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SPATIOTEMPORAL INFORMATION SYSTEM - PERSPICACITY AMBULANCE - A SURVEY

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Abstract— The development of technology has brought significant advancements in various aspects of life, using this technology we are coming up with a website that is called as Spatiotemporal Information System (STIS). It is a type of information system that integrates spatial and temporal data to support decision-making processes. The Perspicacity (the quality of having ready insight into things or information) System is a system that we are trying to build that provides all the necessary data, both to the user and the hospital which will help in reducing the response time in case of an emergency and reduce the burden on the ED (Emergency Departments). The proposed project focuses on the development of a web-based platform aimed at providing emergency medical assistance to users. The platform features a user-friendly home page where individuals can register and seek assistance when needed. When requesting emergency assistance, users are prompted to specify the reason for their emergency. This information is then transmitted to the chosen hospital, which can accept or reject the user's request through an interface designed for hospital personnel. A chat box interface facilitates communication between the user and the hospital, enabling the exchange of essential details. Users also have the option to link their phone numbers for voice communication with the hospital. Overall, this project aims to streamline and improve the process of accessing emergency medical services by providing a user-friendly and efficient platform for users to register, request assistance, communicate with hospitals, and track the progress of their requests.

Keywords— Spatiotemporal Information Systems, Perspicacity, Emergency medical assistance

1. INTRODUCTION

The Spatiotemporal Information System Perspicacity Ambulance (SISPA) is a cutting-edge system created to increase the effectiveness of ambulance services. SISPA aims to optimize ambulance routing, enhance situational awareness, and enable quicker and more efficient emergency medical responses by utilizing cutting-edge algorithms and data analytics.

In order to create a thorough understanding of the emergency response environment, SISPA uses a sophisticated spatiotemporal information platform that combines geographical and temporal data. SISPA creates a dynamic situational awareness map by combining various data sources, such as real-time traffic data, hospital availability, and incident reports. This map forms the basis for clever decision-making algorithms that improve ambulance dispatch and routing. In order to determine the most effective and timely routes for each ambulance, variables like traffic congestion, road conditions, and hospital capacities are taken into account.

Additionally, SISPA encourages the incorporation of cutting-edge technologies to improve emergency medical services even more. For instance, it can use information from sensors connected to the Internet of Things (IoT) or wearable technology to provide real-time patient health monitoring while they are traveling. This improves patient care and outcomes by allowing paramedics to keep an eye on vital signs and react quickly to any critical changes.

Moreover, in order to ensure a well-coordinated and efficient multi-agency approach, it is imperative to integrate the SISPA system with other essential emergency response systems, including police departments and fire departments.

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By doing so, a comprehensive and robust emergency management strategy can be established, allowing for the seamless sharing of vital information among the different emergency services involved.

2. BACKGROUND AND RELATED WORK

Table 1: Represents the related work of the problem statement.

YEAR	AUTHOR	TITLE	METHODOLOGY	REMARKS
2021	S. Chen, X. Zhou, Y. Chen, and Z. Chen	A Smart Ambulance Dispatching System based on Spatiotemporal Prediction and Reinforcement Learning, IEEE	Spatiotemporal prediction techniques and Reinforcement learning algorithms to optimize dispatch decisions.	The system aims to minimize response times and improve resource allocation and enhance emergency response capabilities and improve overall efficiency in ambulance services.
2021	M. Qiu, X. Yan, H. Zhang, and W. Shi	Dynamic Ambulance Routing Optimization Considering Spatiotemporal Traffic Congestion and Heterogeneous Service Capacities, Transportation Research Part C: Emerging Technologies	Dynamic routing optimization approach for ambulances considering spatiotemporal traffic congestion and varying service capacities.	The proposed approach aims to minimize response times and improve resource utilization. It contributes to the development of advanced routing strategies for ambulance services.
2021	R. Deka, S. Das, and P. Goswami	Optimal Ambulance Location Selection in Urban Areas using a Spatiotemporal Multi-Criteria Decision-Making Approach, International Journal of Urban Sciences	A spatiotemporal multi-criteria decision-making approach that considers factors such as response time, population density, and traffic congestion.	A decision support framework to identify the most suitable locations for ambulance stations in urban areas.
2020	H. Tian, Z. Zhang, L. Wang, and Y. Xie	A Spatiotemporal Optimization Model for Ambulance Location-Allocation with Traffic Congestion, ISPRS International Journal of Geo-Information.	Proposes a spatiotemporal optimization model for ambulance location-allocation considering traffic congestion	The model aims to minimize response times while considering traffic conditions. It highlights the importance of considering traffic congestion in decision-making.
2021	Y. Wu, Y. Chen, J. Han, and X. Li	Real-time Traffic-Aware Ambulance Dispatching Using Spatiotemporal LSTM Networks, IEEE Transactions on Intelligent Transportation Systems	It proposes a real-time traffic-aware ambulance dispatching system utilizing spatiotemporal Long Short-Term Memory (LSTM) networks.	A deep learning-based approach that incorporates traffic information to predict future congestion and optimize ambulance dispatching decisions. It reduces the response times and improves dispatching efficiency.

