THE DEVELOPMENT OF A SCHEDULING SYSTEM PROTOTYPE BASED ON THE ANALYSIS OF EXISTING SCHEDULING APPLICATIONS IN ACADEMIC INDUSTRY

Noor Asma Husain[1*], Siti Musleha Ab Mutalib[1], Noor Hayati Mohd Zain[1], Norhidayah Mohd Noor Hussain[1], Mohd Khalid Mokhtar[2], Nurul Iman Nor Hisham[2]

[1] School of Professional and Continuous Education, Universiti Teknologi Malaysia

[2] Lestari Technology Enterprise, Skudai, Johor, Malaysia

*E-mail: asma@utmspace.edu.my

ABSTRACT - A scheduling system is developed based on individual or organisational preferences to create efficient and effective management for prioritising tasks, place, and time. Some scheduling systems will include a database for easy access and storage of large amounts of data. It is challenging to plan class schedules for academic programs due to redundant usage and different semesters in handling student programs and managing task weight for lecturers. Since the class schedule is still a complex issue, to execute administration tasks easier and more efficiently, a few elements must be considered to prepare a class schedule. Therefore, this study will compare and implement a standard process of scheduling framework for future practice in the academic industry and present a practical method for making a comparison based on the studies and the existing scheduling system. This paper discusses the elements that constitute a scheduling system: the objectives, the method used, the constraints faced, and the solution tools used to execute a scheduling system. A scheduling system that emphasises the importance of the elements could generate an optimal presentation of timetables and real-time updates that will help with data handling accuracy and cost-effective and efficient time management. Based on the findings and results, this paper presents a practical method of implementing a scheduling system, including its features, methods, and system design, and executes a robust and responsive scheduling system for e-Scheduler, a web application written in PHP with SQL Server as the database management system, to produce an automated scheduling system.

Keywords: Educational timetabling, Scheduling System, comparative analysis, online system.

1. INTRODUCTION

Scheduling is one of the methods for arranging time effectively. For the academic industry, scheduling would be compulsory to set lesson schedules for students at the beginning of each semester (Saptarini et al., 2018). A learning schedule will allocate time for the students, while teachers will need to prepare a lesson design according to instructional time. Academic learning time will be required as the students will apply the lesson learned to meaningful knowledge, followed by using and demonstrating it. The learning environment will affect the length of time-on-task learning (Pedersen, 2001). Scheduling is considered a system for allocating

resources to a series of tasks in the most effective way possible over time, especially when it is essential for management and educational processes to keep track of related jobs within a specified period (Meccawy, 2018). In general, the scheduling has several resources to be organized, including students, teachers, subjects, and study rooms (Saptarini et al., 2018). The class schedule is one of the platforms that will be very helpful to the instructors in searching for subjects, assigning a subject, time of learning and learning room to a student. According to research, effective scheduling promotes and improves students' academic achievement (Childers, 2018). However, the major problem that led to the development of the scheduling system was the timing constraints by proposing a real-time computing system (Ramamritham & Stankovic, 1994). The problem that would always occur is that setting up and planning for the entire semester would be complex and time-consuming to avoid clashes between classes.

Having an effective scheduling system would also improve time management and self-scheduling rather than manual self-scheduling. The system would help users access other courses or teachers' information and databases to sync with their timeline. Technology nowadays is growing fast and is effectively taking advantage of many aspects of life, including in the learning field. By having a database, users or people worldwide can easily access and store information or data to collect views, reports and queries (Abdullah & Hussan, 2019). These days, software solutions exist to solve complex and manual problems and produce simple and accessible technology features to conquer the problem. Therefore, an automated scheduling system gives the simplest solution to efficiently planning all activities (Meccawy, 2018). Thus, this research did a comparative analysis based on the existing scheduling system. By understanding and making a comparative analysis of current scheduling systems, this research will be able to comprehend the process development that has been carried out to create the scheduling system prototype. The objective of scheduling systems must be to suit the user's needs. The ability to accommodate multiple semesters in UTMSPACE and the task weight of lecturers are two critical challenges that must be addressed. As a result, the prototype development of an online scheduling management system (e-Scheduler) for UTMSPACE institutions is being carried out as part of this research.

