

Design and Implementation of a Responsive Web-based System for Controlling the Financial Budget of Universities

Ayah M. Ahmed^{1*}, Chira N. Mohammed², Akeela M. Ahmad³, Maiwan B. Abdulrazzaq⁴

^{1,2,4}Department of Computer Science, University of Zakho, Zakho, Kurdistan Region, Iraq

³Department of Mathematics, University of Duhok, Duhok, Kurdistan Region, Iraq

e-mail: ayah.ahmed@uoz.edu.krd¹, chira.mohammed@uoz.edu.krd², akeela.ahmad@uod.ac³,
maiwan.abdulrazzaq@uoz.edu.krd⁴

*Corresponding author: E-mail: ayah.ahmed@uoz.edu.krd¹

Abstract: *The management of the financial budget of universities is an extremely complex task due to having numerous different documents and calculation processes. In many developing regions and countries including the Kurdistan Region of Iraq, budget execution and accounting processes are manual. This had deleterious effects on the functioning of their expenditure and income management. This research represents the design and implementation of a responsive web-based system for controlling the financial budget of universities. This system can improve the recording and processing of financial transactions. Moreover, it traces all the stages of the transaction processing from budget releases, does auditing, and accounting of expenditures, incomes, deposits, and funds. Furthermore, it provides financial information on present and past performance. The system is a responsive web-based system, which adjusts the layout of the pages based on the screen size and orientation of the user's device. The system was implemented by using programming languages such as HTML, PHP, JavaScript, jQuery, AJAX, and MySQL. Finally, the provided system needed to be investigated from the performance point of view. Therefore, a questionnaire was used to determine the system's usability by using the System Usability Scale (SUS) tool. The results revealed that a score of 86.250% of satisfaction has been achieved.*

Keywords: Financial Budget; RWD; SUS; SWOT

INTRODUCTION

For more than one reason, organizations regardless of their forms and purposes, use accounting records. In enterprises, account information is used for decision-making, but it can also be used according to an organization's needs and specifications [1]. Primarily, the accounting data required by the organization was manually prepared by the accountant, which has a variety of problems and negatives. Fortunately, technical advances have culminated in the implementation of computerized accounting systems that have helped accountants solve their accounting problems and enhance their jobs [2]. These systems have been used globally in industry and have carried competitive advantages and profits with them. Organizations should strengthen and expand their processes in such a manner that quality knowledge can be generated and used for improved decision-making [3].

The style of system design, however often depends on the organization's volume, the number of transaction details, the scope of tasks, the organizational structure, and the business form [4]. Via many meetings and interviews with budget accountants at universities, it has been observed that all of them continue to use paper and manual instruments to maintain their records. To keep up with the new automated methods of handling financial budget operations found in modern organizations, this equipment is too old. It has also been noted that this system has some negative effects and has created numerous issues, such as: Firstly, it is time-consuming in terms of time, as it takes a long time to pass the information to the relevant units. Second, paper records

are non-value-added operations in terms of value-added operations since they are hard to retrieve, modify, and refile.

There has been a significant amount of research conducted on financial budget systems using various methodologies. One such study, conducted by Song [5], developed a system design specifically for colleges and universities, titled "College Financial Management System Research and Design," with the aim of simplifying financial management tasks and improving efficiency in the institutions under study. The design incorporated modules for user management, account management, employee information management, and student fee management to improve the interpretation of financial management information systems. Findings indicated that the proposed system had the potential to improve decision-making, transaction processing, internal control, report quality, and performance measures. However, the author acknowledged that further investigation was required to address existing deficiencies and improve the design.

Zhijun [6], conducted an analysis and developed a system for managing the budgets of scientific research projects at universities. The study revealed several issues with managing scientific research project funds, particularly in budget management. The system implemented several functions such as source management, budget management, expenditure management, and inquiry statistics. The system development tool utilized was Visual Studio, while the background data management system was SQL Server. The designer emphasized the system's practicality and

effectiveness in achieving dynamic management and budget planning for scientific research projects at universities.

