www.ijbar.org
ISSN 2249-3352 (P) 2278-0505 (E)
Cosmos Impact Factor-5.86

Drones Technology with Advance Controller

[1]A. Rahul, [2]Bipin Kumar sha, [3]D. Harsha Vardhan, [4]M. Sai Krishna, [5]N. Devi Kiran,
[6]M. Swathi, [7]R.S.R. Krishnam Naidu
[1,2,3,4,5]B.Tech Students, Dept. of EEE, NSRIT, Visakhapatnam, AP
[6]Assistant Professor, Dept. of EEE, NSRIT, Visakhapatnam, AP
[7]Professor & HOD, Dept. of EEE, NSRIT, Visakhapatnam, AP
NADIMPALLI SATYNARAYANA RAJU INSTITUTE OF TECHNOLOGY, SONTYAM

Abstract: A drone is a kind of aircraft. A drone is also known as unmanned aerial vehicle (UAV). A drone is 'unmanned' because it does not need a pilot on board to fly it. A person on the ground flies a drone. Some drones are guided by a remote control. Others are guided by computers. Drones are available in different sizes and shapes. Many have cameras that take pictures or record video. Unmanned aerial vehicles, previously used for military purposes, have started to be used for civilian purposes since the 2000s. With the widespread use of unmanned aerial vehicles, mostly used for defence purposes, they have turned into flying vehicles called drones. Today, it is used for different purposes such as taking pictures, taking images from inaccessible places, competitions, and having a good time. However, it continues to evolve, playing an important role in social media and inter-company competition. In recent years, studies have continued on small drones that can fly autonomously, especially in closed areas, and assist people. The cost reduction of electronic components such as microprocessors, sensors, batteries, and wireless communication units shows that drones smaller than 1 kg will soon occur in many areas of our daily life at much more affordable prices.

Key-words: Camera Drone, Racing Drone, Delivery Drone, Surveying Drone, Agriculture Drone, Industrial Drone, Drone for Inspection, Cargo Drone, Fixed-Wing Drone, Hexacopter, Octocopter, Drone with Gimbal, 3D Mapping Drone.

Literature survey:

Drones have gained significant attention in recent years due to advancements in technology. They are used across a wide range of industries, from military and defence to agriculture, logistics, and entertainment. Drones have evolved from primarily being used in military operations to becoming a critical tool for numerous commercial and recreational applications. This literature survey explores the development, technological advancements, applications, and challenges of drone technology.

Introduction:

Drones, also known as unmanned aerial vehicles (UAVs), are aircraft that operate without a human pilot onboard. Instead, they are controlled remotely or autonomously through onboard computers and sensors. Initially developed for military applications, drones have evolved into versatile tools with widespread uses across various industries. Today, they are used in fields such as agriculture, filmmaking, delivery services, environmental monitoring, and infrastructure inspection. Drones come in a range of sizes and capabilities, from small consumer-grade models to large, industrial-grade systems equipped with advanced sensors, cameras, and GPS technology. Their ability to access hard-to-reach areas, capture real-time aerial data, and perform tasks efficiently has made them an essential technology in modern operations. As drone technology continues to advance, their potential applications are expanding, making them a transformative force in sectors ranging from research and development to logistics and entertainment. Despite their widespread adoption, drones face challenges such as limited battery life, airspace regulations, and privacy concerns, which are being addressed through ongoing technological advancements and regulatory frameworks.

Navigation and Control:

PID (Proportional-Integral-Derivative) Controllers: Regulate the drone's movements and stabilize its flight.

Flight Modes: Various modes, such as stabilized, acrobatic, and follow-me modes.

Autopilot Systems: Enable autonomous flight, following pre-programmed routes or commands.

Communication Technologies:

Radio Frequency (RF): Used for remote control and telemetry data transmission.

Wi-Fi: Enables communication between the drone and a smartphone or tablet.

4G/LTE: Allows for long-range communication and data transmission.

Methodologist:

This role involves designing methodologies for drone operations, ensuring that flight plans, data analysis, and outcomes are scientifically sound and reliable and may be responsible for creating standard operating procedures (SOPs) for drone operations, including flight path planning, data capture protocols, calibration of sensors, and the analysis of aerial imagery or sensor data. They work closely with engineers, pilots, and other stakeholders to ensure that drone technology is used efficiently and ethically in various industries such as agriculture, environmental monitoring, surveying, and logistics.

1. Lift and Thrust (Aerodynamics):

Rotors and Propellers: Most drones are equipped with multiple rotors (usually quadcopters with four rotors). Each rotor has blades that spin at high speeds. By spinning, the rotors generate lift, which overcomes the force of gravity and causes the drone to rise.

