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Auto Parts Inventory Management System

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Abstract

The study was conducted to create a user-friendly inventory system using a QR-code scanner that is capable of storing large quantities of data on a small-medium-business. The user can also view supplier info, store, update, view current stocks, display real-time inventory conditions and view cost price and item reports. The QR code scanner can be used to find and view prices of the items. Descriptive method was used in this study to achieve this system and the objectives of the said study.

Keywords: Apache, Database, GUI, Inventory, MySQL, QR Code, XAMPP

1. Introduction

One major concern of many companies focuses on efficient and effective inventory management to achieve a distinct competitive advantage and improve their market position (Naliaka et al., 2015). A good inventory management is required to constantly maintain a good balance between the items that is going in and out of the company, in order to do that inventory management system is used.

In this study, the researcher is expected to create a software application of inventory management system with QR code scanner involved in a computer, loaded with a software capable of interacting with user using Graphical User Interface which will allow to register new items, delete items, modifying item, details of item and contains supplier information, even the smaller businesses have come to rely not just with hardware technologies but also in software systems. Other than that, QR code is versatile when it comes in readability and can store more information 2509 numeric characters and 1520 alpha numeric and most importantly it is secure than the traditional one-dimensional barcode. Today, due to the improved productivity and efficiency of data processing, the use of computer-based business systems has become widespread throughout developed and developing countries around the world.

The objective of this project is to build and validate user-friendly inventory system software which is capable of storing large quantities of data on Small-Medium-Entrepreneurs and to other low-cost company or business products for use.

2. Background of the study

Prior to the invention of technology, inventory management systems relied first on paperwork to track the status of all products. Companies utilized it extensively to manage their storage. However, when a company grows, so does its storage space. As a result, the inventory management system needs more paper, which wastes time, space, and money. You'll need

additional room to keep track of your goods while also storing all your paperwork. It is inefficient since it takes a long time to organize information from all the storage locations and locate information about a certain item in your massive stack of paper.

To overcome this, a computerized inventory management system has been introduced, which has a large amount of storage and is more efficient despite the ability to instantly search for specific information or items. Today, computerized inventory systems are further enhanced by today's newest technology that allows users to change or view item storage and status with just a few clicks, even with real-time item monitoring. Everything is now paperless.

In the existing system, the researcher observes that the inventory management system on the company uses excel database that causes inaccurate inventory, sales, and unmanaged flow of business.

3. Conceptual Framework

The conceptual framework that was used in the study is the Input-Process-Output Model. A process is seen as a collection of boxes (Processing Elements) linked by inputs and outputs in the IPO model. Based on a set of rules or decision points, information, or material items flow through a succession of tasks or activities. What goes in is the input; the process is what produces the change; and what comes out is the result (Armstrong, 2001).

