EMERGENCY AND SAFETY ALERT SYSTEM FOR STUDENTS ON CAMPUS

BY

GIDEON AKHERE DESTINY

PSC2105336

DEPARTMENT OF COMPUTER SCIENCE,

FACULTY OF PHYSICAL SCIENCES,

UNIVERSITY OF BENIN,

BENIN CITY,

EDO STATE, NIGERIA.

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A PROJECT REPORT SUBMITTED TO THE DEPARTMENT OF COMPUTER SCIENCE, FACULTY OF PHYSICAL SCIENCES, UNIVERSITY OF BENIN, BENIN CITY

IN PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE AWARD OF A BACHELOR OF SCIENCE (B.Sc.) DEGREE IN COMPUTER SCIENCE

NOVEMBER 2025

APPROVAL

This project work is hereby approved in partial fulfilment of the requirements for the award of Bachelor of Science (B.Sc.) Degree in Computer Science from the University of Benin.

_____ _____

MR. K. O OTOKITI **DATE**
(*Project Supervisor)*

_____ _____

DOC. (MRS.) A. R USIOBAIFO **DATE**
(*Head Of Department)*

CERTIFICATION

This is to certify that this project work was carried out by **GIDEON AKHERE DESTINY** with Matriculation Number **PSC2105336** under my supervision. It is adequate and satisfactory, both in scope and content, for the award of Bachelor of Science (B.sc) Degree in Computer Science of the University of Benin

_____ _____

MR. K. O OTOKITI **DATE**
(*Project Supervisor)*

_____ _____

DOC. (MRS.) A. R USIOBAIFO **DATE**
(*Head Of Department)*

DEDICATION

This project is dedicated to God Almighty for giving me the strength and wisdom to see it through to completion, and even throughout my stay in the University of Benin (UNIBEN). It is also dedicated to my parents; Mr and Mrs Ikogwe and my brother Master Benedict Ikogwe; for their love, support and guidance throughout my academic journey.

ACKNOWLEDGEMENT

My utmost acknowledgement goes to God Almighty for giving me the strength, wisdom and direction throughout my academic journey. I would like to express my gratitude to my project supervisor who is also the Head of the Department Of Computer Science, Doc. (Mrs.) A.O. Rosemary for her consistent guidance towards ensuring the successful completion of this project.

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ABSTRACT

Campus safety has become an increasing concern in modern educational institutions, as students are often exposed to various forms of emergencies ranging from fire outbreaks, theft, medical crises, to security threats. Traditional methods of handling emergencies, such as manual phone calls, word-of-mouth alerts, or notice board announcements, have proven to be ineffective, slow, and unreliable in reaching students and campus authorities on time.

This project emphasizes the need for a more automated and responsive method of disseminating safety alerts and emergency notifications to students and relevant authorities. To achieve this, the project proposes an Online Emergency and Safety Alert System for Students on Campus, designed and implemented using WordPress as the core development platform.

The system enables students to report emergencies**,** receive real-time alerts**,** and access safety information through an interactive web interface. It also provides administrators with tools to manage user accounts, verify reports, and broadcast urgent notifications to all registered users. The system was developed following the Agile software development methodology, which allowed for iterative design, feedback integration, and continuous improvement throughout the project cycle. Figma served as the primary design tool for creating an interactive and user-friendly interface prototype of the system.

The implementation focuses on the front-end design and user interaction, integrating WordPress plugins such as Ultimate Member for user management and form-based input for emergency reporting. Overall, the system aims to improve campus security responsiveness, enhance communication between students and authorities, and create a safer learning environment within the University of Benin campus.

CHAPTER ONE

INTRODUCTION

1.0 Background of the Study

Ensuring the safety and well-being of students within Nigerian universities has become a pressing concern in recent years. The University of Benin (UNIBEN), like many other higher institutions, is a hub for academic growth, research, and social development. However, it is also exposed to emergencies such as medical crises, fire outbreaks, theft, harassment, and other safety threats (Han et al., 2015). The challenge lies in ensuring that, during such emergencies, relevant authorities and students are alerted immediately so that timely interventions can be made.

At UNIBEN, existing emergency communication methods are still largely manual, fragmented, and slow. For instance, in the event of a fire incident in a hostel, students often rely on word-of-mouth or phone calls to specific security staff. This process frequently leads to delayed responses, inadequate evacuations, and a higher risk of injuries or loss of life (Ajadi, 2025). Similar delays occur in reporting harassment, theft, or health-related emergencies due to the absence of a unified, accessible, and automated alert system.

Globally, universities have begun adopting smart campus safety systems that integrate digital technologies to enable real-time alerts, location-based notifications, and direct communication between students and campus security (Abdullah et al., 2019). However, UNIBEN, like many Nigerian institutions, has yet to implement such measures, leaving a critical gap in emergency preparedness and response.

The proposed Emergency and Safety Alert System for Students on Campus will address this gap by providing UNIBEN students with a centralized digital platform for reporting emergencies, receiving targeted alerts, and interacting directly with campus security. The aim is to enhance response times, minimize casualties, and foster a strong culture of safety awareness within the campus community (Menn et al., 2021).

1.1 Statement of the Problem

At the University of Benin (UNIBEN), ensuring student safety remains a significant challenge due to outdated and inefficient emergency communication methods that rely heavily on manual reporting. During incidents such as fire outbreaks, medical crises, or

security threats, students often depend on word-of-mouth to contact security personnel, resulting in delayed responses, misdirected information, and repeated reporting. The large, dispersed nature of the UNIBEN campus further complicates rapid incident localization, especially when reports lack precise location details—an issue that can prove critical when every second counts. Moreover, the absence of a real-time, automated mass notification system means that safety updates are inconsistently delivered, often through notice boards or social media, which may not reach all students in time. Compounding these problems is the lack of a verification mechanism to filter out false alarms or prank reports, which wastes resources, disrupts campus activities, and erodes trust between students and security personnel. These interconnected issues highlight the urgent need for a centralized, location-aware, and user-friendly emergency alert system capable of delivering timely, accurate, and verified safety information to protect lives and property at UNIBEN.

1.2 Aim and Objectives of the Study

This study aims to design and develop a real-time emergency and safety alert system specifically for the University of Benin that enables students to quickly report incidents, receive targeted notifications, and enhance campus emergency response. To achieve this aim, the study will:

i. identify common emergencies and safety risks within the UNIBEN campus that require instant reporting;
ii. design a mobile/web-based alert system with a user-friendly interface for students and campus security based on the identified emergency and safety risk
iii. implement location-based notification features for targeted alerts;
iv. test and evaluate the system's speed, reliability, and usability in the UNIBEN context.

1.3 Scope of the Study

This study is limited to the design and prototyping of a digital emergency and safety alert system tailored for the University of Benin (UNIBEN). Specifically, it will focus on medical emergency, fire emergency and student robbery or burglary.

1.4 Motivation of Study

The motivation for this project comes from repeated reports of emergencies within UNIBEN—ranging from theft and fire outbreaks to medical crises—where delayed communication can worsen situations (Ajadi, 2025). The personal observation of these delays

highlights the urgent need for an automated, real-time safety communication system tailored for UNIBEN's campus.

1.5 Significance of the Study

This project will benefit:

i. **UNIBEN Students:** Quick, reliable channels for emergency reporting and receiving verified safety alerts.

ii. **UNIBEN Security:** Enhanced ability to monitor incidents, respond faster, and coordinate effectively.

iii. **University Management:** Improved institutional safety reputation and reduced liabilities from mishandled emergencies.

iv. **Researchers and Developers:** A case study for implementing smart campus safety systems in Nigerian universities.

CHAPTER TWO

LITERATURE REVIEW

2.0 Campus Emergency & Safety Alert Systems

Campus emergency and safety alert systems are designed to disseminate time-critical warnings that protect life and property through multiple communication channels such as SMS, Cell Broadcast, mobile push notifications, sirens, email, and digital signage (Waldorf University, 2023). The Common Alerting Protocol (CAP) has become a widely adopted XML-based standard that enables a single alert message to be "disseminated simultaneously over multiple systems," ensuring consistency and speed of delivery (Waldorf University, 2023). CAP's advantage lies in its ability to reduce redundancy, avoid confusion, and guarantee that students, staff, and emergency responders receive the same verified information at the same time.

International standards such as ISO 22322 also emphasize the importance of clarity and timeliness in public warning. According to FEMA (2022), ISO 22322 provides "guidelines for developing, implementing and maintaining public warning," including risk assessment, crafting of message content, and choosing the appropriate communication channel. These guidelines help institutions avoid panic and misinformation by ensuring alerts are structured and actionable.

For large campuses like the University of Benin (UNIBEN), CAP-compliant workflows are especially relevant. They allow one authenticated message to be delivered across SMS, Cell Broadcast, mobile apps, PA systems, and digital signage, similar to the United States' Integrated Public Alert and Warning System (IPAWS) architecture (Alertus Technologies, 2022). This kind of integrated approach minimizes the risk of single-channel failure and enhances resilience during emergencies such as fire outbreaks, medical crises, robbery or burglary or security threats. Fig 2.1 explains how CAP works as an alert system for emergencies below.

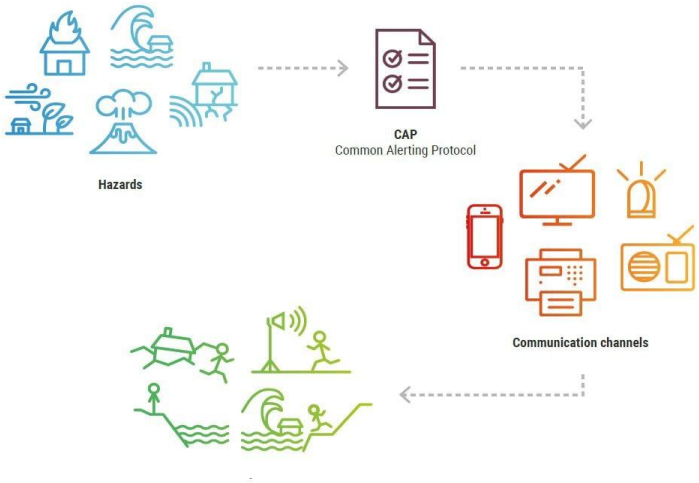

Figure 2.1: CAP-Based Emergency Alert Workflow

2.1 Emergency Communications Centres

Nigeria's National Emergency Number 112 is managed through Emergency Communications Centres (ECCs), which were commissioned by the Nigerian Communications Commission (NCC) to connect citizens directly with first responders during crises (European Telecommunications Standards Institute (ETSI, 2021). According to ETSI (2021), the ECCs are designed to "facilitate easy communication with emergency response agencies," thereby providing a centralized platform for public emergency reporting and coordinated response. These centres serve as a backbone for national-level safety and can be leveraged to support institution-specific systems such as those within university campuses.

Although there is limited public documentation of a fully implemented campus-wide mass-notification system at the University of Benin (UNIBEN), the institution can align with national practice in two ways: first, by authoring Common Alerting Protocol (CAP)-compliant alerts internally through its security or ICT directorates; and second, by establishing collaboration with Edo State responders through the existing 112/ECC network for escalated incidents. This two-tiered framework ensures that minor emergencies can be handled locally on campus, while larger-scale threats can be escalated efficiently to state or national authorities.

This model is consistent with international architectures such as the Integrated Public Alert and Warning System (IPAWS) in the United States, where a single authenticated alert can be disseminated simultaneously across multiple pathways—ranging from mobile alerts and broadcast media to sirens and digital signage (Alertus Technologies, 2022). Integrating CAP-

style workflows with Nigeria's 112 framework would therefore allow UNIBEN to develop a resilient and multi-channel emergency alert system that minimizes communication delays and maximizes coverage.

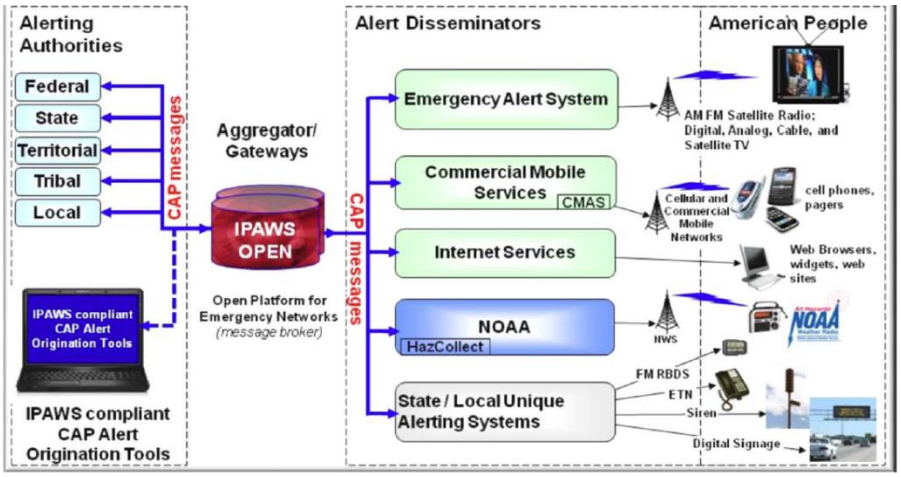

Figure 2.2: FEMA IPAWS architecture.

2.2 Traditional/Manual Alert Methods in Universities

Universities have historically relied on traditional or manual methods to disseminate emergency information. These methods, while accessible, often lack the efficiency and precision needed in critical situations. Some of these methods includes:

i. **Sirens and Public Address (PA) Systems:** Sirens and loudspeakers are useful for immediate campus-wide attention, particularly during fire outbreaks or security threats. However, their limitations lie in the fact that they cannot convey detailed instructions, which can lead to confusion in diverse university environments (Adebayo, 2018).

ii. **Notice Boards and Word of Mouth:** Notice boards, handwritten bulletins, or direct verbal communication have traditionally been used to pass information. These methods are slow to propagate and are ineffective after official hours, making them unreliable in emergencies where response time is critical (Okon, 2019).

iii. **Phone Trees and WhatsApp Groups:** In Nigeria, informal channels like phone trees (calling chains) and WhatsApp groups are commonly used for rapid coordination among students and staff. While these platforms are fast and familiar, they are unstructured, prone to rumor amplification, and lack official verification mechanisms (Eze & Eze, 2020). Research shows WhatsApp is highly and widely used in Nigerian

higher education, serving both official and informal communication purposes (ERIC, 2018; The Journal of Pan African Studies, 2019).