Thrust: The direction and amount of thrust produced by the rotors allow the drone to move in different directions. By varying the speed of individual rotors, drones can control their movement (e.g., forward, backward, sideways) and stabilize their position in the air.

2. Control System:

Flight Controller: The flight controller is the brain of the drone. It processes information from sensors and adjusts the rotor speeds to maintain stability and control. The controller constantly checks the drone's orientation and position in the air and makes adjustments to keep the drone level and stable.

Gyroscope and Accelerometer: These sensors measure the drone's tilt and movement in space. The flight controller uses this data to make corrections and ensure the drone flies smoothly.

GPS: Drones often use GPS for navigation, which helps them know their position in the world, maintain stable flight, and return to home in case of lost signal or low battery.

3. Power System:

Battery: Drones are powered by rechargeable batteries, typically lithium-polymer (LiPo) batteries. These provide the energy to the motors that drive the rotors.

Energy Distribution: The flight controller manages the energy distribution to the rotors, ensuring they get the right amount of power to generate lift and thrust.

4. Communication System:

Remote Controller (Transmitter): The operator uses a remote control to send commands to the drone. This is usually done through radio frequency (RF) signals.

Receiver: The drone has a receiver that picks up the commands from the remote control. These commands are sent to the flight controller to adjust the drone's flight path and actions.

Telemetry: Some drones also send back real-time data (e.g., battery status, altitude, speed) to the operator via the remote control or an app on a smartphone.

5. Stabilization and Navigation:

Autopilot Mode: Many drones have an autopilot feature that allows them to fly autonomously. Using GPS and other sensors, the drone can follow a predefined flight path or hold a position in the air without direct input from the operator.

Manual Control: Drones can also be manually controlled by the operator through the remote control. In this case, the operator adjusts the pitch, roll, yaw, and throttle to change the drone's position and orientation.

6. Camera and Payloads (Optional):

Camera: Many drones are equipped with cameras for photography or video recording. These cameras are stabilized using a gimbal (a rotating platform), which helps keep the footage smooth even if the drone is moving or tilting.

Other Payloads: Some drones may carry other payloads, such as sensors (thermal, infrared), packages, or scientific equipment, depending on the drone's purpose

Proposed Work Explanation

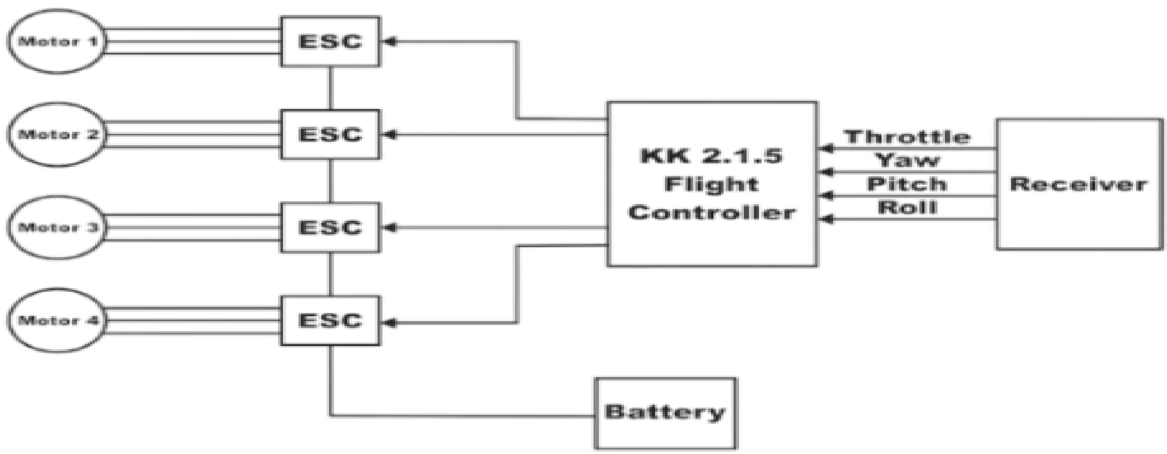


Fig 1:- Block diagram for Drone Technology

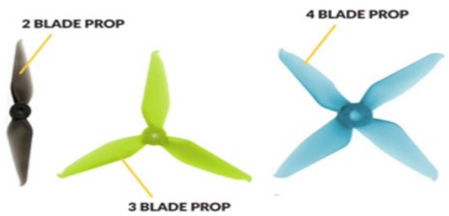
Note: In place of ***KK 2.1.5*** flight Controller we have used ***ADVANCED CONTROLLER FOR DRONE***

PROPELLERS:

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.

