

# Development of Allowance Management Module For Malaysia Public Exam Invigilator Appointment System

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**Abstract** — Operations in examination preparation and management such as assigning invigilators to their appropriate duties and allocating allowances prove to be a complicated problem due to a large number of constraints, such that it is a problem of allocating limited resources among various targets. The Johor Education Department or Jabatan Pendidikan Negeri Johor (JPNJ) is chosen as the stakeholder to provide detailed requirements and feedback to develop a web application which helps solve the problems in preparing for local Malaysian examinations. The project goal of developing the Allowance Management Module of the Public Exam Invigilator Appointment (PEIA) System is to provide a one-stop platform to integrate and consolidate the allowance claim process with other important processes such as appointing invigilators to their appropriate roles and assigning invigilators to respective exam centers. The Agile-waterfall hybrid methodology is chosen to be implemented in the software development process. The developed project has successfully improved and added features based on the requirements gathered. The features include dashboard, automatic calculation of eligible allowances, report generation and email notification. The developed system automates and streamlines the processes which may boost the efficiency as well as helping the authorities to make more informed decisions.

**Keywords** — Jabatan Pendidikan Negeri Johor (JPNJ), invigilators, examination, web application, allowance, Agile-waterfall, development, management.

## I. INTRODUCTION

The operations in preparing examinations can be detailed down to tasks such as printing and packaging question papers, preparation of examination timetables and examination venues, scheduling of invigilators and preparation of invigilation among the invigilators [1][2]. KÜÇÜK MATCI and ACAR [3] describes assigning invigilators to their

appropriate duties and positions proves to be a complicated problem due to a large number of constraints, such that it is a problem of allocating limited resources among various targets.

A manual examination system is more prone to human errors, more time consuming as well as more repetitive as the same data may be stored in different examination branches. Managing and retrieving records and data regarding exam candidates, invigilators and exam centers thus become very tedious and inefficient [4]. Maki [5] highlights technology can assist in administrative tasks such as invigilator administration, student administration, resources administration and financial administration.

The system aims to help solve and work on the constraints and problems faced by authorities as well as invigilators when it comes to administrative tasks in examinations. The features provided in the system hopes to help the authorities make more informed and sound decision for assigning the invigilators and approving the invigilators' allowance claim. The goal of the system is also to make completing the tasks less prone to human error and less time consuming. The system will be developed to enhance the features of the existing Sistem Tuntutan Elaun Penjawat Peperiksaan (STeP) system. Some weakness of the existing system include invigilator has to manually input their personal information, school or office information and invigilation information. Besides, the invigilator has to manually calculate the amount of eligible allowances based on categories which may also involve manually estimating and calculating the distance travelled or distance between two locations. This is not only time consuming, but may also lead to data entry errors.

## II. RELATED WORKS

This section will cover the comparison between the existing system with other similar systems in the market before developing the system. Comparison and analysis between the developed system and other similar systems is important to help identify potential weakness and problems which could be improved in the Allowance Management Module of the PEIA system. Besides, the strength and good features of the similar systems can be included to further enhance the developed system.

### A. AppsForOps Application

The AppsForOps application is an expense claim management application which have mobile, tablet and desktop support. The application helps employee to digitally submit, track and also get their expenses reimbursed. The workflow for the reimbursement of the expense claim is also configurable, such as 1 level of approval of 2 levels of approval. For managers and business owners, they will have full visibility into the expenses incurred by the employees and they are able to digitally receive and approve all the expense claims in one place.

### B. HR.my e-Claim Application

The e-Claim is an application where managers and business owners can review and manage employee expense claims instantly from both web and mobile. Managers receives an email whenever employees submit an expense claim along with corresponding receipts and documents that are to be reviewed. The application also allows for a more fine-grained control over each expense type by setting a monthly limit or yearly limit to each claim entitlement.

Table 1 below shows the comparison between the existing system, AppsForOpps and Hr.my e-Claim application.

