International Journal of Mechanical Engineering and Technology (IJMET)
Volume 10, Issue 05, May 2019, pp. 399-408, Article ID: IJMET_10_05_042
Available online at http://www.iaeme.com/ijmet/issues.asp?JType=IJMET&VType=10&IType=5
ISSN Print: 0976-6340 and ISSN Online: 0976-6359

BUILDING INFORMATICS: REVIEW OF SELECTED INFORMATICS PLATFORM AND VALIDATING SYSTEMS FOR INFORMATION COMMUNICATION TECHNOLOGY SYSTEMS

Amusan Lekan, Owolabi James, Nduka David, Ogundipe Elisha, Akinbo Tomisin and Akinbile Bolatito.

Building Technology Department, Covenant University.
PMB1023 Cannanland. Ota. Ogun State. Nigeria

ABSTRACT

Automation has introduced new dimension to the advent of project and construction execution in construction field. Virtually all aspect of construction is being innovated with cutting edge technology. In this study cutting edge technologies were evaluated and their various validation platforms were evaluated. The following objectives were set and achieved in this study: Establishing different tests that could be carried out to ascertain functionality of an informatics platform, review of features present in available informatics platforms, exploratory study of platform validity system through functionality tests and developing a semantic icon functionality test. Ten (10) informatics platforms were selected for case study, while 40 structured questionnaires was used to collate respondents data as related to on the critical factors that influences the effective use of system usability test on ICT Informatics platform and parameters for newly generated Icon functionality rating scale(IRS). A new test protocol was designed that could be used for carrying out Icon functionality rating evaluation tagged"IRS".

Key words: Functionality, Informatics, Platform

Cite this Article: Amusan Lekan, Owolabi James, Nduka David, Ogundipe Elisha, Akinbo Tomisin and Akinbile Bolatito, Building Informatics: Review of Selected Informatics Platform and Validating Systems for Information Communication Technology Systems, *International Journal of Mechanical Engineering and Technology* 10(5), 2019, pp. 399-408.
http://www.iaeme.com/IJMET/issues.asp?JType=IJMET&VType=10&IType=5

1. INTRODUCTION

Internet adventure commenced in the earlier 1990 and researchers and ICT practitioners has continue exploring ICT and Internet facilities till date. The adventure of ICT in construction field has brought good fortune, by innovating cutting edge technology and strategies and devices that could possibly replace manual works. There have been innovative platforms that were invented through ICT applications that could be found in the field of Medicine,

Engineering, Legal studies, Production technology, Pharmaceutics, Pharmacology, Etymology, Food production, and processing and of recent Building and construction field among others. In construction field, there are a number of applications that have been developed to solve challenges in building cost, production management, design and maintenance among others. However, some of the platforms usually need to be tested and validated for functionality and service consistency so as to validate the functionality of the components. Furthermore, there have been divergent view on the paradigm that could be used to establish functionality of a developed informatics platforms. In order to achieve the validation exercise, the following objectives were set: Establishing different tests that could be carried out to ascertain functionality of an informatics platform, review of features present in available informatics platforms, exploratory study of platform validity system through functionality tests and developing a semantic icon functionality test.

2. REVIEW OF EXISTING RELEVANT LITERATURES ON SOME INFORMATICS PLATFORMS

There have been a number of literary works being carried out on validating mechanism for ICT based informatics platforms. Some selected works were reviewed in this context. Some of the literary works consulted includes John Brooke(1986),Keith Long(2017), UIUX(2017),Amusan et al (2019),Amusan et al(2018), Afolabi et al(2017), Afolabi et al(2018), Azeta et al(2016), Omoregbe et al(2015). However, six(6) studies were selected and reviewed; John Brooke(1986), Keith Long(2017), UIUX(2017), Amusan et al(2019),Amusan et al(2018) Afolabi et al(2018a) among others.

Moreover, John Brooke(1986) developed a rating scale that could be used to conduct usability test on a system. The study developed scale that was formatted in Strongly agree, Agree, Strongly disagree, Disagree, Neural format. The study developed a dirty system usability scale that could be used to rapidly bring out outcome of urgent usability test on ICT software developed.

Keith Long (2017) in a study developed a template that could be used to carry out a quick usability scale test. The template coded outcome of task completion rate on scale of 1 to 3. The scale is used to describe the degree of ease or difficulty encountered while performing a task. The system recommended maximum of 5 system testers, 3 was used to code" system can perform a task quickly without problem, 2 was used to code "performing a task with problem", while 1 was used to represent "not being able to perform the task at all" on the rating scale.

