GPS-Based Nearest Hospital Location System for Accident Victim In Ebonyi State, Nigeria

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ABSTRACT

Accident victims often face delays in getting medical help because of difficulties locating nearby hospitals. In Ebonyi State, this problem is made worse by poor road networks, unreliable internet, and the lack of effective emergency systems. This paper focuses introducing a GPS-based hospital location system to solve these problems. The system helps users find the nearest hospitals quickly by providing real-time navigation. It also works offline, making it useful in areas with poor internet. Additionally, the system includes detailed hospital information, such as available services, equipment, and contact details. By improving access to healthcare, the system aims to reduce emergency response times and save lives. The system was tested for accuracy, speed, and ease of use, showing significant improvements in emergency response. This research offers a practical solution to enhance emergency healthcare delivery in Ebonyi State.

Keywords: GPS, Hospital location, Emergency Response, Accident Victims, Ebonyi State, Emergency healthcare Delivery.

1. BACKGROUND TO THE STUDY

Road accidents are one of the leading causes of injuries and deaths around the world, especially in developing countries like Nigeria. According to the World Health Organization (WHO), about 1.3 million people die from road accidents every year, and millions more suffer serious injuries (WHO, 2023). Most of these deaths occur in low and middle-income countries due to poor infrastructure, lack of proper healthcare facilities, and delayed emergency responses. Nigeria is no exception, as it struggles with inadequate systems for emergency medical care, particularly in states like Ebonyi. Ebonyi State, located in southeastern Nigeria, faces significant challenges in road safety and healthcare delivery. Many roads in the state are poorly maintained, and accidents are frequent. However, the bigger problem is the slow response to emergencies caused by a lack of proper communication systems and tools to locate the nearest hospitals.

In most cases, first responders or bystanders do not know where the closest hospital is or how to get there quickly. This delay in medical care often leads to preventable deaths or worsening of injuries. Over the years, technology has played a key role in improving emergency response systems in many parts of the world. One of the most effective technologies for this purpose is the Global Positioning System (GPS). GPS is a navigation system that provides real-time location and direction services to users. Studies have shown that using GPS-based systems can significantly reduce the time it takes to locate and access emergency healthcare services (Agrawal & Sharma, 2023). For example, in countries like India and Kenya, GPS applications have been successfully implemented to guide emergency responders to hospitals, improving patient outcomes (Kumar et al., 2022).

This study focuses on designing and implementing a GPS-based system to help accident victims and emergency responders in Ebonyi State find the nearest hospitals quickly and efficiently. The system will use GPS technology to identify hospital locations in real time and provide clear directions to reach them. It will also include important details such as hospital names, addresses, and contact information. This will ensure that accident victims can receive timely medical attention, which is critical for saving lives. The use of GPS technology in healthcare and emergency services has proven to be a game-changer in many parts of the world.

By adopting this solution, Ebonyi State can address the challenges of slow emergency responses and improve the overall efficiency of healthcare delivery. The system will not only help reduce fatalities but also serve as a model for other states in Nigeria to follow. Recent research emphasizes that combining technology with emergency systems can significantly improve healthcare accessibility and reduce mortality rates caused by accidents (Olowookere et al., 2023). In conclusion, this study highlights the need for a reliable and efficient GPS-based system to locate the nearest hospitals during emergencies. By leveraging modern technology, this project aims to bridge the gap between accident scenes and healthcare facilities in Ebonyi State, ensuring that accident victims receive the help they need on time.)

2. STATEMENT OF PROBLEM

Accident victims in Ebonyi State often face life-threatening delays in receiving medical attention due to several challenges:
1. Lack of a centralized system to identify the nearest hospital.
2. Delays caused by first responders or bystanders who are unaware of nearby healthcare facilities.
3. Poor road infrastructure and lack of real-time navigation support.
4. Inadequate communication between accident scenes and emergency medical providers.
5. The manual nature of emergency response, leading to inefficiency and preventable loss of lives.

3. OBJECTIVE

The main objectives of study is to design and implement a GPS-based system that locates the nearest hospital for accident victims in Ebonyi State. Other objectives are as follows:
The specific objectives are:
1. To develop a mobile application that uses GPS to identify and display nearby hospitals.
2. To provide real-time directions to the nearest hospital from the accident location.
3. To integrate a database of hospitals in Ebonyi State, including their contact details and capabilities.
4. To ensure the system operates efficiently in areas with limited internet connectivity.
5. To test and validate the system for accuracy, usability, and reliability.

