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Amrita Vishwa Vidyapeetham
Coimbatore

CERTIFICATE

This is to certify that the project entitled, "**Drone Technology** " submitted by Abhishek Sankaramani , Vishal S , Meenakshi Sareesh , Yashwanth PT in fulfilments for the End Sem project of Computational Physics 1st Semester, under Bachelor of Technology Degree in Computer Science Engineering and Artificial Intelligence at
Amrita Vishwa Vidyapeetham, Coimbatore (Deemed University) is an authentic work carried out by him under our supervision and guidance. To the best of our knowledge, the matter embodied in the report has not been submitted to any other University / Institute for the award of any Degree or Diploma

Date: 22/12/2023 **Jithin Velayudhan**

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ABSTRACT

In the relentless pursuit of refining quadcopter efficiency, a multi-faceted approach is embraced to elevate its performance while curbing weight and size. The cornerstone of this endevour involves a meticulous selection of materials, favouring the likes of carbon fiber and advanced polymers renowned for their lightweight yet durable nature. Simultaneously, a critical evaluation of every component is undertaken, seeking optimal efficiency without sacrificing functionality. This comprehensive re-evaluation extends to the very architecture of the quadcopter, where streamlined, aerodynamic designs replace bulky frames, reducing air resistance and overall weight. Furthermore, the miniaturization of essential electronics and the implementation of energy-efficient systems serve as pivotal strategies in this pursuit. Embracing a modular design philosophy ensures adaptability for future advancements, fostering a platform where iterative improvements can thrive. Integral to this progression is the integration of cutting-edge control algorithms, refining stability and performance while utilizing smaller, lighter stabilizing components. This collective effort not only seeks cost reduction but also aims to fortify the quadcopter's capabilities across diverse applications such as surveillance, aerial photography, field surveys, and weather broadcasting, positioning it as a more agile, versatile, and efficient tool in the realm of unmanned aerial vehicles.

KEYWORDS: Quadcopter, BLDC(Brushless Direct Current Motor), Microcontroller, c vxTransmitter-Receiver, Flight controller.

INTRODUCTION

In recent years, the versatility and user-friendly nature of quadcopter drones has made them increasingly popular. They offer a broad range of applications, including surveillance, agriculture, and aerial photography. Quadcopter drones are generally operated through a wireless remote control and can perform several movements such as hovering, taking off, and landing. This paper outlines the design and creation of a quadcopter drone utilizing an Arduino Uno microcontroller. A quadcopter drone is a popular unmanned aerial vehicle that can move and fly in the air using four rotors. With the use of an Arduino Uno microcontroller board, you can control various components of the drone, including its motors and sensors.

Before constructing a quadcopter drone with Arduino Uno, We must acquire all the essential components, such as the frame, motors, propellers, flight controller, battery, and radio receiver. Once we have the necessary parts, we must carefully assemble and connect them to ensure their seamless operation. Once the hardware is assembled, we can program the Arduino Uno board using software like Arduino IDE. With this software, we can modify and regulate the quadcopter's motor speed, altitude, and direction, among other functions. Testing and calibrating the quadcopter drone before the flight is crucial to guarantee its safety and effectiveness. Moreover, it is crucial to comply with all relevant laws and regulations relating to the usage of drones to avoid any potential mishaps or legal ramifications.

LITERATURE REVIEW

Building a quadcopter drone using an Arduino Uno as a controller has become increasingly popular among hobbyists and enthusiasts. A wealth of resources, including tutorials, guides, and open-source code libraries, are available online to help individuals get started with the project. Several studies have examined the feasibility of using an Arduino Uno as a flight controller for a quadcopter drone, concluding that it is a cost-effective and accessible solution for developing stable and responsive flight control. Additionally, the platform's ease of programming and sensor integration is a viable option for developing autonomous quadcopter drones using GPS and ultrasonic sensors. The literature emphasizes the flexibility and programmability of the Arduino Uno as a platform for controlling the various components of a quadcopter drone, such as the frame, motors, propellers, and sensors. Furthermore, the review article highlights the different control methods used in quadcopter drones, including manual, semi-autonomous, and autonomous control. In summary, the literature suggests that using an Arduino Uno as a controller for building quadcopter drones is an accessible and customizable option for hobbyists and enthusiasts. However, the project can be challenging and complex, requiring knowledge and skills in electronics, programming, and mechanics.

