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Drone usage to combat COVID -19: an extensive survey of how drones are used to contain COVID -19 pandemic

Chandra Vadhana
chandra.vadhu@gmail.com
Agni College of Technology, Chennai, Tamil Nadu

Kannappan
mallu.patty@gmail.com
M. S. Swaminathan Research Foundation, Chennai, Tamil Nadu

Agnishwar Jayaprakash
agnishwar@gmail.com
Agni College of Technology, Chennai, Tamil Nadu

ABSTRACT

This paper evaluates the vital role of drones in the case of the current pandemic situation COVID – 19. The main objective of this paper is to assess how drones can play a crucial role at this time of crisis by containing the spread of the virus. Drones or unmanned vehicles have been in use for many purposes during natural calamities and disasters. These include earthquakes, flooding, Tsunami etc. Here, in this paper we emphasize on how drones can be used to contain the current COVID -19 pandemic by spraying disinfectant on various surfaces. Since the corona virus is a fast spreading disease by means of person to person contact and surface contact, it has to be contained to a large extent to avoid further spreading of the virus. Drones play a crucial role in containing the surface spread of COVID – 19 by spraying disinfectants in hotspot areas such as malls, hospitals, high rise buildings and other public places. Here, we have also discussed the importance of sanitization to stop the spread of the virus.

Keywords— *Pandemic, COVID -19, Drone, disinfectant, natural calamities, surface spread*

1. INTRODUCTION

Aerial means of transport is widely used in military and civil emergency medicine owing to the speed of action, inability of ground vehicles to reach out from heights, and the ability of aerial vehicles to reach distant, otherwise inaccessible places. However, apart from these undoubted benefits, air transport also has limitations, which include dependence on weather conditions, relatively lower load capacity compared with ground ambulances, and much higher costs than in the case of land transport.

Unmanned aerial vehicles, commonly known as drones, may be an alternative source to deal with disasters. The 20th century saw the development of unmanned aerial vehicles controlled by radio waves, but it was the turn of the 20th and 21st centuries that resulted in an increased interest in their application for military purposes, mainly as an element of object recognition or antimissile exercises. Work on unmanned aircrafts for direct transport and medical supply has started off late [1]. India first used military drones during the 1999 Kargil war with Pakistan where Israel supplied India with IAI Heron and Searcher drones for reconnaissance. Since then India has procured numerous Israeli military unmanned aircrafts. India's Defense Research and Development Organization (DRDO) has also developed its own domestic Unmanned Aerial Vehicle (UAV) or Unmanned Aircraft Systems (UAS) program.

2. DRONE BASED APPLICATIONS IN INDIA

The drone space reached its inflection point in 2013 when Amazon announced that it would seek to experiment with drones to make deliveries. Since then, we have seen an explosion in the usage of drones and drone-based services in the retail and commercial space. Drones are being explored extensively across an array of industries, including, but not limited to, construction, real estate, e-commerce, agriculture, utilities and energy, financial services, and media and entertainment.

Consumer and commercial drones have grown exponentially thanks to merger and rapid advancement in two completely different technologies: radio communication [3] and smartphones. It is elementary that radio communication help in controlling the aircraft, whereas more interestingly, the advent of smartphones has led to a steep reduction in the prices of various equipment like microcontrollers, chips, accelerometers, cameras and other sensors. These have enabled capturing of data, the utility of which is being amplified by the availability of better computing capabilities.

