Unmanned Aerial Vehicle(UAV)

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Table of contents

Introduction

UAV stands for Unmanned Aerial Vehicle, also known as a drone. It is a type of aircraft that does not require a human pilot on board to fly. Instead, UAVs are controlled remotely by a human operator, or they can be programmed to fly autonomously using pre-programmed flight paths and instructions.

DRB-Hicom Defence Technologies, Universiti Pertahanan inks MoU to collaborate on R&D in automotive, UAV technologies

By NST Business - March 29, 2022 @ 4:05pm

Both parties today signed a memorandum of understanding (MoU), and the exchange of documents was witnessed by the Chief of Defence Forces General Tan Sri Affendi Buang at the Deftech Pavilion during the Defence Services Asia 2022 (DSA 2022) at MITEC.

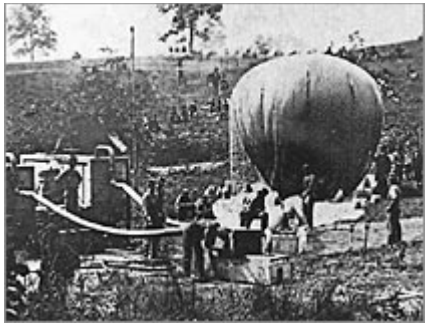
Research Background

- The purpose of UAVs is broad and encompasses a wide range of fields, including engineering, computer science, materials science, and aerospace technology.
- One major area of research has been focused on improving the design and performance of UAVs. This includes developing new materials that are lighter and stronger, improving aerodynamics and stability, and enhancing the power and propulsion systems.
- Another area of research has been focused on improving the autonomous capabilities of UAVs. This includes developing advanced sensors and navigation systems, as well as improving the ability of UAVs to make intelligent decisions based on real - time data.
- In addition, there has been a significant amount of research into the applications of UAVs across various industries. This includes agriculture, where UAVs are used for crop monitoring and management, as well as disaster response, where UAVs are used for search and rescue operations.
- Other research areas include developing new control and communication systems for UAVs, improving their safety and security, and exploring the ethical and legal implications of their use.

History and Applications

UAVs are descended from target drones and remotely piloted vehicles (RPVs) employed by the military forces of many countries in the decades immediately after World War II. Modern UAVs debuted as an important weapons system in the early 1980s

Pre-1900



Perley's Aerial Bomber
February 1863,Perley from New York City designed a patent for unmanned aerial bomber. It's a hot air balloon that could carry a basket laden with explosives attached to a timing mechanism.

Eddy's Surveillance Kite
In 1883, Douglas Archibald took the first successful aerial photographs from a large kite.

1900-1920

Aerial Torpedo

In 1917, the US Navy presented the "Aerial Torpedo", a pilotless biplane bomber made of wood, weighting 270 kg and powered by a 40 horsepower engine from Ford. The characteristics of this vehicle can be listed as: a gyrostabilizer to keep the aircraft level, an automatic steering gyro to keep the aircraft on a preset heading, a barometer to indicate cruise altitude, causing the aircraft to level off, an engine revolution counter to determine when the aircraft should cut power and dive into its target. Also, a wind - driven electrical generator was used to provide power for the gyro motors and the servomotors that moved the aerial torpedo’s flight control surfaces.

1930s

DH.82B Queen Bee

During training missions, the Queen Bee, the first returnable and reusable UAV, was intended to serve as an aerial target. The Royal Navy's anti-aircraft gunners rehearsed shooting them down at first sight. The spruce-and-plywood biplanes had their first flight in 1935 and were equipped with wheels or floats for takeoff from an airport (for use at sea). The radio-controlled Queen Bee had a ceiling of 17,000 feet, a maximum range of 300 miles, and a top speed of more than 100 mph. Up until their retirement in 1947, 380 Queen Bees worked as target drones for the Royal Air Force and the Royal Navy.

1940s

V- 1

Adolf Hitler ordered a flying bomb at the start of World War II with the chilling instruction that it would be used on "non- military targets." The Fieseler Fi- 103, also known as the Vergeltungswaffe (Revenge weapon)- 1 or V- 1, was created by Fieseler Flugzeuhau to launch through a lengthy ramp resembling a catapult and fly at 470 mph. An iconic buzzing noise was made by the propulsion pulsejet that propelled the V - 1 UAV. It had been pre programmed to fly 150 miles before dropping its bomb and could carry a 2,000 - pound warhead. When V- 1s were first used against Britain in 1944, they resulted in over 900 civilian deaths and over 35,000 injuries in British cities.

1960s

AQM- 34 Ryan Firebee

The AQM- 34 Ryan Firebee was a family of target drones developed by the Ryan Aeronautical Corporation in the United States during the Cold War. The first model, the AQM - 34A, was developed in the 1950s as a high- speed target drone for the US Air Force. The AQM- 34 Firebee was a jet - powered aircraft with a wingspan of 22 feet and a length of 26 feet. It was designed to be launched from the ground or air and could be remotely controlled or fly autonomously along pre- programmed flight paths. The drone was capable of flying at speeds of up to Mach 1.4 and at altitudes of up to 60,000 feet. The primary mission of the AQM - 34 Firebee was to provide realistic target practice for military aircraft and anti - aircraft weapons. The drone was also used for reconnaissance and surveillance missions, and it was sometimes equipped with cameras or other sensors to collect intelligence data.

