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The Use of Social Media and UAVs in Emergency Situations: A Review

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ABSTRACT

Over the past few years, extensive and widespread integration of unmanned aerial vehicles (UAVs) and social media has been observed in emergencies. In the present study, an inclusive outline regarding the practice of social media and UAVs in emergency situations along with the prospective impacts they may have on emergency response has been explained.

Some of the key social media sites like Facebook, Instagram, Twitter, and TikTok can be used as valuable means of information sharing in emergencies. Social media data can help authorities detect and counter emergency situations effectively without any delay. Through machine learning algorithms, social media data can instantly be analyzed by monitoring social media activities such as recognizing hashtags, keywords, images, videos, and other signs indicating any possible emergencies.

Sensor-equipped UAVs are capable of providing real-time data in emergencies. These can help in detecting the existence of any harmful substances in the atmosphere including radiation or lethal gases. Similarly, they can help in mapping affected regions, recognizing possible risks, and calculating damages. Authorities and emergency responders can make reasonable decisions and carry out mandatory measures quickly with the help of real-time data obtained from UAVs.

Using UAVs and social media in emergencies leads to increased communication between people and emergency responders. Authorities can use social media sites to quickly circulate important information among the masses like safety tips and evacuation orders. On the other hand, the public can report emergencies and share useful data with emergency responders through social media. UAVs may also prove useful in communicating with emergency responders in remote areas lacking traditional channels of communication.

The incorporation of UAVs and social media in emergencies can revolutionize the whole process of emergency response. Nonetheless, their effectiveness can only be ensured by addressing the possible challenges and risks such as the risk to security and privacy and false information. To ensure the safe and responsible use of UAVs and social media in emergencies, standardized guidelines and protocols must be followed.

Assessing the efficacy of UAVs and social media during emergencies and recognizing opportunities for their improvement and advancement still requires additional research.

Keywords: Social Media, Unmanned Aerial Vehicles, UAV, Drones, Emergency Situations, Disaster, Review

INTRODUCTION

Crisis communication is widely recognized for its capability of transforming instantly and its quick correspondence with all stakeholders. Social media is a progressing arena, and its usage has seen excessive growth. Social media sites have also increased in number including the original platforms such as MySpace and Friendster and currently popular sites like YouTube, Facebook, Instagram, Twitter, and TikTok. Both communication strategists and communication researchers are highly interested in the amalgamation of these two

arenas. Social media advancement has made it easier to convey messages and increased the capability of organizations to reduce the harm they may suffer during crises. On the contrary, Reuter and Kaufhold (2018) believe that social media can also deteriorate the reputation of any company and accelerate the circulation of damaging corporate rumors.

Organizations must develop a crisis communication plan which focuses on the use of social media and recognizes its importance. Similarly, companies that are associated with disaster relief actions must also develop crisis plans to incorporate social media. Organizations of disaster relief are skilled in crisis communication because they play a key role in post-disaster relief and aid. As stated by Palen and Hughes (2018), these organizations work as first responders by providing medical care and arranging settlements for people displaced during a disaster. The government also has a significant hand in disaster relief efforts. Government-run organizations not only offer financial assistance but also arrange for volunteers in emergency situations. They also deliver disaster preparation resources to the public. All these organizations can benefit from social media as it would allow them to interact directly and instantly through emergency relief actions. Like any other crisis-hit corporation, the government, and disaster relief organizations need to develop a comprehensive crisis plan for their social media campaign in emergencies, as mentioned by Abdulhamid et al. (2021).

The usage of Unmanned Aerial Vehicles (UAVs) and social media in disasters and emergencies has mounted rapidly over the years. Some of the most famous social media sites like Facebook, Instagram, Twitter, and TikTok offer a huge pool of information in emergencies because users instantly share pictures and updates of the affected areas. According to Hao and Wang (2020), UAVs or drones are used in multiple ways for emergency response such as conducting search and rescue operations, assessing damages, and delivering emergency goods. Additionally, UAVs are the best means to collect information and keep people updated about situations in isolated places. This study examines the existing research on the incorporation of UAVs and social media in emergencies as well as its advantages, challenges, and forthcoming trends (Rashid et al., 2020).

At the beginning of this paper, the definitions of UAVs and social media will be discussed along with their usage in emergencies. It will then shed light on the advantages of employing UAVs and social media such as the greater spread of situational awareness, their capability to collect and circulate information among the masses, and the delivery of supplies to unapproachable areas. It will also explore the challenges that may emerge with the use of UAVs and social media during emergencies, for instance; ethical, security, and privacy issues.