Also, Amusan, Ayo-Yusuf and Omuh (2019) presented exploratory approach to the study of factors that influences the adoption of ICT and Informatics platform in residential building construction. Some of the identified factors includes: Organizational Related Factors, Professional Related Factors, Construction Industry/Stakeholders' Related Factors, and Internet of Things Related Factors among others.

UIUX Trend (2017) presented System Usability Scale (SUS) the study presented how to calculate system usability scale and how to interpret the scale meaningfully. The study described SUS as a being created to measure the usability nature of computer system and ICT platforms. The use is not limited to measuring of systems alone but, to measure applications such as digital café, commercial kiosks, laptop, mobile Apps among others.

Similarly, Amusan et al (2018) presented a study on Informatics Platform for placing order in maintenance of Residential Building. The study presented and arranged in ergonomic manner various functions and application, the application has functions and icons that could assist project manager, builder, architect and other built environment practitioners to plan maintenance work and place order for jobs that are needed to be done.

Also, in Afolabi et al (2017), a presentation was made on developing material planning and control system which was focussed on an Environment friendly materials'' planning and control system for managing material. In the study methodology and metric that could be used to calculate and derive an appropriate material quantities was presented. Finally, in Afolabi et al (2018) a *web*-based recruiting system for skilled labour was developed in the study. The recruitment portal would help professionals in getting right professionals for construction activity. It is a web based application developed with PhP, MySQL among others.

3. METHODOLOGY

The research approach used in this context was case study approach. Ten (10) informatics/ICT platform was selected for case study while six (6) was selected and used. The analysis covers the design, function, features, and framework for functionality validation. Forty(40) structured questionnaire was used to collate data from respondents on the critical factors that influences the effective use of system usability test on ICT Informatics platform and parameters for newly generated Icon functionality rating scale(IRS)

3.1. States of Different Tests applicable to ICT Platforms

Different tests that could be carried out on ICT platform validation was reviewed and presented in this section. Some of the tests include Icon stability test, System usability scale, Icon function satisfaction test, Connectivity test. Storage capacity test, and Relative agreement index.

3.2. Icon Usability Test

Icon usability test is the type of test that is usually carried out on a newly developed platforms. This usually involve the choice of 5 to 15 testers that would be made to test the system under validation. Digital Ocean(2013) by Carina Kuhr, a UX researcher submitted that five (5) users are enough to find 85% of the usability problem in platform testing. Similarly, Ash Billings a UX design manager at Fish games in Digital Ocean (2013) submitted that the choice of number of testers depends on the nature of test to be carried out, that in order to get conclusive results with 3-5 users or testers, the test need to be carried out 4 or 5 times and then find the average. The more the tests are carried out the more it would be easy to carry out usability tests.

3.3. System Usability Test (SUT Scale)

The test that is often carried out to ascertain the usability of a whole component of a system is referred to as System usability. It involves subjecting the whole aspect of a system to tests. There is universal scale developed to achieve usability test by John Brooke. In John Brooke (1986), developed system usability scale for testing how usable is a system developed. The study developed a quick scale for usability test of an ICT software or platforms. As part of the requirements for the use of the scale, the following parameters should be taken into consideration; type of system in consideration, intended audience that would use the system, the context in which the ICT systems would be used need to be defined in order to determine the fitness of the system. The scale consist The scale consist of semantic component that consist of 10 questions and rating scale of 1 to 5 that spans strongly agree and strongly disagree scale of a typical usability template developed by John Brooke(1986) is shown below:

Table 1 Usability Scale Template

	Parameters for Usability Scale Test					
S/N	**Parameters**	**SD**	**D**	**N**	**A**	**SA**
1	I have preference for this system	1	2	3	4	5
2	The system is complex	1	2	3	4	5
3	The system is not difficult to use	1	2	3	4	5
4	Support of technician is needed	1	2	3	4	5
5	Well integrated functions	1	2	3	4	5
6	System inconsistency is much	1	2	3	4	5
7	People to learn how to use the system	1	2	3	4	5
8	Cumbersome in application	1	2	3	4	5
9	I have confidence in using the system	1	2	3	4	5
10	External help is needed for better understanding	1	2	3	4	5

John Brooke (1986)

According to John Brooke (1986), the usability test is usually best carried out on the system by recording the immediate response of a tester on the system before any debriefing and discussion. The scale is designed on Likert scale 1 to 5. However, a defect is observed on the John Brooke rating scale, it was observed that Neutral scale was rated 3 by John Brooke which suppose not to be so objectively. However, logically, a respondent that indicated to be neutral did not provide adequate basis in the term of a figure or score to work with it is as good as not participating in a survey, therefore, the scale allocated to Strongly disagree (SA 1) and Disagree (D 2) should be higher than neutral scale. Therefore the order supposed to be Strongly Agree (5), Agree (4) Strongly disagree (SD 3) Dis agree (D2) and Neutral(N 1).