1970s

Ryan SPA 147

The downing of an RC- 121 communications intelligence (COMMINT) monitoring plane over the Yellow Sea in 1970, which resulted in the death of the crew on board, prompted the US military to create new unmanned aerial vehicles (UAVs) with COMMINT acquisition capabilities and the ability to fly at great altitudes, above the range of enemy missiles. In order for Firebee target drones to be able to spy on enemy radio communications and take pictures from above 60,000 feet, Ryan Aeronautical got to work altering them. The resulting Ryan Special Purpose Aircraft (SPA) 147 was the first long- haul UAV outfitted for COMMINT at high altitude and was capable of eight hours of continuous flight while carrying a 300 - pound camera.

1990s to Today

Pathfinder

Pathfinder is a solar-powered, ultra-lightweight research aircraft developed by AeroVironment Corporation and being tested for environmental research. In 1997, Pathfinder reached an altitude of 67,350 feet, the highest altitude ever reached by a solar aircraft. This UAV collects wind and weather data with extremely fine sensors and snaps digital images at high

Applications

Aerial Photography and Videography : UAVs equipped with cameras are widely used in the film and media industry for capturing high - quality aerial footage.

Agriculture : UAVs equipped with sensors and cameras can be used in precision agriculture to monitor crop health, soil quality, and irrigation needs.

Search and Rescue : UAVs equipped with thermal cameras and other sensors can be used in search and rescue operations to locate missing persons or disaster victims.

Surveying and Mapping : UAVs can be used in land surveying and mapping to quickly and accurately generate 3D maps and models of terrain and infrastructure.

Applications

Infrastructure Inspection : UAVs can be used to inspect infrastructure such as bridges, buildings, and pipelines, for damage or defects, eliminating the need for manual inspections.

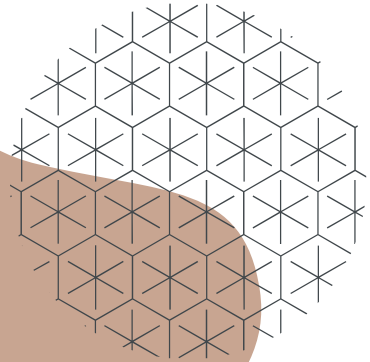
Environmental Monitoring: UAVs can be used to monitor environmental factors such as air quality, water quality, and wildlife populations.

Disaster Response : UAVs can be used to quickly assess damage after a natural disaster, such as an earthquake or hurricane, and aid in disaster relief efforts.

Military and Defense : UAVs are commonly used in military and defense applications for reconnaissance, surveillance, and target acquisition.

Delivery: UAVs are being developed and tested for package delivery services, particularly in areas where road transportation is difficult or inefficient.

