UNMANNED AERIAL VEHICLES (UAV)

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INTRODUCTION TO UAV

Unmanned aerial vehicles (UAVs), also known as drones, are autonomous or remotely piloted aircraft that have become increasingly popular in recent years due to their versatility and wide range of applications. These aircraft can be operated from a distance, making them ideal for use in situations where manned flight is too dangerous or impractical. UAVs are used in a variety of industries, including agriculture, mining, search and rescue, photography and videography, delivery services, and military operations. As technology advances and regulations become more accommodating, the use of UAVs is expected to continue to expand and transform a variety of industries.

HISTORY OF UAV

1800s

Austrian incendiary balloon attack on Venice. The earliest recorded use of an unmanned aerial vehicle for warfighting occurred in July 1849,serving as a balloon carrier (the precursor to the aircraft carrier) is the first offensive use of air power in naval aviation

1900s

In the early 1900s, the first remotely piloted aircraft was developed by Archibald Low, a British engineer. The radio-controlled Kettering Bug was also developed in the United States during World War I, but it never saw combat. During World War II, both the Germans and the Allies developed UAVs for various purposes, including target practice and reconnaissance.

HISTORY OF UAV

1930s

In 1935 the British produced a number of radio-controlled aircraft to be used as targets for training purposes. Prime Minister Winston Churchill and Captain David Margesson, launch of a De Havilland Queen Bee seaplane L5984 from its ramp.

1940s

A remote-controlled drone prototype based on a B-17 Flying Fortress airframe takes off from Hilo Naval Air Station in Hawaii 6 August 1946, to fly to Muroc Army Air Field, California. It is remotely controlled by United States Army Air Forces (USAAF).

HISTORY OF UAV

1980s

Advances in microelectronics and computer technology lead to development of smaller and more sophisticated UAVs. Development of the Predator drone for surveillance and reconnaissance.

RECENT

Creation of commercial drones for both personal and business use, including for delivery, surveying, search and rescue, and photography. As will be mentioned below, ongoing technological developments continue to enhance UAV capabilities and prospective applications.

APPLCATION OF UAVs

Mining	Surveying and mapping of mining sites
Agriculture	Crop monitoring and analysis. Pest and disease detection.
Entertaintment	Live event coverage and broadcasting.
Construction	Site inspection, progress monitoring and infrastructure maintainance.
Public Safety	Search and rescue, disaster response and surveillance.
Logistics	Delivery of goods and inventory management.

MAIN COMPONENT

PROBLEM

Earth is the third planet from the Sun and the only one that harbors life in the Solar System. This is where we all live

SOLUTION

Jupiter is a gas giant and the biggest planet in the Solar System. It's the fourth-brightest object in the night sky

AIRFRAME DESIGN

FIXED-WING

ADVANTAGES	DISADVANTAGES
Efficient for long duration flights and covering large areas	Require more complex and expensive maintenance than some other types of UAVs
Can carry heavy payloads	Require runway or launching device for takeoff and landing
Can fly at high speeds and altitudes	Cannot hover in one place or fly at low speeds

AIRFRAME DESIGN

ROTARY-WING

ADVANTAGES	DISADVANTAGES
They are quite adaptable in terms of takeoff and landing places because they can take off and land vertically.	Have a shorter flight time
Can hover in place	Generally smaller payloads
Able to fly in small spaces and make precise maneuvers since they are more maneuverable than fixed-wing UAVs	Less energy-efficient than fixed-wing UAVs, requiring more frequent battery or fuel replacements during missions.

AIRFRAME DESIGN

HYBRID

ADVANTAGES	DISADVANTAGES
Can take off and land vertically.	Complex design
Can combine the benefits of both fixed-wing and rotary-wing UAVs	High cost
Can transition to fixed-wing flight for longer endurance	Specialized training and maintenance needed

AIRFRAME DESIGN

MULTIROTOR

ADVANTAGES	DISADVANTAGES
Low price and high accessibility	Short flight times
Great maneuverability and simple to operate	Small payload capacity
Can fly in place or at low speeds, making them useful for precise positioning	Low stability in the wind

PROPULSION SYSTEM

TYPES	ADVANTAGES	DISADVANTAGES
Electric motor	Quiet, efficient and low maintenance	Short and limited flight times
Gasoline	Good for larger UAVs and longer flight times	Loud noise and high maintainance required
Jet engine	High speeds and high-altitude capabilities	Expensive and complex design
Solar	Unlimited flight times and environment friendly	Limited power output
Hybrid	Combines feature of multiple propulsion types	Complex design and expensive

