International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 10 (2018) pp. 8005-8013

Analyzing, Designing and Implementing a Web-Based Auction online System

Razan Aldaej, Latifa Alfowzan, Reem Alhashem, Mutasem K. Alsmadi, Ibrahim Al-Marashdeh, Usama A Badawi, Muneerah Alshabanah, Daniah Alrajhi and Mohammed Tayfour

Department of Management Information Systems, College of Applied Studies and Community Service, Imam Abdurrahman Bin Faisal University, Al-Dammam, Saudi Arabia.

Abstract

Nowadays, the online web-based auction system has become the extremely popular component in the electronic marketplace. A practical case study will be introduced in this work to highlight the best practices for analysing and designing an online web-based auction system. The proposed Online Web-Based Auction System (OAS) was designed and implemented using the UML (in order to illustrate the architectural model), Microsoft Access 2010 and ASP.NET programming language. In the proposed OAS, the UML offering several diagrams to enable the new functions to be updated and added easily such as use case, sequence and class diagrams, and user interfaces. The proposed OAS will help the bidders to bid in fast and increase his chances to make a successful bid by suggesting a bid price, and help the seller to achieve maximum profit. Along with the tools that have been used based on the analysis and implementation environment, the proposed OAS offers excellent advantages for the support of system development.

Keywords: Information System; Auction System and Unified Modeling Language.

INTRODUCTION

In the recent years, the electronic marketplace has been an exponentially grown in usability, size and worth. It is expected that this trend will exaggerate in the upcoming years [1]. As a consequence of the rapidly growing internet environment, the customer can conveniently obtain the products that he/she purchases from the traditional market by online auction systems. Online auctions are a main component of the electronic marketplace that makes use of electronic commerce mechanisms.

Auction systems are a main constituent of the electronic marketplace, it allows users at any place to buy and sell products. The sellers are able to set up auctions for any product they have and the bidder who bids the top amount gains the right for purchasing the auction product [1-5].

A scheme for the online auction system based on the campus network was presented by Ren in [6] using the UML technique. Therefore, two steps were adopted to design the scheme of the proposed online auction system based on the use activity diagrams, case diagrams, sequence diagrams, class diagrams and deployment diagrams. The designed scheme provided a certain reference values for realising the digital campus and constructing the campus electronic commerce.

A Secure Online Auction System has been analyzed, designed and implemented by Majadi et al., in [1]. In their work, the authors created their online auction server for carry out auction-related research, to test the countermeasures of fraud in a controlled environment. The designed and implemented online auction system was named the uAuction. The authors claimed that there is a limited of the useful literature for the auction system design and implement. The authors have been employed the Unified Modeling Language (UML) to analyse and design of the proposed uAuction system to show the architectural model, subsystems, activity workflows, use cases, class diagram, system sequence diagrams and user interfaces.

The technological revolution influenced everything [7-16], even the methods of marketing and business applications for the real world business issues. Nowadays, Artificial Intelligence (AI) algorithms were used widely for solving several difficult problems such as image segmentations [17-25], medical image analysis [26-30], nurse rostering problem [31], Healthcare Monitoring [32, 33], Learning Management System [34], patterns recognition and information retrieval [35-46], and river flow forecasting [47-49]. Many researchers have used the AI algorithms and Machine Learning in marketing and business applications such as auction systems [50-54].

The reset of the paper is organized as follow; system analysis will be described in section 2, database testing and construction will be illustrated in section 3. System implementation will be illustrated in section 4. Results will be discussed in section 5. Finally, the conclusion is presented in section 6.

SYSTEM ANALYSIS

The UML has been developed to offer a standardised notation to define Object Oriented Models. However, to effectively apply the UML notation, it must be employed with an Object-Oriented Analysis and Design method [55-59]. Object-Oriented analysis and design (OOAD) refers to a group of methodologies to produce business component based software. The methodology summaries the life cycle of system development identifying the deliverables and tasks in

an object-oriented project [60]. Using a combination of UML notation and process, the life cycle of system development can be reduced, the system can be easily maintained, and the modules reusability can be improved.

Conventionally, requirements analysis comprised of finding functions and relevant data that will be supported by the software system. The entity-relationship diagrams will describe the data that the system will handle, while data flows will describe the functions [61, 62]. Object-oriented software development uses new methods of design, which are supported by computer-aided software engineering tools such as Rational Rose [5].

The UML is a language used to specify, visually model [62], and document the artifacts of an Object-Oriented system under development. It denotes a number of ideas unification from various methods. UML is used in the system design to improve its reusability and maintainability. Object-oriented analysis methods offer class, use case, state chart, sequence and other diagrammatic notations for modeling[61]. UML has been employed effectively in many projects for modeling different requirements and architectures [62].

