International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Enhancing Emergency Response: A Comprehensive Review of Technological Solutions

Rakshita Sarap[1], Mangesh Pangam[2], Saish Rane[3], Martina Dsouza[4]

[1,2,3]Student, Department of Information Technology, Xavier Institute of Engineering
[4] Professor and Project Guide, Department of Information Technology, Xavier Institute of Engineering

Abstract
This review synthesizes five research papers focusing on innovative solutions for emergency communication and response. It examines the development and implementation of chatbot technologies, mobile applications, blockchain frameworks, and location-based services. The findings highlight the potential of these technologies to enhance the efficiency and effectiveness of emergency services in various contexts, including universities and broader public sectors.

Keywords: Emergency response systems, Chatbots, Blockchain frameworks, Location-based services.

1. Introduction

Emergencies demand timely and efficient communication to ensure the safety and well-being of individuals. Recent advancements in technology have opened new avenues for improving emergency response systems. This review analyzes five research papers that propose diverse technological solutions to enhance emergency communication. Each paper presents unique approaches, from chatbots providing real-time assistance to mobile applications that streamline emergency reporting.

2. Literature Survey

2.1 Chatbot Innovations

2.1.1 Chatbot for Communicating with University Students in Emergency Situations:

This paper discusses a chatbot developed using Google's Dialogflow to support university students during crises like COVID-19. Evaluated by over 160 users, the chatbot demonstrated effectiveness in facilitating communication with university services.[2]

2.1.2 Rescue.io:

A Chatbot Solution for Emergency Situations: This paper presents Rescue.io, a multi-channel chatbot that allows users to send silent distress signals. The authors highlight the inadequacies of traditional emergency systems and emphasize the chatbot's potential for rapid, discreet communication during emergencies.[1]

2.2 Mobile Applications

2.2.1 A Mobile Based Emergency Reporting Application for the Philippine National Police Emergency Hotline 911: The i911 app is designed to enhance the efficiency of emergency reporting for the Philippine National Police by using geolocation and user registration. Surveys indicate high user

satisfaction with its features, suggesting its effectiveness in real-time response scenarios.[4]

2.3 Blockchain and Location-Based Services

2.3.1 BEST—Blockchain-Enabled Secure and Trusted Public Emergency Services for Smart Cities Environment: This research proposes a blockchain framework to improve public emergency services, addressing trust and efficiency issues in traditional systems. Simulation results indicate potential benefits in response times and service delivery.[3]

2.3.2 Framework for Location-Based Emergency Services in India: This paper outlines a framework for integrating the National Spatial Data Infrastructure (NSDI) with location-based services to enhance emergency response capabilities. It emphasizes the importance of interoperability and spatial data sharing.[5]

Table 1: Summary of existing solutions

Sr. No.	Title	Methodology	Advantages	Disadvantages
1.	Chatbot for Communicating with University Students in Emergency Situations [2]	This paper discusses a chatbot developed using Google's Dialogflow to support university students during crises like COVID-19. Evaluated by over 160 users, the chatbot demonstrated effectiveness in facilitating communication with university services.	Embedding the website with an inbuilt chatbot or Telegram messaging, can help users to communicate effectively and efficiently. Having a single system to all our doubts and queries is helpful.	If the chatbot provides excessive information, it can result in unnecessary confusion.
2.	Rescue.io: A Chatbot Solution for Emergency Situations [1]	This paper presents Rescue.io, a multi-channel chatbot that allows users to send silent distress signals. The authors highlight the inadequacies of traditional emergency systems and emphasize the chatbot's potential for rapid, discreet communication during emergencies.	People are spending less time on the phone and more time in messaging channels. As the number of wireless 911 calls in the United States are expected to double to 92 million annually by next year. Many of these phone calls will be unintentional or misused.	If the messaging is dependent on Internet Connectivity, then it can be a constraint in situations when the Internet Connectivity is compromised.
3.	A Mobile Based Emergency Reporting	The i911 app is designed to enhance the efficiency of emergency reporting	Using the mobile's geolocation to get access of the victim's	This mobile-based system requires users to register on

