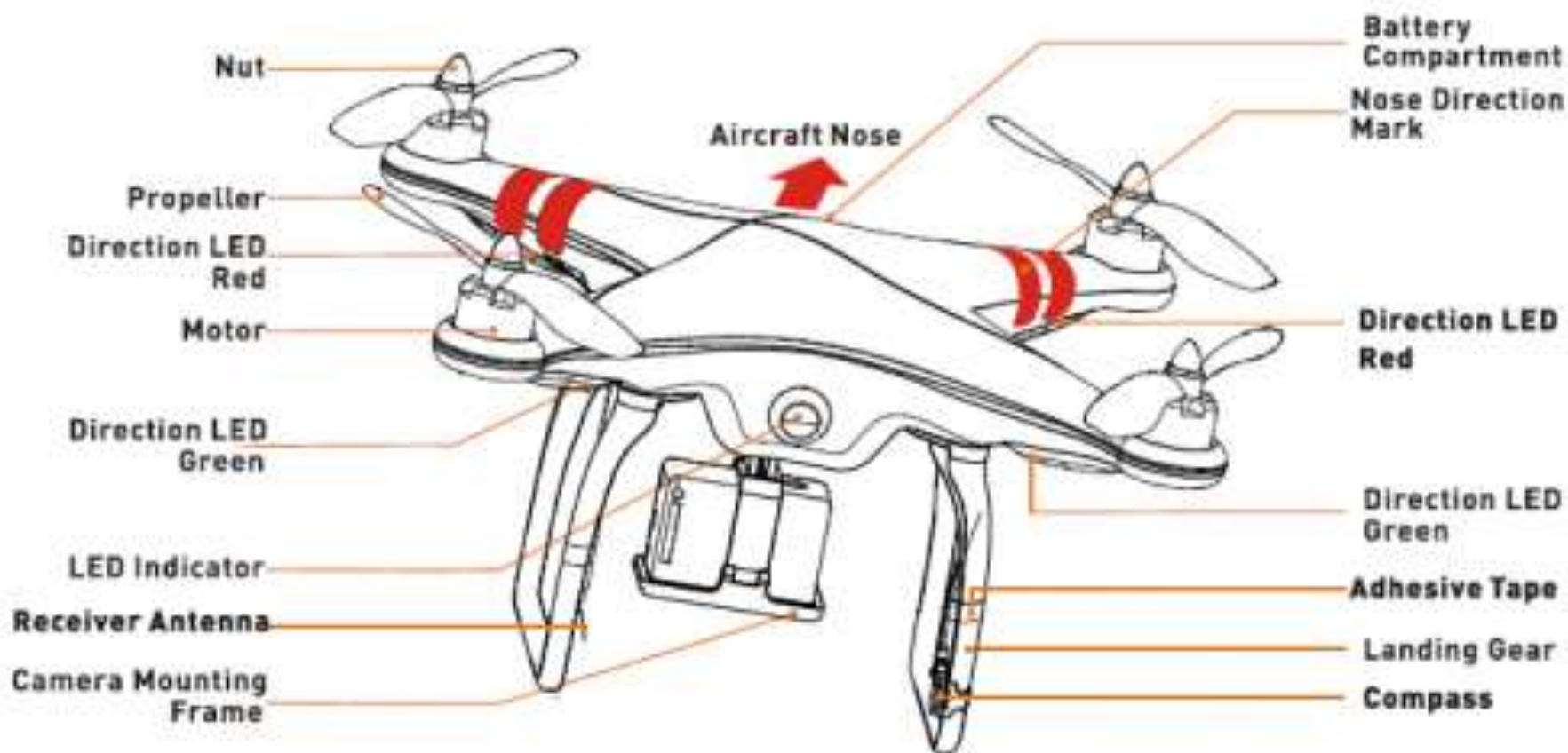
