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Autonomous flying in real-time with RPAS

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Abstract

It is proposed to carry out several iterations of the SDLC (Systems Development Life Cycle) in order to develop an artificial intelligence algorithm capable of making decisions in real time in the field of RPAS (Remotely Piloted Aircraft System). It must be able to maintain the integrity and security of the environment, providing autonomy to one or several RPAS that make up a network to fulfil a common mission. Real-time vision and analysis of images obtained from the RPAS will be used for the algorithm to analyse and redirect them appropriately to the RPAS. On the other hand, it must also obtain the telemetry of each one of the RPAS in order to have an image of the positioning of each one of them, adopting the correct actions without endangering any of the RPAS that make up the network.

Keywords Artificial intelligence in RPAS, Real time image analysis, Autonomous flight with real-time decisions, RPAS, MATLAB, Multiple RPAS mission.

1. Introduction

The great evolution of technologies focused on artificial intelligence allows algorithms capable of making decisions in real time. It also provides autonomy to objects that initially need human supervision in order to carry out the mission for which they are intended. The artificial intelligence algorithms designed must be efficient and have a high success rate, this providing the system with reliability. In this way, they are able to ensure the correct functioning and integrity of the objects on which the decisions will affect. An optimal training set must be generated to train the neural network properly.

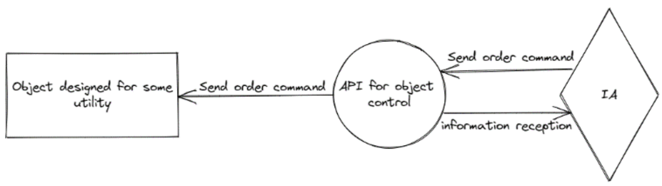

Figure 1: Artificial intelligence application.

Due to the rise of this technology, jobs can become more specialized and devote much more time to the research of new functionalities that facilitate both the use and the autonomy of the objects to which this type of technology is applied.

2. Research proposal

It is proposed to carry out several iterations of the *SDLC (Systems Development Life Cycle)* in order to develop an artificial intelligence algorithm capable of making decisions in real time in the field of *RPAS (Remotely Piloted Aircraft System)*. The decisions taken by the algorithm will directly affect the RPAS's flight behaviour by sending orders to modify its trajectories in order to fulfil the mission for which the algorithm is designed. To make such decisions, images of the environment will be obtained from the RPAS (Malburg, Alvarez-Cedillo and Herrera-Charles, 2020)(Malburg, Rieder, Seiger, Klein and Bergmann, 2021). The algorithm will analyse the received image and conclude with a decision to be fulfilled by the RPAS (Aibin, Aldiab, Bhavsar, Lodhra, Reyes, Rezaeian and Taer, 2021).

Initially, to ensure the security of the environment and the devices to be used, both training and testing will be carried out in a simulated environment using a single midrange RPAS

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until the security and integrity of the designed algorithm is achieved.

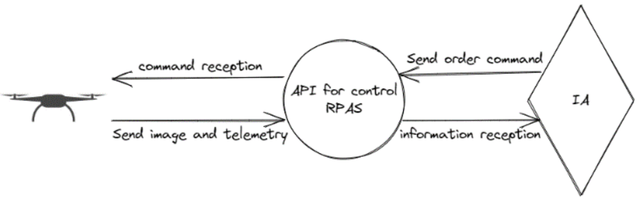

Figure 2: Design phase 1.

After the final design of the algorithm, stabilising it and ensuring a percentage of success within the established ranges that guarantee the characteristics of the mission, the tests will be carried out with a highend RPAS with an almost total capacity for customisation and adaptation of the components.

In order for the algorithm to be efficient, it is intended to be fast in computational time in terms of decision making, since a delay in the resolution of the trajectory may cause irreversible damage to the RPAS or its environment.

As a second phase, the aim is to adapt the algorithm to be able to control a network of RPAS in real time using both the camera and all the telemetry provided by all the RPAS in the network in order to successfully carry out a joint mission with a common objective (Roth, Yang and Ahuja, 2000).

