Development of a Web-Based Rapid Response System for Medical Emergencies in University Clinics: A Case Study of Tai Solarin University of Education

Olayinka Olufunmilayo Olusanya[1*], Akeem Ayoade Owoade[1], Ademola Abiodun Omilabu[1], Adedeji Oladimeji Adebare[1], Godwin Oluwaseyi Odulaja[1], Omotayo Joseph Adeyemi[1], Morolake Oladayo Lawrence[2], Oluremi Adufe Arowolo[3] and Afolakemi Simbo Ogunbanwo[1]

[1] *Department of Computer Science, Tai Solarin University of Education, Ijagun, Ogun State, Nigeria.*
[2] *Department of Computer Science, Baze University, Abuja, Nigeria.*
[3]*Department of Computer Science, Tai Solarin College of Education, Omu-Ajose, Ijebu, Ogun State, Nigeria.*

**Corresponding Author's Email:* yinka_olusanya@yahoo.com

Abstract:
Tai Solarin University of Education (TASUED) has faced challenges in the efficiency and coordination of its clinic emergency response system, leading to delays and raising concerns about the safety of students, staff, and visitors. This study aims to design and implement a computerized TASUED Clinic Emergency Response System to enhance emergency management capabilities. Leveraging technology, the proposed system seeks to streamline communication channels, improve response times, and ensure effective coordination during emergencies. Observational methods and interviews conducted at the TASUED Medical Center revealed inefficiencies in patient registration, waiting times, and staff scheduling. Based on these findings, the system was developed using a top-down design approach and modular testing strategy, ensuring robust and reliable functionality. The implementation includes a user-friendly login interface and a comprehensive dashboard for healthcare professionals, facilitating efficient emergency response. This system's deployment is a significant step towards improving emergency management at TASUED and can serve as a model for other institutions facing similar challenges.

Keywords: *Clinic Emergency Response System, Technology, Efficiency, Coordination*

1 Introduction

Emergency care involves providing timely medical services within minutes or hours to address conditions requiring rapid intervention to prevent death or disability (Hirshon et al., 2013; Kobusingye et al., 2005). This includes treating injuries, communicable and non-communicable diseases, acute decompensation of chronic conditions, and pregnancy complications. These conditions are significant, contributing to approximately 2.1 billion global deaths and disability-adjusted life years annually (Chang et al., 2016). Thus, efficient emergency care is crucial for reducing mortality and long-term disability.

Recent studies have explored various approaches to improving emergency response systems. Ekwunife et al. (2023) designed an Internet of Things (IoT)--based accident detection and reporting system to facilitate prompt emergency assistance. Their methodology included using IoT technology to detect accidents and transmit critical information, such as location and vehicle status, to a cloud platform for alert generation and dispatch to emergency responders. The study successfully developed an embedded device for accident detection, created a hospital database, and integrated an emergency alert system. However, the study did not thoroughly address potential limitations like scalability, reliability, and real-world testing.

Similarly, Boateng-Osei et al. (2023) evaluated the emergency preparedness capacity of the Kwame Nkrumah University of Science and Technology (KNUST) hospital in Ghana. Using a cross-sectional assessment between December 2018 and February 2019, they followed guidelines from the World Health Organization, the Ministry of Health-Ghana, and the Ghana Health Service. The study revealed deficiencies in surge capacity, human resources, triaging, emergency protocol implementation, and medication availability, with a weak overall emergency preparedness level (57.36%). The study’s limitation was its focus on a single hospital, which may restrict the generalizability of the findings.

Tai Solarin University of Education (TASUED) has faced significant challenges in the efficiency and coordination of its clinic emergency response system. For example: "In the past year, TASUED reported X number of delayed emergency responses, resulting in Y critical incidents. This highlights the urgent need for an improved emergency response system.". The current system lacks streamlined communication channels, resulting in delays during emergencies and raising concerns about the safety of students, staff, and visitors. One major issue is the absence of a centralized database for emergency contact information, which hinders prompt access to key individuals during crises. Additionally, the reliance on phone calls and manual reporting exacerbates delays and miscommunication. This study aims to design and

implement a computerized TASUED clinic emergency response system to enhance emergency management capabilities. The proposed system seeks to improve response time, coordination, and effectiveness by leveraging technology and streamlining communication channels.
Therefore, addressing the inefficiencies in TASUED's emergency response system is crucial for ensuring the safety and well-being of the university community. This study will contribute significantly to the advancement of emergency care by providing a model for other institutions facing similar challenges.

Related Works

Ekwunife et al. (2023) aimed to design and implement an Internet of Things (IoT) based accident detection and reporting system for prompt emergency assistance. The methodology involved IoT technology to detect accidents and transmit critical information like location and vehicle status to a cloud platform for alert generation and dispatch to emergency responders. The system architecture included sensors, data transmission modules, and a cloud-based platform. The results demonstrated the successful development of an IoT-based embedded device for accident detection and transmission, the creation of a hospital database, a web-based platform, and the integration of an emergency alert system. However, potential limitations, such as scalability, reliability, and real-world testing, were not explicitly addressed.

Boateng-Osei et al. (2023) study aimed to evaluate the emergency preparedness capacity of the Kwame Nkrumah University of Science and Technology (KNUST) hospital in Ghana. Employing a cross-sectional assessment, data was collected between December 2018 and February 2019, utilizing guidelines from the World Health Organization, the Ministry of Health-Ghana, and the Ghana Health Service. The assessment covered emergency policies, plans, protocols, equipment, and medications. Results revealed deficiencies in surge capacity, human resources, triaging, emergency protocol implementation, and medication availability, with an overall emergency preparedness level rated as weak (57.36%), necessitating urgent interventions. However, the study's limitation was its focus on a single hospital, potentially restricting the generalizability of findings and the depth of understanding certain aspects of emergency preparedness.

Lyons et al. (2018) aimed to provide insights and recommendations on the implementation and optimization of Rapid Response Systems (RRS) in healthcare settings. The methodology involved a review of the literature on RRS from articles in PubMed, synthesizing findings on risk detection, intervention strategies, outcome measurement, process improvement, and implementation. The results identified the heterogeneous nature of RRS, variability in outcomes like mortality and length of stay, mixed findings from interventional studies, opportunities for improvement through monitoring technologies and risk assessment, and the potential for enhancing end-of-life care. However, the study's limitation lies in its reliance on existing literature, which may introduce bias and limit generalizability, while also potentially lacking the most recent developments in the rapidly evolving field of RRS.

Al-khafajiy et al. (2019) aimed to introduce the Smart Hospital Emergency System (SHES), a novel mobile-based system to enhance emergency service efficiency in the UK. The methodology involved developing a prototype leveraging smartphone technologies like sensors and location services to streamline emergency requests and communication. Evaluations included usability testing, reliability assessment, communication performance analysis, unit testing, and Android version compatibility checks. Results demonstrated successful prototype implementation, positive usability outcomes across Android devices, identification of future features, and the system's potential to improve emergency response efficiency through innovative technology solutions. However, limitations included the preliminary nature of usability studies and the need for further extensive testing to assess scalability and robustness.

