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SISTEM INFORMASI INVENTARISASI DENGAN IMPLEMENTASI INTERNET OF THINGS

INVENTORY INFORMATION SYSTEM WITH INTERNET OF THINGS IMPLEMENTATION

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Abstrak – Sistem informasi inventaris tradisional seringkali menghadapi kesulitan dalam pemantauan, pemeliharaan data real-time, dan keakuratan data. Tujuan dari penelitian ini adalah mengimplementasikan IoT ke dalam proses sistem informasi persediaan barang dan mengetahui apa manfaatnya. Dalam penelitian ini, metode yang disebut prototyping digunakan untuk membuat sistem informasi inventaris berbasis web yang terintegrasi dengan IoT. Jumlah stok produk diukur menggunakan sensor ultrasonik yang terpasang pada ESP8266. Data sensor dianalisis dan dikirim ke sistem informasi berbasis web. memungkinkan pemantauan stok secara real-time. Hasil dari implementasi IoT ini mencapai beberapa manfaat, antara lain peningkatan efisiensi operasional yang terlihat dari perubahan DFD. Hasil pengujian sistem menunjukkan sistem dapat mendeteksi barang di tempat penyimpanan dengan akurasi 100%.

Kata Kunci: Managemen Inventaris, Sistem Informasi, IoT

Abstract *– Traditional inventory information systems often face difficulties monitoring, real-time data maintenance, and data accuracy. This research aims to implement IoT into the inventory information system process and determine the benefits. In this research, a method called prototyping is used to create a web-based inventory information system that is integrated with IoT. The amount of product stock is measured using an ultrasonic sensor installed on the ESP8266. Sensor data is analyzed and sent to a web-based information system. allows real-time stock monitoring. The results of this IoT implementation achieve several benefits, including increased operational efficiency which can be seen from the DFD changes. The system test results show that the system can detect goods in storage with 100% accuracy.*

Keywords: *Inventory Mangement, Information System, IoT*

INTRODUCTION

Inventory Information Systems enable organizations to monitor and track inventory more efficiently. In situations where a company has many different inventory items, such as capital goods, equipment, or supplies, the task of managing inventory manually can become very complicated and time-consuming (Rubel, 2021). However, with an inventory information system, inventory data can be neatly organized in a centralized database, making it easier to manage and search for the required inventory information (Pasaribu, 2021).

Inventory Information Systems also enable companies to optimize the use of their inventory (Apriyanti, 2023). With an integrated system, managers can easily monitor inventory and determine when and how many items to order. Real-time and accurate inventory information also helps in planning and optimizing production or operational activities, thereby avoiding inventory shortages or excesses which can affect the company's operational efficiency and costs (Fahmi, 2024). However, traditional inventory information systems often face challenges in monitoring, real-time data maintenance, and information accuracy.

This is where the importance of implementing the Internet of Things (IoT) in inventory information systems becomes increasingly relevant. IoT brings revolutionary potential by connecting various physical objects to a network and enabling real-time exchange of data and information. However, it should be acknowledged that conventional inventory information systems tend to be limited in terms of effective monitoring (Elmaasrawy, 2024). Manual or semi-manual recording often produces inventory data that is not

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always accurate and up to date. In addition, this method is susceptible to human error, such as incorrect recording, inaccurate calculations, or missed reports (Bhambri, 2024).

The application of IoT in inventory information systems can overcome a number of these problems. The use of sensors connected to a network can automatically collect data regarding stock, status changes, or even the condition of goods, without direct human involvement (Raj, 2020). The result is inventory information that is more accurate, real-time, and accessible from multiple locations (Whig, 2024).

The application of IoT in inventory information systems brings tremendous potential benefits, including continuous monitoring without time and space limitations, better and faster decision-making based on real-time information, and reduced risk of human error in recording. In an ever-growing and competitive business context, IoT-based inventory information systems can be a valuable asset for increasing operational efficiency and increasing customer satisfaction (Fahmideh, 2020)

By utilizing IoT technology in inventory information systems, companies can increase operational efficiency, reduce inventory costs, and increase responsiveness to changes in demand or inventory conditions. This helps companies to remain competitive in today's increasingly connected and fast-paced era (Chemma, 2022).

RESEARCH METHOD

The method used in this research is the prototype method. The prototyping method is an approach to system or product development that involves creating an initial model or prototype as a visual or functional representation of the product to be created (Foster, 2021). This method aims to test and validate the concept, design and functionality of the product before developing the final version (Siswidiyanto, 2020). This process can help better identify user needs, address design issues, and minimize the risk of errors in product development.

