

i-manager's

Journal on Information Technology

Experience Information Technology at the Speed of Life

i-manager's

Journal on Information Technology

About the Journal

i-manager's Journal on Information Technology provides a forum to the academics, professionals and advanced level students in IT for exchanging significant information, productive ideas associated with information technology and future prospects in the areas of contemporary information and communications technology. Technology changes so rapidly and the Journal aims to publish high quality papers from academia and practitioners in all areas pertaining to Information Technology and disseminate Knowledge on the same.

i-manager's Journal on Information Technology is presently in its 8th Year. The first issue was launched in 2012.

i-manager's Journal on Information Technology is published by i-manager Publications, one of India's leading Academic Journal Publisher, publishing 28 Academic Journals in diverse fields of Engineering, Education, Management and Science.

Why Publish with us

i-manager Publications currently publishes academic Journals in Education, Engineering, Scientific and Management streams. All of i-manager's Journals are supported by highly qualified Editorial Board members who help in presenting high quality content issue after issue. We follow stringent Double Blind Peer Review process to maintain the high quality of our Journals. Our Journals target both Indian as well as International researchers and serve as a medium for knowledge transfer between the developed and developing countries. The Journals have a good mix of International and Indian academic contributions, with the peer-review committee set up with International Educators.

Submission Procedure

Researchers and practitioners are invited to submit an abstract (200 words)/Full paper on or before the stipulated deadline, along with a one page proposal, including Title of the paper, author name, job title, organization/institution and biographical note.

Authors of accepted proposals will be notified about the status of their proposals before the stipulated deadline. All submitted articles in full text are expected to be submitted before the stipulated deadline, along with an acknowledgment stating that it is an original contribution.

Review Procedure

All submissions will undergo an abstract review and a double blind review on the full papers. The abstracts would be reviewed initially and the acceptance and rejection of the abstracts would be notified to the corresponding authors. Once the authors submit the full papers in accordance to the suggestions in the abstract review report, the papers would be forwarded for final review. The final selection of the papers would be based on the report of the review panel members.

Format for Citing Papers

Author surname, initials (s.) (2019). Title of paper. i-manager's Journal on Information Technology, 8(1), xx-xx.

Copyright

Copyright © i-manager Publications 2019. All rights reserved. No part of this Journal may be reproduced in any form without permission in writing from the publisher.

Contact e-mails

*editor_jit@imanagerpublications.com
submissions@imanagerpublications.com*

i-manager's
Journal on Information Technology

Editor-in-Chief

Dr. Mohammed A. Abdala
Assistant Professor,
Senior IEEE Member,
Networks Engineering Department,
College of Information Engineering
Al-Nahrain University, Iraq.

EDITORIAL COMMITTEE

Dr. Golan Carmi	Head of Technology & Information Systems, Faculty of Management Jerusalem College of Technology, Israel.	Dr. B. B. Meshram	Professor, Department of Computer Engineering and Information Technology, Veermata Jijabai Technological Institute, Mumbai, Maharashtra, India.
Dr. Dan Bouhnik	Faculty Member, Information Science Department, Bar Ilan University (BIU), Israel.	Prof. A. B. Gadicha	Professor, Department of Computer Science & Engineering, P.R.Pote (Patil) College of Engineering & Management, Amravati, Andhra Pradesh, India.
Ashish K. Sharma	Assistant Professor (SS) Department of Informatics, School of Computer Science (SoCS) University of Petroleum & Energy Studies (UPES), Dehradun, India	Dr. Kishor S. Wagh	Professor, Department of Computer Engineering, All India Shri Shivaji Memorial Society's Institute of Technology, Pune, Maharashtra, India.
Dr. Nanhay Singh	Associate Professor, Department of Computer Engineering, Ambedkar Institute of Advanced Communication Technology & Research (AIAC&R), New Delhi, India.	Dr. Manik Sharma	Assistant Professor, Department of Computer Science and Applications, DAV University Jalandhar, Punjab, India.
Dr. Uma Kumari	Assistant Professor, School of Engineering and Technology Mody University of Science and Technology, Lakshmangarh, Rajasthan, India.	Dr. Manish M. Kayasth	Vice Principal, UCCC & SPBCBA & SDHG College of BCA and IT, Surat, Gujarat, India.
Dr. Anil Kumar Malviya	Professor, Department of Computer Science and Engineering, Kamla Nehru Institute of Technology, Sultanpur, Uttar Pradesh, India.	Dr. Uttam K. Roy	Associate Professor, Department of Information Technology, Jadavpur University, Salt Lake Campus, Kolkata, India.
Dr. Ch. D. V. Subba Rao	Professor and Former Head, Department of Computer Science and Engineering, S.V. University College of Engineering, Tirupati, A.P.	Dr. Shruti Kanga	Assistant Professor and Coordinator, Centre for Climate Change and Water Research, Suresh Gyan Vihar University, Jaipur, India.

i-manager's Journal on Information Technology

OUR TEAM

Publisher

Joe Winston

Renisha Winston

Editorial Director

Dr. Joyce Georgina John

Editorial Head

J. Cibino Pearlsy Ross

Editorial Manager

R. Ramani

Issue Editor

Centhil Lakshmi Priya P.G

GM - Operations

Anitha Bennet

GM - Subscriptions

M.U. Sathya

Issue Design

J. S. Joy Robinson

Production Manager

OUR OFFICES

Registered Office

3/343, Hill view,
Town Railway Nager,
Nagercoil, Kanyakumari District - 629001
Ph : 91-4652- 277675
E-mail : info@imanagerpublications.com

Editorial Office

13-B, Popular Building,
Mead Street, College Road,
Nagercoil, Kanyakumari District - 629001
Ph : (91-4652) 231675, 232675, 276675
E-mail : editor_jit@imanagerpublications.com

