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The Development of a Mobile Telehealth Application for Remote Patient Consultation for Rural Namibia

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Abstract: ***Due to technological advancement across the globe, there is a need to use information and communication technology to provide healthcare services especially to people in the remote and rural areas of Namibia. There is inequality with regards to health service delivery in rural areas in Namibia. People in the rural areas do not have easy healthcare access as the nearest health clinics are manned by nurses as there is a shortage of doctors. This means that the mobile doctors do not visit these clinics frequently. This study focuses on how to bridge the gap of an inadequate supply of medical doctors in rural and remote areas through the use of a mobile application for remote telehealth consultation. Telemedicine/telehealth is referred to as the use of information and telecommunication technology to provide healthcare services to patients outside the traditional doctors' consultation rooms. The term telemedicine and telehealth are often used interchangeably. The aim of this research is to develop a mobile telehealth application for remote patient consultation in rural Namibia. The objectives of this research are to: determine the data requirements and specifications for a mobile telehealth application for remote consultation for rural Namibia; to develop a mobile application to facilitate remote consultation in telehealth for the rural areas of Namibia; and to evaluate the developed mobile application for usability and acceptability. The Design Science Research approach will be followed in this research to come up with the prototype and evaluate it. This mobile application will help in bridging the gap of the lack of medical doctors and specialist doctors in the rural and remote areas of Namibia. The application will contain an expert system which stores a number of diseases, the likely symptoms as well as treatment options. This application will assist the nurse to diagnose and treat patients with certain ailments. It will also enable the nurse to consult the doctor directly and the doctor will immediately respond to the nurse. This will enable consultations between patients and doctor as though they were seemingly in the same room. Another feature of the application is that it allows the doctor to other consult specialists in case they are unable to assist the patient. The mobile application will support both text and audio.***

Keywords: telehealth, telemedicine, mobile technology

1. Introduction

Due to technological advancement across the globe, the use of information and telecommunication technology (ICT) is growing rapidly. Tools such as telemedicine, tele-education and health informatics have been developed and are used for easy day-to-day learning and health needs (Wanala & Kaddu, 2013).

There is a need to use information and communication technology to enhance healthcare service delivery especially in rural and remote areas. The need for healthcare services is rapidly growing especially in the rural and remote areas where there is inadequate medical doctors and specialists. Most clinics are manned by nurses; the doctor only visits the clinics once in a while (Stiftung, 2012).

Telemedicine is referred to as the use of information and telecommunication technology to provide healthcare services to patients outside doctors' consultation rooms. The term telemedicine and telehealth are often used interchangeably. Maheu et.al. (2001) states that "the term telehealth has grown in popularity and is now used as a synonym for telemedicine" (Maheu, Whitten, & Allen, 2002). There are a few African countries especially in the sub-Saharan Africa that do not have adequate infrastructure to implement telehealth. However, there are some African countries that use telehealth to provide healthcare services to their citizens especially those that reside in rural and remote areas (Wanala & Kaddu, 2013). Telehealth methods can be classified into four, namely, video conferencing, store and forward, remote patient monitoring and mobile health (McBain, Shipley, & Newman, 2015). Telehealth encompasses the remote delivery of health services including clinical, educational and administrative services through transfer of different forms of information such as audio, video and graphics by means of telecommunication channel (Bali & Naguib, 2001).

This research intends to develop a mobile application which will help in bridging the gap of lack of adequate medical professionals in the rural and remote areas of Namibia. The application will contain an expert system which stores a number of diseases, their likely symptoms as well as treatments. This application will assist the nurse to diagnose and treat patients with certain ailments. It will also enable the nurse to consult the doctor directly and the doctor will immediately respond to the nurse. This will enable consultations between patients and doctor as though they were seemingly in the same room. Another feature of the application is that it allows a doctor to consult specialists in case they are unable to assist the patient. The application will support both text and audio.

The current setup in rural clinics in Namibia is structured as in the flowchart below.

1) The patients walk/ride/drive to the clinic.
2) The nurse checks the patient to see if he/she can treat this patient.

