DESIGNING OF SMS BASED DISTANCE LEARNING PLATFORM FOR HIGHER LEARNING INSTITUTIONS IN DEVELOPING COUNTRIES: EDUCATION IN PANDEMIC CASES

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KeyWords

Distance Learning, Developing Countries, Higher Learning Institution, Short Message Service

ABSTRACT

Distance learning is education and training resulting from the technological separation of learners and instructors that gives learners freedom from traveling, time and place in order to learn. Higher learning institutions from developing countries suffer from suitable low cost solution to offer a distance education especially when it is needed as temporary way out. The web based solution increases challenges in side of students due to network coverage issues from telecommunications providers and many students own handheld device with no internet capability. Major existing and applicable approach to deliver class based lectures is by using presentation slides. According to this study these slides can be re-formatted in SMS and enabling a distance education to take place. The Short Message Service (SMS) stated with GSM a 2G technology and has being adopted by its successor technologies like 4G and 5G; the SMS provides electronic text services between Mobile Station (MS). SMS bundles in country like Tanzania is less expensive when compared with Internet bundles. This study investigate chances of offering SMS based education and gives a blueprint of how SMS can be used to facilitate distance learning in developing countries.

1. INTRODUCTION

1.1 Distance Learning

Distance learning is education and training resulting from the technological separation of learners and instructors that gives learners freedom from traveling, time and place during studying (WONG, 2008; Olha Zadorozhna, 2020). Particularly, adult learners who live at a distance from educational institutions, or who lack the time to attend face-to face classes due to the demands of work and family, have benefited from the growth of distance learning (Bray & Dlugosh, 2008). Distance learning has undergone great changes, especially since the advent of the Internet and communication and information technology (Machado-da-silva *et* al., 2014). Distance learning has become highly popular during the recent years also in developing countries (Thien *et* al., 2013).

In east Africa countries, there is existence of universities whose mode of delivery is only internet distance based, for example Open University of Tanzania. Currently, class based institutes have shift some of their courses into distanced based approach to respond to the educational needs of learners who are not able to attend face-to-face and classroom-based instruction (Tung, 2012; Khalid Alomar, 2016).

1.2 Short Message Service (SMS)

Short Message Service (SMS) was invented by Friedhelm Hillebrand in 1984 and demonstrated in 1992 by Neil Papworth to show how it meet messaging needs of Global System for Mobile Communications (GSM) users (Zhang *et* al., 2005; Jurcut *et* al., 2018; Wikipedia, 2020). The SMS features have been incorporated in each new evolution of mobile network which are based on GSM, including 3G, 4G Long Term Evolution and 5G. According to Devharsh Trivedi (2012) conventional SMS has header and payload; payload has size of 160 characters of which each character is encoded with 7 bits making a total of 140 bytes in length. Common encoding schemes for SMS are American Standard for Information Interchange (ASCII) and UNICODE (Devharsh Trivedi, 2012).

Figure 1.1 show SMS architecture when bearer network is GSM. There are two types of SMS, network initiated SMS and MS initiated SMS. Basically network initiated SMS is an incoming SMS also known as Short Message Mobile Terminated SM-MT, happened when MS-SC sends SMS to the MS. MS initiated SMS is referred as an outgoing message also known as Short Message Mobile Originated SM-MO, occurred when MS sends SMS to MS-SC. The scenario of Figure 1.1 represent flow of MS initiated SMS. Between MS and MSC there is Base Tranceiver Station (BTS) and Base Station Controller therefore, before SMS meets MSC it pass through On-The-Air (OTA) interface to BTS to BSC then to MSC over Signaling System No. 7 (SS7) and viceversa during reception of SMS (Baraka *et* al., 2013).

