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Research Article

Espduino-32 Utilization in the Warehouse Storage Information System of the Metal Processing Industry Department

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A B T R A C T

An information technology system basically includes 3 things, namely hardware such as computers and printers, then software, and also the user or user who controls it, or what is usually called brainware. In the industrial world, information systems are needed to facilitate the work carried out by users. Based on the results of observations at the research location, several problems were found, namely the process of searching for items took a long time due to the location of the items not being well organized and the layout of the shelves in the warehouse being quite confusing. The number of items in the warehouse is also not recorded, making the warehouse manager unable to confirm the number of items in the warehouse. Numbering shelves in the warehouse is also a problem because insufficient lighting makes it difficult for users to find the right shelf in a short time. By designing an information system in the form of a website related to the warehouse inventory system which is connected using WiFi connectivity with the Espduino-32 module which controls the relay to turn on the shelf marker lights when and during the user's search for items. The results obtained from the implementation are that the process of searching for items in the warehouse is easier and can be done in a short time with the shelf number information listed in the search system as well as the indicator lights that will light up during the search process.

INTRODUCTION

An information technology system basically includes 3 (three) things, namely hardware such as computers and printers, then software, and also the user or users who control it, or what is usually called brainware. An Information System is essentially a system consisting of components or sub-systems that can produce information (Arjita, 2020; Wirandi et al., 2023).

Based on observations at the research location, problems were found in the warehouse of one of the departments in the metal processing industry, namely that the process of searching for items took a long time due to the location of the items not being well organized and the layout of the shelves in the warehouse being quite confusing. The number of items in the warehouse is also not recorded, making the warehouse manager unable to confirm the number of items in the warehouse. Numbering shelves in the warehouse is also a problem because insufficient

lighting makes it difficult for users to find the right shelf in a short time.

Research related to information systems in warehouses carried out by (Lubis et al., 2023; Pratiwi & Dachyar, 2020), so that it is easy for company employees to implement, Excel VBA was used. Research using prototype models starts from communication, planning, modeling, construction and testing. The forms created are items data collection form, stock in out form, and inventory form. The available features are edit, search and warehouse statistical information.

Research conducted by (Hamid et al., 2022; Huang et al., 2019) related to storage information systems in warehouses, using a script language, namely HTML, to enable direct checking and monitoring via a computer network system. Warehouse Inventory System (SIGA) created with open-source software using the PHP programming language and MySQL database management, then using a Windows-based server

computer. Product stock information data available in the warehouse has 4 types of products, all of which are included in the database. By using PHP and MySQL in building an information system, research conducted by (Sulaeman, 2021) found that the system designed facilitated the performance of the administration and other parties related to warehousing within the company.

Furthermore, research conducted by (Wardhani & Sukmono, 2023) designed an information system using the EOQ (Economy Order Quantity) method to manage the amount of stock available in the warehouse and also manage stock of items with efficient results in terms of time as well as optimizing storage costs and ordering stock of items.

Research (Veentoar et al., 2022) was carried out based on the inaccuracy of the data written in the report with the facts that actually occurred in the field. Apart from that, the process of fulfilling information needs related to the process of transactions in and out of items took a long time, so an information system was built using the waterfall method and utilizing a website as well as HTML, PHP, Javascript and MySQL as a database. (Faisal, 2019) conducted research related to information systems using Netbeans IDE 8.2 and MySQL database server in building the system. From the results of implementing the designed system, output is produced according to company management needs in the form of items usage reports, logbook reports and items submissions accurately, efficiently and relevantly.

By using the Rapid Application Development method to speed up testing in one iteration cycle, research conducted by (Hetiosa et al., 2022; Simatupang et al., 2022) can help inventory become more efficient and effective. Apart from that, in designing the system, Code Igniter was used as a framework to simplify the system development process.