Abstracting / Indexing



Join with us



<https://www.facebook.com/imanInformTech/>



<https://www.facebook.com/imanagerPublishing/>



<https://twitter.com/imanagerpub>

CONTENTS

RESEARCH PAPERS

- | | |
|----|---|
| 1 | DESIGN AND IMPLEMENTATION OF A COMPUTER-BASED VISITORS' RECORD MANAGEMENT SYSTEM FOR NIGER STATE HOUSE OF ASSEMBLY COMPLEX, MINNA
By Isaiah Michael Oname, Solomon Anibe Tijani |
| 11 | MARKET DEALERS OR PERPETRATORS OF CYBERCRIMES? INVESTIGATING CYBERCRIMINAL ACTIVITIES IN INFORMATION TECHNOLOGY MARKETS IN NIGERIA
By Oluwafemi Osho, Benjamin M. O. Eneche |
| 20 | RESEARCH DATA MANAGEMENT AND INFORMATION SECURITY: ROLE OF LIBRARY AND INFORMATION TECHNOLOGY SERVICE (ITS) UNITS IN FEDERAL UNIVERSITIES OF TECHNOLOGY IN NIGERIA
By Fatimah Jibril Abduldayan, Fasola Petunola Abifarin, Georgina Uchey Oyedum, Jibril Attahiru Alhassan |
| 29 | ENSEMBLE LEARNING APPROACH FOR THE ENHANCEMENT OF PERFORMANCE OF INTRUSION DETECTION SYSTEM
By Musbau Dogo Abdulrahman, John K. Alhassan |
| 40 | INTEGRATED USABILITY EVALUATION FRAMEWORK FOR UNIVERSITY WEBSITES
By Solomon A. Adepoju , Ishaq O. Oyefolahan, Muhammad B. Abdullahi, Adamu A. Mohammed |

Welcome to the Eighth volume of *i-manager's Journal on Computer Science*! The current issue mainly focuses on *Implementation of a Computer-Based Visitors' Record Management System, Investigating Cybercriminal Activities, Research Data Management and Information Security, Ensemble Learning Approach for the Enhancement of Performance of Intrusion Detection System and Integrated Usability Evaluation Framework for University Websites.*

Isaiah Michael Oname and his co-author Solomon Anibe Tijani have proposed a study about the design and implementation of a *Computer-Based Visitors' Record Management System*. The proposed system is a software application designed using JAVA programming language and MySQL database at the back end, used for storing visitors' information. The software handles all necessary operations regarding visitors' check-in and check-out in the Niger State House of Assembly Complex. The study concluded that, this proposed study supports to store the backup files externally to the organization and in the case of emergency. The authors also recommended that, the organization should source for alternative means of power supply rather than depending on the Power Holding Company.

Oluwafemi Osho and his co-author Benjamin M. O. Eneche have proposed a study to explore the roles of IT markets in the promotion and proliferation of cybercrimes in Nigeria. The scope of the study is to formulate appropriate countermeasures that address the whole spectrum of cybercrimes in the country. For that a total of 100 questionnaires were distributed and after initial analysis, 60 were found to be valid. The results of the study showed that, the content and copyright related offences were perpetrated at the market and most respondents agreed or strongly agreed that the identified cybercrimes were illegal. The authors recommend that, future research could consider investigating similar markets in other locations.

Fatimah Jibril Abduldayan et al., have presented a study to identify the available support systems in the Libraries and Information Technology Service (ITS) Units of FUTs in Nigeria. The study used oral face-to-face semi structured interview method conducted on five university librarians and five heads of ITS Units of FUTs in Nigeria. For data transcription and analysis, this study adopted the Braun and Clarke (2006) the matic analysis approach, which involve a six-phase of qualitative data analysis. The findings of the study confirmed that hacking, as a cyber threat; still pose a great threat to intellectual output and research data deposited in the IR of FUTs in Nigeria. The study recommended the need for continued capacity building to improve the cyber security skills and data management skills of ITS staff and librarians, respectively.

Musbau Dogo Abdulrahman and his co-author John K. Alhassan have proposed a study to design an efficient Network Intrusion Detection System (NIDS) using ensemble classifier. The scope of this research work is to develop a novel ensemble based model by integrating Multilayer Perceptron Neural Network (MPNN) and Sequential Minimal Optimization (SMO) classifiers to enhance the performance of the IDS. Kyoto 2006+ intrusion detection dataset is used to evaluate the performance of the model. The results show that the ensemble of MPNN+SMO classifier outperformed ensemble of Random Forest (RF) and Average One Dependency Estimator (AODE) in terms accuracy, detection rate, false alarm rate, and Hubert index measurement. The results showed that it is possible to have a single and powerful classifier that can outperform an ensemble classifier.

Solomon A. Adepoju et al., have proposed a study to analyze the integrated usability evaluation framework for university websites. A framework based on the integration of a Multi Criteria Decision Making (MCDM) approach with an artificial intelligence technique is being proposed to effectively evaluate university websites usability. The criteria used in this study are: speed, navigation, ease of use, content, accessibility, aesthetic, and security. The study results concluded that, the integrated approach proposed in this study will handle both the subjective and objective aspect of usability evaluation thereby eliminating bias exhibited by human being during evaluation which ensures a better ranking and classification of the usability of the selected websites.

EDITORIAL

All papers of this issue were submitted from the 2nd International Conference on Information and Communication Technology and its Applications (ICTA 2018), conducted on 5 -6th September 2018 at Federal University of Technology, Minna, Nigeria. We express our gratitude to the Conveners Dr. Shafii Abdulhamid & Dr. Oluwafemi Osho for their support in ensuring the papers were submitted on time.

We extend our sincere thanks to the authors for their contributions towards this issue and we are grateful to the reviewers for spending their quality time in reviewing these papers. Our special thanks to the Editor-in-Chief, Dr. Mohammed A. Abdala for his continuous support and efforts in improving further the quality of the Journal.

Enjoy reading!