To design an inventory information system, the first step is to identify its needs. This involves understanding the system's purpose, the data that needs to be captured, and the expected functionality (Tilley, 2017). Conducting a literature study is the second step, where principles and concepts related to Inventory information systems, IoT, ESP8266, and Distance Sensors are studied. Research on existing technologies, communication protocols, and relevant data collection and processing methods is carried out. The third step is system design, which involves selecting appropriate hardware and software and designing an intuitive user interface for an IoT-based inventory information system architecture with ESP8266 and Distance Sensor. Finally, a system sensor prototype is created by connecting ESP8266 with a Distance Sensor and programming it to measure distance and send data to a server or cloud. Figure 1 shows the schematic diagram of an IoT sensor prototype.

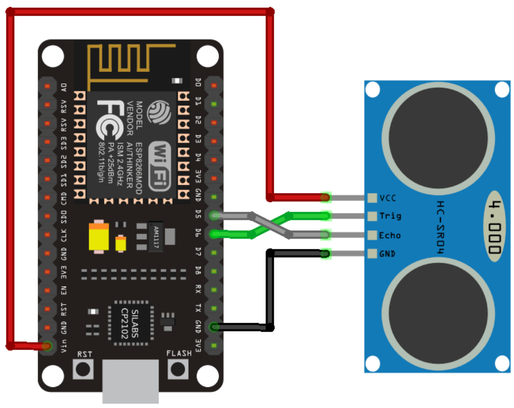


Figure 1. Schematic diagram of an IoT sensor prototype.

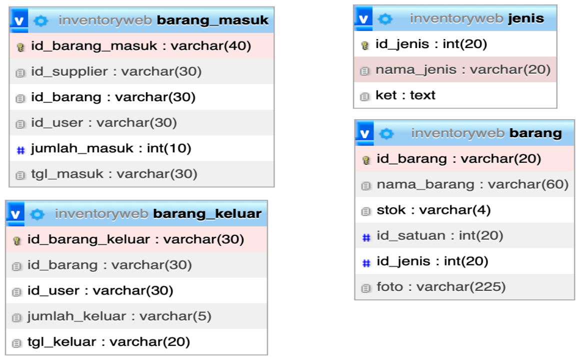
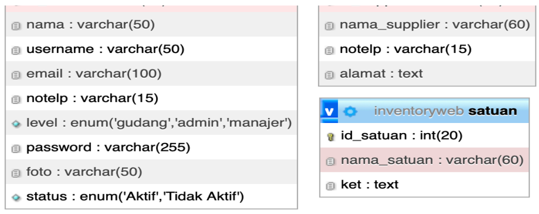


Figure 2. Database Design



Software development is the next step. This is the stage where software is developed to manage and store inventory data in a database, and to connect with IoT prototypes. This includes creating a database, processing data, and developing a user interface (Braude, 2016). Figure 2 shows the database design.

Testing and evaluation involves conducting trials on system prototypes to ensure that they function as expected (Al-Fraihat, 2020). The performance of the system, the accuracy of distance measurement, and the reliability of data transfer between the ESP8266 and the server or cloud should all be evaluated.

Data analysis and results involves analyzing the data collected during the trial and evaluating the results obtained from the IoT-based inventory information system.

RESULTS AND DISCUSSION

An inventory information system with the implementation of IoT (Internet of Things) is a system that uses distance sensors to automatically monitor and report information about goods in a warehouse or storage area. Figure 3 shows the activity diagram of the developed system.

