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# Web-based payroll management system: design, implementation, and evaluation

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## Abstract

The management of employees' salaries is an extremely complex task and time-consuming job due to having a large volume of payroll data and calculations. In many developing regions and countries including the Kurdistan Region of Iraq, the accounting processes of salary are manual. This leads to low speed in the calculation processes of deductions and allowances, easy making errors, difficulty to maintain salaries of previous months, low efficiency, and delay in generating reports. This paper represents the design, implementation, and evaluation of a web-based payroll management system (WPMS). This system can calculate the salary of every employee per month and annum efficiently and effectively. Moreover, it can keep the records of employees' data including their pay, allowances, and deductions on monthly bases in the data mart. Additionally, the system can speedily and automatically generate employees' payslips, accurate reports, and detailed statistics. Furthermore, WPMS provides a user-friendly environment and enables users to easily access, update, and delete data. The system was implemented by using programming languages: HTML, PHP, JavaScript, jQuery, AJAX, and MySQL. To conclude, the system was investigated for its usability by using the system usability scale tool. The results achieved an 87.8% score of usability satisfaction.

**Keywords:** WPMS, SUS, SWOT, RWD, Payslip

## Introduction

The volume of information in organizations has been continuously expanding in recent years, in several ways, it has become more critical for the development and growth of these organizations. Furthermore, this information assists in the successful and professional management of organizations. Therefore, organizations should modernize and operate in parallel with technological advancements [1]. Achieving this goal is essential to adapt to new development and competition in today's business environment. Consequently, organizations invest a lot of money in developing an information system that supports their growth. As a result, organizations will be able to perform more efficiently and effectively with this investment since information can be transferred seamlessly throughout organizations or departments inside the organization [2]. Having a good electronic information system can help with this procedure. The university is one of the most important organizations that should cope with the developments. There are multiple faculties in each university, and each faculty has multiple management units. One

of these units is the payroll unit, which is responsible for managing payroll activities. Data gathering, input, modifications, monitoring, and reporting are all operations that must be performed by the payroll units in each faculty. By using this payroll system, the payroll unit could preserve all payroll records, including personal data and any modifications. Through interviews with payroll employees, it has been noticed that a lot of faculties continue to rely on paperwork and records, which have become conventional methods for managing all payroll activities. These conventional methods have various disadvantages, including time-consuming information transfer to linked units. Moreover, paper records are 'non-value added' operations. Accordingly, conventional payroll systems are inefficient; they do not meet the needs of beneficiaries, and the information delivered is of poor quality.

Numerous studies have been conducted exploring various aspects of payroll systems and utilizing diverse techniques. Singh et al. [3] presented a study titled "automated payroll system (A-PAY)," aimed to digitize the payroll process for faculty members, including the management of their personnel information and the calculation of allowances and deductions. The study utilized Vb.net as the front end and Microsoft Access 2007 with SQL Server 2008 as the back end. The result was a more efficient system with options for data backup and restoration, improved security, reduced calculation errors, and automatic report generation. Hikmah and Muqorobin [4] developed an employee payroll information system for Consulting Engineering Services company. They aimed to eliminate the challenges of manual payroll calculation. They conducted research through observation, interviews, documentation, and literature review, and used PHP and a MySQL database to build the system. The design improved payroll management and provided faster and easier retrieval of employee payroll information, leading to improved administrative processing efficiency. In the study conducted by Lu et al. [5], a comprehensive approach to the design and implementation of a three-tier salary management system for higher vocational colleges was presented. The existing system was found to be complex and time-consuming, leading the researchers to aim for a more efficient and accurate computerized payroll system. The research process involved analyzing the current status, needs, and requirements, and implementing the design using ASP.NET. The results indicated that the study's objectives were successfully achieved, as the developed system was efficient, time-saving, and enabled the organization to manage payroll effectively. Winanda et al. [6] presented a study titled "salary information system." The authors identified inefficiencies in the manual salary calculation system at Tiara Handicraft Enterprise, including high labor requirements and inadequate communication between departments, leading to limited data validity. The objective of their research was to design and implement a new system that addressed these issues. The results indicated that the new automated system was capable of more efficiently and effectively calculating salary data.

