T-UFF (Tracker stuff): application development for warehouse tracking

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Abstract. Era Society 5.0, requires the logistics agents to adapt and follow technology development to create supply chain efficiency. One of the ways is to apply the IoT to warehousing activities, creating a system design Warehouse Tracking app that works to increase order picking time efficiency. This system design application method is using the System Development Live Cycle (SDLC) and follows Object-oriented programming (OOP). This final result study is a system design application based on the IoT and QR codes for operating order-tracking goods in a warehouse. With this Tracker Stuff (T-UFF) app, the time it takes for order picking will be decreased so that it can create activity-efficient logistics for the company.
Keywords: Logistics, System Development Live Cycle (SDLC), Object-oriented programming (OOP), Tracking, Warehouse.

1. Introduction

In Indonesia, great progress has been made in the company industry in the era of Society 5.0. Refers to the concept of development technology such as the Internet of Things (IoT), big data, and artificial intelligence, used to significantly increase the quality of human life. In the industrial sector operational processes, will never miss from the existing role-effective warehouse to use carry out process control shopping and production goods [1]. Activities inside warehouses must consider related planning, organizing, and control logistics in a technical or administrative manner; therefore, the application concept of management warehousing is urgently needed [2].

Warehouse management can be defined as governing science-in-matter practice storage and output stuff in warehouses [3]. This application concept of warehouse management aims to avoid the increased time of order picking which is time for the taking process of an item from storage in a warehouse for fulfilling customer orders with a fast time and will get high satisfaction from the customer [4]. The inefficiency of order picking time is known to cause difficulty for the operator in finding location storage for goods to be sent as a result of a bad inventory.

Order picking is the highest activity cost in warehousing and can reach up to 55% of the total cost of operational warehousing, and is therefore considered a priority in enhancing productivity [5]. Order picking is also important in matters influencing the service level of a customer order, which is determined by the efficiency of order picking and accuracy. Efficiency shows how fast an order can be taken and how quickly that order is available for delivery to customers. Therefore, development systems capable of tracking goods push order-picking time will increase efficiency and effectiveness in operational warehousing [6].

Internet of Things (IoT) implementation in the era of Society 5.0 especially in the warehousing sector can be utilized optimally through system tracking. Logistics tracking is defined as the process of recording goods trip interval from place origin to place goals through company transport [7]. In this

research, tracking refers to an activity of item location searching in a warehouse. Based on that, the author offers Tracker Stuff (T-UFF), an application that is capable of giving information related to position-stored items through the use of a QR code to show the route location of the goods by lighting the lights connected to the microcontroller. Creating the system via Android Studio, which uses a method of the System Development Live Cycle (SDLC) and object-oriented programming (OOP). SDLC is a structured and systematic approach related to the development of software products [8].

SDLC's normally used for designing and developing software with high quality. This method can streamline the cost and time required for making a piece of software but still can maintain quality products to be created. Stages the beginning that was done on the SDLC, do planning system consisting from define the problem and determine the objective system. Then, the stage furthermore is to do an analysis system consisting of, identification problem, and defining need information. The third stage is a design system with a flowchart system, use case diagrams, and class diagrams [9].

The warehouse tracking system was developed several times, but the results finally reached a maximum. One study was previously carried out by [9], entitled ' System Design Information for Tracking Tracing in the Warehouse with Use Technology QR Code, where development study developed with the method approach System Development Live Cycle (SDLC) gets to the stage design system, with initial stages, with requirements analysis, followed by the design to use method object-oriented programming. The tracking tracing process is carried out to help determine the position from inventory in the warehouse and to ensure that the inventory issued follows the FIFO rule. However, the system built its own weakness, that is, the system Existing ERP, which there is still not yet integrated with system information-based IoT, besides it, the system still needs to be developed for software engineering.

Another reviewed study, is research conducted by [10], with the title ' Research on Intelligent Warehouse Management System Based on RFID, Research on Intelligent Warehouse Management System Based on RFID.' This research is known as a system intelligent management warehousing RFID based. Radio-frequency identification (RFID) technology consists of a transmitter, receiver, microprocessor, antenna, and label. RFID can be divided into three types: readers, antennas, and tags. First, readers send an electronic signal through antennas, the transmit tag stores identifiable information internally after the signal is received, and the reader accepts and recognizes the information and sent back by tags through antennas. Finally, the readers send the identification results to the hosts. Based on the study, the RFID-based application described thus far has limited development-related information goods in warehouse management only.