Warm regards,

*Ramani. R
Junior Associate Editor
i-manager Publications*

INTEGRATED USABILITY EVALUATION FRAMEWORK FOR UNIVERSITY WEBSITES

By

SOLOMON A. ADEPOJU *

ISHAQ O. OYEFOLAHAN **

MUHAMMAD B. ABDULLAHI ***

ADAMU A. MOHAMMED ****

*,*** Department of Computer Science, Federal University of Technology, Minna, Nigeria.

** Department of Information and Media Technology, Federal University of Technology, Minna, Nigeria.

**** Department of Mathematics and Applied Science, Federal University of Technology, Minna, Nigeria.

Date Received: 11/01/2019

Date Revised: 06/02/2019

Date Accepted: 25/03/2019

ABSTRACT

The importance of usability of websites in this contemporary era of information communication by universities and other allied academic institutions worldwide is very crucial. This has necessitated the urge and drive for usable websites to be developed by these institutions in order to improve ease of use. However, the need to measure usability of websites effectively have also prompted many researchers to develop different usability evaluation model. Even though there are numerous research efforts in this direction, there is still no universally acceptable usability evaluation model. In this paper, a framework based on integration of a Multi Criteria Decision Making (MCDM) approach with an artificial intelligence technique is being proposed to effectively evaluate university websites usability. The criteria used are; speed, navigation, ease of use, content, accessibility, aesthetic, and security. Thus a new model incorporating fuzzy analytical processing with artificial neural network is proposed.

Keywords: Fuzzy AHP, ANN, Usability, University Website, Website Evaluation.

INTRODUCTION

The Internet is the easiest way to find information about any kind of organization, and the first impression about an organization is almost always based on its website (Ismailova & Kimsanova, 2017). From internet world stats (Internet World Stats, 2017), the number of internet users in the world is over 3.5 billion from 360 million in the 2000 with 51.7% penetration rate. In Nigeria, the number of internet users has grown from 200,000 in 2000 to over 90 million in June, 2017 with penetration rate of 47.7%. As a result, accessing different types of websites is inevitable for different users in the world.

For academic institutions, websites are expected to provide information to a wide range of users, which may be prospective and enrolled students, staff, parents as well as other users. These websites not only serve as a platform for the stakeholders, but also serve as communication tools and help to shape its image (Mentes & Turan, 2012; Abdallah & Jaleel, 2015; Galovicova, Kremenova, & Fabus, 2016).

Millions of people are searching for information on academic institution websites annually of which university websites is one. These include, prospective students looking for schools on potential courses available, area of expertise, fees information among others. Enrolled students search for course information, lecture location, materials and times, account access, results updates, schools calendars, fees payment, news update, teacher's information. Prospective applicant may search for job prospect, vacancies, available facilities, research output, funded projects, sample thesis, and project. The main underlining issue is that users should find what they are searching for easily and the content should be easy to understand (Sarsarabi & Sarsarabi, 2015).

Users of any websites are always confronted with two major issues - how to find the information being sought with ease and retrieving the information in a timely fashion. To achieve this, a high level of usability which is one of the important criteria in measuring website quality

is required (Roy & Pattnaik, 2014; Aziz & Kamaludin, 2015). According to International Standard Organisation (ISO 9241-11), usability can be defined as “the extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use”. It is the “effectiveness, efficiency, and satisfaction specified goals by the users to achieve in particular environments” (Speicher, 2015).

From websites context, usability is a quality attribute that describes the ease with which users navigate through the website. In other words, it is the extent to which a user can successfully achieve a goal by learning and using a product. To disseminate information to the public, a functioning website is required by every organisation. University website, which is one of the specific genre of websites, requires special attention in terms of usability because it serves as a virtual gateways to students from all over the world (Yerlikaya & Durdu, 2017). One core component of web quality is web usability and once the usability features are not good, the web quality will always be poor (Tripathi, Pandey, & Bharti, 2010).

Usability has been shown to be one of the most important issues in ICTs (Pearson, Pearson, & Green, 2007; Manzoor, Hussain, Ahmed, & Iqbal, 2012; Djordjevic, Rancic, & Vulic, 2013; Mvungi & Tossy, 2015). Till date, one of the challenges faced by HCI researchers is how best to measure usability or evaluate website usability. As a result of this, several researchers have proposed different models for website usability evaluation. Most of these models are based on inspection method and formal experimental test which are generally known as the traditional approach. However, in usability there are several criteria involved and determining which one contributes more to usability is a complex decision making process. This therefore necessitates that the problem of usability be formulated using a Multi-Criteria Decision Making (MCDM) approach. Website evaluation hence, belongs to MCDM field, which involves making a preference decision, such as evaluation or selection over the available alternatives using a set of criteria. In MCDM, several alternatives are usually involved, among which

the Decision-makers (DMs) have to give weights to each criterion (Ağırçün, 2012).

However, to get better results from MCDM, there is a need to incorporate computational intelligence techniques into it. This research therefore proposes a methodology based on integrating Fuzzy set theory with an MCDM approach, Analytical Hierarchical Processing (AHP), and Artificial Neural Network (ANN).

1. Literature Review

1.1 Website Usability Evaluation

Usability Evaluation (UE) entails assessing the ease of use of a product so as to discover the usability problems. This will eventually lead to obtaining the measures of overall usability. The evaluation is necessary in order to improve the usability or to determine whether usability objectives have been achieved or not. In usability engineering, UE for any software is composed of various methodologies (Paz & Pow-Sang, 2014; Nagpal, Mehrotra, & Bhatia, 2017).

UE is broadly divided into inspection and empirical methods according to (Fernandez, Insfran, & Abrahão, 2011; Adepoju & Shehu, 2014). Empirical methods involve capturing and analysing usage data from real end-users. More so, a set of predefined tasks are completed in the presence of either tester (human or specific software) who is involved in recording the outcomes of their work. On the other hand, in inspection methods, expert evaluators or designers carry out the evaluation by comparing the conformance of the interface with some established standards and guidelines. However, due to advancement in technology and computing field, UE methods are now classified into six categories which is Evaluator based, User based, Tool based, Model based, Multi Criteria Decision Making (MCDM) based, and Soft Computing based (Nagpal et al., 2017).

