

Streamlining Emergency Ambulance Services with Fast API: A Location-Based Approach for Efficient Healthcare Delivery

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Abstract- In the face of escalating challenges in emergency healthcare services, achieving resilience has emerged as a critical objective. This research paper examines the potential of a location-based emergency ambulance booking system to bolster resilience in the 1990 Suwa Seriya. By embracing digitalization, sustainability, and sectoral transformation, this study addresses the urgent needs of the healthcare system. Through a comprehensive mixed-methods approach, including semi-structured interviews and a web-based survey, valuable insights are gathered from patients, hospitals, and healthcare service providers. These insights inform the development of "Ambu Finder," an innovative solution utilizing advanced technologies. The system, built with the Python framework Fast API, incorporates a Rest API for location tracking, allowing users to swiftly request an ambulance during emergencies. Leveraging geolocation technology, Ambu Finder identifies nearby hospitals with available ambulance services, enabling prompt responses and reduced emergency response times. Additionally, the application, developed using React Native for the mobile platform, offers registered users the convenience of uploading their medical reports, ensuring hospitals are well-prepared to handle critical situations. This research sheds light on the transformative role of digitalization, sustainability, and sectoral transformation in enhancing resilience within emergency healthcare services. By emphasizing the integration of these three pillars and leveraging cutting-edge technologies such as cloud storage, the study underscores their pivotal significance in the successful implementation of the location-based emergency ambulance booking system. The findings provide crucial insights for healthcare stakeholders and offer recommendations for further research and practical implications, ultimately paving the way toward a more resilient healthcare system.

Keywords: Location-based emergency ambulance booking system, Digitalization, Resilience

I. INTRODUCTION

In today's technologically advanced world, the use of web applications and mobile applications has become increasingly prevalent across various industries. This is especially true in the realm of location tracking systems, where the ability to determine one's precise location and find nearby services has become a cornerstone of modern service delivery. Applying this technology to the healthcare sector, specifically in emergency medical services, holds immense potential for improving response times and optimizing the delivery of care.

The efficient management of emergency medical services (EMS) is of utmost importance in ensuring the well-being and timely assistance of individuals in critical situations. In Sri Lanka, the 1990 Suwa Seriya Ambulance Service has

been a crucial lifeline, providing emergency medical care to communities across the country. However, the existing manual system for booking ambulances often leads to delays and inefficiencies, hindering the ability to provide prompt medical attention to those in need. However, when it comes to emergency situations, this service faces certain limitations and issues that hinder its effectiveness.

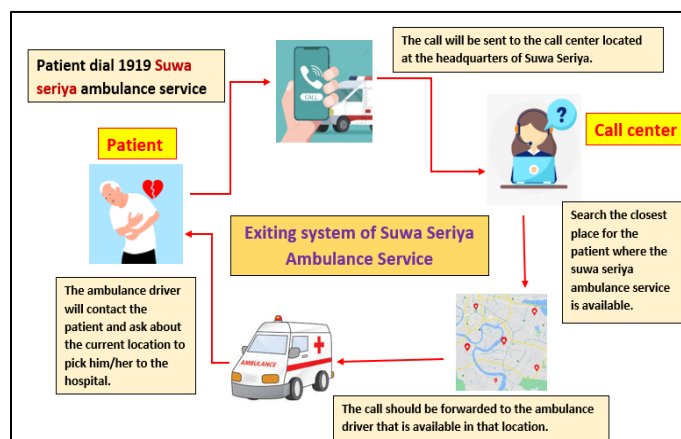


Figure 1. An analysis of the ongoing process of the "Suwa Seriya"

Through interviews with the Suwa Seriya department, it was found that the the ongoing process of the "Suwa Seriya" service involves patients dialing 1990, which redirects them to a call center located at the "Suwa Seriya headquarters". The call center then contacts the nearest available "Suwa Seriya" driver and provides them with the necessary information to pick up the patient. Unfortunately, this procedure is often time-consuming, resulting in delays in emergency responses.

