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RESEARCH ARTICLE

Design and Development of Faculty Scheduling Management System of Cagayan State University Lasam Campus

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Abstract
The system was developed using a structured development method, which entails requirements analysis, system design, and implementation. The Genetic Algorithm was also employed as a key feature for optimizing scheduling, taking into account constraints such as faculty, subject, and room. Other key features of the system were also implemented, including scheduling, conflict, and data management for efficiency. The evaluation of the system was done using the ISO 25010:2023 software quality model, which entailed evaluating functional suitability, performance efficiency, compatibility, usability, reliability, security, maintainability, and portability. In addition, user acceptability and usability of the system were also evaluated using the UTAUT2 model, and the department heads were the main respondents. This showed that the system received very high ratings for all the quality characteristics, and the system was also highly accepted by the users based on all the constructs of UTAUT2, which proved that the system was effective, easy to use, and reliable. The conclusion is that the developed system was successful in addressing the limitations of the manual scheduling method by enhancing its efficiency, accuracy, and usability, thus being appropriate for implementation in academic institutions.

Keywords: *automated scheduling system, faculty management, genetic algorithm, ISO 25010, UTAUT2*

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INTRODUCTION

In the modern, highly competitive higher education environment, there is a need for efficient functioning in all areas for the delivery of quality education. Some of the most important functions in institutes of higher learning revolve around faculty scheduling. Faculty scheduling involves assigning subjects, classrooms, and time slots, taking consideration of faculty availability, subject offerings, and room utilization. This has been performed manually and consistently leads to conflicts, inaccuracies, and inefficiencies. Manual processes are very time-consuming and add to the work of the department heads, further reducing productivity at the institutional level. Al-Bahi and Taha (2020) highlights that manual scheduling frequently results in increased human error, often timetable conflicts, sometimes uneven workload distribution due to its highly complex, and constraint-heavy nature. Bashir and Li (2021) also noted the inefficiency of manual scheduling. They argued that schedulers struggle to manage many constraints at once, which can lead to class overlaps and underused rooms. At present, Cagayan State University – Lasam Campus using a manual method in making an faculty schedule. It involves much valuable time and effort on the part of schedulers, who need to cross-check subject offerings carefully, available rooms, and faculty teaching loads. Unfortunately, manual procedures are very prone to errors with regard to class schedule overlaps, or adjustments when there are changes in either the room assignment or the faculty availability. Furthermore, the absence of an automated reporting feature inhibits the administrators from generating easy and accurate records of the faculty's load, room utilization, and summary timetables. In this regard, the identified issues show the shortcomings of the current system and the urgent need for automation. to deal with this challenges, Faculty Schedule Management System will be developed to make the faculty schedules efficiently and reduce human errors. With integrated optimization features such as Genetic Algorithms, this system will develop the faculty schedules while maintaining conflict-free timetables and optimizing the use of classrooms. The system also allows one to add, edit and update schedules in real-time, provide automatic reports so as to be more accurate and make better decisions. The university will benefit in terms of efficiency and greater satisfaction since manual to automated scheduling system, both the faculty and the Department Head will be benefited. The Faculty Scheduling Management System will not only solve the issue but it is also a sustainable solution to accommodate future demands which this university may require. The system development assists in attaining the Cagayan state university institute quality objectives since it assists in enhancing the efficiency of the activities, improvement of accuracy and quality of the processes involved in the academic work. Excellence, quality service, and innovation are the elements of the Vision and Mission of CSU, and automated scheduling will definitely contribute to the attainment of the established goals because it will assist to refine the process of delivering academic programs, and schedules of classes will be organized and without conflicts. The project also maximizes the zeal to the quality teaching and effective teaching service in the university by streamlining the resources allocation and simplifying the administrative load and encourages the data-based decisions. It is also anticipated that the project will result into realization of a small number of the UNDP Sustainable Development Goals as SDG 4: Quality Education, SDG 9: Industry, Innovation and Infrastructure. The SDG 4 automated faculty scheduling will render the faculty more active, which is essential in management of accessible and quality education. The institutional system is modern and seeks to develop the sphere of technology within the university, which is the introduction of new technologies and optimization algorithms in the form of SDG 9.