2. RELATED WORKS

In this section, several methods of scheduling systems are explained in the context of tools or algorithms that would be required or be used for the proposed scheduling system. According to previous research on the development of scheduling systems, a system needs to understand the scheduling tasks performed for the organization to

reflect on the needs and expectations to solve the issues effectively (Framinan et al., 2014).

2.1. The Comparison Analysis on Academic Scheduling System Research

According to Abdullah & Hussan (2019), they created a class scheduling system to manage university courses with requirements that can select, terminate, generate reports by administrators and give authority to administrators and instructors that request the information. However, class scheduling development is still a complex issue. It considers several elements in terms of its objectives, constraints, and solutions to prepare the class schedule. The development of an automated class scheduling system is to overcome the limitations of the manual scheduling system, which prefers to improve with technological advancement and reduce the load of gathering information and data about students, classes, departments, and arranging timetables. Therefore, to overcome the constraints, the researchers propose developing a scheduling system using the PHP programming language with the database management system MySQL for web applications to execute a web-based design platform for its automatic scheduling system approach. (Abdullah & Hussan, 2019).

The scheduling system can be developed by using various programming languages, including HTML, JavaScript, PHP and many more. Pavel (2019) developed web applications with the PHP programming language and the database management system MySQL. Gamale et al. (2012) propose an Automated Class Scheduling system to design and test the functionalities in terms of speed, accuracy, data handling stability, security, and adaptability in creating class schedules, giving them more outstanding performance and solving primary problems encountered during the preparation of the class schedule. V. Ajanovski (2013) developed a robust web-based application as a base model for future academic management software to handle issues with class routine scheduling management, course enrolment and other functionalities. The Rapid Application Development (RAD) technique is an incremental model that integrates a Google drive and links with an external database using an Apache webserver connection and the SQL language used as a Database Management System (DBMS). It used to render better environments and improve automated scheduling systems to be flexible, easy to use and improve the scheduling quality with unlimited capabilities by building according to the System Development Cycle (SDLC) with six development phases (Nielsen, 2015).

2.2. The Comparison of the Existing and Marketed Scheduling Systems

The scheduling system's features have been adapted to recent technological advances by becoming automated, real-time, and user-friendly. It is also flexible and can integrate with other users, set reminders, offer synchronization, and an integrated payment system to retrieve information and access the scheduling system at any time and place by using any available device effectively and efficiently. Moreover, the scheduling system can be found and synced on various platforms, such as desktop-based, mobile applications and web-based. However, there is still a constraint on accessing functional features because there are limitations based on free features and paid features. Thus, the premium scheduling system offers many features but is very costly to manage and purchase. As a result, a comparison was made between an academic scheduling software available on the market and a software comparison website called G2.com. Table 1 shows the comparison between the educational scheduling processes. However, all scheduling systems must meet the requirements of the user. The comparison of academic scheduling systems above revealed two missing features: the ability to accommodate multiple semesters and the task weight of lecturers. Thus, by referring to the current scheduling system's problems and constraints, this system (e-Scheduler) focuses on developing and adding new elements of student sectioning by semester enrolments and managing the task weight for lecturers for a year.