Indeed, a study in Kaduna State found that "a significant number of students are already using WhatsApp" for educational and social purposes, reinforcing its dominance as a communication medium (ERIC, 2018). This highlights the potential of leveraging WhatsApp in emergency alert systems, while also underscoring the risks of misinformation when relying solely on such platforms. Figure 2.3 illustrates the architecture of a Public Emergency Alert System**,** showing how emergency information is generated, processed, and transmitted to end users through mobile networks.

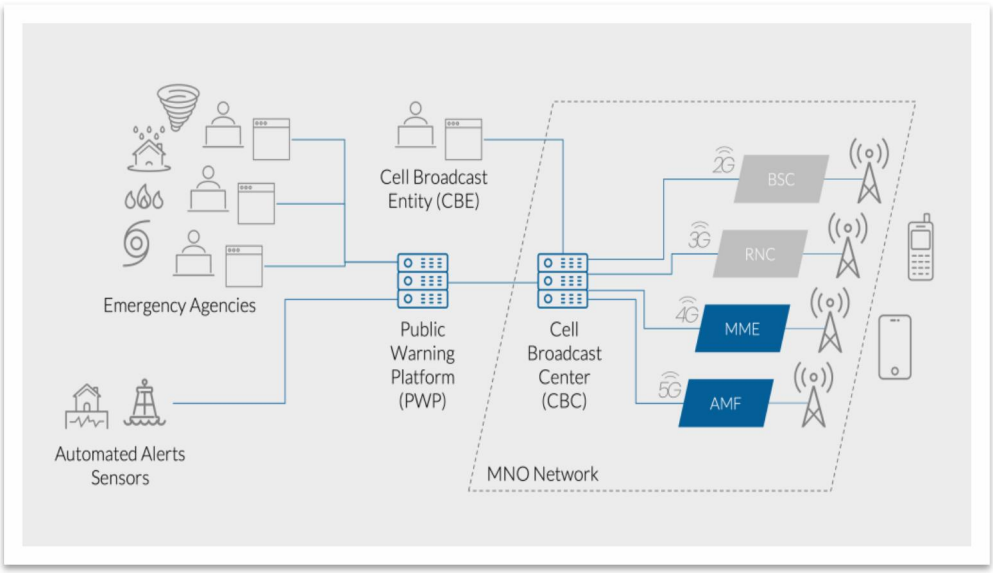

Figure 2.3: Structure of a Public Emergency Alert System

2.3 Disadvantages of Traditional Methods

Traditional campus alert methods, while historically useful, present several limitations in modern emergency management. Given below are disadvantages of traditional methods:

i. **Latency and Coverage Gaps:** Manual relays are often slow, and devices such as loudspeakers and sirens have limited coverage. They may not reach students inside classrooms, hostels, or off-campus residences, leading to delayed responses (Okon, 2019).

ii. **Message Ambiguity:** Sirens and alarm bells can signal danger, but they are ineffective at conveying complex instructions like evacuation routes or shelter

locations. This ambiguity can cause panic or misinterpretation during crises (Adebayo, 2018).

iii. **Informal Channels' Reliability:** Dependence on informal channels such as WhatsApp or phone chains introduces vulnerabilities. While WhatsApp is widely used among Nigerian students, it is unreliable during platform outages and highly susceptible to misinformation (WIRED, 2021). As WIRED (2021) noted, the 2021 WhatsApp global outage "revealed the critical reliance" on the platform in Nigeria, underscoring the risks of depending on a single, commercial channel for emergency alerts.

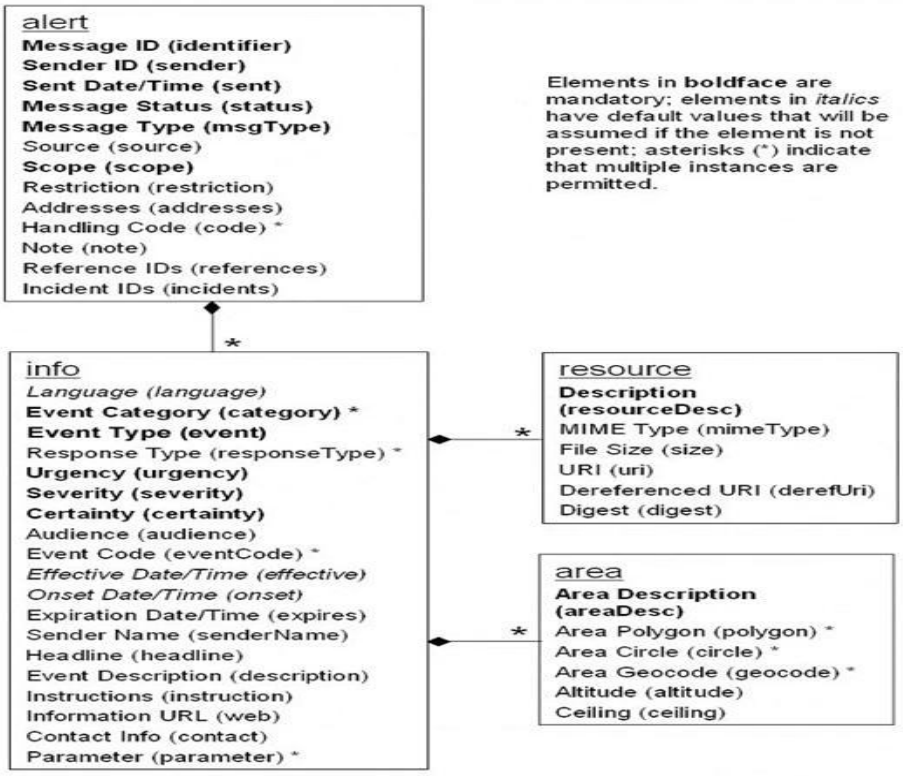

Figure 2.4: Nigeria 112 ECC (Kano) control room.

2.4 Automated/Modern Alert System

In contrast, automated systems offer real-time, multi-channel delivery and greater resilience..

2.4.1 Cell Broadcast (CB) and SMS

Cell Broadcast (CB) technology is designed to deliver alerts simultaneously to all compatible mobile devices within a geographic area without requiring phone numbers, making it highly efficient for emergencies. It does not suffer from network congestion and is widely recommended as a core component of public warning systems worldwide (GSMA, 2020; U.S.

Congress, 2018). As Congress notes, CB "does not get congested and can reach many subscribers instantly."

SMS, while complementary, has limitations. It can experience delays under heavy network traffic and lacks precise geotargeting capabilities. Research further indicates that SMS warnings often fail to provide adequate spatial awareness, limiting their effectiveness unless messages are carefully designed (Bonaretti, 2021).

2.4.2 Mobile App Push Notification and Panic Button

Campus safety mobile applications are increasingly adopted because they consolidate multiple functions into a single platform. These include push notifications, interactive maps, and panic buttons that enable students to instantly alert campus security. Vendors such as Rave Mobile Safety emphasize the ability of such apps to deliver alerts across multiple channels from a unified console (Rave Mobile Safety, 2020). According to Rave Mobile Safety (2020), through one interface, universities can "send messages … simultaneously through text, social media, digital signage and more." This multi-channel approach reduces the risk of missed messages and improves the speed of emergency communication.

2.4.3 Integrated, CAP-Based Gateways

Modern systems are increasingly adopting the Common Alerting Protocol (CAP), which provides a standardized message format for multi-hazard alerts. Integrated architectures, such as the U.S. Integrated Public Alert and Warning System (IPAWS), authenticate a single CAP message and distribute it simultaneously through CB, SMS, radio, apps, and Emergency Alert Systems (FEMA, 2019; Alertus Technologies, 2022). This approach ensures consistency and avoids duplication. As Alertus Technologies (2022) explains, "one message is created to reach as many people as possible." For campuses like UNIBEN, CAP-based systems would streamline emergency communication across multiple channels.

2.4.4 Email, Web, and Social Feed

While email, institutional websites, and official social media platforms are valuable for follow-up information, detailed instructions, or recovery communication, they are not reliable for real-time life-safety alerts. Their slower delivery rates and dependence on internet connectivity make them supplementary rather than primary alert methods (Okon, 2019).

Web-based communication channels such as institutional email, official portals, and social media platforms are valuable for follow-up details, confirmations, and post-incident

communication. However, they are generally not reliable for immediate life-safety alerts because delivery is often slower and requires users to be actively online and checking those channels. International guidance, such as ISO 22322, recommends using high-immediacy channels (e.g., cell broadcast/WEA, SMS, app push) for the first alert, while reserving web channels for supplementary instructions (International Organization for Standardization (ISO, 2015); Federal Emergency Management Agency (FEMA, 2019).

2.5 Benefits of Modern Systems (for UNIBEN)

Modern emergency alert systems offer significant advantages over traditional/manual methods.

i. **Speed and Reach:** One of the main benefits is the ability to send a single authenticated message and distribute it across multiple communication pathways at once (e.g., SMS, push notifications, alerts, email, signage). This ensures simultaneous reach and avoids delays that arise from sequential communication (Alertus Technologies, 2022).

ii. **Geotargeting**: Federal Emergency Management Agency (FEMA) documentation highlights that modern Wireless Emergency Alerts (WEA) and Cell Broadcast (CB) standards are designed to achieve nearly 100% delivery within a defined geographic area, with overshoot limited to less than 0.1 miles (FEMA, 2019). This precision allows UNIBEN to alert only the affected parts of campus, minimizing unnecessary panic.

iii. **Resilience**: Unlike person-to-person voice calls or SMS—which often fail during congestion—CB and app/web-based push notifications are designed to remain functional under heavy network load. Congress.gov (2018) notes that CB channels do not get congested and can reach thousands of subscribers instantly.

2.6 Channel Mix & Student Device Realities

Technology adoption patterns shape the effectiveness of campus alert strategies. In Sub-Saharan Africa, smartphone penetration continues to grow rapidly. GSMA (2023) projects smartphone ownership to rise from approximately 51% in 2023 to 81% by 2030. In Nigeria, the market is heavily Android-dominated, with brands such as Tecno, Infinix, and Samsung being most popular (StatCounter Global Stats, 2023).

For UNIBEN, this implies that campus safety systems should:

i. Prioritize Android app/website support (lightweight and low-data usage).

ii. Retain SMS alerts for students with basic phones.

iii. Keep public address systems and digital signage as redundancies for offline communication.

2.7 Why CAP-Enabled Mobile + Multi-Path for UNIBEN

A CAP-based, multi-channel alert framework offers UNIBEN several benefits.

First, it aligns with ISO 22322 international guidance, which emphasizes clarity, timeliness, and structured message delivery (ISO, 2015). Second, CAP is interoperable with Nigeria's National 112/Emergency Communication Centres (ECCs), enabling escalation beyond campus to national responders when necessary (European Telecommunications Standards Institute [ETSI], 2021). Finally, CAP systems can support progressive, geofenced alerts, which is especially useful when hazards are localized or shifting (e.g., fire confined to one faculty, or protest routes changing) (FEMA, 2019).

2.8 Related Literature

Standards & Guidance:

This section outlines key international standards and frameworks that guide the design and implementation of emergency alert systems. These standards ensure that alerts are interoperable, credible, and effective across different communication technologies and countries.

i. OASIS CAP defines a standardized, all-hazards format for structuring emergency alert messages so they can be disseminated across multiple communication platforms, such as SMS, radio, and mobile applications (Waldorf University, 2021).

ii. ISO 22322:2022 provides practical guidance for developing and maintaining public-warning systems, including how to create message templates, perform risk assessments, and ensure the reliability of alerts (ISO, 2015).

iii. FEMA IPAWS demonstrates how a single Common Alerting Protocol (CAP) message can be authenticated and broadcast through several channels simultaneously — including Emergency Alert System (EAS), Wireless Emergency Alerts (WEA), Cell Broadcasts (CB), and NOAA Weather Radio — thereby maximizing message reach and impact (Alertus Technologies, 2022).

iv.

Effectiveness & Limitations of Channels:

This section discusses how different communication channels perform during emergencies and the challenges that affect their effectiveness. It focuses on factors such as message clarity, geolocation accuracy, and system reliability.

i. SMS and spatial awareness: Studies show that traditional text messages may fail to communicate precise hazard locations or recommended actions unless they include clear geospatial context (Bonaretti, 2021).
ii. WEA/CB geotargeting: Improvements by FEMA and the FCC have made it possible to target alerts more accurately to specific geographical areas (known as polygons), minimizing over-alerting outside affected zones (FEMA, 2019; Federal Communications Commission, 2018).
iii. Performance testing: Researchers have conducted empirical tests on latency (delivery speed) and geofence accuracy of WEA/IPAWS to confirm that these systems perform reliably under real emergency conditions (Bonaretti, 2021).

Campus Systems & User Response:

This section reviews studies related to how students and campus communities respond to emergency alerts. It emphasizes factors influencing compliance, trust, and emotional responses during crisis communication.

i. Compliance with alerts: Research in *MIS Quarterly* found that student compliance depends on their perceived severity of the threat, the clarity of the message, and the credibility of the source (Xu et al., 2020).
ii. Channel perception: Experimental findings show that text alerts are often taken more seriously than messages sent via social media, suggesting that choice of delivery channel directly impacts response effectiveness (Li & Wang, 2021).
iii. Safety drills & messaging: Reports by the RAND Corporation and the U.S. Department of Education highlight the need for trauma-informed communication during drills, as poorly worded alerts can increase anxiety and reduce trust among students (RAND Corporation, 2020; U.S. Department of Education, 2017).

African/Nigerian Context:

This section examines local studies and practical experiences within Africa—particularly Nigeria—regarding emergency alert systems. It reveals ongoing efforts and the unique challenges of developing countries.

i. Local prototypes: A Nigerian study presented a microcontroller-based campus alert prototype, demonstrating early attempts to integrate local hardware and software solutions for real-time notification systems (Oluwole & Eze, 2019).

ii. Platform reliance risks: Nigeria's heavy dependence on social media platforms such as WhatsApp poses resilience challenges, as seen during the global outage that disrupted communication channels nationwide (WIRED, 2021).