TABLE 1. SYSTEM COMPARISON

Features	AppsForOpps	Hr.my e-Claim	STeP
Supported users	Public	Public	Pejabat Pendidikan Daerah (PPD) authorities and exam invigilators
Domain	Business (Employee expense claim)	Business (Employee expense claim)	Education (Invigilator public exam allowance claim)
Platform provided	Web, mobile and desktop	Web	Desktop (Microsoft access)
Dashboard	Provided	Provided	Not provided
Email notification	Yes	Yes	No
Distance calculator	Yes	Unknown	No
Allowance calculator	Yes	Yes	No
View application	Yes	Yes	No

history			
Configurable approval workflow	Yes	Yes	No
Set up claim policies and rates	Yes	Yes	No
Report generation (PDF format)	Yes	Yes	Yes
Auto populate input fields	No	No	No

## III. METHODOLOGY

The software development methodology of choice to be followed in the development of the PEIA system is the agile-waterfall hybrid model. The agile-waterfall hybrid model addresses problems known in the more traditional pure waterfall methodology such as its inflexibility and non-incremental nature [6]. This hybrid development model is able to simulate advantages from both agile and waterfall methodologies which can be applied throughout the software development life cycle in this project. The waterfall methodology will be followed and serves as a foundation during the starting phases of the project such as gathering requirements, understanding business rules and determining project objectives [7]. The base architecture of the project is developed once the requirements are recorded and decided. The waterfall methodology is easy to implement as it is a sequential model and it also requires only minimal amount of resources.

Agile methodology will then take over and drive the development phase. The agile methodology is appropriate for the development phase since it puts more emphasis on rapid development and usage which best fit the needs of the development of the PEIA system compared to other software development methodologies. The values and principles followed in agile methodology are individuals and interactions over processes and tools, working software over comprehensive documentation, customer collaboration over contract negotiation and responding to change over following a plan [8]. Agile methodology allows for easier response to changes in requirements and conditions in an iterative approach where stakeholders or customers feedback are taken into account in each iteration of the development process.

Table 2 shows the planned activities to be carried out in each phase.

TABLE 2. PHASES AND PLANNED ACTIVITIES

Phase	Activity Planning	Outcome
Requirements Gathering	The requirements gathering and design phase will be broken down into sequential activities following the waterfall model. First, interview is carried out with the authorities from JPNJ to gather information about the	Software Requirements Specification (SRS) and Software Design

	proposed system such as the desired features to be included, the business processes, the technical and also economic constraints. Information about the current system such as the problems and challenges faced by the user using the current system is also collected and recorded. Besides, questionnaires following the Kano Model are also distributed to both the PPD authorities and also invigilators to further understand and analysis the importance of the required features of the PEIA system.	Document (SDD) are produced.
System Development	The features and functions to be developed are ranked by priority. Each sprint or iteration will cover a certain number of features according to their priority. The development process will start based on the Gantt Chart plan.	Gantt Chart based on the development process is produced.
Change analysis	Each sprint will involve communication and feedback with the stakeholders if necessary. Any changes to be made will require the SRS and SDD to be redesigned such as changes to the developed features or any new features added.	Revised Software Requirements Specification (SRS) and Software Design Document (SDD) are produced.
System Testing	Blackbox testing and user acceptance testing are carried out with the PPD authorities and invigilators. The goal of the tests is to assess the usability of the system as well as testing if the system can support the user scenarios based on the specifications and requirements given by the stakeholders.	Software Test Documentation are produced.

## IV. RESULTS

### A. Requirement Analysis

Requirement analysis defines the features and the behavior of the system necessary to meet the requirements stated by the stakeholders. Both survey and interview were conducted to elicit requirements and information from the stakeholders. Interview was carried with the authorities from JPNJ to have a clearer understanding and gather information about the current

business process and as-is system. The survey questionnaire is distributed to both the PPD authorities and invigilators. The questions are designed based on Kano's model where a pair of questions is mapped with each requirement. The data collected from the response of the participants can be evaluated based on Kano's evaluation matrix. The requirements can be broken down to 6 categories which are (M) must-be, (O) one dimension, (A) attractive, (I) indifferent, (Q) questionable, and (R) reverse [9].

Table 3 shows the summary of questionnaire results from invigilators.

