

# Tool and Equipment Information Management System

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## Abstract

Organizations that use manual tools and equipment management systems often face security risks, data loss and inefficiencies. Issues with using manual paper-based documents for tools and equipment management include data loss, misplaced information, and human error. Therefore, the Tools and Equipment Information Management System is developed to manage and organize the information of tools and equipment in an organization. The intention is to improve the efficiency of tooling and equipment management, which will improve the overall performance of key manufacturing processes. The project approach is based on a prototype model, and the system is implemented using XAMPP, MySQL, PHP, and HTML. The new system has key functions, including updating, presenting, exporting, and importing data from the database. Additionally, it will manage vendor information, track tools, track maintenance plans, provide reports and allow access for individuals based on their roles and permissions. Finally, this information system is important because it can help firms in managing tools and equipment effectively, observing their status and condition, reducing workplace risks, reducing resource wastage and increasing productivity.

## 1. Introduction

Spring manufacturing can be categorized as a crucial industry as it serves as a fundamental component for a variety of sectors, such as aerospace, automotive, and construction [1]. The production of springs is a significant industry that is essential to numerous economic sectors [2], [3]. There are various approaches to handling tools and equipment depending on the size and complexity of the organization, the type of tools and equipment being used, and the company or workshop [4]. Tools and equipment in a company are the physical objects that employees use to perform their jobs. This can include a wide range of items, such as hand tools, machinery, computers, software etc. Depending on its business and the kind of work it undertakes, a company will require different kinds of tools and equipment [5]. A manufacturing organization, for instance, will require different tools and equipment. Management of tools and equipment is necessary for related businesses to operate properly and effectively [6], [7]. This management consists of physical condition and information details. This aims to prevent operational disruptions, extend equipment life, aid decision making, and maximize resource allocation.

This project focuses on the challenges faced by Shin Li Spring Sdn Bhd, a small and medium-sized spring manufacturing company established in 2006 and located in Selangor, Malaysia. Despite the company operating for over 20 years with industry expertise and a skilled workforce, the company struggles with operational inefficiencies due to the absence of a strong tool management system. The "Master List," a manual paper-based method, is now used by this company to manage and arrange tools and equipment. Despite being in use, this system is not efficient or practicable. The "Master List" attempts to address "Monitoring & Measuring Equipment",

yet it does not provide good solutions to effective tool management. There are also a portion of the tool and equipment records are found in invoices, and the reactive maintenance method leading to the potential of disruptions in operational continuity. The existing tool management approach employed by this company exhibits inefficiencies in both data recording and storage. This methodology raises concerns regarding the comprehensiveness and accuracy of details pertaining to tools and equipment deployed in the production process. Errors, misplacement, and potential loss of critical information are looming consequences. Moreover, the manual data entry process, susceptible to human errors and time-consuming efforts, exacerbates the inefficiency. Ultimately, these shortcomings in data recording and storage could disrupt operational continuity and compromise production workflows.

The existing manual system brought challenges and concerns to the company. The accuracy and comprehensiveness of tool information need to be concerned about due to the inefficiencies in data recording and storage practices. Moreover, human errors can happen during the manual data entry processes, and the absence of structured indexing can cause difficulties in the quick retrieval of information. The company also faces hurdles in generating reliable reports and conducting insightful analyses due to the reliance on paper-based records. The absence of real-time data also puts a strain on the company for decision-making, optimal resource allocation, and reduced downtime risks.

Hence, the development of a web-based information management system for tools and equipment as a solution to address these challenges. This system will feature an extensive database to record data about tools and equipment, maintenance history, condition of tools and equipment, and user accountability [2]. Tools for reporting will make it easier to evaluate the system's efficacy and offer ideas for ongoing development. A team of employees who manage related duties will oversee the tool and equipment information management system. This job entails performing routine system maintenance, which involves setting up employee tools and equipment, installing new tools, and updating the maintenance log. The system can be used to assist the routine system maintenance, which includes updating maintenance logs, adding new tools and equipment, and giving staff equipment. Staff members must also ensure that tools and equipment are properly maintained and keep their system information current.

This paper is divided into several main sections. Section 1 presents the project background. Section 2 gives the related work. Project methodology is explained in Section 3 together with the findings from analysis and design. Section 4 demonstrates the system implementation and testing. The last section gives the conclusion.