Research on information systems related to motorbike spare parts retail conducted by (Hetiosa et al., 2022; Yuniar et al., 2023) using the waterfall method with PHP programming resulted in users being able to carry out transactions easily and increasing effectiveness and efficiency in the company's business processes. (Simatupang et al., 2022; Veeramanickam et al., 2022) utilized Espduino-32 in the parking system. The use of the HC-SR04 ultrasonic sensor is to be able to identify vehicles that are about to park their vehicles and also detect vehicles that have been parked with the aim of making it easier for vehicle owners who are about to park their vehicles to be able to find a parking space. Apart from using Espduino-32 and ultrasonic sensors, researchers also added internet of things. The designed circuit will be connected to the internet to be able to send information to a web server.

Furthermore, this information can be accessed by vehicle users to find out the availability of parking spaces. Apart from information on parking space availability, users can also check information regarding parking rates or fees that must be paid.

Based on the research references described, no solution has been found regarding the problems found at the research location. So, in this research, an information system was designed in the form of a website related to the warehouse inventory system which is connected using WiFi connectivity with the Espduino-32 module which controls the relay to turn on the shelf marker lights when and during the user's search for items.

METHOD

The research was carried out and implemented in one of the storage warehouses of the Electrical Department of PT. Indonesia Tsingshang Stainless Steel (ITSS) in Morowali Regency. The system works by connecting websites that have been designed with the Espduino-32 series using a WiFi network (Figure 1.). The working principle of the designed system is, when searching for items/equipment, the system will provide information regarding the location of the items/warehouse equipment being searched for through the display of information on the monitor screen as well as the shelf light indicator where the items/equipment being searched for are located. The system block diagram is presented in the figure below.
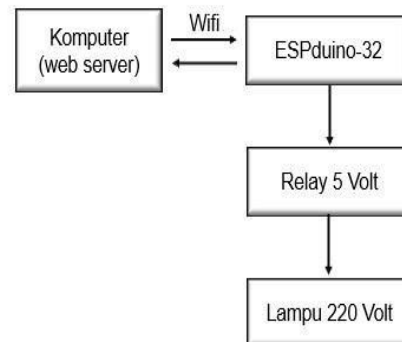

Fig. 1 Design System's Block Diagram

The overall flow can be seen in the block diagram in Figure 2, where the flow starts from when the employee/user accesses the computer, operates the Items Storage Information System in the Warehouse to when the employee/user presses the "Oke" button after the search for items is complete.

In the designed system, the information system and lights installed on each shelf in the warehouse are integrated using contacts on a 5-volt relay which is controlled via Espduino-32 (Figure 2.). As a first step, the user will type the name of the item on the search page on the web server created. If the item you are looking for is available in the

warehouse, information will be displayed on the monitor screen regarding the position of the item on which shelf. Meanwhile, the website will send data to Espduino-32 to activate the relay so that it changes the NO (normally open) contact to NC (normally close) on the relay so that current can pass and the lights installed on the intended shelf will turn on, so that employees/users can Immediately rush to the shelf to get the item you are looking for. Then, to turn off the lights, employees/users who have finished searching for items can press the "okay" button on the pop-up information displayed on the monitor screen so that the web server will send data so that the Espduino-32 turns off the relay so that the NC contact returns to NO and the lights turn off again.
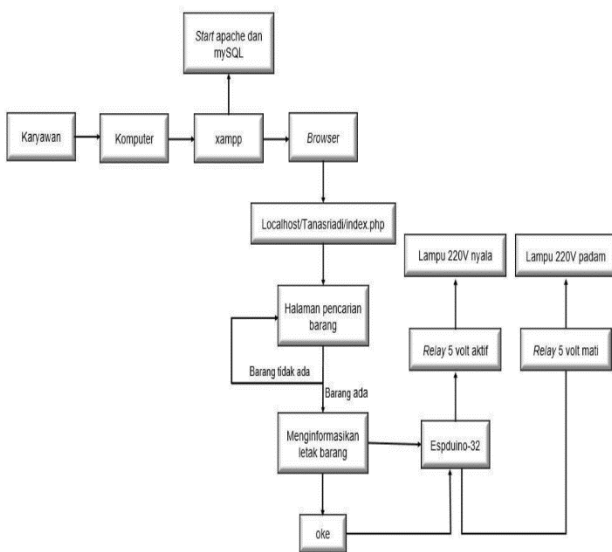
Fig. 2. Item's Information System Block Diagram

Fig. 3. Using HTML in designing a website.

