People’s Democratic Republic of Algeria

Ministry of Higher Education and Scientific Research

University M’Hamed BOUGARA- Boumerdes

Institute of Electrical and Electronic Engineering

Department of Power and Control

Final Year Project Report Presented in Partial Fulfillment of

The requirement for the degree of

Master

In **Electrical and electronic engineering**

Option: **Control engineering & Computer engineering**

Title:

WEB BASED DELIVERY SYSTEM WITH AUTOMATIC DISPATCHING USING PLC

Presented by:

-Bakhouche Romeissa

-Brahimi Feriel

Supervisor:Dr.OUADI .A

Co-supervisor:Dr.NAMANE.R

Registration Number:…../2022

Acknowledgment

First and foremost, we would like to praise Allah the Almighty, the Most Gracious, and the Most Merciful for His blessing given to us during our study path and in completing this project.

We would also like to express our sincere gratitude to our supervisors Mr.NAMANE Rachid and Mr.OUADI Abderrahman for their continuous support, patience, motivation,and immense knowledge.Their guidance was invaluable during the research and writing of this thesis.

Our sincere thanks also goes to ”Nord et West express” delivery agency, for providing us with information in real-life circumstances which was extremely helpful in completing this project.

Dedication

I dedicate this work to my family and friends. A special feeling of gratitude to my loving mother for her unconditional love and care, to my brothers **Abdellah** and **Karim** for their constant encouragement and support. My amazing sisters **Amina**, **Zahra**, **Fatima** who never left my side and always believed in me.

Last but not least, I dedicate this work to all newcomers to this field, in the hopes that it would serve as a reminder that if we can do it, so can you.

Romeissa

This work is wholeheartedly dedicated to my beloved parents **Boubaker** and **Saida** who have been my source of inspiration and gave me strength , who continually provide their moral, spiritual, emotional, and financial support.To my wonderful sisters **Sara**, **Sirine** without forgetting our first dear grandson**"Mayes"**.

I also dedicate this work to my many friends who have supported me throughout the process, with a special gratitude to the best partner and best friend I could ever have**"Romeissa"**,without whom this project would have not seen the light.

Feriel

Abstract

Delivery services play an important role for people wishing to send packages to a different location without having to go through the hardship of traveling for long distances. With their help, people can send and receive a package safely and in a short period of time. Another aspect where delivery services are vital is in e-commerce businesses because a good delivery management is the foundation of its success. Our project is a realization of a delivery service agency where we first designed and implemented an automatic package sorting system based on a Programmable Logic Controller (PLC) that makes use of barcode technology for the identification of different packages, which was extremely useful not only for the sorting process but also for the automatic updating of the database. We have also developed a web-based application that shows all the features and services our agency has to offer for its customers which was carried out using the standard method for object-oriented (analysis and design) modeling language, Unified Modelling Language (UML). As for its implementation, we have used HTML, CSS, and JavaScript for the front-end, PHP and MYSQL for the back-end.

Keywords : PLC, Barcode, Web development, PHP, MYSQL, HTML, CSS, JavaScript and UML.

Contents

List of Figures

List of Tables

List of Abbreviations

CSS: Cascading Style Sheets.
DBMS: Database Management System.
HTML: Hypertext Mark-up Language.
HTTP: Hypertext Transfer Protocol.
HTTPS: Hypertext Transfer Protocol Secure.
DNS: Domain Name Server.
IP: Internet Protocol
VS Code: Visual Studio Code.
MySQL: My Structured Query Language.
PHP: Hypertext Pre-processor.
SQL: Structured Query Language.
UML: Unified Modelling Language.
URL: Universal Resource Locator.
XAMPP: Cross-Platform(X), Apache(A), MariaDB(M), PHP(P) and Perl(P).
PLC: Programmable Logic Controller.
HMI: Human Machine Interface.
CPU: Central Processing Unit.
I/O: Input/Output.
PG: Portable Programming.
IOT: Internet of Things.
NODE-RED: Node Rapid Event Developer.
LD: Ladder Diagram.
SFC: Sequential Function Chart.
FBD: Function Block Diagram.
ST: Structured Text.
IL: Instruction List.
1D: 1 Dimension.
PLCSIM: Programmable Logic Controller Simulator.
OPC-UA: Open Platform Communication United.
OB: Organization Block.
RFID: Radio Frequency Identification.
PAC: Prpgrammable Automation Controller.

General Introduction

Courier delivery services are becoming increasingly popular, they provide cost-effective means to people who wish to send packages to a different place without the need to travel over large distances.Delivery services can also assist organizations in the service industry to become more reliable, especially with the growth of e-commerce.

As the need for delivery services has increased, warehouses now need to handle increased volumes of parcels and greater variety of sizes and shapes while attempting to reduce delivery times. For this reason, manual sorting is no longer a viable option because it takes a long time to finish and leaves room for error.

Our project, as the name implies, ”web based delivery agency with automatic sorting” is divided into two sections. The first section deals with the design and implementation of a delivery service website that demonstrates all of the services we provide, such as online registration and tracking.

In terms of the second, it focuses on implementing an automatic package sorting system using a Programmable Logic Controller (PLC) more specifically Siemens PLC (CPU 1500) and barcode recognition technology to identify the barecode label on each item. Step 7 will also be utilized to provide the application program, and SKTOOL will be used to construct the Human Machine Interface (HMI).

The report consists of 3 chapters.The first chapter offers some fundamental notions and characteristics of delivery agencies, as well as a description of our proposed system. Furthermore, it provides an introduction to web development and automated systems, and the tools used to build our system. The second chapter covers the design process which begins with the design and modeling of our web application using UML diagrams and ends with the creation of the PLC program and its configuration. In the third chapter, the demonstration of the obtained results is given in order to provide the reader with a deeper insight about the functioning of our overall system. Finally, the report terminates with a general conclusion that summarizes the presented work and provides some suggestions for future works.

Chapter 1

System approach and engineering

1.1 Introduction

In this chapter, We will provide an overview of the delivery services business and the challenges that it encounters.We'll also present a description of our proposed system, as well as an introduction of websites and automatic systems, and Finally, we'll go over the tools and technologies that were used to implement the system.

1.2 Delivery agency

A delivery company is a large, all-inclusive service that collects and delivers packages in the quickest period feasible.In recent years, it has become an important part of human life. Especially when the majority of individuals are occupied during the day. Some popular services offered by courier companies :

1.Packaging services
2.Door-to-door shipping
3.Tracking services

1.3 Challenges faced by delivery agencies

Courier delivery companies are changing the way things are delivered to customers.However, the recent demand for more efficient and faster local deliveries poses several challenges for these companies .Here are four of the most common challenges:

1.Errors on the side of communication

One of the problems faced by delivery companies is the lack of information given to their customers. Mostly, information about safety, timing and tracking . Providing all necessary information plus having a good customer support center contributes to having a successful delivery company.

2.Delivering packages without any damage

Delivering packages safely to the customers' place is also one of the biggest challenges in front of delivery companies. Any damage to the product might not only impact the reputation of the delivery service provider, but they might also have to pay for it.

3.Dependency on human resources

Minimizing the reliance on human resources is one of the biggest challenges in front of delivery companies, especially when it comes to sorting since manual sorting takes a lot of time and errors are more likely to occur in this situation.

4.Keeping customers updated

Keeping customers updated with the status of the courier is necessary to maintain transparency. It also reduces the number of calls to the customer support centre.

1.4 System description

Our project consists of two parts, the first part is the agency's website and the second is a simulation of a factory that's concerned with the automatic sorting of packages.

1.4.1 The agency's website

In today's society, regardless of the field of business, the majority of clients will visit the company's website before deciding whether or not to deal with them.

In other words, having a strong online presence, can be a positive aspect in the company's success.

For this reason , we've decides to develop a delivery service website , this latter contains a detailed description of the agency's business and the services it offers.

The services include package delivery from one location to another, the ability to track the packages and the main service is the ability to register online, this step is very beneficial since it allow customers to place their order at a time that is most convenient for them, without having to worry if it's within business hours or not.

Now let's consider the following scenario: a customer who wishes to send a package to a specific address, all he needs to do is visit our website, verify the delivery schedule, and register.Once he has finished the registration process successfully, He will receive a label with all of the information about his order as well as a unique bar code. The received label has to be attached to the customer's packages when brought to the company's office for delivery, this step is crucial to the operation of the following procedure, which is the sorting process.

1.4.2 The automatic sorting

Once the packages arrive at the warehouse, the sorting procedure begins, but before, let's discuss about the sorting system.

It consists of three units where each one deals with the sorting according to some specific parameters.

The first unit deals with sorting according to regions, the second according to the Wilayas and finally the last according to the Dairas.

The identification of parameters is done based on the output of the bare code scanner, where it reads the value and sends it to the PLC to extract each part of the code in order to determine the package's destination. The bare code parts are shown in the following figure

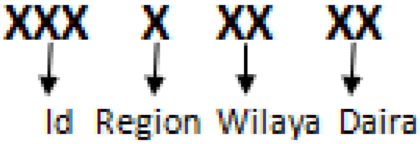


Figure 1.1: Barcode Identification

The parcels first go through the main conveyor(first unit) to sort them with respect to the regions, with the interference of the appropriate pushers,which makes each parcel take its correct path for the next sorting and this happens according to wilayas and then according to dairas.

The following diagram provides a clear explanation of the project's overall structure.

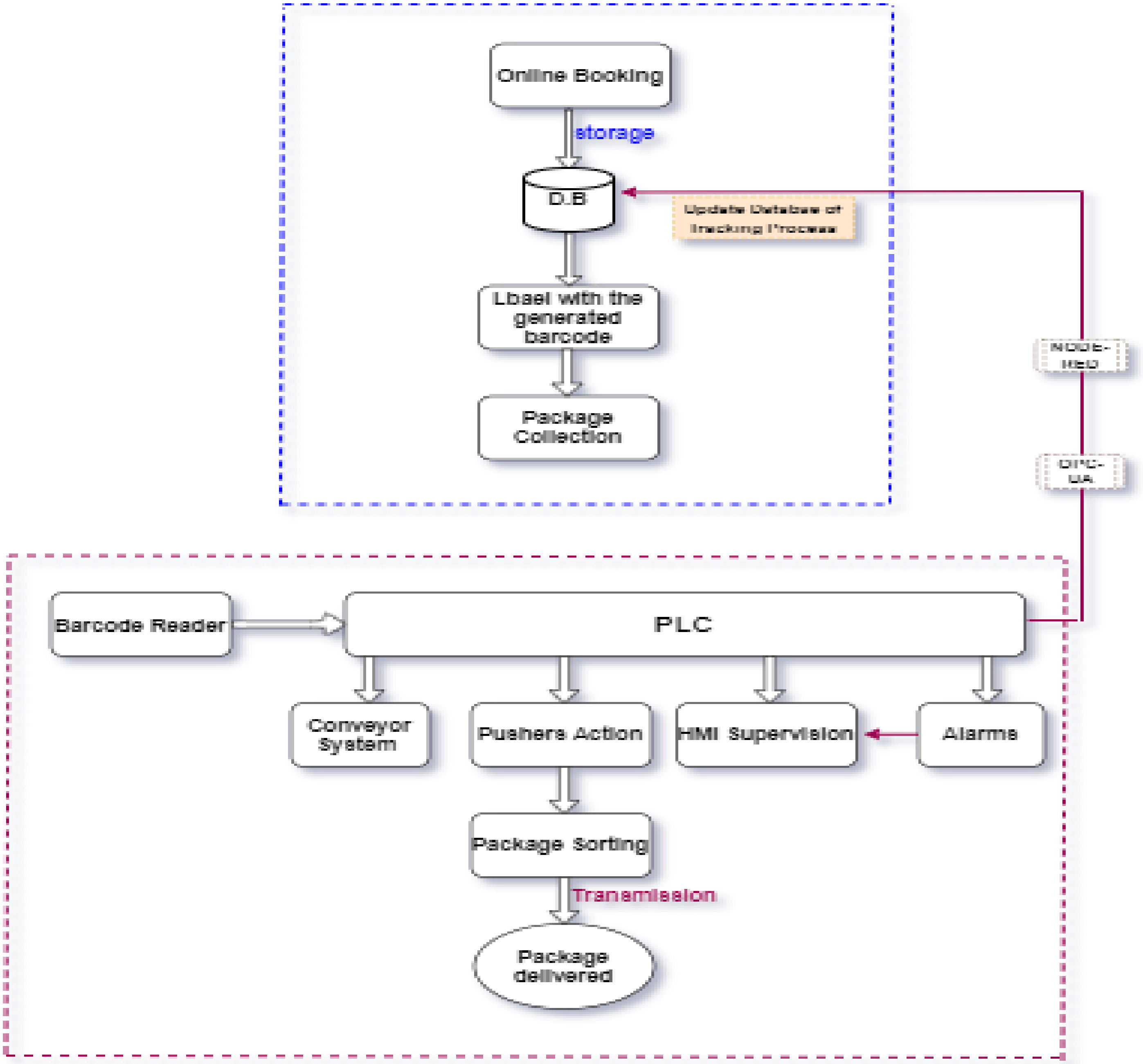


Figure 1.2: General system description diagram

1.5 Website definition and working

1.5.1 Definition of websites

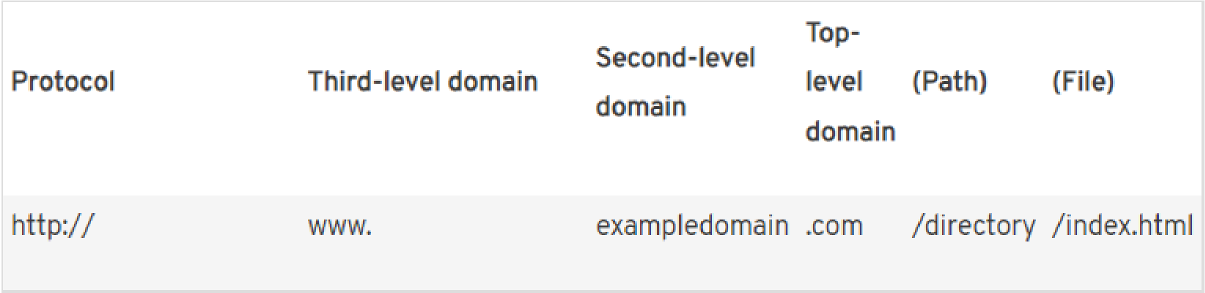
A website is typically a collection of web pages, images and other elements that are linked together to form a larger, structured document. It can be made up of a single page or it could have thousands of pages. These latter are identified by a common domain name and published and stored on a web server. These applications are developed to run in browsers and don't require any installation on the physical machine. Examples of the most common browser are : Google Chrome, Mozilla Firefox or Safari[1].

Domain Name: a domain name is an internet resource name that is universally understood by web servers and online organizations and provides all pertinent destination information. To access an organization's Web-based services,Users must know the precise domain name. example of a domain name is www.google.com

Web server: a web server is a computer that runs websites. It's a computer program that distributes web pages as they are requested. The basic objective of the web server is to store, process and deliver web pages to the users. This intercommunication is done using Hypertext Transfer Protocol (HTTP)[2].

1.5.2 Accessing the web

to access a website all that's needed is to write the desired address into the address bar located in the browser. This address is known as a Uniform Resource Locator (URL), and every web page can be reached with its own individual URL (web address). A URL is made up of several sections; all of which have their own functions. Here is a generic example of a web page URL:



Protocol	Third-level domain	Second-level domain	Top-level domain	(Path)	(File)
http://	www.	exampledomain	.com	/directory	/index.html

Figure 1.3: URL Format

The World Wide Web (WWW) is a system of electronically stored hypertext documents. The hypertext transfer protocol (HTTP) is used in the World Wide Web in order to transfer webpage data from the web server to the browser. In addition to HTTP, there's also an encrypted version of the protocol: Hypertext Transfer Protocol Secure (HTTPS). The HTTP protocol header is followed by the domain name , which consists of a second-level and top-level domain (in this order). In the web, we usually see “www” as third-level domain, but there are other subdomains. URLs are generally comprised of letters, meaning that people can easily remember them. Computers, on the other hand, work with combinations of numbers (known as IP addresses) to find a server on the internet. An additional step is required in order to access content from the web browser. This step requires translating a webpage’s URL into the corresponding IP address. The task is carried out by Domain Name Service (DNS) which is a service that enables a link between domain names and the IP addresses with which they are associated[3].

1.5.3 Working of websites

When a domain name is typed on a web browser, the web browser is actually conducting a series of inquiries that include looking up the IP address of the domain name, locating the web server that hosts the web pages of the domain name, submitting a request to that server for a copy of the web page(s), receiving the web page(s) from the server and finally translating the codes on the web page to present the desired information

1.6 Automatic system

1.6.1 Industrial Automation

The future of manufacturing indicates that factories will be connected and processes will depend more on Automation. The word automation gives the meaning ‘self dictating’ or ‘a mechanism move by itself’ that derived from the Greek words ”**Auto**” and ”**Matos**”where auto means self while Matos means moving[4].

Industrial automation can be defined as the use of technologies and automatic control devices that results the automatic operation and control of industrial processes without significant human intervention and achieving superior performance than manual control. These automation devices include PLCs, PCs, PACs, etc. and technologies include various industrial communication systems.

1.6.2 Programmable Logic Controller

Definition and Basic PLC Operation: Programmable Logic Controllers (PLC) are often defined as miniature industrial computers that contain hardware and software used to perform control functions. More specifically, a PLC would be used for the automation of industrial electromechanical processes, such as control of machinery on factory assembly lines, amusement rides, or food processing. They are designed for multiple arrangements of digital and analog inputs and outputs with extended temperature ranges, immunity to electrical noise, and resistance to vibration and impact[5]. A PLC will consist of two basic sections: the central processing unit (CPU) and the Input/Output (I/O) interface system as shown in the following figure

Let’s see a detailed explanation of each component:

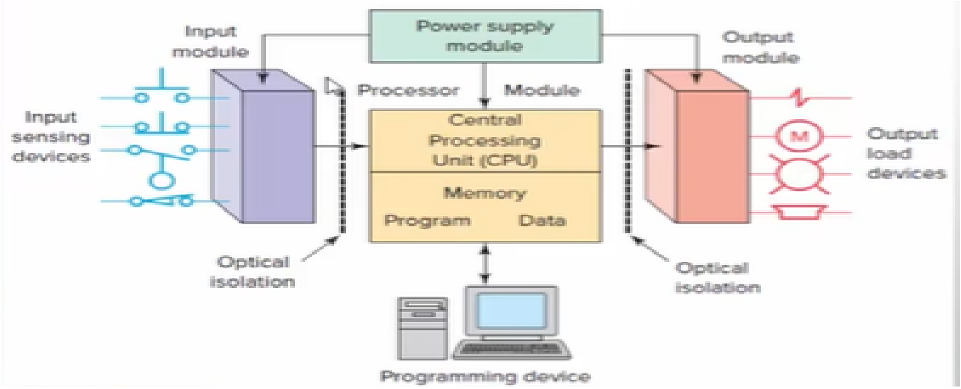


Figure 1.4: PLC architecture block diagram

A.Power Supply

It converts alternating current to direct current to feed to rest of the parts of the PLC, some PLC devices operate with 20VAC, so they are connected directly to the power source(without the feeder).

B.Central Processing Unit (CPU):

It is the brain of the PLC. The CPU processes the input device signal data and sends the results of the operations to the output devices, according to the program stored in the memory. Each CPU has its own specification that affects its speed in executing operations.

C.Input Modules

It receives the signal from the input devices and prepares it so that the CPU can deal with it.The input units are either digital,which deals with the logical signal(0 or 1),or analog units ,which are variable in value like (0-10v),(4-20mA).

D.Output Modules

It prepares the electrical signals coming from the CPU to the outputs to be able to operate correctly. The output units are either digital, which deals with the logical signal(0 or 1), or analog units, which are variable in value like (0-10v), (4-20mA).

E.Programming Device

It is the one that the user creates the program on and then sends it to the PLC device. It is either portable programming(PG) devices that were previously used,or personal computers where the companies producing the PLC device provide software that is installed on PC and then is can be used as a device for programming the PLC.

1.6.3 Advantages of PLC

PLCs have been a standard element of industrial machinery design for many decades,and this is due to several advantages that will be mentioned in the following lines

-PLCs are fairly intuitive to program. Their programming languages are simple in comparison to other industrial control systems, which makes PLCs great for businesses that want to minimize complexity and costs.

-PLCs are available at a wide range of price points, including many extremely affordable basic models that small businesses and startups often use.

-PLCs are extremely versatile, and most PLC models are suitable for controlling a wide variety of processes and systems.

-PLCs are completely solid-state devices, which means they have no moving parts. That makes them exceptionally reliable and more able to survive the challenging conditions present in many industrial facilities.

-PLCs have relatively few components, which makes them easier to troubleshoot and helps reduce maintenance downtime.

-PLCs are efficient and don't consume very much electrical power. This helps conserve energy and may simplify wiring considerations[6].

