# Cloud-Based Inventory System with Quick Response (QR) Tagging for Technology Workshop

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## ABSTRACT

The study aimed to design and develop a Cloud-based Inventory System with Quick Response (QR) Tagging for Technology Workshop to manage inventory system technology workshop. Specifically, the study aimed to design and develop a cloud-based inventory system with QR tagging with the technical features: managed equipment and user data, accurate printed QR code, real-time QR code scanning for equipment, actual monitoring of reports, mobile applications with internet-synchronization. The study also aimed to test the functionality of the aforementioned technical features, evaluate the usability of the system in terms of system usefulness, information quality, interface quality, and overall usability and to develop a user's manual of the system. The method of research used was developmental and descriptive. Test cases were conducted to evaluate the identified technical features of the system. Post-Study System Usability Questionnaire (PSSUQ) a standardized research instrument was used to evaluate the system's usability. Result of the study revealed that the system's technical features has passed all test cases conducted. The usability of the system revealed that the system usefulness, information quality, interface quality, and overall usability were rated strongly agree. The user's manual will guide its target users to use the system effectively. The system can be used on workshops both in school and industry to make the inventory system fast, accurate and convenient with QR technology.

**Keywords**: real-time Quick Response (QR), scanning, mobile application, internet synchronization, PSSUQ

## INTRODUCTION

Inventory management helps companies recognize which and how much stock to order at what time. It tracks inventory from acquisition to the sale of goods. The practice identifies and responds to movements to ensure there's always sufficient stock to fulfill customer orders and proper warning of a lack. Inventory management is significant to a company's health because it helps make sure there is hardly too much or too little routine on hand, limiting the danger of stockouts and erroneous records (Jenkins, 2020).

Additionally, an inventory management system permits a company to preserve a centralized record of every asset and item in the control of the organization, as long as a single source of truth for the location of each item, vendor and supplier information, conditions, and the entire number of a particular item currently in stock. Because inventory frequently consists of movable assets, inventory management systems are crucial for keeping tabs on current stock levels and understanding what items move quickly and which items are more slow-moving, which in turn allows organizations to determine when it's time to reorder with greater accuracy (Zoho Corp., 2022)

According to Pontius (2022) Without an inventory management system, the goods and products that flow through an organization will inevitably be in disorder. Breitmeyer (2015) also mentioned that it takes more effort and physical space to keep track of paper documents, to find information and to keep details secure. When mistakes are made or changes or corrections are needed, often a manual transaction must be completely redone rather than just updated. Another impact of manual systems is on Customer service. Customer queries can be difficult to respond to as information is stored in different places and may even require that you find the right person before being able to respond.

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Technology workshops like automotive, Refrigeration and Air Conditioning, Electronics and Electricity are workshops that usually deals with a number of tools and equipment in conducting various shop activities to enhance knowledge and skills relevant to industry needs. Most of these technology workshops are still using traditional inventory wherein tools and equipment are manually counted and recorded in inventory forms which takes much time, effort and difficulty in retrieving information.

It is in this premise that this study was conducted to improve the inventory process using a Cloud-based inventory system with QR tagging to address the limitations of traditional inventory practices in technology workshops.

**Objectives of the Study**

This study aimed to develop a Cloud-based Inventory System with QR tagging.

Specifically, the study aimed to:

1. develop a cloud-based inventory system with QR tagging in terms of the following technical features:
    a. Managed equipment and user data
    b. Accurate printed QR code
    c. Real-time QR code scanning for equipment
    d. Actual monitoring of reports
    e. Mobile application with Internet- Synchronization
2. test the functionality of the technical features stated in the objectives.
3. evaluate the usability of the system in terms of:
    a. System Usefulness;
    b. Information Quality;
    c. Interface Quality; and
    d. Overall Usability.
4. develop user's manual of Cloud-based Inventory System.

**Framework of the Study**

The study used the input, process, output and outcome framework as shown in Figure 1. The inputs of the study involved review of literature, plan and design of the system. The processes phase involves System Design, Software Development and System Testing. The output of the study involves the developed Cloud-based inventory system with QR tagging and the user's manual. The outcome of the study is the efficient monitoring of inventory and tracking of equipment.

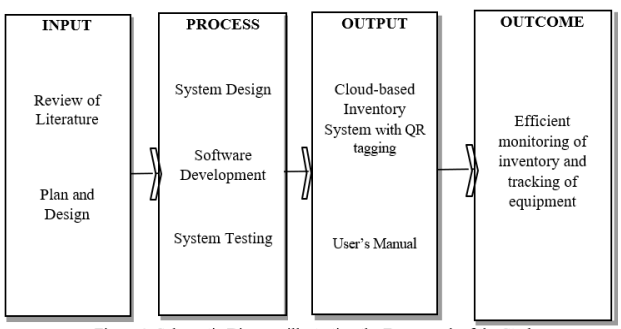

Figure 1. Schematic Diagram illustrating the Framework of the Study

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Scope and Limitation

The study focused on the design and development of Cloud-based Inventory system with QR tagging for technology workshop. The System placed online on a cloud-based platform that all intended users can access the system through a website using a Mobile, Desktop or a Laptop. The system has a user credential login managed by an administrator with an admin account both web and mobile QR application. Also discuss for regular users (ex, the staff, teacher, etc.). The Mobile QR application can view equipment list and able to scan the QR code. It can send user logs and equipment report from mobile to web-app. All features can be managed by the admin account like adding\modifying user credentials, equipment information and QR tagging. User level can only access the mobile QR application.

The admin level can access the system on any devices through web that can input and manage the information of the equipment. It can generate a QR code for tagging of equipment. All data will be stored in a cloud database. Mobile user cannot manage the inventory on mobile application. It is only for viewing, scanning and sending real time reports to the web-app. The mobile can be used offline as long as the user has already login on the first access and once the internet detected, the app will automatically synchronize and update all the data. The study is only intended for hard skills technology workshops (Automotive, Machine Shop, RAC, Electronics and Electricity). Lastly, the system will be evaluated the usability of the system using the adopted survey instrument of Post Study System Usability Questionnaire (PSSUQ).

Significance of the Study

The findings will be significant to the following:

*Administration.* The result of this study will help the organization to organize and manageable inventory system on the technology workshop.

*Technology laboratory assistant.* This study will significantly help Tech Lab assistant to have an efficient monitoring system for inventory stocks and equipment repair status.

*Faculty.* The study will help the faculty by viewing the real-time information, equipment status using mobile QR application and able to send status report.

*Property Personnel.* To simplify tracking of equipment in technology workshop by generating QR codes for tagging and user account management. Enabling comprehensive tracking of equipment maintenance.