Table 2.1: Related Works on Emergency & Safefy Alert System

Author(s)	Year	Objectives	Major Features
Federal Emergency Management Agency (FEMA)	2019	To modernize emergency alerts in the U.S. through the Integrated Public Alert and Warning System (IPAWS).	One CAP-authenticated alert → distributed to multiple channels (Cell Broadcast, EAS, NOAA, apps). Multi-path, redundant communication for resilience.
ETSI (European Telecommunications Standards Institute)	2021	To standardize national emergency number 112 and ECC operations.	Provides protocols for linking citizens to first responders; integrates with local and campus-level alert systems.
Oluwole & Eze (African Journals Online)	2019	To design a microcontroller-based campus alert prototype for Nigerian universities.	Hardware/software integration for on-campus safety notifications; low-cost design; focuses on scalability in resource-constrained contexts.
Rave Mobile Safety (U.S. vendor case studies)	2020	To provide universities with mobile safety apps integrating push alerts and panic buttons.	Unified console for dispatching SMS, push, email, signage alerts; includes "panic button" and geolocation features.
GSMA	2023	To assess mobile technology adoption in Sub-Saharan Africa and its implications for emergency comms.	Smartphone penetration projected from 51% (2023) → 81% (2030); Android-dominated ecosystem (Tecno, Infinix, Samsung).
WIRED	2021	To examine Nigeria's reliance on WhatsApp for communication.	Showed risks of dependence on a single platform when WhatsApp suffered a global outage; raised concerns for emergency alert reliability.

ISO 22322	2015	To provide international guidelines for public warning systems.	Emphasizes risk assessment, message clarity, template-based alerts, and multi-channel delivery. Useful benchmark for UNIBEN's system design.

CHAPTER THREE

SYSTEM ANALYSIS AND DESIGN

3.0 Analysis of the Existing System

In most higher institutions across Nigeria, including the University of Benin, emergency and safety communication systems operate through a mix of traditional and semi-digital procedures. These systems are typically coordinated by the institution's security unit, administrative offices, and information management departments.

When an emergency or safety-related incident occurs, it is usually reported through manual channels such as direct phone calls to security personnel, physical visits to the security post, or through departmental heads and hall wardens who act as intermediaries. Once a report is received, the security unit assesses the situation, verifies the authenticity of the information, and determines the appropriate line of response.

After verification, safety alerts or notifications are disseminated to staff and students through a range of communication tools. Common dissemination methods include public address systems, printed notices on faculty or departmental boards, telephone calls to key officials, and broadcast messages via institutional email systems. In certain cases, information is also relayed informally through student leaders, class representatives, or social media groups managed by departments or faculties.

This existing communication structure can be characterized as manual, semi-coordinated, and dependent on human mediation. It operates without a unified or automated platform for simultaneous information dissemination and response coordination. Most of the processes rely on the initiative of personnel and administrative hierarchies rather than a centralized digital framework.

Overall, the current system employed in many higher institutions in Nigeria is functional for basic communication but lacks an integrated approach to real-time emergency management. It provides an operational foundation that depends on interpersonal communication and institutional protocols, with limited use of modern information technologies for speed, tracking, and corporation.

3.1 Constraints of the Existing System

As established in Chapter Two, most higher institutions in Nigeria still depend on traditional and semi-manual approaches for emergency communication and safety management. Although these methods provide basic channels for information dissemination, they present several critical constraints that limit their effectiveness, particularly during real-time emergencies. These constraints include;

i. **Delayed Dissemination of Information:** Emergencies are often communicated through physical announcements, phone calls, or word-of-mouth reports delivered by security personnel or administrative staff. This manual process causes significant delays, especially during time-sensitive incidents such as fire outbreaks, medical emergencies, or security threats where rapid communication is crucial.
ii. **Limited Communication Coverage:** Traditional channels like notice boards and public address systems are restricted by distance and physical presence. Students or staff who are not within hearing range or near announcement points may miss critical information, resulting in uneven coverage and delayed awareness across the campus.
iii. **Lack of Real-Time Alerts:** The existing system does not provide instant or continuous updates as situations evolve. Once an announcement is made, there is no mechanism for automatically notifying users in real time, leaving many individuals unaware of ongoing developments or safety instructions.
iv. **Unreliable Information Channels:** Communication methods that rely on phone calls, radios, or physical alerts are vulnerable to disruption due to poor network connectivity, power outages, or environmental interference. Consequently, messages may be delayed, distorted, or entirely lost during transmission.
v. **Absence of a Centralized Platform:** There is no unified or integrated system through which emergency information can be managed, tracked, and distributed simultaneously to all stakeholders. This fragmentation makes it difficult for institutions to coordinate responses efficiently or to analyze past incidents for policy improvement.
vi. **Weak Feedback and Reporting Mechanism:** The current system lacks a reliable means for students and staff to report emergencies or confirm receipt of alerts. This

one-way communication flow hinders real-time feedback, preventing early intervention or coordinated action from authorities.

vii. **Resource and Logistical Limitations:** Manual safety management demands considerable human and material resources — including personnel, patrol vehicles, printed notices, and physical supervision. This approach increases operational costs, reduces efficiency, and cannot scale effectively during large-scale emergencies.

viii. **Heightened Security Risks:** Delays and communication breakdowns expose members of the campus community to greater danger during emergencies such as theft, assault, or civil unrest. The absence of prompt and reliable alerts increases vulnerability, as potential victims remain uninformed until after incidents occur.

3.2 Justification of the Proposed System

The development of the Emergency and Safety Alert System (ESAS) is justified by the need to address the communication inefficiencies identified in the existing manual emergency management system used in most higher institutions, including UNIBEN. The traditional approach is slow, lacks coordination, and provides no real-time feedback, making it inadequate during critical incidents.

The proposed ESAS introduces automation and centralized communication, ensuring that alerts are sent instantly to all users through web platforms. This eliminates delays caused by physical announcements and word-of-mouth reporting. It also offers wider communication coverage, reaching all students and staff regardless of their location through SOS alert, email, and push notification channels.

By providing real-time updates, ESAS keeps users continuously informed during emergencies, while its redundant communication paths (multiple delivery channels) enhance reliability even in cases of network failure. The system also establishes a centralized control platform, enabling campus authorities to manage alerts, monitor responses, and analyze past incidents from a single interface.

Furthermore, the system introduces a two-way feedback mechanism, allowing users to report emergencies or confirm receipt of alerts—something the existing system lacks. This interactive structure supports faster intervention and better coordination between security units and the campus community.

Overall, ESAS transforms a slow, manual, and fragmented system into a fast, reliable, and data-driven emergency communication framework. Its web-based and mobile architecture ensures scalability, cost-effectiveness, and improved safety management across higher institutions.

3.3 The Proposed System

The Emergency and Safety Alert System (ESAS) is a comprehensive, automated platform designed to manage and disseminate emergency and safety information efficiently within higher institutions. By leveraging modern web and mobile technologies, ESAS replaces the traditional manual communication process with a unified, real-time digital framework. Its primary goal is to establish instant and reliable communication channels between the university administration, security units, and students during emergencies, thereby reducing response times and improving coordination.

The system authenticates users through verified institutional credentials, ensuring that only legitimate members of the university community can access the platform. Once logged in, students interact with a personalized dashboard that delivers real-time alerts, safety updates, and emergency instructions. At the same time, administrators can issue notifications to all users or specific groups, depending on the nature or location of the incident. A built-in panic/report feature allows students to quickly report emergencies such as fire outbreaks, theft, or medical incidents directly to the security team.

Through its centralized management interface, ESAS provides administrators with real-time monitoring, data logging, and analytical tools for evaluating past incidents and coordinating effective responses. A hierarchical control structure ensures that a designated Super Administrator oversees user privileges and system integrity. Additionally, ESAS employs multi-channel communication—including in-app messages, email, and optional SMS alerts—to guarantee maximum coverage and message reliability.

In summary, ESAS offers a modern, responsive, and secure approach to campus emergency communication, combining automation, centralized control, and multi-channel notifications to enhance safety management and real-time collaboration.

3.4 Proposed System Design

The design of the Emergency and Safety Alert System (ESAS) is meticulously crafted to deliver a highly intuitive, accessible, and robust mobile experience. This focus ensures maximum user adoption and operational effectiveness during critical situations, thereby translating the functional requirements into tangible user interface elements and system interactions. The system's design spans authentication, location services integration, and core emergency management functionalities.

3.4.1 System Splash Screen and Identity Verification

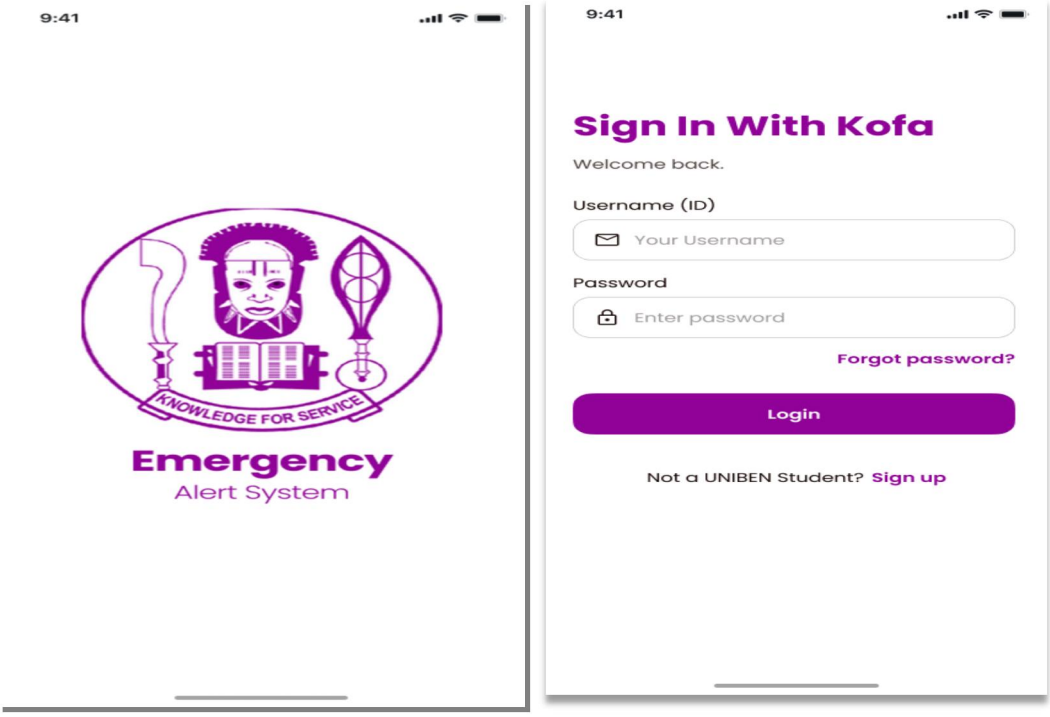

Figure 3.1: Splash Screen and Sign In Screen

The user's initial interaction with ESAS involves an institutional identifier and a secure authentication process, critical for maintaining the network's integrity. The Splash Screen in Figure 3.1 above serves as the initial visual gateway, prominently displaying the University of Benin (UNIBEN) crest and clearly branding the application as the "Emergency Alert System." This immediate visual cue reinforces its official purpose and institutional backing.

Following the splash screen, the Login Interface necessitates secure user authentication. Students are required to sign in using their official matriculation number or other verified

institutional ID as the 'Username (ID)' and a corresponding secure password. This stringent authentication protocol is a cornerstone of ESAS, ensuring that only authenticated individuals can access and utilize the system, thereby upholding the system's security and data integrity. Provision for non-UNIBEN users to "Sign up" exists, allowing for necessary flexibility while maintaining administrative oversight.

3.4.2 Location Services Integration

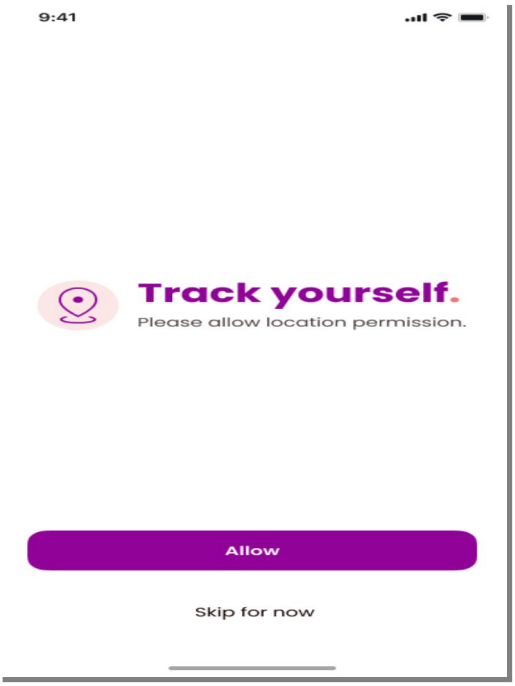

Figure 3.2: Location Permission Prompt Upon Successful Authentication

Accurate and immediate location data is fundamental for efficient emergency response. ESAS prioritizes the integration of location services early in the user experience. The application requests crucial permissions, as depicted in Figure 3.2 (Location Permission). The explicit prompt, "Track yourself. Please allow location permission," is vital. Granting this permission enables ESAS to automatically transmit precise geographical coordinates to the security and administration teams when an emergency is reported. This functionality is pivotal for drastically reducing response times and enhancing the precision of resource deployment, though users retain the option to "Skip for now."

3.4.3 Core System Functionality and Emergency Workflow

The design emphasizes immediate access to emergency reporting, transparent incident tracking, and clear user guidance throughout the emergency workflow. The Home Screen is designed for speed and clarity, featuring a personalized greeting and, most prominently, a

large, central red "SOS" button. This button embodies the core panic/report feature of ESAS, allowing students to instantly trigger an emergency alert to the relevant security and administrative teams. The presence of a "Volunteer for help" toggle also indicates a broader vision for community engagement in non-critical scenarios. A persistent navigation bar at the bottom ensures easy access to primary modules: Home, SOS, Community, and Profile. Immediately after an SOS alert is triggered, the system provides crucial feedback. Figure 3.3 (right) illustrates a pop-up confirmation: "Help is on the way." This visual and textual assurance, accompanied by a green checkmark, helps to alleviate user anxiety. The "Read Instructions" button is vital for disseminating immediate safety directives, guiding the user on necessary actions to mitigate risk or assist responders, thereby directly addressing the communication gaps identified in the existing system.