Despite the limitations of previous studies regarding the development of tracking systems, this study introduces the application of tracking stuff (T-UFF) as a display-capable solution route to the location of goods based on the information obtained from the database by scanning QR Code. This application is also equipped with visual instructions in the form of light, which can guide the user to the intended rack. The system app is connected to a microcontroller that sends a signal to a side-mounted LED light which guide you to specified shelf. The microcontroller uses Arduino because of it's suitability for projects that require high capacity for large circuits [11]. This study aims to design and test the performance of the application. The hope is that this research will produce an output that can be applied in warehousing management, whether for the storage of goods on shelves or off the shelf.

2. Methodology

In conducting this research, the methodology used was the process of applying applications and simulations that will be applied.

2.1. Flowchart System

The methodology described in the system flowchart is illustrated in Figure 1.

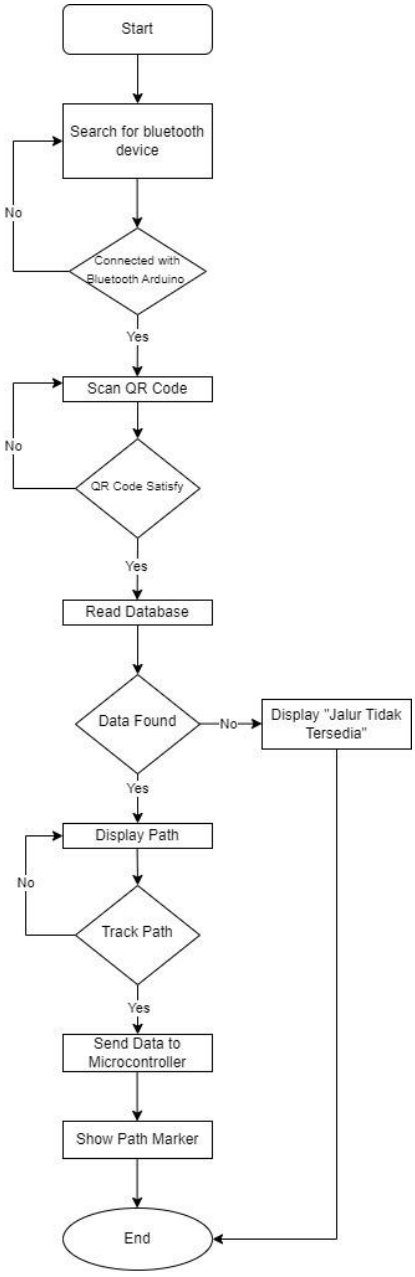

Figure 1. Application System Flowchart.

The system can be explained as follows.

a. The user opens the system, and the screen display appears to search for bluetooth devices.
b. When successfully connected to bluetooth, the user can enter the application. If the connection fails, the button to enter the application cannot be pressed and the user must return to search for bluetooth devices.
c. Then, the application will display a, route layout image, QR Code scan option“start” button, and “stop” button
d. When the scanned barcode is read by the system, it displays the route layout image according

to the QR code.

e. If the scanned barcode is not read by the database system, the information track is not available, and the system ended up appearing early.
f. The successful system display of the route layout will send data to the microcontroller for turning on the light marker route according to the QR Code by “Mulai” button, and the system will be ends with “stop” button or the light will be off.

2.2. Usecase Diagram

To describe the interaction between actors (actor) and the system in this application can be illustrated through the use case diagram that has been shown in figure 2.

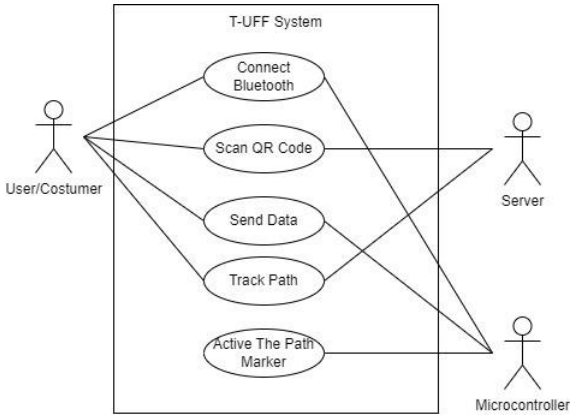

Figure 2. Application Usecase Diagram.