OBJECTIVES OF THE STUDY

This study aimed to design, develop, and evaluate a Faculty Scheduling Management System for

Cagayan State University – Lasam Campus.

Specifically, the study sought to:

1. determine and analyze the current practices, procedures, and policies involve in the existing scheduling management if CSU – Lasam in terms of:
   1.1. loading and allocation,
   1.2. resource management, and
   1.2. reporting generation;
2. design and develop a Faculty Scheduling Management System applying a genetic algorithm;
3. determine the extent of compliance of the developed system using the ISO 25010:2023 software quality standards in terms of the following; and
   3.1 functional suitability,
   3.2 reliability,
   3.3 performance efficiency,
   3.4 usability,
   3.5 security,
   3.6 compatibility,
   3.7 maintainability,
   3.8 portability;
4. determine the acceptability and usability of the design solution in terms of;
   4.1 performance expectancy,
   4.2 effort expectancy,
   4.3 social influence,
   4.4 facilitating conditions,
   4.5 hedonic motivation,
   4.6 habit,
   4.7 behavioral intention,
   4.8 perceived ease of use,
   4.9 perceived usefulness,
   4.10 self-efficacy,
   4.11 response efficacy, and
   4.12 adoption intentions.

CONCEPTUAL FRAMEWORK

The Systems Theory and Optimization Theory have been applied in the construction of Faculty Scheduling System in CSU Lasam Campus. The systems theory is concerned with how technology, operation, institutional, and human factors interact, whereas the optimization theory, by use of Genetic Algorithm, will produce effective and stress-free schedules. The composite theories at that time, offer a combined point of reference when it comes to designing a system that can assure fair distribution of time, thus maximizing resources utilization and increasing process efficiency.

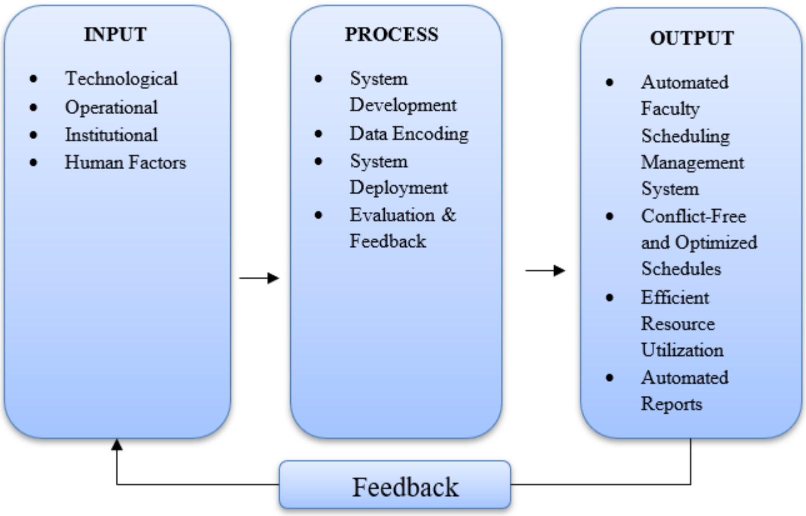

Figure 1. Paradigm of the Study

Figure 1 shows the Paradigm that shows the logical flow of Faculty Scheduling Management System of CSU Lasam Campus. It starts with the input or the totality of information, resources and conditions which the system requires to operate. These include the technological inputs in terms of computerized scheduling system, faculties, subjects and classrooms databases and the optimization algorithm which is the Genetic Algorithm. In its turn, the inputs that are in operation are, are the existing manual plans being followed in the development of a schedule, subject offerings, faculty availability, teaching load and classroom schedules. The institutional inputs can be linked with the university policies in terms of the timing and the academic rules and the administrative demands. These contributions bring the system to realistic conditions and institutional needs.

It is a methodic process by which incomplete products are transformed into worthwhile outcomes. This is initiated by system development incorporating design and coding of the automated scheduling system which was developed to fulfill the needs of CSU Lasam Campus. This is followed by the data encoding where the data that is necessary is encoded into the system such as data on the subject offerings, the profile of the professors and availability of classes. The following step is data encoding and then optimization process where Genetic Algorithm is used during the generation of automatically conflict-free, efficient, and equitable schedules. The schedules will be generated and then system implementation will be carried out and the software will be implemented and tested in actual life setting in a university. This will be accompanied by evaluation and feedback to ascertain accuracy, efficiency and satisfaction of the system by users in order to make a continuous improvement on the system.