## 2. Related Work

In companies in a variety of industries, tool and equipment management is essential [7]. Optimizing production, guaranteeing operational efficiency, and upholding a safe working environment all depend on the efficient administration of tools and equipment [8]. Throughout the life of these tools, they must be purchased, organized, tracked, maintained, and disposed of. Although the degree may vary based on the industry and size of the organization, many businesses still maintain tools and equipment information manually [9], [10]. Spreadsheets, logbooks, or paper-based systems are frequently used in manual methods of maintaining tools and equipment information to track and record data. However, this approach lacks a strong control system, which potentially causes issues such as inadequate maintenance, breakdowns, and safety risks. Inadequate preventive maintenance process may result in increased replacement costs and production delays [11], [12].

The business lacks a mechanism for controlling its tools and equipment. This may result in a variety of issues, such as lack of maintenance on tools and equipment which can cause breakdowns and accidents. Additionally, preventive maintenance is often less expensive than the price of fixing defective tools and equipment. The lifespan of tools and equipment can be shortened by frequent breakdowns, which can cause production delays and higher replacement expenses. Inadequately maintained tools and equipment pose a risk to safety. The business should put in place a tool information management system to prevent these issues. By tracking the state of its tools and equipment and planning preventative maintenance, the organization will be able to lower the chance of accidents. Information management system implementation aids companies in avoiding problems including data loss, inconsistent data, security breaches, inefficiencies, and noncompliance. Productivity, teamwork, decision-making, and overall business performance are all enhanced by its ability to manage tools and information in an effective and secure manner.

Therefore, to assist them in tracking and managing their assets, tools and equipment management software is required. There are several capabilities that this program may offer, including reporting, maintenance management, assignment management, and asset tracking. Investigation into the existing system available in the market for use is also done. The study of these three existing systems plays a vital role by providing more ideas that can be implemented into the proposed system. Through literature reviews, a comparison between the three existing systems is made to acknowledge the similarities and differences between these systems.

The three existing tool and equipment management systems are analyzed: ShareMyToolBox, EZOfficeInventory, and Gigatrak Tool Tracking System. Firstly, ShareMyToolBox is a mobile application that offers features such as tools tracking and sharing, barcode scanning, and this application is accessible on both IOS and

Android devices. On the other hand, EZOfficeInventory is a cloud-based asset-tracking software that facilitate features like asset lifecycle management, maintenance scheduling, and customizable reports. Furthermore, Gigatrak Tool Tracking System applies barcode and RFID technologies for tool management which includes tracking, check in and out, maintenance scheduling, and report generation. **Table 1** shows the comparison results among the systems.

There are some common features between the three existing systems, including tool tracking, maintenance management, and report generation. The differences between the three systems lie in user-specific requirements, such as user-friendliness, system functionality, and cost considerations. The proposed system seeks to build on the strengths of these existing systems while addressing specific requirements, such as access control, customizable roles, and efficient tools and equipment management. The summary emphasized the significance of understanding user preferences and budget constraints in selecting an appropriate tool and equipment management system.

**Table 1** System Comparison

System	ShareMyToolBox [13]	EZOfficeInventory [14]	Gigatrak Tool Tracking System [15]	Proposed System
Log in and registration	√	√	√	√
Tool tracking	√	√	√	√
Maintenance management	√	√	√	√
Tool usage history	√	√	√	√
User management	√	√	√	√
Vendor management	√	√	√	√

**Table 2** Software Development Activities

Phase	Task	Output
Planning	<ul style="list-style-type: none"> <li>Proposed the project.</li> <li>Determine the project schedule, activities and output.</li> <li>Research on related fields.</li> <li>Collection of information and requirements.</li> <li>Determine problem statements, objectives and scope of project.</li> </ul>	<ul style="list-style-type: none"> <li>Project proposal</li> <li>Gantt chart</li> </ul>
Analysis	<ul style="list-style-type: none"> <li>Analyze the information and produce the requirements for the new system.</li> <li>Determine tools for development</li> </ul>	<ul style="list-style-type: none"> <li>System's requirements</li> <li>Context Diagram</li> <li>Data Flow Diagram (DFD)</li> <li>Entity Relationship Diagram (ERD)</li> <li>Flowchart</li> </ul>
Design	<ul style="list-style-type: none"> <li>Create architecture of system.</li> <li>Design the database.</li> <li>Design the user interface.</li> </ul>	<ul style="list-style-type: none"> <li>System architecture</li> <li>Database schema and data dictionaries</li> <li>User interfaces</li> </ul>
Implementation	<ul style="list-style-type: none"> <li>Writing program codes</li> <li>Implementation of web pages and interfaces</li> <li>Implementation of functionality modules</li> </ul>	<ul style="list-style-type: none"> <li>Web pages</li> <li>System modules</li> <li>System prototype I</li> </ul>
System Prototype	<ul style="list-style-type: none"> <li>Perform user testing.</li> <li>Analyze feedback from users.</li> <li>Improvement on the prototype based on feedback</li> </ul>	<ul style="list-style-type: none"> <li>Test case</li> <li>System prototype II</li> </ul>

