IOT AND THE FLYING ANSWER TO COVID-19

Alexandru TĂBUȘCĂ[1]
Gabriel-Eugen GARAIS [2]

Abstract: *IoT devices, especially drones on which we focus here, have demonstrated during the COVID-19 crisis that they have the real potential to actual be now, and not in an uncertain more or less distant future, of a real huge help. From basic surveillance of urban or outdoor areas to deliveries of medical supplies, from spaying different disinfectant materials to remotely checking body temperatures, the drones showed that they could be much more than flimsy toys or paparazzi tools. The usage scenarios and real-live deployments have shown that the drones have a potential that undoubtedly will be tapped in the future for solving more and more issues. In the same time, we must not overlook the arguable concerns related to the possibility of using these devices for spying, controlling and other malevolent approaches.*

Keywords: *iot, drone, covid-19, internet human rights, remote sensors*

1. Introduction

During the current (still!) crisis emerged from the COVID-19 disease, that spread from China's mainland to encompass virtually the entire planet, the necessity to put all technology at the disposal of as many people as possible became a hugely important issue. Using high-tech gadgets and cutting-edge technology just to demonstrate different, possible, usages is not going to cut it anymore. The technology embracers must be able to show the there are also tangible usage, available here and now, able to really make a difference in the worst-case scenarios that humankind can endure. IoT devices had to show that they can do more than a hypothetic well-being increase by reminding us that we have an appointment at the massage parlour today, or that the coffee will be ready in ten minutes. Lives were at stake and automation has to show its full potential.

2. Context and implementations of drone usage during COVID-19

Generally speaking, industrial automation processes or agricultural enhancing machinery have already showed their capacities well before the crisis. It was now the time of showing that some gadget-like machines and some "kids' toys" devices can do more than just being nice to play with. One of the shining examples of real help from the IoT world came from the small and somehow toy-like flying drone.

Drones available off the shelf came into light and were used in many locations – on larger scale in China – as a more reliable, cheaper and safer solution to involving large numbers of personnel for different checking operations, announcements, trespassing in forbidden areas, light delivery duties etc.

Drones were used to very rapidly scan and later continuously supervise large areas, either urban or outdoor. In case that the drone's sensors and/or cameras detected human movement, they were able to broadcast audio messages, warning for example about the necessity to wear protective gear, remain inside or evacuate premises. All these activities were organized and controlled from remote locations, without any need for human personnel to directly go in those areas and increase the risk of their getting in contact with possible infected people or their direct contacts. There is also an already viral video on the internet, from the Chinese region of Inner Mongolia, with an old lady being talked to by a drone – figure 1.
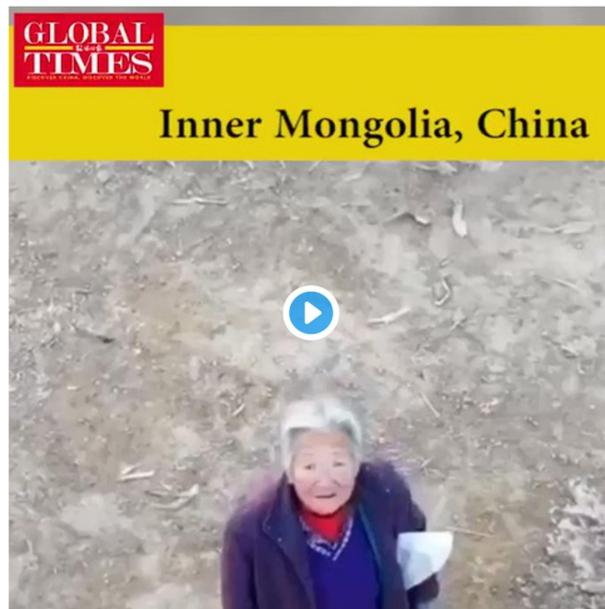

Figure 1. Capture from Global Times Twitter account[3]

In other cases, formerly agricultural field drones were used in urban areas to throw disinfectant materials over large areas and so preventing the spread of the virus. From a DJI[4] report, statistics show that drones are able to cover about 100000 square metres of area, in only one hour, with only one 16 litres disinfectant tank.

