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Third Year Internship Report

Network development and visual recognition engineer

Internship completed

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At Orange

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33600 Pessac

Internship Tutor: Jean-François Helion, IT Project Manager

Thanks

Firstly, I would like to thank very much the people without whom the realization and completion of this internship would not have been possible.

I would like to thank my tutor, Mr Jean-François Helion, who accompanied and supervised me throughout my presence at Orange DTSI. I also thank him for the trust he has placed in me and the patience he has shown towards me.

Finally, I thank the entire Jean-François team for their warm welcome and interest in my work.

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Introduction

I completed my third-year internship at EPITECH Bordeaux within the Orange company in Pessac. I joined the team of the Technical Management and Information System department as an intern for a period of 5 months.

My internship took place under the benevolence of Jean-François Helion, my internship tutor.

The main topic of this course was to maintain and evolve a drone autopilot demonstrator based on visual recognition.

This internship was an important experience from the point of view of my schooling but also from a personal point of view. During this 5-month period, I learned to work in a company and to use the knowledge I acquired during the last three years at Epitech.

In addition to enriching my knowledge in programming and code design, this internship allowed me, through computer and technical monitoring, to acquire new knowledge on the development of software for drone.

Company Presentation

1.1 Orange : Telecommunication

Orange is a French telecommunications company. At the end of 2019, it had nearly 266 million customers worldwide, up from 2018. In 2019, the company is the leader or second operator in 75% of the European countries where it operates and in 83% of the countries in Africa and the Middle East.

Orange was originally a British telecommunications company that became, in 1999, the subsidiary of Mannesmann and, in 2000, that of the France Telecom group, a public company. In 2019, France Telecom employed nearly 148,000 people, including 88,000 in France. The former French public monopoly has therefore become internationalized following the acquisition of Orange. The new group thus created is present in Europe, Africa and the West Indies. Since the acquisition of Orange, most of the brands of the France Telecom group have come under the Orange brand. Since February 2012 and the transition to the Orange brand of fixed telephony activities, all the offers marketed by France Telecom have been using this brand, which, on 1 July 2013, became the group's new name.

In 2018, Orange generated revenue of €41.391 billion across all its activities and had 266 million customers worldwide, including 201 million mobile customers and 18.2 million fixed broadband customers.

Orange expands its activities to the sale of content (music, cinema, download...), e-commerce, online advertising, M2M solutions, home automation and teleassistance.

1.2 Orange : Technical and Information System Directorate

Within orange France, the Information System Department (ISD) develops new IT applications in promising and strategic areas for the group such as the development of very high-speed broadband, content for mobile Internet and portals, multi-service offers, embedded applications...

The team in which I arrived takes care of the SACRE project, this project aims to manage the collection and litigation on the fixed and mobile domains for DEF, DGC, PRO and PME clients. This team is composed of 12 people, a Business Analysts, a project manager, 4 Functional and Technical Experts in France and 4 others in Morocco. The team is also accompanied by 2 alternating.

It is therefore in this context that my internship took place, the integrated team has all it is meeting such as the Daily but also the team meetings with all the teams of the DP SFCE.