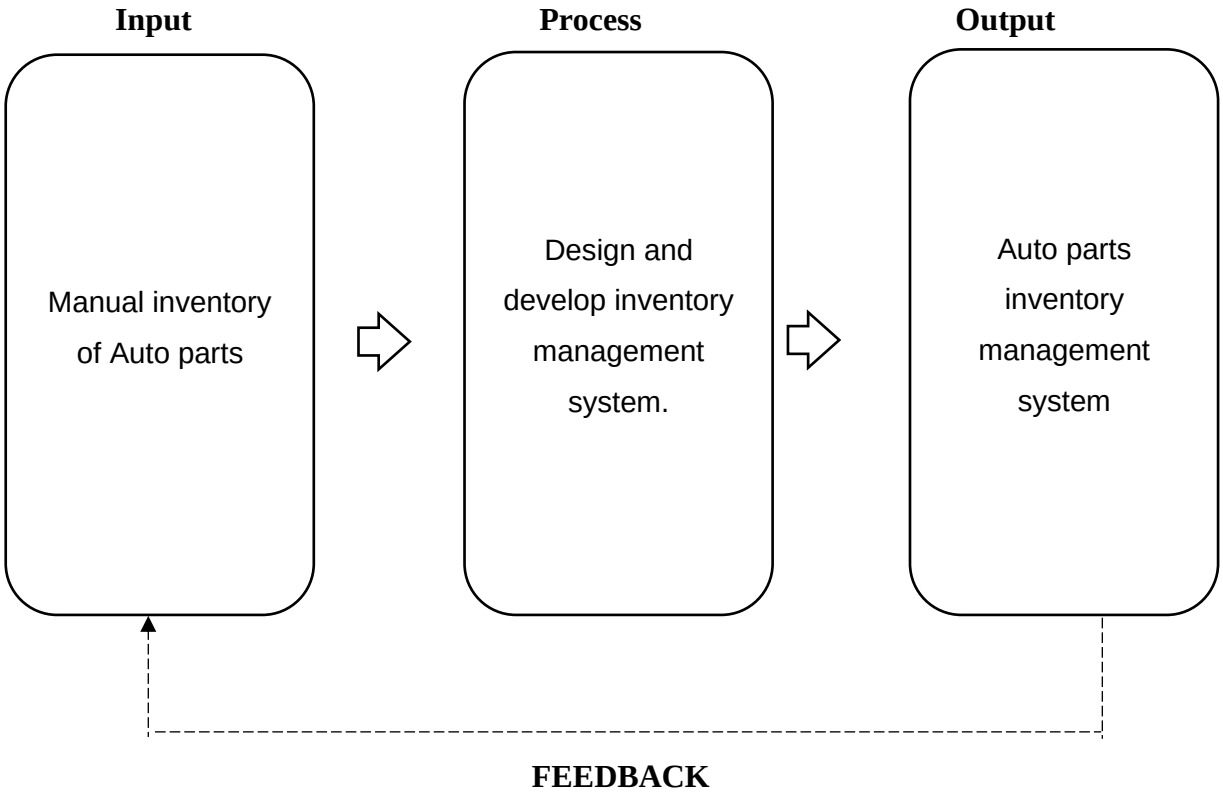

Fig.1: Conceptual Framework

The contextual framework provided the structure to the goals of this study. It consists of four variables, the input, process, output, and feedback. The contextual framework provided the direction of this study.

The input includes manual inventory of auto parts as basis for the study.

The process involves different variables to achieve the goals to build and validate user-friendly inventory system software. It includes designing and developing auto parts inventory management system.

The output shows the achievement of the auto parts inventory management system using QR scanner.

The feedback includes the possible results based on the floated questionnaire to achieve the objectives of this study. Results will also be guided by other researchers who will conduct the same study.

4. Related Literature

According to the U.S. Small Business Administration, "Inventory refers to stocks of anything necessary to do business" (U.S. Small Business Administration, 2010, pp 1-2). Maintaining a broad range without overstretching quickly moving goods, increasing inventory turnover without compromising service is a challenge, according to a report from the United States Small Business Administration. Maintaining a low stock without losing performance, obtaining reduced pricing through bulk buying; maintaining an adequate inventory free of obsolete commodities.

As said by Nicole Fallon (2013), customer happiness is increasingly important to investors in uncertain, frequently changing product marketplaces like consumer electronics. In May, for example, Nokia's American Customer Satisfaction Index (ASCI) rose, prompting claims of increased interest from large institutional investors.

Furthermore, Stair and Reynolds (2009) stated on their book, Principles of Information System, To develop new products and services (product analysis), to select the proper location for manufacturing and distribution facilities (place and site analysis), to determine the best marketing and promotion approaches (promotion analysis), and to set product prices to maximize total revenues (price analysis), sales and marketing information systems are used (price analysis).

According to Janes (2011), computers are extremely dependable devices and powerful personal digital assistants with some excellent accessories' applications such as word processing for all types of business activities, regardless of size. Computers have three benefits over traditional office equipment which process information because they are faster, more accurate, and cost-effective.

As stated by Conrad (2016), automated inventory management system has advantages and disadvantages of. Its advantages are its fast and efficient document production and a well-timed and appropriate data. Its disadvantages however range from dependence on technology, issues relating to accuracy and threats of deception. It is a problem since physical counting or inspection of raw materials and final products is required, and a computerized system requires stringent security measures.

Aitken, Leithwood and Jantzi (2001) stated that a monitoring system is described as a succinct statement of what should be (objectives) and a method for determining what is (process) (procedural and status report). It is also mentioned that it is a framework for selecting, defining, interpreting, and using a wide range of indicators.

Moreover, Cashman, Shelly, and Rosenblatt (2006) stated that an information system is a system that supports business needs by combining information technology, people, and data.

According to them, an information system has five key components, which are the hardware and software used, data, the processes performed, and the people involved. Hardware refers to anything in the application layer of a computer system. Servers, workstations, networks, communication devices, fiber-optic cables, laptop devices, scanners, electronic recording devices, and other technological advancements infrastructures all fit into the category of hardware.

As cited in StudyMode.com (2010), a computer-based system is a complex system that heavily relies on information technology. It simplifies, accelerates, and improves the accuracy of the task. Due to that fact, the automated scheme has become essential to small and big companies for they are expected to give the best services possible. However, some organizations opt to use a system that is not technologically linked. Computer illiteracy and a lack of finances are likely reasons. Companies, particularly the large ones, are advised to move from manual to automated systems to increase their efficiency and production, as well as the industry's image.

A sales and inventory system, which goes hand in hand, is one of most looked automated systems of many organizations. Every business needs a purchasing and inventory system because efficient purchasing and inventory management may lead to increased productivity. Input, output, and restocking are the three main components of inventory operations. Input refers to the process of adding new items to the inventory and replacing old ones with new ones. In the meanwhile, output is the process of removing items from inventory for sale or use, while refill is the process of raising the number of current products in the inventory to meet insufficient products or increasing demand. Most of the retail industry still uses a traditional inventory management system in which a person is assigned to manually inspect and record goods using pen and paper. It is here that all stock-related actions will be archived.

Masinag (2005) is undecided about the need to improve manual stockkeeping and management to offer quick access to prior stock records and, ultimately, to ensure stock security. The study aimed to provide an inventory report to passed to the OIC and an adjustment report for the expired product or stocks.

According to Mendoza (2005), paying attention to analyse and identify the problems faced by the system's personnel promotes a better way of distention reservation and provides the best service to their clients, and most importantly, it familiarizes them with their existing system. The study of the monitored the available stock and for each product and its status. It almost reserved detailed list of a articles likes stock.

