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Institutionalizing Social Network Solutions in Tertiary Educational Institutions

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Abstract
As in other socioeconomic spheres, social networks and media are veritable tools for education as they provide easy channels for information and knowledge exchange and their trendy nature make them very attractive and portable among the young and old. However, these applications are fraught with security challenges ranging from surveillance to invasion of privacy and unwarranted tampering with user data regardless of the seemingly impressive underlying rights of users as claimed by the vendors as to user accounts. Various vulnerabilities are reported daily as well as data leaks. There appears to be no end to these unwarranted infringement on rights of users. Sadly, majority of the popular social networking platforms irrespective of their modus operandi are guilty of this silent crime. Users of such applications are often carried away with flashy features without paying reasonable attention to the security and privacy of their data. In many cases users appear to have relinquished their privacy rights to these platforms owing to the fact that many users who suffer data breaches are either ignorant of such or may not have the wherewithal to challenge the vendors through legal actions. Interestingly a large chunk of users are unaware of their fundamental rights on such platforms. This paper underscores the relevance of social networks and social media in tertiary education vis-à-vis the popularly used social networks and advocates for the evolution and institutionalizing of specific tertiary education social network (TESN) that captures the unique demands of students and lecturers. The rapid application development paradigm is used to demonstrate a prototype of a TESN that ensures privacy and security of user data. It is concluded that this application presents a comparative performance while offering institutional data protection, privacy and security of user data.

Keywords: Privacy, Security, E-learning, Security, Social Media, Social Network

1. INTRODUCTION

Social networks (SNs) and media(SM) platforms are increasingly gaining acceptance and relevance in recent years due to the proliferation of and affordability of internet enabled devices such as smart phones, tablets, phablets, computers, and other innovative platforms. SNs such as myspace, facebook, twitter, instagram, whatsapp, telegram, linkedin, etc. are potential examples and it is estimated that 2.95 billion people used social media globally in 2019(Ortiz-Ospina, 2019). According to statistical projections (Ortiz-Ospina, 2019) the number of users is expected to hit 3.43 billion by 2023. SNs recorded a penetration of 49 percent as at January 2020. SNs are the single cause of network-centric data explosion across different climes and jurisdictions. Figure 1 shows the strengths of the popular SNs in second quarter of 2020.

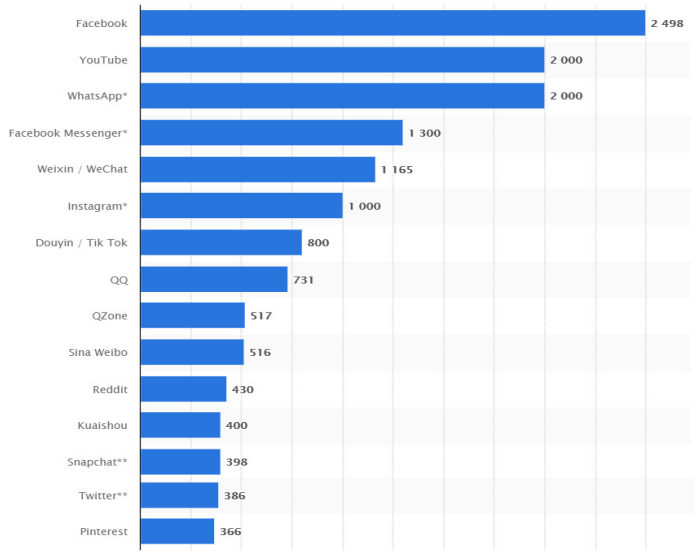


Figure 1: Number of active accounts in millions [source: Clement, 2020]

1.1 Social Network

SNs may be defined in the following perspectives:

a. Social interaction e.g. Facebook, Whatsapp, etc.
b. Content sharing such as Flickr, etc. Content sharing SNs also support extensive social interaction.
c. Messaging and communication solutions e.g. Telegram, Skype, etc.

SNs are somewhat difficult to define owing to their interdisciplinary nature. The sociologist's perception of a SN would certainly differ from that of a computer scientist. The same is true for a broadcast journalist. According to Charu (2016) SNs represent network of interactions and relationships with the nodes reflecting the actors whereas the edges signify the interactions between the actors. Ideally, SNs are special information networks (INs). These special INs may be defined by nodes and edges. The nodes represent actors or the users. The edges are simply the various relationships or interactions that may exist between the actors.

