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UNMANNED AERIAL VEHICLE

ROBOTICS HARDWARE SYSTEM

INTRODUCTION

1. UAVs, or unmanned aerial vehicles, are aircraft that operate without a human pilot on board.
2. They are also commonly referred to as drones.
3. UAVs are designed to be autonomous or remote-controlled.
4. They are capable of performing a wide range of tasks, from aerial photography and videography to search and rescue operations, environmental monitoring, agriculture, and military operations.
5. UAVs come in a variety of shapes and sizes, from small quadcopters to large fixed-wing aircraft.
6. With their advanced navigation and control systems, UAVs are rapidly changing the way we gather information, perform tasks, and explore our world.

HISTORY & APPLICATIONS

1916

The first pilotless aircraft, the Kettering Bug, was developed in the United States for use in World War I. It was designed to fly a pre-determined course and drop bombs on enemy targets.

1935

The British Royal Air Force developed the Queen Bee, a remote-controlled aircraft used for training anti-aircraft gunners.

1940

During World War II, both the United States and Germany continued to develop and use UAVs for reconnaissance and bombing missions.

1950-1960

he United States continued to develop UAV technology for military purposes, including the development of the Ryan Firebee, a long-range reconnaissance drone.

1980-1990

UAVs were used more extensively in military operations, including the Persian Gulf War and the war in Bosnia.

2000-present

AVs have become increasingly popular and have been used for a wide range of non-military applications, including search and rescue, border patrol, environmental monitoring, and aerial photography and videography.

MAIN COMPONENTS

HULL DESIGN

PROPULSION SYSTEM

NAVIGATION SYSTEM & CONTROL

DATA COLLECTION

DATA TRANSFER

POWER MANAGEMENT

ROBOT BODY DESIGN & TASK (HULL DESIGN)

The design of a UAV's body is highly dependent on the tasks it is intended to perform. for example:

- fixed-wing UAV: surveillance or mapping. have a sleek aerodynamic body shape that allows it to fly long distances efficiently
- Quadcopter: for inspection or delivery. have a more compact and agile design that allows it to maneuver in tight spaces.

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material used to construct the body: depending on the task and the environment in which the UAV will operate. For example:

- a UAV used in harsh or extreme conditions may require materials that are resistant to corrosion, heat, or impact.

- Regulation, certification, and compliance are also important considerations for UAV design.
- Depending on the task and the country or region where the UAV will operate, there may be specific regulations and standards that dictate the size, weight, and design of the UAV.
- For example, some countries may require UAVs to be certified for safety and airworthiness, while others may have specific requirements for noise levels or emissions.

PROPULSION SYSTEM

UAVs use a variety of actuators and locomotion systems to move their main body and perform specific tasks.

QUADCOPTERS

use electric motors and rotors to achieve lift and maneuverability,

FIXED-WING UAV

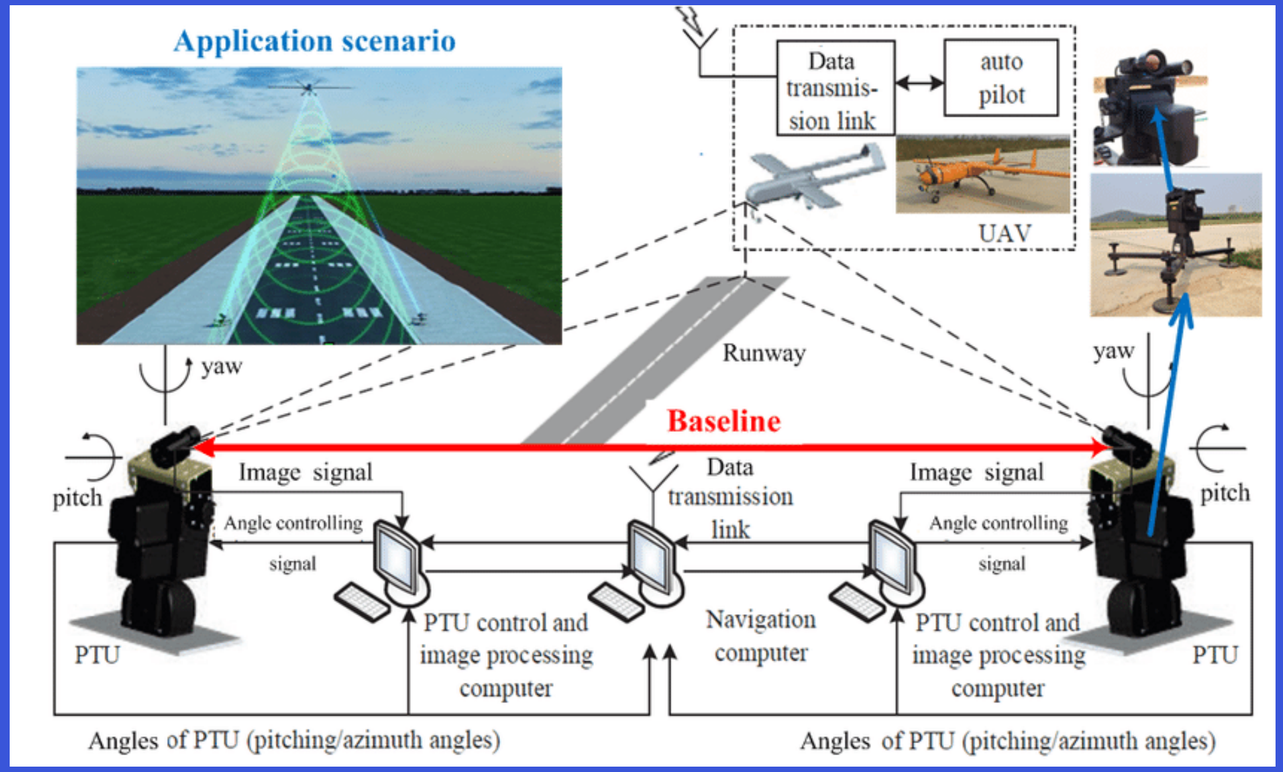
use propulsion systems such as jet engines or propellers.