Use case diagram, class diagram and sequence diagram were selected for the user's requirements analysis; Class Diagrams were selected to represent the classes' static structure.

Therefore, this work designs and implements the online web-based auction system (OAS) using UML. Where in the proposed OAS, the UML offering several diagrams to enable the new functions to be updated and added easily such as: use case, sequence, class diagrams, and user interfaces. The proposed OAS will help the bidders to bid in fast and increase their chances to make a successful bid by suggesting a bid price, and help the seller to achieve maximum profit.

Use Case Diagram

The use case diagram is a visualization of a use-case [58, 62-64], i.e., the auction system interaction with the users. In the proposed OAS the use case mainly consists of register case, search product case, post a product case, view product details case, modify bid amount case, make a bid for product, specify time and price of bidding,.. etc. Figure 1 shows the use case diagram for the actions that the actors (Seller, Bidder and Admin) can perform in an auction.

Mainly 3 actors (Admin, Bidder and Seller) will be interacting with the proposed system*;* each one can do the following:

- Admin:
  - ✓ Admin can manage products
  - ✓ Admin can manage the departments
  - ✓ Admin can manage users
  - ✓ Admin can manage bidding
  - ✓ Admin can create reports.

- Bidder:
  - ✓ Bidder can search for a product
  - ✓ Bidder can view product details
  - ✓ Bidder can modify bid amount
  - ✓ Bidder can make a bid for product
  - ✓ Bidder can edit profile information.

- Seller:
  - ✓ Seller can post a product
  - ✓ Seller can specify time and price of the bidding
  - ✓ Seller can view bidding information
  - ✓ Seller can edit profile information.

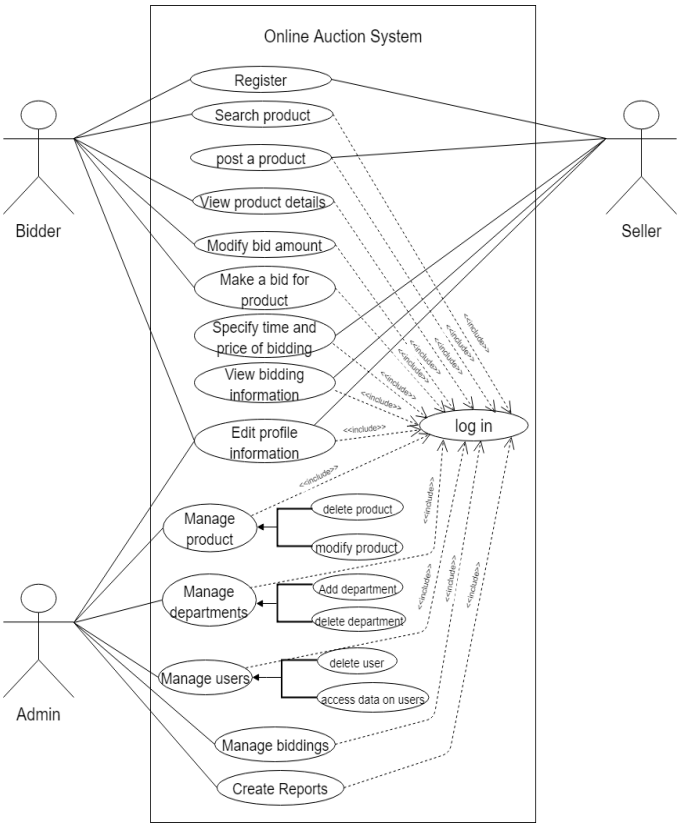

Figure 1: The use case diagram.

Class Diagram

In Object-Oriented analysis and design, the class diagram is the most essential entity. It defines the kinds of objects that are present in the system and describes the static relationships between the system internal classes [58]. The operations and attributes of a class and the constraints that apply to the objects connection can be shown by the class diagram. Figure 5 displays the OAS class diagram. Figure 2 shows the OAS entities, such as admin, product, bidder, seller and bidder, etc.

