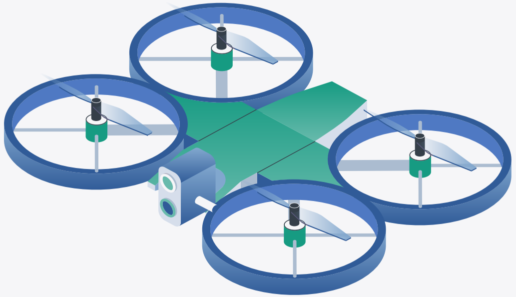

UNMANNED AERIAL VEHICLE

By: Azizi Bin Mohamad Tambi (1919661)

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01

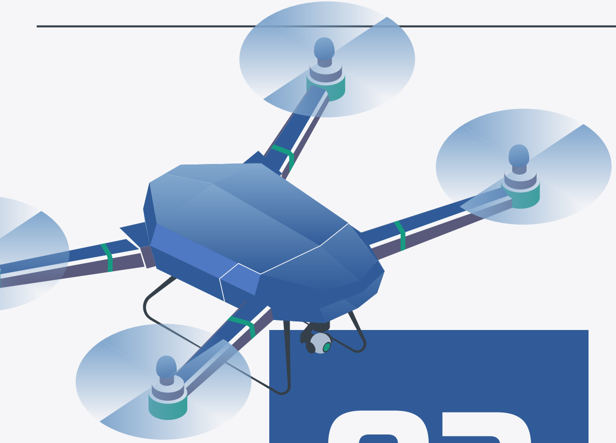
INTRODUCTION

WHAT SHOULD YOU KNOW FIRST

- UAV stands for Unmanned Aerial Vehicle, which is operated without a human pilot on board.
- UAVs can be remotely piloted from the ground or can fly autonomously based on pre-programmed instructions.
- Used for military reconnaissance & surveillance, scientific research, environmental monitoring, search and rescue and more.

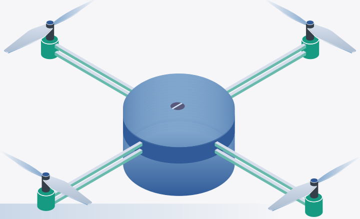
RESEARCH BACKGROUND

- Began in the early 20th century, with the development of remote-controlled model aircraft.
- UAVs were used for reconnaissance and aerial photography during world war I.
- In 1950s and 1960s, the United States began to develop UAVs for military purpose.
- UAVs were primarily used for intelligence gathering however, they also served as test beds for new technologies such as guidance systems and propulsion systems.
- In 1980s and 1990s, smaller and sophisticated UAVs were built where these UAVs are capable of performing wide range of missions.
- Today, UAVs are used in a wide range of fields thanks to the development of microelectronics.



02 HISTORY & APPLICATIONS

KETTERING BUG



- Kettering Bug was the first UAV developed in the early 1920s. It was called after its inventor, Charles Kettering.
- Kettering Bug was essentially an unmanned flying bomb that could be control remotely to fly towards target.
- It was powered by a 40hp engine and was launched from a ramp. Equipped with a gyroscope to stabilize its flight and a barometric altimeter to control its altitude.
- It used a simple radio receiver as a control system to allow the operator to adjust the pitch and yaw.

DRAGANFLYER

- First commercial UAV was called the Draganflyer, developed by a company called Draganfly Innovations in 1980s.
- Draganflyer was small, lightweight helicopter that could be equipped with a camera of other sensors to gather data and information.
- Initially, it was used for aerial photography and videography.
- Today, Draganfly Innovations has continued to develop and refine its UAV technology and has expanded its range of products to include fixed-wing and multirotor UAVs.

APPLICATION

- ❖ Aerial photography & videography.
- ❖ Surveying & mapping.
- ❖ Agricultural monitoring & crop management.
- ❖ Search & rescue.
- ❖ Environmental monitoring & research.
- ❖ Infrastructure inspection.
- ❖ Wildlife tracking & management.
- ❖ Disaster response & relief operations.
- ❖ Mining & mineral exploration.
- ❖ Film & media production.
- ❖ Construction site monitoring & progress reporting.
- ❖ Security & surveillance.
- ❖ Delivery of goods.
- ❖ Military reconnaissance & surveillance.

03 MAIN COMPONENTS OF UAV

I. Frame & Design

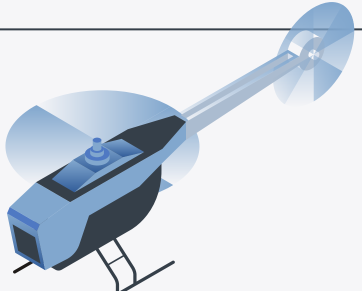
II. Propulsion System

III. Navigation & Control System

IV. Data Collection

V. Data Transmission

VI. Power Management



I. Frame & Design

- The frame & design of an UAV is important as it affect the flight performance, payload capacity, durability, safety and the cost to develop the UAV.
- For the frame, material such as aluminum, carbon fiber, composites and plastics are usually used.
- The choice of materials depend on factors such as the size and weight of the aircraft and its intended application.

I. Frame & Design

Fixed-Wing

- Traditional airplane like design, fixed wing and tail.
- Typically more efficient & have longer flight times but require more space to take off & land.