In additional to normal uses of SMS, the service found extra application including provision of banking services (Baraka et al., 2013), electronic marketing and advertising (Anyasor Marcus, 2016; Ayuba *et* al., 2019), and in questions and answers surveys (Charles *et* al., 2019). Furthermore, SMS operates in store and forward approach which arising security concerns when confidentiality of communicated SMSs is of important (Kaur et al., 2012; Arudchelvam *et* al., 2016). Studies conducted by Rahim Robbi (2017) suggested hashing SMS in bits level, and Saja Ahmed (2018) proposed dynamic key encryption as a solution to security problem of SMS under GSM architecture.
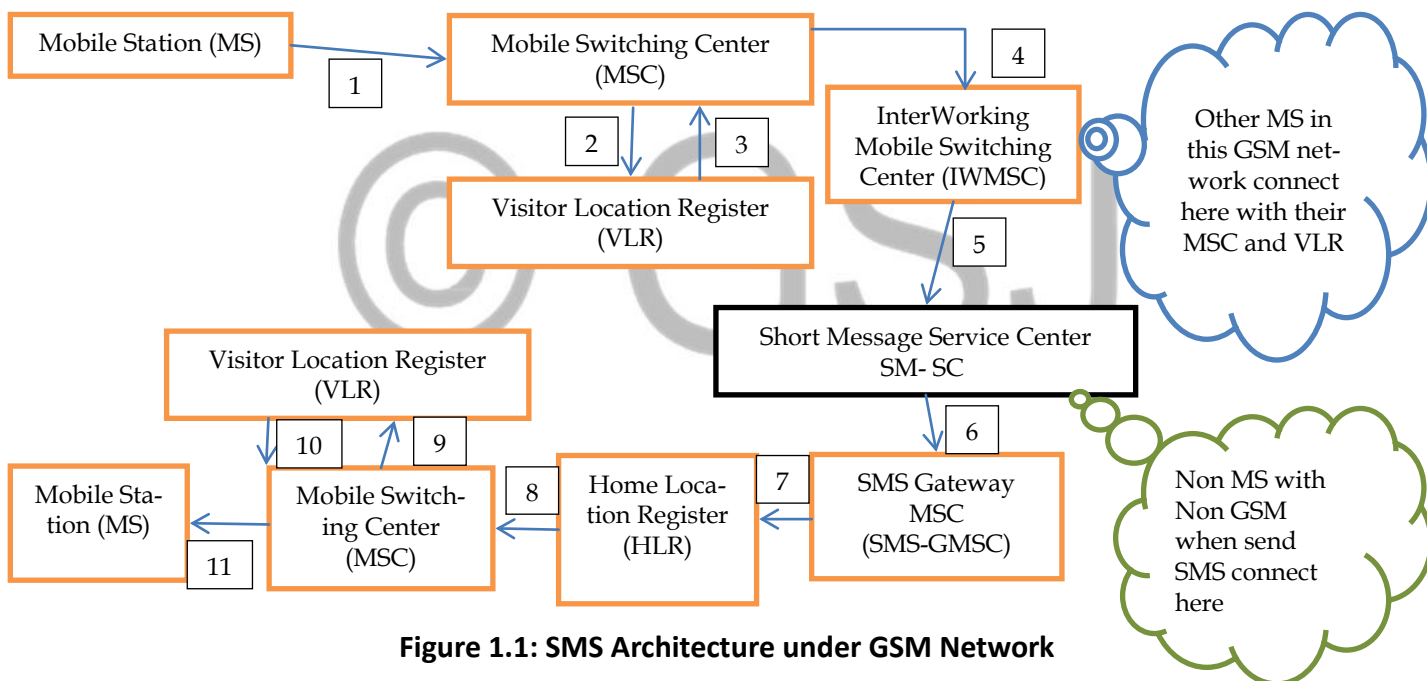

Figure 1.1: SMS Architecture under GSM Network

1.3 Reviewed Online Based Distance Education Platforms

The terms online, internet and web based distance education have been used interchangeably to refer to one idea of non-face to face based education (Ahmad and habibah, 2011; Diana Deacon, 2013). Cao et al. (2002) developed WebVPL system; a Web based Virtual Programming Lab for on-line distance learning. The underlying setting is a collection of Lab server computers hosting education and programming software. Students use personal computers at home to access over the Internet one of the Lab servers. WebVPL facilitates resource sharing among different schools and overcomes the limit of geographical distances. Thien *et* al. (2013) found a web based system called Edmodo to offer distance education in Vietnam with considerations of low internet bandwidth needs of consumers.

