

## UNMANNED AERIAL VEHICLE (UAV)

### 1.1 History

- In 1903, developments in aviation accelerated and soon the first Unmanned Aerial Vehicle was created.
- It was the time of flying bombs, which is a manned or unmanned aerial vehicle or aircraft carrying a large explosive warhead, a pre-cursor to contemporary cruise missiles

### 1.2 Types of Drone

- **Multi-Rotor Drones**



Multi-rotor drones are the easiest and cheapest option for getting an 'eye in the sky.' They also offer greater control over position and framing, and hence they are perfect for aerial photography and surveillance. They are called multi-rotor because they have more than one motor, more commonly tricopters (3 rotors), quadcopters (4 rotors), hexacopters (6 rotors) and octocopters (8 rotors), among others. By far, quadcopters are the most popular multi-rotor drones.

- **Fixed-Wing Drones**



A fixed-wing drone has one rigid wing that is designed to look and work like an aeroplane, providing lift rather than vertical lift rotors. Hence, this drone type only needs the energy to move forward and not to hold itself in the air. This makes them energy-efficient.

- **Single-Rotor Drones**



Single-rotor drone types are strong and durable. They look similar to actual helicopters in structure and design. A single-rotor has just one rotor, which is like one big spinning wing, plus a tail rotor to control direction and stability.

- **Fixed-Wing Hybrid VTOL**



Hybrid VTOL drone types merge the benefits of fixed-wing and rotor-based designs. This drone type has rotors attached to the fixed wings, allowing it to hover and take off and land vertically. This new category of hybrids are only a few on the market, but as technology advances, this option can be much more popular in the coming years.

### 1.3 Technical Uses

#### **Multi-Rotor Drones**

- Visual inspections
- Thermal reports
- Photography & Videography
- 3D scans

### **Fixed-Wing Drones**

- Aerial Mapping
- Drone Surveying – Forestry/Environmental Drone Surveys, Pipeline UAV Surveys, UAV Coastal Surveys
- Agriculture
- Inspection
- Construction
- Security