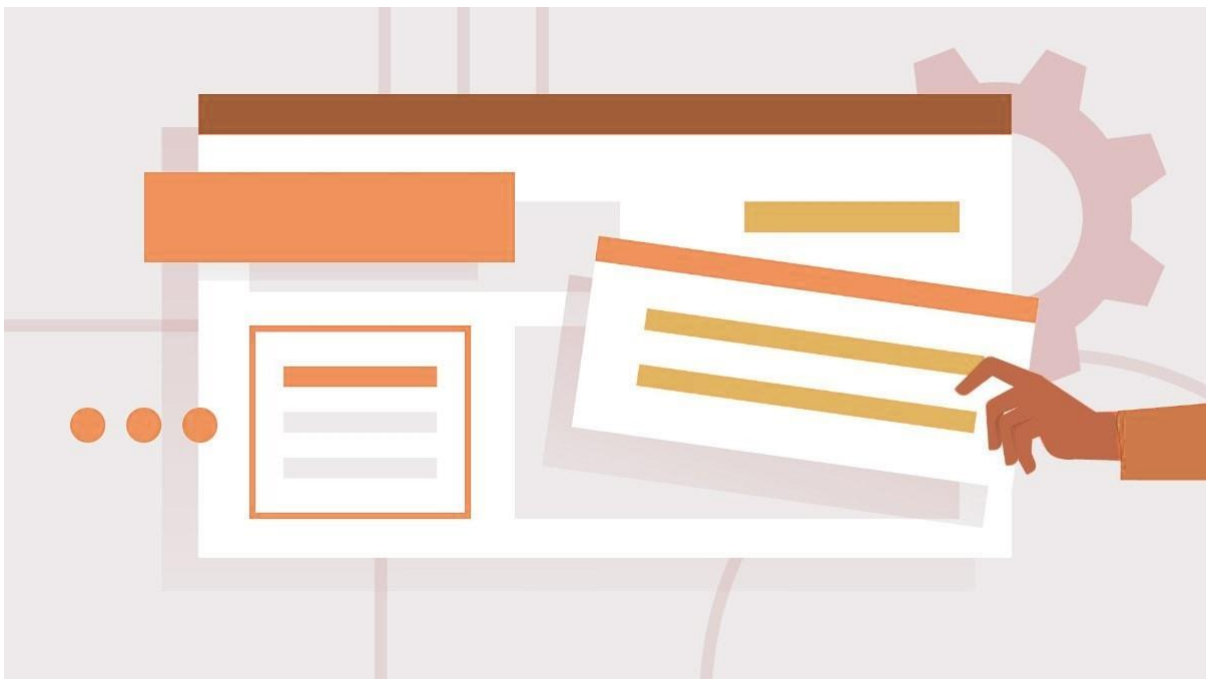
1.3 Orange : Code Room

The mission of the Pessac Code Room is to offer a privileged space to employees to allow them to exchange on the theme of development whether they are experts or Boeotians. It therefore offers introductory sessions in development, electronics or on new technologies as well as events and projects giving free rein to imagination and innovation. The Code Room is currently run by a collective of employees, mainly developers, on their free time. It is in the name of this Code Room that my internship was set up with the aim of maintaining and improving a flight simulator for drone. It offers any employee the opportunity to test new technology such as 3D printing, application development and connected objects.

Work Requested

2.1 The Project

In order to promote new technologies, my internship tutor gave me a project to create or improve an autopilot drone demonstrator based on visual recognition. For that, I will have to develop an application allowing to control the drone (s) to execute or control the proper functioning of certain function. This will subsequently allow visual demonstrations of the drone but also, thanks to a large documentation, to allow novices in computer development to easily understand all the tricks of the software. For that I would have to document each function as well as each possibility with the drone.



2.2 Generals Problems

The first problem that arose very quickly to me was the procedural way used by the former trainee who had to be completely changed into an Object approach. Which finally forced me to take everything from the beginning but to bring a better maintenance of the project.

The second problem was the diversity that my codes had to propose and never do the same thing again, as well as the discovery of Python, which is an interpreted, multiparadigm and cross-platform programming language.

The third problem has been to make my reasoning and code as simple and readable as possible, and to put into practice much of my last three years at Epitech. The confrontation with a project manager was also a discovery for me and therefore an additional adaptation.



2.3 Main Objectives

The main objective of the project, as seen above, is the design or improvement of a drone autopilot demonstrator based on visual recognition. To achieve this goal, several constraints were imposed on me to be able to meet the expectations of the company.

The constraints of the project are:

- Have a simple code.
- Have a readable code.
- Explain each class and function by comments in the files.
- Develop an optimized application.
- Ensure that the application is accessible from any operating system.

Work Done

3.1 Inventory of hardware and software

At first, Jean-François gave me time to take charge of all the software and hardware at my disposal. To do this I start by trying to take in hand the drone via the application already proposed by Tello Edu.