*Future Researchers.* The findings of the study will also benefit and help future researchers as their guide in conducting researches about the inventory system and how to develop software and better improve the existing system.

**Definition of Terms**

To provide a clearer understanding of the terms used in the study, the following terms are conceptually and operationally defined.

*Actual Monitoring.* The term refers to a technique that allows you to determine the current state of queues and channels within a queue manager. The information returned is accurate at the moment the command was issued. (IBM, 2022)

In this study, actual monitoring refers to the real-time inventory, logs and equipment reports from system.

*Cloud-based.* the use of computing properties (hardware and software) that are brought as a facility over a network (typically the Internet). Cloud computing trusts remote services with a user's data, application and computation. (Gill and Chana, 2013).

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In this study, cloud-based refers to the platform being used in the system. Which means there has a hosted service used by the system instead of having a physical infrastructure.

*Functionality.* The capability of the system product to provide functions that meet stated and implied needs when the software is used under stated conditions (ISO 9126 Quality Model).

In this study, the term denotes to the effectiveness of the system requirement to its users.

*Information Quality.* Term refers to the quality of the content of data systems. It is often pragmatically defined as: "The fitness for use of the data provided." Simply put, it is having the right data obtainable at the right time and place and to the right people to run your business. (QSStudy, 2021).

As used in this study, the refers to the system's performance to give clear, fit, reliable, organized, easy to understand, and complete.

*Interface Quality*. The user interface (UI) is the point at which human users interact with a processer, website or application. The objective of effective UI is to make the user's experience easy and intuitive, requiring minimum energy on the user's part to receive maximum desired outcome (Indeed, 2021).

Operationally, the term refers to the design of the system that is simple, clear, consistent, responsive, and efficient.

*Internet-Sync.* The term means that it is connecting data from Mobile device to the server. The decent thing about this function is that if you change phones and the new phone can sync, you will be able to get back your information to your phone (Huner, 2022).

Operationally, it refers to the synchronization of the data from the cloud-server to mobile application once the internet detected.

*Inventory.* The term refers to the stock of goods held for doing business. It is usually required to carry on the business and its allied activities (Akrani, 2012).

In this study, inventory refers to the equipment stock in the technology workshop.

*Overall Usability.* Usability denotes to the quality of a user's experience when interacting with products or systems, including websites, software, strategies, or applications ("Usability Evaluation Basics | Usability.gov," n.d.).

As used in this study, the term states to the system's performance to achieve excellence in terms of usefulness, effectiveness, efficiency, and user's overall satisfaction

*QR Code.* Also named as quick response code (QR code) is a type of level bar code that contains of square black modules on a white upbringing. QR codes are designed to be read by smartphones. Because they can carry information together vertically and horizontally, they can provide a vast amount of information, plus links, text or other data (Chura, 2011).

In this study, QR code refers to the added feature to the system that will be the generated and will be tagged to the equipment.

System Usefulness. The quality of the data system processing itself, including software and data components. (Gorla et al., 2010).

As used in this study, the term refers to the system's performance to help the user become creative and efficient by completing the tasks on time.

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# METHODOLOGY

This section discusses the Research Design, Design Criteria, Software Life Cycle Model, System Design, Software Development Phases which comprises the Application Development and System Testing.

## Research Design

This study adopts the developmental-descriptive method of research. According to Catane (2000), developmental research refers to the systematic work drawing on existing knowledge gained from practical experiences directed to produce new materials, products, and devices, install new processes, systems, and services and improve substantially those already made installed. Meanwhile, Calderon (2010) defined descriptive research as a purposive process of gathering, analyzing, classifying and tabulating data about prevailing conditions, practices, beliefs and cause-effect relationships and then making an adequate and accurate interpretation about such data. The development of the inventory system comprises the developmental research and the evaluation of the system's usability using PSSUQ comprises descriptive research. Furthermore, the study employed software designing and development patterned in PASUC VI guidelines.

## Respondents of the Study

The respondents of the study were the thirty experts and end users categorized as follows, 10 Shop faculty, 10 Staff and 10 IT Experts. They were chosen through purposive sampling. Table 1 shows the frequency distribution of the respondents of the study. The statistical used in the study is the frequency and mean.

Table 1 Respondents of the Study

| Groupings | f | % |
|---|---|---|
| Shop Faculty | 10 | 33.3% |
| Staff | 10 | 33.3% |
| IT Expert | 10 | 33.3% |

## Design Criteria

The design criteria used in the study was based on the different features of the system in order to evaluate the recommended designs of system and test procedures.

These are the main features of Cloud-based Inventory System with Quick Response (QR) tagging for Technology Workshop:

a. Inventory Management. The system provides management functions such as adding, updating, viewing, and deleting data. Sorting and filtering of the data or information are also delivered.

b. Cloud Platform. All data are stored to cloud database and able to access the system anywhere as long as connected to the internet.

c. User Level Authentication. The system has separate account with user-level management for admin and user.

d. Generating QR Code. The system able to generate QR code for equipment tagging.

e. Real-Time monitoring and notification. Monitoring of equipment status through servicing reports and notifications alerts.

f. Compatibility in a different browser. The users can access the system using a commonly available network browser.

g. Mobile Application. The mobile app can scan the QR code and able to send equipment report status to the system.

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## Software Life Cycle Model

Software Development Life Cy le (in short SDLC) is a work flow process which defines the core staged and activities of development cycles. It can be used by system analyst, designers and developers to plan and implement the system and deliver the systems or goods on time and within budget. With numerous of development methodologies, it is never an easy task to choose an appropriate strategy that sometimes even it is inevitable to mix-and match multiple methodologies to fit in a single project (Tiky, 2016).

The researcher used the Agile software process, an iterative and incremental based development, where requirements are changeable according to customer needs. It helps in adaptive development, iterative development and period boxing. It is a theoretical background that promotes foreseen interactions throughout the development cycle. SDLC is a framework that describes the activities performed at each stage of a software development life cycle. The software development activities such as planning, analysis, design, coding, testing and maintenance which need to be performed according to the demand of the customer Sharma, Sarkar and Gupta, (2012). Agile is an iterative method to project management and software advance that helps teams deliver value to their customers quicker and with fewer headaches. Requirements, plans, and results are evaluated continuously so players have a natural mechanism for responding to change quickly (Atlassian, 2021).

In conclusion, agile thinking is a people-centric view to software development. People- centered strategies have been argued for as an important source of competitive advantage, because, unlike technology, cost, or new product development, these human strategies are difficult to imitate (Pfeffer 1998; Millerand Lee 2001).