4. METHODOLOGY

4.1 The Research Design
For this research, **Object-Oriented Analysis and Design (OOAD)** methodology was adopted. This approach is ideal for developing the GPS-based mobile application because it focuses on creating a system by modelling real-world objects and their interactions. In OOADM, the system is broken down into smaller, manageable components (called objects), each representing a part of the system, such as the hospitals, users (like first responders or accident victims), and the GPS module.
The main steps of OOADM for this research design include:

i. **Analysis:** During this phase, key objects will be identified in the system, such as the hospital, location, and emergency responders. Properties will also be defines (e.g., hospital name, address, GPS coordinates) and actions (e.g., getting directions, searching for hospitals).

ii. **Design:** In the design phase, how these objects will be interacted will be mapped out. For example, when a user needs directions to the nearest hospital, the system will use the GPS object to calculate the user's current location and find the closest hospital object. User interface will also be design to make the system simple and easy to use.

iii. **Implementation:** This step involves writing the code for the system based on the analysis and design. The application will be developed using object-oriented programming languages, ensuring that the objects and their interactions are well-represented in the code.

iv. **Testing:** After coding, we will test each object and its interactions to make sure everything works as expected. We will focus on checking if the system can accurately find the nearest hospital and provide correct directions.

v. **Deployment and Maintenance:** After successful testing, the system will be deployed in Ebonyi State. The application will be regularly updated and maintained to fix bugs and ensure that it continues to work effectively.

The reason for choosing OOADM is because it helps in creating a clear structure for the system, making it easier to manage and update. Since the project involves multiple components (like hospitals, GPS, and users), OOADM is a good fit because it allows the modelling of each part of the system separately. This method also supports easy maintenance and future improvements, as each object can be updated or replaced without affecting the rest of the system.

5. DATA PRESENTATION

Data gathering is a crucial part of this study, as it provides the information needed to design and implement the GPS-based hospital location system. The data was collected from primary and secondary sources to ensure accuracy and reliability. The presentation of this data is divided into categories to clearly outline the findings relevant to the system design.

1. **Hospital Information Data:** A survey was conducted to gather details about hospitals in Ebonyi State. This data includes the names, addresses, GPS coordinates, contact information, available medical equipment, and the types of services provided. These details are vital for building the hospital database that the system will rely on.
2. **Road Network and Connectivity Data:** The road network data was obtained from maps and local authorities. It includes information on major and minor roads, traffic patterns, and areas prone to congestion. This data is crucial for the system's route optimization and navigation features.
3. **Emergency Response Patterns:** Interviews were conducted with healthcare workers, ambulance drivers, and first responders to understand current emergency response practices. This information helped identify delays and inefficiencies in the existing system, which the new system aims to address.
4. **Internet Connectivity and Coverage:** Data on internet connectivity in Ebonyi State was gathered from telecommunications providers. This data includes areas with strong signals, weak signals, and no coverage. It guided the inclusion of offline functionality in the system to ensure usability in areas with poor network access.

This structured presentation of data provides a clear foundation for developing a reliable and efficient GPS-based hospital location system.

6. DISCUSSION OF FINDINGS

The system works by using Global Positioning System (GPS) technology to determine the exact location of the accident and identify the closest healthcare facility. The application provides real-time directions, ensuring that the responders can reach the hospital as quickly as possible. The system will also include a comprehensive database of hospitals in Ebonyi State, including critical information such as hospital names, addresses, contact details, and available medical services.

This will ensure that accident victims or emergency responders have all the necessary information to make informed decisions quickly. To make the system usable even in areas with limited internet connectivity, the application will be designed to operate with minimal data requirements, enabling access to the necessary information without relying on a constant internet connection. The app will also be tested and optimized for accuracy, usability, and reliability to ensure it functions effectively under real-world conditions.   .

The study will improve emergency response times by providing accurate and timely information, reducing the likelihood of preventable deaths, and ensuring that patients receive the appropriate care as soon as possible. The GPS-based hospital location system has four main types of users: Accident Victims/General Users, Healthcare Professionals, Emergency Responders, and System Administrators. Each user has specific functions within the system, as shown in the figure 1

