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A Review: An Active Response Smart System For Survival Detection On Disaster Precincts

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ABSTRACT

The disaster and warning smart system has been widely used to create awareness among the general population in an emergency situations. However the existing smart system surveillance and detection system unable to provide real time communication mechanism to gaining the information about earthquake disaster before it. However, an effective and resilient ICT networks played an important role to save the human life. In this research, the different resilient information communication technology (ICT) networks has been reviewed and proposed a new logical architecture which helps to disseminate real time information to various components of networks while provide an active response facility to its cross pounding department. The proposed system detects the under-surface survivals through aliveness sensing techniques (their movements, breathing, and respiration patterns) and sends it to concerned cells such as responders' cell phones, base station unit and relevant quick disaster management response cell.

Key words: Logical Architecture, aliveness sensor, respiration Module, GSM Module

1. INTRODUCTION

The different kinds of disasters that cause a massive damage to the human life and infrastructure. The scientists are not yet successful to convey the prior information about the time and place of earthquake. Still, well-organized disaster management services are vital part later than the earthquake in order to decrease the destruction of living human being. In this regard the restoration of communication services is crucial that can help to find victims under debris. The numerous organizations are engaged in the disaster managing. Objects and plans. Pakistan is one of the highly affected countries. In last two decades the state faced the intensive earthquakes causing the massive destruction and loss of lives. The country's National Disaster Management Authority is responsible for the handling the natural disasters. Though the NDMA is working hard in its capacity but still there are various aspects needs to improve, especially quick and speedy responses after the earthquakes. In this regard the pivot is the need of a better communication networks for the restoring the communication to link it directly to the rescue operation for the quick detection and tracking of the survivals from debris.

In Pakistan National Disaster Management Authority deals with the natural disasters at National and International level. NDMA has participated in many disasters especially earthquakes but could not cope them well as it should. The main hurdle in handling earthquakes is that there is no any permanent, speedy and rapid response resilient ICT networks based architecture for the DM under one umbrella [1]. Nor there is proper early warning system for any disaster accept flood early warning system [2] neither on-time communication networks available to by NDMA. Hence NDMA lacks the latest and appropriate mechanism of networks for the fault-tolerant and continuous communication while there are various types of networks used in various disastrous situations in other countries. DM plan comprises of a number of objectives to enhance the emergency planning, assessment and preparation, under different IT solutions

with different issues discovered, as one such example is SAGA (Self-protection Management Support System) Spanish organization. SAGA is an emergency strategy for disaster management [3]. There is need of significance understanding in emergency situations, many methods are used in that such as, Delphi method is used in dangerous areas for the flow of information between different elements involved in disaster management [4]. Different methods are used to build local resilient networks often involved in the association of native public groups. When international organizations adopted such approaches, result shows that they enhance the ability of a community to be active and acclimate when met with diverse natural tragedies and weather change. Today in our world the global organizations are playing a noticeable and influential role in natural disasters [5]. The NDMA is organization of government of Pakistan that's deal the various kinds of disasters occurred in different places. It work with the collaboration different rescue organization and direct him to the disaster zones. But none of them has any efficient network communication facilities to cope the real time issues being faced by human being in disasters zones. This review paper proposed an ICT networks-based Interaction Retrieval Architecture (IRA) for the earthquake disaster zone [6]. The paper is divided into five section. Ist section described the background of different networks and second section comprises the literature review, the third section present the critical analysis of existing technologies and the fourth section has logical architecture of ICT networks and six section draw the conclusion.

2. LITERATURE REVIEW

Many researcher proposed different kind of wired and wireless communication networks to retrieve the necessary information from the disaster zones such as survival detections and disaster frequency. These ICT networks are also used for the locating the survivals at the upper surface. Some important ICT based networks have been discussed in this thesis. After discussing resilient networks that have been used in Disaster Management further the survivals finding technologies or system are discussed that are used in upper surface detection of the survivals. In addition, the focus of the study is to detect the under-surface survivals especially earthquake zone**.**

2.1 Role of ICT Networks

The world is hit by sudden disasters such as earthquakes, Tsunami, typhoon and hurricanes now a day rapidly. In the earthquake disaster such as, in East Japan in 2011 in which thousands of victims and large number of properties was damaged also electric power and information system were shutdown. Lastly, the researchers propose the systems with functions that are essential for upcoming widespread disaster named Never Die Network. NDN is generally comprised of three networks containing fixed, mobile and air NDNs wireless network. The figure 1 depict the NDN networks [7].

