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# Drones Replacing Pilots: A Dream or Reality

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Content:

## Chapter 1: The drone's emergence

### Introduction

Drones are flying robots controlled by humans from the earth's stations, they equip with strong processors and sensors and cameras to make it smarter and easier to control. With this points we can forget about a lot of their vulnerabilities, but there are main weaknesses, we can't forget it, such as weather, so you can't fly your drone wherever you want. So, can drones replace pilots?? , if it's impossible, why not?? . After that, I'll talk about how we can use it in our life and society.

### Let's start…

### History to today:

In 1973, the U.S. military officially confirmed that they had been using UAVs in Southeast Asia (Vietnam). Over 5,000 U.S. airmen had been killed and over 1,000 more were missing or captured. The USAF 100th Strategic Reconnaissance Wing had flown about 3,435 UAV missions during the war at a cost of about 554 UAVs lost to all causes. In the words of USAF General George S. Brown[1], in 1972, "The only reason we need (UAVs) is that we don't want to needlessly expend the man in the cockpit". Later at the same year, General John C. Meyer[2] said "we let the drone do the high-risk flying ... the loss rate is high, but we are willing to risk more of them ... they save lives!"

During the 1973 Yom Kippur War, Soviet-supplied surface-to-air missile batteries in Egypt and Syria caused heavy damage to Israeli fighter jets. As a result, Israel developed the first UAV with real-time surveillance. The images and radar decoying provided by these UAVs helped Israel to completely neutralize the Syrian air defenses at the start of the 1982 Lebanon War, resulting in no pilots downed. The first time UAVs were used as proof-of-concept of super-agility post-stall controlled flight in combat flight simulations was with tailless, stealth technology-based, three-dimensional thrust vectoring flight control, jet steering UAVs in Israel in 1987.

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[1] George S. Brown: Commander, Air Force Systems Command
[2] John C. Meyer: Commander in Chief, Strategic Air Command

With the maturing and miniaturization of applicable technologies as seen in the 1980s and 1990s, interest in UAVs grew within the higher echelons of the U.S. military. In the 1990s, the U.S. DOD gave a contract to AAI Corporation along with Israeli company Malat. The U.S. Navy bought the AAI Pioneer UAV that was jointly developed by AAI and Malat. Many of these Pioneer and newly developed U.S. UAVs were used in the 1991 Gulf War. UAVs were seen to offer the possibility of cheaper, more capable fighting machines that could be used without risk to aircrews. Initial generations were primarily surveillance aircraft, but some were armed, such as the General Atomics MQ-1 Predator, which used AGM-114 Hellfire air-to-ground missiles.

As of 2012, the USAF employed 7,494 UAVs - almost one in three USAF aircraft. The Central Intelligence Agency has also operated UAVs.

In 2013, it was reported that UAVs were used by at least 50 countries, several of which made their own: for example, Iran, Israel, and China.

## What are drones??

Unmanned Aerial Vehicles (UAVs),commonly known as "drones" drone and also referred to as a remotely piloted aircraft (RPA) by the International Civil Aviation Organization (ICAO), is an aircraft without a human pilot aboard. Its flight is controlled either autonomously by onboard computers or by the remote control of a pilot on the ground or in another vehicle. ICAO classify unmanned aircraft into two types under Circular 328 AN/190:

- Autonomous aircraft – currently considered unsuitable for regulation due to legal and liability issues.
- Remotely piloted aircraft – subject to civil regulation under ICAO and under the relevant national aviation authority.[3]

[3] https://en.wikipedia.org/wiki/Unmanned_aerial_vehicle

## Vulnerabilities

The current generation of UAVs suffer from a number of vulnerabilities like:

Don't sleep: if you're a military drone's operator, you must sit for up to 12 hour to keep attention for a scene where nothing important can happen for days on end. So, you can't keep awake.

The data link can go down:

The greatest vulnerability of the current generation of UAVs is their intelligence, or lack thereof.

"UAVs sometimes aren't that smart" says Bill Sweetman[4]"their self-diagnosis isn't that smart, and by the time they have a problem, it's so late. They lose data link, they lose power, and you're gone." When that happen, information (such as changes in direction, altitude, or even weather.) sent to the aircraft but the connection is lost so, it come back down to the operator.

The data link can go down because of a simple equipment malfunction, but it can be successfully jammed by enemies.