TABLE 3. SUMMARY OF QUESTIONNAIRE RESULTS FROM PPD AUTHORITIES

Question	Assessed Requirement	M	O	A	I	Q	R	Total	Category
A1, A2	Dashboard	0	0	0	1	0	0	1	I
A3, A4	Allow pending allowance claim edit	0	0	0	1	0	0	1	I
A5, A6	Automatic allowance form field population	0	0	0	1	0	0	1	A
A7, A8	Allowance calculator	0	0	0	1	0	0	1	I
A9, A10	Distance calculator	0	0	1	0	0	0	1	I
A11, A12	Email notification	0	0	0	1	0	0	1	I
A13, A14	Generate report in PDF	0	0	1	0	0	0	1	A

### B. System Design

The design of the system is represented using Unified Modelling Language (UML) diagrams during the design phase as part of the requirement analysis process. The UML diagrams are helpful in explaining the expected behavior of the system and the features of the system.

#### 1) Use Case

The system has a total of 7 use cases. The actors of the system are PPD authorities and invigilators respectively. Figure 1 shows the use case diagram of this system

Figure 1. Use Case Diagram of Allowance Management Module of PEIA System

## 2) System Architecture

System architecture design describes a system's the components of the system, the relationship between the components and how they are structured, as well as how the components interact with each other. The Model-View-Controller (MVC) is chosen for this system due to the reusability of components in the system, easy code maintenance and high decoupling between each layer. The MVC architecture is also well supported and easy to implement using the technology stack which are MongoDB, Express.js, React.js and Node.js.

The model layer represents the data classes and models defined in the system. The view layer is the views or interfaces presented to the user. The view layer comprises of static and dynamic pages which are rendered based on requests made by the user. The controller handles and controls the requests of the user which in turn generates appropriate responses which is then returned to the user. The controller requests data from the MongoDB database which is hosted on the cloud, and returns the retrieved data back to the user. Figure 2 shows the MVC architecture of Allowance Management Module of PEIA system.

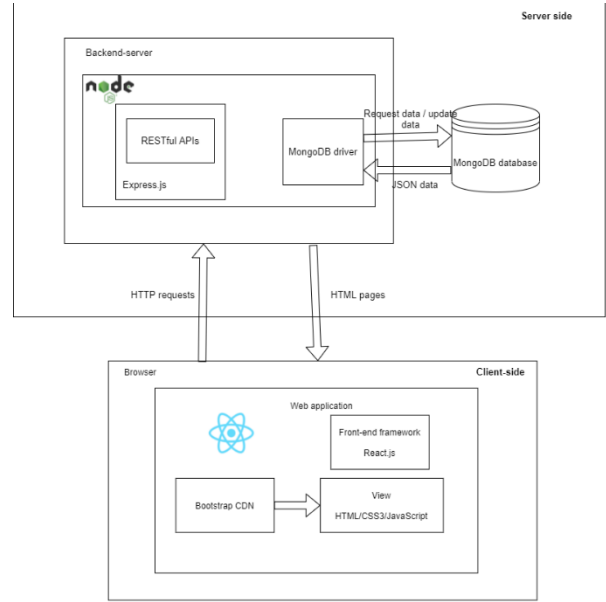


Figure 2. MVC Architecture of Allowance Management Module of PEIA System

## C. System Development and Implementation

The web application for Allowance Management Module of PEIA system is developed using React.js framework while the backend web-services are built with Node.js as the runtime environment and Express.js as the framework.

To address the issue where invigilators have to manually input all personal information every time they create a new allowance claim, the system auto populates the relevant fields for the logged in invigilator as shown in Figure 3. From Figure 4, the system also provides the dashboard view to help users of the system to have better data visualization and to make more informed decisions. Besides, to achieve the goal of improving the usability and user experience of the system, several features such as tooltip, automatic calculation of eligible allowance and address search autocomplete are implemented as shown in Figure 5 and Figure 6.

