International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 05 | May 2022 www.irjet.net p-ISSN: 2395-0072

DEVELOPING A REAL TIME DATA ACQUISITION , FLY-BY-WIRE COMMUNICATION SYSTEM FOR AN UNMANNED AERIAL VEHICLE

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Abstract - "Developing a real-time acquisition, fly-by-wire communication system for an unmanned aerial vehicle" consists of 3 parts: Fly by wire control system, Real-time sensor data visualization from the UAV, and the Communication between the UAV and the ground station. Aiming at the problems in the traditional Unmanned Aerial Vehicle (UAV) like the stability, accuracy, data acquisition, and display system. The fly-by-wire will take care of the accuracy and control stability of the UAV, through sensor data visualization post-processing of the data is done, and the communication is established between the UAV and ground station to control the UAV. All the sensor data can be visualized using wireless sensor networks through Blynk software. The communication between the ground station and onboard controller uses Telemetry. Thus, the proposed system which consists of fly-by-wire integrated with sensor data visualization makes the UAV less weight, more accurate & stable using the feedback loops. The final output can be implemented on any UAV.

Key Words: Fly-by-wire, sensor data visualization, UAV data acquisition, ground station, Blynk, Telemetry.

1. INTRODUCTION

In a traditional UAV with the wiring system there is a chance of failure of the UAV due to damage in wires and also the stability and accuracy of this type of UAV are comparatively less. Considering the problems in the traditional Unmanned Aerial Vehicle (UAV) like the stability, accuracy, data acquisition, and the display system, a new system has been created which contains three parts- the Fly by wire control system, Real-time sensor data visualization from UAV, and the communication between the UAV and the ground station. The fly-by-wire will take care of the accuracy and control stability of the UAV, through sensor data visualization post-processing of the data is done, and the communication is established between the UAV and ground station to control the UAV.

A fly-by-wire system is a type of aircraft system that is fully automated and eliminates the need for manual flight controls. It works by converting the movements of the flight controls to electronic signals, which are then sent to the flight control computers. This sort of system can be used with mechanical or fully by the fly-by-wire controls. This type of system interprets the inputs from the pilot and then calculates the control surface positions needed to achieve a desired outcome. It can also control various aircraft components such as the rudder, aileron, and engine controls. Although the pilot is not aware of all the control outputs that are affecting the outcome, the aircraft is still reacting according to the expected. This type of system helps prevent the pilot from operating the aircraft outside of its safety envelope.

A wireless sensor network is a type of network that collects data about the physical conditions of an environment. These sensors can monitor various environmental conditions such as air quality, noise, and temperature. Similar to wireless ad hoc networks, WSNs rely on the spontaneous formation of networks to collect data. These Wireless Sensor networks can monitor various environmental conditions like temperature, pressure, and sound. A wireless sensor network (WSN) is composed of nodes, each with its own set of components connected to other sensors. These nodes typically have an external antenna or a radio transceiver, as well as an electronic circuit that can be used to interface with the energy source and sensors. The cloud server used for the WSN is Blynk.

Blynk is the server which is designed for Internet of things. It can control hardware in wireless method and can display sensor data. It can also store data and can help to visualize in many ways.

The main important thing is to access the UAV by establishing the communication channel between the onboard microcontroller and the ground station. The method used to establish the connection between the ground station and the onboard microcontroller is Telemetry. 915Mhz telemetry module pair is used to achieve the connection. Telemetry is a highly automated communication process by which the measurements are made and other data is collected at remote or inaccessible points and transmitted to receiving equipment for monitoring, display, and recording.

1.1 Proposed Work

Hardware Components Description

i.NodeMCU

NodeMCU could be a cheap open supply IoT platform. At the beginning, it included firmware that runs on the ESP8266 Wi-Fi SoC from Espressif Systems and hardware that was based on the ESP-12 module.

