REVIEW OF THE UNMANNED AERIAL VEHICLES (UAV) TECHNOLOGY

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ABSTRACT

An unmanned aerial vehicle (UAV), commonly known as drone is an aircraft without any human pilot, crew, or passengers on board. UAV can fly for long periods of time at a controlled level of speed and height. The basic components of a drone are the frame, motors, propellers, battery, flight controller, and sensors engine, power system, electronic control, and communication system. There are numerous civilian, commercial, military, and aerospace applications for UAV. In recent years, autonomous drones have begun to transform various application areas as they can fly beyond visual line of sight while maximizing production, reducing costs and risks, ensuring site safety, security and regulatory compliance. In present investigation, different types of drones and their technical designing has been discussed.

Keywords: UAV, drone, motor, propeller

INTRODUCTION

Any aircraft or flying machine operated without a human pilot is called an unmanned aerial vehicle (UAV) or drone[1,2]. It can be guided autonomously or remotely by a human operator using onboard computers and robots. The first recognized drone was the 'Aerial Target' used by the British Royal Navy in 1917 during World War I[3]. Drones have become increasingly popular in recent years. UAVs were originally developed through the twentieth century for military missions and by the twenty-first, they had become essential assets to most militaries. As control technologies improved and costs fell, their use expanded to many non-military applications. These include aerial photography, precision agriculture, forest fire monitoring, environmental monitoring, policing and surveillance, infrastructure inspections, smuggling, product deliveries, entertainment, and drone racing [4-6]. The basic components of a drone are the frame, motors, propellers, battery, flight controller, and sensors [7].

Parts of UAV: UAVs have several parts;

- Frame: It is a basic structure, within which all other drone parts fit.
- Motors: Generate the force to rotate the propellers and propel the drone.
- Electronic Speed Controller (ESC): An electronic control panel varies the speed of the motor and also works as a dynamic brake.
- Flight Control: This is the brain of the drone. The flight controller takes in inputs from the GPS module, compass, obstacle avoidance sensors, and the remote controller and processes it into information that is given out to the ESCs to control the motors.
- Propeller: Propellers are devices that transform rotary motion into linear thrust. Drone propellers provide lift for the aircraft by spinning and creating an airflow, which results in a pressure difference between the top and bottom surfaces of the propeller.
- Radio transmitter: It is used as a channelized transmitter and communicator with drones.

- Battery, power distribution cables: This battery acts as the power source for the drone. It supplies power to all electronics through power distribution cables.
- Camera: High resolution camera is mounted on the drone and used to capture, save and transmit the photos and video.
- Landing gear: It is used to land the drone safely. An experienced user can balance the motor speed for a safe landing in emergencies.
- First-person video: The control device interface (transmitter) is more expensive than the screen, giving the user an interactive 3D viewing experience also known as first-person point of view (POV). First Person View (FPV) gives an ultimate feeling to the user as if he is flying.

Technological aspects of UAV: In view of technological development and design of UAV various principles of Physics and Engineering are very important. Understanding and development of drones depend on many subjects. The design of drone for a particular application comprises many factors like aerodynamic shape of propellers, strength and weight of drone parts, electric motor, electric speed controller, radio transmitter or receiver, and software interface on mobile or computer for monitoring and data analysis.

Shape designing: The shape, size, and speed of the propeller and drone depending on the aerodynamics of propellers or blades. Fluid dynamics plays an important role to decide the forces acting on the body of a drone. Computational Fluid Dynamics (CFD) modeling of turbo-machinery is essential to decide the amount of thrust generated by propellors and helps for flow dynamics of airflow over drones.

Mechanical Design: Essential factors for mechanical designing of drones are rigid body dynamics to study the motion and forces acting on drones, strength of materials used, and light weight and rigid materials are selected for drone.

Electronics components: Various sensors are used in a drone as per their requirement and application. The position of sensors and their movement give information about the state of the aircraft. Common sensors are laser, radar, camera, gyroscope, accelerometer, compass, barometer and GPS receiver.

Electrical Components: Electric motor with and without brush is required to drive the propellors, Electronic Speed Controller, Flight controller unit and computer processors.

UAV Communication: Drones communication signals include remote control signals, navigation satellite signals, and map transmission signals used by some aircraft types. The remote control sends the upline control data to the drone host, and the host sends the map transmission signal to the remote-control end.

