

CONTEXT AWARENESS FRAMEWORK FOR DEVELOPING MOBILE APPLICATIONS: A SURVEY OF SELECTED SMALL AND MEDIUM ENTERPRISES IN NAKURU TOWN, KENYA

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Abstract

Mobile applications act as valuable tools that can be used by entrepreneurs and small and medium enterprises (SMEs) alike to market their products/services and considerably reduce costs of doing business. The government of Kenya has invested billions of shillings in laying of fiber optic cables in Kenya, improving Kenya's ICT sector and coming up with projects aimed at promoting the use of technology among businesses and citizens alike. With all of these investments, there are challenges that hinder the use of business mobile applications by SMEs. Although context awareness in mobile applications is gaining recognition among mobile user and developer communities, many design scenarios still do not incorporate required context awareness as one of their primary goals. Although there are strong context awareness frameworks for mobile applications, there is still potential to improve the usability of virtual learning systems. The study established that the concept of context independence including the physical context independence and the logical context independence from the applications and mobile devices provides a graceful solution in the form of a methodological framework for the development of context-aware systems for SMEs in Nakuru Town.

Keywords: Context-Awareness; Mobile Applications; Context-Awareness Framework; user-centered mobile applications

I. INTRODUCTION

Mobile computing is defined as computing activity associated with portable computing devices and their mobile users (Girish, 2000) . Such devices come in a plethora of sizes and shapes, have widely varying computational capability, and may be connected to other devices through a multitude of different network technologies. They may range from general purpose laptop computers to specialized devices for data organization, and may be stand-alone, intermittently connected, or continuously connected using wireless networks. Despite this wide spectrum of devices and technologies, mobile computing is characterized by a close association between the portable device and its mobile user. This unifying aspect not only induces many of the problems in mobile computing, but also provides the flexibility to conceive of and implement their solutions raising the issue of context awareness.

The context of users may be a combination of various entities such as their identity, activity, location and mood; their social context may be the nature of their relationship with other persons such as family member,

colleague or friend; and their physical context might include (for instance) the lighting level of the location where they are. The context of a network may be its quality of service parameters, like round-trip time, and the context of a device may be its capabilities, display features or battery level (Chihani et al., 2011)

Mobility has raised new research issues in all areas of computer science and engineering. The most obvious and consequently the earliest to be addressed was the effect of mobility on network protocols. Initial research in routing for packet-oriented data networks with mobile hosts soon found its way into emerging networking standards (Deering & Hinden, 1998). A parallel effort addressed the mobile host problem in connection oriented networks like the Automatic Teller Machine (ATM). The fundamental problems of mobility management and resource management had to be addressed for the successful large-scale deployment of such emerging technologies. It is important to bridge the gap between hardware, sensors, operating system, network and the application. This could simplify the development process from the perspective of the developer (Abowd, 2012).

A context-aware system is a mobile environment in which applications can discover and make use of context information including user location, time, date, nearby devices and other environmental activities to adapt their operations and behavior (Chen & Kotz, 2000). Due to the fast development of wireless communication on mobile devices, different kinds of context-aware architectures were designed and employed for a wide spectrum of applications. However, since the individual focus of each framework was on its specific application domain, the current context-aware systems are heterogeneous in all aspects, such as hardware, mobile resources, operating systems, application software, and platforms.

The serious heterogeneous characteristics of context-aware computing are especially important and become significant drawbacks while developing or integrating context-aware services for the applications in mobile computing environments. This research therefore aims at designing a framework for supporting context-aware applications within a typical mobile environment such as an office or home.

The study therefore sought to provide insights and add to the field of knowledge of mobile applications development. The findings and recommendations therefore aimed to develop a framework to support context-aware applications. The findings can also be useful to concerned bodies in the country for example, the government, financial institutions, the business community, mobile phones service providers as well as the entire Kenyan population that use mobile applications in their daily activities.

II. RESEARCH OBJECTIVES

The main objective of this research was to study and propose a context aware framework in support of mobile applications development for small and medium enterprises in Nakuru Town, Kenya.

The specific objectives of the study were to:

- i. Determine Small and Medium Scale Enterprises mobile phone user's experience with context aware mobile applications in Nakuru Town, Kenya.

- ii. Identify and investigate issues not addressed by currently available mobile applications context handling frameworks in Nakuru Town, Kenya.
- iii. Propose a context awareness framework in support of mobile application development for Small and Medium Enterprises in Nakuru Town, Kenya.

III. RESEARCH METHODOLOGY

A. Research Design

The focus of this study was specifically on the mobile phone application users among SMEs in Nakuru town. To achieve the purpose of the study, this research adopted a qualitative approach which was more appropriate to fulfill the purpose of this research, since this study aimed at capturing the experience of mobile applications users among SMEs. Given the fact that observations, experiences, ideas and point of views are difficult to measure in a quantitative way a descriptive survey research study approach was appropriate so as to use a range of methods to collect the maximum data for this research.

According to Burns (2001) descriptive research is designed to provide a picture of a situation as it naturally happens. It may justify current practice and make judgment and also to develop theories. Main characteristics of this method are that the researcher has no control of variables but he can only report what has happened and what is happening. This research adopted the use of questionnaires to explore its research questions.

B. Target Population

The target population consisted of 5,135 legally registered SMEs in Nakuru Town, in Nakuru Town Constituency (The Kenya Government, 2013). The target population included SMEs who access mobile applications for business use in Nakuru Town.

C. Sample Size and Procedure

Sampling for questionnaire participants was done through non-probability sampling technique called purposive sampling. Creswell (2003) notes that purposive sampling is the rationale for undertaking case study research. The researcher identified potential respondents who were presumed to be in possession of characteristics deemed suitable for the ability to provide required information and were presumed to be in charge of the targeted SMEs. Either the owner or a manager presumed to be in charge of the SME were expected to represent the SME in filling the questionnaires.

The small and medium enterprises selected therefore demonstrated stability by having occupied their office space, whether rental or owned, for more than one year, have done business within the boundaries of the Nakuru Town Constituency within the same period of time and have employed at least 1 employee besides the owner-manager or entrepreneur of the business. A purposive sampling procedure was used to

collect data from the SMEs. According to Yamane (1967), the sample size was calculated using the following formula;

$$n = \frac{N}{1 + N(e)^2}$$

Where;

n is the sample size,

N is the population and

e is the level of precision ± 10 (sampling error or 90% confidence level)

$$n = \frac{5,135}{1 + 5,135(0.1)^2}$$

$$n = \frac{5,135}{1 + 51.35}$$

$$n = 98.09$$

On applying the formula, 98.09 was the result and a sample size of 100 respondents was the number chosen to be utilized in the study. The sample size of 100 respondents from target SMEs was considered to be representative of the SMEs in Nakuru Town.