DESIGN & METHODOLOGY

Building a quadcopter drone with an Arduino Uno controller involves a series of crucial steps that require precision and technical expertise.

First, the frame of the drone needs to be designed and constructed with lightweight and sturdy materials to support the motors, electronics, and batteries.

Then, appropriate motors and propellers need to be selected and installed onto the frame, followed by the installation of necessary electronic components like sensors, GPS modules, motor controllers, and the Arduino Uno board.

Once all the components are installed, the battery needs to be tested to ensure it provides enough power for the motors and electronics to enable stable and responsive flight.

Assembling and testing the drone is the next step, which involves conducting indoor and outdoor flight tests to check for any issues such as motor failure or malfunctioning electronics.

The calibration process is essential to ensure that the drone's sensors and other components are adjusted correctly for stable and responsive flight control.

Finally, the drone's control systems must be tested using a remote controller or through autonomous flight control systems to ensure stable and responsive flight.

Overall, building quadcopter drone with an Arduino Uno controller requires expertise in electronics, programming, and mechanics, as the project can be challenging and complex.

HOW WE CONSTRUCT

-Parts Used in the drone -

1 x 450 size frame with integrated power distribution board

4 x 1000kV motor / 10x4.5 props / ESC combo

1 x 3S / 2200mAh / 20C lipo

1 x Arduino Uno

1 x MPU-6050 gyro / accelerometer

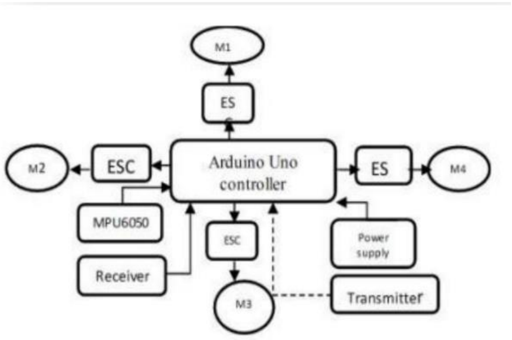
1 x Flysky FS-i6 6-CH TX Transmitter

1 x 2S/3S lipo battery charger

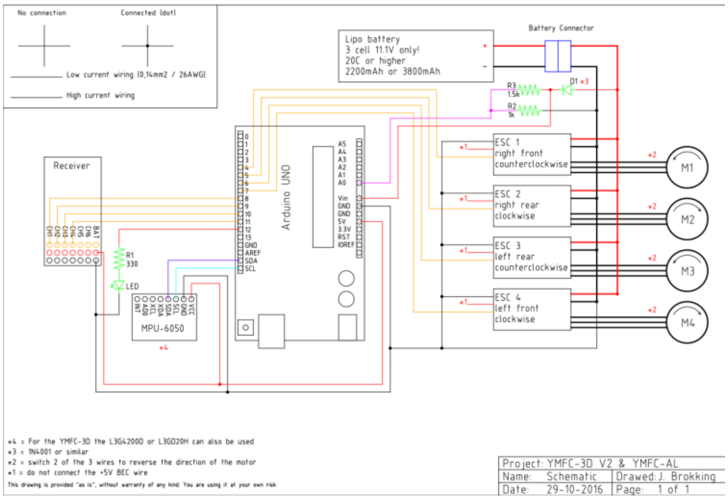
4 x Arduino Ultrasonic Sensors

And some small parts like three resistors (1.5kΩ & 1kΩ & 330Ω), a 1A diode (1N4001 or similar), LED, some wire, a connector for the flight battery, etc.

