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Economic Drones in Education

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Abstract

The immersion of drones in many sectors is evident, and the education sector is no exception, the use of this technology in the classroom is growing little by little. The variety of drones that can be linked to the educational sector makes the student and the teacher begin to develop skills and knowledge in a faster and more intuitive way. But what kind of drones can be more appropriate and efficient within these environments, which can provide the student with greater skills in areas such as programming, design, logical thinking and problem solving, among others, at a more convenient cost boosting STEM education. This article aims to know and review some of the most accessible and economical commercial drones for application in various educational environments.

Keywords: Drone, Education, STEM

Introduction

Drone technology, like many emerging technologies, was initially developed for military uses only, and completely away from civilian use (Ferrández-Pastor, García-Chamizo, Nieto-Hidalgo, Mora-Pascual, & Mora-Martínez, 2016). But as many of these disruptive technologies have been able to break out of their initial circle of users, to become fully available for use in various environments, markets and disciplines (Moncada Sánchez, Espinosa Gómez, & Ferro Escobar, 2020), there are now a wide variety of uses that drones can have in our daily lives. There are innumerable examples of their use in photogrammetry, marketing, video, photography, security, etc. (Finn, 2011; Gillan, McClaran, Swetnam, & Heilman, 2019; Yaacoub & Salman, 2020). Due to technological advances, drones have become an accessible, easy to use, highly efficient and very popular technology. These capabilities of drones have led to an increase in the use of drones in the work environment, which leads by logic to think that students should be prepared to use this technology from the same academic environment.

Drones can and have been recognized as one of the useful technological tools to boost science, technology, engineering and mathematics (STEM) education (Ng & Cheng, 2019). STEM is an educational approach to learning, which seeks to provide student and teacher guidance in inquiry, educational growth and critical thinking, and that is where drone technology can help in the classroom in an innovative, efficient, effective and highly engaging way.

Nowadays drones are so diverse that we can find drones of multiple sizes, types and values, with different characteristics and capabilities, which makes them an accessible and unique tool in classrooms and at all levels of education (Sattar, Tamatea, & Nawaz, 2017).

The best drones for education

Nowadays, the most popular drones in the market have cutting-edge technology, power and exceptional capabilities to perform stable and safe flights. Gradually these technological equipment are more efficient, smaller, faster and more precise (Moncada Sánchez, Espinosa Gómez, & Ferro Escobar, 2020), additionally they present a programming architecture or software development kit (SDK) open or closed, highly available, which can be leveraged by users to create horizontal or vertical growths quickly (Moncada Sánchez, Espinosa Gómez, & Montenegro Marín, 2020). But all this is achieved with the addition of sensors, technology, procedures, functionalities, support and state-of-the-art algorithms, which makes these platforms relatively expensive for the educational environment.

That is why in this article we will make a review of drones that have a low price, good sensors and excellent programs to be used in the educational sector, and that have been designed under the principle of STEM. Initially, we will avoid the systems that must be built from scratch and that require high or advanced knowledge in electronics.

DJI Tello Edu

DJI's partnership with Ryze Robotics resulted in one of the most impressive and smallest drones for children and adults, perfect for flying and education, with a price close to USD 120 (Subash, Srinu, Siddhartha, Harsha, & Akkala, 2020). With this impressive drone one can easily learn programming languages such as Scratch, Python and Switch supported by the 2.0 development kit, which offers a wide range of commands to work with (DJI, 2020; Martínez Escribano, 2020). The Tello EDU SDK supports block programming achieving simple programming that only requires dragging coding blocks on the screen to program it and enable various movements (Martínez Escribano, 2020).

One of the most amazing functionalities that this platform possesses is the possibility of programming several Tello Edu to swarm fly and develop artificial intelligence functions through one device. The Tello Edu can be made to fly on Mission Pads and perform somersaults and other acrobatic movements, these function as guidance points and trigger mechanisms for flight and landing operations (Almendros Carmona, 2021).