Multirotor

- Multiple rotors arranged in horizontal plane, powered by an electric motor.
- Highly maneuverable & can hover in place, making them ideal for aerial photography & surveillance

I. Frame & Design

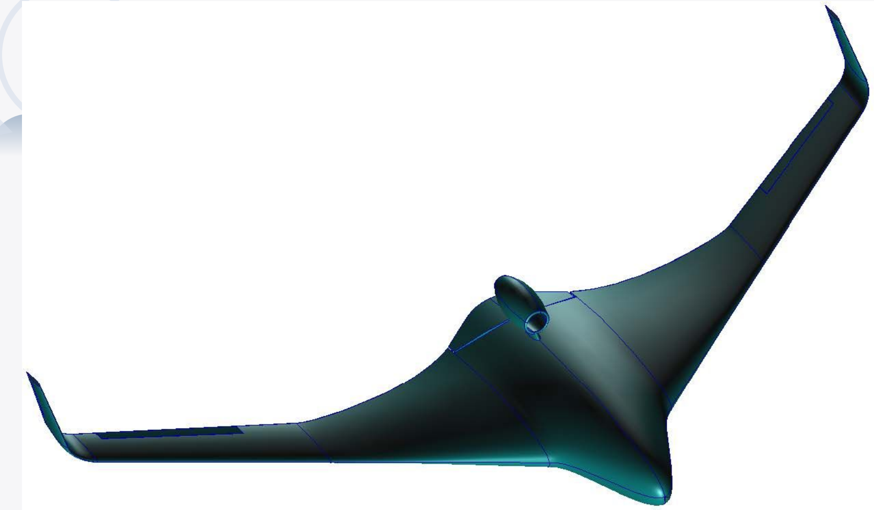
Single Rotor

- Have single rotor, like a traditional helicopter.
- Typically used for applications such as search and rescue & military operations.

Hybrid

- Combine both fixed-wing and multirotor design features.
- Hybrid UAV can take off and land vertically like a multirotor and also fly long distances like a fixed-wing aircraft.

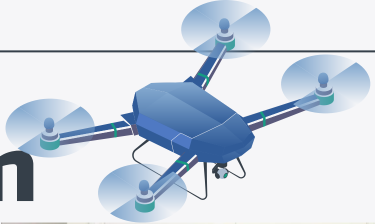
I. Frame & Design



Blended Wing

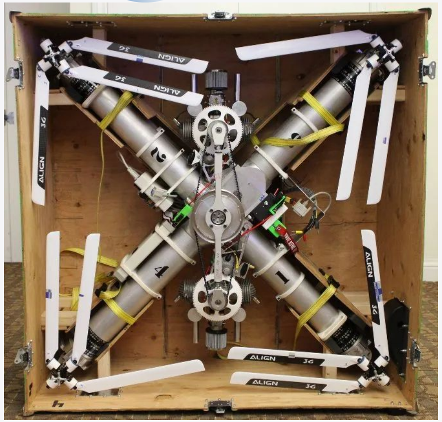
- Have a unique design that blends elements of both fixed-wing and multirotor design.
- Allow the UAV to takeoff and land vertically.
- Efficient for horizontal flight.

II. Propulsion System



Electric Motors

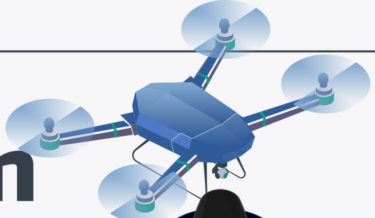
- Most common propulsion systems used in small to medium sized UAVs.
- Used by UAVs for aerial photography, surveillance and other civilian applications.
- Quiet, efficient and easy to control. Rechargeable



Gasoline Engine

- Commonly used in larger UAVs for military applications.
- Powerful and have longer range than electric motors however, loud and less fuel-efficient.

II. Propulsion System



Jet Engine

- Used in high speed and high altitude UAVs such as military drones and experimental aircraft.
- Powerful and have higher top speed than other types of propulsion systems.
- Complex and expensive.

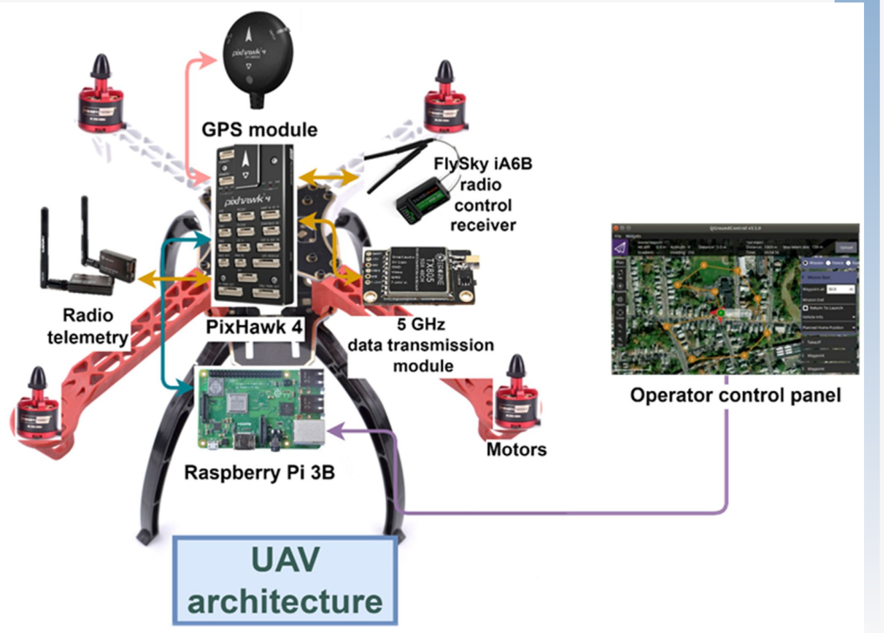
Hybrid System

- Combine 2 or more types of propulsion systems such as an electric motor and a gasoline engine.
- Reason of doing so is to optimize efficiency and performance.