---

[3] https://twitter.com/globaltimesnews
[4] https://www.dji.com/ - one of the best-known commercial drone manufacturers

Figure 2. Emergency unit from Spain, with two DJI AGRAS MG-1 used to disinfect[5]

Drones can also be equipped with infrared/thermic sensors and/or cameras. These devices can then be used in order to check the temperatures of people from afar, in cases were a normal handheld thermometer could put the handler into a higher risk zone.

But perhaps the best way to help, at least from a quantitative point of view, was to use drones for deliveries – especially medical supplies. Drone delivery is a concept that was already probed and even implemented a smaller, pilot-project, scale by different industry visionaries, such as the giant Amazon corporation. Nevertheless, in standard conditions, the normal drone deliveries raise quite enough issues and problems, related to both technical challenges as well as reglementary ones (different legislation and requirements in almost every country for example). Some cases of using drones in the medical field, to fight against another disease called Malaria, were already found in Tanzania or Zanzibar. Usually, the help of drones was normally needed in areas that were not developed enough and, as a consequence, more classical way of delivering goods or expertise were very feeble. During the COVID-19 crisis we found out than even giants like the US, EU, China, Brazil… and almost everybody else, are in need of such capabilities when we do not want people to get in contact to one another. Google's mother company, Alphabet, has in its panoply of tech-companies a drone based one: Wing. Wing has become, in 2019, the first company to receive official approval from the US authorities in order to deploy a pilot-project, together with the well-known FedEx courier company, for drone deliveries to ordinary customers.

---

[5] https://www.scmp.com/coronavirus

Figure 3. Wing drone used for delivering goods[6]

One of the most important and debated issue – there are a lot more, but they are not to be tackled with inside this article – related to drone usage takes into account the privacy concerns as well as the property boundaries. Drone can be (and this is for sure) used for a lot of things on the border between legit and illegit, for things related to surveillance or taking pictures/recording videos inside private properties. Nevertheless, these real concerns should be addressed, and a way must be found in order for the modern society to take full advantage of their enormous potential for good. After researching this topic extensively, we consider that regulators (countries or common over-state entities) should have in mind, at least as a first step, an excellent idea that can be of a real help in this case:

- Create drone streets/highways, exactly above the present-day road infrastructure. This approach would ensure that the drones are not peeking on private properties and that their routes are clear and free of obstacle. Their speed and flight rules will make them cover the same distance way faster than a normal wheeled vehicle. On the downside, bot being able to choose the shortest, most straight forward route will impose a penalty on the drone's delivery trajectory.

In a more specialized implementation, a drone can be used to check the condition of people, from above, in relation to a certain cardio-pulmonary condition. An article published by a team of researchers from University of South Australia shows how a drone can actually be used to remotely extract the characteristics of a person's heart rate, just by analysing the picture/video capture. Even though the capability was first considered for war-zones, a COVID-19 crisis response team might also use such technology for best results [1].

---

[6]   https://techcrunch.com/2019/10/18/alphabets-wing-begins-making-first-commercial-drone-deliveries-in-the-u-s/ - Inaugural flight of Wing delivery-drone, in Christianburg, USA.

3. Concerns related to drone usage

As already mentioned before, the drones are not bringing only joy and goodwill in their path. There are enough concerns and issues that still have to be addressed and solved, maybe event by the old trial-and-error approach, if needed. Instead of doing nothing and just finding the worst-case scenarios for using drones, the scientific community should focus on mitigating the legit concerns, as to make way for the numerous scenarios in which such devices could really make a difference for the best. Unfortunately, one of the main concerns related to drone usage – prying on private areas, illegit surveillance and the like – are indeed very real facts happening even now. China, a great supporter of drone usage and one of the leaders of development and deployment of these devices, has huge problems related to over-surveillance of its populations and generally to the use of high-tech to impose its state-policies without any regard for human rights. On the other hand, in countries with well-established and old democratic regimes, even the current pandemic was not considered enough reason for a possible breach of fundamental rights, related exactly to the using of drones by the police. French police was stopped by a court of law from non-discriminately   using surveillance drones, until privacy concerns were properly and sufficiently addressed [2].