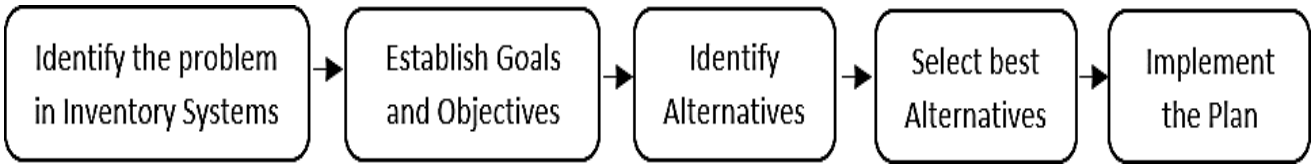


Fig. 2 Phases of Agile Process

Through this model, the system will be guided to design and develop the Cloud-based Inventory System with QR tagging for Technology Workshop. Agile is very important that can help the researcher in designing and building the system. It helps to analyze and improve system throughout the development process.

## Planning

The planning was the first phase in Cloud-based Inventory System with QR tagging for Technology Workshop. During this phase the researcher meets different businesses, restaurants and schools in Negros Occidental to observe their inventory process. The researcher determines the main problem of the Technology Workshops in terms of inventory process and tracking repair status of their hard skills equipment. Technology Workshop don't have an existing system to help them on their inventory management. After several discussions, the proponent finalized the project requirements and the researcher defined the project goals, expectations and the scope for the implementation of a cloud-based inventory system.

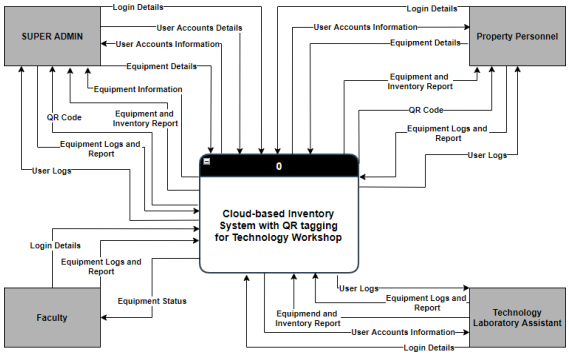


Fig. 3 Planning Phase Diagram

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## Analysis

The researcher conducted interviews to Warehouses and other business in order to determine the existing inventory systems used by nowadays. During the interview, specific questions regarding to what inventory monitoring system or application are used by the business owners were asked. Through the data gathered from different companies located in Negros Occidental, the researchers came upon a finding that most businesses in Negros Occidental do not have efficient inventory system, most of them used local database inventory (see Figure 4).

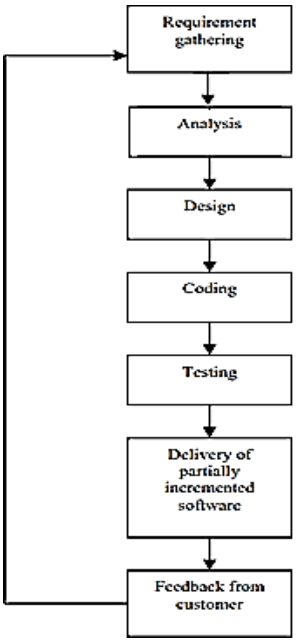


Fig 4. Data Flow Diagram Level 0

The researcher aims to help Technology Workshop inventory management, gathered all the information from faculties and workshop staff as described in Fig. 5.

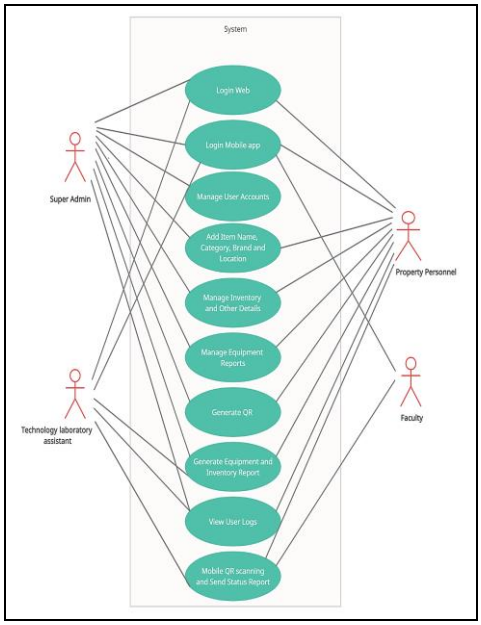


Fig. 5 Data Flow Diagram Level 1

Thus, the result of this phase will help the researcher select the best tools for the development of the proposed system that can provide a concrete solution for the problems encountered by Technology Workshop.

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The ERD (Figure 6) illustrates the interrelationships between entities in the database of the application. Each entity represents a database table. The relationship lines represent the keys in one table that point to specific records in related tables; it is used to visualize a relational database.

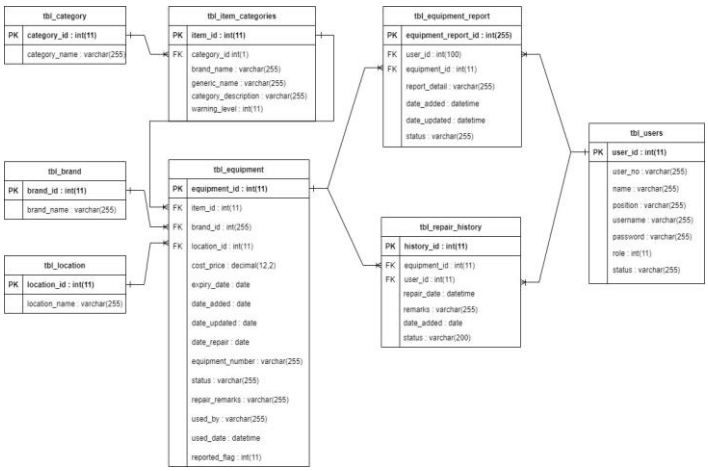


Fig. 6 Entity Relationship Diagram

In this study the Cloud-based Inventory System with QR tagging for Technology Workshop use the case diagram (see Fig. 7) for visualization of the relationship and interaction between the user and the system process.

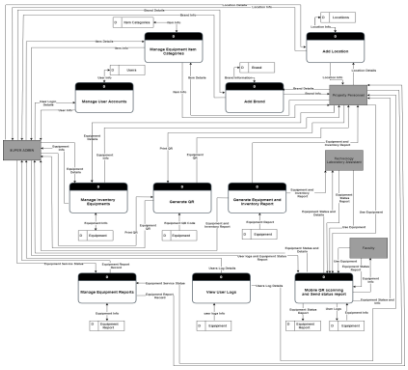

Fig. 7 Use Case Diagram

## Coding

In this phase the researcher determines the module and programming languages to be used both web and mobile app. The development of website will be using php, java, MySQL, jQuery and bootstrap. For mobile QR app will be using JavaScript and react native. For the database will be using a cloud-hosting for the storage of the data. Researcher will implement the design in the best manner which aims to deploy a working system. The system will undergo various stages of improvement, so it includes simple, minimal functionality.