Sr. No.	Title	Methodology	Advantages	Disadvantages
	Application for the Philippine National Police Emergency Hotline 911 [4]	for the Philippine National Police by using geolocation and user registration. Surveys indicate high user satisfaction with its features, suggesting its effectiveness in real-time response scenarios.	locations leading to accurate location tracking.	the app beforehand; otherwise, the app cannot be used.
4.	BEST—Blockchain-Enabled Secure and Trusted Public Emergency Services for Smart Cities Environment [3]	This research proposes a blockchain framework to improve public emergency services, addressing trust and efficiency issues in traditional systems. Simulation results indicate potential benefits in response times and service delivery.	Use of the IoT controller and blockchain framework provides a two-layer security to the overall system.	Requires the creation of an interconnected system of IoT devices within the overall range, which is not cost-effective. Failure of the IoT device or the IoT controller can lead to wrong predictions or no predictions at all.
5.	Framework for Location-Based Emergency Services in India [5]	This paper outlines a framework for integrating the National Spatial Data Infrastructure (NSDI) with location-based services to enhance emergency response capabilities. It emphasizes the importance of interoperability and spatial data sharing.	Implementation of location-based services and a fast SMS system. Integrating the system with the NSDI can lead to proper location tracking and help in providing quick response.	

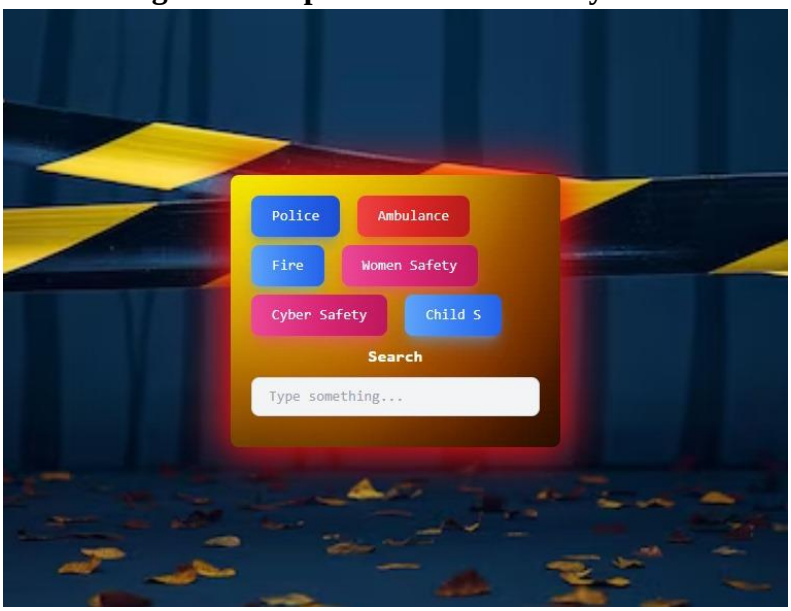
3. Implementation

The implementation of these technologies varies across the papers:

- **Chatbots**: Both chatbot studies (Research Papers 1 and 2) describe systems designed to facilitate real-time communication, utilizing platforms like Dialogflow and multi-channel messaging. User feedback was collected to evaluate effectiveness and satisfaction.
- **Mobile Applications**: The i911 system was developed with user-centered design principles, incorporating features like geolocation and an intuitive interface. It underwent thorough testing and user surveys to assess functionality and acceptance.

- **Blockchain Framework**: The BEST framework leverages Hyperledger Fabric to design smart contracts for emergency services. Simulations were conducted to evaluate performance metrics such as waiting time and service fulfillment.
- **Location-Based Services**: The proposed framework in the last paper emphasizes the integration of ontology for effective data sharing and interoperability among different organizations involved in emergency response.

