Design of a High-Speed UAV for Public Service and Emergency Response

SPARSH KUMAR SINGH[1], YASH SHARMA[2], YATI JAISWAL[3]
[1]ABES Engineering College, Ghaziabad (e-mail: sparsh2832000@gmail.com)
[2]ABES Engineering College, Ghaziabad (e-mail: sharma2110yash@gmail.com)
[3]ABES Engineering College, Ghaziabad (e-mail: yati0523270110@gmail.com)
Corresponding author: Sparsh Kumar Singh (e-mail: sparsh2832000@gmail.com).

ABSTRACT
This is the article about designing a speedy drone for announcing and performing various activities called 'public aid activities.' We shall be using QAV250 drone frame along with this is the lightweight CC3D carbon fiber drone frame flight controller and LibrePilot GCS software for programming our drone. The programming will be carried out in such a way that our drone should be able to fly at full speed to achieve the destination point. LibrePilot is an open source software and hence free to use. This is a highly attractive project and can also find application in the real world scenarios.

KEYWORDS 6TB Fly Sky radio receiver and transmitter, CC3D flight controller, Libre Ppilot open-source GCS software, QAV250 drone chassis

I. INTRODUCTION

AN unmanned aerial vehicle (UAV), usually referred to as an unmanned aircraft, is a plane without a pilot, a flight crew, or any passengers. Unmanned aerial vehicle systems (UAS), which also comprise a ground controller and a drone communication system, contain UAVs as a component. Flying UAVs can have varied degrees of autonomy, from autopilot assistance to completely autonomous aircraft without human interaction, and can be controlled remotely by the user, as with a remote control (RPA). Depending on its design parameters, such as weight or engine type, maximum flying altitude, level of operational autonomy, operational duties, etc., a UAV may be categorized as any other form of aircraft. Beginning with analog control and moving toward microcontrollers, systems on chips (SOC), and single board computers, the computing capabilities of UAVs have kept up with developments in computer technology (SBC). Drones communicate and exchange video and other data through a radio. The drone's initial uplink only had a little bandwidth. Come in later. Through a carrier two-way narrowband radio, the remote operator gets command and control (C&C) information as well as telemetry data on the condition of the aircraft system. Hardware and software development of the technique is separated into two components. the hardware development process that involves building circuits and create a prototype. IoT encryption, circuit schematics, circuit simulation and data collection are all included in the software. By following weather variables temperature, humidity, rain, and barometric pressure, using three types of sensors. By analyzing current weather data and sensor values, the system will be able to display the current weather condition. An ESP8266 microcontroller will control everything data, while NODEMCU will act as a client for receive sensor data from ESP8266. The Thing Speak series, designed to make it Easier for users to check online, there will be this system. the data will be analyzed and compared with Jonatan Meteorology Malaysia to confirm its accuracy and the state of the weather at the time it was collected. Not available Human verification needs, the Internet of Things (IoT) will connect wirelessly and instantly the system with users. Fast-moving drones have revolutionized the field of aerial imagery and data collection. Thanks to high-quality cameras and sensors, these drones help businesses in acquiring images and collecting data in locations that would otherwise be impossible to reach. The acquired images and data can then be analyzed to extract important information that will benefit the business in its decision-making processes [1]. Knowing about the basics of Unmanned aerial vehicles (UAVs) becomes important when looking into the use of fast-moving drones. UAVs refer to a collection of aerial devices that do not need an operator or pilot to fly. One form of UAV is fast-moving drones. Fast-moving drones are designed for speed and fast movement. They are useful for delivering goods in cases of emergencies or for conducting speedy aerial inspections [2]. Another application area of fast-moving drones has been found to be in public broadcasting. Because fast-moving drones can move at very fast speeds and maneuver through difficult terrains, they can be used in emergency cases to broadcast messages to people in a particular area [3]. The fast-moving drones were used in many operations during the lockdown phase, some of which included surveillance of the implementation of the safety protocols, conducting surveys