3.1.1 “Tello Edu” Drone

Once well in confidence with the capabilities of the drone I wanted to start learning about the possible ways to control the drone from a computer running windows 10.

To do this, an SDK is provided directly by Tello. A Software Development Kit is a set of tools to help you program applications. This is to send a command on the Wifi socket associated with the communication with the drone. All this in order are indicated in the pdf documentation of Tello.



From there, I started creating my own little python program allowing me to test my possibilities in more depth. So, I created a program that allowed me to move forward, backward, go forward, go backward, go up, go down, as well as the ability to take off or land. Once the mechanics of movements with a drone assimilated, I embarked on the understanding of the mechanics of sending the Stream of the camera of the drone. For this I had to understand how the video stream was sent, I quickly understood that the video data was sent on a socket and encoded in h264 for greater speed. To overcome the problem of h264 decoding, after some research, I found a python framework allowing me to do the decoding as well as the formatting of the image, this allowed me to easily display the Stream of the drone in a window.

3.1.2 Old Project

Subsequently, Jean-François gave me access to the repository on which the old project was. This allowed me to understand the control options put in place as well as the current project architecture. The architecture of the existing application was mainly procedural while as I researched I realized that it was absolutely necessary an architecture of type Object. So, to do this I decided to retain only the options added to the drone thanks to control suites inside function. So, I located and set apart all the options added by the old project. I finally got away with a circle function that allows me to perform a circle of any type of dimension with the drone, a leap-sheep function that allows two drones to jump one above the other and a search function that allows to perform a search in a room.

So, I now find myself with a good base of knowledge on Tello Edu drones and their programming as well as an option base applicable to the future application. I must therefore now reflect on possible developments.

3.1.3 Evolution Possible

One of the first possible developments that jumped out at me was the shift from procedural code to object-oriented code. To do this I first thought about the architecture that would allow me to have both a quick and simple discussion with the drone while having a stable desktop application. Subsequently, a long period of documentation on the most stable tools to create an application in python. A python framework imposed itself on me, it is called Kivy and is a cross platform python framework Windows, Linux and Raspberry. A second Framework caught my attention, DjiTelloPy which is the Framework provided by Tello Edu on python for ease of communication with the drone. So, I had my two main Framework that will allow me to set up the base of the application. I continued with visual recognition documentation, whether for QRCode or facial recognition. Again, a python framework, called OpenCv, will greatly facilitate me the development of options has low visual recognition.

3.2 Evolution Software

3.2.1 Main Application

After doing all my research, I decided to start developing the main app. Very quickly I arrive at a good result allowing me to have in the background the stream of the drone and over the direction buttons. A big difficulty is then present to me, I wanted to be able, when I stay pressed the button, continue to execute the command. I understood then very quickly that I had to have several states, one when the button is pressed and one when the button was released.

Subsequently a new problem occurred, when I pressed a button the stream of the drone paused, it was no longer updated. To overcome this problem, I had to inquire about python threads that would allow me to run the update of the stream in parallel with the command sends for the mobility of the drone. Once this problem was fixed I had a code bass strong enough to move on to adding the options in the application.

For my first option, I decided to set up the ability to run flips in the 4 different directions. To do this I added a drop-down button that would display the available options once the button is activated. Once in the menu we can now select our flip option to be able to run a flip in the desired direction.

For my second option, I decided to tackle Face Tracking. For this I used the OpenCV Framework for python which allowed me via the call of a function to send me the 4 coordinates at the 4 corners of the face displayed on the image. Thanks to that I later managed to create a rectangle around the face display on the screen. Once this is done, I have more to do than determine the center point of the rectangle. Subsequently, I determined the center of my image returned by the drone I was left with that ordered the drone to keep in constant the central point of the face on the central point of the image of the drone.

For my third option, my choice was QRCode recognition to allow the execution of the command indicated in the QRCode. For this I used the Pyzbar framework, this one allows me to detect as well as decode a QRCode display in an image such as the drone stream. Subsequently, all I had left was added a function that would execute the commands requested by the QRCode.