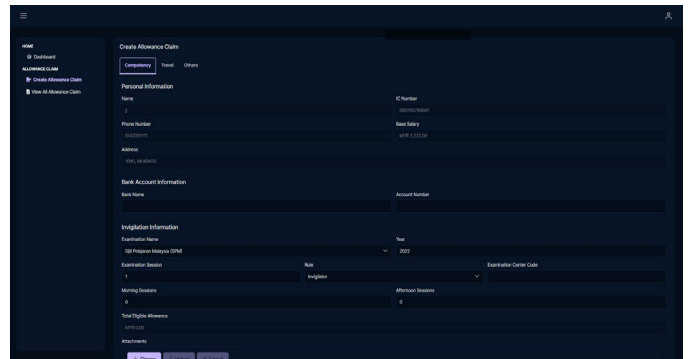


Figure 3. User Interface of Create Allowance Claim Page

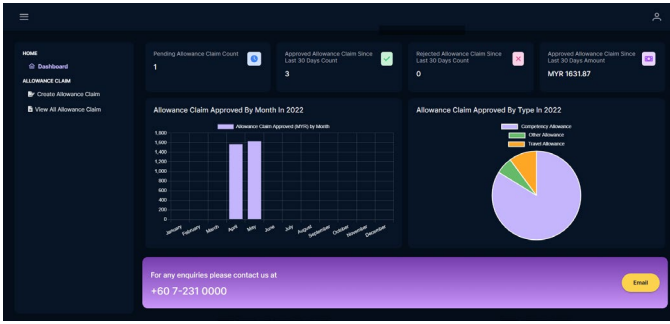


Figure 4. User Interface of Dashboard Page

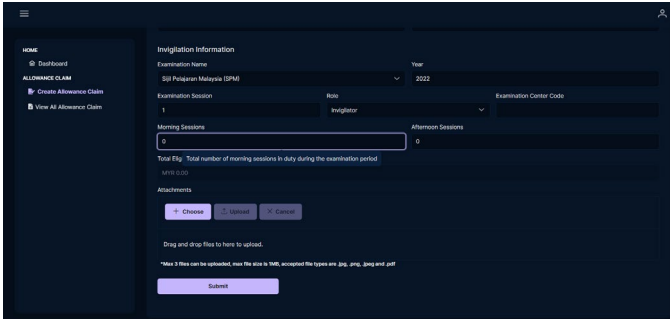


Figure 5. Tooltip for Morning Sessions Field

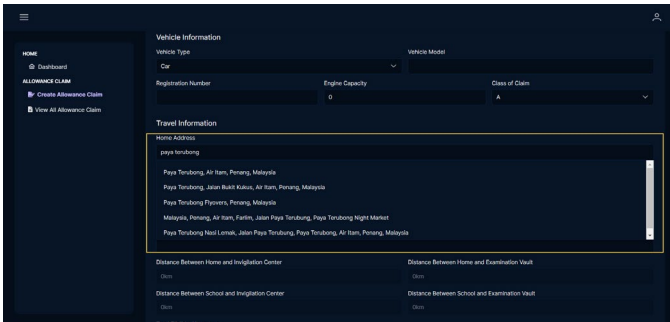


Figure 6. Address Search Autocomplete for Home Address Field

#### D. Testing

System testing that will be conducted for the Allowance Management Module of PEIA system are black box testing and User Acceptance Testing (UAT). The goal of testing is to verify and validate the system from the stakeholders. Feedback and comments will be gathered from the stakeholders to further improve the system.

For UAT, the participant was handed a user manual which contains the task to be completed, and the steps on how to complete each task. The video session is recorded. There are several data which have collected through survey such as user proficiency in using computers, user satisfaction using System Usability Scale (SUS). Figure 7 shows the SUS score scale for the Allowance Management Module of PEIA system. The Allowance Management Module of PEIA system scores 95 which may be classified as "Excellent"

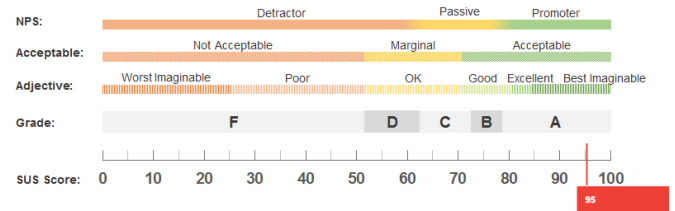


Figure 7. SUS Score Scale

#### V. CONCLUSION

Among the achievements upon developing the system are successfully completing all the requirement objectives stated. Requirements are gathered and analyzed from stakeholders. The results from the requirement elicitation and analysis is also properly documented. The web-based application for the Allowance Management Module has provided higher accessibility as well as removed complicated and manual tasks when managing allowance claims from the invigilators.

However, there are a few ways to further improve the system. The application can be developed as a mobile application in the future which may better support native mobile features such as capturing photos and uploading to the application. Next, the application may also be needed to expand its feature to support new user types. New notification methods such as push notification may be added to provide more options in receiving and sending notifications. Last but not least, the application should support other languages such as Bahasa Malaysia so that the application may be more widely accessible and understood.

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