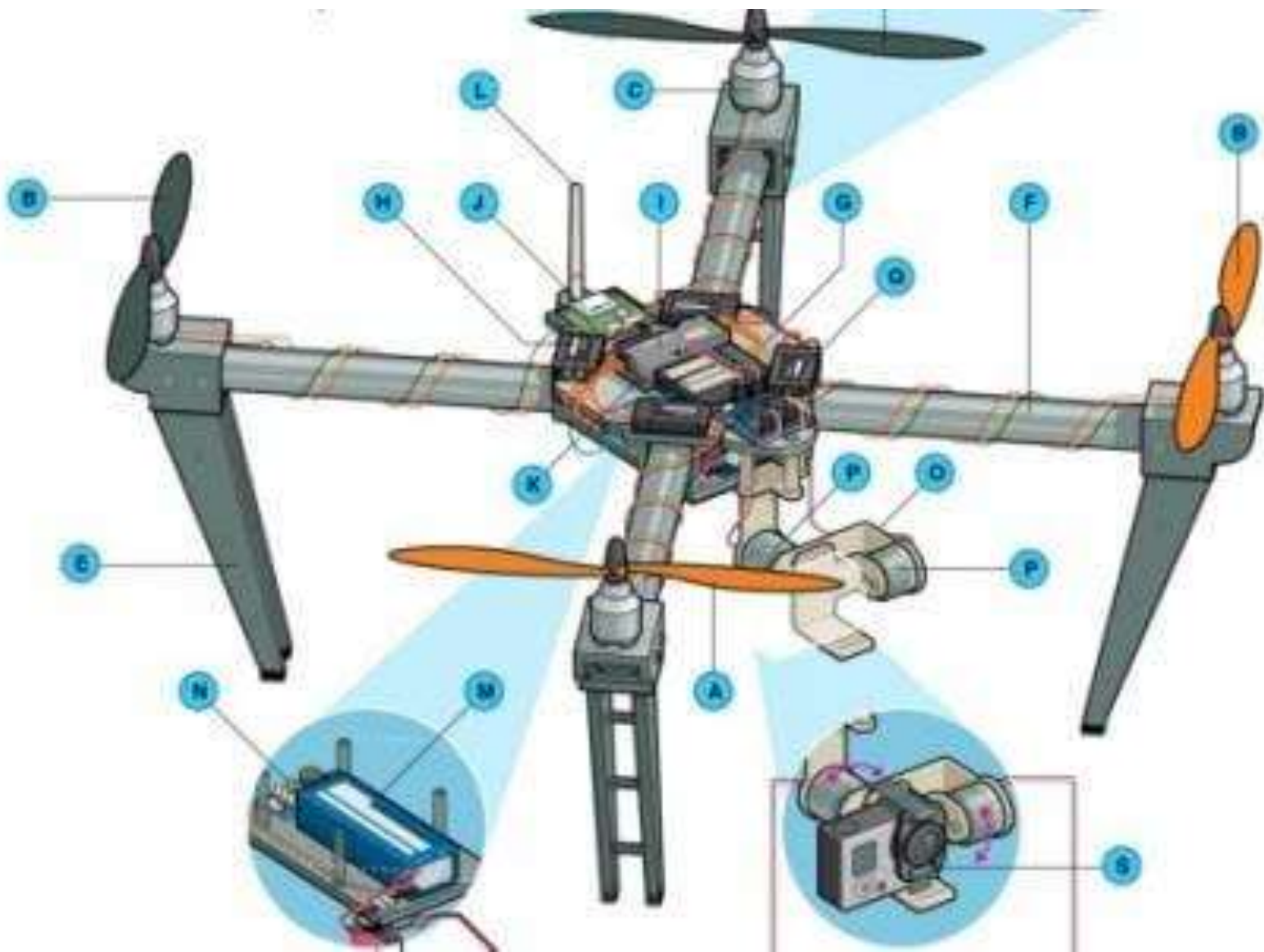