Reyes (2005) was concerned about the manual system's transfer to a computerized system, which would allow for faster, easier transactions and accurate report creation.

On the word of J.De Leon and M. Ferrer (2009), the researchers developed a computerized inventory management system for the “Korean Red Ginseng Enterprise Sales and Inventory System”. The proponents advocated for the deployment of a database to facilitate file access as well as the processing of sales and inventory transactions. The program was designated to generate reports such as monthly reports, inventory reports, sales invoice, and list of items.

According to the study “Computerized Sales and Inventory System for Ronmon Trading” (de Alday, Espino, Ragudo, 2010), replacing the manual method with suggested system resulted in more efficient and accurate transaction processing. The system in question is extremely dependable, since it has reduced mistakes and incorrect data while still delivering important reports with integrity.

In the study entitled “Osaka Sales and Inventory System” (Laranang, Maaño and Nañola, 2009) states that business nowadays takes the advantage of using modern technology to improve their status and ensuring an efficient and newer way to make their work easier. They claim that the Osaka Iridology's primary issue is determining what contemporary effective instrument should be used in building and creating a sales and inventory system that will efficiently handle their transactions. As a result, they create a system that covers all aspects of Osaka Iridology transactions, including drug monitoring and daily sales.

Cited from Tanteo, Bisagas, and Arivada (2009). Bisagas, Arivada, and Tanteo's "Inventory System of Best Choice Rice Dealer" (October 2009) study, the process of manually counting rice bags parallels to the difficulty of calculating the quantity of available inventories and sold products. Since the company's inception, manual inventory report creation, such as daily, weekly, quarterly, and yearly inventory lists of data, has been a major issue. Best Choice Rice Dealer's transaction processing technology will make inventory processing easier for the owner. It will keep track of product availability for reordering to avoid understocking, overstocking, or running out of stock. It will also create inventory data such as sales reports.

It will decrease the difficulties of the management in processing inventory since physical counting goods, stocks, and calculating inventory summary will be the system's duty, according to research by Averion, Gaela, and Libo (2009) titled "Monitoring and Inventory for Discovery Mall.com." It will keep track of product and item availability to avoid understocking, overstocking, and running out of supply. Because of the updated supplier information and pricing list of commodities, the system will also ease the transaction between the dealer and supplier connection.

6. Data Gathering Procedure

First, the researcher prepared the questionnaire based on related studies and information that are relevant to this study. A letter signed seeking for permission to conduct this study was availed. The questionnaire was used to determine if there’s a need for an improvement in the present system.

The researcher identified the appropriate data gathering procedure in conducting the research to wit:

1. The researcher gathers information through books, internet and studies conducted by other individuals and researchers.
2. A letter was presented seeking for approval to conduct the proposed project.
3. Evaluation/survey forms were made via Google Form and floated online to the respondents after the demonstration. The collected data as well, were treated statistically to answer the specific questions posted and presented in the chapter.

7. Statistical Treatment of Data

To ensure that the data which were gathered would yield to simplify but valid numerical information, categorical and quantitative data, the following statistical treatment was utilized for each of the questions that the study sought to answer.

The researcher uses a standard questionnaire to assess the performance of the system. The questionnaire will be distributed to the respondents. The evaluation instrument is based on ISO/IEC 25010's characteristics and sub-characteristics.

ISO 25010 is one of the widely recognized assessment standards for assessing software from a software engineering perspective. Only five software metrics are recommended by ISO/IEC 25010: Excellent, Very Good, Good, Fair, and Poor.

This study will be conducted through a stratified random sampling, and which will serve as the basis of the researchers in gathering data. The researcher will use this kind of random sampling method because it involves the division of a certain population of a community into a smaller sub-group.

Respondents	Frequency
4.51 to 5.00	Excellent
3.51 to 4.50	Very Good
2.51 to 3.5	Good
1.51 to 2.5	Fair
1.00 to 1.50	Poor

Weighted mean method was used in computing and interpreting the result. The formula of computing and interpreting of data is as follows:

Rating = (E*5) +(VG*4) +(G*3)+(F*2)+(P*1) / Respondent

Where:

E = the total number of respondents who answered Excellent
VG = the total number of respondents who answered Very Good
G = the total number of respondents who answered Good
F = the total number of respondents who answered Fair
P = the total number of respondents who answered Poor

8. Software Development Tools

The list of specifications used by the proponent personally in developing the different modules of the system: Windows 10 Professional OS, Microsoft Visual Basic Studio 2010, Quick Response code, MySQL, Apache and XAMPP.

MySQL. Is a database management system that uses a relational model, which consist of a wide range of purposes including directory indexing, data warehousing, e-commerce and the most commonly use of MySQL is web database.

Quick Response code & Barcode scanner. Eyoyo Portable Handheld 1D 2D QR Wireless Bluetooth 2.4G Barcode Scanner Reader

Visual Basic.NET. Microsoft's VB.NET is a multi-paradigm programming language based on the.NET platform. It was introduced in 2002 as a replacement for the Visual Basic programming language. This was the first version of VB.NET (VB.NET 7.0), which used.NET version 1.0 as its foundation.

