



Salford & Co.

ASSIGNMENT 1: **UAV(UNMANNED AERIAL VEHICLE)**

ROBOTIC HARDWARE (MCTE 4396)

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History of UAV

Unmanned Aerial Vehicles (UAVs), also known as drones, have been developed since 1917 when the US Navy created the **Kettering Bug**. Since then, the technology behind them has progressed and been used extensively by the military during conflicts, with the Predator drone being a notable example. Nowadays, UAVs have numerous applications, including scientific research and commercial use. The technology is continually advancing, with new developments in autonomous flight, artificial intelligence, and sensors.

Some industries, such as agriculture and construction, have found innovative ways to use UAVs for tasks such as crop monitoring and building inspections.

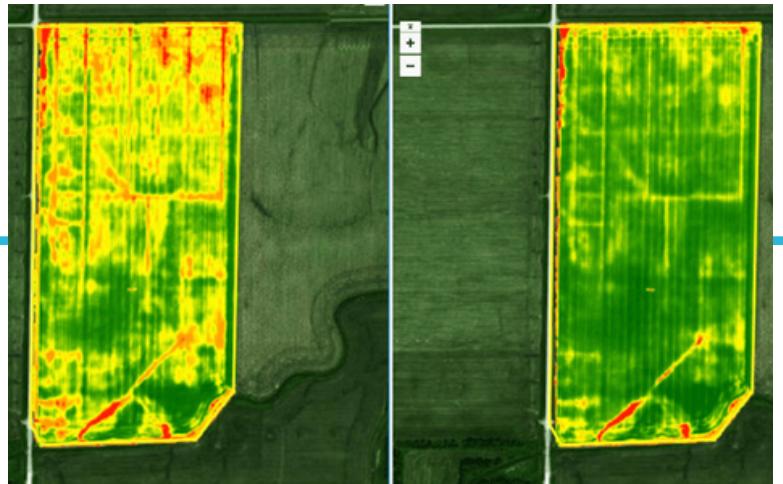


APPLICATIONS

Agriculture

CROP HEALTH

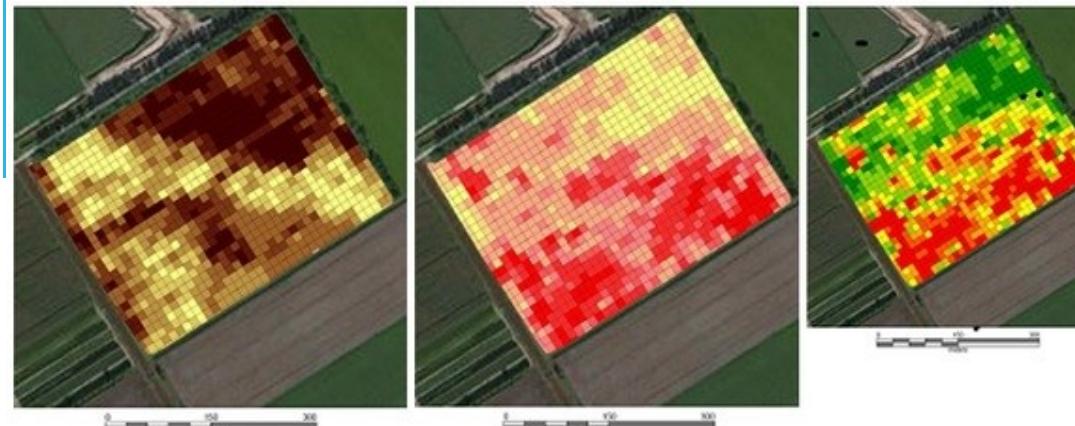
UAVs can measure plant height, chlorophyll levels, and water stress to improve crop production and reduce water use.



