IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

Reshaping Resilience: The Transformative Role of AI-Driven Social Media in Disaster, Risk and Crisis Management

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Abstract : *This era where disasters are more severe and frequent, the convergence of Artificial intelligence (AI) and social media offers an innovative and modern approaches to disaster, risk and crisis management. This study discusses about the capabilities and new potential of AI-driven social media for the transformation of traditional disaster management approach to the modern AI-driven practices through predictive modelling, real-time situational awareness and systematic resource allocation. As social media platforms are leveraging vast amount of real -time data and user data for the detection of early signs of disaster, predicts potential threats and facilitate rapid well- informed decision making. This research involves a qualitative research design by analysing in-depth case studies related to recent disaster and calamities to examine the latest applications and their outcomes for the future opportunities of AI and social media convergence. It also involves the qualitative databases including interviews of associated stakeholders, concerned reports of the authorities, recent researches and social media to provide comprehensive insights about their effectiveness for disaster management. However, the convergence of AI and social media technologies also introduces challenges, including misinformation, data privacy concerns, technological issues. It demands the necessity for robust technological equipped infrastructure support. Therefore, It examines the role of AI and social media, challenges and opportunities for resilient and responsive framework, technological advancements, collaborations to harness future potential.*

Key words*: Artificial Intelligence, Social Media, Disaster Management, Crisis Management, Risk Management, Data Privacy, Real-Time, Predictive Analytics, Misinformation, Technology*

INTRODUCTION

According to recent data 2024 of Datareportal and GSMA Intelligence reported that 69.4 percent people of world uses mobile device, with 138 million people worldwide using them and expanding by 5.35 billion internet users. Users spend 2.5 hours per day on social media as per report [1]. Social media has emerged as proficient advanced communication tool in disaster, risk and crisis management. This has been a transformative synergy from traditional response framework to the AI-driven mitigating structure which harness the vast real time data from social media users to enhance situational awareness, facilitating effective and efficient responses, and optimizes resource allocation. The convergence of AI and social media has revolutionary changes which help in mitigation of any disaster event. Natural language processing, machine learning and predictive analysis of AI technological advancements have a significant impact by forecasting events, interpreting user data in real time on social media, analysing crucial situations and provides insightful information during disasters. Social media is now not only communication tool but it enhanced its role and responsibility by preparing, alerting, resource allocation and mitigating during disaster management by forecasting and responding in real time.

BACKGROUND

AI-driven social media platforms are becoming more widely acknowledged as vital resources for managing risk, disaster and crisis management. Social media utilises user data in real time, improve communication and aid in decision making. These platforms remarkably prove their advancements globally during disaster management by responding, coordinating relief efforts and disseminating vital information during disasters. Nevertheless, there are a number of obstacles and challenges too to their incorporation into disaster management such as misinformation, data privacy concerns and the requirement for an efficient infrastructure to handle the enormous data.

NEED OF AI-DRIVEN SOCIAL MEDIA IN DM

AI-driven tools can detect misinformation, ensuring that only accurate and verified information reaches the public, thus preventing panic and confusion. Social media can be used in disaster management organisations in two broad ways: passive dissemination of information to the public and collection of user feedback, and systematic use as an active emergency management tool for communications, warnings, assistance requests, content monitoring, and situational awareness.

LITERATURE REVIEW

- Singla, Annie & Agrawal, Rajat. (2022)-The study demonstrated about the social media and disaster management, It also incorporated the barriers, users perception and authority responsibilities. It also showcased about challenges and enablers of disaster management through social media framework [1]

Singla, Annie & Agrawal, Rajat. (2022). Social media and disaster management: investigating challenges and enablers. Global Knowledge, Memory and Communication. 73. 10.1108/GKMC-12-2021-0206.

- Phengsuwan, Jedsada & Shah, Tejal & Balan Thekkummal, etc. Use of Social Media Data in in Disaster Management: A Survey - This study incorporated about social media data classification and event detection for spatial and temporal data extraction. It also described about taxonomy along with analysis about data during disaster management [2].