The possibility of drone usage becoming ubiquitous brings in the possibility that people become so accustomed to these devices as to not see or discern clearly their potential for enforcing non-democratic regulations. The drones that were used just some months ago for broadcasting messages to endangered people, for delivering medical supplies to the needy, for checking body temperatures before being allowed to enter a community, to disinfect pubic parks or to verify traffic status can also be used for apocalyptic-like approaches. The same drones can deploy a small weapon (and yes, not only the like of Predator drones can be deadly – an off-the-shelf DJI drone with a handgun can be as deadly as anything else) to kill the ones that do not obey the one-party rules, the same drones can transport almost undetectably small bombs into urban highly populated areas, the same drones can hover at the 20th floor of a building and take pictures of the people in their beds, the same drones can be programmed to follow somebody around and create a complete surveillance pattern, the same drones can take a photo from afar and expose the code someone is keying into his security system console etc.

Drones must be taken into account for their malicious potential from two different perspectives:

-   The governing bodies, especially from pseudo-democratic countries, can deploy a huge armada of such devices to control their people to a degree never seen before.
-   The cybercriminals can also use the drone for their own malevolent purposes, opening a whole new front for the law enforcement bodies to tackle.

The drones can also be constantly linked to the internet – or they can at least return to a certain space where they can recharge, connect to the internet and send their

166

data/receive new programming. All these facts converge to the fact that a set of regulations must be imposed at world-wide level, in order to promote and respect fundamental human rights, freedom and democratic principles [3]. We, humans, have to make sure that our rights are respected, as the technology improves and becomes more and more omni-present in our lives. At a certain point in future, the exhaustive use of very sophisticated IoT-like devices to control people might even bring disasters at planetary level. Without a concerted approach of this issue, starting with respecting our fundamental rights and accepted by all countries, the scenario of the Terminator's Judgement Day[7] might not be such a far science-fiction story.

4. Case study for simple drone programming

We consider that one of the first step into being able to tap the full potential of drone support for our society is to make them much more approachable. Their high-tech, cutting-edge technology aura should be debunked, and their inner workings exposed to more and more people, even starting with children.

Let us remember the case of the personal computers, just tens of years ago. Their environment was only for the "geeks" and super-technologically advanced people, for the enthusiasts or science lovers. Nowadays, children start exploring computers from kindergarten. The result? – a society which treats computers like basic tools, which is used to and employs in every aspect of life smartphones, laptops, desktops or other smart gadgets. We consider that by bringing the drone capacities close to the young ones we might not only make them get used to them, but we can also make use of their invaluable and unending capacity for innovation and finding new ways of using technology. Especially for such an approach, we will exemplify basic drone programming by the use of several wide-spread programming solutions – available to all ages, from children to adults alike.

Nowadays drones can be used in various scenarios like Landscaping, Gaming and basic or advanced Object Recognition. For each of these scenarios, the drones run advanced programming source code in order to handle basic flight operations like balancing and synchronizing the motor speed in order to keep it floating at the desired height and/or follow a specific path in the ways of:

- Horizontal direction
    - Backward
    - Forward
    - Left
    - Right
    - Rotate (also known as Yaw keeping): left / right