### **Single-Rotor Drones**

- Aerial LIDAR laser scan
- Drone surveying
- Carrying heavy payloads

### **Fixed-Wing Hybrid VTOL**

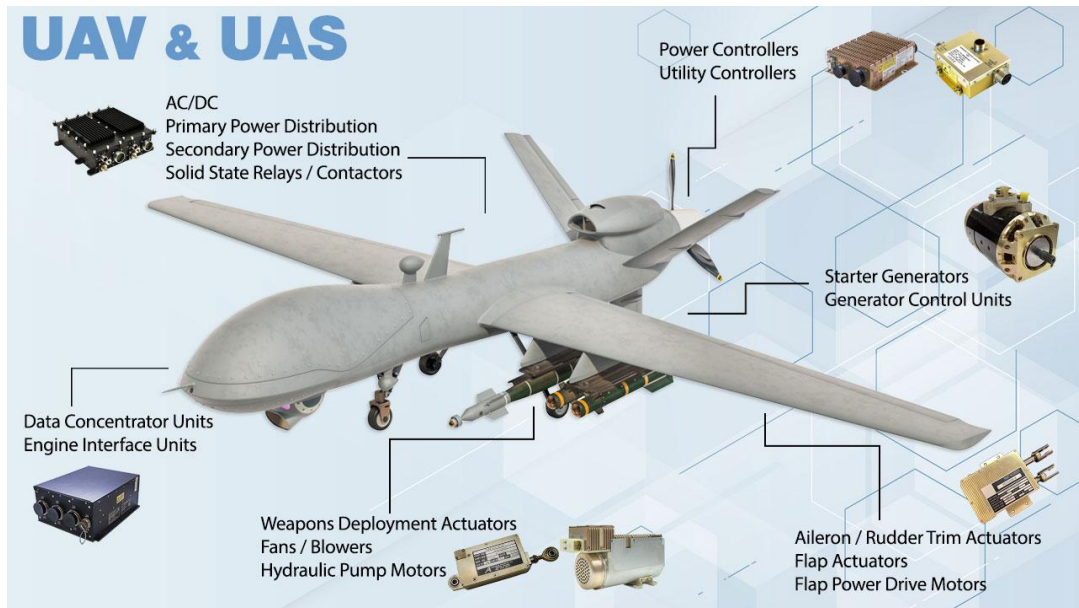
- Drone Delivery

## **1.4 Actuators and Locomotion**

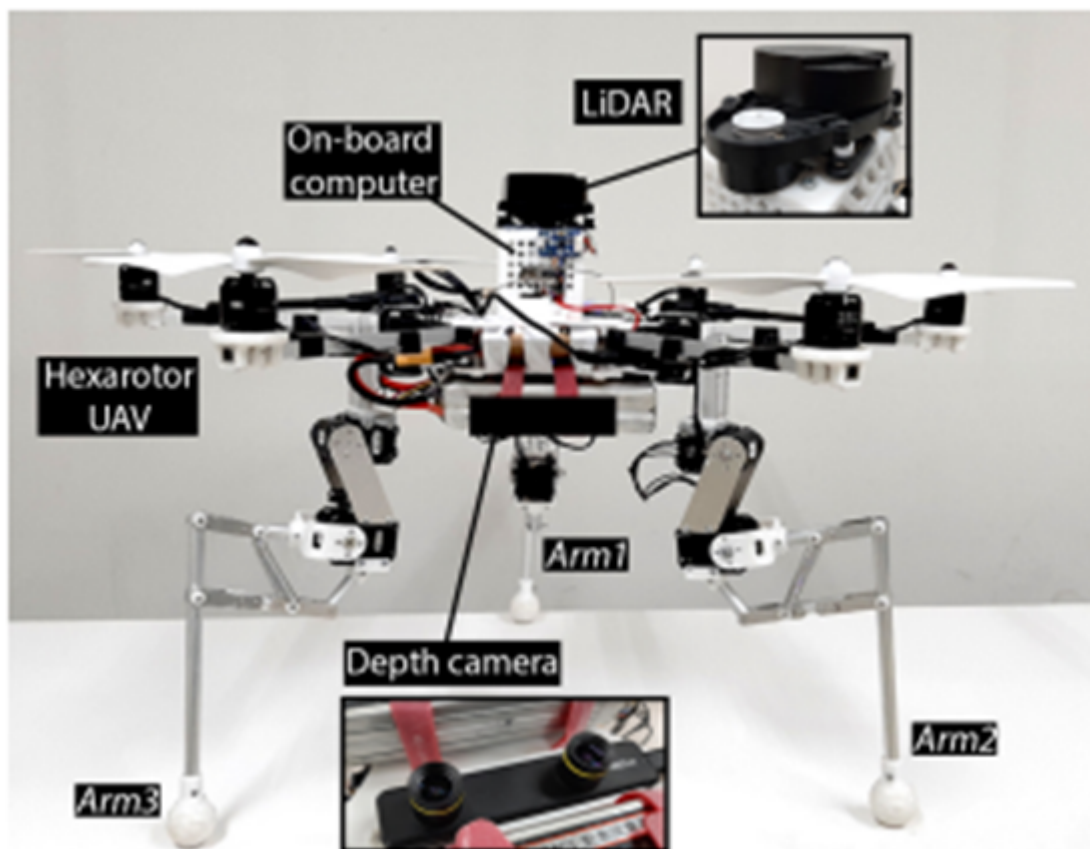
### **UAV Flight Control Actuator**



- Control flight control surfaces on UAVs
- The intelligent actuators are controlled, and hence the aircraft flown, via various communication protocols with a remote pilot or totally autonomously through an on-board pre-programmed computer
- reduced weight
- high reliability
- greater positional accuracy and faster response times.



## 1.5 Navigation System and Controller



### GPS

- GPS is used to determine the position of the vehicle
- The position provided by the receiver can be used to track the UAV
- To avoid accidents in an area heavily populated by other UAV or manned vehicles

- To accurately geographically reference collected data, it is important to know the exact position of the vehicle when a measurement or photo was taken.

### Depth Camera

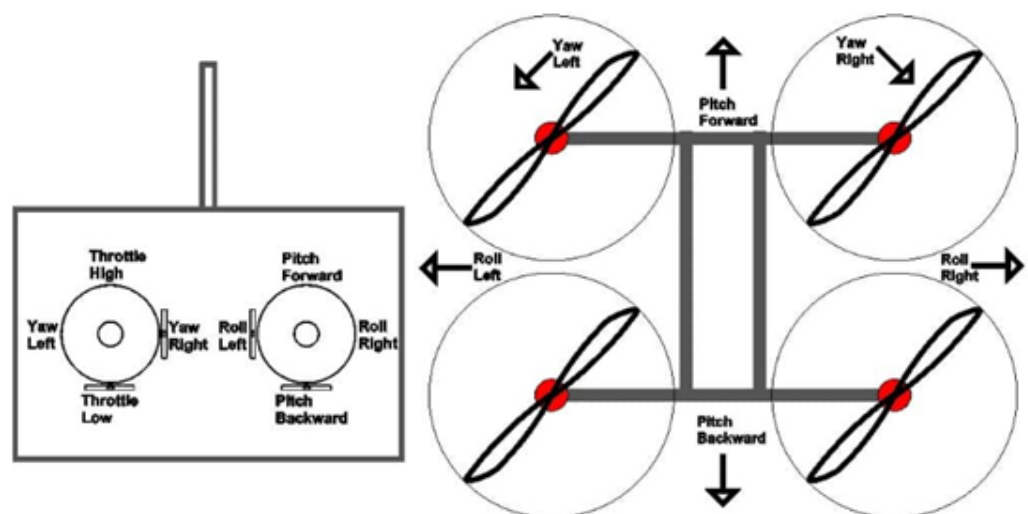
- to obtain depth images of the UAV flight environment.
- Then the image processing board is applied to stratify and segment the depth image
- to obtain the orientation and distance information of the obstacle, thus generating the corresponding obstacle avoidance instructions.