Main Components of ROV



List

Frame

Power System

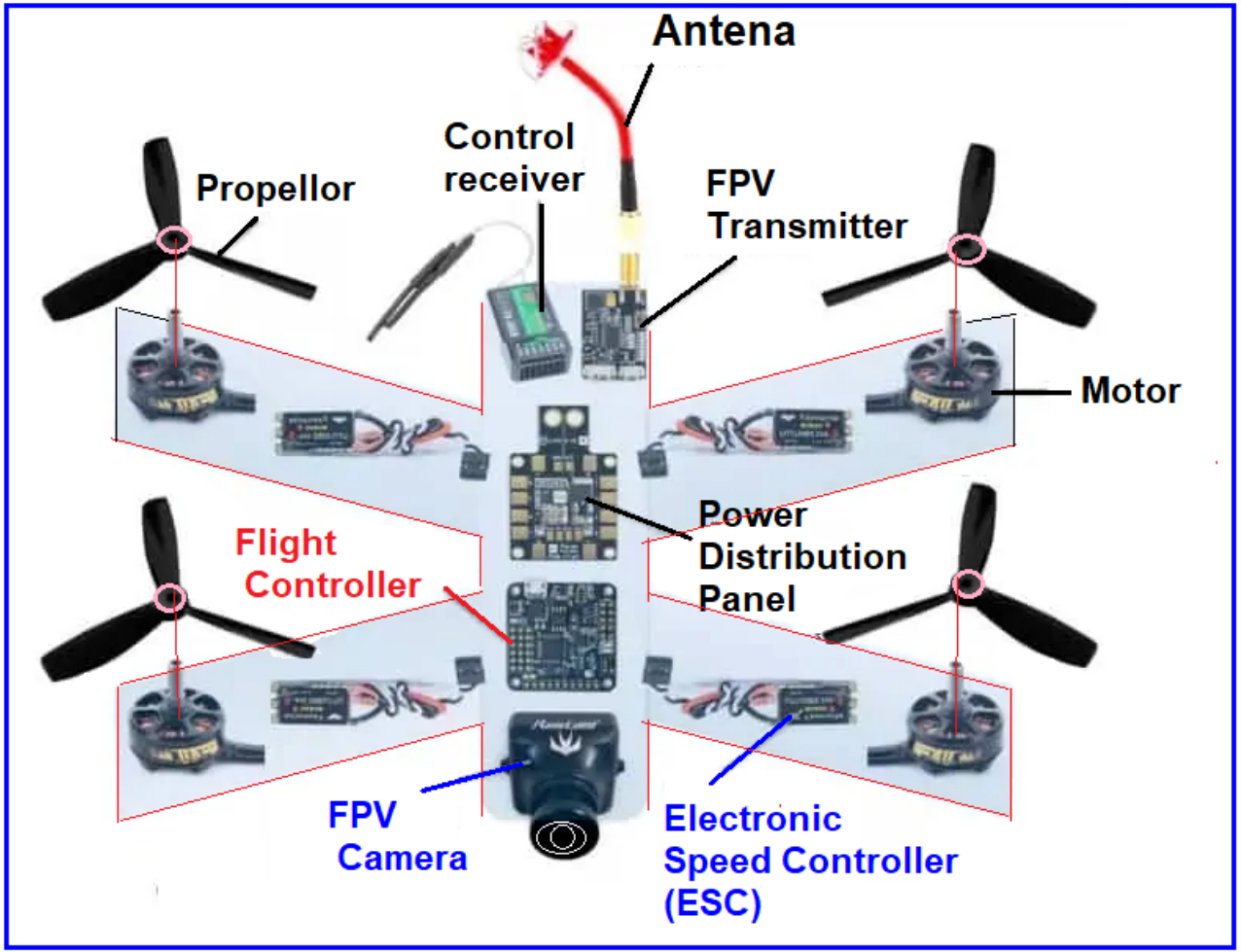
Flight Control System

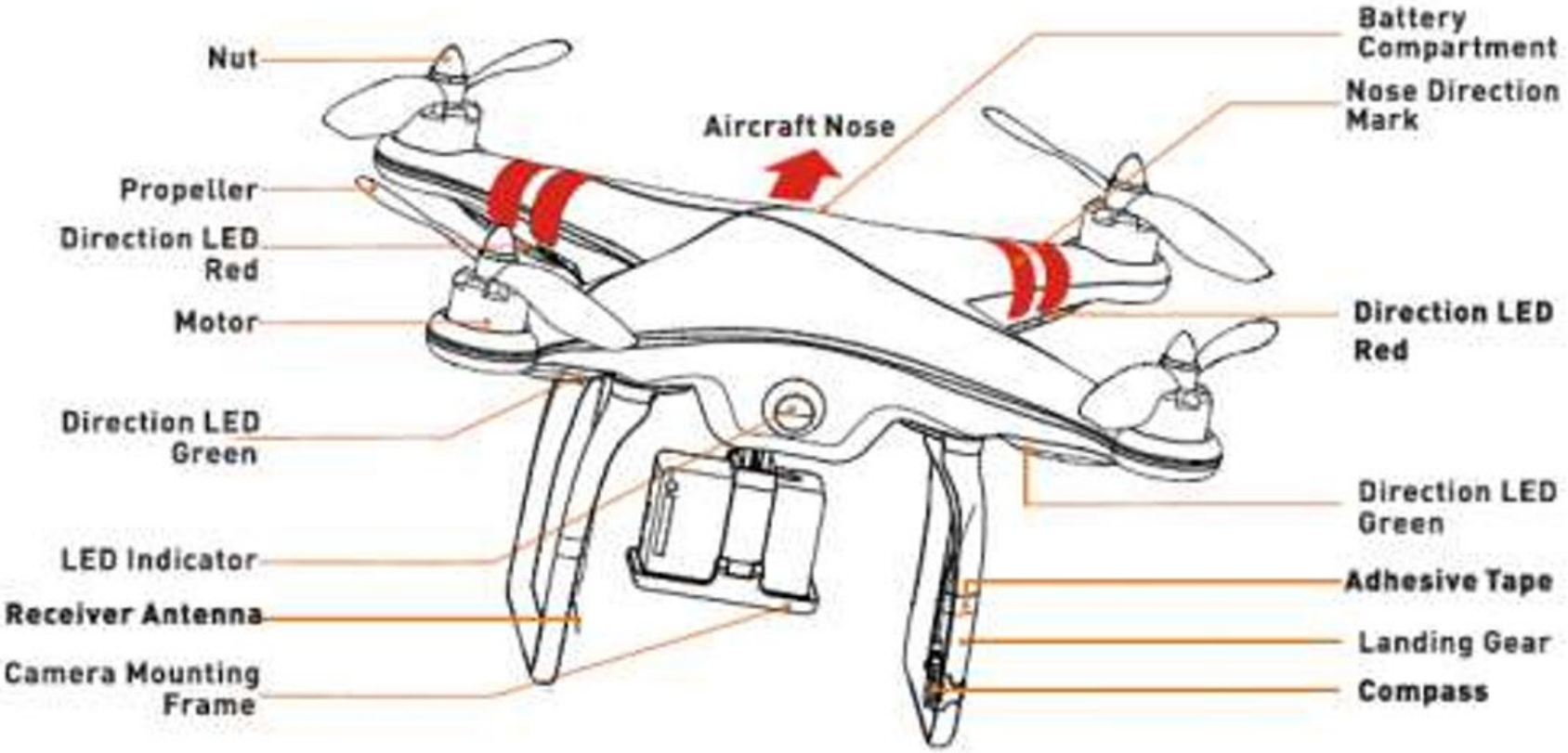
Communication System

Payload

Landing Gear

Parts of Drone




Nut
Propeller
Direction LED Red
Motor
Direction LED Green
LED Indicator
Receiver Antenna
Camera Mounting Frame
Aircraft Nose
Battery Compartment
Nose Direction Mark
Direction LED Red
Direction LED Green
Adhesive Tape
Landing Gear
Compass

Frame

The frame of a UAV is the physical structure that supports all the other components. It is usually made of lightweight materials such as carbon fiber or aluminum, to minimize weight and maximize flight time.

DJI Phantom

popular consumer drone with a quadcopter frame design.

Parrot Bebop

another popular consumer drone with a quadcopter frame design.

Fire Scout

military drone with a helicopter frame design.

Predator MQ-9

military drone with a fixed-wing frame design.

Wingtra One

professional mapping drone with a fixed-wing frame design.

Power System

The power system of a UAV consists of a battery or fuel cell, and an electric motor or gas engine. This provides the necessary energy to power the aircraft and keep it aloft.

DJI Mavic 2 Pro: The DJI Mavic 2 Pro is a popular consumer drone with an electric motor power system.