Capucio et al [7]. developed a web-based budget management system for state universities and colleges. The existing budget process cycle was analyzed, and flaws were identified. The proposed system was developed using the model, view, and controller framework and the rapid application development methodology. Faculty, staff, and students evaluated the system and gave excellent ratings for functionality, usability, and efficiency. The system met the requirements and was strongly recommended for adoption. The development of this system addresses the gap in online budget management and can improve organizational performance.

In another study, Kurniawan et al. [8] presented a web-based financial information system, which was developed for independent educational accreditation institution in Indonesia using the Waterfall method with Laravel and MySQL. The system has two main features, which are budgeting the operations and financial management for accreditation. Its budgeting feature helps prepare financial plans for the future, while the management accounting feature provides information and analysis for problem-solving. The system promotes transparency, accountability, and good accounting practices. The study found that the system was effective in managing finances and accreditation activities in higher education.

Our proposed system is distinct from prior works as it can be applied in universities with one-unit or multi-unit budget accounting. Furthermore, it automates all auditing processes, and its flexible design allows new units, users, transaction types, and categories can easily be added without modifying the code. In addition, the system utilizes a responsive web design technique to dynamically adjust the web page layout based on the user's screen size and orientation.

This study aims to enhance the management of university budgets by proposing a system that facilitates administrative tasks, improves real-time financial data accessibility for management units, facilitates departmental collaboration, and streamlines the sharing of resources, skills, and information among financial units. Successful implementation of the proposed system is expected to enhance universities' budget management practices, enabling them to achieve greater efficiency and effectiveness.

RESEARCH METHOD

More than one style has been used to gather and obtain the requirement of the system development, these styles are:

Data Collection

The first step in developing any system is known to be data collection and analysis. Thus, to be able to develop a system, the research begins by gathering data and requirements from various environments. Therefore,

more than one procedure or instrument has been used at one time to effectively execute this process:

Quantitative Method

The SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis has been used in this study as a quantitative method to analyze both the external and internal factors of the project challenges and relying on the surrounding environments weaknesses and strengths [9]. Both a questionnaire and an interview were conducted with university staff to identify the opportunities and threats associated with information technology services on campus, leading to direct and reliable access to information from beneficiaries. A questionnaire was designed based on SWOT factors, which were modified by experts in the field of strategic planning. By using this approach, the study was able to gather comprehensive data and develop a detailed analysis of the internal and external environment of the universities.

Qualitative Method

SUS is being used to evaluate the implementation of the system with the contribution of potential users, who are working on the manual financial budget for the university, and they are intending to use the system after the completion of the testing stage. The system usability test covers users' interface (UI) presentation and also, it contains other important features such as learning, satisfaction, error rate, the persistence of users over time, and performance.

Observation

Observations have also been made inside the university campus and affected the outcomes and discussion of findings, from which some of the needed data has been collected.

SYSTEM REQUIREMENTS

For developing an effective web system, a range of software and hardware tools is required. These requirements include editors for programming languages, Cascading Style Sheet (CSS), Hypertext Markup Language (HTML), Personal Home Page (PHP), MySQL database, Bootstrap Framework, JavaScript including (jQuery, Ajax, and JSON), web and database server, and a web browser.

SYSTEM DESIGN

This section shows how the system is designed and structured. It contains diagrams to explain the modules that define the system. Moreover, includes the GUI design which describes the graphic interface of the system.

System Modules

The main factors and specifications of the system have been categorized into modules. These modules have been selected based on the system requirements, observations, and interviews with the potential users. The system modules are classified into six categories, as shown in Figure 1.