BIBLIOGRAPHIC RESEARCH

Social Media

Social media is defined as online sites or platforms that are used by people to interact with one another, produce content, share information, and participate in social networking. Facebook, Instagram, YouTube, LinkedIn, Twitter, and TikTok are some of the famous social media platforms. These sites have gained such a prevalent position in the contemporary world that they are now used in disaster situations by emergency response organizations and individuals to obtain immediate updates and data (Imran et al., 2020).

Social Media in Emergency Situations

A sharp rise has been noticed in the use of social media during emergency situations currently. After the occurrence of any disaster such as an earthquake, wildfire, or hurricane, people share images and updates from the affected areas on social media that depict the real-time situations of that place. As stated by Yuan et al. (2020), disaster response organizations

also convey critical information to the public like evacuation orders, closure of roads, and location of shelters through social media. As presented in Figure 1, WMO believes that Common Alerting Protocols should involve everyone during an emergency.

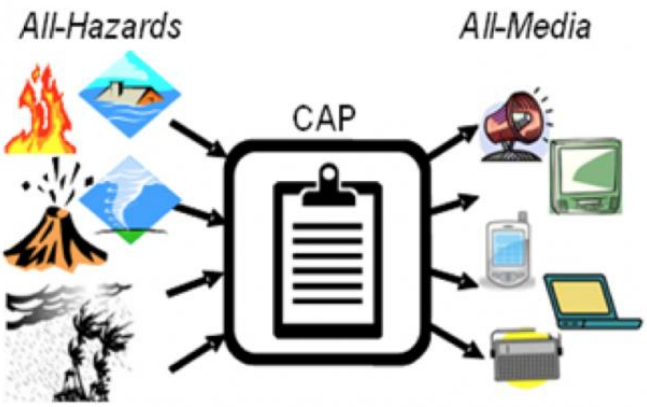

Figure 1. Common Alerting Protocol (CAP) as a clipboard with a standard business form (Source: WMO)

Moreover, individuals from disaster-hit areas can also stay connected and interact with disaster responders using social media. To exemplify, many victims of Hurricane Harvey in 2017 requested aid, rescue, and transportation to a safe location by using social media platforms. Yuan et al. (2020) further argue that social media also allows users to offer help and assistance to disaster-affected people like arranging for food, shelter, and water.

Benefits of Using Social Media in Emergency Situations

Numerous benefits are associated with the application of social media in emergencies; it assembles and broadcasts information quickly, escalates situational awareness, and helps disaster victims get connected to the disaster responders.

The major benefit of social media is its capability of gathering and spread information speedily. With the help of social media platforms, people share actual pictures from the disaster site that portray a comprehensive image of the real situation. Such comprehensive details can help disaster response teams and organizations to make rational decisions regarding response actions and resource distribution.

The second key advantage of employing social media during emergencies is that it enhances situational realization. These platforms are used by emergency response organizations as a channel to observe the circumstances and keep track of response action. These observations allow responders to locate areas that need to focus and they regulate their rescue and response efforts subsequently.

Figure 2. The Influence of social media on emergency management (Source: Patimes)

Lastly, these platforms help disaster victims to stay in contact with emergency responders. Individuals can get stuck and require rescue during emergency situations like floods and hurricanes. In such conditions, social media is the best channel for individuals to get connected with emergency responders so that they can request help and receive mandatory support from them as stated by Abdulhamid et al. (2021).

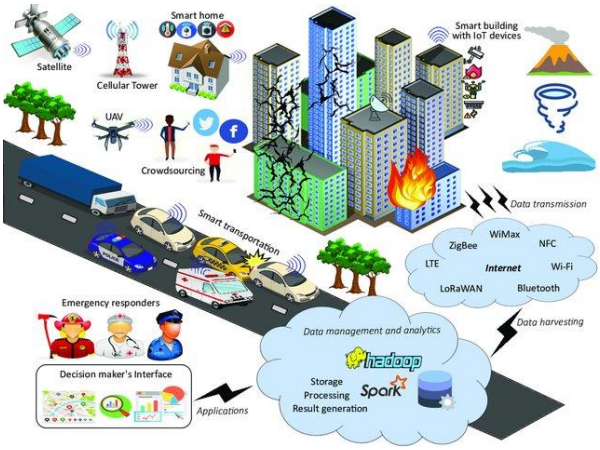

Figure 3. General illustration of BDA (Source: Shah et al., 2019)

Challenges of Using Social Media in Emergency Situations

Although there are numerous advantages of using social media in emergencies, this practice also leads to some undesirable challenges. Some of these challenges involve ethical, security, and privacy concerns.