MQ-9 Reaper: The MQ-9 Reaper is a military drone with a gas turbine power system

AeroVironment Puma: The AeroVironment Puma is a professional drone with a battery-electric power system.

RQ-4 Global Hawk: The RQ-4 Global Hawk is a military drone with a hybrid power system. It features a turbofan engine and a generator that powers the UAV's electrical systems.

Solar Impulse 2: The Solar Impulse 2 is a solar-powered drone with an electric motor power system.

Flight Control System

The flight control system is the "brain" of the UAV, which controls its movements and flight path. It includes a variety of sensors, such as accelerometers, gyroscopes, and GPS, as well as a flight controller that processes the sensor data and sends commands to the aircraft's control surfaces.

The DJI Phantom 4 Pro is a popular consumer drone with a GPS flight control system. It features an advanced obstacle avoidance system and can fly autonomously along pre-programmed flight paths.

The WingtraOne is a professional mapping drone with a vertical take-off and landing (VTOL) flight control system. It can fly autonomously and features advanced sensors and navigation systems for precise mapping and surveying.

The MQ-1 Predator is a military drone with a fly-by-wire flight control system. It is operated remotely and is capable of conducting a variety of missions, including surveillance and targeted strikes.

The General Atomics MQ-9 Reaper is a military drone with a fly-by-wire flight control system. It is capable of conducting a variety of missions, including reconnaissance, surveillance, and targeted strikes.

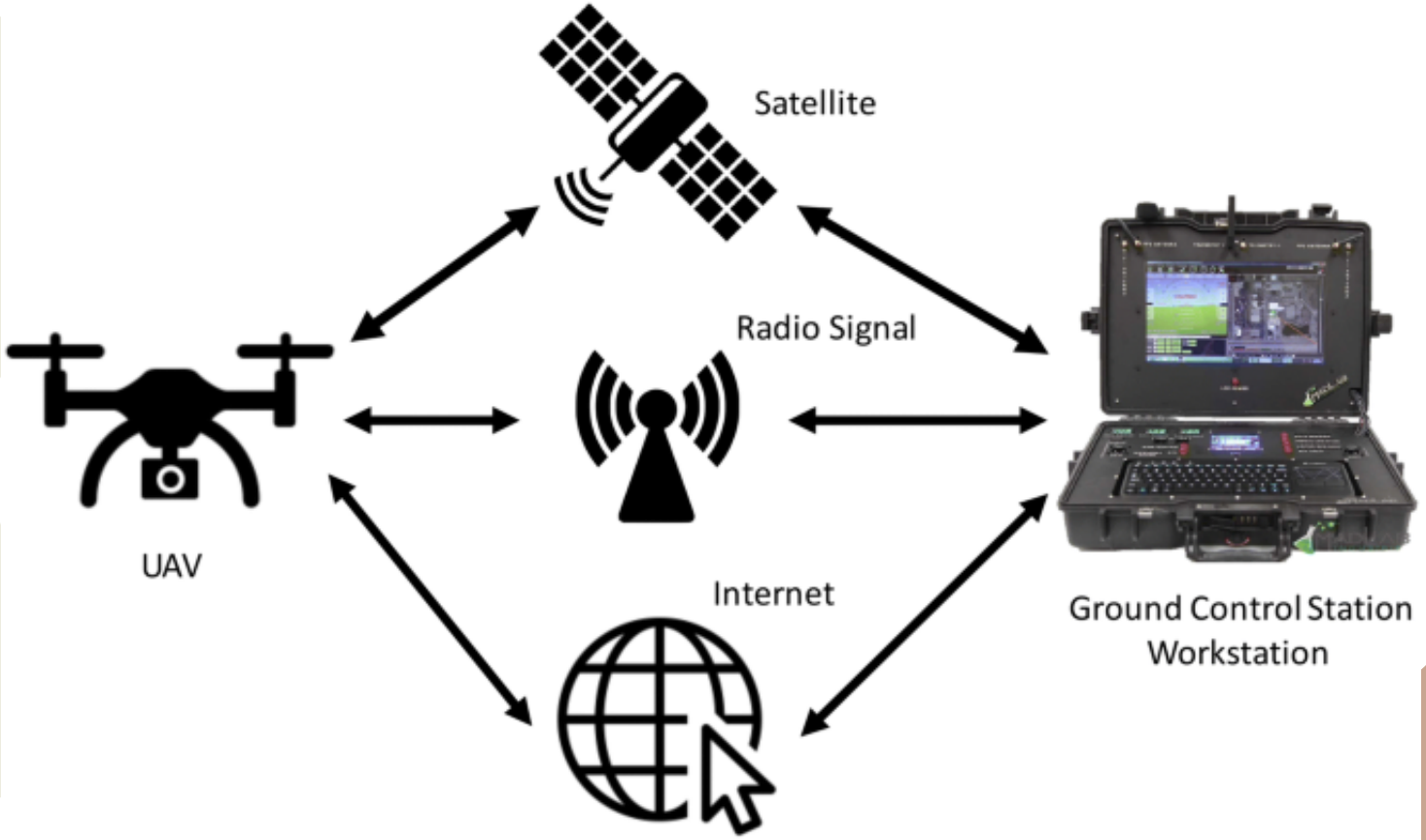
The Parrot Anafi is a consumer drone with a smartphone app flight control system. It features a compact, foldable design and can be controlled using a smartphone or tablet. It is primarily used for aerial photography and videography.

