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Quadcopter Drone With Claw Mechanism For Delivering Objects Or Collecting Samples

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Abstract
In addition to providing a thorough examination of quadcopter drone, this article presents the results of quick deployment systems. Besides keeping the quadcopter stable for a continuous lift, we added a claw mechanism to our design using a 3D print model. The drone with claw mechanism will provide operators with the freedom to use the drone in a wide variety of tasks including delivering objects or collecting samples from different environments.

Keywords: *Quadcopter, drone, microcontrollers, robot.*

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I. Introduction

The society we live in now is changing quickly; this project was fascinating and explored many aspects of programming. Research has been conducted over the past few decades on a variety of materials and tools that aid in the creation of tiny chips for use in a range of applications including robots and drones [1-14]. Professional drone operators are increasingly using the F450 drone since it is a powerful and adaptable aerial vehicle. The F450's robust structure and effective design allow it to carry a variety of weights and carry out a wide range of jobs. The F450 drone is a dependable option with great performance and control, whether you're a hobbyist exploring the skies or a professional looking for a trustworthy instrument for aerial photography or surveillance. The main elements, improvements, add-ons, cutting-edge technologies, and control options that set the F450 drone apart in the drone market will all be covered in detail in this research.

Imagine a future in which the F450 Nylon Fiber Flame Wheel Frame Drone allows drones to fly with exceptional agility and precision. This innovative platform prepares us for our journey as we explore the intricate network of parts that give these airborne drones life, such as the 1000KV Brushless Motor and KK V2.3 Flight Controller. Our drone is ready for smooth flying experiences like never before thanks to the coordinated operation of its propellers, batteries, and ESCs.

Using a 3D print model of a claw attachment that our university's STEM facilities provided, we added a claw to our design while attempting to determine how to maintain the quadcopter stable for a continuous lift (Figure 1). After the print design was complete, we had to consider the best location for it to be placed without interfering with the drone's many specifications and circuits.

Figure 1: Quadcopter Drone with Claw Mechanism

Instruments and components:

- Zip ties, Velcro straps, 3m Adhesive, Allen wrench
- Transmitter controller, 2.4 GHz radio transmitter, multi-copter controller, Hook and spring
- Li-Po Battery high discharge
- Compact Charger 3 port 800mA, 2 cable
- Two sets of 2x propellers with rings- 3x- small, 1x- skinny, 2x- medium format
- 1x Frame plate (top), 1x Frame plate (bottom), 2x Arm (Red), 2x Arm (white)
- 1x Frame plate (bottom), 4x 5V power amp w/ connections
- 25x Hex top screws
- 4x Quad plate, 16x hex top screw, 4x motor hold screw (3 pieces), 4x motor 1000KV

Figure 2: 1000KV Brushless motor

Procedure

To maximize the F450 drone's performance and operation, it is necessary to comprehend its basic components. Every element is crucial to maintaining formality for an accurate drone. Combining parts like the 1000KV Brushless Motor (Figure 2) and KK V2.3 Flight Controller allows the drone to fly with precision and steadiness. The 30C 3s LiPo Battery and the CW & CCW 1050 Propellers provide the drone the thrust and power efficiency. It needs to move through a variety of terrains. The 2-4s 30A RC Brushless ESC improves overall flying performance by assisting with responsive and smooth motor control.

An electronic speed controller is a tool used to regulate a drone's motor speed. The electrical speed controller we acquired as a group It functions as the system's brain, directing the motor's speed in response to data received from the transmitted controller. Additionally, it serves as a mediator between the electric motor and the battery. Timed electric signals that are converted into speed changes drive the motors attached to the electronic speed controller. It creates an alternating three-phase current that is transmitted to the motor by combining the direct current from the battery with a switch mechanism. Alternating current is generated, transmitted, and distributed using a three-phase current system. They are used to transmit throttle data from the controller to the ESC. There are various protocols, including Dshot, Oneshot, Multishot, and Pulse Width Modulation. The frequency at which the signals are delivered is the primary distinction between the protocols. It's important to keep in mind that shorter frequencies result in faster signals and faster drone reaction times. The F450 drone operates on the Pulse Width Modulation (PWM) protocol.

One part of a drone that serves as the brain of the whole thing is the flight controller. It's the most important component a drone needs. A flight controller's duties include sending data to the pilot, ensuring precise flight maneuvers, and stabilizing the aircraft. Depending on the action, it processes many signals and information before distributing them to various components. To determine the ideal speed for each of the four motors, it collects sensors. By doing this, it communicates its intended speed to the electronic speed controller, which converts it into a signal that all four motors can comprehend. The accelerometers and gyroscopes are the sensors found in a flight controller. An accelerometer measures acceleration or vibration in motion based on the object, whereas a gyroscope measures changes in rotation angle per unit of time. Different firmware choices are available for different applications, each offering unique features and specializations. Every firmware has a unique user interface and modifiable parameters. The KKK v2.3 is the flight controller that powers our drone. The Atmega integrated circuit, which is compatible with the Arduino Uno controller, is obtained by this kind of flight controller. The yaw, pitch, and roll potentiometers are three parts that keep the aircraft stable during flight. Both the transmitter controller and the flight controller must undergo "calibration" to guarantee excellent flight

stability. For the flight procedures to have fewer issues, both need to be fixed. The drone is likely to develop numerous technical problems if they are not calibrated.