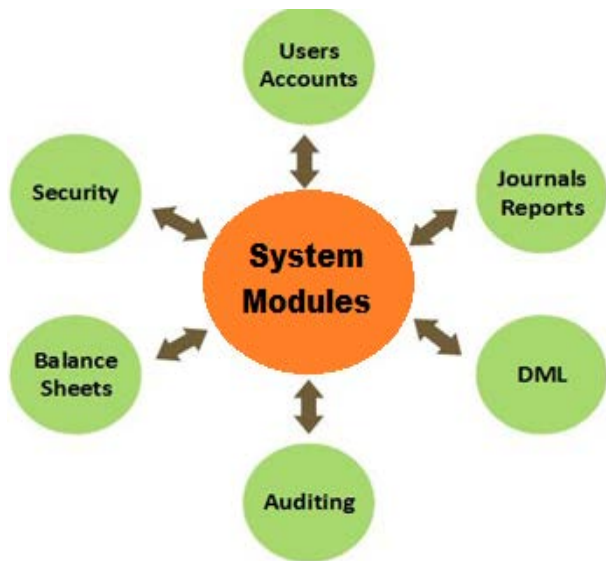


Figure 1. System Modules

Users' Accounts Module

This system is considered a dynamic system due to having the capability of inserting, updating, and removing each faculty with its accounts. Each faculty has many accounts for its users and each account has a distinct role from other accounts. The roles in the proposed system are divided into six categories: main admin, faculty admin, fund accountant, main accountant, auditor, and authorized viewer. Every user is responsible for a variety of tasks. Whereas the tasks of the users depend on their role. Also, each faculty account can have access only to the budget that belongs to his/her faculty. Each user has a profile, which contains information such as the user's name, email, faculty, role, etc. The various types of roles and their tasks and permissions in the system are as follows:

- 1) Main admin: The use case diagram is used to visualize the main admin's role such as the tasks and permissions that have as shown in Figure 2.
- The main admin is the exclusive user who has the authority for adding, editing, and removing an account, giving roles, handling permissions and accessing the settings. In addition, the main admin will have access to the faculty's budget, which belongs to his faculty, as well as to the aggregate budget of all faculties, aggregate reports, and balance sheets. Moreover, initial data can be inserted, edited, and removed only by the main admin such as categories, types, and faculties. Furthermore, the To-Do list of each user can only be added by the main admin.
- 2) Faculty Admin: every user with a faculty admin role can perform the roles of all other users of their faculty except the main admin role. such as DML operations on Journals data, auditing, viewing the dashboard, and also viewing, printing, and exporting Journals reports and balance sheets. Furthermore, they have the authority to change their personal information such as a password, email, and phone number.

- 3) Main accountant: The main accountants do not have authorization for data insertion to only the Fund Journal. while having permission to make DML operations on all other Journals, viewing the dashboard, and also viewing, printing, and exporting Journals reports and balance sheets. Moreover, the main accountants have the authority to change their personal information.
- 4) Auditor: The auditors have the permission to audit, edit personal information, viewing the dashboard, and also viewing, printing, and exporting Journals reports and balance sheets. Whereas they do not have the authorization to correct an error if exists.
- 5) Fund accountant: is only allowed to fund accountants to add, edit and delete data from Fund Journal. Furthermore, the fund accountants can edit their personal information, viewing the dashboard, and also viewing, printing, and exporting Journals reports and balance sheets.
- 6) Authorized viewer: The authorized viewers have the authority for viewing, printing, and exporting Journals reports and balance sheets as well as viewing the dashboard. Furthermore, they have the authority to change their personal information like phone number, email, picture, and password.