XAMPP. Is an open-source application web server where it holds all the scripts and link it together on the application as one.

9. Results and Discussion

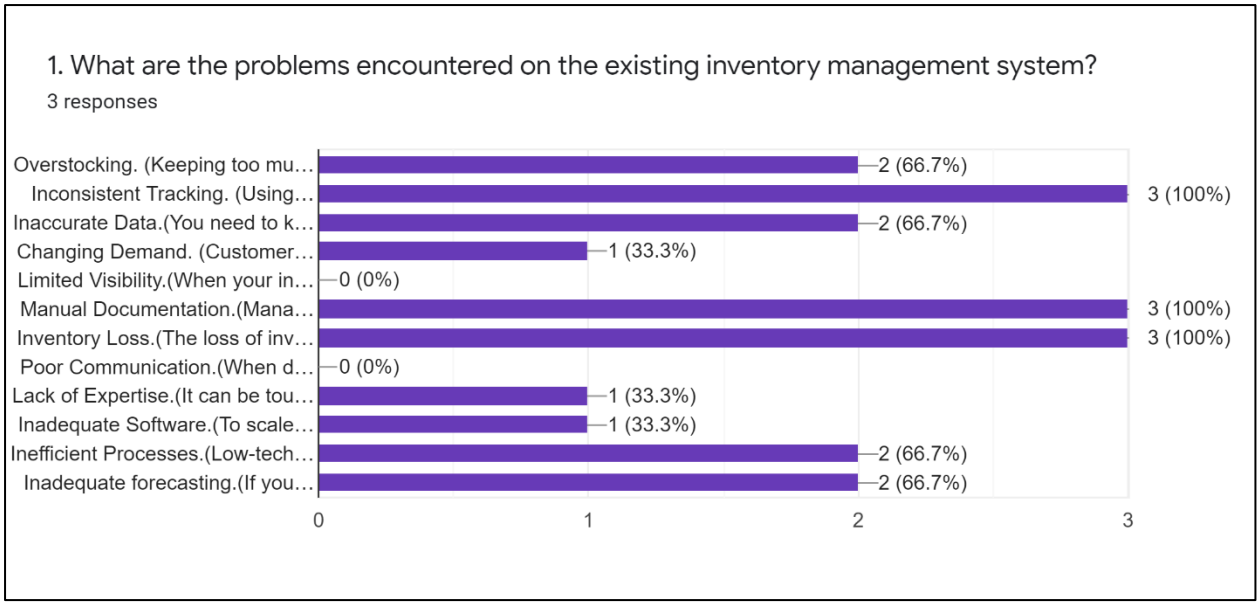

Fig. 2: Problems Encountered

As shown above, Figure 2 the problems encountered on the existing inventory system. Inconsistent tracking, manual documentation and inventory loss got the highest percentage of 100 percent. Followed by overstocking, inaccurate data, inefficient processes, and inadequate forecasting with 66.7 percent. Last on the list are changing demand, lack of expertise and inadequate software with 33.3 percent. Moreover, no encountered problem in terms of limited visibility and poor communication.

Table 1. Functionality of the System

Functionality	**SCORE**	**REMARKS**
1. **Functional Completeness.** (Degree to which the set of functions covers all the specified tasks and user objectives.)	4.3	Very Good
2. **Functional Correctness.** (Degree to which a product or system provides the correct results with the needed degree of precision.)	4.3	Very Good
3. **Functional Appropriateness**. (Degree to which the functions facilitate the accomplishment of specified tasks and objectives.)	4	Very Good
TOTAL	**4.2**	**Very Good**

As presented above, Table 1 shows the weighted mean of the functionality of the system. “Functions Completeness” and “Functional Correctness” got the score of 4.3 and a remark “Very Good”. Followed by “Functional Appropriateness” with a score of 4 and a remark of “Very Good”. The total score was 4.2 and a remark of “Very Good”.

Table 2. Performance Efficiency of the System

Performance efficiency	**SCORE**	**REMARKS**
1. **Time behaviour.** (Degree to which the response and processing times and throughput rates of a product or system, when performing its functions, meet requirements.)	4.6	Excellent

2. Resource utilization. (Degree to which the amounts and types of resources used by a product or system, when performing its functions, meet requirements.)	4	Very Good
3. Capacity. (Degree to which the maximum limits of a product or system parameter meet requirements.)	4.6	Excellent
TOTAL	**4.4**	**Very Good**

As obtained above, Table 2 shows the weighted mean of performance efficiency of the system. "Time Behaviour" and "Capacity" both got the highest score with 4.7 and a remark of Excellent while the item "Resource Utilization" got the lowest score with 4 and a remark of Very Good. The overall score was 4.4 having a remark of "Very Good".

Table 3. Compatibility of the System

Compatibility	SCORE	REMARKS
1. **Co-existence.** (Degree to which a product can perform its required functions efficiently while sharing a common environment and resources with other products, without detrimental impact on any other product.)	4.6	Excellent
2. Interoperability. (Degree to which two or more systems, products or components can exchange information and use the information that has been exchanged.)	4	Very Good
TOTAL	**4.3**	**Very Good**

As indicated above, Table 3 shows the weighted mean of the compatibility of the system. The item "Co-existence" got a score of 4.6 with a remark of Excellent while the item "Interoperatibility" got a score of 4 with a remark of Very Good. The total score was 4.3 having a remark of "Very Good".

