Analyzation of Autonomous Aerial Vehicles and Computational Method Analysis

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis Related Assignments

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Introduction:

In an era defined by technological transformation and artificial intelligence boasting, autonomous vehicles such as multirotor drones have revolutionized society. Drones were initially integrated for military usage with UAVs, missile launchers and rescue missions but have steadily gained attraction to the general public with the rise of the 21st century (Packer, 2013). In the modern world, drones can be used from delivering emergency medications and creating recovery hubs to taking on agriculture tasks (Ayamga, 2021). The idea is to essentially lower costs of human labor and achieve convenience, which has proven to be successful in most cases. In a recently developed journal article (Garcia, 2022), HCI was used to create perception glasses and VR sensors to support drone pilots with disabilities. Controllers were coded with Python and QT5 which were specialized based on the customer needs. Drones in this specific case were used as a therapy and a recovery tool for muscle training which is just one of the many applications that require attention. As a society, it is important that as unmanned aerial vehicles gain more traction, responsibility should be upheld from every direction. Despite all the benefits, how are drones being considered in an ethical security and privacy lens?

By analyzing the latest research and government regulations, the goal is to equip all stakeholders and general public with knowledge that may change the perspectives on how drones are truly impacting the world around us. If we are integrating drones into the same society that "WE" the people have formed ourselves, it is only right to know how these drones can breach the social contracts that have been created since the beginning of time. There are details behind each application in the drone world that have not been exposed fully. Experiments with drone potentiality are conducted every day in top university laboratories and private research facilities, but it is my job to help break down all details and cover the fullest extent.

Background and Significance:

In society, when we think about technology, our minds flash to the latest phone models, cutting-edge devices and streaming platforms. But what if there was something more transformative than the very screens we carry in our pockets? Imagine a swarming metropolis where unmanned drones are delivering packages, flying on medical missions or even acting as security mediums for large businesses. At first glance, the idea of revolutionizing urban lifestyles with drone technology seems extremely intriguing. With no-traffic delivery times and enhanced response curves, everything points at efficiency and convenience. Yet, lurking beneath the surface is a pool of ethical mishaps waiting to occur and privacy to be violated, which would end in immense chaos. For every good deed a drone is capable of conducting, hides a setback. Whether that setback be involved with air traffic congestion, collision or mechanical malfunction, the risks are too large. Moreover, since drones are versatile, their dangers can be as well which would mean someone needs to be held responsible.

Various actors such as company investors, technology innovators, and organizational heads have a large influence on the narrative of drones. The engineers and the technology groups are the ones developing new algorithms and motors in order to ensure efficient designs, but how safe can we really consider these new additions. Despite the intention to push boundaries and succeed in a marketing aspect, the general public is still at risk if policymakers do not involve ethical standpoints on how to regulate a drone. The setting for drone utilization can range from anywhere on public property and free airspace to the backyard of a private property owner, which makes the device ever more dangerous and invasive (Yang, 2022). Each user will have unique goals, whether that be for first response aid and military application or to breach data and pose a threat, implying that a nuanced discussion regarding their functionality needs to be held.

In order to understand how drones are counter-intuitive when it comes to ethical responsibility and safety, literature reviews and policy analysis studies are very salient. Evaluating existing regulations in multiple world regions will allow us to understand how drones are being facilitated in terms of international and private airspace.

Methodology:

Understanding this topic requires a mixed-research methodology where both qualitative and quantitative relations of drones are observed. Given the multidimensional framework of autonomous flight, there are several explanatory variables that can influence the significance of drones within our society. Each article and journal provided within the report is listing data collected through observational studies, legal reports and historical cases. This approach allows the user to understand how drones are affecting various segments of modern technology and ethical considerations. Providing data that reaches beyond percentages and graphs gives room for clear understanding and sympathy, which is always important when trying to consider the security and privacy aspects of drones. Societal impact was the main framework used to conduct research as it will accentuate which ways the government has failed while trying to develop regulations for public airspace. By emphasizing technological advancements, the goal is to inform stakeholders, the general public and officials to reassess airspace regulations and remodel the articles previously signed. Furthermore, applied research is used to provide a technical perspective on how drone signals and power frames can be interfered with for hacking and security breaches. Presenting applied research allows us to draw connections with the Actor-Network Theory as well. The research conducted on applied solutions and implementation

of software requires observation of humans and networks, which in this case will be technology. Ultimately, the goal of using these specific methodologies is to provide a nuanced understanding on how technology can impact civilians who don't consent to participate, specifically causing ethical mishaps.

