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Design and Implementation of an Information Dissemination App for University Communities: A Case Study from an Educational Perspective

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ABSTRACT
This study pinpoints the current challenges with the traditional method of information dissemination in university communities. It designed a model that addressed these challenges, implemented the newly developed system, and was tested using suitable technological tools. The study employed a qualitative research approach and built a mobile-based android app. In particular, 55 students from Obafemi Awolowo University (OAU), 35 lecturers, 20 non-teaching staff, and 11 software developers within the university community were randomly selected for the study. After that, a random sampling of 100 potential users was carried out to determine the app stability (90%), user-friendliness (96%), speed (97%), data consumption (100%), assurance (100%), and performance (90%) in a pilot test. The test result revealed the acceptance rate of the mobile-based system for information dissemination to help mitigate against fake and incredible news. The study not only improved on the inefficiencies of the traditional approach of information dissemination, but revealed that the improvement would further strengthen the relationship among the students and the lecturers, and also help the students to reach out to their lecturers and colleagues easier and faster. Additionally, the study suggests that the developed app can be used to aid effective learning and keep abreast of timely and relevant information.

General Terms
University community, educational planning, ICT and university administration, information dissemination

Keywords
Information dissemination, mobile application, ICT, software development, university communities, education.

1. INTRODUCTION
Information from the university administrator and management is essential for transforming the community's academic, social, and welfare needs. Like those of the university system, information dissemination is a significant and frequently-occurring problem [1], especially with the high dependency on timely and relevant information. For example, suppose the university management is aiming at providing quality education. In that case, information becomes a vital tool for realizing such an objective. To this end, information dissemination becomes crucial for engendering transformation [2, 3].

In this context, information dissemination involves broadcasting a message to the public without a direct response from the receivers [4]. Traditionally, communication is viewed as involving two or more parties. Among these parties, there is the one that sends information and the party that receives the information, interprets it, and sends a response back; this is another unique information. Dissemination mimics this view of communication, where the party that sends information and the party that receives information are involved. With dissemination, the full cycle of the traditional model of communication is not completed. Instead, only the first part is completed. With this kind of situation, information is disseminated by a sender, received by an audience, but no response is returned. For example, in most African universities, especially Nigeria, the situation is such that the disseminated information either delay in reaching the recipients or never get delivered.

In addition, seeing the vast number of options by which news and information are disseminated today in the university community, it becomes a significant source of concern for members of the university community, especially students, to determine the credibility of news and information that is said to be from the administrators of the varsities. Currently, university administrators have maintained the traditional way of passing down information to students, that is, pasting official releases on noticeboards. This comes many times, a few days after all manner of news and rumors are trending among students already, whose first contact with information is through their mobile phones. Many students– unable to access credible news and information– end up propagating rumors, which in no time is known and believed to be true in the university community. Sometimes, this slows down normal activities and smooth day-to-day running of the community. Therefore, there is a need to address the problems above by taking advantage of technological provision using an efficient electronic system of disseminating information by the administrators of the university community, that will directly deliver news and information using a suitable medium.

In the same vein, recent advancements in information and communication technology (ICT) have changed how information is disseminated and acquired today compared to a

few decades ago. New platforms like social media, websites, and email have fast-overtaken the traditional style of pasting information documents on noticeboards. The information on these platforms travel quicker, and are easily accessible to users. Fortunately, with the emergence of ICT, modern digital technology– like a mobile phone– is an essential tool used in most tertiary institutions to disseminate information across the board. For example, it is currently used for teaching large classes [5]. It could result in dissemination [6], creation of awareness on universities-based programs [7], supporting productive learning activities [8 - 12], supporting social interaction among students, lecturers, and other stakeholders in the university community [13 - 15], and improving educational planning and outcomes [16, 17]. In all of these examples, information is disseminated by a sender, received by an individual or audience, and responses are usually expected and given.

However, this paper focuses on solving the problem of information dissemination from the university administrators to the students by using a direct method of sending useful updates to their mobile phones through an Android app. Obafemi Awolowo University (OAU), Ile-Ife, Nigeria, will be used as a case study in this regard. The work's goal is first to design a model based on the requirements, implement a system based on the model, and, finally, test the system with students and other university stakeholders.

The rest of the paper is arranged as follows: in section 2, we described some related literature that is crucial to the topic. In section 3, we described the methodology, requirements, and design specifications for the prototype tool implemented. The full system implementation is described in section 4. Moreover, in section 5, system-testing and results are discussed. The discussion is presented in Section 6. Finally, we presented the conclusion and future work in Section 7.