## What does make a drone smart??

Drones are flying vehicles, so, it's good to know how to land on and take off by itself "It isn't a particularly smart aircraft in its current instantiation" says Cummings "We've been able to take airplanes off and land themselves on the carrier for my entire career in the Navy.

To be called "smart", your drone must have good processing abilities and strong sensors for example:

[4] Bill Sweetman: Chief Editor for Defense Technology at the Aviation Week and Space Technology Group.

Capture a video and analyze in the same time as QR codes, shapes or movements.

You can even measure volumes and rebuild a space in the same time such as was done with MIT.

This upgrades require a powerful processor and sensors (like what I said) like:

Accelerometers, GPS and the ability to communicate over a 3GB/4GB network from time to time. Also, I'd like to be light weight, easy to program and equipped with a good battery.[5]

# Chapter 2: What do you know about your new drone??

## What do you need to know before flying a drone??

You are a new drone owner, here you'll find some things you should know before taking it to skies. If you're flying in the wrong place at the wrong time, or threats someone's life, you'll face the law and put yourself in troubles.

So, you'll supposed to know:

### 1.1 How high and far can you fly a drone?

If you're flying a UAV in United State Airspace, you'll be governed by Federal Aviation Administration's rules. You can't fly your craft more than 400 meters above the ground, must keep it within sight, and shouldn't drive it within 5 miles of an airport without notification the aircraft control tower.

How far can you fly is going to be limited by the space you're flying in and line of sight, because you may lose datalink or can't see anything (the camera can't take a wide photo for everything around your drone) and crash you drone or hurt someone.

### 1.2 Where can't I fly my drone?

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[5] [5] The Mill: Lexus "Swarm" Behind The Scenes: http://vimeo.com/78549177

Autonomous Robotic Plane Flies Indoors at MIT:
http://www.youtube.com/watch?v=kYs215TgI7c

http://intel-software-academic-program.com/pages/courses#drones

You can't fly your drone where do you want, because some places you need a permission to fly it without get in troubles. And you should know the area, it will be easier, clearly you can't drive it through narrow corridors. Finally, it's better to operate it in low and areas.

### 1.3 Sometimes it's just not a good day to fly

When you get your new drone, and you want to fly it, if the weather isn't ideal, you'll crash your new drone. Because drones are light and can't fight the wind, so you should choose good conditions without wind to have fun with your UAV.

### 1.4 Want to get paid?? You'll need a permit.

If you want to use your drone for filming or take photos for an area to make some studies about it, first, you'll need a permission and pay money or you'll end up with troubles.[6]

## How drones are controlled??

Seven models of military drones are involved in the great majority of crashes. Losing data link between the drone and the ground-control station is prevalent cause catastrophic failure. Most drones can operate autonomously for a large amount of time but if contact isn't recovered, they will crash after spending their fuel.[7]

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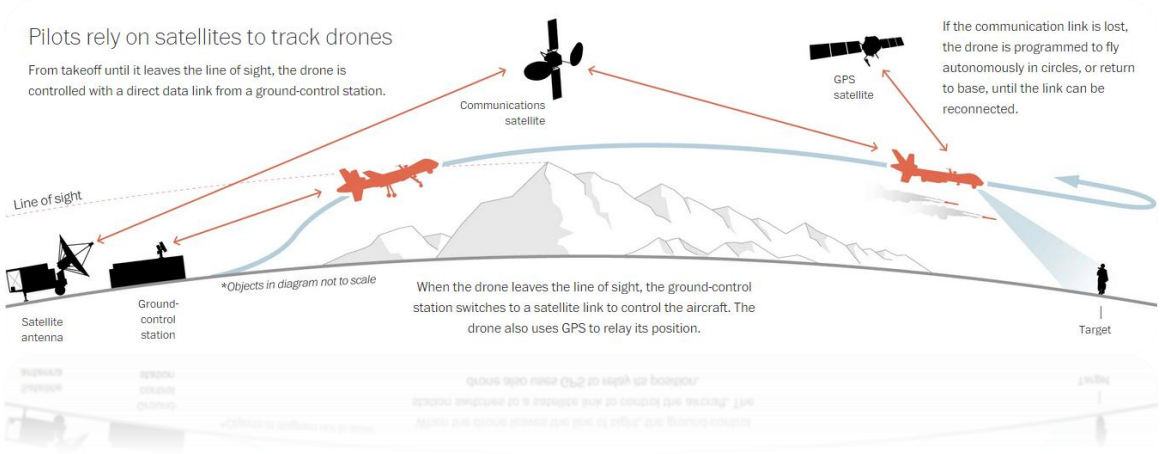
[6] http://www.howtogeek.com/213159/what-you-need-to-know-before-flying-a-drone/