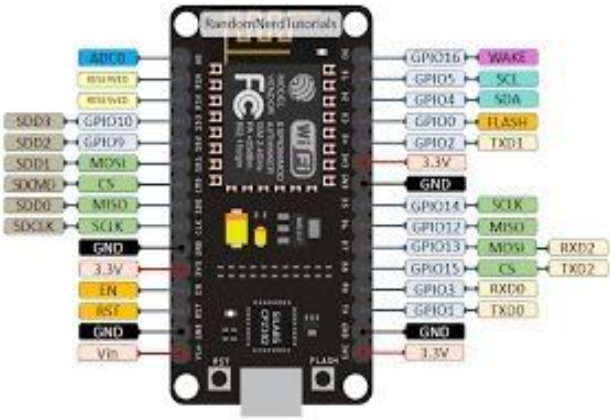


Figure 1 : NodeMCU

ii. ESP8266:

The ESP8266 could be a low-priced Wi-Fi chip, with inbuilt TCP/IP networking computer code, and microcontroller capability, made by Espressif Systems.

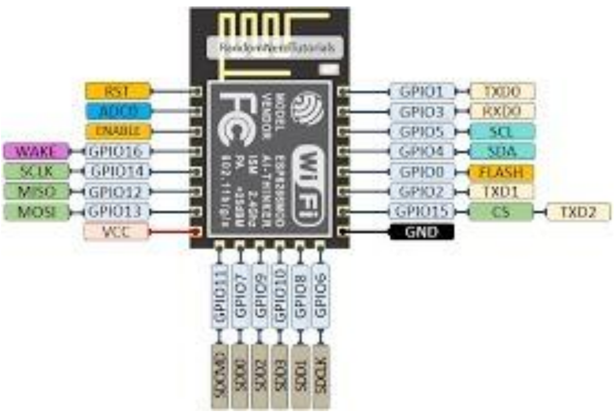


Figure 2 : ESP8266

iii. BMP180:

The BMP180 is that the new digital atmospheric pressure sensing element of old master sensing element officer, with a awfully high performance, that permits applications in advanced mobile devices, like good phones, pill PCs and sports devices.

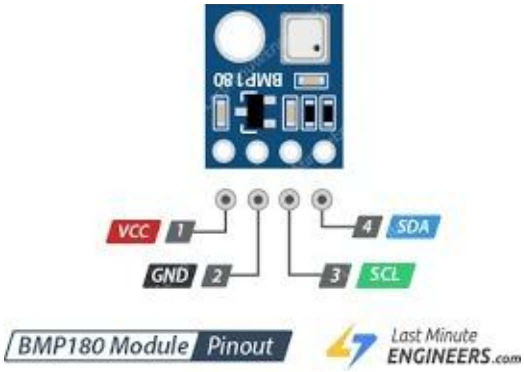


Figure 3 : BMP180

iv. DHT11:

The DHT11 may be a basic, extremist inexpensive digital temperature and wetness device. It uses an electrical phenomenon wetness device and a semiconductor device to live the encompassing air, and spits out a digital signal on the info pin.

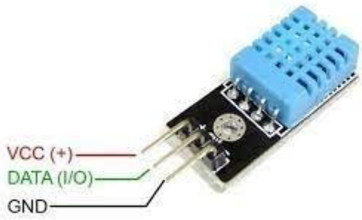


Figure 4 : DHT11

v. Telemetry:

Telemetry is a RF based communication process by which measurements are made and other data collected at remote or inaccessible points and transmitted to receiving equipment for monitoring, display, and recording.

Figure 5 : Telemetry Radio

1.2 Software Description

i. BLYNK:

Blynk is a new platform that allows you to quickly build interfaces for controlling and monitoring your hardware projects from your iOS and Android device. After downloading the Blynk app, you can create a project dashboard and arrange buttons, sliders, graphs, and other widgets onto the screen.