Components of a Quadcopter

SYST 460



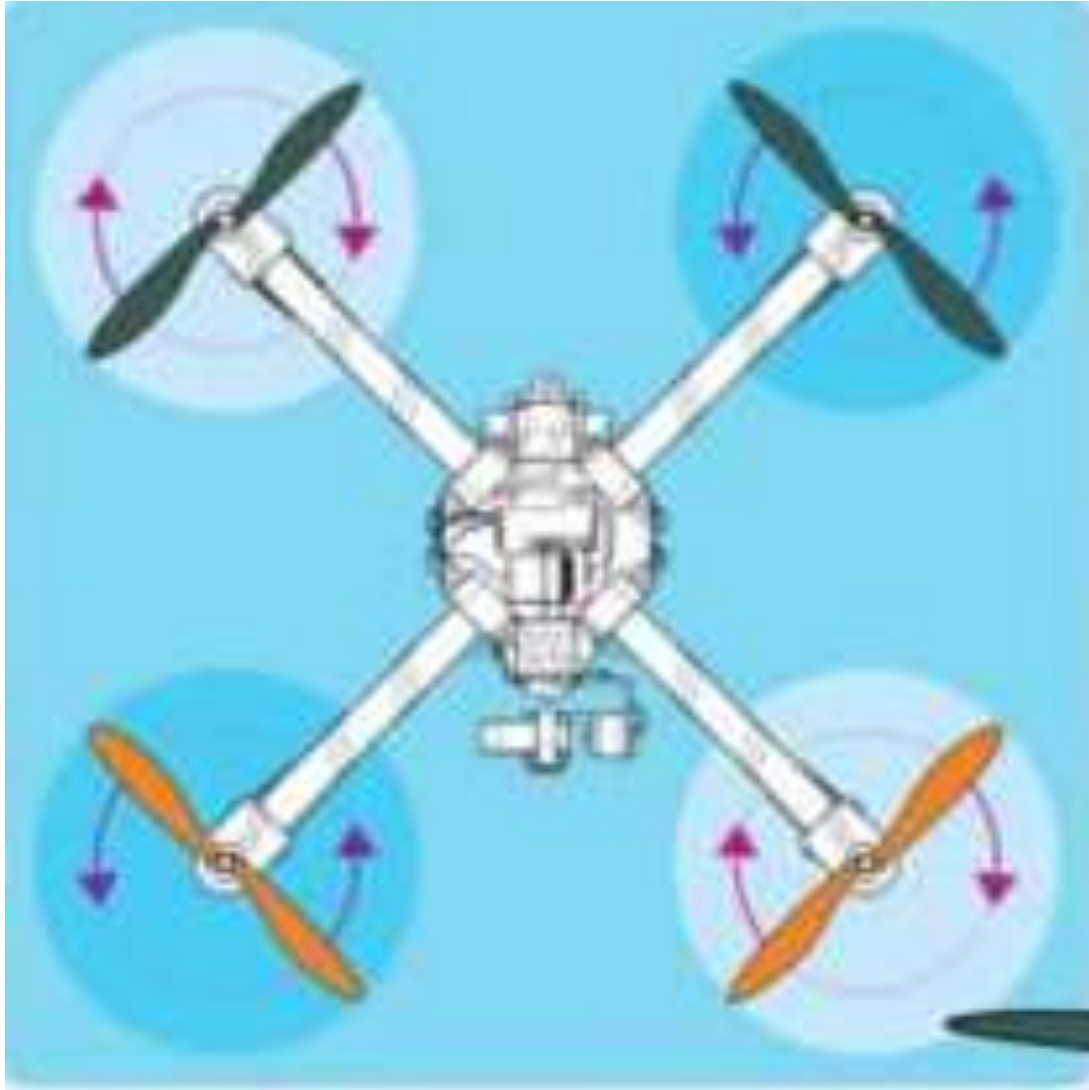


A. Standard Prop

- While some drones like the DJI Phantom look more or less the same from any angle, there is a front and back.
- The “tractor” propeller are the props at the front of the quadcopter. These props pull the quadcopter through the air like a tractor.
- Most drone propellers are made of plastic and the better quality made of carbon fiber.
- You can also buy drone prop guards which you need especially if you are flying indoors or near people.
- This is also an area where we are seeing plenty of innovation. Better prop design will assist with giving a better flying experience and longer flight times.
- There is also some big innovation towards [low noise uav props](#).
- **Tip:** Always good practice to inspect your props before flying and carry an extra set in case you notice some damage on a prop. Never fly with a damaged or bent prop.

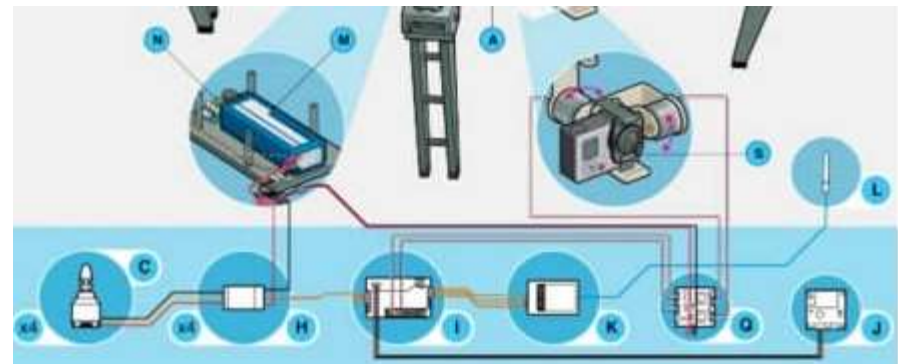
B. Pusher Prop

- The Pusher props are at the back and push the UAV forward hence the name “Pusher props”. These contra-rotating props exactly cancel out motor torques during stationary level flight. Opposite pitch gives downdraft. Again, can be made of plastic with the better pusher props made of carbon fiber. You can also purchase guards for the pusher props.
- **Tip:** Same as for tractor props. Inspect before each flight and carry a spare set.



