Future Scope of Unmanned Aerial System for Consumer Utilities in Covid-19 pandemic

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Abstract - Drones or ‘the eye in the sky’ is the technology of future that promises contactless, time bound and efficient delivery of services at consumer’s doorstep in times of COVID-19 pandemic. Its well-known applications in military and civilian fields are already explored by myriad authors as presented in this work. But there exists a lack of proper categorization of applications of the UAVs to the best of author’s knowledge. This work proposes a model for their proper categorization on the basis of UAVs utilities. It also emphasizes on UAV aided items distribution category by exploring the case study of medicine delivery during COVID-19. The work mentions potential benefits associated with the UAVs deployment during pandemic along with its futuristic applications.

Keywords – UAV, Drones, Model, COVID-19, UAV-aided Data Communication, UAV-aided items distribution, UAV-aided data gathering

1. INTRODUCTION

With the characteristics of light weight, hovering ability, ease of use and deployment; the Drones or Unmanned aerial vehicles (UAV) as shown in Fig. 1, are the flying robots that play a significant role in the provisioning of services. With the assistance of Global Positioning System or Inertial Measurement Unit, the flying machine can be remotely controlled or can be flown autonomously by software controlled flight plans in their embedded systems. The widespread use of UAVs is not only manifested in the military services but also, is significant in commercial applications like weather monitoring, firefighting, surveillance, traffic monitoring, search and rescue. For instance, the Aquila [1] and Loon [2] are the aspiring projects of Facebook and Google respectively to provide Wi-Fi services in remote areas using a network of multi-UAVs. Similarly, consumer vendors such as DHL and Dominos have successfully tested UAVs for cargo and product deliveries in smart city test beds [3–5]. These recent ambitious UAV projects have a strong and vast potential to facilitate various consumer application in futuristic smart cities [6].
With the popularity of the UAVs networks, it is observed that the UAVs are being used for various monitoring and SAR applications and their usage is expected to increase in the upcoming time. Tripicchio and Dabisias [7] utilized the concept of drones in smart farming by developing algorithms that effectively categorized the ploughing technique by using an RGB-D sensor. Similarly Caska and Gayretli [8] designed an algorithm based on the integration of both types of unmanned vehicles, i.e. unmanned ground vehicle and unmanned air vehicle for patrolling of area, where human intervention is considered dangerous. Giitsidis et al. [9] designed a scheme to detect fire and human from high altitude using multi-UAVs having a thermal and optical sensor. Coifman et al. [10] presented a model to utilize multi UAVs for traffic monitoring. They are provided with RWIS (road weather information system) and night vision camerasto work well in bad weather or bad light. The gathered information is sent to groundstations linked with the geographic information system. Quarter et al. [11] and Hausamann [12] have worked on UAVs which were deployed for monitoring the photovoltaic plants and oil pipeline inspections. One of the most striking applications of UAVs is items delivery. In recent years, it has been noticed that the trend of utilizing UAVs for delivery of goods, essential commodities and articles, and construction material is increasing exponentially. Evan Ackerman [13] exploited the benefits of UAVs for delivering of goods purchased from online merchant Amazon. On similar trends, the Bamburry[14], Stolaroff [15] and Brar [16] have discussed about the utilization of drones for delivery of services. Recently, the drones are even utilized to save human lives in critical situations. Claesson et al. [17] investigated the utilization of UAVs for delivery of an automated external defibrillator (AED) for cardiac arrest patients. Similarly, Scott and Scott [18] provided models for utilizing UAVs for the delivery of blood, vaccines, medicines, and other healthcare items, to the area where inaccessible roads hinder the delivery of such urgent products.

Furthermore, the UAVs are also found effective in post disaster area management and for serving the large number of ground users as Aerial base station. Zhan et al. [19], in his study, employed UAVs as data communication nodes which assist in the extension of communication range between User Equipment (UE) and Base Station. Mukherjee et al. [20] developed a scheme by deploying a group of UAVs over the total area (say X) for serving the area with stationary
UAVs by splitting it into small zones X1, X2, and X3. By obtaining the updated information of disaster situations, these aerial vehicles were utilized as Aerial base stations.

Thus, huge amount of literature is prevailing, that entails the work relevant to the UAVs applications in various fields. However, it has been observed that the existing literature mainly focuses on MAC layer, routing and energy, but to the best of the author’s knowledge no work has been carried out on categorization of consumer applications on basis of their utility. Further, there exists a research gap on development of drones for futuristic consumer applications. In the present work the existing proposals have been studied independently and have been categorized according to various parameters considering the different modules and functionality. Each and every category is explained for effective understanding of the problem.