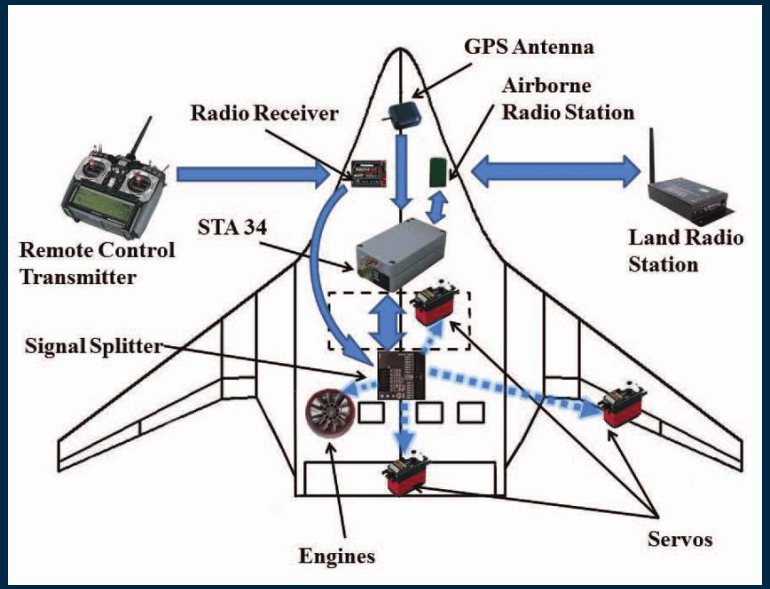
NAVIGATION SYSTEM

TYPES	ADVANTAGES
Global Positioning System (GPS)	A GPS receiver is typically used to determine the UAV's location and velocity.
Magnetometer	Measure the UAV orientation relative to the Earth’s magnetic field that can be used determine its heading
Barometer	Measure air pressure to determine UAV’s altitude
Inertial Measurement Unit (IMU)	sensor package that measures the UAV's acceleration and rotation rates, which can be used to estimate its orientation and position.
Radar Altimeter	Device that uses radar signals to determine UAV’s altitude above ground