(TROPOGO, 2022)

SOIL ANALYSIS

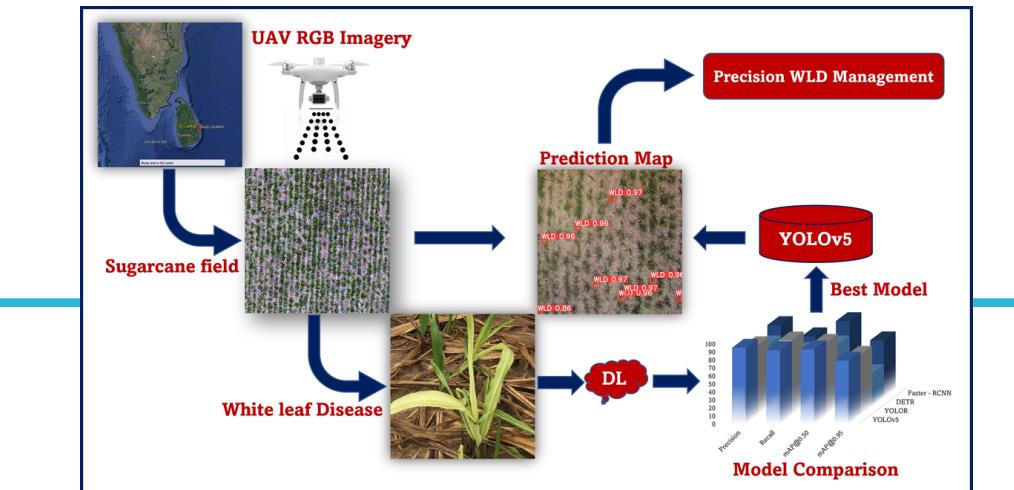
UAVs can measure soil moisture, temperature, and nutrients to optimise fertiliser application and soil health.



(PRECISION FERTILIZING USING DRONES AND SCANNERS, 2015)

PEST AND DISEASE DETECTION

UAVs can detect crop pests and illnesses before they spread and lower crop output.

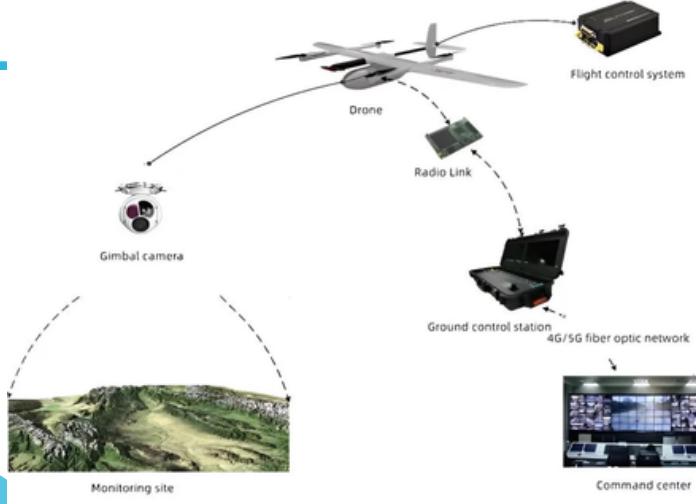


(AMARASINGAM ET AL., 2022)

Military and Defense

SURVEILLANCE

UAVs can provide real-time intelligence and situational awareness in battle zones, helping military and defence organisations make educated decisions and succeed.



RECONNAISSANCE

UAVs can track adversary positions and movements, helping military and defence organisations plan and execute missions. LIDAR, RADAR, RF, Electro-Optical(EO), Infrared (IR)