2. PROPOSED MODEL

2.1 Overview
In the current work, a model for UAV-assisted consumer application has been proposed. The main objective is to develop this model is to provide on-the-go services by utilizing the UAVs in a specific area.

2.2 Model

![Diagram](image)

**Figure 2**: Proposed model for categorization of drones on basis of utility

2.2.1 **UAV-aided data communication**

In UAV-aided data communication, the deployment of UAVs is in the form of balloons and small aircraft. Drones can provide reliable and cost effective wireless communication to User Equipment (UEs) in a smart city. On the other hand, the utilization of Drone Small Cells (DSCs) is a promising solution for temporal and on demand communication service to desired areas. It is specially, suited where fabrication of cellular infrastructure is expensive or challenging due to geographical challenges or where the need is totally temporary such as sport events, off-site media conferences, and political rallies. In above scenario, the host mobile network witness’s huge traffic
load, this causes congestion of channel and data communication delay. The UAVs can handle a part
of the data traffic load. Moreover, in comparison to the traditional terrestrial Base Stations, the UAVs
gain advantages to calibrate their altitude, overcome the Non Line of Sight (NLoS) barriers and have
additional capacity to cover unreachable areas. Significantly, drones play an important role in
connecting the Internet of Things (IoT) devices, like wearable sensors, smart-phones, smart electricity
meters and smart grids to Internet. Generally, these devices have smaller transmission power and less
capacity to communicate over a long distance. In this scenario, UAVs act as wireless data
communicators to upgrade the coverage and connectivity of these small devices. This helps to enhance
Quality of Service, even also for next-gen 5th Generation networks.

![UAV-UEs](image)

**Figure 3**: UAV-aided data communication

2.2.2 **UAV-aided data gathering and scrutiny**

The **UAV-aided data gathering and scrutiny** renders myriad applications like monitoring the
traffic, public safety, homeland security, farm and oil pipeline inspection,
sensor data collection and coverage of sports events as shown in Figure 3.2. The drones can act as data centers to aggregate data, information from the ground applications by continuously moving or remaining quasi-stationary above the serving area. For instance, the moving drones that are deployed for border patrol cover a large geographical area and provide sensitive data to the remote controller without putting human life on risk. The UAVs can also act as a significant medium for data gathering from IoT sensors, ground users, smart grids and reading of energy consumption from smart electricity meters. Thus, UAVs can play a significant role of an interlocutor in rendering internet or 5th generation services to IOT devices and consumer applications.

### 2.2.3 UAV-aided items distribution

![Diagram of UAV-aided items distribution](image)

**Figure 5: UAV-aided items distribution**

The *UAV-aided items distribution* is one of the novel entrants in this domain as shown in Figure 5. The capability of UAVs to hover and cover the distance with good speed, makes them a favorite among various logistic applications. In recent years, the logistic applications have witnessed an increase in the trend of utilizing UAVs for product delivery, such that, the delivery of hot pizzas by a UAVs now a reality. The world’s largest pizza chain Dominos had successfully delivered first ever delivery of food by drone to its customer. Furthermore, to provide deliverables even faster, the online merchant company Amazon had tested its prime air drone delivery in December 2016. United parcel service started testing UAVs to provide medicine in an emergency or congested cities and remote areas. Nowadays, numerous online merchants are also looking for the approval of UAVs as a regular delivery option. DHL, the world’s largest logistics company has started its delivery of goods and logistics using UAVs. Besides this, many start-ups, which are using UAVs for commercial activities, make it more famous by introducing the UAVs to ordinary people.
2.3 ASSOCIATED BENEFITS AND CHALLENGES

In UAV aided data communication the UAVs are deployed as Unmanned Aerial Vehicles small cells (USCs) with a line-of-sight for providing enhanced network coverage and rate of data transmission. These USCs are beneficial to deploy in disaster management situations as they are robust to environmental changes. Major challenges with data communication are deployment, data offloading, security, and privacy.

In UAV-assisted data gathering and scrutiny, UAVs are used for monitoring purposes in areas such as monitoring traffic, pipeline monitoring and inspection for any leakage, real-time coverage of any event and border patrolling. UAVs may also be used for data aggregation as collecting sensor data, collection of data constantly from the user at the ground or from IoT devices. Major Challenges associated with data gathering and analyzing are use of energy, data processing and bandwidth.