The first challenge resulting from the use of social media in emergencies is privacy concerns. People may need to share their personal data, location, and health condition on social media in case they are stuck in a disaster. It can get the individual in trouble if this information reaches a person with mischievous intentions. Moreover, the integration of social media in emergencies can cause the accidental spread of fabricated information making emergency responses even more complicated.

Security concerns are the second challenge resulting from the incorporation of social media in disasters. Social media platforms are at higher risk of cyber-attacks that may interrupt response efforts and lead to the stealing of users' private data. The careless and unintended sharing of sensitive information may put both disaster victims and emergency responders at risk.

Lastly, utilizing social media during disaster situations may give birth to several ethical issues linked with the abuse of susceptible populations and the exploitation of their private data. Rodrigues et al. (2017) believe that emergency response organizations are obliged to defend the privacy and security of disaster-affected people while they collect and distribute information with them.

Figure 4. The future of everything (Source: WSJ)

In the following table a review of recent papers, on the use of social media based in disaster management is presented.

Table 1. Reviewed papers, the use of social media in disasters

Authors	Disaster	Country	Social Media	Methods
Ramakrishnan et al., 2022	Disaster management	United States	Facebook and Twitter	Structural equation modeling
Chen & Ji, 2021	Earthquake, flood	China	Twitter and Sina Weibo	Content analysis/ online surveys, and interviews
Imran et al., 2020	Earthquake, Hurricane	Nepal, United States	Twitter and Facebook	Multimodal content analysis
Kankanamge et al., 2020	Bushfire	Australia	Facebook and Twitter	Content analysis
Saroj & Pal, 2020	Tsunami, earthquakes, floods, hurricanes	Not specified	Facebook, Twitter, LinkedIn, YouTube or Flickr	Literature survey
Lovari & Bowen, 2020	Wildfire	United States	Social Media platforms	Mixed-method approach
Kavota et al., 2020	Carbon dioxide and methane from Lake Kivu	Congo	Social Media platforms	PLS-SEM
Yan & Pedraza-Martinez, 2019	Hurricane	United States	Facebook	Quantitative approach
Rashid et al., 2019	Real-world disaster	China	Social Media platforms	Energy-Aware Drone (SEAD) sensing framework
Niles et al., 2019	Hurricanes, tornado, flooding	United States	Twitter	Quantitative research method
Li et al., 2019	Hurricane	United States	Facebook	Interviews
Fang et al., 2019	Rainstorm, flood	China	Weibo	Surveys
Jamali et al., 2019	Hurricane	United States	Twitter	Machine Learning Algorithm
Yuan & Liu, 2018	Hurricanes and floods	U.S. Florida	Twitter	Interview and survey
Subba & Bui, 2017	Earthquake	Nepal	Twitter	Content Analysis

Unmanned Aerial Vehicles

Definition of UAVs

According to Blyenburgh (2010), these systems are commonly referred to as Unmanned Aerial Vehicles (UAVs) or "Drones," but in most parts of Europe, they are referred to as Remotely Piloted Aircraft Systems (RPAS) or Unmanned Aerial Systems (UAS). Unmanned Aerial Vehicles are operated by remote pilot control or autonomously because they do not require a pilot, as explained by Gupta et al. (2013). The Unmanned Aerial Vehicles system consists of UAVs, a ground control station, and a control link.

UAVs in Emergency Situations

Unmanned aerial vehicles or drones refer to aircraft which are remotely controlled by an on-ground pilot. UAVs can be found in numerous varieties that differ in size, functions, shapes, cameras, and sensors. As per Shakhatreh et al. (2019), UAVs have been employed in emergency response in multiple ways; conducting search and rescue operations, evaluating damages, and providing emergency supplies to the victims.