It is possible to access the Tello EDU video data stream, and to have advanced features such as object recognition, tracking and 3D reconstruction (DJI, 2020).

Some of the features available in the Tello Edu are:

- HD video transmission at 720p.
- Image capture at 5 MP.
- Average flight time of 13 minutes.
- Multiple flight modes.
- Automatic take-off and landing.
- Low battery and fault protection.
- Vision positioning system.
- High stability.

Parrot Mambo Fly

One of the smallest and most robust drones from Parrot, with which we can fly indoors and outdoors with a high degree of maneuverability and superior stability, thanks to its intelligent autopilot system, its powerful sensors and its advanced flight controller. It can be controlled through the Parrot Flypad controller or a mobile device. Its price is close to USD 140 (Bello Guisado, 2019; Parrot, 2021).

The Parrot Mambo Fly has IMU technology, a 3-axis accelerometer and a 3-axis gyroscope installed, with these the drone can remain stable and the pilot can release control, automatically handing over the controller to the autopilot (Scola, Reyes, Carrillo, Hespanha, & Burlion, 2020).

This drone is supported under the Parrot Education program focused on STEM, which has as its philosophy the support of education with drones in homes, classrooms and academic institutions at all levels. With the Parrot Mambo educational drone, you can learn to program algorithms with Tynker and Blockly, additionally you can use languages such as JavaScript, Python and other languages, including full compatibility with Apple Swift Playground (Niel, Mourey, & Bateman, 2021; Parrot, 2021).

Some of the features available on the Parrot Mambo Fly are:

- Integrated 60 FPS vertical camera.
- Possibility of adding a new 720p camera at an approximate cost of USD 40.

- Average flight time of 8 minutes.
- Full battery charge in 30 minutes.
- Multiple flight modes and the ability to perform aerobatics.
- Automatic take-off and landing, with the possibility of drop take-off.
- High stability.

Robolink Codrone

Robolink has developed the Codrone Lite and Pro drones with the goal of encouraging students and teachers in the STEM approach, their formula is to create robotics kits that can become more attractive to the community. The price of the Lite version is USD 120 and the Pro version is USD 180 (Robolink, 2021).

Both Codrone Lite and Pro have been designed by Robolink as a complete kit for teaching programming. The kits come with all the necessary elements to build a programmable controller and a drone, we can access step-by-step tutorials that allow to acquire coding skills in a very short time (Behera, 2018; Deng, Li, Sayegh, Birolini, & Andreani, 2018).

Building and flying the drone takes only about 10 minutes. You can learn to program custom flight patterns or even put several CoDrones to fight. It is lightweight, sleek and flies in a very stable manner. It is designed for indoor use especially. It is also based on the famous free Arduino platform, which means you will learn real coding (Behera, 2018; Deng et al., 2018).

The Codrone features a 3-axis gyroscope and 3-axis accelerometer, as well as a barometer to allow it to fly stable and keep in control of altitude. It includes Bluetooth 4.0 technology to allow your computer to communicate with the CoDrone(Behera, 2018; Deng et al., 2018).

Block coding via Snap and text-based coding with C or Python can be used to program this educational drone. In the near future, you will be able to code the CoDrone in Blockly(Robolink, 2021).

Some of the features available on the Codrone are:

- Use of optical sensors.
- Infrared sensor.
- Average flight time of 8 minutes.
- Full battery charge in 40 minutes.
- Multiple flight modes.

Airblock

Airblock is the first 3-in-1 educational drone that works by land, water and air, developed by the company Makeblock, with a STEM philosophy is for the hobbyist, families, schools and educational institutions, and allows teaching children to program in a simple and intuitive way, its price is close to USD 100 (Makeblock, 2021). The drone is composed of a master core module and six power modules based on the DIY concept, so you can build unlimited different constructions that can be expanded by means of SPC-Makeblock structures. They connect to each other magnetically so that it can be built quickly, it can also be incorporated into a hovercraft or a variety of other DIY configurations (Breuch & Fislake, 2019; Patrik Vostinár, Horvááthová, & Klimová, 2018).