TARGETED STRIKES

Armed UAVs may attack enemy targets precisely and effectively

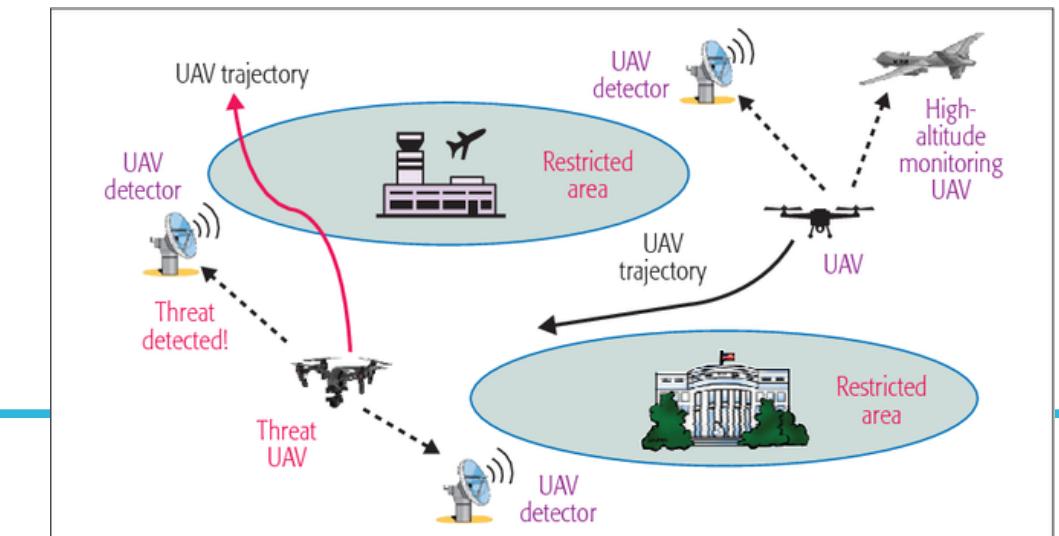
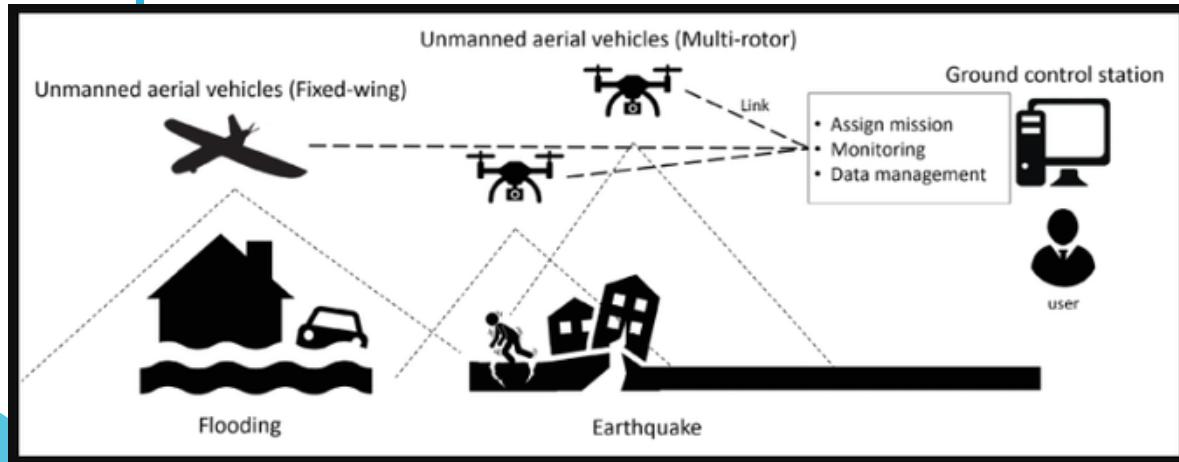


Figure 1. Detection of unauthorized small UAVs around restricted areas.

Search And Rescue

DISASTER RESPONSE

UAVs can help rescue teams prioritise search operations in earthquake, flood, and hurricane zones by delivering real-time data