Figure 1: Never Die Networks (NDN) [7].

The researchers have proposed a new Portable Disaster Recovery Network architecture. This research allows survivors in disaster effected area or any other related search and rescue circumstances to report their positions to a disaster management Center. This assists responders first to rapidly rescue the survivors of these disaster effected areas [8]. In this research, the researchers have proposed a wireless sensor network have been projected for the Disaster Management services. It is especially designed to safe guard people in earthquake from heavy loses [9].

2.2 GIS (Geographic Information System)

It is very important in the natural disasters, especially earthquake the networks that are lifelines must be still working condition. For this purpose, the researchers have proposed a Geographic Information System to develop for the altitudinal calculation of live lines by using GEO apparatuses. The Geographic Information System creates a map of live-lines, which are fast in execution time, modifiable and user friendly to adopt it during the disaster 11-12-13].

2.3 Wireless Ad-Hoc Network

Wireless communication systems and the protocols, particularly mobile systems and devices Device, 5G networks, 4G/LTE, and software based radio are used to managed the disaster from red zones [14]. During various natural catastrophes, mostly vital system setups are generally destroyed, the survivals requirement in this case

will be diverse communications network for their communication, deprived of a hesitation via using wired and wireless access networks, i.e., Wi-Fi or Bluetooth. The researchers have proposed Intelligent Transportation Systems and Services (ITSS) that are used to play a vital role in coping with crises and disasters. The system used micro-simulation model to adopt the efficiency of the networks in the disaster areas. Moreover, the driver reaction is measured and assessed. The results indicate the immense progress while applying the ITSS in saving the human lives. The results also indication an improvement of saving vehicles as well [15-16

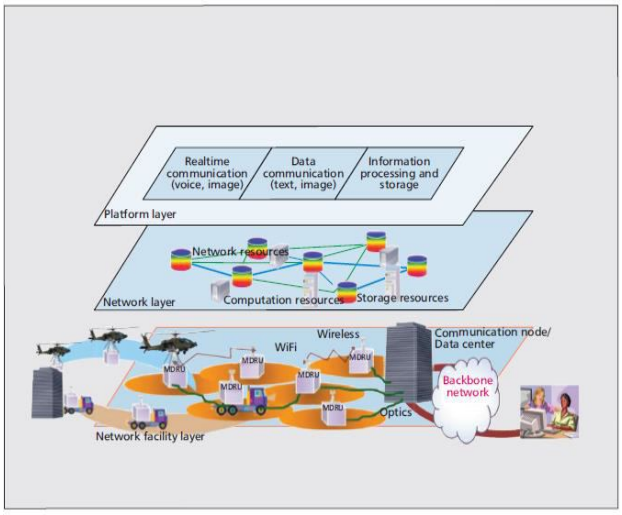

Figure 2. System overview (MDRU) [28]

Another researcher proposes a network architecture that is resilient even through devastating disasters. The researchers have proposed a resilient network architecture which can be used in disasters. The proposed system is MDRU i.e. moveable and deployable rescue unit specially designed for earthquake disasters. The system has capability to share information about the disaster area in very short time MDRU based disaster resilient network shown in the figure 2 [17].

2.4 Social Networks

The long-term investment is required in disaster resilience strategies, the ability to restore communication, plan to respond and to recover in the upcoming disasters are vigorous towards sustainability. The researcher have purposed framework of resilient networks for unstructured large scale data, based upon 36,422 items collected form social media networks such as the data collected from Facebook, YouTube, twitter and instagram for assistance deeds in Nepal earthquake in 2015 [18]. The continuing growth of Social Networks (SNs) and the massive quantity of related users have used these systems in research areas.

2.6 Fanet (Flying Adhoc Network)

Flying ad-hoc networks are attractive an encouraging resolution for diverse use situations connecting UAV, like urban surveillance or search and rescue missions. The system shows numerous and identical detailed communication matters. Moreover, the author describe flexible prototypes and specify the directions whether they could be really accepted dependent on the exact flying ad-hoc network application circumstances. Whereas debating their advantages and disadvantages [19]. It has the benefit of Global Positioning System is available on panel. P-OLSR is now the individual FANET routing method available for Linux implementation [20]. The figure 3 shows the overview of the system.