Kasim Khusanov (2019) developed a web platform to teach pharmaceutical courses in Tashkent Pharmaceutics Institute by re-texting traditional materials into web format. The study of Vijayalakshmi Murugesan (2020) analyses best tools for provision education online during covid-19 and some listed tools were Wideo for producing video content with animations, Canva for creating educational visuals and infographics, Edmodo for providing educational materials and establishing dialogues with parents and Google Classroom for creating online classes, distribute assignements and feedback communications. Okan and Ajda (2018) prototype a web

based class for musical subjects for fine arts high schools in Turkey and their study suggest online approach as best alternative to traditional instrument education. A similar concept for provision of distance educations in dance subjects was conducted by Congdle and Rong (2019).

1.4 Problem Statement

Interest in distance education is increasing among higher learning institutions therefore there is a need for institutions to reform the way of serving it (Costa Humberto, 2020; Pande S. K., 2020). Online (Web) based distance education is a common technique for delivering of such service. Common gadgets used by students' in web based distance educations are laptops and smartphones (Ivanko *et* al., 2020). Literature explained in some cases web based approach may result to awkwardness to both tutors and students in term of financial demands, intellectual property and distribution of teaching materials (Collins and Hubert, 2013; Basharat and Azhar, 2016).

Ten (10) higher learning institutions in Tanzania were surveyed by this study to observe gadgets owned by students. 1123 students were observed and the report was such that 1% owns no mobile phone or laptops, 49% possess only basic mobile phones, 30% owns only smartphones and 20% owns basic mobile phones, smartphones and laptops. This study aimed to develop an SMS platform that will be used by tutors to preparing and communicating their lectures to students. SMS is supported by all mobile phones owned by students in Tanzania therefore the demands to own a specialized gadget for provision distance education will be avoided. In additional, in Tanzania cost of SMS bundles is low compared to Internet bundles, with 500Tsh one can get up to 2000 SMS while in case of internet one can get around 100MB. Currently, telecommunications operators have successfully installing their services in more than 90% of land of Tanzania. In this coverage Internet is lag behind SMS service therefore implementing distance education through SMS will meet more students than using internet based approach.

1.5 Paper organization

The remainder of the paper is organized as follows. Section 2 presents designing the SMS platform. Flow diagram of the platform communication system is presented. Designed system interfaces will also be illustrated. Next, Section 3 offers some concluding remarks and future work, finally section 4 gives acknowledgement.

2. DESIGNING THE SMS PLATFORM

2.1 Requirements Analysis

Requirements analysis involves defining customer needs and objectives in the context of planned customer use, environments, and identified system characteristics to determine requirements for system functions (Peter Wanga, 2015). The following functional and non-functional requirements have been deliberated by the study.

2.1.1 Functional Requirements

a. The system should provide plenty of informative instructions or guidelines to help learning practices.

b. The systems should allow users to retrieve lectures in text formats.

c. Developing system interfaces which can call and implement specific data processing in the system.

d. Accessibility: The service provided by the system must be widely accessible.

e. Easy to use and Effectiveness: The system should provide a user-friendly interface.

f. Interactivity: The system should allow the user to conduct sessions with interaction-enabled software.

g. Modularity and extendibility: The system should be designed with modules that interact with each other only through their interfaces so that they can be replaced without affecting other parts of the system. New components and modules can be added and/or new requirements can be satisfied.

2.1.2 Non-functional Requirements

a. Ease of use.

b. Ease of distribution and integration, making the tool available and ready for application.

2.2 Selected Materials

The survey conducted by this study in ten (10) Tanzania higher learning institutions found out from 200 observed academic staffs 90% of them preferred to use windows Operating Systems (OS) therefore, to meet accessibility requirement the platform will be developed by using Visual Basic Network Enhanced Technology (VB.NET) programming language. Thobius *et* al. (2020) clarified VB.NET provides easiness for program developer due to its features of intellisense and automatically memory management hence coding will take less efforts. VB.NET through its 3.5 and above frameworks provides freely supportive Components Object Model libraries which will assist to communicate with modem and mobile operators networks.