Boutilier and Chan (2020) aimed to optimize ambulance emergency response systems in developing countries, focusing on Dhaka, Bangladesh. Utilizing real data, including patient travel and GPS data, they developed a machine-learning model to predict travel times and a robust location-routing model incorporating demand and travel time uncertainty sets. The research yielded a demand simulation procedure, improved travel time prediction accuracy using random forest models, and policy implications for optimized outpost locations, centralized networks, and small ambulance deployment. The study showcased the potential of integrating optimization with machine learning to address emergency response challenges in resource-limited settings. However, the limitation lies in the study's focus on a specific urban center, potentially limiting generalizability and scalability to diverse settings.

Rinaldi et al. (2022) aimed to develop a web-based e-clinic system for Tamara Clinic in Batam Kota to enhance patient registration and data management processes. Employing a qualitative experimental research method, the study systematically manipulated variables to investigate the system's effectiveness and implications. The research concluded that the web-based system simplifies patient registration, enhances staff efficiency, reduces administrative burdens and errors, improves service quality by reducing queues and waiting times, and increases patient satisfaction. However, successful implementation requires user-centered design, staff training, and continuous evaluation and monitoring.

Wang et al. (2020) aimed to construct and evaluate the effectiveness of a regional elimination of mother-to-child transmission (EMTCT) e-clinic service system in Baoan District, Shenzhen, China. The study established the e-clinic system in 18 maternal and child health providers, analyzing changes in HBV screening rates, DNA detection rates, antiviral therapy rates, and mother-to-child transmission rates before and after implementation. Results showed significant improvements, including higher screening rates, follow-up rates, DNA detection rates, antiviral therapy rates, and decreased mother-to-child transmission rates. However, the study's limitation lies in its focus on a specific district within a short timeframe, potentially limiting generalizability and long-term assessment.

Akinremi et al. (2023) aimed to assess awareness and utilization of emergency response services for road traffic crashes in Nigeria. The web-based cross-sectional study, conducted between July 2022 and March 2023, used convenience sampling and an adapted questionnaire. Findings revealed while awareness was significant, utilization rates were low due to factors like lack of contact information and delayed response times. Recommendations included regular awareness programs, positive financial and behavioral attitudes, consistent training, and addressing response time and equipment issues. However, the web-based data collection method introduced bias, with a skewed age group representation, and the exclusion of emergency service workers limited the study's scope.

San and Htet, (2019) aimed to develop a GIS-based fire emergency response system for urban areas in Mandalay region. The methodology involved utilizing graph theory, network analysis, and Dijkstra's algorithm to model transportation networks and identify optimal routes minimizing response time. Data from Open Street Map was preprocessed, and the system searched for the shortest routes between incident locations and rescue sites using Dijkstra's algorithm. The results demonstrated the successful implementation of a system identifying best route directions, nearest emergency providers, and fire stations based on traffic conditions, generating optimal routes considering travel time and other parameters. However, the study's limitation to the Mandalay region may restrict generalizability to other urban areas.

Prasad et al. (2024) examined the challenges of developing an online ambulance booking system and proposed solutions to improve emergency services, particularly in rural areas. The methodology involved developing a GIS-based prototype integrating ArcGIS network analyst, GPS, and GSM technologies to address routing, accident location identification, real-time ambulance tracking, fastest route determination, response time analysis, optimal hospital routing, and congestion management during peak hours. While specific results were not mentioned, the envisioned system aimed to enhance ambulance service efficiency, reduce response times, optimize routes, and improve patient safety and accessibility through location-based services. However, the study's limitation in terms of practical implementation and evaluation of the proposed system was not addressed.

Lee et al. (2020) aimed to provide an overview of emergency medical dispatch services across Pan-Asian countries, focusing on dispatcher-assisted cardiopulmonary resuscitation (DACPR). The cross-sectional descriptive survey, conducted among dispatch services within the Pan-Asian Resuscitation Outcomes (PAROS) network, collected data on population characteristics, service structures, DACPR implementation, protocols, and quality improvement programs from 9 dispatch services across 9 Asian countries. Findings revealed most services operate tiered response systems with medical oversight and healthcare-trained dispatchers, utilize internally developed DACPR scripts in local languages, implement compression-only DACPR, and track quality indicators. However, variations in DACPR implementation and characteristics were observed, highlighting the need for further research and standardization. Quality improvement efforts included reviewing cases, sharing data, tracking EMS indicators, and providing DACPR protocols with feedback mechanisms.

The development of our system was informed by research work in emergency response systems, such as Boateng-Osei et al. (2023) who established the fundamental principles of rapid response in university settings, and Lee et al. (2020) who pioneered the integration of digital technologies, and its overview in emergency medical dispatch management in Pan-Asian countries.

These studies underscore the importance of developing and implementing effective emergency response systems. These systems range from accident detection and reporting to optimizing ambulance services, rapid response systems, crisis management platforms, and emergency dispatch services. Their primary objectives are to improve emergency preparedness, enhance response times, streamline communication channels, and ultimately save lives during critical situations. However, the existing research is limited, particularly in the context of emergency response e-clinics within university environments in Nigeria.

2. Methodology

The outlines the primary research approach employed in this project, which involved a combination of observational methods and interviews. Regular visits were conducted at the TASUED Medical Center, enabling the researchers to observe and gather insights into the existing system's operations. Furthermore, brief interviews were conducted with students, who provided valuable perspectives and experiences regarding the medical center's functioning. This multi-faceted approach allowed for a comprehensive understanding of the current system, facilitating the identification of potential areas for improvement and the formulation of informed conclusions. The observational component provided first-hand insights into the practical aspects of the medical center's operations, while the interviews with students offered a complementary perspective, reflecting the experiences and needs of the end-users. This triangulation of data sources enhances the validity and reliability of the research findings, ensuring a well-rounded and holistic understanding of the subject matter.

2.1 Observational Study

The primary research approach involved conducting observational studies and interviews at the TASUED Medical Center. The observational study was conducted over 4 weeks, with researchers present at the TASUED Medical Center during peak hours (10:00 AM to 12:00 PM) three days a week. Structured observation forms were used to record patient flow, waiting times, and staff interactions. Semi-structured interviews were conducted with 20 students and 10 staff members, focusing on their experiences and perceptions of the current emergency response system.

2.1.1 Observation Findings

i. **Patient Registration**: The registration process was relatively efficient, with staff promptly greeting and collecting patient information.

ii. **Waiting Area**: The waiting area was well-organized and clean and provided comfortable patient seating.

iii. **Waiting Time**: On average, patients waited approximately 20-30 minutes before consultation, with varying satisfaction levels.

iv**. Staff Professionalism**: The clinic staff, including nurses and doctors, demonstrated professionalism, competence, and a dedicated approach to their roles.

v. **Patient Interaction:** Positive interactions were observed between staff and patients, fostering a supportive atmosphere.