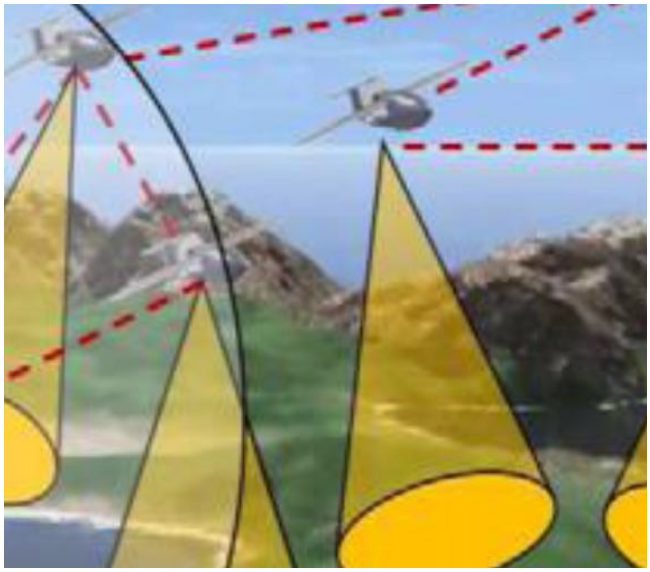

Figure 3. FANET Systems

2.7 UAV (Unmanned Aerial Vehicle)

UAV are ahead of popularity growing communication systems of different service suppliers. Developing system, like mobile edge computing and LTE 4G/5G systems will expand the use of UAVs. Researchers argue the prospective of UAVs, armed with devices, for providing Internet of things services from great heights [21]. In recent times, the use of UAVs, such as gliders and quad copters, has grown consideration for rescue operations [22]. The figure 4 shows the graphical view of UAVs.

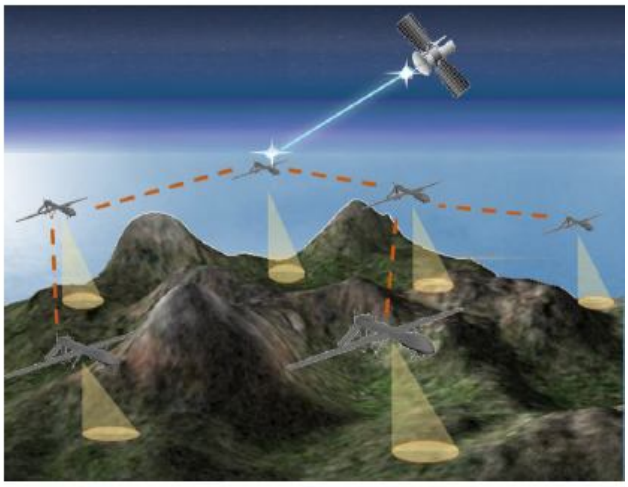

Figure 4. UAV systems

2.8 Drones Technology

The Drone technology has been used in rescue and search operation in different scenarios such as earthquake disaster zones, floods, and upper surface detections. However, drone technology has only capability to identify the upper surface survivals in any disaster zones. The existing drone technologies search and rescue operation were referred and evidenced to be insufficient. However, some researchers start working on drone to increase the capabilities by some modification such as embedded some sensor, high resolution camera and modify and improve the limitations of the pervious drone technologies. In literature a researcher suggests to integrated sensor technology along with drone technology to provide accurate, quick, and safely identify the misplaced survivals in the wilderness and disaster by using multimodal sensing methods. In this method, drone technology was used to send the feedback to operators on field, victims and deliver the necessarily supplies to the survivals [23]. After embedded the multimode sensing technology with drone, the researcher claimed that the modified drone is better, effective and in the rescue and search operation to survivals in any disaster [24]. Indonesia and Japan are the most affected countries by different disasters. the communication networks were badly affected and damaged just after occurrence of disasters while the government used different reliable Communication links to restore and overcome the difficulties in rescues and search operations but unable to find the survivals from disaster timely [25]. However, to overcome the searching problems, the government design and implemented autonomous based operation where they used the autonomous navigation based three-dimensional drone technologies to detect the obstacles and survivals detections and tracking systems [26].

Figure 5. Rotor Wing drone

The most important role of drone till now is to involve in saving human life in many search and rescue operations. Drones uses different technologies, and also have capability for emergency supplies like medicine, water, rescue ropes, life jackets etc. The drones are also used in the sky to monitor and protect rescue workers during fires and SAR processes short of putting them to danger. Constrained area for searchers put the workers at risk, rapid up the rescue work and accumulative the release ability of subsistence. Mostly rotor wing drones are used in search and rescue operations it is shown in the figure 4 (https://www.dji.com/phantom). The table 1 shows the features and limitations of drone technologies.