D. Instrumentation

The main tool of data collection for this study were questionnaires for primary data and secondary data from journals and journal articles, magazines, books as well as published and unpublished research works. The questionnaires were delivered by the researcher to the respondents and picked at an agreed time. After collection of the filled questionnaires and some follow-up, a total of 94 questionnaires were collected. The response rate was 94% and was considered adequate for the researcher to proceed with data analysis.

E. Data Analysis and Presentation

Data analysis refers to the process of generating value from the raw data (Johnson and Christensen, 2004). The primary data collected were coded, edited and analyzed using Statistical Package for Social Science software (SPSS 20.0). Quantitative data collected through the questionnaire were organized and then coded. This was done to ensure similar patterns from the answers given were identified. The collected data were checked for errors and to identify unanswered questions before the data were entered into Statistical Packages for Social Sciences (SPSS 20.0) software. Open ended questions involved qualitative data analysis at some level as the open ended questions provided responses from which themes were developed. Data analysis was carried out after data entry for both closed and open ended questions. Descriptive and inferential statistics were employed to analyze quantitative data. The statistics used include frequency percentages and the results of data analysis were presented using frequency distribution tables, pie charts and bar graphs.

IV. RESEARCH FINDINGS AND DISCUSSION

A. Response Rate

A total of 100 respondents were expected to respond to the call but out of the distributed questionnaires, 94 questionnaires representing 94% were returned, but 6 questionnaires representing 6% were not returned. The researcher did a follow up on the unreturned questionnaires and found out that out that five of the potential respondents were unavailable when the questionnaires were being collected.

B. Business Activities of the respondents

The respondents contacted in this study were asked to indicate by ticking the type of business activity that they carried out. Table 1 indicates the results obtained in relation to this question.

Table 1: Respondents Distribution

S/No	Type of Business Activity	Frequency	Percentage (%)
1	Transport & Communications	30	31.91
2	Wholesale and Retail	21	22.34
3	Services	18	19.15
4	Tourism	8	8.50
5	Agriculture	7	7.45
6	Manufacturing	4	4.26
7	Construction	4	4.26
8	Others	2	2.13
	Total	94	100

Source: Research Data (2014)

As shown in Table 1 the respondents were from different business activities and categories. From the total 94 questionnaires collected a majority of (31.91%) them being in the transport & communications category. The results from other business activities are as follows: wholesale and retail (22.34%), services (19.15%), tourism (8.50%), agriculture (7.45%), manufacturing (4.26%), construction (4.26%), and others (2.13%). From the total 94 questionnaires collected 85 respondents representing (90.43%) responded with

reliable data, which comprise of the fully completed questionnaires and therefore could be in the analysis of the data. This is shown in Figure 4.1.

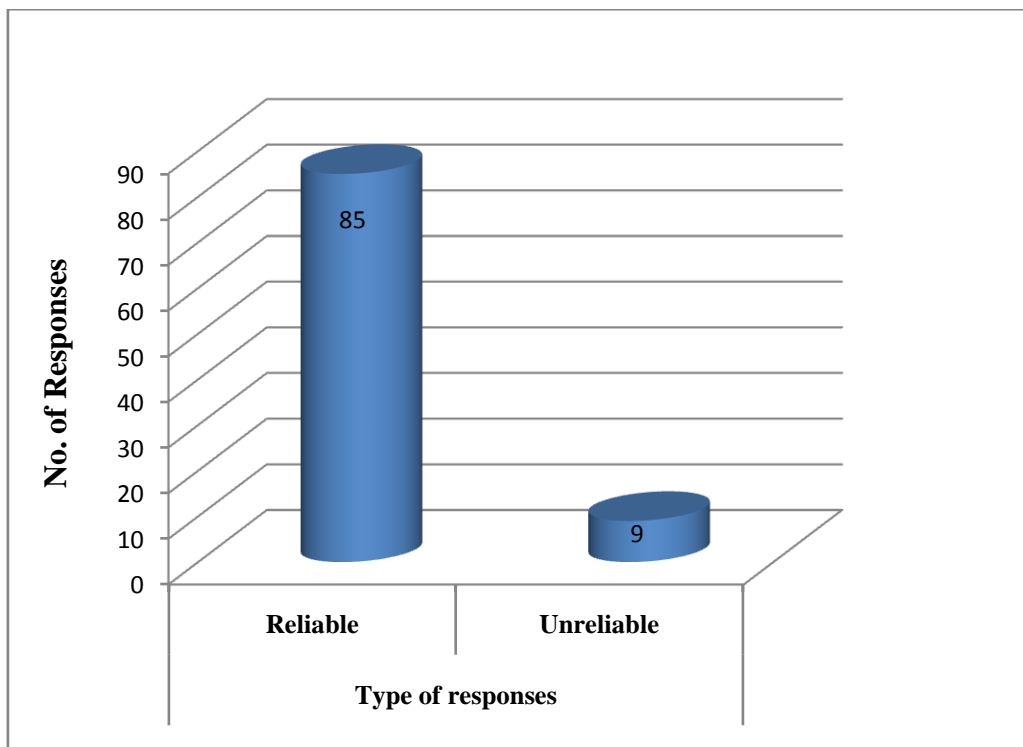


Figure 1: SMEs responses

Source: Research Data (2014)

C. Mobile User Responses on Context awareness

This research focused on the implementation and user experience with context-aware mobile applications and their ability to tailor context-aware information depending on the calculated context. The questionnaire designed for this purpose attached in Appendix II, reflects this fact and comprises statements related to the respondents' experiences when using their mobile applications for business use. Some questions in the questionnaire also aimed at determining the kind of application used by the respondents and what type of contextual information they consider necessary. Users' opinions in most questions are expressed on a five-point likert scale ranging from: *strongly disagree*(SD), *disagree*(D), *Neutral*(N), *agree*(A), to *strongly agree*(SA) or *Very Inappropriately*(VI), *Inappropriately*(I), *Neutral*(N), *Appropriately*(A), to *Very appropriately*(VA).

Each option was coded with number from 1 to 5 respectively, and thereafter analyzed by calculating the mean. An extraction of the results from this evaluation is presented in Table 2.