The propulsion system of a UAV is responsible for providing the necessary power to move the aircraft through the air. The type of propulsion system used in a UAV can vary depending on the size and purpose of the aircraft, but here are some common types of propulsion systems used in UAVs:

1. Electric Motors: Electric motors are commonly used in small UAVs, such as quadcopters, due to their lightweight design and efficient power consumption. They can be powered by batteries or fuel cells.
2. Gasoline Engines: Gasoline engines are often used in larger UAVs, such as fixed-wing aircraft, due to their high power output and ability to provide sustained flight times.
3. Jet Engines: Jet engines are used in military UAVs for high-speed reconnaissance and attack missions. They are also used in some commercial UAVs designed for high-altitude flights.
4. Hybrid Propulsion Systems: Hybrid propulsion systems combine two or more types of propulsion systems, such as an electric motor and a gasoline engine, to provide the necessary power for the UAV. These systems are often used in medium-sized UAVs designed for long-range flights.
5. Solar Power: Some UAVs are powered by solar panels, which convert sunlight into electrical energy to power the aircraft. These are often used in UAVs designed for long-duration flights, such as environmental monitoring and surveillance missions.

NAVIGATION SYSTEM & CONTROL

ensuring that the aircraft can fly safely and accurately to its intended destination



THE NAVIGATION SYSTEM AND CONTROL OF A UAV IS RESPONSIBLE FOR ENSURING THAT THE AIRCRAFT CAN FLY SAFELY AND ACCURATELY TO ITS INTENDED DESTINATION. THERE ARE SEVERAL COMPONENTS THAT MAKE UP THE NAVIGATION SYSTEM AND CONTROL OF A UAV, INCLUDING:

Flight Controller:
the brain of the UAV and is responsible for controlling the aircraft's movements, including its speed, altitude, and direction.

GPS (Global Positioning System):
determine the UAV's location, speed, and altitude. It provides the flight controller with real-time information about the aircraft's position, which is used to adjust the aircraft's flight path as necessary.

Inertial Measurement Unit (IMU):
measures the UAV's acceleration and rotation rates. It is used in conjunction with the GPS to determine the UAV's position and speed accurately.

Gyroscope:
measures the UAV's orientation and angular velocity. It provides the flight controller with data about the UAV's attitude, which is used to control the aircraft's movement.

Magnetometer:
sensor that measures the Earth's magnetic field. It is used to determine the UAV's heading and orientation.

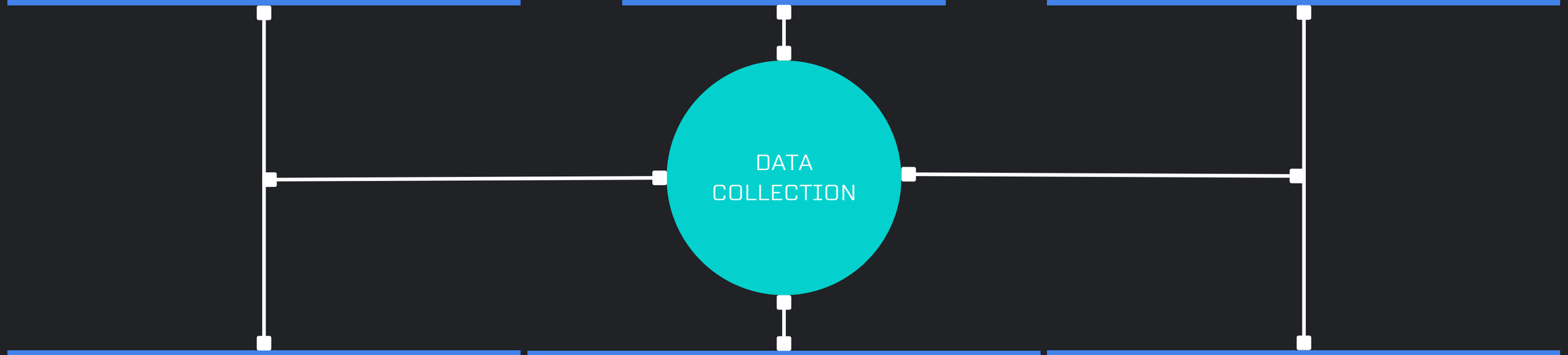
Barometer:
sensor that measures the atmospheric pressure. It is used to determine the UAV's altitude.