In another study, Efendi [7] presented research on the implementation of the Civil Servant Salary SIM system in the Administrative Service Office of the Education Unit in Grogol District, Sukoharjo Regency. The author utilized a combination of interviews, application observation, and literature review to assess the efficiency and effectiveness of the computerized payroll management system. The system was developed using the online-offline model, with the PHP programming language and functional components such as administration

and operations, management reporting, databases, search, and data management. The results showed that the application provided a more efficient, accurate, and effective solution compared to previous manual methods, allowing for the calculation and updating of salary data online, and implementing security measures through user authentication. In a recent contribution to the field, Rumatna et al. [8] aimed to design a payroll information system for the Sorong Islands District office. The Waterfall method was used as the development model and it consisted of 5 stages: requirements definition, system and software design, implementation and unit testing, integration and system testing, and operation and maintenance. The study was carried out by collecting data through direct interviews with 4 resource persons and by using various tools such as Unified Modeling Language, Macromedia Dreamweaver CS 6, and XAMPP. The system was tested using the Black Box Testing technique. The results showed that the payroll information system met the requirements of the Sorong Islands District office and was able to process employee salary data efficiently.

Our proposed system is distinct from prior works in terms of electronic auditing, making the audit process more efficient. Its flexible design makes it suitable for all types of organizations, as new units, allowances, and deductions can be easily added without modifying the code. The system calculates salary differentials for all months, taking into account delays in administrative orders for bonuses, salary increases, and promotions. It also has a responsive web design that adjusts the layout based on the visitor's screen size and orientation.

### **Research method**

More than one style has been used in this system to gather and obtain the requirements. These styles are:

#### **Data collection**

The first phases in system design are data collecting and analysis. Therefore, the design of WPMS started with gathering data and requirements from different environments. This procedure has been conducted using multiple styles and tools, as follows:

1. Quantitative method: For evaluating the system implementation, the system usability scale (SUS) has been used as a quantitative method. Furthermore, some of the essential data were obtained directly through observations.
2. Qualitative method: The SWOT (strengths, weaknesses, opportunities, and threats) technique is used as a qualitative method to determine the system requirements by a detailed analysis of the understudy university's internal and external environments. A questionnaire and an interview were utilized for this purpose. A questionnaire has been developed based on SWOT factors and reviewed by a group of strategic planning specialists and academicians. Resulting in accurate and direct access to the essential information.

#### **Observation**

Observations were also made on the university campus, several of the essential data were gathered directly through this method, which influenced the conclusions and discussion of the results.

### **System requirements**

There is some essential requirement that must be considered to design and build a reliable, efficient, and scalable system as functional requirements, which particularly define system functionalities, behavior, and goals, as follows:

- Make all salary calculation processes automated.
- Inserting new faculties, accounts, and employees.
- Managing permissions and roles.
- Payslips and reports creation.
- Performing audits and fixing errors if they exist.
- Inserting new allowances and deductions.
- Keeping the previous month's salary.
- Retrieving the previous month's salary.
- Keeping employees' personal information.

Additionally, the hardware and software tools that are required to develop and implement the proposed system are:

- Hypertext Markup Language (HTML)
- Cascading Style Sheet (CSS)
- JavaScript including (jQuery, Ajax, and JSON)
- Personal Home Page (PHP)
- MySQL
- Bootstrap framework
- Server side: Web (PHP supported) server and database server.
- Client side: Computing device to run a web browser.

### **System design**

This section describes the system's design by categorizing the main factors and specifications of the system into modules. The system modules are classified into nine categories, as shown in Fig. 1.

#### **Users' accounts module**

There are several accounts for each faculty and each account does have a certain role. Each faculty has five different kinds of roles which are faculty admin, accountant, authorized viewer, auditor, and employee. However, there is only one main admin role for each university, which controls the accounts of all faculties. The system is designed to be a dynamic system that is intended to assist the main admin in the addition, updating, and deletion of faculties and their associated accounts on the system. The role of the main admin is the only role that can grant, delete, and change permissions of other users as well as access the aggregated salary reports of all faculties, whereas all other accounts may only see the salaries information of their faculty. Moreover, they are also limited to doing activities that are specifically assigned to them based on their role, such as the



**Fig. 1** System modules

auditor is in charge of auditing; if an error exists, the auditor will not have the authority to modify it, while the accountant has the authority for inputting, removing, and modifying the data on payslips. Figure 2 shows the flowchart of the system accounts roles.