### 3. Methodology

The prototyping model is a systems development method in where prototype is built, tested and reworked as necessary until an acceptable outcome is developed. This model is used for this project due to the requirements that need to interact with the stakeholders to receive their feedback and complete the system development. This model is an ideal model as it can satisfy the requirements of the stakeholders. The prototype model included phases such as planning phase, analysis phase, design phase, implementation phase and system prototype phase. In contrast, **Table 2** indicates the activities performed in every phase and their outcome.

#### 3.1 System Requirements

**Table 3** and **Table 4** show the functional and non-functional requirements respectively for the proposed system. The functional requirements are divided into six parts which are user login and registration, tool tracking and usage history, maintenance management, user management and vendor management. On the other hand, the non-functional requirements are divided into four parts which are operational, performance, security, and scalability.

**Table 3** Functional Requirements

Modules	Function
1. User Login and Registration	<ul style="list-style-type: none"> <li>The system should allow users to create their own account.</li> <li>Users can log in into the system through their ID and password only.</li> <li>The system should not allow invalid users to enter the system.</li> <li>The system should be able to indicate error message when users entered invalid ID or password or both.</li> </ul>
2. Tool Details	<ul style="list-style-type: none"> <li>The system should be able to show the status of tools.</li> <li>The system should allow users to register, update or delete the data of tools.</li> <li>The system should allow users to make tool requests.</li> </ul>
3. Maintenance Management	<ul style="list-style-type: none"> <li>The system must be able to display the maintenance status of tools and equipment.</li> <li>The system should be able to schedule maintenance tasks for the tools and equipment.</li> <li>The system should record the previous maintenance activities.</li> </ul>
4. Tool Report	<ul style="list-style-type: none"> <li>The system must be able to generate reports on usage of tools and equipment.</li> <li>The system must be able to provide reports on information about tools and equipment.</li> <li>The system should create the maintenance reports.</li> </ul>
5. Vendor Management	<ul style="list-style-type: none"> <li>The system should be able to store the information of vendors.</li> <li>The system should be able to record the history of purchases from vendors.</li> <li>The system should be able to evaluate vendor performance.</li> </ul>

**Table 4** Non-Functional Requirements

Requirements	Description
1. Operational	<ul style="list-style-type: none"> <li>The system should include user-friendly interfaces.</li> <li>The system should be able to work on most web browsers.</li> <li>The system should only access through Internet only.</li> </ul>
2. Performance	<ul style="list-style-type: none"> <li>The system should be functional for 24 hours per day.</li> <li>The system should be able to handle the number of users without slowing down the system or crashing.</li> <li>The system should always be reliable.</li> </ul>
3. Security	<ul style="list-style-type: none"> <li>The system should ensure user authentication and authorization.</li> </ul>
4. Scalability	<ul style="list-style-type: none"> <li>The system should allow increase in the number of users or workload without affecting the performance of the system.</li> </ul>