Table 2: User evaluation questionnaire and results

S.No	Statement	Mean
1	Mobile applications consideration of the contextual information is important for delivery of service	3.92
2	Mobile application taking an action based on context affects the applications flexibility positively.	3.48
3	Mobile application taking an action based on context affects the ease of access positively.	3.45
4	Mobile application taking an action based on context affects the applications performance positively.	4.62
5	Mobile application taking an action based on context affects the applications speed of response positively.	3.93
6	It is appropriate if a mobile phone application disables the ringing mode on sensing presence of many people using Bluetooth technology.	2.94
7	It is appropriate if a mobile phone application sends a meeting agenda to all members on your arrival to the venue of meeting.	4.13
8	It is appropriate if a mobile Application lists all the available tourists' destinations at every point of your travel.	3.92

Source: Research Data (2014)

From Table 2 and Figure 4.2, one sees that all answers display a positive bias. In statements number two to five 25, 30, 40 and 38 respondents out of the 85 respondents strongly agreed that the mobile phone application taking an action based on context affected positively on ease of access, performance, flexibility and speed of response and the responses are statistically significant. For statement number one, 50 respondents representing 58.82% out of 85 respondents were positive to the fact that mobile applications consideration of the contextual information is important for delivery of service by the mobile applications. There is thus a strong bias towards positive answers and no middle values (N). This polarization of results however leads to the data for this statement not to be statistically significant.

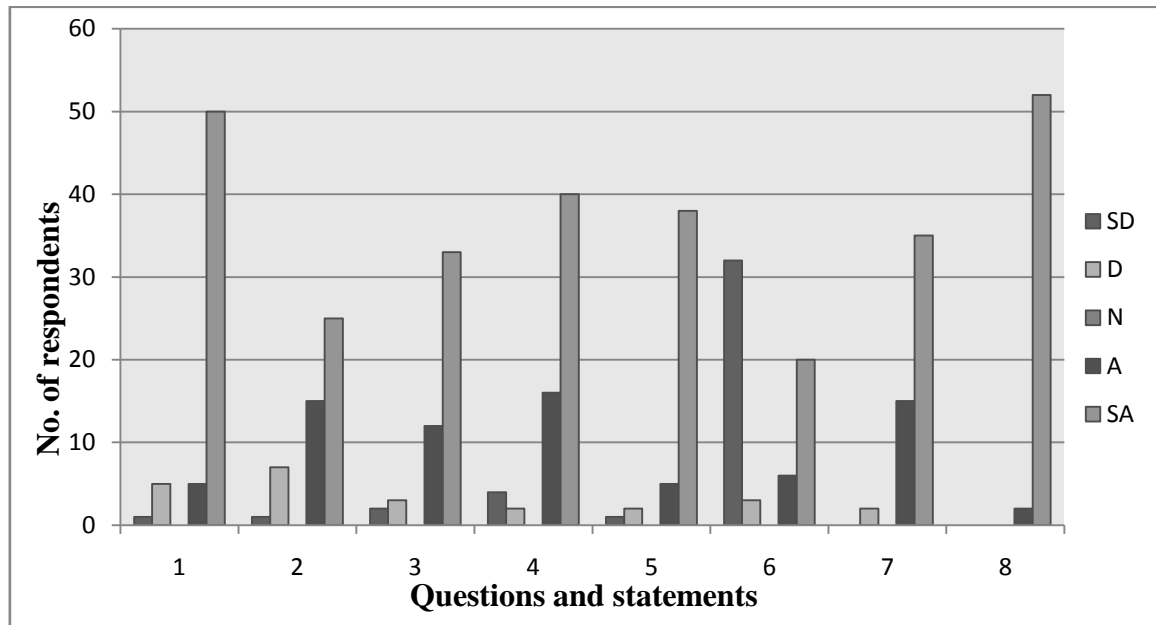


Figure 2: Graph displaying user evaluation results

Source: Research Data (2014)

For statement number seven 41.18% of the respondents point towards this aspect being a useful feature, which makes this an interesting feature to pursue further. This also strongly indicates that a successful user-context computation and the applications generation events on behalf of the user is a key interest of the users as indicated by the respondents. In statements six and eight the user's interest in such applications for use in daily life for common routines is further explored. From the respondents views it is evident that when these issues of proper context handling and management are taken care of, the user experience might improve and increase even more the positive trend in answers to statement six and eight. Moreover, as shown by Zhou et al.(2006) information tailoring is an important task to help users interpret data. This application focuses on tailoring by having minimal information displayed at the same time, when new messages are shown, thereby easing the users' interpretation. The positive responses also highlight a possible opportunity and one should consider pursuing this in further research.

D. Respondents Views on Different Context Awareness Issues

The results presented here illustrate different parts of the questionnaire that addresses different aspects and themes derived from the objectives of the study. Statement one from the mobile applications usage, statements two and five concern performance, user features, speed of response, while other questions in the questionnaire handle the issues of context-awareness, user application features, context aware actors and overall impression based on user experiences with applications used.

Mobile Phone Applications Usage

The research sought to find out the mobile phone application categories that the respondents use for business. The results in Figure 3 show the kind of mobile phone applications that the users access for business purposes.

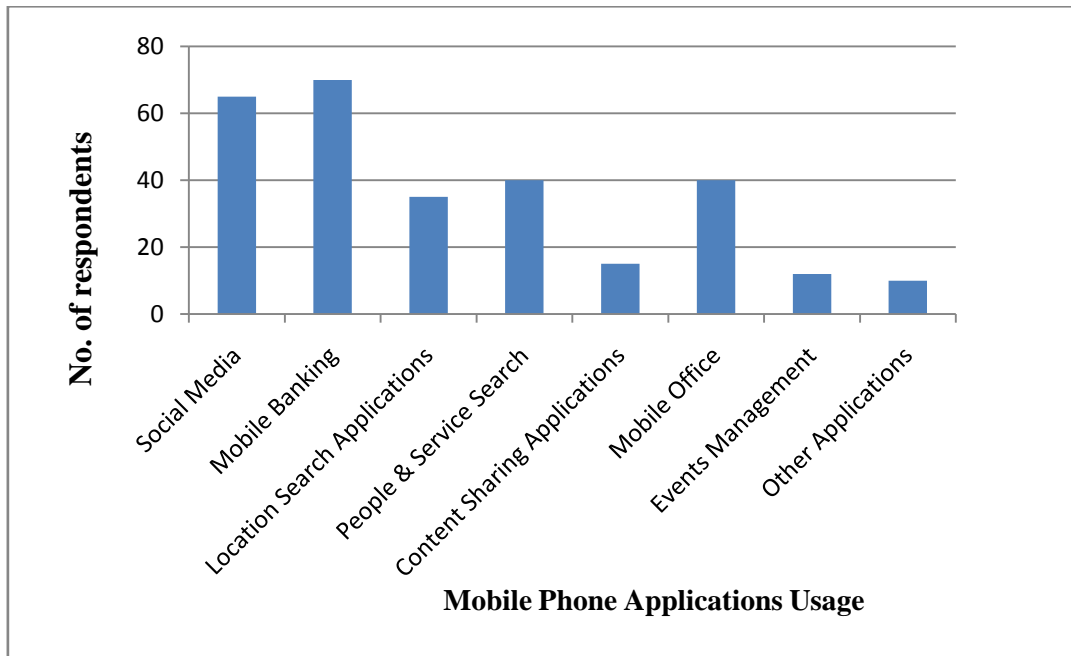


Figure 3: Existing Mobile Phone Applications Usage

Source: Research Data (2014)

