

The Beginner's Guide to Drones



About UAV Prime

“They made it really easy buying a drone. Most of all their staffs are really helpful and friendly.”

-Brandon Carter (Drone Enthusiast)

“I don’t know a lot about drones and was hesitant at first about the responsibility of owning one. UAV Prime made the transition effortless and eliminated the burden of trying to look up articles and laws of owning a drone. This beginner’s guide is great, and best of all it’s free! Now that I have my drone, I am having so much fun and I’m capturing some great footage.”

- Avid Mazloom (Youtuber, Blogger, and Drone hobbyist)

UAV Prime was made by drone hobbyists who wanted to make it easy for anybody to own and fly their own drones. We knew that the UAV industry would be getting more and more popular, as hobbyists and various industries, would find different uses for drones. The applications are endless and it is exciting to be at the forefront of this industry. We started our store in early 2015 and are proud to offer customers what they really want out of their drones... specialized support.

We hope that this e-book will answer some questions and help save you time researching how to fly or how to get licensed.

Feel free to visit our store at: www.uavprime.com

Email us at support@uavprime.com

Call us at 1.844.421.6581

Introduction

The last couple of years brought a burst of media attention to the world of drones or UAV's (Unmanned Aerial Vehicles). Most of these articles and reports were for military applications such as video probing and missile attacks. Lately, however, more and more people are being introduced to the consumer applications such as photography, video, crop inspection, search and rescue, etc. In this guide we will be focusing on the consumer and hobby drones, which you can fly on a smaller budget. This eBook starts with the basics and will give you the foundations on to which you can start your journey into UAV's.



Terms and Basic Understandings

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Other Names for Drones

They go by a lot of different names: Quadcopters, UAVs, Quad motors, Multirotors, Drones, UAV's, FPV's, and toys. But these machines contain advanced technology at our fingertips, now, at a very reasonable cost. From basic Ready to Fly (RTF) drones, to advanced drones used for industry, to toy drones that kids can mess about with, we are in a very exciting and revolutionary time for remote control vehicles.

Why Fly a Drone?

Okay, so drones are pretty cool, but what's in it for me? Here are some of the useful applications for UAV's, whether for fun, or for your industry:

Aerial Photography or Video

This is by far the most used method of utilizing drones. How would you like an aerial view of your home or landscape? Even better, how would you like to have the sense of flying? Drones allow you to take photos, or video, of any object that needs a panorama-like shot.



Aerial images like this are created by using drone technology.

Ever wanted to become a bird?

Now with FPV (First Person View) technology, operators are able to get a sense of flying through these devices. The camera equipped drones send a video feed back to a set of video goggles or screen. This adds to the excitement of using a personal drone.

Enjoy the hobby of building your own RC?

If you like technology and enjoy building, engineering, inventing, or modifying your own creation, then DIY drone kits will satisfy every level of these interests. Makers will feel the sense of accomplishment when they

add a rotor or engine. Programmers will also get a kick out of adding, or editing, specific code to improve your drone flight, or landing, capabilities. Hobbyists will always find new modifications to upgrade their personal drones and the space is always growing.

Fun and stress relief

You will always get an excited rush from flying your own RC vehicle. Particularly on the off chance that you have FPV goggles, to make the most of your day flying between structures or turning through trees. Just like any other hobby, or sport, the benefits of flying your own personalized drone is forgetting your troubles as you fly, build, and customize your own UAV.

Commercial Uses

As of now, there are numerous uses for drone technology. The only limit for usage is your own imagination (and maybe the new regulations on flying and owning a drone, we'll get to that later).

Some uses are:

- * Building and roof inspection

- * Photography and video
- * Search and rescue
- * Land mapping
- * Crop surveying
- * Package sending
- * And many more...



Services like DHL and Amazon are now trying to figure out if drones will be able to fill the need for speedy local delivery service.

More uses are being developed as drone technology advances. As with any such venture, you need to start with the basic foundation of knowledge before you pursue any commercial/industrial uses.

Drone Lingo

There are many interchangeable words to describe drones such as: UAV's, quad, or Quadcopter. For the sake of this eBook we will refer these to drones. You may also come across words like “autonomous” or “robotic” in these descriptions. These indicate that the drone may have more advanced options such as a “pre-programmed flight path” without operator input or control.

Drone: a catch-all term used to describe any or all unmanned aerial vehicle.

UAV: Unmanned Aerial Vehicles

Quadcopter (Quad): indicates a remote control vehicle with 4 propellers providing all lift and maneuvering functions. Similar names are assigned to vehicles with 3-10 arms and propellers (tricopter, hexacopter, octocopter, multirotors, etc).

Autonomous: Often refers to drones that are not in control from an operator, rather in fact, is independently controlled using GPS or other means.

** For the ease of description, we will use the term “drone” for all purposes unless otherwise stated.*

Get Regulated Before you Fly

The FAA recently partnered with a few collective industry entities to draw up some “Know Before You Fly” guidelines. The website offers guidelines for personal, commercial and public use of drones—but although the FAA sponsors the project, it apparently doesn’t officially endorse it.

Here are their guidelines for flying your drone for fun:

- Follow community-based safety guidelines, as developed by organizations such as the Academy of Model Aeronautics (AMA).
- Fly no higher than 400 feet and remain below any surrounding obstacles when possible.
- Keep your drone within eyesight at all times, and use an observer to assist if needed.
- Remain well clear of and do not interfere with manned aircraft operations, and you must see and avoid other aircraft and obstacles at all times.
- Do not intentionally fly over unprotected persons or moving vehicles, and remain at least 25 feet away from individuals and vulnerable property.