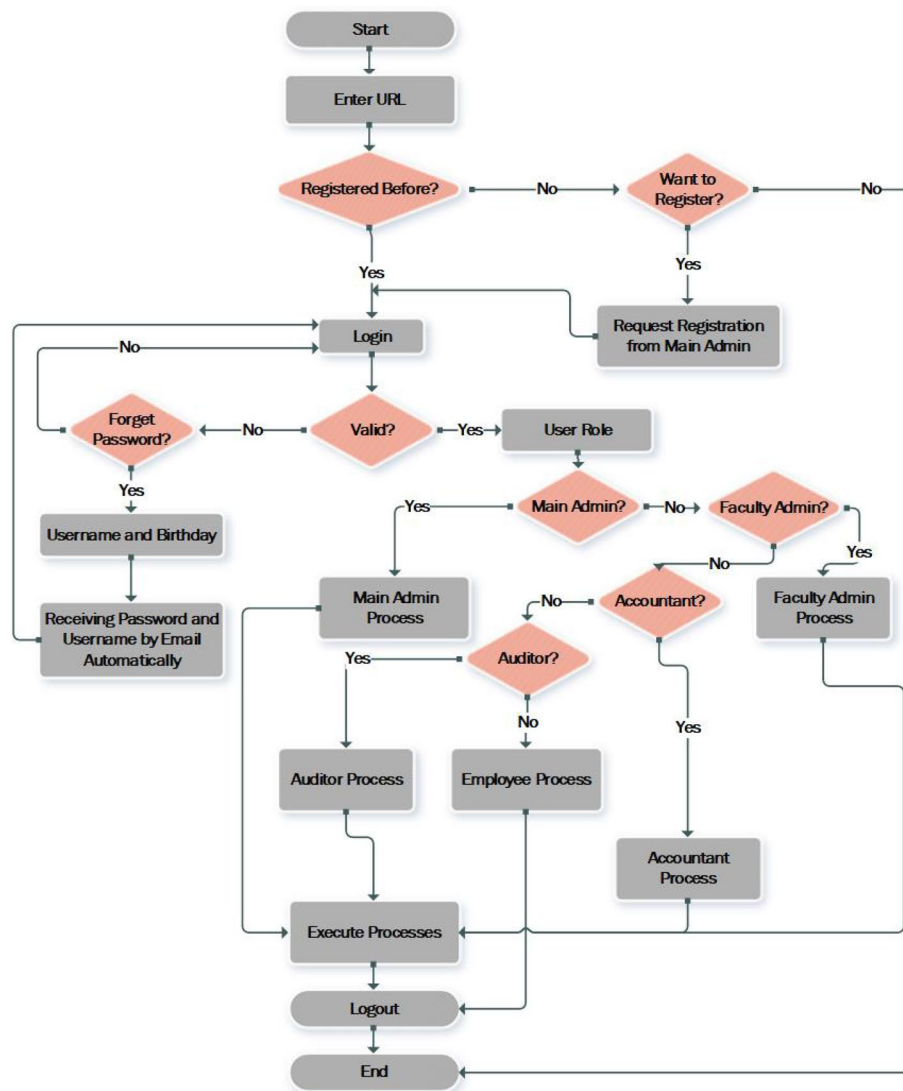
Regardless of a user's role, they all have their profiles, which include their name, faculty, email, etc. Additionally, all users may communicate with each other by sending and receiving messages, while the notification messages can only be sent by the main admin, which is either sent to all admins or employees. The processes of activities and responsibilities of all roles are shown in Fig. 3.

#### **Data manipulation language (DML) module**

The operations (insert, update, and delete) of the data manipulation language (DML) are performed on three sections of the system. After each DML, a notification pops up to inform the user if the operation was successful or if an error occurred. These sections are as follows:

1. DML on payslips: The system can input, modify, and delete employees' salaries, as well as their deductions and allowances. During the execution process, there is a chance of interruptions and errors due to having many allowances and deductions for each employee. MySQL Transactions were utilized to overcome this issue, by grouping all data manipulation operations together sequentially. For a transaction to be completed, all operations within the group must be completed successfully. Otherwise, the whole transaction will fail.

For MySQL Transactions, the keywords "COMMIT" and "ROLLBACK" are used. Whenever a Transaction is finished successfully, the "COMMIT" command is used to apply the modifications to all tables involved. When a failure happens, a "ROLLBACK" command will be sent, which will restore the prior state of all tables referenced in the Transaction.



**Fig. 2** Users' accounts roles flowchart

2. DML on initial data: New users, deductions, allowances, and faculties may all be added, modified, and deleted at any time, making this a dynamic system, as shown in the employees' page in Fig. 4 and the allowances page in Fig. 5. There are some allowances all employees have, so when an employee's salary is added, these allowances are automatically added without the user having to select them.
3. DML on users' personal information: Some of the user's personal information, such as email, password, etc. can be added, updated, and deleted.