from the air, and delivery of essentials. The drones were used in Mysuru City to ensure adherence to social distancing and surveillance of the movements of the individuals in order to avoid direct physical contact and prevent the spread of the virus [4]. The sensor network is an important component of fast-moving drones because it helps them in collecting data from their environment for different applications. With the help of sensor networks, fast-moving drones will be able to adjust their behaviors to changes in the environment and optimize performance [5]. Fast-moving drones need public education concerning the safe operation of the systems to encourage public confidence and integration. Unscary Unmanned Aircraft Systems (UAS) projects involve educating the community about these aircraft as well as providing a framework for using these fast-moving drones. This education plays an important role in helping to integrate fast-moving drones into different sectors [6]. An important part of the fast-moving drones is the human interface which allows users to observe and navigate the drone's movements and actions. Comparative research on different methods used in human interfaces of unmanned aerial vehicles (UAVs) provides information needed to develop better human interfaces for UAVs. This research can allow businesses to improve the human interface to improve their situational awareness and efficiency [7]. When developing fast-moving drones, it is important to have a comprehensive concept of operations (ConOps). The ConOps plan highlights the operational goals, scenarios, and procedures for using drones effectively and safely. The deployment of high-speed drones by businesses, following a comprehensive ConOps plan, helps them achieve their goals and minimize any risks while ensuring maximum gains [8].

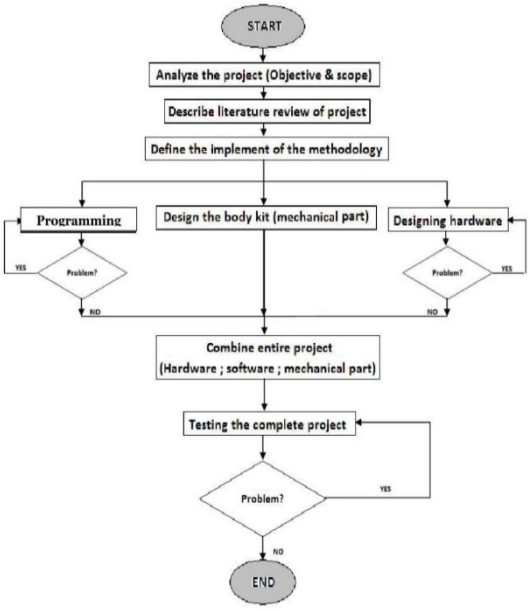


Figure 1. Flowchart of making Drone Project

Figure 2. QAV250 FRAME

II. METHODOLOGY

The advent of fast-moving drones is a disruptive innovation that can find many uses in making public announcements, managing disaster situations, surveillance, traffic control, smart cities, and industrial automation. In this regard, developments in endurance UAVs, autonomy, hybrid-electric power systems, multi-vehicle coordination, edge computing, AutoML, brain-computer interface, Web 3.0, and the Internet of Things (IoT) have tremendously boosted their capabilities [9]–[17]. In addition to the above technologies, human-centered design, natural human-machine interfaces, secure wireless sensor networking, deep learning traffic sign recognition, and IoT-based security surveillance play an important role in improving safety, efficacy, and intelligence of fast-moving drones [18]–[22]. Although tremendous progress has been made, many issues with regards to security, privacy, reliability of communication, and efficacy are still yet to be resolved.

A. QAV250

QAV250 is one such drone frame which is small in size. The miniature frame has been developed to solve problems related to FPV (First Person View) Racing along with the process of visual shooting using drones. The robustness of such miniature frame is quite popular amongst the people. The frame of the QAV250 drone has been made from carbon fiber which highlights the robust construction of the frame. The thickness of 3mm in the arm makes sure that there is no problem related to the breakage of arms while fitting the engine.

Thanks to its good stiffness-to-weight ratio, the carbon fiber frame is extensively used for frame constructions. The carbon fiber frame construction provides for higher stiffness and improved flying characteristics. Due to their low weight and strong swingarms, they demonstrate high mechanical resistance. Being quite compact in shape, this drone frame proves aerodynamic due to the lower acceleration required

for moving it.