C. Brushless Motors

- Practically all the latest drones use a brushless electric “outrunner” type, which is more efficient, more reliable, and quieter than a brushed motor.
- Motor design is important. More efficient motors save battery life and give the owner more flying time which is what every pilot wants.
 - DJI developed and patented a new curved magnet which fits perfectly around the motor allowing the motor to run more efficiently.
- **Tip:** Examine the motors regularly. Make sure they are clean and free from dust. Get to know how your drone sounds. Listen to it. Most of the sound comes from the motors. If it doesn't sound right, then examine your drone. Fly a couple of feet off the ground and close to you and see if one of the motor is failing. It's not a bad option to have a spare motor or 2.



D. Motor Mount

- Sometimes built into combination fittings with landing struts or can be part of the UAV frame..
- **Tip:** Check the motor mounts and areas close to the motors for stress cracks. If you find stress cracks and your quadcopter is under warranty, then you can send it back and have it fixed. Alternatively the manufacturer may have some strengthener motor mounts.
- **Tip:** When you first receive your new drone, it is also a good to examine areas around the motor mounts or where screws are used. Sometimes, screws can be wound in too tight and actually can crack the frame. It maybe just a hairline crack but these won't fix themselves.



E. Landing Gear

- Drones which need high ground clearance may adopt helicopter-style skids mounted directly to the body, while other drones which have no hanging payload may omit landing gear altogether.
- Many fixed wing drones which cover large distances such as the Sensefly eBee, Trimble UX5 or the 3DR Aero-M don't have landing gear and land perfectly fine on their belly.
- Most drone has a fixed landing gear. However, the best drones will have retractable landing gear giving a full 360 degree view.

Retractable Landing Gear Drones

- DJI – Spreading Wings S1000+, Inspire 1
- Walkera – Voyager 3, Scout x4, QR X900
- **Tip:** Examine your landing gear and especially if you've had a bit of a rough landing. This protects the drone, expensive camera or sensors.
- **Tip:** If you can and it suits your needs, buy a drone which has retractable landing gear. Then you don't have to worry about the legs getting in the way of a great photo or video shot. With retractable landing gear, keep it clean and free from dust and dirt. In that way the landing gear doesn't seize up.

F. Boom

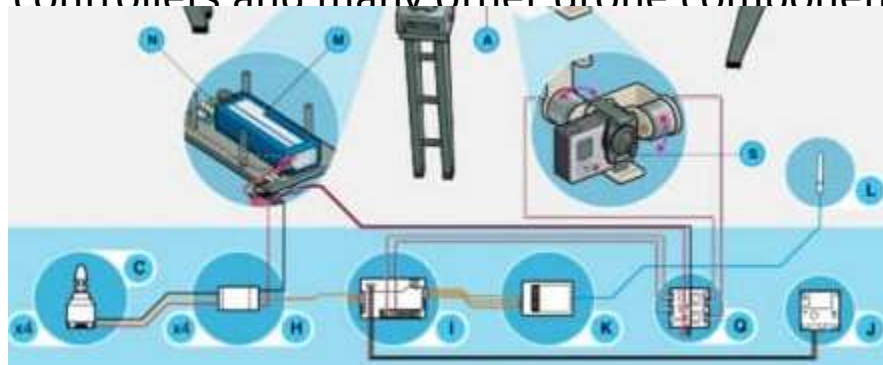
- Shorter booms increase maneuverability, while longer booms increase stability. Booms must be tough to hold up in a crash while interfering with prop downdraft as little as possible. In many drones the boom is part of the main body. Other drone have a definite boom as a separate part.
- **Tip:** Examine and insure that the boom has not become bent as this would effect the flying capabilities.

G. Main Drone Body Part

- This is the central hub from which booms radiate like spokes on a wheel. It houses battery, main boards, processors avionics, cameras, and sensors.
- **Tip:** Most drones are not waterproof so it is vital that the internal components of the main body do not get wet.
- A hard landing may not break the body of the drone but the shock could damage the internal drone components in the main body