2. RELATED WORK

2.1 An overview

ICT facilities have hastened globalization, such as: the computer, internet-enabled mobile device, the fax machine, among many others [18, 19]. The limitations of distance and timely updates have been significantly reduced as information dissemination techniques evolved over the years. The developed countries have maximized the benefits of this more [20 - 22]. The world is becoming smaller as information can now be easily communicated and accessed, bringing about rapid advancement in various sectors; including: education/learning [23, 24], health care [25], agriculture [26], commerce [27], social media [28], manufacturing and technology [29]. As an example, Mobile learning stands the chance of having an unsubtle and relevant impact in establishing a smooth bond between the students and their lecturers in the learning process. This is one way of achieving the universal primary education goal [30]. It will also have a long-term sustainable positive impact on Millennium Development Goals (MDGs) in attaining decent and productive work for all.

2.2 The big problem

In a study commissioned by the Knight Foundation [31], nearly six thousand (6000) students across eleven (11) United States (US) colleges and universities were surveyed. The study discovered that college students found it difficult to distinguish between real and fake news because of the daily barrage of news that got to them [32, 33].

In another study published by Stanford University in 2016 [34], it was discovered that students at different levels were continually having issues in determining the integrity of an online news source. The report was also based on a robust number of responses. Many students, unable to access credible news and information, end up propagating rumors which in no time, are known and believed to be true in the university community. Sometimes, this slows down normal activities and the smooth running of the community. As opined in this paper, direct dissemination of news and information from the community administrators to its members will count as a breakthrough in curbing the crippling effect that rumors have on the smooth running of activities on campuses.

2.3 Information dissemination

Information dissemination is defined as "the transportation of information to the intended recipients while satisfying specific requirements such as delay, reliability [35]. Information dissemination has evolved from the slower traditional medium of oral communication to social media, such as blogs, short messages, social networking websites, and news portals [36]. Clarke [37] described such an effect on scholarly publishing and documented a shift in information dissemination from Gutenberg's printing press to web technologies, online publishing platforms, mobile and semantic Technologies, enabling information professionals access to information anywhere allows audience participation.

A study carried out in Nigeria revealed that revolving around advancements in ICT that influenced the mode of processing, storing, preserving, accessing, retrieving and disseminating information, tertiary institution students and lecturers in Nigeria were not only preferred. However, it increasingly demanded access to electronic sources and networked information [18]. Eighty-seven percent (87%) of internet users have an internet-enabled mobile device [38]. This implies that well-informed and educated societies can be built more quickly than ever before [22].

2.4 Mobile devices and applications

In Nigeria, the growth of wireless infrastructures and mobile devices is tremendous [39 - 44]. Shapshak [45] opined that the adoption of mobile technologies in Africa's developing countries is among the highest rate globally. Forecasts estimate almost two hundred (200) million mobile users in Africa [46]. This is amidst the approximated 1.5 mobile phones in the world [47, 48]. This number is even said to be as high as 2.5 billion [49]. As observed by the Economist.com report [50], mobile phones were reported as reaching 3.3 billion, or half of the world's population [51]. In the survey conducted by Labrique et al. [52] and Gibson et al. [53], mobile phone ownership growth is increasing across the world. Consequently, this established the basis upon which mobile apps are being developed to serve the populace's needs, especially in the university community.

Josette [6] described the mobile application as "a kind of an application system delivered via mobile phone, it is a network-enabled convey of skills and knowledge". This application system can access information seekers anytime and anywhere, using internet service on a smartphone free of cost [54].

2.5 Mobile applications characteristics

Developers should test crucial mobile apps characteristics

during mobile application development. Apps must have small sizes, and a performance check should be carried out to test the app at the maximum memory limit of the mobile device [55 - 57]. Mobile apps should also have a small processing capacity [56, 58, 59]. RAM is another vital characteristic. The larger the app's size, the slower it runs [55, 60, 61]. Developers must further recognize screen size and orientation variation during app development and testing [61 - 64].

Other essential factors are battery-power consumption [55 - 57], mode of input and context awareness [65, 66], diversity in mobile connection [58, 67], operating systems [68 - 70], different hardware devices [55 - 57], interruptions from calls and messages [58, 70, 71], the response time [55, 57] and integration with other applications [58, 60, 72].

2.6 Agile and non-agile techniques for mobile app development

Types of agile techniques include: Adaptive Software Development (ASD), Dynamic Systems Development Method (DSDM), Extreme programming (XP), and Features driven development (FDD). Table 1 below reveals various approaches that have been proposed over the years by researchers for mobile application development, combining different agile and non-agile techniques.

Table 1. MAD Processes Using Agile and non-Agile Approach (adapted from [73])