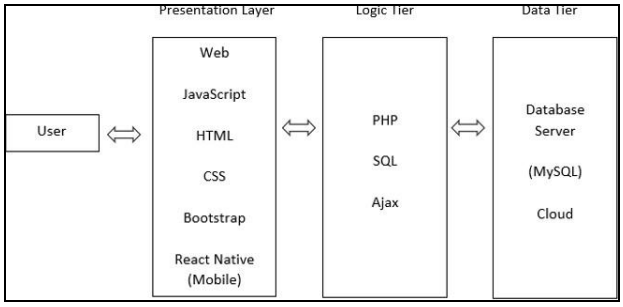


Fig. 8 Three-layer Architecture

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**Testing**

This phase will be having initial and final testing. In the initial testing the researcher will determine the performance and functionality of each feature of the proposed system. The initial testing will be conducted by using the web and mobile application functionality in terms of the following features: Managing equipment and user data, printing QR code, mobile scanning and real-time monitoring of reports. The system is evaluated using the standardize PSSUQ survey questionnaire in terms of system usefulness, information quality, interface quality and overall usability.

Testing plays an important role in achieving and assessing the quality of a software product. On the one hand, we improve the quality of the products as we repeat a test–find defects–fix cycle during development. On the other hand, we assess how good our system is when we perform system-level tests before releasing a product. Thus, as Friedman and Voas have succinctly described, software testing is a verification process for software quality assessment and improvement. Generally speaking, the activities for software quality assessment can be divided into two broad categories, namely, static analysis and dynamic analysis. By performing static and dynamic analyses, practitioners want to identify as many faults as possible so that those faults are fixed at an early stage of the software development. Static analysis and dynamic analysis are complementary in nature, and for better effectiveness, both must be performed repeatedly and alternated. Practitioners and researchers need to remove the boundaries between static and dynamic analysis and create a hybrid analysis that combines the strengths of both approaches (Naik and Tripathy, 2018).

Based on the user feedback, the researcher will consider the adjustment of the proposed system for the final testing and enhancement of the system overall.

Mainline functions: Testing the main functions of the system both web and mobile application.

Basic Usability: It involves basic usability testing of the system. It checks whether a user can freely navigate through the screens both web and mobile without any difficulties.

Accessibility: Checks the accessibility of the system both web and mobile application for the user.

Error Conditions: Usage of testing techniques to check for error conditions. It checks whether suitable error messages are displayed.

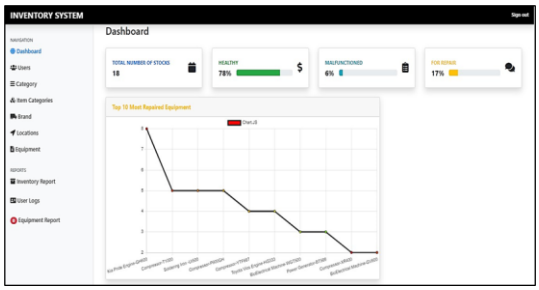


Fig. 9 Cloud-based Inventory System with QR Tagging Architecture

Figure 9 shows the basic overview of the Cloud-based Inventory System with QR tagging for Technology Workshop structure. Admin can access the system through web browsers.

All equipment information will be stored in cloud-database and can generate and print QR code for tagging. Users are able to view the equipment information and able to send report by using the mobile app. It will show the equipment name, date purchased, repair status and other information.

## RESULTS

This chapter deals with the presentation, analysis and interpretation of data that were gathered in based on the objectives of the study.

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Technical Features of the Cloud-based Inventory System with QR tagging for Technology Workshop

The first objective of the study was to design and develop a Cloud-based Inventory System with QR tagging for Technology Workshop. The researcher was able to determine the appropriate design for outline usability of the study.

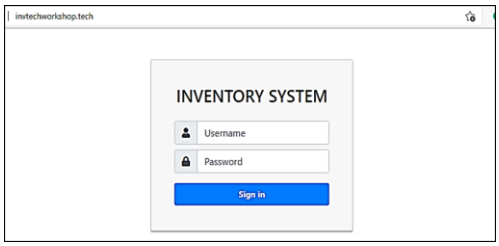


Fig. 10 WEB Login Page

Figure 10 shows the WEB Login Page for the Super Admin, Personnel and Technology Laboratory Assistant. This page is where the Personnel and Technology Laboratory Assistant gain access to the web once they have already account created by Super Admin, it will grant them to access to the main page.

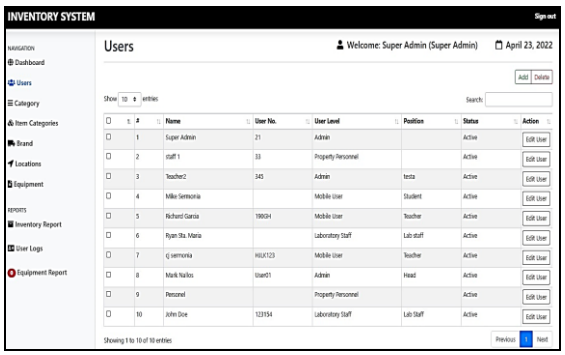


Figure 11. Dashboard

Figure 11 shows the Dashboard for total no. of stocks, total percentage of all the equipment status, Top 10 most repaired and top 10 most used equipment. A real time monitoring report that can help the user to check the condition of the equipment.

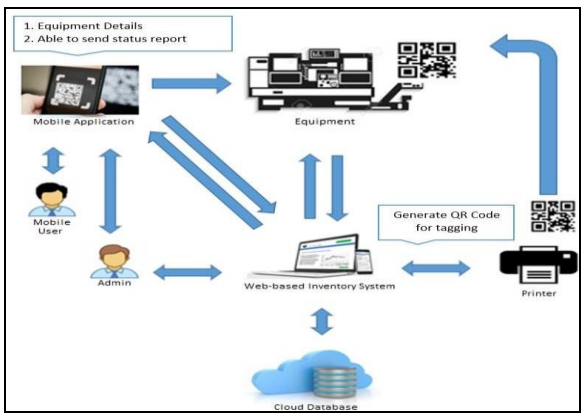


Fig. 12 User Page

Figure 12 shows the User Page where can Super Admin can create account for the users. It can add, delete and modify user details such as: Name, User No., User level, Position and Status. Only Super Admin has the access rights for user account management. For Personnel level, user able to access all feature both web and mobile except for user account management. For Laboratory assistant level, user not able to manage any page modules in web only generating reports (Equipment and Inventory) and able to access all mobile feature. For faculty level, user don't have the access for web only mobile and its features.