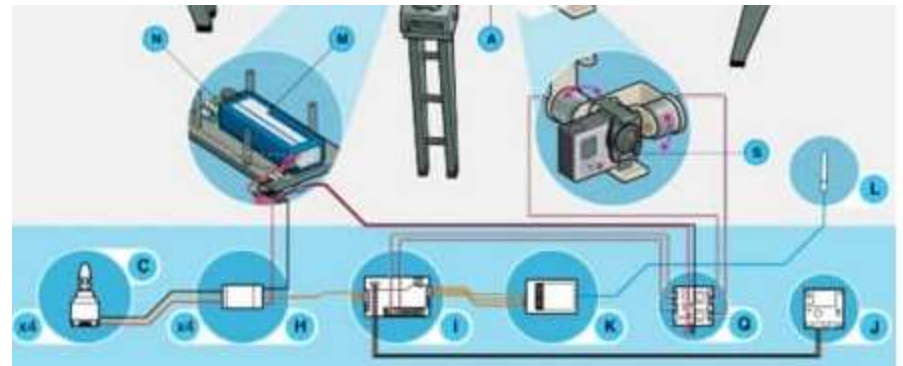
H. Electronic Speed Controllers (ESC)

- Electronic Speed Controllers are an essential component of modern quadcopters (and all multirotors) which offer high power, high frequency, high resolution 3-phase AC power to the motors in an extremely compact miniature package.
- An electronic speed controller or ESC is an electronic circuit with the purpose to vary an electric motor's speed, its direction and possibly also to act as a dynamic brake. It converts DC battery power into 3-phase AC for driving brushless motors.
- The latest ESC innovation was on the DJI Inspire 1 which uses new [sinusoidal](#) drive ESC which replace the more square wave drive of traditional ESCs. The Inspire 1 goes further by using [closed loop torque control](#) and distinct functional redundancy which adds extra efficiency and reliability to the motors.
- **Tip:** The ESC are inside the main frame of the drone and most drone owners won't need to do anything with these. However, companies such as DJI, 3DR and Parrot develop drones which can be customized. What allows this drones to be customized is a Special Development Kit (SDK). With the SDK, then you could re-program the electronic speed controllers and many other drone components.



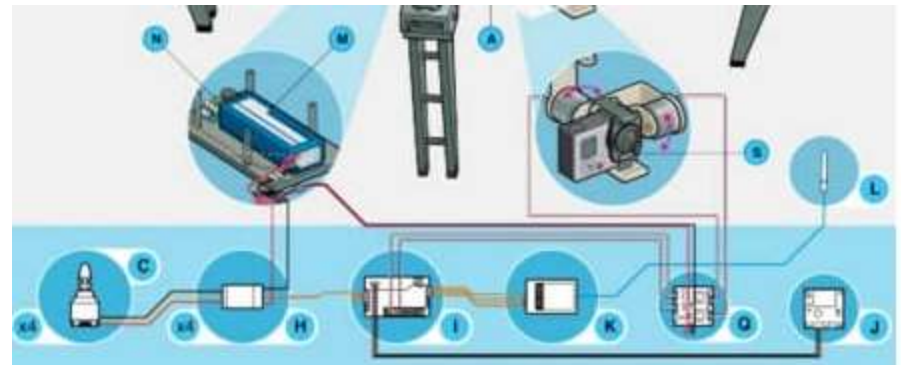
I. Flight Controller

- The [flight controller](#):
 - interprets input from receiver, GPS module, battery monitor, IMU and other onboard sensors
 - Regulates motor speeds, via ESCs, to provide steering, as well as triggering cameras or other payloads.
 - Controls autopilot, waypoints, [follow me](#), failsafe and many other autonomous functions. It's central to the whole functioning of your UAV.
- **Tip:** Most owner won't need to do anything or modify the flight controller by reprogramming. If you needed to create a customized solution then a drone with SDK as mentioned about would allow this.



