The Development of a Web-Based Student Support System Using Java Server Pages and MySQL

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Abstract. This paper details the development of web-based student support system which is known as Postgraduates Information System (PGIS). The system was developed to contend with some of the constraints of manual input. The current system utilizes Microsoft Excel which carries several disadvantages such as lack of control, susceptible to human error, and prone to data inconsistency. A Modified Waterfall Model was the methodology used for this project as the scale of this system was not too large and rather straightforward. This system was developed using Adobe Photoshop, NetBeans IDE, MySQL Server and Apache Tomcat. The system was tested using functional testing and usability test. From the tests conducted, the feedbacks were positive except for some minor adjustments to be made in managing faculties and programs.

1. Introduction
The availability of employment in Malaysia is getting tougher every day. To be ahead of the competition, one of the solutions is to further studies to the highest level possible. It can enhance your prospects as it demonstrates the ability to work independently to achieve goals and learn new skills. As a result, the number of postgraduate students is on the rise. That is why a web-based student support system which is known as Postgraduate Information System (PGIS) is needed mainly to handle the abundance of student data, to generate reports for analysis, and to manage evaluation sessions.

This system was developed by integrating Java EE technologies in order to help simplify the process of record keeping and reports generation. It is also used to help students update their details over time. Moreover, they can also request for evaluation and the coordinator will find the suitable date, time and place for the evaluation session.

This paper is organized into several sections. The introduction focuses on the background and objectives of the system. It is then followed by the motivation of the study. After that is a discussion of the methodologies utilized. Next is the steps undertaken during construction of the system. Then, the verifications done on the system. Finally, the paper is concluded.
2. Motivation
Currently, the postgraduate student data is managed manually using Microsoft Excel. There are several disadvantages in keeping data in Excel such as its vulnerability to fraud as it lacks control and the data can be too easily altered. In addition, it is susceptible to trivial human errors which might lead to misinformation and data inconsistency.

Keeping in touch with the students can also be a problem as their numbers are increasing. Contact through calling or messaging applications for each student would be impractical due to their numbers.

3. Methodology
System Development Life Cycle (SDLC) is one of the most commonly used methodology in system development. It is a type of structured analysis method whereby, the system development is controlled through several phases. These phases have their own deliverables and milestones are used to determine the progress of the project (Shelly & Rosenblatt, 2012).

There are two types of SDLC approaches being either the predictive approach or adaptive approach. The predictive approach is commonly used for projects that are well comprehended and have low risk. The adaptive approach on the other hand is regularly used for projects that are not well comprehended and are of higher risk. Adaptive SDLCs are more iterative which allow the developer to easily adapt the project to changing circumstances (Satzinger, Jackson & Burd, 2011).

A predictive approach was chosen for this project as the requirements were easily understood because the end user already knows what is to be expected from the system. Additionally, it does not have various functions to be developed and is quite straightforward. It is also a low risk system as it did not need to integrate with other systems.

Therefore, a Modified Waterfall Model which is a predictive approach was selected as the development methodology for this project. It is also known as the Sashimi Model. It is more flexible compared to the Traditional Waterfall Model which is more rigid as each phase can only be completed sequentially without going back to previous phases. The Modified Waterfall Model allows for overlapping between phases which can provides flexibility and stability that is much needed for this project.

This model consists of four phases which are the requirements, design, implementation, and verification.

4. PGIS Construction
Requirements: This was the first phase and the most crucial in this approach whereby the requirements of the system were gathered and identified. It defined the purpose of the system and the problems were specified alongside the objectives (Shen, Wall, Zaremba, Chen & Browne, 2004). The System Requirements Specification (SRS) was the deliverable for this phase which included three types of requirements which were the business requirements, functional requirements, and non-functional requirement as shown in Figure 1.
The Modified Waterfall Model was also part of the business requirements and the information collected from the organization which mainly defines the purpose of developing the system. The business requirements consist of the problem statement and the project’s objectives, and scope as shown in Table 1.