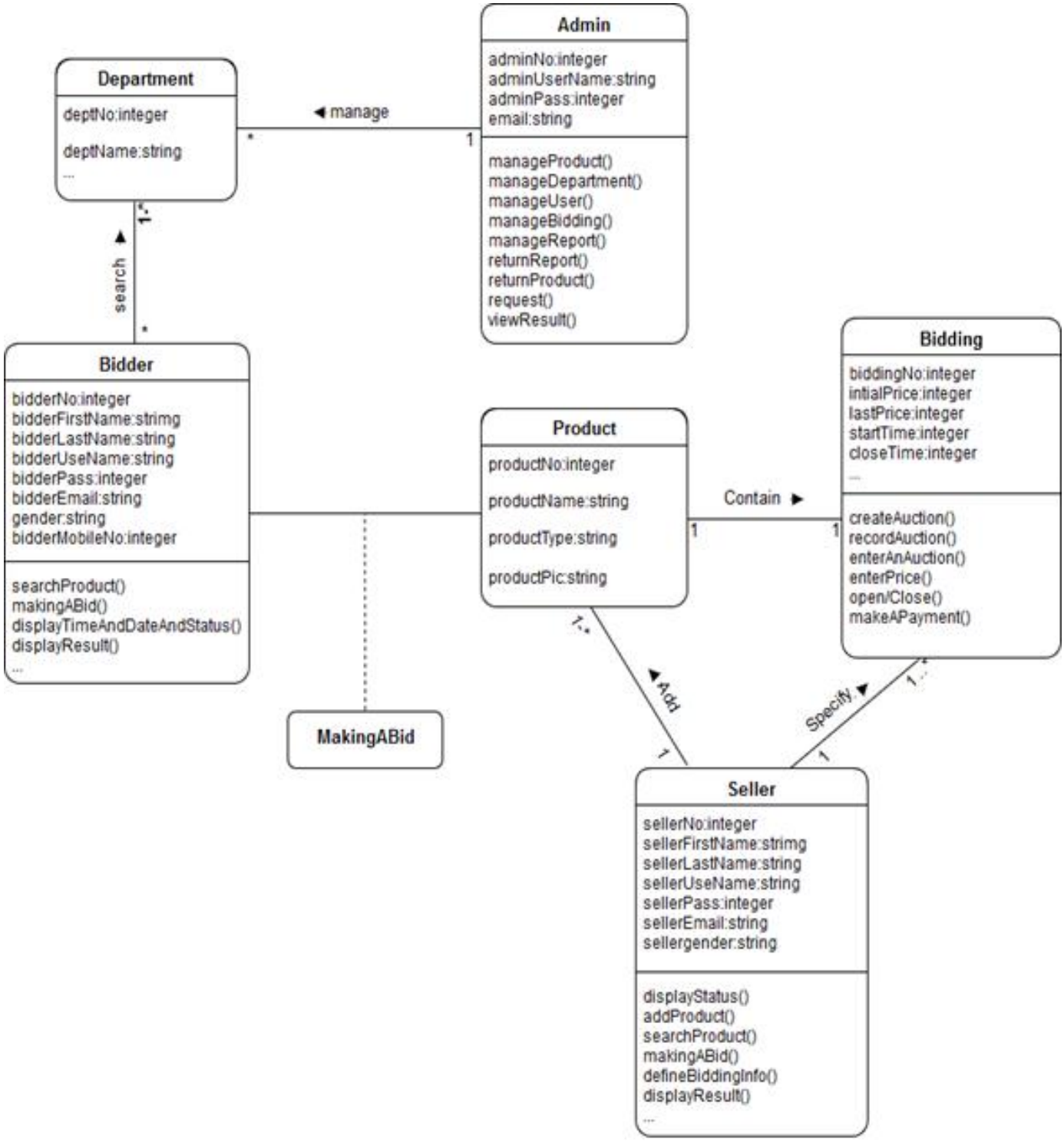

Figure 2: The class diagram of the proposed OAS.

Sequence Diagram

A sequence diagram is one of the UML dynamic models [60, 65], and it defines the interaction scene between the objects in time when the use case was executed and highlights the information sending time priority among objects. Usually, the sequence diagram illustrates the single use-case behavior. Figure 3 demonstrates the bidder sequence diagram in the proposed OAS.