Table 1. Features and Limitations of Drone Technologies

Country	Features	Technology limitations
Canada	1: Infrared Camera and Camera technology	In Canada in three disasters the simple drones were used with Infrared camera and with normal camera embedded to save six lives.
USA	1: Camera/GPRS 2: Heat Sensing Camera and Hook embedded with camera	In USA four types of the technology embedded drones were such as camera/GPRS, Heat Sensing camera, simple camera and hock. Attached used in eight disasters to save fourteen peoples.
China	Hook embedded with camera	In china, drones were used with very simple technology just camera with hock embedded to save twenty-seven survivals in five different disasters.
UAE	High Resolution Camera technology	In UAE two persons were saved with simple camera embedded drone technology
Turkey	Camera Technology	In Turkey ten lives were saved by the single technology-based drone

Similarly, the Italian Fire Crops developed a team of operators and robots (UGV, UAV) in the red zone of Mirandola to provide quick response and recovery of population and building in case of any disaster [64]. The multi drone interaction prototype system was developed by a researcher to allow an operator to supervised and control the rescue operations and set of UAVs by means of multimode communication. The main task of that multimode drone technology was to locate the misplaced person in disaster affected areas [26].

3 LIMITATIONS OF THE EXISTING ICT NETWORKS

Several types of Information Communication networks have been debated in the literature are summarized in the table 2. In this research article we have examined the existing technologies being used in disaster situations and highlight the limitations and weakness of existing technologies and proposed a logical architecture for resilient ICT networks.

Table 2. Summarized limitations and weakness of existing technologies

Year	Title of Publication	Technologies	Working/Limitations
2020	Detection and Localization of Life Signs from the Air Using Image Registration and Spatio-Temporal Filtering. Remote Sensing [27]	Drones	The researchers present a new technique to guess the positions of people from aerial video using image and signal processing designed to detect breathing movements.
2019	PC Controlled Wireless Robot for Detecting Human Presence.[28]	Robot	A PC controller wireless robot was proposed for detecting human presence with the PIR and ultrasonic waves.
2019	Life signs detector using a drone in disaster zones. Remote Sensing [29]	Drone	The proposed system uses image sequences captured by a drone camera to remotely detect the cardiorespiratory sign caused by discontinuous chest movement of survivors
2018	Evaluation of a sensor system for detecting humans trapped under rubble: A pilot study. Sensors [30]	Sensor	A system based on thermal camera, microphone and CO2 sensor was developed to detect the survivals trapped under rubbles.
2018	Rapid Human Body Detection in Disaster Sites Using Image Processing from Unmanned Aerial Vehicle (UAV) Cameras [31]	UAV	The research proposes to detect the human body skin through image processing system through UAV and the camera can clearly detect survivals body or a part of body.
2017	Characteristic ground motions of the 25th April 2015 Nepal earthquake (Mw 7.9) and its implications for the structural design codes for the border areas of India to Nepal [32-33]	Wireless Sensors	The wireless network has been used in Nepal and India with Structural design code for border areas for the purpose of monitoring of the characteristics of the ground motion in earthquake 2015.
2016	UAV-based Photogrammetry and Geo computing for Hazards and Disaster Risk Monitoring [33]	Ad Hoc Networks UAV	The proposed systems are only used to develop a short-term communication between disaster zone and base station. The system does not detect the survivals under surface/Behind the wall.
2016	Social Networks in Crisis Response: Trust is Vital [34]	Social networks	Social networks are only used to separate the information on other social and electronic communication medium for the information about the disaster occurrences. Cannot track aliveness of survivals

2016	Using tweets to support disaster planning, warning, and response [35]	Mobile Social Networks and GIS	Tweets are used to flow the information about the disaster area as an early warning to the community for better planning and quick response. Through SMS services the disaster locations are being indicated
2016	A dynamic decision support system based on geographical information and mobile social networks: A model for tsunami risk mitigation in Padang, Indonesia [36]	Mobile Social Networks and GIS	This system is designed as a field experiment in Padang, Indonesia, to help public officials design tsunami risk maps with timely evacuation routes and transmit these maps to influential leaders in local neighborhoods that are exposed to tsunami risk
2015	A Cooperative Network Framework for Multi-UAV Guided Ground Ad Hoc Networks [37]	Ad Hoc Networks	The proposed framework can form a search maps that are able to define multiple way points for each UAV in the network to follow a non-redundant path for searching and identifying various user nodes and geographical territories.
2015	Autonomous Drones for Disasters Management: Safety and Security Verifications [38]	Drones	A Parrot platform is used to capture videos of its surroundings. Those videos are transmitted by the UAV to a remote computer, which autonomously controls the drone according to its mission. The UAV are capable of disaster management, Safety and Security verifications.
2014	SAR.Drones: Drones for Advanced Search and Rescue Missions[39]	Flying Technology	The researchers present the framework based on visual assessment of disaster areas It also helps rescue teams to locate hotspots (i.e. half-buried person or broken and dangerous areas)
2013	On the performance of Flying Ad Hoc Networks (FANETs) Utilizing Near Space High Altitude Platforms (HAPs) [40]	FANET Networks	A Medium Access Control (MAC) Location Oriented Directional MAC (LODMAC) protocol is used for discovery and data transmission in parallel with the help of directional antennas.

