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Delivery of Basic Commodities using Drone

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Abstract - *This article presents the delivery of basic commodities by using flying drone. First there was bandied construction of the drone, which the most important rudiments are frame, propellers, machine, system of power the electronic control and communication system. The rapid-fire increase in operation of online ordering has increased the demand of force to deliver in multiple crowds. Drone grounded technology is being used to meet this demand for delivering medical appliances. A Hexacopter can achieve perpendicular flight in a stable manner and be used to cover or collect data, delivery in a specific region. With advancing Drown. Healthcare professionals can use drones to transport crucial information such as laboratory reports and medications, as well as conduct routine safety check-ups and to transfer basic commodities. Public frequently need to transport commodities in a timely manner, making traditional options like aero planes and buses impracticable.*

The main objective of this study is to design and manufacture the low cost and low weight hexacopter platform prototype for the delivering commodities to the customers.

Key Words: Hexacopter, Commodities, Medications, Lab repots, Prototype.

1. INTRODUCTION

Drone delivery operations have gained wide attention recently given their potential to save time and cost while reducing environmental impact, delivery is one of the most prominent, because drone delivery could potentially improve the delivery speed of perishable medical appliances. Initially shrouded in mystery due to its predominant use in the military, unmanned aerial vehicles or drones are now ubiquitous in various aspects of life, including civilian, recreational, and military use. They can land and take off on a variety of surfaces, ranging from grassy fields to sandy beaches and asphalted runways. The utilization of drones, which are unmanned aerial vehicles, for civilian purposes has seen a rise in terms of their quantity, dimensions, and weight, as well as the scope of their use.

Drones have the capability to transfer medical supplies such as pharmaceuticals, vaccines, blood products, and medical samples. Unlike motorcycles or trucks, medical deliveries using drones can reach remote or hard-to-reach areas. The utilization of drones for medical delivery has been acknowledged for its life-saving impact during urgent blood deliveries.

The operation of drones can be carried out through remote control using radio waves or autonomously, following a pre-programmed route. Drones often have optoelectronic heads installed on them for the purpose of surveillance and monitoring. The key benefit of drones is that they can rapidly observe and monitor a specific area or object without requiring any supplementary infrastructure. One major advantage is their ability to react quickly due to their short response time.

2. Drone construction:

Drone is composed of two major systems:

1. Movement system
2. Control system.

2.1 Movement system frame:

The fundamental component of a drone is its frame, which must be as lightweight as possible. The primary factor for categorizing frame construction is the quantity of arms utilized. Figure 1 displays the potential options for constructing frames. The categorization of drones is determined by the number of arms and motors employed, resulting in:

a) Bicopters – two engines,
b) Tricopters – three engines,
c) Quadro copters – four engines,
d) Hexacopter – six engines,
e) Octocopters – eight engines.

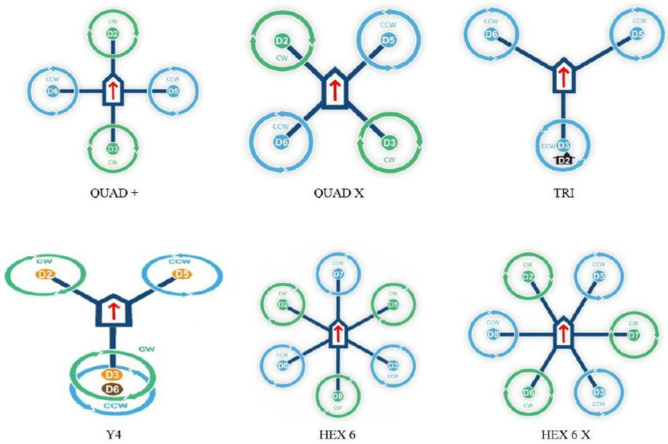

Fig-1: various copters

It is generally recognized that the construction with more arms allows for a more stable flight. The frame is made of carbon cloth 3K. Carbon cloth high stiffness, high tensile strength, high strength to weight ratio, high chemical resistance, high-temperature tolerance, and low thermal expansion. Hexacopter with s550 frame is shown in Figure 2(a) and 2(b). The frame has the wheelbase of 550mm and whole frame kit weighs around 760gm. Some aspects to take into consideration when constructing a drone are the following:

a) **Lift capacity:** It is important to know the weight of all components so that the total weight is not heavier than the total thrust from the motors.

b) **Energy:** The amount of energy on a drone is limited to the capacity of the battery. Increasing the capacity of the battery means adding more weight, more weight means more thrust is needed, more thrust means a higher energy consumption, therefor conservation of energy is important. Each component on the drone requires power, and it is necessary to maintain a balance between the overall power consumption and the total capacity.

