



## Design Of Employee Attendance System Based On RFID And IOT Technology Case Study PT XYZ

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### Abstract

Employee attendance management is an important business process that needs to be done by most companies in general. The utilization of an employee attendance information system can overcome problems related to these business processes such as ineffective processes because they are still done manually, high risk of data manipulation, or complicated recapitulation preparation. The development of the system requires an analysis and design process to minimize the risk of implementation failure. The focus of this research is to design an employee attendance system that can meet the needs of the company in general. This research is a case study research conducted at PT XYZ. The methodology used follows the stages in the software development life cycle (SDLC). The results obtained are a list of system requirements in the form of user stories, system designs, and a prototype system developed with RFID and Internet of Thing (IOT) technology. Testing with scenario-based testing techniques was also carried out on the prototype.

Kata Kunci: Microcontroller, ESP8266, RFID, WEB

### Introduction

Attendance is one important aspect that can support the employee attendance system. Currently, there are still companies or agencies that do not utilize technology for employee attendance, one of which is PT XYZ. This condition causes problems such as: vulnerable to manipulation of attendance data, complicated attendance recapitulation, and high risk of data loss. On the other hand, monitoring time attendance, every minute or hour, is an important activity to assess employee performance in a company. Technology can be utilized to help the problems in managing employee attendance.

Radio Frequency Identification (RFID) and Internet of Thing (IoT) are two technologies that can be utilized to help manage employee attendance. RFID technology allows us to identify various things based on a unique id embedded in a chip. Meanwhile, IoT allows RFID readers to connect to a network. Utilizing RFID and IoT technology for employee attendance management is worth trying by companies with conditions similar to PT XYZ. These two technologies can be used in the development of an employee attendance management system. Several studies have shown that the utilization of these technologies has a positive impact [1][2][3].

Despite its benefits, developing an employee attendance management system is not a simple process. The development process must be done with a software engineering approach to be successful. Two important activities in it are system requirement identification and design [4]. Without an appropriate design, information system development has a high risk of failure [4][5]. The next problem is what kind of system design is appropriate and can be used as a reference for developing an employee attendance management system? This problem is the focus of attention in this research. The purpose of this research is to design an employee attendance system by utilizing RFID and IoT technology.



## Method

This research considers that the selection of methodology must be adjusted to the research objectives or problems to be solved [6]. Because the purpose of this research is to design a system (software), the methodology used in designing this employee attendance system is carried out following the stages of the system development life cycle (SDLC). There are five research steps carried out to produce the proposed system design. Figure 1 shows the research steps along with the outputs produced at each step. The objectives of this research were achieved after the five steps were completed.