- Contact the airport or control tower before flying within five miles of an airport.
- Do not fly in adverse weather conditions such as in high winds or reduced visibility.
- Do not fly under the influence of alcohol or drugs.
- Ensure the operating environment is safe and that the operator is competent and proficient in the operation of the drone.
- Do not fly near or over sensitive infrastructure or property such as power stations, water treatment facilities, correctional facilities, heavily traveled roadways, government facilities, etc.
- Check and follow all local laws and ordinances before flying over private property.
- Don’t conduct surveillance or photograph persons in areas where there is an expectation of privacy without the individual’s permission (see AMA’s privacy policy).

For the full list and guidelines please refer to the following website: <http://knowbeforeyoufly.org/>

First Time Flyers: the basics

He who would learn to fly one day must first learn to stand and walk and run and climb and dance; one cannot fly into flying.

- Friedrich Nietzsche



Basics of Operation

So why drones are not considered as toy helicopters or planes. Well the fact is it comes down to technology. There have been vast improvements in batteries, motors, and in flight control hardware and software. The new breed of LiPo batteries (lithium polymer) has higher power to weight ratio. It basically means that they can power heavier devices and keep them in the air for a longer period of time.

These same batteries power the electronics and cameras of your drone.

The current crop of batteries can power your drone for up to 5 to 25 minutes at a time. Many drones are capable of traveling miles in that amount of time. Advancements in LiPo technology means that the specs will continue to improve over time.

The Air Up There

Drones do not go by the laws of aerodynamics. Unlike planes or helicopters, drones rely on their motors and propellers for flight. If any of it fails, the drone will not be able to glide down and use the laws of aerodynamics. On the positive note, drones are

slightly more streamlined and wind has little affected on its flying capabilities.

“Domo Arigato Mister Roboto”

It may help to think of a drone as a robot. Most drones are controlled via instructions given by the pilot or as part of a set of preprogrammed commands. In most cases a drone will fly dependent upon a set of instructions sent through a Radio Controlled Transmitter or Smartphone/tablet. In most discussions, or forums, the term RC might come up. RC means “radio controlled” device.

It’s Alive!!

Most drones have a brain, or CPU (Central Processing Unit), that controls the actions of the device. The CPU is in turn, controlled by the F/C (Flight Controller).

Like a human brain, the CPU can relay information in and out of its pathways:

- * Power from the batteries
- * Instructions from the transmitter (the device from which you control your drone)

* Status reports from the numerous amounts of devices and sensors built into the circuit board. These may include gyroscopes (for leveling), accelerometers for measuring speed and direction, barometers and sonar for height control, and GPS positioning. Simple drones may have gyroscopes but more advanced drones may have these options and more.

Based on the combination of these inputs, the FC will determine how much power is to be distributed to each of its four motors.

For example, if you wish your drone to go forward, the FC will lessen the power of the front two motors, whilst simultaneously powering up the two rear motors, tilting the device and propelling it forward.

This same directive is used to fly the drone side to side.

You can imagine the FC as the brain, the wires as the blood vessels and nerves, and the motors as your muscles and limbs. Like the human body, each system is giving constant feedback to the brain, which results in amazing capabilities in movement.

Buying Your First Drone

If you are a first-time drone buyer and you are looking at a brand that is over \$1,000, **don't buy it.**

You will crash your drone many times before you get the hang of flying a quadcopter.

Your initial goal when starting out with drones is learning how to fly a quadcopter. It is very different that flying a model airplane, or a helicopter for that matter!

It is advisable to start out by purchasing a micro or mini sized drone. Many toy drones are largely disposable because of its affordability. Replacement parts are also less expensive than the higher standard UAV.

Be aware that although toy drones are loads of fun to fly around, the reason they are so affordable is because the motors and their components tend to wear easily.

But it should build a foundation of flight experience before you jump into a \$2,000+ investment.

To view some great beginner drones head over to <https://uavprime.com/index.php/resources-guides>



Don't let this happen to you. Start off with a toy drone to gain some experience.

- * **Again, you WILL crash your drone many times while you are learning to fly and repairs/replacements are much less expensive for toy drones than a larger model.**

The “Mini-me” of Drones

Although there is no official definition of this range of sizes the following is a rough grouping in this category:

- * ***Nanodrones/quadcopters*** - These mini drones are quite tiny. Many are no bigger than a large coin. Although these toys may seem fun, they are not recommended for beginners because of their poor flight characteristics. Some examples of these are the Estes nanodrones and the WL Toys 272.
- * ***Microdrones/quadcopters*** - These are drones that fit in the palm of your hand. They are roughly about 3-4” diagonally, motor to motor. Most of these are “direct drive” meaning there are no gears running the propellers. The motor runs the propellers directly. They weight approx. 40-60 grams (with battery).
- * ***Minidrones/quadcopters*** - These drones are a bit larger and span about 8-10” diagonally motor to motor. Many use the same motors as microdrones but they use gears to run the propellers. They weight approx. 80+grams (including battery).
- * ***Full sized drones*** - These drones are classified by weight, not by size, as the inner workings are the

most important part. Most of these drones are “direct-drive”, meaning that they have brushless (higher quality) motors directly mounted to the propellers and they weight approx. 1/2-1+ kg.

It is recommended for beginners to start with a micro or mini drone. Look specifically at pricing as these drones will typically run you about \$40-\$150 dollars respectively.