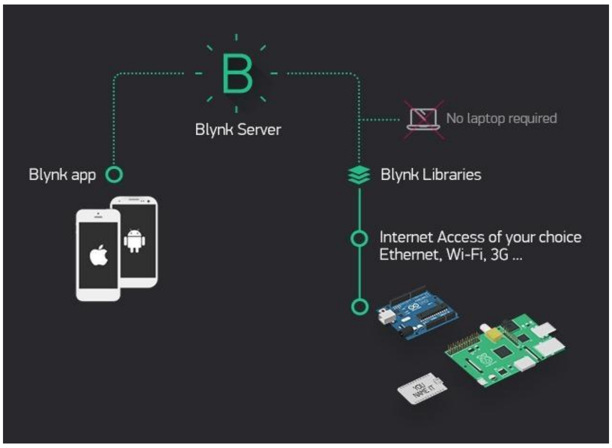


Figure 6 : BLYNK

ii. Arduino IDE:

The Arduino Integrated Development Environment (IDE) is a cross-platform application that is written in functions from C and C++. It is used to write and upload programs to Arduino compatible boards, but also, with the help of third-party cores, other vendor development boards.

Figure 7 : Arduino IDE

iii. Mission Planner:

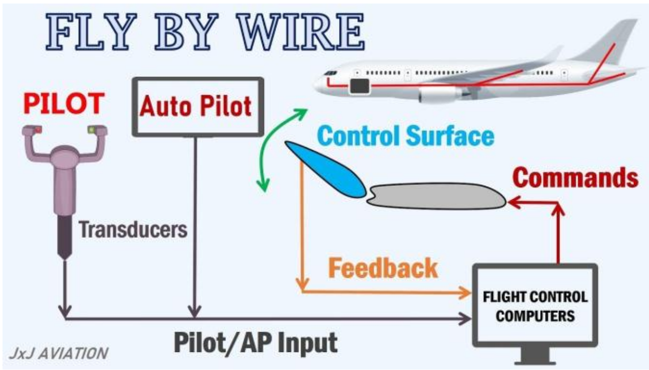
Mission Planner is a ground station software that is used to configure and control a plane, copter or a rover from the laptop.

Figure 8 : Mission Planner

2. METHODOLOGY

A. Fly-By-Wire

- STEP 1: - Creation of servo ports.
- STEP 2: - Configuration of ports.
- STEP 2: - Generating Pulse Width Modulated signals.
- STEP 4: - Mapping servo angle to flight control surfaces.



Fly-by-wire is a system that eliminates the need for manual flight controls. It works by converting the signals from the flight control surfaces to electrical signals, which are then sent to the flight control computers. This type of control system can be used in airplanes like the Boeing 777. It then calculates the control surfaces required to achieve that outcome. Although the pilot is not aware of all the control outputs that are affecting the outcome, the aircraft is still reacting as expected. This type of control system helps prevent the pilot from operating an aircraft that is outside its safety envelope.

B. Wireless Sensor Networks

- STEP 1: - Connecting NodeMCU and ESP8266 to Blynk through Wi-Fi.

- STEP 2: - Interconnecting NodeMCU and ESP8266.
- STEP 3: - Connecting the sensors to the ESP8266 and NodeMCU.
- STEP 4: - Giving commands to ESP8266 to collect the sensor data.
- STEP 5: -Sending the sensor data to NodeMCU.
- STEP 6: - Visualizing sensor data in the Blynk API.

The NodeMCU and the ESP8266 nodes are connected to Wi-Fi by coding them on Arduino IDE, the sensors have been connected to both of them. As soon as the nodes get powered up, the sensors start sensing the environment data like temperature, pressure, vibration etc. The data can be accessed from the ground station through the Blynk API. The results are acquired and analyzed. The telemetry, receiver and transmitter of the appropriate configuration has been selected as per the location.

In the first node the BMP180 is connected to ESP8266 with the battery.

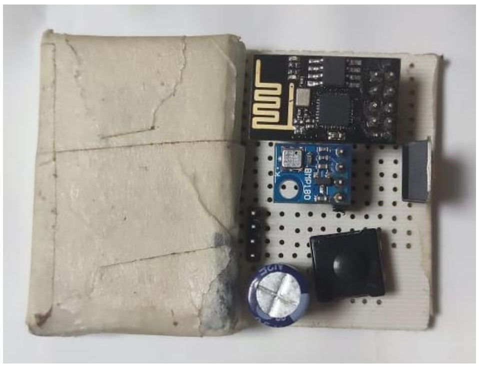


Figure 9 : ESP8266 Node

NodeMCU is connected to vibration sensor.