Fig 2: Two blade propeller

TYPES OF PROPELLERS:



Two-Blade Propellers:

(From fig:2) Two-blade propellers are the most common type of quadcopter propellers. Relatively simple and efficient. Provides good balance between thrust and efficiency. Made of plastic or carbon fibre and variety of sizes and pitches.

Fig 2.1: Two Blade propeller

TYPES OF PROPELLERS SIZE:

Micro: Diameter: Usually less than 6 inches (15 cm).
Example: Small drones for reconnaissance or hobbyist use.

Fig 3: Micro Size blade Propeller

small: Diameter: Typically range from 6 inches (15 cm) to 1 foot (30 cm).
Example: Consumer drones, UAVs used for surveillance.

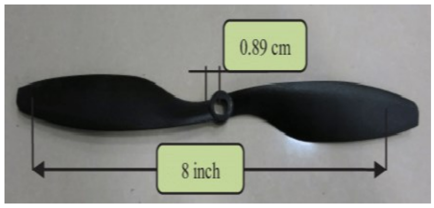


Fig 4: Small Size Blade Propeller

Large: Diameter: Can range from 1 feet (30 cm) to over 5 feet (1.5 meters)
Example: Military drones, UAVs used for commercial purposes like aerial mapping.

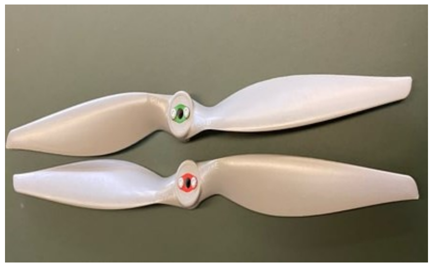


Fig 5: Large blade Propeller

Working of Propeller:

Drone propellers are essential components that provide lift, thrust, and control for flight. They work by spinning to create airflow, which creates a pressure difference between the top and bottom of the propeller.

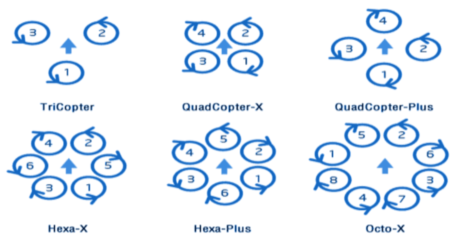


Fig 6: Direction Of Propeller

Types of Material are used to Manufacture in Propellers:

Drone propeller blades are most commonly constructed from plastic or carbon fiber. Plastic propellers are cheaper and more flexible, allowing them to absorb impact better. The increased stiffness of carbon fiber propellers, although providing less durability and decreases vibration thus improving the flight performance of the drone.

Fig 7: Material are used in Propeller

Designing of a Propeller:
The propeller is a spinning wing,Air moves over the surface of the airfoil generating lift but for a quadcopter. a small motor rotates the air foil at high speed and the propeller transform the rotory power to upward lift. unlike an aircraft wing,the propeller is twisted.

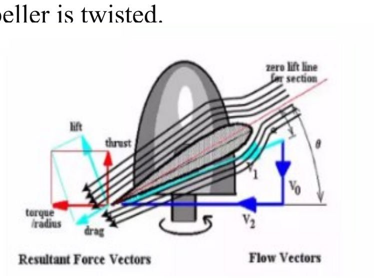


Fig 8: Design of propellers

MOVEMENT OF PROPELLER:
Each pair of opposite propellers are spinning in the same direction. For instance, both the front and back propeller are spinning clockwise while the right and left propeller are spinning anti-clockwise (or vice versa)

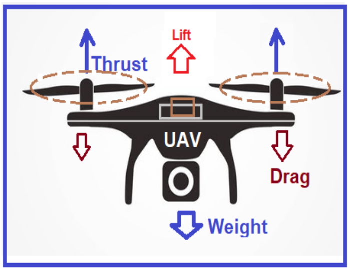


Fig 9: movement of propellers

MOTOR:
Motor is device which converts electrical energy into mechanical energy. It typically involves the interaction between magnetic fields and conductors to produce rotational or linear motion.

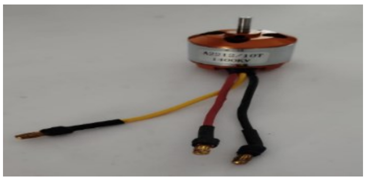


Fig 10: BLDC Motor

Types Of Motors Used in Drones:
Brushless DC Motors (BLDC): Brushless motors are becoming more prevalent in modern drones due to their higher efficiency, longer lifespan, and better power-to-weight ratio. They operate using electronic commutation rather than brushes, which reduces friction and wear, leading to improved performance.