Esssentials in Flight Control System

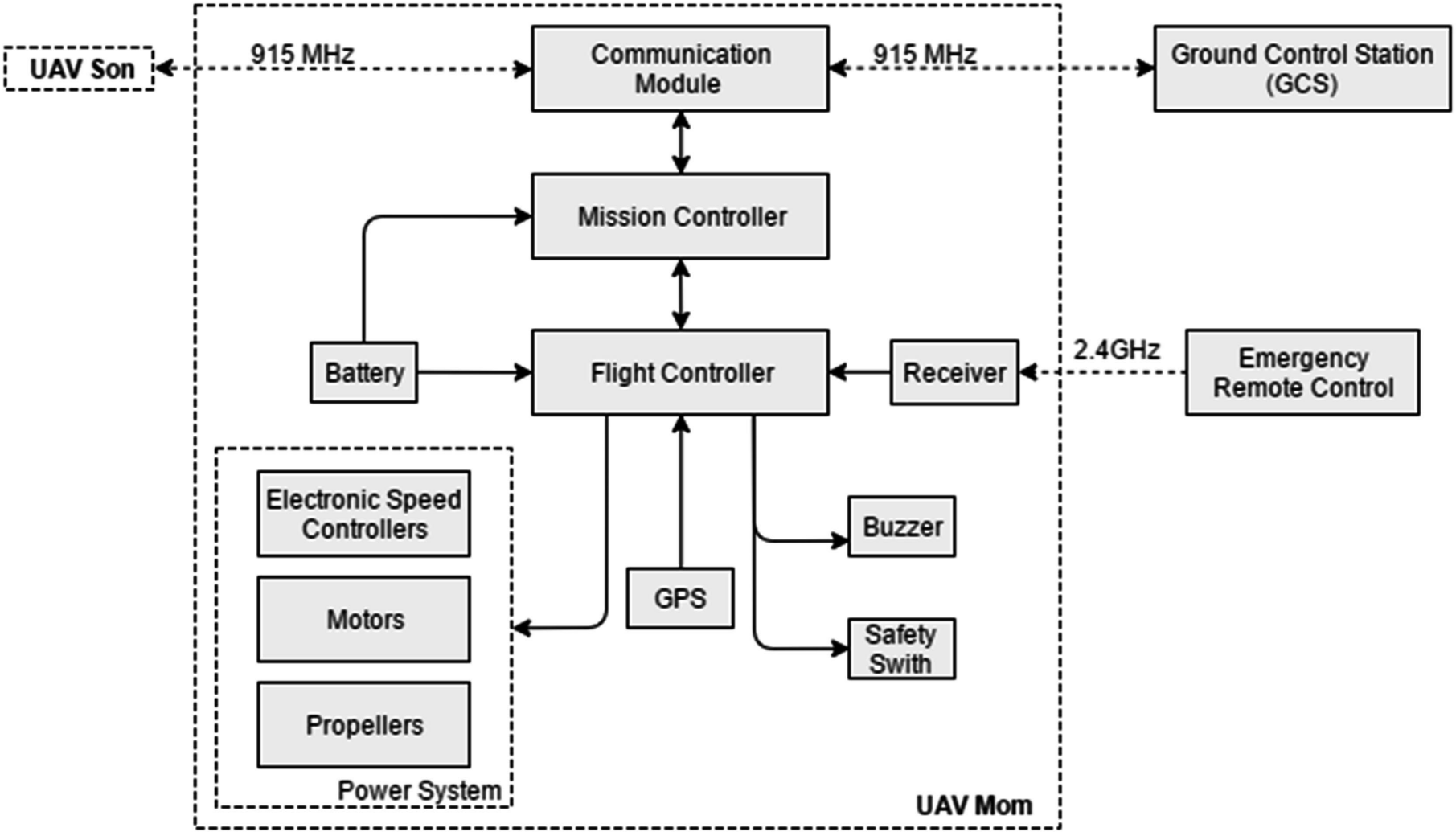
- Flight Controller: The flight controller is the central component of the flight control system. It processes data from various sensors, such as accelerometers, gyroscopes, barometers, and GPS receivers, and uses this information to stabilize the drone and control its flight.
- Sensors: Sensors are used to gather data about the drone's orientation, altitude, speed, and other parameters. Some of the commonly used sensors in UAVs include accelerometers, gyroscopes, barometers, magnetometers, and GPS receivers.
- Motor controllers: Motor controllers are used to regulate the speed and direction of the motors that drive the drone's propellers. They receive commands from the flight controller and adjust the motor output accordingly.
- Power distribution board: The power distribution board (PDB) is used to distribute power from the battery to the various components of the flight control system, including the flight controller, motor controllers, and sensors.
- Radio Control Receiver: The radio control (RC) receiver is used to receive commands from the pilot or ground control station and relay them to the flight controller. It is an essential component of the manual control system for the drone.
- Telemetry system: A telemetry system is used to transmit data from the drone to the ground control station, including information about the drone's flight status, battery level, and sensor readings.
- Battery: The battery provides power to the drone's electrical system, including the flight controller, motor controllers, and sensors. The battery capacity and voltage will vary depending on the drone's size and flight time requirements.
- Frame and motors: The frame and motors are the physical components that allow the drone to take off, hover, and move in various directions. The frame provides a platform for mounting the flight control system and motors, while the motors drive the propellers that generate lift and thrust.

Communication System

The communication system allows the UAV to receive commands from its operator or ground control station, and to send back telemetry data such as flight status, battery life, and sensor readings.