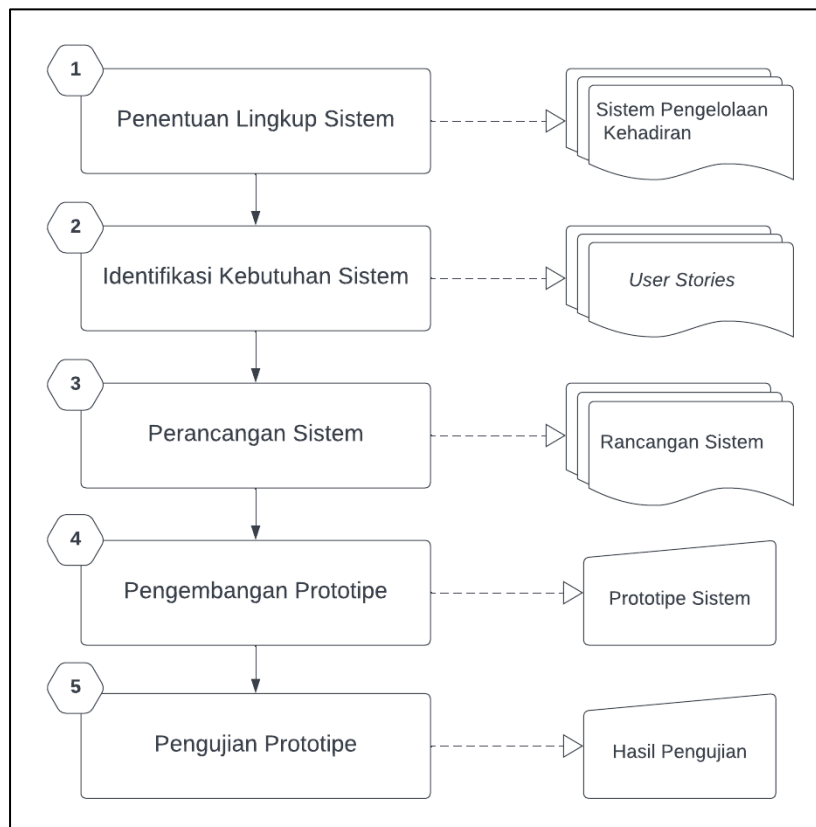


Figure 1. Research Steps

The first research step is to determine the scope of the system. This research makes PT XYZ as a case study. This company is engaged in creative & production, entertainment, food & beverage, and also media. The analysis carried out refers to the business processes carried out by this company. The next step is to identify system requirements that match the company's business needs. User stories were compiled at this stage to show the functionality model of the system. The selection of user stories is done because this technique can explain functional requirements from the user's point of view well and is a recommended technique for small systems [7]. The third step is system design. The design is based on the user stories generated in the previous step. The fourth step is to develop a system prototype. This prototype is a system design that has implemented several features. The purpose of developing this prototype is to ensure that user stories and designs can be implemented into an operating system.

The last step is to conduct prototype testing. The type of testing performed is scenario-based testing. A set of test cases is created based on user stories. The prototype is tested by asking users to run scenarios according to

the test cases. They then rate whether the scenarios they perform in the system match the scenarios written in the test cases.

## Results

The results of this research are the outcomes of each research step described in the methodology section. This section explains the results obtained after performing each research step along with the discussion.

### System Scope and User Story

The scope of the system design produced in this research is the business process of managing employee attendance carried out by PT XYZ. There are two main actors identified, namely employees and operators. Employees are system users who have an interest in proving their attendance. Meanwhile, the operator is tasked with recapitulating the number of employee attendance and reporting it to the head of the human resources department in the company. From these two actors, three user stories were compiled.

Table 1. User Stories for Attendance Management System

Kode	User Story
[US01]	As an employee, I can easily fill in attendance according to the time provided so that my attendance history is recorded by the system.
[US02]	As an operator, I can set the attendance time period so that employees can fill in their attendance in accordance with the applicable time requirements.
[US03]	As an operator, I can view and download employee attendance recapitulations so that I can make reports quickly.

As seen in Table 1, there are three user stories used to design this employee management system. The employee actor has one user story, namely [US01]. While the operator has two user stories, namely [US02] and [US03]. These three user stories are sufficient to represent the functional requirements for the system.

This research also identified non-functional requirements that must be fulfilled by the proposed attendance management system. Firstly, the attendance process must use an employee's unique ID. Second, the attendance process should not take more than 30 seconds for each employee. And third, the system that records employee attendance must be accessible by operators online.

The user stories and non-functional requirements identified are the scope of the system that is designed. Each design produced in the next stage is made to fulfill both. The resulting system design is discussed in the next section.

### System Design

The design of the employee attendance system is based on the three user stories in Table 1 and the three non-functional requirements mentioned in the system scope section. This system design fulfills all these requirements. Figure 2, shows the design of the employee attendance system produced by this research.

In general, the system is divided into two main components, namely a web-based application and employee identity cards. The web-based application here serves to record employee attendance. This application is divided into three parts, namely the front-end, back-end, and database. The front-end part is the interface seen by users, especially operators. Meanwhile, the back-end section contains program codes that handle business logic, process incoming input, data processing, and as a link to the database. The information generated by the back-end is forwarded to the front-end to be presented to the user. Meanwhile, the database functions to store

employee attendance data in the form of data tables. The database is managed through a Database Management System (DBMS).

The second part of the employee attendance system is an employee identity card. This card is embedded with RFID that stores unique employee data such as name, date of birth, employee identification number, and unique card number. The information stored on the card is read through an RFID reader. The RFID reader utilizes IoT technology to transmit the data read from the employee card to a web-based application through an internet-connected network. Alternatively, the device is also designed to connect to the network using WiFi. The utilization of RFID and IoT technology in this system is in these two physical devices.