According to Carton (2009), the development of SM is laden with several ideas and histories consequent upon the myriads of mechanisms and tools that had been deployed for social interaction over centuries. It should however be noticed that while some of these tools are purely mechanical, some are semi-automated while in the subdomain of electronic platforms there are also different degrees or features that could be used to categorize them further with respect to their individual sophistication. It is noted that the earliest development is traced to 1792 during when telegraph was used for the transmission and reception of messages across distances spanning hundreds or thousands of miles (Jasra, 2010). In the early 1800s, Emile Durkheim and Ferdinand Tonnies, both sociologists pioneered the concept of social networking. According to Tonnies social groups are very relevant in any society as the society is characterized by humans who share same or similar value and belief systems or even conflict. This was the underlying reasoning in Tonnies' theory on social contract conceptions. A remarkable development that changed social interactions later in 1800s was the telephone and the radio though the radio communication was half-duplex allowing one-way communication only(Boyd, 2007).

SN tools have age-long applications in tertiary institutions (Nwankwo and Njoju, 2020; Tosun, 2018; Skendžić and Devčić, 2017; VenkoAndonov et al,2015). A typical example is Usenet. Usenet evolved at the University of North Carolina in 1979. It operated as a distributed discussion newsgroup wherein users could create and post messages which other users would read and react to. It affords users the platform to exchange their opinions. This was superseded in 1984 when Bulletin Board System gained acceptance by users across various spheres including the academia. With the emergence of the web in 1991, there was a sort of liberalization on the evolution of various species of online forums. A popular variant among these early SNs is *Friendster* launched in 2003 by Jonathan Abrams. This was closely followed by LinkedIn which commenced operations in 2002 but was launched in May 2003. *MySpace* followed in August 2003 and later emerged the first SM to hit the one million monthly mark in active user accounts in 2004.

These tools receive serious patronage globally (Ortiz-Ospina, 2019) as they continuously promote the collapse of traditional social and geographical boundaries. Their popularity may have led to the emergence of Facebook in 2006 which now hosts over 2.6 billion accounts monthly (Clement, 2020). With this number of active accounts on a monthly basis Facebook has emerged the most successful SN platform. Over the years there has been a somewhat astronomical growth in the use of SN platforms as internet cost declines with proliferation of mobile, portable internet-ready, and smart devices.

Education is a major sector in every economy and in recent times, virtual and online education are receiving much attention (Nwankwo, 2018). This is further enhanced by the covid-19 pandemic, which is subjecting all TEIs to unconditional adoption of blended learning with virtual lectures and labs emerging relatively satisfactory in the delivery of courses. With the aforestated development, there is no gainsaying that the world is heralding a new era that would be markedly tied to the internet and smart devices. Though mobile devices are in every nook and corner of our society, TEIs in developing countries like Nigeria in West Africa and Uganda in Eastern Africa are confronted with challenging socioeconomic maladies including poor infrastructure, power supply, corruption, nepotism, mismanagement and misappropriation of public, culture of resource fraud and misrepresentation, entrenchment of mediocrity, etc. These challenges in some way affect institutional adoption of specialized or customized virtual platforms to support its activities as funds meant for infrastructure acquisition could easily be misappropriated and subsequently embezzled. It is instructive to note that amid the persistence and prominence of these perennial challenges, there has not been a reflection of same in the scores awarded to most institutions by the respective national quality assurance agencies for TEIs such as the National Universities Commission (Nigeria), National Board for Technical Education (Nigeria), etc.

This paper is directed towards evolving a suitable model for TESN platform which could be easily customized, owned, and maintained by a TEI to promote learning beyond the classroom while ensuring security and privacy of communications in the platform unlike the existing publicly available social platforms. The objectives are:

a. To examine the relevance of various social network platforms in tertiary education
b. To develop a system tailored to supporting learning and interaction within and beyond the geographical location of the TEI while eliminating the security risks and leaks prevalent in popular social networks.
c. To improve the security, and privacy of users through the adoption of conditional user-specific signature while relaying a message or multimedia through a SN or SM network. This would prevent illegitimate alteration and data hijacking where the user deems the message or information sensitive.

1.2 Social Media and Social Networks

Social Media(SM) is a strategy and an outlet for broadcasting, while SN is a tool and a utility for connecting with others (Nwankwo, 2018, Cohen, 2009). Cohen (2009). The distinguishing factors between these technologies revolve around their features and functionalities. Hartshorn(2010) notes that the differences are distinctive as SM connote means of information sharing or exchange across a broad audience whereas SN provides a medium through which social engagement otherwise called people engagement occurs especially among those with common interests within a given community. In a similar vein, the style of communication in both platforms are different (Bedell, 2010). Another factor that has been cited as a potential differentiator is the return on investment, Hoffman and Fodor (2010) note that determining the ROI for SM is difficult whereas the ROI from SN could be easily estimated. Furthermore, SM and SN do not share same response times. SN offers real-time message exchange and are more flexible with respect to alteration in messages and information communicated (Nwankwo, 2018; Nations, 2010). However, recent platforms such as Facebook appear to have gone beyond these distinctions by emerging as hybrid solutions, which offer features available on both SNs and SM platforms. In this paper, we use SN as a collective representative for hybrid solutions.