- A.S., Abdul & Manaf, Rosliza & O., Mardiana. (2019). IJPHCS ROLE OF SOCIAL MEDIA IN DISASTER MANAGEMENT. This study demonstrated about the role of communication through social media and its importance during disaster management. It also described about the communication breakdown and its effects in risk and responsive framework [3].

- Jiting Tang, Saini Yang, Weiping Wang, Social Media based disaster research: Development, trends, and obstacles, International Journal of Disaster Risk Reduction - This research described about three features of social media. It defined about subjectivity, timeliness and disequilibrium during disaster and population representation. This study also incorporated about technological barriers, knowledge sharing and multiple collaborations [4].

- Phengsuwan J, Shah T, Thekkummal NB, Wen Z, Sun R, Pullarkatt D, Thirugnanam H, Ramesh MV, Morgan G, James P, et al. Use of Social Media Data in Disaster Management - The study showcased about the lack of research on social media data management and analysis of data categorisation including spatial and temporal analysis. The study also describes about data management during disaster [5].

- Li, Weilian & Haunert, Jan-Henrik & Knechtel, Julius & Zhu, Jun & Zhu, Qing & Dehbi, Youness. (2023). Social media insights on public perception and sentiment during and after disasters: The European floods in 2021 as a case study. Transactions in GIS – This study describes about real time data of social media users and how these data are crucial for stakeholders, agencies related to disaster management [6]

- Seneviratne, Krisanthi & Nadeeshani, Malka & Senaratne, Sepani & Perera, Srinath. (2024). Use of Social Media in Disaster Management: Challenges and Strategies. Sustainability - This study describes about four key challenges such as lack of trust, misinformation, poor quality content, several challenges to overcome. It also showcased about organizations, people and authorities [7].

RESEARCH GAPS

1. Limited assessment of Real-World technologies.
2. Insufficient analysis of technological integration.
3. Misinformation and Disinformation concerns
4. Lack of robust AI-driven infrastructure
5. Inadequate stakeholder's participation.

OBJECTIVES OF THE STUDY

- To explore AI driven social media technologies.
- To examine recent developments related to disaster management.
- To analyse major disaster case studies.
- To develop future recommendations.

RESEARCH METHODOLOGY

- In research methodology, the study will be Qualitative research approach and systematic literature review analysis. The main source of data is Secondary. The data is processed from different sources like Research studies from ResearchGate, Google Scholar, PubMed.
- For the purpose of the case study- Evaluating 5 major disasters globally along with its approach of technologies and social media response. For this, data are from Annual reports, articles, company-websites and e-newspapers, associated stakeholder's statements related to AI, social media and disaster management are included.

Inclusion criteria:

1. Disasters related studies from 2019 onwards.
2. Studies that only focus on artificial intelligence, social media, disaster management including recent developments, strategies, technologies

Exclusion Criteria:

1. Any studies before 2018.
2. Studies that focus on traditional disaster management.

- Review and analyse qualitative data from authoritative reports related to advancements in AI technologies related to social media for mitigating disaster management.

FINDINGS

AI TECHNOLOGIES OF SOCIAL MEDIA DURING DM

- **Natural Language Processing (NLP)**

NLP techniques are used to analyse text from social media. NLP is used in to sort through posts and tweets during disasters in order to allocate resources depending on the quantity and nature of distress signals.

- **Image Recognition and Computer**

Vision AI driven image identification technologies analyse and process images and videos uploaded on social media to evaluate damage, analyse the trajectory of disasters and identify impacted locations. Computer vision algorithms are used to analyse images posted on social media, satellite and drone imagery and other data after any disaster to help estimate the degree of structural damage.

- **Machine Learning and Predictive Analytics**

Leveraging both previous and present social media data, machine learning algorithms analyses patterns to forecast disasters, evaluate possible consequences and enhance response tactics, Based on past patterns and real time special media data, predictive analytics is utilized to estimate the possible direction of a hurricane or the spread of wildfires.

- **Sentiment Analysis**

AI driven social media analyses user sentiments which determine distress and authorities can understand the better situation.