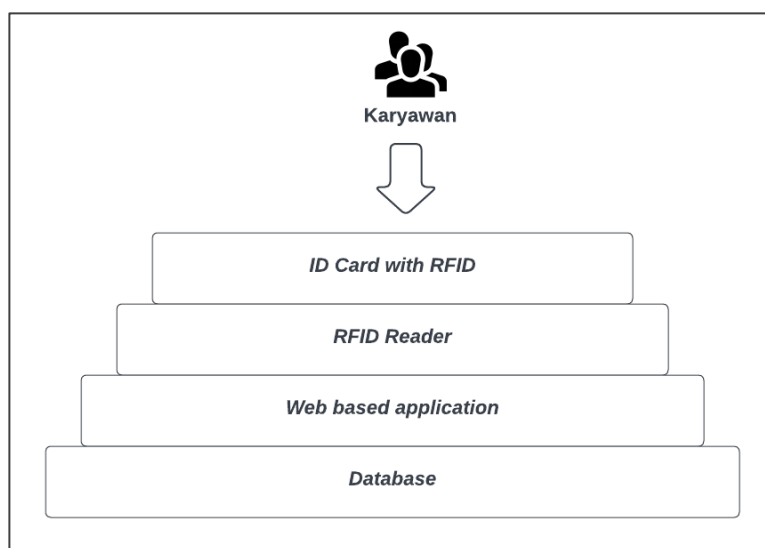
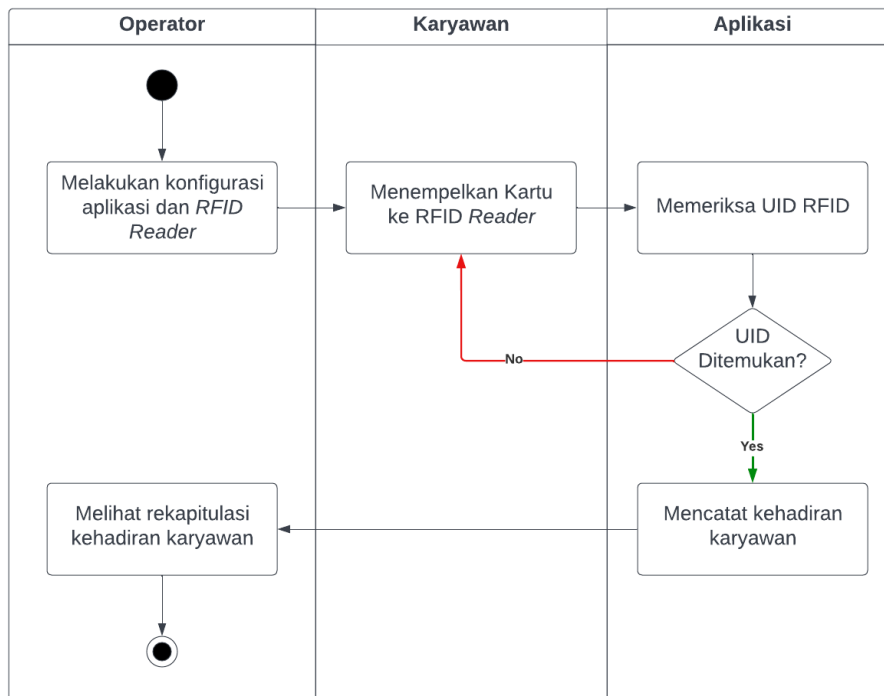


Figure 2. Arsitektur Sistem Kehadiran Karyawan

The system architecture design is divided into four layers: ID card with RFID, RFID reader, application, and database. Figure 2 shows the four layers. The outermost layer is the RFID-embedded employee ID card. The card stores the unique data of each employee. The second layer is the RFID reader. As the name implies, the RFID reader is a device that can read the data in the employee card. This device reads employee data when employees paste their identity cards. The read employee data is then used as input for the attendance recording application. This application is in the third layer and is a web-based application. This application is connected to the database at the fourth layer. In this database, employee attendance records are stored. In the attendance process, employee data read by the RFID reader is compared first through the application with employee data stored in the database. The process of searching for employee data is done with Data Query Language (DQL) in the DBMS. If the employee data is found, the attendance is entered into the database with Data Manipulation Language (DML).

