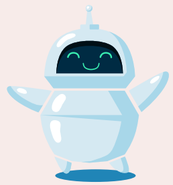
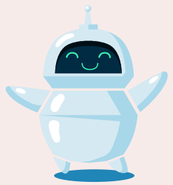
Robotic Hardware Systems (MCTE 4362)



Unmanned Aerial Vehicle (UAV)



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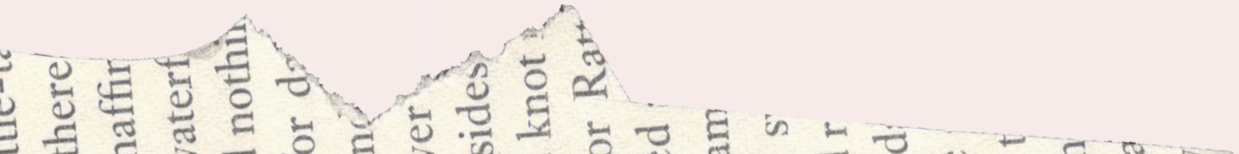
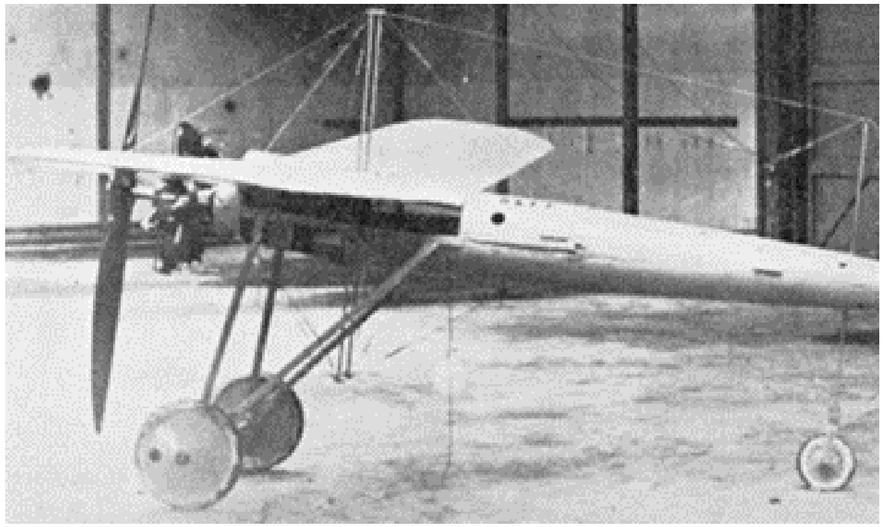
Introduction

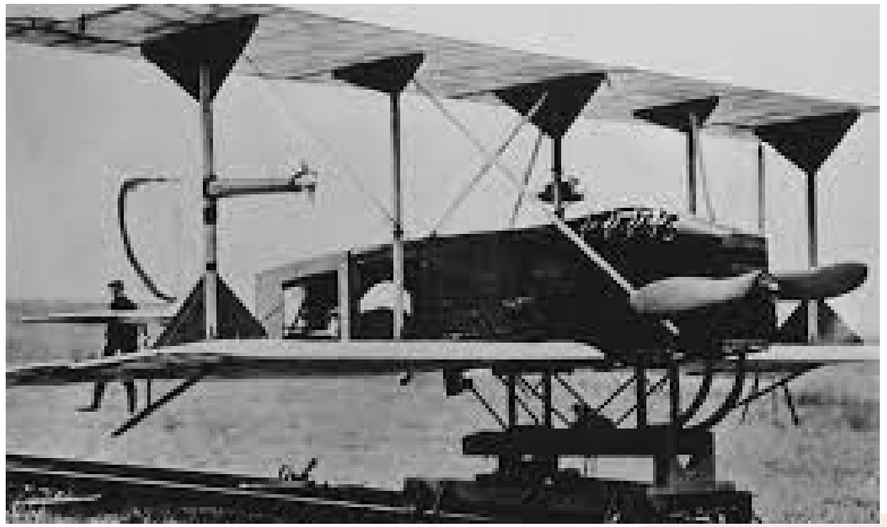
- Definition of UAV: Unmanned Aerial Vehicle (UAV) is a type of aircraft that is operated without a pilot on board.
- UAVs are also known as drones or remotely piloted aircraft systems (RPAS).
- UAVs are used in a variety of applications, from military and surveillance operations to civilian and commercial uses.
- UAVs can be operated remotely or autonomously, depending on the type of mission and technology used.
- UAVs are often equipped with sensors, cameras, and other equipment to collect data and perform specific tasks.
- The use of UAVs is increasing rapidly, and it is expected to grow in the coming years, especially in the commercial and civilian sectors.