Fig 11: BLDC Motor

Outrunner Motors: In outrunner BLDC motors, the rotor rotates around the outside of the stator, giving them a larger diameter. They are often used in applications where high torque is required, such as multirotor drones and electric vehicles.

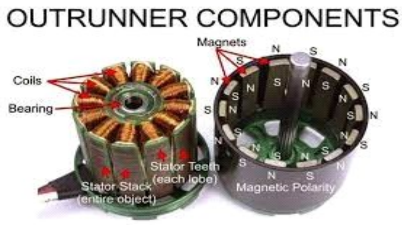


Fig 12: Outrunner Motor

Inrunner Motors: In Inrunner BLDC motors, the rotor is located inside the stator, resulting in a smaller diameter. They typically have higher rotational speeds and are commonly used in applications where compact size and high RPMs are needed, such as RC cars and aircraft.

Fig 13: Inrunner Motor

Pancake Motors: Pancake BLDC motors are characterized by their flat, disc-like shape with a large diameter and short axial length. They are often used in applications where space is limited but high torque is required, such as robotics, gimbals, and some types of drones.

Fig 14: Pancake Motors

Example of common BLDC drones:

1.Micro Drone and Racing Drones:
Motor size:1104,1306,1806
KV rating: 2500v to 4000kv
Thrust :200g t0 400g per motor

Application: light weight, highspeed drones for agility and racing.

2.Hobbyist And General Use Drone:
Motor size :2205,2212,2216.
KV rating:800kv to 2300kv.
Thrust :500g t0 1000g per motor.

Application: versatile use for aerial photography, videography, and general creation flying.

3. heavy lift and professional drone:
Motor size:3508,4006,4114.
KV rating: 400kv to 900kv.
Thrust :1kg to 3kg.

Application: carrying heavy payload such as high-end cameras or delivery packages.

TYPICALLY WEIGHT RANGES:

Micro And Racing Drone Motor:
These motors typically range from 5 grams to 20 grams per motor.

Hobbyist and general use drone motors:
Weight typically from 20grams to 50 grams per motor.

Heavy lift:
Weight ranges from 50 grams to over 200grams per motor.

MOTOR SPECIFICATION:

1. Voltage Rating: BLDC motors are designed to operate at specific voltage ranges, such as 12V, 24V, 48V, etc. The voltage rating affects the speed and torque characteristics of the motor.

2. Power Rating: This indicates the maximum power output the motor can sustain over a period. It is typically measured in watts (W) or kilowatts (kW).

3. Speed: BLDC motors can achieve high speeds, often in the range of hundreds to tens of thousands of revolutions per minute (RPM), depending on the model and application.

4. Torque: Torque is the rotational force produced by the motor and is critical for determining the motor's ability to perform work. It is usually specified in Newton-meters (Nm) or ounce-inches (oz-in).

5. Size and Form Factor: BLDC motors come in various sizes, ranging from small ones used in consumer electronics to larger ones used in industrial applications. The physical dimensions and shape (e.g., round, square) are important for fitting into specific applications.

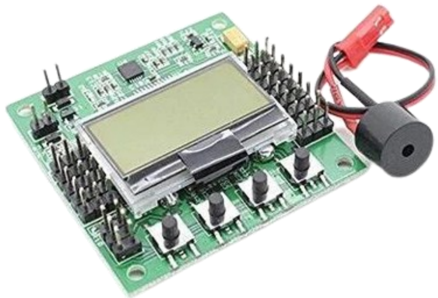
MOTOR PARAMETER:

Specifications	value
Rated voltage	24v
Rated torque	0.2Nm
Rated velocity	3950r/min
Rated current	5 A
Torque coefficient	0.0475Nm/A
Resistance of phase	0.49 Ω
Inductance of phase	0.16mH
Numbers of pole pairs	2
Diameter of stator core	34mm
Diameter of rotor core	21mm

TYPES OF FLIGHT CONTROLLERS

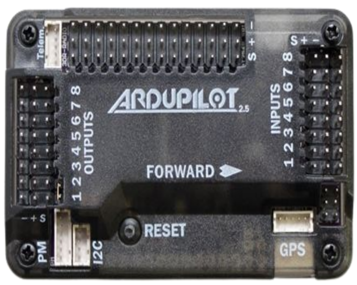
KK 2.1. 5 FLIGHT CONTROLLER BOARD

Microcontroller: Atmel mega644PA 8-bit AVR.
Sensors: MPU6050 gyro scope and accelerometer.
Size and weight: Length - 51 mm, Width- 51 mm, Height - 12 mm, Weight - 50 grams.
Input voltage: 4.8-6.0 VDC.
Com protocol: This board comes with a built-in LCD display and 4 buttons to configure the setting for the flight controller board.