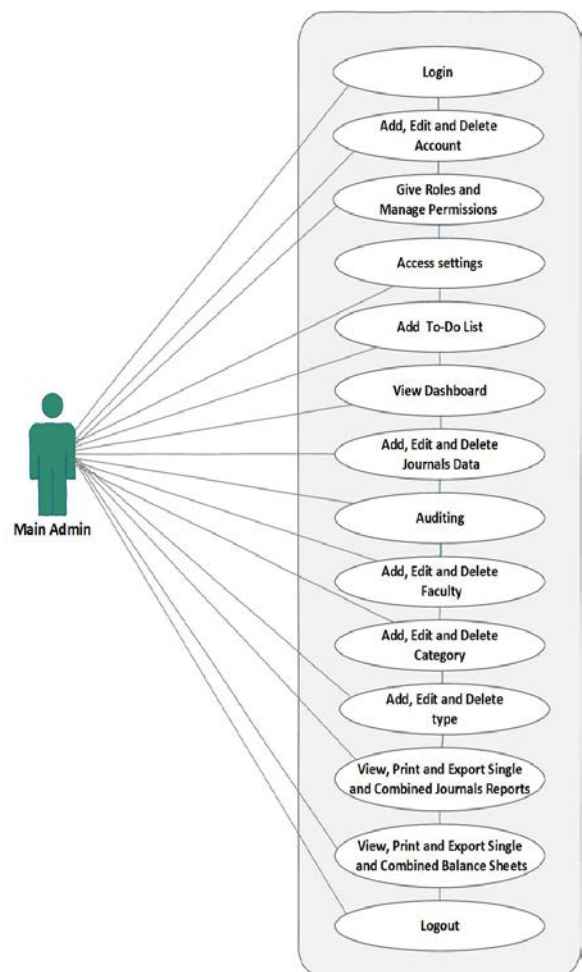


Figure 2. The Use Case Diagram of The Main Admin

Journals Reports Module

One of the most critical aspects of the system is the creation of reports from the Journals. There are five Journals in the system namely General, Deposit, Fund, Expense, and Income, and each of these Journals has a report. The production of all reports is automatic. Also, the system interacts with three different types of Bonds, these bonds are Expense, Receipt, and Transfer. Each bond's data must be inserted to the General Journal first because the General Journal is considered the main Journal in the system, while the insertion of data to the other Journals depends on the contents of the Bonds, for instance, Expense Bond's data can be inserted to both General and Expense Journals or in addition to the previous Journals, can be added to the third Journal such as Deposit Journal. The Journal contains two accounts for Transactions which are credit and debit, as well as Statistical data, for any Transaction, credits and debits totals must be equal and always in balance. When there is no balance in a Transaction, it will not be possible to establish financial statements. Reports display the Transactions that have been added to Journals according to the month that has been chosen as shown in Figure 3, Furthermore, all reports have the functionality of printing and exporting to Excel sheets.

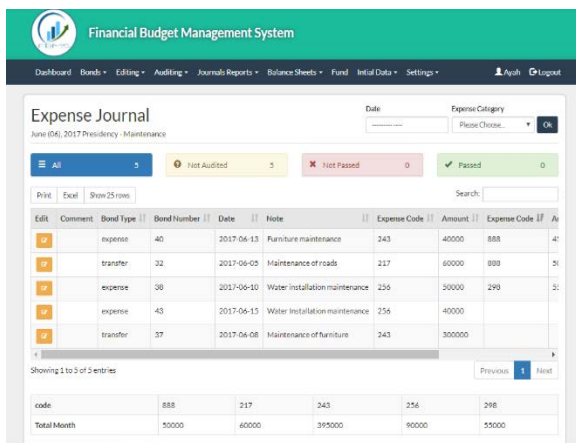


Figure 3. The Report of The Expense Journal

Data Manipulation Language (DML) Module

The DML operations include insert, update, and deleting, these operations are implemented in the system on all Journals, initial data, and user's personal information. After each DML operation, a notification message will appear to inform the user of the success of the operation or the failure of the operation if an error happened during the operation execution.

- i. DML operations on Journals: Each Transaction's debit and credit amounts can be inserted, modified, and deleted as well as DML operations can be performed on the data of all Journals. There is the risk of having errors and the occurrence of interruption during the insertion period since the system contains several Journals and the insertion to all these Journals is carried out on a single page. MySQL Transactions were used in the system to

prevent such errors as it makes all manipulation operations a group of sequential operations. The Transactions will be completed when all operations of the sequential group are successfully executed. The whole Transaction will fail in case the failure occurs in any operation within the Transaction. In case the Transaction is successfully completed, the "COMMIT" command will be issued to apply modifications to all the tables referenced in that specific Transaction. If a failure happens, a 'ROLLBACK' command will be issued to restore the prior state of each table referenced in the transaction.

- ii. DML on initial data: The system is capable of inserting, modifying, and deleting users, categories, types, and faculties.
- iii. DML on users' personal information: DML operations can be performed by the users on some of their personal information such as password, phone number, and email.

Auditing Module

The audit is quite important to ensure that the Journals and balance sheets are correct and without mistakes. The identification and prevention of errors are highly necessary to ensure the efficiency and quality of the records. The auditor has permission to audit the data, but not to alter it. After the insertions of Journals, the auditing process begins by the auditor. The auditing page is shown in Figure 4, which consists of the statistical part and the records auditing part. The statistical part gives statistics about the number of records in the page, the number of records not been audited, the number of records that contain errors, and the number of records without errors. The records auditing part contains the records and each record have three checkboxes; if the record is without mistakes the "✓" checkbox will be clicked, if an error exists the "✗" checkbox will be clicked, while the "N/A" checkbox is automatically checked when the record is not audit yet.