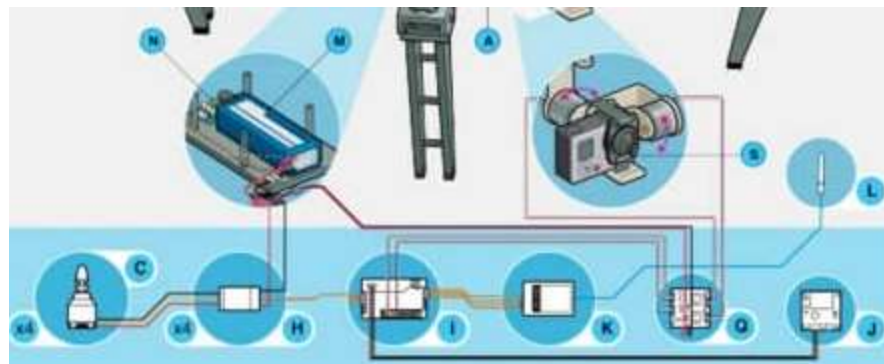
J. GPS Module

- GPS stands for Global Positioning System. It is an American standard which provides location and time information in all weather conditions, anywhere on or near the Earth where there is an unobstructed line of sight to four or more GPS satellites.
- Often combines GPS receiver and magnetometer to provide latitude, longitude, elevation, and compass heading from a single device.
- GPS is an important requirement for [waypoint navigation](#) and many other autonomous flight modes. Without GPS drones would have very limited uses. Along with FPV, drones can navigate long distances and be used for exciting applications such as [lidar](#) and [photogrammetry](#).
- **Note:** Some of the latest drones have added Glonass, which is the Russian equivalent of GPS. This means your drone is almost guaranteed to find many satellites to get its positioning from. With both systems you can fly more accurately and also can fly safer as you know you won't lose satellite connection.
- **Tip:** Most drones allow you to program in a failsafe home point. This allows the drone to fly back to a point if it loses connection to your remote controller. Most drones have a minimum requirement of satellites before the home point can be set. But always set a home point. When buying a drone, keep an eye out for drones which come with both GPS and Glonass.



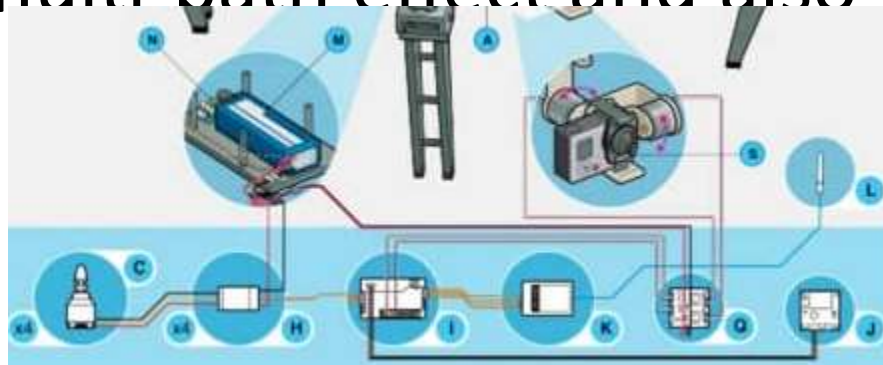
K. Receiver

- Often a standard r/c radio receiver unit. The minimum number of channels needed to control a quad is 4, but 5 is usually recommended. There are many manufacturers of receivers on the market if you are building your own drone.



L. Antenna

- Depending on your receiver, it may be a loose wire whip or helical “rubber ducky” type.
- **Tip:** Pretty easy to upgrade. Circularly polarized cloverleaf antenna gives you further video signal distance and improves the video stability. A very good antenna stops the problem of the multi-path effect and also blind angle.

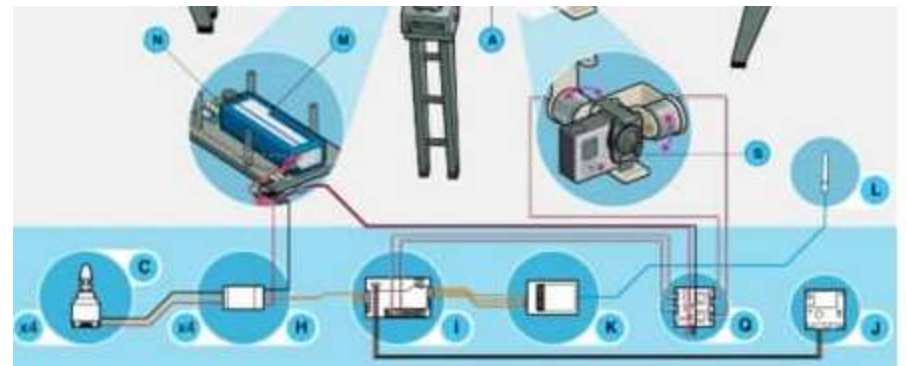


M. Battery

- Lithium polymer (LiPo) batteries offer the best combination of energy density, power density, and lifetime on the market.
- **Tip:** It's always great to carry a spare battery or 2. Read and follow the instructions for charging and storing your battery to make sure it lasts a long time.
- Every so often is always good to fully discharge and recharge your battery.
- Check to make sure your battery doesn't overheat.
- All batteries are dangerous when are physically damaged so never install a damaged battery into your drone.
- Also never try to recharge a battery that has physical damage.
- **Tip:** Make sure you drone components are in good physical conditions. Always think safety.