1.3 **Benefits of SM and SN**

a. Enhance liberal communication across different groups, social classes, and individuals in educational institutions irrespective of location.
b. Promote collaboration on projects for project teams.
c. SM promotes quality content, through webcast, videos, and other multimedia content in addition to text messaging.
d. Enhance relationship between existing and prospective clients, students, customers as it enables active and passive communication of feedbacks, programs, course offerings, information on products, product development, customer services, support, etc.
e. Promotes social relationships.
f. SM offers a right platform for discussions, marketing, adhoc information flows, etc.
g. In TEIs, both tools provide interesting support platforms for group and person-to-person interaction on real-time in various formats e.g. lecture videos, simulations, notices, lecture notes, presentations, etc.

1.4 Shortcomings of common SN Platforms

In addition to the challenges stated earlier, popular SNs pose social and health challenges, which are discussed briefly.

1.4.1 Misleading information

So much information are shared by groups and individuals via social networks, some which are not verifiable hence, their authenticity and reliability cannot be ascertained. This fake information often misleads the people and create problems within society. Fake news can go viral in no time on social network platforms and actions may be taken based on them, which would boomerang later.

1.4.2 Addiction

Addiction to these tools is widespread. This syndrome is characterized by compulsive engagement in social activities on SN platforms despite adverse consequences. The use of SNs is increasing by the day (Pontes, Taylor, & Stavropoulos, 2018) and addiction seem to follow same pattern. Addiction is counterproductive in all respects and popular SNs and SM by their philosophy seem to promote addiction among young people. With the incorporation of some of these applications in android and IOS stock in most smart phones, users of such devices unconsciously and compulsively attach themselves to them. The common highly addictive applications include Facebook, YouTube, Whatsapp, Instagram.

1.4.3 Invasion of privacy

Vital information are exchanged through SNs and SM platforms. With the centralization of data management, and the inability of the user to control the information flow from the point of generation through storage, there are more data breaches, which could lead to loss of valuables, reputation, and even life. The social behavior as conveyed on SNs reveals lifestyles of many users and many cybercriminals and kidnappers have exploited such to inflict havoc on persons. The vendors also exploit user data for their selfish gains.

1.4.4 Mental illness

A wide range of mental disorders especially those that influence the mood, thinking, and behavior. Have been traced to SNs and SM. Such mental challenges includes depression, anxiety disorders, etc. Research has shown

that long stay on social networks causes loneliness and isolation, which eventually leads to depression and anxiety (Kim, et. al., 2020, **Robinson & Smith, 2020) as well as** low self-esteem (Pantic, 2014).

1.5 Institutionalizing SN platforms in TEIs

Technology adoption is a crucial decision across several socioeconomic circles. The same is true for SNs and SM. As these tools become indispensable with their attendant security and privacy issues including intrinsic social surveillance and data breaches TEIs must plan towards domesticating or customizing solutions that would be used in their respective environments. This would curtail excessive exploitation on existing platforms such as Facebook, Whatsapp, etc. TEIs must note that control over their data and activities is an important decision factor in adopting a technology and that regardless of how satisfactory or sophisticated the existing public SN and SM tools appear to be, their vendors do have some predetermined exploitative mindset towards exerting control over the subscribers, data, activities, etc. Irrespective of what these vendors claim, the users actually do not have what it takes to exercise absolute control over their activities and data. Adopting a specialized or domesticated solution would help prevent such exploitations.

2. METHODOLOGY

The rapid application development (Nwankwo et al, 2020) employing a thin object-oriented approach (Nwankwo and Ukhurebor, 2020, Umezuruike, et al 2020) that offers a quick decomposition of the system including the requirements engineering, design and implementation phases. UML tools are deployed to give meanings to real-life actors and other objects involved in the workings of the system. Emphasis would be made to the proposed system especially when evolving specifications, whereas it is assumed that the previous sections had captured the existing situation in the TEIs especially in Nigeria and other jurisdictions within the sub-Saharan Africa.

Using this methodology**,** the problem domain is disintegrated into subcomponents and which are subsequently expressed by way of logical structures called objects. The objects are further differentiated to enable the definition of "who does what?" and "What receives what?" This makes it easier to add functionality and behavior and allow the system gracefully adapt to change.

2.1 Materials

The following pieces of hardware were used:

a. HP Elitebook G2 series@ 2.7GhZ, 16GB RAM; Microsoft Windows 10 OS
b. Techno 9D tablet

The software components used are free and does not impose any cost on the design and/or implementation. They include:

a. Microsoft Visual Studio 2019(community)
b. Net Core SDK 2.2
c. ASP.NET Core
d. jQuery
e. Xamarin.Forms
f. MongoDB

2.2 Sources of data

Observation and a posteriori knowledge constitute the major data sources. Experiential knowledge was relied upon significantly owing to author's extensive knowledge on modern practices in public and private TEIs in Nigeria and Uganda. Student-teacher interaction in at least 20 TEIs within Nigeria and Uganda were duly examined.

