Technology in Society 45 (2016) 83–90

Contents lists available at ScienceDirect

Technology in Society

journal homepage: www.elsevier.com/locate/techsoc

The societal impact of commercial drones

Bharat Rao*, Ashwin Goutham Gopi, Romana Maione

NYU Tandon School of Engineering, Brooklyn, NY, USA

ARTICLE INFO

Article history:
Received 22 December 2015
Received in revised form
26 February 2016
Accepted 26 February 2016
Available online 15 March 2016

Keywords:
Drones
UAVs
Commercial drones
Business models
Privacy
Security

ABSTRACT

The use of drones or Unmanned Aerial Vehicles (UAVs) in commercial applications has the potential to dramatically alter several industries, and, in the process, change our attitudes and behaviors regarding their impact on our daily lives. The emergence of drones challenges traditional notions of safety, security, privacy, ownership, liability, and regulation. With their ability to collect data and transport loads, drones are re-shaping the way we think and feel about our physical environment. However, they also burdened with the perception as being surveillance equipment, and their commercial use has been criticizied by both individuals and activist organizations. In parallel, drones have been legitimized by regulations and licenses from federal agencies, are used by companies for surveying, inspecting, and imaging, and their technological development are driven by active communities of hobbyists and enthusiasts. This tension presents unique challenges to their integration in the currently existing public, governmental and private infrastructure. In this paper, we will take a look at a few of these issues to understand how drones influence society, and present reccomendations for practitioners, policy makers, and reseachers studying this phenomenon.

1. Introduction

The advent of new and emerging technologies has broad economic, social and personal impacts [1]. Most commonly, they influence practice, the way we do things, perform tasks, achieve goals, etc., while creating new capabilities and possibilities for action [2]. The Internet, for instance, did not just allow us to share information faster and cheaper; it completely changed the way we conceive of and use information. Usually, these changes are not just related to the features of the technology, but also how we interpret their usability. Rather than the technology itself, it is our use of it that affects our perception, and thus our behavior [3]. In this paper, we consider how an emerging technology, commercial unmanned aerial vehicles, more commonly known as drones, affects us by challenging some of our societal values and beliefs. In particular, we argue that the way this technology is currently used has an impact on our conception of safety and security, privacy and ownership, individual and commercial liability, and the effectiveness and process of governmental regulation. Drones are thus becoming increasingly important in the fields of science, technology, and society.

Traditionally, discussions around UAVs have been centered on their use in military surveillance and active combat. Since their emergence, the use of UAVs in combat zones has been heavily debated, and the conversation has been focused on their ethics, effectiveness, transparency and legality [4]. Despite multiple criticisms from human rights organizations, their judicial use has been upheld by many of the world's governments. The official stance of governments is that drones prevent causalities by providing accurate surveillance information and precision strike capabilities, while their opponents emphasize their inability to discern between intended and unintended targets [5]. Increasing discussion has also focused on the use of drones over domestic airspace for the purpose of surveillance in the interest of national and local security. The dialog closely mirrors that of combat drones, as it is the same issues of ethics and privacy that shape the conversation [6]. This is particularly reflected in journals of law, ethics and technology policy as there been multiple articles that have described various issues regarding the use of drones over domestic skies [7].

In this paper, we focus on a related but slightly different phenomenon: the emergence of commercial drones. These drones are designed, built and used by individuals, businesses, and organizations. Though commercial drones owe much of their development to their military counterparts, most designs do not resemble the larger and more expensive surveillance drones [7]. Commercial drones typically are built on a small platform, use cheap and easily

* Corresponding author.
E-mail address: brao123@gmail.com (B. Rao).

http://dx.doi.org/10.1016/j.techsoc.2016.02.009
0160-791X/

available components, and can lift only an average of 4 pounds [8]. They emerge primarily from the work of UAV and quad copter enthusiasts, and their creations have historically not been the subject of scrutiny, usually due to their small numbers and lack of public interest.

Drones have the ability to carry multiple sensors, transmitters, and imaging equipment. As the use of drones continues to proliferate, they will impact industries ranging from entertainment to agriculture, from construction to delivery markets [4]. Their use in Hollywood film production has already been legitimized through the creation and use of specialized high-definition imaging drones. Civilian UAVs have the potential of becoming a dominant infrastructural platform. Not only are they cheap and easily available, they can be deployed across many industries to perform complex, expensive and dangerous tasks [9]. Currently, short battery life and the lack of proper regulation (and enforcement) remain the two major limitations for their rapid adoption.