In such a way, it becomes possible to regulate the overall take-off mass within the range of 500-600 grams. The 250 mm wheelbase carbon fiber drone frame weighs about 160 grams. There is a big platform in the center section for the installation of cameras and additional modules. The bracket also holds card cams of 37 mm along with cams in the housing. The bracket allows attaching the HD camera and batteries using the lingerer top and bottom plates for additional space for installing any electronics. The carbon fiber drone frame for Q250 consists of anodized alloy spacers. The arms of this carbon fiber frame have several engine mounting slots for the installation of different engines. There is also a special anti-shake mount for securing a camera on the frame body.

Features:

- Light and Long lasting.
- Composed from very resilient engineering materials.
- The frame is quite sturdy.
- The arm includes several mounting slots for motors.
- Equip anti-vibration bracket for FPV Camera.

B. CC3D FLIGHT CONTROLLER

The data received from the sensors is processed by the flight controller in order to decide the speed needed for the four motors. The speed requirement for the motors is communicated by the flight controller to the Electronic Speed Controller (ESC). This desired speed is translated to a speed that the motor can understand.

The smooth performance of this board makes it immediately compatible with many satellite receivers without the use of additional wiring. S.BUS is also available. Additionally, there is a 32-bit STM32 CPU with 128KB Flash memory and 20KB RAM. Both the gyro and accelerometer make use of the three axis MEMS technology.

The pinboard on the side of OpenPilot CC3D EVO flight controller is very easy to connect and program via one's computer. Using the USB and the OpenPilot software, one will be able to program the OpenPilot CC3D EVO flight controller side panels in Windows, Mac or Linux without using any driver software. This is a user-friendly piece of software that can be used by anyone, even those who don't have programming skills.

One cannot expect much difference when connecting the pin at the right side of the OpenPilot CC3D EVO flight controller and the OpenPilot CC3D EVO flight controller side panels. There is only one technical difference between the connection pins.

- CC3D EVO Hardware Features:
- Works like an app
- Easy to use interface
- Very Intuitive Setup Wizard
- Evolution Code
- It is used to configure the card
- It can run multiple platforms

Figure 3. CC3D FLIGHT CONTROLLER

Has the function of plugging directly into the satellite receiver (no need for a conversion cable)?

- A robust 32-bit STM32 microcontroller with 128 KB Flash and 20 KB RAM operating at 90 MIP.
- Gyroscope and accelerometer with three axes and high-performance MEMs
- Decreased electrical interference and better flying on a compact 36 x 36 mm 4-layer circuit board.
- Linux, Mac, and Windows are all supported by the software.

12. A pure plug-and-play device, direct support for high-speed USB is available without a driver.

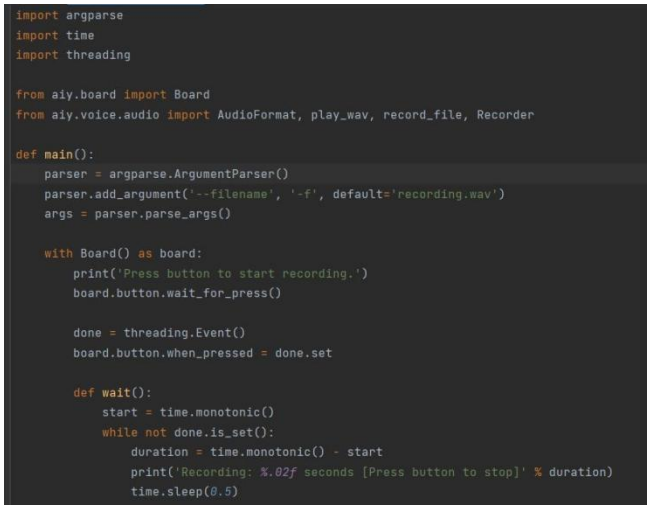
- Support for the Spektrum satellite receiver.
- Support for Futaba S-BUS hardware.