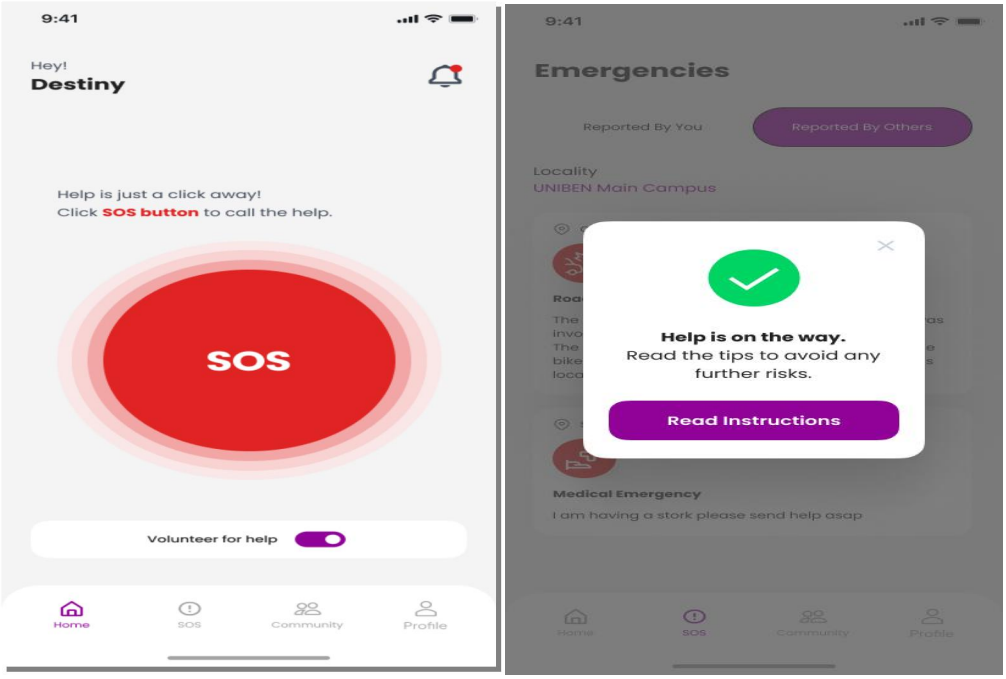

Figure 3.3: SOS Screen and Acknowledgement Popup

Following the acknowledgement, Figure 3.4 illustrates that users can view other SOS or reported emergencies, which offers a transparent overview of active incidents. Each card displays key details such as the Locality (e.g., "UNIBEN Main Campus"), a specific location within the campus (e.g., "Close to the carpark"), the type of emergency (e.g., "Road Accident," "Medical Emergency") and a brief description of the incident. This dashboard exemplifies the system's commitment to real-time updates and coordinated awareness,

allowing students to stay informed about ongoing situations across the campus, fulfilling the need for a centralized, transparent communication platform.

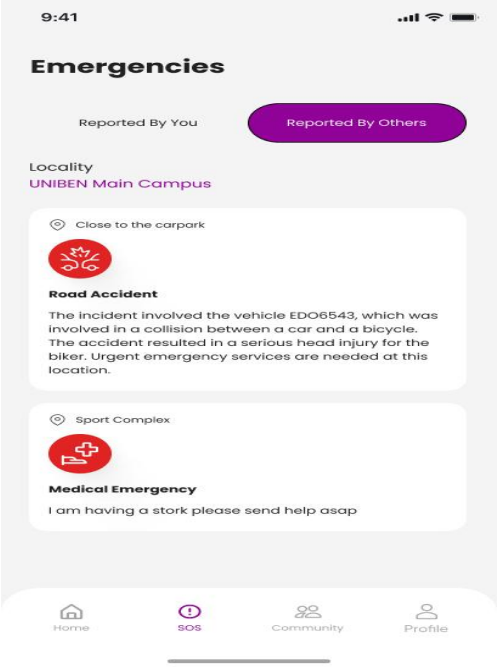

Figure 3.4: Emergencies Tracking Dashboard

3.5 Proposed System Architecture

The Emergency and Safety Alert System (ESAS) employs a robust and modular architecture to guarantee reliability, scalability, and near-instantaneous communication. The design utilizes a layered approach for structural clarity, a client-server model for interaction, and an event-driven pattern for immediate alert processing.

3.5.1 Layered Architecture (N – Tier View)

The foundational structure of ESAS follows a layered (or N-Tier) architecture, separating concerns into distinct, manageable components. This separation allows for focused development and maintenance.

The Layered Architecture Diagram in Figure 3.5 illustrates the core tiers. The system is built around the WordPress Backend Logic and the MySQL Database. The Elementor Frontend (Presentation Layer) handles user interaction, sending requests to the Application Layer (WordPress Backend Logic). This layer contains the Business Logic, which interacts with the MySQL Database for data storage and triggers the Notification Layer (Email, Push, SMS) upon receiving an emergency event. This structure ensures that changes in the user interface do not directly impact the core logic or data storage.

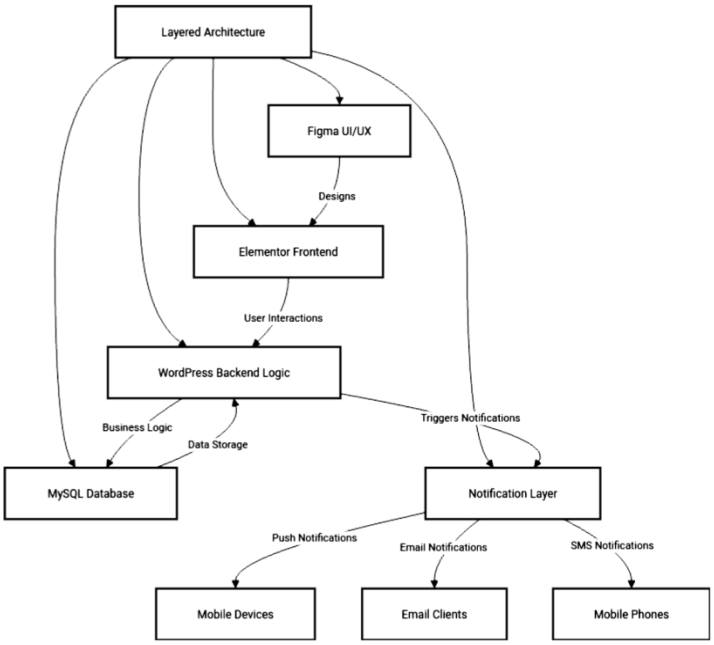

Figure 3.5: Layered System Architecture

3.5.2 Client-Server and Data Flow Architecture

The operational model is based on a client-server relationship, outlining how applications communicate with the central server and how data flows between them. The Client-Server Interaction Model in Figure 3.6 simplifies the primary data exchange. The architecture features three main components: the Student App (Client), the Responder App (Client), and the WordPress Server. Both client applications communicate directly with the WordPress Server to request and deliver content. The Responder App, used by security personnel, also interacts with the Student App by sending responses or updates, demonstrating a peer-to-peer data need, mediated by the server. This model emphasizes the central role of the WordPress Server in managing and coordinating all campus safety information.

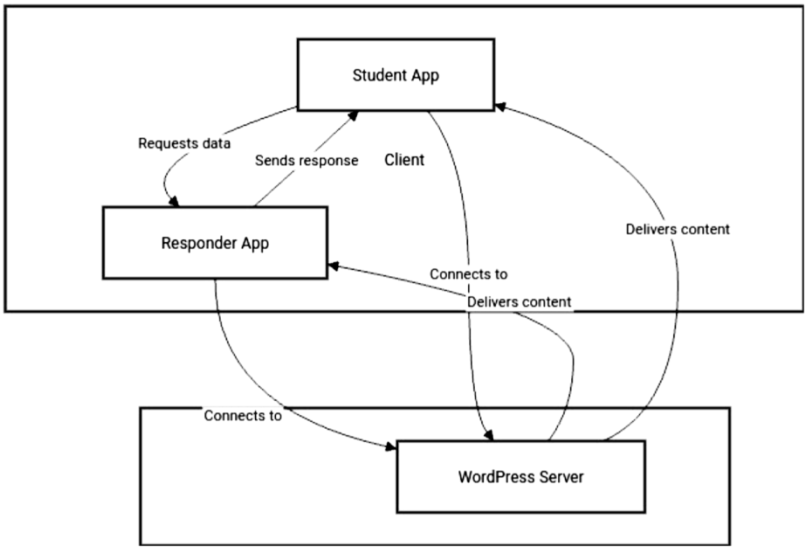

Figure 3.6: Client – Server Interaction Model

A crucial element of the client-server relationship is initial access control. Figure 3.7 details the process: after the Preloader (Splash Screen), the user is directed to the Login Page. The user inputs their Kofa (UNIBEN) details, which are sent to the Web Servers for validation. The server validates and authenticates the login, and upon success, directs the user to the next stage, such as the Location Tracking Prompt.

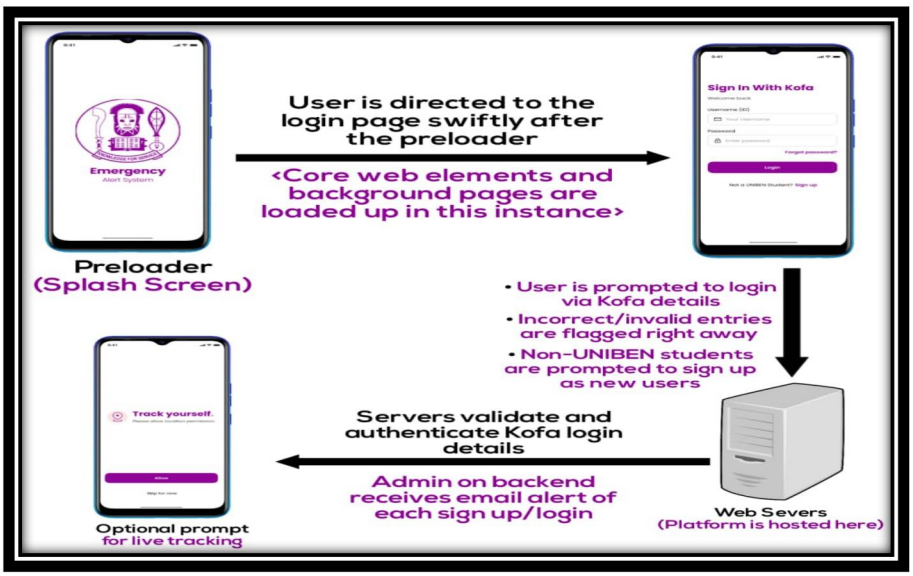

Figure 3.7:Initial Authentication Workflow

3.5.3 User Management Microservices Concept

Although the platform is built on a monolithic framework (WordPress), the internal functionality can be conceptualized using microservice-inspired modules for clear functional separation. The User Management Service Diagram in Figure 3.8 outlines the key services for user handling. The User Management Service controls the creation, fetching, and authentication of users. It interfaces with the User Database (storing User Data), the User Profile Service (managing User History), and the Auth Service (which validates credentials and generates Token Service data). This modular view ensures that essential functions like user registration, history tracking, and security validation are handled by specialized logical components.

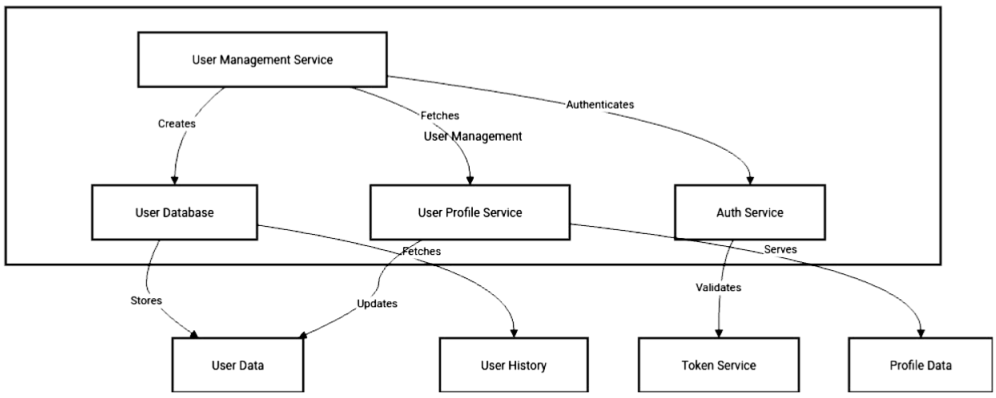

Figure 3.8: User Management Service

3.5.4 Event-Driven Alert Processing

To achieve near real-time alert processing, ESAS utilizes an event-driven architecture (EDA), which minimizes latency between an incident and the response team notification. The Event-Driven Alert Flow in Figure 3.9 below illustrates how urgency is prioritized. The Students Trigger Alerts block acts as the Producer. The alert immediately flows into WordPress Event Hooks/APIs, which function as the Event Broker. This broker instantaneously routes the alert (the 'event') to the Consumers: the Security Dashboards (used by administrators/responders) and the Notification Services (sending Push/SMS/Email). This design ensures that the system doesn't wait for complex processing; instead, it immediately pushes the alert to all necessary parties.

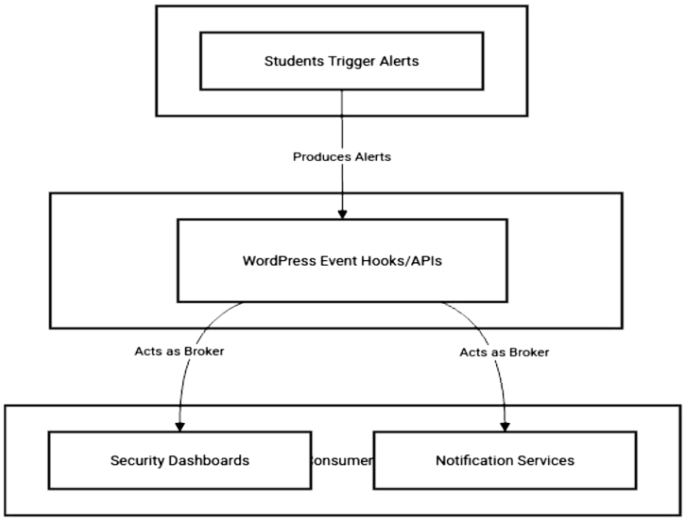

Figure 3.9: Event-Driven Alert Flow

The SOS Alert Workflow in Figure 3.10 demonstrates the practical application of the EDA. When the user taps the SOS Button, the system receives the alert and redirects it to Emergency Response teams (via Call/Mail/SMS). Simultaneously, other platform users receive an alert (based on proximity). The user is then prompted to provide more details, which are logged in the Emergency Reports Section. The workflow concludes with a Pop-up notification for successful alert sent, completing the real-time communication loop.