ARDUPILOT APM 2.6 & 2.8 FLIGHT CONTROLLER BOARD

Micro controller: ATMEGA328P
Sensors :3-Axis Gyro meter Accelerometer, High-performance Barometer.
Size and weight : Length - 70 mm, Width – 45 mm, Height - 15 mm. Weight -80 grams.
Input voltage : 12-16 VDC
Com protocol :12C,SPI,PWM,PMU,and UART.



PIXHAWK FLIGHT CONTROLLER BOARD

Processor: 32bit STM32F427 Cortex M4 core with FPU

www.ijbar.org
ISSN 2249-3352 (P) 2278-0505 (E)
Cosmos Impact Factor-5.86

Sensors: 3-Axis Gyro meter, Accelerometer, High-performance Barometer, Magnetometer.
Size and weight: Length – 82.0 mm, Width -50.0 mm, Height – 16.0mm, Weight- 40 grams.
Input voltage :7 VDC.

NAZE 32 FLIGHT CONTROLLER BOARD

Micro controller: 32-bit STM32.
Sensors: IMU, magnetometer, Barometer.
Size and weight: Length – 32.5 mm, Width -29 mm, Height – 1.25mm, Weight-3grams.
Input voltage: 16 VDC

EVOLUTION OF FLIGHT CONTROLLERS

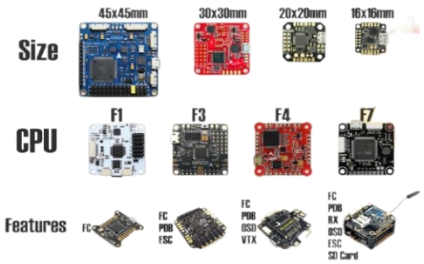


Fig 15: Flight Controllers

SENSOR:
A sensor is a device which is used to detect the physical phenomenon and it gives the respond to other system.

WORKING:
It measures acceleration by measuring the change in capacitance. The red mass is attached to springs that allows it to move along one direction.
The moving plates change their position between the fixed green plates (they together act as a capacitor) and therefore the capacitance between them changes
The change in capacitance between the green plates and the red plates is measured and used to estimate the acceleration.

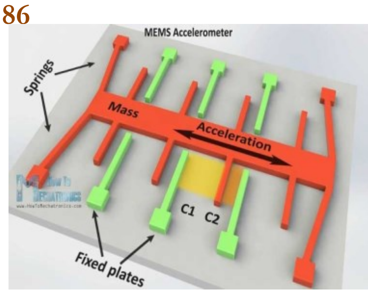


Fig 16: Working of sensors

TYPES OF SENSORS AND ITS MODELS:

GPS Sensors:
Neo 6m
Neo 7m
Neo 6mv2 [drones]

IMU sensors:
MPU 6050 [gyroscope+ accelerometer]
WT901 [gyroscope + accelerometer+ magnetometer]
MPU 9250 [triaxial sensor]
ICM 20948 [low power triaxial sensor]

Magnetometer sensor:
Gy -273
HMC5883L
QMC5883L

Accelerometer:
Gy -291
ADXL345

Gyroscope:
Gy -50
L3G4200D

Barometer sensor:
Gy -68
BMP180
BMP085
BMP280

BATTERIES:
A battery is a device that stores chemical energy and converts it into electrical energy. It consists of one or more electrochemical cells, each containing two electrodes (anode and cathode) separated by an electrolyte. When a battery is connected to an external circuit, chemical reactions occur within the cells, causing electrons to flow from the negative electrode (anode) to the positive electrode (cathode) through the external circuit, producing electric current.
There are two main types of batteries:
1.**Primary Batteries (Non-rechargeable):** These batteries are designed for single use and cannot be recharged. Once their chemical reactants are depleted, they need to be replaced. Common examples include alkaline batteries and lithium primary batteries.

2.**Secondary Batteries (Rechargeable):** These batteries can be recharged multiple times by applying electrical energy to reverse the chemical reactions that occur during discharge. Common examples include lithium-ion batteries, lithium polymer batteries, nickel-metal hydride batteries, and lead-acid batteries.

Primary battery: **Secondary battery:**

Fig 17: Batteries

INTRODUCTION TO DRONE BATTERIES:

Drone batteries are essential components that power the drone during flight. They come in various shapes, sizes, and capacities to meet the diverse needs of different drones. Understanding the key details of drone batteries is crucial for optimizing drone performance.

Fig 18: Batteries for Drones

BATTERY CAPACITY:

Battery capacity is measured in milliampere-hours (mAh) and indicates the amount of energy the battery can store. Higher capacity batteries can provide longer flight times but may also be heavier.