3) If the nurse can treat the patient then she/he treats the patient and discharges them.
4) If the nurse cannot treat the patient she/he refers the patient to a referral clinics or hospital.

Therefore in this research, instead of the nurse referring the patient to a referral clinic/hospital they consult the doctor via the proposed mobile telehealth application, who then gives instruction on how the patient is handled.

2. Problem Statement

The issue of healthcare service delivery especially in remote and rural areas is critical, although the Namibian government in its effort to bring good healthcare services to the rural areas built clinics and health centres in various locations spanning all regions in the country (MoHSS, 2017). Despite these efforts, there are still inequalities in healthcare service delivery in these areas compared to urban areas (Kandjeke, 2012). There is a need to bridge the gap of inadequate healthcare professionals especially in rural and remote areas. According to Kandjeke (2012) people in rural and remote areas struggle to get adequate healthcare services, and as a result they suffer when disease strikes which sometimes leads to loss of lives (Kandjeke, 2012).
Furthermore, there are inadequate healthcare professionals (particularly specialist doctors) to meet their health needs (Stiftung, 2012). Consequently they have to travel long distances in search of good health services. These clinics that are in the rural and remote areas are mostly manned by nurses who sometimes are unable to attend to/treat patients due to a lack of sufficient knowledge and experience (Awases, 2006). The doctors are mostly found in hospitals and in towns and they only visit these clinics once in a while which causes people in the rural areas to suffer when they fall ill (Awases, 2006). The purpose of this research therefore is to develop the telehealth mobile application for remote patient consultation that will aid better health service delivery in Namibia.

3. Aims and Objectives

The aim of this research is to develop a mobile telehealth application for remote patient consultation for rural Namibia that will aid in better health service delivery.

The objectives are to:

- Determine the data requirements and specifications for a mobile telehealth application for remote consultation for rural Namibia;
- Carry out requirements elicitation and analysis for the a mobile telehealth application for remote consultation for rural Namibia;
- Develop a mobile application to facilitate remote consultation in telehealth for the rural areas of Namibia;
- Evaluate the developed mobile application for usability and acceptability.

The main question that this research answers is, “How can remote consultation in rural areas be enhanced through mobile technology for telehealth?”

The sub-questions this research intends to answer are.

- What are the data requirements and specifications for a mobile telehealth application for remote consultation for rural Namibia?
- How can requirements elicitation and analysis be carried out for the a mobile telehealth application for remote consultation for rural Namibia;
- What should be the features of a mobile remote consultation telehealth application developed for the Namibian rural communities?
- How can the developed mobile application be evaluated for usability and acceptability?

4. Literature Review

In order to achieve the aim and objectives of this research, the study looks at different publications so as to get more ground and facts that will help through the research process.

4.1 Telehealth

Telehealth in Africa has the potential of bridging the gap of a lack of adequate medical professionals given the fact that the continent is resource-limited. Telehealth is collection of means or methods for enhancing health care, public health, and health education delivery and support using telecommunication technologies. Meanwhile, the US Federal Health Resource Centre and Service Administration (HRSA) defines telehealth as, “the use of electronic information and telecommunications technologies to support long-distance clinical healthcare, patient and professional health-related education, public health and health administration” (FHRCSA, 2017). Telehealth encompasses the distant delivery of health services including clinical, educational, and administrative services, through transfer of various forms of information (e.g. audio, video and graphics) via telecommunication technologies (Bali & Naguib, 2001).

Telehealth can be categorised into four different groups, namely;

1) Video conferencing or live video: this refers to a two way interaction between a person (patients, nurses) on one end and another person (doctor, specialist doctor) on the other end via audio-visual in real time. This service is sometimes referred to as “real-time” and it is often used as a replacement to the traditional person to person consultation (patients visit doctor in a hospital or clinic).
2) Store and forward: this is a way of recording videos, audios, and photos e.g. x-ray and the patients send it to the doctor via secured communication channels. The doctors or specialist doctors use this information to diagnose and or treat patients remotely.
3) Remote patient monitoring: this is done by health professionals to monitor their patients which include personal health data collection about patients, monitoring and controlling of diseases such as diabetes, high blood pressure and asthma through the use of secure electronic communication.
4) Mobile health: this is a technology that is used to provide healthcare-related services via the use of mobile communication such as PDA’s cell phones and tablets computers (WHO, 2011).