It is built with a very light and solid material (expandable polypropylene) that absorbs impacts and allows the robot to fly indoors without any risk (Makeblock, 2021).

It is programmed using Makeblock App a graphical interface based on graphical or block programming, additionally you can learn the principles of aerodynamics, programming logic and develop your critical thinking skills (Breuch & Fislake, 2019; P Vostinár & Klimová, 2018). The Makeblock application is an all-in-1 controller for Makeblock robots. Their Neuron app is a flow-based programming software with AI and IoT support, which encourages creations with Makeblock Neuron blocks (Breuch & Fislake, 2019; P Vostinár & Klimová, 2018).

Some of the features available in the Airblock are:

- Bluetooth connectivity.
- Modularity, possibility of adding additional sensors (Ultrasound, Barometer, 6-axis Gyroscope, Bluetooth, 6 hollow cup motors, RGB LEDs).
- Average flight time of 8 minutes.
- Full battery charge in 90 minutes.
- Pre-programmed movements that are controlled from the Airblock control or a mobile device.
- Compatible: Android 4.1 onwards / iOS 8.0 onwards
- Apps: mBlock PC, mBlocky and mBlock App

PlutoX

PlutoX is a DIY drone from the Indian company Drona Aviation, designed not only to teach and entertain its users with the fact of flying a drone, but also to help them learn and understand the operation of this technology through construction and design, based on the implementation of the drone. The drone is shock resistant, so that new users do not have to worry about damage and large losses in the learning process. Its price is close to USD 150 (Aviation, 2021; Karthik, Kumar, Fernandes, & Arya, 2020).

PlutoX can be configured and programmed using Cygnus Open Source IDE, working with C++ language, and a large library with numerous open source examples. The SDK has an IDE similar to Arduino. The Cygnus IDE allows easy modifications by simply flashing pre-written code through a phone app called Pluto (Hadidi et al., 2021; Karthik et al., 2020).

It has an HD camera, with which ROS-based image processing can be performed. Its hardware is modular, so it is possible to add new sensors and accessories to improve the flight experience or capture information with them (Hadidi et al., 2021; Karthik et al., 2020).

Some of the features available in PlutoX are:

- Average flight time of 7 minutes.
- Full battery charge in 45 minutes.
- It has a Primus V3R controller.
- Wifi connectivity
- 10-axis stability.

Conclusions

The possibilities are endless when it comes to using a drone, many areas and disciplines can benefit from this new technology, and it makes sense that drones play an important role in the education sector. STEM (Science, Technology, Engineering and Mathematics) or STEAM (Science, Technology, Engineering, Arts and Mathematics) education should be integrated into curricula at the primary and secondary school level, as well as at the university level in higher education, and this integration should and can go hand in hand with drones.

The use of drones in the academy can help facilitate the understanding of other subjects or disciplines, such as physics, robotics, programming or mathematics. Theoretical concepts seen in class can be materialized and understood in practice, concepts such as speed and distance can be understood more quickly and efficiently by students thanks to the use of this technology. Drones awaken in teachers and students creativity, programming logic or problem solving skills and research capacity.

It is important that teachers know how to manage the integration of drones in the classroom, understand that this technology provides assistance to achieve educational purposes and that students should be helped not to lose the objective of integration, since the use of new technologies, such as drones, can distract students due to the novelty.

There are low cost and high efficiency drones on the market, which can be programmed from text or graphic languages, some are already built and others must be assembled by the user responding to the DIY philosophy. Most of them are suitable for indoor flight and their communication can be done through sensors, which today are normal in our mobile devices or computer devices, such as Bluetooth or Wi-Fi. Little by little, drones will go from being motivational tools to being an essential component for the development of education in the classroom.

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