Several issues contribute to the limitations of the current system. They are hospital chosen for the patient by the ambulance driver. If not, the ambulance's medical staff contacts the on-call doctor who selects the hospital, Call waiting happens regularly, the high number of non-emergency cases in happened during the covid 19 pandemic season, services are not always available, the patient has no idea where the ambulance is, Difficult to identify the nearest hospital and decide whether it is in operation. But the major

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issue according to the current system is the ambulance driver will dial the patient's number and ask about their current location in an emergency. That's not practical.

To address these issues, the implementation of an automated healthcare application holds numerous advantages. Such an application enables users to conveniently book an ambulance, utilizing their IP address to determine their location and providing a list of local hospitals with available ambulance services. This eliminates the need for time-consuming phone calls and enables patients to directly contact hospitals and ambulance services with a single click. By streamlining the process and improving accessibility, this solution has the potential to enhance emergency medical services and ultimately save lives. The proposed system aims to develop a web application using the Python programming language with the Folium library, alongside an Android healthcare application using React Native

The main aim of this research is to provide a technology-based solution that utilizes location data to improve healthcare services by displaying local hospitals with ambulance facilities, allowing users to conveniently book an ambulance. The objectives of this research include:

1. To allow users to easily and quickly book an ambulance based on their current location.
2. To provide real-time information on the availability of ambulances and their estimated time of arrival.
3. To improve the dispatch and coordination of ambulances to ensure that they reach the patient as quickly as possible.
4. To provide an efficient and reliable communication channel between the hospitals and the patient or their representatives.
5. To improve patient safety and satisfaction by providing timely and efficient ambulance services.
6. To reduce response time and improve the overall efficiency of the ambulance service.

By achieving these objectives, this research aims to enhance the accessibility, efficiency, and effectiveness of emergency healthcare services through the implementation of a location-based emergency ambulance booking system.

II. LITERATURE SURVEY

Location-based emergency ambulance booking systems have become increasingly popular with the advancement of technology. These systems enable users to request emergency medical services quickly and efficiently by using their current location to dispatch the nearest ambulance. The purpose of this literature review is to explore the advantages, disadvantages, and challenges associated with implementing such systems integrated with web and mobile applications. These applications have become essential components of location-based emergency ambulance

booking systems. These applications allow patients to access the system quickly and easily, reducing response times further.

A. Effectiveness of Web-based Location-based emergency ambulance booking system:

Web-based location-based emergency ambulance booking systems have shown to be an effective way of reducing ambulance response time. A study conducted by Lin et al. (2019) found that web-based ambulance booking systems significantly reduced the ambulance response time and improved the overall quality of care. Similarly, another study conducted by Saeed et al. (2020) found that web-based ambulance booking systems increased the efficiency of the ambulance service and reduced the waiting time for patients.

B. Integration with mobile technology:

Mobile technology has played a significant role in the integration of location-based emergency ambulance booking systems. Several studies have investigated the effectiveness of mobile-based ambulance booking systems. A study conducted by Li et al. (2019) found that mobile-based ambulance booking systems were effective in reducing the ambulance response time and improving the quality of care. Similarly, another study conducted by Wang et al. (2020) found that mobile-based ambulance booking systems significantly reduced the ambulance response time and improved the efficiency of the ambulance service.

C. Advantages of Location-Based Emergency Ambulance Booking Systems:

One of the primary advantages of location-based emergency ambulance booking systems is the ability to dispatch the nearest available ambulance to the user's location. This feature can reduce response times and increase the chances of survival for patients with life-threatening conditions (Al-Ali et al., 2016). Moreover, these systems can also reduce the workload of dispatchers by automating the process of assigning the nearest available ambulance to the user (Abdullahi et al., 2017).

Another advantage of location-based emergency ambulance booking systems is the ability to track ambulance movements in real-time. This feature allows dispatchers to monitor the progress of the ambulance and make necessary adjustments to the route or destination if needed (Al-Ali et al., 2016). Furthermore, real-time tracking can also improve communication between the ambulance crew and the hospital, enabling them to prepare adequately for the patient's arrival (Al-Ali et al., 2016).

