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Military and commercial multipurpose drones are proliferating worldwide. They are active in areas where the use of manpower is often inadequate and in areas that simply are incapable of access otherwise. Drones handle a variety of scouting and operational duties due to their precision and capacity to achieve highly efficient and cost-effective results, especially in hazardous areas. In military operations drones are utilized in a wide range of activities, from Nano class to the Strategic Class at high altitudes for the purpose of reconnaissance and surveillance, detection, tracking and attack. Various drones that are active on the civilian side have now become the trusted wingmen of many backpackers and travelers, capturing high resolution wide-angle fascinating footage and images. On the commercial side, autonomous drones have become an influential alternative in air cargo transportation (Google, amazon, etc.) in many regions where transportation is a

## Modern Day Watchmen Drones Scout for Natural Disasters & Outbreaks



challenge, especially in residential areas. Drone technologies are of course not designed only for cargo transportation. Drone technologies are also frequently used in construction and architectural projects to complete ground surveys, 3D mapping and sketches by using real time images. Additionally, they carry out surveillance and cleaning services for power plants or industrial wind turbines. For instance, they can also be used for routine aerial control of crops

grown in agricultural areas, for mapping, disease detection as well as agricultural spraying and seeding with special equipment mounted on them. In the field of livestock, drones are used in operations such as disease control of animals providing real-time tracking and detection capability that are unbeatable coupled with their ability to cover wider terrain.

The battle against forest fires is another area where

drones and unmanned aerial vehicles (UAVs) have started to play an essential and regular role. Drones equipped with optical and infrared systems are used in the prevention of seasonal forest fires that occur due to long-lasting droughts. These specialized drones detect hot spots in the fire zone, and capture measurements of fire temperature. We see that unmanned aircraft systems (K-MAX etc.) are being used extensively in developed countries, such as the US and Australia, for the intervention of fire with water and chemicals at exactly the right angle, and smaller class drone systems are being used to transport equipment and aid materials to firefighters on the ground. Being able to react at the right time is one of the key parameters for a quick and effective fire response



operation. Although firefighting aircraft or upper segment UAV systems are an important option for large-scale fires, experts believe that expensive systems are not really necessary in order to effectively respond to fires that are low or moderate in severity, saying that reaction time is more important than quality, in terms of not needing to capture high resolution videos or images in order to react decisively. The real-time delivery of critical information to fire units can be conducted with more cost-effective drone systems. Drone capture and relay of critical information such as fire character, fire density, smoke emission, spread rate, and direction and intensity of the wind in a medium-sized region can be conducted without expensive higher resolution images and videos, which is more advantageous in active fire management and for department budgets as well. On the other hand, in countries such as China,



The first live fire drill for high-rise fire fighting drones were held in Dazu, Chongqing, April, 2020

we have frequently seen in social media that medium-sized drones with an integrated fire hose are used effectively for skyscraper or high-rise fires.

Today, UAVs and small-sized drone systems are effectively being used by many countries across the world in response to volcanic eruptions,

hurricanes, tornadoes, floods, nuclear power plant accidents and the list goes on. In addition, we see that they play a critical role in natural disasters such as earthquakes by determining the degree of damage in an earthquake area, examining the status of the transportation network, generating up-to-date 3D mapping

of the disaster area, establishing the temporary communication network, and they are used to carryout proper resource allocation in critical post-disaster activities such as recovery, debris removal and relief distribution. In brief, these systems are essential for the effective and efficient management of disaster operations.

An article published in the Journal of Field Robotics in 2016, reported that rapid damage assessment in post-earthquake situations plays an



## DRONE TECHNOLOGIES

important role in being able to rapidly respond. As in all other disasters, early response phase activities (i.e., evacuation of injured individuals, debris removal, and relief distribution) are essential, especially within the first 30 minutes as the survival rate is 91% and it will fall to 36.7% by the second day. Therefore, post-earthquake damage assessment is an important factor. Since ground-based post-earthquake inspection is extremely time-consuming and unhelpful in heavily damaged areas, aerial systems are widely used for timely investigative and assessment purposes.

