Proceedings of the 5th International Conference on Computing and Data Science
DOI: 10.54254/2755-2721/20/20231060

A novel design of surveillance drone using Internet of Things with surface monitoring provisions

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Abstract. The Unmanned Aerial Vehicle (UAV) environmental monitoring system in an area is multipurpose and easy to use. With the use of targeted mobile networks and drone flight control, the relevant staff can effectively monitor regional temperature and humidity. This study draws on the author's previous expertise to outline the key points of a programme demonstration and system design, as well as to examine the software flow architecture of regional environmental monitoring. As a result of this work, users will be able to easily collect weather as well as other data by using a drone that can be controlled from an Android phone and flown to some faraway, inaccessible site. The mobile node MCU may receive commands from the WiFi module and relay them to the drone. The drone will be flown when the instructions have been sent via the IoT based NodeMCU module. From there, it will gather data via the network and communicate that information to the cloud database over WiFi. This setup has the potential to be implemented into a model for a weather prediction that can accurately foretell winds and temperatures in the immediate vicinity of the surface to an accuracy of 100 meters.

Keywords: unmanned aerial vehicle, AV, DHT11 Sensor, NodeMCU, Blynk app.

1. Introduction

Drones are typically operated via radio frequency (RF) remote, with some models featuring anoptional GPS module for hands-free,autonomous navigation [1]. Instead, I used a different approach with my project and used an IoT based NodeMCU module. The primary goal of this project is to gather information on a certain location via the use of video and data collection. Programming in NodeMCU module is used to determine how far and how wide the drone can fly.A flight controller receives instructions from the system's brain, IoT enabled NodeMCU module. We utilized an Open Pilot APM2.8 microcontroller to keep the aircraft steady and running smoothly, and I attached a camera and weather sensors so that I could record data in real time.

The data gathered by the weather drone may be used to aid humanity in many ways. With the aid of a weather-monitoring drone, we can help people all around the world by collecting data on the state of the planet's climate from afar. In these conditions, it is of the utmost importance to keep a close eye on weather reports.

The temperature chosen is the most crucial factor in this article [2]. Consequently, one cannot access the same areas that he does. With a drone equipped with a DHT11 sensor, we will be able to

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detect it. Air pressure and humidity may also be measured using this drone. The camera on this gadget will allow the drone to spy on a gang from a safe distance.

The following tools and hardware were used in the making of this proposed work:

1.1. Drone frame
A framework within which everything is held in place [3]. The frame of the quadcopter is crucial because it dampens vibrationand holds the motors and other electronics.

1.2. Brushless DC motor
Synchronous DC motors, commonly known as brushless motors (BLDC or BL motor) and electronically switched motors (ECM or EC motor), are synchronous motors operated by DC via an inverter as well as switching power source, generating ac power.

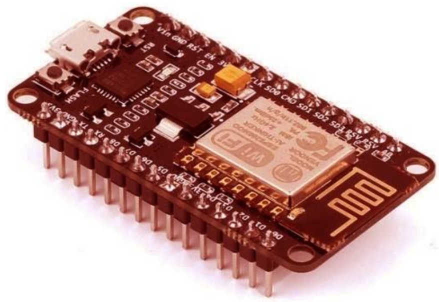

Figure 1. (a) NodeMCU module.

1.3. DHT11 sensor
The DHT11 sensor measures both temperature and humidity and provides a digital output. The technology behind it ensures both great dependability and excellent stability over the long period. There's a connection to the high-performance 8-bit micro-controller. This apparatus has a resistive element and a method for monitoring devices with wet NTC temperature. It can respond quickly, block interference, and provide good performance at a low cost.

1.4. Camera
Drone photography is capturing footage from an unmanned aerial vehicle (UAV) using a remote-controlled or fully-automatic, WiFi enabled, First-Person-View (FPV) The drone will maintain its current altitude even if you let off of the throttle stick. Easy to fly and shoot high-quality images or video with thanks to its one-touch takeoff and landing and real-time high definition camera.

1.5. Battery
There are one or more electrolytic cells in a battery, and their job is to convert the chemical energy into electricity.

2. Related work
D. Palanikkumar et al., 2023 [6] proposed a paper suggesting that wireless sensor networks for drone transportation system need to achieve communicative intelligence with minimal computing cost. Using an unmanned aerial vehicle (UAV) as the anchor node and lightweight neural networks to assess the UAV position information, this work developed a novel localization method that is both computationally and time-efficiently low. MaciejWielgo et al., 2022 [7] proposed a paper relating to an unmanned aerial vehicle-mounted, lightweight, relatively compact K-band synthetic aperture radar (SAR) system is shown here (UAV). This article details the system architecture and the developed SAR imaging technique, and it also offers the first imaging results for this setup. Utilizing a GPS position sensor and inertial measurement unit (IMU) in conjunction with a synthetic aperture radar