SN	Mobile Process	Mobile Development Process Description	Authors and Year	Agile	Non-Agile	Remarks
1	Mobile D	An agile approach for Mobile Application Development	Abrahamsson et al. [74]	XP, Crystal	RUP	With the new architecture line concept proposed, an excellent framework can be produced and justified to guide a mobile app's entire development project in the future.
2	RaPiD 7	Rapid Production of Documentation - 7 steps	Dooms et al. [75]	AM	-	Provides support for human interaction in a co-design workshop to facilitate smooth software development projects
3	Hybrid: ME	Designing an Agile Methodology for Mobile Software Development - A Hybrid Method Engineering Approach	Rahimian et al. [84]	ASD	NPD	An improvement of the mobile development process with the included risk management procedure to develop a suitable mobile App.
4	MASAM	Development Process of Mobile Application SW Based on Agile Methodology	Jeong et al. [76]	XP	RUP, SPEM	Provides support for project management and follow up tool coupled with Eclipse Process Framework
5	Scrum	Scrum to support mobile application development projects in a just-in-time learning context	Scharff et al. [77]	Scrum	-	Commonly used widely in the industry as a framework for developing complex software products that are simple to understand
6	SLeSS	A Scrum and Lean Six Sigma Integration Approach for the Development of Software Customization for Mobile Phones.	da Cunha et al. [78]	Scrum	Lean Six Sigma	Provides support for project management and process improvement to develop a quality product.

2.7 Opportunities for mobile Apps in university communities

a. Mobile Supported Learning (M-Learning): Viewed from the educational perspective, mobile-based technology can enhance several applications in the universities [79]. As Pollara et al. [80] observed, undergraduate students do not only use mobile technologies for socializing, but they also spend lots of time on it for learning likewise.
b. For the educational system that provides learning opportunities, the expectation will be to know what kind of app is essential and most appropriate for development within the scope of available technologies [81]. Such an app can take care of the way course materials or lecture notes are delivered. It also creates on-demand study support whereby a student can quickly contact a lecturer if there is any problem

encountered during study or get in touch with any other coursemate to tackle problems together.

c. Academic Announcement: Researchers have proposed notification systems to help students with academic announcements during their stay on campus [82].
d. Result Dissemination: Josette [6] successfully implemented and designed a mobile application for the result dissemination system at the Catholic University of Rwanda.
e. News Tool: Patil and Koli [83] created a mobile computing environment that allowed students to track news on campus.

In summary, several types of research and development projects on mobile apps exist in the literature that used different development models. Patil and Koli [83] created a mobile computing environment that allowed students to track news on campus in the same vein. It was called CollegeSync. The campus news feed offered varying granularity levels. The system was broken into small parts; there will be a hierarchy level from students to faculty and faculty to principal. It enables users to have up-to-date information anywhere once they have the app installed and an active internet connection. If the website provides updates, all that is needed is to install it on an Android phone with an active internet connection. A user can then use any CollegeSync, which checks for updated content frequently and displays it to them. The system was developed using PHP, MySQL, Android, and Google Cloud Messaging (GCM). Because the application was built using Google Cloud Messaging, which is now deprecated. That functionality is no longer available as the application required this tool to push notifications. Besides, the application also lacked excellent User-Interface and User-Experience; this hindered its widespread adoption.

Dhulia et al. [85] developed an Android application that provided a collaborative communication system within the campus, aiding everyone's participation– students and lecturers alike. However, this Android application was built on the Android 3.0 version of the Android operating system, which is no longer supported. Apart from this, the student needed to open the app every time and click on the "Enable Alert Mode" button to see notifications. This means that any student who does not open the app and click on the button would not be aware of new updates or notifications from the admin.

3. MATERIALS AND METHODS

The qualitative research approach was adopted in this paper. Students, lecturers, and other stakeholders in the University community were used as respondents. In particular, fifty-five (55) students from Obafemi Awolowo University (OAU), Nigeria, across the different faculties and departments, thirty-five (35) lecturers, twenty (20) non-teaching staff, and eleven (11) software developers within the university community were randomly selected for the study. The students, lecturers, and non-teaching staff provided insight into how ICT can alleviate the problem of information dissemination in the University community. On the other hand, the software developers provided further insight into the suitable ICT tool and development model to implement the solution.

3.1 Facilitated application specification technique (FAST)

A methodology based on the Facilitated Application Specification Technique (FAST) was followed in this study. FAST encourages a team of users and developers to identify an existing system's problems, suggest likely elements of the solution. It also identifies and agrees on the most suitable approaches and lays down the first set of requirements for the proposed solution [86].

3.2 Requirements for planning and gathering

For the first stage of the event, the first, third, and fourth authors randomly selected the 55 students, 35 lecturers, and 20 non-teaching staff for interaction and discussion at different times. Also, 11 software developers within the university community were invited for technical interaction and discussions. At this stage, the problem statement and an outline of points to be discussed were available for the interaction. After that, the second author was consulted to provide expert information from an educational management perspective on how a mobile app can facilitate quality learning through lecturers' information. At a later time, a form was sent out to the system's intended users to make their product request. After collating all the lists and trimming out unnecessary elements, the system requirements– which include the students' and staff members' names and IDs, the mobile-based graphics user-interface, the web-based graphical user interface, the database to save updates and users' information– were collected. It was also ensured that the system had low data consumption. Not only was it user-friendly, but also lightweight and fast.