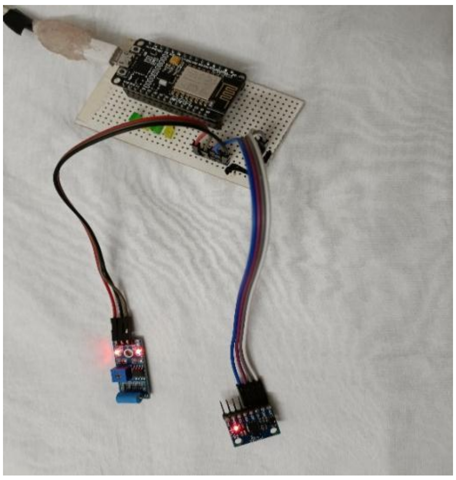


Figure 10 : NodeMCU Node

C. Ground Station Establishment

- STEP 1: - Connecting onboard chip and Telemetry transmitter.
- STEP 2: - Setting up Telemetry receiver to receive the data.
- STEP 3: - Establishment of ground station.
- STEP 4: - Connecting onboard microcontroller to the ground station.
- STEP 5: - Transferring data.

Coming to the overview of the ground station establishment first we have to connect one of the telemetry radio to the computer using micro USB cable, then we need to power up the other telemetry radio attached to the vehicle by plugging into the vehicle's battery. Then open the Mission Planner and go to the Initial Setup | Optional Hardware | SiK Radio page. Next select the exact COM port and set the baud rate to 57600, make sure that the "Connect" button is in the disconnect state as shown. Then press Load Settings button and both the Local and the Remote areas should fill in the values including the firmware Version.

The most common thing to do is to change the NET ID. The default is 25 for most of the radios but if you plan to fly in an area with other pilots who may be using the same radio it is better to change this to some other number. After making the required changes, click the Copy Required items to Remote and press Save Settings.

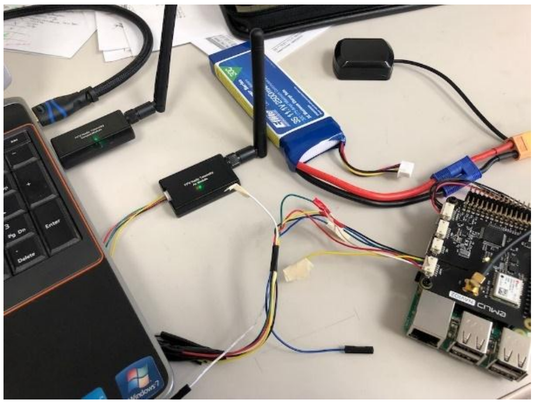


Figure 11 : Telemetry connected to APM

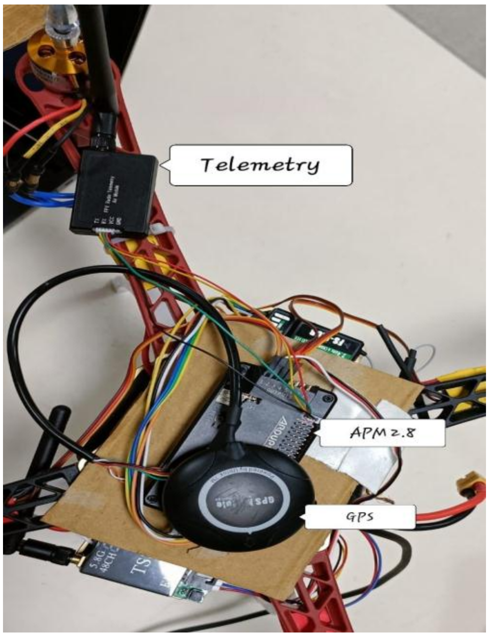


Figure 12 : Telemetry integrated to Drone

Figure 13 : Mission Planner setup

3. Result and Discussion

Fly-By-Wire & Wireless Sensor Network

The values sensed by the sensors are visualized in Blynk. The results are attached below and are tabulated in a table. The sensors gave 92%-95% of accuracy. As per our analysis this is the best way to visualize data in wireless mode in any UAV. Using Fly-By-Wire & Wireless Sensor Network the stability and accuracy of the UAV is increased and using feedback loops the UAV can auto correct itself from the error.