In case of a dam burst or unforeseen floods, especially within the scope of pre-disaster precautions, fixed-wing and multi-rotor UAV systems (operative, tactical UAV systems) perform tasks to determine the existing state of a dam, for example the proactive identification of areas that are at risk of rupture. Locations on the dam that



Preparation of an unmanned helicopter to a two-hour flight in the area of radiation accident radiation measurement, photography and videograph

are perhaps extremely dangerous are monitored to improve safety, even under extraordinary conditions. These systems capture close range information about cracks or fractures in the dam, and they also provide detailed information for the analysis of the flood area. They are also able to perform critical tasks during disasters such as the real-time monitoring of the flood area, providing guidance local units for the evacuation of survivors trapped in the flood area. During evacuation operations, these systems are able to determine the location of damaged buildings, roads and bridges so that rescue teams can designate an

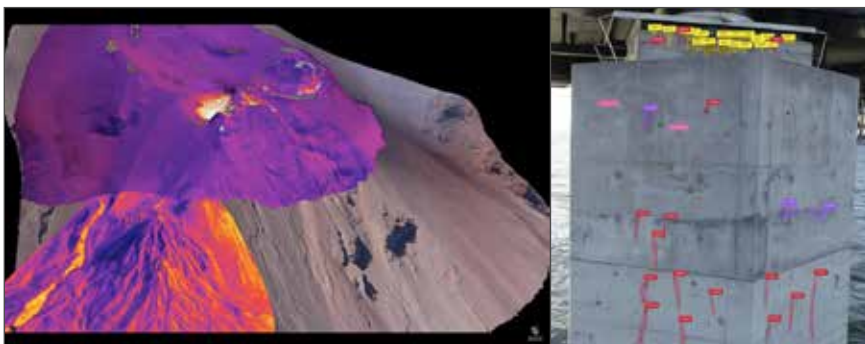
appropriate evacuation route. Apart from these worst-case scenarios, drones are also routinely used for the inspection of civil engineering structures such as motorways, buildings, bridges, pipelines. With the advances in machine learning and AI algorithms, proactive analysis can be completed to identify cracks, leakage and other forms of deterioration.

Clustering and utilizing a mathematical-based approach for UAV route planning in post-disaster crisis management is a key parameter that affects the success of disaster management. It is very important for decision makers to execute precise and careful calculations,

as similar systems simultaneously serving on the same route as a result of calculation errors may lead to a waste of time and unnecessary use of resources. On the other hand, the homogeneous distribution of different UAV operation types in the field and how these systems interoperate in real-time are points that should be focused upon. For disasters that have been experienced before, such as earthquakes, fires, hurricanes and tornadoes, many developed countries have contingency plans in place. Then we must ask, what kind of a role will drone technologies play during this unprecedented global coronavirus outbreak? We will examine this topic in the next section, but first let's take a look at the history and impact of outbreaks in the modern world.

### What is the readiness level of countries for epidemics having unpredictable spread rates?

When we analyze the examples in the world, the first global epidemic started in the Guangdong province of southern China in mid-November 2002 and was announced to the world by the World Health Organization (WHO) in March 2003, when severe pneumonia cases occurred





in Singapore, Hong Kong and Hanoi. The SARS/ CoV epidemic affected 29 countries and resulted in more than 8,000 cases and 774 deaths in 2003. The case-fatality ratio was 7-17%. The eight-month epidemic was limited to only 29 countries and therefore was not declared to be a pandemic as it had not spread on global scale.

Ten years later, the MERS-CoV epidemic originating in the Middle East was reported in September 2012. As of January 2020, the total number of laboratory-confirmed MERS-CoV infection cases reported by the WHO was 2,494 with 858 deaths in 27 countries. Even today, MERS cases continue to be reported. The two examples of virus outbreaks are an indication of the process we have been going through recently, but because of the fact that they only impacted a limited number of countries and did not span the entire globe, interest eventually waned. Both of these examples only occupied the news for

a relatively short while and then news of these infection cases slipped from the headlines and they were forgotten by the general public thereafter.