2.1.2 Recommendations

i. Appointment System: Implementing an appointment system could reduce waiting times and improve overall efficiency, particularly during peak hours.

ii. **Feedback Mechanism:** Establishing a platform for patients to provide feedback would enable continuous service improvement.

iii. **Staff Scheduling Optimization**: Adjusting staff scheduling during peak hours to meet patient needs efficiently.

iv**. Patient Education**: Providing information to patients about expected waiting times, services, and effective clinic utilization.

v**. Regular Staff Training:** Investing in staff training and development to maintain high professional standards.

This sub-outline the observational and interview-based research approach employed, highlighting the findings related to patient flow, waiting times, staff professionalism, and patient interactions. Based on these observations, recommendations are made to enhance the medical center's operational efficiency, patient experience, and overall service quality.

Here is a paraphrased and summarized version of the section on use cases, following the guidelines provided:

2.2 Use Case Modeling

Use case modeling is a widely adopted technique in modern software engineering for defining the interactions between external actors (users or organizations) and the system under consideration. A use case delineates a sequence of steps that outlines how an actor interacts with the system to accomplish a specific goal. This requirement-gathering technique is valuable for system developers as it effectively captures user perspectives and requirements.

Use cases serve as a communication tool between stakeholders and the development team, ensuring a shared understanding of the system's functionality. They provide a structured approach to eliciting, documenting, and validating system requirements from the user's point of view. By representing the system's behavior in a narrative form, use cases offer a user-centric perspective that facilitates the identification of potential issues and ensures that the system meets the intended user needs.

Furthermore, use case modeling promotes traceability, allowing developers to map system components and design elements back to the corresponding user requirements. This traceability aids in the verification and validation of the system, ensuring that the implemented features align with the specified use cases.

In summary, use case modeling is an essential technique in modern software engineering that enables effective requirement gathering, facilitates communication between stakeholders, and ensures a user-centric approach to system development. Its structured and narrative representation of system interactions contributes to the successful implementation of user-focused systems to be adopted in this design.

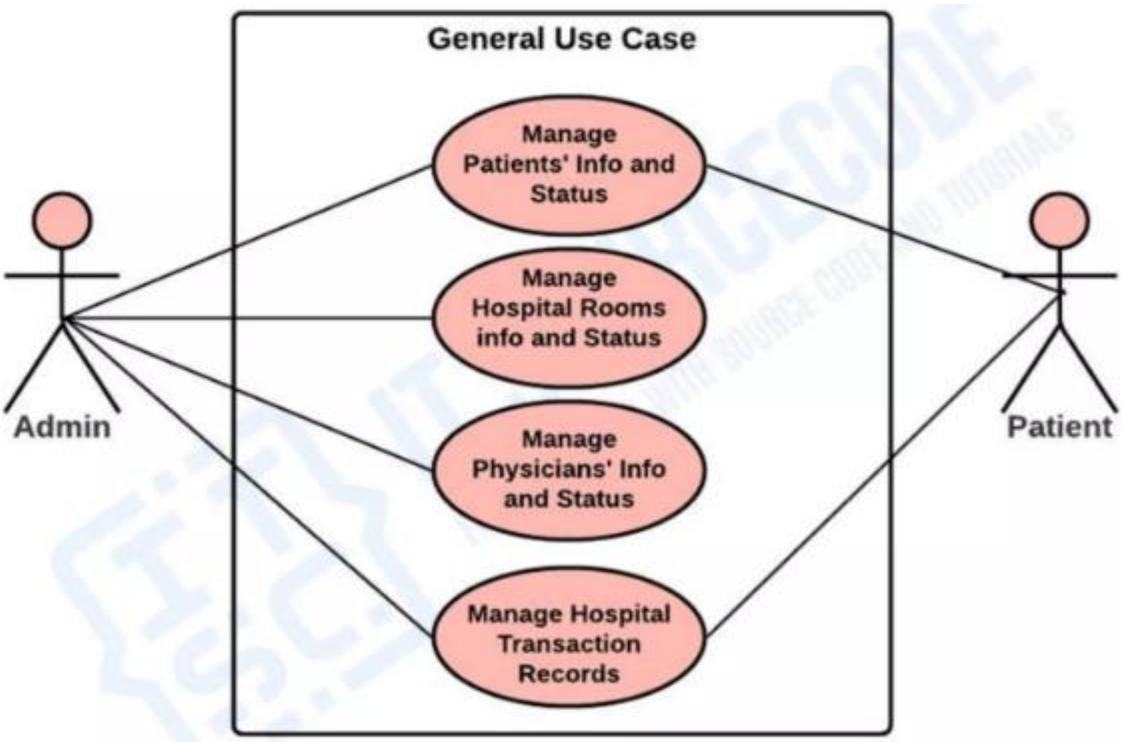

Figure 1: General Use Case for Both Admin & Patient

2.3 Flowchart Modeling

A flowchart is a visual representation that illustrates the sequential flow of steps, actions, or processes within a system, procedure, or algorithm. It employs a graphical notation comprising various shapes, symbols, and connecting lines to depict the progression of information, data, or actions from one step to the next. It modeling serves as an effective tool for understanding, documenting, and analyzing the logical sequence of operations within a system or process. It provides a structured and intuitive representation that facilitates communication among stakeholders, including developers, analysts, and end-users.

The use of standardized symbols and shapes in flowcharts enhances clarity and promotes a common understanding of the system's behavior. By visually mapping the flow of control, decision points, and data transformations, flowcharts aid in identifying potential bottlenecks, redundancies, or inefficiencies within a process. Furthermore, flowchart modeling supports the design and development phases of software engineering by serving as a blueprint for translating system requirements into executable code. It enables developers to visualize the logical flow of the system and identify critical paths, facilitating the implementation of efficient and robust solutions.

2.4 Implementation

The TASUED Clinic Emergency Response System was developed using PHP for server-side scripting, MySQL for database management, and HTML5/CSS3/JavaScript for the front-end interface. The system was built on a LAMP (Linux, Apache, MySQL, PHP) stack, ensuring robust performance and scalability.

In summary, flowchart modeling is a valuable technique that promotes clear communication, logical representation, and a structured approach to understanding and documenting complex systems or processes. Its visual nature and standardized notation contribute to the effective analysis, design, and implementation of systems across various domains.