High-performance 1000KV brushless motors, renowned for their dependability and efficiency, power the F450 drone. To raise the drone off the ground and preserve stable flying characteristics, these motors provide enough push. Compared to conventional brushed motors, these brushless motors are more durable and require less maintenance, which makes them perfect for demanding aerial maneuvers and extended flight periods. Propeller size and voltage input are two of the variables that affect the 1000KV Brushless Motor's performance.

While larger propellers can produce greater lifts but may require higher motor torque, higher voltage inputs result in increased thrust production and revolutions per minute (RPM).

Figure 3: Propellers of Drone

The CW and CCW 1050 propellers (Figure 3), which are essential for creating a lift and moving the drone forward, are a perfect match for brushless motors. These propellers are expertly crafted to deliver the perfect amount of thrust while preserving efficiency and balance. The F450 drone can move with accuracy and agility thanks to the combination of clockwise (CW) and counterclockwise (CCW) propellers, which provide steady and regulated flight performance. The propeller blade dimensions are indicated by the "1050" designation. The propeller is 10 inches in diameter and 5 inches in pitch. The opposing rotation of one CW propeller and one CCW propeller on each motor eliminates torque effects and aids in drone stabilization while in flight.

Upgrading to a premium 30C 3s LiPo battery is an essential improvement for the F450 drone. Compared to conventional batteries, this kind of battery has higher discharge rates, which means it can provide more power and longer flight periods. The drone can stay in the air for longer because of its enhanced battery capacity, making its flights more interesting and adaptable.

Given that it facilitates communication between the transmitter and the drone and converts pilot orders into actions, the receiver is also an essential part. A dependable and high-performing choice, the R8EF RC receiver provides secure and steady signal receiving, guaranteeing smooth control and responsiveness when flying. This receiver can improve the drone's remote-control system's range and dependability with features including an antenna and cutting-edge signal processing technologies.

The F450 drone's ability to be used with a drone claw attachment (Figure 4) is one of its best qualities. This add-on expands the drone's capabilities by enabling it to pick up and transport small objects. The drone claw attachment expands the scope of your drone adventures, whether your goal is to carry out rescue operations, deliver small products, or just do some inventive flying activities.

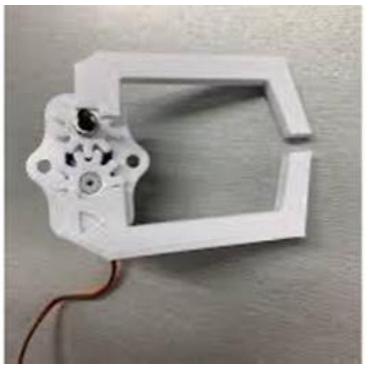

Figure 4: Claw Mechanism of the Drone

This C++ program (Figure 5) is designed for use with an Arduino Uno. The program utilizes solely the claw attachment for it to detect and pick up small objects. Because our claw requires arms 1 and 2 to open/close, we would need to incorporate and connect a servo motor to the claw, connecting from the receiver of the F450 drone to the Arduino board. This is where the code is crucial for the efficiency of the claw. The term "include" & "servo.h" means the library that is necessary for the claw and specifically utilizing the settings for the servo motor. To ensure proper interaction, we use "void setup" to establish and prepare any setup required at the beginning of the program. Serial.begin (9600) means a serial communication that sends commands through the USB cable. It ensures the fast transfer of data to be sent known as "Baud Rate". Once the void setup is completed, we must use the void loop which will ensure that code runs continuously instead of just one time only. Lastly, for the claw to open with its arms, we must set the execution as microseconds between 1000 & 2000. This means that the claw will open/close at 0 degrees & 180 degrees of angle.

```
#include <Servo.h>

Servo esc; //Creating a servo object with name as esc

unsigned long duration;

void setup()
{
esc.attach(9); //Servo motor is connected to pin 9
esc.writeMicroseconds(1000); //initialize the signal to 1000 for 0 degree rotattion
pinMode(7, INPUT);//reading from signal pin of R8EF

Serial.begin(9600);// to see the serial monitor

}

void loop()
{
duration = pulseIn(7, HIGH); //The length of the PWM pulse from R8EF (in microseconds)

if (duration > 1500)
  {
  esc.writeMicroseconds(2000); //2000 for 180 degree rotation of servo motor
  }
else
  {
  esc.writeMicroseconds(1000); //1000 for 0 degree rotation of servo motor
  }

Serial.println(duration);//printing in the serial monitor

delay(100);

}
```

Figure 5: C++ code for the claw mechanism of the drone

The T8FB remote transmitter, a high-performance controller that provides accurate and responsive control over the drone's flight, is paired with the F450 drone. Pilots can maneuver the F450 with ease and accuracy thanks to the T8FB transmitter's controls and design. The T8FB transmitter puts control in your hands, allowing you to do intricate maneuvers and modify flight characteristics.

