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Exploring the Use of Drones in Disaster Management

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Abstract - Drones are already beginning to change the way first responders are taking choices about how they respond to emergencies in part due to the drones ability to have much quicker access to the location than responders on foot, while providing an extremely rapid visual contact from above, and assessment of the emergency scene. Drones are able to be on scene and obtaining useful aerial information typically within minutes. Drones are also able to assess buildings and roads following an earthquake, and can provide directions for the safest access routes into an area. Take those floods in India and Bangladesh – drones were lifesavers! They found towns that needed help ASAP, kept tabs on the water levels, and even spotted when mudslides or disease outbreaks might occur. Because of drones, rescues got done faster after that disaster, and that meant communities could recover quicker. But with their popularity growing and success from many case studies having been achieved, widescale application of drones in the management of disasters has some boundaries and restrictions.

Key Words: Disaster Management, Unmanned Aerial Vehicles, Emergency Response, Aerial Surveillance, Humanitarian Aid

1.INTRODUCTION

Drones are changing how inspections are done. Essentially, instead of putting people in dangerous areas that could be inside chimneys or floods or whatever, drones are fast, have better visibility, can view areas you can't assess, and can help you plan and prevent problems. They help a lot! They provide rapid information and provide an aerial perspective. Cameras and sensors give decision-makers a fast way to see what's happening. Drones can scope out cities and natural spots from afar. On top of this, they can tell if a building is dangerous and guide improvement projects. Since they spot issues fast, cities can prep aid and supplies before a storm arrives. Basically, it's all about getting ready early.

2. LITERATURE SURVEY

Versatile, they can be used for quick situational awareness, are one less level of risk than having "boots on the ground," (including all of the stress related to "boots on the ground," as in the disaster recovery environment), and uniquely, can capture still images of victims trapped in a disaster scene. UAVs in particular may have caused a break in the crisis management continuum and some scholars envision a similar technology in space. In almost all scenarios where UAVs can provide live images from above, they are extremely useful to visualize those immediate dynamic attributes of the disaster post-earthquake, flood, or hurricane. We know from the effective use of UAVs in disaster recovery in Nepal reported on by Meier (2015) that UAVs could revolutionize how aid workers were able to look overhead after the disaster and see the number of buildings and locations that were destroyed, and then use this information to provide the best route for supply and strategic areas for support. Then when it comes to fires, Merino et al. (2012) proved UAVs equipped with thermal scopes which could fly low to the ground to monitor and track the movement or establish patterns on how fire will spread effectively alerted firefighting teams to areas of concern.

3. METHODOLOGY

We pursued a mixed-methods approach toward understanding the role of drones in disaster settings in a broad sense, through academic literature and practical uses. We were able to identify the role of drones in disaster settings through academic literature and grey literature (everything in-between research papers, examples of drones, and government reports on drones). We discovered what was done, what could have been done better, and what we are doing successfully with drones. We paid attention to the technological improvements in the camera on the drone, communications on the drone, and autopilot on the drone because they generally are the most significant from improvements in technology, and represent the largest changes that corresponded with the utility of the drone in disaster situations.

Simulations Faced with impaired visibility, wind speeds, obstructed terrains etc, which the drones had to operate successfully under. The simulations provided a lot of indications with respect to operational efficiencies, indicating some potential scaffolding technical and logistical limitations related to field opportunities. The study also included appraised cases of disaster contexts e.g. earthquakes, floods, and locations exposed to fire. To wrap it all up, we put considerable emphasis on triangulation - considering our secondary literature, simulations and hard facts in relations our results. This lowered bias and significantly strengthened the conclusions drew out of the study.

4. RESULTS

Drones can really help out when disaster strikes, as this study proves. They can quickly show what's going on and keep watch over disaster zones as they happen. In earthquake and flood tests, drones mapped big areas fast – way faster than people on the ground could. Because of this, the first people there could

quickly see the damage, guess how many were hurt, and spot dangers like broken roads Drones have helped with logistics in providing medicine, food and radio in remote locations while conducting the training sessions. Drones have also helped entrepreneurs avoid unwanted ground or roads and hence keeping people safer and providing help to those that are taking others' help and may need water immediately. Drones also didn't have air surveillance which also gave teams a means of keeping from being behind the eight ball of quickly changing environments like rising water, without all the correct work stoppage and distractions.

