Drone Data Monitoring System using IOT through Android App

Keyur Jagda[1], Akshay Gawde[1], Rhythm Pathak[1], Prajakta Pawar[2]
Student Department of Electronics and Telecommunication Engineering, Atharva College of Engineering, Malad(W),Mumbai, India

Abstract: The paper introduces a full framework of a Drone Data Monitoring System that uses IoT technology to efficiently monitor environments. This way, the system functions steadily via an Android application that would allow users to control unmanned aerial vehicles, collect data, and determine results in real time. Advanced sensors from the system promote capture and monitoring of environmental factors like air quality, water levels, and changes in land use.
This proposed system shall work based on the following elements:

Drone Technology: Drones come equipped with high-definition cameras and environmental sensors that capture data from various landscapes-from the city to the countryside.

IoT Integration: The collected data is transmitted through IoT protocols to the central database for processing. This provides remote accessibility and real-time updates on the environmental conditions.

Mobile App: The UI consists of a user-friendly Android app that is user-friendly for people to watch the drones fly, see data analysis, and receive alerts on changes or anomalies with the environment.

These various data processing algorithms use machine learning methods to analyze the incoming data in regard to identifying trends and predictive information based on potential issues like pollution and degradation in habits. This system would help overcome some of the major challenges of environmental monitoring in that it offers timely data to support decision-making processes concerning urban planning and ecological conservation. In addition, it enhances public awareness through the user's participation with real-time environmental data on their mobile devices.

Given this, the Drone Data Monitoring System using IoT via an Android App consequently sums up imposing technological advancement and practical application to the promotion of sustainable development. Future work will therefore focus on an expansion of sensor capability along with integration of additional analytical tools towards functionality and user experience of the system.

Keywords: Drone, Data Monitoring System, IoT, Android App

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I. INTRODUCTION

The integration of Drone into diverse divisions has revolutionized information collection and observing, advertising phenomenal capabilities for real-time examination and decision-making. As UAVs proceed to advance, they are progressively connected in areas such as farming, natural observing, development, and framework assessment. This innovation empowers clients to accumulate huge volumes of high-resolution information proficiently and securely, altogether improving conventional checking strategies.

This paper thus comes up with a proposal that seeks to harness the power of drones in combination with Internet of

Things (IoT) technology to enable comprehensive monitoring of the environmental sector. The system captures critical information from the environment, including air quality, temperature changes, and land use by attaching advanced sensors on the drones. Collected data is transmitted for processing and analysis on a centralized platform and to a dedicated Android application that would provide users with real-time insights into their surroundings.

Drone empower simpler, more secure get to to regions something else blocked off and difficult to reach. On the other hand, utilizing Drone in information collection increments security, as most work force will be kept from

entering perilous situations. Additionally, IoT empowers real-time observing, and information is available on the fly for decision-making. The Android app acts as a simple interface that permits clients to see information patterns, be updated on noteworthy changes within the environment, and oversee drone operations.

Basically, the suggested system is the latest in environmental monitoring systems, integrating advanced drone technology with abilities of the IoT. As such, not only do data collection processes become faster and streamlined, but through more accessible and actionable information, it also creates greater engagement with environmental issues. As the request for effective observing arrangements proceeds to develop, this framework stands balanced to create important commitments to feasible improvement as well as asset administration endeavours.

II. OBJECTIVES

1. To design an IoT-enabled drone system capable of monitoring air quality, temperature, humidity, and distance.

2. Integration of various environmental sensor permit with Wemos D1 Mini sensing readings.

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3. Transmit the collected data to ThingSpeak cloud for storage and analysis.

4. To create real-time monitoring and data visualization in an Android App, using Kodular.

5. Providing accessible environmental data via a user-friendly interface.

6. Deployment of system within drones for remote and hazardous area monitoringystems in drones for remote and hazardous area surveillance.

7. Smart cities, agriculture, and disaster management can use real-time data for impactful decision- making.

8. Using the continuous monitoring of conditions in real-time, promote sustainability through awareness of environmental conditions.

III. PROBLEM STATEMENT

The requirement of continuous and real-time monitoring of the environment grows apace in regards to increasing pollution levels, climate change, and the requirement of better air quality monitoring in urban and rural areas. Practically, traditional methods of data collection are limited through their accessibility, cost, and time restraints in monitoring remote or hazardous areas.