From Figure 2.1 the platform to be developed will be hosted on gadgets which can be installed with windows OS, the recommended version of OS is windows 10. These gadgets also should possess a supportive USB port which is a USB-A female port to allow a connection with modem, therefrom recommended gadgets to be laptops and desktops. These laptops and desktops will be owned by lecturers. The modem to be used is HUAWEI mobile Broadband E303 which is selected due to two facts, first the modem firmware in not locked developer can use AT commands to control the modem and second 3G network is widely deployable in Tanzania than 4G therefore network connections problem will be low. Any gadget which can display, receive and send SMS by using SIM cards will be accepted to be used by students.
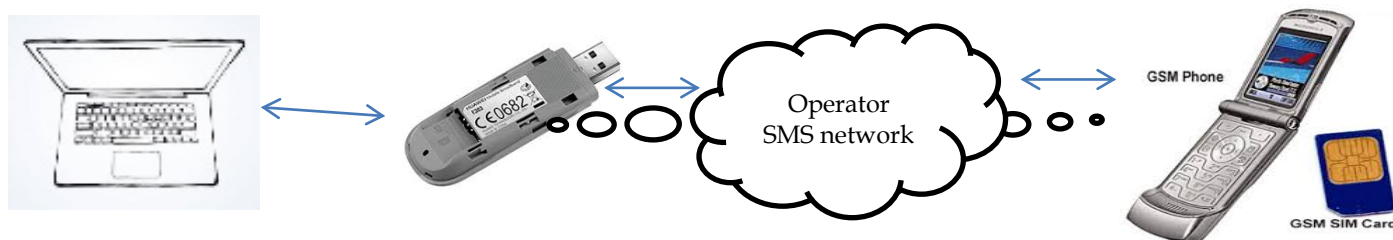

Figure 2.1: Block Diagram of System involved Components

2.3 Structuring of SMS into Slides

Applicable approach to deliver face to face class based lectures is by using presentation slides displayed in a projector or distributing hard printed slides to students. According to this study these slides can be re-formatted in SMS and enabling a distance education to take place. To convert slides into SMS some assumptions should me made.

a. A single lecture may have up to 50 slides.
b. These slides should contain text only or otherwise concepts to be illustrated by diagrams such as block diagrams and flow diagram should be typed in texts.
c. One slide should not exceed more than three bullets whereby each bullet should contain less than 50 characters. This will make a total of 150 characters per single slide which is equivalent to one SMS. Advantageous of doing this is SMS length will be kept less than 160 characters therefore no fragmentation may occur in transport mobile network.
d. Normally cost of operating internet within learning is covered by institutions therefore the study assumes SMS bundles should also be financed by institutions.

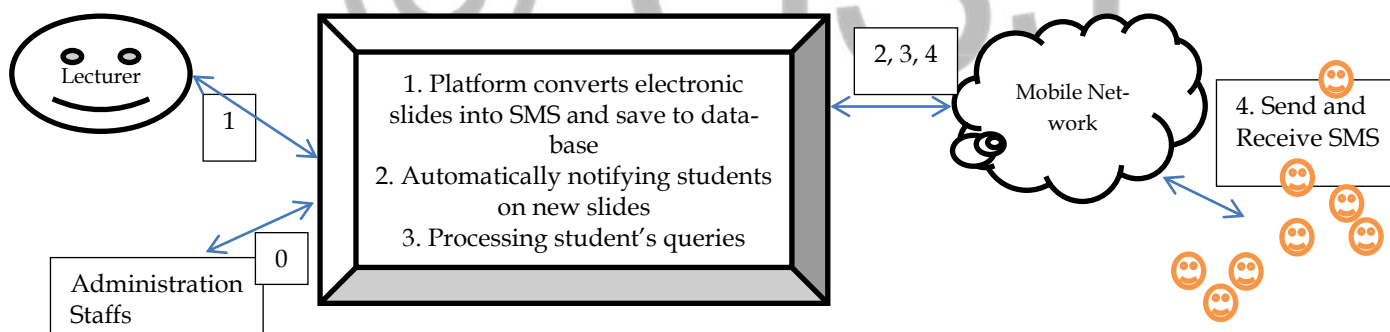## 2.4 Designed SMS Platform Flow Diagram and Interfaces

Figure 2.2 Flow Diagram of the system

In this system there is less effort to prepare materials in format supported by the platform. Administration staffs will be responsible to provides list of registered students and their telephones contacts to lecturers through the platform. From Figure 2.2 lecturers can both copy and paste their slides into the SMS interface of the platform or typing directly to the interface. The SMS interface of the platform will have buttons to save contents into database, to send contents to students and to view queries from students. SQL service database will be used to hold data. Notifications of new SMS slides will be done by sending course code and designed header numbers. Course code and header numbers will be used by students to query the platform. When hosting platform gadget is off or students device is off, mobile network operator databases will store SMSs and deliver them when they become on. This is because SMS-SC works on store and forward bases therefore adds benefits to the platform.

