperature using a temperature sensor, humidity using a humidity sensor and also rain. The system constantly transmits this data to the microcontroller, which now processes this data and continues to transmit it to the online web server via a Wi-Fi connection. This data is updated live for viewing on the online server system. The system also allows the user to set alerts for special cases, the system provides alerts to the user if the weather parameters exceed these values. The IOT-based weather analysis and reporting system provides an efficient Online-based weather reporting system for users.***

Keywords: IOT, Weather Monitoring, ESP8266 NodeMCU, Temperature Sensor, Humidity Sensor, Pressure Sensor, Rain Sensor

I. INTRODUCTION

The Internet of Things (IoT) is considered an innovation and a financial wave in the global data industry after the Internet. IoT is a wise system that associates all things with the internet with the end goal of exchanging data and transmitting it through the data sensing gadgets according to agree upon conventions. It accomplishes the purpose of recognizing, finding, tracking, observing, and monitoring things. It is an increase and extension of the Internet-based system, which develops the correspondence of human and human to human and things or things and things.[2] In the IoT worldview, many of the items that encompass us will be associated with systems in one form or another. It is a current correspondence paradigm that envisions the near future, in which the objects of regular daily existence will be equipped with microcontrollers, handsets for computerized correspondence, and stacks of reasonable conventions that will make them ready to talk with each other and with customers, becoming a vital part of the Internet. The idea of IoT, therefore, aims to make the Internet much more immersive and inescapable.

Additionally, by enabling simple access and association with a wide assortment of gadgets, e.g., home appliances, recognition cameras, control sensors, actuators, showcases, vehicles, etc., the IoT will encourage the advancement of various applications which making use of the potentially gigantic sum and assortment of information created by such questions gives new administrations to subjects, organizations and open organizations. Current technological innovations mainly focus on the control and monitoring of different activities.

These are increasingly emerging to meet human necessities. Most of these technologies' focus on effective monitoring and control of different activities. An effective environmental monitoring system is needed to monitor and assess conditions when the prescribed level of parameters (e.g.: noise and radiation levels) is exceeded. When the objects in the environment equipped with different sensors, microcontrollers and various software applications become an environment or terrain of self-protection and self-monitoring, it is also called intelligent environment. In such an environment, when an event occurs, the alarm or LED will alert automatically.

The effects due to environmental changes on animals, plants and human beings can be monitored and controlled by an intelligent environment monitoring system.[1] By using the intelligence embedded in the environment, the environment is interactive with other goals, this is one of the applications targeted by the intelligent environment. Human needs require different types of monitoring systems, these depend on the type of data collected by the detection devices. Event detection and spatial process estimation are the two categories in which applications are classified.

Initially, sensing devices are deployed in the environment to sense parameters (e.g., temperature, humidity, and precipitation, etc.) while data acquisition, computation, and control action (for example, variations in temperature and precipitation levels from specified levels).

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II. METHODOLOGY

In this project, we will measure Humidity, Temperature and Pressure parameters and display them on the ThingSpeak and ThingShow platform, which makes it an IOT based Weather Station where the weather conditions can be efficiently monitored from anywhere using the Internet. The DHT11 module features a humidity and temperature complex unit with a calibrated digital output signal. The DHT11 sensor module is a combined module for sensing humidity and temperature which gives a calibrated digital signal output. DHT11 gives us a very exact value of humidity and temperature and provides us with a high reliability and long-term stability. This sensor measures the absolute pressure of the air surrounding it. The pressure value depends on both the weather and altitude as well. It depends on how you interpret the data, can easily monitor changes in the weather, measure the altitude, or any other tasks that require an accurate pressure reading. In the given figure below, the block diagram of our model is shown.

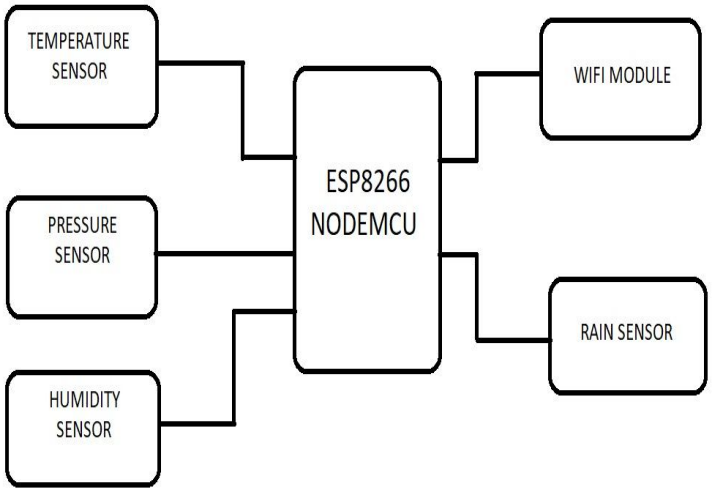


Fig. 1: Block Diagram of Our System

A. Hardware

1) ESP8266 Node MCU

The NodeMCU module is called generic ESP8266 which is responsible for connecting the weather monitoring system to internet. This module has been inserted on a breakout board adapter so that ESP8266 can be interfaced on a breadboard.