Table 1. Comparison between Academic Scheduling Software Features

Supports	Pick time	Prime Timetable	Tes (Edval)	asC Timetables	Docendo	Skooly
Manage class	✓	✓	✓	✓	✓	✓
Manage subjects	✓	✓	✓	✓	✓	✓
Manage period	✓	✓	✓	✓	✓	✓
Manage meetings	✓	✓	✓	✓	✓	✓
Students view	✓	✓	✓	✓	✓	✓
Teachers view	✓	✓	✓	✓	✓	✓
Web-based	✓	✓	✓	✓	✓	✓
Responsive		✓	✓	✓	✓	✓
Import excel file		✓	✓	✓	✓	✓
Software-based			✓	✓		
Drag and drop		✓			✓	✓
Updated interface			✓			
Inventory management						✓
Digital attendance						✓

Announcement/ Notification					■	■
Auto scheduling		■			■	■
Mobile apps						■

2.3 Proposed Method for Prototype Development of an Online Scheduling Management System (e-Scheduler)

By comparing existing and marketed scheduling software and its features, this research proposes a conceptual framework for the prototype development of an online scheduling management system (e-scheduler) to organise and manage classes, lecturers, timetables, and university programmes in UTMSPACE. From the conceptual framework in Figure 1, the database was organised using MySQL, and the system process and interface were developed using HTML programming, PHP scripting and Java scripting. It was proposed to ensure data handling and synchronisation updates through a server with an internet connection. The web-based automated scheduling system needs to be responsive to manage the collaborative features of this framework effectively. According to a report, a computerised scheduling process that integrates with a database is crucial for obtaining a complete list of user information and courses (Nielsen, 2015). By comparison with the current automated scheduling system, the expansion of usage of functionalities, usability, and interface have been improved significantly with the direct involvement of clients and users. To ensure a smooth/proper scheduling process and desired features for the e-scheduler system, a system flow design of the e-Scheduler System Prototype has been proposed.

2.4. System Flow and Designing Proposed for E-Scheduler Prototype

To meet the requirements of UTMSPACE, a system flow design of the proposed e-Scheduler prototype is created, as in Figure 2, to customize an online scheduling system and manage multiple programmes. From the entire process, the development focuses on the important process, which is assigning schedule functions. This function purpose is to assign schedules for the sections and classes for the lecturers, avoiding the clashing of classes in terms of place of the event, lecturers, and scheduling time slots. Figure 3 is the flowchart process design of assigned scheduling.
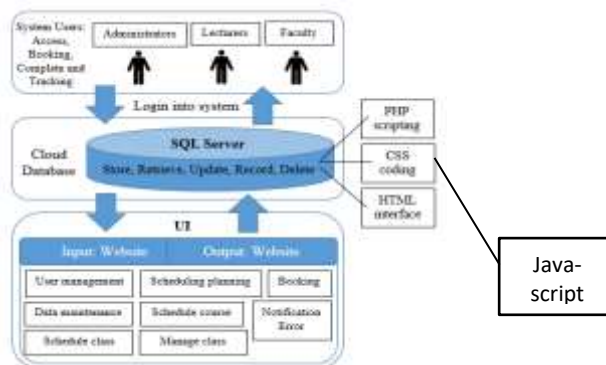
Figure 1. Conceptual Framework of the Online Automated Scheduling System (e-Scheduler)