3.4. Icon Functionality Test

In UIUX Trend (2017) exploratory aspect of functionality test was presented. It was described to consist of parameters for consideration and the rating scale calibrated in Likert scale of 1 to 5 building up further on defect observed on John Brooke scale. The adaptive form of John Brooke (1986) template was used to develop an abridged form of usability scale presented Table 2 tagged Icon Functionality Rating Scale. Icon functionality measurement template was presented in the Table 2. The testing parameters used in the abridged template is summarized as follows: Is the Icon sticky?, Is the Icon slow or fast?, what is the response rate of the Icons?, Are the Icons interactive enough?, Is any training needed before application?, Is the Icon arrangement ergonomic enough?, More functional coded icons needed?, Is there any need to redesign the icons?, Need to rearrange the Icons.

Table 2 Newly Generated Icon Functionality Rating Scale[IFRS]

S/N	**Testing Parameters**	**SA [5]**	**A [4]**	**SD [3]**	**D [2]**	**N [1]**	**AV**	**Rank**
1	More training is needed to navigate the platform with the Icons	0.2	0	0.7	0.5	1	2.4	1st
2	The Icons arrangement is not ergonomics	0.6	0.3	0.3	0	1	2.2	2nd
3	The Icons are slow in response per task	0.4	0.25	0.3	0	1	1.95	3rd
4	The Icons are Sticky	0.2	0.25	0.7	0.5	0	1.65	4th
5	Icon response to tasks is relatively fast	0.4	0.5	0.3	0	0	1.2	5th
6	There is a need for Icons rearrangement	0.8	0.2	0	0	0	1	6th
7	The response rate of return is slow	0.6	0.5	0	0	0	1.1	7th
8	The system is not interactive enough	0.2	0	0	0	0	0.2	8th
9	There is a need to redesign the Icons	0	0.2	0.25	0.5	0	0.95	8th
10	More functional coded icons are needed.	0.6	0.2	0	0	0	0.8	9th
	Total(Average)	4/5	2.4	2.55	1.5	3	13.45	

Field Survey Template 2019

SA----4/5[80%]; A----2.4/4[60%]; SD----2.55/3[85%], D---1.5/2[75%]; N---1/3[33%].

Strongly agree (SA with scale 5), Agree (A with scale 4), Strongly Disagree (SD with scale 3), Disagree (D with scale 2) and Neutral (N with scale 1). The screenshot of an informatics platform used for the validation of an informatics platform tagged "Work order informatics platform for planning and executing maintenance work" is presented in Figures 1 and 2.

Cumulative percentage weight value of each rating scales was calculated vertically, while the percentage implication of each response scale relative to other scale point of .1tester's opinion was determined by dividing the values in the vertical column with scale value on the rating scale. The resultant value from this is in this order: SA----4/5[80%]; A----2.4/4[60%]; SD----2.55/3[85%], D---1.5/2[75%]; N---1/3[33%].

An interpretation scale of UIUX (2017) was used as basis for interpreting the semantic rating scale developed for the Icon Functionality Rating Scale [IFRS], interpretation for the value of the scales for individual scale is presented as follows:

Greater Than or Equal to 80.3 [A] ---Excellent; 60-80.3 [B] ----Good; 68 [C] --- Okay; 51-68 D----Poor; Less than 51 F ---- Awful.