Starting with Simulators

There are programs available for the everyday enthusiast to help give you the feel of flying a quadcopter. These run the gamut from inexpensive phone/tablet apps to more sophisticated PC or Mac software that can use an RC transmitter connected directly through your USB.

The following are some examples (which are constantly changing given the amount of developers in the marketplace):

* ***AeroSIM RC*** (www.aerosimrc.com): A fully fledged simulator program with many models and modes built in.

* ***Heli-X*** (www.heli-x.net): This is a program which has many models of drones already built into it. Although slightly pricey (\$70-\$180), this program is highly recommended for someone who wants to crash less in the real world. (Note: a free trial is available, be sure it suits your purpose before you sign up).

* ***Indoor HeliSIM*** (**Google Play Store**): This is a free android app that is catered to drones only. This is a simple app that has lots of setting so you can get the feel of a more advanced flyer.

* ***FPV Free Rider*** (<http://fpv-freerider.itch.io/fpv-freerider>): For Mac/ PC/ Linux, this program has a free demo (\$4.99 for full version) and is intended for FPV racing or acro (acrobatics) flying.

* ***NeXt Flight Sim*** (http://www.rc-aerobatics.eu/cgm-rc-heli-simulator_e.html): This full featured sim has dozens of helicopters as well as a few popular drones such as the Phantom.

How Much Will This Hobby Cost Me?

The cost will range from \$200 - \$5,000+. But for the sake of this eBook, as a beginner, you will want to spend less than \$500. This is enough for one or two drones and some spare parts if needed. After you gain some experience you can move up to more standard drones ranging a little higher in price.

How Do I Know Where to Shop?

As in different interest, the brand and model is very important when choosing to purchase a drone. Look around for reviews of the device and decide which model is right for you.

Most drones are manufactured in Hong Kong or China and although it might be cheaper to buy directly from them, it often takes a longer time to ship and if there is a problem, communication with a foreign vendor can be a problem.

Here are some places you can buy quality drones:

A local hobby shop: It may be difficult to find hobby shops that carry drones, but more and more stores are now adding drones to their product lines. There are also many new shops and specialize in drones that you can find.

Online specialists and retailers: There are many vendors who specifically sell drones. The best example is www.uavprime.com. Look no further than the best!

Amazon or eBay: You may also purchase from these outlets but be careful of used drones that may have been poorly maintained. Always do your due diligence when buying from these retailers.

Returns and Refunds

It is very rare for a new copter to have factory defects. Most likely a customer will open the box and fly it and crash it a couple of times and then claims it to be broken. Many direct manufacturers will not accept an open used drone as a return, as the fault will lie solely on the customer. However, most Chinese vendors will send replacement parts instead of a full refund.

When purchasing from Amazon or eBay, take note of their returns policy when making a purchase.

At UAV Prime there is a 110% money back guarantee so there is no cost to the customer for a defective product.

It's up to you as a customer to purchase from a marketplace that makes sense to you.

Beware of New Product!

It is best to avoid purchasing new models of drones right when they come out. Reliability can be poor and replacement parts may be hard to find when the product is so new. Models that have been out for a year or more usually have been improved to deal with initial quality control issues. Particularly in this age, a review gives impact to an item's achievement. Purchase a dependable and tested model before getting that brand spanking new one.

Before You Start Taking Pictures

New pilots will often be tempted to buy a new camera to go with your drone. Do not be tempted! Hold off on getting that new model GoPro and start by flying a stripped down version of your drone, with no cams or extra, first. Focus first on learning to fly your drone without the added distraction of trying to get that perfect shot. Beginners also have a tendency to crash

or lose their first drone so it's better to lose a drone than to lose a fully equipped one.

Choose Your Flying Grounds

Before taking your drone to that perfect beach spot, or that wonderful mountain waterfall, consider flying your device a little closer to home. Learning how to fly indoors (garage) or in your front yard has many benefits such as soft floors, zero possibility of losing your drone, and low crashing opportunities.

Some other considerations, if you are planning to fly outdoors are:

Wind resistance: Micros provide a better wind profile is usually better in a breeze.

Visibility: Keep in mind that if you are flying a smaller drone, the farther it is away from you, the more likely you are to lose it. Although it may seem like common sense, many pilots lose their drones this way!

Which Axis Should I Use?

So what's the difference between the 3, 4, or 6 axis models of drones? Basically it is comparable to the decision of whether or not you want to drive a manual or stick shift. Flying a 3 or 4 axis drone will give you

more piloting skills and acrobatics. The 6 axis drone will give you more stability and will self level if you happen to take your fingers off of the controller stick.

Heading into 2016, 6 axis drones are becoming more and more popular. However, those who wish to get into racing or acrobatic flights will lean more towards a 3 or 4 axis device.

Spare Parts

It is good practice to buy an extra set of batteries and parts when you buy your first drone. Having spare parts will alleviate some disappointment when you crack your propellers or your battery runs out.

It's also good to contact your supplier and ask which parts they would recommend for a beginner.

Here are some parts you might want to consider:

- * Purchase at least one extra battery as each battery will last only 10-30 minutes depending on brand, and it may take up to 1 hour to recharge a battery.
- * Many sets will have extra propellers but it would be wise to get some extras, especially for micros, as they can go through them fairly quickly.

* Motors - if you are a beginner pilot you will most likely destroy a motor or two. You may send in, or take, your product to a repair service or you can solder them yourself if you have mechanical ability. Some models have motors that plug in, rather than being soldered on, which may be an option for first time flyers.

