PROJECT PROPOSAL

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March 2022

# Introduction and Motivation

The crime rate in the UK has been growing steadily from 2013/14, reaching a peak of 6.08 million offences in 2019/20[[1]](#footnote-2). One in two women and one in seven men[[2]](#footnote-3) feel unsafe walking alone after dark in a quiet street near their home. In addition, studies have shown that on top of the increasing crime rate, around 60% of assaults go unreported due to lack of evidence or encouragement[[3]](#footnote-4). There is an emerging need for increased surveillance in high-risk areas, but what if this surveillance service could also result in crime prevention, and in the worst case, ensure a crime is both reported immediately and responded to?

Better-fly surveillance drones can offer an economic and an effective solution to address these concerns through a unique technological and social approach. Our company aims to provide a provisional 50 small drones, equipped with state-of-the-art crime detection and alert systems, as well as high-definition cameras and accurate location networks, as an extension of current law enforcement services for public use. A drone will accompany them home at the request of a civilian, via our developed app, with a view to making walking alone at night safer for everyone. We’ve decided to initiate our project locally in Croydon, knowing it is the most dangerous borough in London, with 31,894 crimes in 2021[[4]](#footnote-5) .

# State of the art and context

Our team conducted research in the field of surveillance drones to understand the market and the existing technologies. We discovered that many companies are currently providing drones for security and personal protection services. For example, Airvis[[5]](#footnote-6) is a private company that delivers drones for surveillance, for night patrols and other security implementations. Many features are offered with these drones such as thermal imaging and automatic charging. However, the limitations of existing products in this field are their high cost and the fact that they are only designed for organisational use. Better-fly builds on this by adding the abilities to communicate directly with police (sending live video and audio feed), create disturbances to scare off attackers and the ability to follow a person to create the complete security system needed for this context.

Currently the idea of a drone that can follow and record someone is daunting, and there are other public concerns including noise pollution and the general safety of drone usage. Today, the use of drones is restricted to certain parks in London and there is a lack of legislation for the authorisation of drones in public areas. This comes in line with the fact that the use of drones for public surveillance is only in its infancy, with most applications being for private use.

Our aim is to facilitate a paradigm shift, by combining current technologies to create not only a drone that can detect, alert and report, but also a reliable, ground-breaking safety service that will bring the start of a new age of drone usage.

# Novelty, Creativity and Paradigm Shift

Our drones are not only intended for public use, to aid with both law enforcement and personal safety, but they also possess unique features to actively discourage street crime. In particular, the use of state-of-the-art AI, thermal imaging, and sound detection in order to identify attacks, as well as an alarm system and technology to alert emergency services, allows for civilian protection to be held paramount, without the need for law enforcement personnel. The fact that our product is available upon request through a mobile app, with follow-on-demand software, and accessible as a service to the public, makes it both innovative and an imperative addition to the police force, without extortionate costs.

Noise pollution will be minimised through using large, slow rotors along with noise-reducing shrouds which, combined, can reduce the noise frequency by 12.5 dB[[6]](#footnote-7). Additionally, the drone frame will be made of polyester/carbon fibres to withstand the weather variation in London while having excellent mechanical properties.

In the 20th century, aerial vehicles became crucial for both military and private use. However, very few aerial vehicles are used in the public realm to ensure the safety of the populace. We must urge that the drones will only be dispatched at the request of the civilian, therefore guaranteeing the liberties and freedoms of everyone. It is also important to highlight that under the GDPR legislation[[7]](#footnote-8) (General Data Protection Regulation), the faces of civilians will be blurred in the event of footage release, as is the case with CCTV footage. In this way, the public can benefit from the service, without any violation of liberty, and the use of safety drones can become a commonplace part of nightlife.

The creativity and planning tool we used was a SWOT analysis, as seen in Figure 1.