1.6.4 Programming software

A PLC programming software is used to create a program or instructions for a PLC. The created program will be loaded to the PLC program memory, this program would contain certain instructions to implement functions such as timing, counting, etc.Each PLC brand has its own program and we will include the most prominent in the following list:
Siemens$\Longrightarrow Simaticstep7, Tiaportal.$
$Schneider \Longrightarrow Machineexpertbasic, Twidosuite.$
$Hitachi \Longrightarrow Laddereditor, HXCODESYS, Pro - H.$
$AllenBradley \Longrightarrow RSlogix5000.$
$MitsubishiPLC \Longrightarrow GX - developerFX.$

1.7 Tools and Technologies

1.7.1 Website development tools

Websites consist of two parts: the front end, which users experience, and the back end, which comprises the invisible structure making the front end possible. Front end development is the part that focuses on the visual elements of a website or app that a user will interact with (the client side) Meanwhile, back end development focuses on the side of a website users can't see (the server side). The main technologies and software used for the implementation of the website are HTML, CSS, javaScript for the frontEnd. XAMPP, PHP and MySql for the backend. In this section we will explore these technologies in greater detail.

XAMP

XAMPP stands for Cross-Platform (X), Apache (A), MariaDB (M), PHP (P) and Perl (P). It is a free and open source cross-platform web server solution stack package developed by Apache, consisting mainly of the Apache HTTP Server, MariaDB database, and interpreters for scripts written in the PHP and Perl programming languages. It is a simple, lightweight Apache distribution that makes it extremely easy to create a local web server for testing and deployment purposes. XAMPP is also cross-platform, which means it works equally well on Linux, Mac and Windows. Since most actual web server deployments use the same components as XAMPP, it makes transitioning from a local test server to a live server extremely easy as well[7].

VS code

Visual Studio (VS) Code is an open-source code editor primarily used to correct and repair cloud and web applications coding errors. VS Code is developed by Microsoft and supports the macOS, Linux, and Windows operating systems. VS Code's tools can be used to enhance the functionality of any written code. VS code includes support for debugging, syntax highlighting, intelligent code completion, snippets, code refactoring, and embedded Git[8].

MYSQL

MySQL is an Oracle-backed open source relational database management system (RDBMS) based on Structured Query Language (SQL). MySQL runs on all platforms, including Linux, UNIX and Windows. Although it can be used in a wide range of applications, MySQL is most often associated with web applications and online publishing. MySQL is based on a client-server model. The core of MySQL is MySQL server, which handles all of the database instructions (or commands)[9].

Markup languages

Markup languages: standard text-encoding system consisting of a set of symbols inserted in a text document to control its structure, formatting, or the relationship between its parts[10]. HyperText Markup Language (HTML) and Cascading Style Sheet (CSS) are often called markup languages rather than programming languages, because they, at their core, provide markups for documents with very little dynamism.

HTML: HyperText Markup Language or HTML is the standard markup language for documents designed to be displayed in a web browser. Web browsers receive HTML documents from a web server or from local storage and render the documents into multimedia web pages. HTML elements are the building blocks of HTML pages. They are delineated by tags, written using angle brackets. However, it's worth noting that HTML is not considered a programming language as it can't create dynamic functionality.

CSS: stands for "Cascading Style Sheet" cascading style sheets are used to format the layout of Web pages. They can be used to define text styles, table sizes, and other aspects of Web pages that previously could only be defined in a page's HTML. CSS helps to create a uniform look across several pages of a Web site. Instead of defining the style of each table and each block of text within a page's HTML, commonly used styles need to be defined only once in a CSS document[11].

Programming languages

javaScript: Javascript (JS) is a scripting languages, primarily used on the web. It is used to enhance HTML pages and is commonly found embedded in HTML code. JavaScript is an interpreted language. Thus, it does not need to be compiled. JavaScript renders web pages in an interactive and dynamic fashion. This allowing the pages to react to events, exhibit special effects, accept variable text, validate data, create cookies, detect a user's browser, etc.[12].

PHP: PHP stands for Hypertext Preprocessor it's an open source general-purpose scripting language that is especially suited for web development and can be embedded into HTML. PHP code is usually processed on a web server by a PHP interpreter implemented as a module,in our case XAMPP module.[13].

1.7.2 Software requirement

Totally Integrated Automation Portal(TIA PORTAL): Totally Integrated Automation Portal (TIA PORTAL).It is a single integrated software environment for all controllers,HMI and more, produced by the leading German company in the world of industrial automation SIEMENS, it is an advanced software designed with an easy-to-use interface, to help novice and expert users to work effectively and easily, whether the work involves programming micro controller, designing an HMI display, or others.

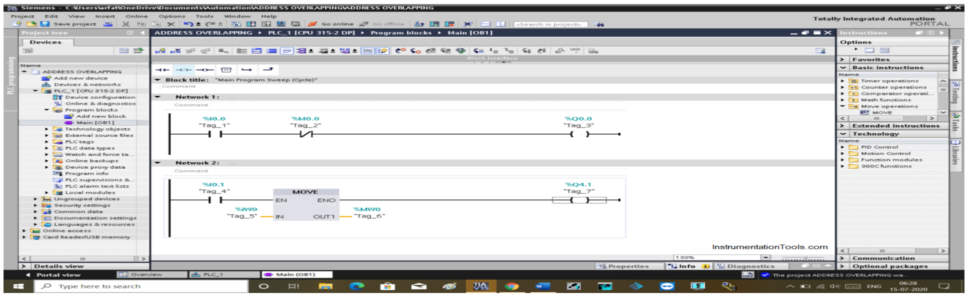


Figure 1.5: TIA PORTAL V16 programming using ladder

Node Rapid Event Developer(Node-Red): Node Red is a flow-based programming tool that was made by Node.js. This tool is mainly used for connecting Internet Of Things (IOT) devices and software applications. However , it can cover not only IoT but also standard web application[14].

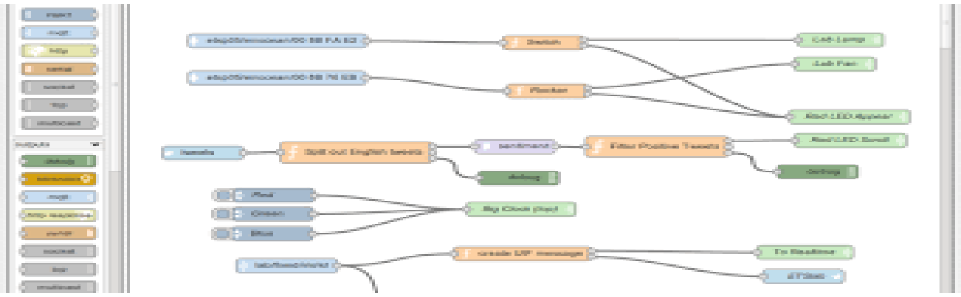


Figure 1.6: NODE-RED program example

1.7.3 Programming PLC

Most PLCs can be programmed using a standard computer and PLC programming software. The International Electrical Code's IEC 61131-3 standard defines five languages for PLC programming:

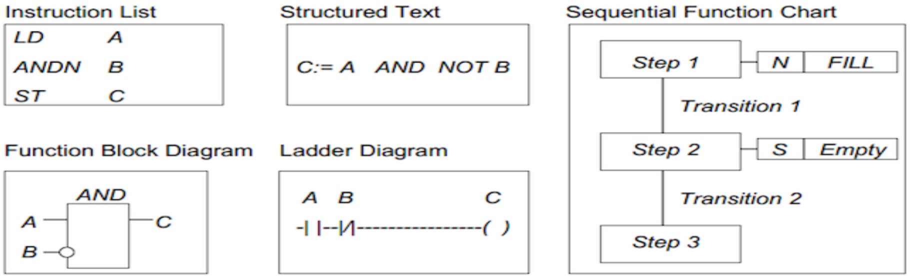


Figure 1.7: Different Types of PLC Programming Languages

1. **Ladder Diagram (LD)**

Ladder Diagram was originally modeled from relay-logic which used physical devices, such as switches and mechanical relays to control processes. Ladder Diagram utilizes internal logic to replace all, except the physical devices that need an electrical signal to activate them. Ladder Diagram is built in the form of horizontal rungs with two vertical rails that represent the electrical connection on relay-logic schematics. You can program all the necessary input conditions to affect the output conditions, whether logical or physical.

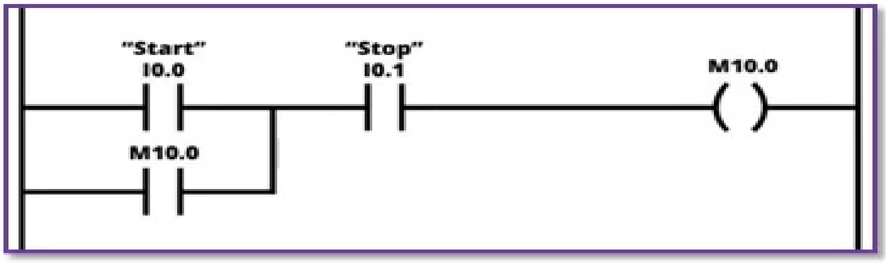


Figure 1.8: Ladder Diagram(LD)

2. **Sequential Function Charts (SFC)**

If you have any experience with flowcharts, then this PLC Programming language will feel familiar to you. In Sequential Function Charts, you use steps and transitions to achieve your end results. Steps act as a major function in your program. These steps house the actions that occur when you program them to happen. This decision can be based on timing, a certain phase of the process, or a physical state of an equipment.

Transitions are the instructions that you use to move from one step to another step by setting conditions of true or false. Unlike traditional flowcharts, the Sequential Function Charts can have multiple paths. You can use branches to initiate multiple steps at one time.

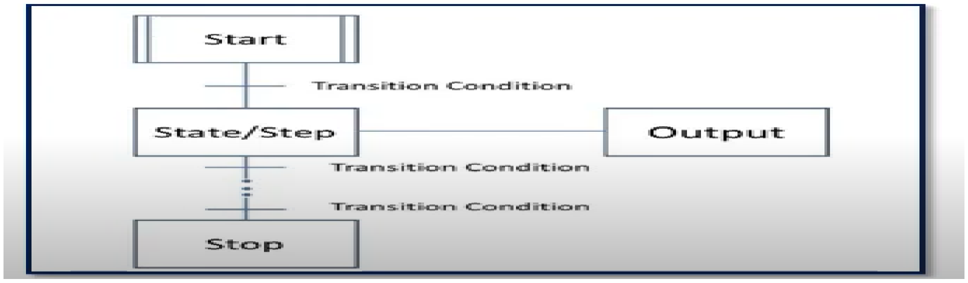


Figure 1.9: Sequential Function Chart(SFC)

3. Function Block Diagram (FBD)

The Function Block Diagram which is also a graphical type of language. The Function Block Diagram describes a function between inputs and outputs that are connected in blocks by connection lines. Function Blocks were originally developed to create a system that you could set up many of the common, repeatable tasks, such as counters, timers, PID Loops, etc. You program the blocks onto sheets and then the PLC constantly scans the sheets in numerical order or is determined by connections which you program between the blocks.

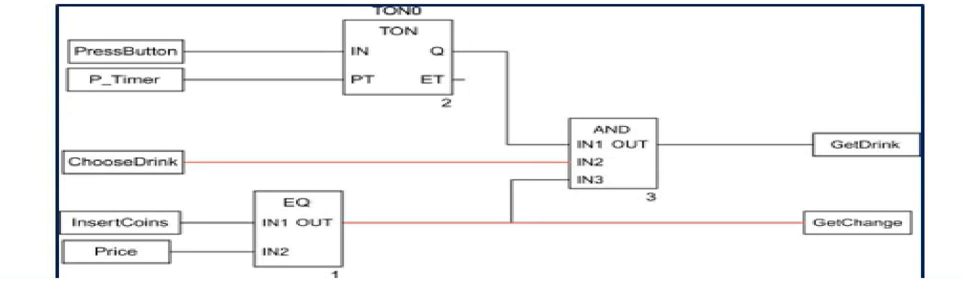


Figure 1.10: Function Block Diagram

4. Structured Text (ST)

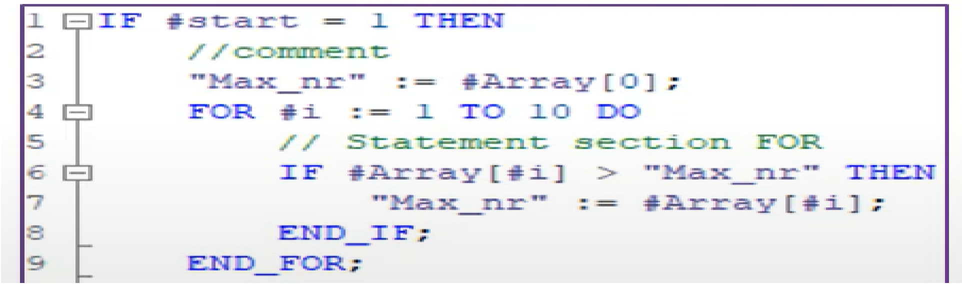
The 4th PLC Programming Language is the Structured Text. This language is a textual based language.

Structured Text is a high-level language that is like Basic, Pascal and “C”. It is a very powerful tool that can execute complex tasks utilizing algorithms and mathematical functions along with repetitive tasks.

The code uses statements that are separated by semicolons and then either inputs, outputs, or variables are changed by these statements.

You must write out each line of code and it uses functions such as FOR, WHILE, IF, ELSE, ELSEIF AND CASE.

If you have experience with Basic or C languages, this PLC Programming Language will come easier than some of the other types of PLC languages.

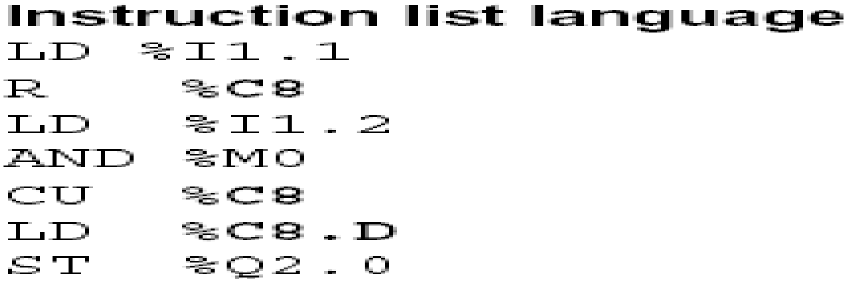


```
IF #start = 1 THEN
    //comment
    "Max_nr" := #Array[0];
    FOR #i := 1 TO 10 DO
        // Statement section FOR
        IF #Array[#i] > "Max_nr" THEN
            "Max_nr" := #Array[#i];
        END_IF;
    END_FOR;
```

Figure 1.11: Structured Text(ST)

5. Instruction List (IL)

We now show you the 5th and final PLC Programming Language which is Instruction List. The Instruction List is also a textual based language.
The Instruction List language resembles Assembly Language. When you use this PLC Programming Language, you will use mnemonic codes such as LD (Load), AND, OR, etc. The Instruction List contains instructions with each instruction on a new line with any comments you might want to annotate at the end of each line[15].



```
Instruction list language
LD  %I1.1
R    %C8
LD   %I1.2
AND  %M0
CU   %C8
LD   %C8.D
ST   %Q2.0
```

Figure 1.12: Instruction List

1D Bar code Scanning System

A 1D bar code (also known as a linear code) is a visual black and white pattern, using variable-width lines and spaces for encoding information. That information – such as numbers or other keyboard characteristics – is encoded horizontally from left to right. 1D bar codes holds a limited number of characters, typically 20-25. In order to add more numbers, the bar code must be longer. A 1D bar code depends on database connectivity in order to be meaningful; after a scanner reads the numbers in the code, they must be linked back to product or pricing date, or other information[16].

Figure 1.13: Barcode Example

While a computer can trump the human brain in many ways, they can still only essentially read binary or base 10; 0's and 1's. This is one of the main reasons a bar code looks the way it does. Think of the black and white as 0's and 1's, or on and offs.
Considering what we know about the light reflection, the black parts don't reflect very well; therefore, they are recorded as a 1. However, the light scanner recognises the white sections, so they are seen as 0's. The bar code scanning system detects the amount of light, which is then translated into a set of digits or data. Information can be retrieved from a computer database using this data.
Bar codes play a crucial part in shipping and tracking items. They can also be used to manage stock as a bar code can keep track of the number of products in storage.

1.7.4 Human Machine Interface(HMI)

The HMI or Human Machine Interface allows operators to "interface" with the system they oversee. It provides a visual overview of the automated system's status and direct control of its operation. An HMI's graphical screens can be programmed to display important status and control information to the operator. Pictures, icons, sounds, and colors can all be used by HMIs to visually represent different operating conditions. And many HMIs deploy touch screen technology for user interaction with elements displayed on the screen[17].

1.8 Conclusion

Through out this chapter, we have defined the delivery service business and the major issues they are dealing with. We have also stated the objectives of our project. In addition, we provided a brief description and some generalities about how websites and automatic systems work. Finally, we looked at the most appropriate tools that were utilized to construct the system.

Chapter 2

System design

2.1 Introduction

Software system are becoming increasingly complex and mission critical. To help manage this complexity they need to be modeled. As a result, the first section of this chapter is devoted to modeling our website using the Unified Modeling Language (UML) and providing a basic introduction to databases. As for the second section, it is dedicated to the creation of the PLC program and its configuration, as well as the design of the entire process using the SKTOOL software.

2.2 Modeling language

Modeling language is any graphical or textual computer language that describes the design and construction of structures and models, according to a set of rules and frameworks. Computer science and engineering are the primary fields where modeling languages are employed for designing models of new software systems.

2.3 Unified Modelling Language (UML)

Unified modeling language (UML) is a popular modeling language that is used to build system and object models graphically. UML is designed to enable users to develop an expressive, ready to use visual modeling language. In addition, it supports high level development concepts such as frameworks, patterns and collaborations. UML diagrams can be divided into two categories; structure diagrams and behavioral diagrams[18].

Structure diagrams display the elements of the modeled system. In a more technical term, they show different objects in a system.

Behavioral diagrams demonstrate what should occur in a system. They describe how the objects interact with each other to create a functioning system.

2.3.1 Types of diagrams

Structure Diagrams

- Class Diagram
- Component Diagram
- Deployment Diagram
- Object Diagram
- Package Diagram
- Profile Diagram
- Composite Structure Diagram

Behavioral Diagrams

- Use Case Diagram
- Activity Diagram
- State Machine Diagram
- Sequence Diagram
- Communication Diagram
- Interaction Overview Diagram
- Timing Diagram

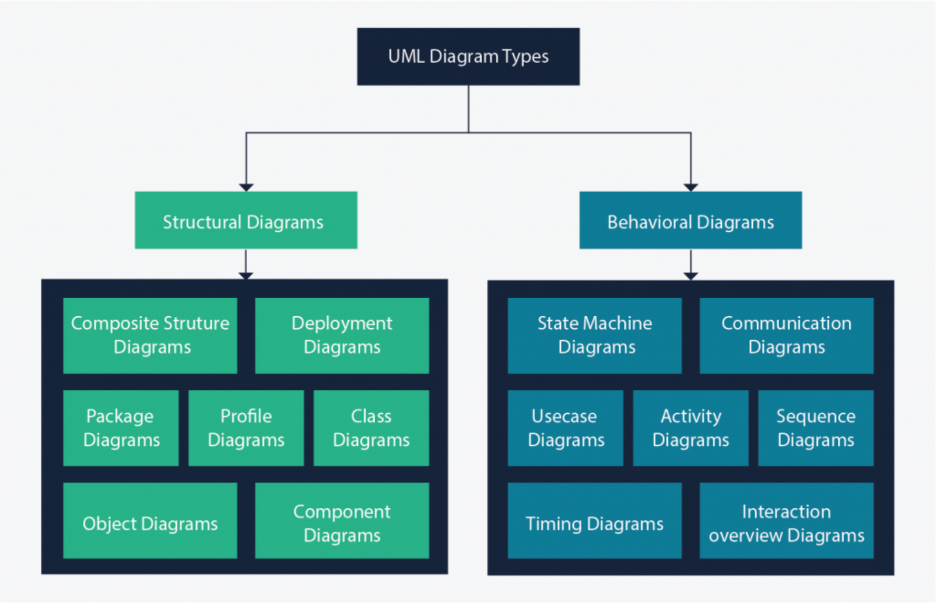


Figure 2.1: UML diagram types

2.4 Modeling using UML (Use case model)

2.4.1 Use Case diagram

As the most known diagram type of the behavioral UML types, Use case diagrams give a graphic overview of the actors involved in a system, different functions needed by those actors and how these different functions interact. An effective use case diagram can help representing:

- Scenarios in which a system or application interacts with people, organizations, or external systems
- The scope and goals of a system

2.4.2 Use case diagram components

1.Actors: an actor is anything with behavior, including the system under discussion (SuD) itself when it calls upon the services of other systems. Actors are not only roles played by people, but organizations, software, and machines.
There are two kinds of external actors in relation to the SuD:
Primary actor has user goals fulfilled through using services of the SuD.
Supporting actor provides a service (for example, information) to the SuD[19].

2.Use case: a use case diagram is a visual representation of a distinct business functionality in a system.Use case is usually shown as an ellipse containing the name of the use case.

3.System boundary: a system boundary defines the scope of what a system will be. A system cannot have infinite functionality. So, it follows that use cases also need to have definitive limits defined. A system boundary of a use case diagram defines the limits of the system. The system boundary is shown as a rectangle spanning all the use cases in the system.