The system planning carried out consisted of creating a website, creating a database, creating a program, synchronizing the website database and program, then testing the circuit, and the final stage was installing the

system at the Electrical Warehouse, Ferronickel Department, PT. ITSS.

Software design is divided into 2, namely website design using Hypertex Markup Language or HTML (Figure 3.), and microcontroller programming. In the website creation process, the Visual Studio Code application uses Hypertex Markup Language or HTML to create interface pages, then Hypertext Preprocessor or PHP as instructions or commands and finally Cascading Style Sheet or CSS to decorate the website appearance as desired (Figure 4.).

After making the interface page structure, the next step is to create instructions or commands using the Hypertext Preprocessor (PHP) programming language. There are several commands that can be created, namely the bacarelay.php, function.php, index.php, and ubahdata.php commands.
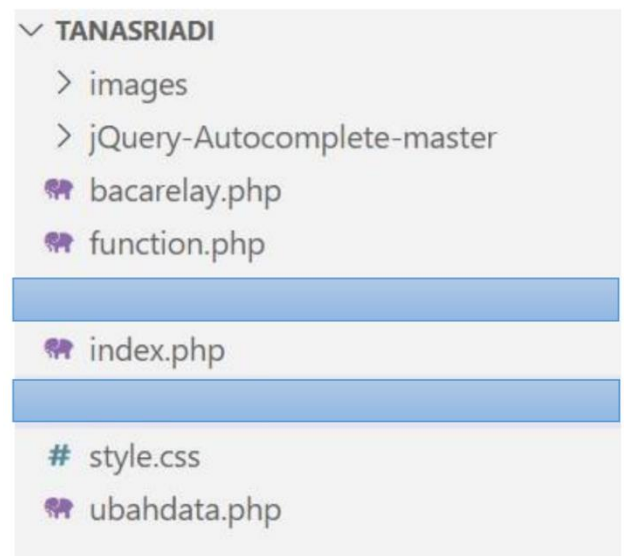

Fig. 4. Commands created using PHP.

The command created has the function of changing the relay value in the item name data storage database, and giving the command that the item name typed on the search page is not displayed as text but as a number, so that communication between the website and Espduino-32 can run, so the relay can work properly with the given input.

Next, using CSS, a program is created to make the website appear as desired (Figure 5.). The appearance created is in the form of adding a background to the website, setting the font model, setting the font location, font color, and creating card columns.

```css
# style.css > 🎨 .content h2
1    u* {
2        margin: 0;
3        padding: 0;
4        outline: 0;
5        font-family: Arial, Helvetica, sans-serif;
6    }
7    body {
8        background-image: url(images/bg.jpg);
9        background-position: center;
10   }
11   .content h2 {
12       text-align: center;
13       font-size: 17px;
14       letter-spacing: 3px;
15       text-transform: uppercase;
16       font-weight: 800;
17       padding-top: 40px;
18       padding-bottom: 20px;
19       color: ■#161614;
20   }
21
22   #card {
23       background: □#fbfbfb;
24       border-radius: 8px;
25       box-shadow: 1px 2px 8px rgb (0, 0, 0.65);
26       height: 350px;
27       margin: 6rem auto 8.1rem auto;
28       width: 300px;
```

Fig. 5. Display of the created CSS coding

Next task is to create a database of items and equipment that available in the warehouse using the XAMPP application (Figure 6.). In this research, samples were input from 12 shelves, with each shelf consisting of 6-7 items and equipment. Apart from inputting items into the database, settings are also made the relay value when the condition is NO or NC.