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(SAR) autofocus technique allows for accurate trajectory estimation, a necessary step in the fabrication of high-resolution radar images. Ahmed.N.Sayed et al., 2022 [8] proposed a paper stating that micro-doppler signatures can be used to accurately categorize UAVs and other objects, such as birds. FlorinLucianChiper et al., 2022 [9] proposed a paper stating as the number of commercial UAVs (drones) continues to rise, the development and implementation of solutions to counteract the resulting security vulnerabilities has emerged as an urgent matter. In an effort to combat the increasing threat posed by drones, several organizations and government bodies have begun researching and developing countermeasures. PrzemysławWojciechowski et al., 2022 [10] proposed a paper stating that drones are becoming increasingly commonplace, and as a result, their owners have begun to notice certain unintended consequences. One major source of this knowledge is First Person View (FPV) drone pilot training schools, as this is by far the most prevalent way that drones are put to use. The visualization technology included into the unmanned aerial vehicle (UAV) provides a sharp, detailed picture of the world around the craft.

3. Methodology

In this scenario, the drone itself serves as the carrier mechanism. NodeMCU and other necessary hardware will be stored inside. Different sorts of data will be gathered by the NodeMCU from sensors like DHT11. Even here, we employ a supplementary tool that facilitates data collection when the drone is not in range of the WiFi network. In this case, we choose to use the connection module. From NodeMCU, data transmission will occur through a mobile network. Then, the Blynk software on our phones or the cloud database we created for ourselves receives the information. The data collected here can be used for a variety of purposes, including but not limited to monitoring, analysis, control, and further analysis.

Digital Temperature and Humidity Sensor (DHT11) is inexpensive. This sensor can take immediate readings of humidity and temperature when interfaced with a microcontroller like the Arduino, Raspberry Pi, etc. Modules and sensors for measuring humidity and temperature using the DHT11 exist on the market. This sensor is different from a module in that it has a pull-up resistor as well as a power indicator light [4]. A sensor for measuringrelativehumidityisDHT11.The capacitance humidity sensor consists of two electrodes and a moisture-retaining substrate serving as the dielectric. Capacitance values shift when humidity levels shift. The IC takes the resistance values, processes them, and converts them to digital form [5]. This thermistor-based temperature sensor makes use of the negative temperature coefficient property of thermistor, which causes their resistance to drop as temperature rises. This type of sensor is typically constructed from semiconductor ceramics or polymers, as they provide a greater resistance value for even the smallest change in temperature. The following figure Fig.2 illustrates the system's schematic view in detail.

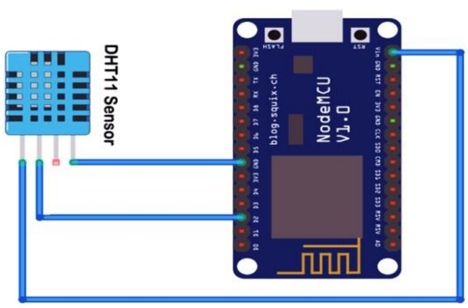

Figure 2. Schematic view.

Blynk is an Internet-of-Things (IoT) platform that allows users to remotely command Internet-connected devices like Arduino, Raspberry Pi, and NodeMCU from their iOS or Android smartphones. The accessible widgets are compiled, and the programme then supplies the correct address, resulting in

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a graphical user interface (GUI) or human-machine interface (HMI). The core of the platform consists of three parts:

3.1. Blynk app

With the widgets we provide, you can easily build stunning user interfaces for your applications.

3.2. Blynk server

This component handles all data transfers between the phone and its peripherals. Use the Blynk Cloud, or set up your own local Blynk server. It's free and available for anybody to use; it can support thousands of devices; and it can be run on a Raspberry Pi.

3.3. Blynk libraries

All the common hardware platforms need it to connect to the server and handle incoming and outgoing commands.

4. Results and discussions

This drone is designed for monitoring the surveillance area with full attention and captures the video of the respective region as well as passes the accumulated data to remote cloud server using Internet of Things (IoT) provision. This proposed drone is used to accumulate the environmental surface weather conditions by using temperature and humidity estimation sensor called DHT11 sensor. This sensor is utilized to this application to grasp the real world weather readings and pass that to the BlynkApp server via NodeMCU Internet of Things module. The proposed model is prepared with the powerful brushless motor enabled drone unit and the controller is designed to operate the drone motors with stable frequency as well as the battery structure is resistant enough to fly the drone in proper range.

4.1. Controller unit operations

The microcontroller unit NodeMCU inbuilt contains a WiFi module to establish the internet connection to carry the Internet of Things provision in detail and the programming environment or Integrated Development Environment (IDE) is used to bound the codes into NodeMCU is Arduino IDE. The Arduino integrated development environment is based on the idea of a sketchbook, which is a standard location for keeping your code. Using the File then select Sketchbook or Open button on the toolbar option, then the user may access recently saved sketches. Arduino, upon first launch, will immediately mean a sketchbook folder for users.