The products of the process and the benefits of the system are the output. To apply to CSU Lasam Campus, the Faculty Scheduling Management System is one of the largest productions that is generated. It will develop a conflict-free and optimization time-table where no classes will conflict with the others. It is also useful in utilizing the resources effectively where the classes offered are utilized well and the faculty time is allocated better. The additional output required would be an automatically generated report such as faculty loads, schedules, and reports on room utilizations which enhance decision-making and administration efficiencies. Finally, overall these products make the administration more efficient, also lessen workload on the staff running it and the users of the faculties and administration are satisfied.

The paradigm in most instances explains the logical connections among the inputs, processes and outputs. It reveals how technology, operational data, institutional policies and the human factors have been combined trying to be processed in the system development and optimization in order to generate a reliable, efficient and user-friendly solution to the long-term challenges of manual faculty scheduling.

METHODOLOGY

This study used the descriptive – analytical design with developmental approach. For the development of the Faculty Scheduling Management System, the Agile Development Model were used structured and flexible approach in system development. The SDLC is common framework composed of with this phases planning, system analysis and requirements definition, system design, development, testing, implementation, and maintenance. On the other side, the Agile Model allowed for iterative and gradual development in order to continuously refine based on user feedback and changing institutional requirements. Modifications were also easily integrated through its iterative sprints in ensuring that the system is responsive to user needs and institutional constraints. The Faculty Scheduling Management System designed to automate the assignment of faculty members to courses, rooms, and time slots. It also use the Genetic Algorithm to provide optimized scheduling with the less conflicts and distribute the work among faculties based on institutional policies. The system were supposed to give efficiency and full transparency into the process of scheduling. The system give user-friendly interfaces and real-time validation features that worked toward easy to use, accuracy, and detection of conflicts. Moreover, this automation of a previously manual process of scheduling greatly reduced time, human error, and supported data-driven decisions within the institution. It is imagined that this system promoted digital transformation and modernization at Cagayan State University – Lasam Campus, providing a reliable, efficient, and transparent scheduling process to department heads and faculty members.

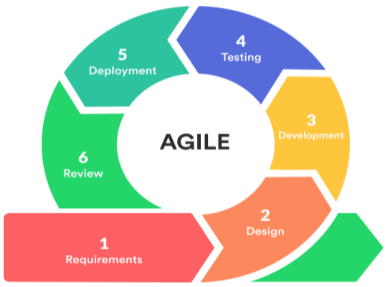

Figure 2. Agile Methodology

The first step, Requirements Phase, as shown in Figure 2, focused on problem identifying requires user interviews and data gathering to get the system requirements and, effect, define the problem with manual scheduling. This phase also sees the need to have an efficient and accurate scheduling system that is free from conflicts and reduces work time. After analyzing the problem and the requirements collected, the researcher set up a system addressing the needs that faculty and administrators experience. The Suggestion Phase covered the creation of a prior design and prototype based on the collected data and problems. This phase allowed to conceptualized and proposed possible solutions that address the process of assigning faculty loads, subjects, and rooms. The researcher created an initial system design and prototype that meet the scheduling requirements and resolve issues related to overlapping classes, room allocation, and faculty availability. The Development Phase, allowed the researcher to work and see the specifications, features, and functionalities. Developed to make automated scheduling. The development in this phase included system coding, integration of components, and testing of functions that include the generation of an automatic schedule, detection of conflicts, and management of data. Also the important features, like as the utilization of the Genetic Algorithm for the optimization of schedules and a user-friendly interface for administrators, are also subjects of this stage. The Testing and Review Phase aimed to test the performance and effectiveness of the system in fulfilling its intended purposes. The performance and efficacy of the system were assessed based on the quality standards set by the ISO 25010:2023, which include functional suitability, reliability, performance efficiency, usability, security, compatibility, maintainability, and portability, using the Likert scale evaluation tool. In addition to this, the acceptability of the Faculty Scheduling System was assessed using the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) model, which include performance expectancy, effort expectancy, social influence, facilitating conditions, hedonic motivation, habit, and behavioral intention to use the system, and then analyzed, and feedback from the end users was gathered to further improve the Faculty Scheduling System. Results was finally be reported, and feedback and suggestions from end users will be gathered to further refine the Faculty Scheduling System.