Default ways of controlling UAVs through the ground control stations in both manual and autonomous missions


UAV Son
915 MHz
Communication Module
915 MHz
Ground Control Station (GCS)
Mission Controller
Battery
Flight Controller
Receiver
2.4GHz
Emergency Remote Control
Electronic Speed Controllers
Motors
Propellers
Power System
GPS
Buzzer
Safety Swith
UAV Mom

Payload

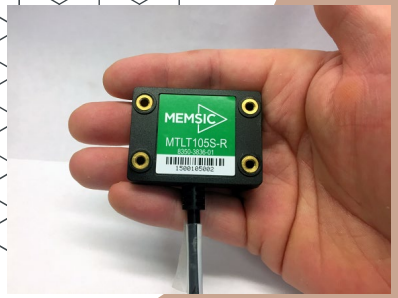
The payload is the equipment or sensors that are carried by the UAV, such as cameras, sensors, or other specialized equipment. The type and size of the payload can vary depending on the intended use of the UAV.

Sensors

- LiDAR
- RADAR
- Accelerometer
- Inertial Measurement Units
- Tilt Sensors
- Current Sensors
- Magnetic Sensors
- Engine Intake Flow Sensors
- etc

INS380SA module pictured here is a complete inertial navigation system

Tilt sensors help drones maintain level flight



Current sensors can be used to monitor and optimize power drain, safe charging of internal batteries, and detect fault conditions with motors or other areas of the system.

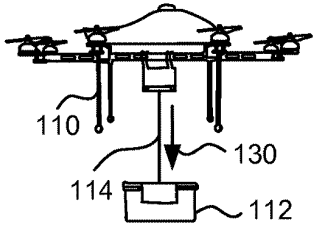
iXM-50 50MP for professional drone camera for high-resolution aerial imaging

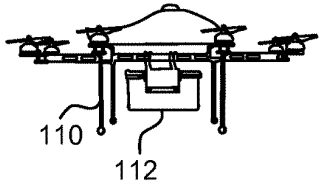
SkyHopper COMBO for SDR data link & LTE networking for Drones, Robotics & IoT

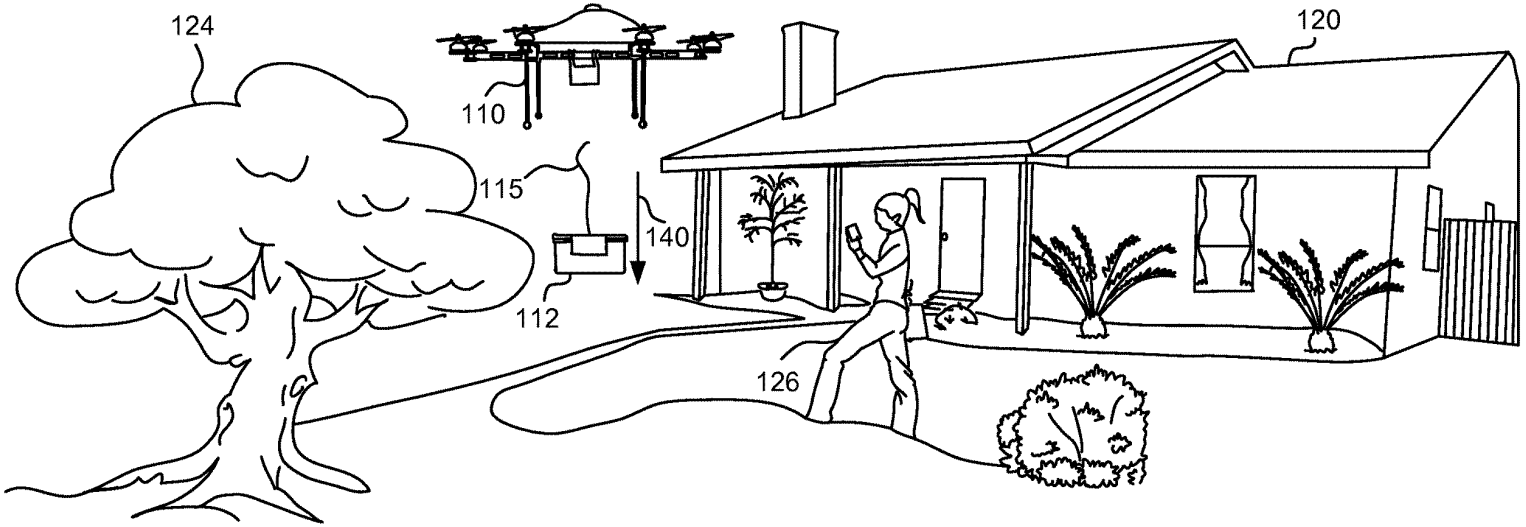
Unmanned Aerial Vehicle (UAV)-based Remote Water Sampling System within UgCS Integrated Systems released by SPH Engineering

Others

- Camera
- Communication systems
- Payload delivery systems
- Sampling equipment
- Weapon systems







Upon arrival to a delivery location, the UAV may release the payload and lower a tether coupling the payload to the UAV 122

Landing Gear

The landing gear is the mechanism that allows the UAV to take off and land safely. It can range from simple skids or wheels to more complex retractable systems.