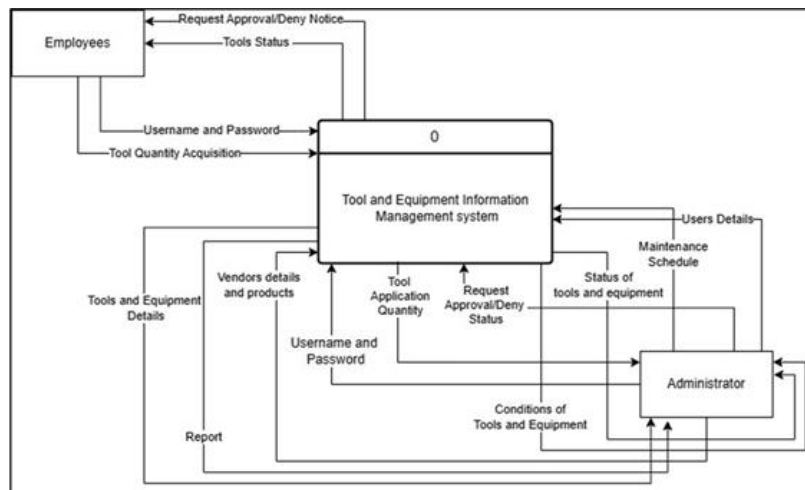
User requirement analysis is a process to determine the early phase of users' needs the early in the development process. This section will clarify some basic tasks that should be able to be done by users. **Table 5** shows the user requirements of the proposed system. The users of the system consist of employers and employees such as technicians, supervisors, and managers.

**Table 5** User Requirements

No.	User Requirements
1	User should be able to input their ID and password to login into the system.
2	User should be able to change status of tools.
3	User should be able to check-in and check-out the tools.
4	User should be able to view all history records in the system.
5	User should be able to log out of system.
6	User should be able to check the information of vendors.
7	Administrator should be able to use admin's ID and password to login into the system.
8	Administrator should be able to create accounts for new users.
9	Administrator should be able to edit the privilege for users based on their roles.
10	Administrator should be able to approve the tool requests from users.
11	Administrator should be able to log out of system.

### 3.2 System Analysis

This phase covered tasks on evaluation of collected data and existing system, analyze on the software and hardware requirements. Diagrams such as context diagram, Data Flow Diagram (DFD), Entity Relationship Diagram (ERD) and flowchart will be created in this phase. The aim for this phase is to have a deep and clear understanding of the project complexity and gain foundation for the stages of development. There are three users who will be involved in this proposed system, Administrator, Employees and Vendors. Information and data that interact between users and system will be present in **Figure 1**.

**Fig. 1** Context Diagram

There are a total of five functional modules which are user login and registration, tool details, maintenance management, tool report, and vendor management. The seven databases will store the data that come from the five modules in the proposed system. All the information is present in the data flow diagram that is shown in **Figure 2**.

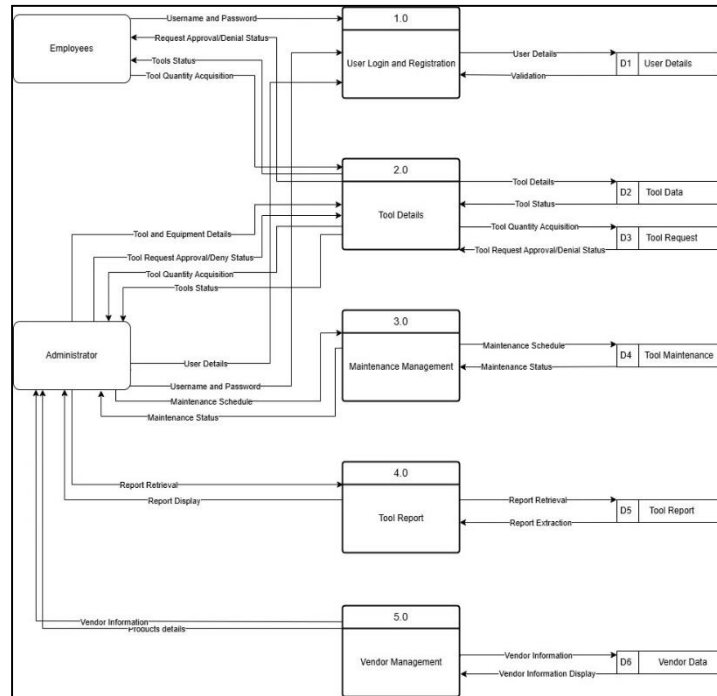


Fig. 2 Level 0 DFD

There are a total of eight entities that are shown in **Figure 3**. These entities are tool maintenance, tool data, tool request, tool report, employee information, user details, product details, and vendor information.