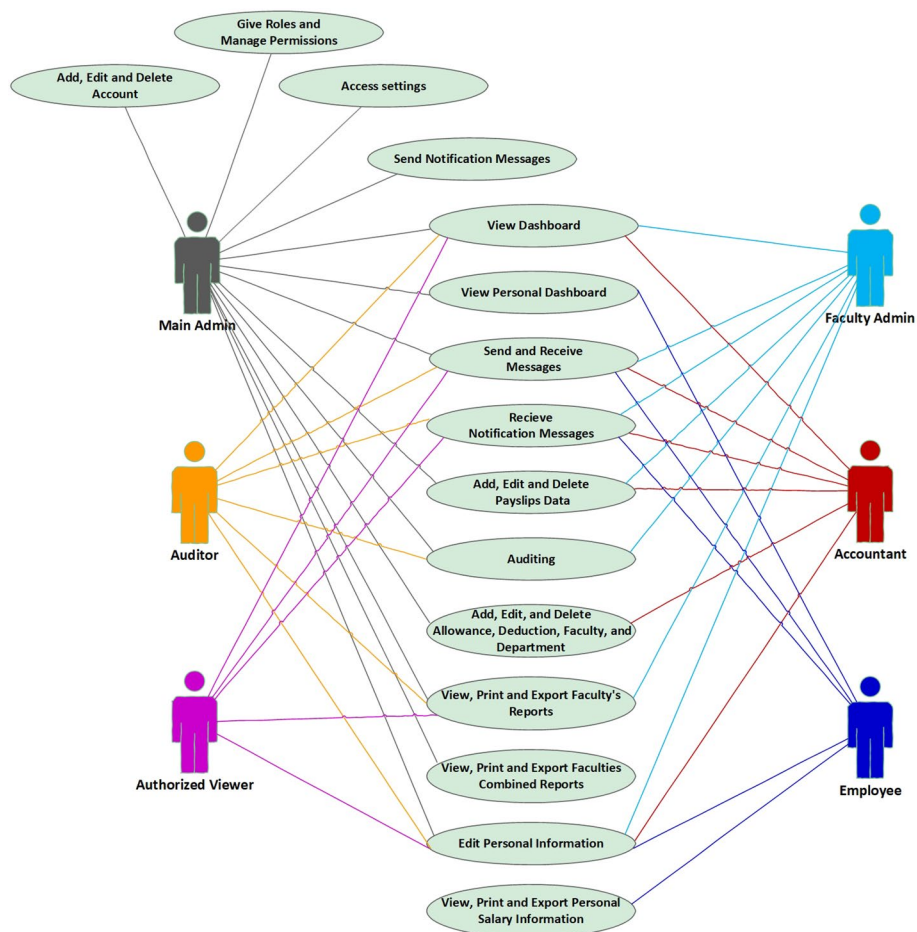


Fig. 3 Users' roles use case diagram

ID	Name	DOB	Gender	Faculty	Department	Employment Date	Document	Email	Phone	Username	Action
1	Chira hadheef Mohammad	1989-02-08	Male	Faculty of Science	Computer Science	2016-06-16		test@test.com	121212	chira	
2	Ayah Mohammed Ahmed	2013-03-06	Female	Faculty of Science	Computer Science	2016-07-13		test@test.com	112233	ayah	
3	Shan Chira Hadheef	2016-07-28	Female	Faculty of Science	Biology	2017-10-12		test@test.com	112233	shan	
4	Srood Hadheef Mohammad	2008-02-07	Male	Faculty of Science	Chemistry	2017-08-15		test@test.com	112233	srood	
5	Saman Hadheef Mohammad	2012-06-05	Male	Faculty of Science	Computer Science	2017-05-19		test@test.com	112233	saman	

Fig. 4 Employees page

### Employee portal module

In the system, the employee portal functions as payroll and human resource extension. Employees that log into their employee portal page will only view information relevant to them and their department. The main page of the employee portal has a distinct user interface than the main page of another user, and also a distinct menu bar. Employees can get up-to-date and precise data and news through the portal. Employees may view their current month's salary as well as prior salaries.

The screenshot displays the 'Allowance Types' management interface. On the left is a blue sidebar with the 'Payroll Management System' logo and a navigation menu. The main content area features a title 'Allowance Types', a '+ Add New Allowance Type' button, and a table listing existing allowance types. The table has columns for ID, Allowance Name, Is Percentage, Description, and Action. Below the table are pagination controls showing 'Showing 1 to 4 of 4 entries' and 'Previous 1 Next'.