2.4.3 Relationships in Use Cases

Use cases share different kinds of relationships. A relationship between two use cases is basically a dependency between the two use cases. Defining a relationship between two use cases is the decision of the modeler of the use case diagram

1.Include: when a use case is depicted as using the functionality of another use case in a diagram, this relationship between the use cases is named as an include relationship. An include relationship is depicted with a directed arrow having a dotted shaft. The tip of the arrowhead points to the child use case and the parent use case is connected at the base of the arrow.

2.Extend: in an extend relationship between two use cases, the child use case adds to the existing functionality and characteristics of the parent use case. An extend relationship is depicted with a directed arrow having a dotted shaft, similar to the include relationship. The tip of the arrowhead points to the parent use case and the child use case is connected at the base of the arrow.

3.Generalizations: a generalization relationship is also a parent-child relationship between use cases. The child use case in the generalization relationship has the underlying business process meaning, but is an enhancement of the parent use case. In a use case diagram, generalization is shown as a directed arrow with a triangle arrowhead. The child use case is connected at the base of the arrow. The tip of the arrow is connected to the parent use case.

2.5 Application modelling

2.5.1 Actors

In our application , we have two types of actors :
Admin: the employee who has access to the list of customers and is in charge of handling customer's receipts and sending emails.
Customer: clients who will make use of our services

2.5.2 Use cases

Table 2.1: Textual description of the website's use cases.

Actors	Use cases
Admin .	**1.Authentication:** by logging in using a valid admin name and password .it is used to decide if the user is eligible to access this section or not **2.List edit:** the ability to delete information from the customer's list . **3.Print receipt:** once the package has been brought to the office, the client's receipt can be printed and given to the customer **4.Delete history:** the admin can eliminate customers from the list who have previously been serviced; all he has to do is input a date, and all customers with orders prior to that date will be deleted. **5.Sending Emails:** When the packages arrive at the destination warehouse and their status is set to ”on delivery” the admin can send them an email letting them know that their packages have reached their destination successfully
Customer	**1.Getting a quote:** to place an order by filling out the form **2.Order confirmation:** to validate the order and proceed with the remaining procedures **3.Order cancellation:** to annul the order and terminate the process **4.Getting a label:** following the successful placement of an order, a label is generated to be applied to the package for delivery. **5.Tracking packages:** to tell the location of the package by entering a valid track-ing number

2.5.3 The website's use case diagrams

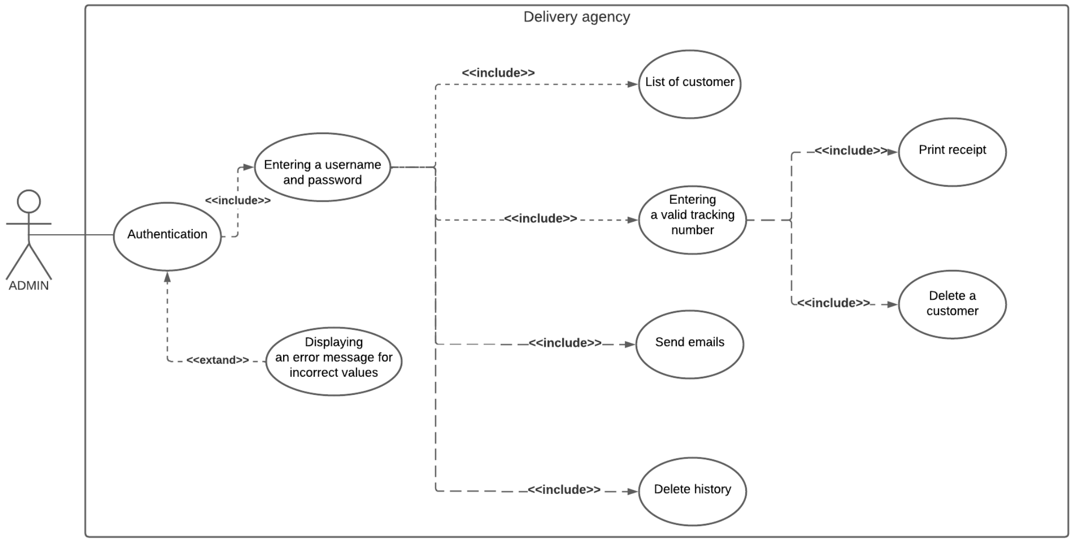


Figure 2.2: The admin's use case diagram

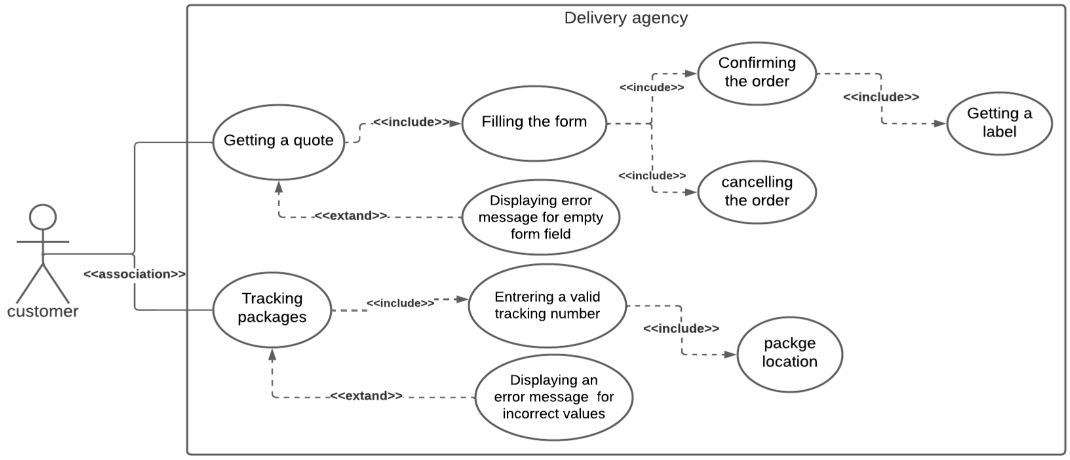


Figure 2.3: The customer's use case diagram

2.5.4 Admin's use case diagram textual description

1.Authentication use case

Table 2.2: Textual description of the authentication use case.

Use case	Authentication
Actor	Admin
Objective	Login and have access to the list of customers.
Precondition	Connect to MySQL database
Scenario	1.The administrator accesses the admin space section of the website. 2.The system prompts the admin for an admin name and password 3.The admin enters his admin name and password. 4. The system verifies that the information entered is valid by sending an authentication query to the local server 5. The server verifies the query, if the entered values were correct the admin is authorized to log in, else an error message is displayed and he'll go back to step two.

2.List edit use case

Table 2.3: Textual description of the list edit use case.

Use case	List edit
Actor	Admin
Objective	Editing the list of customers.
Precondition	Authentication
Scenario	1.The admin inserts a customer's id. 2.The row with the selected id, gets highlighted in red. 3.The admin clicks on the delete button 4. The row gets deleted from the list and the database.

3.Print receipt use case

Table 2.4: Textual description of print receipt use case.

Use case	Print receipt
Actor	Admin
Objective	Printing the customer's receipt.
Precondition	Authentication
Scenario	1.The admin inserts a customer's id. 2. The row with the selected id. gets highlighted in red. 3.The admin clicks the download button 4.A label is presented in the form of a PDF file. 5.The admin downloads the file and presents it to the client.

4.Delete history use case

Table 2.5: Textual description of delete history use case.

Use case	Delete history
Actor	Admin
Objective	Deleting the history of customer's list .
Precondition	Authentication
Scenario	1.The admin inserts a date. 2. All customers with order date prior to the entered date will be deleted from the list and the database.

5.Sending Emails

Table 2.6: Textual description of Email sending use case.

Use case	Email sending
Actor	Admin
Objective	Sending Emails to customers.
Precondition	Authentication
Scenario	1.The admin clicks on send Email button 2.All customers with status set as "on delivery" will receive an email saying that their package has arrived to its destination.

2.5.5 Customer's use case diagram textual description

1.Getting a quote use case

Table 2.7: Textual description of getting a quote use case

Use case	Getting a quote
Actor	Customer
Objective	Placing an order.
Scenario	1.The customer verifies the delivery schedule. 2.Fills out the form and clicks on the send button. 3.The consumer is sent to a page that displays the price of the delivery order, as well as options for confirmation and cancellation of order.

2.Order confirmation use case

Table 2.8: Textual description of order confirmation use case.

Use case	Order confirmation
Actor	Customer
Objective	Order confirmation.
Precondition	Filling out the form
Scenario	1.Once the customer is done with the form, the customer clicks the confirm button. 2.The form gets confirmed. 3.The download label button appear.

3.Order cancellation use case

Table 2.9: Textual description of order cancellation use case.

Use case	Order cancellation
Actor	Customer
Objective	Annul the delivery order.
Precondition	Filling out the form
Scenario	1.Once the customer is done with the form, the customer clicks the cancel button. 2.The form gets cancelled. 3.A message saying your order has been cancelled is displayed.

4.Getting a label use case

Table 2.10: Textual description of getting a label use case

Use case	Getting a label
Actor	Customer
Objective	Getting the label of the delivery order.
Precondition	Filling out the form
Scenario	1.The customer selects the confirm option. 2.The system prompts the customer to download his label. 3.The customer presses the download button. 4.A label is presented in the form of a PDF file 5.The customer downloads the label

5.Tracking packages use case

Table 2.11: Textual description of tracking packages use case

Use case	Tracking packages
Actor	Customer
Objective	Finding the status of the sent package.
Precondition	Connect to MYSQL database
Scenario	1.The customer insert his tracking number. 2.The status of the package is displayed, whether it is being picked up, being processed, or being delivered.

2.6 Modeling using UML (sequence diagrams)

2.6.1 Sequence diagram

Sequence diagrams in UML show how objects interact with each other and the order those interactions occur. It's important to note that they show the interactions for a particular scenario. The processes are represented vertically and interactions are shown as arrows.

2.6.2 Sequence Diagram Notations

1.Dimension
A sequence diagram is drawn in two dimensions, Horizontal and Vertical.
I.Object Dimension
II.Time Dimension

2.Actor
Anyone how use to perform a certain function in the system is actors.

3.LifeLine
A lifeline represents an individual participant in the interaction. It is represented by dashed vertical line drawn below each object.

4.Activation
A thin rectangle box on a lifeline represents the time needed for an object to complete a task.

5.Messages
A message defines a particular communication between Lifelines of an interaction. Messages are drawn from the sender to the receiver. Ordering is indicated by vertical position.

5.1. Synchronous Messages
This message is used when a sender must wait for a response to a message before it continues. Its is shown as a solid line with a filled arrowhead.

5.2. Asynchronous Messages
An asynchronous message does not wait for a response from the receiver before the sender continues. It is shown as a solid line with an open arrowhead.

5.3. Return Message
A return message is used to indicate that the message receiver is done processing the message and is returning control over to the message caller. It is shown as a dashed line with an open arrowhead.

2.6.3 Sequence Fragments

A sequence fragment is represented as a box called a combined fragment, which encloses a portion of the interactions within a sequence diagram. The fragment operator (in the top left cornet) indicates the type of fragment. Fragment types include ref, assert, loop, break, alt, opt and neg, ref, sd[20].

Table 2.12: Type of sequence fragment

Operator	Meaning
alt	Alternative multiple fragments: only the one whose condition is true will execute.
opt	Optional: the fragment executes only if the supplied condition is true. Equivalent to an alt only with one trace.
par	Parallel: each fragment is run in parallel.
loop	Loop: the fragment may execute multiple times, and the guard indicates the basis of iteration.
neg	Negative: the fragment shows an invalid interaction.
ref	Reference: refers to an interaction defined on another diagram. The frame is drawn to cover the lifelines involved in the interaction. You can define parameters and a return value.

2.6.4 Website's sequence diagrams

1.Authentication sequence diagram

To access the admin space page, the administrator must first log in using his admin name and password. For verification, the system sends a query to the server. If these details are stored in the database, the administrator can log in; otherwise, an error message will appear.

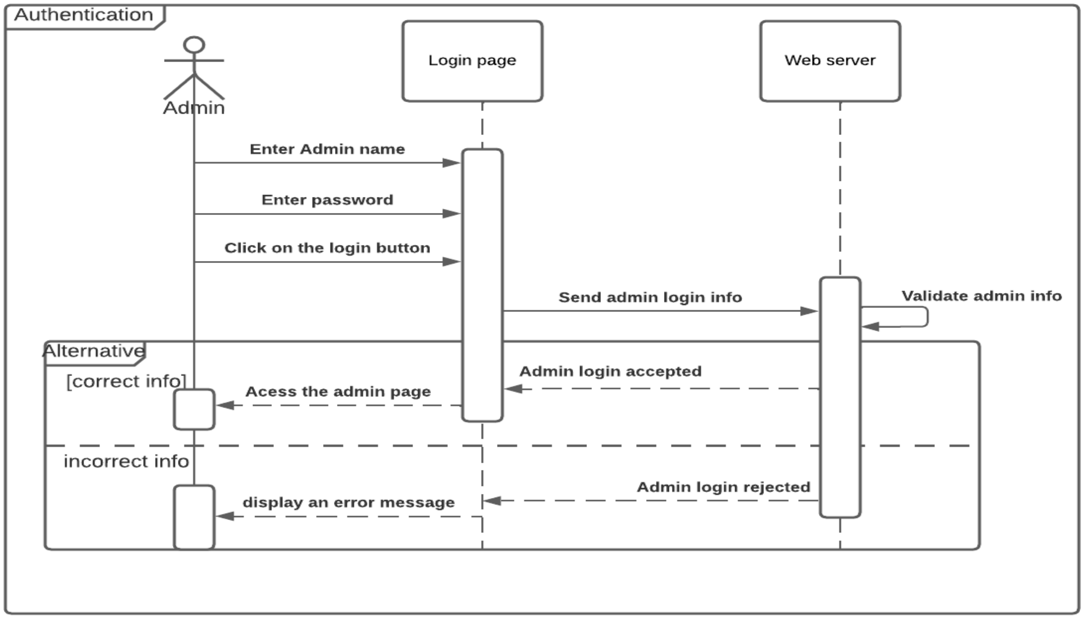


Figure 2.4: Authentication sequence diagram

2.Print receipt sequence diagram

To obtain customer receipts, the administrator must enter a tracking number and then click download. The receipt is then presented as a PDF file, which the administrator can simply download.

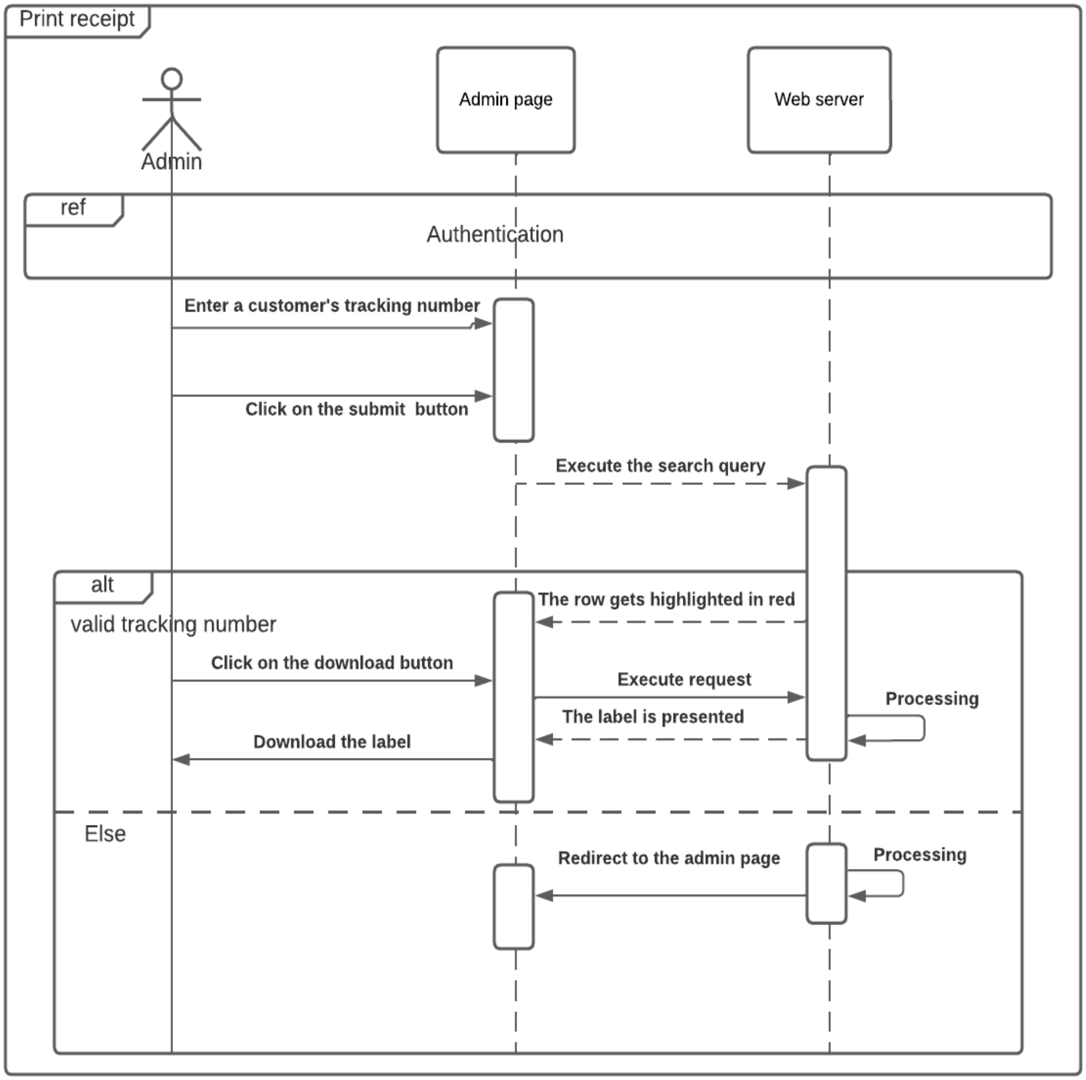


Figure 2.5: Print receipt sequence diagram

3.List edit sequence diagram

To delete a client from the list, the Admin must first enter a tracking number and click submit. The row with the relevant id will be highlighted in red, then by clicking the delete word. The row will be erased from the list as well as the database.

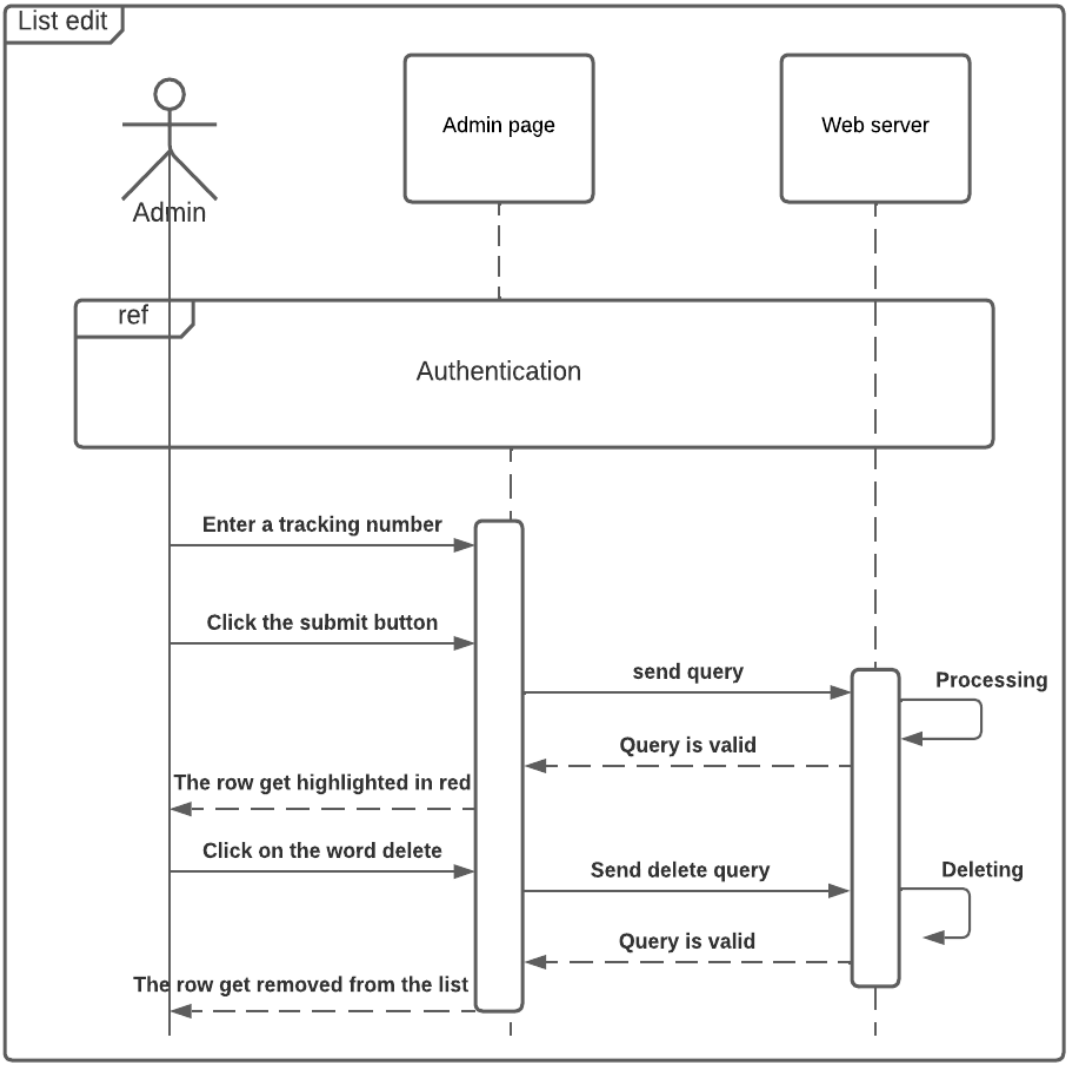


Figure 2.6: List edit sequence diagram

4.Delete history sequence diagram

To delete the history, the admin must first enter a date, then click the transmit button. All clients with order dates prior to the date entered will be removed.