III. Navigation & Control System

GPS

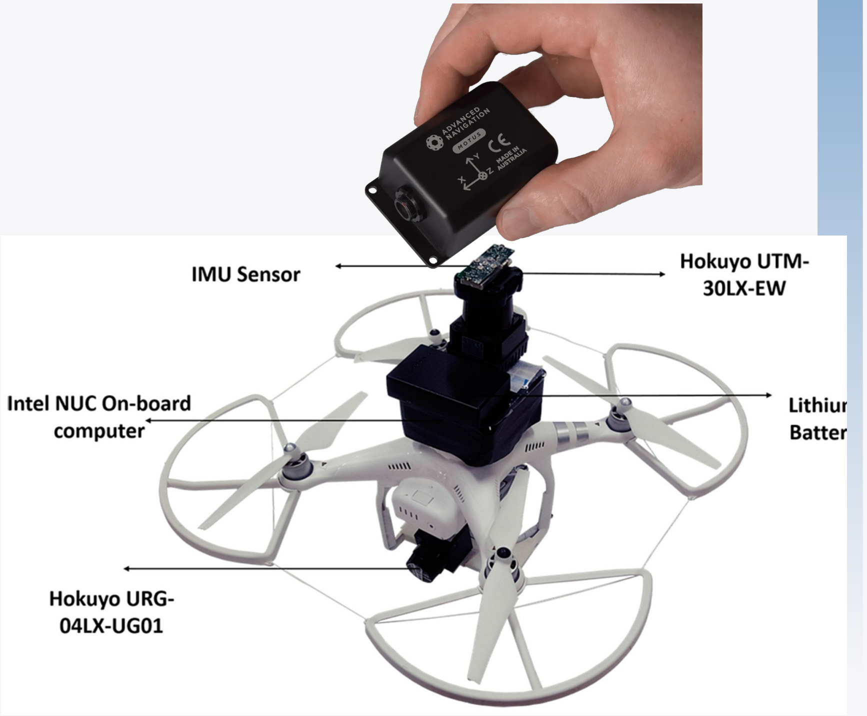
- Global Positioning System (GPS) is a key component of the UAVs navigation system.
- It allows the UAV to determine its precise location and navigate to specific waypoints or targets.
- GPS data is used by the autopilot to adjust its flight path and maintain its position relative to the target.



III. Navigation & Control System

IMU

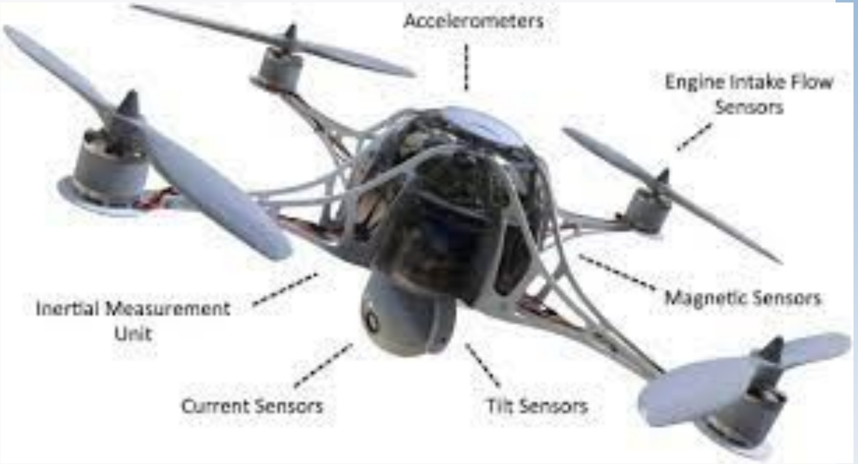
- Inertial measurement unit (IMU) is a sensor system that measures the UAVs acceleration, angular velocity and orientation.
- Data gathered by IMU is used by the autopilot to determine its position and make adjustment to its flight path.



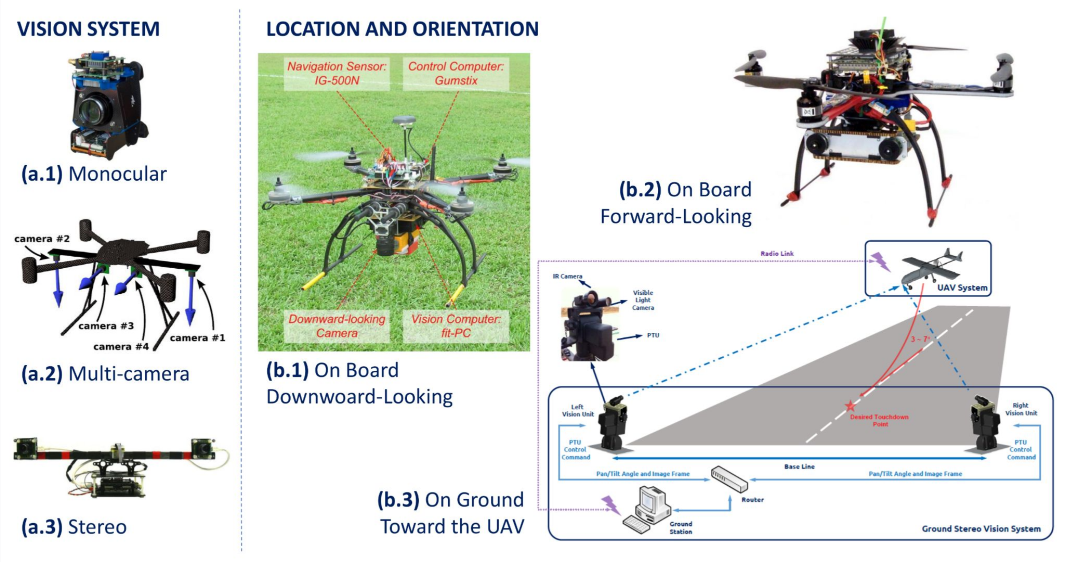
III. Navigation & Control System

Gyroscopes & Accelerometer

- Used in conjunction with IMU to measure UAVs angular velocity and acceleration.
- Provide additional data to autopilot to maintain stability and control during flight.