Fig-2(a): S550 Frame of Hexacopter (Before assembling)

Fig-2(b): S550 Frame of Hexacopter (After assembling)

One of the main benefits of utilizing Hexacopter is that if one or more motors fail, the drone is still able to land safely, unlike quadcopters which will crash. The S550 Hexacopter frame kit is a high-grade, lightweight structure that includes landing gear made of carbon fiber and a printed circuit board (PCB) integrated into it, making wiring easy and organized. The integrated PCB simplifies the wiring process and ensures a clean appearance. The following are the main features of S550 hexacopter:

a) Made by advanced engineering material, super strong & smooth.

b) Easy to assemble and disassemble.

c) The frame is tough and durable.

d) The main glass fiber frame has good strength.

e) The support ridges attached to the arm enhance the forward flight by providing improved speed and efficiency.

f) Features pre-threaded brass sleeves.

g) Large mounting tabs for camera mounting.

h) PCB for easy and neat wiring.

i) Easy assembly.

2.1.1 Propellers and engine:

Following the drone's body, the subsequent crucial parts are the propellers and the engine. The propellers serve as the primary propulsion mechanism of a drone and are subjected to significant stress, highlighting the significance of their durability. The propellers convert the torque generated by the engine into the lifting force that raises the drone into the air. The categorization of drone types is based on the propeller system concerning the direction of flight, which results in the following classifications:

1. + – One is the leading propeller (at least four propellers),
2. X – The most common construction, in which two propellers are leading (with an even number of propellers),
3. Y – Three arms stacked in the Y, where one or two arms can be leading,
4. V – An uncommon configuration involves outstretched arms with two propellers positioned at the front,
5. H – A very rare arrangement where the construction is based on the H-shaped with two propellers leading.

Propellers are instruments that convert rotational motion into linear thrust. In drones, these propellers generate lift by rotating and creating an airflow, which creates a difference in pressure between the top and bottom surfaces of the propeller. This results in a force that propels the drone upwards, countering the effect of gravity. Electronic Speed Controllers (ESCs) are responsible for varying the propeller speeds by regulating the voltage supplied to the motor. The drone's flight controller receives inputs from the human pilot or autopilot, and may also use data from an Inertial Measurement System (IMU), GPS, and other sensors to send the appropriate signal to the ESC. It is critical for propellers to operate optimally as they bear the highest loads and serve as the primary propulsion system of a drone.

By mounting double propellers onto fewer arms, a drone's strength is enhanced, resulting in increased lift capacity and redundancy in the event of engine failure. This design also reduces the overall weight of the multicopter, lowers material costs, and allows for heavier payloads. The opposing rotations of the double propellers balance each other's inertia forces. Additionally, drone wings can be classified according to their adaptability for rotation:

1. Clockwise (CW),
2. Counter Clock Wise (CCW).

Fig-3: Propellers

The size of the wings is a critical factor as it affects the drone's speed and stability. A larger wing diameter reduces the speed and enhances the drone's stability. Additionally, larger wing blades generate greater aerodynamic lift, which results in higher pressure exerted on the propeller hub and increased forces that can cause deformation of the propellers. Furthermore, larger propeller blades require a more powerful engine to handle the torque required to propel the propellers. It is crucial to balance each propeller before using it to minimize vibrations caused by the uneven operation of the system. Selecting the engine and propellers appropriately is vital to enable the drone to lift the given load for an extended period.

Our drone is equipped with six A2212 BLDC Motors, which are commonly used in drones and other multirotor applications. This type of motor is an outrunner brushless DC motor with a 3-phase configuration, as illustrated in Figure 4. It has a 1000KV rating and an 80% efficiency, making it a highly effective motor. An Electronic Speed Controller (ESC) is necessary to regulate the motor's speed. The A2212 1000 KV BLDC Brushless DC Motor for Drones is engineered specifically for multirotor and provides exceptional performance, power, and efficiency. It is ideal for medium-sized quadcopters with 8 to 10-inch propellers.

The A2212 BLDC motor has the following specifications:

a) A kv of 930 RPM per volt, which results in a no-load speed of 10320 RPM with a maximum recommended voltage of 11.1 volts.

b) ESC specifications that recommend a minimum of 18A and a maximum of 30A.

c) At 10V, the no-load current is 500mA.

d) The nominal current is 12A/60s.

e) The motor can be powered by either a 2S or 3S Li-Po battery.