Literature Review:

The unparalleled potential of drones has been largely considered through the lens of innovation and creativity for the past century. In 2010 after Haiti was struck with a level 7.1 magnitude earthquake, drones were utilized by Matternet to travel inaccessible areas to deliver medical supplies and emergency equipment for civilians to survive (Scott, 2017). Since the infrastructure of the cities were all destroyed and road access was limited, artificial intelligence took a powerful stand which changed the lives of hundreds. Furthermore, medical organizations and prominent healthcare models are also looking to integrate drones in their delivery services for rapid blood, vaccine and medication transportation (Scott, J., & Scott, C. 2017). Medical care has a potential to be delivered straight to people's doors instead of having to wait on pharmacy prescriptions. The preceding drone missions were aimed to benefit those in need by leveraging efficiency, but that is not always the case. The same drones that are able to change life for the good are then ones that can cause chaos when least expected. If a drone's tele-operational management system has latency or the turbulence system experiences unexpected winds and building crashes, the possibility for causing physical damage is very high for any human that is around the vicinity. Pilotless drones are prone to computational error which sometimes cannot be manually shifted, causing communication breach and navigation issues. These issues therefore lead to crashes which is an undesired outcome (Sandbrook, C. 2015).

In 2022, an unmanned Uber crashed into a cyclist, consequently applying manslaughter charges to the same individual who had been using AI in order to operate his vehicle. In another case, the same article discussed damages that a UAV had caused after a crash but the charges were not applied to a human, but rather claimed AI at fault. The regulations on AV control do not allow for specifications on how fault is distributed (Shirokova, E. S., & Fedulin, A. M. 2022). This shows that drones not only have the potential to cause physical damages and computing errors, but rather physiological harm.

Furthermore, drones have an ethical dilemma through the lens of business models. With companies such as Amazon and Uber who want to invest in efficient delivery services to lower manual labor costs, drones are the future. There are also conglomerates and firms who would invest in drones in order to increase profits and stock, which will eventually raise drone frequency. This might seem like a great margin for the economy to grow, but what about the blue collar workers who still need jobs? If drones continue to be mass produced and artificial intelligence is relied on, then thousands of jobs are on the line (Anne Hopkins, 2017 and Singireddy, 2018). The potential of drones in this case has a two sided debate since one leans towards economic progression and the other has the social implications of job loss. With the introduction of drones in such niche fields, there would also need to be consideration for the level they will be performing at in the case that navigation errors occur and consumers are unhappy (Anne Hopkins, 2017). Any drones entering in private airspace have disruptive potentials and combative lawsuits as seen in *United States vs Causby* and *Dobbs vs Wiggins* are eligible (Michelle , B. 2015). Overall, the significance of drones and their security aspect is very salient in order to understand how society can flow efficiently without being posed any threats.

Drones have a hand in hundreds of new fields across the globe, but the way we incorporate them is up to us.

When considering drones from an abstract perspective, their ability to create chaos roots in many forms of terrorism. Despite the ability to create “geo-fences” where each drone can be set up with predetermined flight paths for collision avoidance, public disturbance can be caused. to “Drones As A Permanent And Present Danger”, the lack of research has led to drone attacks in several regions of the West Balkans and the European Union. Perpetrators with malicious intent present a clear ethical dilemma in which they manipulate technology with diverse attack vectors and operating modulus (Ivanovic, 2020). Essentially, this article brings light to the fact that drones can be exploited to host acts of violence and threaten public airspace .

In a recent post made by the Spectator Index, a Twitter account run by doctor Abdul-Latif Halimi, Iran has launched dozens of air strike attacks against Israel, all using drone technology. By flying over the territory with ease and locking waypoints on a mission paneer, Iran was able to launch attacks against another country, demonstrating the potential of drones. Drone technology is very prominent in the political sector as well, since countries are able to adopt weaponized flight vehicles and keep them in their arsenal for war. This post highlights the duality that drones foster in both a civil and military community. Of course drones have the ability to revolutionize delivery and surveillance, but the extent available to the public must be re-examined. Drones can be regulated through minimized capability motors and weak GPS signals in restricted airspace to avoid attacks.

The FAA has mild regulations in place which accentuate that drone flight should be taking place in predominantly unpopulated areas, however their integration within civil airspace is far from accepted. Many authors argue that “manned flight for such tasks as pipeline

surveillance, traffic observation, fire-fighting, and filming require precariously low speeds and altitudes. Not surprisingly, they tend to have relatively high accident rates" (Matthews, Robert 2015). Drones in this scenario are thought to be replacement tools for high precision and fatality prevention for demanding tasks. The issue at hand is the vulnerability that heavy AI reliance causes for the public. Drones, similar to any technology, are at high risk of malfunction and misuse, which can only pose a danger in congested regions. Before thinking about the lives that will be saved and the money that will be pocketed rather than spent paying salaries, privacy rights and socioeconomic inequalities must be considered.