III. Navigation & Control System



Machine Vision Systems

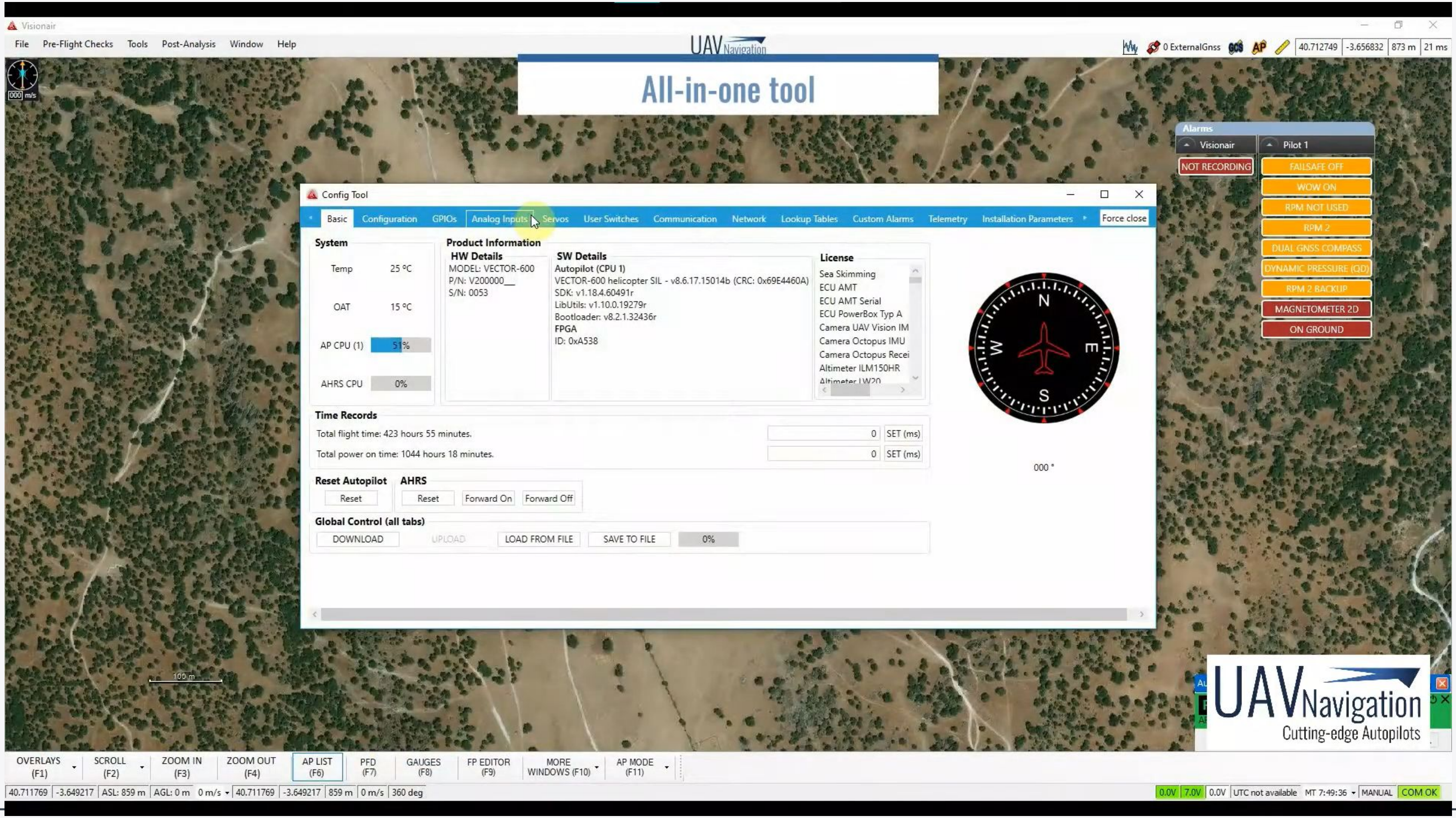
- Cameras and image recognition software are used for some UAVs to navigate and perform tasks.
- For instance, UAV used for aerial photography may use machine vision to track and identify specific objects or landmarks.

III. Navigation & Control System

RC System

- Remote control systems are used in some case by a human operator to control the UAV remotely using ground based controller.
- The controller will send commands to the UAVs autopilot to adjusts the UAVs flight path accordingly.

Navigation Software (VisionAir)



Navigation Software (Mission Planner)

	Command					Lat	Long	Alt	Delete	Up	Down	Grad %	Dist	AZ
1	WAYPOINT	0	0	0	0	-35.0407928	117.8277898	100	X			95.7	104.5	1
2	WAYPOINT	0	0	0	0	-35.0406786	117.8260410	100	X			0.0	159.7	275
3	WAYPOINT	0	0	0	0	-35.0417239	117.8251612	100	X			0.0	141.2	215
4	WAYPOINT	0	0	0	0	-35.0428395	117.8259873	100	X			0.0	145.1	149
5	WAYPOINT	0	0	0	0	-35.0427165	117.8274572	100	X			0.0	134.5	84

Navigation Software (PX4 Autopilot)

IV. Data Collection

Sensors

1. Cameras
2. LiDAR
3. Infrared Sensors
4. GPS
5. Magnetometers
6. Barometers
7. Environmental sensors
   -Gas sensor, thermostat and more.