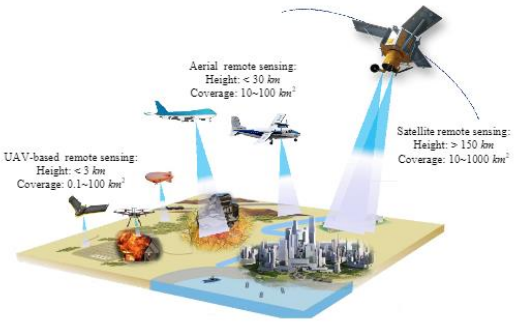

Figure 5. Mini-unmanned aerial vehicle-based remote sensing: techniques, applications, and prospects (Source: Xiang et al., 2018)

UAVs have gained a significant place in the current world due to their use in emergencies. They not only provide easier ways to assimilate and disperse information and enhance situational consciousness but also detect the areas that require more attention. They can prove to be the best source to carry out search and rescue operations as they cooperate with emergency responders in locating and supplying resources to disaster-hit people.

UAVs not only assist the organizations engaged in emergency response but also help individuals that are in dire need of emergency supplies and aid. As exemplified by Munawar et al. (2021), when the COVID-19 pandemic hit the world, test kits and medical supplies were delivered to people in far-flung areas through UAVs which protected them from contacting the virus by eliminating the need to visit the hospital.

Benefits of Using UAVs in Emergency Situations

Using UAVs in emergencies brings many benefits to emergency responders. These advantages include quick assembling and distribution of data, an upsurge in situational responsiveness, and delivery of aid to unapproachable locations.

UAVs' use in emergencies is very beneficial because they can assemble data and disperse it in no time. As deliberated by Munawar et al. (2021), these drones contain sensors and cameras enabling them to obtain authentic pictures and data from the disaster-hit region and help emergency responders to make rational choices regarding response efforts and supply allocation. As presented in Figure 6, UAVs are being tested to carry AED in difficult terrains in order to help during an emergency.

Figure 6. UAV with AED (Source: Wankmüller et al., 2020)

The second advantage of using UAVs in emergencies is that it facilitates situational alertness. With the help of UAVs, disaster response organizations not only observe the situations frequently but also trace their response efforts. Such data proves helpful to locate the most deprived areas and modify response actions subsequently. In Figure 7, a firefighting UAVs is being used to help reach a high floored building caught on fire, faster and without any danger for the firefighters.

Figure 7. Firefighting UAV (Source: Inside Unmanned Systems)

Emergency responders can also use UAVs to deliver supplies in inaccessible places. Major disasters like hurricanes and earthquakes result in many obstacles and debris which restrict access to disaster-affected regions. As per Madridano et al. (2020), UAVs offer an aerial overview of the ongoing conditions and help locate places that need more attention.

Challenges of Using UAVs in Emergency Situations

UAVs are beneficial tools to be used during emergencies, but their usage can bring forth certain challenges. They can give rise to many security, ethical, and safety-related challenges.

Safety concerns are the biggest challenge encountered by emergency responders while using UAVs. They can run into other flying objects which may result in injury and destruction. Furthermore, they may malfunction and crash, leading to individual injuries or demolition of the property. UAV operators need to follow safety protocols and strict rules to reduce these safety challenges. They must receive appropriate training and endorsements, follow the guidelines and flight limitations, and maintain their equipment.

Security concern is the second biggest challenge linked with UAVs' use in emergencies. Their use can lead to the stealing of private data because of their susceptibility to cyber-attacks. Sometimes, UAVs are used with negative intentions to deliver explosive materials or spy on others. Therefore, UAV regulators need to follow validation protocols, execute strong encryption, and keep networks and tools secure to overcome these security concerns.

The ethical concern is the third challenge raised with UAVs' use in emergencies which are associated with the privacy and exploitation of disaster-hit people. UAVs have the

potential to infringe on individuals' privacy as they contain sensors and cameras that obtain pictures and information from disaster sites. The utilization of UAVs also causes the threat of bias and discrimination in the distribution of emergency resources to helpless people. As stated by Velev et al. (2019), emergency response organizations are obliged to protect the well-being and privacy of disaster victims while collecting information to carry out emergency response effectively.

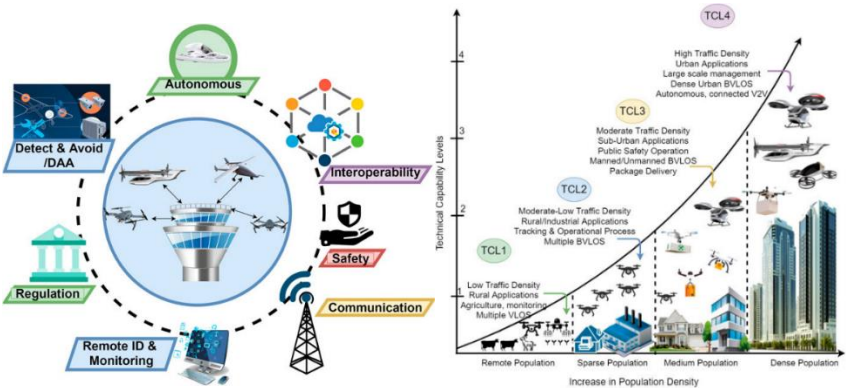

Figure 8. U-space automation levels and UTM's technical capability levels (Source: Shrestha et al., 2021)

In the following table a review of recent papers, with the use of UAVs based on a disaster and the methodology that has been used, is presented.