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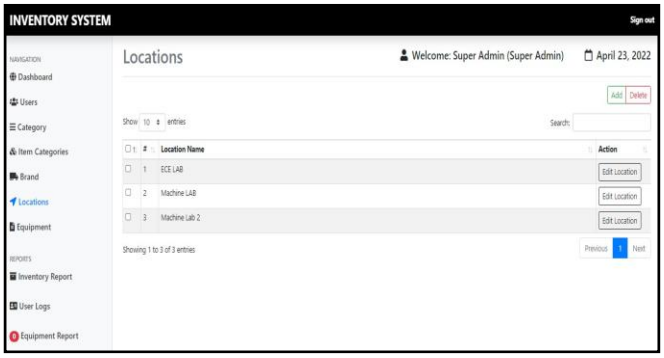


Fig.13 Category

Figure 13 shows the Category Page where can Super Admin and Property Personnel can add Category Name. By clicking the add button user able to add and it can also modify a Category name. Deleting a Category details is basically by ticking the small box and click delete button.

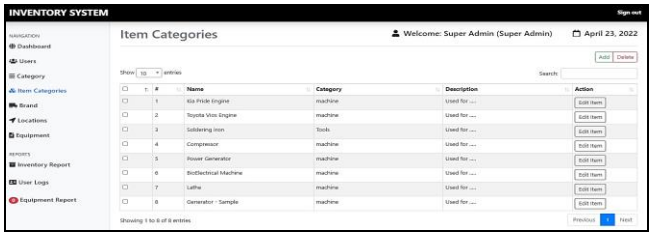


Fig. 14 Item Categories Page

Figure 14 shows the Item Categories Page where can Super Admin and Property Personnel can add and delete equipment details. By clicking the add button user able to add and it can also modify an Equipment name, category and description. Deleting an equipment detail is basically by ticking the small box and click delete button.


Fig. 15 Brand Page

Figure 15 shows the Brand Page where can Super Admin and Property Personnel can add Brand Name. By clicking the add button user able to add and it can also modify a Brand name. Deleting a Brand details is basically by ticking the small box and click delete button.

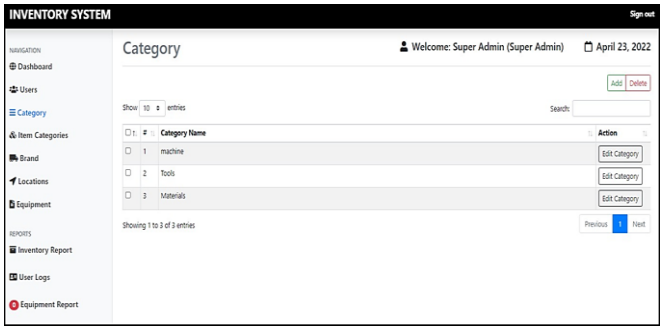


Fig. 16 Locations Page

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Figure 16 shows the Location Page where can Super Admin and Property Personnel can add Location Name. By clicking the add button user able to add and it can also modify a Location name. Deleting a Location name is basically by ticking the small box and click delete button.

The Equipment page (see Fig. 17) where can Super Admin and Property Personnel can add Equipment Details. By clicking the add button user able to add and modify Equipment, Brand, Location, Engine Number, Engine Cost and Purchase date. On the Action Buttons, user able to see 3 buttons “Edit Items”, “Print QR” and “History”. For choosing “Edit button”, user able to update equipment details, equipment status (Healthy, for Repair and Malfunctioned) and date for the schedule of repair. For choosing “print QR”, user able to generate QR Code

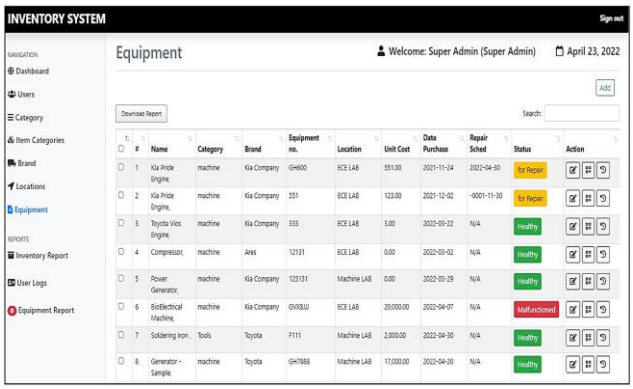


Fig. 17 Equipment Page for the equipment tagging. For choosing “History button”, user able to see equipment history. By clicking Excel button at the upper right, user able to download the excel file for the equipment report.

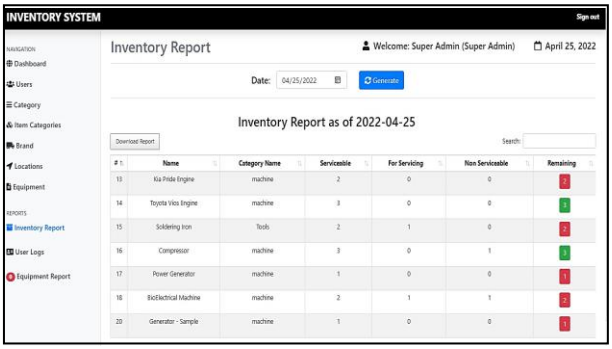


Fig. 18 Inventory Report Page

Figure 18 shows the Inventory Report Page where can Super Admin, Property Personnel and Laboratory assistant can view inventory report details and able to generate excel file. There are indicators for stock warning level, 2 stocks below will change its color into red and 3 stocks above will change it to green. User able to adjust the inventory report date by choosing a date and clicking the generate button.

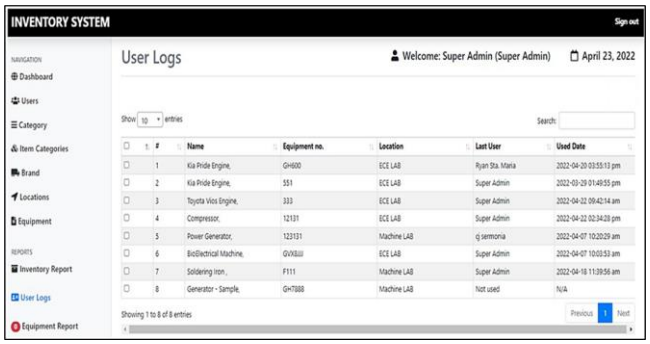


Fig. 19 User Logs Page

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Figure 19 shows the User Logs Page where can Super Admin, Property Personnel and Laboratory assistant can view User Logs details and Equipment details used by the users.

