

Civil Use of Autonomous Pilotless Aerial Vehicle

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Abstract— The pilotless, self-triggered and self-driven, autonomous, the computer programmed aerial vehicle commonly called as “Unmanned-Aerial-Vehicle”, UAV and generally known as “Drone” is one of the tremendous inventions of this century. This machine is not only small in size, but due to being a human-less, it is highly risk-free for humans as it is controlled remotely, however, work in the environment where human reach is difficult or impossible. The utilization of human brain waves to operate such a machine is an added technological advancement, which is the evolution of BCI, “Brain-Computer Interface”, that has provided the power of autonomous to this machine. This paper discusses the civil use of UAVs i.e. autonomous pilotless aerial vehicles, how they work, their characteristics, their structure and dynamics, their applications mostly commercial use etc. The concept of BCI (Brain-Computer Interface) with AI (Artificial Intelligence) to automate such machines with the computer as well as the present use of this drone for imaging and adventure photography for Vlogs is also discussed briefly.

Index Terms— Autonomous; Drones; Photography; Pilotless; Remote-Sensing; Unmanned Aerial Vehicles; Vlogs;

1 INTRODUCTION

Establishing the connection between the human brain and computer is a renowned idea which was rarely thought by anyone in the early '20s but some automakers or computer hardware designing companies were doing research on it from a different perspective. From early 20's technology especially in artificial intelligence, outstanding work is conducted and received applause because of positive outcomes [1]. This survey research relates generally to the art of aerial exploration, and all the more especially to a surveillance camera systems having an electro-optical imaging sensor or cluster with zoom focal point ability that naturally accomplishes target ground determination for the observation mission. The creation additionally identifies with a technique for utilizing such a sensor to produce pictures with desired ground determination i.e. field of view. The development likewise identifies with an unmanned elevated vehicle that joins the observation camera systems to meet surveillance mission destinations with no human contribution. Usually, the BCI i.e. “Brain-Computer Interface” technology is very popular in this field. BCI technology is specially designed for the handicap and old age people unable to perform normal muscular functions or communicate with others. Although our hands also perform operations on the signals of the brain so to use this hypothesis we can design a device that can convert those brain signals to control a machine, but a normal human can also use it [2]. Fig.1 shows various functional quadcopter drones [3] [4] [5] [6].

Acronyms Used

AI	Artificial Intelligence
AIAA	American Institute of Aeronautics and Astronautics
BCI	Brain-Computer Interface
EEG	Electroencephalography
MAV	Micro Air Vehicle
UAS	Unmanned Aircraft System
UAV	Unmanned Aerial Vehicle / Uninhabited Aerial Vehicle

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2 SHORT HISTORY

As per earlier records, UAVs (Unmanned Aerial Vehicles) were first used as warfighting vehicles occurred in 1849 [7]. A lot of improved development happened to automate UAVs. The first mechanical-based UAV was made by Americans Lawrence and Elmer Sperry in 1916 [8]. They constructed architecture for the gyroscope, stabilized the structure, and stepped consequently built the first autopilot for this pre-programmed flying machine. In the same year, a pilot-less aircraft was also designed by them [8] [9].

3 UAV STRUCTURE AND DYNAMICS

Advancement of the uninhabited i.e. un-peopled airplane, or so-called “Robotic Aircraft”, as “Unmanned Aerial Vehicle” i.e. UAV and “Micro Air Vehicle” i.e. MAV equipped with independent control gadgets has advanced rapidly especially in defence applications worldwide. The enthusiasm for this field is evolutionary and keeps on spreading. Despite the fact that these air vehicles could be named being for either military or common purpose, but the most striking advancements to fall it is into the military applications widely. With advancement, the self-decision taking uninhabited flying machines additionally hold wonderful potential for common utility applications and keeping in mind that a portion of these common uses is as of now being under research investigation. UAVs with their major impact mostly used in aero-space scenarios, where it accomplishes the critical missions e.g. recognition of scenes of the site through image recognition technology or saving or defence missions in hostile fields [10] [11]. The way of action of UAV is that it forms fling using the sample observation tool along with data fusion simultaneously, which make it efficient than a pilot plane [10]. Considerable work was done to interface the brain with a computer to automate the aircraft autopilot with programming and artificial intelligence [1]. This has grown an evolution to AI with the new domains of virtual reality and BCI, “Brain-Computer Interface”. The first brain-computer controlled drone race took place in the University of Florida, held in 2016 which it called the race controlled by the thoughts of the pilots [12] [13] [11].