RESULTS AND DISCUSSION

The Current Scheduling Management Practices in CSU–Lasam

The existing method for scheduling management in CSU-Lasam is the current scheduling management practice, which utilized the spreadsheet method through the Microsoft Excel system for faculty loading, class scheduling, and room assignments. Though the system provides a general framework for organizing schedules, it does not possess advanced features to address the complexities involved in schedule management. Though it provides the capability to encode and store data, it does not guarantee the proper and safe storage of data, as well as the prevention of loss and unauthorized modifications to the data. As a result, critical scheduling information is made vulnerable to error, loss, and inconsistency. Furthermore, the system does not adequately deal with challenges that come about during the scheduling process, hence promoting inefficiencies and inconsistencies in the management of the schedule.

Loading and Allocation

For the loading and allocation of the faculty members, the system utilizes Excel sheets in which the subjects, time slots, and faculty loading are manually encoded. Although the system provides a visual representation of the schedule allocation, the validation features are not provided. One of the limitations identified in the system is that it does not allow the identification of overlapping schedules. The conflicts in the faculty members' allocation or the timing slots are not identified or validated by the system, which requires the scheduler to do the validation manually.

Resource Management

Although it allows room scheduling, it does not have the capability to check changes in real time. This makes it difficult to immediately know if a room has already been assigned to another class. This results in what could be called "double booking," especially if many are working or updating the Excel file at different times. Because of the lack of capability in the program, it becomes necessary for those who schedule to manually check everything, which could be time-consuming. Another issue associated with the current system is that it does not provide a clear picture of the utilization of the rooms or facilities within the school. For example, one cannot be able to ascertain whether the room is maximally utilized or not. This is evidenced by the fact that some rooms are maximized, yet others are not. This shows that the resources are not maximally utilized. This indicates that the absence of an automated system makes it hard to maximize the resources within the school.

Report Generation

However, the process of generating reports, based on the present Excel-based method, is still possible. It takes a lot of work, however. A lot of time needs to be spent by a person scheduling the data, reports. Also, since everything needs to be done manually, there is always a scope for error, especially since data is constantly being updated. Any small error may impact the accuracy of the reports.

Challenges and Gaps in Current Scheduling Practices

From the observations, it is clear that there are a number of challenges that have been identified in the current scheduling system. One of the main challenges is the lack of the ability to automatically detect the presence of overlapping schedules, both for faculty and rooms. This makes the whole process dependent on manual checks. There is also a lack of a way to validate the room assignments. This makes the whole process more prone to conflicts. In addition, there is a lack of tools and features that help in the maximization of the available rooms. Another problem is the lack of a central and real-time system. This is because, in the current method, it becomes a problem to keep track of the changes while at the same time ensuring that everyone works from the same version of the schedule. Because of the problems, the entire process becomes more labor-intensive and prone to human errors. This is because the system lacks the ability to incorporate the advanced features that would make the entire process more effective in the management of the scheduling process.

Design and Development of the Faculty Scheduling Management System Using a Genetic Algorithm