It is important to consider the balance between flight time and weight when choosing a battery for a drone.

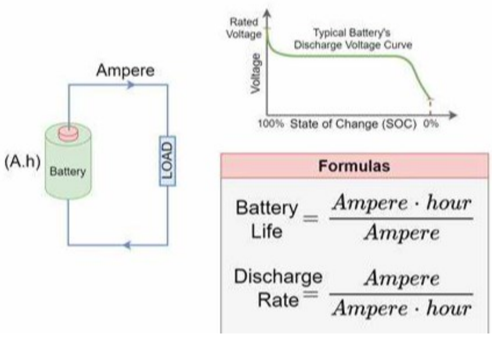


Fig 19: Formula

TYPES OF DRONE BATTERIES:

The most common types of drone batteries are Lithium Polymer (LiPo) and Lithium Ion (Li-Ion). LiPo batteries are lightweight, high energy-density, and capable of delivering high discharge rates. Li-Ion batteries are known for their longer lifespan and stability but have lower energy density compared to LiPo batteries.

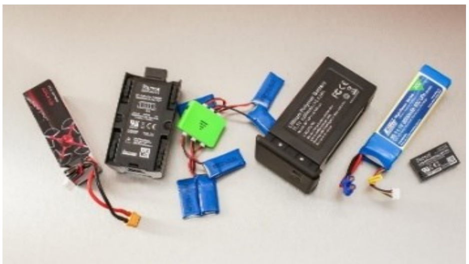


Fig 20: Different types Batteries

LIPO (LITHIUM POLYMER) BATTERIES ARE COMMONLY USED IN DRONES FOR SEVERAL REASONS:

High Energy Density: LiPo batteries offer a high energy density, meaning they can store a lot of energy relative to their size and weight. This is crucial for drones, as they need to be lightweight to achieve efficient flight but also require sufficient energy storage for prolonged flight times.

High Discharge Rate: LiPo batteries can discharge power at a high rate, which is necessary for providing the bursts of power required during takeoff, maneuvers, and maintaining stability in flight.

Low Self-Discharge Rate: LiPo batteries have a relatively low self-discharge rate compared to other types of batteries, which means they can hold their charge for longer periods when not in use. This is beneficial for drone operators who may not use their drones frequently.

Shape and Size Flexibility: LiPo batteries can be manufactured in various shapes and sizes, allowing for flexibility in design and integration into different types of drones. This enables drone manufacturers to optimize the battery layout for aerodynamics and weight distribution.

Rechargeable: LiPo batteries are rechargeable, allowing drone operators to reuse them multiple times, which is cost-effective and environmentally friendly compared to single-use batteries.

High Voltage: LiPo batteries typically have higher voltage ratings compared to other rechargeable batteries, which is advantageous for powering the high-performance motors commonly used in drones.

Lithium Polymer (LiPo) Batteries sizes:

Standard Sizes: LiPo batteries come in various sizes and shapes, but common dimensions for drone batteries range from small, compact packs to larger ones used in professional drones.

Small Packs: Small LiPo batteries used in micro and mini drones can have dimensions around 40mm x 20mm x 15mm (length x width x height).

Medium Packs: Medium-sized LiPo batteries for consumer drones may have dimensions around 100mm x 35mm x 25mm.

Large Packs: Larger LiPo batteries used in professional or industrial drones can be much larger, with dimensions ranging from 150mm x 50mm x 40mm to over 200mm x 100mm x 50mm or more.

THE C RATING OF A BATTERY INDICATES ITS MAXIMUM CONTINUOUS DISCHARGE RATE RELATIVE TO ITS CAPACITY

1. Small and Toy Drones:

C Rating Range: 5C to 20C

Explanation: Small and toy drones typically have lower power requirements, so they can operate efficiently with lower C-rated batteries.

Example: A small drone with a 500mAh battery might have a C rating of around 5C to 10C.

2. Consumer Camera Drones:

C Rating Range: 20C to 40C

Explanation: Consumer camera drones require more power for stable flight and to support features like GPS, altitude hold, and camera stabilization. Hence, they often use batteries with higher C ratings.

Example: A consumer drone with a 3000mAh battery might have a C rating of around 25C to 30C.

3. Professional and Racing Drones:

C Rating Range: 40C to 100C+

Explanation: Professional drones used for filmmaking, aerial photography, or racing demand high-performance batteries with high discharge rates to support rapid

Battery C RATE Chart:

The below chart shows the different battery C Rates along with their service times. It is important to know that even though discharging a battery at different C Rates should use the same calculations as an identical amount of energy, in reality there are likely to be some internal energy losses. At higher C Rates some of the energy can be lost and turned in to heat which can result in lowering the capacity by 5% or more.