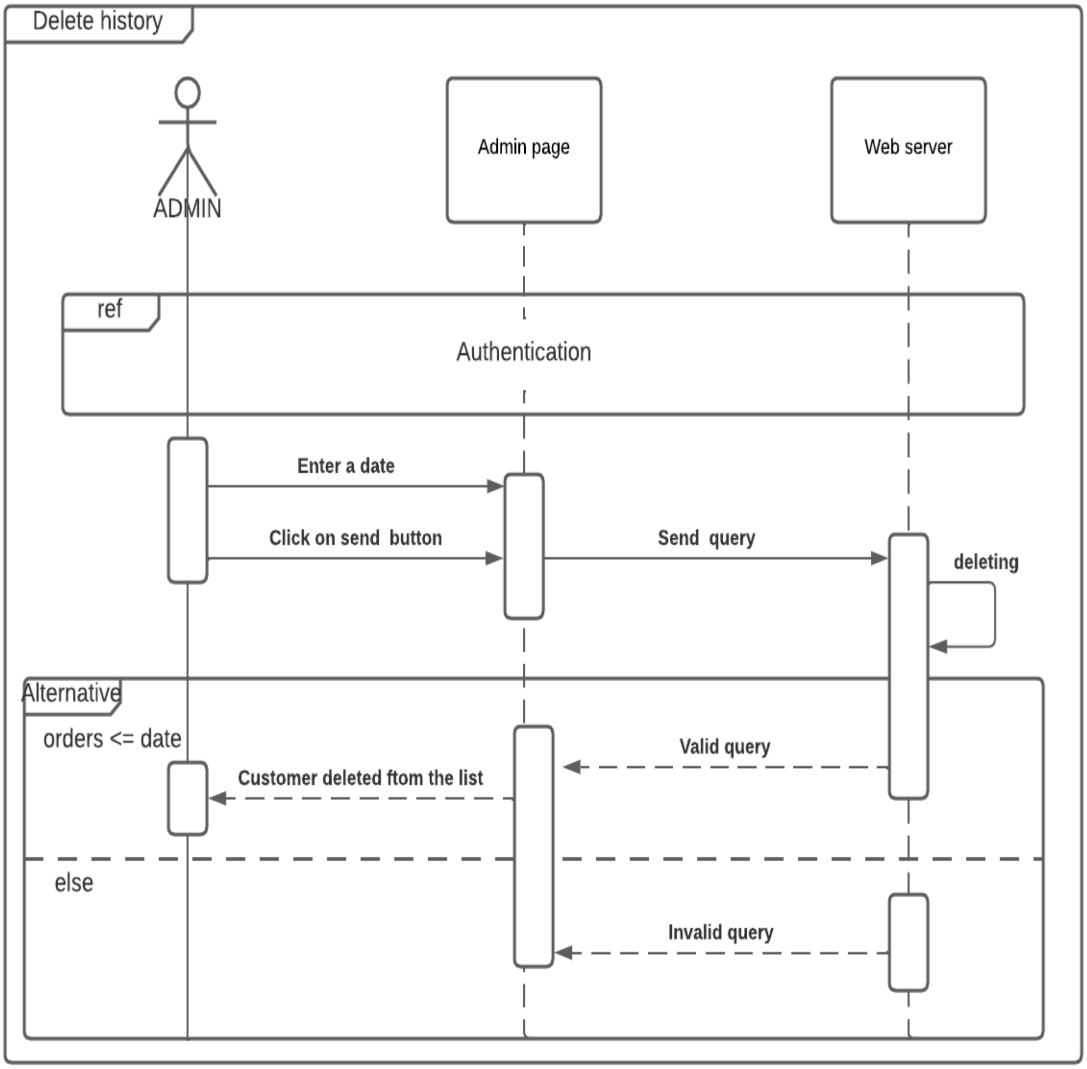


Figure 2.7: Delete history sequence diagram

5.Emails sending sequence diagram

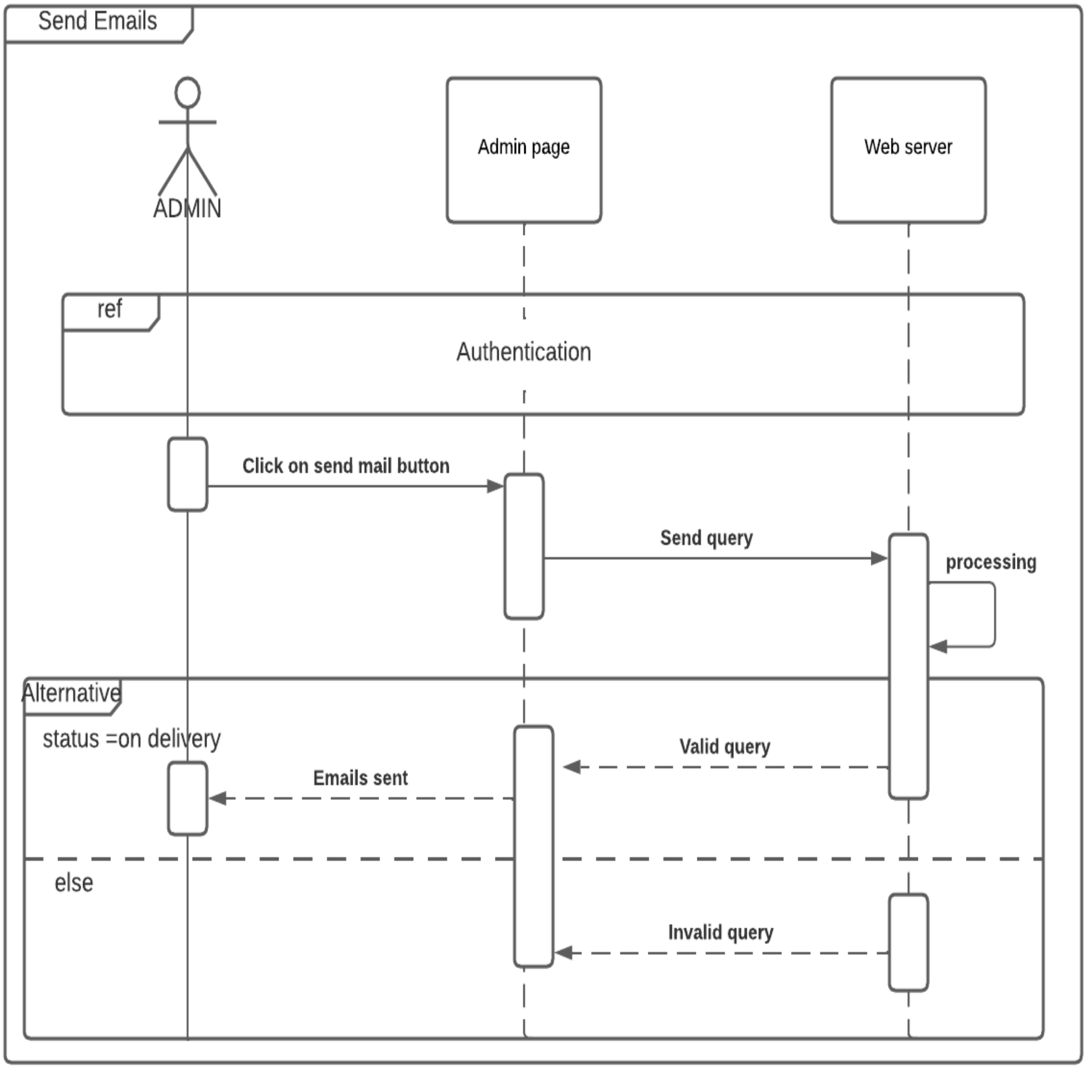


Figure 2.8: Emails sending sequence diagram

6.Get a quote sequence diagram

To place a delivery order, the consumer must complete out the form and click send. If he fills out all of the form fields, he will be directed to a page where he can confirm or cancel his order; otherwise, an error message asking to fill out the missing fields will appear.

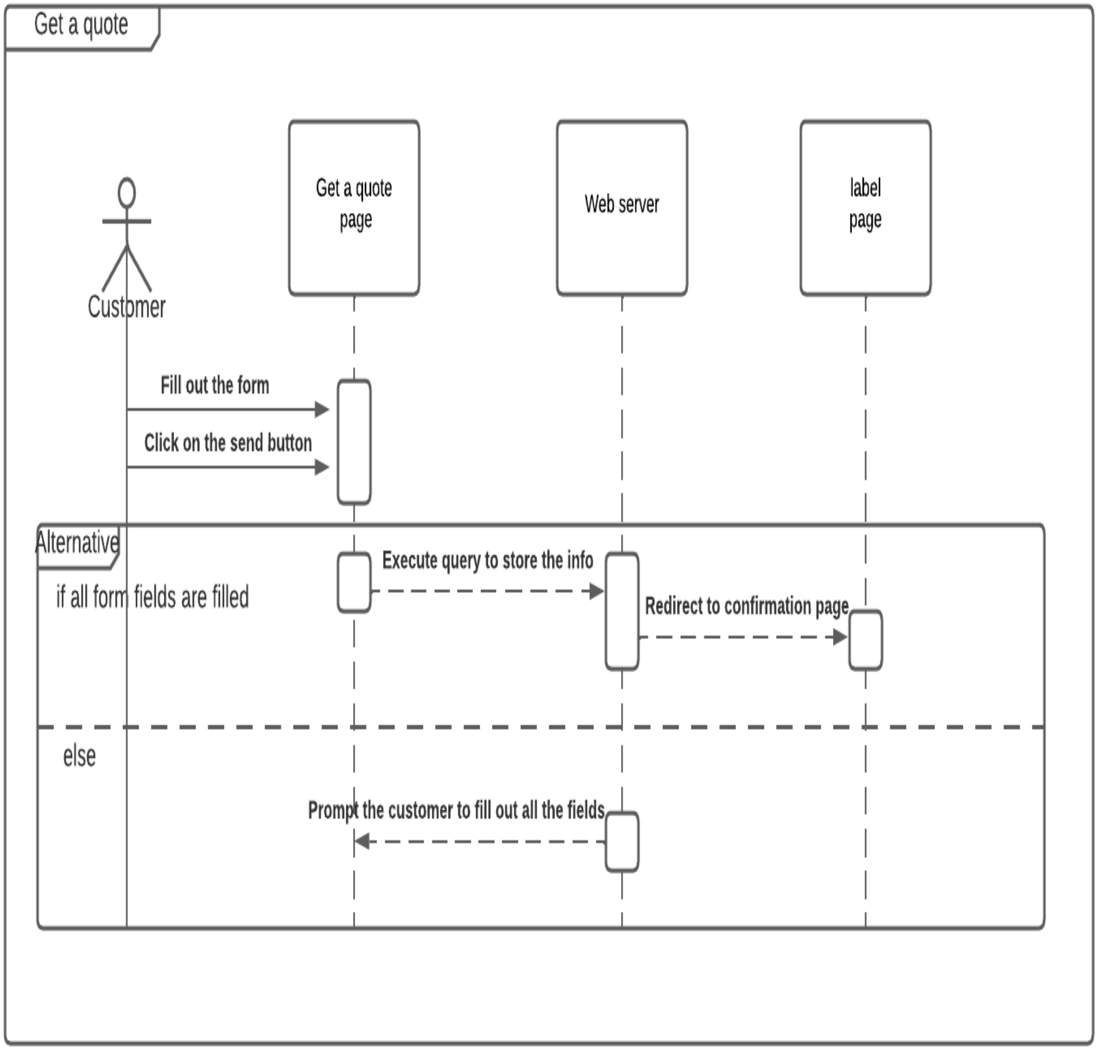

Get a quote
Customer
Get a quote page
Web server
label page
Fill out the form
Click on the send button
Alternative
if all form fields are filled
Execute query to store the info
Redirect to confirmation page
else
Prompt the customer to fill out all the fields

Figure 2.9: Get a quote sequence diagram

7.Order confirmation sequence diagram

The order confirmation and label downloading processes are combined in the sequence diagram below. Because the two go hand in hand. After the customer confirms his order by pressing the confirm button, a download your label option will appear, allowing him to quickly download his label.

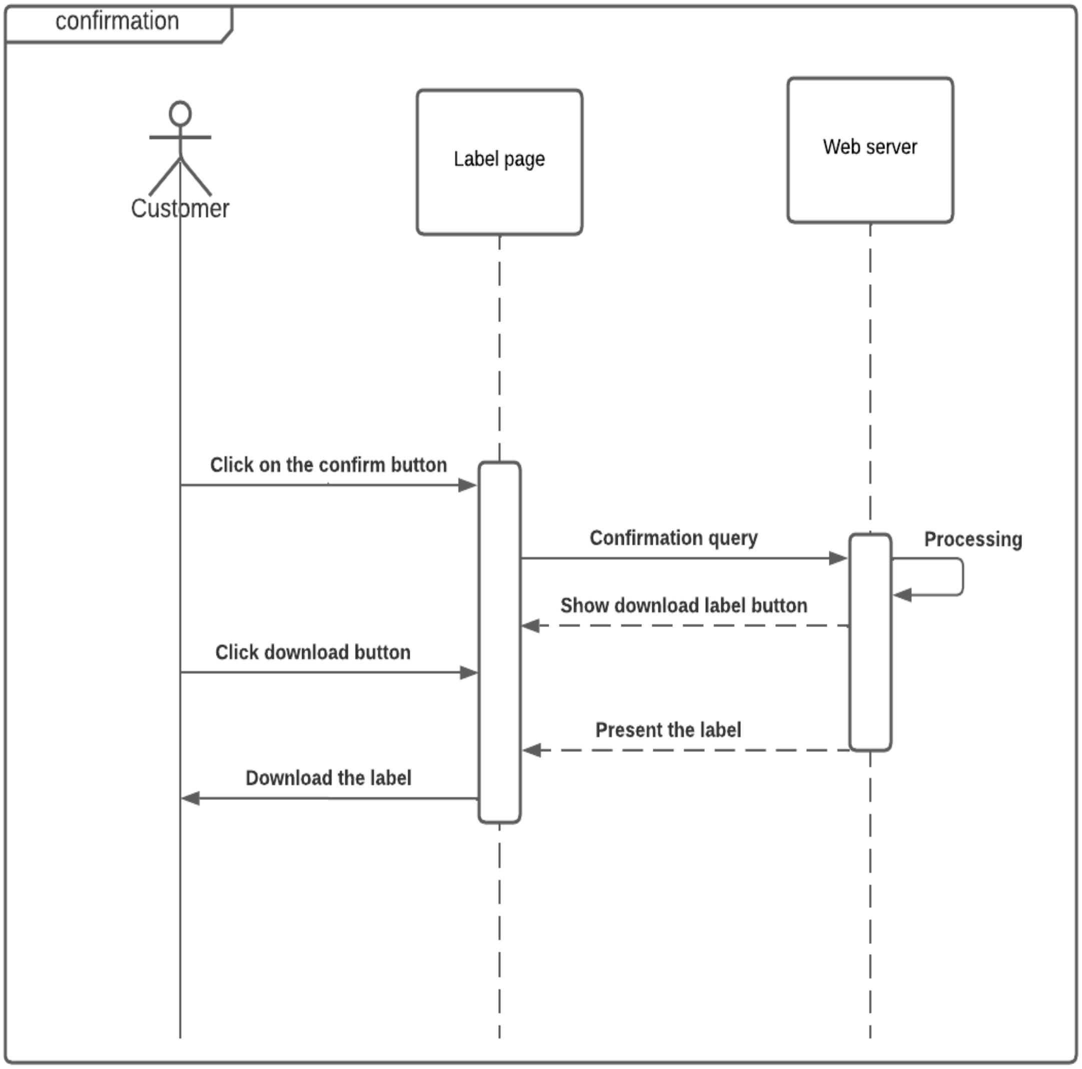


Figure 2.10: Order confirmation sequence diagram

8.Order cancellation sequence diagram

If a customer changes their mind after completing the form, he can easily cancel his order by using the cancel button.

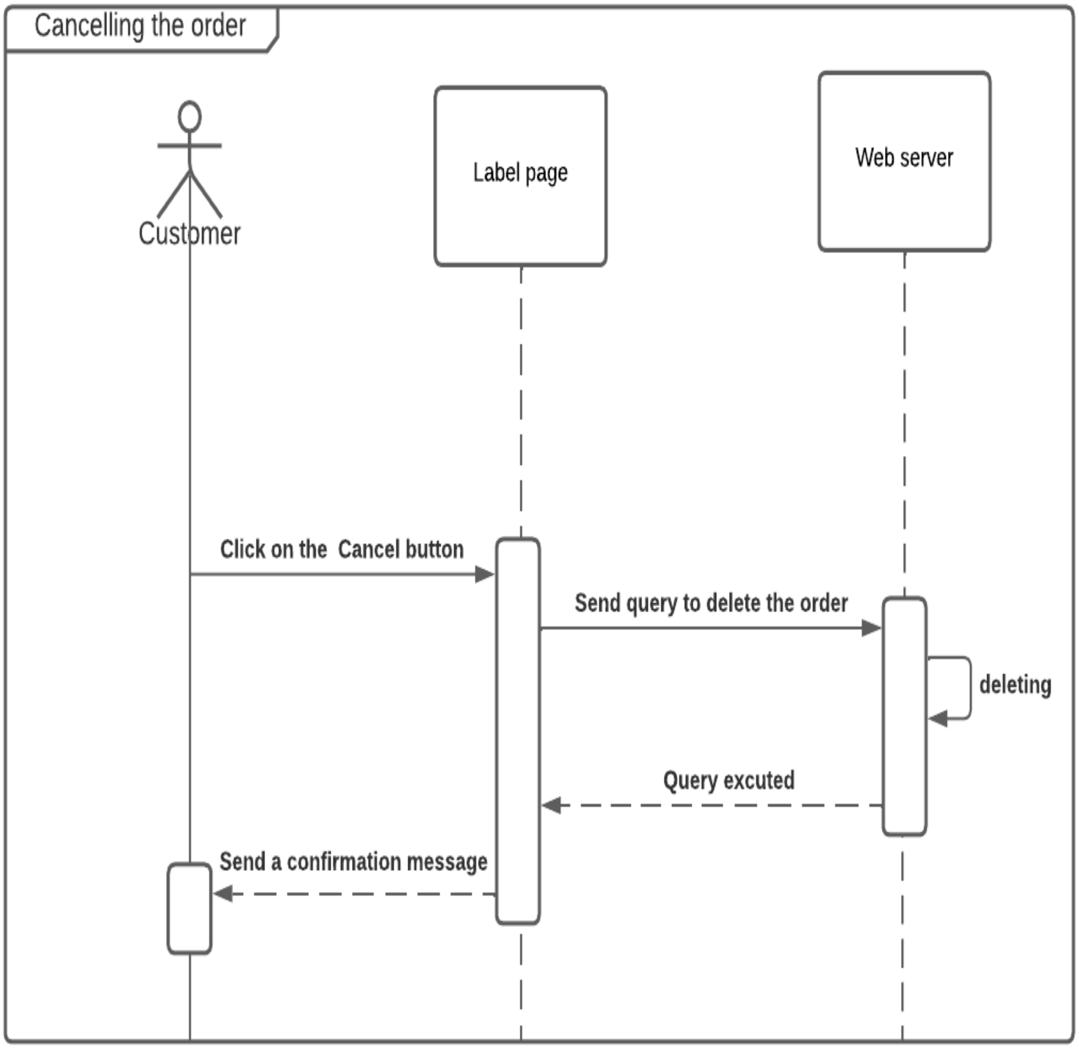

Cancelling the order
Customer
Label page
Web server
Click on the Cancel button
Send query to delete the order
deleting
Query excuted
Send a confirmation message

Figure 2.11: Order cancellation sequence diagram

9.Tracking sequence diagram

The customer can simply enter his tracking id into the tracking section to find out the status of his package. If he submitted a valid tracking number, he will be able to know where his package is at the moment. If he does not enter a legitimate tracking number, he will be requested to do so.

