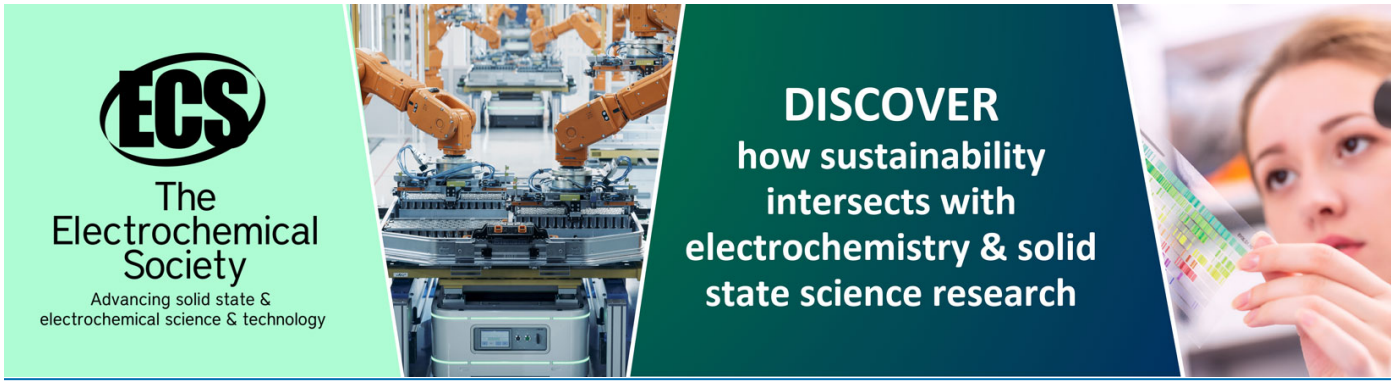
Inventory control and distribution of medicine stocks by using a just in time method based on interactive web applications



Inventory control and distribution of medicine stocks by using a just in time method based on interactive web applications

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Abstract. Management of an inventory data within an agency requires an interactive management system to provide ease and informative data presentation. Data processing using an interactive system makes it easy for users to understand and interact with data, especially if the agency concerned is an agency that is in charge of long-term data storage, complex data processing, data collection and data distribution processes, controlling inventory availability, and data collection conducted every day. Data storage and conventional data processing has several weaknesses such as high error rate in data processing, the system is not interactive so that it troubles and impedes the inventory data collection process by users, and can produce data ambiguity that can cause misinformation. By using the inventory control model Just-In-Time (JIT) Inventory method that allows the compilation of data collection and inventory stock requests as needed so that it can easily distribute and minimize wasted stock, the processing, storage, and data collection of a particular data inventory can be controlled well and can provide clearer information. As a result, implementing inventory control methods into a web application can provide web applications that have better functionality in processing, storing, and collecting data.

1. Introduction

Management of data and goods in a large agency must have optimal management by calculating various parameters so as to minimize data collection errors. In addition to the system being used to have a powerful machine in managing data, interactive displays also need to be used to minimize human error. Effective management of goods and data has been a long discussion for almost 100 years among engineers [1]. Research that has been more focused on creating an inventory control that can accommodate a lot of data in a more efficient time. However, another problem that is more obvious occurs in the real world which has unexpected problems, and it is not enough to just focus on the formation of systems that can accommodate large amounts of data and time efficiently [1].

The complexity in a modern industry, management, and failures that have occurred become a concern in recent years, especially if the management includes data safety and accuracy [2]. In industries such as hospitals or pharmacies, it is necessary to apply the principles of data safety and accuracy while maintaining the ease of data management and minimizing failures.

In the era of globalization, a management system must be able to increase the level of satisfaction and ease of operating the system by users [3]. Especially if the system used has a chain, which means that an action will affect other actions. For example, when user requests stock of goods to the warehouse system, in addition to the system having to verify the user requesting the request, the system must verify stock availability in the warehouse, so when the request is received, the stock in

the warehouse will be reduced, the stock of the user requesting goods will be added, and notes it will be saved as request history. Systems have a chain path must be considered because when a stage is missed or an error occurs, the next stage will be affected. In the previous case example, if there is a malfunction in verifying the availability of goods in the warehouse, the system must be able to handle it so that the next steps are not affected.

At the moment, the data processing system becomes more dynamic, there are challenges in the process of creating a system that simultaneously implements interactivity in the system [5]. In addition to the complex developed system, complex system design and data flow, its development is also risky. Especially if the data collection system for health goods and medicines in a hospital, due to stock availability, a clear and precise flow affects patients and health within the hospital itself.