C. SOFTWARE IMPLEMENTATION

LibrePilot GCS Software

Free model drone project software called LibrePilot is made to accommodate both fixed-wing and propeller aircraft. David Ankers, Angus Peart, and Vassilis Varvero Poulos founded OpenPilot in late 2009 with the intention of using it as a learning tool and to fill gaps in existing small drone platforms.

OpenPilot was developed in order to produce LibrePilot in July 2015. Hardware like an inertial navigation system board, a primary control board, a GPS receiver, and a 2.4 GHz serial communication link to the ground station may all be connected with the open-source autopilot software OpenPilot. The GPL Version 3 license governs the distribution of the OpenPilot software. The integrated Sarthe firmware and the Ground Control Station are the two halves of the OpenPilot



```
import argparse
import time
import threading

from aiy.board import Board
from aiy.voice.audio import AudioFormat, play_wav, record_file, Recorder

def main():
    parser = argparse.ArgumentParser()
    parser.add_argument('--filename', '-f', default='recording.wav')
    args = parser.parse_args()

    with Board() as board:
        print('Press button to start recording.')
        board.button.wait_for_press()

        done = threading.Event()
        board.button.when_pressed = done.set

        def wait():
            start = time.monotonic()
            while not done.is_set():
                duration = time.monotonic() - start
                print('Recording: %.02f seconds [Press button to stop]' % duration)
                time.sleep(0.5)
```

Figure 4. OpenPilot python program

project (GCS). While the ground control station is developed in C++ using Qt, the firmware portion of the project is written in C

Application

A number of possible uses and advantages of the use of a fast-moving drone in accordance with the described abstract and methodology are numerous. Some of the main applications of this type of drone include:

Public Announcements: This type of fast-moving drone will be useful to conduct announcements aimed at informing the public about any kind of important information. In this way, the drone will be able to notify people about any natural disasters, about the maintenance process in the city, as well as about high and low tides for beach visitors.

Advertising: In addition, the drone will be useful for advertising certain products or special services of some particular businesses located in a particular area. In this way, the fast movement and distance will enable reaching a considerable number of clients.

Public Aid Activities: Finally, the fast-moving drone will be suitable for conducting certain aid activities, especially when the area is quite distant from the city center.

Effective Surveillance: Given the quick speed and nimbleness of the drone, it is suitable for use in surveillance work where the aircraft may help to cover large areas, detect any threats, and even assist in law enforcement activities.

Environmental Surveillance: The drone may have different sensors to enable it to monitor different environmental factors and conditions.

Film Work and Photography: As a result of its speed, the drone is also applicable in films or photography where the aircraft can be used to capture different images from various angles.

III. CONCLUSION

The above review discusses how fast-moving drones technology has developed and evolved along with integration into new areas such as AI, cloud computing, wireless sensor networking, blockchain, Industry 4.0, smart transportation, and the metaverse. Although drones provide many advantages in automation, surveillance, health care, disaster management, agriculture, and smart cities, concerns about security, privacy, communication, human-computer interface, and regulations still persist. The integration of advanced technology like CNN computer vision, Wi-Vi/Li-Fi sensing, VANET communication, and ground intelligent control system further improves the performance of drones. Solving all these technological and human-related problems will help to safely deploy drones and make them widely popular in intelligent and connected environments in the coming days.

References

[1] Amy E. Frazier, “Capturing and Processing Drone Imagery and Data,” from her book Capturing and Processing Drone Imagery and Data. Edition July 2021

[2] Garvit Pandya, “Basics of UAV” Edition: February 2021.

[3] Magazine - Electronics for You, “Fast moving drones for public announcements” March – 2021

[4] Article - Business Standard, “Dumping old ways in Lockdown”, “Mysuru City uses drones” April – 2020

[5] I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, “A survey on sensor networks,” IEEE Commun. Mag., vol. 40, no. 8, pp. 102–105, 2002.

[6] Ericsson, L. Overarching Interoperability Pro le. Unscary Unmanned Aircraft Systems (UAS) and Common
Systems Integration (CSI). 2006.