On January 1, 2020, the emergence of the novel type coronavirus COVID-19 was officially announced to the world by the Chinese Center for Disease Control and Prevention. With a population of 11 million people, Wuhan city, the capital of Hubei province, was quarantined on January 23rd. Since the first cases were not notified to relevant authorities in a timely manner and the Chinese were on holiday in different countries because of the Chinese new-year, the virus spread to other Asian countries through these travelers who had been in direct contact with Wuhan and then the virus headed towards Europe, America and eventually to the rest of the world. According to data as of April 30th, the number of total cases confirmed by official authorities unfortunately exceeded 3.5 million and the virus spread

to approximately 190 countries as the world has been struggling to fight this pandemic. As part of the initial measures, countries suspended their all flights and closed their borders, and then within the scope of quarantine measures, numerous measures were adopted that restricted the daily lives of the citizens (restriction of social and cultural activities, lockdown of all workplaces except for drugstores and supermarkets, curfew etc.) The speed of the transmission of the virus from an asymptomatic, silent carrier to hundreds and even thousands of people in a short time, the fatality rate particularly in older citizens and people with lower immunity revealed that all measures and restrictions should be strictly implemented across the world.

Having been seriously accused from many countries such as the US, for not notifying global authorities about the outbreak in a timely manner, and being accused

of hiding developments about the virus before it became a pandemic, the People's Republic of China presently seems to have taken control of the virus through the implementation serious measures. The lockdown across the whole city was lifted as of April 8th. According to mathematical models, countries that invest in technology and that are prepared for epidemics and natural disasters such as South Korea, Taiwan and Hong Kong are successfully managing the process for the time being. Activities such as the application of effective testing kits for numerous patients and suspected cases and every citizen's isolation from social life - as if they were positive for COVID-19, and the effective implementation of emergency action plans of these countries in the field will be examined as best practices in the years to come. For example, China's construction of

## DRONE TECHNOLOGIES



a hospital in only eight days in Wuhan, the daily execution of ten thousand tests in South Korea, and - though being China's neighbor - Taiwan locked down its airspace and land borders without losing any time, etc. Without doubt, the aforementioned countries' implementation of strict measures (including imposing significant fines or prison sentences if the lockdown measures are broken) should be considered a critical step in the prevention of the further spread of the virus. With the lessons learned from the aforementioned cases, every country should be able to identify their own urgent action plan and adopt their own measures to manage processes that are critical in the event of future natural disasters or pandemics.

Leaving the healthcare aspect of the pandemic to the experts, it will be quite helpful to review how recent utilization of drone

systems and technologies has been effective in slowing down the spread of the pandemic. The variety of functions that the drone watchmen of the pandemic perform have earned them the distinction of becoming leading protectors in this battle.

China, the country where the virus originated, is at top of the list of countries that have benefitted from the advantages of using technology to manage the further spread of this pandemic. It is useful to say that the data at this point originates from China as well, and with caution for this reason we will be able to clearly see the effectiveness of these efforts in light of the data provided by independent channels in the upcoming days.

On February 25, 2020, the company DJI Drone, which controls nearly 80% of the commercial drone market announced that

they launched the active utilization of drones for the prevention of the spread of the virus with the Chinese public safety authorities who endeavor to clear the country and to seek ways of using new technologies to overcome the crisis. Thus, a new duty was added to the task list of modern-day drones in this new and unprecedented challenge.

### Watchers of the pandemic – Are drones really effective?

Collaborating with the Chinese Agricultural Technology Organization, the Chinese company DJI announced at the end of February that they allocated US\$ 1.5 million to the efforts exerted for fighting against the pandemic, adding that they developed convenient methods for spraying chlorine or ethyl alcohol based disinfectant from the air to open public

spaces and they have launched these operations after research and test processes were completed.

According to the assertions of DJI, in China where more than 50 million people was under quarantine, only in the city of Shenzhen, in addition to the disinfection operations conducted by drones spanning an area of over 3 million square meters, aid in fighting the virus was provided to 1,000 districts in this way. In DJI's statement, the company stated that in such a pandemic, where time played a critical role, on account of the disinfection operations executed by the army of drones, results were achieved 50 times faster than traditional methods in an area covering 600 million square meters, such as factories, residential areas, hospitals and wastewater treatments plants.