2) DHT11 Sensor

DHT11 is a digital sensor responsible for collecting temperature and humidity data from our surroundings. It has three terminals namely:

a) VCC
b) GND
c) Data

VCC connects to 5V supply, GND connects to GND and data pin connects to A0 of Microcontroller.

3) BMP180 Sensor

The BMP180 sensor module is a barometric sensor which is capable of measuring atmospheric data; it can give out data like, atmospheric pressure at ground level, atmospheric pressure at sea level and altitude. We will be only extracting atmospheric pressure data at ground and sea level, but we will be sending only the atmospheric pressure data at ground level to ThingSpeak server, which is the relevant data for your locality.

It has the following pins:

a) SDA – Serial data
b) SCL – Serial clock
c) VCC – 3.3V
d) GND – ground

It is taken care while connecting the supply to this module as it operates on 3.3V DC and 5V will kill the module. It operates on the I2C bus, which is as same as I2C display adapter module.

4) Rain Sensor

This sensor is a plain conducting plate that detects rain and then uses an Op-Amp IC which amplifies the signal and then sends it to the microcontroller. It is built out of LM393 IC, which is a generalized comparator op-amp. It has an onboard potentiometer that canbe used to trim the values. Furthermore, it is very effective and simple.

B. Software

We have used Arduino IDE for the coding purpose and ThingSpeak and ThingShow online analytics platform for the data visualization. In the coding part, we have at first used four libraries ESP8266WiFi, DHT (for DHT11 sensor), SFE_BMP180 (for BMP180), and Wire (for I2C).

After that, we initialize variables and make instances for DHT11, BMP180, Wi-Fi name, Wi-Fi password and some other variables those are being used in the code. Define Pin for DHT11 sensor, we are using GPIO 0 (D3) here. Value of altitude variable depends on our location. We can Google our location's altitude. Alternatively, we can find our location altitude by knowing pressure in our area. The code for getting altitude is given in the example of BMP180 library.

Next, we declare an object of Wi-Fi Server library, so we can access its functions. The argument for the instance formed will be port number where the server is listening. Since 80 is the by-default port for HTTP, we will use this value.

In Void setup() function, we have initialized the baud rate, DHT11 sensor, and BMP180 using .begin() function then connected the module with the Wi-Fi using WiFi.begin(ssid, password) function.

In void loop() function, we got the temperature in Celsius and Fahrenheit and store this data in different variables using dht.read() function. Then we got the pressure using pressure.sealevel(); function, it has two arguments namely sea level pressure and altitude. Pressure will be in millibar(mb). Then, we have printed this data on serial monitor.

III. SYSTEM DESIGN

This project explains about IoT based Live Weather Station Monitoring Using NodeMCU ESP8266. We have interfaced DHT11 Humidity & Temperature Sensor, BMP180 Barometric Pressure Sensor**,** FC37 Rain Sensor, with NodeMCU ESP8266-12E Wifi Module. We have also measured humidity, temperature, Barometric pressure and rainfall and upload the data to a web server and then to the ThingShow application. Once the code is uploaded, we can find the IP address of NodeMCU in the serial monitor. With the same IP, we can go to any web browser and display the data in a beautiful widget format. The project can be used in remote areas or in a freezer where the data is to be monitored. The figure given below, shows the actual circuit model that we have implemented here.