Most importantly, the information illustrated that drones really expedite decision-making in emergencies. Command centers are basically overwhelmed with live video, better imagery than human beings can give from the ground, and sensor data almost in real time. Having the skill of supply this information to groups meant having the skill of cut and paste maps with up-to-the-minute information, produce newer better plans with; and enhance co-working with other teams.

Drones really shine in terms of obtaining stuff to people who need it. Load them with mapping and prediction tools, and they can even pinpoint which rescues matter most, save time, and put people and gear where they're needed most.

Fig. 1 Ariel disaster view by drone

- Drone aerial surveys are significant in flooded regions in that they provide real-time, high-density imagery of water-scarce regions.
- They help the authorities in assessing the extent of damage, pinpoint buried survivors, and offer safe routes to tread while conducting natural disaster rescues.
- The innovation makes decision-making automatic and enables efficient utilization of relief resources.

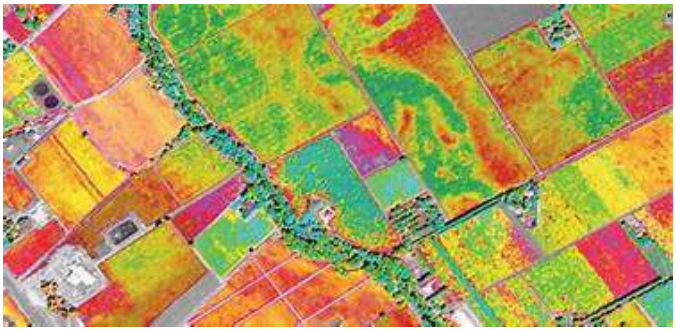

Fig. 2 Thermal view by drone of disaster area

- Thermal drone cameras pick up heat emanations in disaster areas, making it possible to find entombed survivors or people in areas of low visibility.
- They are superb in night time operations or smoky conditions where regular cameras don't work.
- The technology improves accuracy in rescues with fewer risks to rescuers.

Fig. 3 Drone Delivery of Essential Supplies in Disaster Areas

Drones are awesome for taking food, water, and meds to folks stuck after disasters like floods or earthquakes. They can fly over messed-up roads, so they get help to people fast. Getting supplies there quickly can save lives when every second counts.

5. DISCUSSIONS

While the potential of drones in disaster response are virtually limitless, there are still challenges need to be solved when working to unlock their full value. The biggest challenge is regulatory limitations. The limitations of airspace, as well as designations of restricted flight areas and then slow approval processes to get clearance for the use of drones during a disaster are some of the biggest areas for concern - where the drones may potentially become useless to a circumstance gain advantages that may enhance their use. Emergency managers and responders are left trying to decide whether it is better to abide by the law of the airspace or to get into the air as quickly as possible; if a clearance protocol was fast tracked for emergencies which would remove several of the problems. Technical limitations besides regulatory and restrictions also a main barrier.

The capabilities of drones are limited. They can't transport large goods, the batteries run out, and bad weather stops them from flying. Therefore, maybe avoid using a drone for important activities. But technology advancements like high-capacity batteries, strengthened airframes, and sophisticated autonomous guidance will be anticipated to toughen the drones and push the ranges of flight.

This is carried out via cooperation with government agencies, private organizations, and research centers for purposes of developing joint operational guidelines as well as interoperability systems. This not only maximizes the application of drones but also lays the platform on which further improving their application in all forms of disaster scenarios becomes possible.

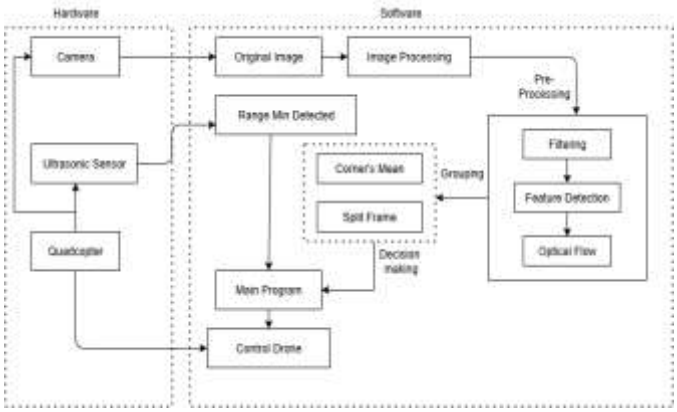

Fig. 4 Flowchart of drone work process

1. What a Drone Detects: It starts with what the drone carries – things like GPS, cameras, microphones, and IMU.
2. Information Tidying Up: The weather or rapidly shifting conditions could cause this raw data to be inaccurate. It is fixed with innovative techniques (such as Kalman filters).
3. This drone uses heat-sensitive cameras to spot stuff like people, water sources, unstable buildings, or damaged roads. It also sees things in its way so it doesn't crash.
4. The Drone Decides: What to do Then? It keeps you secure, helps you finish tasks, and lets you talk to friends.
5. Getting to Work: Then, the drone acts. Some examples are:
   - Delivering help to people in need.
   - Providing real-time updates to response groups.
   - Mapping terrain with locations for rescue.

