Quaduino

Project Report

Course Name: Electronics in Service to Society (R4EC30116L)

Date: January-May 2023

Team Members:

Chirag Patil

Email: cupatil_b20@el.vjti.ac.in

Yash Deshpande

Email: yadeshpande_b20@el.vjti.ac.in

Atharva Bendre

Email: aubendre_b20@el.vjti.ac.in

Shreyas Bhatlawande:

Email: sgbhatlawande_b20@el.vjti.ac.in

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1. PROJECT OVERVIEW

What is a Quadcopter?

Quadcopter is an unmanned aerial vehicle (UAV) or drone with four rotors, each with a motor and propeller. A quadcopter can be manually controlled or can be autonomous. It's also called *quadrotor helicopter* or *quadrotor*. It belongs to a more general class of aerial vehicles called multicopter or multirotor.

Components We Used:

- 450 size Quadcopter Frame
- 4 x 1000kV motor, 10x4.5 propellers and 30A ESC Combo
- 3S, 2200 mAh, 30C, 11.1V Lipo Battery
- Arduino Uno
- MPU 6050 Gyroscope/Accelerometer
- Flysky fs-16x Transmitter
- Flysky fs-iA10B Receiver
- OV7670 CMOS VGA Camera Module
- Resistors- 1k, 1.5k, 330 ohms
- 1N4007 1A Diode
- Some LEDs, Jumper Wires, etc

2. OVERVIEW OF THE MAIN COMPONENTS:

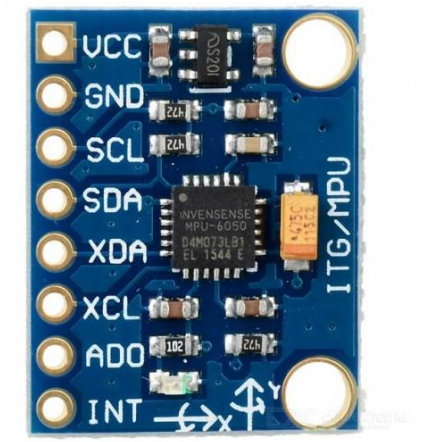
- **1000kV Brushless DC Motors**:
  As their name implies, brushless DC motors do not use brushes. With brushed motors, the brushes deliver current through the commutator into the coils on the rotor. One big advantage is efficiency, as these motors can control continuously at maximum rotational force (torque). The 1000kV rating of the motor means that for every 1 Volt drop in Voltage, the motor increases speed by 1000 rpm. Here we use 11.1V battery and hence the top speed of our motors would be 11,000 rpm.
- **30A ESCs**:
  ESC stand for Electronic Speed Controller. It is an electronic circuit that controls and regulates the speed of an electric motor. The ESCs are directly connected to the battery to draw constant current.
- **3S, 2200 mAh, 11.1V LiPo Battery**:
  This is the main juice of the quadcopter. The battery used is Lithium Polymer battery with 3 cells and a quantity of 2200 mAh which provides a voltage of 11.1V in the circuit. All the components are connected to the battery. This battery should be handled safely as it is combustible and volatile.
- **Arduino Uno**:
  Arduino Uno is the brain of the quadcopter as it controls the flight. All the coding and processing is handled by the Arduino board and the Arduino communicates with the receiver and ESCs to control the motor speed accordingly.
- **MPU 6050 Gyro/Accelerometer**:
  MPU6050 sensor module is complete 6-axis Motion Tracking Device. It combines 3-axis Gyroscope, 3-axis Accelerometer and Digital Motion Processor all in small package. This sensor is used to position the quadcopter and maintain its stability.
- **FlySky fs-i6 Transmitter and Receiver**:
  This is from where the pilot can control the aircraft. It has controls for Throttle, Roll, Yaw and Pitch. For this project we'll be using a readymade Transmitter Receiver Combo, but in the future attempts would be made to make a makeshift Transmitter and Receiver module from scratch. Rest things are self explanatory like resistors, wires, etc.