Table 1: Business Requirements

| Function                  | Description                                                                                                                                 |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| Problem Statement         | 1) The Postgraduate students data is currently managed manually using Microsoft Excel.                                                        |
|                           | 2) It is hard to keep in touch with the students as the number of them grows bigger.                                                        |
| Project Objectives        | 1) To construct an information system to manage students’ information, reports generation and students’ evaluation.                         |
|                           | 2) To implement the Java EE technologies into the information system.                                                                        |
| Project Scope             | Consists of two main scopes which are users and system. The users are students and administrator while the system part consists of the functions that will be used by both types of users. |

There are many ways to record functional requirements. Commonly, it is denoted using natural language such as English so that it can be easily obtained from the end users. It is a traditional way to collect requirements by picking up verbs and nouns during conversations with end users (Chung, Nixon, Yu & Mylopoulos, 2012). Table 2 illustrates the objective of the functional requirements which is to help achieve the business requirements.
Table 2: Functional Requirements

| Function                  | Description                                                                 | User                   |
|---------------------------|-----------------------------------------------------------------------------|------------------------|
| Login                     | User’s login is created by administrator. By default, student email will be set as the username while their metric number as the password. They can change their password after login for the first time. As for the administrators, the login details are more flexible as they can set their username and password freely. | Student & Administrator |
| Add/Update Student Details| All students are required to add their personal, program and supervisor details upon first time login. They can update those details whenever there are changes to be made especially mobile phone number and email. | Student                |
| Add/Update Evaluation Requests | Students can request for evaluation by selecting evaluation type, chairperson and three panels for the evaluation session. | Student                |
| Manage Users             | Administrator can add and update users’ login details and their status whether they are active or inactive. Graduated students will be set to inactive which disable them from accessing the system | Administrator          |
| Manage Faculty           | Administrator can add and update faculty. There will be no delete capability as it might disrupt previously added data. | Administrator          |
| Manage Program           | Administrator can add and update program that is offered for Postgraduate students. There will be no delete capability as it might disrupt previously added data. | Administrator          |
| View Statistical Reports | Administrator can view the reports, print them as Portable Document Format (PDF) or save as Excel. The reports are categorized by faculty, intake year, program and supervisor. Administrator can also see the list of students in this function. | Administrator          |
| Approve Requests         | Administrator can approve requests for evaluation and set the date, time and venue for the session. | Administrator          |

Table 3 shows the non-functional requirements, which is the specification on how well a system must function when operating.
Table 1: Non-Functional Requirements

| Characteristic | Description |
|----------------|-------------|
| Access Security | Focuses on how well the system is safeguarded against deliberate and intrusive faults from internal and external sources. |
| Availability   | Focuses on how well users can depend on the system to be up (able to function) during “normal operating times.” |
| Reliability    | Focuses on how well the software system consistently performs the specified functions without failure. |
| Usability      | Focuses on how well users to be able to learn, operate, prepare inputs and interpret outputs through interaction with the system. |
| Scalability    | Focuses on how well the software system is able to expand its processing capabilities upward and outward to support business growth. |

**Design:** The next phase of the methodology was the design phase. It is a phase that accentuated how the system should be carried out in order to fulfill the requirements identified in the requirements phase. Database analysis, and designing system interface worked hand in hand during this phase.

By using SRS as the reference, the data needed for the system should be identified and analyze meticulously. Use Case Diagram, Context Diagram, Data Flow Diagram (DFD) and Entity Relationship Diagram (ERD) were illustrated using Microsoft Visio 2010 to provide a better insight on how the data would be processed by the system.

The diagrams have also been used in this project to specify, model, and document the system. The database was analyzed thoroughly as it subsequently determined the flow of the system.

On the other hand, storyboarding was used to design the interface of the system. Storyboard is a set of layouts that imitate the sequence of steps for a particular use case or user process (Satzinger et al., 2011). The interface design was sketched on paper to get a better visualization of the system interface that was to be developed. Storyboarding also helped identify deficiencies in the design since the entire plan was laid out. It also inspired new ideas to the plan and facilitated in rearranging existing resources before the development begins. Changes were tedious to implement once the development process initiated.

**Implementation:** The implementation phase involves the actual development of the system. The system was built upon what had been documented from the requirement and design phase. This is the stage where the actual development of the system starts.

First off, NetBeans IDE 8.0.2 was installed bundled with Apache Tomcat 8.0.15.0 web server. For this project, NetBeans also became the platform to handle the MySQL database as it has the capability to integrate with MySQL server. NetBeans is a platform that is frequently used for handling Java programming projects. Apache Tomcat on the other hand would be the bridge in connecting MySQL and JSP. Adobe Photoshop CS6 was also used to design images that were used in the system.
Establishing the connection was tricky as there were many procedures needed to be kept an eye on especially when there was more than one object in the environment. Once it was up and running, database construction began and programming logic could take place only after the database was successfully built. The database structure was constructed by referring to the Use Case Diagram, Context Diagram, DFD and ERD in the design stage.