1.2 Fuzzy Analytical Process Hierarchy (FAHP)

Fuzzy AHP is a combination of classical AHP and fuzzy set theory. Equation (1) defines a triangular fuzzy number. AHP as proposed by Saaty (Internet World Stats, 2017; Mentis & Turan, 2012), is a traditional powerful decision-making methodology. It is being used to determine the priorities

among different criteria by comparing alternatives for each criterion, and determining an overall ranking of the alternatives. AHP produces the best choice among decision alternatives as the final outcome (Srichetta & Thurachon, 2012).

Basically, AHP has three components which are : Hierarchy Construction, Priority Analysis, and Consistency verification (Ravankar, Ravankar, Kobayashi, & Emaru, 2017).

At the top of the hierarchy is the overall goal of the decision problem. The intermediate levels are represented by the criteria and sub-criteria affecting the decision. The bottom level represents the possible alternatives.

Pairwise comparison matrix is used to calculate the relative importance weights of decision criteria in each level of the hierarchy. To get this done, the decision maker uses the fundamental scale or weight between 1 (equal importance) and 9 (extreme importance) defined by Saaty (Saaty, 2008) to assess the priority score for each pair of criteria in the same level.

That is, the pair-wise comparison matrix (see equation 2) is constructed where the elements a_{ij} in the matrix is interpreted as the degree of the precedence of the i^{th} criterion over the j^{th} criterion. Thereafter, the average weight for each normalized criterion is computed.

The decision alternatives are evaluated by taking into account the weights of decision criteria. The alternative scores are then combined with the criterion weights in order to get an overall score for each alternative.

In fuzzy AHP, triangular fuzzy numbers are used to represent common sense linguistic statements used in the pair-wise comparison (Djordjevic et al., 2013). The final step is to now obtain the overall priorities by aggregating the pair-wise comparison and the synthesizing the priorities (Srichetta & Thurachon, 2012). In conventional AHP, it is difficult to deal with imprecise or vague nature of linguistic assessment as it is common in usability evaluation.

Hence, fuzzy AHP are applied when the pairwise comparisons are imprecise due to inability of the decision makers to make exact preferences. This may be due to some uncertain and unknown information in the decision making process.

1.3 The Triangular Fuzzy Numbers (TFNs)

The TFNs used in the pair-wise comparison are defined by three real numbers expressed as a triple (l, m, u) where $l \leq m \leq u$ for describing a fuzzy event is represented as,

$$\mu\left(\frac{x}{\tilde{M}}\right) = \begin{cases} 0, & x < l \\ \frac{(x-l)}{(m-l)}, & l \leq x \leq m \\ \frac{(u-x)}{(u-m)}, & m \leq x \leq u \\ 0, & x > u \end{cases} \quad (1)$$

The linguistic description is shown in Figure 1.

1.4 Fuzzy Pair-Wise Comparison Matrix

Fuzzy judgment matrix $\tilde{A} = \{\tilde{a}_{ij}\}$ of n criteria or alternatives is depicted as follows:

$$\tilde{A} = \begin{bmatrix} 1 & \tilde{a}_{12} & \dots & \tilde{a}_{1n} \\ \tilde{a}_{21} & 1 & \dots & \tilde{a}_{2n} \\ \dots & \dots & \dots & \dots \\ \tilde{a}_{n1} & \tilde{a}_{n2} & \dots & 1 \end{bmatrix} \quad (2)$$

where, \tilde{a}_{ij} is a fuzzy triangular number, $\tilde{a}_{ij} = (l_{ij}, m_{ij}, u_{ij})$, and $\tilde{a}_{ij} = 1/\tilde{a}_{ji}$. For each TFN, \tilde{a}_{ij} or $M = (l, m, u)$, its membership function $\mu_o(x)$ or $\mu_u(x)$ is a continuous mapping from real number $-\infty \leq x \leq \infty$ to the closed interval $[0, 1]$ and can be defined by equation (1).

Figure 2 shows the steps involved in fuzzy AHP, which has been described.

1.5 Artificial Intelligence Application in Website Usability

There have been only a few researches on applications of AI methods like fuzzy logic, Artificial Neural Network (ANN) (Saaty, 2008), and Genetic Algorithm (GA) in website usability evaluation research till date. In the work of Sohrabi, Mahmoudian, and Raeesi (2012), GA and ANN were employed to improve the performance of e-commerce websites. This is aimed at making the websites more flexible and highly functional. Oztekin, Delen,