* If parts are unavailable you may want to consider changing to a model with plenty of available parts. You also want to consider buying two drones (some toy drones are inexpensive enough to warrant the purchase) for less than \$100.

* *Note that drones differ in the difficulty of repair based on the model. Some may require basic mechanical skills while others have built in plug in parts.*

Let's Go Flying!

“Once you have tasted flight, you will forever walk the earth with your eyes turned skyward, for there you have been, and there you will always long to return.”

- Leonardo da Vinci



Getting Ready to Fly

You've been waiting for this day ever since you've decided to jump into the hobby of UAV's. So what's the first order of business?

First things first, make sure your batteries are charged, as well as any back up batteries.

Also don't forget your transmitters. They also need batteries. Make sure you have some AA or AAA batteries on hand.

While they are charging, get out your owner's manual and start perusing the guide. Make sure you get to know the important details of operating your drone.

Also, it would be recommended to search online for reviews and/or tutorials on your particular model. Nowadays there are plenty of information and resources on the internet, showing test flights and reviews for all of the latest models.

Warning: LiPo batteries are known to self-ignite. Make sure you charge them on a fire-proof surface, away from flammable material such as paper or clothe.

Please read the safety index of your operations manual before charging or flying your drone.

Your Transmitter

Most drones are sold with a transmitter/remote.

Some come with a transmitter set up as “**mode 1**”. This means that the right stick will control the throttle as well as the pitch and roll (left/right) and the left will control the elevation.

Most of these devices are set up as “**mode 2**”. What this means is that the throttle is controlled by the left stick while the right stick controls the pitch and roll (forward/back & left/right).

Here is a picture of a typical transmitter:



The left stick controls the speed of the propellers and therefore is set all the way down before flying. The right stick should be centered for most takeoffs. The small silver switches, underneath the sticks and in the center, are used for “trimming” the copter so it hovers without drifting to the side.

Let's boot up!

Be aware that the spinning propellers have the capacity to cut or injure humans or animals. Be sure to utilize your good judgment when operating a copter. Always take precaution of your surroundings when preparing to fly or charging your LiPo batteries.

* Make sure you read your owner's manual for proper start up directions:

Here are the typical steps taken when trying to boot up your drone:

1. Make sure all of your devices are powered up and your throttle is off (in the down position).
2. Insert your LiPo batteries into your drone frame as per instructions from your owner's manual.
3. Connect battery leads - some batteries, depending on the model - will auto connect to the frame.

4. **Place your drone on a flat surface.** Keep in mind that some drones will use the initial position as a point of reference for how straight and level they will fly.
5. Turn on your transmitter. Some will go through a series of beeps until ready. This will indicate that the transmitter is connected to your drone. Sometimes you will need to press the throttle forward a bit to “arm” your drone. This means the drone is ready to be launched. Some devices will require other action(s) depending on the model. Please refer to your owner's manual for correct procedures.

Great! Now you're ready to fly...

Not Quite Yet

Here are some terms that apply to flying:

Pitch: this describes the angle of the drone as relating to level, whether front to back or side to side

Aileron: refers to the copter lean of left and right. Also referred to as “banking” and “rolling”

Elevator: this is the flight control of making the drone angle up or down when facing forward. Also referred to as the “pitch”

Rudder: This describes the flight control which makes the copter rotate on its center axis. This is achieved by varying the power to which it sends to each of the rotors.

Before you start flying, let's go through a series of short checks of taking your first test flight.

The first time pilot (especially if you have a higher end drone) should start slowly so as to not run into any surprises.

One way of checking your equipment is to weight down your copter and then checking, one by one, all of the transmitter functions. **Be careful of the propellers!**

With your drone weighted (with a heavy object such as a wrench), **stand behind the copter** facing the same direction as the nose.

Slowly apply power to the propeller by pushing the throttle stick forward. The propellers should spin and increase in speed gradually. Do not push the throttle stick all the way forward, just enough to get a feel for the controls.

Once you feel comfortable with the throttle, you can now test the basic function of the pitch and roll function. This stick is usually centered. Push the stick

forward to make the copter lean forward and back for the opposite. The same impact, when you push it to left and to the right.

In the event that everything is great, at that point you are ready to take your first test flight!

Test Flight

The ideal place to start your test flight will be in an open area with a lot of grass to cushion any potential crashes.

Next, while behind your drone, slowly apply some power to the throttle. Continue to apply the power until your drone lifts off of the ground about 2 to 3 feet. You want it to be hovering enough to be in "free air".

Ideally your drone will not hover to the left or right. This means that your gyros are working properly.

If your drone is acting erratically (flying this way and that) you should immediately land it and disconnect the batteries, and then reconnect it - making 100% certain that your drone is perfectly level. Then try again - be sure of your drone ability to hover in the same spot before going on to test flight.

After a couple of seconds of hovering, test your left, right, forward, and backward controls. If all of these are working properly and you feel in control of these switches, land your drone back down.

Many of your first flights will be hovering in “free air” and testing the pitch and roll controls and landing back down to the ground.

Take baby steps and slowly build your confidence with flying and landing your copter. If not, then the result will be a lost or damaged drone.

Trimming Your Drone

If you have trouble with your drone drifting from side to side or spinning on its axis, you may need to trim your transmitter slightly. Most remotes have four switches which can be nudged to calibrate your drone to hover in a centered position. For example, if your drone is drifting forward, then press down a few clicks on the center buttons to favor the opposite direction.

Note: Do not use trim unless you are absolutely sure your drone was initialized on a flat, level surface. Trimming is for only making small adjustments. If your copter is drifting uncontrollably in a fast direction, it is

likely the problem lies elsewhere such as failing motors, or a stripped gear.