Park et al. (2017) conducted a study in South Korea, which involved developing a location-based ambulance dispatch system that integrated real-time traffic information and ambulance GPS data. The system was designed to optimize ambulance routes and reduce response time. The study found that the system significantly reduced response time and improved the quality of ambulance services. However, there were technical issues related to the system's accuracy and connectivity, as well as concerns about the system's cost-effectiveness.

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Tran et al. (2017) conducted a similar study in Vietnam, which involved developing a location-based ambulance booking system for patients in a large urban area. The system was designed to provide real-time information on ambulance availability, location, and estimated arrival time. The study found that the system significantly reduced response time and improved the quality of ambulance services. However, there were technical issues related to the system's connectivity and accuracy, as well as a lack of trust among patients and healthcare providers in using the system.

Benefits of Location-Based Ambulance Booking System
The location-based ambulance booking system offers several benefits. Firstly, it provides a faster response time by enabling ambulances to be dispatched to patients based on their location. This is important, as response time is critical in emergency situations, and can have a significant impact on patient outcomes (Laurent et al., 2013). Secondly, it improves the quality of ambulance services by reducing the risk of miscommunication between patients, dispatchers, and ambulance drivers. The system provides accurate location data and enables patients to communicate their needs and medical history directly to the ambulance driver. This can lead to a more effective and efficient delivery of care (Tran et al., 2017). Finally, the system can reduce costs by optimizing ambulance routes and reducing unnecessary trips (Park et al., 2017).

Another benefit, a study by Bari et al. (2016) found that such systems can significantly reduce ambulance response times, thereby improving patient outcomes. The authors noted that the system can be particularly beneficial in areas with high population density, where ambulance dispatch can be challenging.

Similarly, a study by Alshabani et al. (2020) found that a location-based ambulance booking system can help reduce the burden on emergency call centers, as users can directly request an ambulance through the system. This, in turn, can help free up call center resources for more urgent cases, improving overall emergency response efficiency.

D. Challenges of Location-Based Emergency Ambulance Booking Systems

Challenges of Location-Based Ambulance Booking System
Despite the benefits of a location-based ambulance booking system, several challenges must be addressed to ensure its success. Firstly, there may be a lack of trust among patients and healthcare providers in using a new system. This may be due to concerns about data privacy and security, as well as the reliability of the technology (Tran et al., 2017). Secondly, there may be technical issues related to the system's connectivity and accuracy, such as poor GPS signals or outdated mapping data (Park et al., 2017). Finally, there may be cultural and social factors that affect the system's adoption, such as the preference for traditional ambulance services or the reluctance to use technology among certain populations (Laurent et al., 2013).

Current Research on Location-Based Ambulance Booking System
Several studies have been conducted on the implementation of a location-based ambulance booking

system. Laurent et al. (2013) conducted a pilot study in France, which involved implementing a smartphone-based ambulance booking system in a rural area. The study found that the system significantly reduced response time and improved the quality of ambulance services. However, there were concerns about the system's reliability, as well as a lack of trust among healthcare providers and patients in using the system.

Despite their many advantages, location-based emergency ambulance booking systems face several challenges. One of the most significant challenges is the accuracy of location data. The accuracy of location data can be affected by various factors such as network congestion, weak signals, and device malfunctions (Abdullahi et al., 2017). These issues can result in delays in dispatching the ambulance, which can be critical in emergencies.

Another challenge, a study by Amin et al. (2018) noted that such systems may not be accessible to all users, particularly those who do not have access to smartphones or internet connectivity. This can create disparities in access to emergency medical services, particularly in low-income or rural areas.

Another challenge is the need for efficient and reliable communication infrastructure. These systems require fast and reliable communication channels between the ambulance crew, dispatchers, and hospitals to ensure smooth and efficient operations (Kumar et al., 2019). Moreover, these systems also require sufficient backup systems and redundancies to ensure uninterrupted service in the event of system failures or outages.