2.3 Analysis of the existing system

The activity diagrams in Figures 2 and 3 respectively how information flows in an average TEI, notice that a University is used in this case. For other TEIs like polytechnics, and colleges of education, the difference is not significant other than the nomenclature in the offices in respective establishments. The various objects are depicted using the context common nouns: University, Lecturer, Student, Registry, Bursary, etc. The information flow is represented by way of arrows from one object or activity to another. The existing system reflects a traditional information system where information originating at one point in the system is communicated by way of paper-based memos, notices, meetings, information boards, extracts, etc.

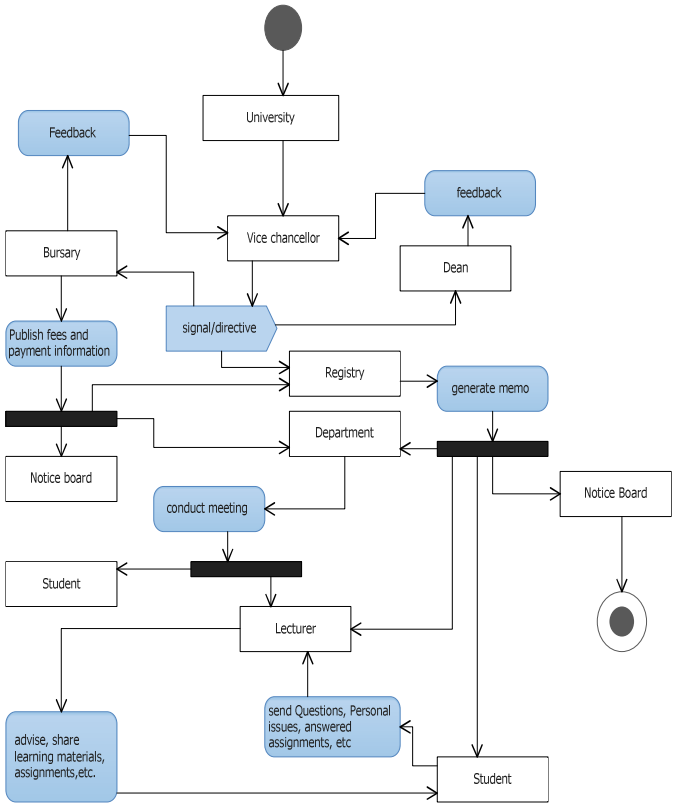


Figure 2: Activity diagram of the existing system

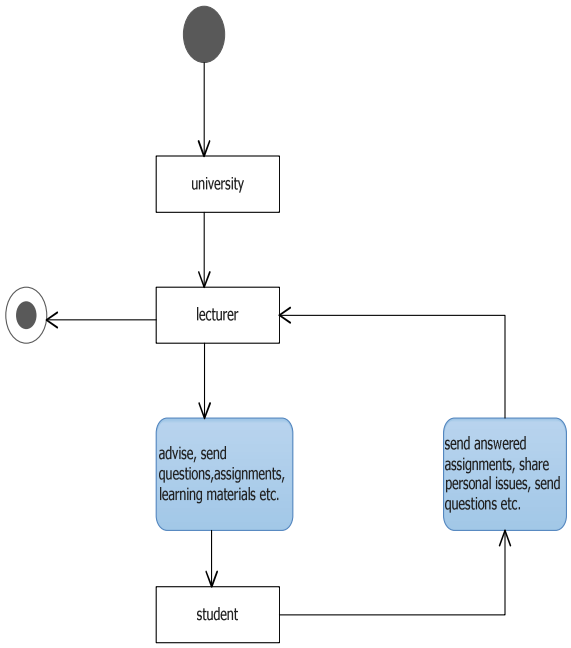


Figure **3:** Activity Diagram showing communication exchange between lecturers and students

2.4 Analysis of the Proposed System

Use cases are used to depict the various functionalities expected from the proposed institutionalized SN. The use case diagram reflects the user's activities i.e. a high level behaviour of the system. Figure 4 is the use case diagram of the user behaviour on the proposed system. It shows the actor (user) and the various use cases. The arrows in the diagram illustrate the flow of data and interaction between the actors and their use cases. The actor tagged 'user' is a 'generalized' participant and may be further 'specialized' into the following: *student, lecturer, assistant*, etc. Several use cases that describe various actions the user could perform are indicated in Figure 4. These actions include: signing up, creating an entity (study group, research group, message, lecture board, etc.), sharing materials (lecture note, assignment, contribution, seminar, presentation, tutorials, past exam questions, etc.), updating and deleting an entity, activating security/privacy mode, disengaging from a group, platform, etc. The use case diagram also shows relationships between individual use cases. For example, there is an "include" dependency between the use case 'signup' and 'validate data'. The implication is that every signup activity is automatically followed by a validation activity. Figure 5 shows the moderator behaviour on the system.