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*Figure 1. SWOT analysis for the use of surveillance drones in public, highlighting the Strengths, Weaknesses, Opportunities and Threats associated with the project.*

# Implementation method and Project Plan

The drone frames will be made of carbon fibre, featuring a cover to protect against weather and collisions. The drone will feature a regular and a thermal camera allowing for operation in any visibility condition. The video feeds will be streamed live using two FPV (First Person View) systems, one digital higher-quality stream (810p,120 FPS with 10km range)[[8]](#footnote-9) and a backup analogue system which can operate with poor signal quality and higher 20km range[[9]](#footnote-10). If any critical components fail, a parachute will also deploy. The drone will be controlled with the Pixhawk autopilot[[10]](#footnote-11) which takes stability data from onboard sensors (e.g. gyroscope and accelerometer) while onboard GPS locates the drone in space. This information will be sent to ground stations which control the drone using GPS data from the user’s phone from a companion app which will be developed. Once authorized, the drone will follow the user at a set distance and height while focusing the camera on the subject. The drone will feature a siren which reaches a volume of 95 dB [[11]](#footnote-12) to draw attention to itself in the event of an attack. The drone has a 47-minute flight time[[12]](#footnote-13) until the battery has discharged by 80%, allowing it time to return to recharge point. The battery will be replaced by a technician to reduce turnaround time. The motor’s maximum thrust will be 4.7 kgf [[13]](#footnote-14), this value is greater than the drone’s weight 2.6 kg and close to the recommended thrust to weight ratio of 2:1 12. The AI system will use PyTorch, a machine learning framework, and the data analysis program Pandas to develop Convolutional Neural Networks (highly effective in image and sound recognition[[14]](#footnote-15)). The image recognition will be designed to detect weapons. The sound recognition system will identify specific words and cries for help. Both systems build on existing detection of similar objects[[15]](#footnote-16) and sounds[[16]](#footnote-17).

The risks pertaining to this project have been considered with a risk assessment, seen in Table 1.

*Table 1. Risk Register*

The main risks to avoid are the failure to meet the deadline in three years and the failure to meet the budget. To limit these risks both the budgeting and planning have accounted for major margins to ensure that the project still has the funds and the time to run over. The other major risk to acknowledge is public disapproval. A substantial advertisement campaign will be implemented to combat this, and to present Better-fly as a reliable, accessible, and trustworthy company.

The project will be broken up into 4 main components: aerodynamic design, structural design, AI, and software design, allowing us to produce and test prototypes in an iterative process, as shown by the PERT chart in Figure 2.

Timeline

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Figure 2. PERT chart showing project timeline and key project milestones.

# Cost and Governance Structure

The basis of estimates is conducted from work packages, the HR plan, the project schedule, the risk register, and SWOT analysis using a bottom-up approach. The work packages contain hardware, software, maintenance, general management, and media outreach. The direct hardware cost comes from drone components, shown in the pie chart in Figure 3, that account for a total of £1683.90 per drone. The total cost breakdown is shown in Figure 4.

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*Figure 3. Cost breakdown for drone components*

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*Figure 4. Total cost breakdown for the project.*

A direct and variable Research and Development (R&D) cost is set for developing the follow-on-demand software. Other direct recurring costs are also identified, including the salaries of the outreach and media team, customer service, and the technicians responsible for the maintenance of the drones. 10% of the project funding is allocated to risk maintenance.

Additional marginal costs, including the staff bonuses and the product testing costs, are accounted for, as well as an inflation rate of 3% each year.

The Croydon police department has 1 inspector, 21 constables, and 650 police officers, with salaries ranging between £22K - £81K. In addition, there are 4996 operating police cars[[17]](#footnote-18). The use of Better-fly drones can have a positive economic effect, in comparison to these conventional methods of law enforcement. By reducing the number of patrolling police cars, not needing to pay police salaries, and attracting more investments in an area with an improving safety level, Better-fly drones have many financial benefits.

The governance structure consists of a three-level hierarchy. The first level involves a project manager who is responsible for keeping track of progress and milestones, evaluating risks, and approving decisions. The engineering teams are placed on the second level and are responsible for aerodynamic and structural testing, producing control systems and software development. The third level involves the outreach and media team, customer service and technicians who are responsible for communications with the public and drone maintenance.

An Earned Value Management (EVM) approach will be used to control the spending during the project. Figure 5 shows the planned value as time progresses, denoted as the blue curve, with 10% margins of error. The vertical dashed lines identify the milestones. The actual spending can be later drawn in the graph to keep track of the budget.

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*Figure 5. The planned Cost vs. Time for the project*

# Wider impact and Societal importance

Brand visibility is imperative in convincing the public that the safety drone is a service that they can depend on and should take advantage of. The rapport of trust between the public and the brand is essential for both the success of the product, and the security of vulnerable members of society, which is the goal of the service. Thus, a 24-hour chat service will be made available for any questions or concerns about the service, and the app and service will be accessible to all and simple to use.