Fig. 6. Database display on the system being established

After the website design is complete, the next step is to create a program to synchronize the Espduino-32

microcontroller (Figure 7.) with the website that has been designed. Programming is carried out using the Arduino IDE application with the programming display as follows

```cpp
void loop() {
    //koneksi ke server/web server apache
    WiFiClient client;
    const int httpPort = 80;
    //uji koneksi ke server
    if (!client.connect(host, httpPort)){
        Serial.print ("Gagal Koneksi ke Server");
        return;
    }

    //baca status relay
    String LinkRelay;
    HTTPClient httpRelay ;
    LinkRelay = "http://"+String(host)+"/TAnasriadi/bacarelay.php";
    httpRelay.begin(client,LinkRelay);
    //ambil isi status relay
    httpRelay.GET();
    //baca status respon
    String responseRelay = httpRelay.getString();
    Serial.println(responseRelay);
    httpRelay.end();
```

Fig. 7. Designed Synchronization Program

In the hardware design section, this research uses an Espduino-32 microcontroller using 12 digital pins connected to a 5 volt relay. The wiring diagram of the circuit can be seen in Figure 8. The 220 voltage enters each relay and uses the NO contact as the initial condition, and the relay voltage input is obtained from Espduino on the 5V pin and ground on the GND pin.
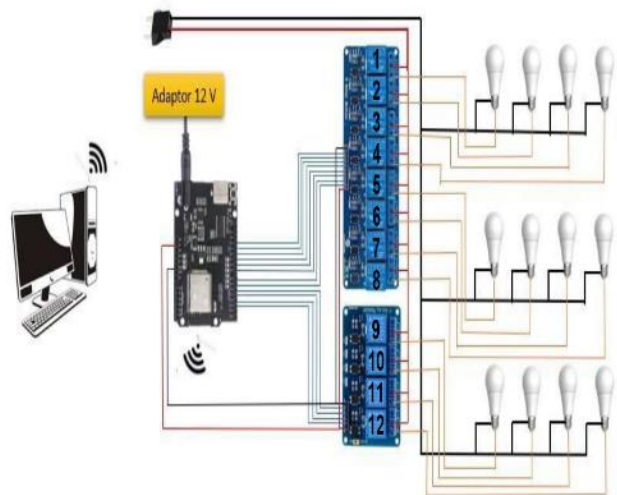

Fig. 8. System Design's Block Diagram

RESULT AND DISCUSSION

The entire system hardware installation took 4 days, which took quite a long time because the installation was carried out in quite a large electrical warehouse plus the electrical warehouse was quite large (Figure 9.). Beside of that,

adjustment to working hours in the warehouse area is also the cause of the installation taking a long time. The cables used for the installation process match the cables facilitated by the company which is fiber cable with 1.5 mm diameter (Figure 10.).

Fig. 9. Research location and application of research results

Fig. 10. The process of cutting and connecting cables on shelves in the warehouse

Next, the phase cable on each light fitting is connected to the NO relay contact. The phase cable on the rack 1 light fitting is connected to relay 1, the phase cable on the rack 2 light fitting is connected to relay 2, the phase cable on the rack 3 light fitting is connected to relay 3, and so on until connecting the rack 12 phase fitting cable to relay 12.

The system created can be accessed by users via computers in the electrical warehouse, and beforehand it must be ensured that the computer and Espduino-32 are connected to the WiFi in the warehouse, so that the computer and

Espduino-32 are connected to each other (Figure 11.). Next, the user opens the XAMPP application on the computer (Figure 12.), then presses the start button on the Apache module so that the server created can run on the website and presses the start button on the MySQL module so that the database created can be accessed on the web server created.

Fig. 9. Results of making a controller using Espduino-32

Fig. 10. MySQL and Apache Module

Next, open the web browser on the computer, then go to the search page and type in the localhost address that has been created so that the web server that has been created will appear as shown in Figure 13.
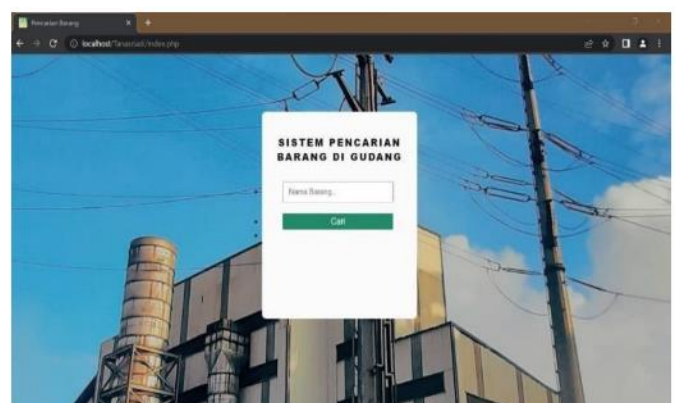

