Unmanned Aerial Vehicles in Consumer Applications

By Neeraj Kumar, Deepak Puthal, Theocharis Theocharides, and Saraju P. Mohanty

The recent advances in communication, computation and sensing technologies have paved the way for researchers, academia, and aircraft industries to strive for the design of efficient enabling technologies for unmanned aerial vehicles (UAVs). UAVs are being deployed for surveillance, monitoring, and various other operations in wide range of applications such as military, consumer, and commercial. A web of UAVs forming a heterogeneous network offers dynamic solutions to provision wireless and internet connectivity to devices, sensors, and machines in various situations, such as-natural disasters, mountainous terrain, etc. Thus, achieving high-speed wireless communication for next-generation communication systems (5G) has emerged as one of the applications of UAVs. Remote sensing and surveillance, as well as critical infrastructure monitoring and control, are further applications which UAV technologies are disrupting. However, researchers in this area face significant challenges, such as, power and energy constraints, physical (size and weight) constraints, security and communication issues, all of which need to be tackled by adopting advanced and innovative tools and technologies. UAVs have strong potentials to play a significant role in supporting the smart communities to collect, analyze, process, and transmit huge volume of seamless data generated by various IoT-based solutions in smart ecosystem. Despite advancements in communication protocols and the revolution in the radio technologies, it is quite difficult to satisfy the communication and security challenges in heterogeneous UAV networks. Some unique exemplary challenges, such as efficient service discovery, time-critical communication between devices, dynamic choice of the appropriate radio technologies, network offloading and energy constraints, remain a continuous quest among researchers and require significant effort to address.

Earlier significant emphasis focused on cloud offloading where data analytics was offloaded from the UAV to a datacenter. At the present, the UAV can act as the edge of the network, as an IoT device, embedded with intelligence and complex data analytics capabilities. Moreover, the network capacity enhancements through network offloading can help to address various challenges in UAV networks. The positive and negative traits of software defined networking and content centric networks in heterogeneous UAV networks are yet to be explored. The amalgamation of UAVs with Internet of things (IoT), advanced sensor technologies, and cloud/edge computing, has extended their role in the design and development of future smart cities. Small size, high manoeuvrability, and ease of deployment of UAVs make them suitable for boundless viable applications such as-traffic monitoring, remote sensing, logistic transportation, disaster monitoring, and agriculture. Further, UAVs are being evaluated in various consumer applications. For example, Amazon, Dominos, and DPDHL have explored product delivery using UAVs. However, there are lot of challenges attached to the wide applicability of UAVS in consumer application in future smart cities. The evolutionary transformation in consumer applications can help to improve the quality of service (QoS) and quality of experience (QoE) for end user domain associated to all smart communities. So, keeping these aspects in view, the theme of this Feature Topic is to provide an in-depth analysis both theoretically and analytically of the enabling technologies and architecture along with communication and security challenges of UAVs when deployed in commercial application in future smart ecosystem. Therefore, in this special section, state-of-the art research advances in UAV are presented.

The article “Location Aware Network of Drones for Consumer Applications: Challenges and Solutions,” by Vashisht and Jain proposes a network of drones-based architecture to support efficient management between multiple drones for sensing, analyzing and processing data and summarizes the open issues and future directions. This multi-UAV network utilizes the extended concept of mobile ad-hoc network for efficient packets transfer. Using this architecture, the usage of location-aware drones have been presented as Product delivery agent, and QoS enhancement agent for Internet services.

The article “Obstacle Avoidance for Unmanned Aerial Vehicles in Unknown Environments Using Visual Features,” by Padhy et al., proposes method to rely solely on the scene structure acquired from the frontal monocular camera of a UAV and performs a light-weight predictive operation for the next course of maneuver. The relative size of the object on the image plane keeps on increasing as the UAV moves towards the object.

The article “Combining UAVs with AI technology for traffic congestion recognition,” by Jian et al., presented a practical traffic congestion recognition framework based on UAVs. First, the traffic scene images are captured by UAV system based on route planning technology. Subsequently, the aerial image data is further processed by using convolutional neural networks (CNNs). Finally, the output recognition result will be transferred to traffic management center.

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