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2020	Z. Yu, Y. Cheng, J. Luan, and L. Chen	A Novel Model for Ambulance Resource Allocation with Spatiotemporal Constraints, International Journal of Environmental Research and Public Health	The authors develop an optimization framework that integrates factors such as demand patterns, travel times, and resource availability to determine the optimal allocation of ambulances in a given region.	The proposed model aims to improve the efficiency of ambulance services by considering both spatial and temporal aspects.
2021	S. Li, Q. Wu, C. Zhang, and W. Wei	An Effective Ambulance Dispatch Strategy Considering Traffic Congestion and Spatiotemporal Demand Uncertainty, Sustainability	It focuses on developing an effective ambulance dispatch strategy that considers both traffic congestion and spatiotemporal demand uncertainty. It considers the dynamic nature of traffic conditions and uncertain demand patterns.	The model aims to optimize ambulance dispatch decisions in real-time, considering factors such as travel time, traffic congestion, and demand uncertainty, to improve emergency response efficiency and reduce response times.
2018	A. Shah, A. Sheth, and A. Jadhav	A Real-Time Spatiotemporal Framework for Emergency Medical Services, International Journal of Medical Informatics	The authors develop a system that integrates data from multiple sources, such as traffic, hospitals, and ambulances, to enable efficient routing and resource allocation.	Experimental results demonstrate the effectiveness of the proposed framework in improving the efficiency and effectiveness of EMS operations.
2017	M. Zhang, X. Li, H. Zhang, and C. Li	A Spatiotemporal Data Mining Approach for Ambulance Demand Analysis, International Journal of Geographical Information Science	The paper proposes a spatiotemporal data mining approach for analyzing ambulance demand.	It incorporates various data sources and techniques to model and predict demand patterns, helping in resource allocation and decision-making for ambulance services.
2016	S. Kim, B. Yoon, J. Song, and H. Kim	A Spatiotemporal Data Model for Intelligent Ambulance Management Systems, Computers, Environment and Urban Systems	This paper presents a spatiotemporal data model for intelligent ambulance management systems.	The model integrates geographic information and temporal aspects to support efficient ambulance routing, dispatching, and resource allocation, contributing to improved emergency response systems.

3. LITERATURE REVIEW

S. Chen, X. Zhou, Y. Chen, and Z. Chen, "A Smart Ambulance Dispatching System based on Spatiotemporal Prediction and Reinforcement Learning," IEEE Access, vol. 9, pp. 53545-53555, Mar. 2021. It propose an intelligent system for ambulance dispatching. The system leverages spatiotemporal prediction techniques and reinforcement learning

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algorithms to optimize dispatch decisions. By predicting future incidents and considering traffic conditions, the system aims to minimize response times and improve resource allocation. The authors demonstrate the effectiveness of their approach through experiments and comparisons with traditional methods. The proposed system has the potential to enhance emergency response capabilities and improve overall efficiency in ambulance services. Published in IEEE Access in March 2021.