2.4.1 Landing Interface

The landing interface is expected to direct lecturer to select necessary information such as faculty, year of study and semesters. These selections will be used by the system to generate header numbers for identification of particular slides. For example from Figure 2.3 the header number can be 232 plus course code. The whole identification pattern should not exceed 7 characters, to total 157 characters per SMS slide.
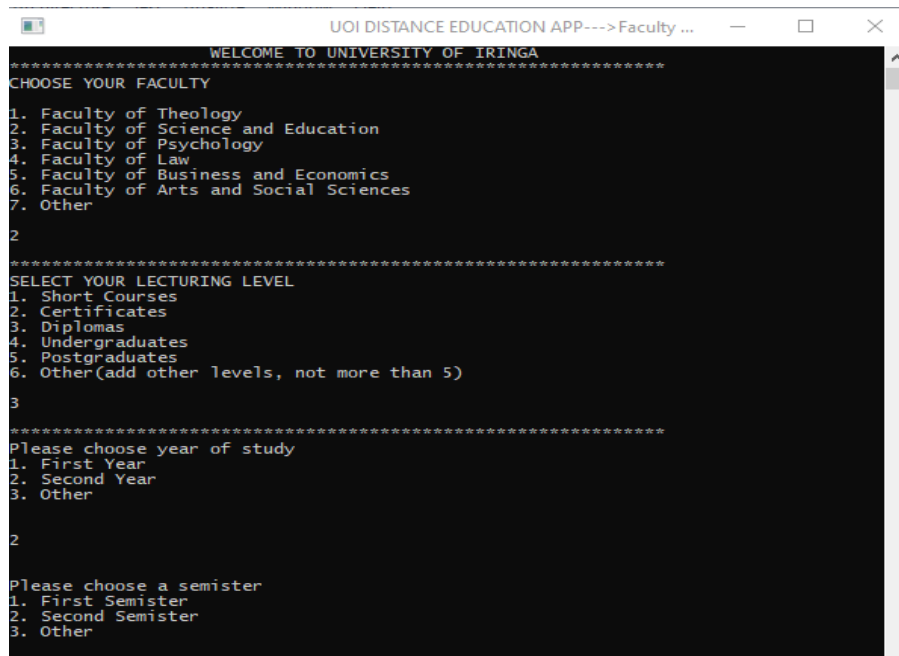
Figure 2.3: Landing Interface of the Platform

2.4.2   Login Interface

Login interface will allow tutor to select his/her academic position and enter login credentials. This will create secure environments to lecturers.