The questionnaire results of this study was that mobile banking and social media was the most commonly used applications by the SMEs. 70 (82.35%) of the respondents reported mobile banking as the most common use of their mobile phone for business, and many also reported social media as their preferred method for communication via the mobile phone. The respondents also indicate that they often need people, service and location search applications in order to facilitate there day to day business activities. Of the 85 respondents in this study, 40 (47.05%) of them used people and service search applications while another 35% used location search applications. The trend is due to the ability and ease of using the internet on their phone, leading to different available applications for the users.

Frequency of Mobile Phone Applications Usage

In relation to the frequency of mobile phone applications usage, Figure 4 indicates the results from the respondents. A majority of 56 respondents representing 65.88% frequently use Mobile phone applications for business use.

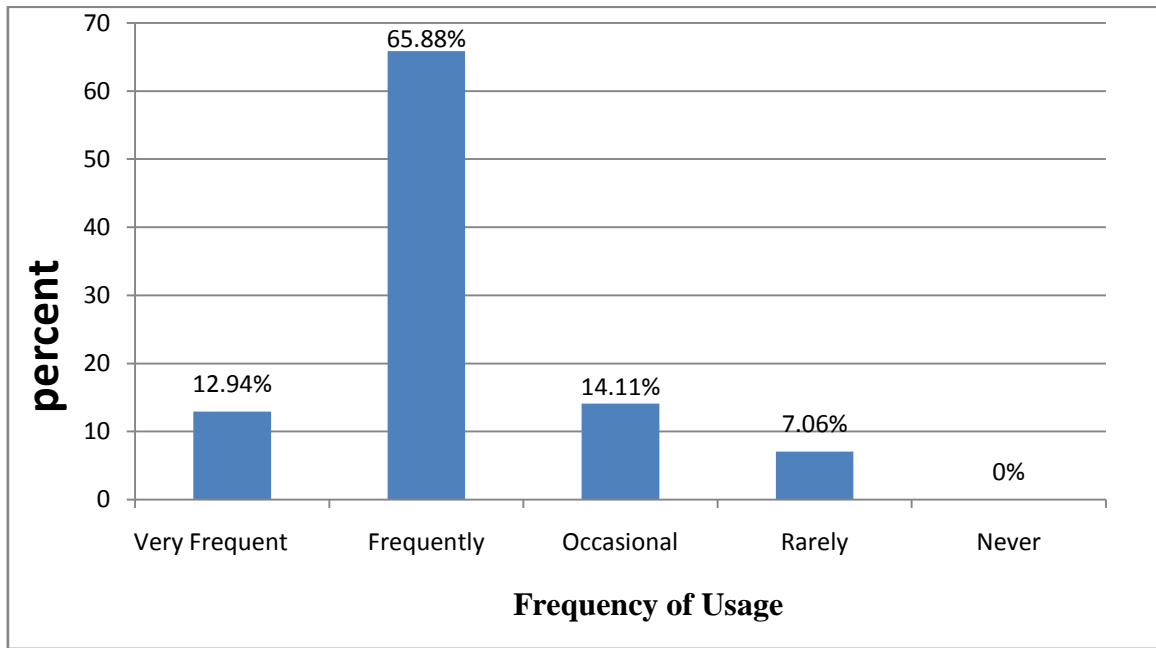


Figure 4: Frequency of Mobile Phone Application Usage

Source: Research Data (2014)

Context aware Actors

The researcher also sought to determine how mobile users among the SMEs view the actions of a context aware application based on perceived test scenarios. Table 3 shows the statements obtained from the questions presented to the respondents in question five of the questionnaire, these statements helped analyze their responses as seen in Figure 5.

Table 3: Statements on Context Aware Actors

No	Statement
S1	A mobile phone application disables the ringing mode on sensing presence of many people using Bluetooth technology.
S2	A mobile Application lists all the available tourists' destinations at every point of your travel.
S3	A business mobile application informs all your colleagues about your presence in a particular location.
S4	A mobile phone application sends a meeting agenda to all members on your arrival to the venue of meeting.

Source: Research Data (2014)

Based on the statements indicated on Table 3 users' opinions are expressed on a five-point Likert scale and the results from the statements are indicated in Figure 5.