### **Workflow System**

The design of the interaction between users and the employee attendance system is made in the form of a system workflow. The users of this system, according to the user stories identified, are operators and employees. While the user interface where the two actors interact is on the RFID reader and web-based application. The sequential system workflow can be seen in Figure 3.



Gambar 3. *Workflow System*

The workflow of the employee attendance system starts with the operator configuring the application and RFID reader. The first user created by the admin is the operator. The application configuration includes setting the time allowed for attendance, adding new employee data to the system, and other settings related to the attendance process. Meanwhile, the configuration on the RFID reader is done to ensure that the device is connected to the network via WiFi. If it is confirmed that the RFID reader is connected by the application via WiFi, then this configuration is complete.

After the configuration is done, employees can take attendance by attaching their ID card to the RFID reader. When the employee does so, the application will read the user ID (UID) and check if the employee's data is found in the database. If the UID is found, the application will record the employee's attendance log into the database. Otherwise, if the UID is not found then the employee must repeat the process of tapping the card into the RFID reader. If the employee's UID is not found then there are at least four possibilities. First, the employee's data has not been added into the database through the app. Second, the RFID reader is not connected to the network. Third, the RFID card inside the ID card is damaged or malfunctioning. Fourth, the application fails to connect to the database. The employee attendance process is complete when the application successfully adds the attendance log into the database.

The last system workflow is to display a report or recapitulation of employee attendance. This activity is performed by the operator. This report is processed based on the attendance log data that has been added to the database through the process of tapping the card to the RFID reader by the employee. In the report, the accumulated employee attendance, employee attendance time, and employee tardiness markers can be seen. The operator can choose the report time range between daily, weekly, monthly, or manually select the start date and end date of the report. For other business process purposes, reports created by operators through this system can be downloaded in PDF form for printing. Figure 3 briefly summarizes the process flow of the employee attendance system in this study.

## Prototipe System

The system prototype in this research is part of the resulting design. The scope of the prototype developed includes the interface or main page of the application, a page that displays employee data, and a page that displays employee attendance recapitulation. The application prototype is made with PHP and HTML programming languages. Meanwhile, this prototype database uses MySQL DBMS. The prototype development scope is carried out on localhost. The application and RFID reader interact via WiFi but are not connected to the internet.

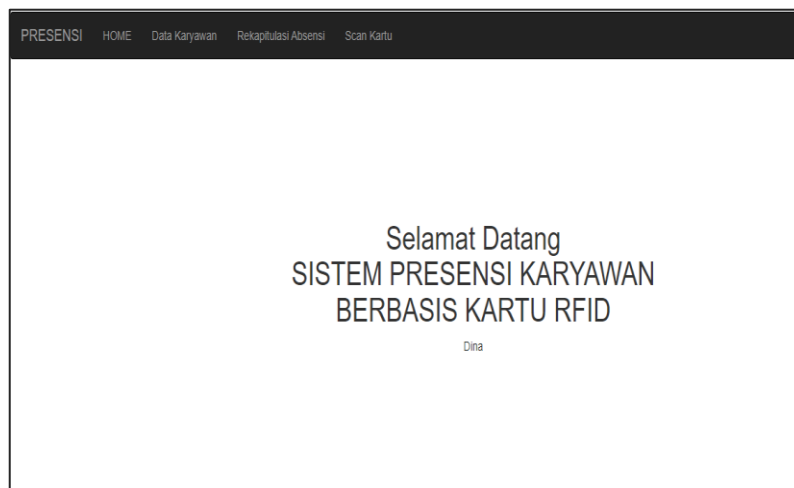
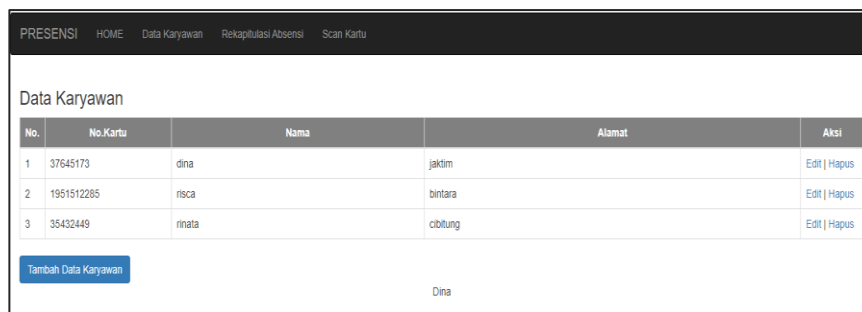