In the picture above, from the use-case diagram owned by the system, three entities are involved: the the user, server, and microcontroller, respectively. First, the microcontroller is connected to the user via bluetooth. When the QR Code is successfully read and appropriate with the database, the server will produce a layout image at once sending data to the microcontroller to turn on the LED according to the specific rack route based on the scanned barcode

2.3. Class Diagram

To find out about the description of the coding structure in this application, it can be seen in Figure 3.

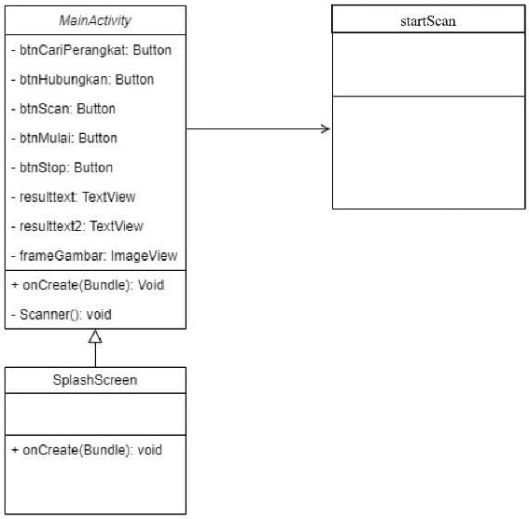

Figure 3. Application Class Diagram.

a. MainActivity:
    1. Contains variable member private: btnCariPerangkat (button), btnHubungkan (button), btnMulai (button), btnStop (button), btnScan (Button), resulttext (TextView), resulttext2 (TextView), and imageframe (ImageView).
    2. Define the ` onCreate` method to initialize the layout and set the ` OnClickListener` to the ` btnScan` button , 'btnCariPerangkat' button, 'btnHubungkan' button, 'btnmulai' button, 'btnStop' Button.
    3. Contain method private `Scanner` in charge answer For configure and launch barcode scanner.
b. Start Scan:
    1. Inherit class ` CaptureActivity` from package ` com.journeyapps. barcodescanner`.
    2. Represent activity custom: Start the scanning process.
c. Splash Screen:
    1. Inherit class ` AppCompatActivity.'
    2. Represent splash screen activity.
    3. Arrange appearance content and define the ` onCreate` method for starts `MainActivity` after pause time.

2.4. Development Method Prototype

The Development Method Prototype is a research method applied in the manufacturing system writing end of prototypes. This prototype aims to be able to know about the schema implementation T-UFF application in warehousing. The application of the prototype method is as follows:

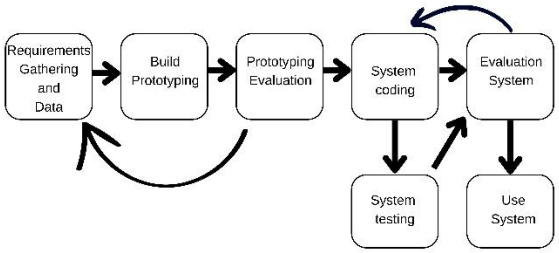

Figure 4. Development Model System Prototype.

The prototype method is used for the development of device software, which represents a new paradigm in the manufacturing or development of software [12]. The prototype method is evolving in the world of development or manufacturing device software, which has also revolutionized the method of development or manufacturing device software, the sequential system known as the waterfall method [13].

3. Analysis and Discussion

3.1. T-UFF Application Start Page

Fig. 5 shows the initial display when the application was opened. To operate this application, the tablet device must be connected to bluetooth, which sends a signal to the Arduino. At the start of the application, the bluetooth connection settings display will appear, and the user presses the search device option; if the device is found, they can press the connect option; therefore, the application is ready to use by pressing the MASUK APP button.