Figure 1 : Implementation of the system



4. Future Scope

The reviewed papers indicate several areas for future research and development:

1. **Real-World Implementation**: Further studies should focus on the practical deployment of these technologies in diverse environments to validate their effectiveness and address any challenges encountered during implementation.
2. **Integration of AI**: Future developments could explore the integration of artificial intelligence and machine learning to enhance the responsiveness and adaptability of emergency systems.
3. **User Training and Awareness**: Initiatives should be taken to educate users on the functionalities of these systems to maximize their benefits during emergencies.
4. **Scalability and Performance Optimization**: Research on optimizing blockchain solutions for scalability and performance will be crucial for their successful application in public emergency services.
5. **Cross-Disciplinary Collaboration**: Future frameworks could benefit from collaboration between technologists, emergency services, and policymakers to ensure comprehensive solutions that meet the needs of diverse communities.

5. Conclusion

The reviewed research highlights the transformative potential of technology in enhancing emergency communication and response systems. The integration of chatbots, mobile applications, blockchain frameworks, and location-based services represents a significant advancement in how emergency services

can operate effectively and efficiently.

1. **Chatbots**: Innovations like university-specific chatbots and Rescue.io demonstrate the capacity for immediate, user-friendly assistance in critical situations, significantly improving communication between individuals and emergency services.
2. **Mobile Applications**: Applications such as i911 illustrate how technology can streamline the reporting process, ensuring that accurate information reaches responders swiftly, thereby enhancing overall response efficiency.
3. **Blockchain and Interoperability**: The proposed blockchain frameworks offer a promising solution to the issues of trust, transparency, and efficiency in public emergency services, showcasing potential for improved service delivery in smart city environments.
4. **Location-Based Services**: The frameworks designed for integrating spatial data underscore the necessity of interoperability among various organizations to enhance situational awareness during emergencies.

References

1. Clegg J., "Rescue.io: A chatbot solution for emergency situations", Medium, 2017. Available at: https://medium.com/square-one-labs/rescue-io-a-chatbot-solution-to-emergency-situations-dd267f174554 .
2. Balderas A., García-Mena R. F., Huerta M., Mora N., Dodero J. M., "Chatbot for communicating with university students in emergency situation", Heliyon, 2023. Available at: https://pubmed.ncbi.nlm.nih.gov/37809667/
3. Bhawana, et al., "Best-blockchain-enabled secure and Trusted Public Emergency Services for Smart Cities Environment", Sensors, 2022. Available at: https://www.mdpi.com/1424-8220/22/15/5733
4. S. B. Edillo, et al., "A mobile based emergency reporting application for the Philippine National Police Emergency hotline 911: A case for the development of I911", IEEE Conference publication, 2017. Available at: https://ieeexplore.ieee.org/document/8330110
5. Indian Institute of Remote Sensing. Available at: https://www.iirs.gov.in/iirs/sites/default/files/StudentThesis/aditi_finals_thesis.pdf

References in the Reference List at the End of the Research Paper

1. Cabral E.L. dos S., et al., "Response time in the emergency services. systematic review", Acta Cirúrgica Brasileira, 2018. Available at: https://www.scielo.br/j/acb/a/f3jpSRsjg7tdZqqzf5Q7vKJ/
2. Snyder S., "Integrated fire and ambulance siting: A deterministic model", Socio-Economic Planning Sciences, 1995. Available at: https://www.academia.edu:443/27679844/Integrated_fire_and_ambulance_siting_A_deterministic_model
3. Carret M.L.V., Fassa A.C.G., Domingues M.R., "Inappropriate use of emergency services: A systematic review of prevalence and associated factors", Cadernos de Saúde Pública, 2009. Available at: https://www.scielo.br/j/csp/a/QZvVddHCK8d8nzDbJjRC3Gy/?lang=en
4. Kobusingye O.C., "Emergency medical services", Disease Control Priorities in Developing Countries, 1970. Available at: https://www.ncbi.nlm.nih.gov/books/NBK11744/
5. Christ M., et al., "Modern Triage in the emergency department", Deutsches Arzteblatt international, 2010. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC3021905/