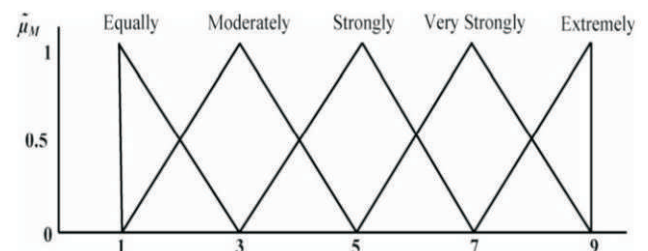


Figure 1. Fuzzy Set Definition with Triangular Membership Function

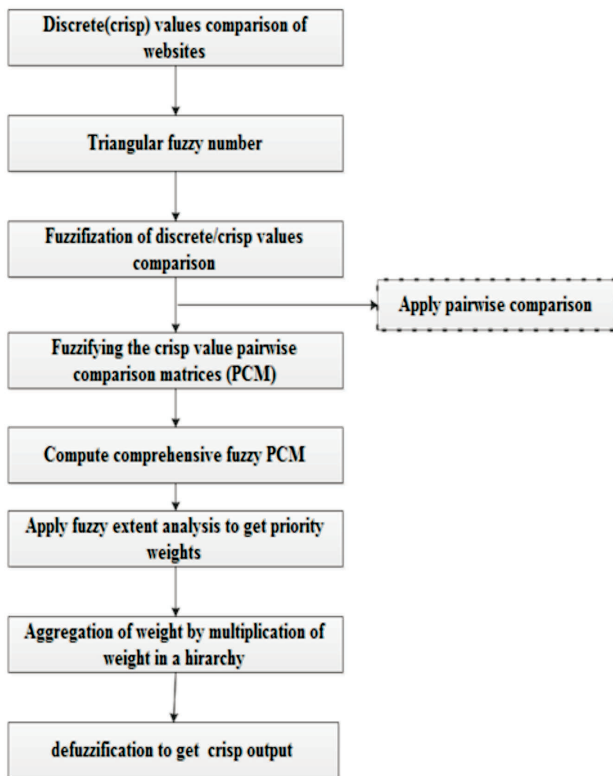


Figure 2. Fuzzy AHP Steps

Turkeyilmaz, and Zaim (2013) in their work developed an evaluation model for assessing e-Learning systems usability. The model was based on different machine learning techniques like support vector machine, ANN, and Decision Trees. Website users experience assessment was carried with the aid of ANN by Amanatiadis, Mitsinis, and Maditinos (2015).

1.6 Web Usability Evaluation Model

There have been several efforts by researcher all over the globe to formulate models for university usability evaluation. While most papers focus on academic website quality (Dominic & Jati, 2010; Devi & Sharma, 2016a; Devi & Sharma 2016b; Rochimah, 2016), there is considerable few papers that have targeted usability. Some of the studies which have provided general overview for web usability evaluation model are discussed next.

Shakel model (Shackel, 1991) is made up of four usability evaluation criteria which are learnability, flexibility, effectiveness, and user attitude. Nielsen's model (Nielsen, 1999), which is cited frequently in the usability engineering

identified five attributes of usability as learnability; efficiency; memorability; low error rate (easy error recovery); and subjective satisfaction.

International Organization for Standardization (ISO) model base usability on as effectiveness, efficiency, and satisfaction. A more recent ISO 9126 (Botella et al., 2004) model formulated usability as dependent on understandability, learnability, operability, attractiveness, and usability compliance. Another model for academic library websites usability proposed by Joo (Joo, Lin, & Lu, 2011) identified effectiveness, efficiency, and learnability as the usability construct.

Some studies have proposed different academic website usability evaluation models and they are discussed as follows. WUEM model was developed by Manzoor and Hussain (2012) to evaluate the usability of ten top ranking engineering universities in Asia. It was based on web design, page design, navigation, and accessibility. Delice and Gungör (2009) proposed a method integrating the use of heuristic evaluation with AHP in order to identify usability problems in a university website. It was evaluated based on design consideration, website operation, and website user accordance.

Usability ranking of some universities were carried through the use of fuzzy AHP and Fuzzy integrated with technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) by Nagpal, Mehrotra, Bhatia, and sharma (2015b). Response time, ease of use, ease of navigation and informative were user as the criteria in the evaluation. In another study by Nagpal, Mehrotra, Bhatia, and Bhatia (2015a) fuzzy AHP was used to rank some educational websites based on usability criteria of response time, ease of use, ease of navigation and informative as done earlier in their previous work (Nagpal et al., 2015a). Furthermore, a combination of fuzzy AHP and entropy approaches was used by Nagpal, Mehrotra, and Bhatia (2016) to evaluate the usability of some academic websites. Roy, Pattnaik, and Mall (2017) proposed a new model integrating objective and subjective approach by using fuzzy AHP and entropy method to evaluate usability ranking.

Clearly from the review, only very few studies have

adopted the use of MCDM approach in website usability studies, especially in university websites. Even those studies which attempted to use it have not incorporated the use of AI techniques as widely adopted in other area like inventory classification (Kabir & Akhtar Hasin, 2013), machine tool selection (Taha & Rostam, 2011), (Sadeghian & Sadeghian, 2016), banks performance prediction evaluation (Wanke, Kalam Azad, Barros, & Hadi-Vencheh, 2016), vendor selection (Lakshmanpriya, Sangeetha, & Lavanpriya, 2013) among others.

2. Proposed Framework

The proposed methodological framework for the new integrated model is shown in Figure 3. This provides the stage by stage procedure in which the model is constructed.

In the first stage, the goal of the research goal is defined. The goal of the research is to develop an integrated model for university website evaluation. Step 2 involves the identification of the criteria to be used in the evaluation. This is established based on extensive literature review and classification. Several authors made use of different criteria for evaluation usability in different genre of websites as discussed earlier in the paper. This divergent criteria mainly depend on the type of evaluation to be done as well as the websites to be evaluated. It was based on this that the authors identified seven main criteria, which is very important in contemporary university websites. They are speed, navigation, ease of use, accessibility, aesthetic, and security.

Speed has to do with how fast the website is able to load when accessed by the users. It also involves the swiftness at which users are able to retrieve information from the websites when requested. Ease of use is the comfort at which users can access information and communicate with the websites without too much efforts. Navigation deals with the ability of the users to interact and move around easily within the webpages in the websites. Accessibility is the ability of the websites to be easily used by different types of users irrespective of any form of disability. It also involves provision of adequate tools that