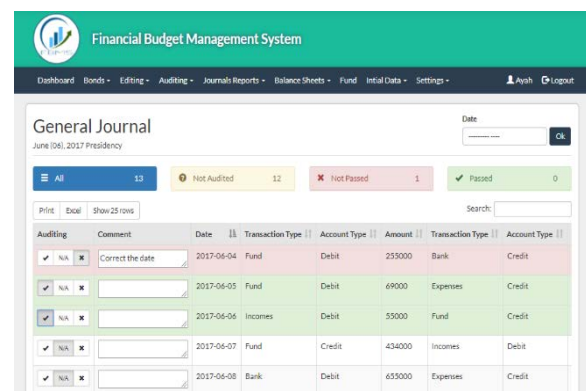


Figure 4. The Auditing Page of General Journal

In case an error exists, the accountants will fix it, so the balance sheets can be generated. The process of auditing is shown in Figure 5.

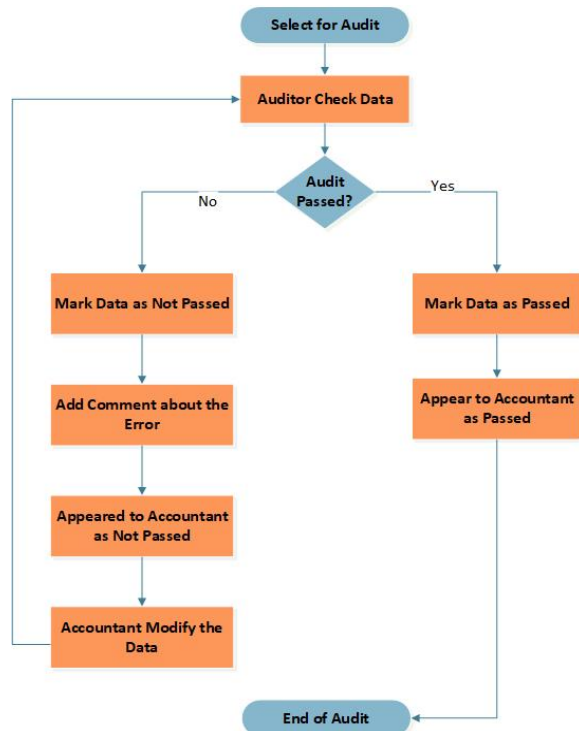


Figure 5. The Auditing Flowchart

Balance Sheets Module

Balance sheets are financial documents that identify the amount of money circulating in each Transaction on a specific date. Also, Balance sheets contain summarized information about Transactions as well as includes debit and credit accounts which are automatically generated. To attain a final value, all Transactions need to be calculated. It is possible to merge the balance sheets of all faculties. Besides, these sheets are printable and can be converted to an Excel file. After the auditing process is completed, the balance sheets will

be generated, which consists of seven types, such as Transactions, Expense categories, Expense types, Deposits, Incomes, Imprest, and Fund balance sheet. The general balance sheet in the system is the Transaction balance sheet that contains the total of debit and credit accounts of all Transactions in the system. A variety of different calculations exist for each sheet. The steps of the calculation processes of balance sheets are shown in Figure 6.

Security Module

The security of the data in this system has been taken into consideration by applying many security features to the system such as data protection and data encryption. The encryption of the users' passwords is a crucial security step that must be taken in creating any new system that requires users' passwords [10]. If an attack happened to the systems' database, the data of the system including passwords can be easily stolen if they are not encrypted, due to that, in this system, sensitive data are encrypted using Bcrypt encryption. Bcrypt encryption is an algorithm for hashing passwords that are based on the Blowfish cipher algorithm [11]. This algorithm prevents passwords from being stored in plain text. Rather it hashes the passwords and only saves the hashed one, this avoids the attacker from directly accessing the real passwords.