The Equipment Report Page (see Fig. 20) where the Super Admin, Property Personnel and Laboratory assistant can view equipment report details. Once the Super Admin able to receive a report from a Mobile user, Admin

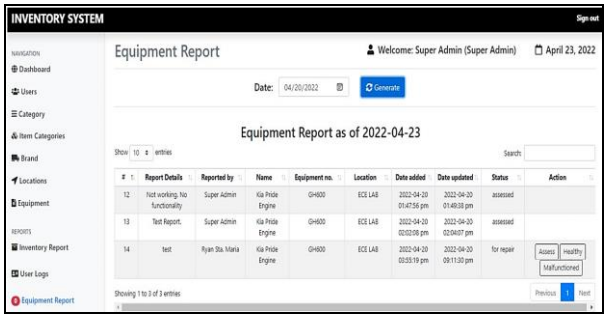


Fig. 20 Equipment Report Page

able to see buttons: Scheduled for repair, Malfunctioned and Assess. Admin also able to change Healthy status once successfully repaired. Admin Users able to adjust the equipment report date by choosing a date and clicking the generate button.


Fig. 21 Mobile Login Page

Figure 21 shows the Mobile Login Page for the Super Admin, Personnel, Technology Laboratory Assistant and Faculty. This page is where the Personnel and Technology Laboratory Assistant gain access to the Mobile once they have already account created by Super Admin, it will grant them to access to the main page.

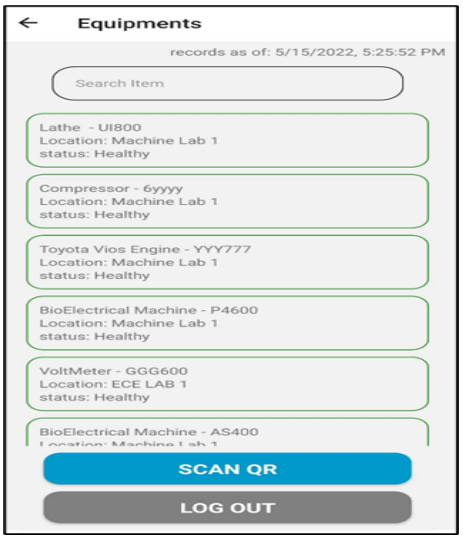


Fig. 22 Equipment List

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Figure 22 shows the Equipment List, where mobile user will be able to see the updated list of equipment both online and offline. It will notify the user if there's no connection. By clicking yes, user will be able to use the app by the following features: viewing equipment list and QR scanning.


Fig. 23 Mobile Scan Page

Figure 23 shows the Mobile Scan Page for the Super Admin, Personnel, Technology Laboratory Assistant and Faculty. User able to scan the QR code tagged to the equipment.

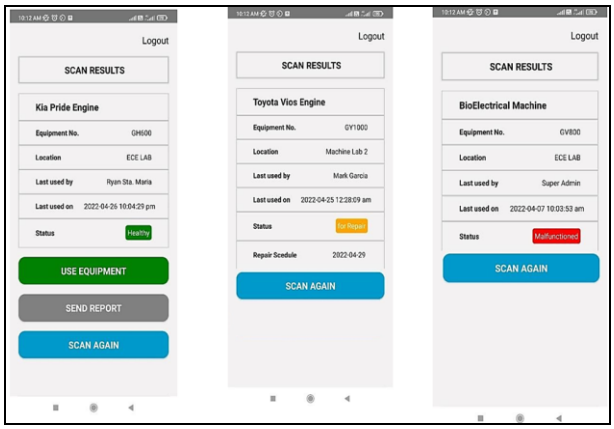


Fig. 24 Mobile Result Page

Figure 24 shows the Mobile Result Page for the Super Admin, Personnel, Technology Laboratory Assistant and Faculty. User able to see all the details of the equipment. By clicking use equipment, it means that user will use the equipment on that day and time and it will send user log in web. By clicking send report, user can send report by typing it on the popup text field and clicking the send report button. By clicking scan again, it will redirect to scan page to rescan a new QR code.

**Test the Functionality of the System Technical Features**

The second objective of the study was to test the functionality of the system based on its technical features using a test case.

The test case results of the Cloud-based Inventory System with Quick Response (QR) tagging for Technology Workshop among end-users and IT experts in terms of system usefulness, information quality, interface quality and overall satisfaction using the parameters of PSSUQ-3. The system acceptability results are shown in Table 3 and 4.

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Table 2 Summary of the Functionality Test Results

| No. | Features | Results |
|---|---|---|
| 1 | Managed equipment and user data | Passed |
| 2 | Accurate printed QR code | Passed |
| 3 | Real-time QR code scanning for equipment | Passed |
| 4 | Actual monitoring of reports | Passed |
| 5 | Internet-Sync in Mobile application | Passed |

Table 2 presents the test results in the Cloud-based and Inventory System with Quick Response (QR) tagging for Technology Workshop. The researcher conducted the tests by adding equipment details to generate QR code, creating user accounts, conducting real time mobile scanning and actual monitoring of equipment and inventory report. For mobile feature the researcher was able to use the mobile application while offline and once internet is detected the data will synchronize automatically. All features are working based on the test cases conducted on the system which can be seen in Appendix A and B.

**Evaluation of the System Usability**

The third objective of the study was to assess the level of usability of the Cloud-based Inventory System with Quick Response (QR) tagging for Technology Workshop among end-users and IT experts in terms of system usefulness, information quality, interface quality and overall satisfaction using the parameters of PSSUQ-3. The system acceptability results are shown in the Table 3.

Table 3 Mean score in the level of Usability of Cloud-based and Inventory System with Quick Response (QR) tagging for Technology Workshop

| PSSUQ Criteria | Mean |
|---|---|
| System Usefulness | 1.47 |
| Information Quality | 1.54 |
| Interface Quality | 1.42 |
| Overall Usability | 1.48 |

| Criteria | M |
|---|---|
| 1. Overall, I am satisfied with how easy it is to use this system. | 1.50 |
| 2. It was simple to use this system. | 1.47 |
| 3. I was able to complete the tasks and scenarios quickly using this system. | 1.60 |
| 4. I felt comfortable using this system. | 1.33 |
| 5. It was easy to learn to use this system. | 1.37 |
| 6. I believe I could become productive quickly using this system. | 1.57 |
| 7. The system gave error messages that clearly told me how to fix problems. | 1.70 |
| 8. Whenever I made a mistake using the system, I could recover easily and quickly. | 1.63 |
| 9. The information (such as online help, on-screen messages, and other documentation) provided with this system was clear. | 1.47 |
| 10. It was easy to find the information I needed. | 1.57 |
| 11. The information was effective in helping me complete the tasks and scenarios. | 1.47 |
| 12. The organization of information on the system screens was clear. | 1.43 |
| 13. The interface of this system was pleasant. | 1.43 |
| 14. I liked using the interface of this system. | 1.37 |
| 15. This system has all the functions and capabilities I expect it to have. | 1.50 |
| 16. Overall, I am satisfied with this system. | 1.37 |
| As a whole | 1.48 |