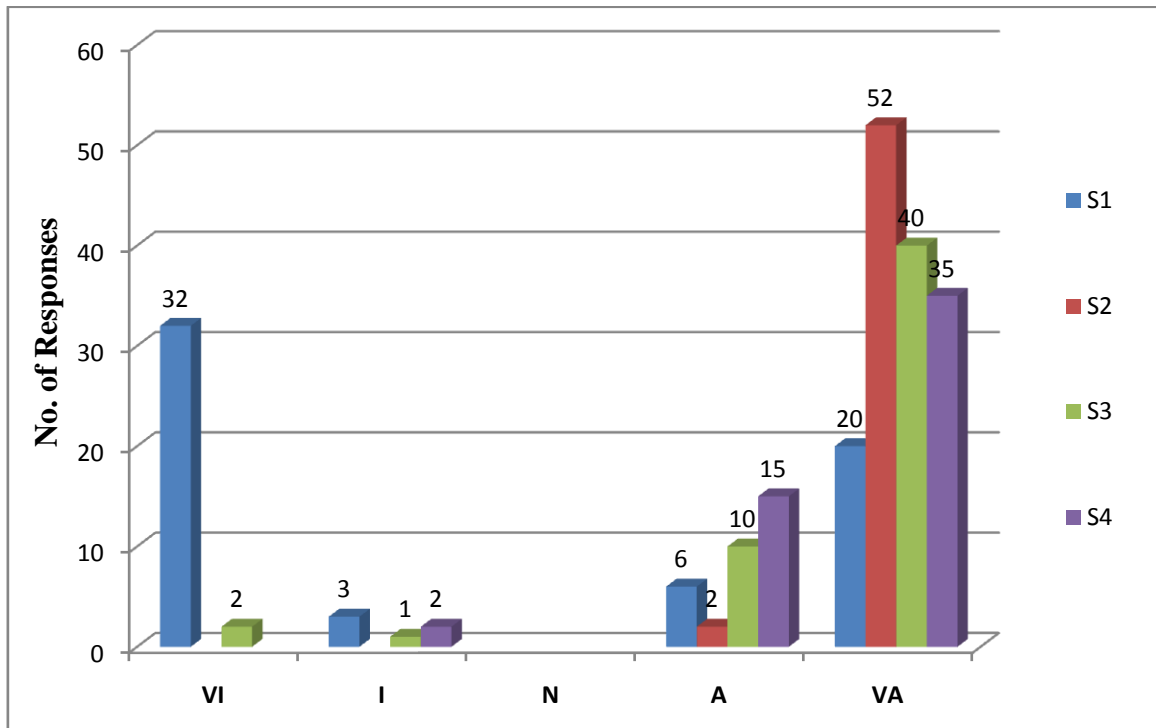


Figure 5: Statements regarding Context aware Actors

Source: Research Data (2014)

Opinions are split regarding integration of context aware actors. Users agree that use of contextual information is useful, but disagree on different scenarios of action by the actors. The majority, 32 out of 85, found the mobile phone application disabling the ringing mode on sensing presence of many people using Bluetooth technology as inappropriate or very inappropriate, highlighting that context aware actors should be further pursued in the context-awareness framework.

Context-aware Information

In terms of context-aware information the respondents were asked to take a stand in respect to first; the usefulness of contextual information for the delivery of service and secondly the user satisfaction on applications action on behalf of the user based on the contextual information, with results shown in Figure 6. For the first statement a clear majority supported this assertion (71/85). On the second issue raised opinions are somewhat spread depending on the aspect to be achieved by the application.

Table 4: Statements on Contextual Information

SNo	Statement
Q1	Mobile applications consideration of the contextual information is important for delivery of service
Q2	Mobile application taking an action based on context affects the ease of use positively.
Q3	Mobile application taking an action based on context affects the applications flexibility

	positively.
Q4	Mobile application taking an action based on context affects the applications performance positively.
Q5	Mobile application taking an action based on context affects the applications speed of response positively.

Source: Research Data (2014)

Based on the questions and statements the results of the users view on the described aspects are shown in

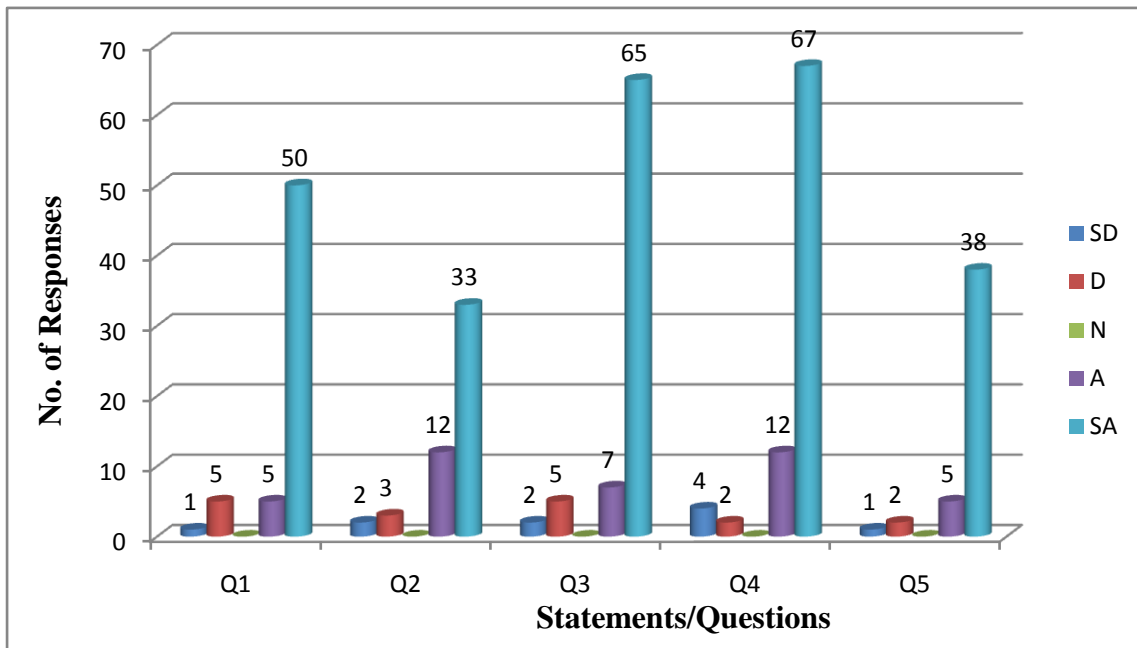


Figure 6: Statements regarding contextual information

Source: Research Data (2014)

The literature review and the results presented point at the ability for modern applications to adapt to their environment as a central feature as Edwards (2005) argued that such tailoring of data and sharing of contextual information would improve user interaction and eliminate manual tasks. Results from the user responses support this. The user found it both attractive as well as have positive attitudes towards the usefulness of contextual information to enhance core application.

E. Performance

The results in Figure 5 visualize the answers from statement 4. This statement deal with the performance of the application in order to verify correct behavior expected of the application. There is a strong positive bias, 67 out of 85. This fact shows the need for context awareness by the application and it fulfills the goal of effective and better user experience.

F. Application Features and Overall Impression

The respondents were asked for an opinion regarding the features of the mobile applications they have used before regarding issues and features of context awareness. Results from these statements show unanimous responses on each of the questions and they are backed by the earlier statements dealing with expected behavior of the application features (Statements 2, 3, 4 and 5).