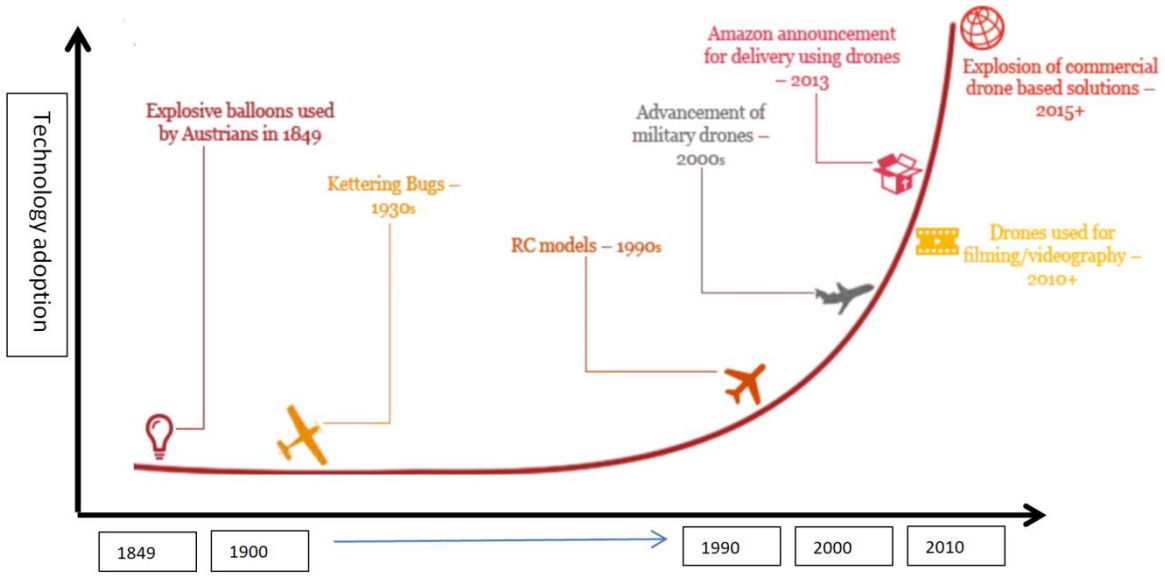

Fig. 1: Exploration of drone applications based on timeline

The drone space in India is catching up very fast with that of other developed countries. It is predicted that the market for drones in disaster management will supersede the other applications. In India there are six segments across which we have seen drone-based solutions being explored. Amongst these, infrastructure and agriculture [2] are seeing the most traction, in line with global trends.

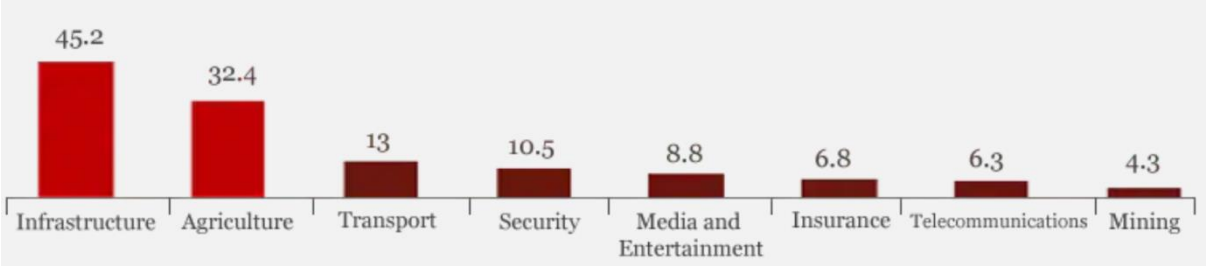

Fig. 2: Drone usage for various applications

Types of drones for different applications:
The figure below shows the areas where drones are applied and how this will benefit the respective field. For example, if you take agriculture, there are a lot of applications such as compilation of plant count, which can be done faster and accurately.