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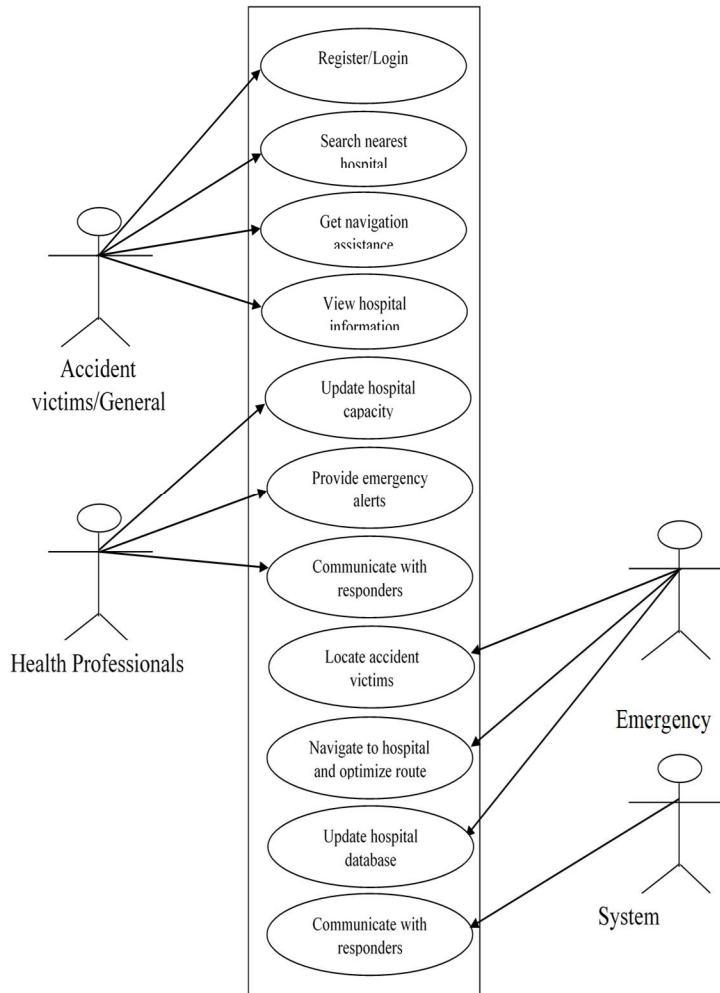Vol. 16 No. 1, 2025 - www.cisdijournal.net

Fig. 1: Use Case Diagram of GPS-based hospital location system for Accident Victim in Ebonyi State

Figure 1 describes the GPS-based hospital location system which has four main types of users: Accident Victims/General Users, Healthcare Professionals, Emergency Responders, and System Administrators. Each user has specific functions within the system, as shown in the diagram. The accident victims/general users can search for the closest hospital based on their current location using the GPS feature, provides directions to the selected hospital, ensuring users can navigate easily, even in unfamiliar areas, access detailed information about hospitals, including services offered, available facilities, and contact details and retrieve hospital locations and essential details even in areas without internet connectivity. Healthcare Professionals are medical staff working in hospitals that interact with the system to ensure accurate information and preparedness for emergencies, update the system with real-time data, such as bed availability and specialized services, notify the system about emergencies or capacity changes, which helps in decision-making for incoming patients and send information to emergency responders to prepare for incoming accident victims.

Emergency Responders (Ambulance Drivers, Paramedics) handle the transportation of accident victims and interact with the system to improve response times, use the system to find the exact location of accident victims needing assistance, provides optimized routes to hospitals, considering factors like traffic and road conditions, check hospital readiness, such as the availability of beds and medical equipment, before arriving, helps responders identify the fastest routes, reducing delays during emergencies. System Administrators manage the system's functionality and ensure it operates efficiently for all users and update hospital information, such as contact details, services, and locations.

7. CONCLUDING REMARKS

GPS-based hospital location system is crucial for improving emergency healthcare access, particularly in regions like Ebonyi State with limited infrastructure and connectivity challenges. This system bridges the gaps in existing emergency response frameworks by offering real-time navigation and offline functionality. It empowers users, including accident victims, healthcare professionals, and emergency responders, to make timely and informed decisions during emergencies. By addressing the unique challenges of rural and semi-urban areas, this study contributes to saving lives and enhancing healthcare delivery. The system also provides a foundation for further innovations in healthcare technology, offering opportunities for expansion and integration with other emergency services.

8. CONTRIBUTIONS TO KNOWLEDGE

This study makes significant contributions to knowledge by addressing the challenges of emergency healthcare access through the introduction of a GPS-based hospital location system. It introduces an innovative solution tailored to the unique needs of rural and semi-urban areas like Ebonyi State, where limited internet connectivity and infrastructure often delay emergency response. The study integrates offline functionality, enabling users to access critical hospital information even without internet connectivity.

It also includes real-time navigation with details on services, equipment, and availability. These features empower users, including accident victims, emergency responders, and healthcare professionals, to make quick and informed decisions during emergencies. Furthermore, this study bridges the gaps identified in existing studies by focusing on practical implementation in underserved areas. It provides a scalable framework that can be expanded to other regions facing similar challenges, contributing to the broader field of healthcare technology and emergency response systems. Through its practical applications and innovative approach, this study advances the understanding and use of GPS technology to improve healthcare access and save lives.

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