Actuators

1. Servos
2. Brushless DC motors
3. Electronic speed controllers (ESCs)
   -Adjust speed accordingly.
4. Linear Actuator
   -Used for applications such as landing gear deployment and camera gimbal control.
5. Solenoids
   -Used for applications such as parachute release and payload deployment.

Cameras:

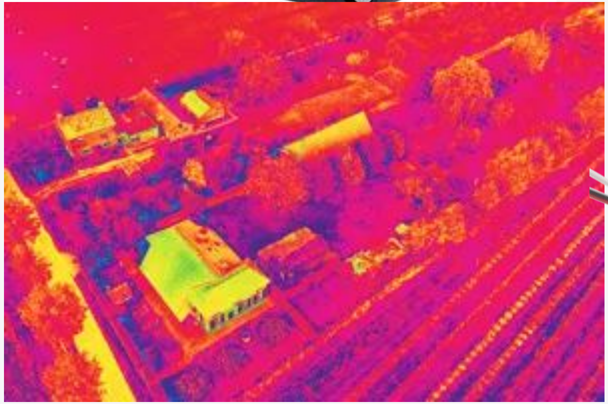

PHASEONE
INDUSTRIAL
High-Resolution & Multispectral
Aerial Imagery Cameras for Drones / UAVs


Lumenera


Lumenera

LiDAR:

Infrared:



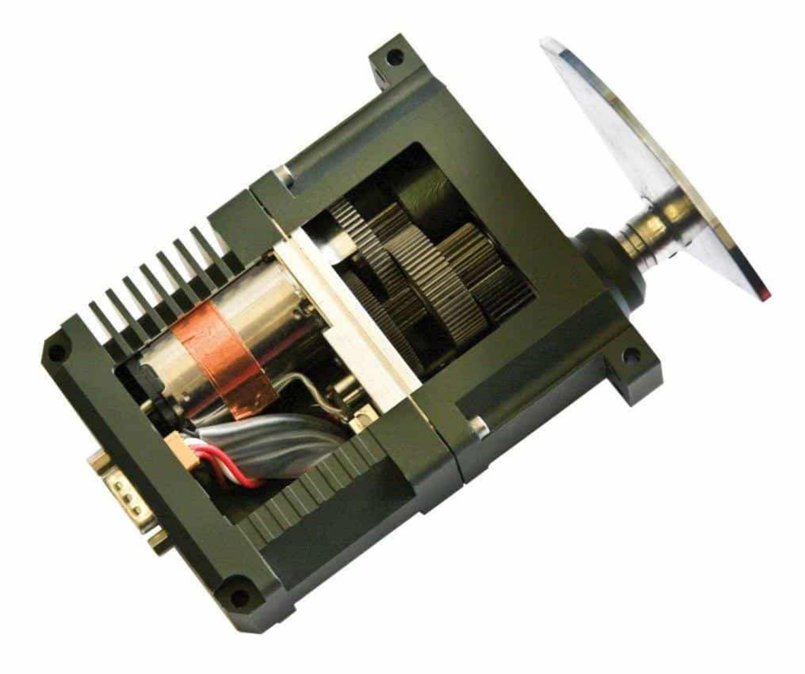
GPS:

Magnetometer:

Barometers:

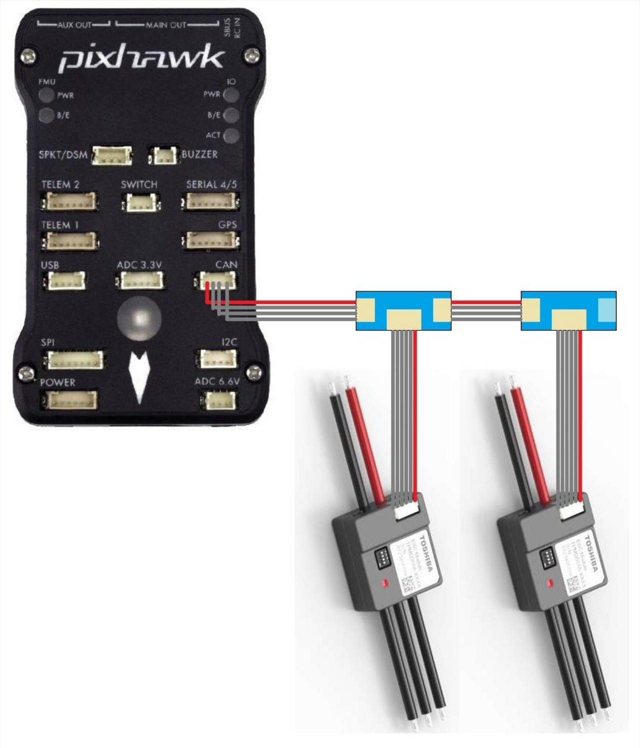
Gas Sensor:

Servos:



Brushless DC motor:

ESCs:



Linear Actuator:

Solenoid:

Data Acquisition

USB DAQ System

Standalone or modular solutions

Get simultaneous, high-speed data sampling in plug-and-play and hot-swappable USB format for standalone or modular solutions

Benchtop DAQ System

3- to 8-slot Mainframes with built-in DMM

Benchtop systems offer your choice of mainframe and mix-and-match of plug-in modules

LXI DAQ System

LXI Switch and Control Instruments

Standalone instruments that perform the same function as their companion 34980A-Series benchtop plug-in modules

V. Data Transmission

Radio Communication:

- Most common method to transmit data for UAVs.
- Achieved by using variety of frequency bands, such as 2.4GHz or 5.8GHz.
- Can transmit data such as telemetry data, video and control signals.