6. Banu Soylu, et al., "A hub-and-spoke network design for relocating emergency service vehicles", Computers & Operations Research, 2024. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0305054824003708
7. Eeva Saario, et al., "Nutritional risk screening by the Emergency Medical Services: Agreement with In-Hospital Assessment", International Emergency Nursing, 2024. Available at: https://www.sciencedirect.com/science/article/pii/S1755599X24001484
8. Misra S., et al., "From sensors to safety: Internet of emergency services (IOES) for emergency response and disaster management", Journal of Sensor and Actuator Networks, 2023. Available at: https://www.mdpi.com/2224-2708/12/3/41
9. Rajanikanth Aluvalu, et al., "The novel Emergency Hospital Services for patients using Digital Twins", Microprocessors and Microsystems, 2023. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0141933123000406
10. Nathan B. Roberts, et al., "Current summary of the evidence in drone-based Emergency Medical Services Care", Resuscitation Plus, 2023. Available at: https://www.sciencedirect.com/science/article/pii/S2666520422001473
11. Joseph El Dahdah MD, et al., "CHATGPT: A valuable tool for Emergency Medical Assistance", Annals of Emergency Medicine, September 2023. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0196064423003542
12. Villas-Boas S., Kaplan S., et al., "Patterns of US Mental Health–Related Emergency Department Visits During the COVID-19 Pandemic", JAMA Network Open, July 2023.Available at: https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2807138
13. Schumacher Jessica R., et al., "Potentially Preventable Use of Emergency Services: The Role of Low Health Literacy", Medical Care, August 2013. Available at: https://journals.lww.com/lww-medicalcare/abstract/2013/08000/potentially_preventable_use_of_emergency_services_.4.aspx
14. Ceyhun Araz, et al., "A fuzzy multi-objective covering-based vehicle location model for emergency services", Computers & Operations Research, March 2007. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0305054805001164
15. Daniel Coles, et al., "Beyond 'flood hotspots': Modelling emergency service accessibility during flooding in York, UK", Journal of Hydrology, March 2017. Available at: https://www.sciencedirect.com/science/article/pii/S0022169416308022
16. Marks P.J., et al., "Emergency (999) calls to the ambulance service that do not result in the patient being transported to hospital: An epidemiological study", Emergency Medicine Journal, September 2002. Available at: https://emj.bmj.com/content/19/5/449.short
17. Silva F., Serra D., "Locating emergency services with different priorities: The priority queuing covering location problem", Palgrave Macmillan, London, 1970. Available at: https://link.springer.com/chapter/10.1057/9781137535696_2
18. Nicholl Jon, Coleman Patricia, Parry Gareth, Turner Janette, Dixon Simon, "Emergency priority dispatch systems - A new era in the provision of ambulance services in the UK", Pre-hospital Immediate Care, January 1999. Available at: https://www.researchgate.net/publication/255611643_Emergency_priority_dispatch_systems_-_A_new_era_in_the_provision_of_ambulance_services_in_the_UK