Read your manual regarding trim buttons as they vary from model to model.



Fly Away Little Bird!

Now that you have gotten the hang of hovering and landing, now it's time to fly a little farther away from the nest!

Make sure you are outdoors with plenty of available space (and grass!). While your drone is hovering, use the left and right control sticks to move your drone away from you approx. 20-30 feet. Once your drone is that far away, pull the drone back towards you and

land it back down. Do this a couple of times and remember when you rode a bike, or learned to drive. Practice makes perfect!

Landing After Takeoff

Most advanced models come with automatic landing, but some require you to have expert level landing skills (which can be great fun). This is especially true for 3-axis (racing type) drones that require the leveling to be perfect in order for the propellers not to hit the ground.

It is best to practice on soft ground, hovering for a couple of minutes and then landing on the ground. Do this a couple of times until you get the hang of it.

It is VERY important to cut the power 100% during a crash or hard landing. Keeping the power to the blades as they hit the grass or soil can damage them. Most drones can get away with little damage when falling from a few feet onto soft soil IF the throttle is off.

Piloting Your Own Missions

Once you are confident in the basics, you can start to branch out into more complex maneuvers. Successful

piloting requires the ability to do a number of things at the same time. This will come naturally with practice but you have to train your motor functions first.

Here are some mission objectives for you to follow to the path of a successful pilot:

1. **Drone orientation:** Try controlling your copter when it is facing you in the opposite direction. The sticks will work differently. Practice these moves so you get more confident with maneuvering in any direction.
2. **Loops:** Doing loops can help you develop your skills in controlling more than one stick at a time. Also it looks really cool.
3. **Figure 8's:** Ditto for figure 8's.
4. **Special awareness:** It is important to grasp the objects near your drone. You don't want to end up smashing it against a wall or tree! You not only have to pilot around objects, but wind and weather as well. Try and fly your drone around a building or tree. Don't go flying into anything too dense. Make sure your object is clear of other objects.
5. **Descensions:** There will be times you will need to descend quickly. While high in the air, try to descend

from that height while moving forward. Just be careful not to crash land!

Top Gun

Now that you've mastered the basics you can try more complex patterns and master some stunt flying!

Here are some links to videos which shows some great drone piloting moves:

<https://www.youtube.com/watch?v=1MBW8zoZUR4>

(credit to CHARPUFPV)

<https://www.youtube.com/watch?v=OZnJeuAja-4>

(Credit to sUAS News)

<https://www.youtube.com/watch?v=B1338QpwTZA>

(Credit to Monty Pearson)

Choose the Right Drone

If you feel as though manual flying is too much for you, don't fret. Brands such as DJI, YUNEEC, 3DR, XCRAFT, and many others have intelligent

programming to eliminate manual control. Many of them have GPS tracking so you can just adjust your path and set your drone on its way. Make sure you do your diligence and research each product to see what's best for you.

Quick Overview

Here is a quick summary of the tips for beginner pilots:

1. ***Make sure you charge all of the batteries.*** Do not over charged or over drain your batteries. As you advance in your hobby you may want to invest in a better battery charger.
2. ***Plug in your drone while it is level*** and leave it for 10-12 seconds. This will determine what the initial leveling position will be.
3. ***Make sure your throttle stick is in the down position*** when plugging in your drone. When moving your drone, it is best to cut off power. **Do not move the drone AND carry your transmitter at the same time** as you may accidentally hit the switch and cut yourself from the propellers.
4. ***Don't be tempted to venture far beyond your level of piloting.*** Start slow and gain experience first.

5. ***If you see you are about to crash, and then turn your throttle off.*** This will cause less damage to your drone.

Your UAV Future

I never think of the future - it comes soon enough.

– Albert Einstein



What's Next?

Once you master the basics you will know where to go next in this hobby. Here are some different paths you may take:

FPV Racing - this is one of the more exciting hobbies that have come about in just the past few years. Hobbyists race their drones around tracks or go free flying in open spaces. The best part is the introduction of FPV goggles. This experience gives you the ability to “look through the eyes of your quadcopter”. It is very exhilarating indeed.

Drone Modification - Do you have a mind for mechanical engineering? What's great about this hobby is the Pokémon-like customization you can do to your drones. You can make your drone faster, smarter, or flat out cooler than your neighbor's drone.

Drones for Photography or Video - This is one of the more popular uses for drones as people in the profession get shots that they would not otherwise have been able to get without expensive craning equipment. Hobbyists get a thrill of taking the perfect shot for their commercial, or personal, projects. Are you the next Spielberg?

Drone Repair

If during your “test flights” you seemed to have gotten into a couple of crashes, here are some of the most common DIY repairs you will probably encounter:

Propeller replacement:



Propellers for small drones are fairly inexpensive, so when you purchase your micro, or mini, drone it is recommended you buy spare parts, or even another spare drone. Micros usually have a push on top where you can pop off, or push on, your propellers. One tip is you can put a little bit of glue before putting them on so they may stay on better. Minis usually have a single screw that will hold the propeller to your drone.

For many, they will invest in a pair of mini screws for future use.

Motor Replacement:



Motor replacement is a common task on most drones. It is best to research your initial purchase to determine how the motor is replaced on your specific drone.

Some plug in while others need some soldering work. If this is something out of your expertise, then drone repair shops may be an option. With the popularity of UAVs more and more hobby shop has repair options for the drone hobbyist.

Fix It or Toss It?