Fig. 11. Webpage Display

After the web page appears, the user can enter the name of the item to be searched for on the item search page, then press the search button, the system will display a pop-up information on the location of the item. If the item name

has been entered in the system database created, the information pop-up form will appear as in Figure 14.
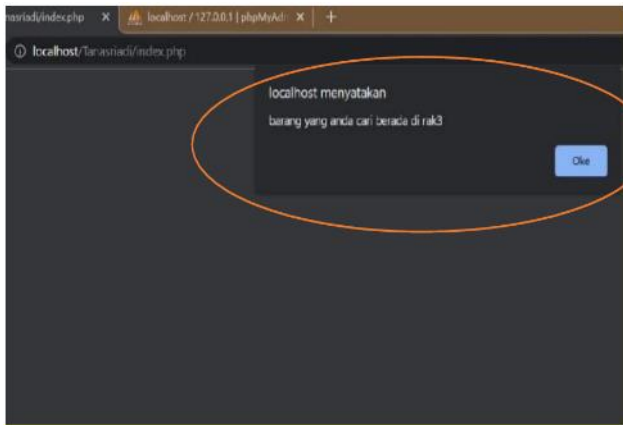

Fig. 12. Pop-up display of information regarding items in the warehouse

When pop up information on the location of items appears on the web server search page, the Espduino-32 receives a command signal from the database to activate the relay according to the command given. The command signal obtained from the database is in the form of a number, if the value sent is number 1 it will activate relay 1, if the value sent is number 2 it will activate relay 2, if the value sent is number 3 then it will activate relay 3, and so on until the desired value The number 12 is sent to activate relay 12 so that Espduino-32 will activate the relay so that the NO contact closes and passes current to the lamp fitting, so that the 220 V lamp will turn on. And when the "OK" button is pressed on the item location information pop-up, the relay value in the database will return to 0, so Espduino-32 gets a command to turn off the relay so that the 220V light will go out (Figure 15.).

Fig. 13. System Test Results Overall

When the user types the name of an item that has not been entered in the system database on the web server search page, then presses the search button, the system will carry out a command on the web server to return to the interface page or to the Index.php page, so that the website display will return to the beginning , and the web server will not send commands to Espduino-32 so that the relay is not active and does not turn on the shelf lights in the warehouse.

To input goods available in the warehouse, warehouse admins can access them on the computer in the warehouse, then open a web browser and type *localhost/phpmyadmin/* on the browser search page, then the created database will appear (Figure 16.). After that, select the "*pencarian_barang*" database folder then select the "*rak*" table, then the item name data file will appear, and warehouse admins can change the item name, or add a new item name as desired by tapping twice on the shelf column that we want to add and then typing the name of the item we want to enter.
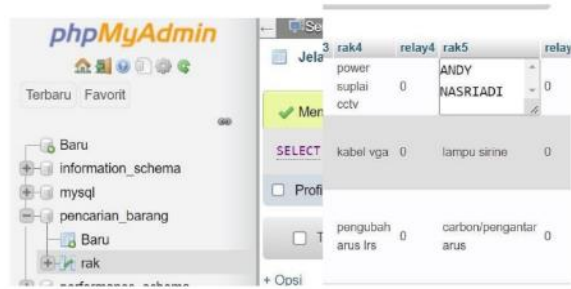

Fig. 14. Database page display

The name of the item entered into the system database is data taken from the data available on each shelf, as seen in Figure 17. Then the items available on each shelf are re-checked so that from this process the data on the name of the item is obtained are really available in the warehouse and entered into the system database that has been created
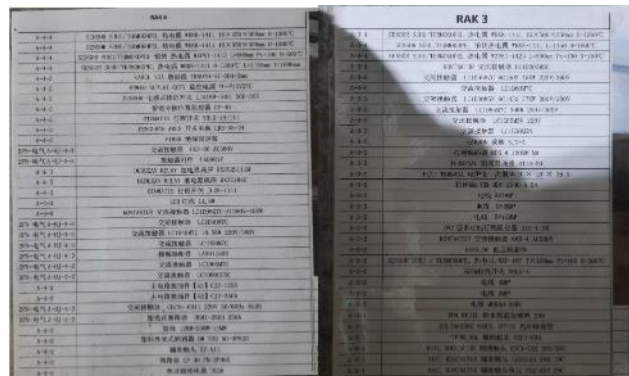