3.3 System design specification

In this phase, the application, network, user-interfaces, and databases are designed using the Unified Modelling Language (UML) tools. The initial design is the mobile app and web app architectures shown in Figures 1 and 2, respectively. Both figures serve as the design blueprint for the app. We used both architectural design structures to represent the system's various components and the relationship between the components. Besides, the architectural designs were also used as a communication vehicle among developers and selected end-users.

Furthermore, Figures 3 and 4 show the use case and activity diagrams, respectively. Both diagrams were used to model the system and represent the core functions and sequence of activities that can be performed by the end-users

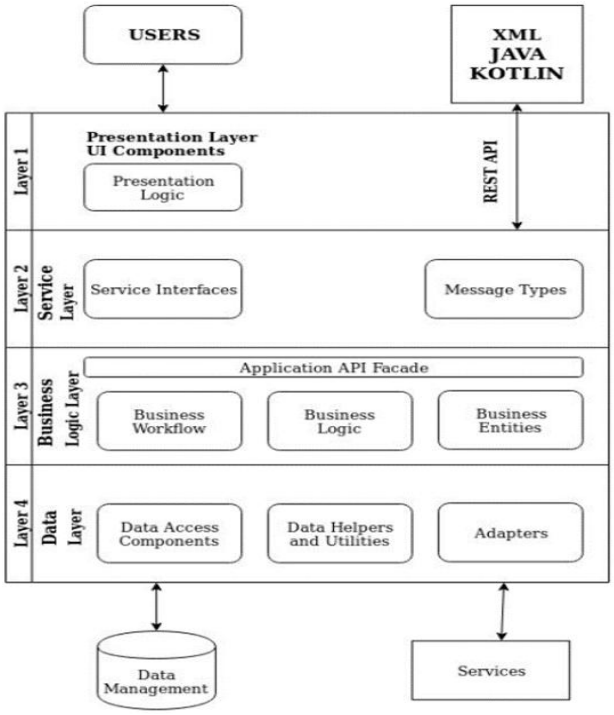

Fig 1: Mobile platform system architecture

Fig 2: Web platform system architecture

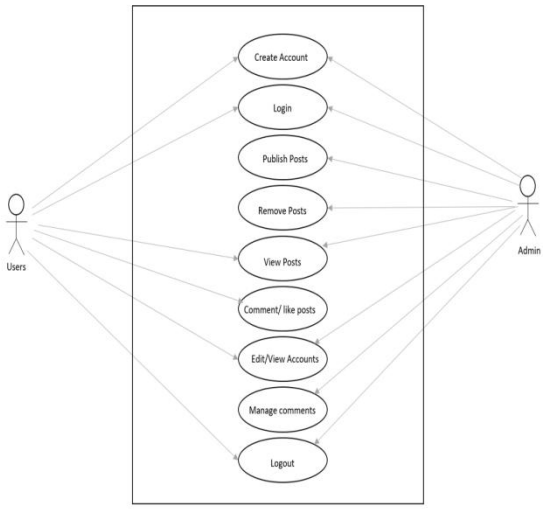

Fig 3: Use case diagram

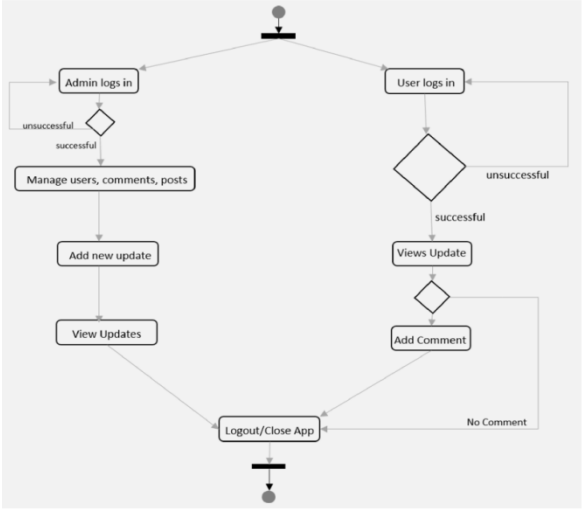

Fig 4: Activity diagram

As Figure 3 reflects, the use case diagram represents the basic requirements for implementing the mobile app. In particular, two actors (users and administrators) are identified in the use case diagram. Some of the identified roles of the user are as follows: (i) the user is authenticated into the system through the Android app; (ii) the user is shown the most recent updates in a listview, with the most recent at the top of the list; (iii) the user can check the details of an update by clicking on it in the list view; (iv) the user can add a reaction to an update. In this case, the reactions can only be a like or a comment. For the administrator: (i) an administrator can manage updates, that is, add an update, edit or remove an update; (ii) the administrator can view and manage the user's account; and (iii) the administrator can manage comments. These are a few of the elicited requirements gathered for the system.