The cases that occur in this study focus on the design and implementation of a data collection system for health goods, including medical devices and medicines in a hospital using the Just In Time Method. The development is carried out because the management of existing goods still uses manual methods which are very risky when there is an error in data collection. The transaction process that is still manual is also an obstacle in the process of receiving and distributing goods, so that data and transaction history are at risk of being lost or not stored properly.

2. Method

2.1. Related Work

Just In Time (JIT) Method has been widely used in various fields. Apart from being used in the field of machine learning, JIT is also used in predicting data to be presented and predicting the error rate of data. Yin, S,. et al (2016) using JIT to predict and detect non-linear errors to a deterministic disturbance in data [2]. The study explained that the JIT used was data-based JIT or Just In Time Learning-based Data Driven (JITL-DD). JITL-DD is composed of two parts, the first is an offline process which contains data preparation in the database and setting parameters that will be used later. The second, an online stage that contains data processing that has been prepared using JITL-DD. As a result, the JITL-DD method is effective in detecting nonlinear errors against a deterministic disturbance in dynamically processed data.

Zhiwen, Z ,. et al (2020) also use JIT in logistics to provide information on logistics quality [3]. In the research conducted, it was explained that Supply Chain Information Logistic Quality (SCILQ) plays an important role in increasing logistics efficiency, minimizing logistics costs, and improving logistics services. By combining SCILQ with JIT, SCILQ can provide the right information at the right time in the right amount. Thus, the SCILQ method in combination with JIT can provide a new perspective in an evaluation that is carried out.

JIT is used to keep the material from being wasted in the processing process, such as in cases of overproduction, cases of delays in transportation or distribution processes, and other unexpected cases [4]. Kong, L., et al (2018) used the JIT strategy to schedule batch distribution in a construction plant. In his research, Kong investigates cases that occur and creates a decision support system in solving distribution scheduling problems by taking into account several factors such as arrival time and time spent on a trip, focusing on minimizing delays, minimizing remaining resources, and minimizing carbon dioxide emissions. generated. Each environment with various values and weights is united in an objective function that transforms various objective problems into a single objective problem.

2.2. Methodology

The methodology used in this study is divided into four parts. The first is collecting information, the second is the design of the system flow, the third is system development, and the fourth is system testing.

Collecting information in research is carried out in two ways. The first is collecting information related to the flow of transactions in the hospital, the second is collecting information related to the literature from the research. The collection of transaction flow information from the existing processes

in the hospital is done by interviewing the hospital and recording what complaints they have experienced. Apart from complaints, other information such as transaction flows for both receipt and distribution of goods, transaction flow for goods requests, and additional features to facilitate the use of the system are also recorded.

Information collection related to literature review is collected as a reference for the system creation process. Since this research uses a website-based information system, information related to the framework, the programming language used, the required server, database design, and additional libraries, information is also collected so that the manufacturing process can run well. Of course, information about the management system, and JIT methods is also collected as reference material.

The transaction flow information that has been collected will then be analyzed the system so that the system that will be made runs according to what is desired. Database design is carried out after the information has been successfully analyzed.

The results of the analysis are then used to start the system design to be made. The method of making the system is done by the Agile method, which is a method used in the process of designing and making applications. Meanwhile, the transaction process in it uses the JIT method.

Agile method is a project management that prioritizes teamwork, communication between developer and client, and is easy to adapt to make decisions and changes during development [6]. There are several basic principles in the Agile method, among others: 1) The interaction runs directly between developers and between developers and clients; 2) Prioritizing the testing process in each feature developed instead of creating a guide document for experiments; 3) Collaboration between developer and client is done based on a contract and this requires the developer to understand the client's desires and develop together; and 4) Changes in the middle of development, and delivery of feedback from customers on each feature that has been successfully developed so that everything is done according to what the customer wants [6]

There are several provisions that exist in the system to be made. Conditions are determined from the collection of information that has been made previously. These provisions include (1) There are multiple levels for users to enter into the system; (2) Each level has its own function in data management; (3) There are multi transactions that can be made between user levels; (4) There are calculations in several functions according to agency calculation standards.

3. Result and Discussion

In the research, a flow is generated that can show how the system is made. The flow in question is shown in figure 1.