Table 2. Reviewed papers, the use of UAVs in disasters

Authors	Disaster	Country	Methods
Carreras-Coch et al., 2022	Wildfires, water floods, terrorist attacks	Spain	Literature Review
Nedelea et al., 2022	Pandemic	Not Specified	Experimental study
Robakowska et al., 2022	Medical Emergencies	Not Specified	Literature review
Gupta et al., 2013	Weather monitoring, military training, wildlife surveys	India	Survey paper
Li & Hu, 2021	Emergency Rescue	China	Literature Review
Masroor, Naeem, & Ejaz, 2021	Not specified	Not Specified	Multi-criterion optimization approach
Yakushiji et al., 2020	Disasters in Japan	Japan	Case Study
Madridano et al., 2020	Building Emergencies	Not specified	3D trajectory planning method
Mohapatra, 2020	Emergency Situations	Not specified	Offline drone instrumentalized ambulance
Giordan et al., 2020	Engineering Geology Applications	Not Specified	Geological surveys
Bayanbay et al., 2019	Emergency Medical Assistance	Not Specified	Experimental study
Lee et al., 2019	Natural disasters or missing person searches	South Korea	Vision-based localization algorithm
Oubbati et al., 2019	Emergency Vehicle Guidance	Not Specified	Emergency vehicle guidance in urban areas
Gkotsis et al., 2019	Evacuation operations	Greece	Literature review
Carrillo-Larco et al., 2018	Health emergency	All in high-income countries	Systematic Review

Social Media and UAVs in Emergency Situations

Integration of Social Media and UAVs in Emergency Situations

Incorporating UAVs and social media during emergencies can boost the efforts of emergency response and ring about better resources for disaster victims. Emergency response organizations get a detailed review of the circumstances with the combination of data obtained from the cameras and sensors of UAVs and images collected from social media sites. Such a comprehensive overview allows them to accelerate response efforts and allocate resources effectively.

The best way to embody UAVs and social media in emergencies is by using monitoring devices of social media. With the help of these tools, emergency response organizations can observe social media sites to get immediate data about situations and updates about victims. Response actions can be adjusted according to the needs of people by following the information gathered from UAVs.

The combination of social media observing tools and UAVs can represent the circumstances authentically. The sensors and cameras fixed in UAVs capture high-resolution pictures and information helping disaster responders observe factual situations and classify areas that require more attention.

Figure 9. UAVs used for social distancing (Source: DW)

UAVs and social media can also be amalgamated in emergencies by using them to distribute emergency resources and communication. Resources can be delivered to unapproachable places through UAVs which can protect individuals from getting exposed to danger as they do not need to visit medical facilities themselves. UAVs also provide the best source of communication as it allows emergency responders to interact with disaster victims and deliver them assistance and instructions (Yuan & Liu, 2018).

In the following table a review of recent papers, on the use of Social Media based on a disaster is presented.

Table 3. Reviewed papers, combination of social media and UAVs in disasters

Authors	Emergency Situations	Country	Methods
Zhang et al., 2023	Emergency Situations	Not Specified	Multi-Criteria Approach
Xing et al., 2021	Earthquake	Jiuzhaigou, China	Crowdsourced Social Media, Mobile Phone Signaling Data
Hashemi-Beni & Gebrehiwot, 2021	Flood	Not Specified	Deep Learning, UAV Optical Data
Munawar et al., 2021a	Flood	Not Specified	Literature Review
Munawar et al., 2021b	Flood	Not Specified	Aerial Imagery, Convolutional Neural Network