The drone information observing framework utilizing IoT overcomes this issue with the integration of different natural sensors on a drone stage. It permits for the real-time checking of discuss quality, temperature, and stickiness, as well as the location of impediments inside an region where conventional observing may be troublesome or illogical. Given IoT and cloud-based administrations, the information will be remotely accessible, empowering speedy understanding and incite decision-making.

IV. METHODOLOGY

To develop a drone-based IoT monitoring system, it incorporates Wemos D1 Mini and several sensors. It integrates an MQ135 sensor for air quality monitoring, DHT11 for temperature and humidity measurement, and the ToF V53L0X sensor for distance measurement. The integrated Wemos D1 Mini acts as the central processing unit for collecting and transmitting data.

The architecture of the system is segmented into several layers. These include the sensing layer, the communication layer, and the application layer. The sensing layer includes the MQ135, DHT11, and the ToF

V53L0X, which collect real-time environmental data. The collected data at the communication layer is carried out using Wi-Fi capability of the Wemos D1 Mini to the ThingSpeak cloud platform. That data is stored, and analysis or visualization can be done in real-time.

This layer involves the Android app developed using Kodular. The app connects to the ThingSpeak API such that it is possible to monitor sensor data remotely through smartphones. The app includes a user-friendly interface provided with real-time graphs and alert messages based on the data received from the cloud.

A rechargeable battery connected to the Wemos D1 Mini provides the system's power so that the system works during drone operation and beyond. The drone is also equipped with a GPS module for location tracking; this can be used to tag the environmental data with geographical coordinates.

Its IoT system is scalable, so it can fit any number of additional sensors: a CO2 sensor, a wind speed sensor, etc. The data collected on it will be exportable if further analysis is needed.

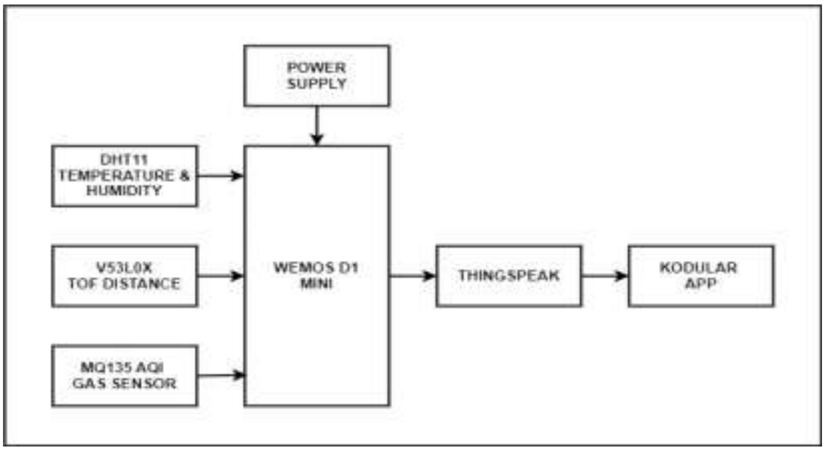


Figure 1: System Architecture (Block Diagram)

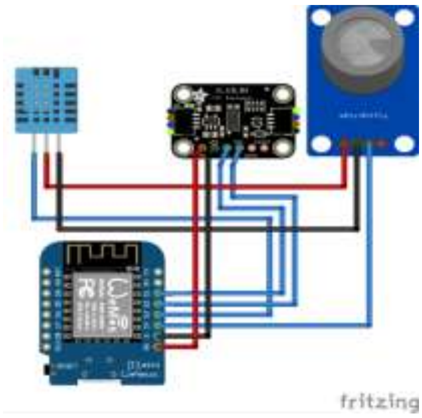


Figure 2: Circuit Diagram

V. WORKING

The system starts by initializing the Wemos D1 Mini and setting up the sensors. The MQ135 sensor measures levels of various gases in the air, which are then used to calculate the Air Quality Index (AQI). The DHT11 sensor measures the surrounding temperature and humidity, and the ToF V53L0X sensor calculates the distance between the drone and obstacles to avoid collisions while flying.

Once the sensors collect that data, it is processed by the Wemos D1 Mini and sent over Wi-Fi to the cloud platform known as ThingSpeak. The data is stored in ThingSpeak, processed, and analytics as well as real-time visualizations are built for each sensor. Users can login into the ThingSpeak platform or view the data directly through the custom Android app built using Kodular.

