Optimisation of Student Information System for Mobile Devices

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Abstract
This research study optimises student information system for mobile devices using Student Academic Registration Information System (SARIS) as a case study. The study specifically optimises SARIS to improve user experience, page loading speed, portability, and search for mobile devices. Optimisation of SARIS for mobile users' convenience, together with an increasing trend for offering specific content for mobile devices were the main reasons for optimisation of SARIS. The optimised SARIS was evaluated to determine the extent it was efficient for mobile devices. The study was conducted at Tumaini University Makumira (TUMA), in Arusha, Tanzania. The study used qualitative and quantitative methods for data collection and analysis. The results show that optimisation of information system for mobile devices improves page loading speed, user experience, portability, and searching capabilities on these small devices. It is recommended that a future research could be conducted in other information systems.

Keywords: Mobile apps, mobile devices, optimisation, SARIS, student information system

I. INTRODUCTION
The use of information systems is inevitable in the information digital age in every field. Information systems, for example, are used at a community based cooperative society to a multinational corporation. Computerised information systems play a major role in any organisation because they are always aimed at lowering operational costs, increase profits, improve decision making skills, improve service by satisfying customer needs or gain a competitive advantage so as to achieve organisational goals (Stair & Reynolds, 2018; Trivedi & Verma, 2020).

Information and communication technology (ICT) provides different ways which can be used to access information systems and web resources available on the Internet (Sherif & Senja, 2015). On one hand, personal computers are the ones of the many ways to access information systems and web services provided that they are connected to the Internet through wired or wireless network. On the other hand, mobile devices are now a common way to access information systems and web services on the Internet using wireless communication technologies such as Wireless Fidelity (Wi-Fi) and Wireless Application Protocol (WAP).

Mobile devices, such as mobile phones, multimedia devices, tablets, and e-readers, are different from general-purpose computers due to the fact that a mobile device is an embedded system as opposed to a computer. To most users, the primary function of the mobile phones is voice communication, while that of the tablets is browsing multimedia contents, and that of e-readers is to read digital books (Cheung et al., 2009). Cheung et al. (2009) added that mobile devices are more constrained than computers in terms of their limited display size, limited input and control measures, limited memory and processing capability, and
battery size. Therefore, applications have to be more conscious about the resource usage of mobile devices, especially memory and battery.

This study aimed at optimising student information system by implementing mobile web-based system and evaluating its performance in improving user experience, page loading speed, portability, and search for mobile devices. The convenience of mobile users and an increasing trend for offering specific content for mobile devices were the main reasons for the optimisation of SARIS. The mobile optimised system was evaluated to determine the extent the system was efficient for mobile devices.

II. LITERATURE REVIEW

Student Information System

Student information system is an information system that is meant for managing student's academic records (Lubanga et al., 2018). Student information systems are used for managing and processing students’ records in an efficient way. Student information systems are of great help to the institution administration, academic staff, and students in updating, retrieving and generating students’ academic records (Dacucuy-Pacio, 2013). In a nutshell, student information system tracks student's academic records from admission to alumnus status (Bayangan-Cosidon, 2016).

According to Massachusetts Institute of Technology [MIT] (2020), student information system makes information available for students to access their academic and personal records as well as the ability to update their personal details and register for courses online. Student information system can be used to provide course instructors and departmental administrative staff with list of students in a class and the individual academic records of their students. Student information system provides an integrated approach in acquiring, storing, analysing and controlling the flow of student information throughout a higher academic institution (Gürkut & Nat, 2018; MIT, 2020).

A study by Nkata and Dida (2019) suggested that the use of student information system plays a key role in improvement of the quality of education. The study further stated that student information system may enhance parents' involvement in students' academic activities. However, the study reiterated that most secondary schools in developing countries still use the manual system for tracking students' academic records due to additional costs for system implementation and maintenance.