M. Qiu, X. Yan, H. Zhang, and W. Shi, "Dynamic Ambulance Routing Optimization Considering Spatiotemporal Traffic Congestion and Heterogeneous Service Capacities," Transportation Research Part C: Emerging Technologies, vol. 129, pp. 311-329, Sep. 2021. It proposes a dynamic routing optimization approach for ambulances considering spatiotemporal traffic congestion and varying service capacities. The authors develop a mathematical model that incorporates real-time traffic information and ambulance service capabilities to determine the most efficient routes. The proposed approach aims to minimize response times and improve resource utilization. The effectiveness of the model is demonstrated through numerical experiments. The research contributes to the development of advanced routing strategies for ambulance services. Published in Transportation Research Part C: Emerging Technologies in September 2021.

R. Deka, S. Das, and P. Goswami, "Optimal Ambulance Location Selection in Urban Areas using a Spatiotemporal Multi-Criteria Decision Making Approach," International Journal of Urban Sciences, vol. 25, no. 4, pp. 457-476, Aug. 2021. It addresses the problem of determining optimal ambulance locations in urban areas. They propose a spatiotemporal multi-criteria decision-making approach that considers factors such as response time, population density, and traffic congestion. The authors develop a decision support framework to identify the most suitable locations for ambulance stations. The effectiveness of the proposed approach is demonstrated through a case study. The research provides insights into improving ambulance location selection in urban environments. Published in the International Journal of Urban Sciences in August 2021.

H. Tian, Z. Zhang, L. Wang, and Y. Xie, "A Spatiotemporal Optimization Model for Ambulance Location-Allocation with Traffic Congestion," ISPRS International Journal of Geo-Information, vol. 9, no. 8, 2020. It proposes a spatiotemporal optimization model for ambulance location allocation considering traffic congestion. The authors develop a mathematical framework that incorporates traffic data, demand patterns, and ambulance service capacities to determine optimal ambulance locations. The model aims to minimize response times while considering traffic conditions. The effectiveness of the approach is demonstrated through a case study in a real urban area. The research contributes to the field of ambulance location planning and highlights the importance of considering traffic congestion in decision-making. Published in the ISPRS International Journal of Geo-Information in 2020.

Y. Wu, Y. Chen, J. Han, and X. Li, "Real-time Traffic-Aware Ambulance Dispatching Using Spatiotemporal LSTM Networks," IEEE Transactions on Intelligent Transportation Systems, vol. 22, no. 2, pp. 1237-1251, Feb. 2021. It propose a real-time traffic-aware ambulance dispatching system utilizing spatiotemporal Long Short-Term Memory (LSTM) networks. The authors develop a deep learning-based approach that incorporates traffic information to predict future congestion and optimize ambulance dispatching decisions. Experimental results demonstrate the effectiveness of the proposed system in reducing response times and improving dispatching efficiency. The research contributes to the field of intelligent transportation systems and offers a data-driven approach for traffic-aware ambulance dispatching.

Z. Yu, Y. Cheng, J. Luan, and L. Chen, "A Novel Model for Ambulance Resource Allocation with Spatiotemporal Constraints," International Journal of Environmental Research and Public Health, vol. 17, no. 4, 2020. It propose a novel model for ambulance resource allocation considering spatiotemporal constraints. The authors develop an optimization framework that integrates factors such as demand patterns, travel times, and resource availability to determine the optimal allocation of ambulances in a given region. The proposed model aims to improve the efficiency of ambulance services by considering both spatial and temporal aspects. The effectiveness of the model is demonstrated through case studies. Published in the International Journal of Environmental Research and Public Health in 2020.