In UAV-aided items distribution, UAVs may be used to deliver small packet goods or medicines in disaster-prone areas. Aquila & Loon are the two examples of this domain by Amazon and Google respectively. Challenges associated with UAV-aided items distribution are location accuracy, energy efficiency and public safety. Although a multi-UAV system is better than a single-UAV system, some of the above constraints are needed to be kept in mind while implementing Multi-UAV systems.

3. CASE STUDY AND FUTURE SCOPE OF UNMANNED AERIAL SYSTEM IN COVID-19

3.1 Unmanned Aerial Vehicle apparatus for Delivery of Necessary Items in COVID-19 Pandemic. The futuristic use of drones can be witnessed in item delivery that makes us to utilize the drones in the field of interaction free distribution of goods and medicine in lieu of COVID-19 pandemic.

3.1.1 UAVs delivering essential medicine during COVID-19 Pandemic

Due to the COVID-19, the aim of mobile robotic system is to minimize the direct human to human interaction for items delivery. The complexities involved in the proposed system are allocating the tasks and division of mentioned tasks/jobs, organizing and maintaining the constant communication links between the vehicles and mobility control. An approach for implementing the various aspects of hybrid vehicle delivery systems should aim for collaborating vehicles on the ground and in the air. With the help of this, human-to-human interaction will be minimized so that the virus spread can be constrained by ensuring social distancing. The benefits of the proposed model are as following:-
• **Increasing their Utilities potential** - In this observation, the proposed model can cater how the delivery services play a vital role to fulfill the rising demands of delivered goods.

![UAV-aided medicine delivery](image)

**Figure 6**: UAV-aided medicine delivery

• **Time bound Items delivery** - It helps to prioritize the utmost mandatory goods required in emergency situations like disaster affected areas. With UAVs, the goods can be easily delivered in short time in the crowded city or the city affected by traffic jams.

• **Dependable medium of communications** - A hybrid model by utilizing the UAV network with VANET (Vehicular Ad Hoc Networks) can be operated and monitored safely. The concept of UAV makes last mile delivery possible which means it increases the consumer expectations and provides efficient result. In real-world scenario this study helps to analyze appropriate network approaches and capacity gain. Time-dependent delivery such as delivery of medical goods is a primary factor of the delivery performance by UAV. After comparing all these three complexities, it is concluded, that UAVs play a very important role in items distribution during covid-19.

### 3.1.2 Potential Benefits and Future Scope of Unmanned Aerial System in COVID-19 pandemic

UAVs or Drones having a remarkable quality of reaching out to the inaccessible areas can play a major role in various domains as follows:

1. **Surveillance of Gatherings**: Drones equipped with night vision or surveillance cameras may help in monitoring the crowd. During COVID pandemic this helps in maintaining the social distancing by monitoring the crowd gathering at public places. It can also help the police officials to avoid visiting the places physically.

2. **Public Statements**: Along with surveillance cameras, drones can also be equipped with loudspeakers to notify people about the guidelines put in place in a state of emergency.

3. **Screening of Masses**: Drones equipped with an Infrared camera or thermal camera can measure the temperature of several people simultaneously while infrared thermometers can measure the temperature of people individually. This helps in the screening of people in the crowd without any human contact with the infected person.

4. **Showering of Disinfectants**: Similar to sprinkling pesticides in agriculture, drones can be used for showering disinfectants in geographical areas which help in reducing the risk of further spread of coronavirus.
4. CONCLUSION

UAVs promise a bright future for interaction free delivery of services in pandemic times. However, the provisioning of these metrics is a challenging task. For the purpose three techniques utilizing the different environments for UAV networks are proposed in this work. First technique, utilizes the UAVs as data communication agent, the consumer can provide with the on-the-go facility. The consumer can demand the Internet facility as per their requirement at any place. Second technique, utilizes UAVs as the data gathering and scrutiny agent, which can help deliver efficient and time bound services like avoiding the crowd and traffic of cities, monitoring the defunct and underground pipelines and ensuring safety and security of cities. Third technique, utilizes the UAVs as items distribution agent. This service uses the consumer’s location to deliver various items or products such as hot pizza, parcels and newspaper. The major focus of the technique is to minimize the delay of transportation for basic amenities in smart cities. Furthermore the role of UAVs as medicine delivery agent in containment zones during COVID-19 is explored. This functionality makes them the technology of future that can even be used in sanitation and hygiene, making public announcements, screening of crowds and avoiding of physical visits to the maximum extent possible.

REFERENCES