For my fourth option, I decided to reproduce the second option but with a QRCode has the place of the face. To do this, the Pyzbar Framework allows me, once a QRCode is recognized in the image, to retrieve the 4 coordinates of the 4 corners of the QRCode. This allowed me subsequently to execute my Tracking function.

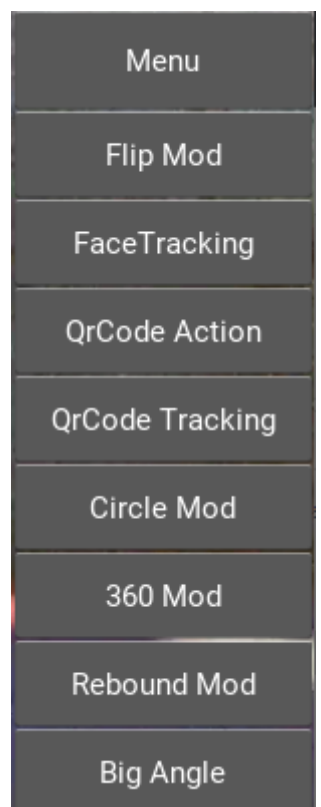
For my fifth option, I decided to add an option from the old project which was the circle option. This allows the user, once the option is selected, to adjust via a scroll bar the radius of the desired circle as well as the inclinations in degrees of the circle. This option allows, once well adjusted, then to search for objects or QRCode in a closed room.

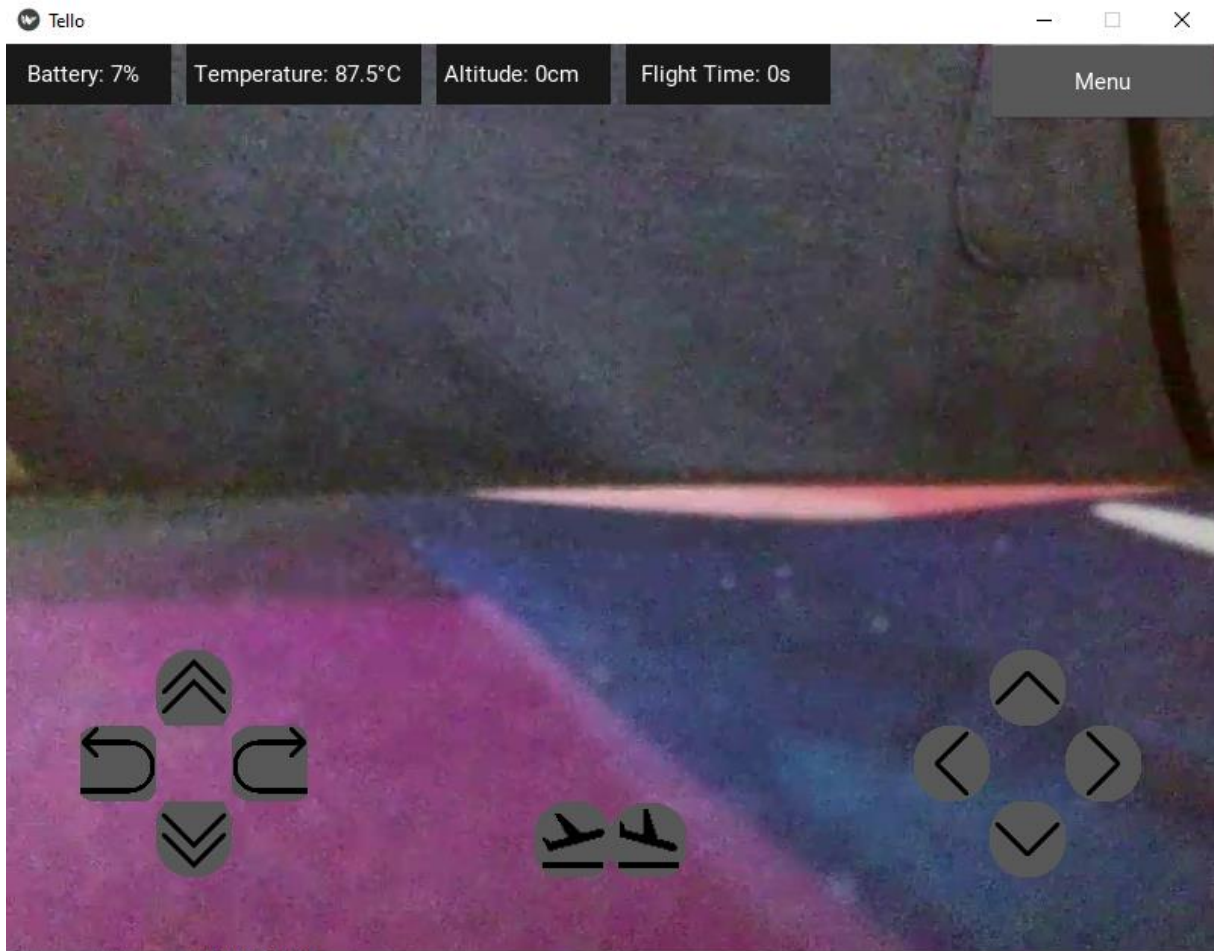
For my sixth option, I wanted to make sure that the drone can make a complete turn on itself to start visualizing the room in which it is. For this it is therefore enough just to press the button and the drone will perform a complete turn on itself without moving from the point where it is.