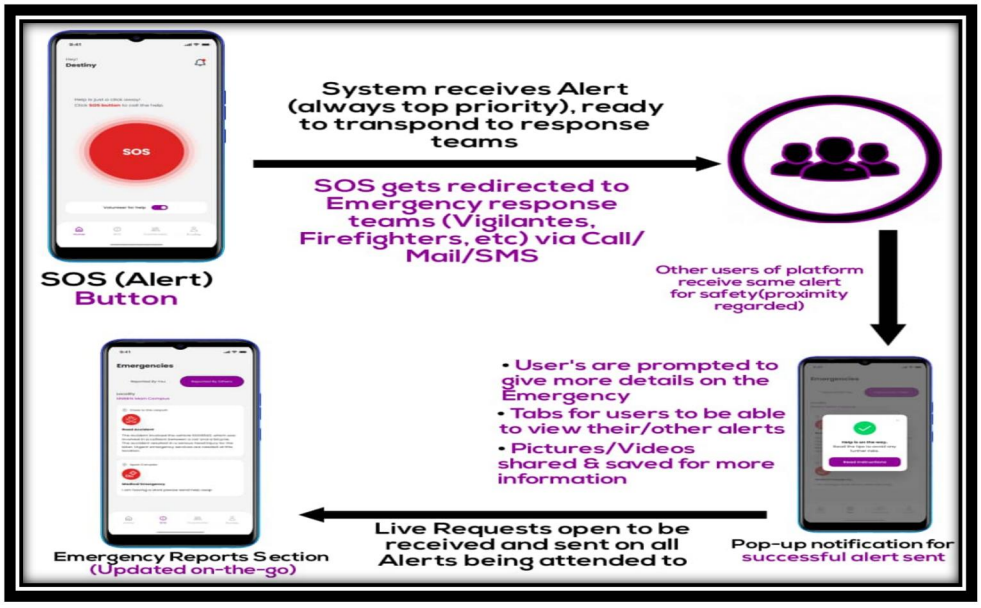

Figure 3.10: SOS Alert Workflow

3.6 System Design Tool (Figma)

Figma is a cloud-based design and prototyping tool used for creating user interfaces and collaborative system design. It enables designers and developers to visually define, prototype, and refine digital systems. Unlike traditional desktop-based design tools, Figma is browser-based and allows real-time collaboration among multiple users.

Figma supports the creation of wireframes, prototypes, and high-fidelity user interfaces, making it suitable for both the conceptual and final stages of system development. It also integrates with collaboration tools such as FigJam, where brainstorming and flow mapping can take place. For the Emergency and Safety Alert System for Students on Campus, Figma is employed to design interfaces such as the login page, SOS alert screen, emergency report section, and real-time notification screens.

3.6.1 Wireframing

Wireframing is the process of creating low-fidelity sketches of system pages to define structure and functionality. In Figma, wireframes are drawn using frames, shapes, and placeholder text. This helps to outline the system flow before high-fidelity designs are implemented.

For the Emergency Alert System, wireframes represent:

i. The Preloader/Welcome screen

ii. Login interface (student and admin access)

iii. SOS alert button page

iv. Emergency report dashboard

Figure 3.11 illustrates the low-fidelity wireframe created in Figma, which outlines the basic structure and layout of the proposed system's interface before detailed design and prototyping.

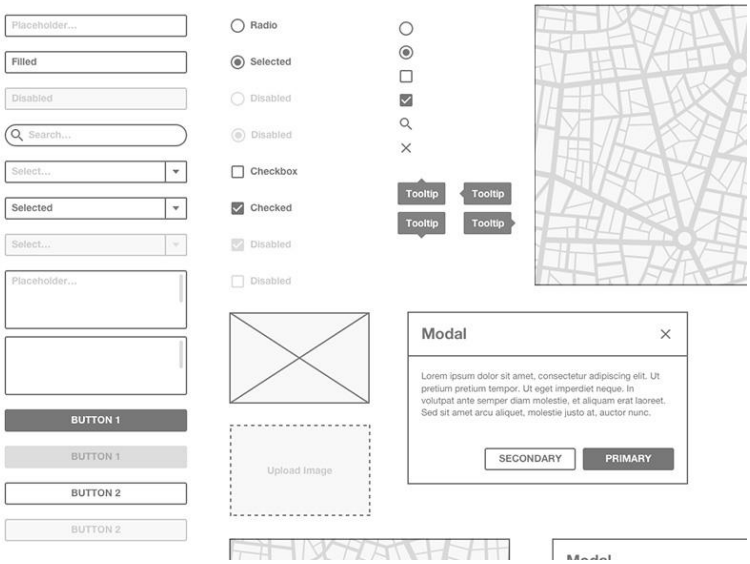

Figure 3.11: Wireframe in Figma

3.6.2 Prototyping

Prototyping in Figma connects different screens using interactions and triggers to simulate how the system behaves. With prototypes, developers and testers can click through the design to understand user flow and confirm requirements.

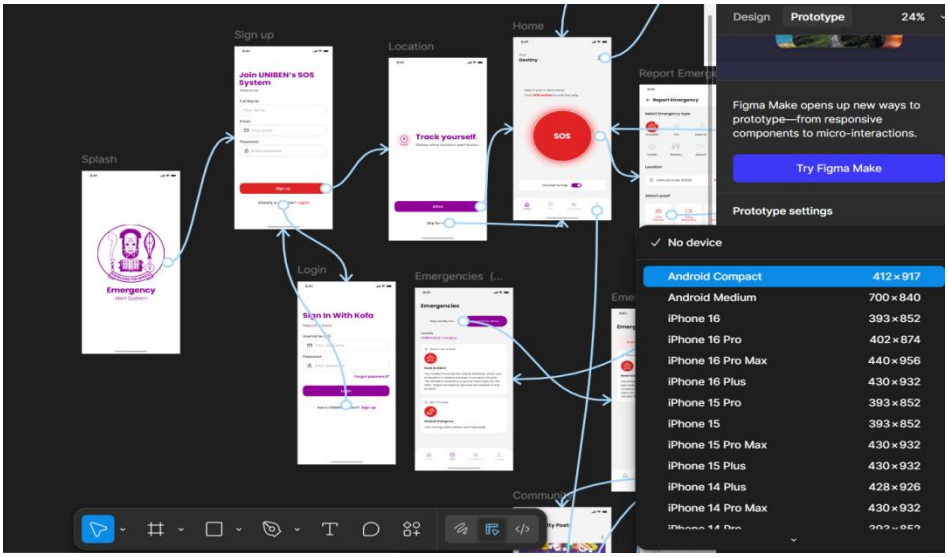

Figure 3.12: Prototyping in Figma

In this project, prototyping demonstrates:

i. How a user logs in with Kofa details.

ii. How pressing the SOS button triggers a confirmation overlay.

iii. How alerts are routed to the Emergency Reports section.

iv. How users upload media (pictures, videos) during an incident.

Table 3.1: Prototyping Elements in Figma

Element	Description	Application in Project
Frames	Containers for each screen or UI layout.	Each system page (login, SOS, reports) is represented as a frame.
Hotspots/ Links	Define clickable areas linking frames together.	Clicking the SOS button directs users to the confirmation screen.
Overlays	Floating windows appearing above the main screen.	Alert confirmation messages are designed as overlays.
Animations	Screen transitions such as slide, dissolve, instant.	Emergency alerts slide into view for clarity.

3.6.3 Figma Frames – Components and Design System

In Figma, **frames** are the foundational building blocks of every interface design. They serve as containers that hold and organize design elements such as text, buttons, icons, and images. Frames can represent anything from a single button to an entire screen layout. They help structure the design, maintain alignment, and make it easier to manage different sections or components of a project.

For this project:

i. Screen Layout Organization: Each major screen in the SOS platform, such as the Home Dashboard, Emergency Report Form, Login Page, and Account Panel, is designed inside its own frame.

ii. Login Form Frame: The login form is built using nested frames, one for the main form container and others for input fields like username, password and also the submit button. This allows for precise alignment and consistent styling between the student and admin login portals.

iii. Design System Frame: A dedicated frame is created to store the project's design system including typography, colors, icons, and spacing rules.

iv. Design System Frame: A dedicated frame is created to store the project's design system, including typography, colors, icons, and spacing rules.

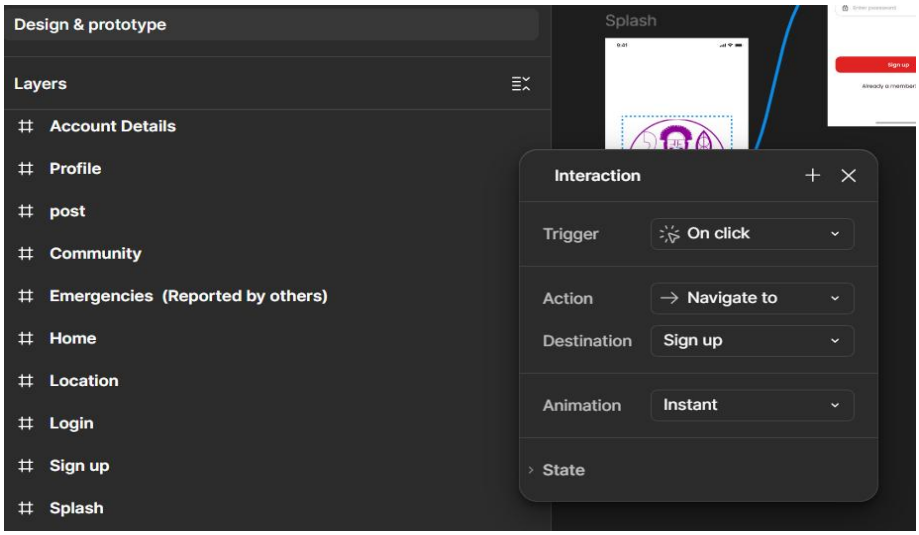

Figure 3.13: Layers and Frame Overview in Figma

Table 3.2: Component Detail

Layer/Section	Design (in Figma)	Application in Project
Splash Screen	Designed as the opening frame that displays the app's logo and name, with animation or fade effects to introduce the platform's identity.	Serves as the first interface users see when launching the app, establishing brand presence and leading to the login or register screen.
Login/Sign In	Built using frames containing input fields (username and password), a "Sign In" button, and optional links for "Forgot Password."	Used by returning users (students or admins) to access their accounts securely before reaching the main dashboard.
Register / Sign Up	Frame includes form fields for full name, email, password, and student ID, aligned within a clean layout and consistent spacing.	Allows new users to create an account on the platform, ensuring data collection for authentication and emergency contact setup.
Account Section	Organized as a parent frame containing sub-frames for profile picture, settings, and navigation links. Components like buttons and icons are reused here.	Acts as the user's personal dashboard where profile, SOS history, and settings can be managed easily.
Profile	Designed using frames with placeholders for user image, name, student ID, contact details,	Displays user identity and contact information; can be updated as needed to

	and an edit button.	ensure accurate emergency records.
SOS (Emergency)	The SOS button is created as a reusable component inside a frame, with variants for default, hover, and pressed states.	Central feature of the platform that allows users to instantly trigger an emergency call to security or health teams.
Instructions	Designed within a scrollable frame containing text blocks, pictures, and step-by-step visuals explaining what to do in case of an emergency	Guides users on how to navigate the app and use the SOS feature effectively during emergencies.

3.6.4 Application of Figma in the Project

By applying Figma systematically, the Emergency Alert System benefits from:

i. **Visualization of User Flow:** End-to-end student journey (login → alert → confirmation → reports).

ii. **Rapid Prototyping:** Quick iterations of the system interface before coding begins.

iii. **Consistency:** Unified look and feel across all screens through a design system.

iv. **Collaboration:** Multiple stakeholders (project supervisor, developers) can review designs in real-time.

v. **Efficiency:** Reduced errors in development as designs are fully interactive and developer-ready.

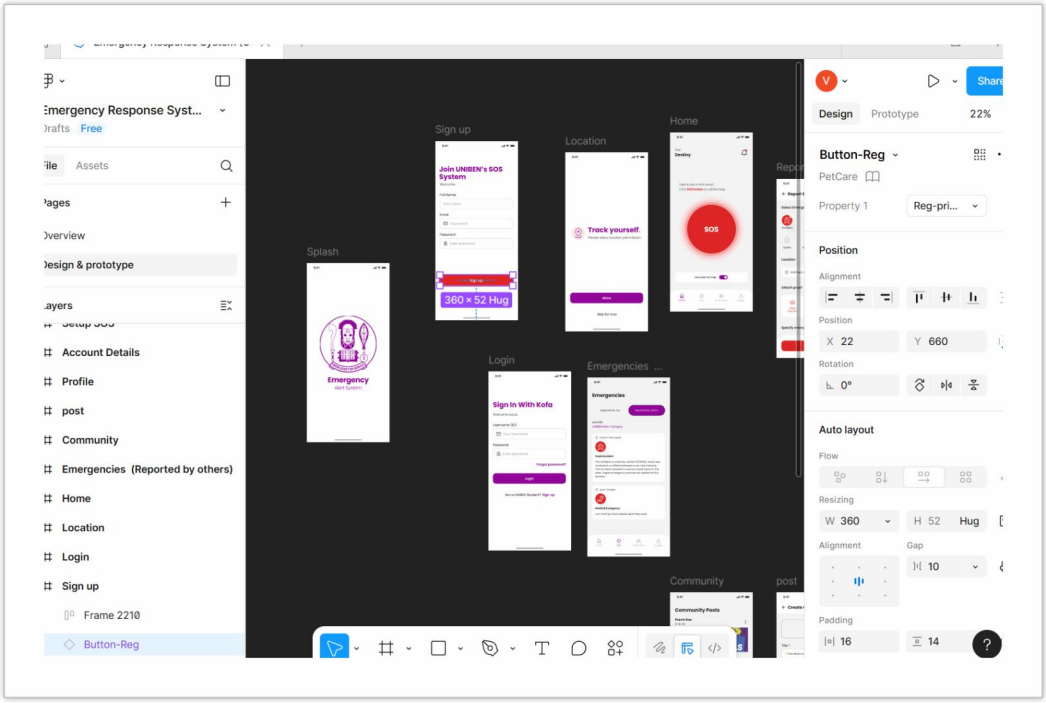

Figure 3.14: Full Figma Workspace

Figure 3.14 presents the Figma design workspace with an active project, showcasing its main sections; the Layers panel, Canvas, and Properties panel. The Layers panel (left) organizes all project elements such as pages, headers, and components, enabling easy navigation through the system layout. The Central Canvas displays the actual design prototype, where wireframes and interface components of the Emergency and Safety Alert System are created and refined. On the right, the Properties panel provides tools for styling, layout adjustments, and switching between Design, Prototype, and Code modes. This structured setup makes Figma an efficient platform for both designing and testing user interfaces collaboratively before system implementation.