History & Applications

- The first UAV was developed in 1917 by the US Navy for target practice.
- The use of UAVs increased significantly during World War II, when they were used for reconnaissance and other military purposes.





- UAVs have been used for military purposes since World War I, when the US Navy developed the first UAV for target practice.
- During World War II, both the Allies and the Axis powers developed and deployed UAVs for reconnaissance, target practice, and other military purposes.
- The use of UAVs expanded in the Cold War era, as the technology became more advanced and capable.
- In the 1980s and 1990s, UAVs began to be used for civilian and commercial purposes, such as aerial photography, surveying, and environmental monitoring.
- In the early 2000s, the use of UAVs in military operations increased significantly, with the US military relying heavily on UAVs for reconnaissance, surveillance, and strikes in Afghanistan and Iraq.

- In recent years, UAV technology has become more advanced and affordable, making it accessible to a wider range of industries and applications.
- Applications of UAVs:

1. Military: UAVs are used for reconnaissance, surveillance, and combat operations.
2. Civilian: UAVs are used for agriculture, environmental monitoring, mapping, and disaster relief operations.
3. Commercial: UAVs are used for aerial photography, film production, and package delivery.
4. Scientific: UAVs are used for atmospheric research, geology, and wildlife tracking.

Military.

Civilian.

Commercial.

Main Components of the Vehicle

1. Hull Design

- The hull is the main body of the UAV, which includes the wings, fuselage, and tail.
- Types of hull designs used in UAVs:

1. Fixed-wing: These UAVs have a fixed wing and require a runway for takeoff and landing.
2. Rotary-wing: These UAVs have rotors and can take off and land vertically.
3. Hybrid: These UAVs combine the features of fixed-wing and rotary-wing designs.

Fixed Wings:
General Atomics MQ-1 Predator.

Rotary-wing:
DJI Phantom 4.

Hybrid:
Lockheed Martin K-MAX

Main Components of the Vehicle

2. Propulsion System

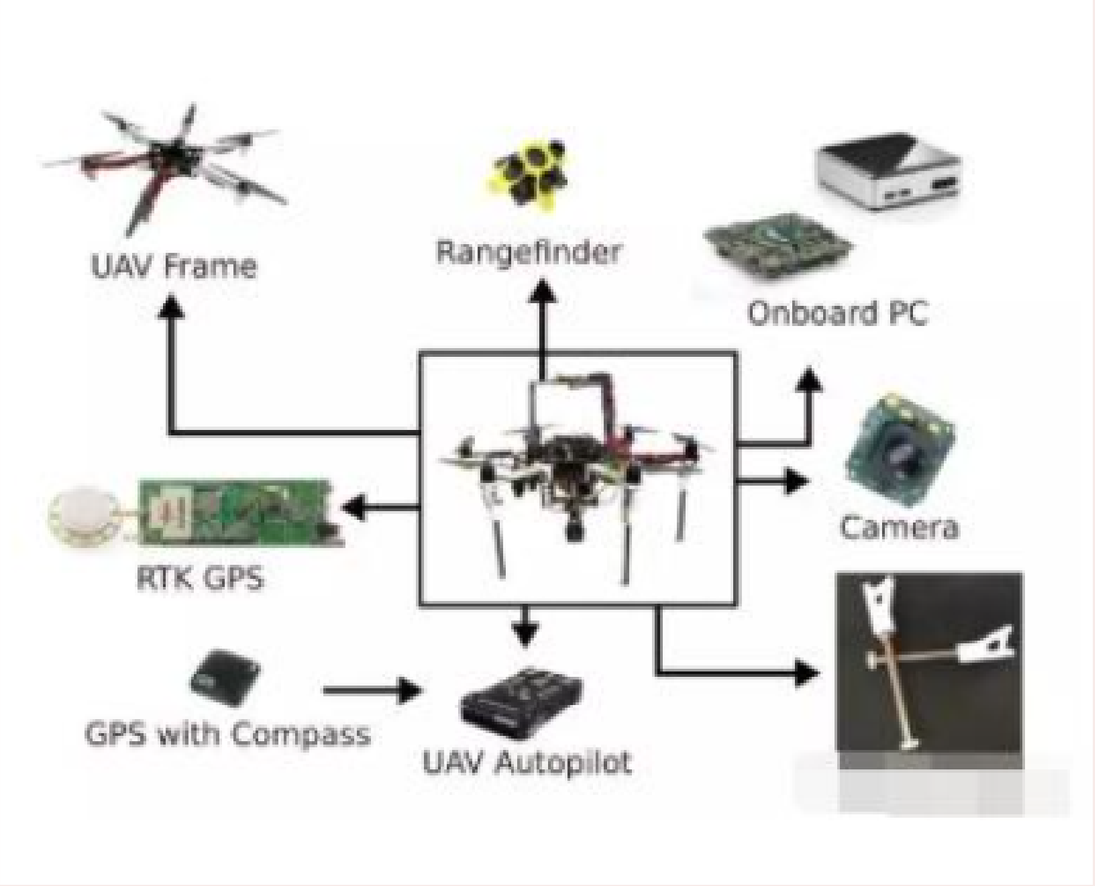
- The propulsion system is responsible for generating the thrust that propels the UAV forward.
- Types of propulsion systems used in UAVs:
  - Internal combustion engines: These engines burn fuel to generate thrust.
  - Electric motors: These motors use batteries to generate thrust.
  - Jet engines: These engines use combustion to generate high-speed thrust.