Figure 4. Prototype Main Page Interface

The developed prototype prioritizes the functional aspects of the system. The application interface is made as simple as possible but still pays attention to usability. The application of simplicity aspects to produce good usability is done when designing the user interface on this system. This is one of the good design principles to do [8]. Figure 4 shows the interface for the main page of this application. The main navigation structure is placed at the top of the interface. While the rest of the interface is used to display the main information according to the usage scenario. For example, if the Employee Data navigation menu is selected, the application interface will change to the employee data page shown in Figure 5. The main information is presented at the bottom while the main navigation remains at the top. This kind of interface design is made by paying attention to the principle of consistency in layout.



No.	No.Kartu	Nama	Alamat	Aksi
1	37645173	dina	jaktim	Edit   Hapus
2	1951512285	risca	bintara	Edit   Hapus
3	35432449	rnata	cibitung	Edit   Hapus

Figure 5. Employee Data Page Interface

The developed application prototype includes functionality to record employee attendance. If the employee's data has been added, then they attach the card to the RFID reader, then this application records the attendance

data into the database. The recapitulation of attendance data in the database is displayed by the attendance recap page interface. The attendance recap page is as shown in Figure 6.

No.	Nama	Tanggal	Jam Masuk	Jam Istirahat	Jam Kembali	Jam Pulang
1	risca	2022-06-23	16:40:23	16:43:12	16:43:43	19:16:58
2	dina	2022-06-23	16:44:29	00:00:00	00:00:00	19:16:35
3	rinata	2022-06-23	19:18:09	19:31:42	19:31:54	00:00:00

Figure 6. Absence Recap Page Interface

### Simulation of Prototype Usage

In the final part of this research, a simulation of the use of the system prototype was conducted. The simulation carried out is also part of scenario-based testing. The user stories mentioned in Table 1 were previously used as a reference in making test cases. This simulation proves that the system prototype created fulfills the three user stories which are the functional requirements for this system. The activities carried out in this simulation follow the system workflow in the previous Figure 3, which includes:

1. The operator performs initial configuration for attendance recording purposes.
2. Employees take attendance by attaching the card to the RFID reader.
3. The operator views the employee attendance recapitulation.

The number of scenarios run is adjusted to the number of user stories used, which is three scenarios.

The RFID reader device used is as shown in Figure 7. Before the simulation, it has been confirmed that the RFID reader device is successfully connected to the application. Or in other words, the integration between input, process and output works as it should. RFID as input and microcontroller that handles the process, resulting in output displayed in a web-based application interface. In this simulation, a mobile phone is used as an access point to connect the device and application via WiFi. The IP address used in the simulation is 192.168.85.1 and the ESP 8266 microcontroller. The utilization of ESP 8266 devices like this is common and is also used by other studies in the field of IoT [9][10][11].