---

[7] https://en.wikipedia.org/wiki/Terminator_2:_Judgment_Day

- Vertical
  - o Up
  - o Down

Some of the programming languages used for the presented drone case study include widely spread names like Java, Python, Swift or Scratch. The drone that was used for this case study case is a TELLO Ryze, which comes to the opportunity to use an educational platform - presented in figure 4. TELLO is a drone produced and commercialized by DJI company, one of the most prominent names in this industry.
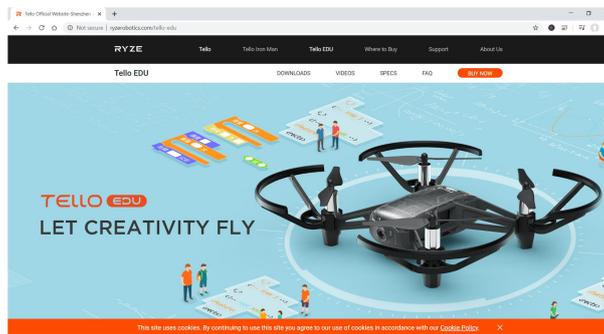

Figure 4 – Educational TELLO[8]

The case study will include three examples of how to actually create code that becomes a program the TELLO drone will understand and abide by.

One of the presented programming possibilities is based on the simple application that can be installed on any mobile phone or tablet and can be programmed (at basic levels) even starting with children's age. The downloadable educational application is called DroneBlocks and is presented in figure 5.
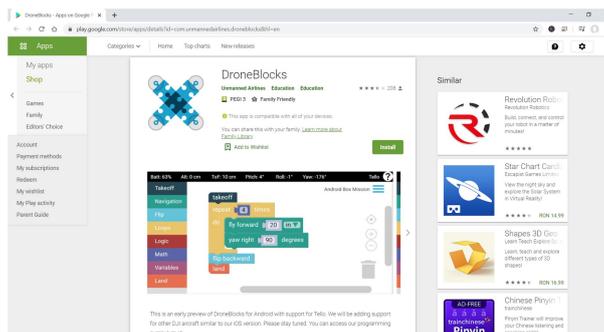

Figure 5 – DroneBlocks application from Google Play store

---

[8] https://www.ryzerobotics.com/tello-edu

The DroneBlocks application includes management for Altitude, Time of Flight, Pitch, Roll, and Yaw. The application has over 50.000 downloads and is currently at version 2.6, from January 7, 2020 (at the time of the drafting of this article).

The manufactures of TELLO, DJI, understood that their future success will be based on attracting the younger generation into exploring and using these flying devices. The best approach is to not bet all on a highly technical approach, but to create first a friendly and attractive environment that would be easy to understand, use and exploit for young children. A (semi-)programming environment, based on blocks and color-codes is a sure path, already tested and with proven results.

In figure 6 we present the flow of simple programming mode that will create a set of five actions, which include: take off, fly forward for 20 inches, flip backward, yaw right 90 degrees and land. The blocks have to be put together, linked through the contour indentation of one block matching the extrusion of another, and they are also color-coded for certain different actions: navy-blue for starting to fly, green for moving through the air or orange for finishing the aerial trip.
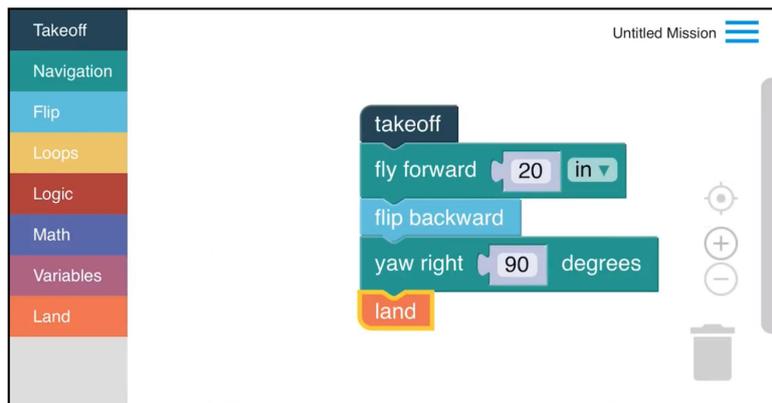

Figure 6 – DroneBlocks programming interface

The DroneBlocks programming is adapted for different environments and levels, including educational areas such as: science, technology, engineering and mathematics. DroneBlocks offers two main coding environments to choose from: Block (DroneBlocks) and JavaScript (DroneBlocks Code).