For my seventh option, after looking at the options provided by the Tello app on the phone, I noticed the bounce option. This option allows you to automatically go up and down from 0.5 to 1.2m from a flat surface located under the device. So, I started to reproduce this option through a function.

Finally, for my last option, I decided to add the wide-angle option also available on Tello's mobile app. This option allows the user to record a short video while flying backwards and up. This allowed me to discover how to record a video from a stream sent by the drone.

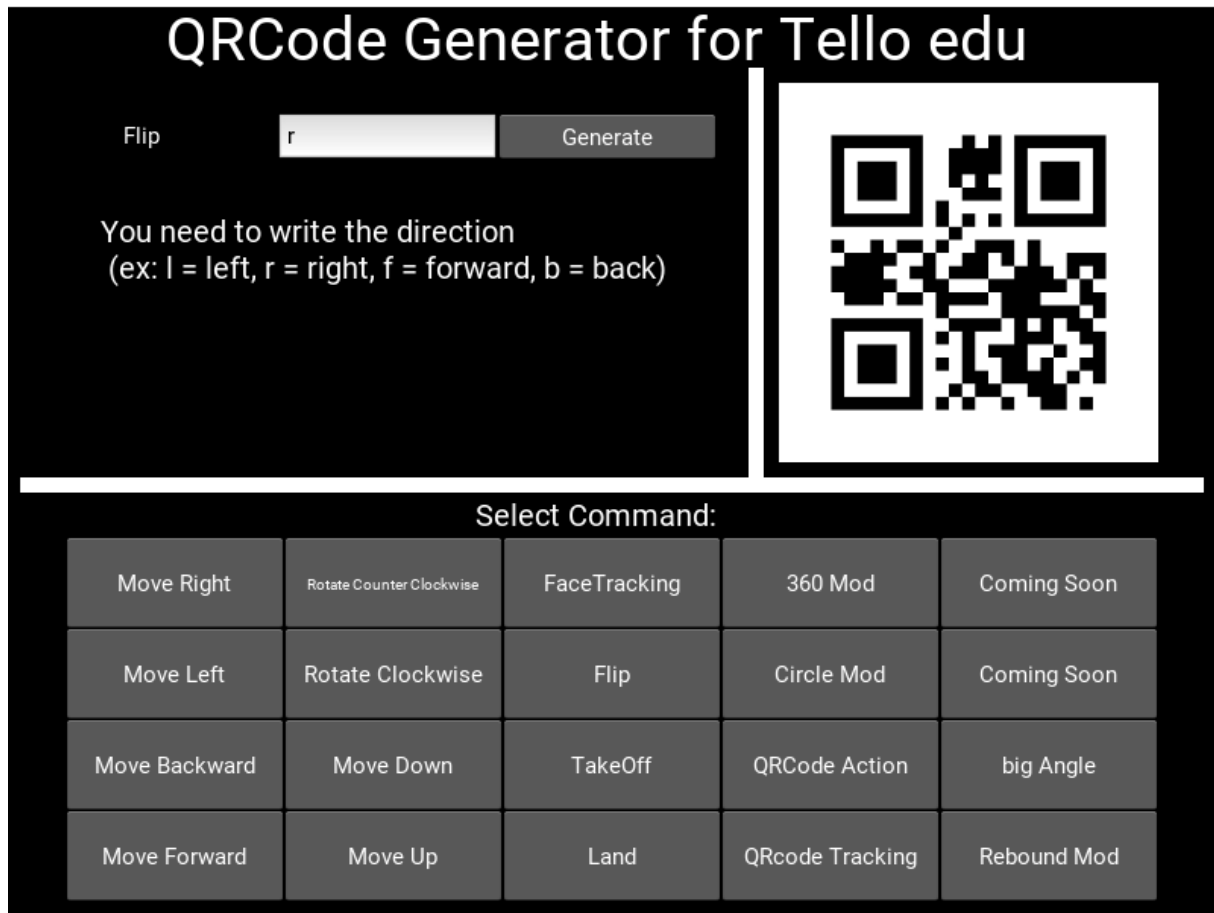
Subsequently, thanks to a more precise documentation of the Tello SDK, I realized that it would be possible to retrieve information such as the temperature, the percentage of battery available, the altitude of the drone in relation to its starting point or the total time of flight performed. So, I added all this information to my main application window