The thrust generated by the motor with a 1045 propeller and 3S power is 800gm.

Fig-4: A2212 BLDC motor

Brush engines have been commonly utilized in the construction of drones, but research has demonstrated that the use of brushless motors enhances durability and efficiency while also decreasing the wear and tear on moving parts. As a result, the engines can operate for extended periods without complications or the need for immediate maintenance.

2.2 The electronic control and communication system:

The flight control system is accountable for managing the drone's ascent, descent, rotation, stability, and response to external forces. Although there may be differences in speed and algorithms used, most control systems are equipped with the same sensors. The control system is comprised of the following components:

a) Flight controller, responsible for machine control capabilities,

b) ESC (Electronic Speed Control) –the unit responsible for engine rpm,

c) Aurdoplot AMP 2.8 controller.

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2.2.1 Flight controller:

Air traffic controllers play a vital role in controlling the movement of planes in and out of airport airspace, guiding drones during take-off and landing, and monitoring drones throughout their flight.

These controllers utilize radio equipment to communicate with drones. For controlling options, we are utilizing the FSCT6B Fly Sky transmitter and receiver, as shown in figure5.

Fig-5: FSCT6B Flight Controller

In order to configure the transmitter and receiver we use software application called T6Config. In this way we configure the transmitter. The following are the steps to configure the transmitter and receiver:

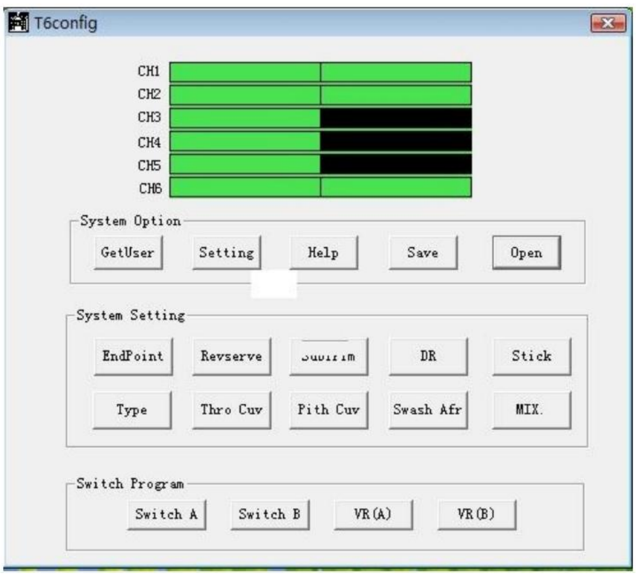

Fig-6: Application Interface

Figure 6 shows the application interface of the T6Configure software.

To initiate the programming process, follow these steps:

Step1: To begin, connect the programming line of the transmitter to a PC and turn on both the transmitter and the application software.

Step2: Next, click the 'SETTING' button and a new screen will appear. This function is designed to enable the selection of the USB port for the programming line, which enhances the communication between the transmitter and PC. It is crucial to ensure the correct port is selected; otherwise, the channel output display will not show any data changes, and any other settings made will be invalid.

Step3: Once the correct port has been selected, Click the 'OK' button to confirm the selection.

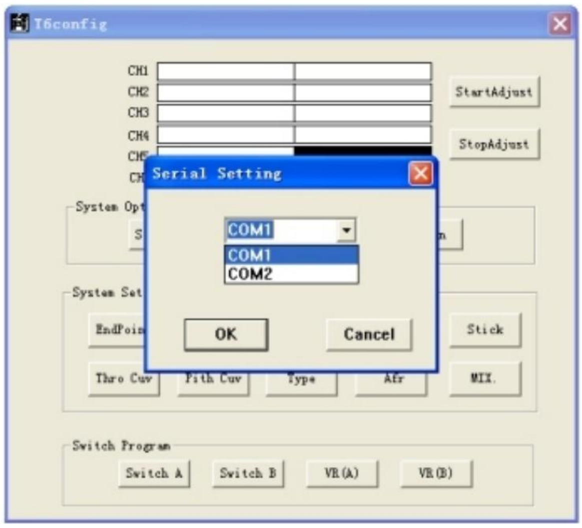

Fig-7: Setting values using T6config

Step3: Modify the server's movement to an appropriate angle for optimal control, as depicted in Figure 8. Each server can be adjusted individually and has two components: the left half and the right half.