Fig. 15. Item Information on Each Shelf

In this research, samples were input from 12 shelves, with each shelf consisting of 6-7 items and equipment. There is no limit to adding the number of item names we want to enter in the database, as long as warehouse admin can create empty tables in the database.

However, because the computers that available in the warehouse use Hanzi characters, so to make it easier for the warehouse admin to input new item names in the system database in the warehouse, 25 empty columns have been created on each shelf (Figure 18.).

The created system can be said successful if the name of the item typed on the web server search page displays a pop-up of information on the location of the item corresponds to the data entered into the database. Beside of that, the item typed on the web server search page makes changes the value of the relay column number in the database so that the website and Espduino-32 can communicate with each other to activate a relay.
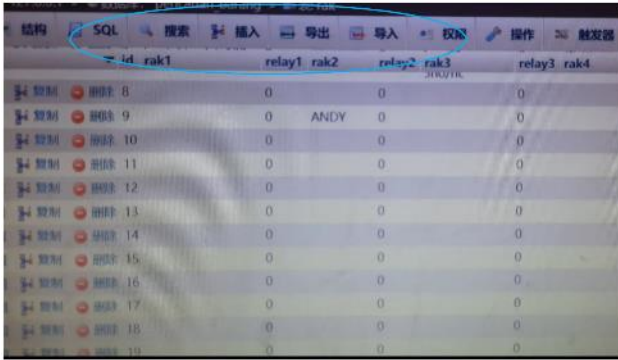

Fig. 17. Shelf No.1 Testing

Fig. 16. The empty database that has been created

Fig. 18. Shelf No.4 Testing

From the results of experiments carried out by retrieving data from the database and testing the system directly in the electrical warehouse, by testing the search for each of the 4 items on each shelf (Figure 19-20), the results obtained were that the system was made to run smoothly with 0% error.
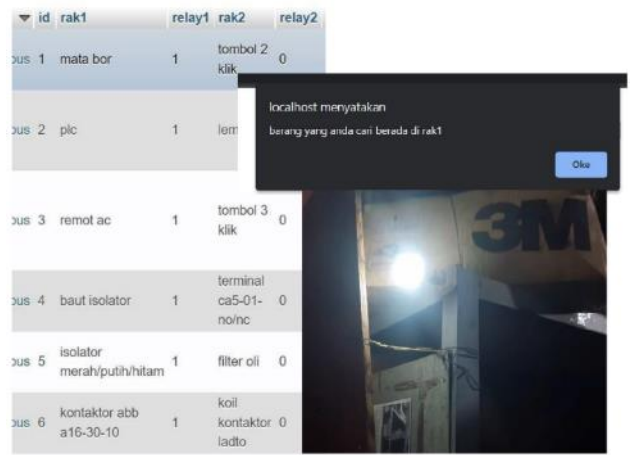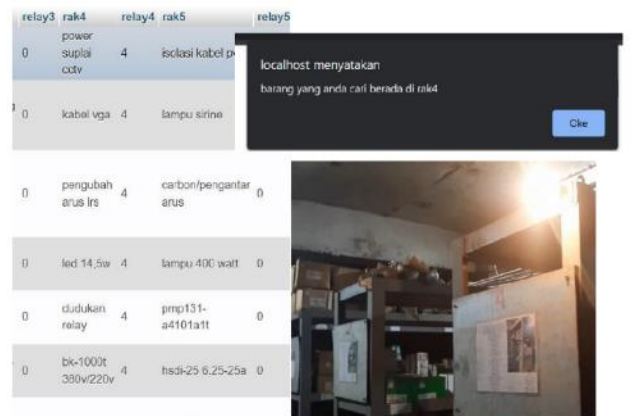
Table 1. Items' Name Database