A majority of the respondents 77 (90.58%) stated that the applications they have used cannot be personalized. This implies that the users can only use the mobile application as it is but cannot be tailored to fit their preferences. 55 (64.70%) respondents also stated that the application used does not display aspects of its own context. These are reasonable points of view, and one could easily see that most applications do not make use of the contextual information in their context. The results of these statements are indicated in Figure 7

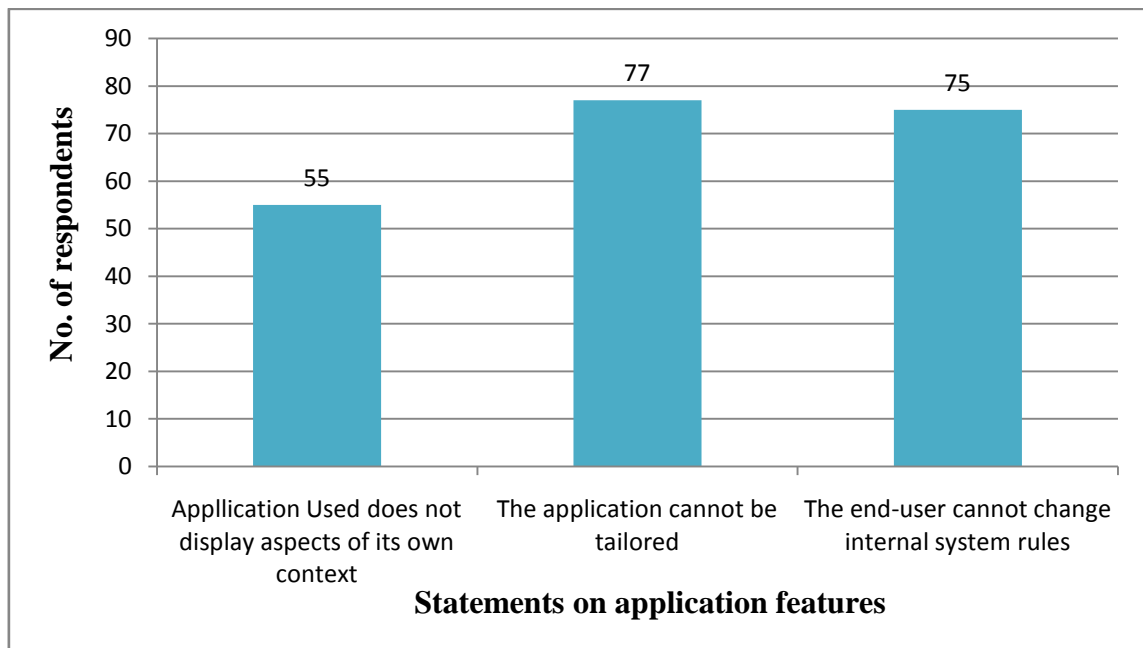


Figure 7: Statements regarding mobile application features

Source: Research Data (2014)

G. Results Discussion

This section aims to elaborate, discuss and justify the research contribution of the data and results presented in relation to the literature. Simplicity and effectiveness are the governing objectives of the interaction between client devices and the context it finds itself in. A simple underlying architecture eases the use and interaction of context with the device. Therefore it is important to be able to have attention to the developed solution and the data it incorporates and presents. The results as presented from statement two to

five support the use of contextual information to achieve better performance, flexibility, user satisfaction, speed of response and ease of access. Most questions asked have an overwhelmingly positive bias. It is however important to keep in mind that the group of user respondents were from selected SMEs in Nakuru town which implies that the results are leaned on the use of mobile applications for business. For this to be generalized, more research needs to be conducted with different groups of users.

In respect of context-awareness, some interesting features emerged in this work. The ideas from Chen et al.(2004) where they propose the use of Bluetooth to create a smart meeting room are also evident this research. They present and pursue the concepts of using context information as a basis for providing users with information and services. This research extends those ideas even further by using context not only as a factor for providing information or services, but to also use it as a basis of mobile applications acting on behalf of the user for a better experience. This feature of context aware applications is well received by the users as indicated by very positive responses to statement one.

V. Proposed Context Awareness framework

Based on the observations described in previous sections the context awareness framework architecture follows the general framework presented by (Bardram & Hansen, 2010) but makes some modification and improvements. The modified context-awareness framework consists of five layers: the device layer, the resource layer, the context layer, the storage layer, and the application layer; as shown in Figure 8.

The content of each layer is described as follows.

- i. The device layer: This layer contains the physical equipments and devices operated and used in the context-aware systems including sensors, identifiers, mobile devices, and actuators, etc
- ii. The resource layer: Entire resources of the context aware computing environment including places, persons, devices, and objects are constructed and managed in the resource layer. The resources of the environment are generally called the domain knowledge of the system and the knowledge can be described by representations of ontology or semantic networks.
- iii. The context layer: Context processing is the core of a context-aware system. Context information is generated and managed in this layer. The interactive activities in the resource layer are presented as context and used to adapt behavior of the system. Context model is needed here to define and represent context data.
- iv. The storage layer: The storage layer stores not only the context data of the current status but also the historical context data in the context-aware system.

The context data produced in the context layer are used to provide the services of applications in the application layer. In order to easily access context data, an effective context database is

important. The choice of types of context databases has to match the representing structure of context model in the context layer.

- v. The application layer: In this layer, application can be built and executed by querying the current status of context and the related historical context data from the context database in the storage layer.

Based on the framework, the architecture of context awareness framework based on a context database management is shown in Figure 8.