4. LOGICAL ARCHITECTURE OF PROPOSED RESILIENT ICT NETWORKS

The proposed resilient IRA comprises various components such as Early Warning System Networks (EWSN), Rapid Response Networks (RRN), Central Disaster Management Organization Database Cell (CDMDC), Quick Disaster Management Response Centre (QDMRC) and NDMA as shown in figure 6. Moreover, the early warning and repaid response networks consist with with different communication networks such as drone based, social, GIS/GSM and underwater networks. The CDMDC is another component of IRA which contain various information data for instance, geographical data, registered cell phone information as well as ICT networks. Furthermore, the architecture has QDMRC component which is responsible to share the disaster information with NDMA office. Furthermore, the architecture has QDMRC component which is responsible to share the disaster information with NDMA office CDMDC is another component of IRA which contain various information data for instance, geographical data, registered cell phone information as well as ICT networks social, GIS/GSM and underwater networks[41-42-43-44].

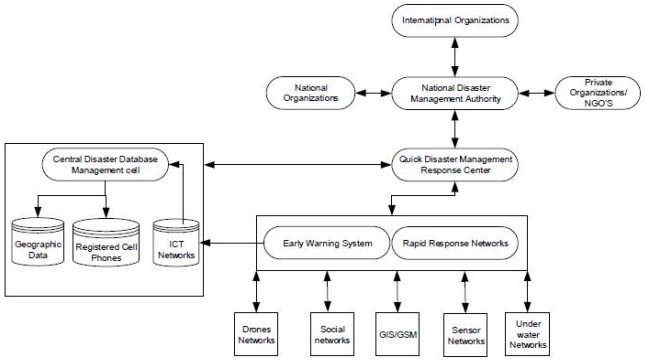

Figure 6. Resilient Interaction Retrieval Architecture (IRA [45-46])

4.1 Components of Resilient IRA

The proposed architecture has four components which are being used to retrieve the information of live survivals, data about survivals and transmit that collected within disaster zone to base-station. These four components of prototype are discussed in the following section.

4.2 Early Warning System Networks (EWSN)

The EWSN is the important component of the IRA which is used to generate the early warnings alerts and communicate them quickly with the disaster management response center as illustrated in figure 7 and has following features:

- Consist of multiple resilient ICT networks to transmit the early warning alerts.
- EWSN component has network redundancy in case of failure of GSM network it will sends the information via another available network.

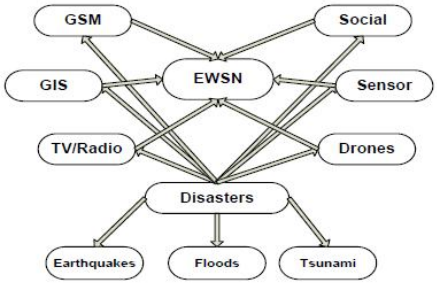

Figure 7. Early Warning System Networks (EWSN) [45-46]

4.3 Rapid Response Networks (RRN)

The rapid response component is used to detect the survival from the earthquake disaster zones. The RRN has various kinds of communication networks to detect the survivals and communicate that information about the survivals to the base station component of IRA. The figure 8 depicted rapid response networks component. It has following features:

- The RRN is the core component of the prototype system effectively work during the occurrences of any natural disasters especially earthquakes.
- Perform quick and speedy response to collect survival detection Information
- Establish communication between all components of the IRA prototype system.