Landing Gear

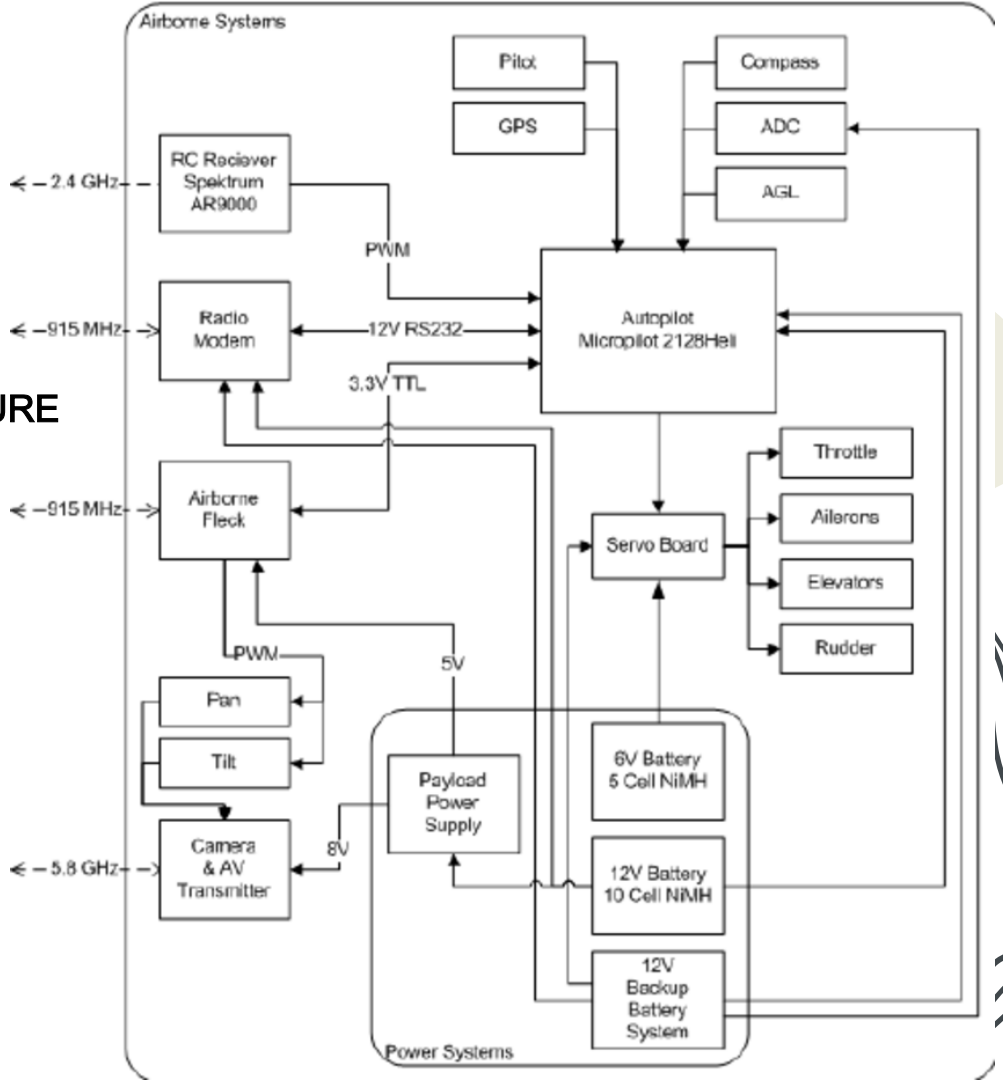
PHANTOM 4 RTK uses skid for landing gear.

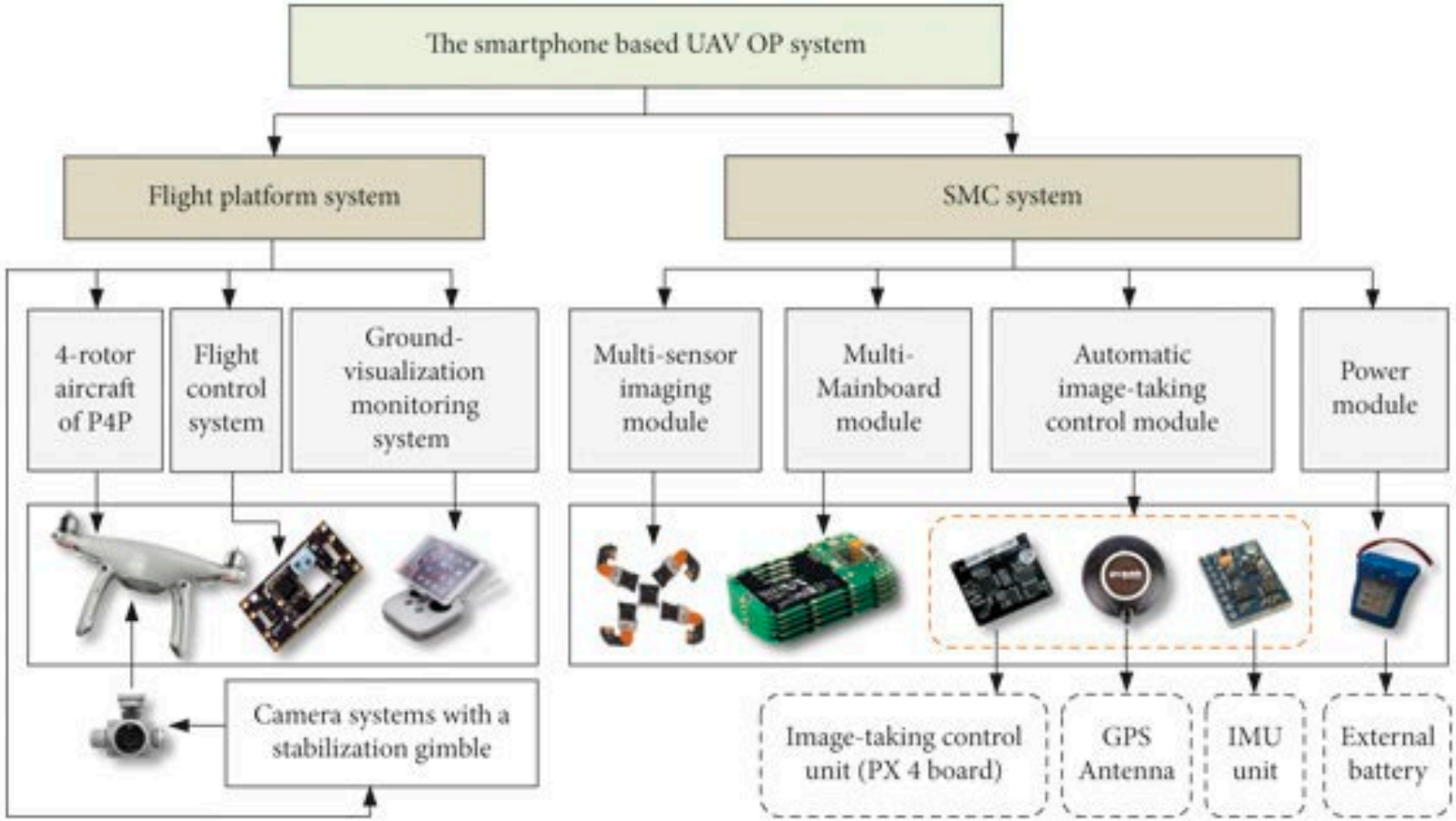
DRS-M300 Drone Parachute System for emergency landing.