Concerning how our product will be pitched to the general public, it’s important that those who need the service the most are fully aware of how to access it. For this reason, there would be posters in nightclubs, pubs, bars, gyms, and other establishments which remain open until late at night. It is from these locations that members of the public may need to walk home alone, and a QR code to the app to request a drone, as a walking companion, could be provided on these flyers. In terms of advertising on social media, the best platform would be dating apps, as they facilitate meeting with strangers alone, and this is exactly the situation our brand hopes to make safer than it is at present.

The possible impact this product could have, not just in the London Borough of Croydon, but eventually across the UK and even internationally, is considerable. The current services available are limited by the lack of police personnel across the UK, and their ability to be anything more than a deterrent.

A recent social media post from the Croydon MPS[[18]](#footnote-19) telling women to ‘avoid’ walking alone at night demonstrates the market need for a product that can act as both a CCTV system, emergency services alert system and a deterrent.

We are Better-fly. We make the drone that walks you home and we will make sure to protect the citizens of your city.

1. Number of crime offences in England and Wales 2002-2021. https://tinyurl.com/cumb836m [Accessed 23/03/2022] [↑](#footnote-ref-2)
2. New data shows extent to which women feel unsafe at night. https://tinyurl.com/yhh3344a [Accessed 23/03/2022] [↑](#footnote-ref-3)
3. The Criminal Justice System: Statistics. https://tinyurl.com/ycxpk62r [Accessed 23/03/2022] [↑](#footnote-ref-4)
4. Croydon Crime Overview. https://tinyurl.com/2p97vc2w [Accessed 23/03/2022] [↑](#footnote-ref-5)
5. Drone Security at Night.  https://tinyurl.com/3x66nc34 [Accessed 15/02/22].   [↑](#footnote-ref-6)
6. Drone Noise https://tinyurl.com/y43ch5rt [Accessed 15/02/2022]. [↑](#footnote-ref-7)
7. How CCTV face blurring software delivers regulatory compliance for video footage. https://tinyurl.com/2p84mse5 [Accessed 08/03/2022]. [↑](#footnote-ref-8)
8. DJI. DJI FPV - Specs - DJI [Internet]. DJI Official. 2022 [cited 22 March 2022]. Available from: https://tinyurl.com/5479ctet [↑](#footnote-ref-9)
9. What is the range of a drone? [Internet]. FPV Frenzy. 2022 [cited 22 March 2022]. Available from: https://tinyurl.com/4jw7xmb2 [↑](#footnote-ref-10)
10. Basic Concepts | PX4 User Guide [Internet]. Docs.px4.io. 2022 [cited 22 March 2022]. Available from: https://tinyurl.com/4e7jfmte [↑](#footnote-ref-11)
11. Akozon. Intercom Buzzer [Internet]. Amazon. 2022 [cited 22 March 2022]. Available from: https://tinyurl.com/2p8uueyf [↑](#footnote-ref-12)
12. Drone Flight Time Calculator [Internet]. Omnicalculator.com. 2022 [cited 22 March 2022]. Available from: https://tinyurl.com/4wscumdb [↑](#footnote-ref-13)
13. Mirko FPV. T-MOTOR AIR40 2205 2450KV - MOTOR REVIEW & THRUST TEST [Internet]. 2022 [cited 22 March 2022]. Available fromhttps://tinyurl.com/49r5n4cy [↑](#footnote-ref-14)
14. Singh J. Audio and Image Features used for CNN [INTERNET].2018 Dec 20 [cited 22/03/2022]. Available from: https://tinyurl.com/mr3ffvfs [↑](#footnote-ref-15)
15. Dempsey M. The Hidden Detectors Looking for Guns and Knives [Internet].2020 June 12 [cited 22/03/2022]. Available from: https://tinyurl.com/rmd49epu [↑](#footnote-ref-16)
16. Sydorenko I. AI Sound Recognition: Can a Machine Listen and Hear [Internet].2021 Nov 27 [cited 22/03/2022]. Available from: https://tinyurl.com/y6xcsxhw [↑](#footnote-ref-17)
17. Inside Croydon. *Met Police’s Town Centre Team has started its new beat.* 06/12/ 2021. *https://tinyurl.com/mryhvuph*. [Accessed 19/03/2022]. [↑](#footnote-ref-18)
18. King J. Police force’s ‘outrageous’ post telling women to avoid walking at night. *METRO.*12/11/ 2021. <https://metro.co.uk/2021/11/12/police-forces-post-telling-women-to-avoid-walking-at-night-15589557/>. [Accessed 08/03/2022].  [↑](#footnote-ref-19)