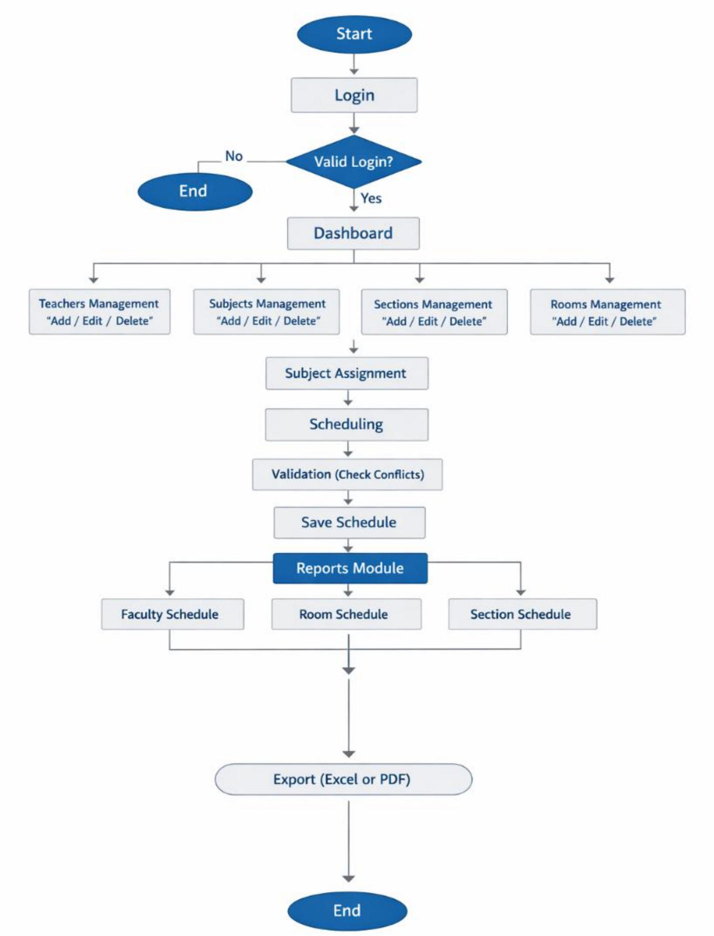

Figure 3. Flowchart of the System

Figure 4 illustrates the flowchart of the Automated Scheduling System, which adopts a structured approach in managing academic scheduling. This system enables an efficient process in handling academic scheduling. This process can be explained as follows:

The Automated Scheduling System begins when a user logs in to the system by providing valid login information.

• The system validates the user's status, either Admin/Dean, to access the dashboard.

The user can now input and manage the primary data required by the system.

This will do:

- Input teacher data.
- Inputs subject data, which includes encoding subjects, units, and hours.
- Inputs sections, which include corresponding year levels.
- Inputs rooms, which include corresponding room type and capacity.

After completing the inputting of primary data, the user can now assign subjects to teachers. This includes:

- Inputs subjects to teachers.
- Each subject is associated with a corresponding section, semester, and school year.

The user can now generate a schedule. This includes:

o Inputting time, day, and room corresponding to each subject assignment.

o Each subject assignment may encounter a conflict, which may be a teacher conflict, a room conflict, or a section conflict.

• If conflicts are detected on the schedule:

o The system will notify the user and prevents saving.

• If there are no conflicts are found:

o The schedule is successfully saved into the database.

The system allows viewing of generated schedules:

o Faculty Schedule (per teacher)

o Room Schedule (including vacant slots)

o Section Schedule

The user can then export schedules:

o Export to Excel for editable format

o Export to PDF for final presentation and reporting

• After exporting, the process ends or the user may continue managing schedules.

Table 1: ISO 25010:2023 Summary

	Weighted Mean	Descriptive Value
A. Functional Suitability (What does the app or technology do?)	4.44	Very high extent
B. Performance Efficiency (Does the app or technology use an optimal amount of resources?)	4.44	Very high extent
C. Compatibility —can the app or technology work cross-platform or share data with other products, systems or components?	4.06	High extent
D. Usability—can specific users use the app in specific conditions?	4.33	Very high extent
E. Reliability—an extremely important issue	4.19	High extent
F. Security (Does the app or technology protect information and data?)	4.29	Very high extent
G. Maintainability (Will it be possible for the app to be modified or improved in the future, or will it adapt to changes in the environment?)	4.4	Very high extent
H. Portability (can the software be used in various environments?	4.22	Very high extent
General Weighted Mean	**4.30**	**Very high extent**