ID	Allowance Name	Is Percentage	Description	Action
1	Degree	Yes	It is acceptable for all employees	[Delete] [Edit]
2	Encourage	No	For all academic staff in university	[Delete] [Edit]
4	University Service	Yes		[Delete] [Edit]
5	Risk	Yes		[Delete] [Edit]

**Fig. 5** Allowances page

### Statistics module

The system includes numerous statistics, which can be found on the dashboard and reports. When there is a change or update in the system's data, these statistics are automatically updated accordingly. The statistics are shown to users based on their role and permissions as well as which faculty they are from, while the university's overall statistics are available to the main admin only. Some statistics include the total of all existing staff and separate them based on their role either academic or administrative, as well as differentiate the academic staff based on their degrees.

The other statistics are displayed in graphics and charts. In general, they represent the total of all salaries, net salaries, as well as the amount saved and received by every employee for each month separately or the entire year, as well as each employee, has its own separate statistics that are displayed on his dashboard. Moreover, the monthly total of each allowance of all staff and the auditing results have their own statistics.

### Payslips module

Every employee has a payslip, which contains information about their salaries, such as basic salary, receiving salary, ranking, grade, as well as all of their allowances and deductions. Each content of an employee's payslip can be modified and added to, as well as removed from the system. The Payslip page is shown in Fig. 6.

### Data mart module

Typically, a data mart comprises historical data obtained from transaction data. In this system, the data mart serves as an archive. A data mart is not updated regularly. The system stores all months' salaries in the data mart since need to compare each month's salaries to the prior months' salaries, and the percentage of variance is stored in the variance report. Moreover, the accountant will not need to insert all of the



**Payslips**  
Faculty of Science - May (06), 2022

Search By:  Name  Bank Account

Navigation: First, Previous, Next, Last

**Employee Details:**  
 ID: 1, Full Name: Chira Nadheef Mohammed  
 Grade: 1, Rank: 1, Basic Salary: 1300000  
 Retirement: 91000, Tax: 10450, Date: May 2022  
 Document: Choose File (No file chosen), Comment:

**Bank Account:** 100201, Title: Asslist. Lecturer  
**Degree:** Master, **Department:** Computer Science

**Allowances:**

Allowance Type	%	Allowance	Amount
Degree	100	1300000	1300000
University Service	75	975000	975000
Encourage	300000	300000	300000

All Allowances: 2575000

**Total:** 3875000  
**Total Deductions:** 104450  
**Net Salary:** 3770550  
**Saving:** 22984  
**Receiving:** 206856

**Note:** Basic salary increased due to Rank increase

Buttons: + Add Allowance, + Add Deduction, Save

**Fig. 6** Payslips page

employees' payslips content for each month, nevertheless, the prior salary will exist, and the accountant will only edit the information that has changed as the month date. In addition, through the data mart, all employees can view their salaries in the previous months.

### Auditing module

Performing an audit is crucial to ensuring that the quality of information and the reliability of reports are high. The auditing procedure is carried out by the auditor. All payroll reports are audited by the auditor to ensure that they are accurate, timely, and dependable. The auditor has not the authority to fix any errors that may occur but does have the authority to identify the error and leave a note for the accountant to correct it. Figure 7 shows the auditing process.

The auditing page is shown in Fig. 8. When it loads, all of the "N/A" sign buttons are automatically selected, indicating that the row is not yet been audited. If the record is free from mistakes, the auditor must press the "✓" sign button. If there is a mistake in the record, the "✗" sign button must be pressed.

### Reports module

This system contains many reports. The WPMS's report generation is one of its most important features, and it is worth noting that all reports are generated automatically. There are eight categories of reports: comparative balance sheet report, payslips report, payslips variance report, bank report, old payslips report, employee payslips report shown in Fig. 9, allowances report, and deductions report. These reports can be viewed by all users except the account that have the employee's role, and they can also be printed and exported to Excel.