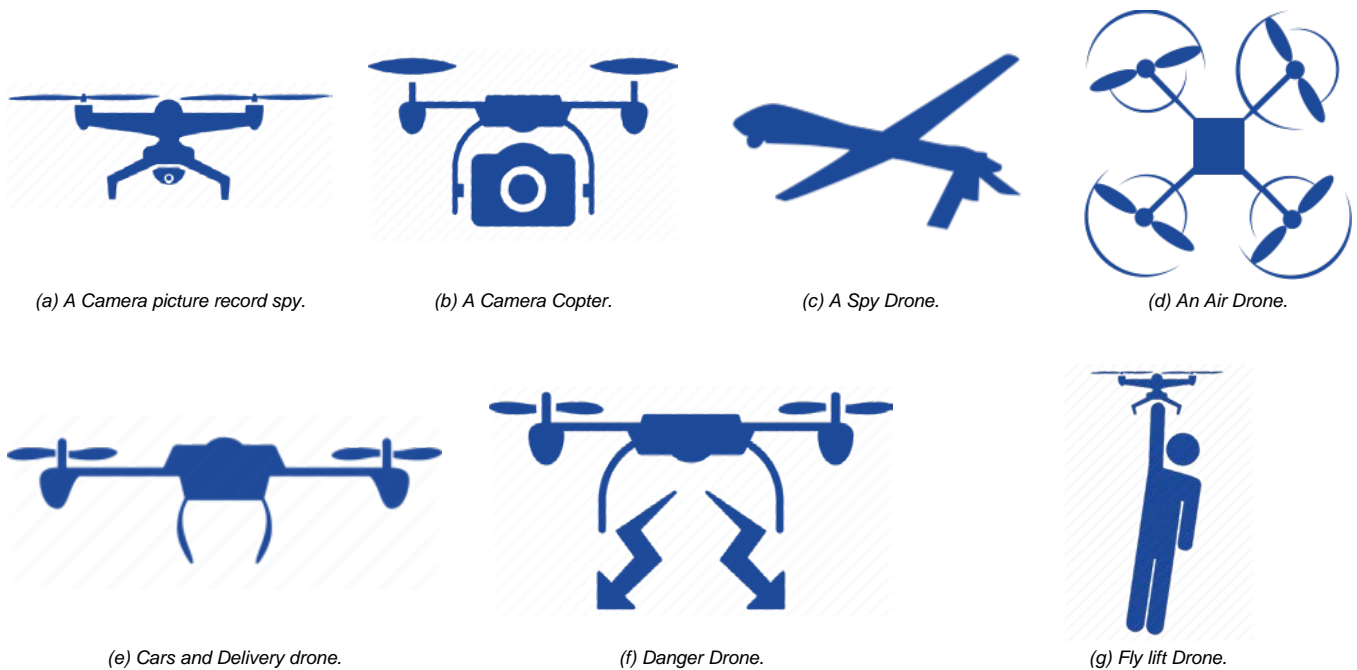


Fig. 1. Quadcopter vector Drones of various use and functions. Figures adapted from [3].

4 CHARACTERIZING UAVS

UAS i.e. “Unmanned Aircraft Systems” is a kind of fueled aerial vehicle worked remotely or independently with pre-programmed flight also called “Drones”. Some of the common known drowns are (1) A Camera picture record spy, (2) A Camera Copter, (3) A Spy Drone, (4) An Air Drone, (5) Cars and Delivery drone, (6) Danger War Drone, and (7) Fly lift Drone, etc. All are shown in Fig.1 with their purpose of built.

Fig.2 shows how the drone works. These air vehicles are remotely controlled from earth or base stations via some satellite link through the operator to operate freely, securely, and far remotely usually at a distance of continents as well [14].