Finally considering the above research, Location-based emergency ambulance booking systems have advantages such as reducing response times, automating the dispatch process, and tracking ambulance movements. However, they also face challenges such as accuracy of location data and patient privacy. There are not any research papers can find to ambulance service or 1990 Suwa Seriya in Sri Lanka. So, Integration with web and mobile applications has improved efficiency and accuracy, but challenges such as accuracy of location data and patient privacy need to be addressed to ensure the system's effectiveness. The current manual process of the 1990 Suwa Seriya service involves patients calling a hotline and ambulance drivers manually contacting patients for their location. This outdated method leads to delays and inefficiencies. To fill this gap, this research is based on designing a location base ambulance system using Fast API.

III. METHODOLOGY

This research paper focuses on providing a technology-based solution to improve healthcare services by displaying local hospitals with ambulance facilities. The aim is to enable users to conveniently book an ambulance according to their preferences and location. The research methodology comprised several steps to gather data and design the system.

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Data collection commenced with semi-structured interviews conducted with Suwa Seriya headquarter in Colombo also with around 15 patients, 10 hospitals, and available healthcare services in both urban and rural areas. These interviews provided valuable insights into the existing challenges and requirements of ambulance services, contributing to the development of an effective solution.

Additionally, a web-based Google Forms survey was distributed around 15 individuals related to the medical and healthcare fields, as well as patients, with a specific focus on pregnant women, heart patients, cancer patients, and other relevant categories. This survey aimed to gather a broader range of perspectives and opinions, ensuring comprehensive data collection on the importance of location-based ambulance services.

After gathering the necessary data, the system design phase was initiated. The proposed solution, called "Ambu Finder," allows individuals to book an ambulance in emergencies through a web application or mobile application.

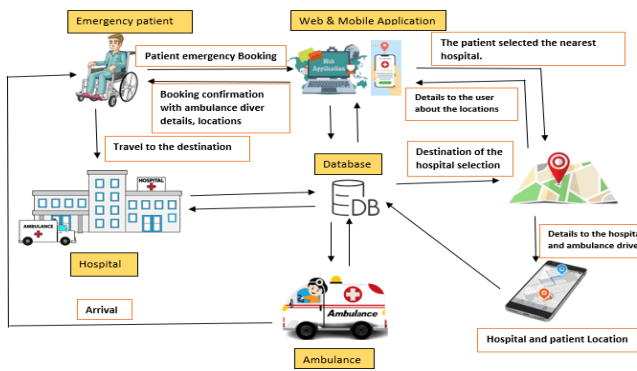


Figure 2. The Process Diagram of the system

The process is simple, as users only need to click the "Book an ambulance" button. The application then utilizes the user's IP address to track their current location and displays the nearest hospitals with available ambulance services on Google Maps.

Users can choose a hospital from the displayed list according to their preferences. Once a hospital is selected, the system sends the booking details, including ambulance driver information and confirmation, to the user who booked the ambulance. Subsequently, the ambulance travels to the destination without requiring additional details from the user. The hospital tracks the patient's location and sends all the necessary information to the ambulance driver. Furthermore, the system allows patients to track the ambulance driver's location and estimate the time of arrival at the destination. Notably, user login is not mandatory for this system, ensuring ease of access and usability.

For registered users, the system provides the option to upload medical reports. When booking an ambulance, the

system automatically sends the medical reports to the selected hospital. This feature eliminates the need for patients to worry about carrying their medical reports as the hospital already possesses a copy before the patient arrives. Consequently, hospitals can be better prepared to face the patient's situation in an emergency. Moreover, the system proves valuable for patient's visiting clinics, as they can schedule the booking of an ambulance. This feature ensures that patients can rely on timely transportation to the hospital, eliminating concerns about delays.