N. Battery Monitor

- Provides in-flight power level monitoring to flight controller. Your battery is critical to flying safely. If you fly to far out and your quadcopter runs out of battery then it will either make an emergency landing or will crash.
- **Tip:** Know your drones flying time, battery levels and where to read these levels. Dont push the boundaries of flying on low battery power.



O. Gimbal

- The [drone gimbal](#) is the pivoting mount that rotates about the x, y, and z axes to provide stabilization and pointing of cameras or other sensors.
- **Tip:** If you don't have a great gimbal, then it doesn't matter how good the camera is. The gimbal is all important to taking great photo and video.
- **Tip:** If you are having problem with [jello effect](#), which is caused by vibration from the drone getting to the camera, then look at installing or changing the gimbal dampers. This change alone can make a big difference.

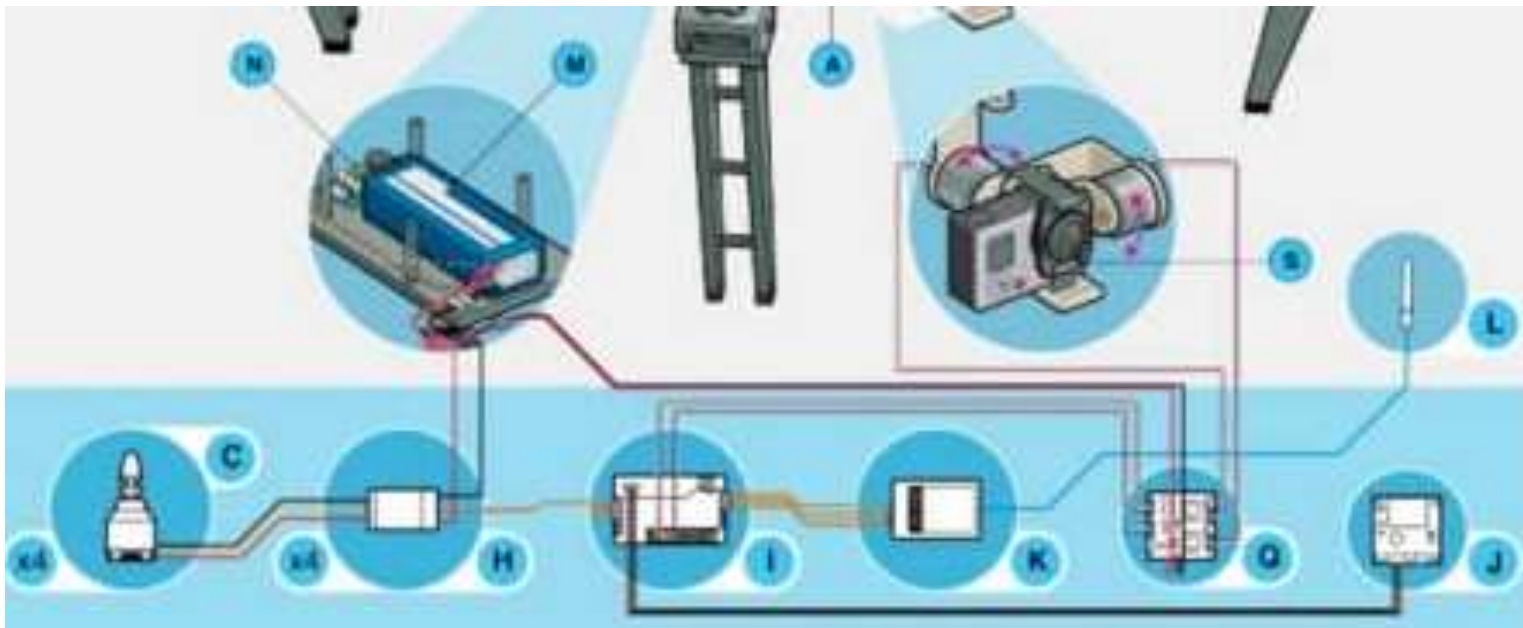


P. Gimbal Motor

- Brushless DC motors can be used for direct-drive angular positioning, too, which requires specially-wound coils and dedicated control circuitry that have only recently become commercially available.

