



To what extent is the use of drones ethical?

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Abstract

At the time of their invention, drones were categorized as unreliable technology. However, one cannot deny that they have since come a remarkably long way. Drones are now machines that are vastly capable, and ones that once built and programmed, require minimal to no human effort to operate. This research paper focuses on how these flying machines have and still are changing the world to what many believe is a better one. Granted drones function for the human population's convenience, entertainment, and in extreme cases, for saving their lives. It should still be mentioned that the ethicality of drones is a topic that is fragile and sensitive, to say the least. They have been at the center of numerous controversies, being we'll to drop bombs, shoot people, and spy. Some think they save lives; some think they take them away. This paper weighs both sides of the story to understand the ethicality of drones.

Keywords: Drones, Ethics, Military use

Introduction

Have you ever thought about what you couldn't do with a drone? Let's consider that you wanted to take a nice photograph or video from the air. A drone would be your go-to. What about having a nice t-shirt delivered to your literal doorstep in a matter of minutes? A drone could do that too. With the technology available today, a drone could fulfil any purpose under the sun in an efficient way with unmatched precision. This invention is already well into changing the modern world with its limitless applications.

As of May 2022, the FAA has registered nearly 900,000 drones in the USA alone, with almost 40% of these being for commercial operation (Satell, 2022). These may include delivery services, agriculture, weather monitoring and many more. However, these flying machines also have a scary side. Drones have an unfortunate history of being used for targeted killings and smuggling weapons across borders. They have also gained a bad reputation by being misused to spy on people.

But what are drones? By definition, a drone is a remotely piloted or autonomous vehicle designed for use in the air. They have many complex electronic components and specialized parts to aid them in their specific purposes. For example, a drone to be used for mapping may be equipped with both RGB and thermal cameras, a GPS module, and LiDAR sensors (heliguy, 2021). Drones also look very different depending on their purposes. For example, a standard photography and videography drone looks like a quadcopter, not too large or made of particularly fancy materials. However, a military drone like the MQ-9 Reaper looks like a futuristic aircraft with far bigger dimensions and is adorned with various deadly weapons and reconnaissance equipment. Starting out as little more than unmanned balloons in the latter half of the 18th century, drones have evidently come a long way since then.

This paper will discuss the ethicality of drones and thoroughly examine how they work and what their possible applications are. The subject of their possible applications is a particularly sensitive and controversial one due to a drone's wide applications. After all, they can be used for both saving and taking lives. Considering all the aforementioned points in their entirety will help answer the research question, "To what extent is the use of drones ethical?"

The design and engineering of drones

To help answer the research question, it is necessary to learn the design and engineering that goes into the making of a drone. This will help in gaining a better understanding of the topic and establish a drone's limits so that all their prospective uses can be determined.

The process of creating any piece of machinery always starts with its basic design. Drones are no different. The basic design of a drone depends on what type of drone it is. The three types of drones that currently exist are multi-rotor drones, fixed-wing drones, and single-rotor drones. A fourth type, fixed-wing hybrid drones are still under development (Rennie, 2016).



Image 1: Multi-rotor drones (Yinka-Banjo and Ajayi, 2019)

Multi-rotor drones are the most common and cost-effective type of drones, usually made of plastic and aluminum. They can have anywhere between three and eight rotors, if not more, each coming off of an arm extending from the main body of the drone (as seen in Image 1). The body contains essentially all the components of the drone apart from the motors. Meanwhile, the rotors are essentially fixed-pitch blades that spin to generate lift. The more rotors a drone has,

the more thrust it will be able to generate, enabling a drone with more rotors to carry a higher payload. Other than making the drone hover or descend, the speed of these rotors can also be adjusted so that the thrust generated can

overcome other forces acting against the drone and make it ascend. Furthermore, the speed of each rotor can also be adjusted individually to make the drone turn or tilt. In essence, this is also how multi-rotor drones move on a horizontal axis; by tilting in the direction that it wants to move in. A multi-rotor drone flies by receiving signals from its remote control. The signals are received by the central flight controller, which in turn sends the information contained within the signal to the electronic speed controllers (ESCs) of each motor to increase or decrease its speed. The difference in the speeds of the motors causes the same difference in speed in the rotors, which allows the drone to move or hover. A drone also contains gyroscopes, which monitor the drone's attitude, allowing it to remain stable (Corrigan, 2020).