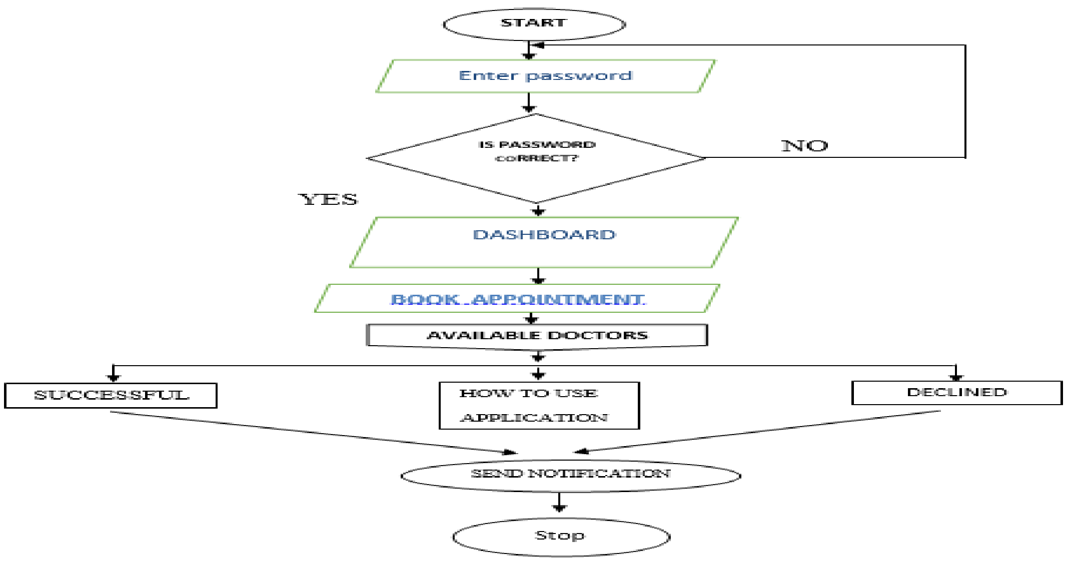

Figure 2: The flowchart of the TASUED clinic emergency response application

3. Results and Discussion

The developed system employed a top-down design approach for data processing. Access to information is facilitated through the home page, which serves as the primary entry point. The system comprises multiple subsystems, each designed to perform specific tasks and functionalities. The implementation process followed a modular approach, where each individual module underwent thorough testing and validation before proceeding to the final integration and comprehensive testing of the entire system. This approach ensured that the individual components functioned as intended and met the specified requirements.

The top-down design methodology allowed for a structured and organized implementation process, enabling developers to break down the system into manageable units and tackle complex functionalities in a systematic manner. By focusing on the higher-level modules first and gradually incorporating lower-level components, the system's architecture and overall functionality were established, providing a solid foundation for subsequent development and testing phases.

The modular testing strategy ensured that each component was rigorously evaluated and validated before being integrated into the larger system. This approach facilitated early detection and resolution of potential issues, minimizing the impact of errors and reducing the overall complexity of the testing process.

In summary, the system implementation and testing phases adhered to industry-standard practices, employing a top-down design approach and modular testing strategy. This methodology contributed to the development of a robust and reliable system, ensuring that the individual components and the overall system functionality met the specified requirements and delivered the desired outcomes.

3.1 Login Interface

Figure 3 illustrates the login interface of the TASUED Clinic Emergency Response System. The user interface is designed for ease of access, ensuring that users can quickly and efficiently log in to the system.

1. **User Interface Design**: The login page features a welcoming message, "Welcome Back!", which prompts users to enter their email and password. This straightforward design facilitates user interaction, promoting a user-friendly experience.
2. **Background and Context**: The background image showcases the entrance of Tai Solarin University of Education (TASUED), reinforcing the university's identity and

the application's context within the educational institution. This visual connection to the university helps users associate the application with their familiar environment, enhancing user engagement and trust.

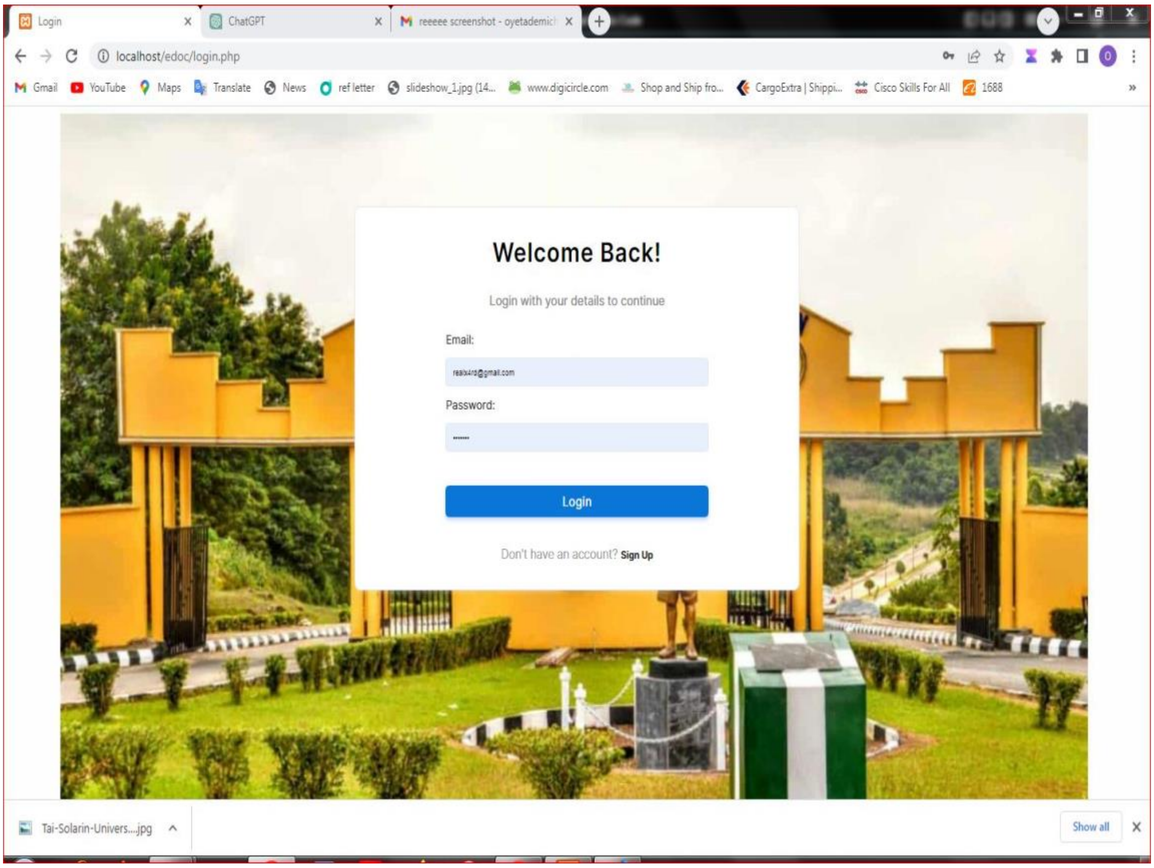

Figure 3: Login Page

3. **Security Measures**: The login form includes standard fields for email and password, ensuring secure access to the system. This design aligns with common security practices, maintaining the confidentiality and integrity of user data.
4. **Additional Features**: Below the login form, there is an option for new users to sign up, indicating the system's ability to accommodate new users. This feature ensures the scalability and adaptability of the system to cater to a growing number of users over time.