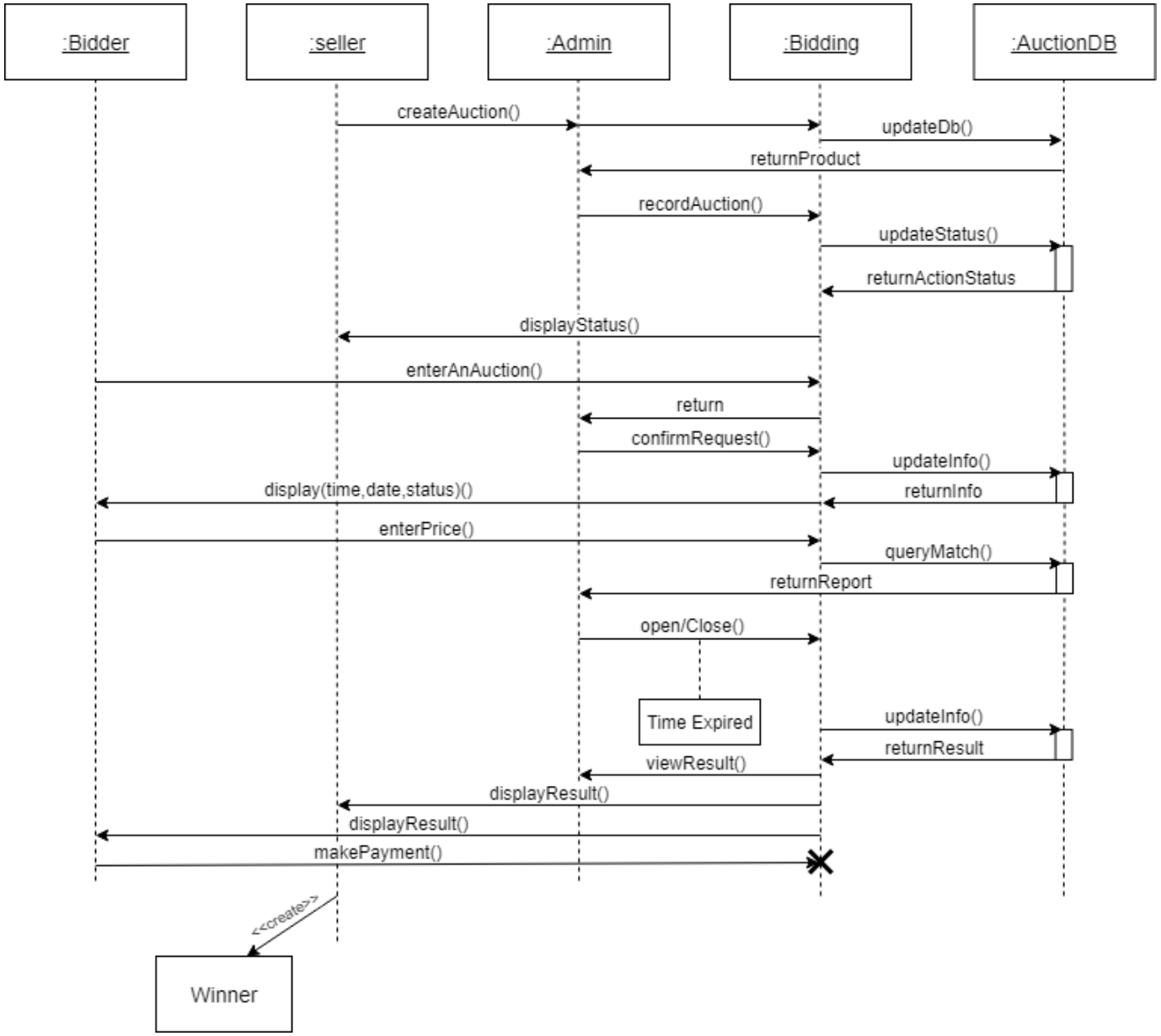

Figure 3: The bidder sequence diagram.

DATABASE TESTING AND CONSTRUCTION

The database testing is essential for finding errors that can affect the security, consistency, reliability and performance of the system, and it is important for system validation against the user specified requirements [66, 67]. Microsoft Access 2010 was used for database implementation. The tables below are examples of the created tables.

Table 1: Seller table

Seller | Admin

SellerNo	SellerFName	SellerLName	SellerUserName	SellerPassword	SellerEmail	Gender	MobileNo
1	امل	سالم	amal	1234	amal@homail.com	انثى	5560089789
2	سها	سعد	suha	8989	suhasj@hotmail.com	انثى	4456779076
3	ايمان	محمد	eman	76868	eman.d@hotmail.com	انثى	5564590787
4	أفنان	سعود	afnan	667766	afnan.dmd@gmail.com	انثى	7778878987
6	لولوة	خالد	lolo	123123	lolo@hotmail.com	انثى	0909090909
8	منال	مكباتي	manal	12345	manal@hotmail.com	انثى	0898989898
(جديد)							

Table 2: Bidder table

BidderNo	BidderFName	BidderLName	BidderUserName	BidderPassword	BidderEmail	Gender	MobileNo
1	وفاء	عبدالعزيز	wafa	123456	wafa@hotmail.com	أنثى	0555558533
2	محمد	سلطان	mohammed	4444	moh@gmail.com	ذكر	0578884747
3	سارة	ماجد	sara	4545	sara@outlook.com	أنثى	0589558522
4	نوف	نايف	nouf	6767	nouf@hotmail.com	أنثى	0556441477
5							
6							
(جديد)							