Camera:
used to provide visual information about the UAV's surroundings, which can be used for navigation and obstacle avoidance.

Thermal Imaging Sensors: detect and measure heat signatures from objects on the ground, which can be used for applications such as search and rescue, wildlife monitoring, and building inspection

Cameras: capture high-resolution aerial imagery and video, which can be used for mapping, surveying, and surveillance.

Environmental Sensors: measure various parameters such as temperature, humidity, air quality, and wind speed. They can be used for applications such as weather monitoring, climate research, and disaster response.



Spectrometers: measure the light spectrum emitted or absorbed by objects. They can be used for applications such as mineral exploration, crop health monitoring, and pollution detection.

Radar: detect the location and movement of objects on the ground or in the air, even in adverse weather conditions. They can be used for applications such as surveillance, border security, and search and rescue.

Lidar: uses lasers to measure distance and create 3D maps of the environment. It can be used for applications such as topographic mapping, urban planning, and forestry management.

DATA TRANSMISSION

RADIO FREQUENCY (RF)	It uses radio waves to transmit and receive data between the UAV and the ground control station (GCS). It is widely used in applications such as real-time video transmission, telemetry data, and command and control.
CELLULAR COMMUNICATION	uses cellular networks to transfer data between the UAV and the GCS. It is typically used for longer distance communication and can provide higher bandwidth than RF communication.
SATELLITE COMMUNICATION	used for long-distance communication where cellular or RF communication is not available or reliable. It can provide a reliable and secure communication link for UAVs operating in remote areas or over the ocean.
WIFI & BLUETOOTH	Short-range wireless communication technologies that can be used to transfer data between the UAV and nearby devices such as smartphones or tablets.
STORAGE & DEVICE	Some UAVs can carry onboard storage devices such as SD cards or hard drives to store data. Once the UAV lands, the data can be retrieved by physically accessing the storage device.

power management

POWER MANAGEMENT ON UAVS IS A CRITICAL ASPECT THAT ENSURES THE SMOOTH OPERATION OF THE SYSTEM DURING THE MISSION. THE POWER MANAGEMENT SYSTEM OF A UAV IS RESPONSIBLE FOR PROVIDING POWER TO ALL THE ONBOARD SYSTEMS, INCLUDING THE PROPULSION SYSTEM, NAVIGATION SYSTEM, COMMUNICATION SYSTEM, AND PAYLOAD.

1. BATTERIES: MOST UAVS USE BATTERIES AS THEIR PRIMARY POWER SOURCE. LITHIUM-POLYMER (LI-PO) BATTERIES ARE COMMONLY USED DUE TO THEIR HIGH ENERGY DENSITY, LOW WEIGHT, AND LONG LIFESPAN.

2. SOLAR PANELS: UAVS THAT OPERATE FOR EXTENDED PERIODS IN SUNNY AREAS CAN USE SOLAR PANELS TO RECHARGE THEIR BATTERIES OR PROVIDE POWER TO ONBOARD SYSTEMS DIRECTLY.

3. FUEL CELLS: FUEL CELLS CAN BE USED TO PROVIDE POWER TO UAVS THAT REQUIRE EXTENDED FLIGHT TIMES. HYDROGEN FUEL CELLS ARE COMMONLY USED DUE TO THEIR HIGH ENERGY DENSITY AND LOW WEIGHT.

4. HYBRID SYSTEMS: SOME UAVS USE A COMBINATION OF POWER SOURCES, SUCH AS BATTERIES AND SOLAR PANELS OR BATTERIES AND FUEL CELLS. HYBRID SYSTEMS CAN PROVIDE EXTENDED FLIGHT TIMES WHILE REDUCING THE WEIGHT OF THE ONBOARD POWER SYSTEM.

POWER MANAGEMENT SYSTEMS ON UAVS MUST BE DESIGNED TO BE EFFICIENT AND RELIABLE. THEY MUST BE ABLE TO PROVIDE POWER TO ALL THE ONBOARD SYSTEMS WHILE MINIMIZING WEIGHT AND MAXIMIZING FLIGHT TIME. THE POWER MANAGEMENT SYSTEM MUST ALSO BE DESIGNED TO BE RESILIENT TO FAULTS AND FAILURES TO ENSURE THE SAFETY OF THE UAV AND THE SURROUNDING ENVIRONMENT.

CONCLUSION

UAV stands for Unmanned Aerial Vehicle, also known as a drone. It is a type of aircraft that can be operated remotely without a human pilot on board. UAVs are typically used for a variety of purposes, including military operations, scientific research, commercial applications, and recreational activities. They are equipped with various sensors, cameras, and other types of equipment that allow them to perform specific tasks such as surveillance, reconnaissance, inspection, delivery, and mapping. Some UAVs can also be autonomous, meaning they can operate independently without human intervention.