

Unintentional Harms in Drone Food Delivery

The pandemic has led to a massive change in shopping behaviour and food consumption among consumers. Many food delivery companies are starting to provide “contactless” deliveries because of the potential infectious risks between couriers and customers. The drone delivery model comes in handy to solve social distancing problems. However, the technique is under development. We would discuss the unintentional harms in drone delivery activities that hinder the technology into the market, which is divided into three main areas: privacy, safety, and customer satisfaction.

The idea for the drone delivery service that we developed is similar to other drone delivery concepts. Our drones collect items from shops near the university, then send them to most of the outdoor locations at Bristo Square and George Square to our staff and students. The system accepts lunch orders from students in the morning and delivers them at lunchtime. Due to the limited capability of the drone, customers can only order up to four items each time from no more than two shops. There is a pre-determined list of delivery locations defined as three-word addresses, powered by Wha3Words [1], which is convenient for customers to type the textual address when placing their purchase.

An ethical examination reveals that the commercial uses of drones could result in severe privacy problems for individuals, due to the cameras equipped on the drones [3]. Drones with camera capabilities are capable of tracking citizens, collecting and storing specific information, and this data will be automatically synchronized to the company’s database. Generally speaking, data collection of information systems or services require customer consent to terms of use of the service, and they can choose not to use the products to avoid having their data collected. However, the drone system invades the privacy of people who do not specifically choose to use or buy the service [12]. Because drones must fly over their houses and collect data to proceed with delivery activities. Furthermore, drones can be remotely authorised by hackers to achieve specific surveillance tasks which expose people’s privacy. If companies are data breached or cyber-attacked, the consequences can be disastrous.

Apart from the privacy issues, drones, which are the critical component of the drone delivery system, are vulnerable to physical threats of being stolen, intentionally broken, or other forms of physical damage. Due to their size limitation, smaller drones are difficult to accommodate efficient safety mechanisms [4]. Another safety threat of drones is a collision between them, or with individuals and buildings. In our design, we have taken measures against these risks by setting up no-fly zones. However, the system is still not immune to potential weather-related crashes or injuries to people, which can be highly unethical. If the safety and stability of the drones are deficient, it will undoubtedly pose a severe threat to individual and property safety. To add, the failure rates of drones are directly proportional to costs, and companies are at high risk of facing unforeseen expenses.

And finally, customer satisfaction can also be unintentional harm from the company side. Compared to traditional delivery methods, the drone delivery mode seems to overcome ground transportation limitations and make the delivery process faster. However, any unexpected factors may prevent the delivery from being successful. Drones are fragile and lack the ability to resist strong airflow and wind. Under extreme weather, they tend to deviate from their flight paths and have difficulty maintaining balance, which may lead to spillage of meals or even crashes. Moreover, a study reveals that drones are “substantially more annoying” than vehicles in terms of noise pollution [5], which customers may be concerned about.

Some of the issues above arise from the privacy of the drones, which can be mitigated through appropriate technical measures [6]. For example, "DJI" integrates a "Local Data Mode" module into its platform, which means that their drones are not vulnerable to hacking and have no information such as photos, videos and recordings in restricted airspace [7]. Meanwhile, drone-based service providers must pledge accountability to safeguard against violating privacy issues. Relative laws and regulations must be constructed and assimilated into the company's internal policy. To address the privacy concerns above, developers are accountable for building products that are more trusted, and companies have an even greater responsibility to make the public feel trusted.

In terms of the safety of drones, we see work done in Ciarletta proposes that drones could equip built-in safety parachuting systems to minimise damage when a collision is unavoidable [8]. However, on a statistical level, the accident rate for drones is very

small. In some aspects, the safety of drones is linked to the acceptance of the public. What's needed for marketing efforts is focusing on creating positive consumer perceptions of the use of this technology. It is our responsibility to recognize the skewed perspective and harms to the public impacted by our products [9]. It's vital that we focus on both the technical side of security and the aspect of safety that depends on user understanding.