4.2. Blynk assisted Internet of Things

A large majority of embedded applications are becoming Internet-enabled, a phenomenon known as the "Internet of Things" and in addition to communicating with other individuals and objects, these linked gadgets also send sensor data to cloud space and cloud-based computing services, where it is processed and analyzed to yield valuable insights. Improved gadget connection and decreased Cloud computing costs are facilitating this pattern. The following figure, Fig.3 illustrates the resulting flow diagram of the drone and the entire climate monitoring setup is available to accumulate information as well as pass that to the remote IoT server.

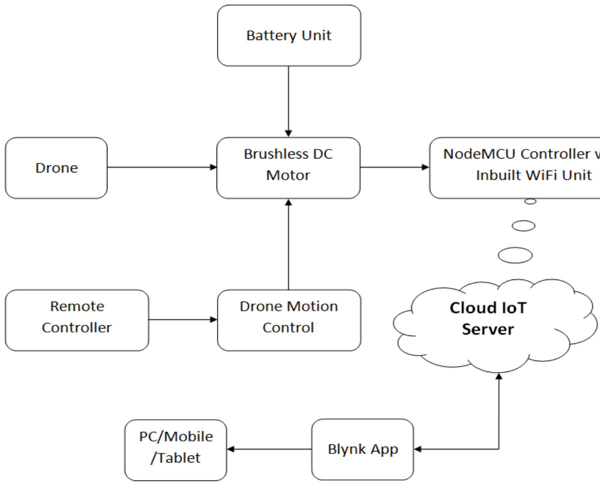

Figure 3. Resulting flow diagram.

The following algorithm, Algorithm-1 is an illustration of the process that makes the whole design successful:

Algorithm-1: Drone Flying and Data Manipulation Strategy

(a) In case the received data is equal to "F," the onward moving mechanism will be activated.
(b) Secondly, the backward-going mechanism will be activated if the signal obtained is equal to the value B.
(c) Third, the Left going procedure is activated if the collected information is an L.
(d) Right moving mechanism is activated if the received signal equals "R."
(e) The Stop mechanism activates if the collected information equals "S," as in 5.
(f) The DHT11 sensor records both the temperature and the relative humidity in a continuous cycle.
(g) The values are displayed in a screen display, which is also the seventh feature.
(h) It uses NodeMCU-ESP8266 to establish a wireless connection to a router.
(i) Sends the information to the specified cloud server.
(j) In addition, it links up with a network connection via WiFi or any defined data card's connectivity medium.
(k) Information can be sent to a cloud server or a mobile device
(l) Keep an eye on the accumulated data and respond accordingly.

4.3. Drone surveillance

In the specific circumstance involving drones, the backend of the console is the one that is responsible for receiving the flow of alerts that are transmitted by implies of the smartphone device. This is accomplished through the use of a rule chain that is incorporated with the free software internet of things platform using Blynk App. The strategy that was implemented consisted of managing information and communications in the same way as if they were product collected by Internet of Things sensors, and designing the flow with a dedicated Internet of Things platform in order to take advantage of the versatility and robustness of those sensors. The front end of the platform is a powerful tool that helps the decision maker select the alerts that need to be inspected by a drone. An example of this is shown in the following figure, which is Fig-4, and the clear statistical points that were marked by the drone are mentioned clearly over the figure.

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Figure 4. Surveillance with statistical point pecification.

The statistics that are displayed in the sidebars pertain to a time period that covers the preceding 30 days; however, the range of the duration option can be changed. It is feasible to discover details about the types of findings and their attribute values in the line on the left.

The current identification of the investigations is also given, which makes it easy to determine how often of them are fresh and the number of them still need to be completed. A frequency distribution depending on the attribute values of the report kinds is displayed in the bar on the right, along with a table that contains the record of the investigations and their respective statuses. On the main map, several geo-referenced pins are displayed to identify the locations of the reports, with the kind of the symbol correlating to the nature of the report and the colour according to the stage at which the request is being processed. Although a good methodology for decision-making has not yet been created, the decision-maker is assisted in the meticulous examination of all of the signals received in order to separate out the most harmful ones that call for an investigation by drone from the overall picture, which is represented in Figure-5. The following figure, Fig-5 illustrates the proposed drone model with all hardware specifications in that.

Figure 5. Proposed drone.

5. Conclusion

In conclusion, the drone may be fitted with an IoT based NodeMCU module to perform efficient data gathering operations through the integration of regional environmental monitoring as well as Internet of Things technology. The drone captures the video frames from the surveillance limit and transmits that to the server for verification and monitoring of regions. Furthermore, the NodeMCU terminal node may be used efficiently to gather environmental temperature and humidity throughout the monitoring process itself. Implementing this system allows the user to manage the temperature readings of the respective surveillance area and accumulate the data from the corresponding region is transmitted to the cloud server over a network by using IoT assisted NodeMCU module as well as the result is shown on the Blynk app.

In future, the work can be further enhanced by means of adding some Artificial Intelligence logic to manipulate the records as well as adding some more sensors like fire, gas and all to monitor the target areas in clear manner.

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