Several organizational and industrial standards associations have been created to either design drones and or to support their integration with existing infrastructure. They have developed new and unique market-focused applications and service platforms, and have influenced the social perception of this technology and its associated business models. This somewhat inevitable growth of drone-based businesses seems destined to transform consumer behavior as well as reshape our notions freedom and responsibility [10]. In the following sections, we will look at how this technology was developed, how it was adopted, and how it is used in individual and commercial applications. It will provide an overview of what drones are, how they have come to be, and how they are perceived and used today. We will then use discourse analysis to explore the impact that drones have had on various societal aspects, and provide recommendations for practitioners, policy makers, and researchers studying this new phenomenon.

2. Background

The definition of UAVs, commonly known as drones, is rather broad. This is understandable considering the wide range of configurations that exist. In practice, any aerial vehicle that does not rely on an on-board human operator for flight, either autonomously or remotely operated, is considered a UAV [9]. UAVs range in size from large military drones with a wingspan of nearly 200 feet to commercially available inch-wide micro drones. Their ranges of flight vary, with some commercial drones being confined to a few feet away around the operator to advanced military drones that can fly for over 17,000 miles without having to land. Likewise, there is a huge variation in their maximum flight altitude, which can be anything from a few feet to a maximum of 65,000 feet [10].

Most commercially available drones today follow a similar design (refer Fig. 1). The basic design has a microcontroller that acts as a flight control, usually with four but up to eight motors and propellers, a radio receiver, electronic speed control, and a battery, built on a light plastic or metal frame [11]. In addition, gyroscopes and other sensors are added to increase the mid-air stability of the drone and a GPS device can be used for navigation. Most hobbyist drones also carry a camera for aerial imagery, and a gimbal for added image stability. Additionally, other sensors can be attached, though there is a trade off with increased functionality and weight [11]. DJI, 3DRobotics and Parrot are some of the leading hardware manufacturers, and their sales includes both assembled drones and drone components [10].

2.1. Development

The development of unmanned aerial vehicles (UAV) is primarily rooted in military research. Though it was initially conceived as a weaponized vehicle for the purpose of reducing the risk to human operators in hostile territory, the technology, capabilities, and use of UAVs have since evolved to include surveillance and the collection of data [11]. The shift from exclusively military drones to civilian application can be traced to the aftermath of Hurricane Katrina in 2005 [12]. In the broad rescue effort that followed, military drones equipped with accurate infrared cameras were widely recognized as a useful field asset. This led to the Federal Aviation Administration (FAA) first issuing certificates to allow M7RQ series military drones to be used over civilian skies in 2006 [13]. Since then, drones have entered the mainstream market after years of development in the open source and maker communities. For example, 3DRobotics, one of the leading drones manufacturer, began in 2009 with ArduPilot, an open source autopilot platform based on the Arduino [14]. Likewise, DJI and Parrot have open source hardware and software projects where a community of enthusiasts is invited to join the development process. Though most of the development initially was in hardware, there has also been a major improvement in autopilot software that allows autonomous flight. An example is Openpilot, a project that aims to create universal autopilot software that can be used to fly civilian drones for humanitarian, academic, and hobbyist applications [15].

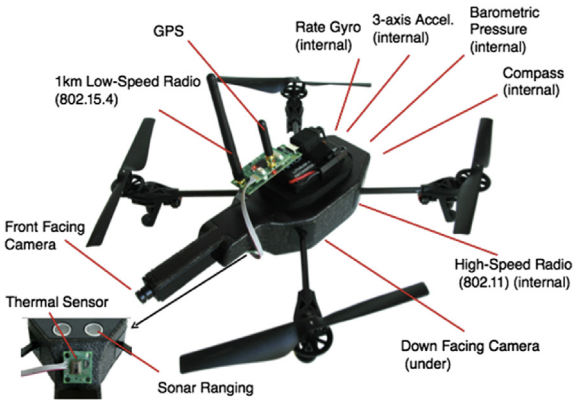

Fig. 1. Structure of a commercial drone.
Source: http://wise.ece.cmu.edu/redmine/attachments/download/88/drk-parts.png

The development of drones draws a parallel to that of other emerging technologies, like 3D printers. By creating and providing access to development tools, drone manufacturers have invited the open source community to their design process. Since the open source projects consisted of geographically distributed communities, most of the designs were created digitally using modeling software. This made it easy to share, test, and modify the designs [16]. 3D printers also played an important role in this process as they allowed rapid prototyping and manufacture of drone components. In fact, the 3D files containing the design of certain parts are available online for anyone to download and print for free [17]. The drone manufacturers utilize the passion and expertise of the community to create technology that best serves their need. The availability of support, knowledge, and access to resources provided by the community has greatly helped in reducing the barriers to entry for new drone hobbyists and amateur developers [18].

In addition to manufacturers, drone-related services have emerged as a new business in this area. These services take many forms, the simplest being the provision of drone assembly, maintenance, and repair [19]. Rental services for drones have also popped up in many cities, and they allow individuals and companies access to drones on an hourly or daily basis. These rental drones are