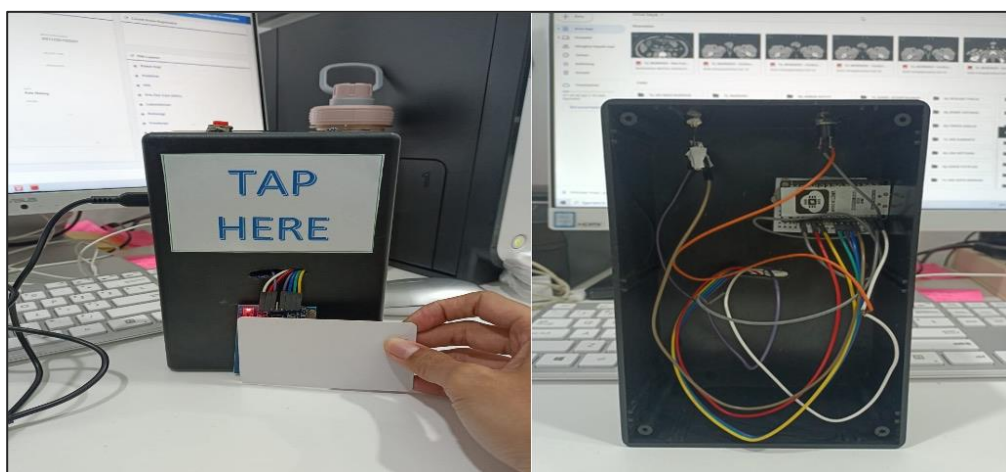


Figure 7. RFID Reader Device for Simulation

In the simulation, if the user brings the RFID card closer to the RFID reader (see Figure 7 on the left), the prototype system will read the UID and record the attendance log into the database. The response from the system can be seen by the employee through a monitor connected to the RFID reader. For example, Figure 8 shows the display seen by the employee when he/she is about to paste his/her card. If the card fails to be read, there will be a notification on the screen.

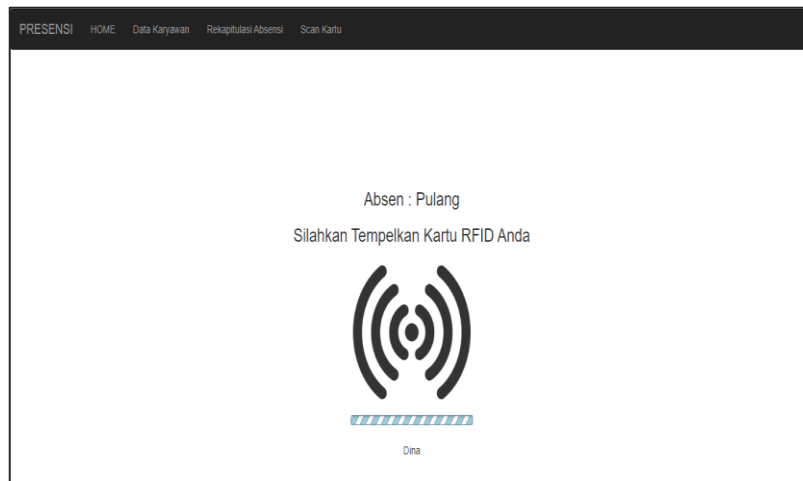


Figure 8. Screen Display When Employee Reports Attendance

The scenario to view the recapitulation of employee attendance by the operator is also carried out in this simulation. The operator does not need to access the same interface as the employee. There is no need for the operator to access the RFID reader except for the initial configuration. Therefore, the operator can access the system directly by logging in first. The interface to view the recapitulation report can be accessed through the main navigation menu of the system.

No.	Nama	Tanggal	Jam Masuk	Jam Istirahat	Jam Kembali	Jam Pulang
1	risca	2022-06-23	16:40:23	16:43:12	16:43:43	19:16:58
2	dina	2022-06-23	16:44:29	00:00:00	00:00:00	19:16:35
3	rnata	2022-06-23	19:18:09	19:31:42	19:31:54	00:00:00

Figure 9. Display of Attendance Recapitulation during Simulation

The simulation successfully shows how the operator runs the scenario of creating an employee attendance recapitulation report. Figure 9 is the display seen by the operator when accessing the attendance recapitulation page. Important information related to attendance is presented in tabular form. The information includes the employee's name, date, entry time, break time, return time, and return time. In the context of this research case study, the attendance process is carried out four times a day. Testing the scenario to see this recapitulation is the last scenario tested through simulation. In the end, every scenario in the test case was successfully run by the system. Testing this prototype is also the last research step before conclusions are formulated.



## Conclusion

The conclusion of this research was compiled after all the research steps were carried out. The results of each research step became the basis for preparing the research conclusions. There are three conclusions formulated in this study, namely: (1) The functional requirements identified for this system include three user stories, namely employees who can perform attendance with RFID cards; operators who can configure the system, and operators who can view recapitulation reports. The three user stories are as mentioned in Table 1. (2) The system design produced by this research consists of 2 system components and 2 user groups. The system components in question are RFID readers for reading RFID cards and web-based applications. While the user groups in question are employees and operators. (3) The prototype testing conducted successfully fulfilled all test cases compiled based on three user stories. This shows that the design produced in this research can be developed into a system that operates in the context of the usage scenario according to the existing user stories. The three conclusions show that the design produced in this research can help develop an employee attendance system that meets the needs of the organization in general. With the design, the risk of implementation failure can be reduced because the two main stages of system development, namely analysis and design, have been completed through this research.

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