19. Segal S.P., Bola J.R., Watson M.A., "Race, quality of care, and antipsychotic prescribing practices in psychiatric emergency services", Psychiatric services (Washington, D.C.), March 1996. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC7306413/
20. Mahama M., et al., "Emergency response time and pre-hospital trauma survival rate of the National Ambulance Service, Greater Accra (January – December 2014)", BMC emergency medicine, October 2018. Available at: https://link.springer.com/article/10.1186/s12873-018-0184-3
21. Tansley G., et al., "Spatial access to emergency services in low- and middle-income countries: A GIS-based analysis", PLOS ONE, November 2015. Available at: https://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0141113
22. Sanjuan-Quiles, et al., "Handover of Patients from Prehospital Emergency Services to Emergency Departments: A Qualitative Analysis Based on Experiences of Nurses", Journal of Nursing Care Quality, 2019. Available at: https://journals.lww.com/jncqjournal/fulltext/2019/04000/handover_of_patients_from_prehospital_emergency.14.aspx
23. Purnell Tanjala S., et al., "Clinician Perceptions of an Electronic Medical Record During the First Year of Implementation in Emergency Services", Pediatric Emergency Care, February 2010. Available at: https://journals.lww.com/pec-online/abstract/2010/02000/clinician_perceptions_of_an_electronic_medical.7.aspx
24. T. Erden, et al., "Multi-criteria site selection for fire services: the interaction with analytic hierarchy process and geographic information systems", Natural Hazards and Earth System Sciences, October 2010. Available at: https://nhess.copernicus.org/articles/10/2127/2010/nhess-10-2127-2010.pdf
25. Al-Shaqsi S., "Models of international emergency medical service (EMS) systems", Oman medical journal, October 2010. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC3191661/
26. Tansley G., et al., "Population-level spatial access to prehospital care by the National Ambulance Service in Ghana", Prehospital emergency care, 2016. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC5153373/
27. Syi Su, et al., "Modeling an emergency medical services system using Computer Simulation", International Journal of Medical Informatics, December 2003. Available at: https://www.sciencedirect.com/science/article/abs/pii/S1386505603001515
28. Eckstein M., Schlesinger S. A., Sanko S., "Interfacility Transports Utilizing the 9-1-1 Emergency Medical Services System", Prehospital Emergency Care, April 2015. Available at: https://www.tandfonline.com/doi/full/10.3109/10903127.2015.1005258
29. Koichi Tanigawa, et al., "Emergency medical service systems in Japan: Past, present, and future", Resuscitation, June 2006. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0300957206001511
30. Sharma M., Brandler E.S., "Emergency medical services in India: The present and future: Prehospital and disaster medicine", Cambridge Core, April 2014. Available at: https://www.cambridge.org/core/journals/prehospital-and-disaster-medicine/article/abs/emergency-medical-services-in-india-the-present-and-future/E91F6B69AB28EEA6E4D92865C81434FE
31. Duncan E.A.S., et al., "Epidemiology of Emergency Ambulance Service calls related to mental health problems and self-harm: A national record linkage study", Scandinavian journal of trauma, resuscitation and emergency medicine, 2019. Available at: https://sjtrem.biomedcentral.com/articles/10.1186/s13049-019-0611-9

32. David Matthias, Schwartau Imke, Anand Pant Hans, Borde Theda, "Emergency outpatient services in the city of Berlin: factors for appropriate use and predictors for hospital admission", European Journal of Emergency Medicine, December 2006. Available at: https://journals.lww.com/euro-emergencymed/abstract/2006/12000/emergency_outpatient_services_in_the_city_of.8.aspx
33. Burkholder T.W., Hill K., Calvello Hynes E.J., "Developing emergency care systems: A human rights-based approach", Bulletin of the World Health Organization, September 2019. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC6705504/
34. Martinez Alpiste I., et al., "5G-based Smart Ambulance: The future of the emergency service in the global pandemic and beyond", IEEE ComSoc Technology News, October 2020. Available at: https://research-portal.uws.ac.uk/en/publications/5g-based-smart-ambulance-the-future-of-the-emergency-service-in-t
35. Snooks H., et al., "NHS emergency response to 999 calls: Alternatives for cases that are neither life threatening nor serious", BMJ, August 2002. Available at: https://www.bmj.com/content/325/7359/330.1.short
36. Meents E., Boyles T., "Emergency medical services: Poor response time in the rural Eastern Cape", SAMJ: South African Medical Journal, December 2010. Available at: https://www.scielo.org.za/scielo.php?pid=S0256-95742010001200009&script=sci_arttext
37. Ahmed S., et al., "Impact of traffic variability on geographic accessibility to 24/7 emergency healthcare for the Urban Poor: A GIS study in Dhaka, Bangladesh", PLOS ONE, September 2019. Available at: https://journals.plos.org/plosone/article?id=10.1371%2Fjournal.pone.0222488
38. Goldenberg M.N., Parwani V., "Psychiatric Emergency Department volume during covid-19 pandemic", The American journal of emergency medicine, March 2021. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC7263232/
39. Baker T., et al., "Emergency and critical care services in Tanzania: A survey of ten hospitals - BMC Health Services Research", BMC Health Serv Res, April 2013. Available at: https://link.springer.com/article/10.1186/1472-6963-13-140
40. Douglas D. Brunette, John Kominsky, Ernest Ruiz, "Correlation of emergency health care use, 911 volume, and jail activity with welfare check distribution", Annals of Emergency Medicine, 1991. Available at: https://www.sciencedirect.com/science/article/abs/pii/S0196064405808340