Asif et al., 2021	Disaster Type	Not Specified	Automatic Image Analysis
Fromm et al., 2021	Situation Awareness	Emergency Control Rooms	Augmented Reality, Social Media Data
Rashid et al., 2020a	Wildfire	Not Specified	Computational Model, Social Drone
Rashid et al., 2020b	Disaster Response	Not Specified	Car Sensing Framework
Terzi et al., 2020	Rescue missions	Not Specified	Algorithms and framework
Yuan et al., 2020	Hurricane	Not Specified	Social Media Data Analysis
Kyrkou & Theocharides, 2019	Emergency Response	Not Specified	Deep-Learning-Based Image Classification
Joseph et al., 2018	Emergency response, recovery	Not Specified	Case studies
Martínez-Rojas et al., 2018	Emergency Situations	Not Specified	Systematic Literature Review
Havas et al., 2017	Emergency Management	Not Specified	Social Media, Crowdsourcing Analysis
Rodrigues et al., 2017	Military, traffic management, natural disaster prevention	Brazil	Literature Review

Future Ideas Combining the Above Technologies

The advantages of including UAVs and social media in emergencies are well-recognized. Nevertheless, there is still scope to improve and bring revolution in the coming future. One way can be to utilize machine learning algorithms for evaluating social media information instantly. These algorithms can help authorities effectively detect and react to emergencies, terrorist attacks, and natural disasters. Social media activities can be monitored through machine-learning algorithms which categorize indicators like hashtags and keywords representing possible emergencies and authorities can use such information to react efficiently and instantly (Wei et al., 2021).

Another way is using UAVs that contain sensors for collecting and transmitting actual information in disasters. These sensors can sense the existence of dangerous substances, radiation, and hazardous gases in the atmosphere. Moreover, they are also effective in mapping disaster-hit regions, detecting possible risks, and evaluating damages. Authorities can make sensible and valid choices to safely and instantly take mandatory actions (Wei et al., 2021).

Figure 10. Emergency-response drones to save lives in the digital skies (Source: EUROPA)

It is recommended to establish systematic guidelines and protocols regarding the use of UAVs and social media for a better future. Since these technologies are evolving at a very fast rate, ensuring their ethical and responsible use must be the top priority of the operators. With the help of standardized guidelines and protocols, it can be made sure that UAVs and social media are incorporated during emergencies safely, efficiently, and effectively. They also help attract people to these technologies by increasing their confidence and faith in them which would result in their extensive use and success. The integration of UAVs and social media during emergencies has a very bright future. Some inspiring recommendations and ideas may prove very efficient for their consistent growth, success, and execution in the coming future. According to Martinez and Cardona (2018), the emergency response system can be improved to protect more people by establishing standardized guidelines and protocols, using machine learning algorithms, and supplying UAVs with sensors.

CONCLUSION

The practice of emergency response has transformed with the integration of UAVs and social media as it reduces the communication gap between emergency responders and disaster-affected people and produces authentic and factual data regarding the disaster. Authorities can tackle every kind of crisis and emergency like natural disasters or terrorist attacks more effectively with their amalgamation. UAVs and social media deliver a large pool of information to make rational decisions and enhance situational awareness and save more lives in the long run.

A key advantage of using social media and UAVs during emergencies is that it gives access to information instantly. Facebook, Instagram, Twitter, and TikTok are useful social media platforms that provide information about disasters. Authorities can immediately respond to disasters by assessing the data obtained from social media. Sensor-equipped UAVs are not only capable of gathering and transferring data proximately but also able to detect possible risks and hazardous substances and assess the damage caused by the disaster. Collectively, all this information can help in making rational decisions.

The process of using UAVs and social media during emergency situations develops the capability of emergency responders to stay connected with the affected population. Authorities can quickly convey essential information and instructions like protection tips and evacuation orders to the public through social media sites. On the other hand, people can also report disasters and share useful information with emergency responders through social media. Some areas are unreachable and have no access to traditional channels of communication, therefore, UAVs are the best means to communicate with people stuck there.

Even though many benefits are associated with the use of UAVs and social media in emergency situations, there is still a need to address the possible challenges and risks linked with it. Careless use of social media in emergency situations may spread rumors and misinformation which may cause confusion and panic among people. The inappropriate use of UAVs can also compromise the security and privacy of people. The implementation and maintenance of these technologies are very expensive; therefore, their cost must be evaluated properly.

The process of emergency response has become revolutionized with social media and UAVs. They are capable of saving lives by accelerating communication and providing factual information. Its effectiveness can be enhanced by addressing potential challenges and risks like privacy and security concerns and dissemination of misinformation. Moreover, the safe and responsible use of UAVs and social media in disasters can be guaranteed by establishing standard guidelines and protocols.

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