Table 4. Usability of the System

Usability	SCORE	REMARKS
1. Appropriateness recognizability. (Degree to which users can recognize whether a product or system is appropriate for their needs.)	4.3	Very Good
2. Learnability. (Degree to which a product or system can be used by specified users to achieve specified goals of learning to use the product or system with effectiveness, efficiency, freedom from risk and satisfaction in a specified context of use.)	4.3	Very Good
3. Operability. (Degree to which a product or system has attributes that make it easy to operate and control.)	4	Very Good
4. User error protection. (Degree to which a system protects users against making errors.)	4.6	Excellent
5. User interface aesthetics.	4	Very Good

(Degree to which a user interface enables pleasing and satisfying interaction for the user.)		
6. Accessibility. (Degree to which a product or system can be used by people with the widest range of characteristics and capabilities to achieve a specified goal in a specified context of use.)	4.3	Very Good
TOTAL	**4.3**	**Very Good**

As presented above, Table 4 shows the weighted mean of usability of the system. It has resulted that the item "User Error Protection" got the highest score of 4.6 and a remark of Excellent. "Appropriateness recognizability", "Learnability" and "Accessibility" got the same score of 4.3 and a remark of "Very Good". The items "Operability" and "User Interface aesthetics" got the lowest score of 4 a remark of Very Good. The total score was 4.3 having a remark of "Very Good".

Table 5. Reliability of the System

Reliability	**SCORE**	**REMARKS**
1. Maturity. (Degree to which a system, product or component meets needs for reliability under normal operation.)	4.3	Very Good
2. Availability. (Degree to which a system, product or component is operational and accessible when required for use.)	4.3	Very Good
3. Fault tolerance. (Degree to which a system, product or component operates as intended despite the presence of hardware or software faults.)	4	Very Good
4. Recoverability. (Degree to which, in the event of an interruption or a failure, a product or system can recover the data directly affected and re-establish the desired state of the system.)	4	Very Good
TOTAL	**4.2**	**Very Good**

Table 5 shows the weighted mean of the reliability of the system. As observed, the item "Maturity" and "Availability" both got the highest score of 4.3 and a remark of "Very Good" while the following items "Fault Tolerance" and "Recoverability" got the same score of 4 and a remark of "Very Good". Overall score was 4.2 having a remark of "Very Good".

Table 6. Security of the System

Security	**SCORE**	**REMARKS**
1. Confidentiality. (Degree to which a product or system ensures that data are accessible only to those authorized to have access.)	4.6	Excellent
2. Integrity. (Degree to which a system, product or component prevents unauthorized access to, or modification of, computer programs or data.)	4	Very Good
3. Non-repudiation.	4.3	Very Good

(Degree to which actions or events can be proven to have taken place so that the events or actions cannot be repudiated later.)		
4. Accountability. (Degree to which the actions of an entity can be traced uniquely to the entity).	4	Very Good
5. Authenticity. (Degree to which the identity of a subject or resource can be proved to be the one claimed.)	4.3	Very Good
TOTAL	**4.2**	**Very Good**

Table 6 shows the weighted mean of the security of the system. As observed, the item "Confidentiality" got the highest score of 4.6 and a remark of "Excellent" while the following items "Non-repudiation" and "Authenticity" got the same score of 4.3 and a remark of "Very Good". The item "Integrity" and "Accountability" got the lowest score of 4 with a remark of Very Good. Overall score was 4.2 having a remark of "Very Good".

Table 7. Maintainability of the System.

Maintainability	**SCORE**	**REMARKS**
1. Modularity. (Degree to which a system or computer program is composed of discrete components such that a change to one component has minimal impact on other components.)	4.3	Very Good
2. Reusability. (Degree to which an asset can be used in more than one system, or in building other assets.)	4.3	Very Good
3. Analysability. (Degree of effectiveness and efficiency with which it is possible to assess the impact on a product or system of an intended change to one or more of its parts, or to diagnose a product for deficiencies or causes of failures, or to identify parts to be modified.	4	Very Good
4. Modifiability. (Degree to which a product or system can be effectively and efficiently modified without introducing defects or degrading existing product quality.)	4	Very Good
5. Testability. (Degree of effectiveness and efficiency with which test criteria can be established for a system, product or component and tests can be performed to determine whether those criteria have been met.)	4.3	Very Good
TOTAL	**4.2**	**Very Good**

As presented above, Table 7 shows the weighted mean of maintainability of the system. It has resulted that the item "Modularity", "Reusability" and "Testability" got the score of 4.3 and a remark of Very Good. The items "Analysability" and "Modifiability" got the lowest score of 4 a remark of Very Good. The total score was 4.2 having a remark of "Very Good".