Therefore, in the context of icon functionality test conducted on the Platforms presented in Fig1 and 2, 85% Strongly disagree to the points that the icons are defective and not

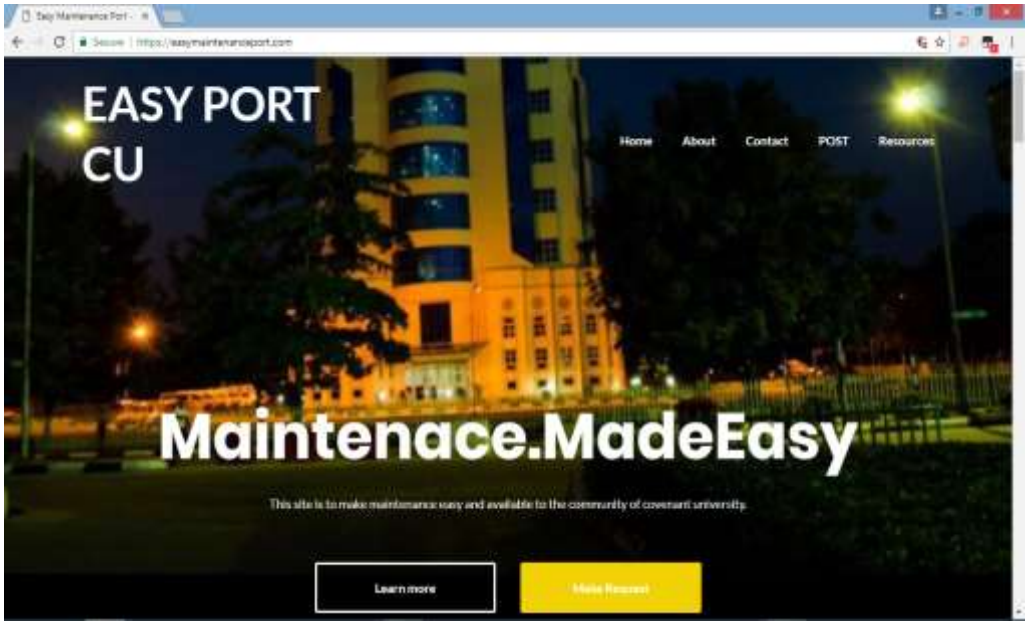
ergonomic and that it is not in order in the presents state, the fact that 80% indicated strongly agree to the point raised which are negative indicated the fact that the developers should still need to reappraise the whole system for better functionality outcome.

Table 3 Critical Success Factor that Determines Effective System Usability Test on ICT Informatic Platforms

	Success Parameters for Deploying Usability Scale		
S/N	**Success Factors**	**Relative Agreement Index**	**Rank**
1	Unambiguous assignment for testers/platform users	0.76	1st
2	Good internet connectivity	0.76	1st
3	Adequate working knowledge of the ICT platforms	0.76	1st
4	Pre-communication with platform verifiers about what to do	0.75	2nd
5	Making the Icons on the platform as interactive as possible	0.75	2nd
4	Making available testing manual for system testers	0.75	2nd
6	Adequate memory bandwidth	0.75	2nd
7	Keeping system testing operation opened as much as possible	0.74	3rd
8	Ergonomic arrangement of the Icons on the system for easy access	0.74	3rd
9	Adequate reward system for verifier	0.73	4th
10	Allocating sufficient testing time for system testing	0.72	5th

Unambiguous assignment for testers/platform users (RAI 0.76), Good internet connectivity (0.76), Adequate working knowledge of the ICT platforms (RAI 0.76) were all ranked 1st. Similarly, Pre-communication with platform verifiers about what to do, Making the Icons on the platform as interactive as possible, Making available testing manual for system testers, Adequate memory bandwidth were ranked 3rd with RAI value of 0.75. Similarly, Keeping system testing operation opened as much as possible, Ergonomic arrangement of the Icons on the system for easy access were ranked 4th with RAI value of 0.74. The testing assignment should not be made ambiguous, the instruction should be well simplified for understanding. Also good working knowledge of using computer application is essential, while pre-communicating the assignment to the system tester would help eliminate hiccup during testing.

3.4.1. Screen Shot of a Typical Maintenance Informatics Ergonomic Portal



Amusan and Ayo-Yussuf et al (2019).

Figure 1 Request Access Portal Page

Maintenance made easy portal page was presented in Fig.1. The page contains the access page that contains all navigational details for the portal. Icons that leads to the detail about home page, resources available on the portal page, information access pane to learn about the page and icon points to make request for maintenance operations.