UAVs comes under three categories: (1) Rotary crafts, (2) Aircraft or zeppelin balloons, and (3) Settled-wing crafts. The basic function of each category type offers improvement in certain kinematic-dynamic parameters that make it effective for specific applications [15]. Aircraft or zeppelin balloons are used for natural weather and atmosphere checking missions, beach front scouting [15]. Settled-wing crafts can fly with high speed and are broadly being utilized in the military applications, for example, sea ice thickness mapping, airborne observation, and multipurpose inspections etc. [15] [9]. Rotary crafts have the most mixed variety; they are being produced in various structures, for example, mono-rotor i.e. helicopter or multirotor

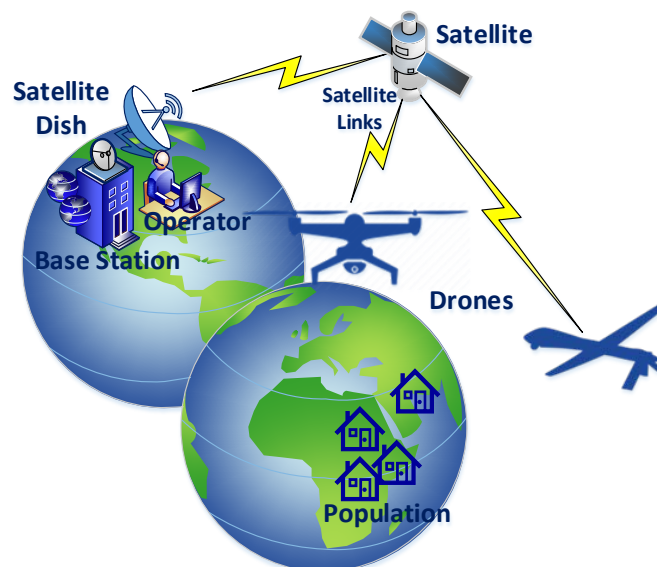


Fig. 2. How usually UAVs or Drones work.

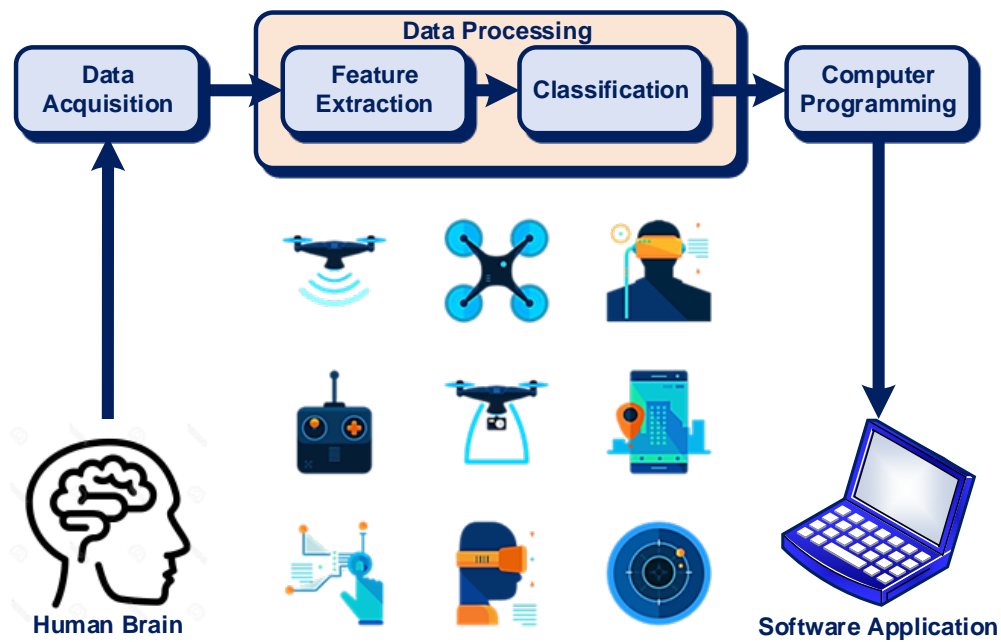


Fig. 3. Brain Computer Interface to operate UAV. Partial Figure adapted from [3].

i.e. quadcopter, and so forth. In contrast to the other two classes, the Rotary crafts have got amazing considerations for their tremendous commercial use. Being cost effective their capacity of accurate moving in restricted space makes them the perfect machines [9] [15] [16] [17] [18] [19] [20].