### LIDAR (Light Detection and Ranging)

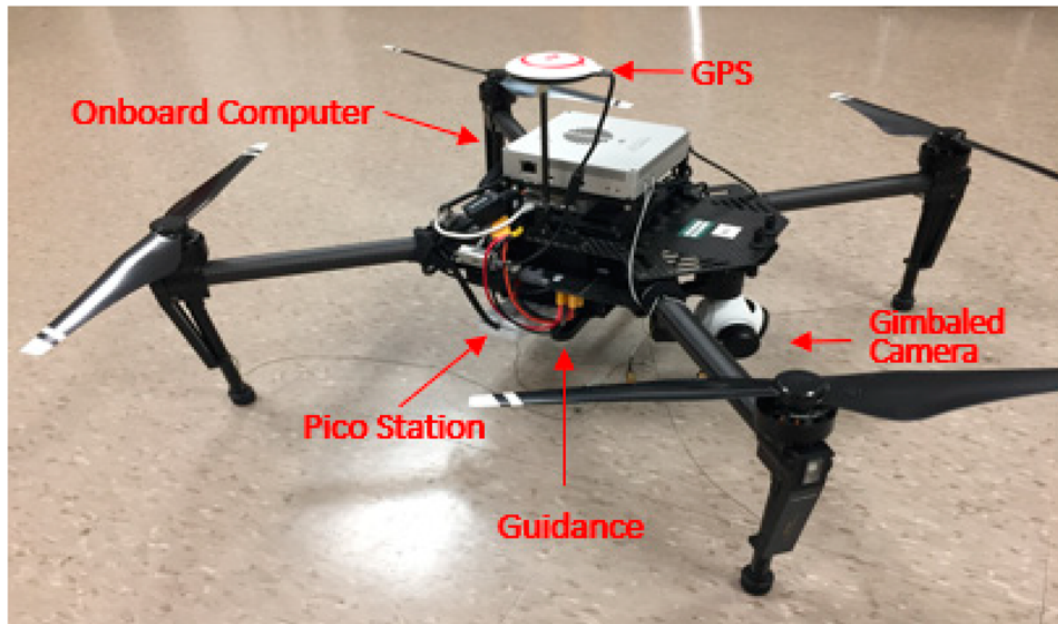
- sends out pulses of laser light and measures the exact time it takes for these pulses to return as they bounce from the ground.
- measures the intensity of that reflection.
- LIDAR uses oscillating mirrors to send out laser pulses in many directions so as to generate a “sheet” of light as the drone moves forward. Through measuring the timing and intensity of the returning pulses, it can provide readings of the terrain and of points on the ground.

### Tactical UAV Remote Controller

- A drone controller works by sending a radio signal from the remote control to the drone, which tells the drone what to do.
- Radio signals are sent from the radio transmitter in the drone controller and received by the drone’s receiver.



## Onboard Computer



### 1.6 Data Collection

- Remote Sensing- Thermal Camera
- Agriculture- Smoke Sensor / Humidity Sensor
- Transporter - obstacle avoidance sensor
- Mapping - Multispectral, thermal or LiDAR sensors
- Surveillance- Face recognition, object recognition and other tracking technologies

### 1.7 Data Transmission

#### RF Transmission

- Radio Frequency Transmission is used to transmit and receive information to and from the UAV.
- These transmissions can include location, remaining flight time, distance and location to target, distance to the pilot, location of the pilot, payload information, airspeed, altitude, and many other parameters.
- Drones are typically run by 2.4 gigahertz radio waves.

### 1.8 Power System Management

#### Batteries

- There are many different types of batteries used onboard UAVs, which has its respective advantages and disadvantages.
- The most common batteries for drones are Lithium Polymer (Li-Po) and Lithium Ion (Li-Ion).

- The most suitable type of battery is determined by comparing the power density, energy density, weight, volume, cycle life, cost, safety and maintenance
- Each of the criteria affect different aspects of the drone, power density affects the acceleration capabilities, energy density determines the range, cycle life determines how often the battery will need to be replaced.

#### Combustion Engine

- Petrol and diesel engine and the components includes an engine block containing a combustion chamber, pistons, fuel injectors, and an intake and exhaust valve
- Diesel engines have the highest effective efficiency of all the combustion engines
- The advantages of combustion engine drones comprise of longer flight times, robustness, small, light-weight and having a good specific fuel consumption.
- The disadvantages comprise of being heavier compared to battery-powered drones and require more complex maintenance