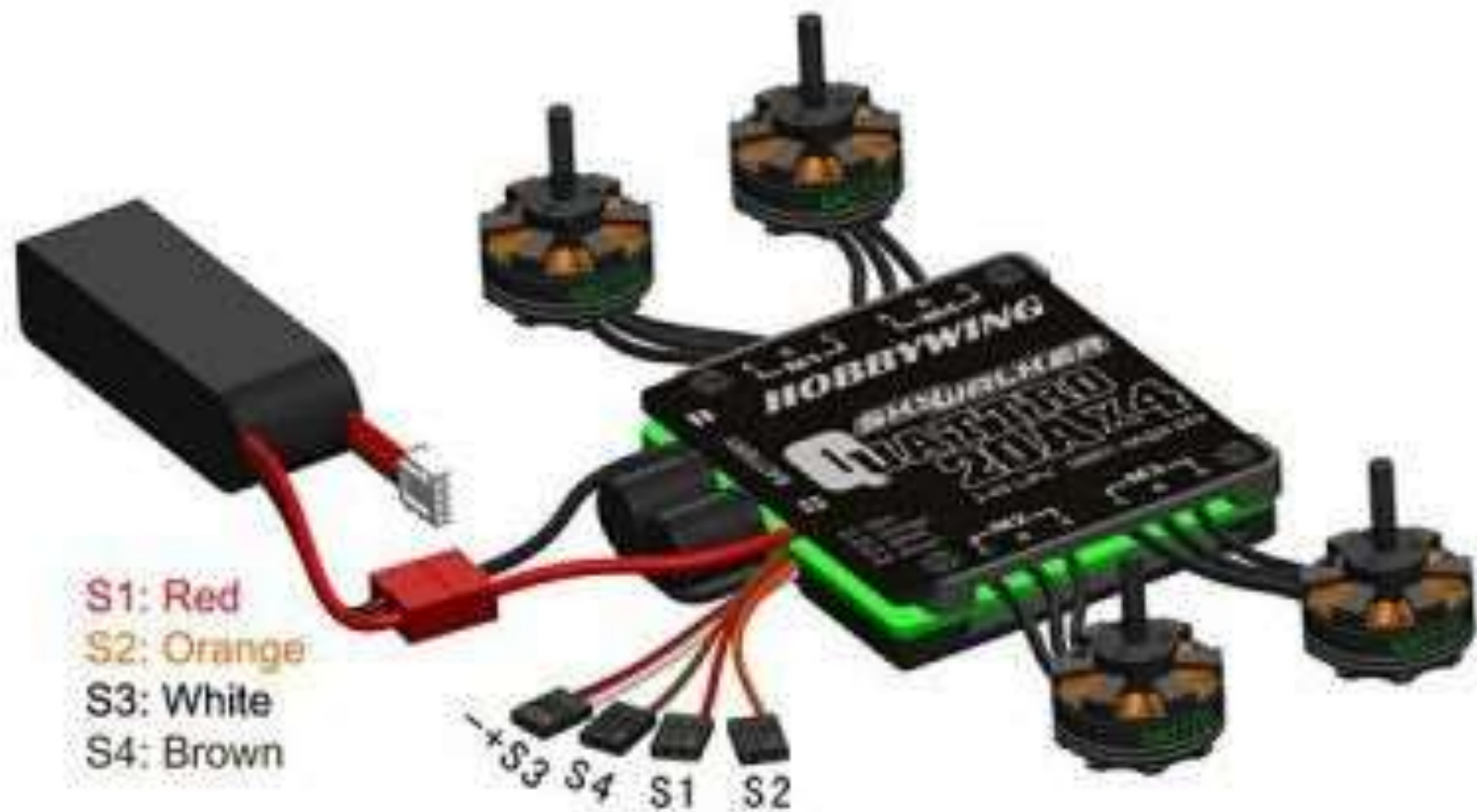
Q. Gimbal Controller Unit

- Allows control of direct-drive brushless gimbal motors as if they were standard hobby servos.



R. Camera And Sensors

- GoPro or other compact high definition video unit with onboard storage. Real-time streaming is possible on the latest drones such as the [DJI Mavic Pro](#), the new [Phantom 4 Pro](#) and the top professional [Inspire 2 filming quadcopter](#). With the wrong camera on your drone, you will never be able to take professional videos or photos. Some of the problems are rolling shutter, jello and barrel effect.
- Many drone manufacturers produced gimbals which are compatible with the GoPro Hero camera range. The latest drone from 3DR called the SOLO was designed specifically with the GoPro Hero cameras in mind.
- However, this year we also seen a move towards all in one drones with come with an integrated gimbal and camera. The camera is specifically designed for aerial filming and photography.



S1: Red
S2: Orange
S3: White
S4: Brown

-+ S3 S4 S1 S2

How to Build a Racing Quadcopter

- <https://www.youtube.com/watch?v=a8JyCGXrFbk>

Quadcopter Racing

- <https://www.youtube.com/watch?v=H19z1X3V4UQ>