Regarding the flight terminology used above, the actual types of movement like pitch, roll and yaw are presented graphically in figure 7.
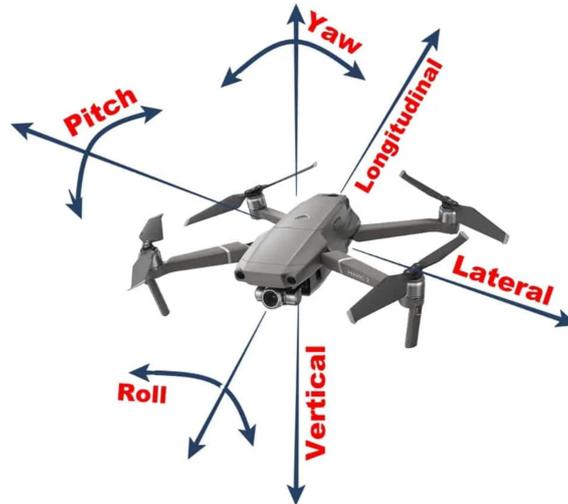
Figure 7 – Flight moves types of drones or quadcopters

If we think about the Scratch[9] programming language, which is free of charge and was developed by the Lifelong Kindergarten Group at the MIT Media Lab, we get a very wide spectrum of possibilities for creatively program drones to perform simple tasks during defined flight missions… even by tech-wise children that are the main target of Scratch. Inside figure 8 the interface of Scratch is presented with actual code for control of the TELLO drone.
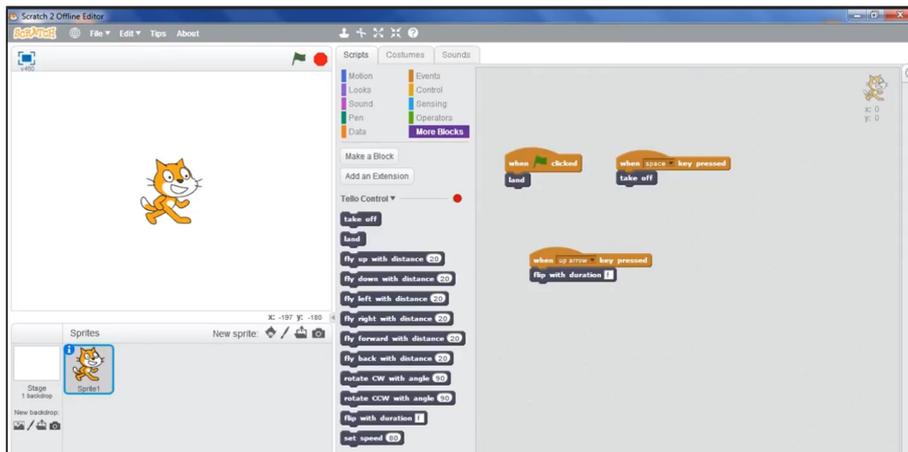

Figure 8 – Scratch interface with simple code for TELLO

---

[9] https://scratch.mit.edu/

And finally, we present the official Software Development Kit (SDK) from TELLO. The Tello SDK 2.0 connects to the drone using a Wi-Fi UDP port, to control the quadcopter with text commands. Python is needed to be downloaded and an example file from Tello's website called *Tello3.py*. Inside the table below we have the most important Tello's SDK control commands, with their basic descriptions.