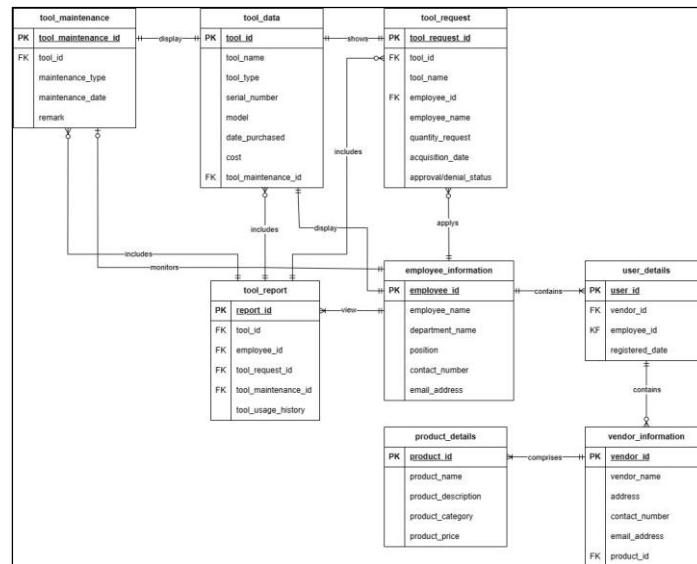


Fig. 3 Entity Relationship Diagram

**Figures 4 and 5** show the flowchart of users who will interact with the system. The flow of employees will be using the system indicated in **Figure 4**, whereas the flow of administrator will be using the system shown in **Figure 5**. The elements A, B, C, D, and E in **Figure 5** refer to user login and registration, tool details, maintenance management, tool report, and vendor management, respectively.

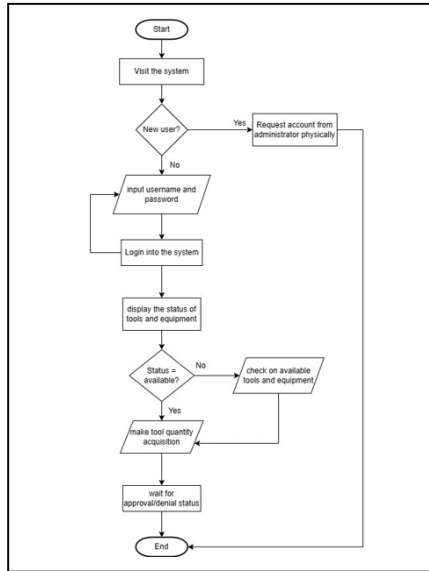


Fig. 4 Flowchart for Employees

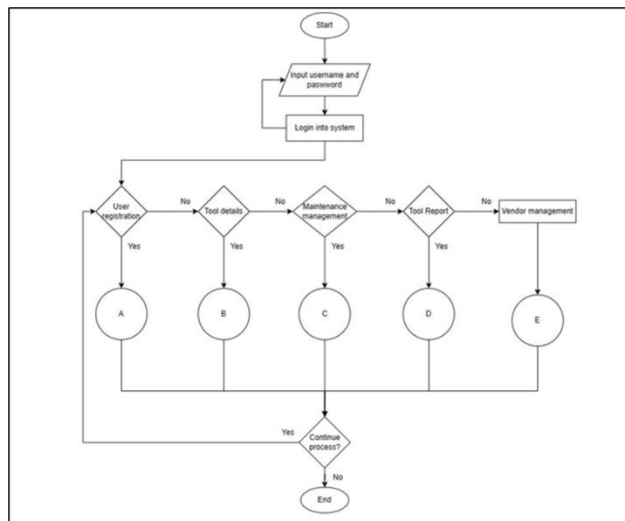


Fig. 5 Flowchart for Administrator

### 3.3 System Design

This is the third phase of prototype model where it mainly focusses on the design of the system structure. System architecture is illustrated in **Figure 6**.

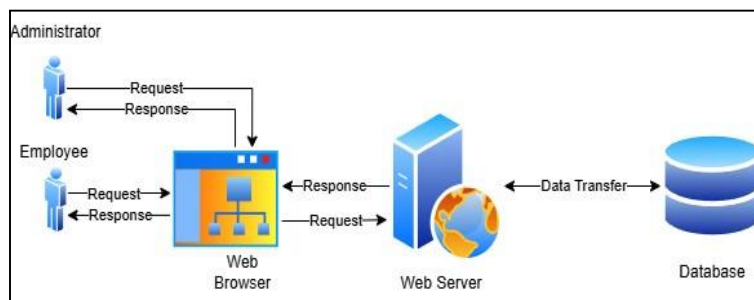


Fig. 6 System Architecture

The schema table is listed in the following.