Amusan et al (2019)

Figure 2 Screen Shot of Access Point for Connecting Information about Navigating the Site

This is the maintenance home page which covers the various information that is required for the site to be well utilized. These are included on the top right corner above the home pages

Table 4 Review of Case in Point of ICT Platforms

S/N	Informatics/Web-based Platforms	Detail	Limitations/Scope	Validating System
1	A Voice-based Mobile Prescription Application for Healthcare Services (VBMOPA) by Ikhu-Omoregbe N. A. and Azeta A. A.(2014). International Journal of Electrical and Computer Sciences, 10 (2). pp. 73-78	Voice user interface(VUI) was used in design and voice recognition system.	The device is to solve challenges on Health care issues. Multidisciplinary in approach.	TCP connection test and Text messages. Ping remote tool is usually used to verify network connectivity
2	*Developing a Secure Integrated E-Voting System.* Handbook of Research on E-Services in the Public Sector: E-Government Strategies and Advancements by Ayo, C. K. and Daramola, Olawande and Azeta, A. A. (2009)	This chapter presents an overview of an integrated electronic voting (e-Voting) system comprising: the electronic voting machine (EVM), Internet voting (i-Voting) and mobile voting (m-Voting)	The system presents an integrated electronic voting (e-Voting) system.	XML internet voting, Mobile voting. TCP connection test and Text messages are validating systems.
3	*Adapted Cloudlet for Mobile Distance Learning: Design, Prototype and Evaluation.* Published in Seventh International Conference on the Applications of Digital Information and Web Technologies, Taipei by Azeta, A. A. and Omoregbe, N. A. and Misra, Sanjay and Adewumi, A. O. and Olokunde, T. O. (2016) .	The application covered the aspect of Cloudlet technology.	Addressing the dearth of mobile device.	Usability test, XML voice test, TCP and Text messages validation platform
4	*Design and implementation of a virtual classroom system.* 8th International Conference of Education, Research and Innovation (ICERI2015), 16th –18th November 2015, Seville, Spain by Omoregbe, N. A. and Azeta,A.A. and Bello-Osagie,Uyiosaifo and Agarana,M. C. (2015)	The application presents virtual classroom systems to create class without boundary.	The study developed an application that could be used for virtual classroom application.	Usability test, XML voice test, TCP and Text messages validation platform. PHP and XML was used in framework configuration.
5	*Environment-Friendly Material Planning and Control SystemforManaging ConstructionMaterials by Afolabi et al.(2017).* AsianJournaloflnformation Technology, 16 (6). pp. 479-485. ISSN 1682-3915	The application was designed to assist in material planning on construction sites.	An application that could be used in material planning on construction site was developed in the study.	Undefined
6	*Workorder Informatic Platform for Planning of Resuidential Buildings. International Journal of Civil Engineering and Technology by Amusan et al(2018). 10(2)*	The application was designed to assist in Work order and Planning of Residential Building Project	The application could assist in placing request order for maintenance work in residential building project.	SUS templates, UIUX, template, Guerrilla Usability Test.

A review of ICT application and platforms is presented in Table 2. The detail of various platforms, limitations and validating mechanism was used presented in Table 2 above.

3.5. Connectivity Test

Connectivity test is a type of test that could be carried out on an ICT platform to determine the extensive of connectivity that exist between one component and the other on a platform. Connectivity test can also be used to test a remote network connectivity of a unit or component to part of a system or port. Some of the tests that could be carried out on an ICT platform according to IBM (2018) include Ping remote tools, TCP connection test and Text messages. Ping remote tool is usually used to verify network connectivity. On the other hand TCP connection test is usually used to test connection of a system to a remote system or server. Test message is also used to test the level of acceptance of a system connection by other networks, this is determined by sending a message through a network to the platform under test and expect a response, the system that accept the message with corresponding feedback is considered to be good, rejection of the message indicates non connectivity.

3.6. Storage Capacity Test [SCT].

This test is usually conducted on databases to ensure the adequacy of space for data storage. It is a phase in the development of ICT or informatics platform or software development. It is also an integral part of storage technology testing by Microsoft corporations in the form of Window Hardware Certification (HCR) [Technopedia 2018). In SCT test, an application or program is tested to ascertain the level of storage capacity in case of message bouncing when sent across a database server.

3.7. Item Relativity Index Scale (IRIS)

Item Relativity Index Scale (IRIS) is used to process questionnaire to be able to measure all the extreme aspect of respondents or testers opinion on questionnaire being used to validate a platform. It involves the use of Likert rating scale to calibrate the response parameters. It involves tabulating measurement parameters against the rating scale. The parameters are in the form of nominal scale or string variables while the rating scale is in ordinal scale, the rating scale is often calibrated on Likert scale 1 to 5. Refer to Table 2, the table contains an Icon Functionality rating scale. The scale used in the presentation is in the following order. Strongly agree (SA with scale 5), Agree (A with scale 4), Strongly Disagree (SD with scale 3), Disagree (D with scale 2) and Neutral (N with scale 1).