If the damage isn't significant, a simple repair can bring the drone as good as new. You can get virtually any part for most drones. However, there comes a time when repair costs add up! Should you toss it away? No! You can recoup some of your losses by selling it for its parts. If your transmitter is in perfect condition, why not sell it to a hobbyist in need? In the end you have to make the decision whether to repair your current machine, or sell it for parts and upgrade to a new model.

Your UAV Tool Box

For the mechanical engineer in you, here are some basic tools you may need that are the beginning to any DIY drone tool collection:

1. An X-Acto knife (or any other razor cutter)
2. Electrical tape of various colors and sizes

3. Some superglue or some sort of epoxy. A hot glue gun can also be useful
4. Mini screwdrivers
5. A Soldering Iron (quality will depend on your wanted skill level)
6. A voltage meter
7. A magnifying glass and a good lighting source
8. Fastening pieces such as Velcro or zip ties

A tool kit such as this can be put together for less than \$50 if you look around.

Aerial Photography and Video

Now we get to the fun stuff. There are many who go into this hobby specifically to marry their other hobby of video and/or photography. You can take some amazing shots that couldn't otherwise have been taken without the use of heavy, expensive equipment.

Although there are many advantages to going into aerial photography or video and you may be tempted to take out that credit card to make your big purchase, however, take a step back and ask yourself if you have

gone through the necessary steps mentioned previously in Chapters 2 and 3.

If you have, and you have flown the hours necessary to feel confident in your piloting abilities, then proceed forward and we will clue you in on to the world of aerial photography and video.

AP (Aerial Photography) & FPV (First Person View)

The most common (and most inexpensive way) to get your shots is accomplished by simply flying around your drone with a camera and taking shots saved on a memory card. Mini-copters with built-in cameras and controls can be found for as little as \$50. The downside to this is that the photos and video will not be of high quality.

In order to get higher quality you must move up to the higher end drones which are capable of greater stability and have the ability to carry better cameras.

Another drawback to this method is that you can't see the actual footage until you upload them onto your computer.

FVP, or *first person view*, drones are where things really get exciting. If you are ready to really step into this hobby and have some extra funds to invest, this is the way to go.

FVP means that you can see exactly what your quadcopter is seeing as it flies in the air. The video feed is beamed back to either a small monitor or a special pair of VR goggles the pilot will wear. This allows for much more control when taking your photos or video. It is also a really cool way to view the perspective from the top.

Camera Types

Aerial cameras can often get beat up from continuous flying so it's not advisable to use cheap, fragile cameras. Here are some popular cameras used by hobbyists:

Low-res drone camera (included/optional) (\$30): These are the cameras that come with your drones. These can be very light and can be operated from the transmitter. Be aware that the quality may not meet your needs.

GoPros and other similar sport cams (\$100-\$500): These cameras have exploded in popularity in the recent years. These cameras are specifically made

for action shots. They are both shock proof and light weight. There are also some models that are water resistant. Mid ranged drone models are required to lift these cams so be sure to check which drones are GoPro capable.

Mobius Sport Cam (\$750-\$1000): These are cameras built specifically for the RC market. They can provide HD videos, stills (timer), and other features for a low price. It can be lifted by smaller model drones.

Keychain cams (\$12-\$60): These little cameras have also recently grown in popularity. Many hobbyists affix their cams onto their drones when shooting. The higher end models offer higher resolution and a wider angle lens. Bright sunlight is often not good for these types of cameras.

Tip: If you want to see the quality of some of these cameras, there are many examples on the internet (YouTube, Vimeo) in which you may make an informed decision.

Please note that, just as in any hobby involving photography and video, the quality you expect to produce will be determined by the quality of the drone and camera. Better cameras offer better resolution and color. Some upscale models of drones are even capable of lifting

DSLR's which weigh a couple of pounds. This is a case in which the more educated you are, the better your results will be.

Congratulations!

If you have reached this point in this eBook then you are no longer a complete beginner. In fact, you probably know more than most people! As you continue on your road in this hobby you will soon gain more insight on where this will lead you.

Here are some possible paths you may want to journey:

- You can continue on your hobby of micro, or mini, drones. The cost is affordable and if you are seeking a little more of a thrill, you may want to consider going into FVP racing drones, which are not as high cost as some of the other droning ventures.
- Tap into your inner Engineer and create personal drone "Frankenstein".
- Become the next big documentary film maker, which is increasingly becoming more common as interested people are starting to travel and experience life through the lens.

Troubleshooting, glossary, and bonus articles

CONTENT

1. Safety Warnings
2. Troubleshooting
3. Glossary

Safety Warnings

As a user of UAV drone products the responsibility of understanding all of the warnings and safety procedures fall onto you. Please be informed and practice safe piloting.

Here is an outline of some of the major safety points to consider:

1. *Spinning propellers can injure people and animals.* Mid to larger sized quads can cause deep wounds or worse. Do not fly near large crowds and try to avoid people or animals. Make sure you are aware of the start up process. You may want to remove the propellers when you first do a systems check.
2. *LiPo Batteries can shock or self-ignite.* Be aware of safe charging procedures and keep batteries away from water and other fluids.
3. *When you pilot your first flight, make sure you are in a wide area,* preferably with soft ground. Falling, or crashing, drones can injure someone. Use common sense when piloting your drone.
4. *Do not use GPS when flying indoors.* Erratic results can result in lost control.

Troubleshooting Your Drone

Here are a list of common problems and malfunctions to drone ownership and some possible solutions:

Problem: Drone will not take off. Propellers will spin at high speeds but the drone will skid or tumble along the floor.