Table 8. Portability of the system

Portability	**SCORE**	**REMARKS**
1. Adaptability. (Degree to which a product or system can effectively and efficiently be adapted for different or evolving hardware, software or other operational or usage environments.)	4	Very Good
2. Installability. (Degree of effectiveness and efficiency with which a product or system can be successfully installed and/or uninstalled in a specified environment).	4	Very Good
3. Replaceability. (Degree to which a product can replace another specified software product for the same purpose in the same environment.)	4	Very Good
TOTAL	**4**	**Very Good**

Table 8 shows the weighted mean of the portability of the system. All the choices got the same score of 4 and a remark of "Very Good". The total score was 4 having a remark of "Very Good".

10. Block Diagram

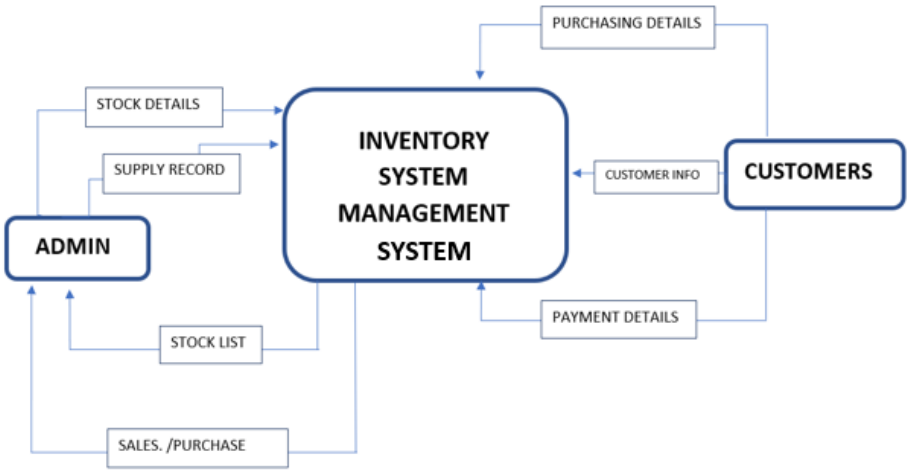

Fig. 3: Block Diagram

11. Project Technicalities

System Log-in

Fig. 4: System Log-in

The first interface is the Log-in Page where the users need to log-in to enter the system.

Graphical User Interface

This type of interface, what you see on your screen, shows options for selection to navigate through these screens. The GUI gives the administrator a tool that contains all the possible features that can be changed or modify in order to their needs.

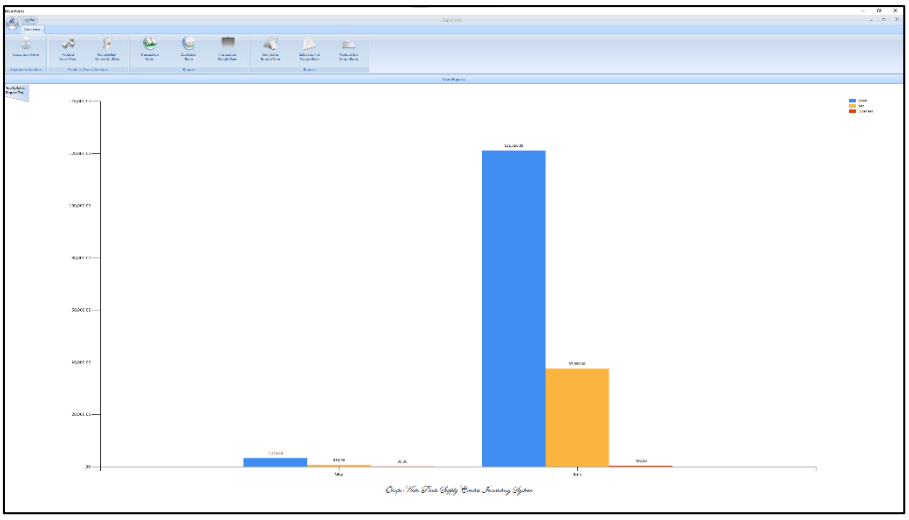

Fig. 5: Graphical User Interface.

The system contains 10 buttons. The first button is the Users menu and under the user menu, you can access the adjustment form, employee form, expenses form, users form, product form, product setting, suppliers' profile and database. The second button is for the customers' form where you can process new client. The third button is receiving item deliveries form where you can receive new deliveries and process transfer items from stockroom to sales. Fourth button is transaction form for processing purchased items. Fifth button is quotation form where you can give an estimate of the items. Sixth button is daily sales report form where you can see the daily report of gross sales, net sales, expenses, and final net sales. Seventh button is sales journal report form where you can see total yearly sales report, total yearly initial net sales,

total yearly expenses report, final net sales report. The eighth button is product end count inventory form where you can see if the stocks is tallying with sales.