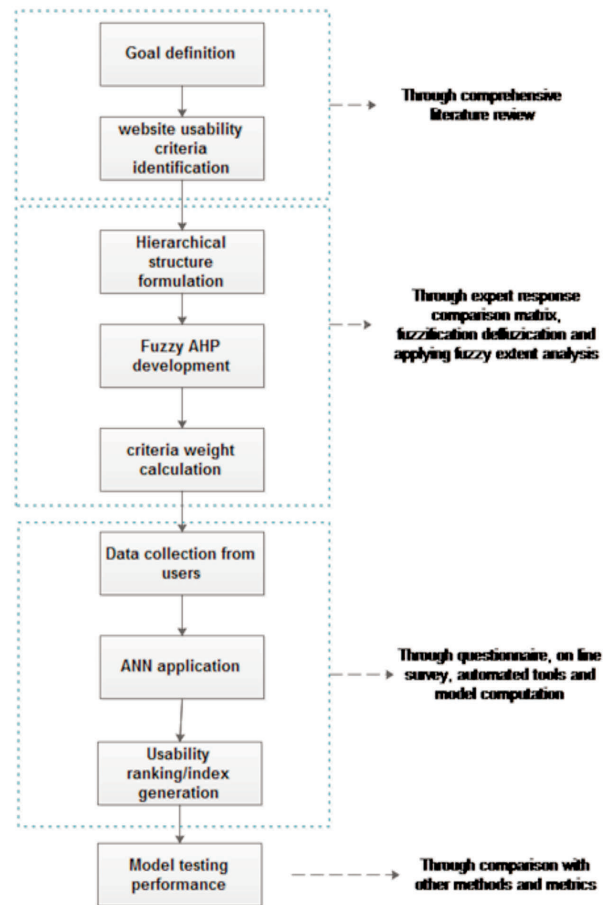


Figure 3. Methodological Framework of the Proposed Model

allows disabled users to use the websites without any constraint. Aesthetic deals with the visual appeal of the websites to the users or how attractive and pleasing the website appears to the users. Lastly, security on the other hand is the ability to use the websites without the fear of any form of vulnerability and intrusion into privacy. This paper incorporates security as one of the key criteria, which many authors in the past neglected.

Stage three involves the formulation of the hierarchical structure in AHP. The structure is presented in Figure 4.

Here, the structure is broken into three components; goal, criteria, and alternatives. The goal is already formulated and the criteria has been identified as stated above. The alternatives are the university websites to be used. In this case, a total of six university websites with good web visibility bases on world webometric ranking will be considered.

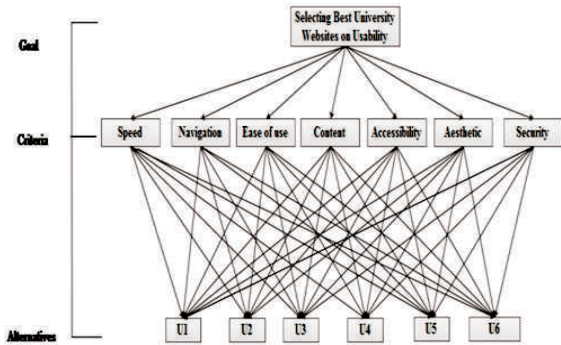


Figure 4. Hierarchical Structure of FAHP Model

The pairwise comparison is to be done by experts as well users of the websites via questionnaire. This will be used to construct the appropriate comparison matrix, which is of the form given earlier in equation (1).

The last stage involves feeding of the criterion obtained from Fuzzy AHP model into ANN network as inputs. Once the weight of each factor has been determined from the Fuzzy AHP model, the corresponding data of each website evaluation criteria will be collected in order to train the neural network.

Figure 5 shows the ANN structure with the input layers (obtained from FAHP weight), the hidden layer, and output layer.

In the last stage, the model will be compared with other existing usability evaluation methods. Also standard machine learning performance metrics will be used to test the performance of the proposed model in addition to sensitivity analysis.

Conclusion

Usability university websites is of utmost concern to every

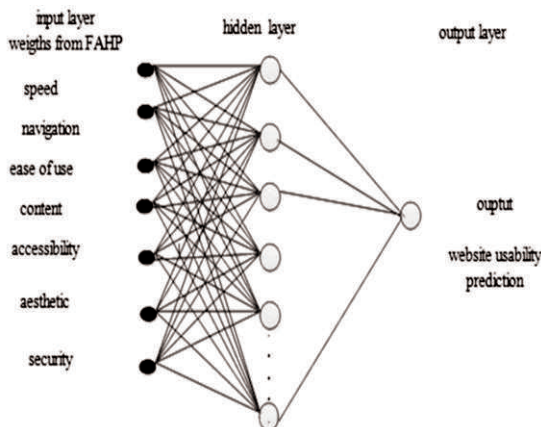


Figure 5. The Integrated Model with ANN Structure

stakeholder in the university community. While efforts have made in the time past to develop models for usability evaluation in general, only little has not been done for University website evaluation. Due to diversity of websites and its usage by different categories of users, different evaluation models have been proposed. However, there are still not a generally acceptable model, hence the need for a more wholistic one as proposed in this study.

The integrated approach proposed in this study will handle both the subjective and objective aspect of usability evaluation thereby eliminating bias exhibited by human being during evaluation. This will further ensure a better ranking and classification of the usability of the selected websites. The research is ongoing and in the future work the model will be implemented and the appropriate performance analysis will be done.

References

- [1]. Abdallah, S., & Jaleel, B. (2015). Website appeal: Development of an assessment tool and evaluation framework of e-marketing. *Journal of Theoretical and Applied Electronic Commerce Research*, 10(3), 45-62.
- [2]. Adepoju, S. A., & Shehu, I. S. (2014, September). Usability evaluation of academic websites using automated tools. In *User Science and Engineering (i-USER), 2014 3rd International Conference on* (pp. 186-191). IEEE.
- [3]. Ağırgün, B. (2012). Ranking B2C web sites with AHP and TOPSIS under fuzzy environment. *Neşehir Bilim ve Teknoloji Dergisi*, 1(2).
- [4]. Amanatiadis, A., Mitsinis, N., & Maditinos, D. (2015). A neural network-based approach for user experience assessment. *Behaviour & Information Technology*, 34(3), 304-315.
- [5]. Aziz, N. S., & Kamaludin, A. (2015, August). Using pre-test to validate the Questionnaire for Website Usability (QWU). In *Software Engineering and Computer Systems (ICSECS), 2015 4th International Conference on* (pp. 107-111). IEEE.
- [6]. Botella, P., Burgués, X., Carvallo, J. P., Franch, X., Grau, G., Marco, J., & Quer, C. (2004, January). ISO/IEC 9126 in practice: What do we need to know. In *Software*

Measurement European Forum (Vol. 2004).