For the activity diagram in Figure 4, the user and the administrator's sequence of activities is shown. The activity diagram begins with the initial stage, where the user logs in. If the login is successful, the user is taken to the next activity. If login fails due to wrong credentials, the user cannot proceed to the next activity. Upon successful login, the user can view the updates starting from the most recent to the oldest. If the user has a comment or reaction (like), it is sent on the post; but if not, then the user can move to the next activity or decide to close the app. For the administrator, the initial stage for login is also required. Upon successful login, the administrator will see new notifications of users, comments

and reactions. The administrator can manage new users and new comments, add a new update, view the added updates, edit new and existing updates, and delete old updates if necessary. Finally, the administrator closes the app/logout.

3.4 Software requirements

Adobe XD was used to simulate mobile and web apps' look and feel with graphic elements before they are finally developed. This mainly helps to abstract developers from repeated development and revisions because of the user's request as development only begins when users have experienced how the app will look and feel at the design stage in Adobe XD.

Android Studio Integrated Development Environment (IDE) was required to develop the mobile application for the users of the system. JetBrains WebStorm Integrated Development Environment (IDE), commonly called WebStorm, was used for the development of the web-based and server-side based apps of the system. Node.js was used on the server to run the server-side app that is developed in Node.js. Lastly, Firebase, which is one of the essential tools used in this project, was used to provide a single backend from which the users, on the mobile app, and the admin, on the web app, can interact with the same services through the use of APIs. Firebase provided cloud storage, cloud functions, authentication, hosting, and real-time database.

3.5 Construction and prototyping

In this phase, the design and code were generated based on the system requirement using the design phase model. Iteration was minimized in this phase because the model implemented in the design phase is usually user-approved. Hence, implementation in this stage was swift, and testing was enabled.

4. SYSTEM IMPLEMENTATION

The prototype system had two main components: The Android application for the end-users and a web-based application for the system administrator. The system's two components are also structured into two main parts: the frontend and the backend. The frontend has the graphical user interface (GUI), which presents a user-friendly window that allows the user and the administrator on their respective components to interact with the system. The system has a central backend that houses its functionalities, operations, and dynamism.

The technologies used for developing the user's frontend are Flutter– one of Google's user-interface tools for developing applications for the web, mobile, and desktop platforms from the same codebase, and Extensible Markup Language (XML). The admin frontend was developed using Hypertext Markup Language (HTML) for creating web pages, Cascading Style Sheet (CSS) for describing the presentation of a document written in a markup language, and JavaScript for traversing and manipulating web pages. The technology for the backend is Firebase, Google's real-time database, and backend service. Besides, the implementation was on a 64-bit Windows 10 Pro Operating System (OS) with an Intel(R) Core™ i7-2670QM CPU @ 2.20 GHz processor and 12GB RAM.

4.1 Frontend – Graphics User Interface (GUI)

The different pages of the system are hyperlinked. This causes navigation between the different pages of the system to be easy for both the user (on mobile) and the administrator (on the web). The mobile app GUI consists of the account creation and login page where the user is authenticated. The home page shows new updates. An update details page shows the full details and text of the updated news item, and of course, a landing page, the first page the user will see when the app is launched. Figures 5, 6, 7, and 8 show the create account and login page, home page, landing page, and details page, respectively.