In terms of security and privacy, each faculty has its budget independently from other faculties and each one of these faculties has several accounts for its users, each of these accounts can only access the budget of the faculty that belongs to. Also, every user's account has permission to only access the information related to the account's role. Moreover, the system prevents the use of the "Get" method for protection purposes, which transfers the data via URL and exposes the URL data.

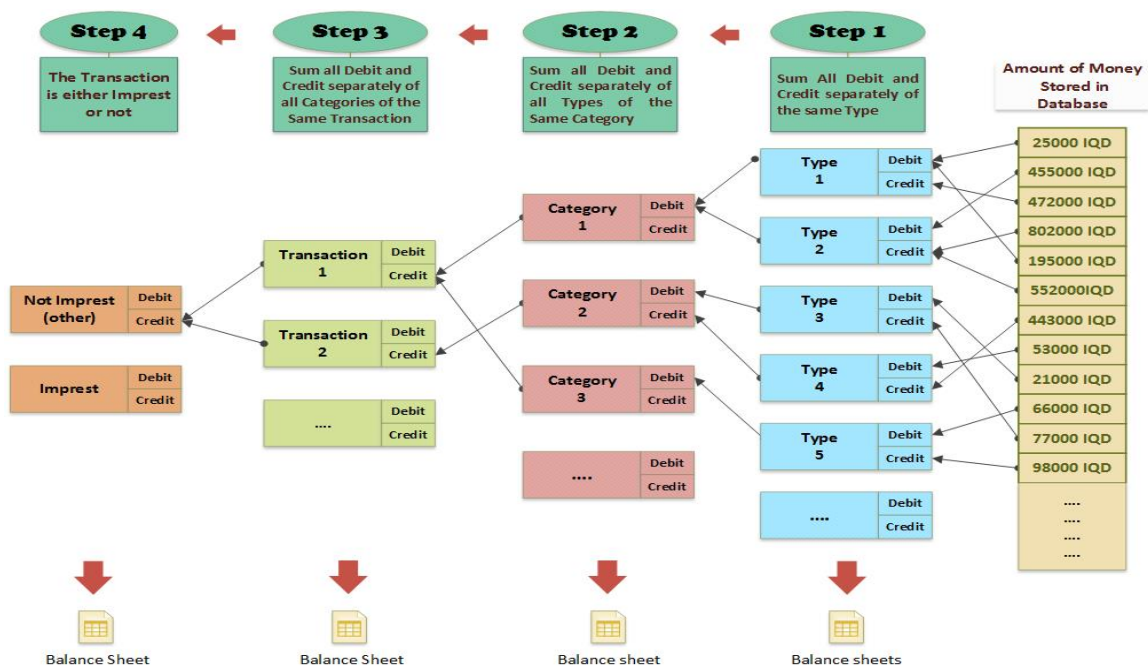


Figure 6. The Balance Sheets Calculation Process

Graphical User Interface (GUI) Design

The graphical user interface GUI of the system is both user-friendly and easy to use. For all types of users' accounts, the GUI consists of two separate sections, dashboard and menu bar, as shown in Figure 7. The dashboard is a very effective way to monitor data from multiple sources because it provides real-time data and combines important information in one single location for the users. All the users based on their roles have different menu bars contents from each other.

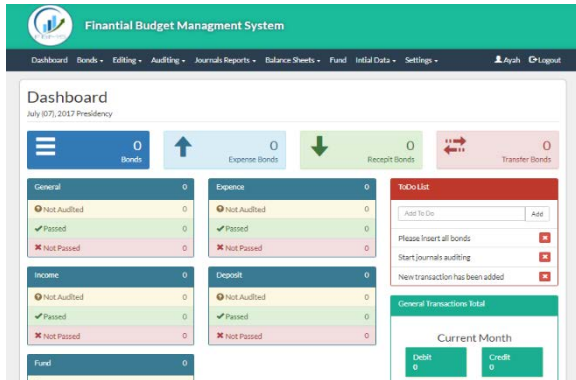


Figure 7. GUI Design

In terms of web pages design, this system has followed the Responsive Web Design (RWD) technique, this technique by its role adjusts the layout of the pages based on the screen size and orientation of the user's device [12], due to this the system becomes more user friendly and easily readable, as seen in Figure 8.