3.2.2 QRCode Generator

In a second step, to facilitate the creation of QRCode for the option of order execution via QRCode, I started the development of an application specialized in the creation of QRCode for the drone. For this, I had to list all the possible commands as well as the constraints of each command to avoid creating a QRCode that does not comply with the drone's expectation. Once all this was listed, all I had to do was format all the data. For the UI I therefore decided to make sure that each of the possible commands is a button that once press allowed to create a QRCode. Once the command is selected, the user is prompted to enter a value corresponding to the command (for example: left button selected, user must enter a number between 20 and 500 in cm). After all this it remains only to press the generate button which allows to generate our QRCode which will register in a folder of the project but also which will be displayed on the application.



3.2.3 Drone Swarm

In a third step, Jean-François wanted to be able to control several drones at once. For this, the "ap" command allows to connect the drone to a proxy, thanks to it we can contact all the drones without necessarily being connected to each one. A problem then jumped out at me, knowing that with each new connection of the drone to the proxy the IP address changes. So, I had to create a function allowing me to detect and record the current IP address of the drone. Once that was done, I could interact with each of the drones. Then I started by building the application, I based myself on max possibility of having 8 drones connected at the same time. So, I divided my window into 8 boxes, one for each possible drone. Each of its box, once a drone is connected, displays buttons for all the basic controls of a drone. So, we can move only one drone at a time or all at the same time. This application will have caused me a lot of problems compared to the detection of drones and the dissociation of commands for each drone.



3.2.4 Documentation

One of my main goals was documentation, so to do this I had to set up documentation tools such as a readme or via comments directly in the code files. I started by making a readme, this one contains a small introduction to the project explaining the main usefulness of this project. Subsequently, I added a tutorial section to learn how to install python as well as all the dependencies of the project and this on Windows, Linux, Raspberry. Finally, after installing everything perfectly, a detailed explanation of each of the applications present on the project await the user.

After doing the readme, comes the time to comment on my functions. This step is rather difficult because the explanation must be concise but at the same time complete. I had to make sure that my reasoning during the unfolding of the function was as clear as possible. For this I took each of my functions one by one and I began to make a precise explanation of each of the functions on paper. After that I had more than just make a summary of each of the explanations in commentary.

3.3 Technology watch

Technology watch or "technological intelligence" makes an important contribution to improving the capacity for innovation in the company. For my technology watch to be effective and truly serve the company's strategic objectives, I had to follow clear methods and use effective tools.