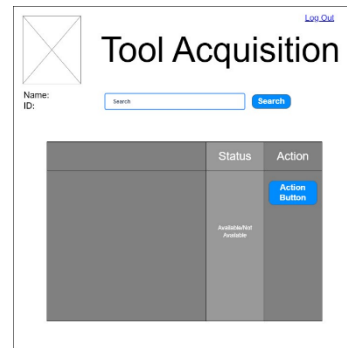
- i user\_details (user\_id (PK), vendor\_id (FK), employee\_id (FK), registered\_date)
- ii employee\_information (employee\_id (PK), employee\_name, position, contact\_number, email\_address)

- iii tool\_data (tool\_id (PK), tool\_name, tool\_type, serial\_number, model, date\_purchased, cost, tool\_maintenance\_id (FK))
- iv tool\_request (tool\_request\_id (PK), tool\_id (FK), tool\_name, employee\_id (FK), employee\_name, quantity\_request, acquisition\_date, approval/denail status)
- v tool\_maintenance (tool\_maintenance\_id (PK), maintenance\_type, maintenance\_date, remark)
- vi tool\_report (report\_id (PK), tool\_id (FK), employee\_id (FK), tool\_request\_id (FK), tool\_maintenance\_id (FK), tool\_usage\_history)
- vii vendor\_information (vendor\_id (PK), address, contact\_number, email\_address, product\_id (FK))

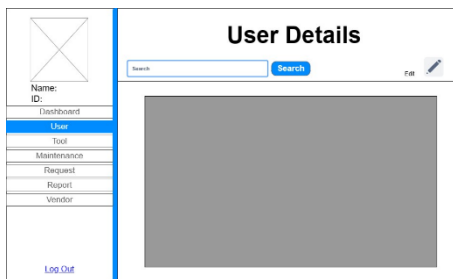
This section indicates the user interface design of the proposed system. The user interface designs will show the layout of the system interface that users will interact with. Draw.io was used to generate these designs, The proposed system’s user interface is seen in **Figures 7** through **14**.



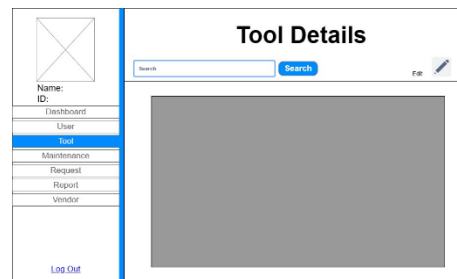
**Fig. 7** Login and Registration Interface Design



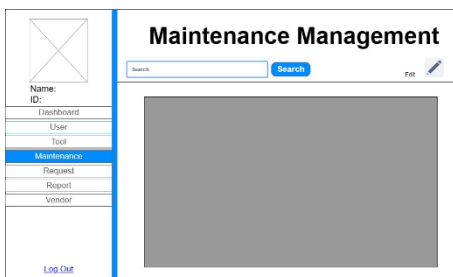
**Fig. 8** Employee Tool Acquisition Interface Design



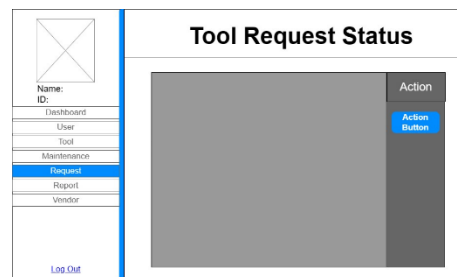
**Fig. 9** Administrator’s User Details Interface Design



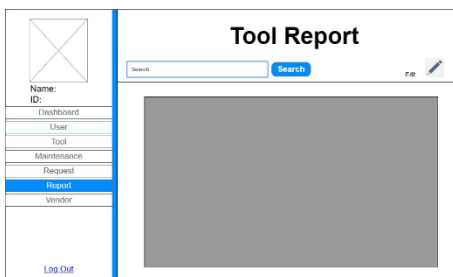
**Fig. 10** Administrator’s Tool Details Interface Design