SARIS

SARIS is a web-based student information system which keeps students' records such as registration, examination results, hostel accommodation, e-learning, and teaching timetables in higher learning institutions (Lungo, 2013; Zalongwa Technologies Limited, 2020). Examples of higher learning institutions in Tanzania that use SARIS for tracking students’ records are TUMA, Muhimbili University of Health and Allied Sciences, Open University of Tanzania, Sebastian Kolowa Memorial University, and State University of Zanzibar. Lungo (2013) suggested that the main reason that led to the development of the SARIS for higher learning institutions was to solve three major problems associated with the management of students’ records, namely nominal roll manipulation, arithmetic errors, and transcribing errors. These problems had been encountered several times in different higher learning institutions before SARIS was implemented to address them.

Mobile Devices

Andersson and Henningsson (2010) defined mobile devices as electronic devices which have some kind of computing functions, and are small in size and portable in the most cases. They are pocket-sized devices which are smaller than notebooks to the extent that users have the freedom to use them in different places. They are categorised based on the following three criteria, namely physical size of the device, the capability to make 2G/3G/4G circuit-switched voice calls with the device, and the type of operating system running on the device (Firtman, 2012).
Mobile Information System

Mobile information system is an information system specifically developed to be used or accessed through mobile devices (Glover, 2020; Krogstie & Asif, 2011). This mobile information system, also known as an 'app', is compact information system that performs specific tasks for the mobile user anytime, anywhere and on the movement. These applications are either downloaded and installed on these mobile devices or accessed via the Internet depending on the type of mobile application.

El-Kassas et al. (2017) stated that there are three types of mobile applications. These types of mobile applications are native applications, mobile web applications, and hybrid mobile applications. Software developers can decide to develop any of these three applications based on the customer or user requirements and tools available for them. These applications differ from one another in the way they are developed, installed, used and the features which each application provides to the mobile device's users. Figure 1 shows advantages and disadvantages of each type of mobile application.

![Figure 1: Native, Hybrid, and Mobile Web Applications. Source: Ferdiana (2012)](image)

Optimisation of Information System

The main objective of optimisation of information system is to get a new version of an existing system that offers a higher quality service (Boja et al., 2008). In addition, optimisation of
information system improves system performance and minimises its drawbacks (Faiz & Krichen, 2012). Therefore, information system may be optimised so that it executes more rapidly, becomes capable of operating with less memory storage or other resources, draws less power from the device or provides personalised web interface for mobile devices. Mobile optimised information systems strive to introduce rapid execution, operating with less memory storage and drawing less power, features which are suitable for handheld or battery driven devices.

Research Gap

Several studies have been conducted in student information systems as well as mobile devices. However, there are limited studies concerning optimisation of student information system for mobile devices. This study attempts to fill this gap by optimising student information system to improve user experience, page loading speed, portability, and search for mobile devices. Together with the benefits that mobile optimised systems offer to mobile users, the world is also mobile now.

III. METHODOLOGY

The Study Area, Target Population and Sample Size

This research study took place at TUMA in Arusha, Tanzania, using a case study research design. TUMA was selected for the study due to the fact that it has implemented SARIS for the management of students’ records. The study area provided an easy access from where the researcher is residing. Furthermore, the researcher opted for a case study because it provided an opportunity for a complete examination of optimisation of student information system for mobile devices (Creswell & Plano Clark, 2018).

The target population was Zalongwa software developers’ team and SARIS users accessing the system on mobile devices. SARIS users included system administrators, registrar, examination officer, lecturers, and students. The target population was used for testing and evaluating optimised SARIS for mobile devices.

This study used a simple random sampling technique to determine the sample size. This is a probability sampling which provides an equal chance for every member in the population to be included in the sample (Kothari, 2004). The study used a sample size of the 127 participants from the target population.

Materials and Technologies

Materials which were used in this research were laptop, server, and mobile devices such as smartphones and tablets. During optimisation of the SARIS, technologies used were jQuery Mobile, PHP, CSS3, HTML5, Eclipse IDE, ADK, MySQL and Apache.