And for the ethical implications of customer satisfaction, as a commercial company, we are greatly concerned about both our market value and social value. As mentioned earlier, there is a need for more research to minimize the impact of drones as a noise source to society, for example constructing more silent or aerodynamics designs [10]. It's much more crucial to incorporate disciplines that naturally understand human behaviour since what we're generating and delivering has an impact on people. By bridging the gap between those who develop and deploy technology and those who are touched by it, we can better fit our technology to our individual and societal needs [11].

Drone delivery system is feasible, it breaks through the restrictions from the ground traffic and provides a more flexible and economical solution to the food delivery industry. How this technology will be implemented and whether it will bring convenience to human beings, is up to the responsibility and safeguards that we either participate in or don't.

Reference:

1. The What3Words system maps the earth's surface using $3\text{m} \times 3\text{m}$ tiles, each with a unique three-word address. Retrieved from: <https://what3words.com/>
2. "Legal and Ethical Concerns of Commercial Drone Use". *Workplace Ethics Advice*, 2021, <https://www.workplaceethicsadvice.com/2016/04/legal-and-ethical-concerns-of-commercial-using-drones.html>
3. Forbes, Stephen Rice, 2019. *Eyes in The Sky: The Public Has Privacy Concerns About Drones*. Retrieved from: <https://www.forbes.com/sites/stephenrice1/2019/02/04/eyes-in-the-sky-the-public-has-privacy-concerns-about-drones/?sh=4ac5c6276984>
4. Yaacoub, Jean-Paul et al. "Security analysis of drones systems: Attacks, limitations, and recommendations." *Internet of Things* vol. 11 (2020): 100218. doi:10.1016/j.iot.2020.100218
5. *Int. J. Environ. Res. Public Health* 2021, 18(11), 5940; *Drone Noise Emission Characteristics and Noise Effects on Humans—A Systematic Review*. Retrieved from: <https://doi.org/10.3390/ijerph18115940>
6. G.S. Ilgi and Y.K. Ever. 2020. *Critical analysis of security and privacy challenges for the Internet of drones: a survey*. Retrieved from: <https://doi.org/10.1016/B978-0-12-819972-5.00011-2>
7. Margaritoff, M. (2017). *Drone-maker DJI rolls out 'Local Data Mode' to address security concerns*. [online] The Drive. Retrieved from <https://www.thedrive.com/aerial/14823/drone-maker-dji-rolls-out-local-data-mode-to-address-security-concerns>
8. Laurent Ciarletta, Loic Fejoz, Adrien Guenard, and Nicolas Navet. 2016. *Development of a safe CPS component: The hybrid parachute, a remote termination add-on improving safety of UAS*. In *Embedded Real-Time Software and System*. Retrieved from: <https://orbilu.uni.lu/handle/10993/23406>
9. "Don't Ask If Artificial Intelligence Is Good or Fair, Ask How It Shifts Power". *Nature.Com*, 2021, <https://www.nature.com/articles/d41586-020-02003-2>.
10. *Int. J. Environ. Res. Public Health* 2021, 18(11), 5940; *Drone Noise Emission Characteristics and Noise Effects on Humans—A Systematic Review*. Retrieved from: <https://doi.org/10.3390/ijerph18115940>
11. David Ryan Polgar, *Responsible technology: how can the tech industry become more ethical?* <https://www.information-age.com/responsible-technology-how-can-the-tech-industry-become-more-ethical-123492514/>
12. James, Garforth. The University of Edinburgh, Professional Issues (Level 10) (2021-2022)[SEM1], Lecture: Responsibility
13. UK Civil Aviation Authority, 2007. *Flying in Towns and Cities*. Retrieved from: https://publicapps.caa.co.uk/docs/33/CAP2007_EU_Drone_Rules_Factsheet_V7%205.pdf