No.	Shelf 1	Shelf 2	Shelf 3	Shelf 4	Shelf 5	Shelf 6	Shelf 7	Shelf 8	Shelf 9	Shelf 10	Shelf 11	Shelf 12
1	LCIE 120	Terminal CA5-01-NO/NC	Sekring	Power Supply CCTV	Isolasi Kabel	YTM391-D03-G00	Tali Fambel	Sensor Crane	Switch Kunci LAY-50	Tombol Switch LW39	DCMJ(Ky) 0.48-19	Besi U
2	Baut Isolator	Kontaktor LCID32CC	Plat Tembaga	Pengubah Arus LRS	Lampu Sirine	BMY-8020-100C	Dudukan Isolator	DZ47S LE 2PC S0A	Otomatis LX19-111	ZYJ220-66-106 DC220	HH15-630/3Q SA	Skun DT-150
3	Remote AC	Filter Oli	Selongsong Kabel Optik	Dudukan Relay	Penghantar Arus	HZD=L/M 2-20mm/S /200	Relay	CDM3L-250S 250A	Timer KG316T	NT3 630A 500V	PTS-80-09	Skun SYT-30
4	Kontaktor LCIE120	Tombol 3 Klik	Karbon SJG-4	BK-1000T 380V/220	PMP131-A4101A1T	PGR-4C-E	Travo BK-100	DZ47S C6 3P 6A	NS1000N 3P	VFDB40 45 45KW	YSF-5580KJ BTH	DCMJ(KY) 0.48
5	PLC	Tombol 2 Klik	ToA Kecil	CP 30 FM-2P005	Pita Print LM-1R300 B-AS	Sensor Pintu	Kabel Fiber Optik	LV540 326 400A	MCB CDL-63	Tombol Switch LW39	HZYN-98008M	HYD3-10/ 0.5-50

No												
6	Kontaktor ABB A16-30-10	Lem Fox	Terminal HSCI-CA5	SFERE 200 450V-800	Lampu 400 Watt	Pita Print LM-1R300B-AS	Lampu Indikator	Baut M20x1	Fiting Lampu Pegang	MCCB CM3-100H/3300TH	CAP2-400/D/4-40	WSSX-411 0-100C
7	Mata Bor	Koil Kontaktor Ladto		LED14,5w	CT Trafo	HSDI-256.25-25A	Colokan	Push Button	MCB 3 Phasa	AC110V-220V DSN-AMY		
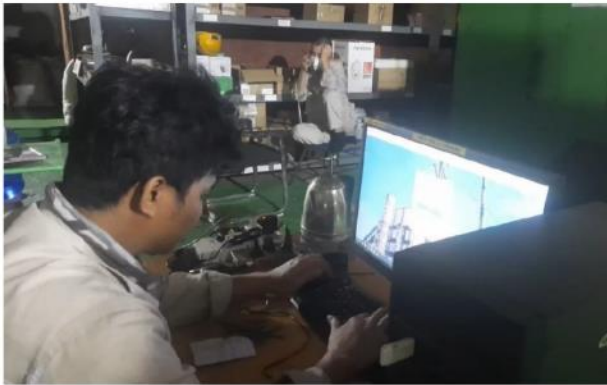
Fig. 19. The system designed is used by the warehouse admin

After carrying out the installation, a trial of the designed system (Figure 21.) was carried out on 10 employees from several divisions in the Ferronickel department. The 10 employees gave a "BAIK SEKALI" which means "VERY GOOD" in assessment of the implemented system, as shown in Figure 22.

Fig. 20. Feedback of Assesment in Implementation System

CONCLUSION

Based on the results of application and testing on the system that has been built, it can be concluded that the use of Espduino-32 in the system designed and implemented in one of the metal processing industry warehouses is functioning well. The process of searching and retrieving tools in the storage warehouse becomes easier and faster due to the presence of indicators for the position of the being stored. The number of items that can be added to the database system is unlimited. It is hoped that for further development, the information system can add other types of indicators such as speakers which can provide information in the form of sound.

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