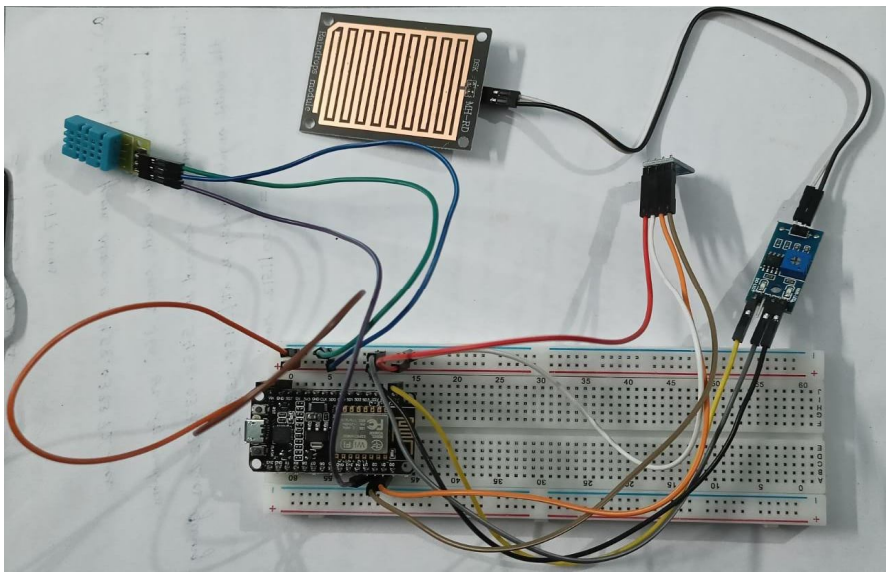


Fig. 2: Actual Circuit of the Model

IV. EXPERIMENTAL RESULTS

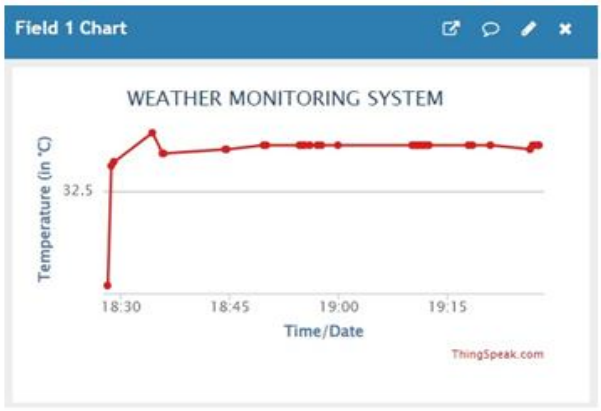


Fig. 3: Temperature Graph

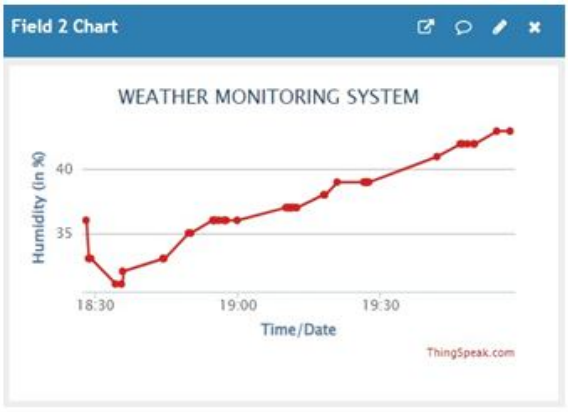


Fig. 4: Humidity Graph

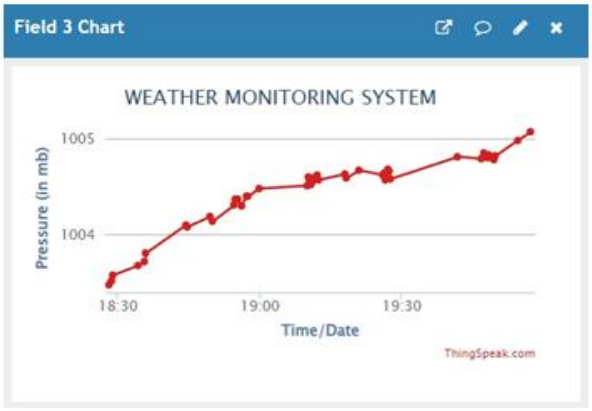


Fig. 5: Pressure Graph

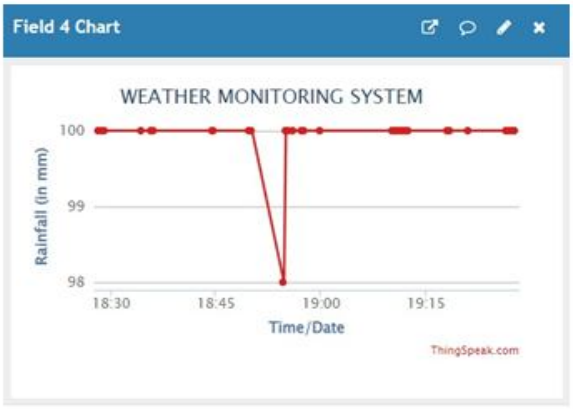
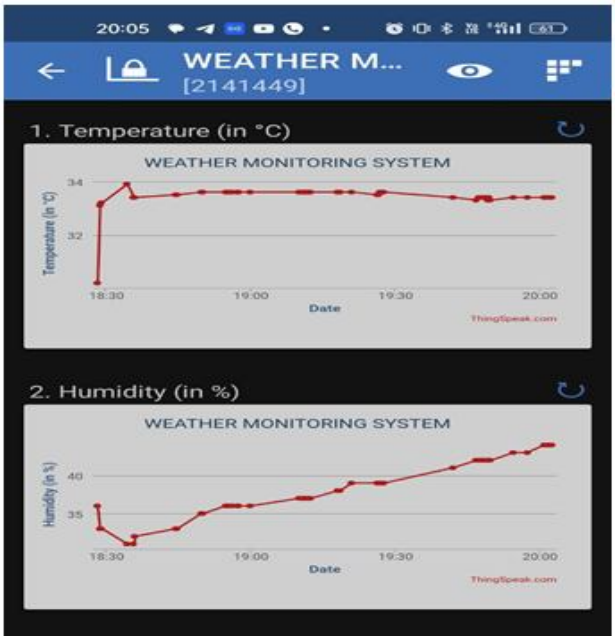


Fig. 6: Rainfall Graph



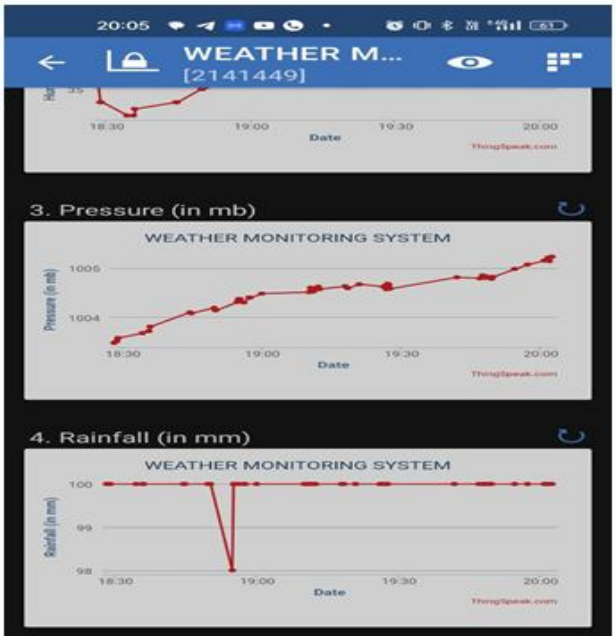


Fig. 7: Temperature and Humidity Graph in ThingShow Application in the Phone(left)
Fig. 8: Pressure and Rainfall Graph in ThingShow Application in the Phone(right)

The figure-3,4,5 and 6 shows the graphs of temperature, humidity, pressure and rainfall respectively that we have obtained in the ThingSpeak dashboard. The last two figures, i.e., figure-7 and 8 shows the same data on the ThingShow application in the phone, making it more compatible and user-friendly. DHT11 module has a humidity and temperature complex unit with a calibrated digital signal output which implies DHT11 sensor module is a combined module which is used for sensing humidity and temperature that gives a calibrated digital signal output. DHT11 gives us a very precised value of humidity and temperature and ensures high reliability and long-term stability. It is a barometric pressure sensor that works with an I2C interface. This sensor measures the absolute pressure of the air surrounding it. The pressure value depends on both the weather and altitude together. It depends on how we interpret the data, can easily monitor changes in the weather, measure the altitude, or any other tasks that require an accurate pressure reading. BMP 180 Pressure Sensor. Rain sensors can detect water beyond what a humidity sensor can detect. Rain sensor basically detects the water that completes the circuits on its sensor boards printed leads. The sensor board generally acts as a variable resistor that will alter directly from a value of 100k ohms when it is wet to a value of 2M ohms when it is dry. In short, the more wet the board, the more current that will be conducted.