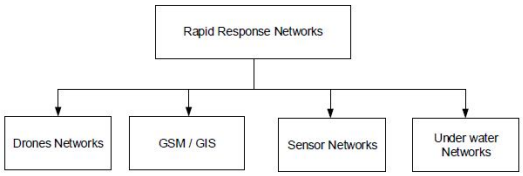

Figure 8. Rapid Response Networks (RRN [45-46])

4.4 Central Disaster Management Database Cell (CDMDC)

The central disaster management database contains different data cells such as geographical data, registered mobile phone information and ICT networks cells.The geographical data cell contains the geographical information of various disaster zones and the registered cell phone maintains the occupant cell phone information living in disaster affected areas. In the same line the ICT networks cell contain the information of available resilient ICT networks mainly working in disaster areas. The figure 9 shows the various cells of CDMDC. It has following features:

- Maintain the entire record of the design system network and other important information necessary for the rescue operations.
- Population records has been maintaining by this component.
- Continuously update the information about registered cell phones,disaster zones and available networks.

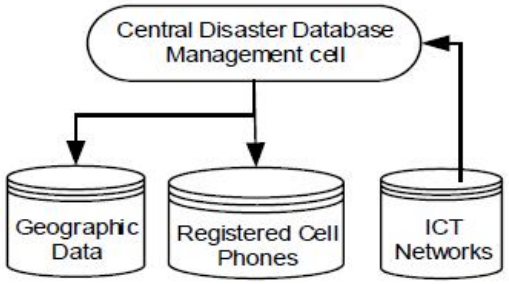

Figure 9.Central disaster Management Database Cell [45-46].

5. CONCLUSION

In this research, a critical review has been carried out and examined the capabilities of existing technologies. Which were used in to identify the survivals identification in earth quake disasters zones or another kind of disaster. Many researchers have proposed various resilient networks to save the human being lives from the any kind of disaster and provide quick rescue aids to the affected areas and track the human bodies.in addition, the different technologies has been used to executed the survival detection and rescue operations such as drone, Infrared Camera and Camera technology, Heat Sensing Camera and Hook embedded with camera, unmanned aerial vehicles, heterogeneous-network, public safety communications, flying adhoc network and etc. however, these technologies have not a real time based communication architecture to transfer the real time information from affected areas to cross pounding base station as mentioned in table no 2. In this article we have proposed a Logical architecture for An Active Response Smart System which will be consist of four components for different purposes as discussed in section 4.

REFERENCES

[1] Ahmed Z. Disaster risks and disaster management policies and practices in Pakistan: A critical analysis of Disaster Management Act 2010 of Pakistan. International Journal of Disaster Risk ReductionJun vol 1 no 4:15-20. . 2013

[2] Chatfield AT, Scholl HJ, Brajawidagda U. Tsunami early warnings via Twitter in

government: Net-savvy citizens' co-production of time-critical public information services. Government information quarterly. vol 30 no 4.377-86. Oct 1, 2013

[3] Canós JH, Borges MR, Penadés MC, Gómez A, Llavador M. Improving emergency plans management with SAGA. Technological Forecasting and Social Change. Vol 80 no 9:1868-76. Nov 12013

[4] K. Laakso and J. Palomäki, "The importance of a common understanding in emergency management," Technol. Forecast. Soc. Change, vol. 80, no. 9, pp. 1703–1713, 2013.

[5] M. F. Olwig, "Multi-sited resilience: The mutual construction of 'local' and 'global' understandings and practices of adaptation and innovation," Appl. Geogr., vol. 33, no. 1, pp. 112–118, 2012.

[6] H. U. Salam++ S. Memon L. Das, A.-U.-REHMAN*, and Z. HUSSAIN "Drone Based Resilient Network Architecture for Survivals in Earthquake Zones in Pakistan ". "S u r j s s," vol. 50, no. 1, pp. 175–182, 2018.

[7] Y. Shibata, N. Uchida, and N. Shiratori, "A Resilient Network and Information Management System for Large Scale Disaster," in 2016 30th International Conference on Advanced Information Networking and Applications Workshops (WAINA), pp. 655–660. 2016

[8] R. G. L. Narayanan and O. C. Ibe, "Joint Network for Disaster Relief and Search and Rescue Network Operations," Wirel. Public Saf. Networks 1 Overv. Challenges, vol. 56, no. 14, pp. 163–193, 2015.

[9] B. Duruturk, N. Demir, I. Koseoglu, U. B. Onal, and M. Ercanoglu, "Gis- Based Determination of Landslide Properties in Regional Scale: Karabuk Province (NW Turkey)," Ann. Valahia Univ. Targoviste, Geogr. Ser., vol. 17, no. 1, pp. 37–46, 2017.