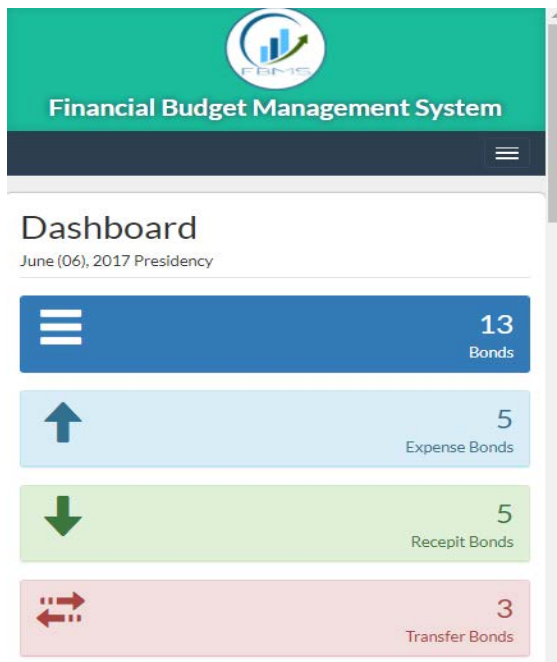


Figure 8. Responsive Web Design

SYSTEM USABILITY TESTING

It is critical to determine what is the usability test means here? It means tracking a user's actions while

dealing with the system and evaluating the usability of the system [13].

The usability test covers users' interface presentation and tells users how to communicate with the system. Also, it contains other important features such as learning, satisfaction, error rate, the persistence of users over time, and performance [14]. The general usability process for developing a system with the degree of usability needed will be presented here. This process is implemented with a small variance by most usability practitioners, is based around a concept evaluate-redesign loop. By analyzing the intended users and the activities that users conduct, practitioners start the procedure.

SUS was designed to objectively assess the system's performance, efficacy, and satisfaction as a quantitative tool. The SUS consists of ten items, favorably formulating the odd-numbered items and negatively formulating the even-numbered items [15]. The system is tested by the contribution of (24) potential users, the results of the system testing were analyzed as in Table 1 and Table 2.

Table 1. SUS Score by The Participants

Participant	SUS Score	Participant	SUS Score
1	87%	13	72.5%
2	82.5%	14	95%
3	75%	15	92.5%
4	87.5%	16	90%
5	82.5%	17	95%
6	95%	18	92.5%
7	72.5%	19	100%
8	100%	20	85%
9	95%	21	87.5%
10	72.5%	22	100%
11	95%	23	100%
12	100%	24	100%
SUS Total Score		86.250%	

Table 2. SUS Questionnaires

#	Questions	Strongly Disagree	Strongly Agree
1	I would like to make frequent use of the system		24
2	I have found the system unnecessarily complicated	22	2
3	The system was simple to use		24
4	To be able to use the system, I will require assistance	19	5
5	The different functions are quite well integrated		24
6	There's so much inconsistency in the system	21	3
7	Many individuals will know to use this system very rapidly		24
8	This system is very cumbersome and requires to be used with considerable effort	22	2
9	I felt very comfortable using this system	3	21
10	Before I could get going with this system, I needed to learn many things	18	6

The smallest SUS score is (72.5), whereas the highest score is (100), as seen in Table I. The overall SUS score is thus (86.250%), meaning that the system is generally accepted as a (70%) acceptable ratio in compliance with the rules of the SUS tool. Depending on

the user's degree of acceptance, each of the above 10 template questions has been graded from (1 to 5). The score was calculated according to the following:

- Subtract 1 out of the score for every odd-numbered question.
- Subtract their value from 5 for every even-numbered question.
- Take the new values and add the overall score, then multiply it by 2.5.

According to the potential users involved in the sus assessment, the system is user-friendly and easy to use and provides a complementary connection between the management of financial units, which makes the financial budget processes much easier and faster. The result of the SUS showed that the system satisfies all the user's requirements with (86.250%) total satisfaction.