CHAPTER FOUR
SYSTEM IMPLEMENTATION

4.0 Introduction

This chapter presents the processes involved in the implementation, testing, and evaluation of the Emergency and Safety Alert System (ESAS)**.** It discusses the development environment, tools, and technologies adopted to build the system, as well as the rationale behind each choice. The chapter also elaborates on the programming languages and plugins that facilitated the platform's functionality and optimization. Furthermore, it details the testing and evaluation procedures carried out to ensure that the system meets its design objectives in terms of performance, reliability, and usability.

4.1 System Implementation Platform and Tools

The implementation of the Emergency and Safety Alert System (ESAS) was carried out using WordPress as the primary development framework. WordPress is a free, open-source content management system (CMS) that supports efficient creation, customization, and management of dynamic web applications. Its flexibility, plugin ecosystem, and ease of use made it the most suitable tool for implementing the ESAS platform.

WordPress was selected due to its proven reliability, scalability, and support for both web and mobile accessibility. It allows for rapid prototyping and deployment of core system modules such as user authentication, emergency notifications, and reporting features without extensive manual coding. The platform also provides robust backend management features, enabling administrators to manage content, users, and system data effectively.

Through the integration of specialized plugins, themes, and widgets, WordPress served as the backbone for achieving the project's objectives — a secure, efficient, and user-friendly emergency alert platform tailored for higher institutions.

4.1.1 Secondary Tools

i. **Harmonweb**: The hosting and domain management of the ESAS platform were implemented using Harmonweb, a reliable Nigerian-based web hosting provider. Harmonweb was chosen for its affordability, uptime guarantee, and secure server infrastructure. It supports automatic backups and server-side protection, ensuring the platform's continuous availability, especially during emergency traffic surges.

ii. **cPanel**: Access to cPanel through Harmonweb provided a convenient interface for server and file management. Features such as email account configuration, SSL

certificate integration, and scheduled backups were essential for maintaining data integrity and system security. The cPanel environment also simplified administrative tasks like database setup, webmail creation, and subdomain management for different platform modules.

iii. **Widgets**: Widgets were utilized to display dynamic and real-time information such as recent emergency reports, resolved cases, and security updates. These elements were strategically placed on key pages of the system to enhance accessibility and user interaction.

iv. **Media Library**: The WordPress Media Library was used for managing all multimedia resources, including images, icons, and vector graphics. It helped ensure a consistent visual style across the platform while enabling administrators to easily upload and manage visual content related to safety alerts and emergency responses.

v. **Platform Theme**: The overall look and feel of the ESAS platform were guided by the visual designs created in Figma (as discussed in Chapter Three). Using Elementor and the WordPress Appearance Customizer, these designs were implemented into responsive and visually appealing web pages. The chosen theme ensured clarity, consistency, and usability across devices and screen sizes.

vi. **Telegram Bot**: Integrated as a free, real-time alert channel that sends instant SOS notifications to users through a dedicated Telegram group or channel, ensuring quick accessibility and minimal delivery delays.

4.2 Programming Languages Used

Several web technologies were employed to enhance the system's structure, style, and functionality. These include:

i. **HTML (HyperText Markup Language):** Provides the foundational structure of all web pages, including text fields, buttons, and layout components.

ii. **CSS (Cascading Style Sheets):** Responsible for the visual styling and layout customization of web elements. It ensured that the ESAS interface was both responsive and aesthetically appealing.

iii. **PHP (Hypertext Preprocessor)**: The server-side scripting language that powers WordPress. It handled backend logic such as user authentication, data storage, and emergency report management, ensuring smooth communication between the client interface and the database.

These technologies work together to form a cohesive and interactive system architecture capable of handling both user interactions and backend operations efficiently.

4.3 Optimization and Integration Plugins

To extend the native capabilities of WordPress and optimize the platform's performance, several essential plugins were integrated into the system:

i. **LiteSpeed Cache**: Implemented to optimize loading speeds, compress images, and cache frequently accessed content. This plugin improved user experience by reducing latency and supporting high-traffic efficiency.

ii. **Ultimate Member:** Managed all user-related operations including registration, login, profile management, and role assignment. It allowed secure differentiation between students, administrators, and super administrators, while also supporting potential integration with existing institutional databases.

iii. **WPForms and Forminator**: These plugins were used to create dynamic forms for emergency report submissions. Users could report incidents directly from the interface, and the submitted data were securely stored and retrievable by administrators.

iv. **Tablesome**: Automatically generated live data tables displaying emergency reports and alerts in real time. It enabled administrators to view, filter, and manage reported incidents efficiently.

v. **WP Mail SMTP**: Configured to enable secure and automatic email notifications. It handled alert distribution, password recovery, and account verification, ensuring that both users and administrators received timely updates.

vi. **Wordfence and Blackhole for Bad Bots**: Provided robust security measures to safeguard the platform against cyber threats, brute-force login attempts, and malicious bot activities. These plugins ensured that sensitive data remained protected and system integrity was maintained.\

4.4 Active/Live Platform

This section presents the live and fully functional version of the SOS emergency reporting platform developed for UNIBEN students. The platform has been deployed and is accessible online, showcasing its major features, interface layouts, and user interaction components. Each page has been carefully designed and optimized for responsiveness, ensuring smooth usability across both desktop and mobile devices

4.4.1 Homepage (Landing Page)

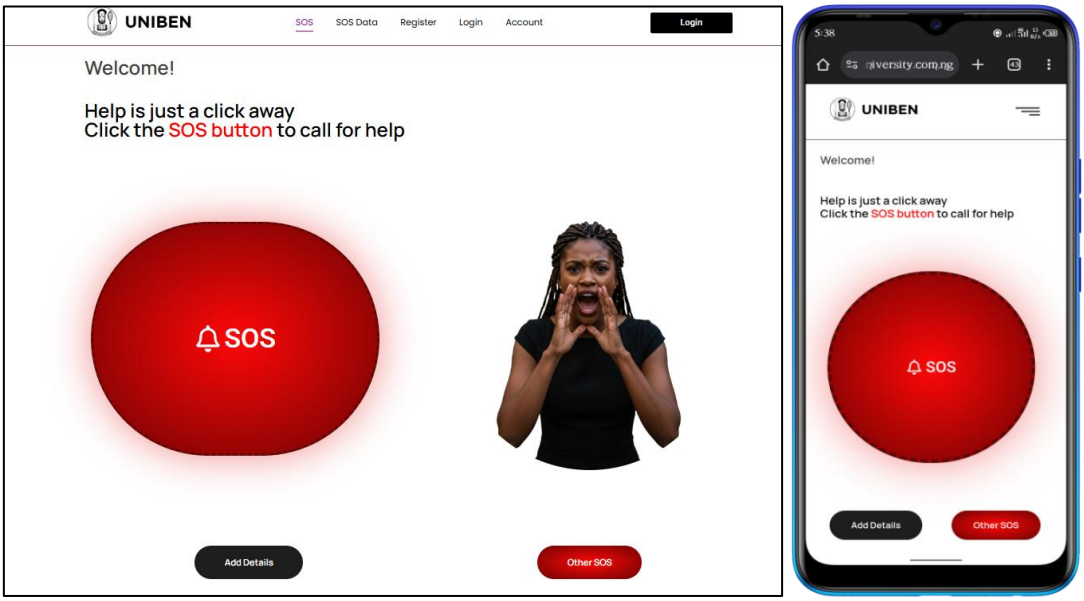

Figure 4.1: Desktop and Mobile View of Homepage

In Figure 4.1 above, The homepage serves as the main access point for users upon visiting the SOS platform. Both desktop and mobile layouts were designed; however, mobile integration was prioritized, as most emergency cases are reported using mobile devices due to their portability, accessibility, and speed of use during urgent situations. At the top section of the page is a header menu that contains well-structured navigation links and submenus, allowing users to easily move between different sections of the platform such as registration, emergency reports, and help instructions.

The central feature of the homepage is a large red SOS button, designed with UI/UX best practices to immediately attract attention and encourage quick user interaction during emergencies. Its size, placement, and color were chosen intentionally to make it unmistakable and highly accessible. Beneath the main SOS button are two complementary action buttons. The first allows users to add details about the emergency being reported, providing additional context such as location and type of incident. The second button enables users to view other reported emergencies, fostering awareness and transparency across the platform.

4.4.2 Footer

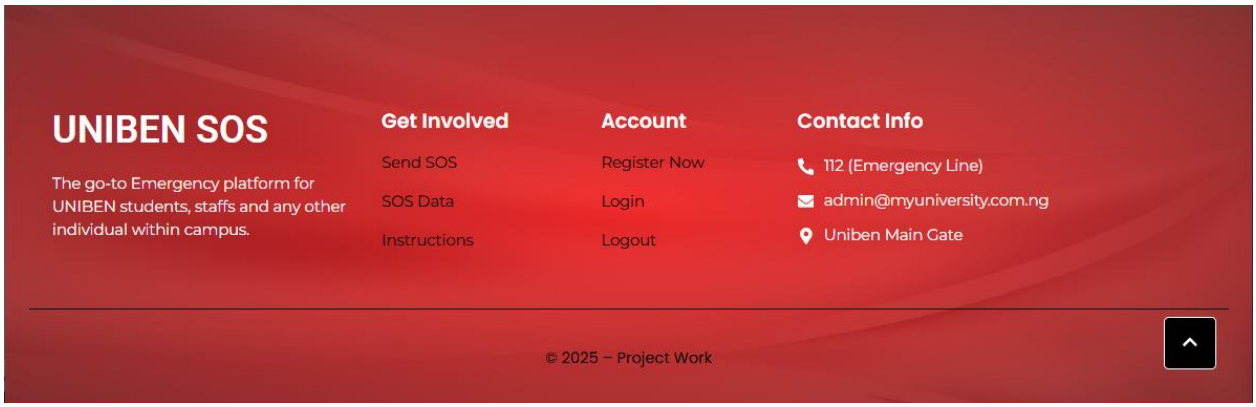

Figure 4.2: Platform's Footer Section

The footer section of the UNIBEN SOS platform as shown in Figure 4.2, appears consistently across all pages and serves as an essential navigation and contact hub. It features the "UNIBEN SOS" header, which reinforces the platform's identity, followed by quick links such as Login, Logout, Register, and other shortcuts to important pages. These links give users easy access to account actions and core site areas, ensuring smooth navigation even from the bottom of the page.

Also, the footer contains a dedicated Emergency Contact area that provides the official phone number, email address and physical address for direct communication during urgent cases. This inclusion ensures users have reliable alternatives to reach help outside the web interface. The footer's structure and color balance were designed to align with the platform's overall visual identity while emphasizing accessibility, functionality, and emergency readiness.

4.4.3 Popup Form For Emergency Details

The SOS Details Popup appears when a user selects the "Add Details" button on the homepage, providing an alternative means of reporting emergencies for those who may not wish to place a direct call through the SOS button. This feature was designed with inclusivity and accessibility in mind, ensuring that users can still communicate urgent incidents effectively in situations where voice calls are impractical, such as noisy environments or low network reception areas.

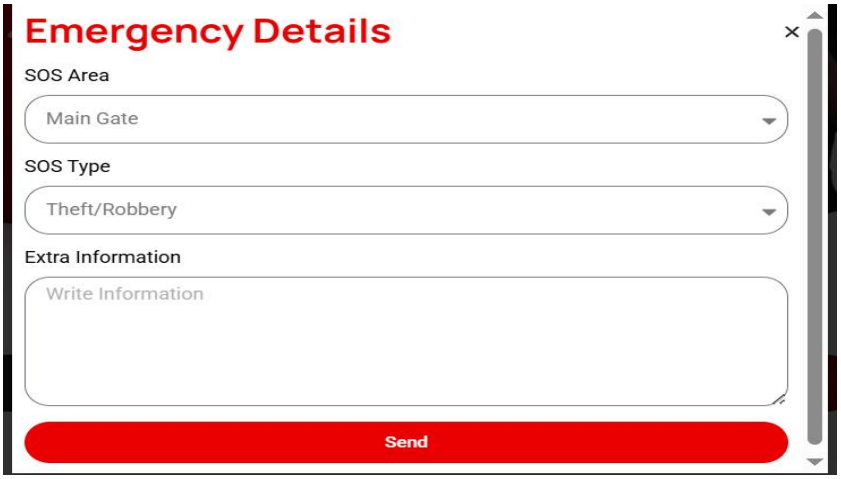

Figure 4.3: **Form for Additional Emergency Details**

The popup interface contains three input fields: SOS Area, SOS Type, and Extra Information. In Figure 4.3 above, The SOS Area field presents a dropdown list of major and well-known locations within the UNIBEN main campus, allowing users to specify exactly where the emergency is occurring. The SOS Type field enables users to categorize the nature of the emergency (such as theft, accident, or fire) to help responders understand the situation at a glance. Finally, the Extra Information box provides space for users to add more detailed descriptions or contextual notes about the incident.

Following the user submission, the backend configuration of the SOS form, as shown in the Figure 4.4 below, manages how the data is processed and distributed. The backend setup defines the form's email notification settings, which include the administrator's webmail address that sends out the notifications, as well as an option to automatically select and forward messages to all registered users on the platform. Each of the form fields (SOS Area, Type, and Extra Information) is included in the message body, ensuring that recipients receive complete details of the report. The sample of the email notification below shows the structured emergency report as received by users, providing a clear and immediate communication channel between the platform and its community.