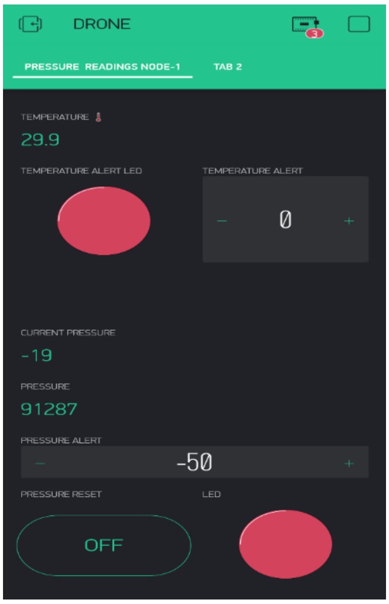


Figure 14 : Result A(Blynk App)

Sl.No	Name of the sensor	Value Recorded
01	Temperature	**29.9**
02	Pressure	**91284**
03	Humidity	**98**

Table 1 : Result A(Blynk App)

Sl.No	Name of the sensor	Value Recorded
01	Temperature	**27.9**
02	Pressure	**92173**
03	Humidity	**96**

Table 2: Result A(Blynk App)

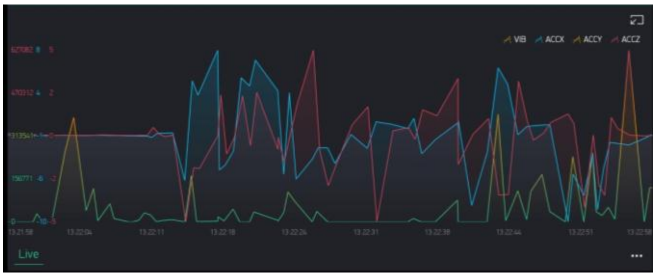


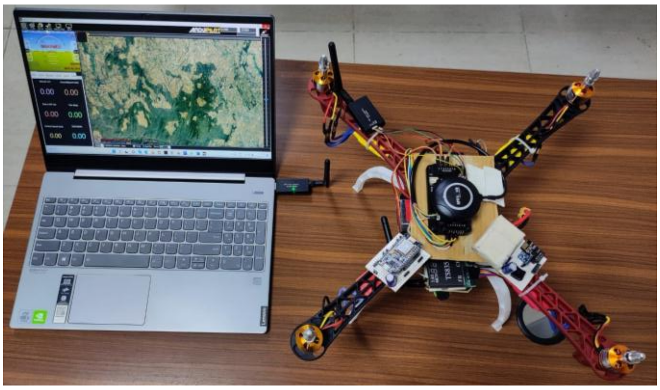
Figure 15 : Result Graph (Blynk)

C. Telemetry

Figure 16: Drone Position and Orientation on Mission Planner

Figure 17 : Setting boundary for drone fly on Mission Planner

Using Mission Planner we can get the exact loacation and the orientation of the UAV and also we can set the borders for the the UAV to fly.



Final Integrated System

All the nodes from the wireless sensor networks, fly-by-wire and telemetry radio is implemented on the UAV to get the final integrated system.

4. CONCLUSIONS

In this project initially, we have established nodes using NodeMCU and ESP8266, then connected the sensor to them. The sensors collected the data and pushed the data to Blynk through the Wi-Fi. Through Blynk we have visualized the recorded data and Blynk stores the sensor data in a very handy manner. We can make any decisions through the data visualized and analyzed through this project. As per our analysis this is the best way to visualize data in the wireless mode in any UAV. The data recorded are 92%-95% accurate.

Then we integrated this system with the telemetry module, through this the exact position and the orientation of the UAV was detected. This integrated system can be installed on any UAV and the accuracy is better than the other existing systems.

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BIOGRAPHIES

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