This paragraph gives an example of the use of telehealth. The article by Stickland (2011) discusses the use of telehealth technology to provide rehabilitation to patients suffering from chronic pulmonary diseases. According to this article, pulmonary rehabilitation (PR) is an efficient therapeutic approach which aims at improving patients with chronic obstructive pulmonary disease (COPD) health outcomes. The objective of this article is to compare the effectiveness of PR-administered through telehealth (PR telehealth) and the PR delivered in person through outpatient-in-hospital-based program (Standard-PR) (Stickland, et al., 2011). According to (Seizler, Simmonds, Rodgers, Wong, & Stickland, 2012), "Telehealth PR is an effective tool for increasing COPD PR services, and demonstrated, increases the quality of life and exercise capacity comparable with Standard-PR". In conclusion patients that received PR program via telehealth received exactly what the patients that visits the centre where PR programs are delivered physically. Telehealth can be used to help people in rural areas to get good health care services.

4.2 Related work on telehealth platforms

This section gives examples of telehealth platforms. ConnectMed is a South African telehealth start-up which is a web-based application. It enables patients to get treatment from general practitioners through videos for common diseases, either directly through applications (ConnectMed Prime) or indirectly through clinics (ConnectMed Care) (Kelven, 2017). ConnectMed Prime targets middle and upper-class income groups, i.e. people who have easy internet access and use the private healthcare system (Kelven, 2017).

Telehealth in Africa has the potential of bridging the gap of lack of adequate medical professionals given the fact that the continent is resource-limited. Telehealth is adopted in some African countries such as South Africa and Kenya. A free Android mobile application has been developed in Kenya by Shimba technologies to provide mobile healthcare service access remotely. The key function of this application is to provide health-related information and also to help patients to locate reputable healthcare services (CHMI, 2011).

The purpose of discussing the two applications above is to show the differences between the proposed application and the application to be developed by this research. The proposed application is to be used at the clinics because the problem identified is that most rural clinics are manned by nurses and not doctors due to a shortage of doctors in the Namibian healthcare system. These nurses need to consult the doctor in cases where they cannot treat a patient. The mobile application has an expert system that the nurse can consult before referring the case to the doctor. Unlike the two applications mentioned above, the proposed application is text and voice-based only because video cannot be supported considering the poor connectivity in the rural areas.

The environments where these applications are used are different in terms of comparability. At first ConnectMed South Africa could not be adopted into the full mainstream Kenyan health sector due to environmental, socio-economic and operational factors. In its place a free Android mobile application was developed in Kenya by Shimba technologies to aid its adoption. This is also the case in Namibia, which is a different country from the two countries mentioned above. These countries have environmental and socio-economic differences which may make these applications incompatible. For example Connect Med targets middle and upper-class income groups, i.e. people who have easy internet access and use the private healthcare system (Kelven, 2017). While the proposed remote telehealth system targets patient in remote or deep rural areas who may not have access to doctors. The proposed remote telehealth application will be used in public health-care centers. The proposed remote telehealth application will be developed through local and indigenous inputs not from an outside contribution that may not have the full knowledge of the rural areas.

5. Significance of Research

The significance of the research is as follows:

- This study intends to take the scarce doctor skills to the people in rural and remote areas of Namibia.
- The beneficiaries of this research are mostly people from rural and remote areas.
- Patients in the rural areas will be able to have more and easy access to doctors' services
- Finally there will be an improved patient-doctor relationship through the use of the telehealth mobile application. The doctor and the patient will be seemingly in the same room and not remote from one another.
- Nurses will also benefit from this research as they will gain more knowledge on how to handle and/or treat patients suffering from certain diseases in their respective areas.
- The users of this application who the nurses and the doctors are assisted in carrying out their work without any limitations.