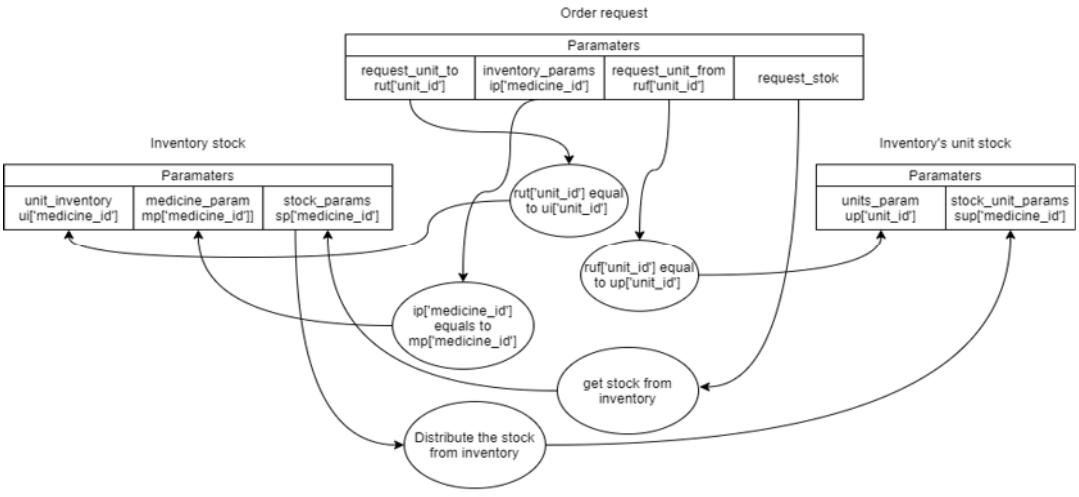

Figure 1. Flow of how the system performs the Just-in-time method.

From the picture shown in Figure 1, it shows that the order request flow includes the parameters from which the order was made, where the order was directed, what goods or drugs to order, and the number of orders to be ordered. Both the destination unit and the original unit each have their own total drug inventory that can be ordered and distributed according to the order request. Each order request has a *medicine_id* parameter which allows the system to check whether the ordered drug is available or not in the inventory stock. In each order there is also a quantity of stock ordered, so the stock ordered will be checked for availability in the inventory stock, if the stock is still available, the stock will be immediately distributed to the inventory unit from which the request was requested so that the request can be continued while the order still wants to be responded to.

Just in time method works directly to connect units requesting goods and units that distribute goods. In this case, the unit in charge of delivering goods is a warehouse unit within the agency, and units that have access to request goods are the pharmacy unit, operating room unit, and inpatient unit. When a unit requests goods to the warehouse, the unit must first fill in the details of what items will be requested along with the stock and description. Requests will be processed directly to the warehouse unit. When the warehouse unit has received a request, the warehouse unit has access rights to accept or reject the request. When the warehouse unit has received a request from the unit concerned, the warehouse unit will send additional information and total items that can be sent by the warehouse unit. When it has been sent and received by the unit requesting a request, the stock will automatically change depending on the number of requests and the distribution amount of the goods sent.

On the other hand, if the warehouse unit cannot send goods for some reason, the warehouse unit can reject the request and then send a message why the request was rejected. The message will be immediately received by the unit making the request. Direct transactions that are carried out will shorten the distribution time, and the calculation of stock items will automatically reduce human error in calculating stock items.

The system implementation is built with an interactive design, so that users can use the system properly and easily. Process requests using the JIT method are not displayed in the system interface. This is because it is a method used behind the scenes of the system and works in data management. The system implementation for requests from units is shown in Figure 2.

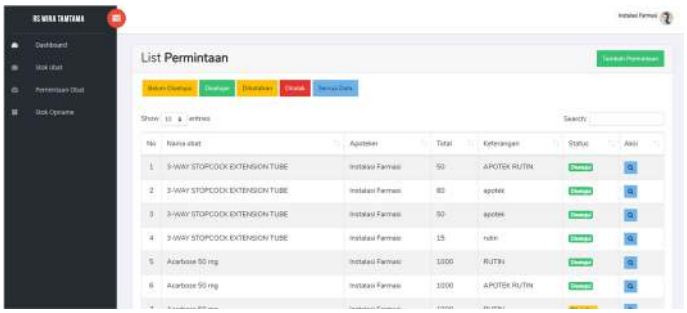

Figure 2. System implementation at a level other than the inventory master

Table 1. Data simulation

No	Type of data	Amount
1	Drug data	1,547 data
2	Entry data	1,159 data
3	Distribution data	3,004 data
4	Total data requests	3,348 data
5	Total stock data stored	1,473 data

The system was tested with approximately 1500 drug data entered into the system database. Then the data is simulated and has the results shown in Table 1.

Some of the test results of the web application system with the JIT method are shown in Table 2 for warehouse admin levels and Table 3 for other installation levels.

Table 2. Warehouse admin level system test results

No	Category	Problem	Solution
1	Drug Data	Unable to get the drug data list because the system is consuming too many resources and unable to load the data.	Optimization of sql processing in getting data from the database.
2	Income data collection	It cannot add drug entry data because there is a mismatch of the type of data entered and the type of data that is allowed.	Changes the data type when data is entered into the system.
3	Distribution data collection	There is an error writing the algorithm so that the distribution process cannot be carried out.	Improvements to the goods distribution algorithm.
4	Drug order queue	Unable to load data because it ran out of server resources so the data failed to display.	Optimization of SQL processing in getting data.