Image 2: Fixed-wing drones (Dodson, 2022)

Fixed-wing drones look very similar to airplanes, with one rigid wing generating lift (as seen in Image 2). It does this by having a higher surface area on the top of the wing than the bottom causing air to flow faster over the top of the wing than the bottom, creating low pressure above the wing and high pressure below it. This difference in air pressure essentially sucks the wing up and takes the drone with it. Therefore, these drones only need energy from an engine or propeller powered by fuel or a battery to move the drone forward and lift it into the air. Their design allows them to glide with no power whatsoever, which, combined with their ultra-lightweight carbon fibre bodies makes them extremely energy-efficient machines. Thus, some fixed-wing drones can stay aloft for up to 16 hours. They can even fly at much higher altitudes and carry more weight than all other types of drones. Despite all their advantages, fixed-wing drones do have a lot of disadvantages. Since they are always moving forward to stay in the air, they cannot hover without additional thrusters. They also need a runway to take off and land and are very expensive. Therefore, they are nowhere near as versatile as multi-rotor drones (The Corona Wire, 2022a).



Image 3: Single-rotor drones (Uyanik and Wesley, 2019)

Single-rotor drones closely resemble helicopters, with just one rotor responsible for generating lift, and another small tail rotor to control its direction and horizontal rotation, acting as an anti-torque device (as seen in Image 3). The large rotor generates lift by spinning at a high speed, forcing air downwards and creating a pressure difference that sucks the drone upwards. However, the main spinning rotor also creates a torque which can cause the whole drone to spin, which is why the smaller rotor is also needed. The horizontal movement of the drone is controlled by altering the

angle of the main rotor (The Corona Wire, 2022b). Single-rotor drones are built to be powerful and durable, often used to carry heavy payloads such as LiDAR sensors. However, they are extremely complex machines due to the inherent instability caused by the presence of just one rotor. Therefore, they are expensive and require a lot of maintenance, while being hard to fly and prone to vibrations.

Fixed-wing hybrid drones are still under development. The idea is to have the best of both worlds; a machine capable of hovering and taking off/landing vertically, as well as achieving the efficiency and speed of fixed-wing drones (Rennie, 2016).

The application and uses of drones

The earliest recorded usage of 'drones' dates back to 1849, when the Austrian military laid siege to Venice. These 'drones' were merely balloons equipped with bombs that would be dropped from them once a time fuse ran out. They would, however, be more aptly classified as unmanned aerial vehicles since they were not remotely piloted or even pre-programmed to carry out a task. Such technology did not exist at the time.

The first recorded use of proper unmanned aircraft, drones in their classic definition, was during World War I. The first drone was developed by English engineer and physicist Archibald Montgomery Low in 1917, working with Geoffrey de Havilland to create the monoplane. On the basis of this, drones such as the Hewitt-Sperry Automatic Airplane and the Kettering Bug, essentially flying torpedoes, were developed and used for the rest of the war. Between World War I and II, drones were further developed and used for a plethora of military purposes, from flying bombs to being used for unmanned munitions deliveries.

During the Cold War, drones were used for reconnaissance for the first time. The American Aerojet-General SD-2 Overseer was conceived in the late 1950s but never saw operational service due to a poor navigation system. Other reconnaissance drones such as the Ryan Model 147 and Lockheed D-21 were also developed during this time (Goebel, 2012).

Drones continued to be used and still are used for military purposes, from combat to reconnaissance to many others that did not make it past the conceptual stage. The commercial use of drones started in 2006 and is now used in various different fields. These include agriculture, cartography, engineering, drone delivery, search and rescue and entertainment amongst others (Outsource2India, 2022). Drones have a vast number of prospective uses, limited only by the user's imagination.

In agriculture, drones are used for a variety of different tasks. Specialized drones are used to spray fertilizers and insecticides on the crops aurally to keep them healthy and well-nourished, as well as to keep harmful insects away. Drones equipped with lasers, sensors and tanks are also used in the seeding process, usually mapping the area

at first to determine the best places and appropriate spaces which should be given between each plant, and then dropping the seeds aurally. This technique is also used to plant large numbers of trees in short amounts of time in environmental conservation efforts. They can also be used to monitor soil health. Specialized drones with on-board high-resolution cameras and sensors can also be used to survey the fields and single out unhealthy crops along with lending advice on how to boost their health (GeoPard Agriculture, 2022).

Drones equipped with LiDAR and cameras are used in mapping and cartography to create 3-D models of areas and get aerial shots, which can be uploaded as new data to be used for various different purposes including urban planning. This is also how they tie into engineering, with civil engineering being the field where they are especially handy. Drone mapping is used to understand the topography of any given piece of land, so that engineers can come up with an accurate design for a structure, such as a bridge or building, and know how much work needs to be done pre-construction, such as levelling the land.

Drones are also now used for delivery, usually consisting of powerful and stable specialized drones that can take a payload, usually packed in an attached box. Some multi-billion-dollar companies such as Amazon have already adopted it as a technique to deliver their products. Start-ups such as Swoop Aero (Swoop Aero, 2022) and Matternet (Matternet, 2022) have taken this one step further by implementing it to deliver medicines to remote parts of the world, or even congested city centers in small amounts of time (Outsource2India, 2022).