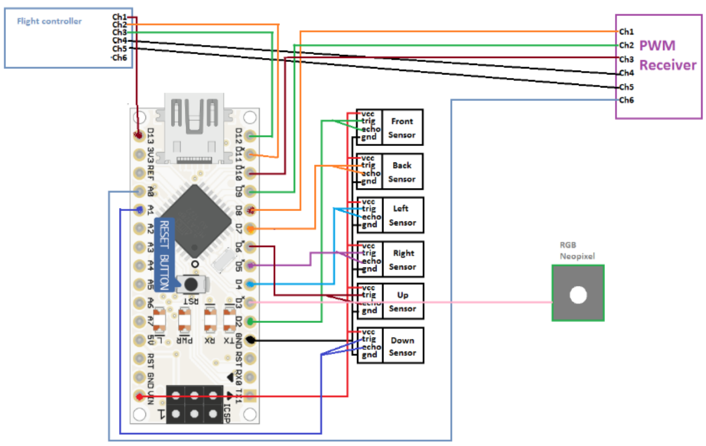
The Circuit Diagram Of Proposed Work –



The Circuit Diagram Of Quadcopter Using Arduino UNO –



The Circuit Diagram Of Ultrasonic Sensors –



The Functions of the important parts of Quadcopter –

1. Arduino UNO –

The quadcopter drone's movement is controlled by the Arduino Uno, which is a circuit board equipped with sensors that can detect any orientation changes. The Arduino Uno receives different commands from the user to control the speed of motors, ensuring that the quadcopter remains stable in fly mode. The controller board and Electronic Speed Controllers (ESCs) work together, with the flight control board giving commands to the ESCs. The ESCs, in turn, receive these commands from the microcontroller circuit board and further give commands to the motors for rotation. The flight control board generates various commands for ESC and motors according to the user's needs, controlling the entire system. In addition to controlling the motors and ESCs, the Arduino Uno also includes an accelerometer and gyro meter, which help with the stabilization of the quadcopter drone. The microcontroller acts as the brain of the quadcopter, responsible for all actions a quad can perform, from take-off and landing to autonomous flight as well as camera and sensor control.

2. ESC (Electronic Speed Controller) –

In the quadcopter drone design, Electronic Speed Controllers (ESCs) play a vital role in controlling the speed and direction of the brushless motors that drive the propellers. The ESCs receive the PWM signal from the flight controller or radio receiver, which is then converted into electrical power that is delivered to the motors. By manipulating the magnetic forces created by the windings and magnets within the motor, the ESCs can regulate the motor's speed and direction of rotation. In essence, the ESCs act as an intermediary between the flight controller and the motors, ensuring that the motors operate at the desired speed and direction, which is essential for achieving stable and responsive flight control.

3. Gyro and Accelerometer (MPU6050) –

in a quadcopter drone, the MPU6050 sensor is an essential component that combines both a gyro and an accelerometer into a single package. The accelerometer measures linear acceleration and detects changes in the drone's speed and direction, while the gyro measures angular velocity and detects changes in the drone's orientation. It provides real-time data on the drone's movement and orientation, which is crucial for the flight controller to maintain stable and responsive flight control. By constantly analysing the drone's orientation and movement, the MPU6050 helps to stabilize the drone during flight and compensate for external factors such as wind or turbulence. The MPU6050 is an important sensor for maintaining the drone's position and orientation in the air, providing the flight controller with accurate data on the drone's movement and ensuring a stable and safe flight.

4. Transmitter and Receiver –

Almost every 4 channel RC transmitter can be used for Quadcopter. The most important feature is the used receiver output pulse. The range should be approximately 1000 till 2000 with a 1500 center position

HOW WE CONNECT

Here all the hardware part is done now the software part begins, first we Remove the propellers, disconnect the flight battery and upload the setup program to the Arduino Uno. Open the serial monitor at 57600baud and complete the setup by executing the requested actions.

After the setup is completed all the settings are stored in the EEPROM of the Arduino.

To make sure that everything is working correct it's necessary to run some basic checks. Remove the props, disconnect the flight battery and upload the ESC calibration program to the Arduino. Open the serial monitor at 57600baud.

Receiver input check

Send the letter 'r' to start the receiver monitor. Now move the sticks and see if the values on the screen correspond with the movements of the sticks.