6. Research Methodology

A design science research approach will be followed. This approach aims to learn about the behaviour of artefact under different inputs and it creates an opportunity to understand the mechanisms of the artefact that creates its performance (Peffers, Tuunanen, Rothenberger & Chatterjee, 2007). Artefact prototype may not be similar enough to a real world product that will eventually be implemented in the real world (March & Storey, 2008). Complexity of mechanisms may exceed our ability to understand and incorrect use of previously established theories. Methods such as interviews will be carried out, according to (Kothari, 2004) so as to get a general insight into how the users feel about the current activities and what problems they experience with them. For data that characterises a rural setup/environment, issues of connectivity, availability of health professionals, and the ICT literacy levels of staff, etc. are what is required. The requirements gathered during the requirement elicitation phase will be fed into the prototype to be developed, in that the characteristics of the prototype will be derived from these requirements.

6.1 Research process

Using the software development life cycle stages, specifically the incremental process model we aim to complete the study by following the stages below:

6.2 Analysis

This is the requirement elicitation phase, whereby requirements will be gathered from stakeholders who will ultimately be the users of the system.

6.3. Design phase

This phase starts with the requirements document delivered from the analysis stage. A mobile application will be designed and developed. The application will appear on the screen of the mobile phone and the user has to launch it.

6.4 Implementation phase

The project will be software based. To implement the application, the following will be done:

- Create a database for data storage
- Create a mobile based application
- Create a backend web based for the administrator

6.5 Evaluation phase

The artefact is evaluated accordingly (Peffers, Tuunanen, Rothenberger & Chatterjee, 2007). Testing is a continuous process and it will be conducted numerous times while developing the application (Myers, Sandler & Badgett, 2011), during the application's implementation and afterwards.

6.6 Incremental testing

This type of testing is performed to preliminarily assess the program product being at the early stages of its development and to provide the developer with this assessment for further analysis (CERTIFICATION, 2017).

6.6 Prototype

The requirements gathered during the requirements elicitation and analysis phase will be used to design the prototype.

7. Limitations of the Study

The limitations of this study are as follows:

- Due to time constraints, the research will only focus on some of the clinics (five clinics) and one hospital in the Hardap region of Namibia and not all.
- The application does not allow patients to use it from home. The patients have to go to the clinic where the nurse will use this application to diagnose, treat or refer patients to doctor. This is because from the very beginning it was made clear that the problem was in the clinics which are manned by nurses.
- Due to poor network coverage in some rural areas and financial constraints, our mobile application will not be able to cater for video conferencing because video takes a large amount of data storage.

8. Assumptions

The following assumptions are made:

- The research assumes that nurses and doctors have basic knowledge on how to use mobile devices.
- The research also assumes that there is at least fair network connectivity that will allow internet access in these clinics that are situated in the remote and rural areas of the Hardap region.
- The infrastructure is there in rural healthcare centres to support telehealth
- The research assumes that data will be collected from willing participants easily.
- The research also assumes that the end product of this research will be accepted and implemented by the stakeholders.
- The use of telehealth for remote patient consultation will effectively improve healthcare service delivery to the people in rural Namibia
- The risks and benefits of telehealth in public institutions in Namibia will be mitigated

9. Ethical Considerations

Ethical considerations refer to "all the precautions, steps and efforts that will be carefully applied to protect the research participants while interacting with them for data production" (McMillan & Schumacher, 2006). It consists of both preliminary and post interactions; recording and writing of the report for data collected during this study. The researcher will first request approval from the NUST research ethics committee. Furthermore, permission will be obtained from the Ministry of Health and Social Services before any interview or survey is conducted. Next, the researcher will request approval from the respondents as well as the institutions identified for data collection. This will be done through the use of informed consent, which will specify all ethical aspects (Bryman & Bell, 2011). It will include issues such as voluntariness, confidentiality and anonymity. The permission of the participants will be requested for their voices to be recorded. The real identity of respondents and institutions will not be used throughout the research.