Types of Propulsion System	Advantages	Disadvantages
Internal Combustion Engines	High power output, long range.	High maintenance, noisy.
Electric Motors	Quiet, low maintenance	Short range, low power output.
Jet Engines	High speed, high altitude.	High fuel consumption, expensive.

Main Components of the Vehicle

3. Navigation System & Control

- Navigation system and control are critical components of UAVs that ensure the vehicle stays on course and responds to commands.
- The most common navigation system used in UAVs is GPS, which provides location, altitude, and speed information.
- Other navigation systems and control mechanisms used in UAVs include gyroscopes, which detect changes in orientation, accelerometers, which detect changes in speed and direction, and autopilot systems, which control the vehicle's movement without human intervention.
- Each type of navigation system and control mechanism has its advantages and disadvantages, such as accuracy, reliability, and cost.



Main Components of the Vehicle

4. Data Collection

- Data collection is the process of gathering information using various sensors and instruments mounted on the UAV.
- Different types of sensors and instruments used in UAVs for data collection include cameras, LiDAR, infrared sensors, and others.
- UAV applications that require different types of data collection instruments include aerial photography, mapping, surveying, crop monitoring, wildlife tracking, and more.

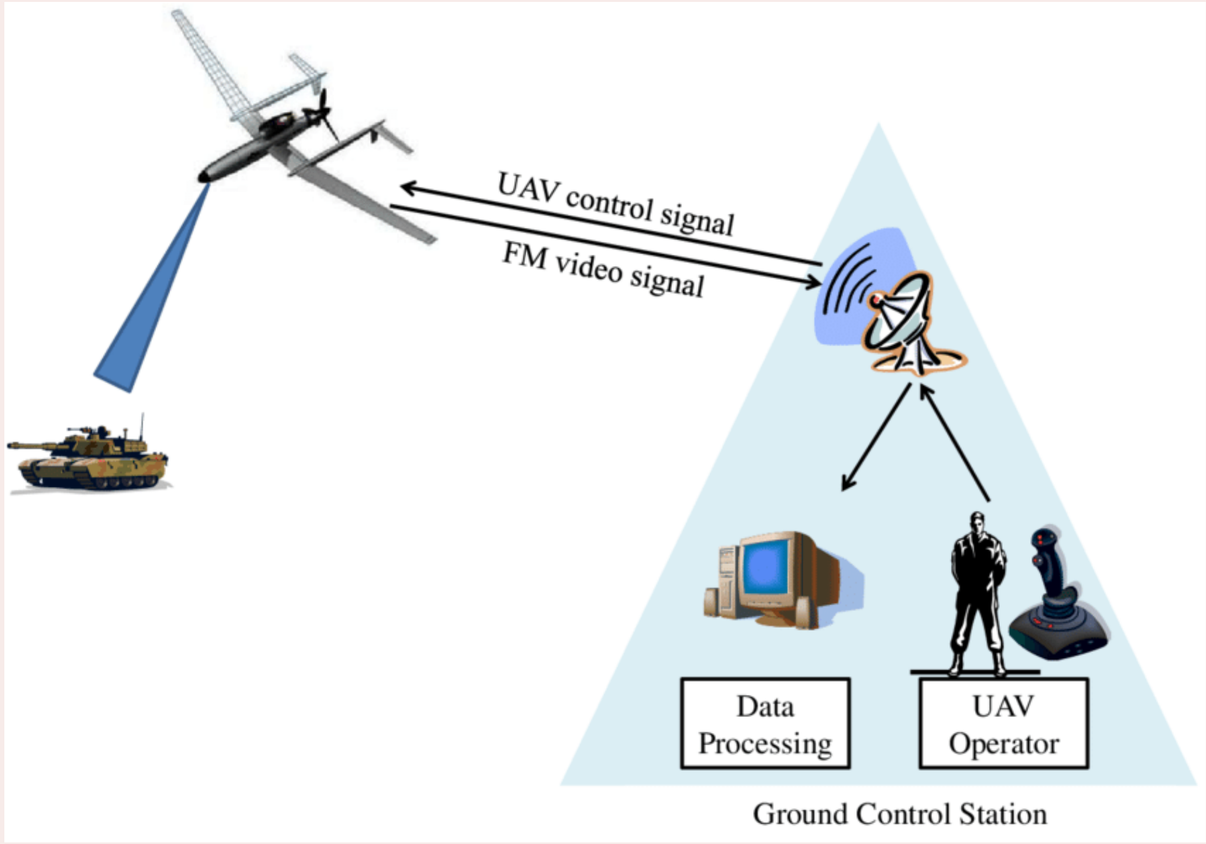
Velodyne VLP-16 LiDAR Sensor.

Fuel Sensor.

Main Components of the Vehicle

5. Data Transmission

- Data transmission refers to the process of transmitting data from the UAV to the ground station or other devices.
- Different methods used for transmitting data from UAVs include radio frequency, satellite communication, and cellular networks.
- Each method of data transmission has its advantages and disadvantages, such as speed, range, and cost.



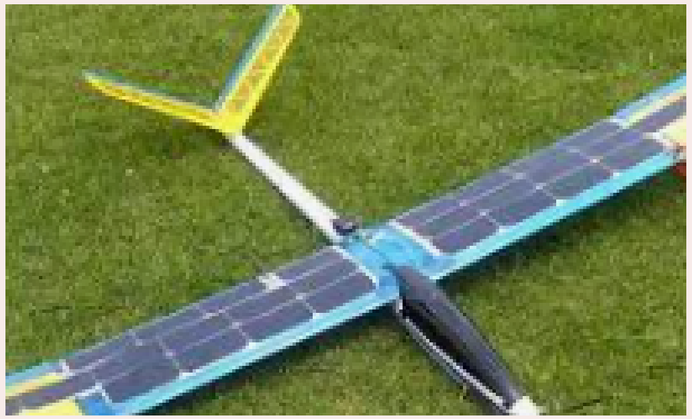
Main Components of the Vehicle

6. Power Management

- Power management is the process of managing the power source and usage in UAVs.
- Different types of power sources and management systems used in UAVs include batteries, fuel cells, and solar panels.
- Each type of power source and management system has its advantages and disadvantages, such as energy density, weight, and cost.

Battery.

Fuel Cell.



Solar Panel.

Conclusion

- The presentation covered the main components of UAVs, including hull design, propulsion system, navigation system and control, data collection, data transmission, and power management.
- UAVs play an important role in modern society, with applications in military, commercial, and civilian sectors.
- Future trends and developments in UAV technology include increased autonomy, artificial intelligence, and improved sensors and instruments for data collection.

Thank You