[10] A. Bostrom, J. E. Vidale, and A. Ahn, "Earthquake experiences, risk perceptions and Early Warnings on the U.S. West Coast," Soc. Risk Anal. Annu. Meet. , vol. 20, pp. 112–122, 2015.

[11] J. W. Cheng, H. Mitomo, T. Otsuka, and S. Y. Jeon, "The effects of ICT and mass media in post-disaster recovery - A two model case study of the Great East Japan Earthquake," Telecomm. Policy, vol. 39, no. 6, pp. 515–532, 2015.

[12] Q. Chen, J. Zhang, and Z. Hu, "A Topology Control Strategy with Reliability Assurance for Satellite Cluster Networks in Earth Observation," Sensors, vol. 17, no. 3, p. 445, 2017.

[13] A. Sevtap Selcuk-Kestel, H. Sebnem Duzgun, and L. Oduncuoglu, "A GIS-based software for lifeline reliability analysis under seismic hazard," Comput. Geosci., vol. 42, pp. 37–46, 2012.

[14]] P. Rawat, M. Haddad, and E. Altman, "Towards efficient disaster management: 5G and Device to Device communication," in Proceedings of the 2015 2nd International Conference on Information and Communication Technologies for Disaster Management, ICT-DM 2015, pp. 79–87. 2016

[15] Z. Alazawi, O. Alani, M. B. Abdljabar, and R. Mehmood, "Transportation Evacuation Strategies Based on VANET Disaster Management System," Procedia Econ. Financ., vol. 18, pp. 352–360, 2014.

[16] T. Andre, K. A. Hummel, and A. P. Schoellig, "Application-Driven Design of Aerial Communication Networks," IEEE Commun. Mag., vol. 52, no. May, pp. 129–137, 2014.

[17] T. Sakano et al., "on Movable and Deployable Resource Units Citation : Disaster Resilient Networking - A New Vision based on Movable and Deployable Resource Units (MDRUs)," IEEE Netw., vol. 27, no. 4, pp. 40–46, 2013.

[18] T. Papadopoulos, A. Gunasekaran, R. Dubey, N. Altay, S. J. Childe, and S. Fosso-Wamba, "The role of Big Data in explaining disaster resilience in supply chains for sustainability," J. Clean. Prod., vol. 142, pp. 1108–1118, 2017.

[19] G. Avdikos, G. Papadakis, and N. Dimitriou, "Overview of the application of High Altitude Platform (HAP) systems in future telecommunication networks," in 2008 10th International Workshop on Signal Processing for Space Communications, , pp. 1–6.2008

[20] A. Bujari, C. T. Calafate, J. C. Cano, P. Manzoni, C. E. Palazzi, and D. Ronzani, "Flying ad-hoc network application scenarios and mobility models," Int. J. Distrib. Sens. Networks, vol. 13, no. 10, pp. 1–17, 2017.

[21] O. K. Sahingoz, "Ad Hoc Networks Flying Ad-Hoc Networks (FANETs): A survey," Ad Hoc Networks, vol. 11, no. 3, pp. 1254–1270, 2013.

[22] N. H. Motlagh, M. Bagaa, and T. Taleb, "UAV-Based IoT Platform: A Crowd Surveillance Use Case," IEEE Commun. Mag., vol. 55, no. 2, pp. 128–134, 2017.

[23] M. Erdelj, E. Natalizio, K. R. Chowdhury, and I. F. Akyildiz, "Help from the Sky: Leveraging UAVs for Disaster Management," IEEE Pervasive Comput., vol. 16, no. 1, pp. 24–32, 2017.

[24] A. Kelleher, "SAR DRONE SENSOR SUITE," Worcester Polytechnic Institute, 2017.

[25] M. S. Alvissalim et al., "Swarm quadrotor robots for telecommunication network coverage area expansion in disaster area," in SICE Annual Conference (SICE), Proceedings of, 2012, pp. 2256–2261. 2012

[26] S. Hayat, E. Yanmaz, and R. Muzaffar, "Survey on unmanned aerial vehicle networks for civil applications: A communications viewpoint," IEEE Commun. Surv. Tutorials, vol. 18, no. 4, pp. 2624–2661, 2016.

[27] Perera, A.G., Khanam, F.T.Z., Al-Naji, A. and Chahl, J.,Detection and Localisation of Life Signs from the Air Using Image Registration and Spatio-Temporal Filtering. Remote Sensing, 12(3), p.577. 2020

[28] Gupta, A., 2019. PC Controlled Wireless Robot for Detecting Human Presence.