4. CONCLUSION

The study has presented a study on some selected ICT applications and informatics platforms. The study has presented different tests that could be carried out on systems or platform being tested. The study has presented also various methods that could be used to ascertain level of usability of a systems. The states of different tests that could be carried out in testing ICT platforms before use. Also, related articles were reviewed to situate the work in perspective of works that have been carried out on ICT and building informatics applications in Building. Finally, a new template that could be used in system validation and testing was developed and presented in this study, the template is tagged “Icon Functionality Rating Scale [IFRS]” and presented in Table 2.

ACKNOWLEDGEMENT

The support of Covenant University and Covenant University Centre for Research and Innovations (CUCRID) is acknowledged for sponsoring this research and funding the publication of the research data. Many thanks

REFERENCES

[1] Amusan Lekan M, Ayo-Yussuf Kehinde and Omuh Ignatius(2019) Exploring Factors That Influences The Adoption Of Ict-Based Building And Construction Informatic Platforms" Has Been Accepted For Publication In International Journal Of Civil Engineering And Technology (IJCIET), Volume 10, Issue 01, (January 2019).

[2] Amusan Lekan, Tunji-Olayeni P, Afolabi A.O, Ogunde A. Omuh I.O Owolabi J.D.(2018 Workorder Informatic Platform for Planning of Resuidential Buildings. International Journal of Civil Engineering and Technology. 10(2).

[3] Afolabi,A.O. and Fagbenle,Olabosipo I. and Mosaku,T.O. and Amusan,L.M. and Ojelabi, Rapheal A. and Tunji-Olayeni, P .F (2017) *Environment-Friendly Material Planning and Control SystemforManaging ConstructionMaterials.* AsianJournaloflnformation Technology, 16 (6). pp. 479-485. ISSN 1682-3915.

[4] Omoregbe, N. A. and Azeta, A. A. and Bello-Osagie, Uyiosaifo and Agarana, M. C. (2015) *design and implementation of a virtual classroom system.* 8th International Conference of Education, Research and Innovation (ICERI2015), 16th –18th November 2015, Seville, Spain.

[5] Afolabi, A.O. and Oyeyipo, Opeyemi and Ojelabi, Rapheal A. and Amusan, L. M. (2018) *Construction Professionals' Perception Of A Web-Based Recruiting System For Skilled Labour.* Journal Of Theoretical And Applied Information Technology, 96 (10). pp. 2885-2899. ISSN 1817-3195.

[6] Ayo, C. K. and Daramola, Olawande and Azeta, A. A. (2009) *Developing a Secure Integrated E-Voting System.* Handbook of Research on E-Services in the Public Sector: E-Government Strategies and A Voice-based Mobile Prescription Application for Healthcare Services and Advancements.

[7] Ayo, C. K. and Daramola, Olawande and Azeta, A. A. (2009) *Developing a Secure Integrated E-Voting System.* Handbook of Research on E-Services in the Public Sector: E-Government Strategies and Advancements.

[8] Azeta, A. A. and Omoregbe, N. A. and Misra, Sanjay and Adewumi, A. O. and Olokunde, T. O. (2016) *Adapted Cloudlet for Mobile Distance Learning: Design, Prototype and Evaluation.* Published in Seventh International Conference on the Applications of Digital Information and Web Technologies, Taipei.

[9] Digital Ocean(2013) the Simplest Cloud Platform for Developers. https://www.digitalocean.com.retrieved14/1/2019.

[10] IBM (2018) Testing Network Connectivity. IBM Network Center.https://www.BM.com/support /knowledge/retrieved on 4/1/2019

[11] Technopedia(2018)http//www.techopedia.com.defintion/4367i storge-testingretrieved on 4/1/29.

[12] John Brooke(1986) SUS-Aquick and dirty Usability Scale.Digital Equipment Corporation.USA .

[13] Keith Long(2017) Guerilla Usability Template. Usability Study Template .Free Template Design.1-2.

[14] UIUX Trend (2017) Measuring and Interpreting System Usability Scale.UIUX Research Trend.1-18. Exploring Factors That Influences the Adoption of ICT-Based Building And Construction Informatic Platforms.International Journal of Civil Engineering and Technology.15(1).