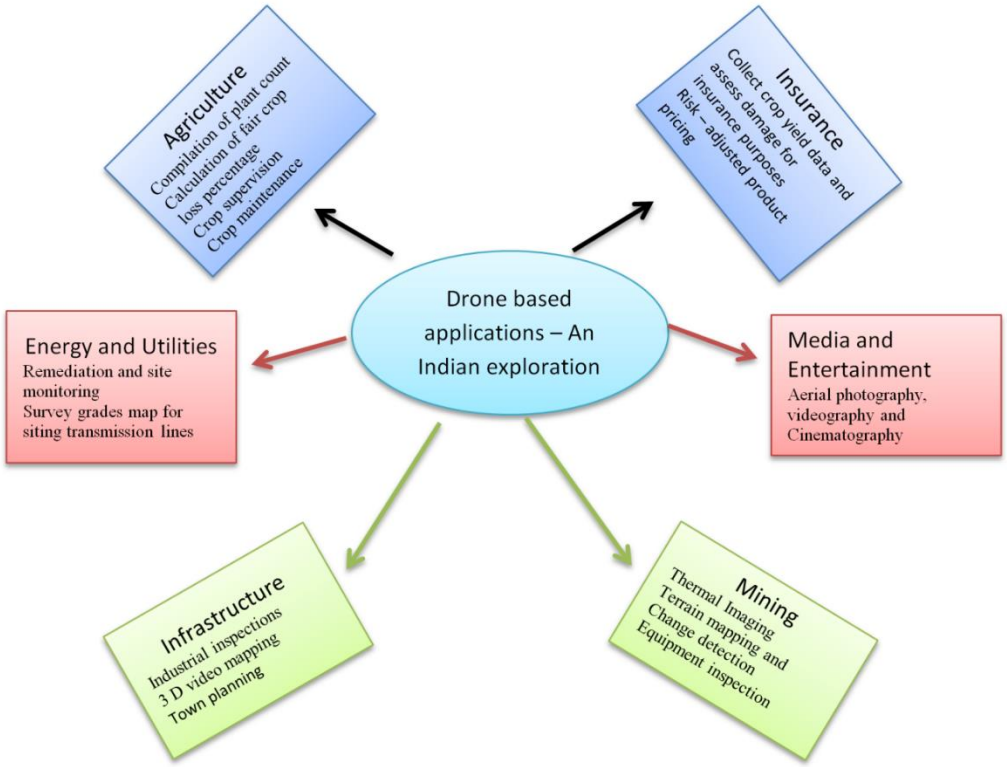

Fig. 3: Various applications of Drones

3. DRONE DESIGN AND ITS SIGNIFICANCE

Four major UAVs (Unmanned Aerial Vehicles) or drones can be identified based on its design and features. These are:

3.1 Multi rotor UAVs

Multi Rotor drones are the most common types of drones which are used by professionals and hobbyists alike. They are used for most common applications like aerial photography, aerial video surveillance [4] etc. Multi-rotor drones are the easiest to manufacture and they are the cheapest option available as well. Multi-rotor drones can be further classified based on the number of rotors on the platform. They are Tricopter (3 rotors), Quadcopter (4 rotors), Hexacopter (6 rotors) and Octocopter (8 rotors). Out of these, Quadcopters are the most popular and widely used variant.

Although easy to manufacture and relatively cheap, multi-rotor drones have many downsides. The prominent ones being it's limited flying time, limited endurance and speed. They are not suitable for large-scale projects like long distance aerial mapping or surveillance. The fundamental problem with the multicopters is they have to spend a huge portion of their energy (possibly from a battery source) just to fight gravity and stabilize themselves in the air. At present, most of the multi-rotor drones out there are capable of only a 20 to 30 minutes flying time (often with a minimal payload like a camera).

Fig. 4: Multi motor UAV

3.2 Fixed Wing Drones

Fixed Wing drones are entirely different in design and build to multi-rotor type drones. They use a 'wing' like the normal airplanes out there. Unlike multi-rotor drones, fixed wing type models [5] never utilize energy to stay afloat on air (fixed wing types can't stand still on the air) fighting gravity. Instead, they move forward on their set course or as set by the guide control (possibly a remote unit operated by a human) as long as their energy source permits. Most fixed wing drones have an average flying time of a couple of hours. Gas engine powered drones can fly up to 16 hours or higher. Owing to their higher-flying time and fuel efficiency, fixed wing drones are ideal for long distance operations (be it mapping or surveillance). But they cannot be used for aerial photography where the drone needs to be kept still on the air for a period of time.

Fig. 5: Fixed wing UAV

3.3 Single rotor UAVs

Single rotor drones look very similar in design & structure to actual helicopters. Unlike a multi rotor drone, a single roter model has just one big sized rotor plus a small sized one on the tail of the drone to control its heading. Single rotor drones are much efficient than multi rotor versions. They have higher flying times and can even be powered by gas engines. In aerodynamics, the lower the count of rotors the lesser will be the spin of the object. And that's the big reason why quadcopters are more stable than octocopters. In that sense, single rotor drones are much efficient than multi-rotor drones.

Fig. 6: Single rotor UAV

3.4 Hybrid VTOL (Vertical take - off and Land)

These are hybrid versions combine the benefits of Fixed wing models (higher flying time) with that of rotor-based models (hover). This concept has been tested from around 1960's without much success. However, with the advent of new generation sensors (gyros and accelerometers), this concept has got some new life and direction. Hybrid VTOL's are a mix of automation and manual gliding. A vertical lift is used to lift the drone up into the air from the ground. Gyros and accelerometers work in automated mode (autopilot concept) to keep the drone stabilized in the air. Remote based (or even programmed) manual control is used to guide the drone on the desired course [5].