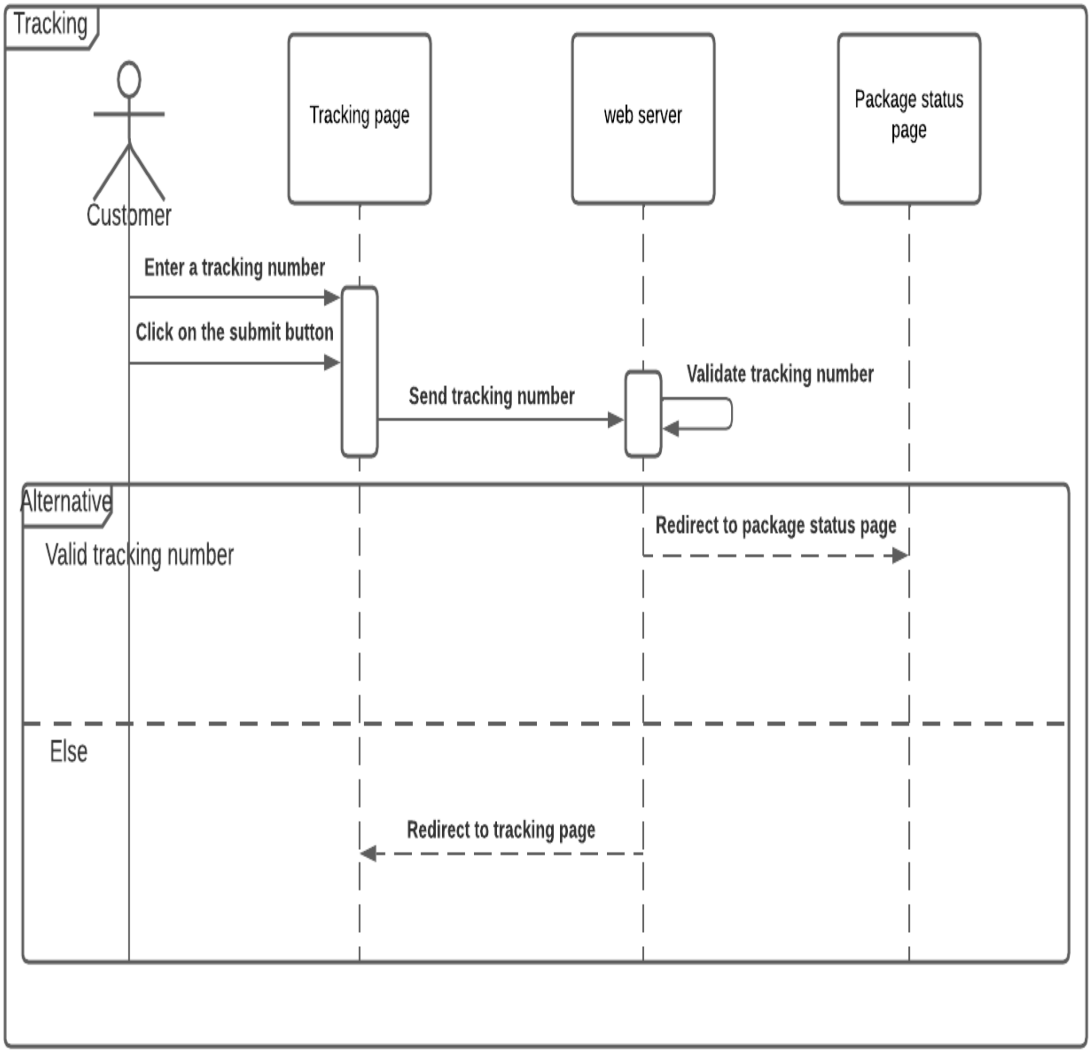


Figure 2.12: Tracking sequence diagram

2.7 Introduction to databases

2.7.1 Definition of databases

A database is an organized collection of structured information, or data, typically stored electronically in a computer system. A database is usually controlled by a database management system (DBMS). Together, the data and the DBMS, along with the applications that are associated with them, are referred to as a database system, often shortened to just database[21].

2.7.2 Types of databases

There are various types of databases used for storing different varieties of data the following are the most common ones[22] :

1.Relational database
This database is based on the relational data model, which stores data in the form of rows(tuple) and columns(attributes), and together forms a table(relation). A relational database uses SQL for storing, manipulating, as well as maintaining the data. Each table in the database carries a key that makes the data unique from others. Examples of Relational databases are MySQL, Microsoft SQL Server, Oracle, etc.

Properties of relational databases

- All of the values in a column have the same data type
- Each row is unique
- The sequence of rows is insignificant
- Each column has a unique name
- Integrity constraints maintain data consistency across multiple tables

2.NoSQL database
Non-SQL is a type of database that is used for storing a wide range of data sets. It is not a relational database as it stores data not only in tabular form but in several different ways. It came into existence when the demand for building modern applications increased. Thus, NoSQL presented a wide variety of database technologies in response to the demands.

Properties of NoSQL databases

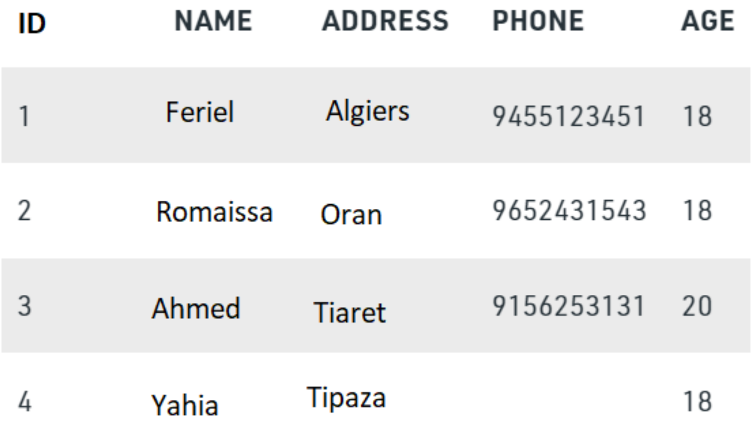
- They have higher scalability
- They use distributed computing

- They are cost effective
- They support flexible schema
- They can process both unstructured and semi-structured data

Since we've used relational database in our project, let's learn more about them.

1.Important terminologies in relational model

Let's take the table STUDENT in the next figure as an example,to better grasp these terminologies[23].



ID	NAME	ADDRESS	PHONE	AGE
1	Feriel	Algiers	9455123451	18
2	Romaissa	Oran	9652431543	18
3	Ahmed	Tiaret	9156253131	20
4	Yahia	Tipaza		18

Figure 2.13: Student table

Attribute: attributes are the properties that define a relation, eg;ID, Name.
Relation Schema: a relation schema represents name of the relation with its attributes. e.g.; STUDENT (ID, NAME, ADDRESS, PHONE and AGE) is relation schema for STUDENT. If a schema has more than 1 relation, it is called Relational Schema.
Tuple: each row in the relation is known as tuple. The above relation contains 4 tuples.
Relation Instance: the set of tuples of a relation at a particular instance of time is called as relation instance. Table 1 shows the relation instance of STUDENT at a particular time. It can change whenever there is insertion, deletion or updation in the database.
Degree: the number of attributes in the relation is known as degree of the relation. The STUDENT relation defined above has degree 5.
Cardinality: the number of tuples in a relation is known as cardinality. The STUDENT relation defined above has cardinality 4.
Column:column represents the set of values for a particular attribute.
NULL Values: the value which is not known or unavailable is called NULL value. It is represented by blank space. e.g.; PHONE of STUDENT having ID 4 is NULL.

2.Constraints in relational model

While designing relational model, we define some conditions which must hold for data present in database, they are called constraints. These constraints are checked before performing any operation (insertion, deletion and updation) in database. If there is a violation in any of constrains, operation will fail.
The main constrains are the following:

Domain constraints: these are attribute level constraints. An attribute can only take values which lie inside the domain range. e.g.; If a constrains AGE is set to be greater than 0 is applied on STUDENT relation, inserting negative value of AGE will result in failure.
Key integrity: every relation in the database should have at least one set of attributes which defines a tuple uniquely. Those set of attributes is called key. e.g.; ID in STUDENT is a key. No two students can have same ID number. So a key has two properties:

- It should be unique for all tuples
- It can't have NULL values

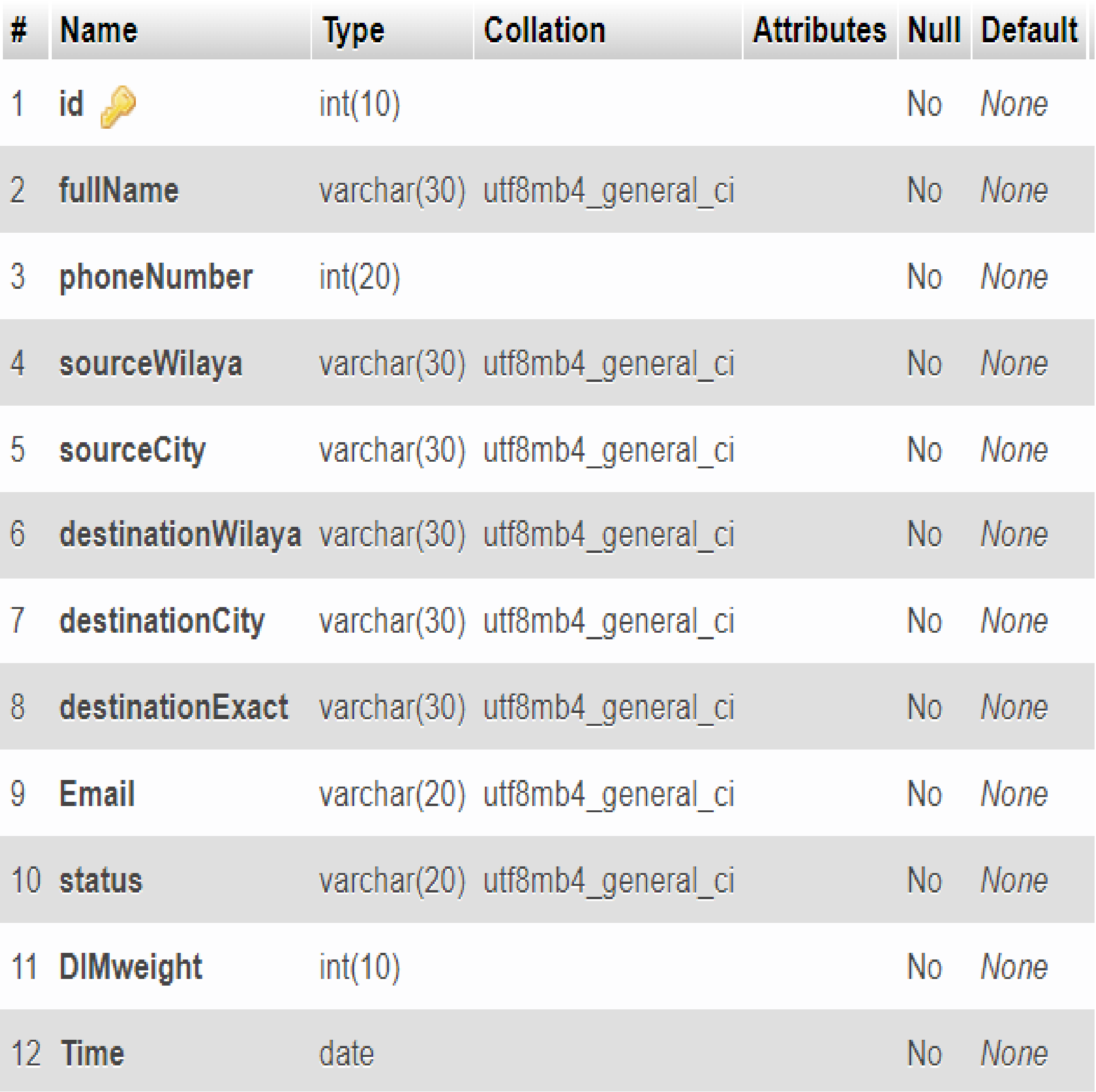
2.7.3 Database schema

For our website, the use of a database was essential. Because we wanted to maintain track of our clients' information, as well as the necessity for a rapid and efficient access to data that had been stored in order to automate receipts.
The database schema is comprised of three tables that are represented as follow:

1.Customer table
It has consisted of 12 attributes:

1. **id:** this is a primary key that uniquely identify each customer
2. **fullName:** it holds the full name of the customer
3. **phoneNumber:** it holds the phone number of the customer
4. **sourceWilaya:** it holds the name of the source or starting wilaya
5. **sourceCity:** it holds the name of the source or starting Daira
6. **destinationWilaya:** it holds the name of the destination wilaya
7. **destinationCity:** it holds the name of the destination Daira
8. **destinationExact:** it holds the rest of the destination address.Detailed information like exact name of the city and building
9. **Email:** it holds the Email of the customer
10. **status:** it holds the status of the package

11. **Dimweight:** it holds the dimensional weight of the package
12. **Time:** it saves the date of the order.

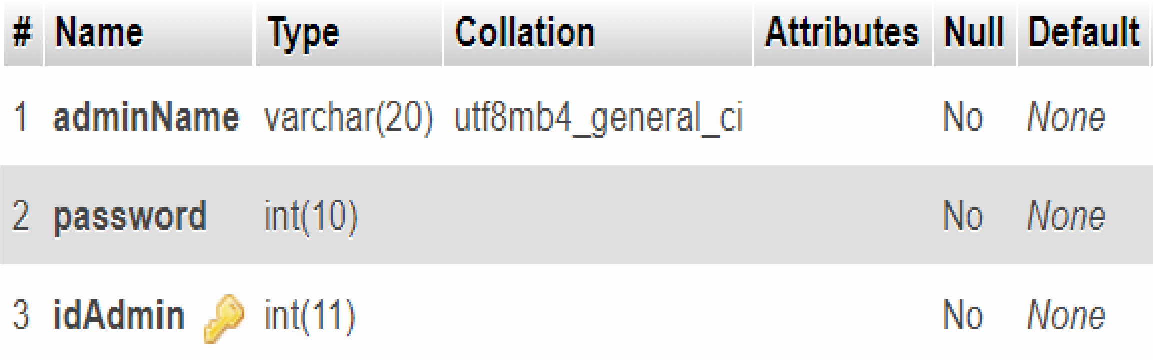


#	Name	Type	Collation	Attributes	Null	Default
1	**id** 🔑	int(10)			No	*None*
2	**fullName**	varchar(30)	utf8mb4_general_ci		No	*None*
3	**phoneNumber**	int(20)			No	*None*
4	**sourceWilaya**	varchar(30)	utf8mb4_general_ci		No	*None*
5	**sourceCity**	varchar(30)	utf8mb4_general_ci		No	*None*
6	**destinationWilaya**	varchar(30)	utf8mb4_general_ci		No	*None*
7	**destinationCity**	varchar(30)	utf8mb4_general_ci		No	*None*
8	**destinationExact**	varchar(30)	utf8mb4_general_ci		No	*None*
9	**Email**	varchar(20)	utf8mb4_general_ci		No	*None*
10	**status**	varchar(20)	utf8mb4_general_ci		No	*None*
11	**DIMweight**	int(10)			No	*None*
12	**Time**	date			No	*None*

Figure 2.14: Customer table

2.Admin table
This table is used in the authentication process, it has consisted of 3 attributes:

1. **adminName:** it holds the name of the authorized admin
2. **password:** it holds the password to access the admin's space in the website
3. **idAdmin:** this is a primary key that uniquely identify each admin



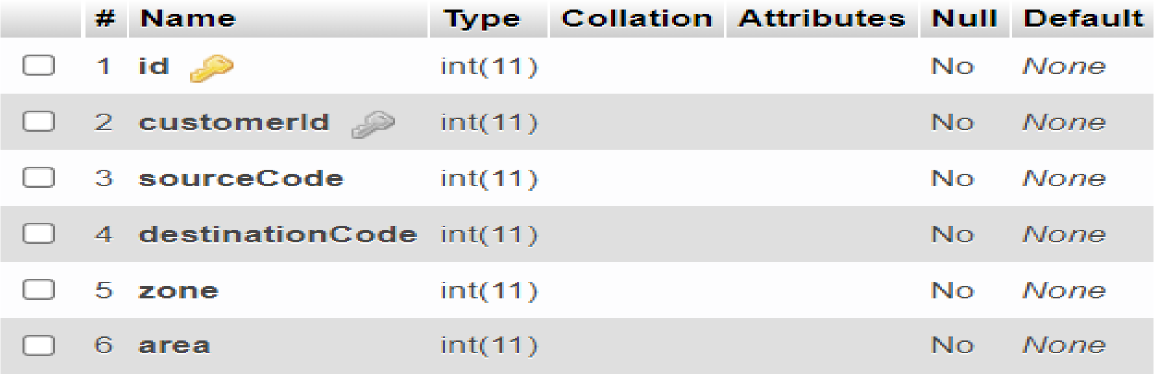
#	Name	Type	Collation	Attributes	Null	Default
1	**adminName**	varchar(20)	utf8mb4_general_ci		No	*None*
2	**password**	int(10)			No	*None*
3	**idAdmin** 🔑	int(11)			No	*None*

Figure 2.15: Admin table

2.Tracking id generation table
This table is used to generate tracking number by appending certain attribute together as shown below, it has consisted of 6 attributes:

1. **id:** this is a primary key that identify each row uniquely
2. **customerId**: this is a foreign key that holds the value of the attribute id from the customer's table
3. **sourceCode:** it holds the area code of the source wilaya. e.g.;Algiers has a code of 16
4. **destinationCode:** it holds the area code of the destination wilaya.
5. **zone:**according to the classification of **wilayas**, it holds a certain value.e.g.;Algiers and Boumerdes have a zone number of 1
6. **area:** according to the classification of **Dairas**, it holds a certain value.

For the creation of the barcode :
we appended the following attributes id+zone+destinatioCode+area, This sequence is crucial for the sorting procedure to be executed correctly.



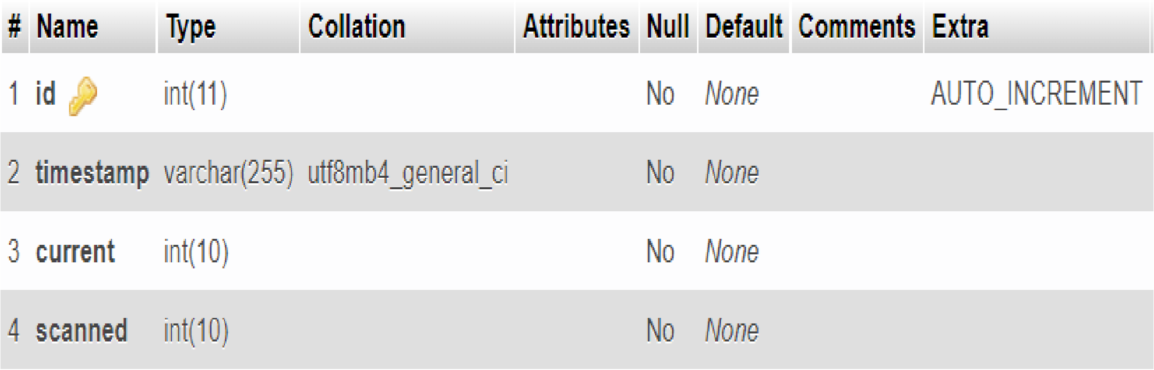
	#	Name	Type	Collation	Attributes	Null	Default
□	1	**id**	int(11)			No	*None*
□	2	**customerId**	int(11)			No	*None*
□	3	**sourceCode**	int(11)			No	*None*
□	4	**destinationCode**	int(11)			No	*None*
□	5	**zone**	int(11)			No	*None*
□	6	**area**	int(11)			No	*None*

Figure 2.16: Tracking id generation table

3.Traking table

This table is used in the tracking process ,it has consisted of 4 attributes:

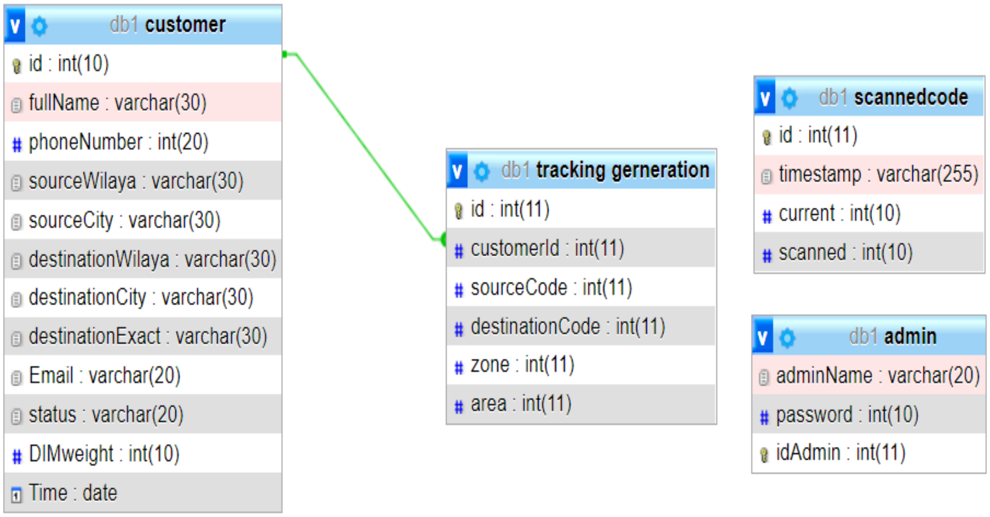
1. **id:** this is a primary key that uniquely identifies each row
2. **timestamp:** it holds the time in which the tracking number was scanned.
3. **current:** it contains the area code for the wilaya in which the warehouse is located. e.g.;if the warehouse is in Algiers is will hold a value of 16
4. **scanned:** it holds the scanned tracking number



#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra
1	**id**	int(11)			No	*None*		AUTO_INCREMENT
2	**timestamp**	varchar(255)	utf8mb4_general_ci		No	*None*		
3	**current**	int(10)			No	*None*		
4	**scanned**	int(10)			No	*None*		