**Verification:** The fourth phase in this process model is verification. Verification is the process of evaluating a system or its component to decide whether the products of a given development phase satisfies the conditions imposed at the start of that phase (Williams, 2006). In this phase, the system was tested to make sure that it was conformance with the system requirements stated in the earlier phases. The testing process conducted was divided into two types which were the functional testing and usability testing.

### 5. Verification
The verification phase tasks that was elaborated and analyzed. There were two types of testing that were performed in this phase which were functional testing and usability testing. In total, there were 13 who played the role of testers for this system.

**Functional Testing:** Functional testing focuses solely on the outputs created in response to selected inputs and execution conditions (Williams, 2006). For this project, testing involves ensuring of the functionality specified in the functional requirements list. These functions must help eliminate the problems that were trying to be solved and achieve the research objectives simultaneously.

Table 4 shows the functions, users, expected outcomes and comments for this system once it was tested functionally by the testers.

| Function               | User                          | Expected Outcome                                                                 | Comment |
|------------------------|-------------------------------|----------------------------------------------------------------------------------|---------|
| Login                  | Student & Administrator       | 1) User would be able to enter the system by keying in their username and password as created by administrator.  
2) Active users can directly enter the system.  
3) Error message would be displayed upon wrong login details, inactive login or even blank fields. | OK      |
| Add/Update Student Details | Student                      | 1) Students are required to add their personal, program and supervisor details upon first time login.  
2) They can update the details when changes occur.  
3) Error message would be displayed when required fields are left blank. | OK      |
| Add/Update Evaluation Request | Student | 1) Students can request for evaluation by selecting evaluation type, chairperson and three panels for the evaluation session.  
2) Error message would be displayed when required fields are left blank. | OK |
| Manage Users | Administrator | 1) Administrator can add and update user’s login details.  
2) Error message would be displayed when required fields are left blank or unmatched passwords. | OK |
| Manage Faculty | Administrator | 1) Administrator can add and update faculties.  
2) Error message would be displayed when required fields are left blank. | OK |
| Manage Program | Administrator | 1) Administrator can add and update postgraduate programs.  
2) Error message would be displayed when required fields are left blank. | OK |
| View Statistical Reports | Administrator | 1) Administrator can view the reports, print them as Portable Document Format (PDF) or save as Excel.  
2) Administrator can also see the list of students and their details in this function. | OK |
| Approve Requests | Administrator | 1) Administrator can approve requests for evaluation and set the date, time and venue for the session.  
2) Error message would be displayed when required fields are left blank. | OK |
| Logout | Student & Administrator | 1) Users should be able to logout from the system. | OK |

**Usability Test:** Usability testing is the process by which the human-computer interaction characteristics of a system are measured and weaknesses are identified for rectification. It is a black box technique where the testers have no knowledge on how the system works. It checks whether the user interface is easy to use without help from the researcher. Additionally, it can also test the ease of understanding the system and how convenient it is to them.

For this testing, there were a total of 11 testers whom allocated their time and opinion in order to make it a better system. They were asked to test the student part of the system as the administrator part was already tested by the supervisors during functional testing. Their participation and input had been a big help in detecting errors, improving system navigation and general improvements. Figure 2 shows the overall analysis of the questionnaire for this study to measure user satisfaction through the responses after using the system.
From Figure 2, it can be concluded that most respondents were satisfied with the navigation part of the system while the least satisfied part is the interface. The ease of use and simple flow of navigation might be the reason for the high satisfactory percentage while the interface shortcoming was most probably because of its lack of graphical elements in the system screens.

6. Discussion
This section summarizes the pros and cons of this study. Recommendations and further improvements will also be discussed to provide a further depth into this system so that it can stay afloat in the long run.

The Advantages of PGIS: There are several advantages of this system that can be derived from the research conducted such as:

i. It can assist the coordinator in keeping track of postgraduate students much easier than before.
ii. Student data confidentiality, integrity and availability can be preserved.
iii. Students can request for evaluation sessions without too much hassle.
iv. Data entry process should be simplified and reports can be generated quickly by using this system compared to the manually designed reports in current implementation.

The Limitations of PGIS: There are several limitations of this system that were detected during the verification phase such as:

i. Status must be set for faculties and programs so that data reliability can be maintained in the future if inactivity persists.
ii. The statistic by supervisor need to be improved as the current implementation only displays the data of the primary supervisor.

7. Conclusion
PGIS was constructed using NetBeans, and Java EE technologies to manage student information, reports generation and students evaluation. All the information can be gathered and manipulated through this system. In the future, PGIS will be integrated with an email notification function.
especially during request for evaluation process and its approval and, a mobile application can be
developed for this system in order to use the current technology comprehensively.

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