The TASUED Clinic Emergency Response System's login interface exemplifies a user-centric design, integrating security features and university branding. This setup ensures efficient access for users while maintaining a secure environment. The interface is intuitive, with clear options for both returning and new users, highlighting the system's potential to enhance emergency response capabilities within the university. The implementation of this system marks a significant step towards improving emergency management and response efficiency at TASUED.

3.2 Overview of the TASUED Clinic Emergency Response System Dashboard

The figure below showcases the dashboard of the TASUED Clinic Emergency Response System, highlighting the user interface designed for healthcare professionals. The dashboard is specifically tailored to Dr. Akeju, demonstrating the system's ability to provide personalized and efficient management of emergency medical services within the university.

3.2.1 User Interface and Functionalities

1. User Identification and Logout Option:

- The top left section displays the user's name and email address, confirming the active user is Dr. Akeju. This area also features a "Log out" button for secure session termination, ensuring user data protection and system security.

2. Navigation Menu:

- A sidebar on the left offers quick access to essential functionalities, including:
    - **Dashboard:** The main overview screen.
    - **My Appointments:** A section to view and manage scheduled patient appointments.
    - **My Sessions:** A feature for tracking ongoing and upcoming sessions.
    - **My Patients:** A repository for patient information and records.
    - **Settings:** Configuration options for personalized system settings.

3. Main Dashboard Overview:

- The central part of the dashboard provides a welcoming message to Dr. Akeju, emphasizing the system's commitment to delivering comprehensive services. A prominent button labeled "View My Appointments" facilitates easy access to the appointment management module.

4. Status Summary:

- A summary section at the bottom left displays key statistics:
    - **All Doctors:** The total number of doctors using the system, currently listed as 3.
    - **All Patients:** The total number of patients registered, also listed as 3.
    - **New Booking:** Indicates no new bookings at present.
    - **Today's Sessions:** Shows zero sessions scheduled for the day, reflecting real-time updates.

5. Upcoming Sessions:

- The right side of the dashboard highlights upcoming sessions scheduled until the next week. Currently, no sessions are listed, as indicated by the message, "We couldn't find anything related to your keyword."

6. Today's Date:

- The top right corner displays the current date, ensuring users are aware of the date while navigating the system.

The TASUED Clinic Emergency Response System's dashboard is designed for optimal usability, providing healthcare professionals with an intuitive and comprehensive interface. The system supports efficient appointment management, real-time status updates, and easy navigation, which are critical for enhancing the emergency response capabilities of the university clinic. This user-centric design ensures that medical staff can effectively manage their duties, ultimately improving patient care and emergency response efficiency.

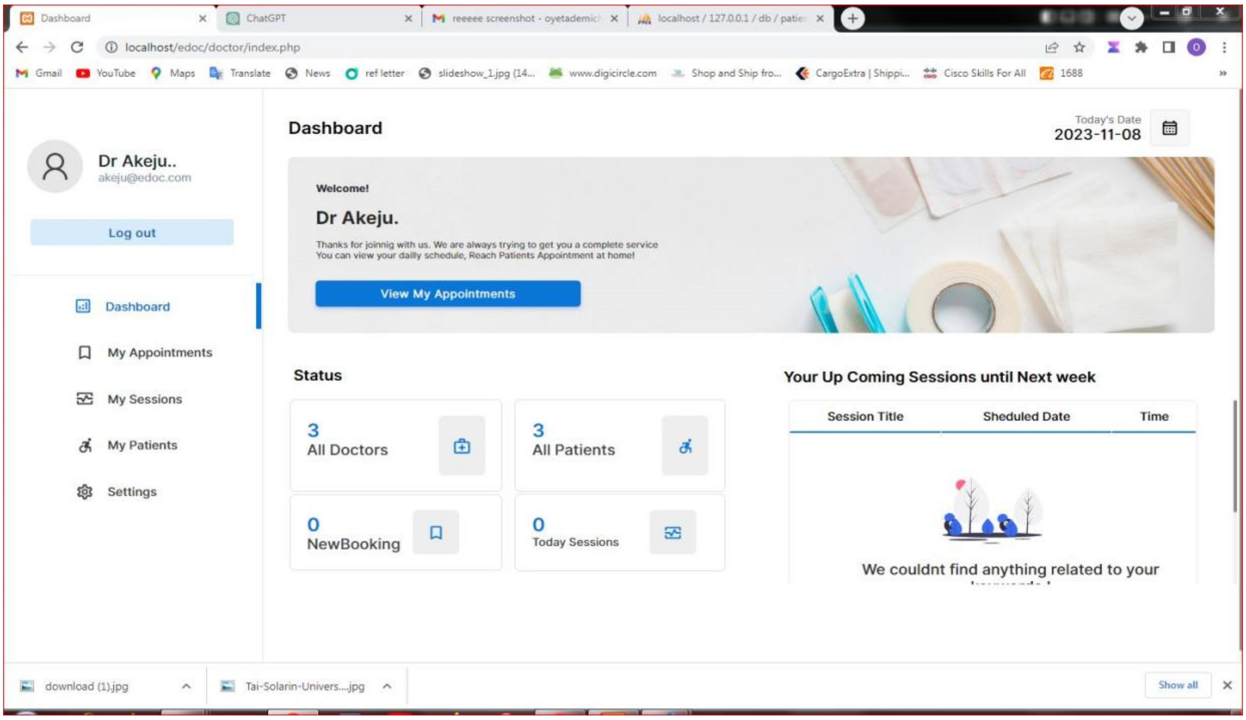

Figure 4: TASUED Emergency Response Dashboard

3.3 Administrator Interface of the TASUED Clinic Emergency Response System

Figure 5 below displays the administrator interface of the TASUED Clinic Emergency Response System, illustrating the functionalities available for managing medical personnel within the system.

3.3.1 User Interface and Functionalities

1. User Identification and Logout Option:

- The top left corner identifies the current user as an administrator, with the email "admin@edoc.com". A "Log out" button is provided to ensure secure termination of the session.

2. Navigation Menu:

- A sidebar on the left offers quick access to essential functionalities, which include:
    - **Dashboard:** The main overview screen.
    - **Doctors:** The section for managing doctor profiles.
    - **Schedule:** The area for viewing and organizing schedules.
    - **Appointment:** The module for managing appointments.
    - **Patients:** The section for managing patient records.

3. Doctor Management Section:

- The central section allows administrators to add and manage doctor profiles. The current screen shows the "Add New Doctor" interface.
- A search bar at the top enables quick retrieval of doctor profiles by name or email.