Table 3: Bidding table

BiddingNo	ProductNo	BiddingInitialPrice	BiddingLastPrice	BiddingStartTime	BiddingCloseDate	BiddingCloseTime	SellerNo	AdminNo
1	1	900		٠٢:٢٥ م	04/08/39	٠٢:٥٥ م	1	0
2	2	300	750	٠٤:١٠ م	2/08/39	٠٥:١٠ م	1	0
3	5	200	400	١٠:٠٠ م	2/08/39	١٠:٣٠ م	6	0
4	6	500	0	١٠:٣٠ م	2/09/39	١١:٠٠ م	2	0
5	7	1500	1700	١٠:٤٥ م	2/08/39	١١:١٥ م	2	0
(جديد)	0	0	0				0	0

SYSTEM IMPLEMENTATION

This section shows the proposed work's artifacts in addition to the implementation which came after the system analysis and design. The system analysis and configuration results of the proposed system are presented. The ASP.NET programming language and HTML have been used relying on their features that make them appropriate for this work. The user have to register as a bidder or seller (as shown in figure 4) to be start using the proposed system, the proposed system, OAS puts a user (bidder or seller) on the welcome web page from where a registered user (bidder or seller) can be verified by the proposed system site to start a protected session (log in) as displayed in figure 5. An unregistered user has to fill the form of the registration to use the system. A bidding interface is represented in figure 6.

Figure 4: Registration interface

Figure 5: Log in interface

Figure 6: Bidding interface

RESULTS AND DISCUSSION

The proposed system has been tested in order to measure its usability, where the proposed system was tested by operating on Internet Explorer, Google Chrome and Mozilla Firefox with the local host server. Twenty students evaluated the system prototype from Imam Abdulrahman Bin Faisal University (IAU). After given a brief explanations about how to use the system, the students have been tested the proposed system and answer the survey questionnaire (contains 10 questions measured by 5-point Likert Scale). The aim of the proposed survey is to measure the user satisfaction about the proposed system and prove its usability. The results obtained shows a high percentage of the students approve that the OAS is usable, useful and achieved the main project target.

Table 4: The results of data collected from the 20 students.

	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10
Strongly disagree										
Disagree										
Neutral	**4**	**3**	**5**	**3**		**2**	**1**	**2**	**1**	**2**
Agree	**6**	**9**	**6**	**5**	**9**	**9**	**14**	**12**	**15**	**12**
Strongly agree	**10**	**8**	**9**	**12**	**11**	**9**	**5**	**6**	**4**	**6**

CONCLUSION

This paper highlights the best practices in building and designing a web-based auction system. In this work, we designed and implemented online web-based auction system (OAS) using the UML, Microsoft Access 2010 and ASP.NET programming language. In the proposed OAS, the UML offered several diagrams to enable the new functions to be updated and added easily such as use case, sequence and class diagrams, and user interfaces. The proposed OAS will help the bidders to bid in fast and increase their chances to make a successful bid by suggesting a bid price, and help the seller to achieve maximum profit. Along with the tools that have been used based on the analysis and implementation environment, the proposed OAS offered excellent advantages for the support of system development.

REFERENCES

[1] Majadi N, Trevathan J and Bergmann N. uAuction: Analysis, Design, and Implementation of a Secure Online Auction System. In Dependable, Autonomic and Secure Computing, 14th Intl Conf on Pervasive Intelligence and Computing, 2nd Intl Conf on Big Data Intelligence and Computing and Cyber Science and Technology Congress (DASC/PiCom/DataCom/CyberSciTech), 2016 IEEE 14th Intl C, pp. 278-285.

[2] Hillston J and Kloul L. Performance investigation of an on-line auction system. *Concurrency and Computation: Practice and Experience*, 2001, 13(1): 23-41.

[3] Bichler M. An experimental analysis of multi-attribute auctions. *Decision Support Systems*, 2000, 29(3): 249-268.

[4] Sandholm T. Approaches to winner determination in combinatorial auctions. *Decision Support Systems*, 2000, 28(1-2): 165-176.

[5] Sheldon F T, Jerath K, Kwon Y-J and Baik Y-W. Case study: Implementing a web based auction system using UML and component-based programming. In Computer Software and Applications Conference, 2002. COMPSAC 2002. Proceedings. 26th Annual International, pp. 211-216.

[6] Ren C. Research and Design of Online Auction System Based on the Campus Network Using UML. In 2009 Second Pacific-Asia Conference on Web Mining and Web-based Application, 6-7 June 2009, pp. 129-133.

[7] Almrashdah I A, Sahari N, Zin N A H M and Alsmadi M. Instructors acceptance of distance learning management system. In Information Technology (ITSim), 2010 International Symposium in, pp. 1-6.