Battery: Light weight and highly efficient wattage battery is important as it improves performance and also increase its lifetime.

Software-based interface: A user interface for data collection and analysis using mobile or computer is required.

TYPES OF UAVs

Over the past decade, drone technology has advanced significantly, making drones inexpensive and increasingly common in both professional and civil environments.
Different types of UAVs are used for various purposes, a simple and practical classification of the different drone types based on various parameters.

Types of drones according to wing types: According to wing types, their uses, their advantages, and disadvantages, there are four main types of drones. They are Multi-rotor drones, Fixed-wing drones, Single-rotor helicopter drones and Fixed-wing hybrid VTOL drones.

Types of drones according to their sizes: Drones can be classified according to their size, from very small drones (nano) to large drones. Very small drones length up to (150mm), Small drones up to (300mm), Medium drones up to (300-1200mm), Large drones more than 120cm.

Types of drones according to their payload capacity: Here the drones are classified according to their weight carrying capacity. How much weight (payload) a drone can carry will depend on the power of the motor, and the lift generated by the propeller in standard weather conditions. The four categories based on the weight of the payload they can carry are as: Featherweight drones payload capacity 4 grams to 100 grams, Lightweight drones capacity with 150-270 grams, Middleweight drones capacity of payload is 400-1460 grams and Heavy-lift drones capacity is more than 1,000 kg.

Types of drones according to drone range (Flight distance): According to the range they can be used for, UAVs can be classified into very close range, close range, short range, mid-range, and long range. For very close-range drones flight distance is up to 5 km, close range drone can fly up to 50 km, range of short range is up to 150 km, mid-range drones can flight up to 644 km and long range drone can fly beyond 644 km. Further, the flight time of drone increases with respect to range.

Types of drones according to number of propellers: According to the number of propellers, they can be classified as Bicopter (2 propellers), Triplecopter (3 propellors), Quadcopter (4 propellers), Hexacopter (6 propellers) and Octacopter (8 propellers). More number of propellers, more is the stability of drones and load-carrying capacity but such drones need more battery power to drive more motors to get high power. Out of these, a quadcopter is a more popular drone for their vertical landing, low cost and compact size.

Types of drones according to their power sources: Power source is essential in working of drone, such as batteries or fuel. Based on the different power sources, drones can also be classified into different types.

1. Battery-powered drones: Three common types of drone batteries include lithium polymer (LiPo), nickel-metal hydride (NiMH), and nickel-cadmium (Nickel-Cadmium) batteries.
2. Gasoline-powered drones: Gasoline is used as fuel for large-sized drones because it is light and cheap. Gas powered drones have long flight times and large payload capacities.
3. Hydrogen fuel cell drones: They are more efficient at high altitudes.
4. Solar drones: Solar-powered drones[8] use the sun as a power source, converting sunlight into electricity in order to charge their batteries. This allows them for long flights as long as the sun is available.

Types of drones according to their usage, abilities & equipment: Toy drones, Photography/ videography drones, Racing drones, Ready-to-fly (RTF) drones, GPS drones, Professional drones, Military drones and Delivery drones.

Types of drones according to motors: According to the motor type, drones are of two types-brushed motor drones and brushless motor drones.

RESULT AND DISCUSSION:

In recent years, autonomous drones have begun to transform various application areas as they can fly beyond visual line of sight while maximizing production, reducing costs and risks, ensuring site safety, security and regulatory compliance, and protecting the human workforce in times of a pandemic. They can also be used for consumer-related missions like package delivery. There are numerous civilian, commercial, military, and aerospace applications for UAVs. These include: General uses like-Recreation, Disaster relief, archeology, conservation of biodiversity and habitat, law enforcement, Aerial surveillance. Their commercial uses include filmmaking, journalism, scientific research, surveying, cargo transport, mining, manufacturing. They are also being used in Forestry e.g., solar farming, thermal energy, firefighting, ports and agriculture. Lot oopportunities can be seen in drone technology but unfortunately, there is also a threat of using them in crime and terrorism. Also lots of challenges are involved with the use and development of drone technology[9] e.g., lack of investment and relevant technology, insufficient research and development have made it harder for India. Present investigation revealed that for specific utilization, particular type of drones are designed and developed. Drones are very helpful for easiness of human life.

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