The value of each component can be altered between 0% to 100%.

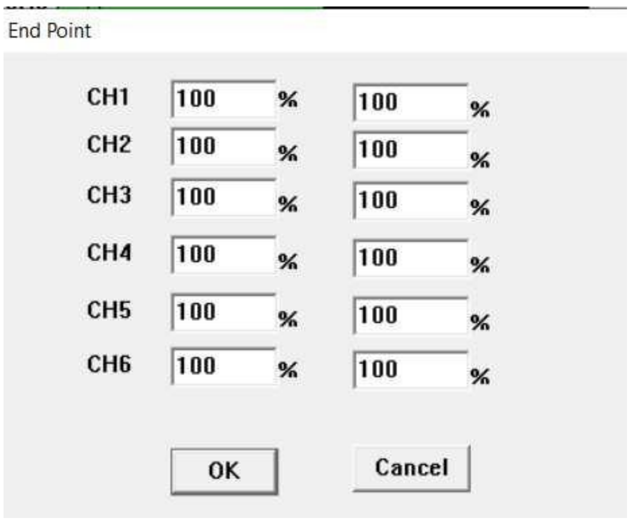

Fig-8: Adjusting the controls

2.2.2. ESC (Electronic Speed Control):

ESC or Electronic Speed Control is a component that enables the drone's flight controller to regulate and adjust the electric motor's velocity. When the flight controller sends a signal, the ESC adjusts the motor's voltage up or down to vary the propeller's speed accordingly.

The maximum current rating is a common specification for ESCs, as they are responsible for handling the highest current load. ESCs with a larger current-handling capacity are typically bigger and heavier, which may be a crucial factor for smaller unmanned aerial vehicles (UAVs). Furthermore, ESCs have a refresh rate measured in Hertz, which indicates how frequently the motor speed can be modified. To maintain stability and manoeuvrability, multirotor drones like quadcopters rely entirely on rotor speed balance and require precise control over motor RPM, resulting in higher refresh rates for ESCs in these types of drones.

Fig-9: Electronic Speed Controllers

Electronic Speed Controls (ESCs) have the ability to perform active or regenerative braking, a technique that converts a motor's mechanical energy into electrical energy that can recharge the drone's battery. When the drone decelerates, the motor can act as a generator, and the ESC manages the surplus current, which can be directed back into the battery.

3. ArduPilot AMP 2.8 controller:

ArduPilot is a software package that includes navigation software, also known as firmware when compiled for microcontroller hardware targets, which operates on the vehicle, such as Copter, Plane, Rover, Antenna Tracker, or Sub. It also includes software for controlling the ground station, such as Mission Planner, APM Planner, QGround, Control, MA Proxy, Tower, and other applications.

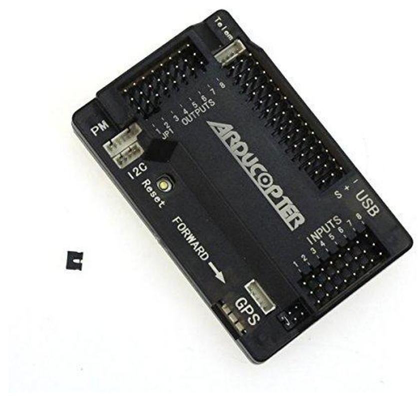

Fig-10: ArduPilot AMP 2.8 controller

This technology provides users with the ability to convert any fixed or rotary-wing vehicle into a completely autonomous mode of transportation, including multirotor vehicles, cars, and boats. Additionally, it is equipped to execute programmed GPS missions that involve navigating through various waypoints.

The Flight Controller displayed in Figure 10, namely the Ardupilot APM 2.8, is an exceptional device that enables the conversion of any fixed-wing, rotary-wing, or multi-rotor vehicle into a fully autonomous one. This remarkable controller facilitates numerous tasks, including GPS-programmed missions with waypoints, thanks to its integrated compass.

4. Mission Planner's Programmable Functions:

Mission Planner is a ground station program that enables the user to:

1. Plan drone missions
2. Monitor flights in real-time
3. Adjust autopilot settings
4. Troubleshoot autopilot issues

4.1. Take Off:

This function initiates the following actions:

- Directs the drone to take off from the ground.
- Specifies the pitch angle for fixed-wing drones.
- Establishes a desired altitude for ascent.