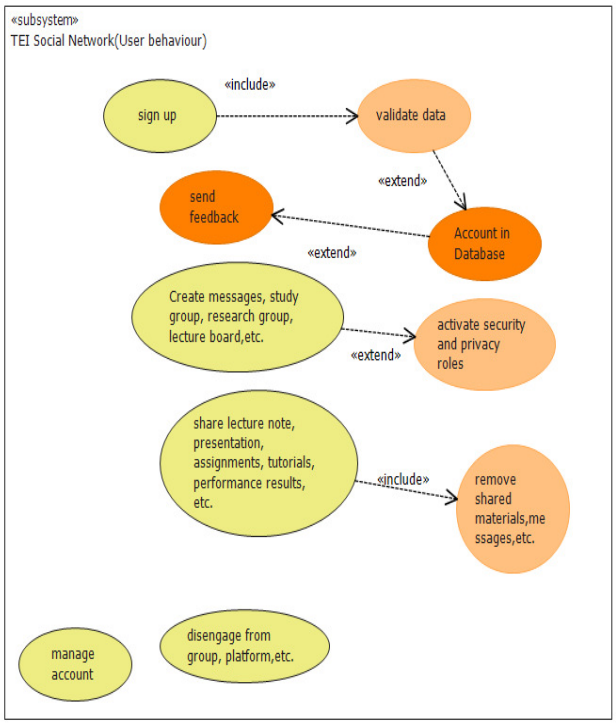


Figure 4: User behaviour Use case diagram

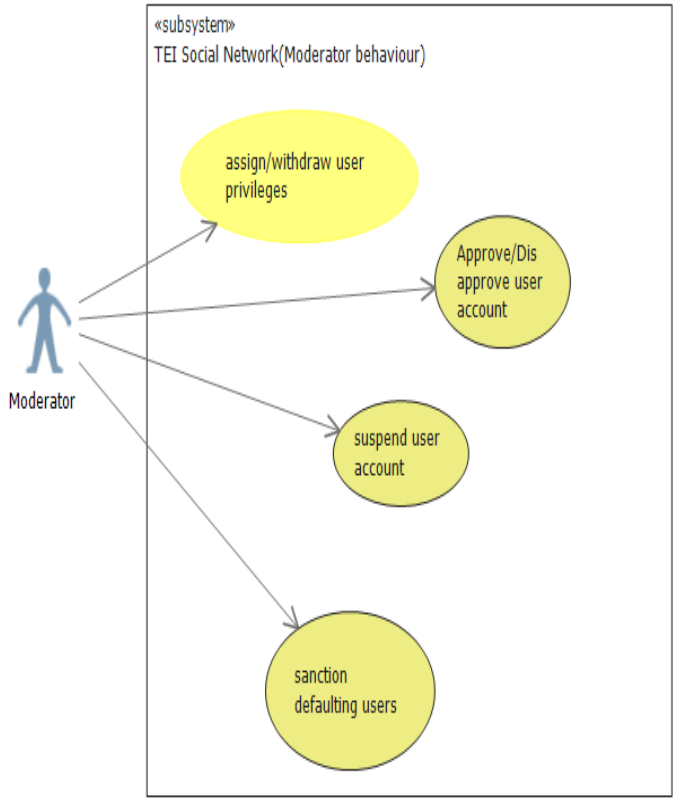


Figure 5: Moderator/Admin behaviour Use case diagram

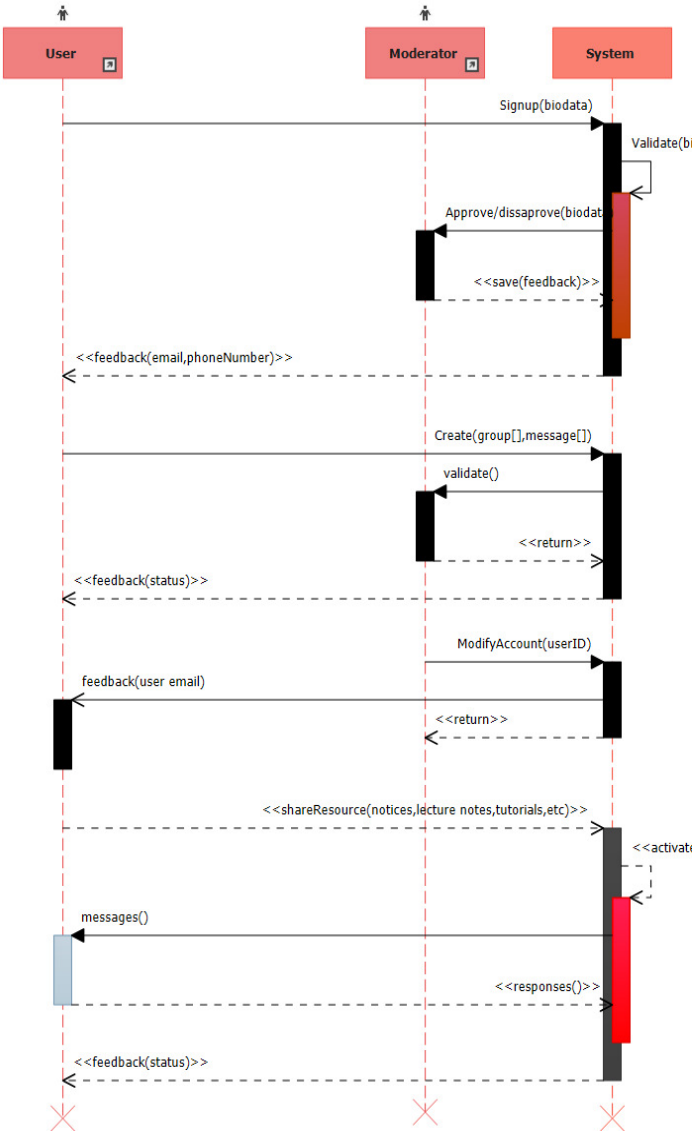
Figure 6: Interaction among participants on the system

3. Discussion

In section 2, a high level behaviour of the system was presented. In this section, the behaviour of the proposed system is further simplified through sequence diagrams and class diagrams respectively. This section also presents the user interface specifications as well as some elements on the implementation of the system.

3.1 Interaction in the system

The interactions in the system is depicted in Figure 6 using a sequence diagram. The sequence diagram shows the information flows in the system. However, this sequence diagram in Figure 6 contains high-level interrelationships among the various components. These would be further simplified using class diagrams in figure 7.



3.2 System structure

The system structure is presented at two levels: high and lower level using the component diagram (Figure 7) and class diagram (see Figure 8) respectively. The high level structure shows the logical organization of the system into menus. Each menu may have one or more submenus. The backend is a NoSQL database. The class diagram shows the various objects and their interrelationships. The generalized 'user' is disintegrated into its specialized child objects: student, lecturer, and assistant respectively using inheritance relationships. The 'moderator' is also captured as a child of the 'user' object. The attributes and methods are specified. These objects would be implemented as *collections* in the database thereafter; the attributes would be translated into fields whereas the methods constitute actual method in class implementation in the application program.