The Android application, through APIs provided, retrieves data from ThingSpeak and shows graphically. It possesses a dashboard where users can view the position of the drone equipped with a GPS module and the AQI, temperature, and humidity. Also, in case sensor readings cross a specified threshold, alert notifications are sent, and hence the application is very useful for instantaneous monitoring in hazardous environments.

IV. HARDWARE USED

1. ESP8266 MICROCONTROLLER

NodeMCU is an open-source IoT platform. It includes firmware which runs on the ESP8266 Wi-Fi SoC from Espressif Systems, and hardware which is based on the ESP-12 module. The term "NodeMCU" by default refers to the firmware rather than the development kits. The firmware uses the Lua scripting language. It is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It takes advantage of many open-source projects, such as lua-cjson and SPIFFS.

2. MQ-135 AQI GAS SENSOR

The MQ-135 is a gas sensor utilized to degree discuss quality through the discovery of gasses counting smelling salts, nitrogen oxides, benzene, smoke, and carbon dioxide. It is touchy to a

wide extend of gasses, and so it finds exceptionally tall applications in air-quality checking frameworks. It works on the guideline that changes resistance due to the concentration of target gasses within the environment.

When used with a microcontroller, like Arduino or ESP32, the MQ-135 provides a real-time AQI value. The sensor's analog output can be processed using equations to approximate AQI by converting these levels of gas concentration into the normal AQI categories (good, moderate, unhealthy, etc.). Calibration and compensation for temperature and humidity are frequently necessary to gain higher accuracy. The MQ-135 is cheap and widely used in IoT-based environmental monitoring projects to track pollution and indoor air quality.

3. VL53L0X SENSOR:

This sensor is a carrier/breakout board for ST's VL53L0X laser-ranging
sensor measuring distance up to 2 m. The VL53L0X makes use of time-of-flight measurements of infrared pulses for ranging, allowing to give accurate results independent of the target's color and surface. Distance measurements can be read through a digital I²C interface. There's a 2.8 V linear regulator and integrated level-shifters, so it can be used over an input voltage range of 2.6 V to 5.5 V. The 0.1" pin spacing also makes it easy to use with standard solderless breadboards and 0.1" perfboards.
Resolution 1 mm Maximum range\t: 200 cm2
Interface: I²CMinimum Operating Voltage: 2.6 V
Operating voltage: 5.5 V Supply current\t: 10 mA3

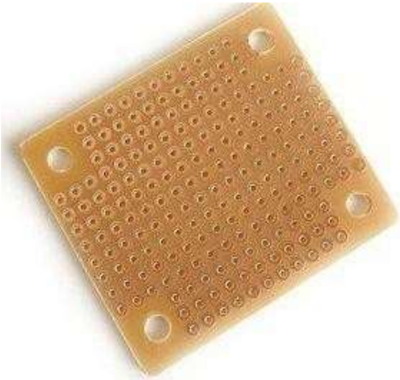
4. DHT11 TEMPERATURE HUMIDITY SENSOR:

The DHT11 is a basic, ultra-low-cost, computerized temperature-hygrometer sensor. It employments a capacitive mugginess sensor and a thermistor to sense encompassing discuss, and spits out a digital flag on the information stick (there's no require for an analog input stick). It isn't that precarious in utilizing it but requires exact timing to seize information, once each two seconds; in this way, your sensor readings are up to two seconds ancient after you are utilizing the Adafruit library. It comes with either a 4.7K or 10K ohm resistor that you simply will need to utilize as a pullup from the information stick to VCC. Operating Voltage: 3.5V to 5.5V

Operating current: 0.3mA (measuring) 60uA (standby) Temperature Range: 0°C to 50°C
Humidity Range: 20% to 90%

Resolution: Temperature and Humidity both are 16-bit Accuracy: ±1°C and ±1%

5. Zero PCB (Perf Board)



Perfboard or Noissue Pcb. A perfboard is a material used to prototype electronic circuits (also called DOT PCB). It is a thin, rigid sheet with holes pre-drilled at standard intervals across a grid, usually a square grid of 0.1 inches (2.54 mm) spacing. These holes are ringed by round or square copper pads, though bare boards are also available. Inexpensive perfboard may have pads on only one side of the board, while better quality perfboard can have pads on both sides (plate-through holes or double-sided board). Since each pad is electrically isolated, the builder makes all connections with isolated wire or special wiggly wire used for "point to point". Discrete components are soldered to the prototype board such as resistors, capacitors, and integrated circuits. The substrate used in the cheapest perfboard is typically made of paper laminated with phenolic resin; more expensive boards are made of fibreglass-reinforced epoxy laminate.