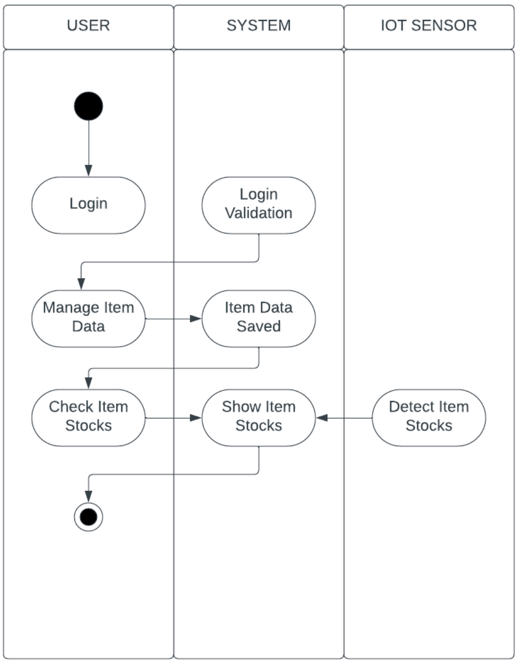


Figure 3. System’s Activity diagram

The system entails a secure login process for users, granting access to an item management module where they can add, edit, or delete item data, including names and types. Simultaneously, a sensor system integrated into the storage infrastructure continuously monitors item stock levels. Upon detection of changes, the sensor automatically transmits data to the central system, which processes and updates real-time stock information for each item. Users can conveniently view this information through a user-friendly dashboard, accessing details like current stock levels, recent changes, and alerts. The system also provides notifications in cases of critical stock levels or system-related issues, ensuring users stay informed for prompt decision-making.

User Interface Design

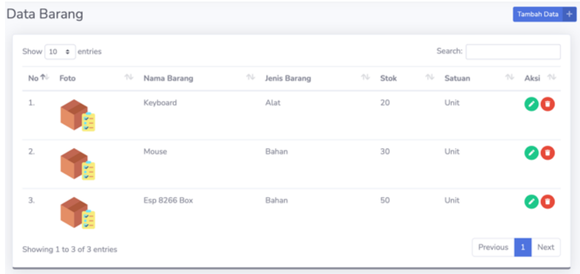


Figure 4. User Interface

The result of this stage is an intuitive and responsive user interface including page layout, navigation, input forms, display of inventory data, and user interface interactions with the system.

Figure 4 shows the interface of the item menu in the inventory information system accessed via a web browser. This menu shows data of item name, item type, stock and unit. There is an action menu for adding, editing , and deleting data.

In this interface, users can clearly see the main item such as name, type, stock and unit in table format. The action menu in the form of icons such as "Add Data," "Edit Data," and "Delete Data" is also clearly visible on the side. When users want to add, edit, or delete data, they will be redirected to the appropriate page with a form they can fill out.

Implementation of IoT

Distance sensors integrated with the system using appropriate methods. Figure 5(a) shows the Data Flow Diagram of a traditional inventory information system where the admin checks goods manually then enters stock data into the system database.

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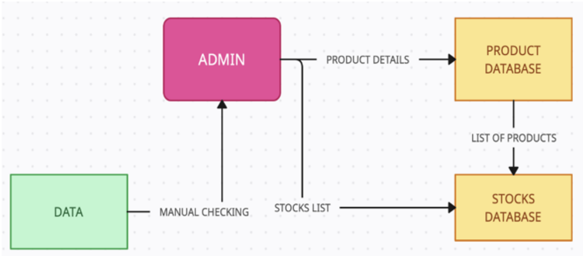
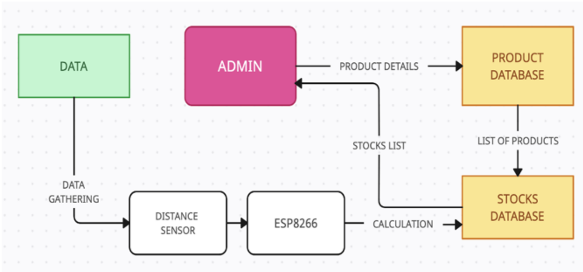


(a)



(b)

Figure 5. DFD Changes

Figure 5(b) shows the data flow diagram of an inventory information system that has been integrated with the Internet of Things. Data that previously had to be input manually, is now obtained via a proximity sensor, then the data is calculated and sent via esp8266 to the cloud database. This reduces system interaction with the user which will eliminate human error and increase system accuracy.

The implementation of IoT in this system helps improve operational efficiency by providing real-time information about stock, thereby enabling better planning. With IoT connectivity, stock monitoring can be done remotely, making it easier to manage businesses with multiple storage locations.

Data obtained from this system enables better inventory management, including timely and optimal procurement planning.