- **AI technologies integrate with social media with GIS**

This technology is used to analyse flooding and it helps in evacuation also by incorporating GIS.

- **Data Mining and Social Media Monitoring**

AI technologies continuously analyse social media sites for pertinent information, reducing noise and concentrating on information that can be used to control disasters. Automated monitoring systems are used to monitor conversations connected to disasters as they emerge and send notifications to response team, enabling them to take immediate actions.

- **Automated Misinformation Detection and Content Moderation**

During disasters, AI tools are used to prioritise reliable and accurate data by recognising and reducing damaging content and disinformation that spreads on social media. Virtual assistants and chatbots

- **Chatbots and Virtual Assistants**

Chatbots can provide information about safety measures, safe zone and safety routes during disasters and resource allocation.

RECENT DEVELOPMENTS RELATED TO DM IN INDIA

AI Mission for Disaster Management in India;

- **Amendment to Disaster Management Bill 2024 Management Act**

Proposing significant modifications to the Disaster Management Act of 2005, the Union government tabled the DM (Amendment) Bill 2024.This entails formation of new urban authorities and setting up national and state disaster databases and forming Urban Disaster Management Authorities in state capitals.

- **Urban Disaster Management Authorities**

In order to address the particular difficulties associated with managing urban disasters, the bill suggests the establishment of an urban disaster management authority which would be reserved exclusively for state capitals and large cities having municipal corporations.

- **SDMA and NDMA**

Disaster management plans which were formerly within the purview of the State Executive Committee (SEC) and the National Disaster Management Authority (NDMA) and the State Disaster Management Authorities (SDMAs). This modification will enable more specialized planning across various geographic regions.

- **Global AI Initiatives**

India has incorporated goals for DM and developed a project – GPAI and CDRI.

- **International Partnerships**

Nations are extending their international cooperation to improve their capacity to respond to disasters through the use of social media and AI.

CASESTUDIES

Major disaster case studies from 2019 to 2024, highlighting the role of specific AI technologies and social media platforms in response and recovery efforts:

1. Tropical Cyclone Halima – Mozambique

This disaster made landfall in Mozambique causing widespread flooding, displacement and infrastructure damage.

AI and social media Technology Success Analysis:

- *Predictive Analytics by IBM Watson* – Early warning systems and well- planned evacuation preparations were made possible by IBM Watson's AI models which accurately anticipated the cyclone's path.
- *Drone assistance by DJI Matrice 300 RTK* with AI integration mapped floods and detected stranded people in order to facilitate immediate rescue.
- *Social Media Analysis by Hootsuite, Sprinklr* – It scanned social media networks to detect current requirements and assistance.

2. Wildfires in California, USA

This disaster was a combination of intense heat and dry weather caused severe wildfire.

AI and Social Media Technology Success Analysis:

- *Early detection by Google AI, NVIDA Metropolis* – AI based sensors and satellite imagery analysis for firefighting resources by early detection.
- *Resource Management by Palantir, Fireman* – AI systems such as Palantir and Firemap streamlined the deployment of personnel and apparatus for combating fires, resulting in faster responses.
- *Social Media Monitoring by Twitter API, Dataminr* – These technologies evaluated the user data in real time and improved situational awareness and directing evacuation operations.

3. Earthquake in Turkey

A powerful earthquake struck eastern Turkey leading to significant loss of life and property damage'

AI and Social Media Technologies Success Analysis:

- *Lockheed Martin's SAR AI* for rescue operations analysed sensor and smart data device to find stranded survivors inside buildings that collapsed'
- *Damage Assessment by Pix4D* with AI and drones are utilized to prioritized regions for rescue and to conduct aerial surveys.
- Social Media Coordination through *Facebook crisis responses* .

4. Jakarta Flooding, Indonesia

Severe flooding in Jakarta caused by unusual monsoon rainfall displaced thousands of lives.