[8] Haddad F, Alfaro J and Alsmadi m K. HOTELLING'S T^2 CHARTS USING WINSORIZED MODIFIED ONE STEP M-ESTIMATOR FOR INDIVIDUAL NON NORMAL DATA. *Journal of Theoretical & Applied Information Technology*, 2015, 72(2).

[9] Almarashdeh I and Alsmadi M K. How to make them use it? Citizens acceptance of M-government. *Applied Computing and Informatics*.

[10] Almarashdeh I and Alsmadi M. Investigating the acceptance of technology in distance learning program. In 2016 International Conference on Information Science and Communications Technologies (ICISCT), 2-4 Nov. 2016, pp. 1-5.

[11] Almrashdeh I A, Sahari N, Zin N A M and Alsmadi M. Instructor's success measures of Learning Management System. In Electrical Engineering and Informatics (ICEEI), 2011 International Conference on, pp. 1-7.

[12] Haddad F and Alsmadi M K. Improvement of The Hotelling's T2 Charts Using Robust Location Winsorized One Step M-Estimator (WMOM). *Journal of Mathematics (ISSN 1016-2526)*, 2018, 50(1): 97-112.

[13] Almarashdeh I and Alsmadi M. Heuristic evaluation of mobile government portal services: An experts' review. In Internet Technology and Secured Transactions (ICITST), 2016 11th International Conference for, pp. 427-431.

[14] Alsmadi M K, Badawi U A and Moharram H M. SERVER FAILURES ENABLED JAVASPACES

SERVICE. *Journal of Computer Science*, 2014, 10(4): 671-679.

[15] Almarashdeh I A, Sahari N, Zin N A M and Alsmadi M. Acceptance of learning management system: A comparison between distance learners and instructors. *Advances in Information Sciences and Service Sciences*, 2011, 3(5): 1-9.

[16] Almarashdeh I A, Sahari N, Zin N A M and Alsmadi M. THE SUCCESS OF LEARNING MANAGEMENT SYSTEM AMONG DISTANCE LEARNERS IN MALAYSIAN UNIVERSITIES. *Journal of Theoretical & Applied Information Technology*, 2010, 21(2).

[17] Farag T H, Hassan W A, Ayad H A, AlBahussain A S, Badawi U A and Alsmadi M K. Extended Absolute Fuzzy Connectedness Segmentation Algorithm Utilizing Region and Boundary-Based Information. *Arabian Journal for Science and Engineering*, 2017: 1-11.

[18] Thalji Z and Alsmadi M. Iris Recognition using robust algorithm for eyelid, eyelash and shadow avoiding. *World Applied Sciences Journal*, 2013, 25(6): 858-865.

[19] Alsmadi M K. A hybrid Fuzzy C-Means and Neutrosophic for jaw lesions segmentation. *Ain Shams Engineering Journal*.

[20] Badawi U A and Alsmadi M K S. A Hybrid Memetic Algorithm (Genetic Algorithm and Great Deluge Local Search) With Back-Propagation Classifier for Fish Recognition *International Journal of Computer Science Issues*, 2013, 10(2): 348-356.

[21] M A, K O and S N. Back Propagation Algorithm : The Best Algorithm Among the Multi-layer Perceptron Algorithm. *International Journal of Computer Science and Network Security*, 2009, 9(9): 378-383.

[22] Alsmadi M k, Omar K B, Noah S A and Almarashdah I. Performance Comparison of Multi-layer Perceptron (Back Propagation, Delta Rule and Perceptron) algorithms in Neural Networks. In 2009 IEEE International Advance Computing Conference, 6-7 March 2009, pp. 296-299.

[23] Alsmadi M k, Omar K B and Noah S A. Proposed method to decide the appropriate feature set for fish classification tasks using Artificial Neural Network and Decision Tree. *IJCSNS* 2009, 9(3): 297-301.

[24] Sharma M, Purohit G and Mukherjee S. Information Retrieves from Brain MRI Images for Tumor Detection Using Hybrid Technique K-means and Artificial Neural Network (KMANN). Networking Communication and Data Knowledge Engineering. Springer, 2018, pp. 145-157.

[25] Gao Y, Li X, Dong M and Li H-p. An enhanced artificial bee colony optimizer and its application to multi-level threshold image segmentation. *Journal of Central South University*, 2018, 25(1): 107-120.

[26] Alsmadi M K. A hybrid firefly algorithm with fuzzy-C mean algorithm for MRI brain segmentation. *American Journal of Applied Sciences*, 2014, 11(9): 1676-1691.

[27] Alsmadi M K. MRI brain segmentation using a hybrid artificial bee colony algorithm with fuzzy-c mean algorithm. *Journal of Applied Sciences*, 2015, 15(1): 100.