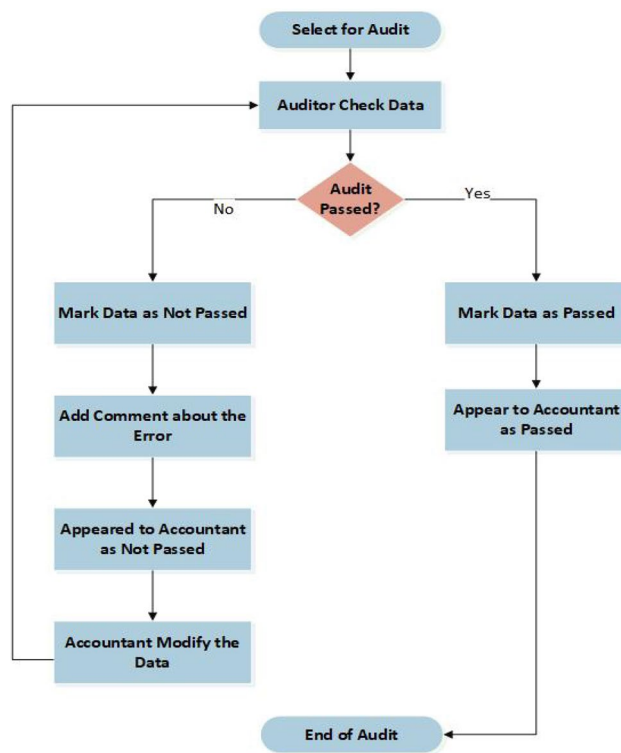


Fig. 7 Auditing flowchart

**Payslip Report - Auditing**  
 Faculty of Science - May (05), 2022

All 6
Not Audited 2
Not Passed 2
Passed 1

Print Excel Show 25 rows Column visibility Search:

#	Auditing	Comment	Full Name	Title	Grade	Rank	Basic Salary	Degree	Encourage	University Service	Risk	Total
1	<input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/>	Add Attachments	Chira Nadheef Mohammed	Assist. Lecturer	1	1	1300000	1300000	300000	975000	0	3875000
2	<input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/>		Ayah Mohammed Ahmed	Assist. Lecturer	1	2	500000	375000	0	375000	190000	1400000
3	<input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/>	Error in Risk Allowance	Shan Chira Nadheef	Assist. Researcher	2	3	100000	45000	0	75000	0	100000
4	<input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/>		Srood Nadheef Mohammed	Programmer	2	2	200000	90000	0	150000	80000	500000
5	<input checked="" type="checkbox"/> N/A <input checked="" type="checkbox"/>		Saman Nadheef Mohammed	Assist. Researcher	2	3	50000	22500	0	37500	0	110000

Showing 1 to 5 of 5 entries Previous 1 Next Save

Fig. 8 Auditing page

### Security module

With the widespread transmission of information via the World Wide Web, security concerns have risen to the fore. The security of salary information is critical. The system's users' passwords are encrypted. Password encryption is one of the most basic security requirements for any program that accepts user passwords. In this system Bcrypt password encryption has been used, which hashes the passwords based on the Blowfish block cipher algorithm and saves only the hashed passwords [9]. Bcrypt is also an adaptive function, so the number of iterations can be increased over time to

Months	Allowances					Total	Deductions				Total Deductions	Net Salary
	Basic Salary	Degree	Encourage	University Service	Risk		Center	Marriage Advance	Retirement	Tax		
January	1300000	975000	200000	1300000	0	3775000	5000	60000	91000	10450	166450	3608550
February	1300000	975000	200000	1300000	0	3775000	5000	60000	91000	10450	166450	3608550
March	1300000	975000	200000	1300000	0	3775000	5000	60000	91000	10450	166450	3608550
April	1300000	585000	200000	975000	0	3060000	5000	60000	91000	10450	101450	2958550

**Fig. 9** Employee's payslip report

make it slower, making it resistant to brute-force search attempts even as computing power increases [10].

For user authentication, the WPMS utilizes the “Session” object, which enables each user for accessing only the data regarding their faculty. Additionally, it allows users to access only the information that is relevant to their role. Furthermore, for security reasons, the “Get” method is avoided by the system, which makes the data be sent via URL parameters and displayed in the address bar of the web browser.

### Graphical user interface (GUI) design

Users can interact by using graphical icons and visual indicators with the graphical user interface (GUI) [11]. WPMS's graphical user interface (GUI) is user-friendly and easy to use. As shown in Fig. 10, the user's main page's GUI consists of two primary parts: a menu bar and a dashboard. The menu bar is developed to let the user quickly navigate to the needed pages as it's a drop-down menu and can be slid In and Out. Furthermore, each user's menu bar is distinct from that of other users, as the content of the menu bar appears according to the user's role. The dashboard displays the most necessary information in a visual representation, which is collected and arranged on a single screen for monitoring. Moreover, if a change is made in the system, the dashboard's displayed data is automatically updated.

In this system, the responsive web design (RWD) method is applied. It is a method in web design that allows designing pages that are optimized for different types of devices [12]. As shown in Fig. 11, which allows the information to be shown in the best possible way for the given screen size.

### Compatibility testing

Compatibility testing is a type of testing for making sure that all system's functions are effectively running on various platforms, the proposed system has been tested accordingly, which proved that the system is working effectively. Table 1 displays the system's compatibility testing results.