Fig. 7: Hybrid VTOL drone

4. DRONES FOR SPECIAL APPLICATIONS: DISASTER MANAGEMENT FOR COVID -19:

4.1 COVID- 19 in India

The first case of the COVID -19 pandemic in India was reported on 30 January 2020, originating from China. As of 4 May 2020, the Ministry of Health and Family Welfare have confirmed a total of 42,533 cases, 11,707 recoveries (including 1 migration) and 1373 deaths in the country. Experts suggest the number of infections could be much higher as India's testing rates are among the lowest in the world. The infection rate of COVID-19 in India is reported to be 1.7, significantly lower than in the worst affected countries such as Spain, Italy, USA. The Indian government announced a lockdown period of 21 days initially and again extended it to another 24 days, till May 17, 2020. 1. Despite 45 days Global lockdown, social distancing & isolation, Covid -19 cases are only increasing.

Fig. 8: Statistics on COVID – 19 in India

The graph above shows that the number of persons infected with COVID -19 has increased drastically, in spite of the continuous lockdown announced by the Indian government. This gives us a benefit of doubt as to how the disease is spreading so fast in spite of precautions such as lock down.

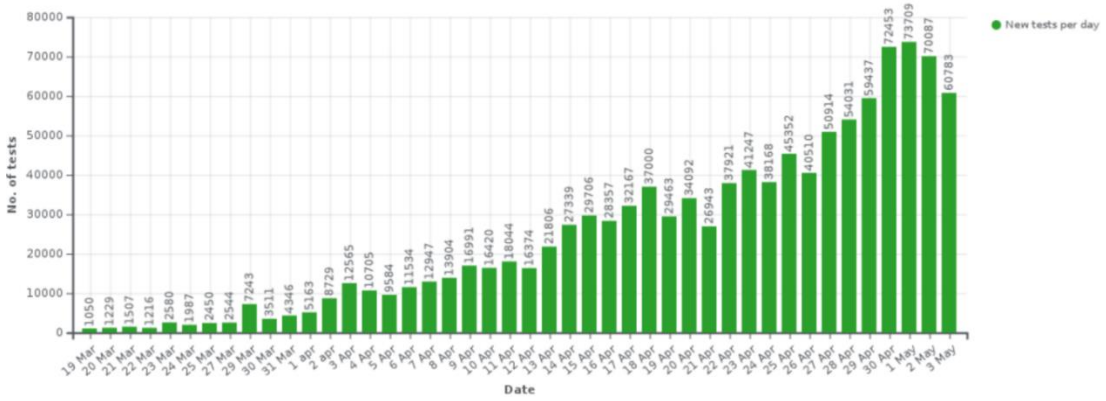

Fig. 9: Statistics on number of tests conducted per day

Here again, the above graph shows that the people reporting to various test centres for symptoms of corona virus is also quite high. This huge number calls for buying as many testing kits in order to confirm the positive cases. The growing numbers sends an alarm bell and soon every individual in the country will have to take the test for being safe.

If the disease is not spreading by direct contact, what is the reason for the increase in Covid19? The clear answer to this question is "Surface Spread". The only other way corona virus/Covid 19 is able to keep spreading apart from direct contact is surface spread.

According to WHO & various Research Studies, COVID 19 can survive 72 hours on plastic & stainless-steel surfaces. This means majority of public places like metros, markets, shops, etc. are most likely the locations where surface spread of Covid 19 occurs. These places are frequented by hundreds and thousands of people every day and therefore tracing also becomes very difficult. There may be persons without symptoms, recovered persons etc who are potential carriers of the virus through surface contact.