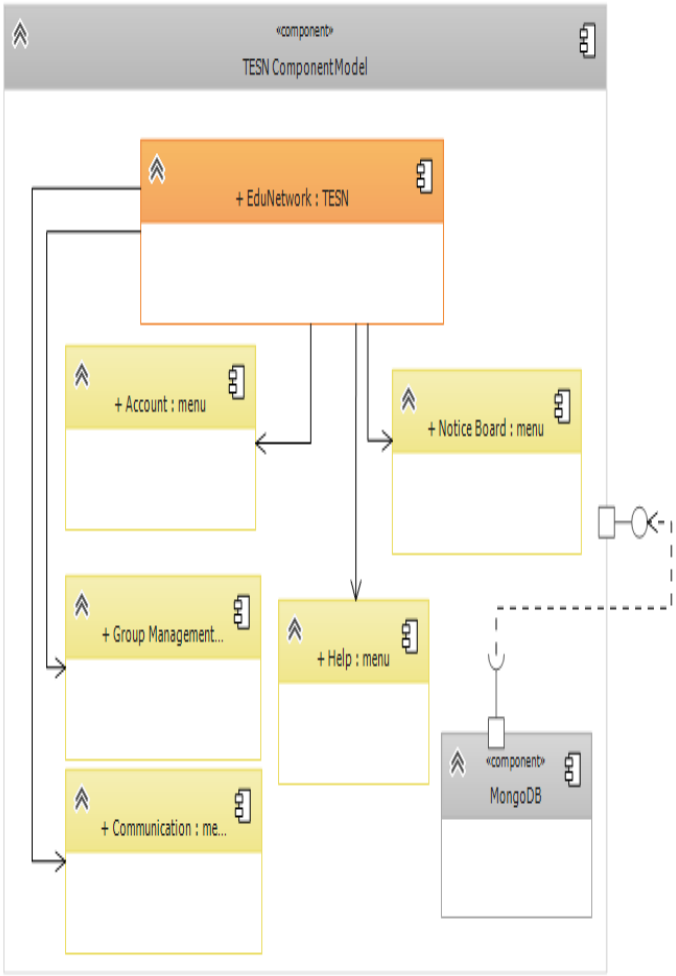


Figure 7: System structure at high level

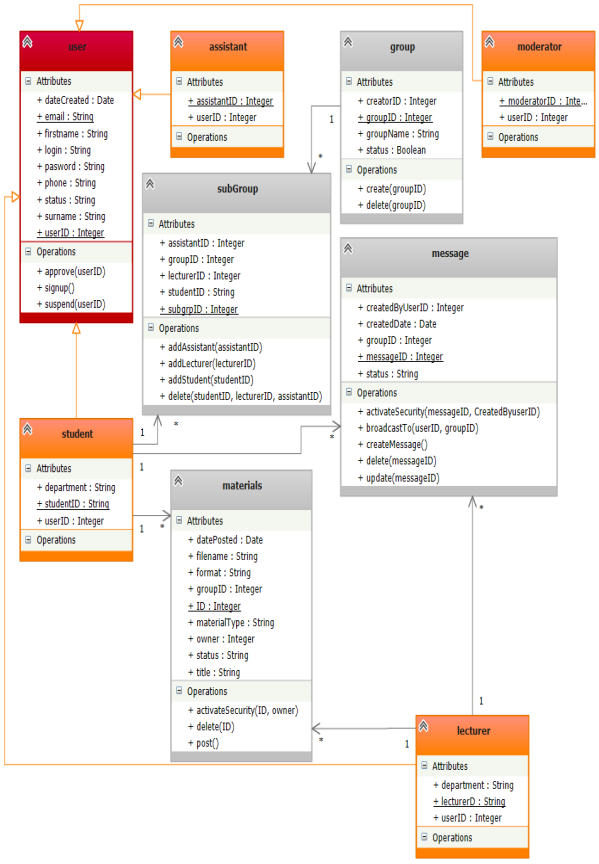


Figure 8: Logical Object Model of the system

3.3 Implementation

Two platforms are considered in the implementation of this system: Web and Mobile (Android) respectively. The implementation platform used was Microsoft Visual Studio 2019. This platform offers a relatively simple integrated development environment (Nwankwo and Ukhurebor, 2020) regardless of the application platform (web, mobile-iOS, Android, Windows; etc.).

In addition to the IDE, the following tools were used

a. Ngrok(to provide external/internet access to the local platform where the web application runs. It is an encrypted TCP channel/tunnel which offers internet-accessible address. It also links the external side of the said tunnel to communicate with the local system
b. Twillo