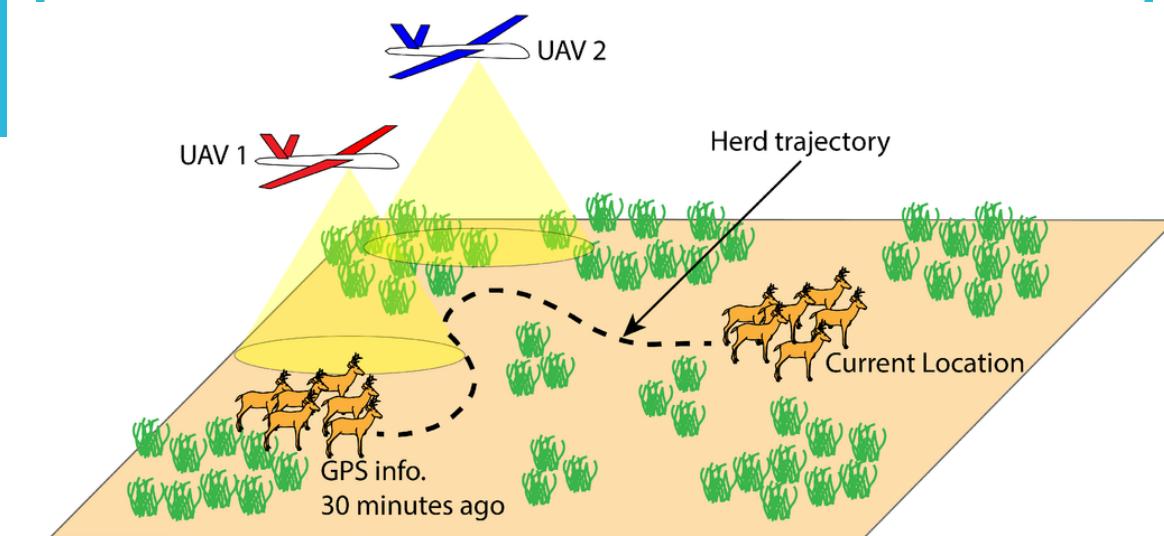
LAW ENFORCEMENT

UAVs can search for missing people or criminal suspects in real time, improving public safety.



WILDLIFE CONSERVATION

UAVs can detect and monitor wildlife populations, giving conservation organisations data on animal behaviour and habitat utilisation.



Aerial Photography and Videography

REAL ESTATE

Capture high-resolution images and videos of properties for sale, providing potential buyers with a detailed view of the property and its surroundings



FILM AND TELEVISION

aerial footage for movies, TV shows, and commercials, providing a unique perspective and enhancing the visual appeal of the production



TOURISM

tourist destinations, providing visitors with a unique view of the area and promoting tourism

AIRFRAME DESIGN

FIXED WING UAVS

REGULAR WINGS

- Horizontal flight motion



LIGHTWEIGHT

- To reduce drag and increase flight motion



LONG RANGE

- Mostly the design is focused for long-range surveillance



ROTARY-WING UAVS



DJI PHANTOM

SHORTER RANGE

- shorter-range missions, such as search and rescue, inspection, and aerial photography

VERTICAL LIFT-OFF

- They can take off and land vertically, making them ideal for operations in confined spaces.
- Use rotors to generate lift and maneuver in the air

Parrot Bebop



ROTARY WINGS

- Quadcopters, helicopters
- High mobility

HYBRID UAVS



COMBINED FEATURES

- These are UAVs that combine the features of both fixed-wing and rotary-wing UAVs
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HIGH MOBILITY

- They can take off and land vertically like a helicopter, but can also fly like a fixed-wing aircraft



LONG RANGE

- Manage heavy payloads such as agriculture which is crop management

PROPULSION

ELECTRIC PROPULSION



DJI Mavic Air 2

ADVANTAGES

- Suitable for small, lightweight UAVs
- Quieter than other types of propulsion systems

DISADVANTAGES

- Limited range and endurance
- Not suitable for larger UAVs that

GASOLINE PROPULSION



ADVANTAGES

- Reliable and have been used in aircraft for many years
- Gasoline engines can be used to power larger UAVs

DISADVANTAGES

- Noisy and emit pollutants
- Gasoline engines require regular maintenance

HYBRID PROPULSION



ADVANTAGES

- Hybrid propulsion systems can give the benefits of both electric and gasoline power systems
- Designed to use a variety of fuels,

DISADVANTAGES

- Complex operations require specialized design and maintenance,
- Not be suitable for small UAVs that

JET PROPULSION

ADVANTAGES

- Capable of providing high speeds and long ranges
- Designed to run on a variety of fuels,

DISADVANTAGES

- Expensive and complex
- Not suitable for small UAVs



NAVIGATION

GPS NAVIGATION

- **DJI Phantom 4 Pro:** Uses GPS for navigation and autonomous flight modes, such as ActiveTrack and TapFly
- **General Atomics MQ-9 Reaper:** Use GPS for navigation and features autonomous flight modes, such as automatic takeoff and landing