Cellular Communication:

- Used in areas with cellular coverage.
- Can transmit data such as video and telemetry data.

Optical Communication:

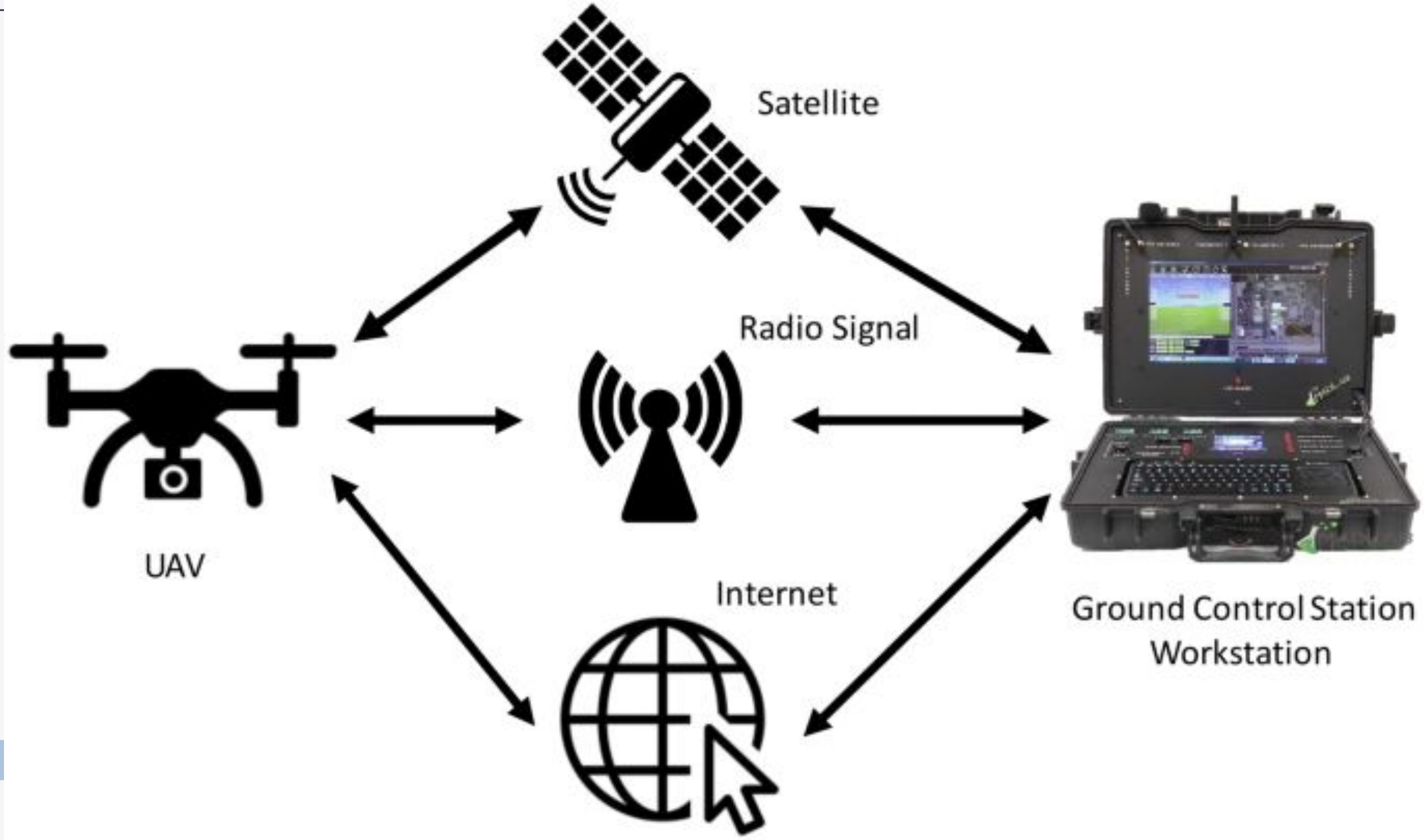
- Used in areas with clear line-of-sight between UAV and ground control station.

Satellite Communication:

- Used in areas without cellular coverage.
- Can transmit data such as video and telemetry data but typically has higher latency and costly.

Wi-Fi:

- Wi-fi can be used for data transmission between UAV and ground control station if they are within range of each other.
- Can transmit telemetry data and video.


Satellite
Radio Signal
UAV
Internet
Ground Control Station
Workstation

VI. Power Management

Power Converters:

- Used to convert battery voltage to required voltage for various components of UAV.
- Can be step-up or step-down converters.

Power Distribution Boards:

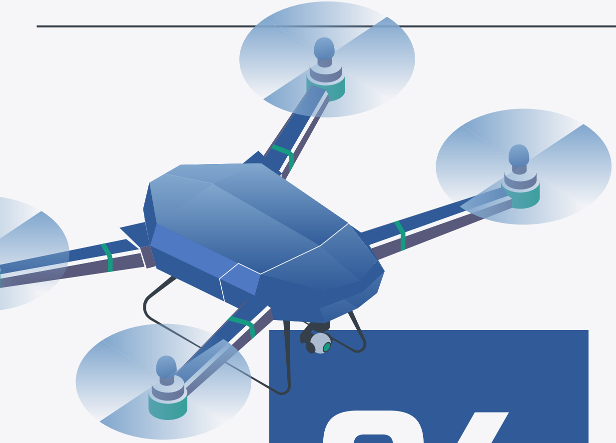
- Used to distribute power from battery to various components.
- Can be designed to provide multiple output voltages.
- May include fuses or circuit breakers for safety.