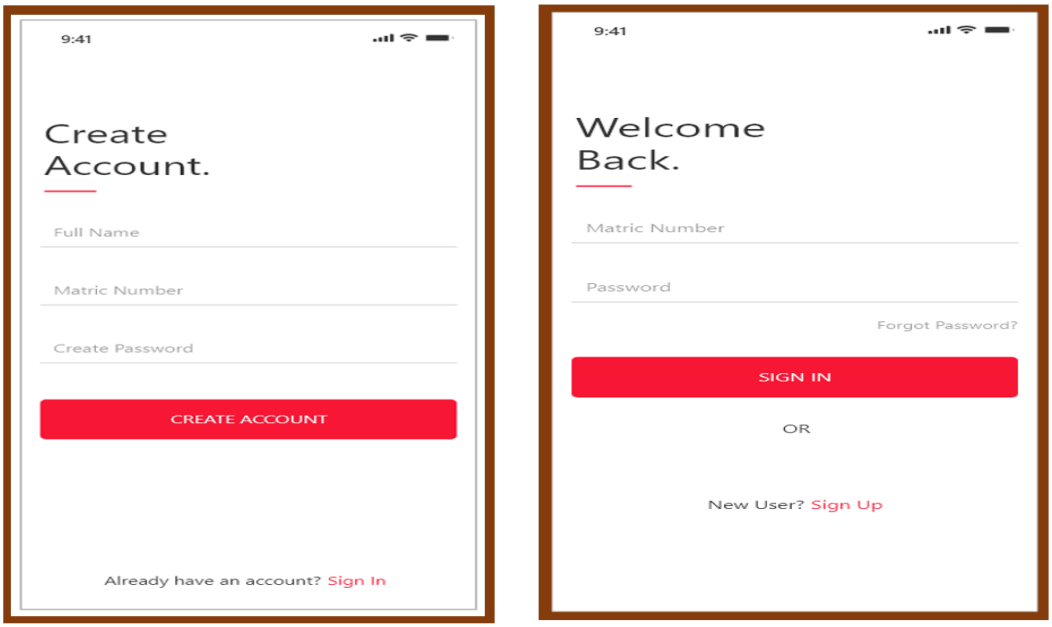

Fig 5: Create an account and login page

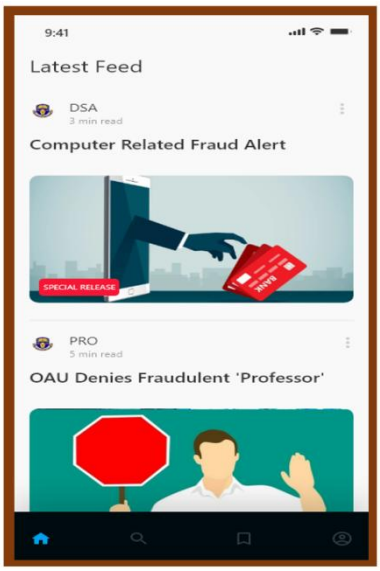

Fig 6: Home page

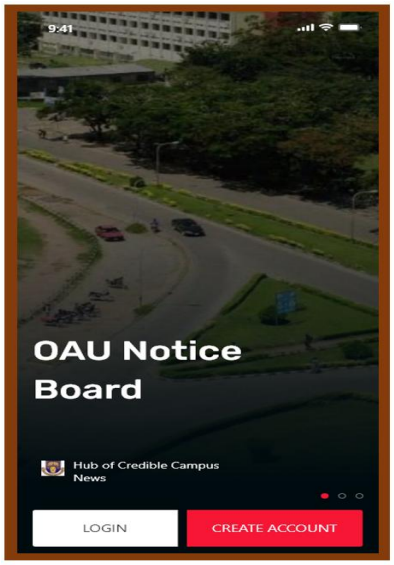

Fig 7: Landing page

Fig 8: Details page

On the other hand, the web app GUI for the system administrator has the login/signup page to authenticate identity before access into the system, as shown in Figure 9. Next is the dashboard page, where the system admin can view all news and updates on the system, as shown in Figure 10. Here, the admin manages all news, posts, and updates. As Figure 11 shows, the system admin can add a new news update to the system. When the admin adds a new item to the system, it automatically synchronizes at the users' end on the mobile app. Managing the users and their roles is the sole responsibility of the system admin. As Figure 12 shows, the system admin can manage other system users by editing the roles assigned to the different categories of users represented on the system. As part of the system admin responsibility, a user can be deleted. At the same time, the user's information can be updated. Similarly, Figure 13 shows the profile page where the system admin views and manages his/her profile.