4. Doctor List:

- Below the search bar, there is a table listing all registered doctors. The table includes columns for:
    - **Doctor Name:** The name of the doctor, currently listing "Test Doctor".
    - **Email:** The email address of the doctor, "doctor@edoc.com".
    - **Specialties:** The area of specialization, listed as "Accident and emergency".
    - **Events:** Action buttons for editing, viewing, or removing the doctor profile. The available actions are represented by "Edit", "View", and "Remove" buttons.

5. Add New Doctor:

- A prominent "+ Add New" button on the right allows the administrator to add a new doctor to the system.

6. Date Display:

- The top right corner of the interface displays the current date, ensuring administrators are aware of the date while managing the system.

The administrator interface of the TASUED Clinic Emergency Response System is designed to facilitate the efficient management of medical staff. It provides comprehensive tools for adding, editing, viewing, and removing doctor profiles, along with a user-friendly navigation menu for accessing different sections of the system. This interface ensures that administrators can effectively manage medical personnel, which is crucial for maintaining an organized and responsive emergency clinic environment. The clear and intuitive design of the dashboard enhances administrative efficiency and supports the overall goal of improving emergency medical services within the university.

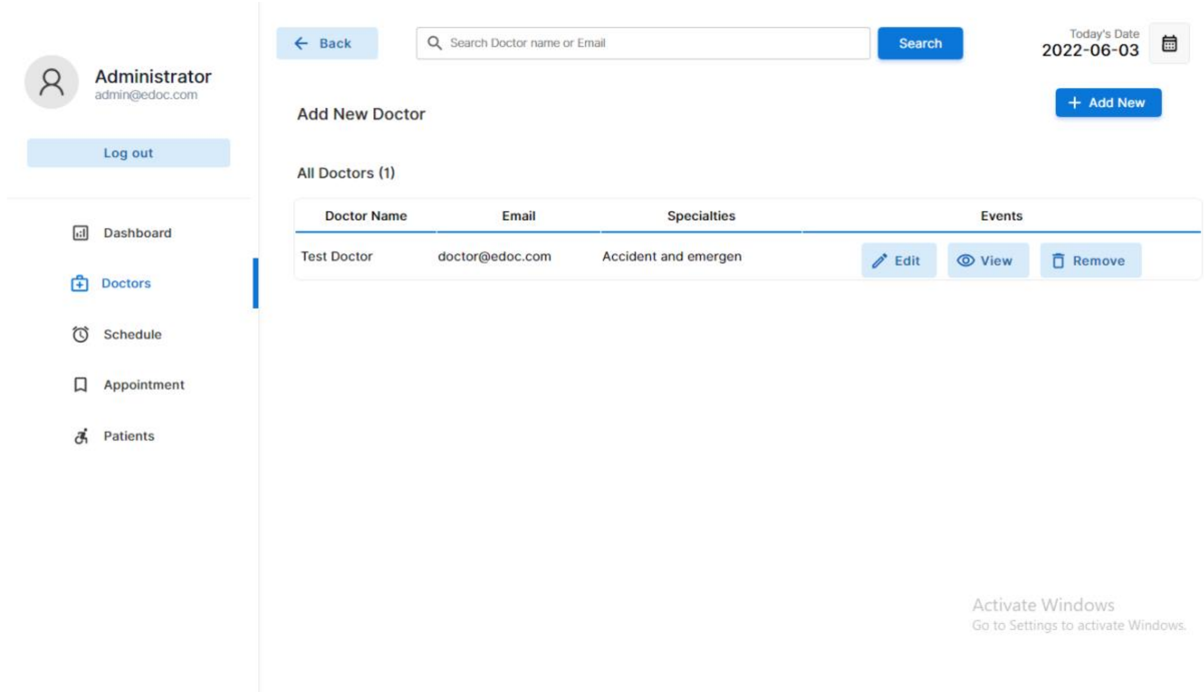

Figure 5: Administrator Interface

3.4 Patient Interface of the TASUED Clinic Emergency Response System

Figure 6 below displays the patient interface of the TASUED Clinic Emergency Response System, highlighting the functionalities available for patients to manage their healthcare interactions within the system.

3.4.1 User Interface and Functionalities

1. User Identification and Logout Option:

- The top left corner identifies the current user as "Test Patient" with the email "patient@edoc.com". A "Log out" button ensures secure termination of the session.

2. Navigation Menu:

- A sidebar on the left provides easy access to essential functionalities, including:
    - **Home:** The main overview screen.
    - **All Doctors:** A section to view all available doctors.
    - **Scheduled Sessions:** The area to view and manage scheduled sessions.
    - **My Bookings:** The module to manage patient bookings.

- **Settings:** For personalizing user preferences and settings.

3. Home Section:

- The central part of the interface welcomes the user and offers a search function to find available doctor sessions.
- A prominent search bar is provided for patients to locate doctor sessions by entering a doctor's name or session details.

4. Status Overview:

- The status section displays key metrics:
    - **All Doctors:** Indicates the total number of doctors, currently 1.
    - **All Patients:** Shows the total number of patients, currently 2.
    - **New Booking:** Displays the count of new bookings, currently 1.
    - **Today Sessions:** Indicates the number of sessions scheduled for today, currently 0.

5. Upcoming Booking:

- On the right, the "Your Upcoming Booking" section details the next scheduled appointment:
    - **Appointment Number:** The identifier for the appointment, currently 1.
    - **Session Title:** The title of the session, "Test Session".
    - **Doctor:** The name of the doctor, "Test Doctor".
    - **Scheduled Date & Time:** The appointment is scheduled for January 1, 2050, at 18:00.

6. Date Display:

- The top right corner of the interface shows the current date, ensuring users are aware of the date while managing their interactions.

The patient interface of the TASUED Clinic Emergency Response System is designed to facilitate patient management of healthcare interactions efficiently. It provides comprehensive tools for searching doctor sessions, viewing upcoming bookings, and accessing essential healthcare information. The intuitive navigation menu and clear status overview enhance patient experience and streamline the process of managing healthcare appointments. This interface supports the overarching goal of improving healthcare accessibility and response within the university environment, ensuring patients can effectively engage with the emergency response system.