The AIAA, American Institute of Aeronautics and Astronautics Inc. characterizes a UAV as “An aircraft which is designed or modified, not to carry a human pilot and is operated through electronic input initiated by the flight controller or by an onboard autonomous flight management control system that does not require flight controller intervention” [8] [21]. The working pilot or a traveller/passenger is allowed or part of travel by a UAV. Subsequently, the rocket of any type does not come under this category of drones [8] [21].

5 USE OF BRAIN-COMPUTER INTERFACE “BCI”

The UAVs are triggered through computer commands activated through the human brain using “Brain computer interfaces” i.e. BCI technology. BCI is a system consists of modernized gadgets used as wearable consisting of sensors which read the mind of the human and provide a signal to the computer, which then activate machines remotely. The major use of this technology is to rehabilitate persons with disabilities via assistive technology gadgets. Another main use of this technology is to operate UAV located remotely via brain and computer [2] [22] [23] [24] [25].

Fig.3 shows the concept of BCI operating UAV. The brain waves are read as a set of signals through the data acquisition module, which converts signal in the form of data to process it by extracting features and decoding into commands. The commands are handled through programming languages which execute the code for a particular action to operate or

control remote machine or UAV. Various techniques for examining changes in brain activity have been found for use in BCI, extending from nuclear magnetic resonance to electrode microarrays embedded directly into brain tissue. Among these methodologies, scalp-recorded Electroencephalography (EEG) is a prevalent decision. Presently EEG is economical, making it reasonable for use in assistive gadgets [2] [26] [27] [28] [29] [30].

6 UAVS FOR REMOTE SENSING AND EARTH RESEARCH

Since UAVs are human-less vehicles, these are the best choice to capture the geography of the earth. Various focal length cameras are used to capture high-quality earth images exploring cities, lands, farms, oceans, mountains, valley and desserts etc. capturing all natural beauty. UAVs are also used to sense the atmospheric pressures and weather conditions above earth space. To get instant updates of earth-surface dynamics, researchers frequently depend on access to the most recent remote detecting information. Significant progress has been made in the advancement of specific Earth perception sensors for estimating an extensive variety of procedures and highlights. UAVs are therefore the best option to capture information of high-resolution images, high-density pixel data, and other remote sensing geo-spacial data with low and economical cost and high operational flexibility [27] [28] [31].

7 MILITARY SURVEILLANCE

UAVs are mostly under focus in military use for surveillance and aviation work due to their outstanding performance measures and flexible handlings. It is used for the purpose of navigation, image photography of any desired location, and also used for attack and self-destruction in defence purpose.

UAVs are also most helpful to photograph mediators, mission organizers, and control pilots in their missions of guaranteed success. It keeps in mind while taking pictures (1) Picture resolution with sufficient coverage to determine other related information for the investigators, (2) capturing the geospatial data of the location and neighbouring ground to exactly find the object of concern [21] [32] [33] [34].

8 AERIAL ADVENTURE PHOTOGRAPHY FOR VLOGS

Capturing videos and dubbing the story of adventure tour is one of the healthy hobbies of youngsters and youths these days around the world. The uploading those videos on social media YouTube channels make them a big sense as Vlogs when the people of interest comment and advise more. This not only promotes tourism but people who never seen such adventure beauty of the world can enjoy the virtual journey. The youths are more interested in handy camera with stand, smartphone, WiFi, memory and a sophisticated high efficient aerial drone camera that can capture the videos above the lake, mountain, busy road or building from the height. The industries are more interested in such products to facilitate common people with the economic outcome and more of that a best and healthy hobby [14] [10] [27] [35] [36] [37].

9 CONCLUSION

The development of UAVs have changed the views of the people around the world as these vehicles are pilotless hence could fly fearlessly having no human risk. Mostly these are currently used commercially as a source of adventure photography above the hills, mountains, buildings, valley, lake, road etc. operated via remote control. This has brought quality in video imaging and gave a boost to the field of photography with low risk and cost-effectiveness.

Another main use is military, defence, and surveillance. The drones work on brain-computer interface BCI technology. The main applications are spying, destruction remotely. There is a need to improve the manufacturing of such product with the reduction in size, weight and cost, with an increase in camera features, battery time, the field of access, and durability.

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