The Role of Blockchain Technology in Disaster Relief and Response

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Abstract

Disasters have a devastating impact on nearly any area of human life and different business markets and global regions. During natural disasters, the movement of human activity comes to a halt, but with some initiative and assistance, it can be re-established. Technological advances of the modern century are a boon that can play a vital role in safeguarding civilization during and after disasters. In this study, we commence by outlining general issues that have occurred as a result of any catastrophe. Following that, key features of blockchain technology are discussed. Finally, we present prospective use-cases of blockchain to address essential requirements during an emergency and conclude the benefits of blockchain in various use-cases.

Keywords

Blockchain, Smart contract, Disaster response, Healthcare, Supply chain management

1. Introduction

The planet and its inhabitants struggle with natural calamities every year. Natural or human-made events invariably impact all nations and their populations around the world. Over the years 2000-2018, 10,888 disasters killed 1,132,313 people globally, resulting in a $3085 billion loss [5]. Figure 1 depicts the continent-wide percentage distribution of events, fatalities, and overall loss during 2000-2018 [15]. It's challenging to compete with natural disasters. However, the effective disaster response framework can minimize the infrastructure damage and loss of lives from these disasters. Table 1 describes the most apparent issues that occurred during the disaster response and relief phase. Maintaining critical services and guaranteeing a steady supply of essentials, medicines, medical equipment, food, etc., are becoming challenging [1]. To strengthen cooperation between regulatory bodies involved in disaster management is also a significant challenge [2].

The primary asset of the contemporary period is modern technologies which can assist us in facing the obstacles experienced during emergency response. Internet of Things [3], Artificial Intelligence, Cloud Computing [4], and Blockchain is some emerging technologies in disaster management [12]. Blockchain is identified as novel technology in the field of disaster response. Blockchain provides a self-contained and accessible framework for data processing and storage [6]. The key features of blockchain technology that are vital for disaster management are depicted in Figure 2. In the rest of the article, some possible use cases for disaster relief and response are discussed. Section 3 concludes this article with some future research goals.

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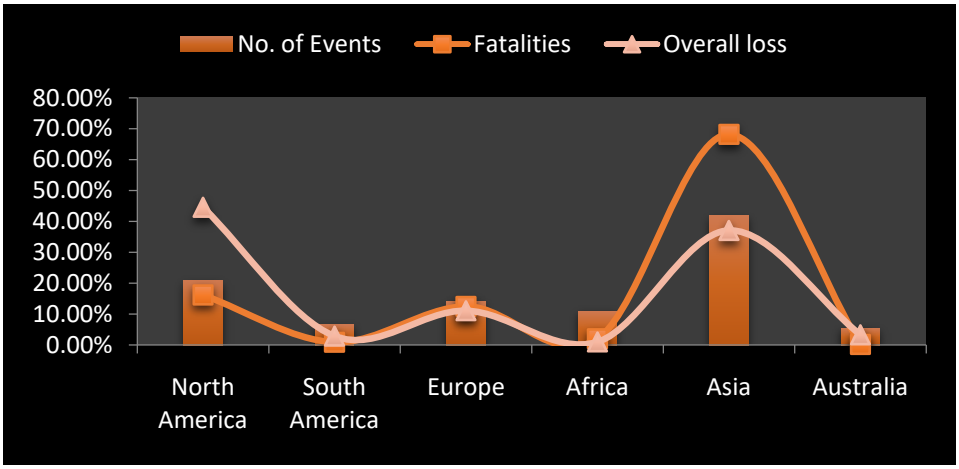

Figure 1: Percentage distribution by continent

2. Use-Case Applications for Disaster Response through Blockchain

This section presents an overview of how blockchain can help a variety of emergency relief use cases. Figure 3 depicts a view of various disaster response use-cases.