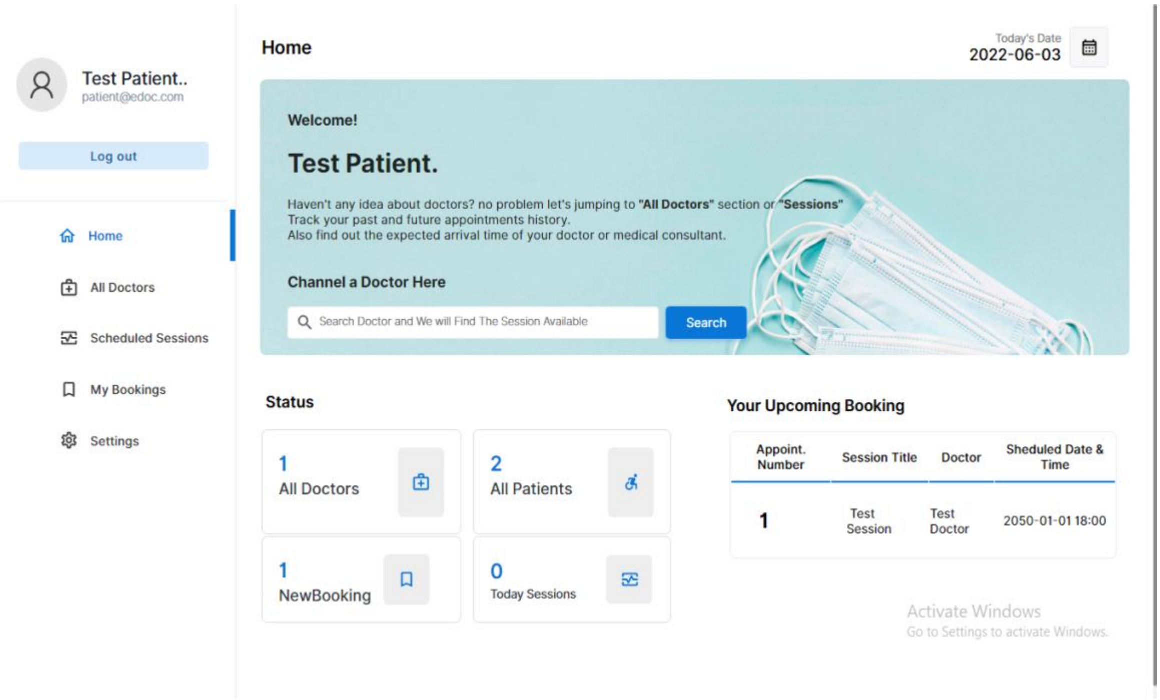

Figure 6: Patient Management Interface

3.5 Patient Booking History Interface of the TASUED Clinic Emergency Response System

Figure 7 below illustrates the "My Bookings" history interface of the TASUED Clinic Emergency Response System, highlighting the system’s ability to manage and display patient appointment records.

Interface Overview

1. User Identification and Logout:

- The user is identified as "Test Patient" with the email "patient@edoc.com". A "Log out" button ensures secure session termination.

2. Navigation Menu:

- The sidebar on the left provides navigation options, including:
  - **Home:** Main dashboard.
  - **All Doctors:** View all available doctors.
  - **Scheduled Sessions:** Manage and view scheduled sessions.
  - **My Bookings:** Access booking history.
  - **Settings:** Adjust user settings and preferences.

3. My Bookings Section:

- The main section of the interface is dedicated to displaying the patient's booking history.
- **Filter and Date Search:**

    - A date filter option allows the patient to search for bookings within a specific date range.
    - A "Filter" button facilitates the search functionality.

4. Booking History Display:

- The interface shows detailed booking information in a card format for each appointment:
    - **Booking Date:** All appointments were booked on November 2, 2023.
    - **Reference Number:** Each booking has a unique reference number for identification:
        - OC-000-7
        - OC-000-9
        - OC-000-10
    - **Appointment Number:** Sequentially numbered:
        - 01
        - 02
        - 03
    - **Doctor Details:**
        - **Doctor's Name:** Dr. Olusanya is the attending doctor for all appointments.
        - **Scheduled Date:** November 2, 2023, for all appointments.
        - **Start Time:** Each appointment starts at 13:00 (24-hour format).

5. Date Display:

- The top right corner of the interface shows the current date, ensuring users are aware of the date while managing their bookings.

The "My Bookings" history interface of the TASUED Clinic Emergency Response System provides a comprehensive and user-friendly platform for patients to manage their appointment history. Key functionalities include filtering bookings by date and viewing detailed information for each appointment, such as booking dates, reference numbers, appointment numbers, and doctor details. The design ensures patients can efficiently track and manage their healthcare appointments, thereby enhancing their overall experience with the emergency response system. This interface supports the system's goal of improving healthcare management within the university environment, ensuring patients have access to organized and detailed appointment records.

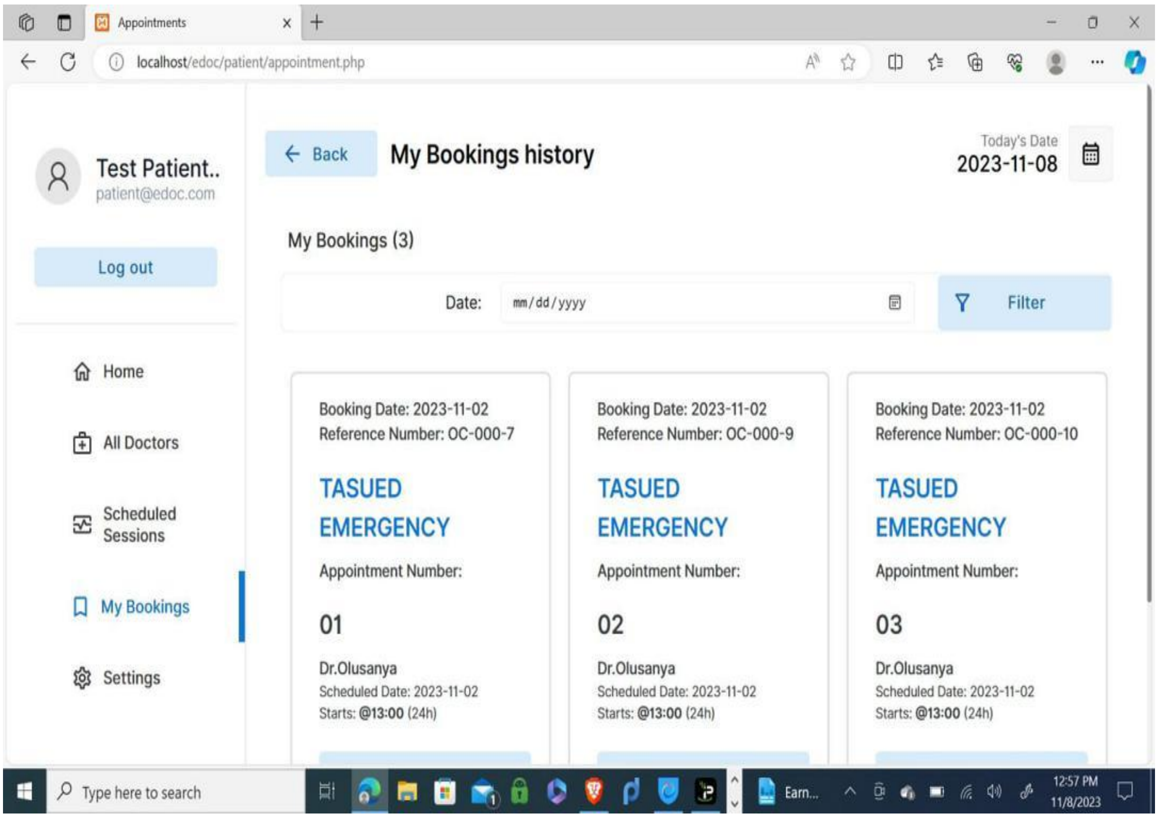

Figure 7: Patient Booking History Interface

3.6 Emergency-Specific Features:

The system includes an 'Emergency Alert' feature that allows users to trigger an immediate response from medical staff. This feature bypasses the regular appointment system, notifying on-duty personnel via SMS and push notifications. The system also integrates with campus security for rapid coordination in severe emergencies.