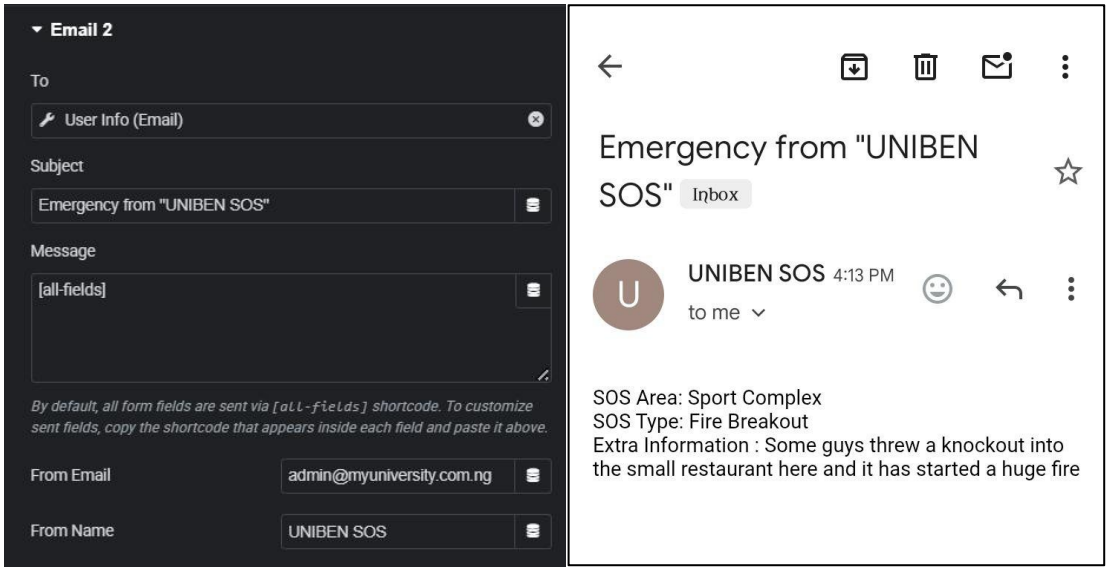

Figure 4.4: Email Alert Configuration and Outcome

4.4.4 Live Emergency (SOS) Feed

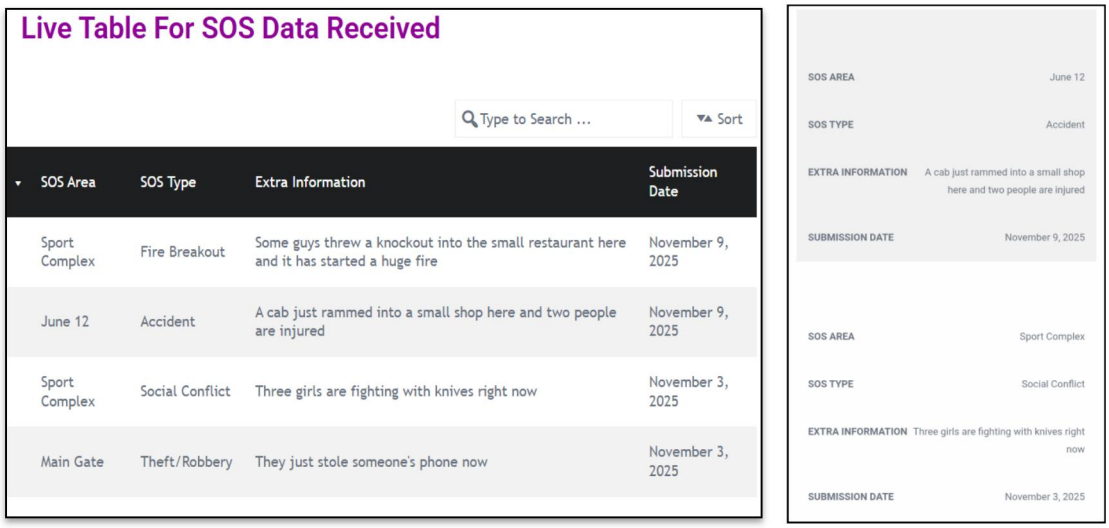

Figure 4.5*:* Live SOS Report Feed/Data

The Live SOS Feed is a central feature of the UNIBEN SOS platform, providing users with real-time access to all emergencies reported on the system. This interface shown in Figure 4.5, displays the details of each report, including the SOS Area, SOS Type, when it was reported, and any extra information submitted by the reporting user. The design has been optimized for both desktop and mobile views: on desktop, the reports are presented in a structured table format, while on mobile devices, the layout is stacked to enhance readability and accessibility.

The feed includes sorting and search functionalities, allowing users to quickly locate specific reports based on area, type, or keywords from the extra information field. This ensures that

users can efficiently filter and monitor emergencies of interest. Additionally, the table is configured to automatically update without error and failure, displaying new submissions instantly with each reload.

4.4.5 Telegram Bot Alert Integration

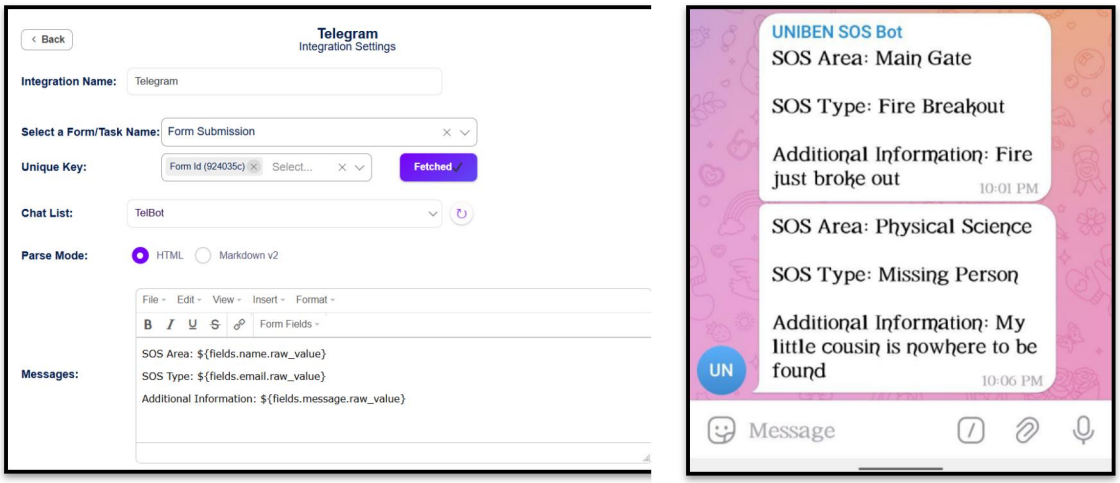

Figure 4.6: Telegram Bot Integration and Outcome

The Telegram Bot Integration serves as the second channel for sending emergency alerts to users, providing a faster and more accessible alternative to traditional email notifications. Telegram was selected because it offers free API access and seamless automation, unlike WhatsApp, which requires a paid API for message delivery, and SMS, which involves additional costs and may experience instability due to network limitations. This makes Telegram the most reliable and cost-effective option for real-time emergency communication within the UNIBEN SOS platform.

The screenshot illustrates the bot integration and automation workflow, which was configured to link the platform's emergency form to a Telegram channel through the bot's API Token and Chat ID. Once the integration is complete, users who have joined the UNIBEN SOS Telegram channel automatically receive alerts whenever a new emergency report is submitted. The automation process monitors the Elementor form for new submissions, retrieves the details (such as SOS Area, Type, and Extra Information), and transmits them instantly through the Telegram bot. This ensures that students and responders are notified in real time, directly on their mobile devices.

4.4.6 Users Account

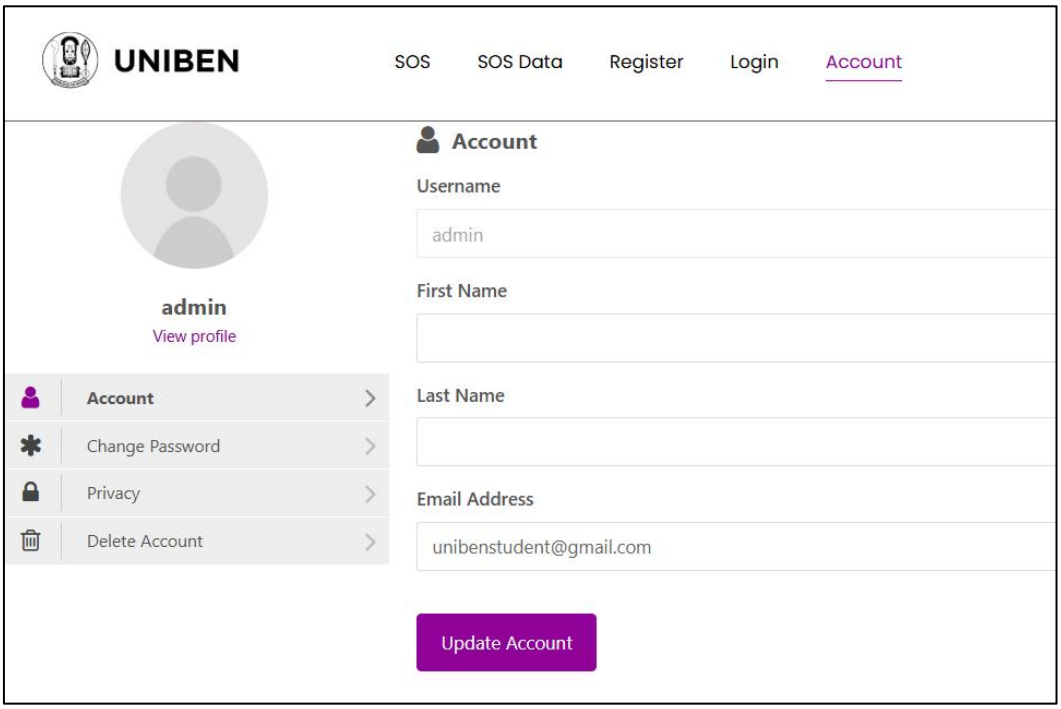

Figure 4.7: Registered Users Account Section

The Account Section of the UNIBEN SOS platform in Figure 4.7 above is dedicated to registered users and provides tools for managing personal information, privacy, and identity within the system. This section allows users to edit their profiles, including changing their usernames, uploading profile and cover photos, and updating their first and last names. These features help create a recognizable digital identity, making it easier for emergency responders or administrators to identify and verify users during response coordination. Users can also update their email addresses to ensure they receive all system alerts and notifications through their preferred communication channel.

In terms of privacy and data protection, the platform aligns with ethical data privacy standards such as the General Data Protection Regulation (GDPR), which grants users control over how their information is shared and used. As such, users are allowed to hide their profiles from search indexing or visibility by other users, request and download their personal account data, and even delete their accounts entirely if they choose to withdraw from the system.

4.5 System Testing

The Testing phase of the UNIBEN SOS platform involved systematic assessment procedures aimed at ensuring reliability, usability, and overall system performance. The platform was

tested through three main categories: Functional Testing, Performance Testing, and Usability Testing. Each category focused on specific objectives to validate the effectiveness of the emergency reporting system.

1. Functional Testing

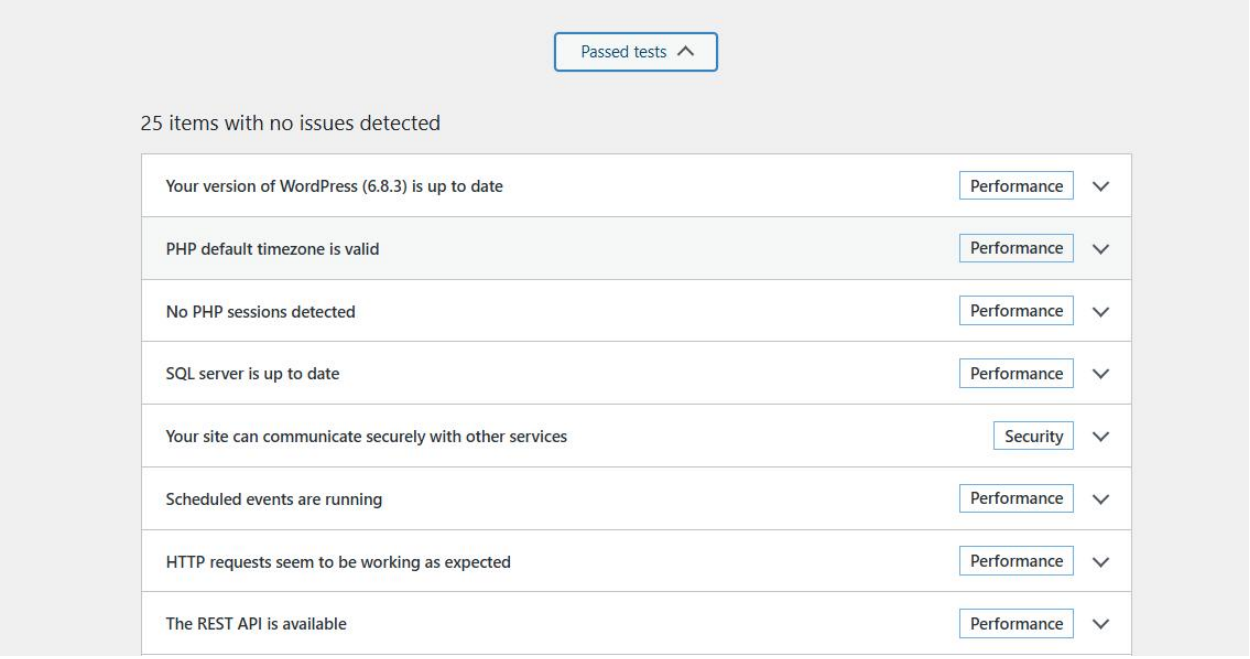

Figure 4.8: **WordPress Functional Testing Results**

In Figure 4.8 above, Functional testing was carried out to verify that all system components performed their intended operations correctly within the WordPress environment. The testing covered key modules such as PHP sessions, scheduled events, HTTP requests and other basic features like user registration, login/logout authentication, emergency form submission, email notifications and Telegram alert automation. Each feature was tested repeatedly under various user scenarios to confirm error-free execution and data integrity.