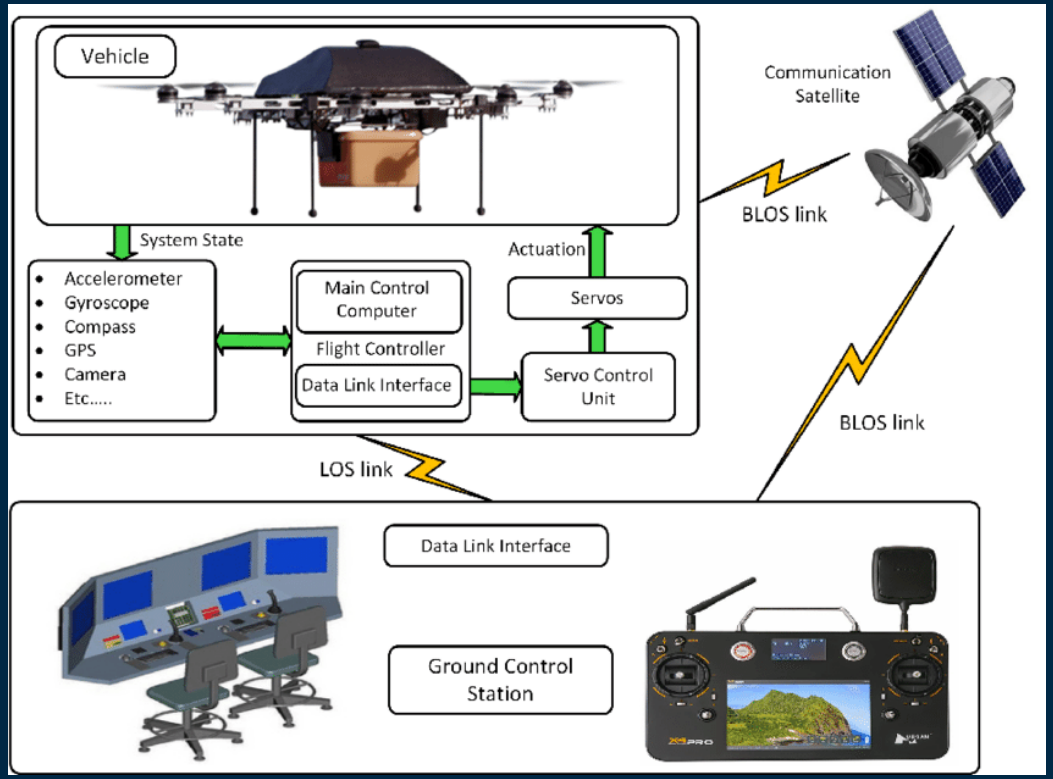
CONTROL SYSTEM

TYPES	ADVANTAGES
Flight Controller	The "brain" of the UAV, which receives input from sensors and determines how to adjust the aircraft's control surfaces, motors, or other components to achieve desired flight behavior
Gyroscope	A sensor that measures the UAV's orientation and angular velocity, which allows the flight controller to make adjustments to maintain stability and control
Telemetry system	A device that allows data to be transmitted between the UAV and a ground control station, such as flight data, sensor readings, or video feeds

NAVIGATION AND CONTROL SYSTEM



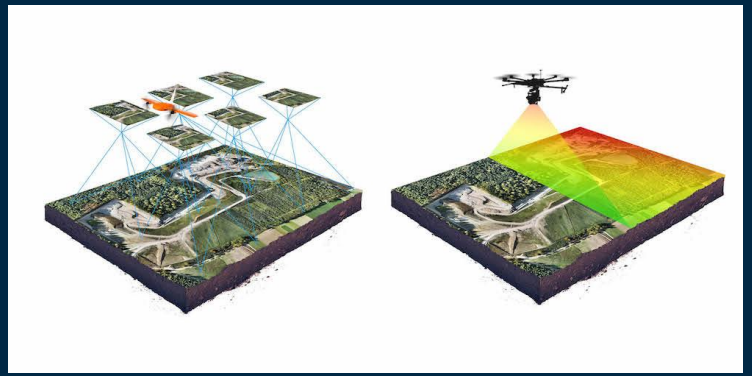
SYSTEM ARCHITECTURE



DATA COLLECTION

- Aerial imagery (RGB) - Captured by high-resolution cameras
- Thermal imagery (IR) - Captured by thermal cameras and nightvision
- LiDAR data - Captured by LiDAR sensors such as the Velodyne Puck LITE
- Video data - Captured by cameras similar to those used for aerial imagery, or specialized cameras such as GoPro for zooming capabilities.

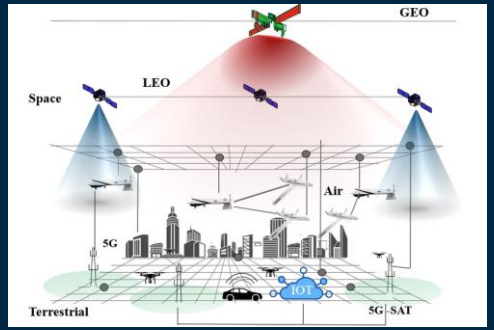
Aerial RGB Camera



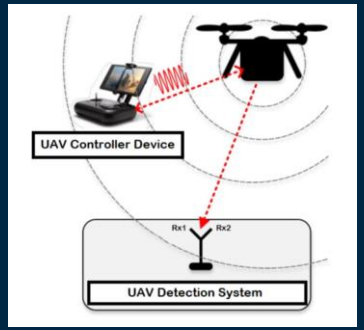
LIDAR Camera

DATA COLLECTION

- Satellite Communication - When the UAV is flying in remote locations without cellular network coverage, this technique is used.
- Bluetooth - Short-range communication is often accomplished using this technique. When the GPS signal is weak in some places, Bluetooth location can be used to increase positional accuracy.
- Wi-Fi - Drones can be controlled remotely through mobile application over the internet. Enables the commercial drones to be remote-ready.
- Radio Frequency Communication - Demands a straight line of sight between the UAV and the base station and is frequently employed for short-range communication.



Satellite Communication



Radio Frequency Communication

POWER MANAGEMENT

TYPES	ADVANTAGES	DISADVANTAGES
Lithium Polymer	High energy density, lightweight	Limited flight time and risk of fire
Gasoline	Widely available and long flight time	Loud noise and emissions
Jet fuel	High power output	Expensive and requires specialized output
Hydrogen fuel cell	Efficient and clean power source	Limited availability and expensive