C-Rate	Discharge Time
60C	1 min
30C	2 min
20C	3 min
5C	12 min
2C	30 min
1C	1h
0.5C or C2	2h
0.2C or C5	5h
0.1C or C10	10h
0.05C or C20	20h
0.01C or C100	100h

Fig 21: Flow chart of C Rating

Software Used for Drone Using Mission Planner:

Mission Planner is a ground control station for Plane, Copter and Rover. It is compatible with Windows only. Mission Planner can be used as a configuration utility or as a dynamic control supplement for your autonomous vehicle. Here are just a few things you can do with Mission Planner Load the Firmware (the software) into the autopilot board (i.e. Pixhawk series) that controls your vehicle. Setup configure, and tune your vehicle for optimum performance. Plan, save and load autonomous missions into you autopilot with simple point-and-click way-point entry on Google or other maps. Download and analyse mission logs created by your autopilot.With appropriate telemetry hardware you can Monitor your vehicle's status while in operation. Record telemetry logs which contain much more information about the on-board autopilot logs. View and analyse the telemetry logs. You Can aslo Operate your vehicle in FPV (first person view)

Fig 22: mission planner Dashboard

When the copter is not connected to flight controller the aptitude, ground speed will be shown zero values and cannot respond to drone

Fig 23: when mission planner is disconnected

Mission Planner has a special Drone ID tab in its DATA view for use with Open Drone ID modules attached to the autopilot which allows monitoring status, attaching the required GPS for operator location of the GCS, and UAS and Operator ID string setup.

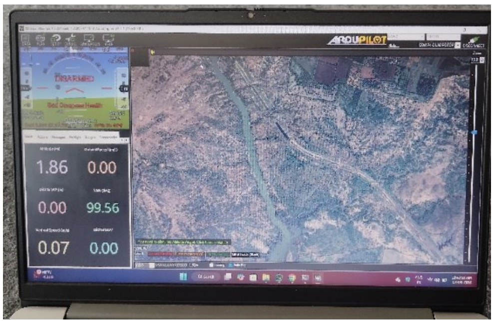


Fig 24: when mission planner is Connected

The future scope of drone technology using AI

Autonomous Navigation and Control

1. Improved obstacle avoidance: AI-powered drones will navigate through complex environments with increased accuracy.

2. Enhanced autonomous flight: Drones will be able to fly independently, making decisions based on real-time data.

Computer Vision and Object Detection

1. Advanced image recognition: AI-powered drones will be able to identify and classify objects, people, and animals.

2. Real-time object tracking: Drones will track objects, enabling applications like surveillance, monitoring, and inspection.

Predictive Maintenance and Inspection

1. Predictive analytics: AI-powered drones will analyse data to predict equipment failures, reducing downtime and increasing efficiency.

2. Automated inspection: Drones will inspect infrastructure, detecting defects and anomalies, and providing detailed reports.

Environmental Monitoring and Conservation

1. Wildlife tracking and monitoring: AI-powered drones will track and monitor wildlife populations, habitats, and behaviour.

2. Environmental monitoring: Drones will monitor air and water quality, detecting changes and anomalies.

Smart Cities and Urban Planning

1. Urban planning and development: AI-powered drones will aid in urban planning, monitoring urban growth, and optimizing infrastructure development.

2. Traffic management: Drones will monitor and manage traffic flow, optimizing traffic light timing and reducing congestion.

Construction and Infrastructure

1. Site monitoring and inspection: AI-powered drones will monitor construction sites, detecting issues and providing insights for optimized construction processes.

2. Infrastructure inspection: Drones will inspect infrastructure, detecting defects and anomalies, and providing detailed reports.

Public Safety and Security

1. Surveillance and monitoring: AI-powered drones will aid in surveillance and monitoring, detecting and responding to security threats.

2. Emergency response: Drones will aid in emergency response situations, providing critical information and support.

Medical and Healthcare

1. Medical supply delivery: AI-powered drones will deliver medical supplies, including blood, vaccines, and medications.

2. Remote healthcare services: Drones will aid in remote healthcare services, providing medical consultations and monitoring patient health.