3. RESULTS AND DISCUSSION

The customization of required elements was developed to improve from a manual to an online scheduling system to manage multiple programmes in UTMSPACE easily. The result is also achieved by designing and developing a database management structure (DBMS) and manage a control panel, to store data information in the system. The web-based scheduling system interface was developed using HTML and PHP programming languages for an attractive and user-friendly interface. Figure 4,5,6, and 7 depict the scheduling system database and website interface designed for UTMSPACE, known as an e-Scheduler. The prototype system meets the basic general requirements of a scheduling system, including a user-friendly and responsive user interface and various data stored as in Figure 6. The elements that must be adapted to address the complexities of issues have been identified to solve the constraints on managing multiple programs and balancing a lecturer's task weight per year. It results in a fully automated solution that can function in different semesters and adds task weight elements to view performance and avoid an unbalanced distribution of teaching hours among lecturers based on the credit hours of the subjects, as in Figure 7. As a result, the prototype system provides a complete solution to UTMSPACE's academic scheduling system problems and constraints.
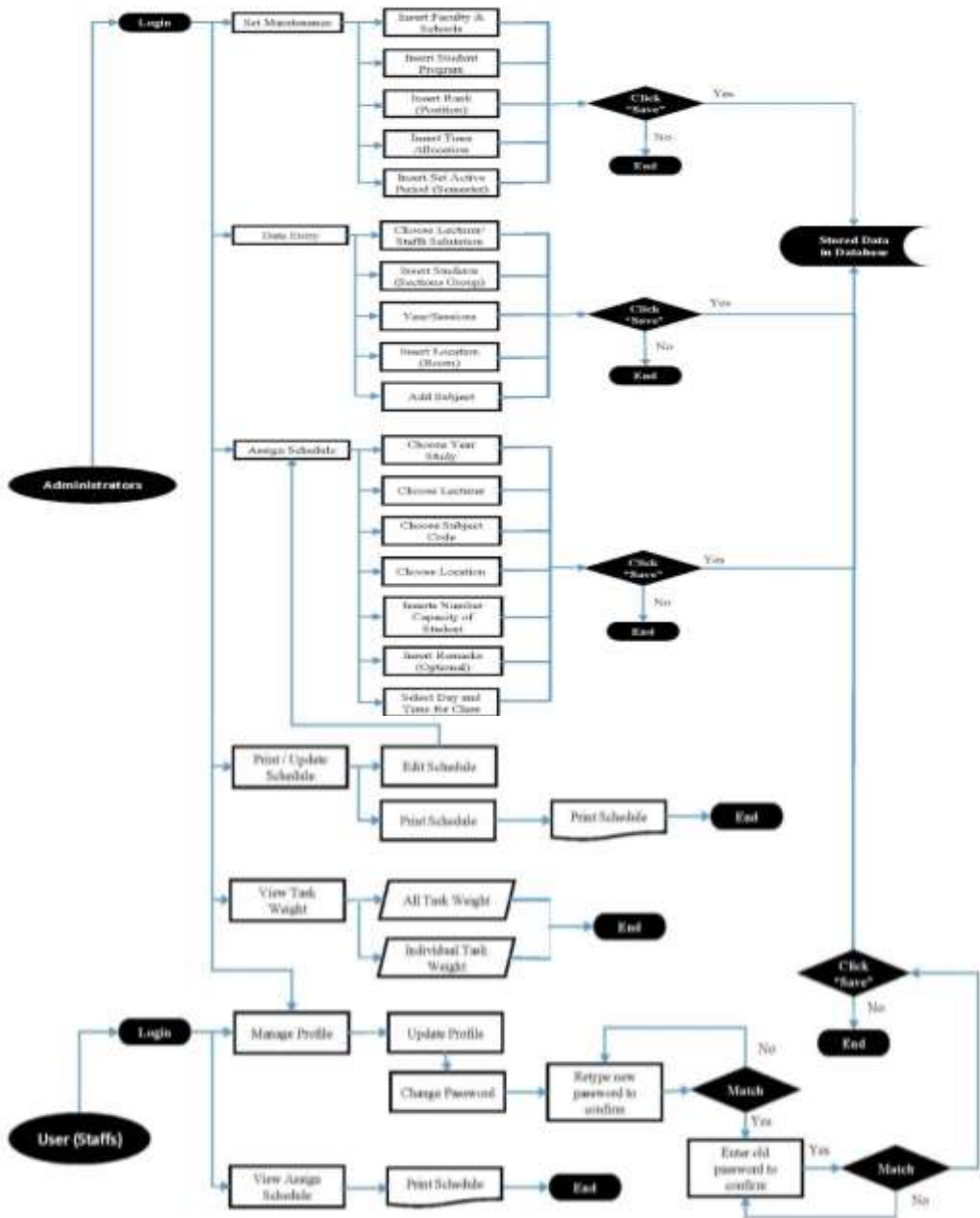
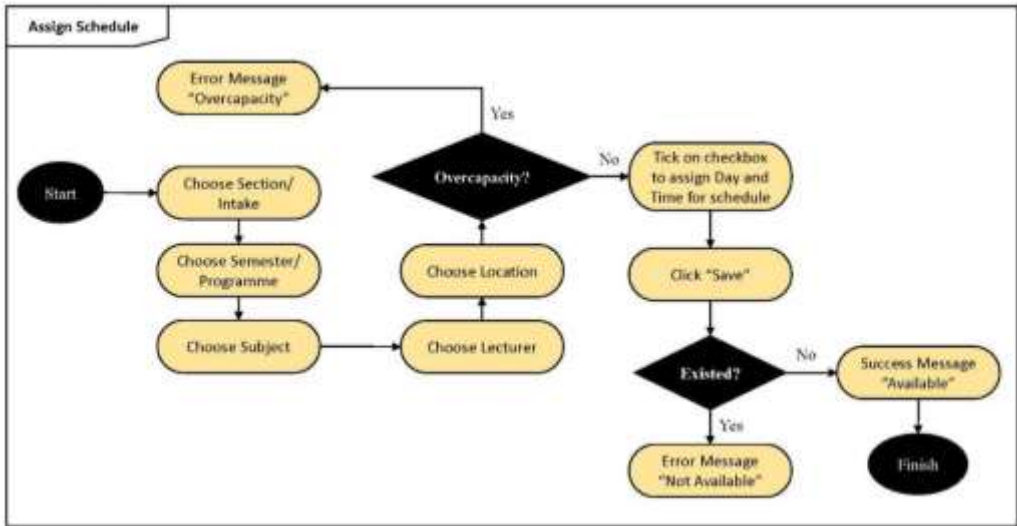**Figure 2**. System Flow Design of e-Scheduler
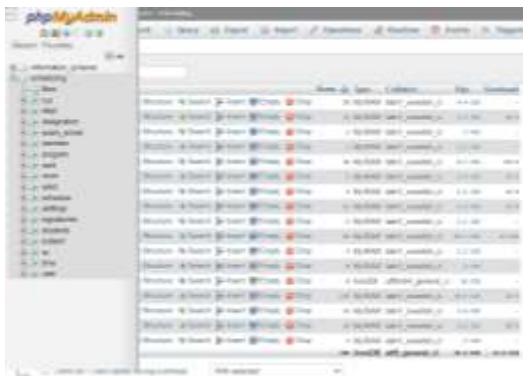
Figure 3. System Flow Design of Assign Schedule