Special attention was given to plugin compatibility and workflow integration, ensuring that tools such as Ultimate Member, Elementor, WP SMTP, and other plugins worked seamlessly together without conflicts. The form submission module was tested for proper data transmission and email delivery, while the notification dispatch system was monitored to confirm that Telegram alerts were sent instantly after each form submission. These tests validated the functional readiness of the platform, confirming its capability to handle live user interactions reliably.

2. Performance Testing

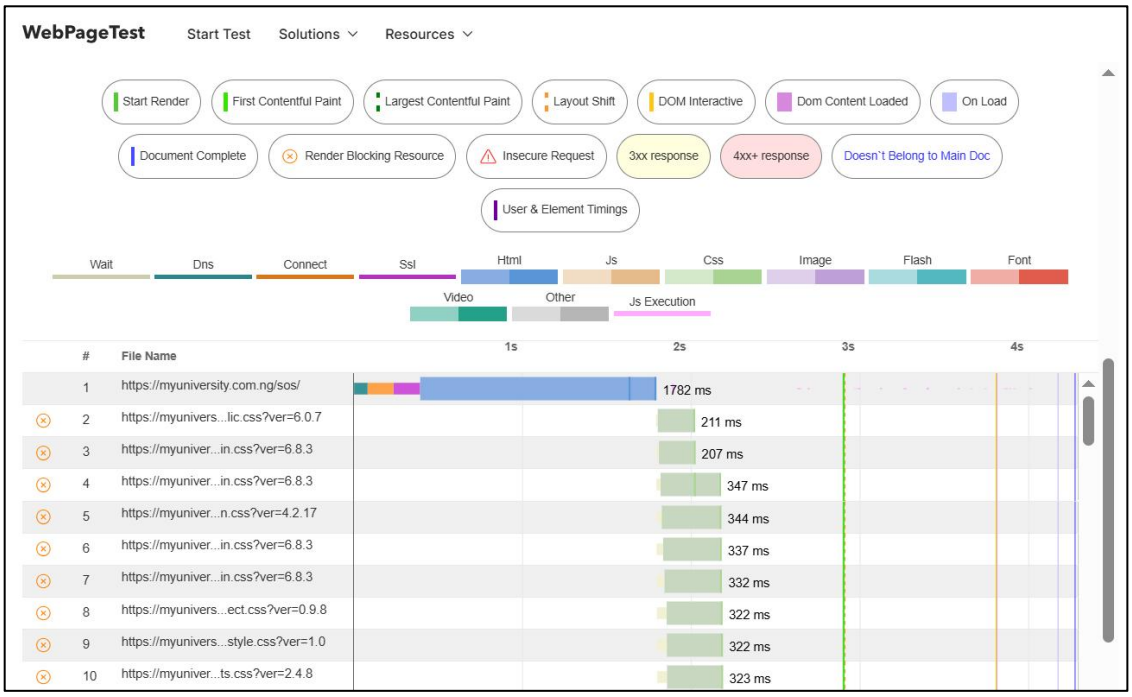

Figure 4.9: WebPage Test Results

Performance testing focused on evaluating the system's responsiveness, stability, and load-handling capacity under different network conditions and simulated concurrent user activities. Tools such as GTmetrix, Pingdom, Google PageSpeed Insights, Loader.io, and Uptrends were employed to assess the site's overall performance metrics. Tests were conducted for both desktop and mobile access.

Table 4.1: Performance Testing Result Summary

Testing Tool	Metric Evaluated	Result Summary	Status
GTmetrix	Page Load Time	2.1 seconds (A grade for performance)	Passed
Pingdom	Uptime and Response Time	99.8% uptime; 580ms average response	Passed
Google PageSpeed Insights	Performance Score (Mobile/Desktop)	Mobile: 88, Desktop: 96	Passed
Loader.io	Concurrent User Test (50	Stable; no crash or timeout	Passed

	users)	recorded	
Uptrends	Network Stability and Downtime	No downtime detected during 24-hour monitoring	Passed

The results indicated that the UNIBEN SOS platform maintained fast loading speeds, high availability, and stable response even under moderate simultaneous user loads. These outcomes confirm that the system can support real-time reporting without performance degradation.

3. Usability Testing

Usability testing was conducted with a diverse group of participants consisting of 7 sample users (students) from the University of Benin. The main objectives were to assess the ease of navigation, clarity of interface elements and overall user satisfaction when interacting with the platform. The test sessions involved practical scenarios such as registering an account, submitting an emergency report, and viewing existing reports. Feedback was collected through surveys and observation notes.

Table 4.2: Usability Testing Results

Evaluation Criteria	Description	Average User Rating (1–5)	Remarks
Navigation Ease	Ability to move between pages intuitively	4.7	Simple and straightforward
Clarity of Icons and Labels	Visibility and readability of buttons and texts	4.5	Clear and descriptive design
SOS Button Accessibility	Ease of finding and pressing the SOS button	4.9	Prominent and easily accessible
Form Submission Process	Simplicity and response of the emergency form	4.6	Smooth with immediate feedback
Notification Efficiency	Speed of receiving Telegram or Email alerts	4.8	Very fast, minimal delays

Mobile Responsiveness	Layout adaptability across different screen sizes	4.7	Well optimized for mobile use
Overall User Satisfaction	General experience and comfort using the platform	4.8	Highly satisfactory

The feedback confirmed that users found the system highly intuitive, visually clear, and efficient for reporting emergencies. Both students and administrators appreciated the simplicity of the design and the reliability of notifications, validating the system's effectiveness for real-world deployment.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

5.0 Summary

This project focused on the design and implementation of an Emergency and Safety Alert System **(ESAS)** for Students on Campus, developed specifically for the University of Benin (UNIBEN). The motivation stemmed from the observed inefficiencies and delays in the existing emergency communication methods across Nigerian universities, which rely heavily on manual or **traditional** systems such as phone calls, notice boards, and social media groups.

The study began by establishing the background and significance of campus safety, highlighting the need for a centralized, real-time, and automated platform that allows students to report emergencies quickly and receive verified alerts. A comprehensive literature review explored existing emergency communication standards and technologies, including the Common Alerting Protocol (CAP), FEMA IPAWS, and ISO 22322:2022, as well as research on user compliance and response behaviour during crises. The review also examined relevant Nigerian and African studies that underscored the technological and infrastructural challenges of implementing similar systems locally.

In the system analysis and design phase, weaknesses of the existing manual system were identified, such as communication delays, limited coverage, and lack of feedback mechanisms. To overcome these challenges, the project proposed an automated, web-based solution capable of facilitating two-way communication between students and campus security personnel.

The system design adopted the Agile methodology, allowing for iterative prototyping, feedback integration, and user-centered refinement. Figma was used to design an interactive prototype that reflected a practical, user-friendly interface consisting of components like the Splash Screen, Sign-In Page, SOS Button, Emergency Reporting Form, and Live Alert Dashboard.

The implementation was carried out using WordPress as the core platform, complemented by plugins such as Ultimate Member for authentication, WPForms for emergency reporting, Telegram Bot integration for instant alerts, and LiteSpeed Cache for performance optimization. Testing procedures—including functional, performance, and usability tests—

confirmed that the system was reliable, fast, and intuitive, with strong user feedback highlighting its accessibility and responsiveness across both desktop and mobile platforms.

Ultimately, the project demonstrated that the Emergency and Safety Alert System (ESAS) could effectively address the communication gaps in UNIBEN's existing safety infrastructure, offering a scalable model adaptable to other Nigerian institutions.

5.1 Conclusion

The development of the Emergency and Safety Alert System (ESAS) has shown that digital automation and web-based communication can significantly improve emergency responsiveness and coordination within university environments. By integrating multi-channel notifications and real-time alert reporting, the system bridges the communication gap between students and campus authorities—an area that has long hindered effective crisis management in Nigerian universities.

The project successfully fulfilled its objectives by providing a functional prototype that enables verified users to report incidents, receive alerts instantly, and access safety guidelines through an intuitive platform. It also reinforced the importance of adopting global standards, such as CAP and ISO 22322, for message consistency and interoperability.

Through iterative Agile development and the use of design tools like Figma, the project underscored the significance of user experience (UX) and rapid prototyping in building practical solutions tailored to local needs. The combination of WordPress flexibility, plugin integration, and Telegram automation also demonstrated how open-source technologies can be effectively leveraged to build cost-efficient, reliable safety communication systems in academic settings.

In conclusion, the Emergency and Safety Alert System (ESAS) provides a foundation for modern campus safety management, enhancing situational awareness, reducing response time, and fostering a secure learning environment. Its implementation within UNIBEN represents a crucial step toward integrating digital transformation into university emergency management frameworks.

5.2 Recommendations

Based on the outcomes of this study, the following recommendations are proposed to enhance future development, scalability, and adoption of campus safety systems in Nigerian institutions:

i. **Institutional Integration:** The University of Benin should formally integrate the Emergency and Safety Alert System into its security and ICT infrastructure, ensuring continuous maintenance, real-time monitoring, and administrative control by the university's safety units.

ii. **Multi-Channel Expansion:** Future versions of the system should incorporate additional notification channels such as SMS gateways**,** mobile push notifications**,** and potential integration with the National 112 Emergency Communication **Centres (**ECCs**)** for escalation of severe incidents.

iii. **Mobile Application Development:** A dedicated Android and iOS mobile application should be developed to complement the web platform, offering offline capabilities and improved geolocation accuracy during emergencies.

iv. **Database Integration and Analytics:** Integrating a database-driven analytics module would allow administrators to monitor incident frequency, response times, and safety trends—providing valuable insights for policy-making and continuous improvement.

v. **Awareness and Training:** Regular student sensitization and safety drills should be conducted to ensure that users understand how to report incidents, respond to alerts, and follow safety procedures effectively.

vi. **Scalability and Collaboration:** The model developed for UNIBEN can be expanded to other Nigerian universities and institutions. Collaborative efforts with state emergency agencies and telecommunication providers would **e**nsure interoperability and nationwide readiness.

By implementing these recommendations, the Emergency and Safety Alert System can evolve into a comprehensive digital framework for emergency communication, contributing to safer campuses and improved institutional resilience across Nigeria.

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APPENDIX

VITAL & ADDITIONAL CODES

HEADER PHP CODE

```
<?php
Function custom_theme_header() {
 ?>
 <header class=”site-header”>
  <div class=”logo”>
   <a href=”<?php echo home_url(); ?>”><?php bloginfo(‘name’); ?></a>
  </div>
  <nav class=”main-nav”>
   <?php wp_nav_menu(array(‘theme_location’ => ‘primary’)); ?>
  </nav>
 </header>
 <?php
}
Add_action(‘wp_head’, ‘custom_theme_header’);
?>
```

FOOTER PHP CODE

```
<?php
Function custom_footer_content() {
 ?>
 <footer class=”site-footer”>
  <p>&copy; <?php echo date(‘Y’); ?> Campus SOS Platform. All Rights Reserved.</p>
 </footer>
```

```
<?php
}
Add_action(‘wp_footer’, ‘custom_footer_content’);
?>
```

TABLESOME LIVE SOS SHORTCODE

[tablesome id=”2” filter=”true” search=”true” sort=”true”]

TELEGRAM BOT INTEGRATION (WEBHOOK)

```
{
 “nodes”: [
  {
   “parameters”: {
    “path”: “sos-alert”,
    “method”: “POST”
   },
   “name”: “Webhook”,
   “type”: “n8n-nodes-base.webhook”
  },
  {
   “parameters”: {
    “chatId”: “YOUR_TELEGRAM_CHAT_ID”,
    “text”: “🚨 New SOS Alert: {{$json[‘area’]}} – {{$json[‘type’]}}”
   },
   “name”: “Send Telegram Message”,
   “type”: “n8n-nodes-base.telegram”
```

```
    }
  ]
}
```

REGISTRATION PAGE ADDITIONAL CSS

```
/* Registration Page Styling */
.page-id-45 form {
  Background: #f9f9f9;
  Border-radius: 10px;
  Padding: 25px;
}
.page-id-45 input[type=”submit”] {
  Background-color: #e63946;
  Color: #fff;
  Border: none;
  Border-radius: 6px;
  Padding: 10px 20px;
  Cursor: pointer;
}
```

LOGIN PAGE ADDITIONAL CSS

```
/* Login Form Customization */
.login form {
  Border-radius: 12px;
  Box-shadow: 0 0 10px rgba(0,0,0,0.1);
```

```
}
.login #wp-submit {
  Background: #1d3557;
  Color: #fff;
  Border-radius: 6px;
}
```

CUSTOM SOS SUBMISSION SHORTCODE

```
Function custom_sos_form_shortcode() {
  Ob_start(); ?>
  <form id=”sos-form” method=”post”>
    <input type=”text” name=”sos_area” placeholder=”Enter SOS Area” required>
    <select name=”sos_type”>
      <option value=”Fire”>Fire</option>
      <option value=”Accident”>Accident</option>
      <option value=”Security”>Security</option>
    </select>
    <textarea name=”extra_info” placeholder=”Additional Info”></textarea>
    <input type=”submit” name=”submit_sos” value=”Report Emergency”>
  </form>
  <?php
  Return ob_get_clean();
}
Add_shortcode(‘sos_form’, ‘custom_sos_form_shortcode’);
```

NOTIFICATION TRIGGER

```
Function send_onesignal_notification($title, $message) {
  $content = array(
    "en" => $message
  );
  $fields = array(
    'app_id' => "82729666728BH",
    'included_segments' => array('All'),
    'headings' => array("en" => $title),
    'contents' => $content
  );
  $fields = json_encode($fields);
  $ch = curl_init();
  Curl_setopt($ch, CURLOPT_URL, https://onesignal.com/api/v1/notifications);
  Curl_setopt($ch, CURLOPT_HTTPHEADER, array('Content-Type: application/json;
        charset=utf-8',
                                'Authorization: Basic YOUR_API_KEY'));
  Curl_setopt($ch, CURLOPT_RETURNTRANSFER, TRUE);
  Curl_setopt($ch, CURLOPT_HEADER, FALSE);
  Curl_setopt($ch, CURLOPT_POST, TRUE);
  Curl_setopt($ch, CURLOPT_POSTFIELDS, $fields);
  Curl_exec($ch);
  Curl_close($ch);
}
```