Battery Management Systems:

- Used to monitor and manage battery during flight.
- Can monitor battery voltage, current and temperature.
- May include features such as cell balancing and overvoltage protection.

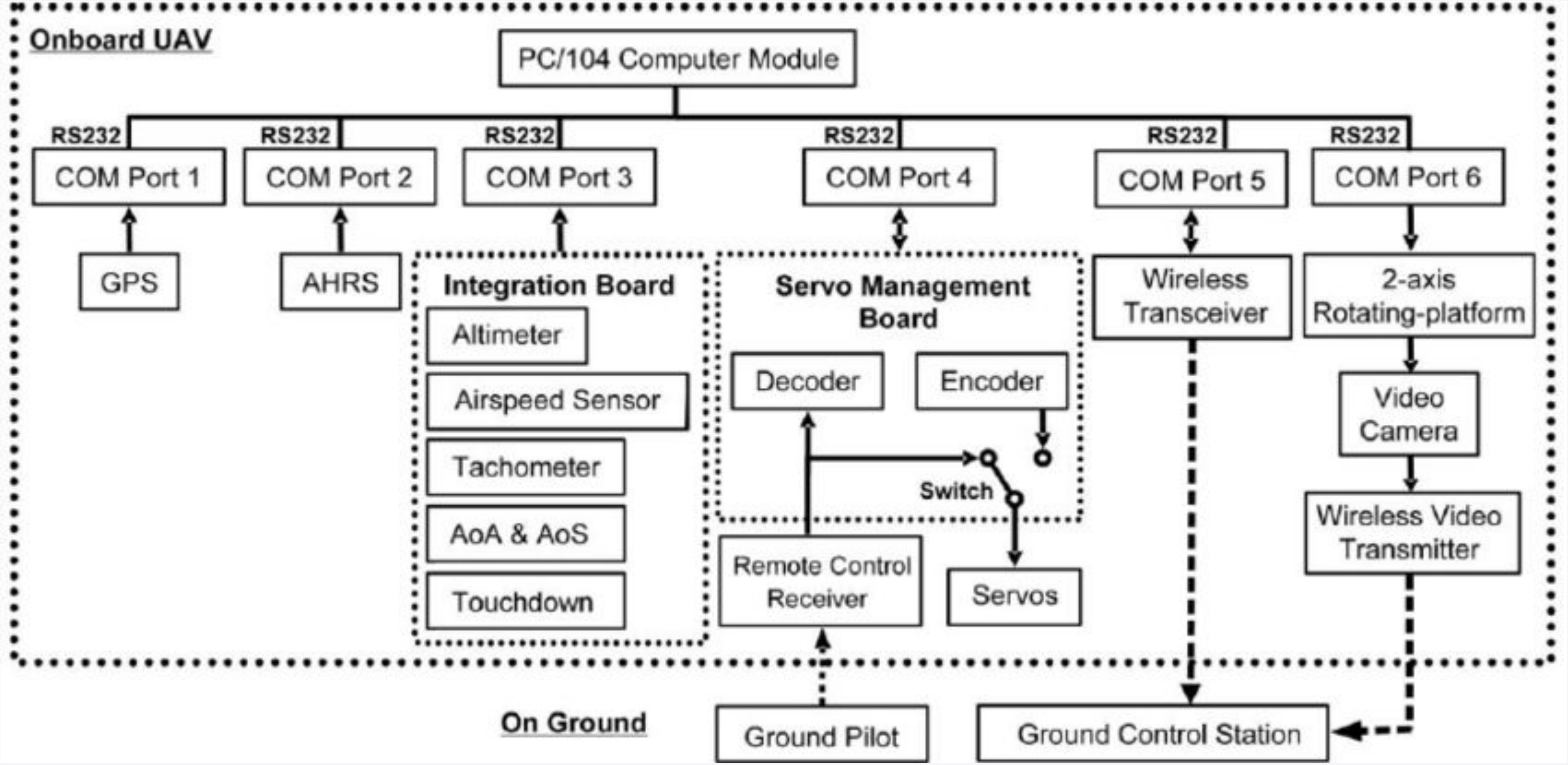
Redundant Power Systems:

- Used to ensure that UAV can continue to operate in event of power failure.
- Include redundant batteries, redundant power converters, or backup power sources such as solar panels.