Table 1 shows the evaluation results for the system in relation to the ISO 25010 quality characteristics that had an overall weighted mean of 4.30 and interpreted as Very High Extent. From the results, two criteria under the system's evaluation had the highest mean value of 4.44: Functional Suitability and Performance Efficiency. This indicates that the system is functional in that it performs all the required functions and that the system is efficient in that it uses the resources in the most efficient way possible. The results also indicate that the system is easy to use, secure, maintainable, and portable, as indicated by the Usability, Security, Maintainability, and Portability criteria with a value of 4.33, 4.29, 4.40, and 4.22, respectively, all interpreted as Very High Extent. The results for the system's compatibility and reliability were at 4.06 and 4.19, respectively, and interpreted as High Extent, indicating that although the system performs very well in these areas, there are still areas for improvement in these two criteria. The results indicate that the system is functional and efficient and acceptable to the targeted users; hence, a reliable system for automating the faculty scheduling process.
These findings are also supported by the study conducted by Turner (2021), which emphasized that systems with high functional suitability are effective in meeting user requirements. In addition to that, Campbell (2022) emphasized that performance-efficient systems reduce the time and workload for processing. Moreover, the findings are also consistent with the study performed by Edwards (2021) and Sanchez (2021), which emphasized the importance of usability and security for ensuring the level of satisfaction among users of educational management systems.

Table 2: UTAUT2 Summary

Acceptability and Usability	Weighted Mean	Descriptive Value
A. Performance Expectancy	4.56	Strongly Agree
B. Effort Expectancy	4.5	Strongly Agree
C. Social Influence	4.33	Strongly Agree
D. Facilitating Conditions	4.5	Strongly Agree
E. Hedonic Motivation	4.67	Strongly Agree
F. Habit	4.89	Strongly Agree
G. Behavioral Intention	4.78	Strongly Agree
H. Perceived Ease of Use	4.84	Strongly Agree
I. Perceived Usefulness	4.67	Strongly Agree
J. Self-Efficacy	4.84	Strongly Agree
K. Response Efficacy	4.67	Strongly Agree
L. Adoption Intentions	5	Strongly Agree
General Weighted Mean	**4.68**	**Strongly Agree**

Table 2 shows the Acceptability and Usability of the system as a whole received a weighted mean of 4.68, which translates to Strongly Agree. This indicates that the system has been perceived very positively by the respondents. The highest score was received by the system in the aspect of Adoption Intentions with a score of 5.00, implying that the respondents are totally willing to use the system when available. The other high scores were received in Habit (4.89), Perceived Ease of Use (4.84), and Self-Efficacy (4.84). These imply that the respondents are not only comfortable using the system but are also confident in using the system regularly. Other high scores received by the system included Behavioral Intention (4.78), Hedonic Motivation (4.67), Perceived Usefulness (4.67), and Response Efficacy (4.67). These imply that the system has been perceived as useful and efficient by the respondents and that they enjoy using the system. The other high scores received by the system included Performance Expectancy (4.56), Effort Expectancy (4.50), and Facilitating Conditions (4.50). These imply that the system has been perceived as a productivity enhancer and that it is easy to use and that there are available resources for use.

Conclusion

The study concludes that with the existing manual scheduling system, which is often characterized by inefficiencies, conflicts, and time-consuming tasks, there is a great opportunity to improve this system in an effective manner by developing an Automated Faculty Management System. This system was successful in providing accurate schedules, eliminating conflicts, and streamlining faculty loads, rooms, and sections, addressing one of the key issues identified in this study. It was also successful in providing high levels of system quality in terms of functionality, efficiency, security, and reliability, while also being user-friendly and easily adoptable by users. Furthermore, users also showed high acceptance, confidence, and willingness to use this system, which implies that this system is meeting their needs and is effective in providing support to them, and therefore, this system is likely to improve their scheduling system in a significant manner.

Recommendations

1. School Administration should use and implement the Automated Faculty Management System in lieu of the existing manual scheduling system, as the system has proven to have high efficiency, accuracy, and user acceptability.

2. Department Heads should use the system in generating faculty loads and class schedules, as the results have shown high user acceptability, high behavioral intention to use the system, and high productivity.

3. IT Personnel should constantly maintain and improve the system, especially in terms of reliability, compatibility, and security, to ensure the smooth performance of the system and to effectively deal with any technical problems that may arise.

4. Future Researchers, should further enhance the system by incorporating advanced features to make the system more user-friendly, portable, and to boost system performance.

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