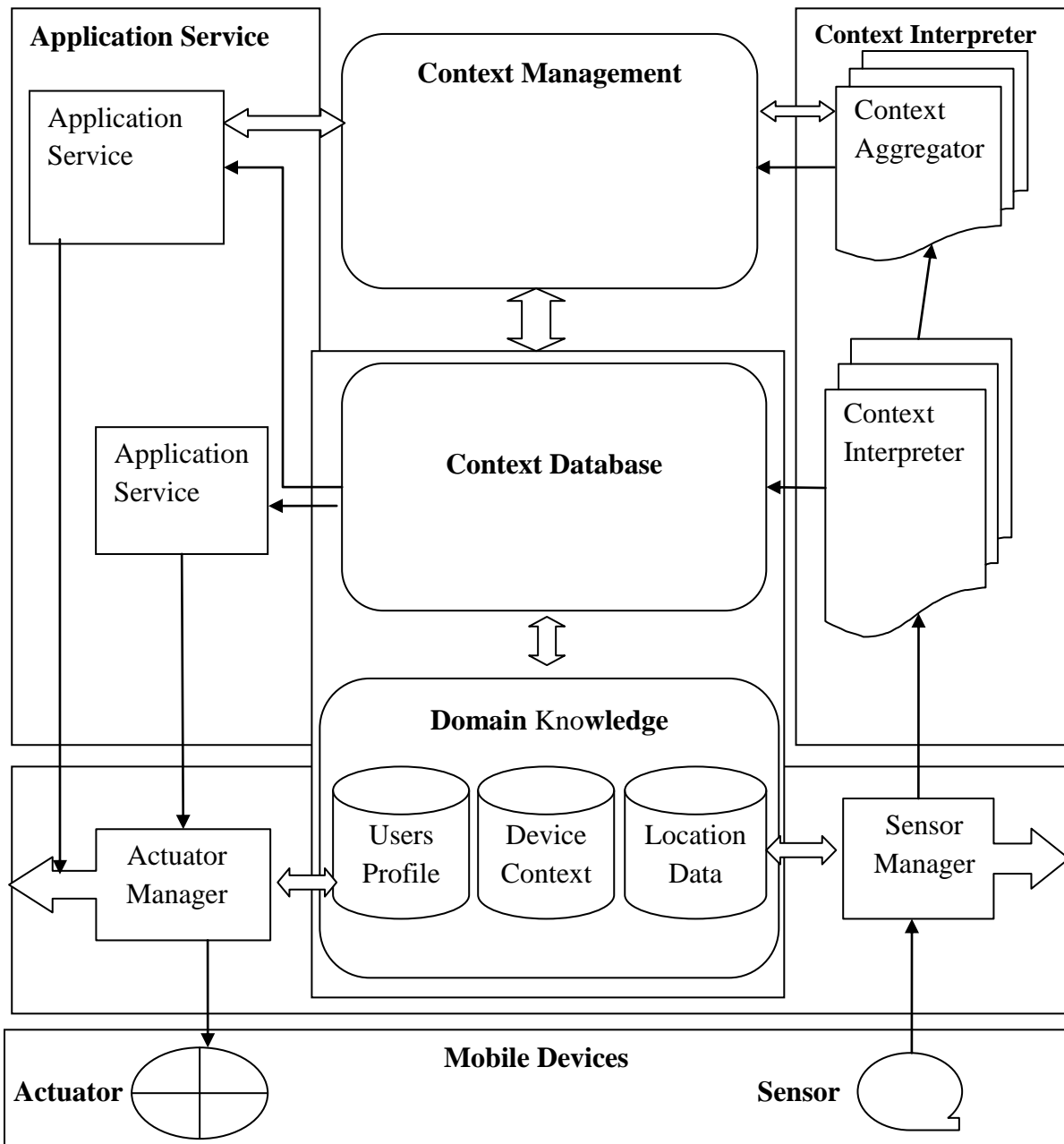


Figure 8: Context Awareness framework

Source: Author

A context awareness framework architecture context server acquires and processes user context from the low-level sensors or mobile devices. Applications therefore request context entities through standardized data structures. The application developers can therefore truly focus on implementing high-level application without worrying about low level hardware, context information acquisition, and programming structure. To meet these objectives, context awareness architecture based on an efficient context database management and implementation is conceived with appropriate software developments regardless of the hardware and software implementations in different heterogeneous devices.

VI. CONCLUSIONS

The main goal of this thesis was to conceive and design a context awareness framework to support mobile applications development in a mobile computing environment. The main contribution of this work therefore originates from the defined research objectives. Accordingly, in this research work tailoring of user experiences has been investigated in areas of context-awareness in a mobile environment.

The researcher visualized that there is need for evolvement of the mobile user experience that comes from utilizing as much resources as possible from the context by active context awareness as opposed to passive context awareness. Context-awareness has been applied in many settings, with hospitals (Gkonis et al., 2011), meeting environments (Ahmed et al., 2005) and tourism (Ferris et al., 2010) being a few examples. The research however aimed at SMEs located in Nakuru town who use Mobile phone applications for business operations and transactions.

It was also evident that although mobile devices' performance is continuously improved and hardware evolved, they do fall short when the demands get high enough as described by the SMEs in Nakuru town on the basis of mobile applications ease of use, flexibility, and performance and user satisfaction. The literature review shows that considerable amount of work has previously been done in context-awareness, but the issue with existing research is that most approaches consider only one, or just a few sources of context-aware information and the efficiency of the architecture in which context acquisition is based. The answer to this as discussed in this research work is to apply a new approach to context acquisition, handling and management, a framework architecture that is based on the context database. The results and discussion were presented in chapter four. These results show a number of aspects that needs to be incorporated and addressed in context awareness framework architecture.

Objective (i) was stated as follows: To determine Small and Medium Scale Enterprises mobile phone user's experience with context aware mobile applications in Nakuru Town, Kenya; With regards to use of contextual information by currently available business mobile applications in Nakuru Town the research findings indicates

that there is a reasonable level of dissatisfaction among the SMEs on the way in which these applications handle the contextual information. Those who use mobile applications among the SMEs strongly agreed that the mobile applications they have used do not present the contextual information nor does it make use of the context effectively. The respondents asserted the usefulness of contextual information for the delivery of service and secondly the user satisfaction on applications action on behalf of the user based on the contextual information. These observations justify the fact that there is need for context awareness by the application and it fulfills the goal of effective and better user experience.

Objective (ii) was stated as follows: To identify and investigate issues not addressed by currently available mobile applications context handling frameworks in Nakuru Town, Kenya. Context-aware integration and manipulation of the context as a separate component was noted to be a major aspect for effectiveness of context aware mobile applications. Identified research gaps highlighted the feasibility of applying multi-dimensional context-awareness in mobile applications, as the common approach today is to use a single or few dimensions of context-awareness. Such a multi-dimensional approach based on the context database manipulation to context-aware information greatly enhances the tailoring and adaptation possibilities for the applications. This is supported by the different views of the respondents on certain actions that can be taken by the mobile applications. These findings enable the study to make a conclusion that to enable the context communication and the facilitation of context information in applications the representation and ontology must be standard. The developer of context-aware applications for mobile devices does not necessarily want to be aware what is happening in the context recognition framework, he just wants to have a standard and static list of available contexts that applications may use.

Objective (iii) was stated as follows: To propose a context awareness framework in support of mobile application development for Small and Medium Enterprises in Nakuru Town, Kenya. Respondents confirmed the feasibility of the approach based on the gaps identified and highlighted a way to implement and aggregate sources of context-aware information, which, when combined, create an even stronger data foundation for the system to make weighted context-aware decisions on and to be exploited further by the mobile application regardless of their different heterogeneous platforms.

In this thesis a context-awareness framework architecture based on context database for mobile computing is proposed and developed. The main contribution in this work is to demonstrate the concept of context independence including the physical context independence and the logical context independence. The heterogeneous environments in mobile computing will gain a graceful solution. This work is intended as a starting point of future research on context-aware computing

This thesis argues for a shift in focus from using context-aware technologies to design context-adaptive applications to using these technologies to enable context-aware actors. Based on this shift in focus, this

research has put forward a methodological framework serving as a basis for a discussion of the possibilities for design of context-aware applications within the described approach.