5. INDIAN CONDITIONS

India is also less hygienic than the western world. Citizens spit, sneeze, cough and litter on roads & public places. Some citizens don not even wear footwear but those who do, sometimes park their slippers right inside their homes. Note that this is the same slippers worn outside (where surface contact is possible). How to combat Surface Spread? Chlorine based Disinfect spray has been proven by WHO & Other renowned virology institutes (site names) to kill 99% bacteria & viruses. So until a Covid19 vaccine is developed, there are only 2 ways to combat Covid19:

(a) Social distancing, masks, self-isolation & maintain strong immunity
(b) Disinfection of Public Places using Government authorized Chlorine based disinfectant & spraying all public areas repeatedly till a vaccine emerges to eliminate indirect Contraction of the Virus or commonly known as Surface Spread of the Virus.

Spraying disinfectant in public areas will curb Surface spread to a great degree. Research based on studies & data obtained from several sanitization operations across the country has indicated a sudden stagnation or dip in the number of cases in the city.

5.1 Using Drones to Sanitize Public Places and High-rises

With this approach, an ISO-9001 company Garuda Aerospace has brought out an Automated Disinfecting Unmanned Aerial Vehicle (UAV) [8] that aids in Sanitization of Public Places, Hospitals & Tall buildings. Named as 'Corona-Killer', these drones can be used to spray disinfectants on buildings up to 450 feet. Drone operations are faster, longer & safer than manual spraying by workers who can become potential carriers of COVID-19. Also, drones can reach heights which are not possible through manual spraying. Drone based Swacch Bharat campaign to Clean India on a regular basis will prevent the spread of COVID-19, future pandemics & communicable diseases arising due to unhygienic conditions.

6. FEATURES OF CORONA KILLER -100

The following table depicts the features and performance measures of Corona Killer – 100 which is used to spray disinfectant on surfaces to contain the spread of COVID – 19:

Table 1: Features of CORONA KILLER – 100

S. No	Parameter	Specification
1.	Dimension	1436x1436x550mm (arm unfolded, without propellers) 710x820x550 mm (arm folded without propellers)
2.	Total weight	10.5 kg (without battery) 23.5 kg (with fully loaded battery)
3.	Standard take-off weight	23.5 kg
4.	Max trade off weight	25 kg
5.	Hovering time	10 minutes
6.	Max Operating speed	8 m/s

7.	Max flying speed	10 m/s
8.	Recommended operating temperature	10°C to 40°C
9.	Liquid tank volume	10 L
10.	Number of nozzles	4
11.	Spraying span	3.5 to 4 m
12.	Theoretical operational efficiency	200000 sq. m per day/ 8 hrs & 6 sets of batteries
13.	Max spraying speed	16 L/minute
14.	Max transmission range	1000 m (Unobstructed)

This Corona-Killer -100 drone sanitization drone which is currently being used in 26 cities was selected as one of the top 10 socio economic innovations by NITI Aayog in 2016. It consists of patented autopilot technology [9], advanced flight controller system & is equipped with fuel efficient motors that enables the drone to be deployed for 12 hours a day. The features include: Payload capacity of 15-20 litres, flight duration of 40-45 minutes & maximum ceiling height of 450 feet which is sufficient to disinfect tall buildings across India [6]. Each drone can cover 20 km a day. Garuda Aerospace's present fleet of 300 Corona Killer-100 drones can conduct sanitization operations covering 6,000 km every single day.

Drone manufacturer Garuda Aerospace has catered to diverse needs such as agricultural survey[7,10], reconnaissance and surveillance. They have executed several government orders over the past 4 years. They also have formed a unique drone aggregator platform which can supply over 16,000 drones from various associate companies if a massive cleaning campaign takes place. This is an instance of how Indian firms are rising to the occasion and coming up with products and services to aid the community and government in fighting the COVID-19 pandemic.

Fig. 10: Corona Killer -100 drones used for sanitizing various cities in India

7. CONCLUSION

In this paper we have analysed various types of drones based on their applications and their design. It was also found that the drones have been used for various disaster management purposes and that they have been used widely in military and civil applications. In the current scenario, COVID – 19 is a virus spreading very fast, all over the world and causing many deaths. In order to contain this COVID – 19 pandemic, two different measures, one is person to person contact should be avoided by social distancing and the other one is to stop the surface spread by sanitization. The complete sanitization of an area is possible only with the help of drones and the Corona Killer – 100 is one such drone which was used by Garuda Aerospace Private Limited, to contain the spread of the disease in 26 different cities of India. This shows that done based sanitization can be very effective to contain the spread of COVID – 19.

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