Table 3 presents the mean score in the level of usability of the Cloud-based and Inventory System with Quick Response (QR) tagging for Technology Workshop. The results revealed the overall mean score of 1.48 interpreted as strongly agree based on the PSSUQ Norm. The data further revealed that the highest mean score of 1.54 on the aspect of Information Quality interpreted as strongly agree. On the other hand, the lowest mean score was 1.42 on the aspect of Interface Quality. The findings simply that the Cloud-based and Inventory System with Quick Response (QR) tagging for Technology Workshop further was within the minimum standard requirement. The PSSUQ results serve as the basis of the acceptability of the system. According to Seffah et al. (2006), usability is increasingly recognized as an important quality factor for interactive software systems, including traditional GUIs-style applications, Web sites, and the large variety of mobile and PDA interactive services. Unusable user interfaces are probably the single largest reasons why encompassing interactive systems – computers plus people, fail in actual use.

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Among the four subscales, the Interface Quality obtained the lowest mean score, which means that the evaluators are satisfied with the visual part of the web application as confirmed by the results of a Research on the "Usability evaluation of a health care application based on IPTV." (Rebeiro et al., 2015)

Table 4 PSSUQ -3 Norms (Means and 99% Confidence Level Interval)

| | PSSUQ (Current) | | | PSSUQ (Original) | | | CSUQ (Original) | | |
|---|---|---|---|---|---|---|---|---|---|
| *Item* | *Lower Limit* | *Mean* | *Upper Limit* | *Lower Limit* | *Mean* | *Upper Limit* | *Lower Limit* | *Mean* | *Upper Limit* |
| Q1 | 2.60 | **2.85** | 3.09 | 3.36 | **4.00** | 4.64 | 3.12 | **3.30** | 3.48 |
| Q2 | 2.45 | **2.69** | 2.93 | 3.40 | **4.02** | 4.64 | 3.36 | **3.54** | 3.72 |
| Q3 | 2.58 | **2.85** | 3.11 | 3.07 | **3.73** | 4.40 | 2.73 | **2.91** | 3.09 |
| Q4 | 2.86 | **3.16** | 3.45 | 3.53 | **4.15** | 4.76 | 3.09 | **3.27** | 3.45 |
| Q5 | 2.79 | **3.06** | 3.34 | 3.37 | **3.98** | 4.59 | 3.05 | **3.23** | 3.41 |
| Q6 | 2.40 | **2.66** | 2.91 | 2.75 | **3.41** | 4.07 | 2.77 | **2.95** | 3.13 |
| Q7 | 2.07 | **2.27** | 2.48 | 2.92 | **3.57** | 4.22 | 3.61 | **3.82** | 4.03 |
| Q8 | 2.54 | **2.86** | 3.17 | na | **na** | na | 3.40 | **3.61** | 3.82 |
| Q9 | 3.36 | **3.70** | 4.05 | 4.38 | **4.93** | 5.48 | 4.58 | **4.79** | 5.00 |
| Q10 | 2.93 | **3.21** | 3.49 | 3.64 | **4.18** | 4.73 | 3.82 | **4.03** | 4.24 |
| Q11 | 2.65 | **2.96** | 3.27 | 3.87 | **4.48** | 5.09 | 3.94 | **4.15** | 4.36 |
| Q12 | 2.79 | **3.09** | 3.38 | 3.42 | **4.02** | 4.63 | 4.11 | **4.32** | 4.53 |
| Q13 | 2.37 | **2.61** | 2.86 | 3.15 | **3.79** | 4.43 | 3.95 | **4.13** | 4.31 |
| Q14 | 2.46 | **2.74** | 3.01 | 2.81 | **3.43** | 4.04 | 3.70 | **3.88** | 4.06 |
| Q15 | 2.41 | **2.66** | 2.92 | 3.02 | **3.55** | 4.08 | 3.43 | **3.61** | 3.79 |
| Q16 | 2.06 | **2.28** | 2.49 | 2.32 | **2.91** | 3.51 | 3.01 | **3.19** | 3.37 |
| Q17 | 2.18 | **2.42** | 2.66 | 2.37 | **2.92** | 3.47 | 3.02 | **3.20** | 3.38 |
| Q18 | 2.51 | **2.79** | 3.07 | 2.44 | **3.00** | 3.56 | 3.47 | **3.68** | 3.89 |
| Q19 | 2.55 | **2.82** | 3.09 | 3.10 | **3.69** | 4.29 | 3.13 | **3.31** | 3.49 |
| SysUse | 2.57 | **2.80** | 3.02 | 3.26 | **3.81** | 4.36 | 3.19 | **3.34** | 3.49 |
| InfoQual | 2.79 | **3.02** | 3.24 | 3.58 | **4.06** | 4.54 | 3.95 | **4.13** | 4.31 |
| IntQual | 2.28 | **2.49** | 2.71 | 2.42 | **2.93** | 3.43 | 3.17 | **3.35** | 3.53 |
| Overall | 2.62 | **2.82** | 3.02 | 3.30 | **3.76** | 4.22 | 3.43 | **3.61** | 3.79 |

Table 4 shows the PSSUQ Norm. The PSSUQ Norm is a PSSUQ Mean score database that is collated from other systems. The standard provides a comparison reference to the System being studied if their product is comparable or better than the rest (with a 99 percent confidence interval). To conform to the industry requirements, the mean achieved by the System should be within the specified mean ranges in PSSUQ Norm.

Table 5

Mean score in the level of Usability of Cloud-based Inventory System with Quick Response (QR) tagging for Technology Workshop as a whole

Table 5 shows the results of the survey from the respondents. After computing the mean of the different subscales, the strength of deviation of whether the system is within the accepted standard was then normalized to the PSSUQ Norm showed in Table 4.

Table 5 presents the summary of mean scores on the level of usability of the Cloud-based Inventory System with Quick Response (QR) tagging for Technology Workshop as a whole as evaluated by the ten (10) Shop Faculty, ten (10) Staff and ten (10) IT Experts.

The level of overall usability of the system is very high (M = 1.48) as the questionnaire has used a seven- point response scale with lower scores indicating better performance. The average mean score of the Overall Usability of 1.48 is higher than the mean score for the the Overall Usability based on the PSSUQ Norm 3 which is 2.82.