[29] Al-Naji, A., Perera, A.G., Mohammed, S.L. and Chahl, J. Life signs detector using a drone in disaster zones. Remote Sensing, 11(20), p.2441. . 2019

[30] Zacharie, M., Fuji, S. and Minori, S., 2018, October. Rapid Human Body Detection in Disaster Sites Using Image Processing from Unmanned Aerial Vehicle (UAV) Cameras. In International Conference on Intelligent Informatics and Biomedical Sciences (ICIIBMS) (Vol. 3, pp. 230-235). IEEE. 2018

[31] Zhang, D., Sessa, S., Kasai, R., Cosentino, S., Giacomo, C., Mochida, Y., Yamada, H., Guarnieri, M. and Takanishi, A., Evaluation of a sensor system for detecting humans trapped under rubble: A pilot study. Sensors, 18(3), p.852. 2018.

[32] S. Misra, R. Goswami, T. Mondal, and R. Jana, "Social networks in the context of community response to disaster: Study of a cyclone-affected community in Coastal West Bengal, India," Int. J. Disaster Risk Reduct., vol. 22, pp. 281–296, 2017.

[33] C. Gomez and H. Purdie, "UAV- based Photogrammetry and Geocomputing for Hazards and Disaster Risk Monitoring – A Review," Geoenvironmental Disasters, vol. 3, no. 1, p. 23, 2016.

[34] Humplik, T., Smedley, S.B., Collins, E.A., Sullivan, E. and Ma, C.K., Social Networks in Crisis Response: Trust is Vital. Center for Naval Analyses Arlington United States. 2016.

[35] Landwehr, P.M., Wei, W., Kowalchuck, M. and Carley, K.M., Using tweets to support disaster planning, warning and response. Safety 109 science, 90, pp.33-47. 2016.

[36] Ai, F., Comfort, L.K., Dong, Y. and Znati, T., A dynamic decision support system based on geographical information and mobile social networks: A model for tsunami risk mitigation in Padang, Indonesia. Safety science, 90, pp.62-74. 2016.

[37] Sharma, V. and Kumar, R. A cooperative network framework for multi-UAV guided ground ad hoc networks. Journal of Intelligent & Robotic Systems, 77(3-4), pp.629-652. ., 2015

[38] Apvrille, L., Roudier, Y. and Tanzi, T.J., May. Autonomous drones for disasters management: Safety and security verifications. In 2015 1st URSI Atlantic Radio Science Conference (URSI AT-RASC) (pp. 1-2). IEEE. 2015,

[39] S. Temel and I. Bekmezci, "On the performance of Flying Ad Hoc Networks (FANETs) utilizing near space high altitude platforms (HAPs)," in RAST 2013 - Proceedings of 6th International Conference on Recent Advances in Space Technologies, , pp. 461–465.2013.

[41] G. Remy, S.-M. Senouci, F. Jan, and Y. Gourhant, "SAR.Drones: Drones for Advanced Search and Rescue Missions," Journées Natl. des Commun. dans les Transp., vol. 1, pp. 1–3, 2013.

[42] Hussain, Zahoor, S. Zafar Nasir, Muhammad Ismail, Muhammad Hammad-u-Salam, Raza Hussain Shah, Syed Faiz ul Huda, and Sara Hafeez Rajput. "IOT Based Smart Energy Harvester Linked to Human Body Motions (ISEHLHM)." International Journal of Computer Science and Network Security 19, no. 63-69. 8 2019

[43] Hussain, Zahoor, Zafar Nasir, Sayed Hyder Abbas Musavi, and Muniba Memon. "An Approach to Energy Economy In Household Environment Using Smart System (SSFEE)." IJCSNS 19, no. 74-78. 3 (2019):

[44] Mohd Kassim M. IoT Water Quality Monitoring for Smart City. International Journal of Advanced Trends in Computer Science and Engineering: vol 9, no 1.5, 240-246. 2020

[45] Salam, H. U., S. Memon, L. Das, and Z. HUSSAIN. "Drone Based Resilient Network Architecture for Survivals in Earthquake Zones in Pakistan." Sindh University Research Journal-SURJ (Science Series) 50, no. 01 175-182. 2018

[46] Hussain, Zahoor, Raza Hussain Shah, and Nisar Ahmed Memon. "Sensor based survival detection system In earthquake disaster zones." Int. J. Comput. Sci. Netw. Secur 18, no. 5 ,46-52 2018