[28] Alsmadi M K. A hybrid Fuzzy C-Means and Neutrosophic for jaw lesions segmentation. *Ain Shams Engineering Journal*, 2017.

[29] Park S H and Han K. Methodologic Guide for Evaluating Clinical Performance and Effect of Artificial Intelligence Technology for Medical Diagnosis and Prediction. *Radiology*, 2018: 171920.

[30] Kermany D S, Goldbaum M, Cai W, Valentim C C, Liang H, Baxter S L, McKeown A, Yang G, Wu X and Yan F. Identifying Medical Diagnoses and Treatable Diseases by Image-Based Deep Learning. *Cell*, 2018, 172(5): 1122-1131. e1129.

[31] Jaradat G M, Al-Badareen A, Ayob M, Al-Smadi M, Al-Marashdeh I, Ash-Shuqran M and Al-Odat E. Hybrid Elitist-Ant System for Nurse-Rostering Problem. *Journal of King Saud University-Computer and Information Sciences*, 2018.

[32] Almarashdeh i, Alsmadi M K, Farag T, Albahussain A S, Badawi U A, Altuwaijri N, Almaimoni H, Asiry F, Alowaid S, Alshabanah M, Alrajhi D, Fraihet A A and Jaradat G. Real-Time Elderly Healthcare Monitoring Expert System Using Wireless Sensor Network *International Journal of Applied Engineering Research*, 2018, 13(6): 3517-3523.

[33] Rasmi M, Alazzam M B, Alsmadi M K, Almarashdeh I A, Alkhasawneh R A and Alsmadi S. Healthcare professionals' acceptance Electronic Health Records system: Critical literature review (Jordan case study). *International Journal of Healthcare Management*, 2018: 1-13.

[34] Almarashdeh I, Alsmadi M K, Jaradat G, Althunibat A, Albahussain S A, Qawqzeh Y, Badawi U A, Farag T and Eldaw K E. Looking Inside and Outside the System: Examining the Factors Influencing Distance Learners Satisfaction in Learning Management System *Journal of Computer Science*, 2018.

[35] Al Smadi A M, Alsmadi M K, Al Bazar H, Alrashed S and Al Smadi B S. Accessing Social Network Sites Using Work Smartphone for Face Recognition and Authentication. *Research Journal of Applied Sciences, Engineering and Technology*, 2015, 11(1): 56-62.

[36] Alsmadi M. Facial recognition under expression variations. *Int. Arab J. Inf. Technol.*, 2016, 13(1A): 133-141.

[37] Alsmadi M and Omar K. Fish Classification: Fish Classification Using Memetic Algorithms with Back Propagation Classifier. 2012.

[38] Alsmadi M, Omar K, Noah S and Almarashdeh I. A hybrid memetic algorithm with back-propagation classifier for fish classification based on robust features extraction from PLGF and shape measurements. *Information Technology Journal*, 2011, 10(5): 944-954.

[39] Alsmadi M, Omar K B, Noah S A and Almarashdeh I. Fish Recognition Based on Robust Features Extraction from Size and Shape Measurements Using Neural Network *Journal of Computer Science*, 2010, 6(10): 1088-1094.

[40] Alsmadi M K. An efficient similarity measure for content based image retrieval using memetic algorithm. *Egyptian Journal of Basic and Applied Sciences*.

[41] Alsmadi M K. Query-sensitive similarity measure for content-based image retrieval using meta-heuristic algorithm. *Journal of King Saud University - Computer and Information Sciences*.

[42] Alsmadi M K, Hamed A Y, Badawi U A, Almarashdeh I, Salah A, Farag T H, Hassan W, Jaradat G, Alomari Y M and Alsmadi H M. FACE IMAGE RECOGNITION BASED ON PARTIAL FACE MATCHING USING GENETIC ALGORITHM. *SUST Journal of Engineering and Computer Sciences (JECS)*, 2017, 18(1): 51-61.

[43] Alsmadi M K, Omar K B, Noah S A and Almarashdeh I. Fish recognition based on robust features extraction from color texture measurements using back-propagation classifier. *Journal of Theoritical and Applied Information Technology*, 2010, 18(1).

[44] Badawi U A and Alsmadi M K. A GENERAL FISH CLASSIFICATION METHODOLOGY USING META-HEURISTIC ALGORITHM WITH BACK PROPAGATION CLASSIFIER. *Journal of Theoretical & Applied Information Technology*, 2014, 66(3).

[45] Yousuf M, Mehmood Z, Habib H A, Mahmood T, Saba T, Rehman A and Rashid M. A Novel Technique Based on Visual Words Fusion Analysis of Sparse Features for Effective Content-Based Image Retrieval. *Mathematical Problems in Engineering*, 2018, 2018.