1000kV Brushless DC Motors

30A ESCs

3S, 2200 mAh, 11.1V LiPo Battery

Arduino Uno



MPU 6050 Gyro/Accelerometer

FlySky fs-i6 Transmitter and Receiver

3. METHODS & STAGES OF PROGRESS

The Actual Build Process:

We referred to a lot of YouTube video tutorials for guidance. The one playlist by Joop Brokking attracted us and we decided to go along with it. We bought the parts, assembled them according to the circuit diagram and the basic was ready. The next tough part was to program the Arduino board to make the quadcopter work. Though the program codes were available on Joop Brokking's website, we decided to go through it and understand the code where we decipher what line of code does exactly what job.

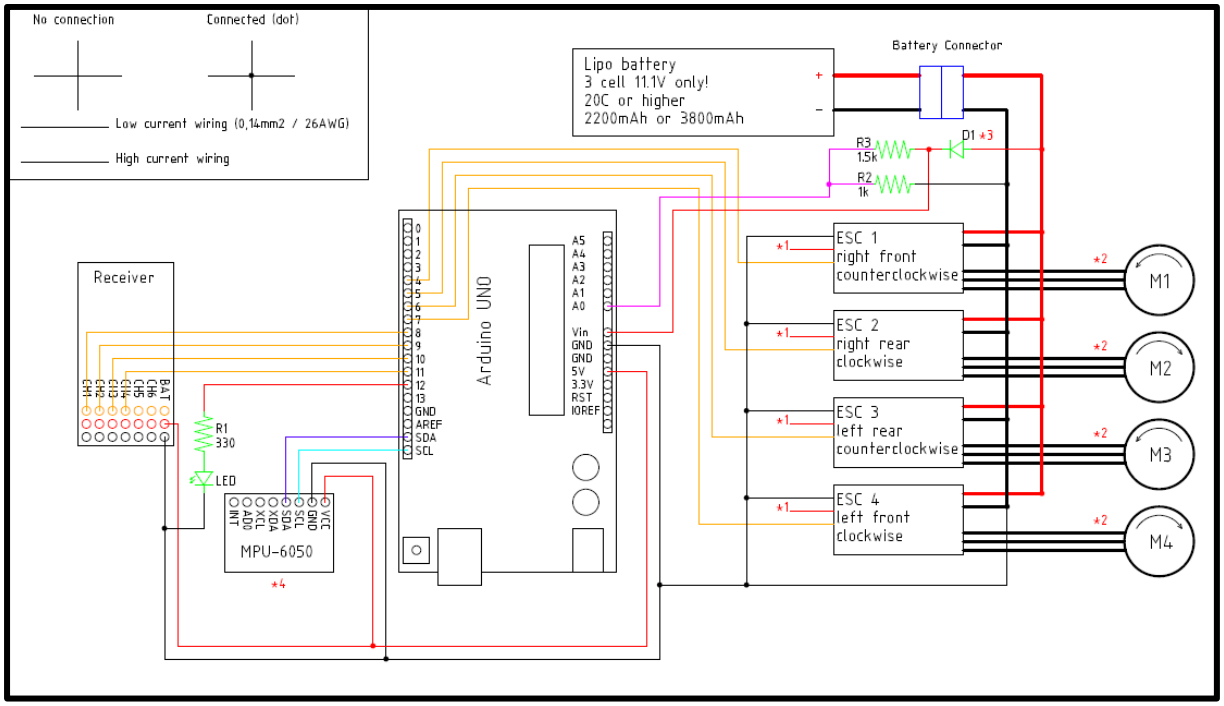
There are three sets of codes-

1) **Setup**: where we initialize the Arduino Uno for the quadcopter code and set up and calibrate the MPU 6050 sensor

2) **ESC Calibration**: This is the most important step as it makes sure the motors are spinning in accordance with each other, and finally

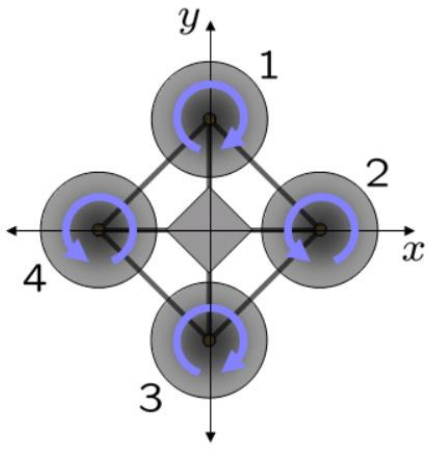
3) **Flight Controller**: This program loads the actual flight control data onto the Arduino and after this step, the drone is ready to fly.