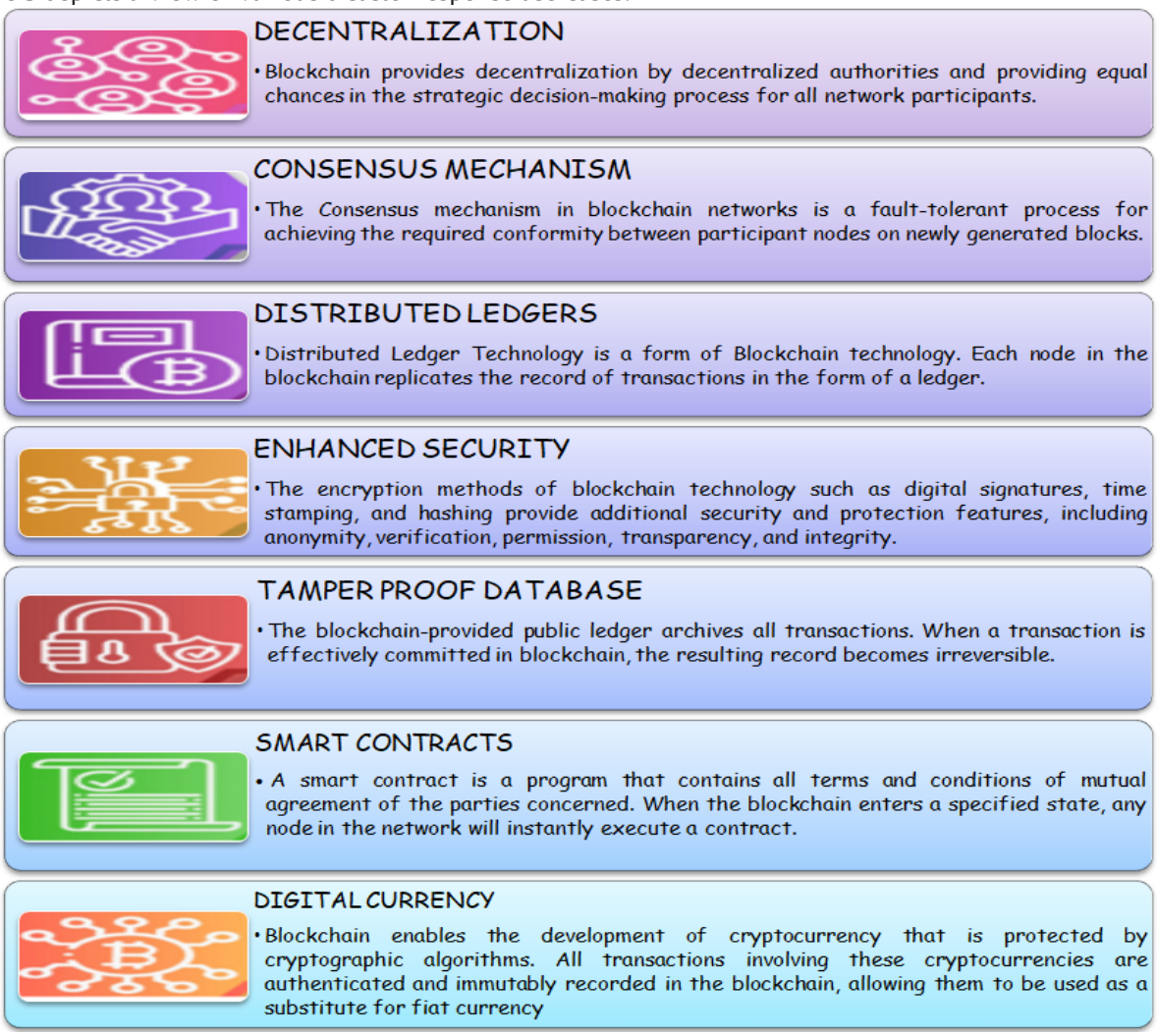

Figure 2: Key features of blockchain

Table 1
Issues faced during emergencies

Challenges	Description
Distribution of funds	Financial institutions, private agencies and peoples are come forward to donate money to help the needy peoples during or post crises. The allocation of donated funds should be in a straightforward way to that in need. Many nations are unable to do so due to bureaucracy and lack of a transparent donation process [7]. Furthermore, People would be more likely to contribute if they can view the utilization of their donated funds.
Utilization of technologies	Due to a lack of awareness about the technologies in various areas, people cannot utilize the information and communication technologies during crises. Many contemporary nations already implemented novel programs, strategies, and technology to enhance emergency relief effectiveness.
Data sharing in real time	Exchanging real-time information such as emergency location, affected population, death count, recognition of victims etc., should take place in real-time to make people more aware. Some technological barriers to disaster data are inadequate data, transparency, vulnerability threats on personal information, data tempering, centralized storage.
Operational coordination	Working forces (Rescue teams, NGOs, Governments, etc.) address several issues in emergency relief. Cooperation between agencies may help them assist each other in fulfilling their emergency service commitments. It is essential to define best practices, protocols, and recommendations that are well accepted.
Voluntarily Approach	Independent and collective community rehabilitation efforts must be balanced against any strategic planning of the government. Community engagement is necessary to improve disaster response efforts. People should make collaborative efforts to cope with situations and provide help to the affected community.
Medical Services	Some of the disasters lead to various diseases and harm to health. The demand for medicines and medical care equipment arisen during an emergency. Medical care cannot be provided timely to the affected population unless adequate supply chain management is implemented. Also, the quality of medical products should be validated before supplying.