Well known to all companies working in high-tech sectors where innovation is essential, it can sometimes be defined or summarized by a "state of the art". Indeed, technology watch allows to have a complete view on a market and its evolutions from a "technical" point of view: technologies implemented by customers, suppliers, partners and competitors as well as developments around emerging technologies.

It strengthens the ability to learn continuously. In sectors of activity where innovation is a constant process, R&D teams are constantly working on research and must continually "learn". All information that may be important for understanding technological developments and innovations being researched must be detected. This avoids making decisions based on incomplete information or reinventing things that already exist.

During my experience in a company, I had to run a technology watch on the theme of python development. For this, I first found educational sites such as W3Schools. Subsequently, I did research from github or stack overflow, which allow to discover new possibilities with the python.

Remaining Work

4.1 Improved visual recognition

Thanks to the knowledge accumulated during the last months of the internship, I think that the visual recognition system could be improved by using more trained assets. A facial recognition module is an xml file containing all the information that IA needs. To obtain this xml file, we must train our IA which gradually learns. So, we would have to train this AI much longer. The second point of improvement of visual recognition would be to change the camera of the drone to have a camera that will make an image clearer. Because the IA has trouble recognizing faces or QR Codes when the light is lower or because the camera does not make the point well

4.2 Router detection enhancement

In a second step, I think the drone detection when they are connected to a router could be improved. Indeed, currently drone detection is made to look for on all possible IP addresses of the router. This way of searching is very slow since there are more than 1000 possibilities. To improve it would first have to query the router through a command to know that they IP address have been set up. Subsequently we will have that the IP address available is therefore much less address to check. This technique would allow us to easily lose 10 seconds at the launch of the drone Swarm application.

4.3 Installation improvements

In a final step, I think that the installation of the different applications could be improved. Indeed currently, the user must install python and then all the dependencies of the project via a requisitions.txt. Subsequently to launch an application, the user must go to the folder and then launch via a terminal the main python file for the application. So, to improve this installation, I think that for the Windows side a file .bat could allow me to install all the dependencies as well as python, then via a file .exe to launch the application. For Linux and Raspberry, a .sh file would make it possible to do the same as the .bat file, which means install all the dependencies.

Conclusion

This internship was very rewarding for me because it allowed me to discover the professional world and the operation and problems of a company. Through Orange, I was able to rediscover the drone sector with a more critical look. Indeed, now, I know the main problems encountered by the development of a drone autopilot demonstrator, how it is created, and the pitfalls to avoid. It is worth highlighting an important point that allowed me to adapt quickly: it is the trust that I was given in the company when I arrived, which allowed me to easily find my place there.

Throughout my internship, I worked independently, which proved simple thanks to Epitech's pedagogy, which advocates independence. I had to learn how to manage my time. I was also able to reuse some of the teachings received at Epitech.

This internship at the end of the third year allowed me to work on an interesting and concrete project: maintain and evolve a drone autopilot demonstrator based on visual recognition. This project gave me the opportunity to improve my knowledge of python, learn how to interact with a drone, create an end-to-end python application and manage communication with other professional stakeholders for the completion of the project.

During my internship in Orange, I had the opportunity to work on drones and contribute to the technological advancement of the project. I believe that I have participated effectively and constructively in the project by demonstrating professionalism and building on the achievements of my schooling.

The work carried out has been very enriching for my professional experience, both in the technical field and in the human aspect. The atmosphere in the service was very pleasant and I have very good memories of it.

Bibliography

[https://fr.wikipedia.org/wiki/Orange_\(entreprise\)](https://fr.wikipedia.org/wiki/Orange_(entreprise))

https://www.google.com/url?sa=i&url=https%3A%2F%2Feveryday.codes%2Fnews%2Fpython-3-8-released-whats-new%2F&psig=AOvVawONGIFVUgTPikNJzWOIzOoN&ust=1624444495969000&source=images&cd=vfe&ved=OCAoQjRxqFwoTCJiso76Fq_ECFQAAAAAdAAAAABAK

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