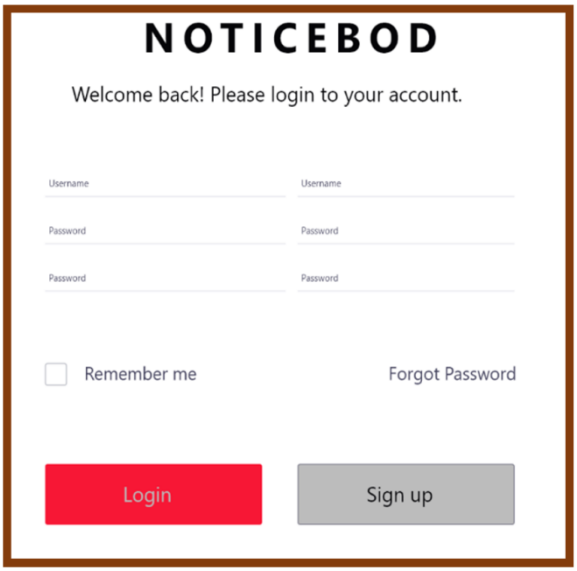

Fig 9: Admin login/signup page

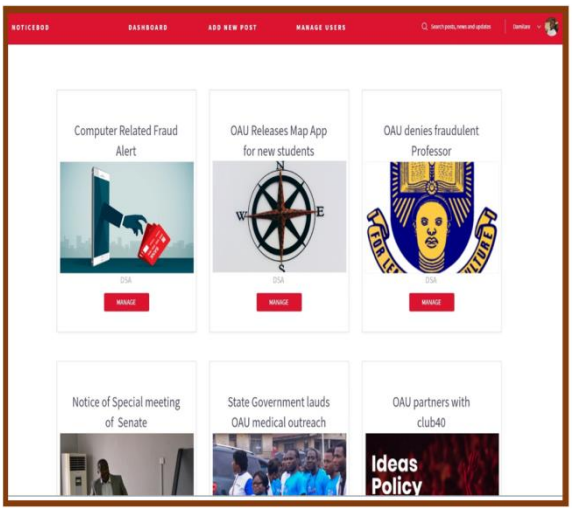

Fig 10: Admin Dashboard

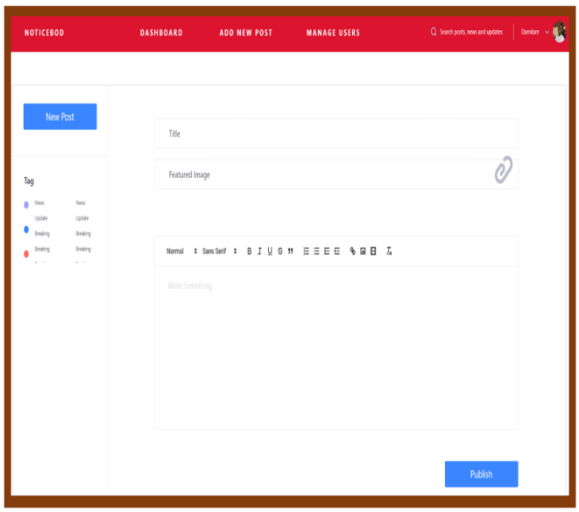

Fig 11: Add new post page

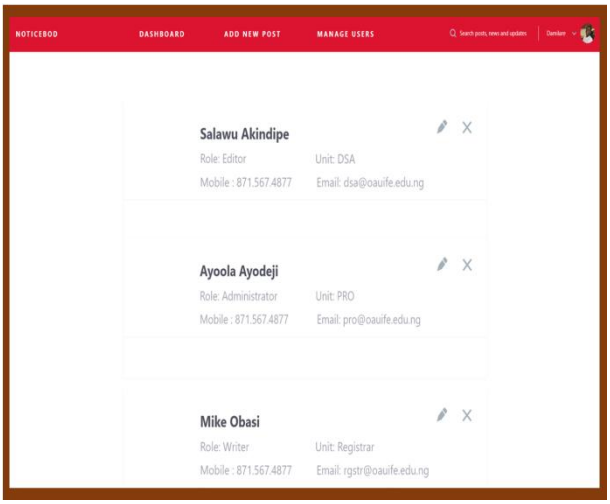

Fig 12: Manage users page

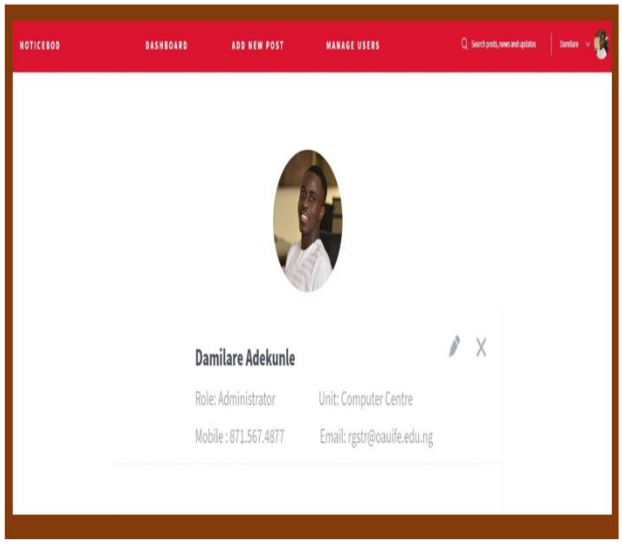

Fig 13: Profile page

4.2 Backend – Graphics User Interface (GUI)

The backend controls the routines and operations of the system, as specified by the developer of the system. The backend was developed using Firebase, Google's real-time database and backend as a service. The administrator component's communication with Firebase was written using JavaScript, and the users were written using Dart.

5. SYSTEM TESTING AND RESULT

Alpha testing was carried out at every phase of the system development to ensure that all the system modules functioned as expected. Furthermore, beta testing was carried out. With beta testing, the system's potential users were given access to the system to use and provide their ratings based on specific criteria. These criteria include: (i) app stability- to measure the crash-ability of the app, that is, to know if the app crashed on the user's device or not; (ii) user-friendliness- to measure the user's interaction with the system and how well the user can make meaning of the entire system and its functionalities; (iii) speed- to measure how quickly the user can retrieve information from the backend, especially on the home page, and the details page; (iv) data consumption- to measure how much traffic is generated for each meaningful use of the app, (v) performance- to measure the overall performance of the app on the device, compare to other apps, in terms of size and stress freeness; and (vi) assurance- to measure the confidence level of the user in the credibility of the news from the app.

The rating was taken from a measurement scale of "strongly agree" to "not agree" based on the Likert Scale Survey Questions [87] by using an online form. The short questionnaire was used to receive a response based on specific questions that were asked about the criteria listed above. This was used to determine if the system met the requirements that were stated initially. The random sampling technique was used to select the users within the community, and the response obtained spanned from undergraduate students to postgraduate students and staff members in the university. The results harvested from the users who filled in the form are shown in Table 3 and are graphically depicted in Figure 14.