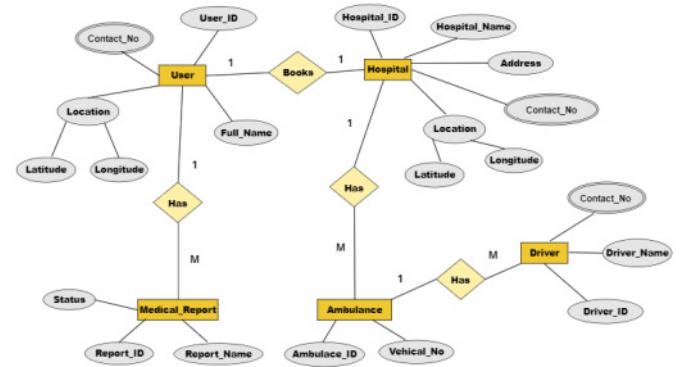


Figure 3. The Entity Relationship Diagram of the system

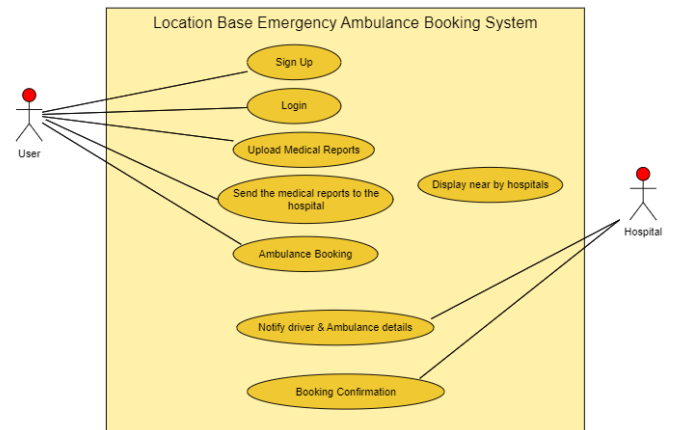


Figure 4. The Use Case Diagram of the system

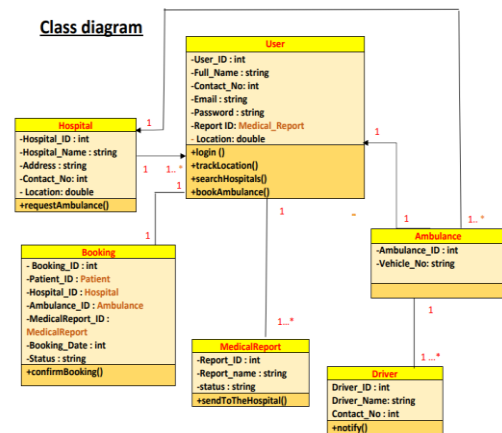


Figure 5. The Class Diagram of the system

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The diagrams above illustrate how the ER diagram, use case diagram, and Class diagram appear according to the Process diagram.

The functional requirements of the system include user login and registration (not mandatory), displaying the user's location on a map with nearby hospitals, enabling the user to choose a hospital from the provided list or search for their preferred hospital, utilizing the user's IP address to determine their location, notifying hospitals about patient requests, facilitating the retrieval of patient medical records by the hospital, displaying hospital and driver information in the booking confirmation, and providing the capability to upload medical reports.

In terms of technology, the web application is developed using the Python programming language, with HTML, CSS, and JavaScript used for the application's front-end. A database is constructed and linked to MongoDB Atlas, enabling cloud access to data. The Folium library is employed to retrieve the user's location and display it on a map. PyMongo, a Python library, is utilized to access databases on MongoDB Atlas and retrieve user and hospital information. Additionally, a function is written to filter local hospital sites and display them as a list and on a map. To facilitate the functions, the Rest API is built using the Python framework FastAPI.

Regarding the mobile application, React Native is chosen as the development framework. The system can be integrated with either MongoDB Atlas or Firebase for data management. Furthermore, OpenCV is utilized to enhance the functionality of the application.

A. Web application

This is how the web application's main user interface will appear.