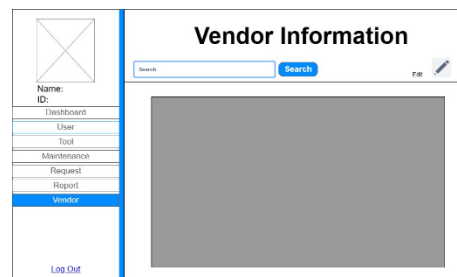
**Fig. 11** Administrator’s Maintenance Management Interface Design



**Fig. 12** Administrator’s Tool Request Interface Design



**Fig. 13** Administrator’s Tool Report Interface Design



**Fig. 14** Administrator’s Vendor Information Interface Design

### 4. Result and Discussion

The results and discussion section presents the system implementation and testing results. The Tool Management System implemented using HTML, PHP, Javascript, and CSS to develop the functional modules and the user interfaces. The main tools used in this project is XAMPP Control Panel, MySQL Database, and Visual Studio Code. There are a total of five functional modules been developed in this system which are:

1. User login and registration module allows administrator to register accounts for users and users able to login into the system with given account.
2. Tool details module allows administrator to organize the tool information.
3. Tool maintenance module allows administrator to manage the tool maintenance issues.
4. Tool report module allows administrators to view the report and assist in decision making.
5. Vendor management module allows administrator to acknowledge on the vendors information.

Figure 15 to 22 illustrate the interfaces of each functional modules in the Tool Management System.

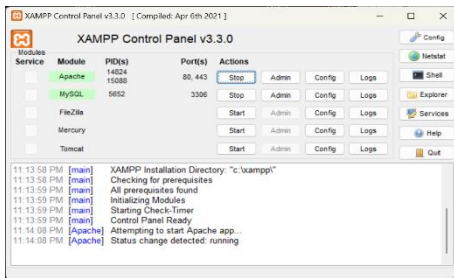


Fig. 15 XAMPP User Interface

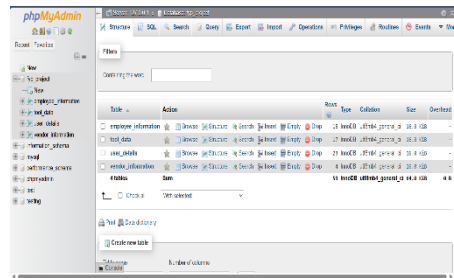


Fig. 16 MySQL Database User Interface

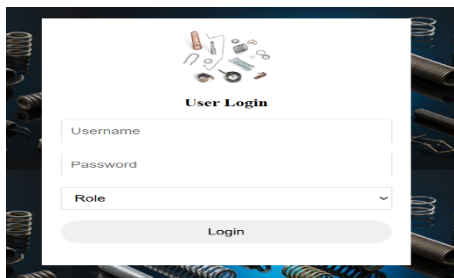


Fig. 17 User Login Interface



Fig. 18 Account Registration User Interface

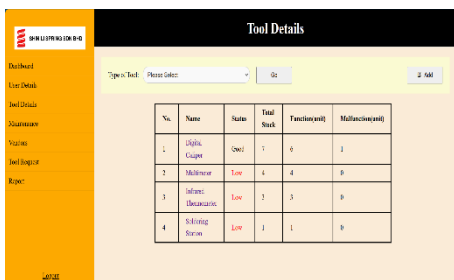


Fig. 19 User Interface of Tool Details Module

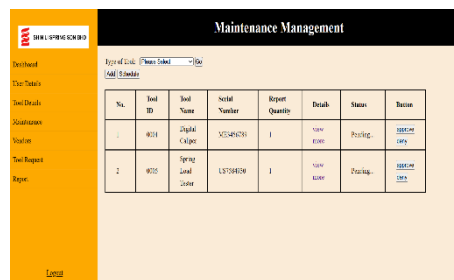


Fig. 20 User Interface of Maintenance Management Module

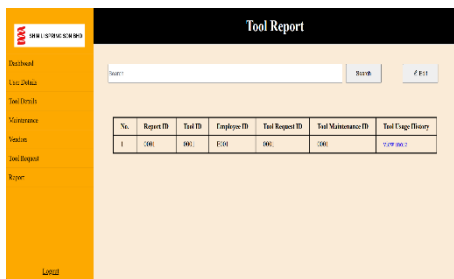


Fig. 21 User Interface of Tool Report Module



Fig. 22 User Interface of Vendor Management Module

Test cases are prepared to perform the functional test to the system. **Table 6** to **10** will explain deeply on the test case for each functional module in the Tool Management System.