Figure 4. PHP MyAdmin Interface

Figure 5. Control Panel for e-Scheduler

Figure 6. Homepage interface of e-Scheduler

Figure 7. Task Weight for Lecturers

3.1. Future Works

From the comparative analysis and development of the scheduling system, the e-Scheduler system can be expanded in the future by enhancing the scheduling system into an auto-responsive scheduling system. The system can be synchronized through multiple gadgets, has a wide scope of features, and improves the system on par with existing commercialized scheduling system software. In general, scheduling systems can also be enhanced in security features where the login system is integrated with multiple security features for a more secure form of authentication.

4. CONCLUSION

A scheduling system is built based on individual or organisational preferences to produce efficient and effective management for prioritising activities, places, and time. The issue that constantly arises in the academic industry is that setting up and planning for the entire semester is complex and time-consuming to avoid class clashes. According to research on the creation of scheduling systems, a system must comprehend the organisation's scheduling activities to reflect on its needs and expectations to resolve challenges effectively. The aim of scheduling systems should be to meet the needs of the users. However, based on current and marketed scheduling technology, there are still some limitations to fulfilling the requirements of UTMSPACE. By developing a prototype of an online scheduling system with an integrated DBMS, the multiple semester sectioning and balancing of task weight for the lecturers per year can be realised. As a result, customisation of essential components built to transition from a manual to an online scheduling system in UTMSPACE, making it easier to manage multiple programmes.

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