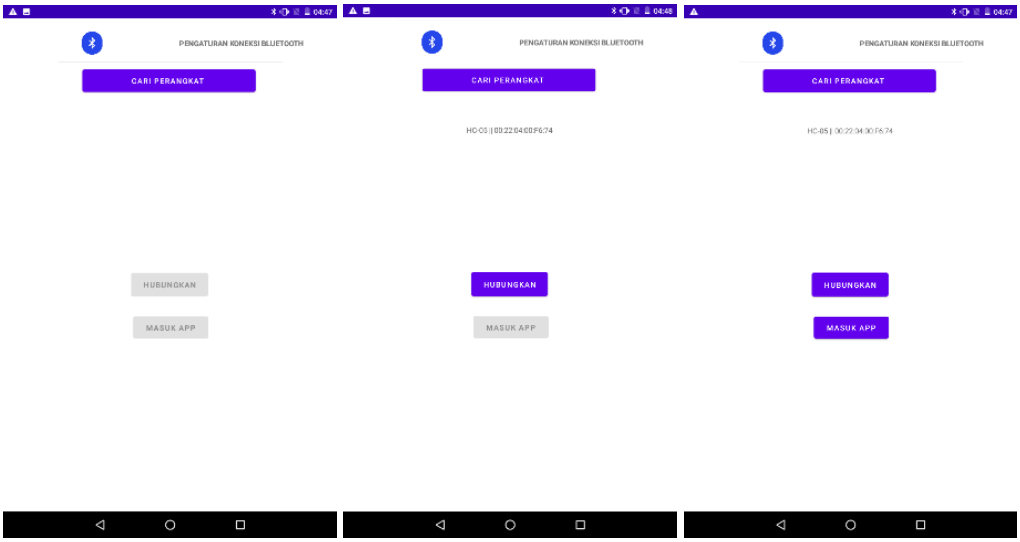

Figure 5. The Initial appearance of the T-UFF application.

3.2. Main Menu Display of T-UFF Application

On the page, the main menu display is shown in relation to the route layout image warehouse used as a whole. This page also displays two captions: scan data and routes/paths. Information scans will provide information about the identity rack you want to know, and the route track contains route-related information about going to the rack you search for. If we want to know the route to the rack, click the SCAN QR button to open the camera, and then it will work to find the identity rack by the way they scan the QR code rack. After identifying the identity rack, the available START button sends a signal to the microcontroller that turns on the LED light to the location of the goods according to the QR Code. The type of microcontroller for this case is Arduino Mega 2560 R3. Viewing this initial scan data as well as the track will provide no information on is data available because it hasn't been done QR scan that has registered in the database application. Meanwhile, the STOP button can be used if the user wants to stop and turn off the lights of a particular shelf and search for a route to another shelf.

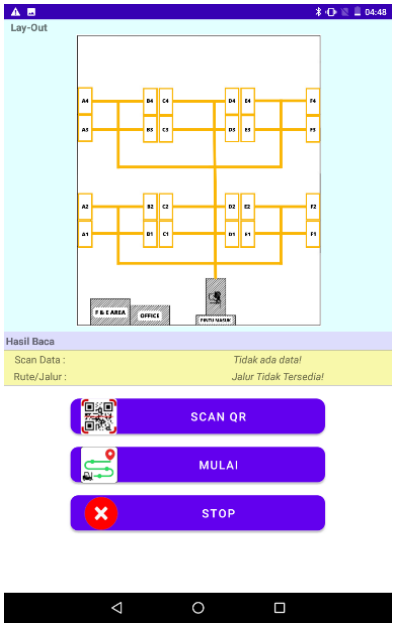

Figure 6. Display of the Main Menu of the T-UFF Application.

3.3. Appearance QR Code use Showing Identity Rack

If it is easy to search for an item, then each shelf in the warehouse is given a number identity from A1-A4, B1-B4, C1-C4, D1-D4, E1-E4, and F1-F4 which can be read via the QR Code.

Figure 7. Qr Code Identity Rack.

3.4. App Display When Reading Shelf Identity and Showing Routes

If the scanned QR Code can be read by the database, the application will display layout images, and the results will show the location of the goods and the route according to the QR Code. Subsequently, the user can push the start button to send data to the microcontroller to power the LED light route. From this view, the user can easily follow the route and finally get to the rack.

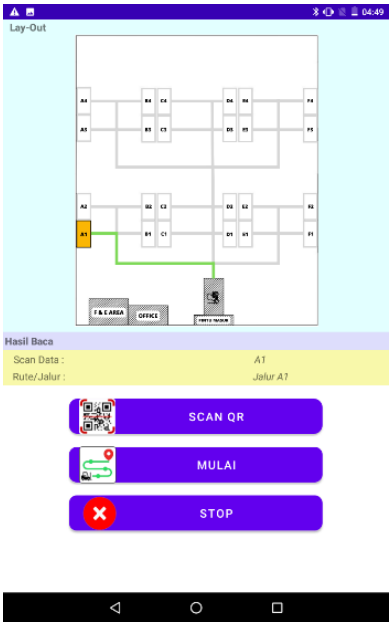

Figure 8. Display Applications When Shows route Goods Positions.