[7]. Delice, E. K., & Güngör, Z. (2009). The usability analysis with heuristic evaluation and analytic hierarchy process. *International Journal of Industrial Ergonomics*, 39(6), 934-939.

[8]. Devi, K., & Sharma, A. K. (2016a). Evaluating the Quality of Academic Websites using proposed framework – a survey study. *International Journal of Computer Trends and Technology*, 40(1), 25-30.

[9]. Devi, K., & Sharma, A. K. (2016b). Framework for evaluation of academic website. *International Journal of Computer Techniques*, 3(2), 234-239.

[10]. Djordjevic, N. D., Rancic, D. D., & Vulic, I. (2013, October). The relative importance of the usability factors for web portals. In *Telecommunication in Modern Satellite, Cable and Broadcasting Services (TELSIKS), 2013 11th International Conference on* (Vol. 2, pp. 571-574). IEEE.

[11]. Dominic, P. D. D., & Jati, H. (2010, June). Evaluation method of malaysian university website: Quality website using hybrid method. In *Information Technology (ITSim), 2010 International Symposium in* (Vol. 1, pp. 1-6). IEEE.

[12]. Fernandez, A., Insfran, E., & Abrahão, S. (2011). Usability evaluation methods for the web: A systematic mapping study. *Information and Software Technology*, 53(8), 789-817.

[13]. Galovicova, T., Kremenova, I., & Fabus, J. (2016). *Usability Evaluation of University Websites*. Retrieved from http://www.eunis.org/eunis2017/wpcontent/uploads/site/10/2017/06/EUNIS_2017_paper_10.pdf.

[14]. International Organization for Standardization. (1998). *Ergonomic Requirements for office work with Visual Display Terminals (VDTs)-Pt. 11: Guidance on Usability* (ISO 9241-11).

[15]. Internet World Stats, (2017). *Internet World Stats Usage and Population Statistics*. Retrieved from: <http://www.internetworldstats.com/stats1.htm#links>.

[16]. Ismailova, R., & Kimsanova, G. (2017). Universities of the Kyrgyz Republic on the Web: Accessibility and usability. *Universal Access in the Information Society*,

16(4), 1017-1025.

[17]. Joo, S., Lin, S., & Lu, K. (2011). A usability evaluation model for academic library websites: Efficiency, effectiveness and learnability. *Journal of Library and Information Studies*, 9(2), 11-26.

[18]. Kabir, G., & Akhtar Hasin, M. A. (2013). Multi-criteria inventory classification through integration of fuzzy analytic hierarchy process and Artificial Neural Network. *International Journal of Industrial and Systems Engineering*, 14(1), 74-103.

[19]. Lakshmanpriya, C., Sangeetha, N., & Lavanpriya, C. (2013). Vendor selection in manufacturing industry using AHP and ANN. *The SIJ Transactions on Industrial, Financial & Business Management*, 1(1), 29-34.

[20]. Manzoor, M., & Hussain, W. (2012). A web usability evaluation model for higher education providing Universities of Asia. *Science, Technology and Development*.

[21]. Manzoor, M., Hussain, W., Ahmed, A., & Iqbal, M. J. (2012). The importance of higher education website and its usability. *International Journal of Basic and Applied Sciences*, 1(2), 150-163.

[22]. Menten, S. A., & Turan, A. H. (2012). Assessing the usability of university websites: An empirical study on Namik Kemal University. *Turkish Online Journal of Educational Technology-TOJET*, 11(3), 61-69.

[23]. Mvungi, J., & Tossy, T. (2015). Usability evaluation methods and principles for the web. *International Journal of Computer Science and Information Security*, 4(7), 165-171.

[24]. Nagpal, R., Mehrotra, D., & Bhatia, P. K. (2016). Usability evaluation of website using combined weighted method: Fuzzy AHP and entropy approach. *International Journal of System Assurance Engineering and Management*, 7(4), 408-417.

[25]. Nagpal, R., Mehrotra, D., & Bhatia, P. K. (2017). The state of art in website usability evaluation methods. In *Design Solutions for User-Centric Information Systems* (pp. 275-296). IGI Global.

[26]. Nagpal, R., Mehrotra, D., Bhatia, P. K., & Bhatia, A.