[7] http://www.washingtonpost.com/wp-srv/special/national/drone-crashes/how-drones-work/




## 5 steps to build your own drone

1. Age-old Aviation question: speed or loiter capability??

   I chose a multi-rotor aircraft over a fixed-wing or helicopter because I wanted to be able to get a static view. Multi-rotor aircraft are also fast, very stable, and able to launch vertically in the tightest of confines-even inside a room and out a window.

   Multi-rotors typically use anything from three motor-propeller assemblies to eight, mounted at the end of arms that are centrally interconnected. I chose the "Y6" configuration, composed of three motor-mount arms with two co-axially mounted motor-propeller assemblies at the end of each arm. With two motors per thrust point (one facing up as a “tractor,” and one down as a “pusher”), the Y6 has redundancy. Because it has only three arms, it gives a mounted camera a wide field of view. I needed the UAV to be as small and stable as possible. Smaller fixed-wing UAVs often fly “squirrelly” but that’s not true of a well-designed Y6, with its multiple points of thrust stabilized by a high performance flight control computer.

2. Better be brainy…

   Multi-rotors fly with remarkable speed and stability because they have a number of points of thrust, not just one. Each works against and with other thrust points-and with and against gravity-to move the craft along three axes, and, if needed, hold it steady in on position.

A multi-rotor pitches, rolls, yaws, and hovers by varying the speed of its motors (each connected to a fixed-pitch propeller) individually, which varies thrust (for pitching and rolling) and torque (for yawing). This type of aircraft, however, is inherently unstable unless "balanced" by a very powerful flight control computer, one that can analyze aircraft attitude and position, then provide control inputs (as motor speed rate changes) orders of magnitude faster than a human's ability. Think of trying to balance a baseball atop the tip of a pencil: You're not really "balancing" it, but constantly moving the pencil under the baseball in a dance with gravity to get a few brief moments of relative stability. But most people don't have the eye-hand coordination for such a feat. Similarly, until recently, sensors and computers simply couldn't work fast enough to use multiple thrust points to control a small aerial vehicle.

We can use multi-axis gyroscopes for spatial orientation and accelerometers to measure change in velocity to guide multi-rotor and other types of aircraft, and micro-electromechanical magnetometers for navigation, and pressure sensors (barometers) for altitude determination.

The Hoverfly PRO control module uses 16 parallel processors in its flight control computer to analyze thousands of inputs per second from the onboard three-axis gyroscope, three-axis accelerometer, and digital pressure sensor.

The controller, a printed circuit board that measures just 2.75 by 2.75 inches by 0.5 inch high, takes flight control inputs from a digital receiver (taking commands from a user-controlled transmitter on the ground) and tells the Kestrel to go, stop, and hover.

The board commands the camera to pivot up and down, and side to side, has an altitude-hold function, and overlays vital flight data on live video fed to a ground station—if a video transmission system is mounted to the craft.

You need GPS control unit, which, when mated to the PRO board, adds three-dimensional position hold, automatic return-to-home, and waypoint navigation.

3. Flight component, power and remote control

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| SOURCE | COMPONENT |
|---|---|
| **Graves RC** | Six "Cheetah" 2212-13 brushless outrunner electric motors. |
| **APC Propellers** | Six propellers (and two spares). |
| **HobbyKing** | Since each motor requires an electronic speed controller (ESC), which converts direct current from a battery pack to three-phase electric power to drive the brushless motor, I bought six 25-amp Turnigy Plush ESCs and a spare; two 5-amp/1-hour and two 6-amp/1-hour lithium polymer lightweight battery packs and battery charger; 16 AWG thin-strand, high-conductivity flexible copper wire; gold-plated bullet connectors, power connection plugs, and shrink tubing. |
| **JR Radios** | A 2.4-gigahertz digital spread spectrum X9503 9-channel transmitter with an R921 receiver, with a main and redundant secondary antenna. |
| **Servowires.com** | When I worked on the UAV with the flight control receiver mounted next to the HoverflyPRO board, I had very limited space, so I couldn't use standard-size connection wires between the two. I had two-inch, three-strand interconnect wires custom-made. |
| **DPCAV** | Because so much power would be surging through the wires, circuits, and components, and because even a single short or brownout for a fraction of a second can cause a multi-rotor to crash, I bought an "L-C Type" power supply filter. |
| **HobbyTown USA** | Two three-strand servo wires for power connections. |
| **Radio Shack** | A soldering iron, soldering iron station with "hands free" alligator clips, and high-conductivity silver-core solder. |