Distribution of essentials	During crises, transportation and delivery of food, clothing, water, and other essentials are hindered. The timely delivery of these essentials to the proper place is a significant challenge during emergencies. The emergency situation affects producers and consumers both, which results into starvation, malnutrition, poverty etc.
Emergency Shelters	People may be forced to evacuate their homes, workplaces as well as communities due to catastrophic events. In response to crises situations, NGOs and government emergency relief agencies provide temporary accommodation. Survivors and aid workers face a number of ecological, social, cultural, financial and technological challenges.

2.1. Information Sharing

Reliable, legitimate, correct, and valuable information about the current scenario is required to implement disaster relief and response activities. Blockchain provides a platform for rapid news releases, aid information, quick events announcements, information updating, and publicly sharing disaster information. Miners on blockchain verify the authenticity, integrity [11], and accuracy of information before posting it.

2.2. Medical Care

Disasters frequently have serious health consequences such as injuries, infections, diseases, disability, psychosocial challenges, and loss of lives. Catastrophic events necessitate various healthcare needs that vary according to location and time, which results in a significant impact on the delivery of medical facilities. Blockchain can provide a reliable framework for managing health care services [14] through smart contracts and Distributed Ledger Technology (DLT). Also blockchain's shared storage could significantly maintain the confidentiality and integrity of medical records [13].

2.3. Supply chain management

Natural disasters will eventually affect the global supply chain, resulting in disrupted deliveries of essential commodities to the affected regions. The instability of the supply chain has resulted in severe supply and demand crises. Blockchain technology plays a significant role in constructing an effective supply chain system. End-to-end monitoring in the supply chain can be made more open and reliable with blockchain. A decentralized environment for maintaining a permanent database for all transactions [10] and assets can be traced from output to distribution.