Fig-11: Waypoints in Mission Planner

4.2. Landing:

- Sends a command to the drone to land at a specific location.
- ArduCopter will descend to 10m above ground level and then gradually descend until it reaches the ground.
- ArduPlane will maintain its current heading and shut off the throttle when the drone is within 2 seconds of the landing point or within 3 meters of the landing point.

Fig-12: Adjusting Landing points in Ardupilot.

4.2. Waypoints:

- The most fundamental instruction in a drone mission.
- Guides the drone to a specific location in three dimensions.

Fig-13: Adjusting Waypoints in Ardupilot.

5. Power Module:

The Power Module is a straightforward method of supplying your APM with clean power from a LiPo battery while also measuring current consumption and battery voltage through a 6-position cable.

Fig-14: Power Module

6. Battery:

Drone operation requires the use of on-board batteries. Lithium polymer (LiPo) batteries are commonly employed due to their high energy density relative to their size and weight, providing a higher voltage per cell and powering the drone's on-board systems with fewer cells than other rechargeable batteries, as illustrated in Figure 14. LiPo batteries are similar to other batteries in terms of their basic principle of operation and chemical reactions taking place in the cell. In Li-ion cells, one electrode is made of porous carbon, and the other is composed of metal oxides, with the role of the electrolyte being played by complex lithium salts dissolved in a mixture of organic solvents. LiCo2 is the most commonly used cathode material.

Fig-15: Lithium Battery

7. DEVELOPED PROJECT:

Fig-16(a): Front View of Drone (Hexacopter)

Fig-16(b): Top View of Drone (Hexacopter)

8. SUMMARY

This undertaking focuses on a methodical approach to online delivery utilizing an automated Hexacopter that employs an interfaced android device as its primary processing unit. The Hexacopter will utilize Google Maps to deliver packages to clients, thus saving time and labour. Eventually, solar energy will replace battery power as the main source of energy. The goal is to continue optimizing the cost of utilizing Hexacopter for product delivery so that low-income individuals can use them more readily.

9. CONCLUSION

In conclusion, the Hexacopter project has been a challenging and rewarding experience that has demonstrated the power and potential of UAV technology. Through the use of a range of technical skills and tools, including T6 Configure and Mission Planner, we have been able to design, build, and operate a sophisticated hexacopter system that can achieve a range of applications, from aerial photography and videography to search and rescue operations. Throughout the project, we have encountered a range of technical and engineering challenges, such as selecting the appropriate components, designing and assembling the drone, and testing and optimizing its performance. However, through careful planning, design, and testing, we have been able to overcome these challenges and achieve optimal performance and functionality from the hexacopter system.

REFERENCES

[1] Castillo, Lozano & Dzul, "Modelling and Control of Mini-Flying Machines," Special issue 2005 Springer PP-39-59.

[2] The Global Drone Revolution. Aerial Transport, Agritech, Commerce & Allied Opportunities

[3] Setting Manual for Black or Blue version (Atmega168) Volume[1] PP112[Online].Available:http://www.kkmulticopter.kr/?Modea=manual [Special issue March 29,2014]

[4] Kardasz P, Doskocz J, Hejduk M, Wiejkut P, Zarzycki H (2016) Drones and Possibilities of Their Using. J Civil Environ Eng 6: 233.

[5] Piotrowski P, Witkowski T, Piotrowski R (2015) Unmanned remote-controlled flying unit. Measurement Automation and Robotics 19: 49-55.

[6] Bogusz P, Korkosz M, Wygonik P, Dudek M, Lis B (2015) Analysis of the impact of a supply source for the properties brushless DC motor with permanent magnets designed to drive a flying unmanned camera. Overview Electrotechnical 5.

[7] Alberstadt R (2014) Drones under International Law. Open J Political Sci 4.

[8] Bardley TH, Moffitt BA, Fuller TF, Mavris D, Parekh D (2013) Design studies for hydrogen fuel cell powered unmanned aerial vehicles. Am Institute of Aeronautics and Astronautics.

[9] Ogden LA (2013) Drone Ecology. BioSci 63: 776.

[10] Puttock AK, Cunliffe AM, Anderson K, Brazier RE (2015) Aerial photography collected with a multirotor drone reveals impact of Eurasian beaver reintroduction on ecosystem structure. J Unmanned Vehicle Systems 3: 123- 130.

[11] Rango A, Laliberte A, Steele C, Herrick JE, Bestelmeyer B (2006) Using unmanned aerial vehicles for rangelands: current applications and future potentials. Environ Practice 8: 159-168.