General Atomics
MQ-9 Reaper

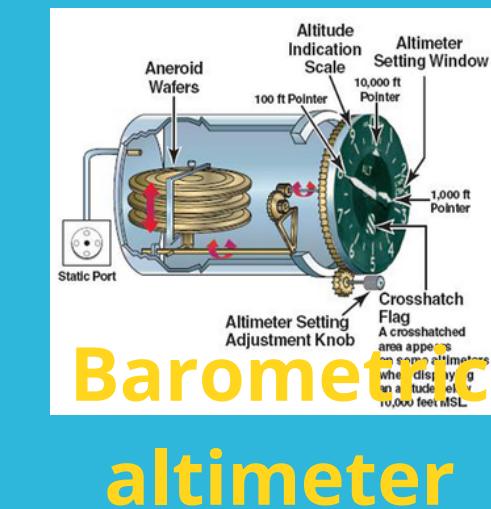


DJI Phantom 4 Pro

NON-GPS NAVIGATION



- **Northrop Grumman Bat:** Uses INS and Barometric Altimeters for navigation in GPS-denied conditions.
- **Skydio 2:** computer vision and obstacle avoidance sensors for navigation



DATA COLLECTION

DATA COLLECTION

- Cameras: **DJI Mavic 2 Enterprise Dual** uses a dual-sensor camera system, including a 12-megapixel RGB camera
- LiDAR: **RIEGL VUX-1** utilise a high-precision LiDAR sensor that can be mounted on a UAV for topographic mapping
- Thermal Sensors: **DJI Matrice 300 RTK** with FLIR thermal camera
- Accelerometers and gyroimeters: **DJI Matrice 200 Series V2** uses accelerometers and gyroscopes for precise flight control and navigation
- Magnetometer: **DJI Phantom 4 RTK** uses a magnetometer for precision mapping and surveying applications.

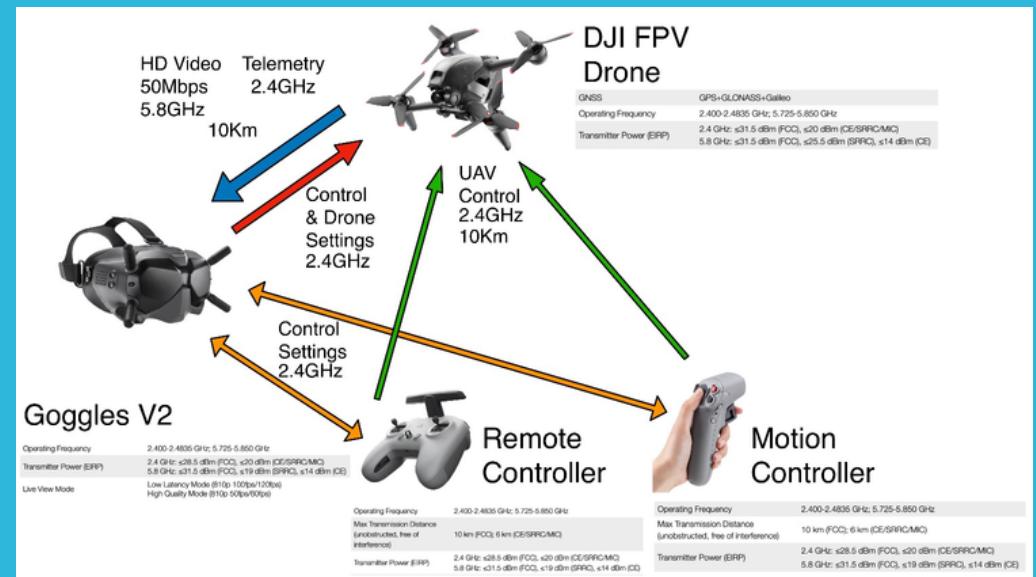
DATA TRANSMISSION

DATA COLLECTION

- **DJI Mavic Air 2:** Wi-Fi to transmit images and videos to a mobile device that can transmit 1080p video up to 10 km away using Wi-Fi.
- **DJI Matrice 300 RTK:** Uses cellular networks, such as 4G LTE or 5G, to transmit data over long distances which transmits 1080p video up to 15 km away using cellular networks.
- **Parrot Anafi USA:** Uses satellite communication systems, such as Iridium, to transmit data over long distances and in remote areas that can transmit 4K video up to 7 km away using satellite communication.



Satellite
communication
system via DJI



WI-FI transmission
data

POWER TRANSMISSION

POWER TRANSMISSION



- Hybrid Power: **NASA Greased Lightning** is combined with battery-powered electric motors and a gasoline engine for propulsion
- Battery Powered: **DJI MAVIC 2** produces no emission and pollution
- Solar Powered: **NASA Helios** is environmentally friendly and can provide unlimited flight times in sunny conditions