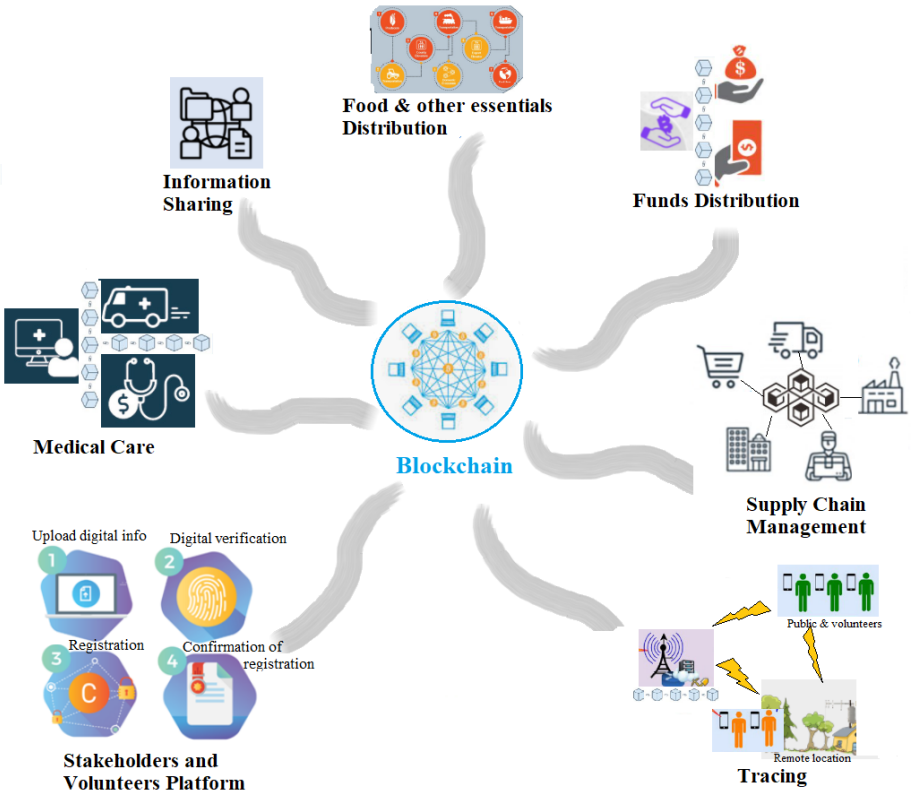

Figure 3: Proposed use-cases (blockchain enabled) for disaster relief and response phase

2.4. Funds distribution

During emergencies, various organizations, private sectors, and donors are come forward to provide financial assistance to affected communities. Blockchain technology offers a platform to assist donors, beneficiaries, and charity organizations [8] with secure and transparent funds distribution facilities. Bitcoin and Ethereum blockchain can be used to implement this use case. All the stakeholders can directly connect through a common platform. The smart contract provides the facility of mutual agreement between all entities.

2.5. Food and other essentials distribution

The timely delivery of basic needs such as food, clothes, water, etc., is halted during emergencies. Blockchain technology has the potential to create pragmatic and adaptive solutions to assist with the timely and efficient distribution of essentials [9]. The manual documentation and comprehensive agreement approach have been replaced with a smart contract mechanism. Distributed record maintenance can record each transaction with a timestamp.

2.6. Tracing

With the integration of other technologies (IoT), blockchain provides a decentralized platform to trace missing persons, locate shelters and local relief centers, and statistically count impacted persons and damages. By providing pseudo-anonymity, the identity information of the victim can be preserved and secure.

Table 2
Role of blockchain for identified use-cases

Use-cases	Advantages of using blockchain technology					
	Decentralization	Confidentiality	Availability	Lower cost	Immutability	Automation
Information sharing	✓	✓	✓	✓	✓	✓
Medical care	✓	✓	✓	✓	✓	✓
Supply chain management	✓	---	✓	✓	✓	✓
Funds distribution	✓	✓	✓	✓	✓	✓
Food and other essentials distribution	✓	✓	✓	✓	✓	✓
Tracing	✓	✓	---	---	✓	✓
Stakeholders and volunteers platform	✓	✓	✓	✓	✓	✓

2.7. Stakeholders and volunteers platform

Blockchain can provide a common platform for all stakeholders, help seekers, and volunteers through DApp. All entities can register on the platform with primary data entries and digital fingerprints; release information about the campaigns started for helping needy people; volunteers can upload information about the shelter, location, essentials, and other facilities they can provide on their own. The current situation, relief progress, confirmation of fulfillment of needs, and additional disaster-related information can be shared on the platform.

3. Conclusion

Disasters have a broad impact on every aspect of life, such as medical care, financial services, economy and policy making. Blockchain technology has the potential to play a critical role in the management of post disaster situations. Many different use cases can be supported by blockchain such as supply chain management, fund distribution, food and essential distribution, information sharing, medical care, location tracing and volunteers' registration. The implementation of blockchain in these use-cases in real-time is a future goal of our research. Table 2 outlines the various benefits of blockchain in proposed use cases.

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