Drones equipped with both regular and thermal cameras are also used in search and rescue missions by many agencies around the world. They are a logical choice for the job, since they are light, fast, agile, and most importantly, unmanned. They help rescue personnel quickly locate those who need help and guide them out, or alert teams to their location so they can be rescued (Altigator, 2014).

Lastly, drones are also now being used to create aerial light shows. Fleets consisting of hundreds of drones equipped with really bright LED lights are made to hover in the air, with their lights being programmed to display many different patterns, messages, and animations. Drones were recently used in this way for the Queen of England's Platinum Jubilee in 2022, programmed to show her beloved corgi dogs along with several other images (Skymagic, 2022).

A thorough evaluation of drones

Now that the uses of drones have been discussed, the crux of this paper boils down to the ethicality of using drones. Drones are an immensely powerful piece of technology that can save and take lives, but this stark moral contrast between their capabilities raises the question - is the use of drones ethical?

As has been covered in this paper, drones have many uses that a lot would consider to be ethical. Such uses include the ones that save lives. Drone delivery is an extremely ethical use of this incredible machine. It can quickly deliver medicines and potentially even deliver human organs in short amounts of time, to remote places, in a way that may even be more eco-friendly. Even when they are not saving lives, drones are ethical due to the convenience factor that they play in delivery due to the short amount of time that they take to get packages to those who need them. Furthermore, with regard to the matter of saving lives, drones are also used in search and rescue missions. They are swift and nimble, and when equipped with thermal cameras they can quickly find trapped or stranded people.

Drones are also ethical in agriculture, as they reduce the amount of human labor required in the process of cultivating crops. They can perform tasks such as spraying insecticides, one that can potentially be harmful to farmers if they inhale or ingest the toxic chemicals. Therefore, they are an amazing alternative to manual labor, which can be exploited in a way that start-ups such as DroneSeed have. DroneSeed uses drones to plant large numbers of trees in short amounts of time, an extremely ethical use of the drone's versatile capabilities (DroneSeed, 2022).

However, the unethicity of using drones comes in when they are weaponized and misused. They are used in wars by many countries around the world, killing many on the battlefield and sometimes even carrying out targeted assassinations. They are even used as mobile aerial platforms to launch and drop bombs that often injure innocent civilians. These are all extremely unethical uses of drones (Callamard, 2020).

Most recently, drones have been used in the Russo-Ukrainian conflict, mostly in Eastern Ukraine, where drones such as the Switchblade are being used as missiles, to launch missiles, and to carry out surveillance and gather intel. Although they are being used by Ukraine, the country defending itself, it still is an unethical use since it is, after all, being used in a war to hurt others in hopes to push them into a retreat (Fuchs, 2022).

Drones have also been used in the process of smuggling, being used to smuggle illegal goods such as drugs and weaponry, including fully automatic guns and IEDs, across sovereign international borders. Such uses are also unethical since they promote violence and terrorism. Incidents like these have happened in India, on the border with Pakistan (Rana, 2022).

The reason most people consider using drones unethical is the invasion of privacy they can create when used by common people of the world. They have been used to spy on people and stalk them in various instances, which is not only illegal but also morally wrong (Dark Reading, 2022). Drones are an incredible tool, but an equally terrible weapon, which is why their use should be regulated through licensing in a way similar to that of legally owning firearms.

Conclusion

Drones have had a vast variety of recorded uses since their invention, many of which are widely considered to be unethical. However, the modern world is already rapidly changing due to the applications of this invention. First invented in the midst of the First World War in 1917, drones were little more than remote-controlled missiles used solely for military purposes. Since then, drones themselves and their uses have come a long way. Depending on the type of drone, they can carry out a multitude of tasks, which include military tasks such as spying and bombing, but also more ethical tasks such as spraying fertilizers and pesticides, creating 3-D scans for urban planning, delivering parcels, medicines, and soon maybe even human organs, creating giant aerial light shows, and even being used in search and rescue missions to swiftly locate those in need of help. Of course, the military uses are why drones seem unethical to use. However, they are not solely responsible for drones' bad reputation. Drones, under private ownership, have been used to spy on people. They have also been used to smuggle drugs and weapons across international borders. If the usage of drones can be controlled, and we can prevent these machines from falling into the wrong hands, the pros of using drones far outweigh the cons. They can easily be the key to the utopian society one can only just dream of. Drones, when properly applied, have uses that can be extremely beneficial to society, and thus it can be said that the use of drones is ethical to a large extent.

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