Predator UAV has wheels that allowed to be rolled on ground.

Building Your Own

UAV SYSTEM ARCHITECTURE




The smartphone based UAV OP system
Flight platform system
SMC system
4-rotor aircraft of P4P
Flight control system
Ground-visualization monitoring system
Multi-sensor imaging module
Multi-Mainboard module
Automatic image-taking control module
Power module
Camera systems with a stabilization gimble
Image-taking control unit (PX 4 board)
GPS Antenna
IMU unit
External battery

UNMANNED AERIAL VEHICLE (UAV) COMPETITION

Following the successful launch of the ICUAS UAV Competition at ICUAS 2022 in Dubrovnik, the competition is back for the second edition at ICUAS 2023!

The competition details and official rules **are now available** in the **competition rulebook**.

The UAV Competition is jointly organized by the Laboratory for Robotics and Intelligent Control Systems (**LARICS**) from the University of Zagreb Faculty of Electrical Engineering and Computing through EU Horizon CSA Aerostream and the Center for Advanced Aerospace Technologies (**CATEC**) from Seville through EU H2020 METRICS project, with support from ICUAS.

By bringing in the CATEC and Metrics support, the Competition builds on the tradition of European Robotics League and offers unique opportunities for students to test and compare their skills with those of their peers, worldwide. The competition is open to any full-time BSc, MSc, and PhD students and others of similar proficiency. There is **no fee** to participate.

The competition will take place in two stages. The first stage ("qualifiers"), involving simulation in ROS-Gazebo environment, will take place remotely. The second stage ("finals"), involving live trials, will take place at the conference venue, allowing the finalists to meet and participate in the conference.

COMPETITION TIMELINE

January 16, 2023: Simulation stage kick-off; rulebook published

March 1, 2023: Team registration closed

April 15, 2023: Simulation stage upload deadline

April 26: Finalists announced

June 6-9, 2023: Finals (live trials at the conference venue)
-the exact date will be announced in the conference program-

Malaysia's Market

Malaysia Market

Market Player

1. Aerodyne Group
2. Meraque Services Sdn Bhd
3. Aonic

Potential Client

Agriculture: FELDA (Federal Land Development Authority), Sime Darby Plantation, Rubber Research Institute of Malaysia (RRIM)
Construction: Sunway Construction, Gamuda Berhad, IJM Corporation Berhad
Oil and Gas: PETRONAS, Shell Malaysia, ExxonMobil Malaysia
Logistics and Delivery: Pos Malaysia, DHL Malaysia, J&T Express

Price Range

>300 USD

Current Trend

Demand for drone capabilities has been widely focused on services such as package delivery for food items and pharmaceutical products, and retail applications, which will be further enabled by technological advancements.

Potential Applications

Agriculture: UAVs can be used for crop monitoring and mapping, which can help farmers to optimize crop yields and reduce operational costs.

Construction: UAVs can be used for surveying and inspection of construction sites, which can help construction companies to monitor progress, detect defects and ensure compliance with safety regulations.

Search and rescue: UAVs can be equipped with cameras and thermal sensors, which can be used to search for missing persons or stranded hikers in remote areas.

Oil and gas: UAVs can be used for inspection and maintenance of oil and gas infrastructure, such as pipelines and offshore platforms, which can help to reduce risks and improve safety.

Obstacles

Talent

High skill and talent needed to be developed.

Funding

Stable funding and continuous support from local leader.

Market Access

thorough understanding of regulatory requirements, market dynamics, and customer needs

Obstacles

Innovation

Creative ideas essential for the industry to prosper.

Commercialisation

More exposure to gain recognition and investment.

Regulation

To foster safer sky, all users must be registered in the system.

Conclusion

In conclusion, the development of UAV (unmanned aerial vehicle) technology in Malaysia has been steadily growing over the past few years, with a range of organizations and industries utilizing drones for a variety of applications. The increasing adoption of UAV technology has led to improvements in efficiency, safety, and productivity in various sectors such as agriculture, construction, oil and gas, infrastructure, security, environmental, logistics and delivery, mining, and media and entertainment. However, there are still challenges that need to be addressed, such as regulations and safety concerns, as well as the need for more skilled personnel in the UAV industry. Overall, the future of UAV technology in Malaysia is promising, with the potential for continued growth and innovation as more organizations and industries embrace the benefits of this cutting-edge technology.