Two projects were created side by side in same solution: ASP.Net Core Web Project (EduTESN) and Xamarin.forms android project (eduTesnMobile) respectively (see Figure 9). The two projects use a common database tagged *EduTESN*, which enables synchronization in which case activities on both platforms have a common store in line with best practices. The pre-development activities include:

a. Installation of the entityframework core package
b. Installation of the .NET MongoDB Driver to provide asynchronous communication with MongoDB.
c. Installation of the Twilio package

These were done by using the following NuGeT commands on the package management console:

PM>dotnet add package Microsoft.EntityFrameworkCore.Tools
PM>dotnet add package Twilio
PM>dotnet add package MongoDB.Driver

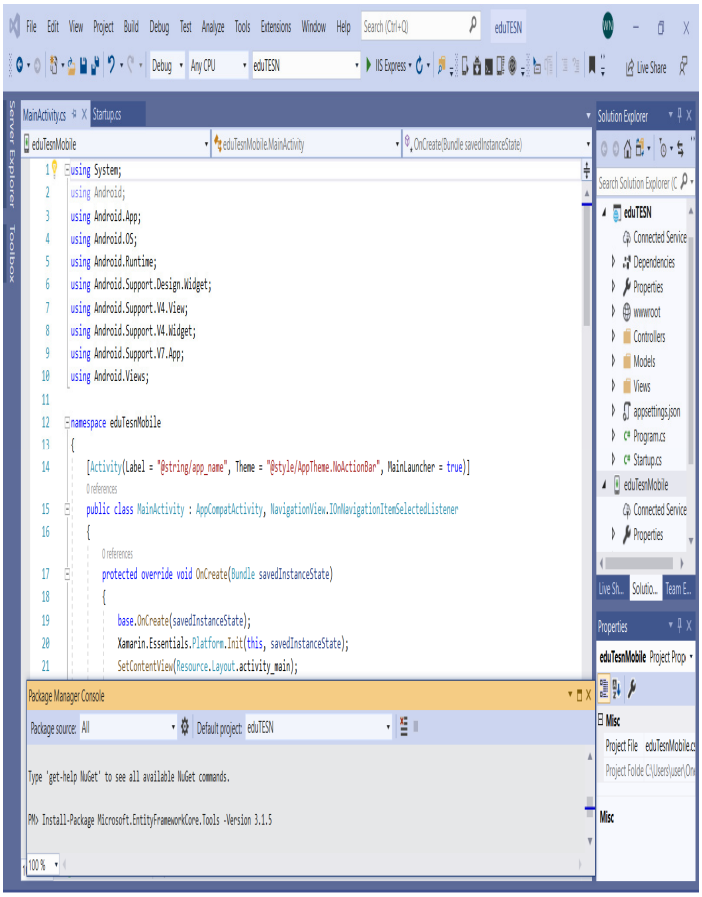


Figure 9: Web and Android app development (side-by-side)