Table 3. Other installation-level system test results.

No	Category	Problem	Solution
1	Drug stock	It cannot load data because the required resource is too large.	Optimization in sql so that it can load more data.
2.	Request for medicine	Unable to load list data from the results of drug requests to the warehouse admin because the required resources are too large.	Optimization in sql so you can get data fast.
3	Opname stock	Failed to add stock taking due to algorithm errors and system calculations.	Algorithm improvements and system computation improvements and SQL optimization to speed up the data loading process.

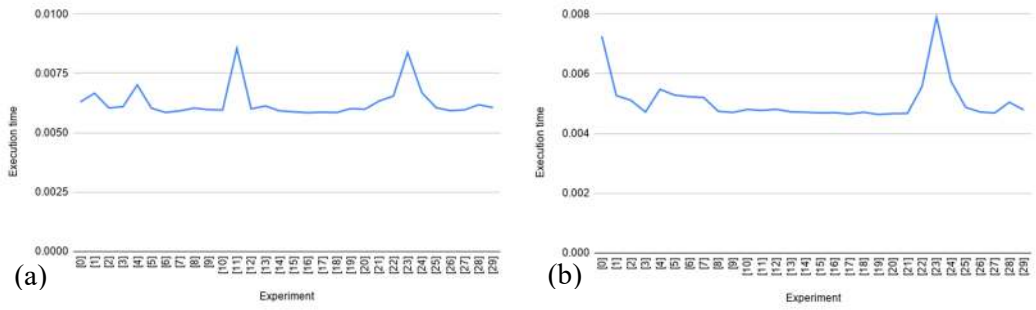

Figure 3. (a) Data on the effectiveness of data processing time of entry. (b) Data on the effectiveness of processing time input data with unit information.

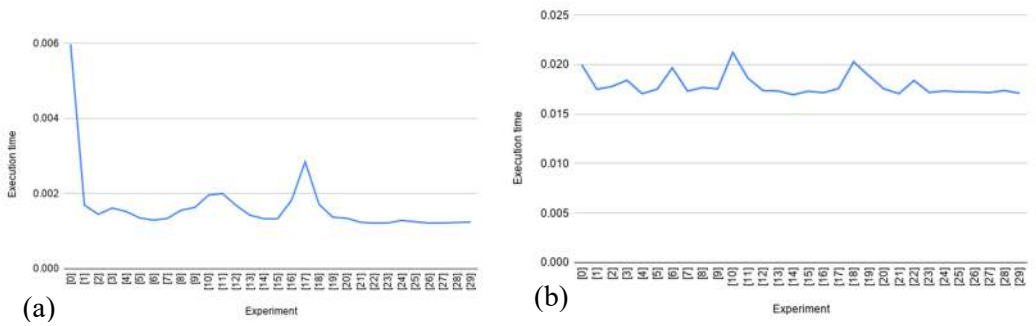

Figure 4. (a) Data on the effectiveness of time to process stock taking. (b) Data processing time effectiveness of request data.

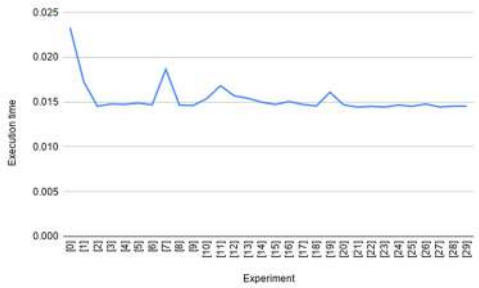

Figure 5. Time effectiveness on distribution data processing.

The results of the time effectiveness of the algorithm and the results of the optimization that have been carried out in processing the data are shown in Figure 4.

From the results of Figure 3 and Figure 4, it can be seen that in Figure 4 (a), the input data processing process has a fairly high average execution time compared to other data. Likewise, Figure 3 (b) which shows the execution time required to process the input data with category names can still be said to be quite high.

Meanwhile, Figure 4 (a) and Figure 4 (b), which explain, respectively, the processing of stock taking and request data is still relatively fast. Likewise in Figure 5, which shows distribution data processing can still be said to have a short average time. This is because the data that are related to other data are not as much as the input data.

4. Conclusion

The application of the JIT method to a web application system can make it easier for users to process goods requests and process goods distribution. With an interactive display, users can easily select items registered in the system. In addition, the system which is given various features can also provide a good user experience for users. The effectiveness of using the JIT method provides a conclusion that this method can be applied in a web application well. However, a lot of data processing requires an increase in the capacity and power of the Central Processing Unit of the server service used for smooth data processing.

In the future, it is necessary to optimize the algorithm used so that the web application system can run well even though it does not take up a lot of resources.

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