[7] Drury, J.L.; Richer, J.; Rackliffe, N. & Goodrich M. A. Comparing situation awareness for two unmanned
aerial vehicle human interface approaches. Miter Corp, Bedford, MA, 2006.

[8] IEEE Computer Society, IEEE Guide for Information Technology System Definition Concept of Operations
(ConOps) Document, IEEE Std 1362-1998. DOI: 10.1109/IEEESTD.1998.89424.

[9] Concept of operations for endurance unmanned aerial vehicles. Air Combat Command, Version2. 3
December1996. http://fas.org/irp/doddir/usaf/conops_uav/

[10] Huang, H.M.; Pavek, K.; Novak, B.; Albus, J. & Messin,
E. A framework for autonomy levels for unmanned systems (ALFUS). In Proceedings of AUVSI Unmanned
Systems 2005.

[11] Harmon, F.G.; Frank, A. A. & Chattot, J.-J. Conceptual design and simulation of a small hybrid-electric
unmanned aerial vehicle. J. Aircraft, 2006, 43(5), 1490-1498. doi: 10.2514/1.15816.

[12] Kalra, N.; Ferguson, D. & Stentz. A. Hoplites: A market-based framework for complex tight coordination in multi-robot teams. In Proceedings of the IEEE International Conference on Robotics and Automation, ICRA 2005, 1170-1177, 18-22 April 2005. doi: 10.1109/Robot.2005.1570274

[13] Taruna Saini, Sudhakar Kumar, Tarun Vats, Manraj Singh. “Edge Computing in Cloud Computing Environment: Opportunities and Challenges”.

[14] Gopal Mengi, Sunil K Singh, Sudhakar Kumar, Deepak Mahto, Anamika Sharma, “Automated Machine Learning (AutoML): The Future of Computational Intelligence”, International Conference on Cyber Security, Privacy and Networking (ICSPN 2022), 309-317.

[15] Sudhakar Kumar, Sunil K Singh “Brain Computer Interaction (BCI): A Way to Interact with Brain Waves” , Insights2Techinfo, pp.1.

[16] Peñalvo, F. J. G., Sharma, A., Chhabra, A., Singh, S. K., Kumar, S., Arya, V., & Gaurav, A. (2022). Mobile cloud computing and sustainable development: Opportunities, challenges, and future directions. International Journal of Cloud Applications and Computing (IJCAC), 12(1), 1-20.

[17] Devashish Gupta, Sunil K Singh “Evolution of the Web 3.0: History and the Future”, 1 , Insights2Techinfo, pp.1.

[18] C. Maag and D. Muhlbacher, “Studying effects of advanced driver assistance systems (ADAS) on individual and group level using multi-driver simulation,” IEEE Intell. Transp. Syst. Mag., vol. 4, no. 3, pp. 45–54, 2012.

[19] Singh, R., Singh, S. K., Kumar, S., & Gill, S. S. (2022). SDN-Aided Edge Computing-Enabled AI for IoT and Smart Cities. In SDN-Supported Edge-Cloud Interplay for Next Generation Internet of Things (pp. 41-70). Chapman and Hall/CRC.

[20] Singh, S. K., Sharma, S. K., Singla, D., & Gill, S. S. (2022). Evolving Requirements and Application of SDN and IoT in the Context of Industry 4.0, Blockchain and Artificial Intelligence. Software Defined Networks: Architecture and Applications, 427-49.

[21] Inderpreet Singh, Sunil Kr Singh, Sudhakar Kumar, Kriti Aggarwal, "Dropout-VGG based Convolutional Neural Network for Traffic Sign Categorization", the proc. of 2nd Congress on Intelligent Systems (CIS 2021), Lecture Notes on Data Engineering and Communication Technologies. Springer, Berlin, Heidelberg.

[22] Soumya Sharma, Sunil K Singh, "IoT and its uses in Security Surveillance" , Insights2Techinfo, pp.1.