The F450 drone provides both novice and expert drone enthusiasts with a dynamic and thrilling flying experience thanks to its sophisticated features and control capabilities. Unleash the F450's full potential with its sophisticated features and accurate controls and enjoy the exhilaration of flying like not before.

II. Conclusion

To put it simply, the incorporation of quadcopters is a big step toward improving maneuverability in a variety of operational areas. We may traverse the intricacies of the contemporary world with more agility, resilience, and compassion by utilizing innovation, moral values, and cooperative endeavors.

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References

[1] M. R. K. Akanda, "Catalogue Of Potential Magnetic Topological Insulators From Materials Database", Iosr Journal Of Applied Physics (Iosr-Jap) 15 (3), 22-28 (2023)

[2] M. R. K. Akanda, "Scaling Of Voltage Controlled Magnetic Anisotropy Based Skyrmion Memory And Its Neuromorphic Application", Nano Express 10, 2 (2022). Https://Iopscience.Iop.Org/Article/10.1088/2632-959x/Ac6bb5/Pdf

[3] Md. Rakibul Karim Akanda And Roger K. Lake, "Magnetic Properties Of Nbsi2n4, Vsi2n4, And Vsi2p4 Monolayers", Applied Physics Letters 119, 052402 (2021). Https://Doi.Org/10.1063/5.0055878
[4] Md. Rakibul Karim Akanda, In Jun Park, And Roger K. Lake, "Interfacial Dzyaloshinskii-Moriya Interaction Of Antiferromagnetic Materials", Phys. Rev. B 102, 224414 (2020). Https://Journals.Aps.Org/Prb/Abstract/10.1103/Physrevb.102.224414
[5] M. R. K. Akanda, "Catalog Of Magnetic Topological Semimetals", Aip Advances 10, 095222 (2020). Https://Doi.Org/10.1063/5.0020096
[6] M. R. K. Akanda And Q. D. M. Khosru, "Fem Model Of Wraparound Cntfet With Multi-Cnt And Its Capacitance Modeling", Ieee Transactions On Electron Devices 60, 97–102 (2013). Https://Ieeexplore.Ieee.Org/Abstract/Document/6375797
[7] Yousuf, A., & Akanda, M. R. K. (2023, June), *Ping Pong Robot With Dynamic Tracking* Paper Presented At 2023 Asee Annual Conference & Exposition, Baltimore, Maryland. Https://Peer.Asee.Org/43897
[8] M. R. K. Akanda And Q. D. M. Khosru, "Analysis Of Output Transconductance Of Finfets Incorporating Quantum Mechanical And Temperature Effects With 3d Temperature Distribution", Isdrs, 1–2 (2011), Https://Ieeexplore.Ieee.Org/Abstract/Document/6135292
[9] M. R. K. Akanda, R. Islam, And Q. D. M. Khosru, "A Physically Based Compact Model For Finfets On-Resistance Incorporating Quantum Mechanical Effects", Icece 2010, 203–205 (2010). Https://Ieeexplore.Ieee.Org/Abstract/Document/5700663
[10] M. S. Islam And M. R. K. Akanda, "3d Temperature Distribution Of Sic Mesfet Using Green's Function", Icece 2010,13–16 (2010). Https://Ieeexplore.Ieee.Org/Abstract/Document/5700541
[11] M. S. Islam, M. R. K. Akanda, S. Anwar, And A. Shahriar, "Analysis Of Resistances And Transconductance Of Sic Mesfet Considering Fabrication Parameters And Mobility As A Function Of Temperature", Icece 2010, 5–8 (2010). Https://Ieeexplore.Ieee.Org/Abstract/Document/5700539
[12] Md. Rakibul Karim Akanda, In Jun Park, And Roger K. Lake, "Interfacial Dzyaloshinskii-Moriya Interaction Of Collinear Antiferromagnets Mnpt And Nio On W, Re, And Au", Aps March Meeting (2021). Https://Ui.Adsabs.Harvard.Edu/Abs/2021aps..Mare40004a/Abstract
[13] Rakibul Karim Akanda, "3-D Model Of Wrap Around Cnteft With Multiple Cnt Channel And Analytical Modeling Of Its Capacitances", Department Of Electrical And Electronic Engineering (Eee) 2013.
[14] Akanda, Md. Rakibul Karim, "Magnetic Properties Of Ferromagnetic And Antiferromagnetic Materials And Low-Dimensional Materials", University Of California, Riverside Proquest Dissertations Publishing, 2021, 28651079.