AI and Social Media Success Analysis

- *Prediction by Google Flood Forecasting Initiative* – It predicted flood levels with a high degree of accuracy and allowing for better framework protection and evacuations.
- *Traffic Management by Waze and AI Traffic Flow Analysis* – Traffic flow during evacuations was optimised using these AI driven systems with Waze data to facilitate quick travel to safety.
- *Social Media Mapping by Crisis Mappers and Ushahidi*- These websites employed social media information to generate comprehensive maps of flooding that directed restoration and remedial activities.

5. Wayanad Floods, Kerala India

Significant land slides and cloud burst occur due to heavy monsoon rainfall and floods resulted in displacement in thousands of lives.

AI and Social Media Technology Success Analysis:

- *DeepMind and Google AI Flood Prediction* – this was used for early evacuations which reduced victims of events.
- *Rescue Operations by SAR AI by DJI and Drones technology* proved effectiveness in search operations by providing real time data.
- *Social Media Crowdsourcing by Facebook and Crisis Response Tools* analysed real time data from post, check-ins and messages helped in allocation of resources and detecting an affected areas for better coordination with rescue and relief operations.

These disasters case-studies highlighted how these technologies including AI driven and social media play crucial role in preparedness, detection. resource allocation and mitigating in pre and post disaster management.

CHALLENGES AND OPPORTUNITIES

- **Data Quality and Reliability** - Due to rapid spread of false information and irrelevant content which impedes disaster response, AI driven social media platforms have difficulties with data accuracy. The difficulty of creating AI systems that can filter reliable content is still not over.
- **Inaccuracies in AI systems** – Social media user data numerous time proved to be false and inaccurate.
- **Data and Ethical Concern** - User consent is essential to have for a robust DM framework.
- **Technological and Infrastructure Gaps** – The adoption of AI driven social media is impeded in disaster prone areas with limited digital infrastructures.
- **Stakeholders Coordination** – Collaboration across several entities is essential for effective disaster management
- **New and Efficient Technology Development** – Developments of new technology and developments are crucial for DM.
- **Integration with Traditional Systems** – in order to maximize the benefits of AI- driven technologies, it is necessary to integrate them with existing disaster management frameworks. Recent associated authorities agreed to have land grid system to forecast disasters prior to event along with AI GIS and drones.

CONCLUSION

The convergence of social media and AI is bringing about a revolutionary change in crisis. risk and disaster management. Recent disasters in India can proved that social media and many other technologies are providing data which helps in preparing framework and mitigating during DM. This examined that the AI driven social media has played a crucial role in management of DM by real time user analysis, forecasting, sentiment analysis.

Recent data and publications, especially those from reputable sources like UN and World Bank emphasizes how important it is to have efficient frameworks and mechanisms in place to fully utilise social media and AI in DM. The floods in Wayanad proved for the need of better flood control measures, increased community readiness and efficient use of technologies to enable real time monitoring and responses. In summary, the findings of this study underscore the necessity of sustained innovation, cooperation and technological expenditure to augment the efficiency of disaster management protocols and guarantee a more robust and adaptable strategy for future emergencies.

To conclude, AI driven social media platforms drastically enhanced disaster relief efforts, these issues must be addressed for better utilization. Building a more responsive and resilient approach to disaster management will require sustained innovation, strategic integration and collaboration assuring preparedness and responsiveness to future disasters.

SUGGESTIONS

Future researchers and authorities should collaborate to improve framework, planning of pre, existing and post DM mapping for better and efficient regulations during disaster management. Social scientists, AI technologists, engineers, disaster management authorities and policy makers should develop useful and culturally appropriate aI solutions. Accurate data and relevant information should be collected through social media user's data but misinformation and disinformation should not be there. For making resilient plan for DM correct, reliable and accurate data with local authorities' collaborations with union authorities can provide the better results and evacuations. For instance, Wayanad Floods in Kerala utilises AI technologies for detection like GIS, remote sensing but there should be land grid system employed with Ai should be incorporated.

ABBREVIATION

DM – Disaster Management
AI - Artificial Intelligence
SM – Social Media
ML – Machine Learning
NLP – Natural Language Processing
GIS – Geographic Information System

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