Figure 10 shows the login window on android. Authentication is via user email and password. Figure 11 shows a group window and some active users in the window. The three dots at the upper right corner contains a list of the menus.

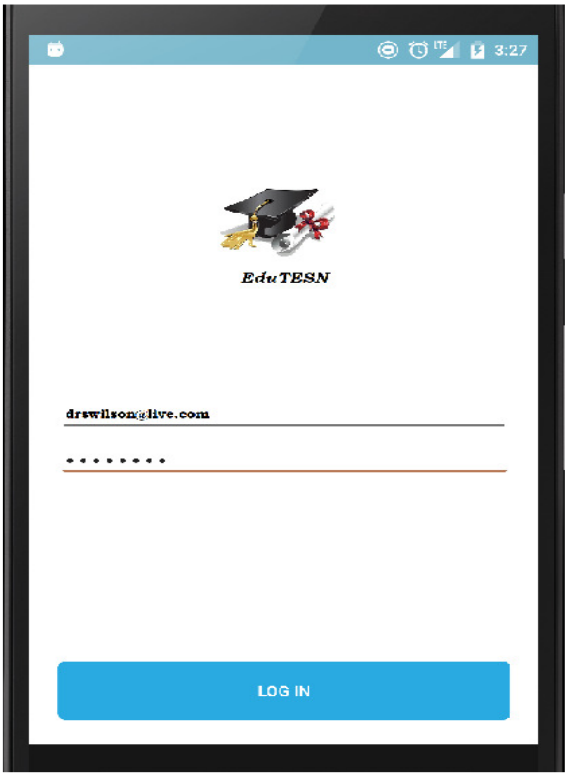


Figure 10: Login window on mobile platform

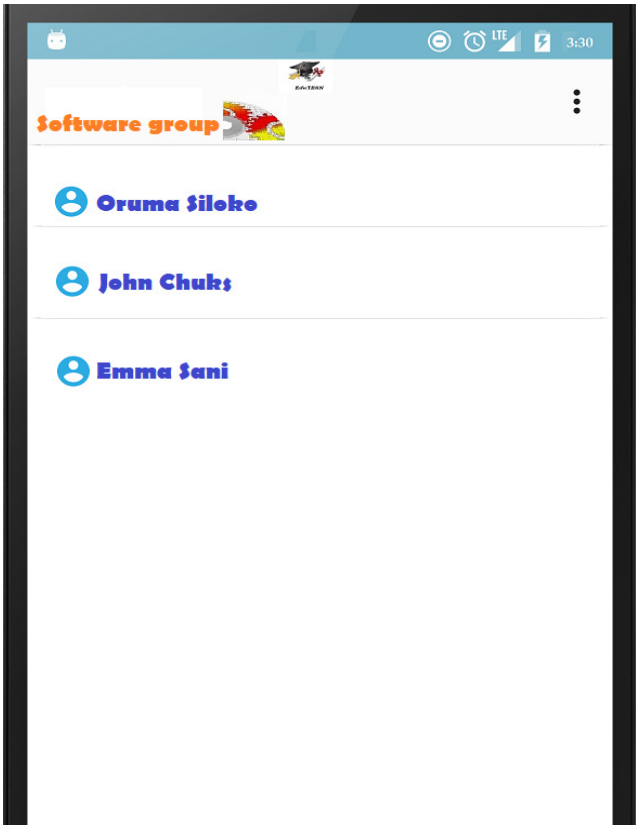


Figure 11: Group view

i.

ii.

4. CONCLUSION

This paper demonstrated a rapid approach that may be adopted by a TEI to evolve their specialized SN solution on various platforms e.g. mobile, web, etc. Following this brief presentation, the following conclusions are drawn:

SN and SM would likely remain interesting and vital tools for learning and research support purposes for the next 50 years hence their strategic adoption and integration into the educational processes in a TEI cannot be overemphasized when factors such as information and knowledge sharing and dissemination are brought to bear.

These tools promote and support effective and efficient relay of information in various formats and social interaction while ensuring that data generated are secure and privacy maintained as against the popular social media where the vendors repose regardless of their agreements collect data from user accounts for reasons known to them. The proposed system meets and fulfils all user requirements for interaction beyond the school environment.

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