3.7 Usability Testing:

A usability test was conducted with 30 participants (20 students and 10 staff members) to evaluate the system's effectiveness. Participants were asked to complete a series of tasks, including booking an appointment, triggering an emergency alert, and accessing medical records. The System Usability Scale (SUS) was used to measure user satisfaction, resulting in an average score of 85, indicating excellent usability.

4.0 Conclusion

The implementation of the TASUED clinic emergency response application has markedly improved emergency response efficiency and effectiveness. The system's streamlined communication and immediate access to critical patient data have significantly reduced response times, ensuring prompt medical assistance. Both clinic staff and patients have provided positive feedback, emphasizing the application's user-friendliness and practicality. TASUED's clinic now serves as a model for similar institutions, demonstrating the university's commitment to enhancing healthcare services. The project's success at TASUED suggests its potential to revolutionize emergency response systems in comparable healthcare settings, thereby positively impacting patient care.

The development of the TASUED clinic emergency response application represents a significant advancement in ensuring the safety and well-being of the university community. By addressing TASUED's specific needs and challenges, the project offers a tailored solution that improves the speed, efficiency, and effectiveness of emergency responses within the university.

The application's architecture and design were meticulously crafted to meet the specific requirements of TASUED's clinic staff and patients. A comprehensive literature review identified key technologies and best practices in healthcare emergency response, ensuring the final application is reliable and user-friendly. Future improvements and expansions are anticipated, focusing on integrating the application with TASUED's existing systems and incorporating continuous user feedback. Potential additional features include real-time tracking of emergency response teams, predictive analytics for resource allocation, and seamless communication with external emergency services.

In this era of technological advancement, the TASUED clinic emergency response application exemplifies the university's dedication to stakeholder safety and well-being. It demonstrates the transformative power of technology in healthcare and serves as a model for other institutions aiming to modernize their emergency response systems. With ongoing collaboration and innovation, there is significant potential to further enhance the application, making TASUED an even safer and more responsive environment for all.

Recommendations:

We recommend a phased rollout of the system, starting with a pilot program in one department before campus-wide implementation. Key performance indicators for evaluating the system's success should include response time to emergency alerts, user satisfaction scores, and the number of successfully managed emergency incidents.

References

Akinreni, T., Filani, T., Asuni, O., & Owodunni, F. (2023). Awareness and utilization of Emergency response service to road traffic crashes in Nigeria: A cross-sectional study. *Journal of Public Health and Emergency,* 7 17. https://dx.doi.org/10.21037/jphe-23-31.

Al-khafajiy, M., Kolivand, H., Baker, T., Tully, D., & Waraich, A. (2019). Smart Hospital Emergency System (SHES): Improving Emergency Communication Through Smartphone Technologies. Multimedia Tools and Applications, 78(9), 20087-20111.

Boateng-Osei, E. A., Osei, I., Diji, A. K.-A., Pambour, B. A., Wireko-Gyebi, R., Okyere, P., & Lomotey, A. Y. (2023). Emergency preparedness capacity of a university hospital in Ghana: a cross-sectional study. **African Journal of Emergency Medicine*, 13*, 152–156.

Boutilier, J. J., & Chan, T. C. Y. (2020). Ambulance emergency response optimization in developing countries. *Operations Research*, **Articles in Advance**, 1-20. https://doi.org/10.1287/opre.2019.1969.

Chang C.Y., Abujaber S., Reynolds T.A., Camargo C.A., Obermeyer Z. (2016) Burden of Emergency conditions and emergency care usage: new estimates from 40 countries. Emerg Med J 2016;33(11):794–800 . https://doi.org/10.1016/j.afjem.2023.05.001.

Ekwunife O.C., Obayuwana .A., Ebu, J. Sunday., Odey, N.T., Ehima, C.C., Enofe P.O., Otuole U.E., Ohiocheoya R.E. (2023). Design and implement an Internet of Things (IoT) based accident detection and report system for emergency assistance. *International Research Journal of Modernization in Engineering Technology and Science. (IRJMETS).* 5, 11. 837-845.

Hirshon ,J.M., Risko N, Calvello EJ, SSd Ramirez, Narayan M, Theodosis C. (2013). Health systems and services: the role of acute care. Bull World Health Organ 2013;91:386–8 .

Kobusingye O.C., Hyder A.A., Bishai, D, Hicks ER, Mock C, Joshipura M. (2005).Emergency Medical systems in low-and middle-income countries: recommendations for action. Bull World Health Organ 2005;83(8):626–31 .

Krausz, M., Westenberg, J. N., Vigo, D., Spence, R. T., & Ramsey, D. (2020). E-Health in crisis Management - emergency response to COVID-19 in Canada: *Platform development and implementation. JMIR Preprints.* https://doi.org/10.2196/preprints.18995.

Lyons, P. G., Edelson, D. P., & Churpek, M. M. (2018). Rapid Response Systems. Resuscitation. https://doi.org/10.1016/j.resuscitation.2018.05.013.

Lee, J. H., Ong, M. E. H., Shin, S. D., Tanaka, H., Nishiuchi, T., Ma, M. H. M., ... & Lee, E. J. (2020). Dispatcher-assisted cardiopulmonary resuscitation: A Pan-Asian resuscitation outcomes study phase 2 survey of emergency medical dispatch services. **BMC Emergency Medicine*, 20*(1), 1-8.

P. S, Prasad, Ahmed, A., Sab, M. M., Sravan, R., & Ganesh. (2024). The Smart Ambulance

Services. *International Journal of Research Publication and Reviews,* 5(1), 2137-2140.

Rinaldi, M., Anisa, D., & Farhansyah, F. (2022). Development of an E-Clinic System Based on Website at Tamara Clinic, Batam City. **Comorbid: Pharmacology, Medical Reports, Orthopedic, and Illness Details**, 1(4).https://ojs.transpublika.com/index.php/COMORBID/.

San Hay Mar Shwe, & Htet Ne Oo. (2019). GIS-Based Fire Emergency Response System for Mandalay. *International Journal of Open Information Technologies.* 7. 39-35.

Wang, W., Tang, W., Luo, Y., Zhu, N., & Wang, L. (2020). Construction and Evaluation of the E-clinic Service System in Baoan District, Shenzhen, China. *American Journal of Nursing Science*, 9(4), 281-285.