V. DISCUSSION

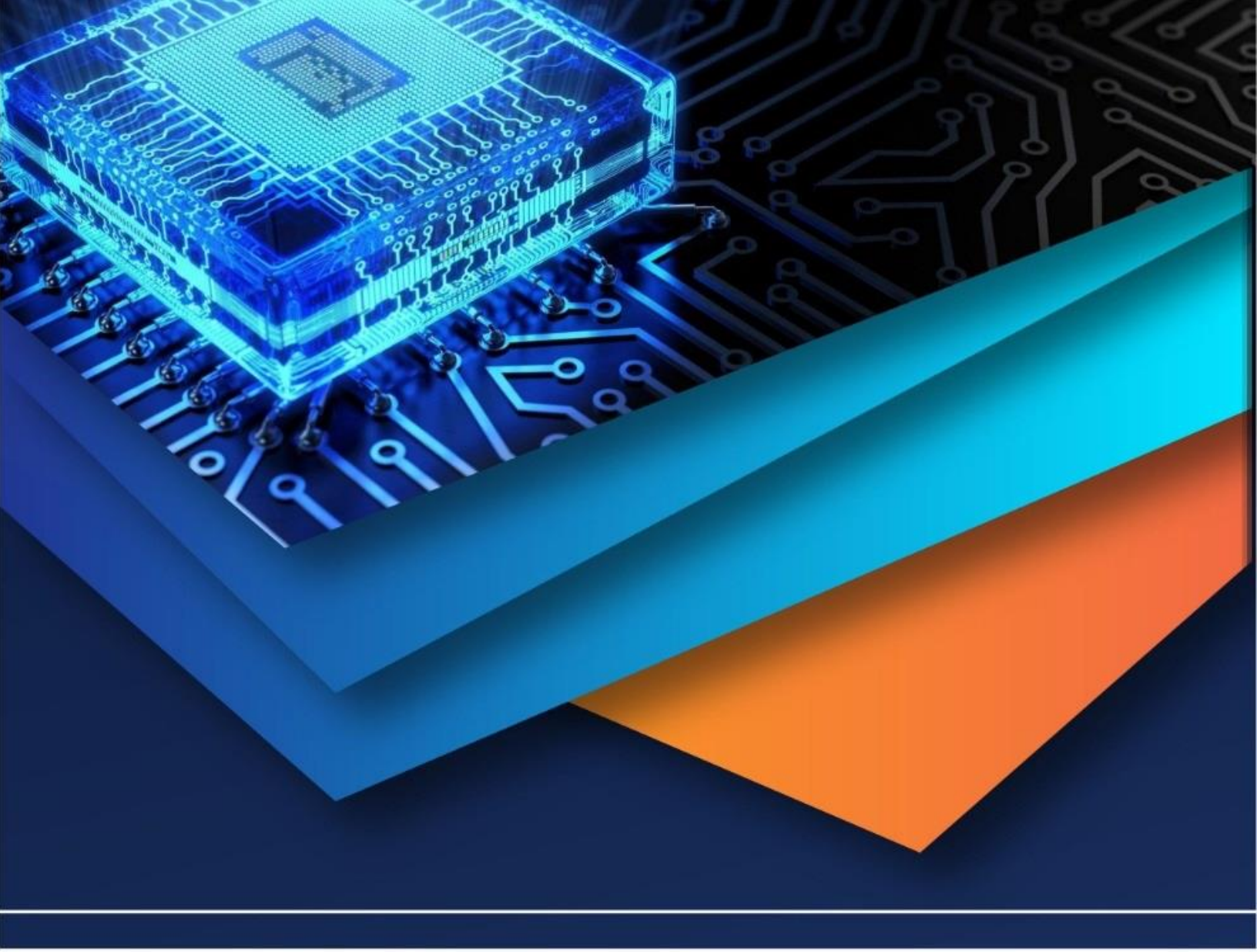
By keeping the weather station (hardware model) in the environment for monitoring enables self-protection (i.e., smart environment) to the environment. To implement this, we have used the sensor devices in the environment for collecting the data and analysis. By using sensor devices in the environment, we have brought the environment into real life. Then the collected data and analysis result is available to the user through the Wi-Fi. The smart way to monitor environment in an efficient manner. It also sends the sensor parameter to the cloud. This data will be helpful for future analysis and it can be easily shared to others also. This model can be enhanced to monitor the developing cities and industrial zones for pollution monitoring. To protect public health from pollution, this model provides an efficient and low-cost solution for continuous monitoring of environment.

VI. FUTURE SCOPE

According to the observations and analysis of the results that we have procured from our project, further modifications can be implemented in the hardware as well as the software part if deemed necessary. The scalability of our model can be increased by integrating more different kinds of sensors in the future. The concept of self-alarming can also be achieved, which will make the model more dynamic and robust.

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