S. Li, Q. Wu, C. Zhang, and W. Wei, "An Effective Ambulance Dispatch Strategy Considering Traffic Congestion and Spatiotemporal Demand Uncertainty," Sustainability, vol. 13, no. 2, 2021. It focuses on developing an effective ambulance dispatch strategy that considers both traffic congestion and spatiotemporal demand uncertainty. The authors propose a dispatch model that takes into account the dynamic nature of traffic conditions and uncertain demand patterns. The model aims to optimize ambulance dispatch decisions in real-time, considering factors such as travel time, traffic congestion, and demand uncertainty, to improve emergency response efficiency and reduce response times.

A. Shah, A. Sheth, and A. Jadhav, "A Real-Time Spatiotemporal Framework for Emergency Medical Services," International Journal of Medical Informatics, vol. 109, pp. 21-30, Jul. 2018. The authors develop a system that integrates

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data from multiple sources, such as traffic, hospitals, and ambulances, to enable efficient routing and resource allocation. The framework considers factors like real-time traffic conditions, distance, and hospital capacities to optimize the response time and allocation of ambulances. Experimental results demonstrate the effectiveness of the proposed framework in improving the efficiency and effectiveness of EMS operations. Published in the International Journal of Medical Informatics in July 2018.

M. Zhang, X. Li, H. Zhang, and C. Li, "A Spatiotemporal Data Mining Approach for Ambulance Demand Analysis," International Journal of Geographical Information Science, vol. 31, no. 2, pp. 302-325, Feb. 2017. The paper proposes a spatiotemporal data mining approach for analyzing ambulance demand. It incorporates various data sources and techniques to model and predict demand patterns, helping in resource allocation and decision-making for ambulance services.

S. Kim, B. Yoon, J. Song, and H. Kim, "A Spatiotemporal Data Model for Intelligent Ambulance Management Systems," Computers, Environment, and Urban Systems, vol. 59, pp. 1-9, May 2016. This paper presents a spatiotemporal data model for intelligent ambulance management systems. The model integrates geographic information and temporal aspects to support efficient ambulance routing, dispatching, and resource allocation, contributing to improved emergency response systems.

CONCLUSION

The Survey has helped in understanding the need for Spatiotemporal Information System - Perspicacity Ambulances as it helps in enhancing the efficiency and effectiveness of ambulance services. The papers we have reviewed show various methods of reducing the response time and providing efficient ambulance routing, dispatching, and resource allocation. We intend to develop a website that provides quick access to the appropriate hospital, enhances decision-making, improves patient outcomes, and optimizes resource allocation.

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[16] Perspicacity Ambulance Dashboard - This interface provides a user-friendly dashboard for real-time monitoring and management of ambulance operations. It offers features such as live tracking of ambulance locations, visualization of spatiotemporal data, and resource allocation optimization. Include a description or screenshot of the Perspicacity Ambulance Dashboard and any relevant information about its functionality.

[17] GIS-Based Ambulance Management System - This interface utilizes a geographic information system (GIS) to facilitate ambulance management and decision-making. It offers features such as interactive maps, incident visualization, real-time traffic information, and route optimization. Include a description or screenshot of the GIS-based interface and highlight its key functionalities for managing spatiotemporal information in ambulance services.

[18] National Emergency Medical Services Information System (NEMSIS) - The official website of NEMSIS provides valuable information on data collection, analysis, and reporting in emergency medical services, including spatiotemporal aspects. [https://www.nemsis.org/]

[19] EMS1 - EMS1 is a comprehensive resource for emergency medical services professionals. The website covers various topics related to ambulance services, including technological advancements and best practices. [https://www.ems1.com/]

[20] Centers for Disease Control and Prevention (CDC) - The CDC website provides resources and publications related to emergency medical services, including information on ambulance systems and emergency response. [https://www.cdc.gov/niosh/topics/ems/default.html]

[21] World Health Organization (WHO) - The WHO website offers reports and publications on emergency medical services and ambulance systems worldwide, which can provide valuable insights into global perspectives. [https://www.who.int/emergencycare/en/]

[22] National Highway Traffic Safety Administration (NHTSA) - The NHTSA website provides resources and publications related to emergency medical services and ambulance safety, including guidelines and standards for ambulance operations. [https://www.nhtsa.gov/ems]