In the statement, in addition to disinfection operations, it was also noted that drones were actively used in various areas during the fight against the pandemic. Speakers mounted on drones were used to deliver audio warnings at crowded venues and at meetings in outdoor areas, and that they also relayed critical information on protective measures against the disease to people through banners. Moreover, the

statement underlined that thermal cameras integrated on drones were used to monitor body temperature in order to support medical staff in the identification of new potential cases as well as to collect the data in a register. A video shared on February 13th on the website of a publication broadcasting in Chinese displayed that drones integrated with thermal cameras and speakers had instructed residents to come out to their balconies or in front of their windows without leaving their residences and then then measured their body temperature. In addition to these measures, according to a report which was issued in this period in the *Global Times* - again a Chinese newspaper, a system was launched that was mounted on the helmets of security guards capable of measuring the body temperature of anyone at a diameter of five meters. It was reported that the system gives alarms as it identifies a person with a fever. During these times it is difficult to provide aid to millions of families that are incapable of leaving their homes, and now aid has been provided by drones. Chinese media frequently shared images of drones conducting the transportation of food, equipment and drug to people in need, on behalf of organizations and without



bearing any risks. Surely, it is quite hard to tell at this moment whether these applications are merely a part of propaganda or they are genuinely complementary parts playing a role in minimizing the effects of this pandemic.

It is still discussed whether or not the activities performed by drones in China cover the whole population living across an area of considerable size and meanwhile with the spread of the virus in Europe, European countries' frequent and active utilization of similar implementations had wide

press coverage. On March 15th, Spain launched the utilization of the first speakers mounted systems on drones, used to inform and warn citizens, and later we witnessed the utilization of drones that are typically used in agricultural areas, capable of carrying 10lt of disinfectants to spray and disinfect public spaces in Spain. Following Spain, on March 19th, France also started to use speakers mounted drones to warn people to keep their social distance. These drones were initially used in Nice and then in the other cities of the country. In Italy,

drone systems started to be used by municipalities to watch the actions of the population in public space upon the permission of the Italian Civil Aviation Authority (ENAC). Countries such as Belgium and Austria also have launched the utilization of several drone systems for the identification and monitoring of crowds as well as to keep up the social distancing. In addition to the aforementioned applications of drone systems, Norway and Spain approved testing of various methods for the measurement of body temperature from a safe distance of 2 to 3 meters by thermal cameras. Similarly, we observe the utilization of drone systems to ensure social distancing and the monitoring of crowds in America and in various geographies of the world. Though partially, Turkey has been one of the countries benefiting from drone technologies during this period. We





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AFAD Team Earthquake Exercise

witnessed municipalities benefiting from these systems in Istanbul - a highly populated city, by using them as mobile announcing systems to inform and warn residents gathered in parks and to reach the recreational fishermen spending time near the waterside. Law enforcement teams have also been using thermal camera mounted drones in public areas as well.

## Conclusion

As a result of the merciless consumption of our world's resources, such pandemics, natural and man-made disasters stand in front of us as the reality of today and the future of our world. Under the guidance of organizations, such as AFAD (Disaster and Emergency Management Presidency) in Turkey, it behooves municipalities, relevant public institutions

and organizations of countries to actively benefit from the drone technologies (systems capable of carrying thermal cameras, accessing risky and dangerous narrow and small areas, delivering aid and systems capable of reconnaissance - surveillance) in action plans that they will be preparing within this scope. Certainly, just like other countries, there are severe restrictions in Turkey (green and red zones) in operating unmanned systems in public spaces. The instruction on unmanned air vehicles published by the Directorate General of Civil Aviation (DGCA) regulates in detail the grouping of UAV systems, license of pilots and flight permits, no-fly zones, flight conditions and requirements. Again, according to the data

provided by the DGCA, there are currently over 50 thousand registered drone operators in Turkey, with a rapidly increasing trend. Within the scope of the rules identified by decision makers, all relevant authorities should assess and consider all the aspects of regulations and the previously designed emergency action and implementation plan on the application of the measures to be adopted in cases of man-made disasters or natural disasters that occur abruptly and where time plays a major role in saving the lives of people. If required, temporary assignment of these registered drone operators throughout the country, depending on their competence and qualities, could be an effective solution as well. Licensed and qualified pilots with a designated number of

flight hours would be able to provide benefit through their experience.

This pandemic will surely have a lasting in one way or another, yet Turkey is still a country of earthquakes, therefore the establishment of a network-centric and strategic structure that enables the efficient and effective utilization of various military class UAV systems, cost-efficient drone systems of smaller scales is essential. The Turkish Armed Forces and AFAD units and other volunteering search and rescue teams in the field and municipalities under the coordination of the Ministry of National Defense and relevant Ministries will certainly render Turkey one of the pioneers in the world in this area by taking advantage of evolving drone technology now 🚀