Figure 2.17: Tracking table

2.7.4 Application relation model



db1 customer
id : int(10)
fullName : varchar(30)
phoneNumber : int(20)
sourceWilaya : varchar(30)
sourceCity : varchar(30)
destinationWilaya : varchar(30)
destinationCity : varchar(30)
destinationExact : varchar(30)
Email : varchar(20)
status : varchar(20)
DIMweight : int(10)
Time : date

db1 tracking gerneration
id : int(11)
customerId : int(11)
sourceCode : int(11)
destinationCode : int(11)
zone : int(11)
area : int(11)

db1 scannedcode
id : int(11)
timestamp : varchar(255)
current : int(10)
scanned : int(10)

db1 admin
adminName : varchar(20)
password : int(10)
idAdmin : int(11)

Figure 2.18: Tables and their relationships

2.8 Control System Architecture

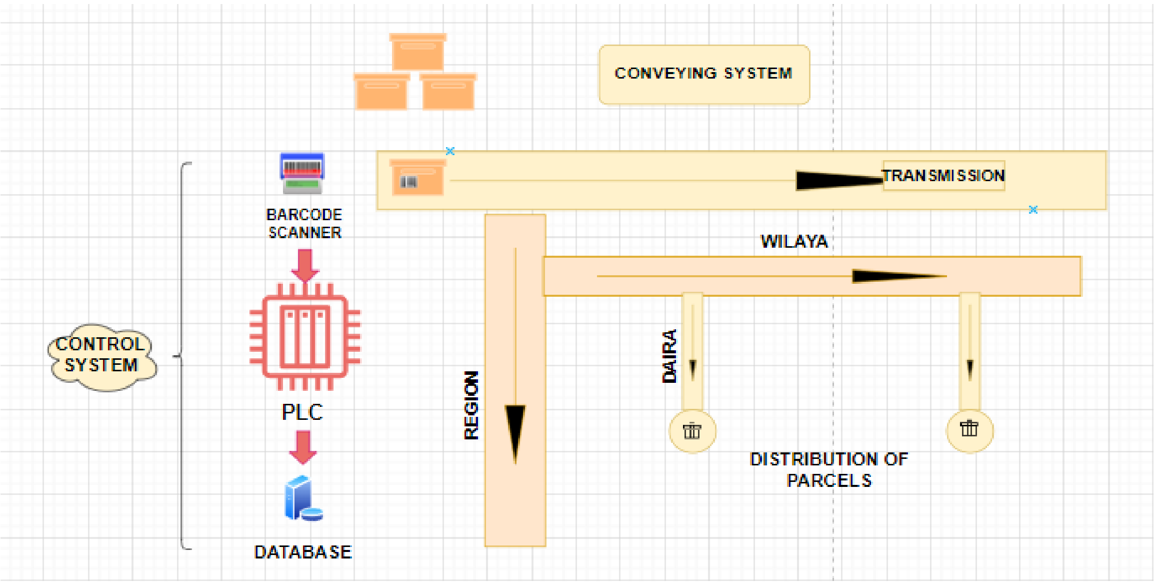
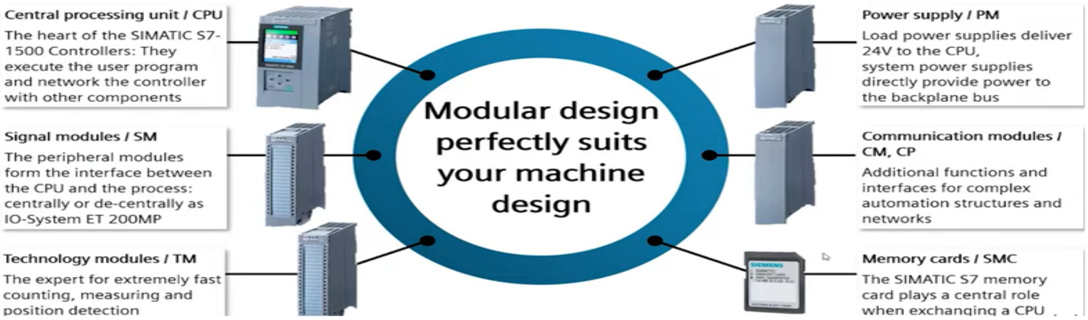


Figure 2.19: Automatic sorting system architecture design

2.8.1 Presentation of PLC s71500

It's a Siemens mini PLC controller. It is a small logic controller that revolutionized traditional automation when it was introduced in 1996. It's an excellent choice for basic control tasks because it's quick, simple, and space-saving. It's utilized in industry for small-scale automation projects.



Central processing unit / CPU
The heart of the SIMATIC S7-1500 Controllers: They execute the user program and network the controller with other components

Signal modules / SM
The peripheral modules form the interface between the CPU and the process: centrally or de-centrally as IO-System ET 200MP

Technology modules / TM
The expert for extremely fast counting, measuring and position detection

Power supply / PM
Load power supplies deliver 24V to the CPU, system power supplies directly provide power to the backplane bus

Communication modules / CM, CP
Additional functions and interfaces for complex automation structures and networks

Memory cards / SMC
The SIMATIC S7 memory card plays a central role when exchanging a CPU

Figure 2.20: General description of PLCs71500

2.9 Programming the PLC s7-1500

2.9.1 PLC Configuration

To build the system in a proper way, we need extra software applications and they have a direct relationship with the previously mentioned ones(TIA PORTAL NODE-RED), which are:

.PLCSIMULATION(PLCSIM) Advanced v4.0(for the general simulation)
.Open Platform Communications United Architecture(OPC-UA) Client

Tia Portal Siemens is used because it enables us to work conveniently with the TIA project server,and connecting PLC s7-1500 to a SQL database which is required in our project,and to monitor the system in an easy and direct way,we chose to add the supervision feature via HMI SAMKOONSK which is a high-quality human machine interface product, integrating entirely CPU unit, input and output unit, display, memory and other module units. It can be widely applied in industrial control systems of all sectors of industry ,through which the worker can follow the process and monitor it.

Node-Red was used as a link between the Tia Portal and the database, which in turn needs a data bus which in this case is the OPC-UA Client protocol.

The configuration of the PLC is one of the essential steps that we go through, the important steps are mentioned below:
-Activate OPC-UA server
-Activate PUT/GET communication
-Activate Security
-Licence Medium
-Supported

2.10 Functional Description

2.10.1 Defining Variables and Data Types

In PLC programming, variable are divided into two types: global and local variables, The main difference between them is that global variables can be accessed globally in the entire program, whereas local variables can be accessed only within the function or block in which they are defined.

2.10.2 Program Description

Programming a PLC can sometimes be a daunting task. The best method is to break the task into some smaller steps. Our system is separated into numerous components, as explained on previous pages, and the program is divided into multiple networks, each of which represents a distinct part of our system. We shall see how the program was constructed in the following pages.

1. Conveyor Program

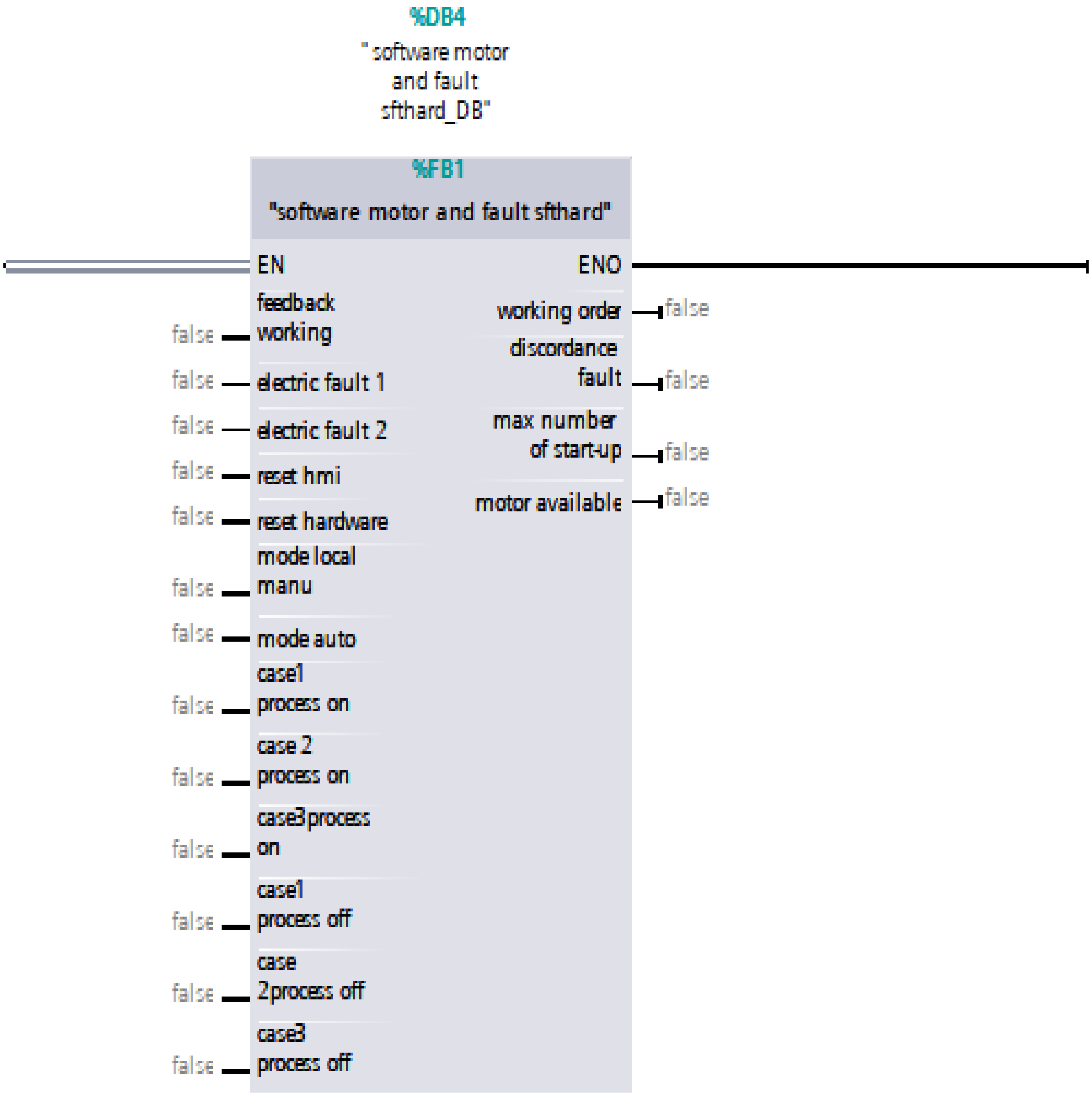
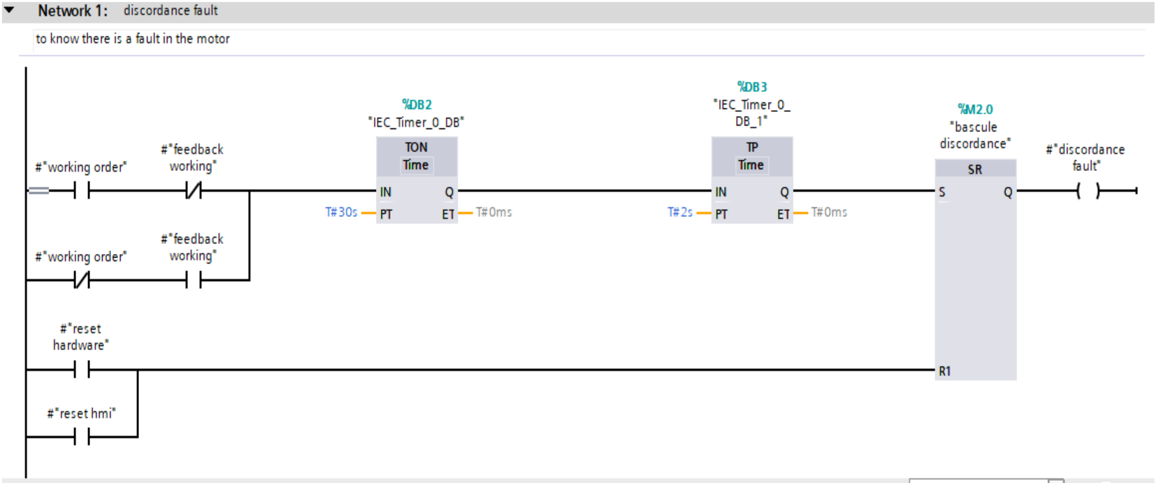


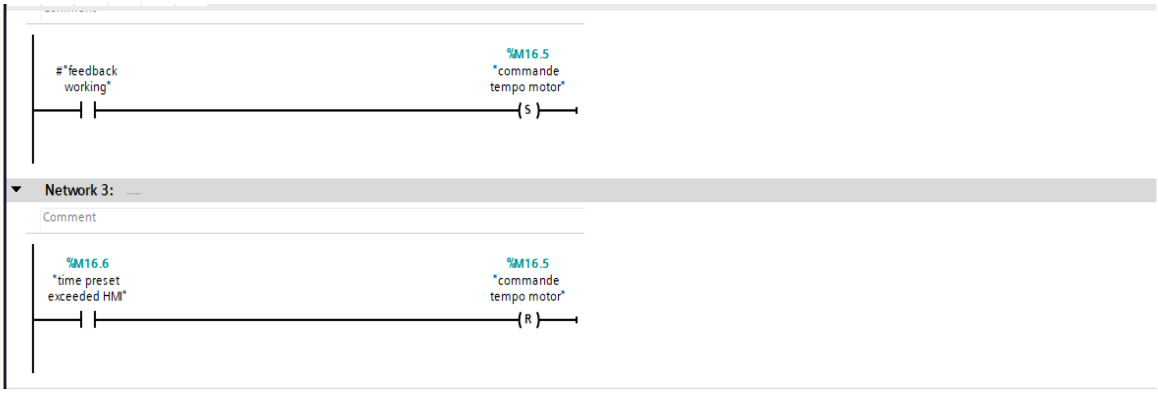
Figure 2.21: General conveyor program

Our conveying system's complete program is represented in the diagram above. We tried to examine each situation and construct a suitable network before running the conveyor properly, to avoid the maximum defects that can occur,


Network 1: discordance fault

to know there is a fault in the motor

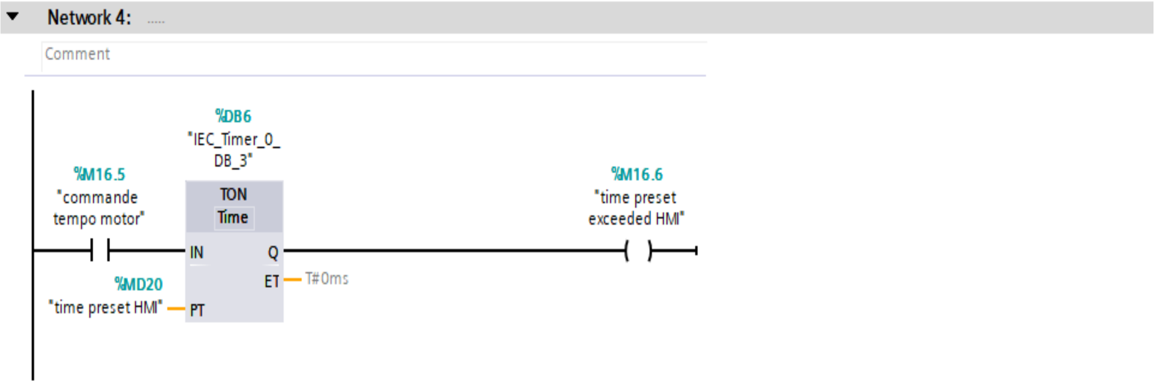
Figure 2.22: Conveyor Discordance Fault



Network 3: .....

Comment

Figure 2.23: Conveyor operation control part A


Network 4: .....

Comment

Figure 2.24: Conveyor operation control part B

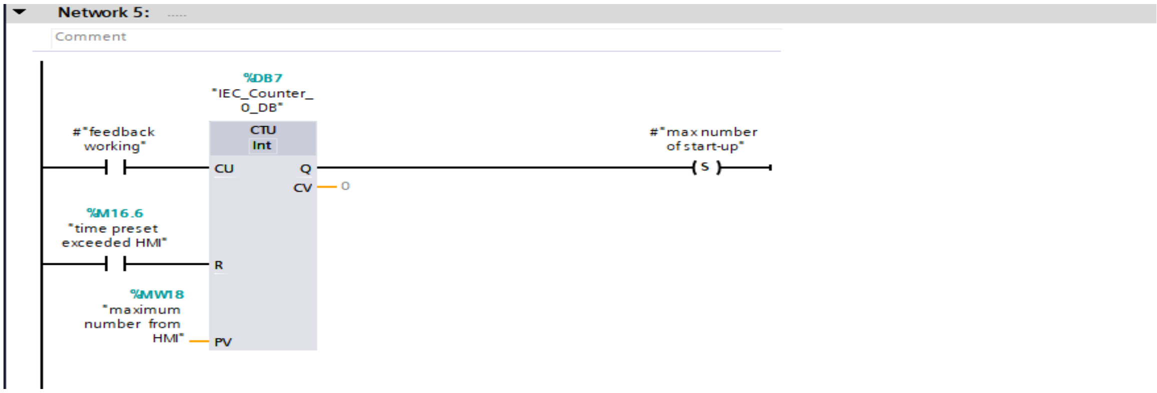


Figure 2.25: Conveyor operation control part C

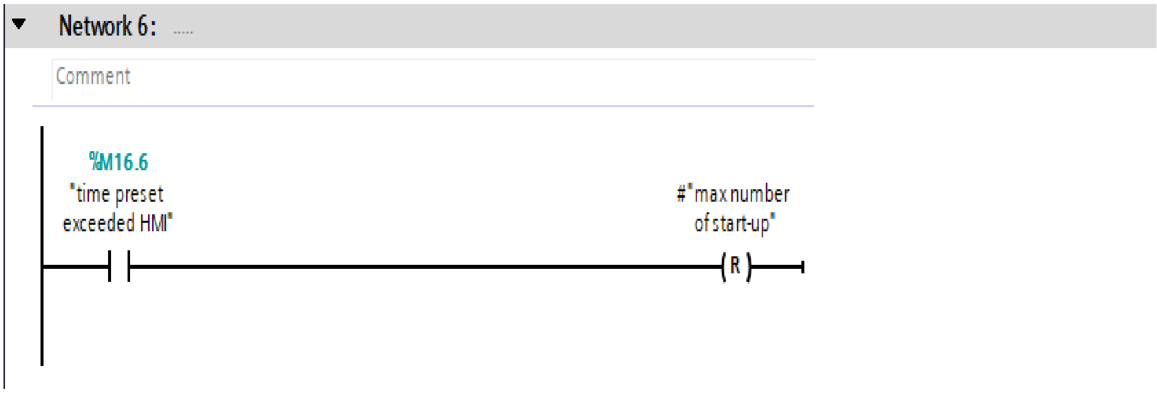
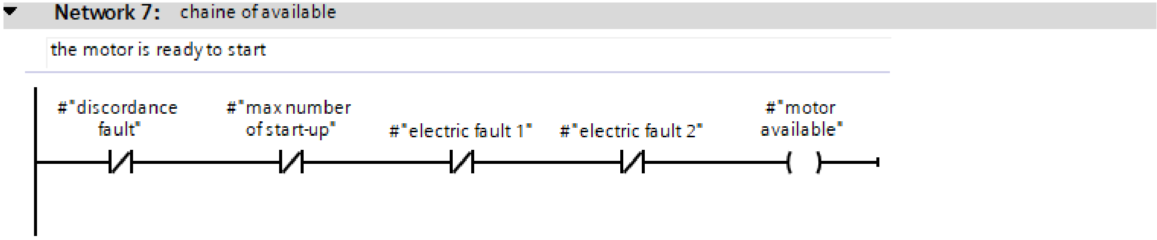