- (2015a). FAHP approach to rank educational websites on usability. *International Journal of Computing and Digital Systems*, 4(04), 251-260.
- [27]. Nagpal, R., Mehrotra, D., Bhatia, P. K., & Sharma, A. (2015b). Rank university websites using fuzzy AHP and fuzzy TOPSIS approach on usability. *International Journal of Information Engineering and Electronic Business*, 7(1), 29-36.
- [28]. Nielsen, J. (1999). *Designing Web Usability: The Practice of Simplicity*. New Riders Publishing.
- [29]. Oztekin, A., Delen, D., Turkyilmaz, A., & Zaim, S. (2013). A machine learning-based usability evaluation method for e-Learning systems. *Decision Support Systems*, 56, 63-73.
- [30]. Paz, F., & Pow-Sang, J. A. (2014, December). Current trends in usability evaluation methods: A systematic review. In *Advanced Software Engineering and Its Applications (ASEA), 2014 7th International Conference on* (pp. 11-15). IEEE.
- [31]. Pearson, J. M., Pearson, A., & Green, D. (2007). Determining the importance of key criteria in web usability. *Management Research News*, 30(11), 816-828.
- [32]. Ravankar, A., Ravankar, A. A., Kobayashi, Y., & Emaru, T. (2017, November). Optimal robot path selection using Fuzzy Analytical Hierarchical process. In *Multidisciplinary Digital Publishing Institute Proceedings* (Vol. 2, No. 3, p. 111).
- [33]. Rochimah, S. (2016). The improvement of software Quality Model for academic websites based on Multi-perspective approach. *Journal of Theoretical & Applied Information Technology*, 86(3), 464-471.
- [34]. Roy, S., & Pattnaik, P. K. (2014). Some popular usability evaluation techniques for websites. In *Proceedings of the International Conference on Frontiers of Intelligent Computing: Theory and Applications (FICTA) 2013* (pp. 535-543). Springer, Cham.
- [35]. Roy, S., Pattnaik, P. K., & Mall, R. (2017). Quality assurance of academic websites using usability testing: An experimental study with AHP. *International Journal of System Assurance Engineering and Management*, 8(1), 1-11.
- [36]. Saaty, T. L. (2008). Decision making with the analytic hierarchy process. *International Journal Of Services Sciences*, 1(1), 83-98.
- [37]. Sadeghian, R., & Sadeghian, M. R. (2016). A decision support system based on artificial neural network and fuzzy analytic network process for selection of machine tools in a flexible manufacturing system. *The International Journal of Advanced Manufacturing Technology*, 82(9-12), 1795-1803.
- [38]. Sarsarabi, S. S., & Sarsarabi, A. H. (2015, June). Promoting University Website Based on Webometrics. In *1st Global Conference On Technology In Language Learning* (pp. 1-10).
- [39]. Shackel, B. (1991). Usability - Context, Framework, Definition, Design and Evaluation. In B. Shackel and S. Richardson (Eds.), *Human Factors for Informatics Usability* (21-38). Cambridge: Cambridge University Press.
- [40]. Sohrabi, B., Mahmoudian, P., & Raeesi, I. (2012). A framework for improving e-commerce websites usability using a hybrid genetic algorithm and neural network system. *Neural Computing and Applications*, 21(5), 1017-1029.
- [41]. Speicher, M. (2015). What is usability? A characterization based on ISO 9241-11 and ISO/IEC 25010. *arXiv preprint arXiv:1502.06792*.
- [42]. Srichetta, P., & Thurachon, W. (2012). Applying fuzzy analytic hierarchy process to evaluate and select product of notebook computers. *International Journal of Modeling and Optimization*, 2(2), 168-173.
- [43]. Taha, Z., & Rostam, S. (2011). A fuzzy AHP-ANN-based decision support system for machine tool selection in a flexible manufacturing cell. *The International Journal of Advanced Manufacturing Technology*, 57(5-8), 719.
- [44]. Tripathi, P., Pandey, M., & Bharti, D. (2010, February). Towards the identification of usability metrics for academic web-sites. In *Computer and Automation Engineering (ICCAE), 2010 The 2nd International Conference on* (Vol. 2, pp. 393-397). IEEE.
- [45]. Wanke, P., Kalam Azad, M. A., Barros, C. P., & Hadi-Vencheh, A. (2016). Predicting performance in ASEAN banks: An integrated fuzzy MCDM–neural network

approach. *Expert Systems*, 33(3), 213-229.

[46]. Yerlikaya, Z., & Durdu, P. O. (2017, July). Usability of university websites: A systematic review. In *International*

Conference on Universal Access in Human-Computer Interaction (pp. 277-287). Springer, Cham.

ABOUT THE AUTHORS

Solomon A. Adepoju is presently in the Department of Computer Science at Federal University of Technology, Minna. He is a member of Computer Professional Registration Council of Nigeria (CPN), International Association of Computer Science and Information Technology (IACST), SIGCHI, and International Society on Multi Criteria Decision Making (MCDM) among others. He holds B.Tech (Mathematics / Computer Science) and M.Sc. (Computer Science) from the Federal University of Technology, Minna and University of Ibadan respectively. He has co-authored papers which have appeared in some National and International Journals. His areas of interest include Human Computer Interaction (website usability/accessibility), ICT4D, and MCDM.



Ishaq O. Oyefolahan is currently a Senior Lecturer in the Department of Information and Media Technology at Federal University of Technology, Minna, Nigeria. Prior to joining his current department, he was an Assistant Professor at the Department of Information Systems, International Islamic University Malaysia. His fields of interest are Business Intelligence, Web and Mobile Applications Development, Utilization and Evaluation, Business-IT Alignment, and Knowledge Management. He has published several Technical papers in International, National Journals, and Conferences.



Dr. Muhammad B. Abdullahi is a trained Mathematician and Computer Scientist. He is presently in the Department of Computer Science, Federal University of Technology, Minna. He is a chartered Information Technology practitioner and a member of the Computer Professionals Registration Council of Nigeria (CPN) and also a full member of Nigeria Computer Society (NCS). He is currently the Vice Chairman of Nigeria Computer Society, Niger State Chapter. He received his Doctor of Philosophy (Ph.D) Degree in Computer Science and Technology from Central South University, Changsha, Hunan, P. R. China in 2012. His research interests are majorly in the areas of Trust, Security and Privacy issues in Wireless Sensor, and Ad-Hoc Networks, Internet of Things (IoT), Peer-to-Peer Networking, Cloud Computing, Big Data Analytics, Machine Learning, Data Mining, Ambient Intelligence, and Computer Science Education. His research results are published in refereed Journals and Conference proceedings.



Dr. Adamu A. Mohammed is an Associate Professor in the Department of Mathematics and Applied Science at Federal University of Technology, Minna. He is currently the acting Director, Information Technology Services (ITS). He is a Zend Certified PHP Engineer (2014). He is a Member of Mathematical Association of Nigerian (MAN), Science Teachers Association of Nigeria (STAN), and Nigerian Mathematical Society (NMS). He bagged his first Degree at Usman Danfodio University Sokoto in March 2000 and obtained B.Sc, Mathematics (First Class Honours). In October 2004 and February 2012 respectively, he was awarded M.Tech and Ph.D. in Applied Mathematics from the Federal University of Technology, Minna, Niger State.





3/343, Hill view, Town Railway Nager, Nagercoil
Kanyakumari Dist. Pin-629 001.
Tel: +91-4652-276675, 277675

e-mail: info@imanagerpublications.com
contact@imanagerpublications.com
www.imanagerpublications.com