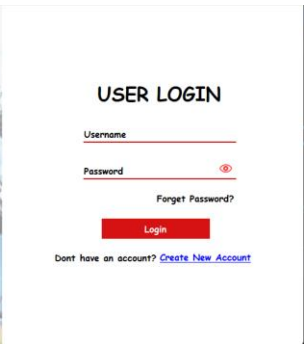
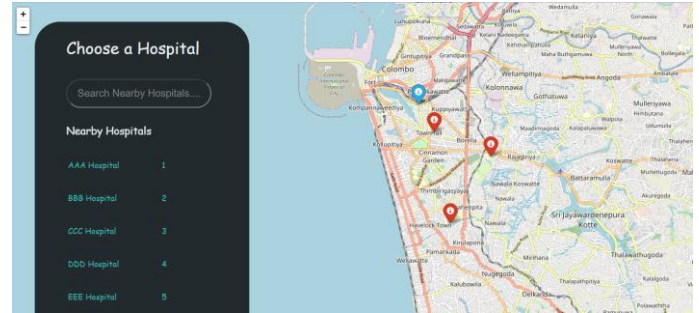
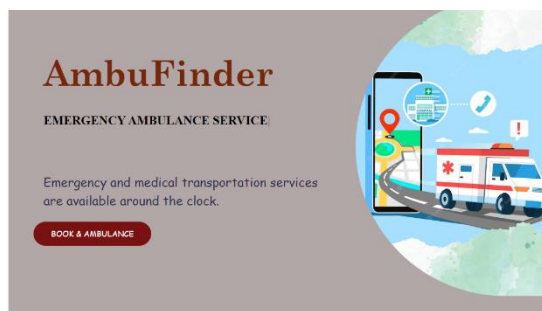
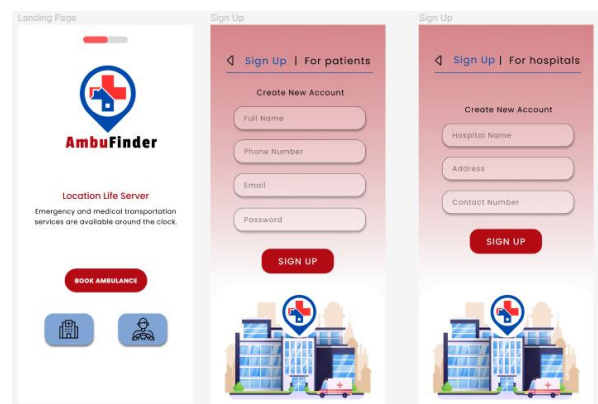


Figure 6. User interface of the web application

B. Mobile application

This is how the mobile application's user interface will appear.



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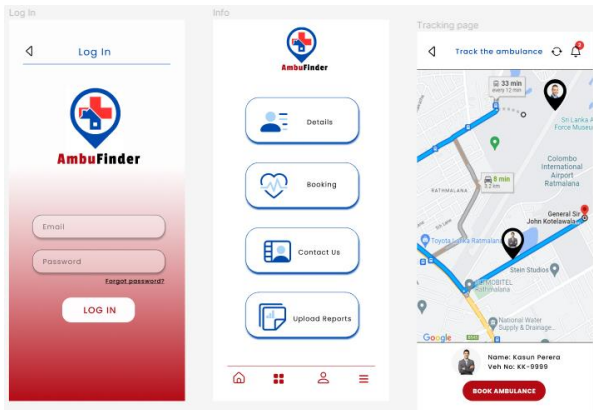


Figure 7. User interface of the mobile application

By following this methodology and utilizing appropriate technologies, the "Ambu Finder" system aims to provide an effective solution for emergency ambulance bookings, enhancing healthcare services and ensuring timely assistance for individuals in need.

IV. CONCLUSION

This research paper highlights the significance of a location-based emergency ambulance booking system in improving healthcare services. The 1990 Suwa Seriya program relies on manual processes where ambulance drivers must call patients during emergencies to determine their location. This outdated method leads to delays and inefficiencies. The "Ambu Finder" system provides a user-friendly interface for individuals to conveniently book ambulances during emergencies. By utilizing technology and location-based tracking, the system efficiently identifies the nearest hospitals with available ambulance services. It streamlines the process by eliminating the need for extensive user input and enables hospitals to receive patient requests, track their location, and provide necessary details to the ambulance driver. Additionally, the system allows registered users to upload their medical reports, ensuring hospitals are well-prepared to handle emergency situations. With its potential to reduce response times, improve coordination, and enhance patient care, the location-based emergency ambulance booking system demonstrates the benefits of digitalization in achieving resilience and transforming the healthcare sector.

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