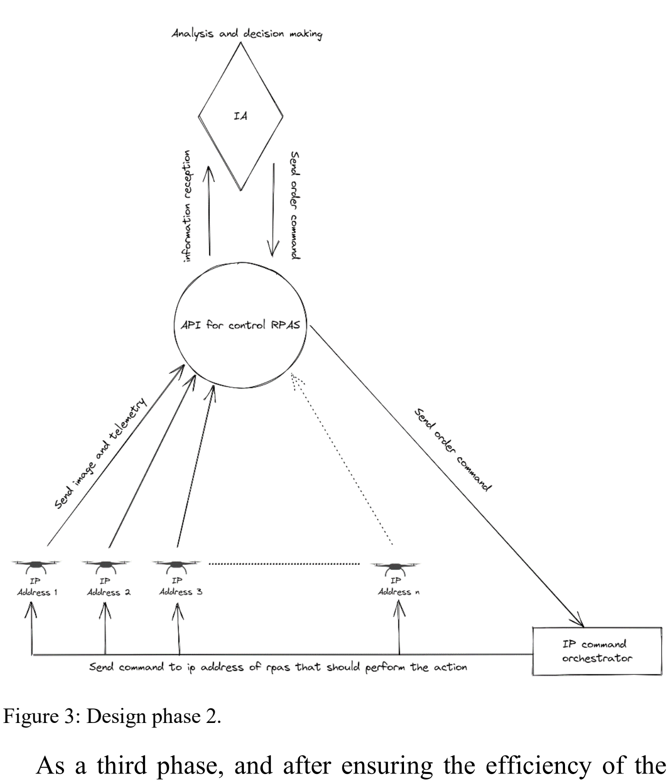

Figure 3: Design phase 2.

As a third phase, and after ensuring the efficiency of the algorithm and its correct functioning in the RPAS, it is intended to implement an automated surveillance network capable of identifying potential threats, establishing communication between the algorithm and the network of RPAS capable of carrying out this prototype mission.

Not all the RPAS must have the same model and the same characteristics, but each of them must have a purpose within the video surveillance network.

This is a handicap due to the fact that the development responsible for sending the orders to each of the members of the network, must be able to discriminate between the existing RPAS models and model a readable message according to the communications interface designed for the model in question.

On the other hand, based on this example, it could be extrapolated not only to the field of RPAS, but it would also be interesting to implement a video surveillance network with different aerial devices, terrestrial devices and cameras. In the latter case, we must ensure that they are devices with an implemented API that allows the reception of orders and sending of data to feed the designed algorithm (McCane, Caelli and DeVel, 1997).

When making this prototype, it is important to take into account the computation time consumed in sending the orders. Also, on the other hand, the communications must be good enough to be able to maintain the network of devices without losing control of them. If that were to happen, the model would be exposed to the possible loss of one of the devices or a loss of security of the network in charge of it.

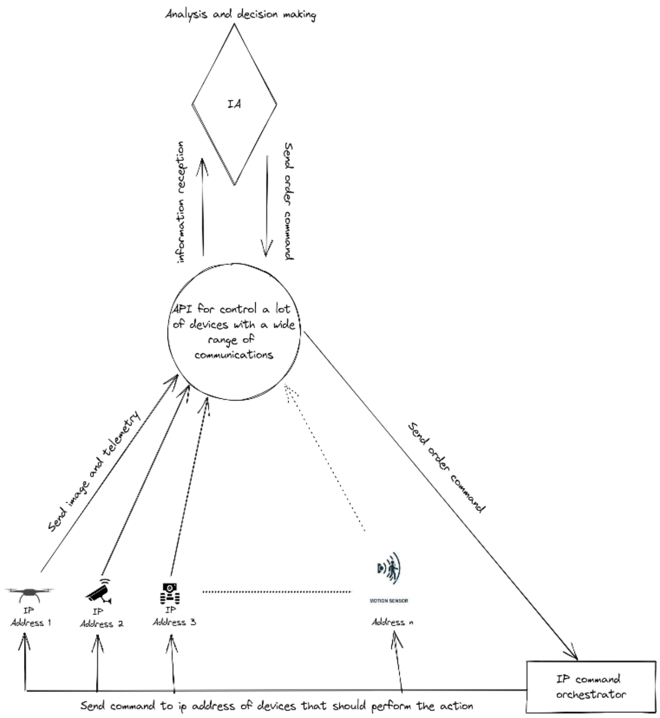

Figure 4: Design phase 3.

3. Conclusion

Artificial intelligence is something intangible that cannot be seen or touched, but it has the great capacity to provide new uses and autonomy to objects that were not designed for it.

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Focusing on the field of RPAS, initially, they were considered as an amusement that occupied our leisure time, but thanks to the evolution of artificial intelligence, we can provide them with autonomy to perform tasks such as autonomous surveillance.

Thanks to this, the aim is to develop an algorithm that is capable of directing a network of drones autonomously without the need for human intervention and ensuring the integrity of both the devices and their environment.

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