6. Connecting Wires

Since stranded wire is more flexible than solid core wire of equal size, it can be used when the wire needs to move around frequently.

7. Female Burg Strips

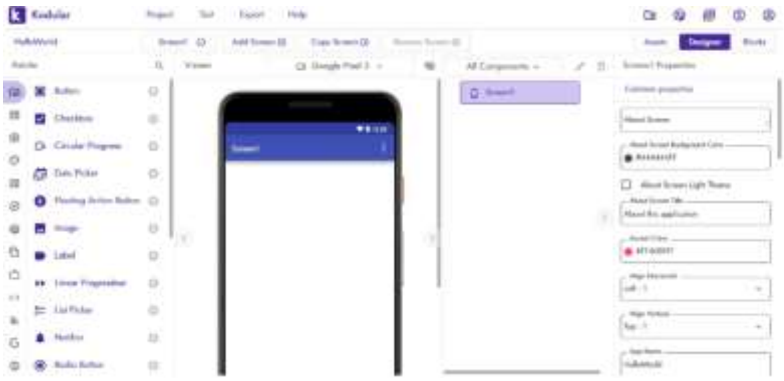
The female connector is generally a receptacle that receives and holds the male connector.

8. Jumper Wires

Jumper wires are the wires that have connector pins at each end that are used to connect the various points on the breadboard and with the other components. They are either used for input or output purpose and are one of the most basic & essential components in a breadboard.

V. SOFTWARE USED

1. KODULAR (App Development)



Kodular (formerly Makeroid) is a web-based open-source toolkit for mobile app development. This includes an innovative component and block design that allows for a free drag-and-drop mobile application creator for Android without coding based on MIT App Inventor.

2. THINGSPEAK (Cloud Storage)

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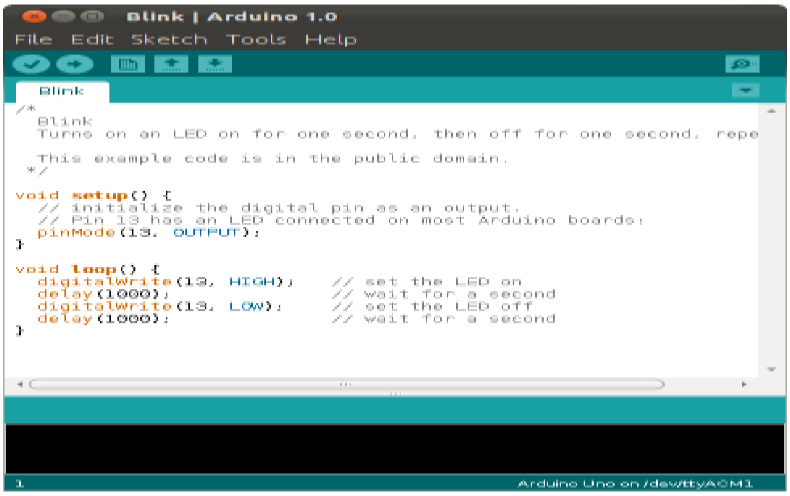
According to the developers, "ThingSpeak is an open-source Internet of Things (IoT) application and API to store and retrieve data from things using the HTTP and MQTT protocols via the Internet or Local Area Networks. ThingSpeak enables the creation of sensor logging applications, location tracking applications, and a social network of things with status updates."

ThingSpeak was originally launched in 2010 by ioBridge, sustaining a service in support of IoT applications.

The functionality has integrated support from the numerical computing softwareMatlabof MathWorks, enabling analysis and visualization of uploaded data by the ThingSpeak users using Matlab without incurring the cost of a Matlab license from Mathwork.