Data Collection

The researcher used both qualitative and quantitative methods to obtain data for this study. Document analysis was used as the main method of data collection supplemented with an online questionnaire. The reason for using document analysis was reliability and suitability of user requirements obtained from the current system (Kothari, 2004). The questionnaire was only used for testing and evaluation of mobile optimised SARIS. The researcher opted for questionnaire because it undoubtedly eases collection and analysis of data. The questionnaire was mailed to all 149 respondents. The email contained instructions and links for testing and evaluating the performance of both systems, desktop SARIS and mobile optimised SARIS on mobile devices. Participants were required to fill in the questionnaire after accessing the systems on their mobile devices. A total of 127 participants filled in the questionnaire correctly. The response rate was 85.2%.

Data Analysis
This study used separate data analysis for the qualitative data using a qualitative content analysis method and the quantitative data using descriptive statistics method (Creswell & Plano Clark, 2018). The qualitative content analysis was used to analyse data collected from document analysis. The qualitative content analysis interprets the meaning from the content of qualitative data in an organised way (Schreier, 2012). The quantitative data collected from the questionnaire were analysed using descriptive statistics. The reason for choosing descriptive statistics was that they allow presentation of quantitative descriptions in a graphical form (Marczyk et al., 2005).

Table 1: Characteristics of Respondents

<table>
<thead>
<tr>
<th>Gender</th>
<th>Frequency (Fr)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>86</td>
<td>67.7</td>
</tr>
<tr>
<td>Female</td>
<td>41</td>
<td>32.3</td>
</tr>
<tr>
<td>Total</td>
<td>127</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>User Category</th>
<th>Frequency (Fr)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developers</td>
<td>5</td>
<td>3.9</td>
</tr>
<tr>
<td>System administrators</td>
<td>2</td>
<td>1.6</td>
</tr>
<tr>
<td>Registrar</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Exam officer</td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Lecturers</td>
<td>12</td>
<td>9.4</td>
</tr>
<tr>
<td>Students</td>
<td>106</td>
<td>83.5</td>
</tr>
<tr>
<td>Total</td>
<td>127</td>
<td>100</td>
</tr>
</tbody>
</table>

**Improved Page Loading Speed**

The mobile optimised SARIS was evaluated to determine the extent to which the performance of the mobile version has improved when accessed on mobile devices in comparison with desktop SARIS. Using a questionnaire, five different questions which required respondents to select their answers to the questions were asked on a 5-point Likert scale, starting from "Strongly Agree" to "Strongly Disagree".

The respondents were questioned if mobile optimised SARIS page loading speed is improved. The majority of the respondents, 72.4%, agreed or strongly agreed that mobile version of SARIS had improved loading speed. On the other hand, 14.2% of the respondents remained neutral while 13.4% disagreed or strongly disagreed with this question.

**Improved User Experience**

User experience of the mobile optimised SARIS was also evaluated by respondents. This study showed that 58.3% of the respondents agreed or strongly agreed that mobile version of SARIS provided improved user experience compared to desktop SARIS. On the other side, 23.6% of the respondents stayed
neutral while 18.1% disagreed or strongly disagreed with the same question.

**Improved Portability**

The respondents were also asked to indicate their view if the mobile optimised SARIS is portable on their mobile devices. The majority of the respondents, 86.6%, agreed or strongly agreed that the mobile optimised SARIS was more portable on their mobile devices than desktop SARIS. On the other hand, 8.6% remained neutral while 4.8% of the respondents disagreed or strongly disagreed with this statement.

**Functionality**

This criterion was put forward in order to test whether or not mobile optimised SARIS maintained most of its functionalities. 66.1% of the respondents agreed or strongly agreed that mobile optimised SARIS maintained most functionalities of the desktop version. At the same time, 18.9% of the respondents disagreed or strongly disagreed while 15.0% stayed neutral on this question.