4. Onboard camera and imagery transmitter/receiver system

| SOURCE | COMPONENT |
|---|---|
| **ReadyMadeRC** | A GoPro high-definition camera around which I was building the entire system, and a 1.5-watt, 900-megahertz video transmitter and antenna, a ground receiver, an external antenna for the ground receiver, and an adapter cord to run from the GoPro Hero camera to the video transmitter. (While the GoPro will record high-definition video to its onboard flash memory card, the video transmitted will be lower resolution due to limited bandwidth of the transmitter.) |
| **New Generation Hobbies** | A kit for a two-axis (tilt and roll) gimbal mount for the GoPro, and two HiTec "Mighty Feather" digital servos to be controlled by the HoverflyPro to keep a stable image and allow for remote tilting of the camera. |
| **Local electronics store** | I also bought a portable seven-inch LCD compact television—for a video monitor—from a local electronics store. |
| **FCC** | Before I could legally even turn the video transmission system on, however, I needed an FCC hand-held amateur radio operator's license. After a 16-hour cram session and a small fee, I received my Amateur Radio Service Technician Class license, call sign KD0NFV. |

5. Designing, engineering and constructing the UAV with a little help from friends…

I could have simply mounted all of the components on a pre-built hobbyist multi-rotor body, but I wanted the final aircraft to be as light and small as possible, very strong, built specifically around my components, and have no parts such as wires or electronic speed controllers (ESCs) dangling in the open. With the dimensions of all of the components, I used illustration software to sketch out the smallest craft possible.

For construction material, I chose carbon fiber because it's extremely light and strong, although notoriously difficult to cut, and it's an electrical conductor, so I could not have any exposed wires. Carbon fiber is also excellent at dampening vibrations, important for any flight controller, as vibrations can affect the performance of the accelerometer and gyroscope. Then the hard part come: I had to engineer each individual piece of the UAV body, so I use an older version of Turbo CAD cause I had no experience in engineering or computer-aided design, Using exact dimensions of the Hover fly PRO controller, ESCs, motors.

Virtually constructing the body of the craft with Turbo CAD, I was able to include folding-forward arms for ease of transport, perfectly align all holes for screws (I wanted everything to be connected mechanically, with no glued parts), and gain a sense of how it would balance with all components mounted-vital for multi-rotors.

With the parts engineered, I needed them milled from the pieces of carbon fiber stock. This turned out to be much more difficult than I imagined. Few machine shops work with carbon fiber. So it was difficult to get help, but I found Jason Sauer of Pinnacle Machining in Fort Collins, Colorado, who agreed to help me.

There is no universal file format for CAD; Sauer was able to redraw the Turbo CAD files for the simple parts by hand, but for the more complex pieces, I had to figure out how to convert the files.

Stymied, I put an advertisement on Craigslist, and within 30 minutes heard from Tom Hanson, (a machinist-turned-engineer who has his own firm, Hardware Collaborative). He was intrigued by my project (he often donates his time to educational engineering projects), and converted the files in minutes.

With the files completed, Sauer cut all of the parts (to a 0.0001-inch tolerance) on his three-axis Haas computer numerical-control milling machine.

Then, I bought an assortment of black anodized hex cap screws from C.D Fasteners, and very-hard-to-find black anodized aluminum locking nuts from Fastener Express.

Thanks to Sauer's skill, the pieces of the craft fit together perfectly. Carefully cutting, soldering, and shrink-tubing (to insulate and protect the soldered wires and connectors), I finished the construction of the kestrel-6.[8]

[8] http://www.airspacemag.com/flight-today/build-your-own-drone-18095141

## Chapter 3: Drones replacing pilots

Nowadays, the technology advancement can facilitate our lives more and more. As an outcome of such advancement, drones we can do many things such fighting, filmmaking and rescue. As drones are flying robots, they can replace pilots and saving lives. Let's discuss this thing.