Tello Commands

Control Commands

Command	Description	Possible Response
Command	Enter SDK mode.	ok / error
takeoff	Auto takeoff.	
land	Auto landing.	
streamon	Enable video stream.	
streamoff	Disable video stream.	
emergency	Stop motors immediately.	
up x	Ascend to "x" cm. x = 20-500	
down x	down "x" Descend to "x" cm. x = 20-500	
left x	Fly left for "x" cm. "x" = 20-500	
right x	Fly right for "x" cm. "x" = 20-500	
forward x	Fly forward for "x" cm. "x" = 20-500	
back x	Fly backward for "x" cm. "x" = 20-500	
cw x	Rotate "x" degrees clockwise. "x" = 1-360	
ccw x	Rotate "x" degrees counterclockwise. "x" = 1-360	
flip x	Flip in "x" direction. "l" = left "r" = right "f" = forward "b" = back	
go x y z speed	Fly to "x" "y" "z" at "speed" (cm/s). "x" = -500-500 "y" = -500-500 "z" = -500-500 "speed" = 10-100 Note: "x", "y", and "z" values can't be set between -20 – 20 simultaneously.	

Read Commands

Command	Command	Possible Response
speed?	Obtain current speed (cm/s).	"x" = 10-100
battery?	Obtain current battery percentage.	"x" = 0-100
time?	Obtain current flight time.	"time"
wifi?	Obtain Wi-Fi SNR.	"snr"

Table 1. Tello command line instructions

Such control commands can be stored and later called by triggering at specific events like internal conditional functions or external manual controls from mobile applications or dedicated hardware controllers.

The actual TELLO application is downloadable from Google Play or Apple Store and has over 1.000.000 installations. This number shows the real interest of users, not only about playing with such small and (almost) inexpensive drones but also the desire to go beyond it and start producing lines of code that can customize the drone's behaviour. Inside figure 9 the you can see the Tello App (Google Play version).
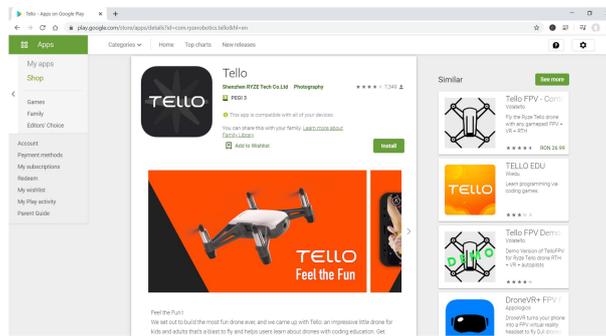

Figure 9 – Tello, Google Play App

The Tello case study presented in this article shows the possibility of starting to program drones in a more playful manner, one that includes actual hardware devices as small robots that can perform simple tasks. In this case, our drone can be made to perform flight applications called "missions" inside the dedicated APPs.

4. Conclusion

Our conclusion is that the age of drones has just started, accelerated by the COVID-19 crisis, which made society understand that we need to make use of all the tools available to us in order to overcome the risks that one situation might bring.

Not only drones but other IoT devices also have demonstrated during these months that a more fast-forward approach might bring much needed advances that can prove invaluable under certain conditions. Remote control or smart robots can access high-risk areas, mobile apps can keep track of infected people and develop a map of contacts to be checked for disease signs, UV enabled machines can disinfect hospitals and other dangerous zones before human personnel can get there, high-capacity or grid-computing can help decipher the disease's code and (eventually, when we will get there) automated factories will produces and distribute medical supplies and vaccines.

5. References

[1] Al-Naji, A.; Perera, A.G.; Mohammed, S.L.; Chahl, J. "Life Signs Detector Using a Drone in Disaster Zones.", Remote Sensing no.11, 2019

[2] Fouquet H.; Sebag G.; "French Covid-19 Drones Grounded After Privacy Complaint", Bloomberg.com, 2020

[3] Tăbușcă, S.M. "The Internet between Promotion and Infringement of the Fundamental Rights. Freedom vs. Cybercrimes", Journal of Information Systems and Operations Management, vol.5.2.1, 2011

https://www.ryzerobotics.com/tello-edu (accessed: April 27, 2020)

https://www.dji.com/products/steam (accessed: April 27, 2020)

https://scratch.mit.edu/about (accessed: April 27, 2020)

https://www.droneblocks.io/apps (accessed: April 27, 2020)