User Form

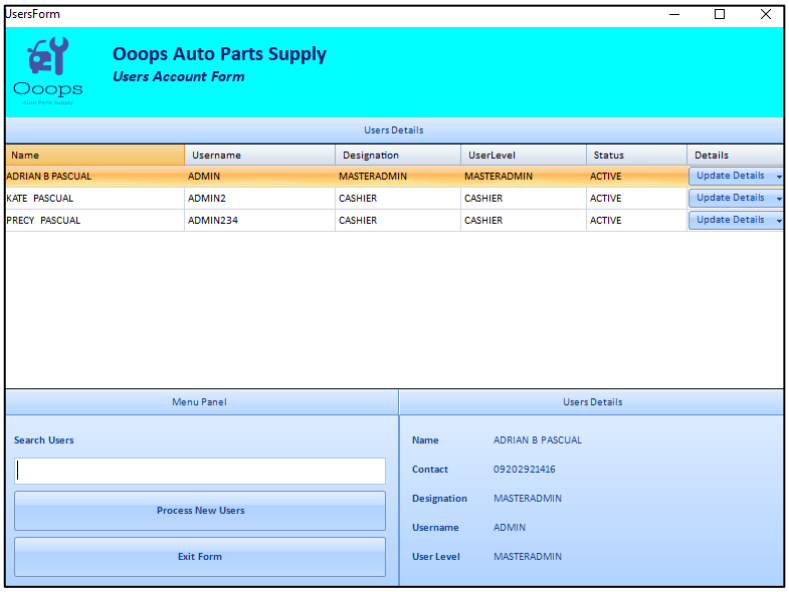

Fig. 6: User Form.

This form contains user details: name, username, designation, user level, status and deactivate account. To process new user the user will click the USERS that created earlier in the employee form select employee fill the form then set the Username, Password, Designation and User Level then click the process button.

Adjustment Form

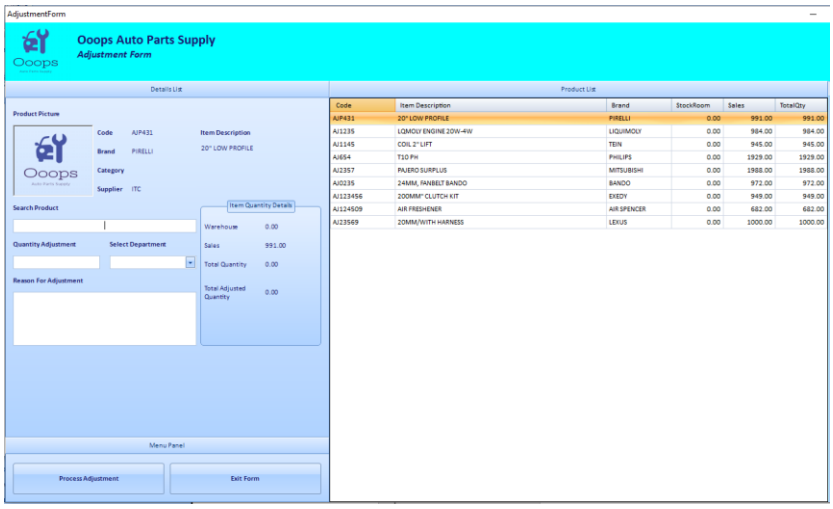

Fig. 7: Adjustment Form.

This from allows the user to view Product List Code, Item Description, Brand, Stockroom, Sales and Total Quantity. To adjust quantity, the user can input the quantity adjustment then select department stock room or sales, lastly add reason for adjustment and hit the button for Process Adjustment.

Expenses Form

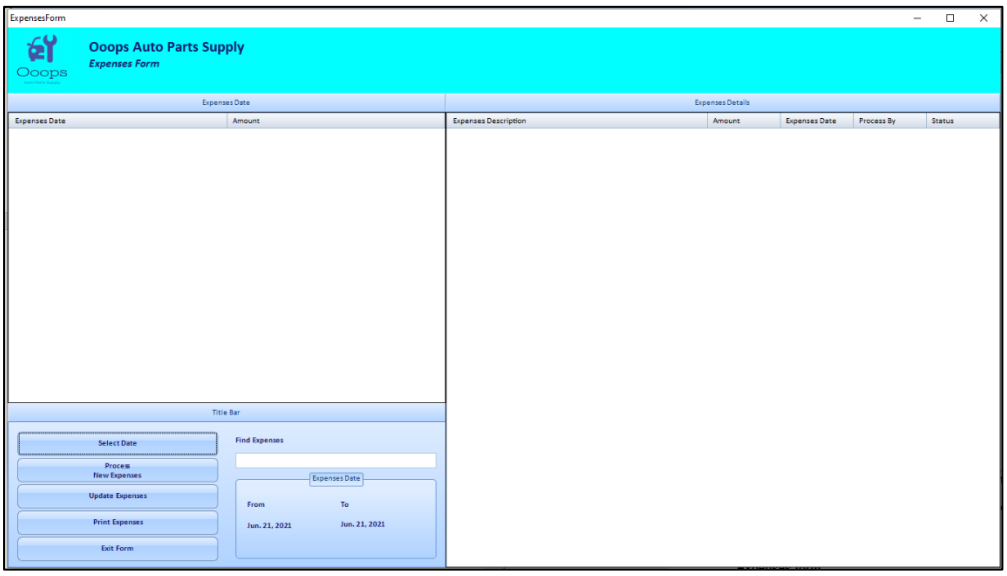

Fig. 8: Expenses Form.

This contains select date, process new expenses, update expenses, print expenses. The user can track or see all your expenses with complete description, amount, expenses date, process by and status.