10. Conclusion

This research is on the development of a mobile health application for remote patient consultation. The Hardap region of Namibia will be used as a case study for the collection of data that feeds into the development of the mobile remote consultation telehealth application. The application will help bridge the gap of a lack of medical doctors and specialists in the rural and remote areas of Namibia. The mobile application will enable consultations between patients and doctors to occur as though they were in the same room although they are remote. The application developed will support both text and video.

References

[1] Awases, M. (2006). *Factors affecting performance of professional nurses in Namibia.* Retrieved from University of South Africa institutional reopository: http://uir.unisa.ac.za/bitstream/handle/10500/2358/thesis.pdf
[2] Babbie, E., Halley, F., & Zaino, J. (2000). *Adventures in social research.* Sage Publications Inc.
[3] Bali, R., & Naguib, R. (2001). Towards getalt telehealth: considering social, ethical and cultural issues. *Canadian conference on electrical and computer engineering, 2*, pp. 1367-1371.
[4] Bryman, A., & Bell, E. (2011). *Business research methods 3e.* Oxford University Press.
[5] CHMI. (2011). *MedAfrica.* Retrieved from http://healthmarketinnovations.org/program/medafrica-0
[6] Cresswell, J. (2014). *Research design: qualitative, quantitative and mixed methods approaches.* SAGE Publications Inc.
[7] Denscombe, M. (2010). *The good research guide: for small-scale social research projects.* McGraw-Hill.
[8] FHRCSA. (2017). *What is telehealth?* Retrieved from http://www.cchpca.org/what-is-telehealth
[9] Kandjeke, J. (2012). *Follow-up report of the Auditor General on the performance audit study on the MoHSS-referral system for the financial year 2008, 2009 and 2010.* Namibia: Office of the Auditor General.
[10] Kelven, U. (2017). *S.A.'s ConnectMed launches operaions in Kenya.* Retrieved from http://techloy.com/2017/03/30/sas-connectmed-launches-operations-in-kenya/
[11] M. -H. (2017). Retrieved from http://www.mhss.gov.na/national-directorates/Hardap-Region/55/
[12] MacWhinney, B., & Wagner, J. (2010). Transcribing, searching and data sharing: the CLAN software and the TalkBank data repository. *Gesprachforschung*, 154-173.
[13] Maheu, M., Whitten, P., & Allen, A. (2002). *E-health, telehealth and telemedicine: a guide too startup and success.* John Wiley and Sons.
[14] McBain, H., Shipley, M., & Newman, S. (2015). The impact of self-monitoring in chronic illness on health utilisation: a systematic review of reviews. *BMC health services research, 15*(1), 565.
[15] McMillan, H., & Schumacher, S. (2006). *Resaerch in education: evidence-based inquiry.* New York: Pearson.
[16] Rabiee, F. (2004). Focus group interview and data analysis. *Proceedings of the Nutrition Society, 63*, 655-660.
[17] Seizler, A., Simmonds, L., Rodgers, W., Wong, E., & Stickland, M. (2012). Pulmonary rehabilitation in chronic obstructive pulmonary disease: predictors of program competion and success. *COPD - Journal of Chronic Obstructive Pulmonary Disease, 9*(5), 538-545.
[18] Stickland, M., Jourdain, T., Wong, C., Rodgers, W., Jendzjowsky, N., & MacDonald, G. (2011). Using telehealth technology to deliver pulmonary rehabilitation to patients with chronic obstructive pulmonary diseases. *18*(4), 216-220.
[19] Stiftung, E. (2012). *The Namibian health system.* Retrieved from http://www.fesnam.org/pdf/2012/reports_publications/PAPER_HealthSystem_BenediktBrock meyer
[20] Wanala, D., & Kaddu, A. (2013). A meta-analysis of telemedicine in Africa. *Journal of Pathology Informatics, 4*(1), 6.
[21] WHO. (2011). mHelath new horizon for health through mobile technologies. *Global observatory for ehealth series, 3*(6).