Fig. 10 The user interface of WPMS

### System usability testing

Usability refers to a system’s capacity to be easily utilized to achieve a given purpose [13]. This is a feature that measures how easy the user interface is to use in web applications and computer software. When it interacts with a system, it is referred to as the “user experience”. When taken to its most basic level, this involves monitoring how the user interacts with the system. There must be a structured process to creating an effective system, starting with high-level goals and working down to particular objectives [14]. When it comes to defining “usability,” it’s important to talk to potential users. The

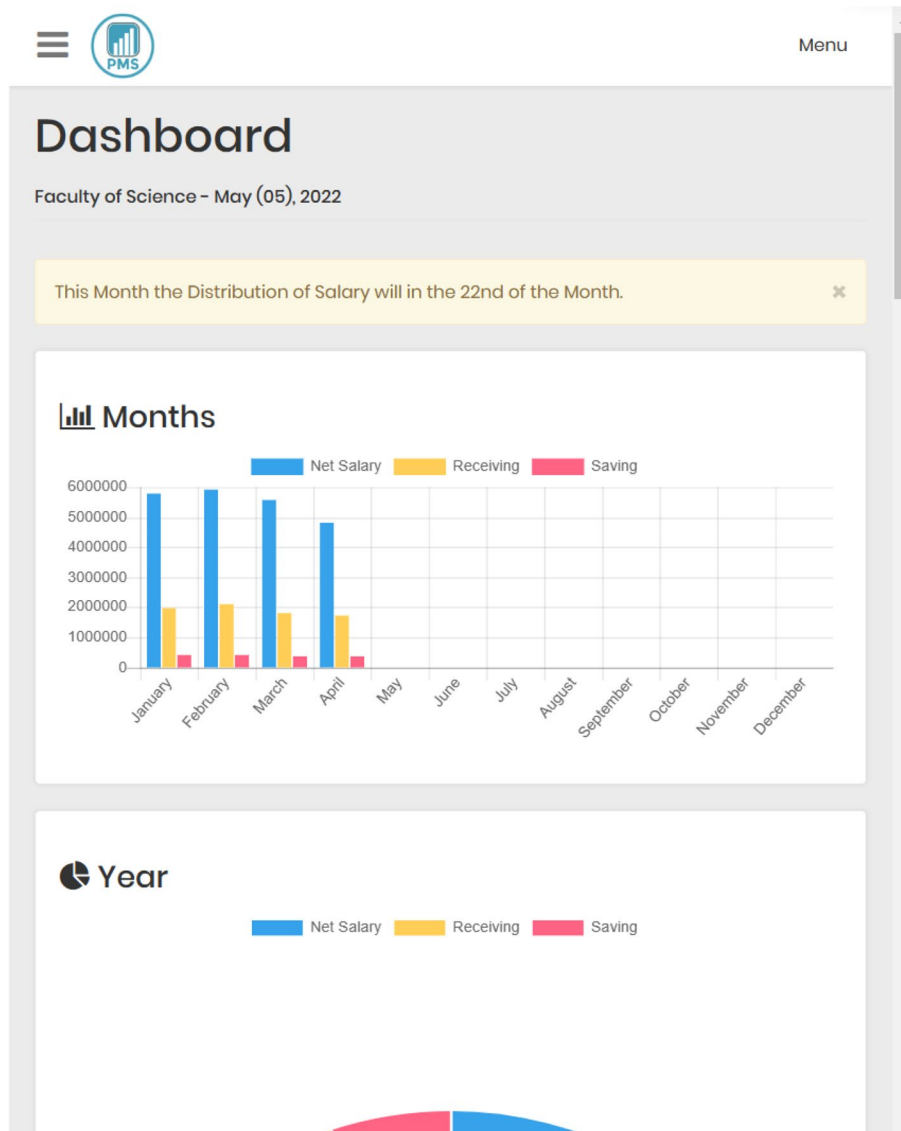


Fig. 11 Responsive web design of WPMS

Table 1 Compatibility testing

Operating system	Browser	Design	Functionality	Performance
Windows 10/11	Chrome	Yes	Yes	Yes
Windows 10/11	Firefox	Yes	Yes	Yes
Windows 10/11	Edge	Yes	Yes	Yes
macOS Big Sur	Safari	Yes	Yes	Yes
macOS Big Sur	Chrome	Yes	Yes	Yes
iOS 16.1	Safari	Yes	Yes	Yes
Android 12	Chrome	Yes	Yes	Yes

operational criteria for determining whether or not an information system is useable include: efficiency, effectiveness, satisfaction, accessibility, and usefulness [15].