Product Form

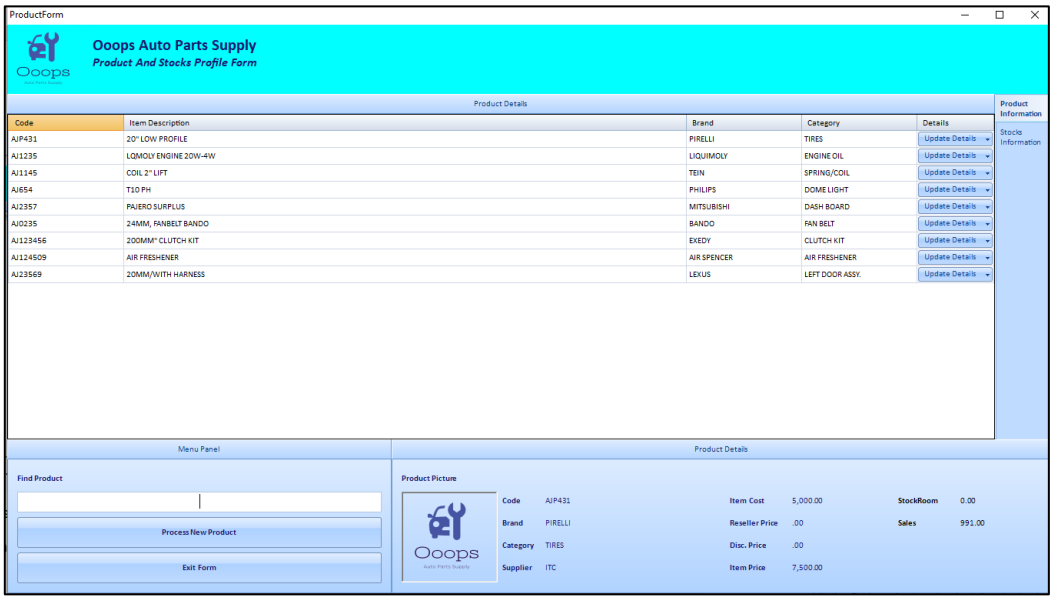

Fig. 9: Product Form.

This form allows you to view product information, stocks information and process new product. When processing new product, the user will up the form that Contains Item Barcode, Code, Brand, Category, Supplier, Item Description, Retail Unit, Retail Equivalent, Selling Unit, Item Cost, Reseller Price, Discounted Price, and Item Price then click process new product button.

Product Setting Form

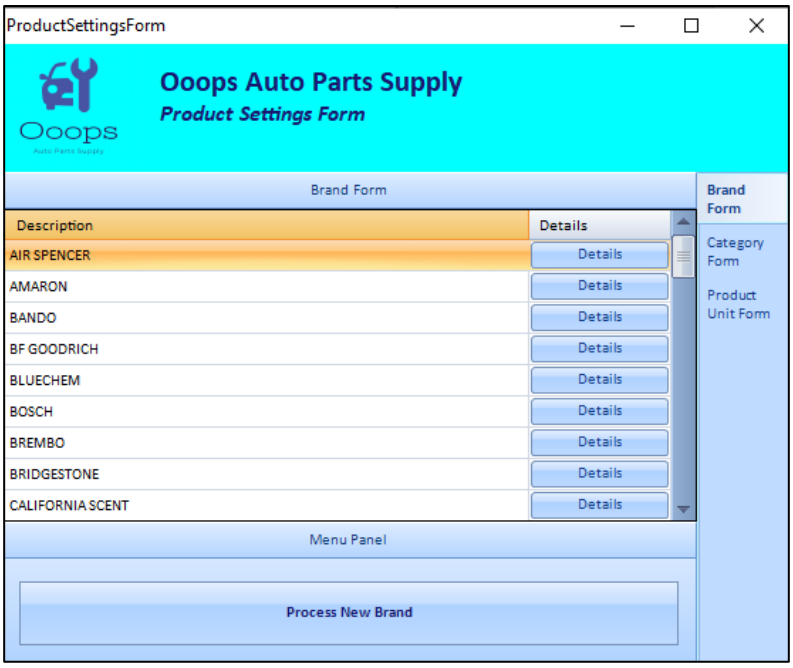

Fig. 10. Product Setting Form.

This form allows the user to put brand, category, and product unit.

12. Conclusion

The findings from this study yield several important conclusions and recommendations for the Ooops Auto Parts Supply. Firstly, the proposed system demonstrates its potential to be an asset by introducing convenience to inventory and sales processes. It establishes a secure and comprehensive tracking system for inventory items, simplifies purchase processing, reduces inventory management workload, and streamlines item retrieval through QR code scanning. The system's security features, including a login logger and QR code integration, provide an additional layer of protection.

13. Recommendation

To enhance reliability, it is advisable to implement a multiple connection or network-based system that offers real-time updates and minimizes data discrepancies in inventory results. Additionally, incorporating a system based QR code generator can further boost the efficiency and functionality of the inventory system, making it easier to generate QR codes for items and thereby improving tracking and retrieval processes. These recommendations aim to maximize the benefits of the proposed system for Ooops Auto Parts Supply.

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