Figure 2.26: Conveyor operation control part D


Network 7: chaine of available

the motor is ready to start

Figure 2.27: Start conveyor condition

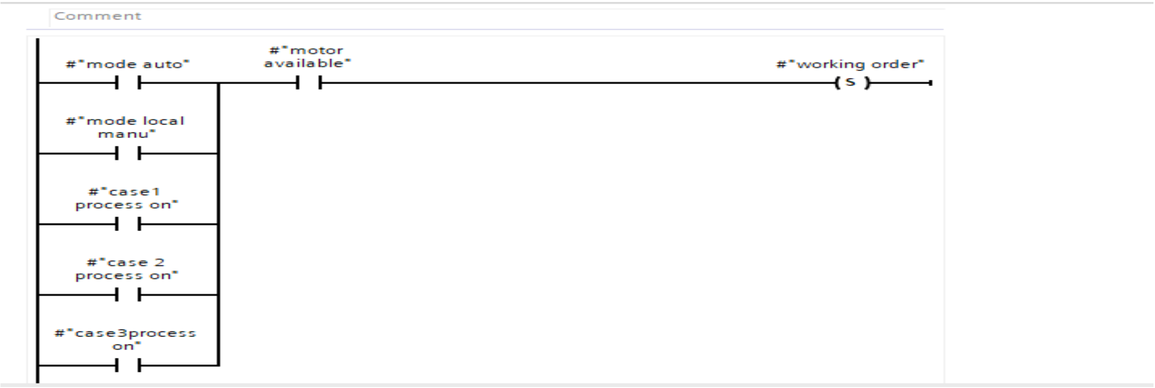


Figure 2.28: Conveyor working order

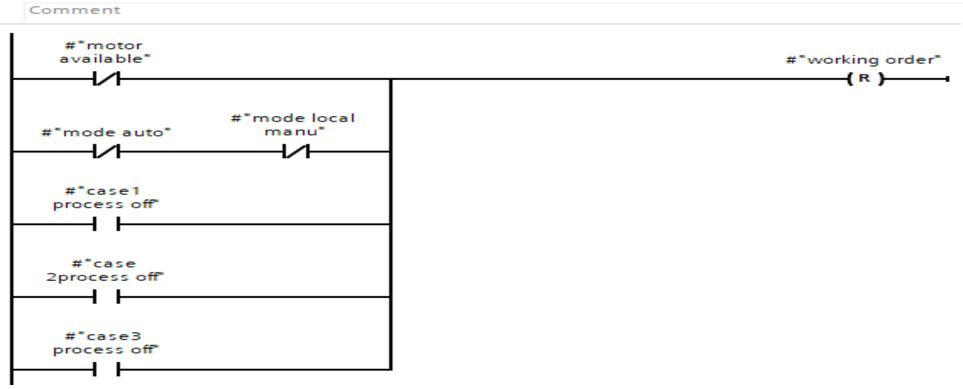


Figure 2.29: Conveyor stop order

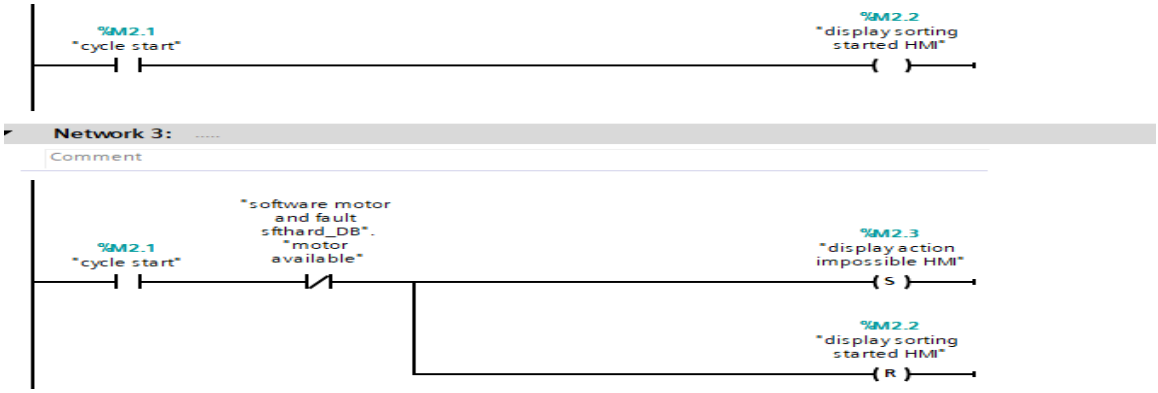

%M2.1
"cycle start"
%M2.2
"display sorting started HMI"
Network 3: .....
Comment
%M2.1
"cycle start"
"software motor and fault sfthard_DB". "motor available"
%M2.3
"display action impossible HMI"
S
%M2.2
"display sorting started HMI"
R

Figure 2.30: HMI display conditions

2. Pushers program

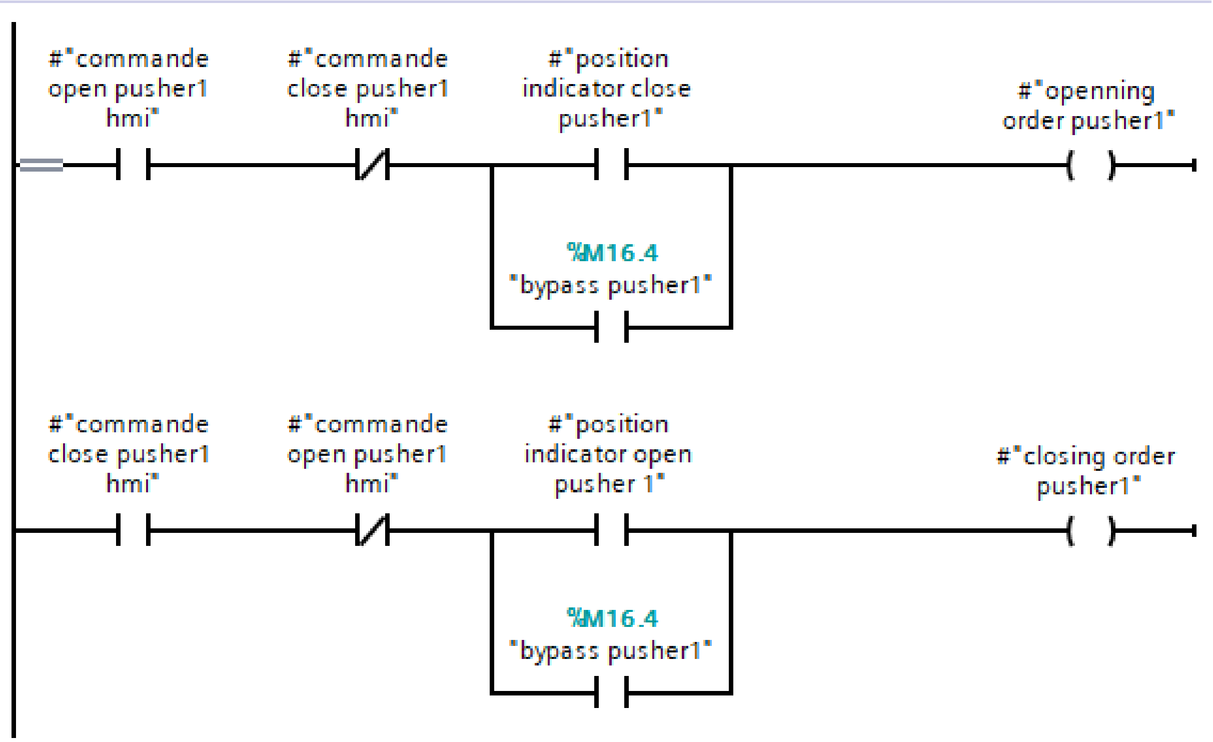

#"commande open pusher1 hmi"
#"commande close pusher1 hmi"
#"position indicator close pusher1"
#"openning order pusher1"
%M16.4
"bypass pusher1"
#"commande close pusher1 hmi"
#"commande open pusher1 hmi"
#"position indicator open pusher 1"
#"closing order pusher1"
%M16.4
"bypass pusher1"

Figure 2.31: Pushers Command program

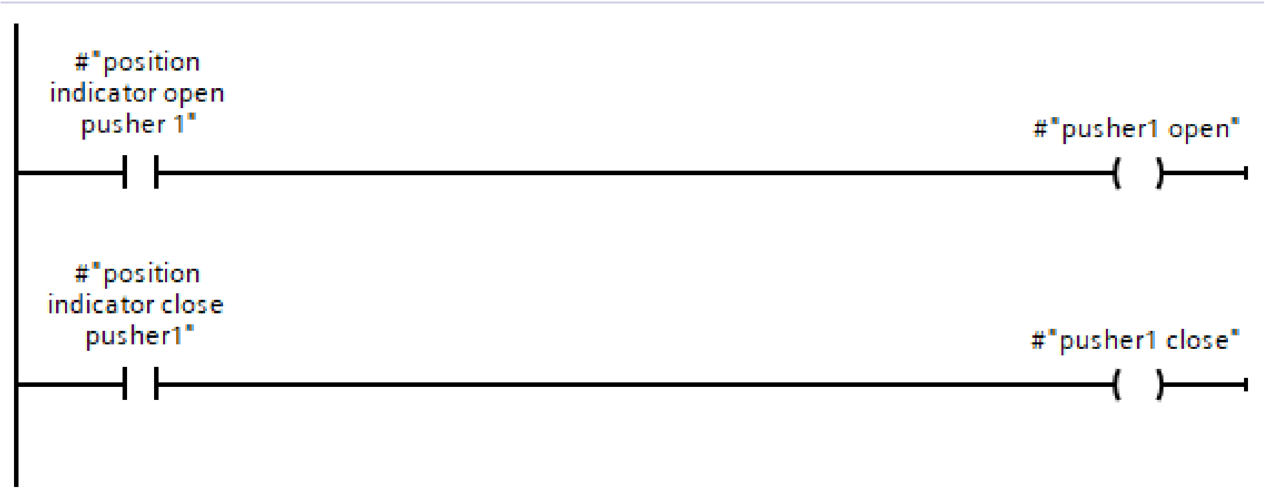
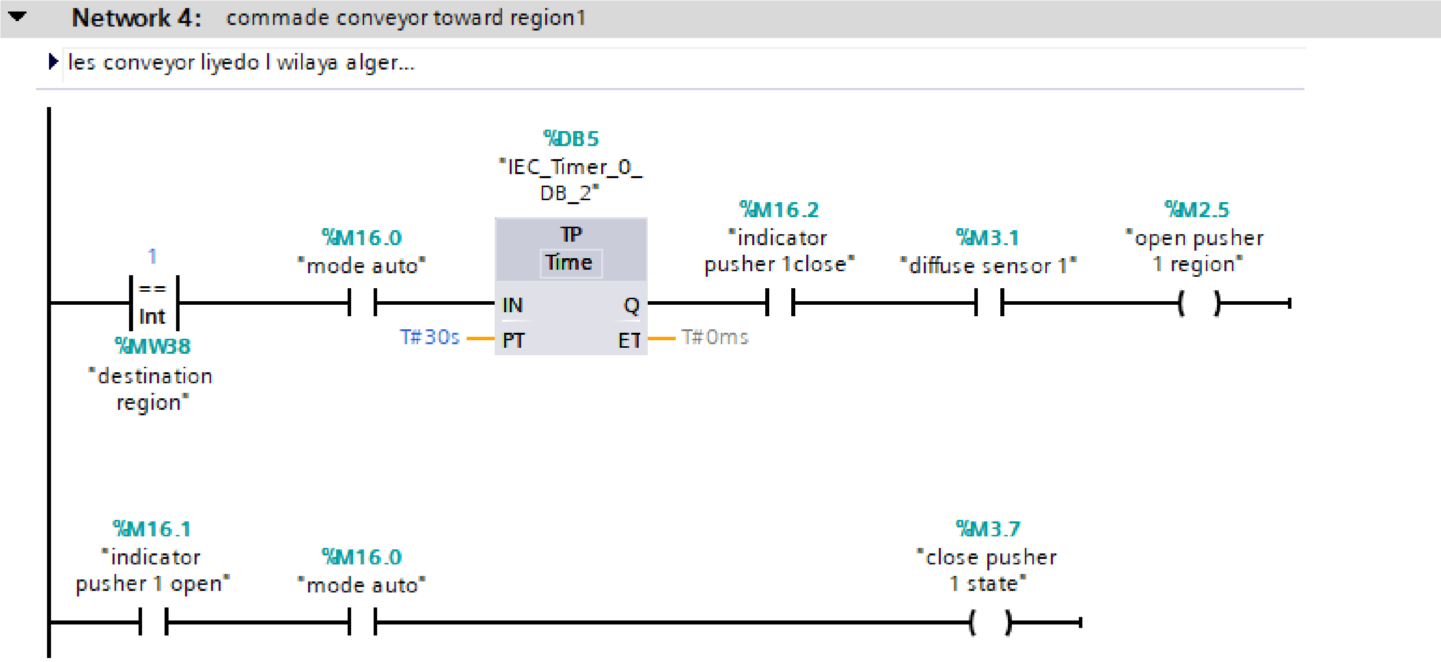

#"position indicator open pusher 1"
#"pusher1 open"
#"position indicator close pusher1"
#"pusher1 close"

Figure 2.32: Pushers position program

3. Sorting to region program


Network 4: commade conveyor toward region1

les conveyor liyedo l wilaya alger...

Figure 2.33: Parcel sorting toward region program

This program is responsible for the first sorting to the required region; in the example above, if the destination region is equal to 1, the pusher is activated after a certain amount of time. Other programs that deal with sorting to the wilaya and subsequently to the daira by activating the appropriate pushers and confirming the sorting condition will use the same technique.

We have a comparison of region, wilaya, and daira codes among the sorting conditions, and the software to identify the most recent is

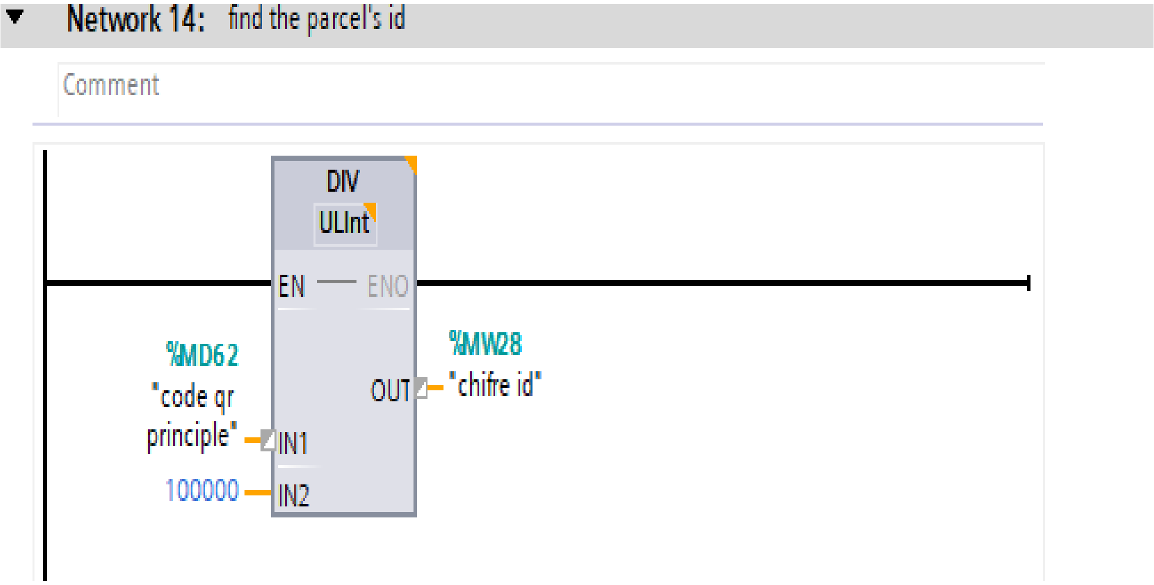


Figure 2.34: Program to find parcel's id

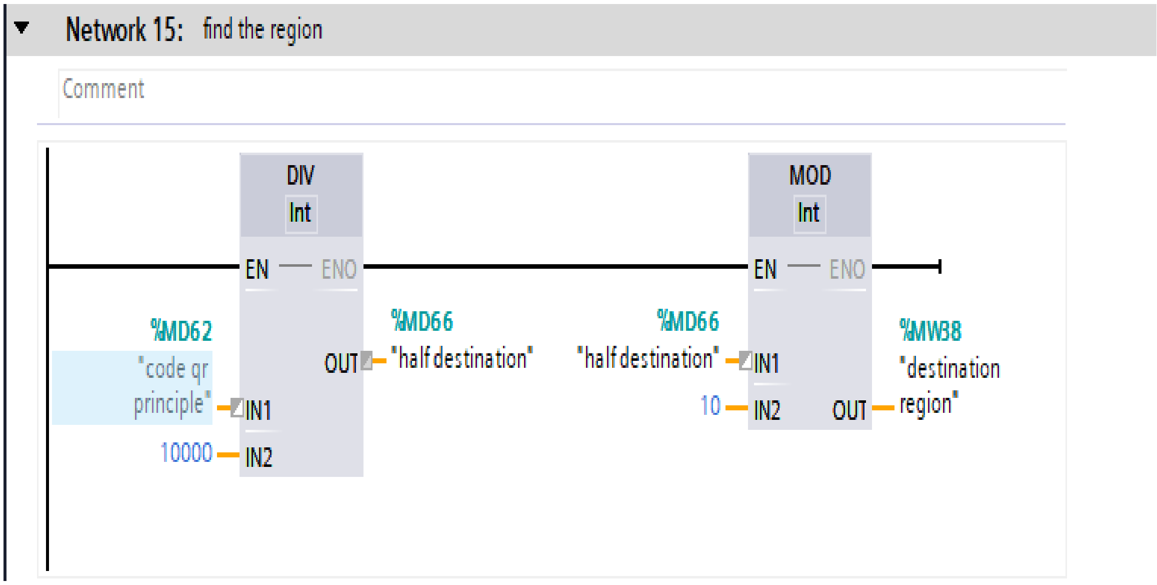


Figure 2.35: Program to find the region

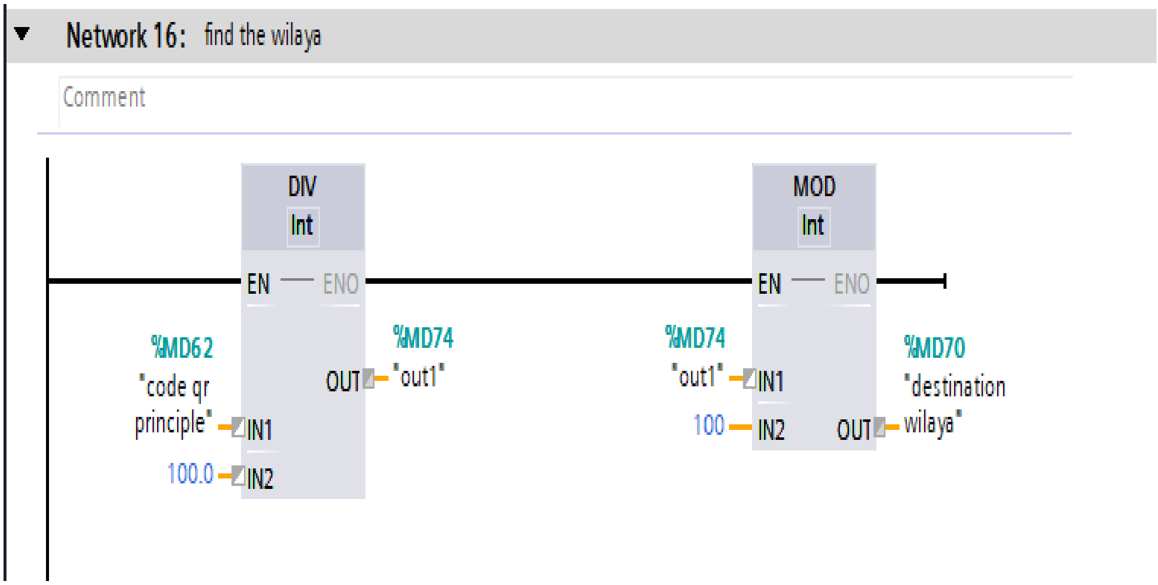


Figure 2.36: Program to find the wilaya

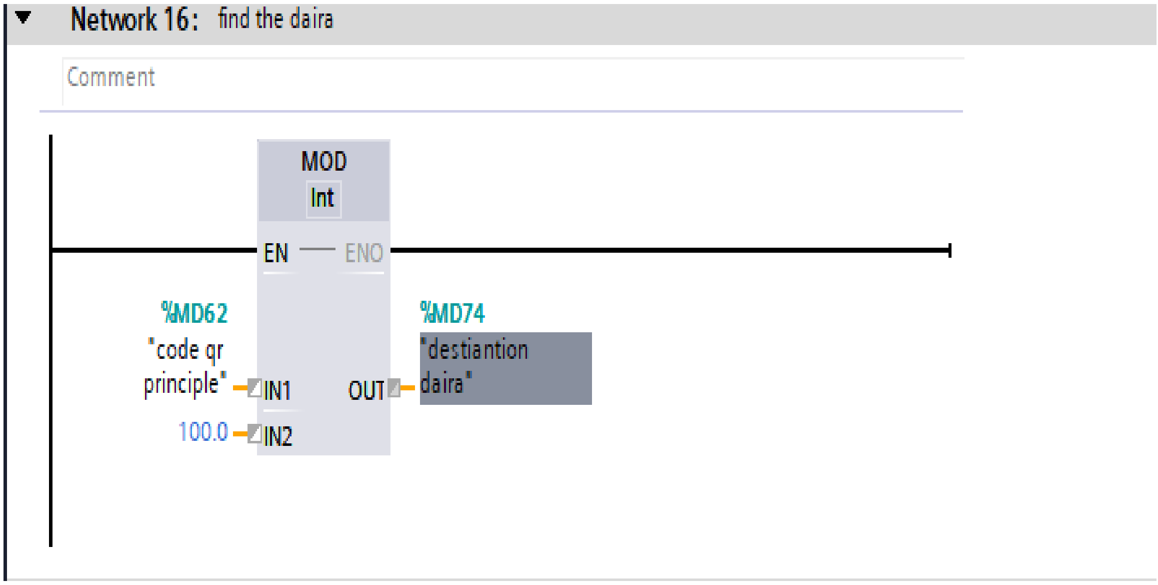


Figure 2.37: Program to find the daira

The lack of parcel's label is one of the most common error,so we developed that help to detect that fault.