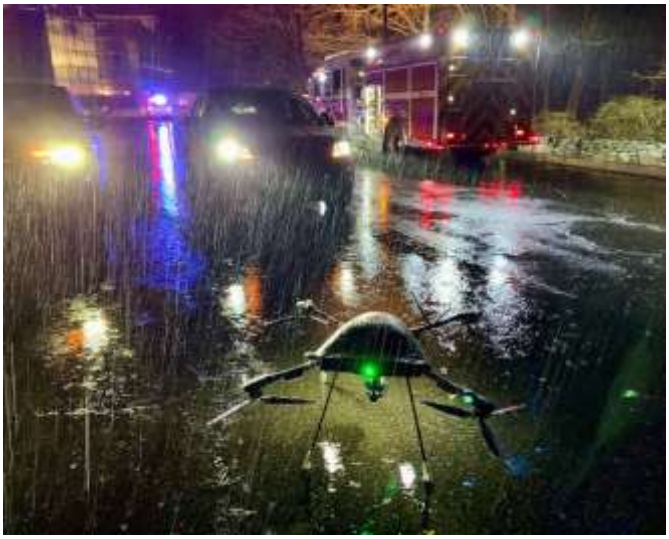

Fig. 5 drones facing weather challenges

This diagram shows some of the difficulties under which drones are currently working to provide disaster response work in inclement weather, i.e., rain and visibility. To rely on simply the ground forces for situational awareness would clearly show down any response and even disregard the use of drones altogether. There needs to be research on more complicated structures, lighter frameworks, and navigation systems to improve the operational reliability of drones in dynamic environments.

6. CONCLUSIONS

Severe weather such as huge rainstorms and low visibility may sometimes limit the advantages of drones for usage in disasters as was shown here here. But drones because they can see things in ways that we can't. And they can collect data humans can from on the ground. So, we will keep designing drones to be ready for the weather with a durable build, and clear steps to accomplish their actions in changing weather situations. Drone technology is going to revolutionize disaster response. People in disaster response agencies are going to respond far faster and safer, soon. Drones can find people in need, deliver services, supplies, and monitor activities. They are truly valuable for disaster relief.

With that last statement being said, the future improvements in AI, data sorting algorithms, and long distance batteries will all contribute to the continued improvement with drones. They will do more than matter, they will also keep responders safe.

REFERENCES

[1] Murphy, R. R., & Stover, S. L. (2008). Rescue robots for mudslides: A descriptive study of terrain requirements. Journal of Field Robotics, 25(1-2), 3–16. \\https://doi.org/10.1002/rob.20218
[2] Erdelj, M., Natalizio, E., Chowdhury, K. R., & Akyildiz, I. F. (2017). Help from the sky: Leveraging UAVs for disaster management. IEEE Pervasive Computing, 16(1), 24–32. https://doi.org/10.1109/MPRV.2017.11
[3] Khan, A., & Gupta, R. (2020). Applications of drone technology in disaster management: A review. International Journal of Disaster Risk Reduction, 46, 101521. https://doi.org/10.1016/j.ijdrr.2020.101521
[4] Disaster Relief Using Drones. (2022). International Federation of Red Cross and Red Crescent Societies (IFRC). Retrieved from https://www.ifrc.org
[5] Meier, P. (2015). Digital humanitarians: How big data is changing the face of humanitarian response. CRC Press
[6] UN Office for the Coordination of Humanitarian Affairs (OCHA). (2021). Drones in Humanitarian Action: A guide to the use of unmanned aerial systems in humanitarian response. Retrieved from https://www.unocha.org.
[7] Watts, A. C., Ambrosia, V. G., & Hinkley, E. A. (2012). Unmanned aircraft systems in remote sensing and scientific research: Classification and considerations of use. Remote Sensing, 4(6), 1671–1692. https://doi.org/10.3390/rs4061671