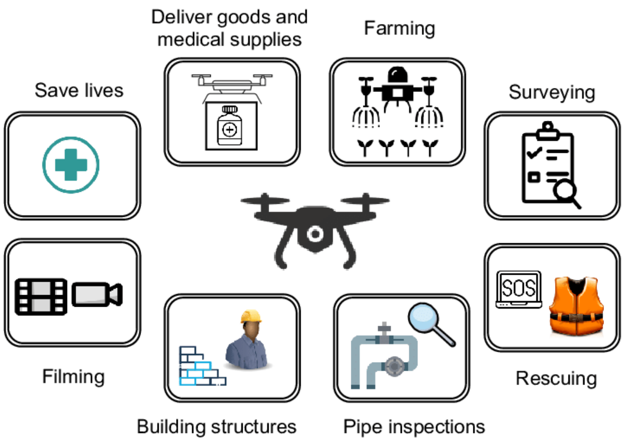


Fig 25: future of drone using AI

RESULT

The results of using drones in various fields have been transformative, offering significant advancements in efficiency, accuracy, and safety. In agriculture, drones allow for precise monitoring of crop health, soil conditions, and irrigation needs, leading to more sustainable farming practices. In environmental monitoring, drones are used to assess the health of ecosystems, track wildlife, and gather data from hard-to-reach areas, such as forests or oceans, without disturbing the environment. In industries like construction, surveying, and logistics, drones provide quick, cost-effective ways to gather aerial data, map terrains, and monitor infrastructure. The ability to capture high-resolution imagery and real-time data has revolutionized industries by improving decision-making, reducing human labour, and enhancing safety during operations. Overall, drones have proven to be a valuable tool in gathering data, offering new perspectives, and streamlining processes across a wide range of sectors.

Fig 26: Drone

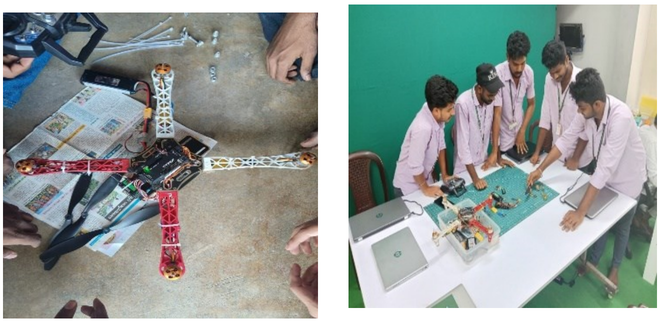


Fig 27: Students Work Analysis

CONCLUSION

drones have emerged as a powerful and versatile technology with the potential to revolutionize a wide range of industries. From precision agriculture and environmental monitoring to aerial surveying, logistics, and disaster response, drones are providing new solutions that improve efficiency, accuracy, and safety. The integration of advanced sensors, autonomous systems, and AI-driven technologies is expanding the capabilities of UAVs, enabling them to perform complex tasks with greater autonomy and precision.

REFERENCE

[1] AGILE-DRONE: Autonomous GPS-Enabled Delivery with Integrated Android Interface and Radio Telemetry https://ieeexplore.ieee.org/document/10744361
[2] Drones for automated parcel delivery: Use case identification and derivation of technical requirements https://www.sciencedirect.com/science/article/pii/S2590198224002392
[3] Ground-to-Air Vision-Based Anti-UAV Detection and Tracking Methodologies https://www.mdpi.com/2504-446X/9/1/58
[4] Autonomous Landing Guidance for Quad-UAVs Based on Visual Image and Altitude Estimation https://doi.org/10.3390/drones9010057
[5] Underwater DVL Optimization Network (UDON): A Learning-Based DVL Velocity Optimizing Method for Underwater Navigation https://doi.org/10.3390/drones9010056
[6] A Cloud Detection System for UAV Sense and Avoid: Analysis of a Monocular Approach in Simulation and Flight Tests https://doi.org/10.3390/drones9010055
[7] Lifecycle Environmental and Economic Impacts of Drone-Truck Parallel Systems https://www.mdpi.com/2504-446X/9/1/54
[8] Enhancing Wildlife Detection Using Thermal Imaging Drones: Designing the Flight Path https://doi.org/10.3390/drones9010052
[9] Applications of Medical Drones in Public Health https://www.researchgate.net/publication/358616729_Applications_of_Medical_Drones_in_Public_Health_An_Overview
[10] Medicine Delivery Drone

https://www.researchgate.net/publication/343694959_Medicine_Delivery_Drone
[11] Drone a technological leap in health care delivery in distant and remote inaccessible areas: A narrative review https://pmc.ncbi.nlm.nih.gov/articles/PMC10833029/
[12] Current Advancements in Drone Technology for Medical Sample Transportation https://www.mdpi.com/2305-6290/8/4/104
[13] Significant Features and Applications of Drones for Healthcare https://www.worldscientific.com/doi/full/10.1142/S2424862222500245
[14] Medical Drone Managing System for Automated External Defibrillator Delivery Service https://www.mdpi.com/2504-446X/6/4/93
[15] The Application of Drones in Healthcare and Health-Related Services https://doi.org/10.3390/drones4030030