Figure 2.4 Login Interface of the platform

2.4.3   SMS Slides Processing Interface

This interface will allow selection of course code, typing or pasting slides text, load list of registered students from excel sheet given by administrative and sending SMS to students. Sending panel is divided into five independents parts. Each part will represent single SMS therefore it will have 157 characters.
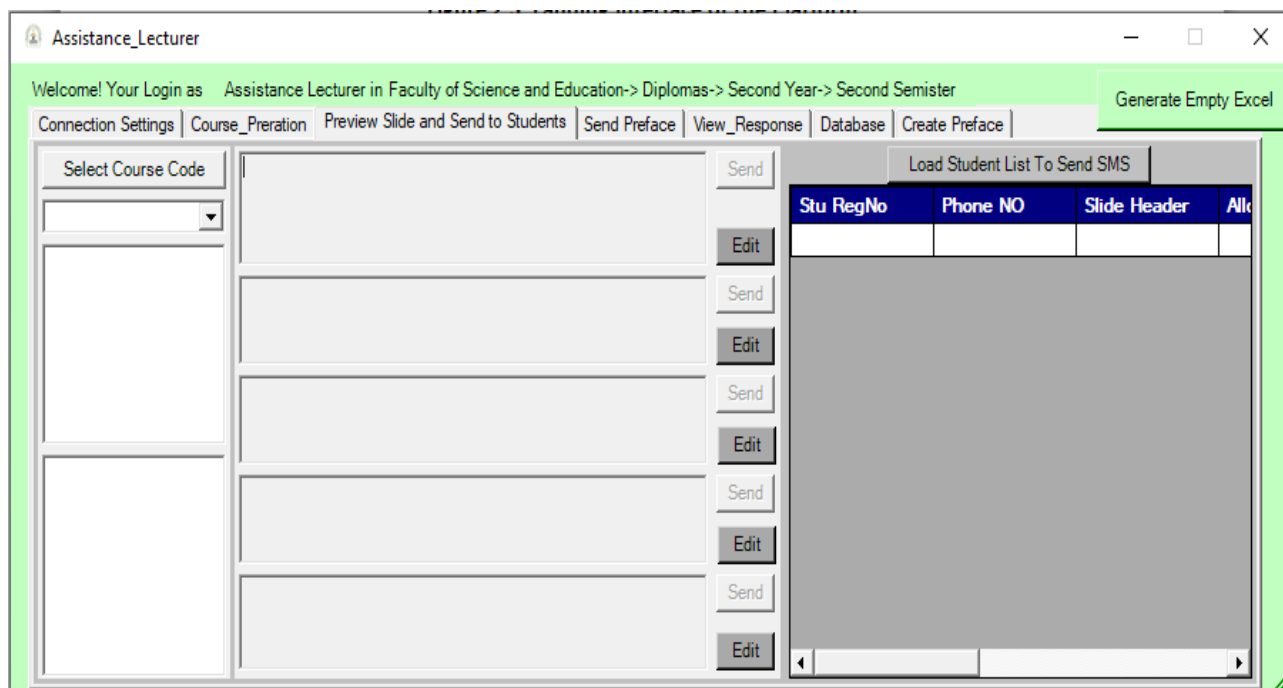

Figure 2.5: SMS Slides Processing Interface

2.4.4   Students Resposes Interface

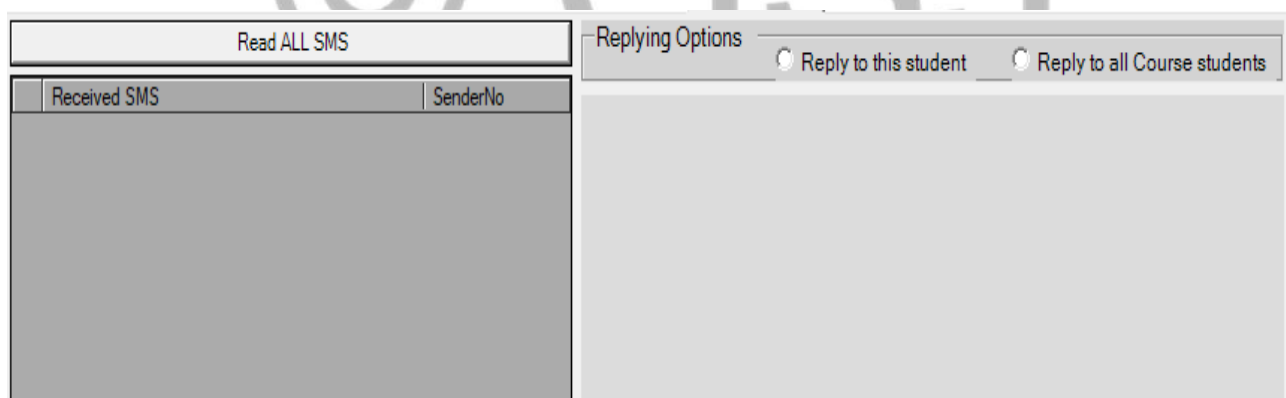In this interface lecturer can view questions asked by students and responding in personal or to all students.

Figure 2.6 Students Resposes Interface

3.   CONCLUSION AND FUTURE WORK

This paper gives the blue print of how SMSs can be used to enhance distance learning in developing countries. It provides require-ments analysis, data flow and expected interfaces. The future work of the study is to develop and implement the platform prototype. The prototype will be used to see the community acceptances of the platform.

4.   ACKNOWLEDGMENTS

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