**Table 6** Test Case for User Login and Registration Module

Module: User Login and Registration				
Test Case ID	Description	Expected Result	Actual Result	Result
M1-1	To check whether administrator can create user accounts	The administrator should be able to create user accounts	The administrator has successfully created for user accounts	Pass
M1-2	To check whether users can login into the system	The users should be able to login into the system	The users successfully have login in the system	Pass
M1-3	To check whether the system will block invalid users	The system should be able to block invalid users	The system can block invalid users	Pass
M1-4	To check whether the system will restrict login when invalid ID or password or both is entered	The system should be able to restrict login when wrong credentials has been entered	The system can restrict login when wrong credentials has been entered	Pass

**Table 7** Test Case for Tool Details Module

Module: Tool Details				
Test Case ID	Description	Expected Result	Actual Result	Result
M2-1	To check whether the system can show the status of tools	The system should be able to display the status of tools	The system successfully displays the status of tools	Pass
M2-2	To check whether the system allows administrator to register, update or delete the data of tools	Administrator should be able to register, update or delete the tools' data	Administrator can register, update or delete the tool's data	Pass
M2-3	To check whether the system allow users to make tool requests	The system should allow users to make tool requests	The system successfully allows users to make requests	Pass

**Table 8** Test Case for Tool Maintenance Module

Module: Maintenance Management				
Test Case ID	Description	Expected Result	Actual Result	Result
M3-1	To check whether the system can display the maintenance status of tools	The system should be able to display maintenance status	The system can display maintenance status	Pass
M3-2	To check whether the system can schedule maintenance tasks	The system should be able to schedule the maintenance tasks	The system successfully adds maintenance tasks	Pass
M3-3	To check whether the system can record previous maintenance activities	The system should be able to record the history activities of maintenance	The system can record the history activities of maintenance	Pass

**Table 9** *Test Case for Tool Report Module*

Module: Tool Report				
Test Case ID	Description	Expected Result	Actual Result	Result
M4-1	To check whether the system can generate reports on usage of tools	The system should be able to generate reports on the usage of tools	The system can successfully generate tool usage reports	Pass
M4-2	To check whether the system can provide reports on information about tools	The system should be able to provide tool information reports	The system can provide tool information reports	Pass
M4-3	To check whether the system can create maintenance reports	The system should be able to create maintenance reports	The system can create maintenance reports	Pass

**Table 10** *Test Case for Vendor Management Module*

Module: Vendor Management				
Test Case ID	Description	Expected Result	Actual Result	Result
M5-1	To check whether the system can store information of vendors	The system should be able to store information of vendors	The system successfully stored the vendors information	Pass
M5-2	To check whether the system can record the history of purchases from vendors	The system should be able to record the purchases history from vendors	The system can record the purchases history	Pass
M5-3	To check whether the system can evaluate the performance	The system should be able to evaluate the performance	The system can evaluate the performance	Pass

## 5. Conclusion

In conclusion, a web-based management system will be developed to assist the stakeholders in organizing their tools and equipment in the company. To conduct this project, research on existing systems is done to understand more about the relevant systems, which can be beneficial while developing the proposed system. Moreover, the prototype model is chosen as the system development approach to build the system, and activities are planned in each phase so that the project can be completed within the timeframe. System requirements are also explained in this project to understand the functional and non-functional requirements of the proposed system. User requirements are analyzed to know about the users' needs. Next is the system analysis, which presents a context diagram, data flow diagram, entity relationship diagram, and flowchart. Lastly, the system design illustrates the interface design of the system.

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## Conflict of Interest

Authors declare that there is no conflict of interests regarding the publication of the paper.

## Author Contribution

This journal requires that all authors take public responsibility for the content of the work submitted for review. The contributions of all authors must be described in the following manner:

The authors confirm contribution to the paper as follows: **study conception and design:** Kor Wei Yan, Nureize Arbaiy; **data collection:** Kor Wei Yan, Nureize Arbaiy; **analysis and interpretation of results:** Kor Wei Yan, Nureize Arbaiy; **draft manuscript preparation:** Kor Wei Yan, Nureize Arbaiy. All authors reviewed the results and approved the final version of the manuscript.

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