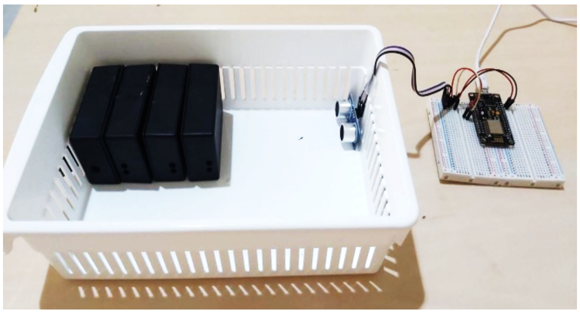


Figure 6. Physical Component

Figure 6 shows the physical components of the Internet of Things (IoT) system that was implemented. This system consists of an ultrasonic sensor connected to an ESP8266. Ultrasonic sensors work by sending sound waves and measuring the time it takes for the waves to bounce back. These sensors are installed in strategic locations, such as on top of storage shelves or in stock areas. The sensor will continuously capture data based on its environment, such as the distance from the sensor to nearby objects or the movement of objects around it. The main role of the ESP8266 is to provide WiFi connectivity. This allows the microcontroller hardware or the microcontroller itself to connect to a WiFi network and communicate with other devices, servers, or online services.

The data collected by the sensors is then sent to the IoT information system via a wireless network, such as Wi-Fi.

In this system, data from sensors is processed to determine the number of items in stock. The way this data is processed varies depending on the type of sensor used and business requirements.

To determine the quantity of goods, a formula or algorithm is used that corresponds to the data received. For example, if an ultrasonic sensor is used to measure the distance to a nearby object (in this case, an item on a shelf), the following formula can be used:

$$\text{Number of Items} = \frac{\text{Maximum distance} - \text{Measured distance}}{\text{Item Height}}$$

Where maximum distance is the maximum distance that can be measured by the ultrasonic sensor. The distance measured is data received from sensors, for example the width of an inventory shelf. Item Height is the average height of items stored on the shelf. Table 1 Illustrates a scenario wich show the the relationship between the distance measured by the sensor and the number of items available, where the length of each item is 3 cm and the storage length is 10 cm. It can be seen in table 1 that the system can detect goods with 100% accuracy.

Table 1. Distance and Number of Items

No	Distance	Number of Items
1	10 cm	0
2	7 cm	1
3	4 cm	2
4	1 cm	3

Once the quantity of goods is detected, the IoT information system enables real-time stock monitoring. Automatic notifications can be set to notify if the quantity of an item reaches a certain limit or if there are significant changes in stock.

Data obtained from this item count detection system can be used to manage inventory, optimize business processes, and ensure the availability of sufficient items in stock.

Table 2. Power Consumption

Time	Description	Watt	Voltage
06.00	Idle	0.2	5V
08.00	Acvite	3 W	5V
18.00	Active	3 W	5V
22.00	Idle	0.2	5V

Table 2 illustrates the power usage of a the device during specific time periods, differentiating between active and idle states. The data showcases estimated power consumption in watts, offering insights into energy requirements throughout the day.

The final stage of system development is system testing. In the system test, we're checking how smoothly the admin login, item data management, and IoT sensors work together. First, we're making sure the admin login is secure, only allowing authorized users and handling login errors properly. Next, we're testing the system's ability to manage item data—adding, editing, and deleting items accurately with good validation. We're also checking if IoT sensors integrate well, transmitting data in real-time and handling disruptions effectively. The goal is to ensure a hassle-free and secure experience for users, whether they're logging in, managing items, or relying on IoT sensors for data.The results can be seen in Table 3.

Table 3. System Testing

Function	scenario	Expected result	Result
Admin Login	Enter username and password and press the login button	login successful	success
Managing item data	Select the item data menu and the user can add, edit and delete data	all functions work	success
IoT sensors	Put a number of items in the storage area where the sensor has been installed	The system displays the number of items in real time and precisely	success

It can be seen in table 3 that all scenarios in the functional test were successful.

CONCLUSION

In conclusion, a system that uses ultrasonic sensors connected to the ESP8266 for inventory management with Internet of Things (IoT) technology provides various benefits, including:
Operational Efficiency, Better Inventory Management, and Remote Monitoring Capabilities.

The advantages of this research include the application of IoT technology and ultrasonic sensors for real-time stock monitoring, as well as the system's ability to provide automatic notifications when stock changes occur or reaches a certain limit.

However, potential drawbacks include the limited accuracy of ultrasonic sensors under certain conditions, dependence on an internet connection, and the need for increased data security aspects.

For future research, it is recommended to optimize sensors, improve IoT security, and integrate the system with existing inventory management, as well as conduct industry-specific studies to identify more specific challenges and benefits.

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