Results and Discussion:

The multifaceted implications of AI are analyzed through a wide array of sub-systems that include economics, healthcare, transportation and security ethics. Drones have demonstrated the unique ability to engage in humanitarian efforts while also being able to prioritize cost effectiveness, which evidently proves revolutionized technology. Being able to allocate resources for underserved villages and deliver medical supplies after natural disasters is a singular extent to which drones can benefit us. Unfortunately, the same way AI can help us come together in times of support, they can hurt the general public just as badly. Integrating drones in civil airspace with thousands of radars flashing everyday in the sky to indicate commercial flight, is only a call for disaster. Considering that autonomous vehicles are controlled by mission planners and telemetry modules for connection, the ability to crash after an error or signal interference is very high. Drones that are considered for use in urban areas have a higher potential to cause harm due to a denser population and more property that can be trespassed. Furthermore, the risks being posed to privacy are also at an all time high. With new developments of Optical Flow, LiDaR sensors and PixHawk power boards, data collection is becoming very efficient. While this may be

appealing to business models for self improving algorithms and profit boosts, the general public is at risk of infringement upon security and privacy. Drones are capable of recording footage, hacking into networks and picking up on data, which means weak networks can be exploited and abused by users who have malicious intent.

When trying to pitch a new business model or patented product, users are generally given the benefits of implementation and cost analysis, but what are the downsides of the situation? When observing drones from a socioeconomic perspective, it is quite clear that a large gap of inequity will be formed. Essential workers and simplistic tasks that are handled by manual labor will be replaced by AI as they can only be programmed to complete their designated assignment with a low margin of error. The traditional job patterns will become skewed and skilled labor will be demanded at a higher rate, requiring citizens who have lower educational levels to be placed at a disadvantage. In this world, a degree or large range of experience is required to showcase skills to a potential employer, but if jobs are constantly being replaced by computer technology, how much can we really benefit from AI before everything is on the decline.

Overall, drones have a large risk of security infringement, but their resourcefulness for disadvantaged communities and economic relief patterns cannot be ignored. The Federal Aviation Administration needs to develop regulations that will prevent malicious intent, but allow for drone usage in specified sectors. There needs to be limitations that will prevent flight paths from entering restricted airspace, trespassing private properties and recording footage, which is the first step to an optimistic integration. Collaboration between agencies, stakeholders and engineering societies will allow for a unique creation of regulations that will tackle drone exploitation from every angle. If the FAA can prevent security breaches while also allowing drones to be used in company models safely the economy will benefit and so will society.

Actor-Network Theory plays a significant role in the correct implementation of technology (Heeks, 2015). Drones are the actors that influence power dynamics and social relations embedded within our network. They have the ability to facilitate communication and shift the balance of the economy based on their production. In order to fully understand why ANT is important, we have to realize that drones and humans are in a hybrid relationship. With stakeholders and government officials who have final say over regulations, the level at which drones influence us can change. We as civilians have the ability to control drones and cause a pattern change in society.

After being equipped with the knowledge to understand how the technical aspect of the drone works, it is easy to understand why individual users can be considered threats. The power of behavior and choice causes outcomes to shift, whether it be inadvertent or not. Consider a scenario where a recreational drone user decides a flight path in restricted territory and thus violates privacy and causes public disturbance with the threat of endangerment. Of course this scenario can be deemed as “rare”, but in the potential that it arises, the user's decision can influence the outcome. In the case the user has malicious intent, drones need to be hardware designed to have an autonomous switch off based on the territory they are entering and the altitude they are reaching. This is the portion where the FAA needs to regulate the extent of the drones capability before being placed in a commercial market.

The Social Construction of Technology (SCOT) essentially implies that the autonomous framework we are using is shaped by social circumstances. Based on the values, needs and perspectives of the general public, technology is designed in a manner to be a convenience. When a new technology is initially developed, their beta and alpha modes are tested to pick up on errors based on survey responses. As the technologies are going through phases of remodeling

and changing algorithms, they are being tailored to fit the needs of the public, once again. This can be seen in drone models through military upgrades on UAVs and the commercial drones that are currently in the market. Moreover, SCOT accentuates the role of social groups and stakeholders in how drones are regulated and why the product is on an incline for sales.

Conclusion:

The rapid presence of drones has a security and privacy threat, but with cautious analysis, the FAA can influence the extent to which drones are being implemented. There are projects in this world such as the Facebook initiative to provide internet through drones that boast popularity, but that is not where the extent of drone impact ends. After conducting a risk analysis assessment, it is clear that the only way drones are able to safely operate within society are through secure regulations. Drones cannot be allowed to fly in restricted international airspace or trespass another's property. In order to assure that drone regulations are re-evaluated, public awareness initiatives must be carried out and articles must be published for consistent reminders. The more that the popularity of the subject spreads, the more it becomes an issue and required to be reviewed. The future research that will be conducted will test surveillance data and capabilities within drones, and how their modifications can cause an influence as well. The threats don't simply end when they are unable to fly over private property, they can still capture data with strong modem connections and record videos with 360 LiDAR sensors. The full capabilities of drones is yet to be fully explored and future research will allow us to fully understand how drones can be influencing our community.

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