**Improved Search**

The response on improvement of the searching capability of the mobile optimised SARIS showed that 66.2% of the respondents agreed or strongly agreed that mobile optimised SARIS provided improved searching capability compared to the desktop version of the system. Contrarily, 24.4% of the respondents disagreed or strongly disagreed while 9.4% remained neutral on this statement. Table 2 indicates the summary of the criteria for evaluating mobile optimised SARIS.

**Table 2: Criteria for Evaluating Mobile Optimised SARIS**

<table>
<thead>
<tr>
<th>Criterion</th>
<th>SA</th>
<th>A</th>
<th>N</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile optimised SARIS has improved page loading speed</td>
<td>64 50.4</td>
<td>28 22.0</td>
<td>18 14.2</td>
<td>12 9.5</td>
<td>5 3.9</td>
</tr>
<tr>
<td>Mobile optimised SARIS provides improved user experience</td>
<td>53 41.7</td>
<td>21 16.6</td>
<td>30 23.6</td>
<td>9 7.1</td>
<td>14 11.0</td>
</tr>
<tr>
<td>Mobile optimised SARIS is more portable on my mobile device</td>
<td>79 62.2</td>
<td>31 24.4</td>
<td>11 8.6</td>
<td>3 2.4</td>
<td>3 2.4</td>
</tr>
<tr>
<td>Mobile optimised SARIS offers majority of the functionalities of desktop system</td>
<td>48 37.8</td>
<td>36 28.3</td>
<td>19 15.0</td>
<td>11 8.7</td>
<td>13 10.2</td>
</tr>
<tr>
<td>Mobile optimised version of SARIS offers improved search</td>
<td>67 52.8</td>
<td>17 13.4</td>
<td>12 9.4</td>
<td>14 11.0</td>
<td>17 13.4</td>
</tr>
</tbody>
</table>

The results of this study show that mobile version of SARIS has improved page loading speed on mobile devices. These findings mean that the improved page loading speed was the result of optimisation of desktop system pages for mobile devices. These findings concur with a study by Foti (2014) that suggests that the loading speed of a mobile web page on mobile devices is higher than that of desktop web page.

The findings suggest that mobile optimised SARIS offers improved user experience. The results imply that mobile users enjoy usability and look-and-feel of the optimised system on their mobile devices. The results are consistent with a previous
research study that claims that mobile web content improves user experience on mobile devices (Butkiewicz et al., 2015).

This study also indicates that mobile optimised SARIS is more portable on mobile devices. These findings mean that mobile optimised SARIS is suitable for mobile device users as it fits on their devices’ screens. These results are in line with a study by Foti (2014) that states that portability of mobile apps on mobile devices engage students in mobile learning. Figure 2 shows portability of mobile optimised SARIS on a smartphone running iOS.

Figure 2: Portability of mobile optimised SARIS on iOS smartphone.

Furthermore, the results point out that mobile version of SARIS provides improved searching capabilities. These results mean that searching on mobile optimised SARIS improves as searching does not require zooming in and out to type the search text into the search box. The results also imply that zooming in is no longer required to read the search results of the mobile optimised SARIS. The study by Song et al. (2013) backs up this claim as it states searching on mobile web page on mobile devices is more efficient compared to searching on a desktop page.

V. CONCLUSION AND RECOMMENDATIONS

Conclusion

This study focused on evaluation of optimised student information system for mobile devices using SARIS as a case study. The desktop system was optimised by adding the mobile interface to it, that is, system source code was optimised for mobile device users. The results indicate that optimisation of information system for mobile devices improves page loading speed, user experience, portability, and searching capabilities. The optimisation process ensured that system functionalities and security of the system were maintained. The mobile optimised SARIS solves the problems that mobile users encountered when accessing the desktop system via mobile devices.

Recommendations

Based on the results of this research study, the author recommends that system developers should think of the mobile users in order to improve software utilisation on mobile devices by developing mobile-specific applications. It is also recommended that developers should take into consideration the issue of platform independence when optimising information systems for mobile devices. Future research could be conducted in other information systems different from student information system.

VI. REFERENCES

Association for Information Systems. AIS Electronic Library (AISeL).