**System Usefulness**

Table 6 shows the summary of responses from items 1 to 6 of the usability questionnaire. These items were the basis for identifying the System Usefulness (SYSUSE). Item 1 achieved the highest perceived mean indicating that most of the respondents are overall satisfied with how easy it is to use the system.

Table 6 Mean Score in the level of System Usefulness of the System

| Criteria | M |
|---|---|
| 1. Overall, I am satisfied with how easy it is to use this system. | 1.50 |
| 2. It was simple to use this system. | 1.47 |
| 3. I was able to complete the tasks and scenarios quickly using this system. | 1.60 |
| 4. I felt comfortable using this system. | 1.33 |
| 5. It was easy to learn to use this system. | 1.37 |
| 6. I believe I could become productive quickly using this system. | 1.57 |
| System Usefulness (SYSUSE) | 1.47 |

Based on the means from items 1 to 6, the System Usefulness of the Cloud-based Inventory System with Quick Response (QR) tagging for Technology Workshop is 1.47. Comparing this value to the PSSUQ Norm,

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the developed system is within the required industry standard of 2.80 indicating that the quality of the system bears the ability to satisfy stated or implied needs.

Among the subscales, the first subscale or the System Usefulness received the second- highest score. This result is confirmed by several studies that used PSSUQ, such as the study on the "Mobile phone apps for the prediction of prostate cancer: External validation of the Coral and Rotterdam apps" Most of the available studies on mobile phone apps concentrate on usefulness and not on the accuracy of the information given by the app (De Nunzio et al., 2019).

**Information Quality**

Table 7 shows the summary of responses from items 7 to 12 of the usability questionnaire. These items were the basis for identifying the Information Quality (INFOQUAL). Item 12 achieved the highest perceived mean score indicating that the organization of information of the system screens was clear.

Table 7 Mean Score in the level of Information Quality of the System

| Criteria | M |
|---|---|
| 7. The system gave error messages that clearly told me how to fix problems. | 1.70 |
| 8. Whenever I made a mistake using the system, I could recover easily and quickly. | 1.63 |
| 9. The information (such as online help, on-screen messages, and other documentation) provided with this system was clear. | 1.47 |
| 10. It was easy to find the information I needed. | 1.57 |
| 11. The information was effective in helping me complete the tasks and scenarios. | 1.47 |
| 12. The organization of information on the system screens was clear. | 1.43 |
| Information Quality (INFOQUAL) | 1.54 |

Based on the mean score from items 7 to 12, the Information Quality of the Cloud-based Inventory System with Quick Response (QR) tagging for Technology Workshop is 1.54.

Comparing this value to the PSSUQ Norm, the developed system is within the required industry standard of 3.02 indicating that the quality of the system bears the ability to satisfy stated or implied needs. According to Sauro and Lewis, the item that has earned the lowest ranking since the introduction of the PSSUQ is item 7. Sauro and Lewis also added that the average ratings of InfoQual tend to be poorer than the average scores of other subscales (Sauro, J., & Lewis, J. R., 2016). Moreover, in the study "Usability Web Analysis Using PSSUQ Method (Case Study on SME's Websites Application Fostered of Dispora Bandung Indonesia) "the results of the study show that the SMEs web application in general is well received by the user, both on the application made, the usability of the application can help to promote SMEs products and the quality of the interface. The results of the study indicate that there is a need for improvements related to the quality of information in the catalog of products (Lestari S. & Bahri S., 2020).

**Interface Quality**

Table 8 shows the summary of responses from items 13 to 16 of the usability questionnaire. These items were the basis for identifying the Interface Quality (INTERQUAL). Item 14 and 16 achieved the highest mean score indicating that most of the respondents liked the interface and overall satisfied with the system.

Table 8 Mean Score on the Interface Quality of the System

| Criteria | M |
|---|---|
| 13. The interface of this system was pleasant. | 1.43 |
| 14. I liked using the interface of this system. | 1.37 |
| 15. This system has all the functions and capabilities I expect it to have. | 1.50 |
| 16. Overall, I am satisfied with this system. | 1.37 |
| Interface Quality (INTERQUAL) | 1.42 |

Based on the mean score from items 13 to 16, the Cloud-based Inventory System with Quick Response (QR) tagging for Technology Workshop is 1.42. Comparing this value to the PSSUQ Norm, the developed system is within the required industry standard of 2.49 indicating that the quality of the system bears the ability to satisfy the stated or implied needs.

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In the study "Development of the Telehealth Usability Questionnaire (TUQ) "The Interface Quality sub-scale deals with how pleasant the system was to use for the consumer. It measures if s/he liked the system and if the system had all the functionality and capabilities s/he expected. Interface quality measures the interaction between the patient and the telemedicine technology or computer system. This includes the quality of the graphical user interface, navigation ease, and an overall impression of how the patient interacts with the telehealth system (Parmanto et al., 2016)

**Development of the User's Manual**

The last objective of the study was to develop a user manual for Monitoring and Inventory System with Quick Response (QR) tagging for Technology Workshop. The manual was developed consisting of all essential information for the user to make full use of the system. The manual includes a feature of the system, functions, and capabilities. The purpose was to guide the end-user on how to use the system.

## DISCUSSION

This presents the summary of findings, conclusions and recommendations based on the objective of the study.

**Summary of Findings**

1. The Cloud-Based Inventory System with Quick Response (QR) Tagging for Technology Workshop has the following technical features: Managed equipment and user data, Accurate printed QR code, Real-time QR code scanning for equipment, Actual monitoring of report. The system has a mobile application for scanning and management that has an offline mode where in the user could still use the application and synchronize the data once the internet is detected.
2. The system is functioned and operational according to the aforementioned technical features, manage and track equipment in the technology workshop based on the test cases made by the researcher.
3. The level of the usability of the system was rated by the respondents as strongly agree in terms of; usefulness (1.47), information quality (1.54), interface quality (1.42) and overall usability (1.48) which are high based on the survey results.
4. The system manual was developed as an output of the study. It includes the step-by-step guidelines on accessing the system's features which can assist the user on how to use the system.

## CONCLUSION

Based on the findings of the study, the following conclusions were formulated:

1. The Cloud-Based Inventory System with Quick Response (QR) Tagging for Technology Workshop has technical features which can efficiently and effectively manage equipment and user data. The system likewise can generate and scan QR codes for equipment using Real time monitoring of equipment through reports and notifications.
2. Using a test case, the system is useful and within the minimum standard requirements.
3. The system is acceptable in terms of its usability which includes the system usefulness, information quality, interface quality and overall usability based on the results of the PSSUQ survey.
4. The system manual was developed to manage and track equipment inventory on technology workshop. The users find it convenient to use the system without asking the researcher for help.

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