Circuit Diagram for the Connections:



But how does a Quadcopter work?

Quadcopters make use of 4 Motors. Two of these motor spin clockwise while the other two spin counterclockwise. Motors on the same axis spin in the same direction, as illustrated here. It uses the basic principle of Newton's Third Law of motion by pushing the air opposite to the direction of desired motion and moving around.



FINAL BUILD PHOTO:

4. CONCLUSION & FUTURE WORK

Applications of the Quadcopter:

1. AERIAL PHOTOGRAPHY:
Drones are now being used to capture footage that would otherwise require expensive helicopters and cranes. Fast paced action and sci-fi scenes are filmed by aerial drones, thus making cinematography easier. These autonomous flying devices are also used in real estate and sports photography. Furthermore, journalists are considering the use of drones for collecting footage and information in live broadcasts.

2. GEOGRAPHIC MAPPING:
Available to amateurs and professionals, drones can acquire very high-resolution data and download imagery in difficult to reach locations like coastlines, mountaintops, and islands. They are also used to create 3D maps and contribute to crowd sourced mapping applications.

3. SHIPPING AND DELIVERY:
Major companies like Amazon, UPS, and DHL are in favor of drone delivery. Drones could save a lot of manpower and shift unnecessary road traffic to the sky. Besides, they can be used over smaller distances to deliver small packages, food, letters, medicines, beverages and the like.

4. DISASTER MANAGEMENT:
Drones provide quick means, after a natural or man-made disaster, to gather information and navigate debris and rubble to look for injured victims. Its high definition cameras, sensors, and radars give rescue teams access to a higher field of view, saving the need to spend resources on manned helicopters. Where larger aerial vehicles would prove perilous or inefficient, drones, thanks to their small size, are able to provide a close-up view of areas.

5. SEARCH AND RESCUE:
Presence of thermal sensors gives drones night vision and makes them a powerful tool for surveillance. Drones are able to discover the location of lost persons and unfortunate victims, especially in harsh conditions or challenging terrains. Besides locating victims, a drone can drop supplies to unreachable locations in war torn or disaster stricken countries. For

example, a drone can be utilized to lower a walkie-talkie, GPS locator, medicines, food supplies, clothes, and water to stranded victims before rescue crews can move them to some place else.

6. WEATHER FORECAST:
Drones are being developed to monitor dangerous and unpredictable weather. Since they are cheap and unmanned, drones can be sent into hurricanes and tornadoes, so that scientists and weather forecasters acquire new insights into their behaviour and trajectory. Its specialized sensors can be used to detail weather parameters, collect data, and prevent mishaps.

7. PRECISION AGRICULTURE:
Farmers and agriculturalists are always looking for cheap and effective methods to regularly monitor their crops. The infrared sensors in drones can be tuned to detect crop health, enabling farmers to react and improve crop conditions locally, with inputs of fertilizer or insecticides. It also improves management and effectuates better yield of the crops.

Issues being Faced:

Although the entire process was a guided process, problems were not at bay. The major problem persistent is the random auto resetting of the Arduino board.

The motors while spinning suddenly stop mid-flight and the calibration fades away. We've been looking into this issue but couldn't find a viable solution till date though works over it are all in process.

Hence due to this reason, we restrict the quadcopter to a maximum flight time of 2 minutes in order to look for safety and not to damage the frame.

Future Scope

In the future we plan on adding a GPS module over it so that it can automatically land based on satellite signals.

We also plan on mounting a proximity sensor on either side of the quadcopter so that it doesn't crash along walls by quickly moving away from them.

And other similar things such as a Barometer, a Gimbal and Video Camera would be added to the quadcopter to enhance its utility.

5. REFERENCES

- Blog reference:

  Joop Brokking's YMFC-3D

- Video References:

  Joop Brokking's Video Tutorials

  Swapnil Nimbalkar's Arduino Drone