Drones are planes remotely controlled by human from earth, and they are smaller than planes. So, you'll need more money to mix between both of them because, you'll use more sensors and cameras to balance your drone.

In a dangerous situation, I prefer a pilot, because drones don't have the ability to control themselves and deal with it, but a pilot can save the situation in the needed time. Moreover, you may lose the datalink with your drone and kill a lot of souls by a technical mistake, and you may have a problem in hardware or software because you should make the drone bigger to transport people from one place to another.

More important, any expert can steal your aircraft, if he determined to do so.

That is he can hack your drone by controlling your datalink and disabling the connection between the main operator and his drone. So, the hacker can do whatever he want with the drone such as kidnapping and fighting. If the drone is an airplane transporting passengers, then the hacker can kidnap them and cause the operator a lot of troubles.

As a conclusion, pilots are better than drones to complete a mission or travel from place to another saving lives whenever it is possible

## Chapter 4: How can we use drones in our life??

### Uses

- Commercial Aerial Surveillance

  Aerial surveillance of large areas is made possible with low-cost UAV systems. Surveillance applications include livestock monitoring, wildfire mapping, pipeline security, road patrol and antipiracy. The

trend for the use of UAV technology in commercial aerial surveillance is expanding rapidly with increased development of automated object detection approaches.

- Commercial and motion picture filmmaking

  Use of UAVs for filmmaking is generally easier on large private lots or in rural and exurban areas with fewer space concerns. In certain localities such as Los Angeles and New York, authorities have actively interceded to shut down drone filmmaking efforts due to concerns driven by safety or terrorism.

  In June 2014, the FAA said it had received a petition from the Motion Picture Association of America seeking approval for the use of drones in video and filmmaking. Seven companies behind the petition argued that low-cost drones could be used for shots that would otherwise require a helicopter or a manned aircraft, which would reduce costs. Drones are already used by movie makers and media in other parts of the world.

  Drones were used in the 2014 Winter Olympics in Sochi for filming skiing and snowboarding events. Some advantages of using unmanned aerial vehicles in sports are that they allow video to get closer to the athletes, and they are more flexible than cable-suspended camera systems.

  In the United States, Falkor Systems has targeted extreme sports photography and video for drone use, focusing on skiing and base-jumping activities.
  Additionally, all images collected are subject to the Data Protection Act as it applies to their collection, storage, and use for commercial purposes. Drone photography laws are still in a state of flux, so these rules could change in the future.

- Journalism

  Some journalists in the United States are interested in using drones for newsgathering. The Professional Society of Drone Journalists was established in 2011 and describes itself as "the first international organization dedicated to establishing the ethical, educational, and technological framework for the emerging field of drone

journalism." Drones have been especially useful in covering disasters such as typhoons. A coalition of 11 news organizations is working with the Mid-Atlantic Aviation Partnership at Virginia Tech on how reporters could use unmanned aircraft to gather news.
Some universities have made the drone journalism lab like the University of Nebraska-Lincoln and the University of Missouri has created the Missouri Drone journalism program.

- Demining

  The Space Assets for Demining Assistance program from the European Space Agency aims to improve the socioeconomic impact of land release activities in mine action. It is developing and has tested UAV technology for demining in Bosnia-Herzegovina.

- Search and Rescue

  UAVs were used in search and rescue after a hurricanes struck, Louisiana and Texas in 2008. Predators, operating between 18000 and 29000 feet above sea level, performed search, rescue and damage assessment. There were an optical sensor and a synthetic aperture radar. And it could send images through clouds, rain or fog and in daytime or nighttime conditions. Photos taken before and after the storm are compared, and a computer highlights areas of damage. Micro UAVs, such as the Aeryon Scout, have been used to perform search and rescue activities on a smaller scale, such as the search for missing persons.

We can use drones in other ways such as Wars, Reconnaissance, Animal Rights, Scientific Researches and Law Enforcements.[9]

## Conclusion:

Unmanned Aerial Vehicle have vulnerabilities and strong points, but, if you know how to use it, you can forget about its vulnerabilities.

Drones can't replace pilots in any situation because pilots are better than them in saving lives and dealing with dangerous situations and there are a lot of problems that drones are facing.

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[9] https://en.wikipedia.org/wiki/Unmanned_aerial_vehicle

## Thanks:

First of all, thanks for national center for distinguished and Ms. Hiba for supervising and helping me in this research, and I won't forget my friends who helped me.

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