[46] Saritha R R, Paul V and Kumar P G. Content based image retrieval using deep learning process. *Cluster Computing*, 2018: 1-14.

[47] Alsmadi M K. Forecasting River Flow in the USA Using a Hybrid Metaheuristic Algorithm with Back-Propagation Algorithm. *Scientific Journal of King Faisal University (Basic and Applied Sciences)*, 2017, 18(1): 13-24.

[48] Adeyemo J, Oyebode O and Stretch D. River Flow Forecasting Using an Improved Artificial Neural Network. EVOLVE-A Bridge between Probability, Set Oriented Numerics, and Evolutionary Computation VI. Springer, 2018, pp. 179-193.

[49] Ahani A, Shourian M and Rad P R. Performance Assessment of the Linear, Nonlinear and Nonparametric Data Driven Models in River Flow Forecasting. *Water Resources Management*, 2018: 1-17.

[50] Milgrom P R and Tadelis S. How Artificial Intelligence and Machine Learning Can Impact Market Design. 2018.

[51] Dowlatshahi M and Derhami V. Winner Determination in Combinatorial Auctions using Hybrid Ant Colony Optimization and Multi-Neighborhood Local Search. *Journal of AI and Data Mining*, 2017, 5(2): 169-181.

[52] Milgrom P and Segal I. Deferred-Acceptance Clock Auctions and Radio Spectrum Reallocation. 2017.

[53] Boughaci D and Lassouaoui M. Stochastic Hyper-Heuristic for the Winner Determination Problem in combinatorial auctions. In Proceedings of the 6th International Conference on Management of Emergent Digital EcoSystems, pp. 62-66.

[54] Boughaci D. Metaheuristic Approaches for the Winner Determination Problem in Combinatorial Auction. Artificial Intelligence, Evolutionary Computing and Metaheuristics: In the Footsteps of Alan Turing, Yang X-S (ed). Springer Berlin Heidelberg, 2013, pp. 775-791.

[55] Fontoura M, Pree W and Rumpe B. UML-F: A modeling language for object-oriented frameworks. In European Conference on Object-Oriented Programming, pp. 63-82.

[56] Teixeira l, Xambre A R, Figueiredo J and Alvelos H. Analysis and design of a project management information system: practical case in a consulting company. In CENTERIS/ProjMAN/HCis, pp. 171-178.

[57] Almarashdeh I, Elias N F, Sahari N and Zain N A M. Development of an interactive learning management system for malaysian distance learning institutions. . *Middle East Journal of Scientific Research, 14(11), . 10.5829/idosi.mejsr.2013.14.11.2339*, 2013, 14(11): 1471-1479.

[58] Rajagopal D and Thilakavalli K. A Study: UML for OOA and OOD. *International Journal of Knowledge Content Development & Technology*, 2017, 7(2): 5-20.

[59] Torchiano M, Scanniello G, Ricca F, Reggio G and Leotta M. Do UML object diagrams affect design

comprehensibility? Results from a family of four controlled experiments. *Journal of Visual Languages & Computing*, 2017, 41: 10-21.

[60] Dennis A, Wixom B H and Tegarden D. Systems analysis and design: An object-oriented approach with UML. 2015.

[61] Dick J, Hull E and Jackson K. Requirements engineering. 2017.

[62] Bello S I, Bello R O, Babatunde A O, Olugbebi M and Bello B O. A University Examination Web Application Based on Linear-Sequential Life Cycle Model. 2017.

[63] ALMRASHDEH I A, SAHARI N, ZIN N A M and ALSMADI M. DISTANCE LEARNING MANAGEMENT SYSTEM REQIUREMENTS FROM STUDENT'S PERSPECTIVE. *Journal of Theoretical & Applied Information Technology*, 2011, 24(1).

[64] Almarashde I, Althunibat A and Fazidah El N. Developing a Mobile Portal Prototype for E-government Services. *Journal of Applied Sciences*, 2014, 14: 791-797.

[65] Karim S, Liawatimena S, Trisetyarso A, Abbas B S and Suparta W. Automating functional and structural software size measurement based on XML structure of UML sequence diagram. In Cybernetics and Computational Intelligence (CyberneticsCom), 2017 IEEE International Conference on, pp. 24-28.

[66] Begg C and Connolly T. Database systems: A practical guide to design, implementation, and management. 2002.

[67] Onuiri E E, Omoroje H C, Ntima C G and Omotunde A A. Intelligent Tourism Management System. *American Scientific Research Journal for Engineering, Technology, and Sciences (ASRJETS)*, 2016, 18(1): 304-315.