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REFERENCES

1. Abowd, G. (2012). Celebrating an intellectual disappearing act. *Journal of Personal and Ubiquitous Computing*, 5(2) , 4-7.
2. Ahmed, S., Sharmin, M., & Ahamed, S. (2005). A Smart Meeting Room with Pervasive Computing Technologies. *Networking and Parallel/Distributed Computing*, 62(8) , 366-371.
3. Bardram, J., & Hansen, T. (2010). *Context-based workplace awareness*. Retrieved May 26, 2014, from Comp Supp CoopWork: <http://dx.doi.org/10.1007/s10606-010-9110-2>
4. Bellotti, E., & Keith. (2001). *Intelligibility and Accountability: Human Considerations in Context-Aware Systems' Human Computer Interaction*. ACM Press.
5. Burns, N. (2001). *The Practice of Nursing Research Conduct, Critique and Utilization*. 2nd Edition W.B.
6. Carter, R. L., & Crovella., M. E. (1997). Server selection using dynamic path characterization in wide-area networks. *IEEE Conference on Computer Communications* (pp. 123-127). Kobe, Japan: INFOCOM.
7. Chen, D., & Kotz. (2000). *A survey of context-aware mobile computing research, Technical report TR2000-381*. Dartmouth College: Dept. of Computer Science.
8. Chen, H., Perich, F., Chakraborty, D., & Finin, T. (2004). Intelligent Agents Meet Semantic Web in a Smart Meeting Room. *Third International Joint Conference on Autonomous Agents and Multiagent Systems* (pp. 854-861). New York: IEEE Computer Society,.
9. Chihani, B., Bertin, E., Jeanne, F., & Crespi, N. (2011). Context-aware systems: a case study. *The International Conference on Digital Information and Communication Technology and its Applications*, (pp. 718-732). France. Heidelberg.
10. David, P., Irwin, J., Lovett, T., & O'Neill, E. (2009). *Event-based mobile social network services*. Boston: In MobileHCI.
11. Deering, S., & Hinden, R. (1998). *RFC 2460: Internet protocol, version 6 (IPv6) specification*. Heidelberg: IEEE.
12. Dey, A. (2001). Understanding and Using Context. *Personal Ubiquitous Computing*, 45(9) , 4-7.
13. Dietmar, J., Markus, Z., Alexander, F., & Gerahrd, F. (2010). Recommender Systems. *An Introduction - Cambridge University Press*, 5(6) , 15-19.

14. Diwakar, G., Eisha, K., & Shriya, J. (2010). Context-aware authentication framework. *Mobile Computing Applications, and Services*,3(8) , 26–41.
15. E., A. (2010). A view of cloud computing. *Commun*, 51(9) , 50-58.
16. Edwards, W. K. (2005). Putting computing in context: An infrastructure to support extensible context-enhanced collaborative applications. *ACM Transactions on Computer-Human Interaction (TOCHI)* , 446-474.
17. Ferris, B., Watkins, K., & Borning. (2010). Location-Aware Tools for Improving Public Transit Usability.
18. G. Chen, D. K. (2000). *A survey of context-aware mobile computing research*, Technical report TR2000-381. Dartmouth College: Dept. of Computer Science, Dartmouth College.
19. Gediminas, A., Bamshad, M., Francesco, & Alexander, T. (2011). *Context-aware recommender systems*. AI Magazine.
20. George, M., & Henry, N. (2013). Context awareness in mobile computing. *International Machine Learn Applications*, 1(2) , 5-6.
21. Girish, W. (2000). Designing Adaptive Environment-Aware Applications For Mobile Computing. In *SPIE/ACM Multimedia Computing and Networking*, 6(8) , 1-2.
22. Gkonis, P. P., Anadiotis, A., Kalamani, D., Andrade, M., & Detti, A. (2011). A content-centric, publish-subscribe architecture delivering mobile context-aware health services. *IEEE Future Network & Mobile Summit* (pp. 1-9). FutureNetw.
23. Goel, D., Kher, E., & Joag, S. (2010). *Mobile Computing, Applications and Services. Lecture Notes of the Institute for Computer Sciences*. Springer Berlin Heidelberg,: Social Informatics and Telecommunications Engineering.
24. Government, K. (2014). *Central Government Integrated Financial Operations Management Systems*:. Nairobi: Government Printer.
25. Government, K. (2013). *Local Authority Integrated Financial Operations Management Systems: Business Register Municipal Council of Nakuru. LA Name: - 576*. Nakuru: The Kenya Government.
26. Guizzardi, G. (2005). Ontological Foundations for Structural Conceptual Models, . *PhD Thesis,University of Twente TI-FRS* , 15.
27. Huanhuan Cao, D. J. (2008). Context-aware query suggestion by mining click-through and session. *14th ACM SIGKDD international conference on Knowledge discovery and data mining*. (pp. pages 875–883). ACM.
28. Kuenning, G. H., & Popek, G. J. (October 1997). Automated hoarding for mobile computing. *16th ACM Symposium on Operating Systems Principles* (pp. 95-98). Saint-Malo, France: IEEE.
29. Lincoln, D., Endler, M., Barbosa, S., & Filho, J. V. (2011). Middleware Support for Context-Aware Mobile Applications with Adaptive Multimodal User Interfaces. *Ubi-Media Computing*, 23(5) , 106-111.

30. Mei, L., Zhang, Z., & Chan, W. K. (2009). More Tales of Clouds: Software Engineering Research Issues from the Cloud Application Perspective. *Proceedings of the 2009 33rd Annual IEEE International Computer Software*. IEEE Computer Society.
31. Merriam-Webster. (2014). *Merriam-Webster*. Retrieved August 6, 2014, from Merriam-Webster Online: <http://www.merriam-webster.com>
32. Michael, M., & Willy, M. (2012). The Effect of MFI Credit on Revenue of SMEs, a Survey of Small Medium Enterprises in Nakuru Town. *International Journal of Science and Research (IJSR)*, 7(2) , 8-10.
33. Raz, d., Juhola, A., & Serrat-Fernandez, J. (2006). *Fast and Efficient Context-Aware Services*. Canada: John Wiley & Sons.
34. Schilit, B., & Theimer, M. (1994). *Disseminating Active Map Information to Mobile Hosts*. IEEE Network.
35. Schmidt, A., Langheinrich, M., & Kersting, K. (2011). *Perception beyond the Here and Now*. Retrieved May 20, 2013, from IEEE Computer: <http://dx.doi.org/10.1109/MC.2011.54>
36. Strang, T., & Linnhoff-Popien, C. (2004). A Context Modeling Survey. *First International Workshop on Advanced Context Modeling, Reasoning and Management*,. Nottingham, UK: UBICOMP 2004,.
37. Technology, M. o. (2011). *ICT Policy*. Nairobi: The Government Printer.
38. Zhou, M., Houck, K., Pan, S., Shaw, J., Aggarwal, V., & Wen, Z. (2006). Enabling Context-Sensitive Information Seeking. *Conference of Intelligent User Interfaces*.