All the channels should read 1000us till 2000us with a center position of 1500 (+/-8).

Gyro / accelerometer angle check

After the receiver check is completed send the letter 'a' to start the angle check.

Don't move the quadcopter because the gyro needs to calibrate itself. After the calibration the roll and pitch angles are shown. The yaw value is the output of the gyro and will go back to zero if the yaw rotation stops.

Check if the angles correspond with the movement of the quadcopter:

- Nose up is positive pitch and nose down is negative pitch.
- Left wing up is positive roll and left wing down is negative roll.
- Nose right is positive yaw and nose left is negative yaw.

Calibrating the ESC’s

Electronic speed controllers or ESC's for short are controlled with a 1000us till 2000us pulse. 1000us means off and 2000us means full throttle. To make sure that all the ESC's react the same way it's important to calibrate the 1000us and 2000us point. Without calibration the motors will perform different and the quadcopter doesn’t fly well or might even crash.

Remove the props and upload the ESC calibration program to the Arduino. Disconnect the USB cable and follow the instructions in the manual to calibrate the ESC's.

In most cases this is done with the following steps:

1. Place the throttle stick in the upper position (full throttle)
2. Connect the flight battery
3. After some beeps place the throttle stick in the lowest position
4. Disconnect the flight battery

Uploading the flight controller software

Disconnect the flight battery and upload the flight controller software to the Arduino. Disconnect the USB cable and connect the flight battery.Hold the quadcopter firmly in your hand and start the motors with the following sequence:

Start = throttle down and yaw left
Stop = throttle down and yaw right

Increase the throttle up to the point when it almost starts to become weightless. The quadcopter should now try to level itself. If you move the quad it should start to counteract the movement until it is level again. When the roll or pitch stick of the transmitter is moved the quadcopter should move in the same direction

ARDUINO CODES

1. Drone Setup

This file contains code for setting up the drone

Drone Setup.txt

2. Flight Controller

This file contains the code for setting up the Drone Controller

flight controller.txt

3. ESC Calibration

This file contains the code for calibrating the esc systems

esc calibrate.txt

4. Drone Obstacle Avoidance

Drone Obstacle Avoidance Code.txt

WORKING PRINCIPLE

A quadcopter drone uses the principles of aerodynamics to achieve flight. It features four propellers that generate a high-pressure airflow, which results in an uplift force that counteracts the earth's gravitational pull, enabling the drone to fly. As the propellers rotate, they create a torque force that tends to rotate the drone in one direction. To maintain stability during flight, two propellers are rotated in a clockwise direction, while the other two are rotated in an anti-clockwise direction, cancelling out the torque forces and keeping the system balanced. The flight controller is responsible for regulating the speed and direction of each propeller, allowing for control of the drone's movement. This control is achieved through the use of sensors such as the MPU6050, which provide real-time data on the drone's orientation and movement. By analysing this data and making adjustments to the propeller speed and direction, the flight controller can maintain stable flight and allow the drone to perform various maneuvers.

CONCLUSION

In summary, utilizing an Arduino Uno as a controller for a quadcopter drone can be a fascinating and fulfilling project for enthusiasts and hobbyists alike. The Arduino platform provides an adaptable and customizable solution for handling the drone's motors, sensors, and other components. However, constructing a quadcopter drone can be challenging, requiring expertise and proficiency in electronics, programming, and mechanics. It is essential to meticulously design and assemble the drone, subject it to rigorous testing, and adhere to safety protocols to prevent accidents or equipment damage. Furthermore, it is important to recognize that there are numerous other platforms and technologies accessible for constructing drones, and the selection of Arduino Uno may be influenced by specific requirements or preferences. All things considered, constructing a quadcopter drone using Arduino Uno can be an exciting and informative experience for those with an interest in the field of robotics and automation. This paper has demonstrated the development and execution of a quadcopter drone through the use of an Arduino Uno microcontroller. The drone was capable of executing multiple movements, such as takeoff, hovering, and landing, responding to user commands from the wireless remote control. The quadcopter drone design proposed in this study offers an affordable option for creating a drone suitable for a variety of purposes.

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