Table 2. Testing Result with Hundred (100) Users

	App Stability	User Friendly	Speed	Data Consumption	Assurance	Performance
Strongly Agreed (%)	90.0	60.0	17.0	80.0	93.0	20.0
Agreed (%)	10.0	36.0	80.0	20.0	7.0	70.0
Fair Agreed (%)	0.0	4.0	3.0	0.0	0.0	10.0
Not Agreed (%)	0.0	0.0	0.0	0.0	0.0	0.0

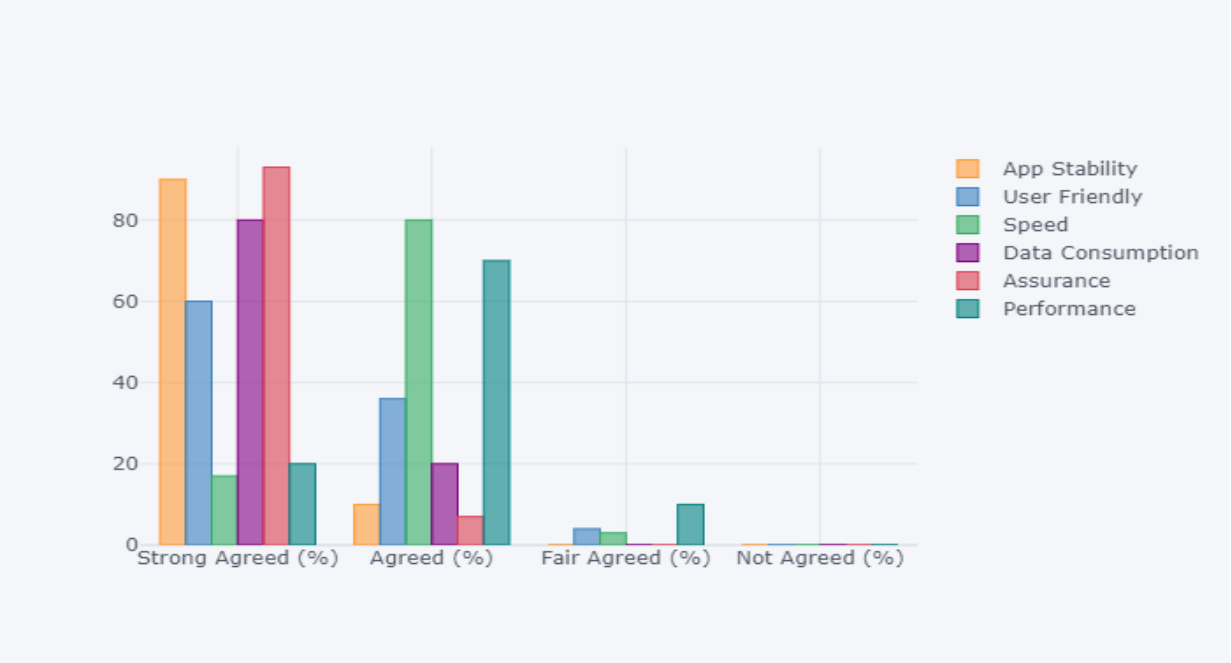

Figure 14: Test results graph

6. DISCUSSION

As shown in Table 2 and Figure 14, a random sampling of hundred (100) users was carried out in OAU. 90% of the users strongly agreed that the app is stable and did not crash on their device. 60% strongly agreed that the app is user-friendly, which the remaining 36% just merely agreed with the user-friendliness of the app. 17% strongly agreed that the app is fast, which a more significant percentage of 80% also agreed. The remaining 3% somewhat agreed that the app had good speed on their device. 80% of the users strongly agreed with the app's data consumption, and the remaining 20% agreed that the app consumed less data with respect to other apps of similar nature. 20% of users strongly agreed with the app's general performance on their device, and 70% also agreed. The remaining 10% fairly agreed with the performance of the app on their device. Suffice it to say, the system provided real-time updates from the administrators in a most comfortable manner for the system users.

7. CONCLUSION AND FUTURE WORK

This paper focuses on the building, testing, and distribution of the mobile app that would make information dissemination easier and more accessible for a university community. This app's primary purpose is to stand as a source of credible information for members of the university community, especially students. The system developed has enabled users of the credibility of news disseminated to them first hand on their mobile devices. The design methodologies were achieved using the unified modeling language (UML). The implementation was done using Android, web, and backend technologies.

In the implementation of this project and interpretation of the results from the testing, it is clear that a mobile-based system for information dissemination was accepted by over 90% of users, who believed that such a platform would help mitigate against fake and incredible news. A conclusion like this is arrived at because the information that use to go many steps and pass through many hands before reaching the final user can now reach the users directly.

Furthermore, with the mobile and web apps' implemented features, it is recommended that the app is used by members of the university community, primarily to facilitate effective learning and to keep abreast of timely and relevant information. This will help the students and the lecturers' relationship and help the students reach out to their lecturers and colleagues easier and faster.

This study can also be extended in the future by making the user's app available on other mobile platforms like iOS, Windows phones since mobile phones play a vital role in human development [88]. Again, more work in this direction is required to test further the reliability and scalability prowess of the implemented app.

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