CONCLUSION

The findings of the study have shown that there is an urgent need for an electronic financial budget system in all understudy universities. The system is built to protect and promote users' privacy by allowing users to view only pages and data belonging to their functions and units. Moreover, the sensitive data are encrypted to enhance data protection so the attackers cannot access sensitive data directly. The budget of all units in some understudy universities has been created in the university presidency, whereas in other universities, all units produce their budget independently, after that the university presidency unifies the budget of all these units into a united one. The proposed system is built to be very flexible, which accepts both cases and has the functionality of adding new units. Furthermore, it generates the balance sheets and reports automatically and without mistakes due to the electronic auditing process and making all the required calculation processes automatically. The result of the SUS assessment showed that the total satisfaction was (86.250%), which means that the system is user-friendly and easy to use and satisfies all the user's requirements.

REFERENCES

- [1] M. I. Alnajjar, "Impact of accounting information system on organizational performance: A study of SMEs in the UAE," *Global Review Of Accounting And Finance*, vol. 8, no. 2, pp. 20-38, 2017.
- [2] A. Trigo, F. Belfo, and R. P. Estébanez, "Accounting Information Systems: evolving towards a business process oriented accounting," *Procedia Computer Science*, vol. 100, pp. 987-994, 2016.
- [3] K. I. Dandago and A. S. Rufai, "Information Technology and Accounting Information System in the Nigerian Banking Industry," *Asian Economic and Financial Review*, vol. 4, no. 5, 2014.
- [4] F. P. C. Lim, "Impact of Information Technology on Accounting Systems," *Journal of Multimedia Services Convergent with Art, Humanities, and Sociology*, vol. 3, no. 2, 2013.
- [5] X. Song, "College Financial Management System Research and Design," in *2015 4th International Conference on Sensors, Measurement and Intelligent Materials*, 2016: Atlantis Press, pp. 318-321.
- [6] C. Zhijun, "Analysis and Design of the B/S based Dynamic Management System for the Budgets of University Scientific Research Projects."
- [7] J. N. Capucao, T. Palaoag, and S. Sierra, "Web-based System for State Universities and Colleges Budget Office Management," in *IOP Conference Series: Materials Science and Engineering*, 2020, vol. 803, no. 1: IOP Publishing, p. 012009.
- [8] A. Kurniawan, L. Nurlaela, N. Indahwati, L. Bhilawa, and D. A. Dermawan, "Development of a Web-Based Financial Information System for Independent Educational Accreditation Institutions," in *International Joint Conference on Science and Engineering 2021 (IJCSE 2021)*, 2021: Atlantis Press, pp. 745-749.
- [9] K. Zima, E. Plebankiewicz, and D. Wieczorek, "A SWOT analysis of the use of BIM technology in the polish construction industry," *Buildings*, vol. 10, no. 1, p. 16, 2020.
- [10] K. Jacksi, F. Ibrahim, and S. Zebari, "Student attendance management system," *Sch. J. Eng. Technol. SJET*, vol. 6, no. 2, pp. 49-53, 2018.
- [11] N. Provos and D. Mazières, "A Future-Adaptable Password Scheme," presented at the Proceedings of the FREENIX Track: USENIX Annual Technical Conference, Monterey, California, USA, 2009.
- [12] M. Y. Putra, "Responsive Web Design Menggunakan Bootstrap Dalam Merancang Layout Website," *INFORMATION SYSTEM FOR EDUCATORS AND PROFESSIONALS: Journal of Information System*, vol. 5, no. 1, pp. 61-70, 2020.
- [13] J. R. Lewis, "The system usability scale: past, present, and future," *International Journal of Human-Computer Interaction*, vol. 34, no. 7, pp. 577-590, 2018.
- [14] S. Q. Sabri, A. M. Ahmad, and M. B. Abdulrazaq, "Design and Implementation of Student and Alumni Web Portal," *Science Journal of University of Zakho*, vol. 5, no. 3, pp. 272-277, 2017.
- [15] R. A. Grier, A. Bangor, P. Kortum, and S. C. Peres, "The system usability scale: Beyond standard usability testing," in *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 2013, vol. 57, no. 1: SAGE Publications Sage CA: Los Angeles, CA, pp. 187-191.