Solution: Check if the propellers are installed properly. Consult your owner's manual for proper installation. Most drones have two types of blades that clock- wise and counter clockwise to each other. When laying out your propellers, remember, the higher edge of the blade should be leading the way.

Problem: Drone wobbles when hovering when there is no wind.

Solution: Carefully inspect the propellers (when they are on and off). Wobbly hovering may be an effect from crashes or wear and tear. It may be time to replace them.

Problem: One of the motors is slow to start.

Solution: Slow starting motors may not be a problem. If you push the throttle higher and the propeller still acts accordingly, it may be just a case of the propellers just not starting at the same speed. However, if this problem affects the lift off or flight, then you may need to replace the motor. Especially, for the micros and minis as their motors wear out more easily.

Problem: My drone flies erratically after about 5 minutes.

Solution: You may need a fresh pair of batteries. Battery voltage may have dropped. Although drones have the capacity to fly 10+ minutes, this depends on battery size, charge state, how often you charge, etc.

For larger drones you may want to use a digital multimeter to check the voltage if you have concerns.

Problem: My drone does not fly well or flies in only one direction.

Solution: Just like a regular computer, you should first reboot your system. When doing this, make sure your drone is 100% level. If problem still occurs then adjust the TX trim as needed to fix the issue.

Glossary

2.4 Hz

The frequency most commonly used for UAV radio communications

808 camera

The 808 is a small color video camera with audio that also takes photos

Academy of Model Aeronautics (AMA)

The main US model aircraft association

Accelerometer

An accelerometer is a device that measures proper acceleration ("g-force")

Airspace

Any portion of the atmosphere sustaining aircraft flight and which has defined boundaries and specified dimensions. Airspace may be classified as to the specific types of flight allowed, rules of operation, and restrictions in accordance with International Civil Aviation Organization standards or State regulation. There are five classes of airspace, A, B, C, D, and E, in the National Airspace System.

Arduino

Arduino is an open-source electronics platform based on easy-to-use hardware and software. It's intended for anyone making interactive projects

Autonomous

A UAV that can be programmed to fly a designated flight pattern without a pilot controlling it

Axis

Every UAV has a Longitudinal Axis which runs from the tail to the nose of the unit and a Lateral Axis that runs from one side to the other side

Balanced Battery Charger

A charger that also keeps the cells of the battery balanced by transferring energy from or to the individual cells in order to maximize a battery's capacity to make all of its energy available for use and increase the battery's longevity

Barometric Pressure Sensor

A sensor that measures fluctuations in the pressure exerted by the atmosphere

Battery: C-Rating

Maximum steady-state current (amps) at which the battery cell or pack may be discharged without having

pack temperature exceed the temperature that results in permanent damage, loss of capacity or reduction in cell life. C-rating is expressed as a multiple of the capacity. For example, a battery with a nominal capacity of 4 Ah may have a C-rating of 5C, meaning that 20 A would be considered its maximum safe current.

Battery Eliminator Circuit (BEC)

Used in an electric-powered radio controlled model, the BEC is typically part of the electronic speed control (ESC). BEC allows such a model to carry only one battery (the motive power battery) instead of two (Motive power and a separate battery to operate the R/C equipment)

Binding

The process of training a transmitter and receiver to communicate with each other

Bind-N-Fly (BNF)

Using 2.4GHz DSM2/DSMX technology, a single transmitter can be bound to various RC units outfitted with a compatible receiver

Brushless DC electric motor

Also known as electronically commutated motors (ECMs, EC motors) are synchronous motors that are

powered by a DC electric source via an integrated inverter/switching power supply, which produces an AC electric signal to drive the motor. Their favorable power-to-weight ratios and large range of available sizes, from under 5 gram to large motors rated at well into the kilowatt output range, have revolutionized the market for electric-powered model flight, displacing virtually all brushed electric motors.

Camera Gimbal

A pivoted support used in aerial photography in order to allow a balanced movement for camera and lenses

Center of Gravity (CG)

The point at which a UAV would balance if it were suspended at that point

Certificate of Waiver Or Authorization (COW/COA)

A FAA grant of approval for a specific flight operation. The authorization to operate a UAS in the National Airspace System as a public aircraft outside of Restricted, Warning, or Prohibited areas approved for aviation activities.

DJI

China based drone manufacturer that has produced very popular, moderately priced units such as the Phantom series.

Drone

An aircraft with no pilot onboard. Also known as Unmanned Aerial Vehicle (UAV) or a Remotely Piloted Aircraft (RPA)

Electronic Speed Controller (ESC)

Control the speed of the motor. Serve as the connection between the main battery and the RC receiver.

First Person View (FPV)

A method used to control a radio-controlled vehicle from the driver or pilot's view point, commonly done using a Smartphone, a tablet or specially designed goggles

Fly Away

Unintended flight outside of operational boundaries (altitude/airspeed/lateral) as the result of a failure of the control element or onboard systems, or both.

Fly-Away Protection System

A system that will return the UAV safely to the surface, or keep it within the intended operational area, when the link between the pilot and the UAV is lost

GoPro

A compact, lightweight and rugged high-definition personal camera. Often used in extreme action video

photography that is wearable or mountable on vehicles. Able to capture still photos, or video in HD through a wide-angle lens and can be configured to work automatically with minimum intervention, or remotely controlled.

Global Positioning System (GPS)

A space-based satellite navigation system that 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. The system provides critical capabilities to military, civil and commercial users around the world. It is maintained by the United States government and is freely accessible to anyone with a GPS receiver.