3.5. Appearance Application When Reading No QR Code Registered

If one's own ability displays the route going to shelves that have been identified in the manufacturing process, the application will enter related to the route on each rack that is entered into the database. Thus, when the application reads a QR Code that is not registered, the results on the scanned data can only read the QR Code text and display images, and routes/paths are not available.

Figure 9. Display Application When Reading No QR Code Registered.

3.6. Display Prototype Implementation The T-UFF Application

When the QR code is successfully scanned, the application can read according to its database. Using the START button, the application sends a signal to the microcontroller, which turns on the LED light route according to the QR code location, as shown in Fig. 8, through a bluetooth signal. The LED light is turned on because it receives an order from the Arduino as a microcontroller or giver command. The flow that occurs when the LED lights up, that is, the Arduino receives the signal over the bluetooth from the T-UFF application; then, the Arduino issues power by 5 V to the relay module with a capacity of 5V to be connected to each lamp and the route ordered. The LED lights have a capacity of 12V and are divided into segments. Relays will get help power from the power supply to turn on the light route. The total number of segments in the prototype is 42. The segment is every path in the warehouse layout. When the user has finished turning on the light as a guide to determine the location of the shelf, they can press the STOP button via the application, which sends a signal to the Arduino to turn off the light that was previously turned on.

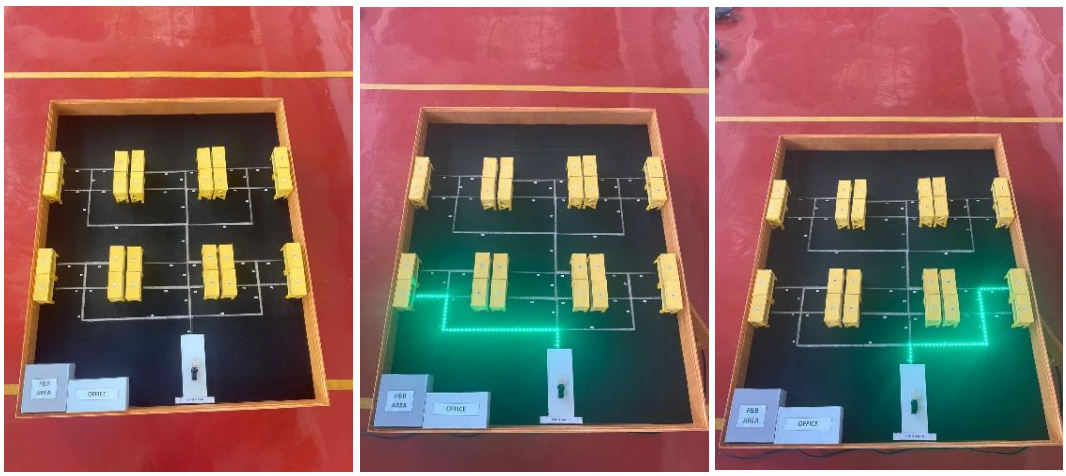

Figure 10. Display Prototype T-UFF Application.

3.7 Benefit of T-UFF Application

The T-UFF application has the benefit of being able to directly show the forklift route to the shelf where the desired goods are stored. In addition, by implementing this application, you can avoid placing items incorrectly, thereby preventing the loss of things. In this way, it will reduce order picking time, thereby speeding up the movement of goods in the warehouse to create efficiency and improve the quality of customer service.

4. Conclusion

After designing and manufacturing the T-UFF application, this system can identify related storage locations for goods and show the route to that location using the Android application. Utilization of the camera on the smartphone serves to support the operation Scan QR feature to read the identity shelf via QR Code. Through the identification of the identity shelf, the application sends a signal to the microcontroller via Bluetooth and turns on the LED light route according to the identified QR code location. In use, the user can know the position placement of goods and routes to that location instantly. In addition, the user can avoid placing items incorrectly, thereby preventing the loss of things. In this way, it will reduce order picking time, thereby speeding up the movement of goods in the warehouse to create efficiency and improve the quality of customer service. This research can continue to develop, one of which is the implementation of a real-time system and an upgrade of the best route guide. Subsequently, the application can show the current location of the forklift on the best route to further speed up the order-picking process by minimizing route-selection inefficiencies.

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