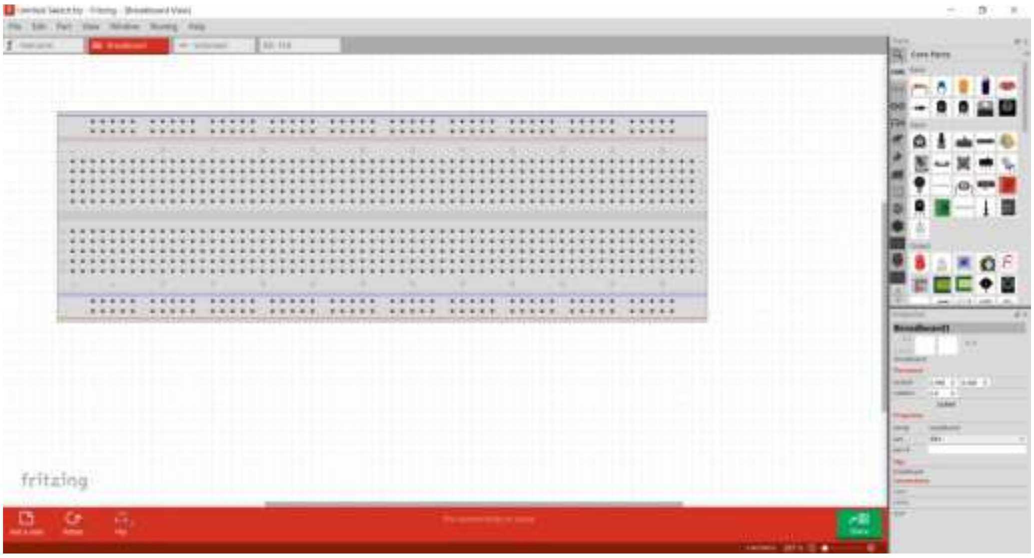
ThingSpeak enjoys a close relation with Mathworks, Inc. In fact, all of the ThingSpeak documentation is incorporated into the Mathworks' Matlab documentation site and enables registered Mathworks user accounts as valid login credentials on the ThingSpeak website. The terms of service and privacy policy of ThingSpeak.com are between the respecting user and Mathworks, Inc.

ThingSpeak has been the subject of articles in specialized "Maker" websites, such as Instructables, Codeproject, and Channel 9.



3. Arduino IDE

The Arduino IDE is Java-based, cross-platform application running on Windows, macOS, and Linux. This is the place through which the software is written and uploaded to the Arduino board. The source code for the IDE was released under the GNU- GPL. The Arduino IDE supports variants of C and C++ languages with some special rules and code structuring. The Arduino IDE provides a software library from the Wiring project, which provides a set of input and output procedures. User-written code needs to contain just two basic functions, one to start the sketch and one providing the main program loop. Both functions will be compiled and linked together by the GNU tool chain included within the IDE distribution, creating an executable cyclic executive program. The Arduino IDE uses avrdude to convert the binary executable to a text file in hexadecimal encoding, which the loader program in the firmware of the board uploads to the Arduino board.



4. **Fritzing**

Fritzing, a free and open-source hardware project, makes electronics such as a creative medium accessible to anyone. We provide a software application, a community website, and services in the ideology of Processing andArduino, making a creative ecosystem in which users can

document their prototypes, share them with other people, teach electronics in the classroom, and design and manufacture professional pcbs.

VI. APPLICATIONS

1. Air quality monitoring in urban areas.
2. Agricultural monitoring for weather and environmental conditions.
3. Disaster management and post-disaster environmental assessment.
4. Smart city development and real-time environmental analysis.
5. Industrial site monitoring for pollutant levels.
6. Wildlife conservation and habitat monitoring.
7. Traffic pollution monitoring in congested areas.
8. Educational tool for IoT and environmental science learning.

CONCLUSION (11 Bold)

A cost-effective and scalable real-time environmental monitoring solution, the Drone Data Monitoring System harnesses IoT technology. It combines with the Wemos D1 Mini, several sensors to collect data before uploading it to the ThingSpeak cloud platform for users to achieve timely, actionable insights into air quality, temperature, humidity, and distance. The Android application is user-friendly for remote monitoring and thus may be applied in a multitude of applications such as smart cities, agriculture, and disaster management. This system then demonstrates how IoT and drone technology may be used to solve environmental challenges in ensuring sustainability by means of continuous monitoring.

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