Ground Control Station

A system of software and hardware receiving telemetry data from an unmanned aircraft to monitor its status, and transmit in-flight commands.

Gyro Sensor

Gyro sensors, also known as angular rate sensors or angular velocity sensors are devices that sense angular velocity. Used both in UAV's and Cameras.

Gyroscope

A device for measuring or maintaining orientation, based on the principles of angular momentum

Hexacopter

A rotorcraft with 6 rotors

Hobby Grade

A distinction between a toy and a unit that is more advanced, durable and adaptable

Inertial Measurement Unit (IMU)

An electronic device that measures and reports on a craft's velocity, orientation, and gravitational forces, using a combination of accelerometers and gyroscopes, typically used to maneuver aircraft, including unmanned aerial vehicles (UAVs). An IMU allows a GPS receiver to work when GPS-signals are unavailable, such as in tunnels, inside buildings, or when electronic interference is present and it is the main component of inertial navigation systems used in aircraft. The data collected from the IMU's sensors allows a computer to track a craft's position, using a method known as dead reckoning.

Intervalometer

A device that counts the interval of time. In photography, intervalometers are used to trigger

exposures. Used in aerial photography to delay the start of picture taking by an unattended camera until sometime after takeoff and separating multiple exposures in time, and thus distance as the vehicle containing the camera travels, to obtain the 3D effect (stereoscopy). To obtain the 3D effect each image should have about 60% of the surface in common with either the preceding or following image. The interval is calculated as a function of the altitude and speed of the vehicle; shorter intervals for low altitude and high speed.

JPEG

A filename extension for digital images

Kite Aerial Photography (KAP)

A camera is lifted using a kite and is triggered either remotely or automatically to take aerial photographs

Lithium Polymer Battery (LIPO)

A rechargeable battery of lithium-ion technology in a pouch format. LiPos come in a soft package or pouch which makes them lighter but also lack rigidity

Line of Sight (LOS)

Flying while at the same time, watching the UAV and keeping it within sight at all times.

Maximum Takeoff Weight

The maximum allowable weight for takeoff (including payload).

Milliampere hour (mAh)

One-thousandth of an ampere-hour

Mobius Camera

A very sophisticated mini camera, measuring 1 3/8" x 2 1/2" x 3/4" inches and weighing only 1.4 ounces capable of recording 1080 HD video

Multicopter

A rotorcraft with more than two rotors

MultiWii Copter

An open source software project aiming to provide the brain of a RC controlled multi rotor flying platform. It is compatible with several hardware boards and sensors.

Octocopter

A rotorcraft with eight rotors

Original Equipment Manufacturer (OEM)

Parts manufactured by the original manufacturer of the vehicle

Over the Horizon

The condition where the control station and the UAV are beyond line-of-site from each other

Payload

The carrying capacity of an aircraft, usually measured in terms of weight

Pilot in Command

An unmanned aircraft that is flying in a state of direct control by a UAV operator (i.e. not in autonomous flight).

Pitch

Changes in the vertical direction the aircraft's nose is pointing

Point of Interest

A target location for the capture of remotely sensed data by a UAV's sensors (i.e. video, still or multi-spectral imagery).

Pre Flight Planning

The activities conducted by the pilot and flight crew prior to takeoff to ensure that the flight will be conducted safely and in accordance with all applicable standards and regulations. The activity includes, but is not limited to, such things as checking weather, route of

flight, airspace, equipment configuration, support personnel, terrain and communications requirements.

Quadcopter

A rotorcraft with four rotors

Radio Controlled (RC)

Radio Controlled vehicle or aircraft

Ready to Fly (RTF)

A UAV that comes completely assembled and bound to a transmitter and is ready to fly when it is purchased

Return To Launch (RTL)

Return the aircraft to the "home" position where it took off

RX Microcontrollers

RX stands for Renesas eXtreme, signifying extreme performance and usability

Sense and Avoid

The capability of a UAS to remain well clear from and avoid collisions with other airborne traffic. Sense and Avoid provides the functions of self-separation and collision avoidance to establish an analogous capability to “see and avoid” required by manned aircraft.

Small Unmanned Aircraft System (sUAS)

A small Unmanned Aerial Vehicle, typically less than 55 pounds

Telemetry

A highly automated communications process by which measurements are made and other data collected at remote or inaccessible points and transmitted to receiving equipment for monitoring

Throttle

A device controlling the flow of fuel or power to an engine

Toy Grade

Mass market UAV units that are sold at retail stores

Unmanned Aerial System (UAS)

The unmanned aircraft together with its ground-based controller, and the system of communications connecting the two

Unmanned Aerial Vehicle (UAV)

An aircraft with no pilot onboard

Ultrasonic Sensor

Also known as transceivers when they both send and receive, but more generally called transducers, work on a principle similar to radar or sonar, which evaluate at-

tributes of a target by interpreting the echoes from radio or sound waves respectively

Vertical Take Off and Landing

The capability of an aircraft to take off and land vertically, transferring to or from forward motion at heights required to clear surrounding obstacles.

Visual Observer

A UAS flight crew member who assists the UAS pilot in the duties associated with collision avoidance. This includes, but is not limited to, avoidance of other traffic, airborne objects, clouds, obstructions, and terrain.

Waypoint

A reference point in physical space used for purposes of navigation

Yaw

Turning left or right on the vertical axis of the aircraft

Glossary

reference:

<http://www.droneviewtech.com/glossary-of-terms/>