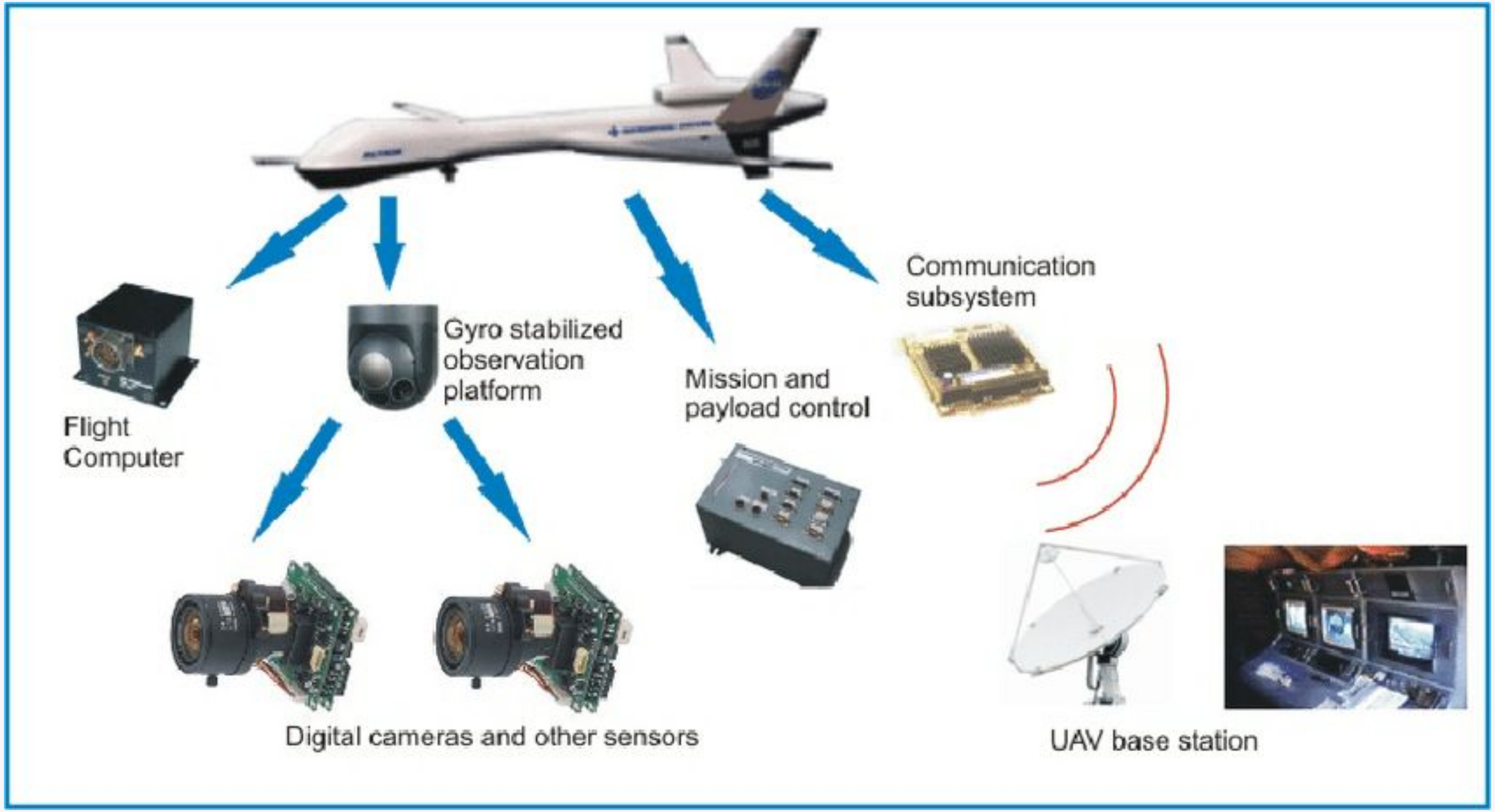


04 BUILDING YOUR OWN

Complete UAV's System Architecture



Hands On Session



SUAS Competition

Student Unmanned Aerial Systems Competition hosted by the Seafarer Chapter

The new, innovative aspect of ICUAS '22 is that it will include – for the first time – an Unmanned Aerial Vehicle (UAV) Competition. The Competition is **student-focused**, offering unique opportunities for students to test and compare their skills with those of their peers, worldwide. The main idea and timeline of the competition are described below.

The competition is open to any full-time BSc, MSc and PhD students (a proof of student status will be required later). There is no

RECENT POSTS

Report on ICUAS 2022 in IEEE Control Systems

Proceedings published in IEEE Xplore

Ri4rover

Home Competition Gallery Contributors Resources Leaderboard

Research Infrastructure for Real-Time Onboard Vision Enabled Robots

A research facility for researchers to utilize for developing and testing unmanned vehicles in a controlled environment. The facility aims to foster the development of unmanned vehicle solutions through challenges and competitions.

Welcome to join lpcvc.slack.com (2023-uav-chase channel) to receive news about the challenge

Competition Video: 2023 IEEE Autonomous UAV (Unmanned Aerial Vehicle) Chase Challenge

Sponsors: National Science Foundation, IEEE Computer Society, and Purdue College of Engineering

05 MALAYSIA MARKET

Market Player:

1. CTRM Aviation
2. Zetro Aerospace
3. Aerodyne Group
4. DJI
5. Intel

Who can use this?

1. Researchers
2. Private Companies
3. Royal Malaysia Police
4. Malaysian Armed Forces
5. Department of Agriculture
6. Department of Survey and Mapping Malaysia
7. NGOs

OBSTACLES

Regulatory Challenges

UAV operations are subject to strict regulations. Regulations may vary depending on the type of UAV and location of operation.

Safety Concerns

UAVs can pose a risk to people and property of not operated safely.

Regulatory Challenges

UAVs are complex systems that require sophisticated sensors, navigation and communication technology. Signal interference, software bugs and hardware failures affects UAVs performance.

Top Things To Remember When Using UAV

Follow Regulations:

UAV operations are subject to regulations and restrictions that vary depending on the locations.

Be mindful of weather condition:

Weather conditions can affect the performance and safety of UAVs. Avoid flying in high winds, rain or other adverse weather conditions.

Pre-flight checks:

Ensure that the UAV in in good working condition and all systems are functioning properly. Check battery life, GPS signal and sensors before takeoff.

Respect Privacy:

If the UAV is equipped with a camera or other sensors, be respectful of individuals' privacy rights and avoid flying over private property without permission.

06 CONCLUSION

In conclusion, UAVs have become popular for a wide range of applications, from aerial photography and mapping to search and rescue and more. With advances in technology, UAVs are becoming more accessible, easier to operate and capable of performing complex mission.

However, there are also challenges associated with the use of UAVs. To ensure the safe and effective use of UAVs, it is crucial to follow regulations, perform pre-flight checks, plan flights carefully and be prepared for emergencies. With careful consideration and responsible operation, UAVs have the potential to transform many industries and improve our lives in countless ways.