Measurement of usability may be done using various methodologies and techniques. As one of the most popular surveys is Nielson ratings, that commonly used during the early phases of product development to properly understand the potential user [15]. Usability testing may be done by conducting a questionnaire, which is one of the most used methods. Additionally, another method designed to quantify the system’s efficiency and satisfaction is the system usability scale (SUS) method [16].

The system has been tested by the contribution of (25) potential users, who have answered the 10 SUS questions, which are shown in Table 2. These questions have been graded from 1 to 5 by users based on how much they agree with the questions. It is shown in Table 3 that 75% is the lowest SUS score whereas 100% is the highest, according to the SUS rules, it is a perfect score, while the score of 75% is an allowed ratio. The following is how the scores were determined by SUS:

1. Take 1 point from the final score for each question with an odd number.
2. Subtract the value of each even-numbered question from 5.
3. After finding the new values, add them to the overall score. Simply multiply by 2.5.

The SUS survey results of the system were (87.8%), which indicates a high degree of overall satisfaction with the system. In case the system’s usability score is lower than 68, there are likely major issues with the system.

**Conclusion**

The results of the analysis showed that all understudy universities have an urgent need for an electronic salary system. The SWOT analysis identifies the university’s most promising chances for developing new ICT technologies to improve communication between academic departments, faculties, and the university’s presidency. WPMS is built to be flexible, since additional faculties, allowances, deductions, etc. can be inserted at any time. In accordance with the requirements and needs, the system considers the security issues into account, such as the password of the user

**Table 2** SUS questions

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

**Table 3** Participants' score

Participant	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	SUS score
1	5	1	5	1	4	1	4	1	5	2	97.5
2	5	1	5	1	5	1	4	2	5	1	95.0
3	5	1	4	1	5	1	4	1	4	2	90
4	5	2	4	1	5	1	5	1	5	1	92.5
5	5	1	5	1	5	1	4	2	5	1	95
6	4	1	5	2	4	2	4	1	4	2	82.5
7	5	1	4	2	4	2	5	2	5	2	80.0
8	5	2	4	1	5	2	5	1	4	1	90.0
9	5	2	5	2	5	2	4	2	5	1	87.5
10	5	1	4	2	5	1	4	2	5	1	90.0
11	5	1	4	2	5	2	5	1	5	1	92.5
12	5	2	5	1	5	1	4	2	4	3	85.0
13	5	1	5	1	5	1	5	1	5	1	100
14	5	1	5	1	5	2	4	1	4	2	90.0
15	5	2	5	1	4	2	5	2	5	5	80.0
16	5	2	5	2	5	2	4	2	5	5	77.5
17	5	2	5	1	5	1	4	1	4	4	90.0
18	4	2	4	2	4	2	5	1	5	5	75.0
19	5	1	5	1	5	1	5	1	5	1	100
20	5	1	5	2	5	1	5	1	5	5	87.5
21	5	1	4	1	5	2	4	2	5	4	82.5
22	3	2	5	1	5	1	2	1	5	5	87.5
23	4	2	5	1	5	5	5	2	5	4	85.0
24	4	1	5	1	4	1	4	2	4	3	85.0
25	4	1	5	2	4	2	4	2	4	3	77.5
Agree	24	0	25	0	25	1	24	0	25	11	
Disagree	1	25	0	25	0	24	1	25	0	14	

Average score = 87.8

being encrypted. Furthermore, each user may only access pages and data related to their role and their faculty, also the system avoids utilizing the "Get" method. The system automates report production and auditing procedures, which save a significant amount of time, whereas manual data collection, takes a long time. An additional feature of the system is having a data mart that contains all the salaries for all months, which allows employees to find out all the details about their salaries. The system's satisfaction was high, according to the SUS evaluation results, which was (87.8%). The results also showed that the system is user-friendly, adaptable, and simple to use.

#### Acknowledgements

Not applicable.

#### Author contributions

AMA carried out the system's analysis and programming as well as made the initial preparations for writing the research. CNM carried out the design of the system and participated in programming. AMA performed the statistical analysis of the system evaluation. All authors read and approved the final manuscript.

#### Funding

There has been no significant financial support for this work.

**Availability of data and materials**

The data that support the findings of this study are available on request from the corresponding author.

**Declarations****Competing interests**

The authors declare that they have no competing interests.

Received: 16 November 2022 Accepted: 25 February 2023

Published online: 20 March 2023

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