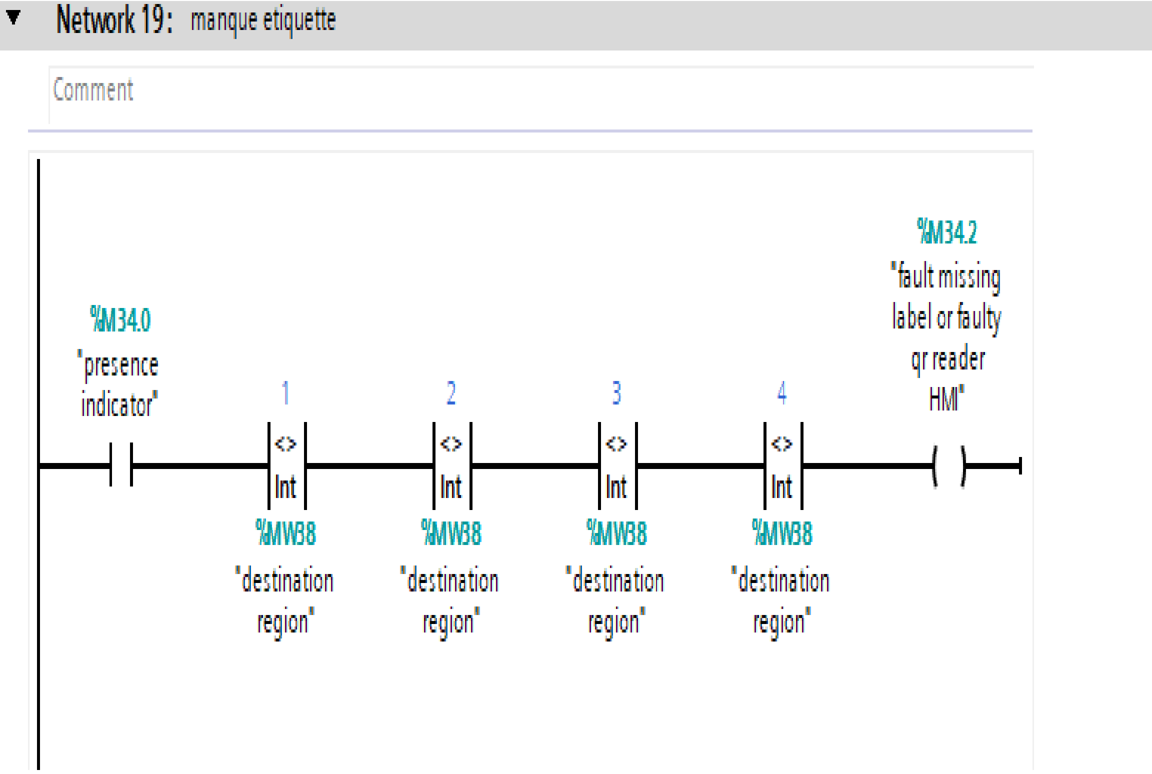


Figure 2.38: Program to detect missing labels error

2.11 Supervision using HMI SAMKOON

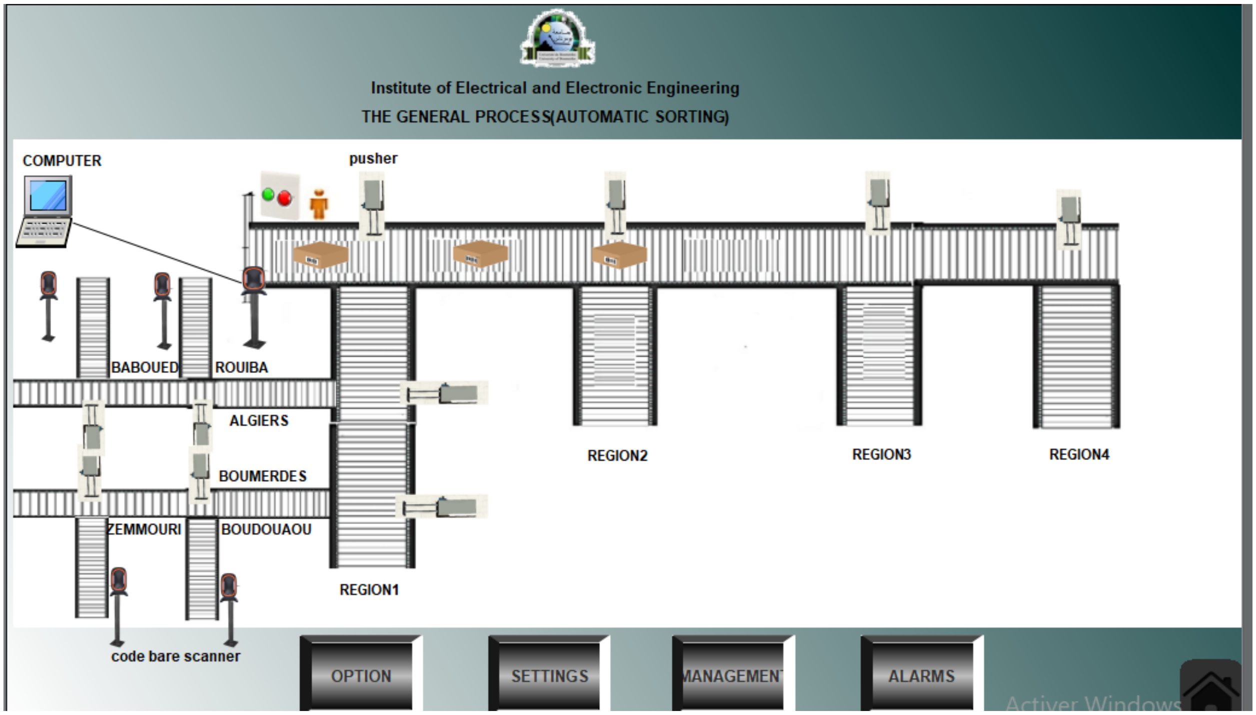


Figure 2.39: HMI process screen

The entire system is displayed in a clear and understandable manner utilizing HMI SAMKOON supervision, where we can see the conveying mechanism that moves the parcels. In the following sections, we'll focus on various scenarios in which we'll select a specific source and destination and go through all of the procedures from barcode scanning through parcel distribution.

2.12 Conclusion

In the first part of this chapter we modeled our website using UML to make it easier for the reader whether he's a developer or not, to comprehend the process and obtain a clear picture of how it works. We utilized use case diagrams and sequence diagrams to explain how the software's actions are carried out in the right order. We've also defined databases and demonstrated how they were used on our website.
As for the second part, we've shown how the PLC was programmed and set up, as well as how the sorting system was designed using the SKTOOL software.

Chapter 3

Implementation,Results and Discussion

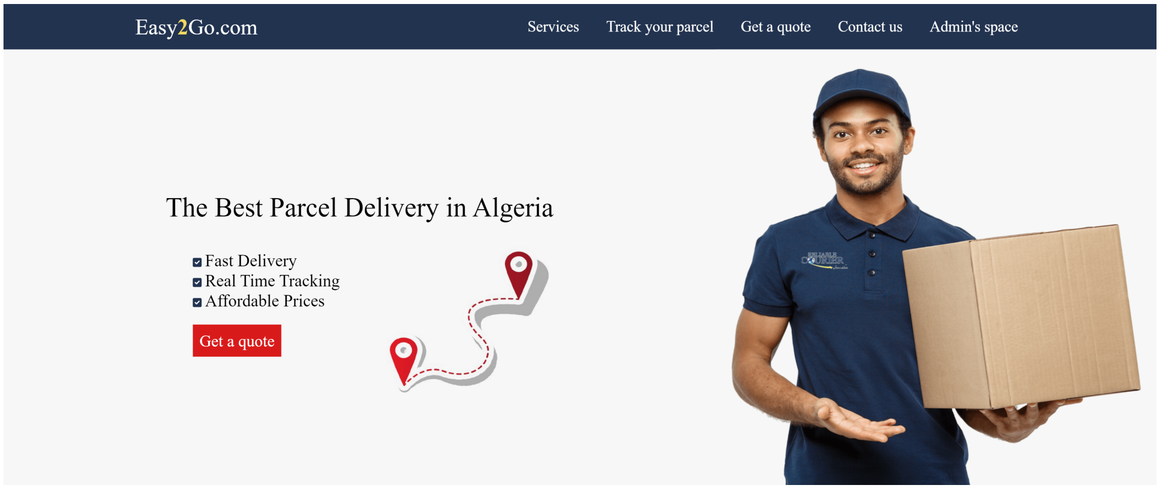
3.1 Introduction

In the previous chapters, we have identified the tools and technologies used to build our project . In this chapter, We'll give a presentation of the full project, starting with a demonstration of the website and its functionalities along with some user interfaces and ending with a simulation of an automated sorting system by testing a selected scenario and discuss the outcomes. Finally, we will discuss our acquired results.

3.2 Interfacing with the website

3.2.1 The external pages of our website

1.The homepage section
The following figure represents the homepage of our website, it gives visitors an immediate sense of the content of our work. It contains the header on top that is used as a guide to other important information throughout the internal pages of the website.



The Best Parcel Delivery in Algeria

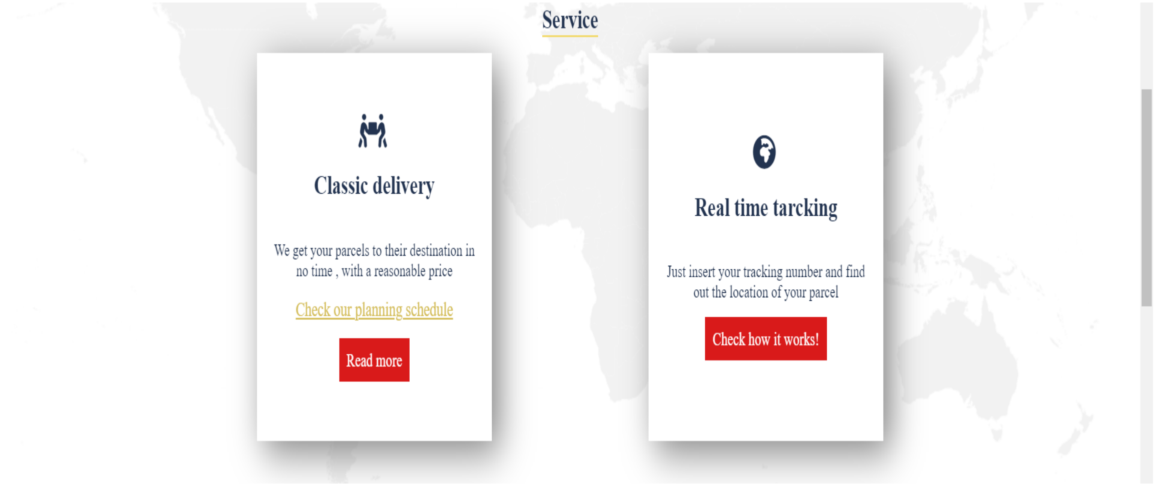
- ☑ Fast Delivery
- ☑ Real Time Tracking
- ☑ Affordable Prices

Figure 3.1: The homepage

2.The services section

This section of the website highlights the features and services we provide.

- Classic delivery : we used the term ”classic” to refer to dealing with customers who want to deliver a package from one location to another, not e-commerce sellers. The customer can click the read more button to get to a web page that explains the delivery process and the pricing mechanism used.
- Real time tracking :a feature that allows customers to track their packages by inserting their tracking number. The customer will be directed to a page that explains how tracking works if they click the check how it works button



Classic delivery

We get your parcels to their destination in no time , with a reasonable price

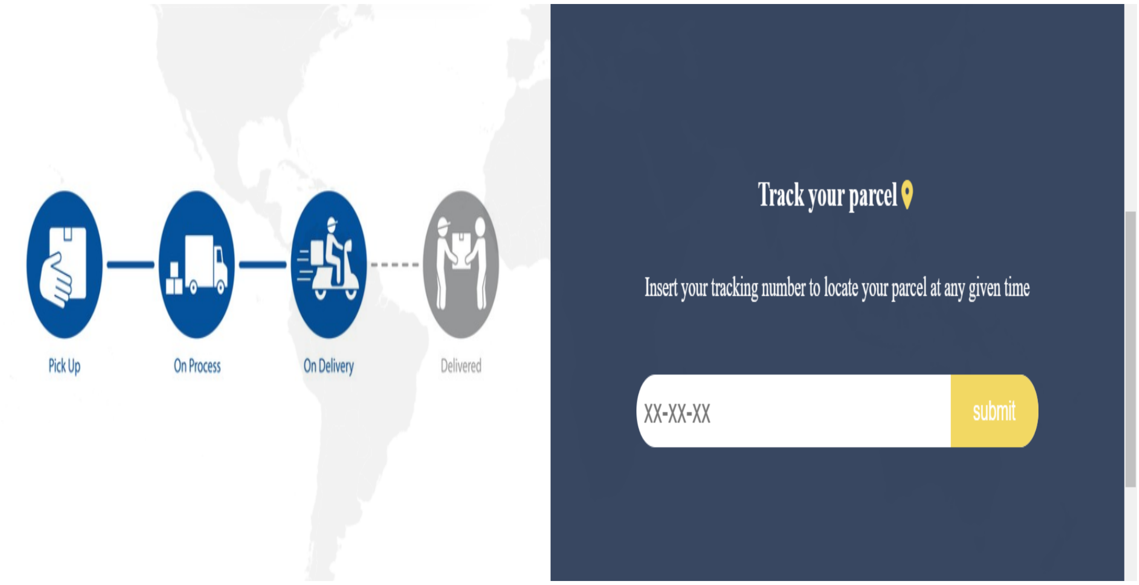
Real time tarcking

Just insert your tracking number and find out the location of your parcel

Figure 3.2: The services section

3.The tracking section

This section is dedicated to package tracking. By entering the tracking number provided to the customer when the delivery order was placed. The customer will be sent to another page that offers information about the status of his package. The next sections will provide more details.



Track your parcel

Insert your tracking number to locate your parcel at any given time

Figure 3.3: The tracking section

4.The registration section

This section of the website is the most significant since it is the first step in ensuring an error-free delivery procedure. It allows consumers to register online, which is highly useful because it allows them to place their order at their leisure. Once the form has been completed and the send button has been pressed. The consumer will be led to another page where he can view the price, confirm and download the label, or cancel his order.

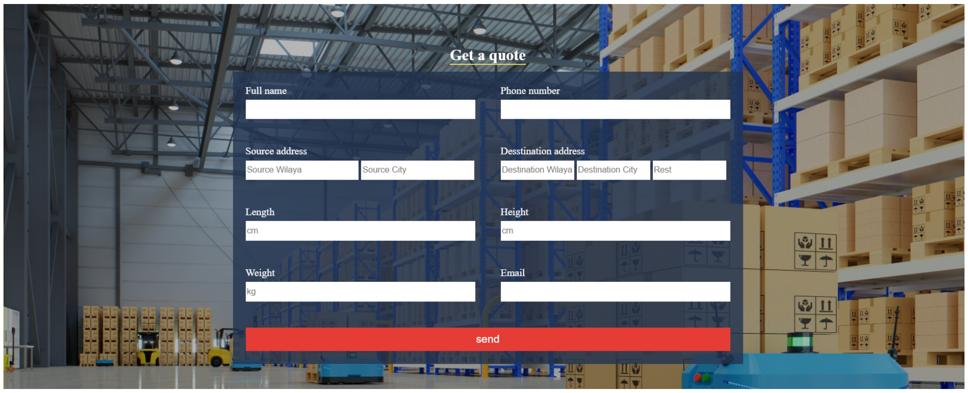
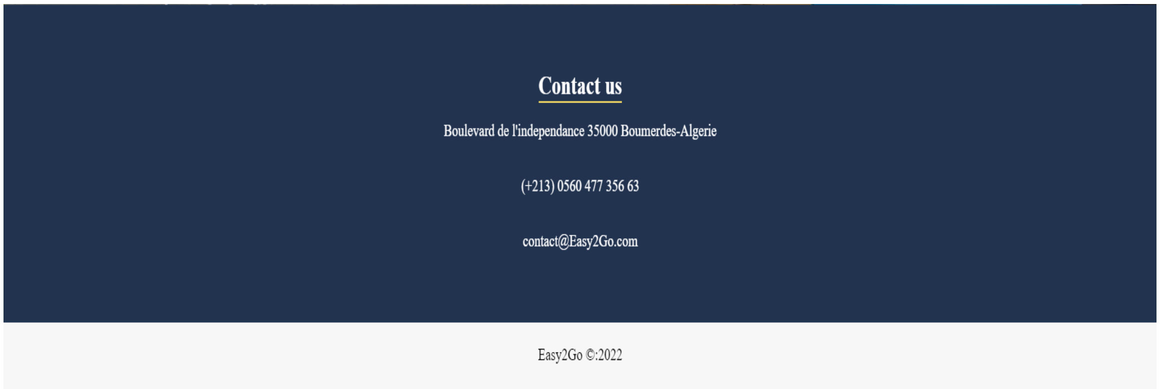


Figure 3.4: The tracking section

5.The contact us section
This section was created to assist the user by offering information on how to contact us. Note that these information are not real and they are used for demonstration purposes only .



Contact us

Boulevard de l'independance 35000 Boumerdes-Algerie

(+213) 0560 477 356 63

contact@Easy2Go.com

Easy2Go ©:2022

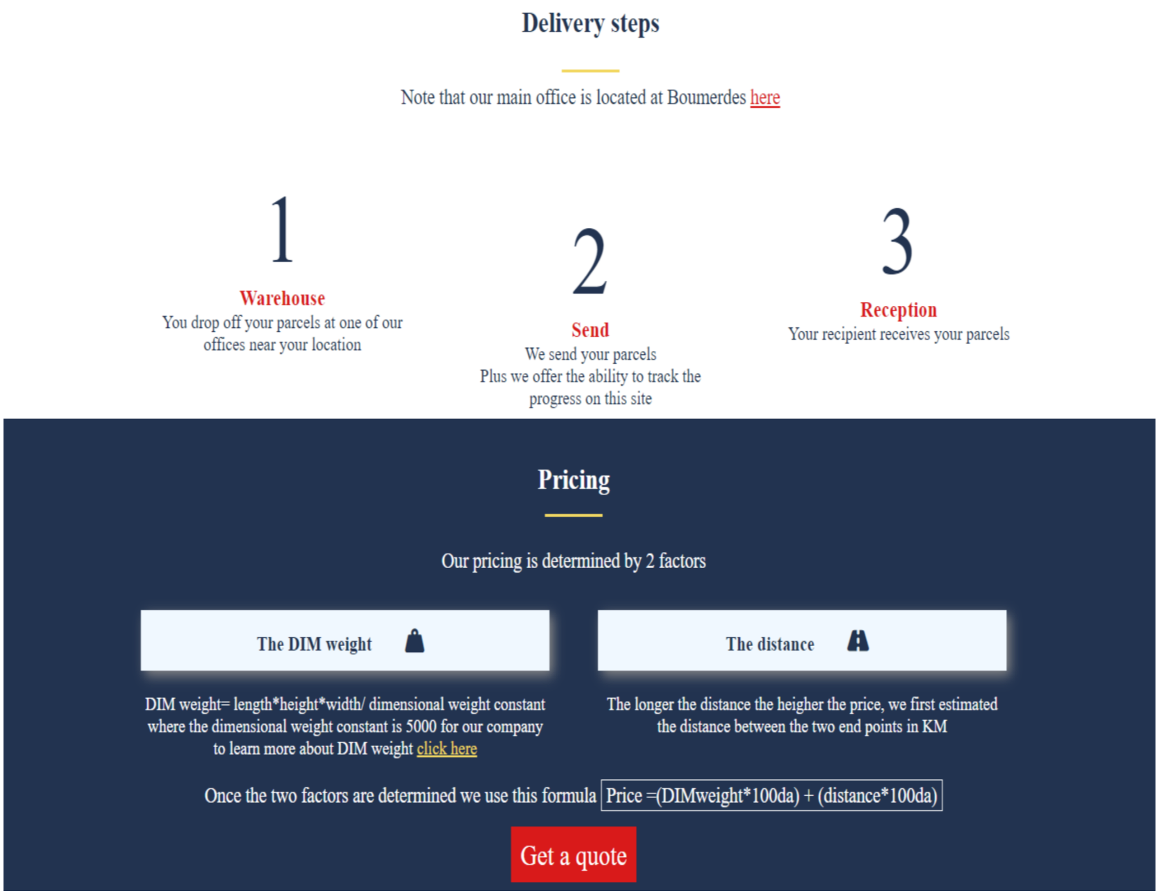
Figure 3.5: The Contact-us section

3.2.2 The internal pages of our website

1.The delivery steps and pricing method page
In this section of the website, we outline the processes that must be followed in order to ensure a problem-free delivery and a positive user experience.
In addition, we've demonstrated the price strategy that was used. It is based on two factors:

- The Dim weight : it reflects a package's density,that is the amount of space it occupies in relation to its actual weight . Using the formula formula: **DIM weight= length*height*width/ dimensional weight constant** , where the dimensional weight constant is 5000 for our project
- The distance: we estimate the distance between the two end points in km

Once the two factors has been estimated we use this formula :
Price =(DIMweight(Kg) *100da)+(distance(Km) *100da)



Delivery steps

Note that our main office is located at Boumerdes here

1
Warehouse
You drop off your parcels at one of our offices near your location

2
Send
We send your parcels
Plus we offer the ability to track the progress on this site

3
Reception
Your recipient receives your parcels

Pricing

Our pricing is determined by 2 factors

The DIM weight

DIM weight= length*height*width/ dimensional weight constant where the dimensional weight constant is 5000 for our company to learn more about DIM weight click here

The distance

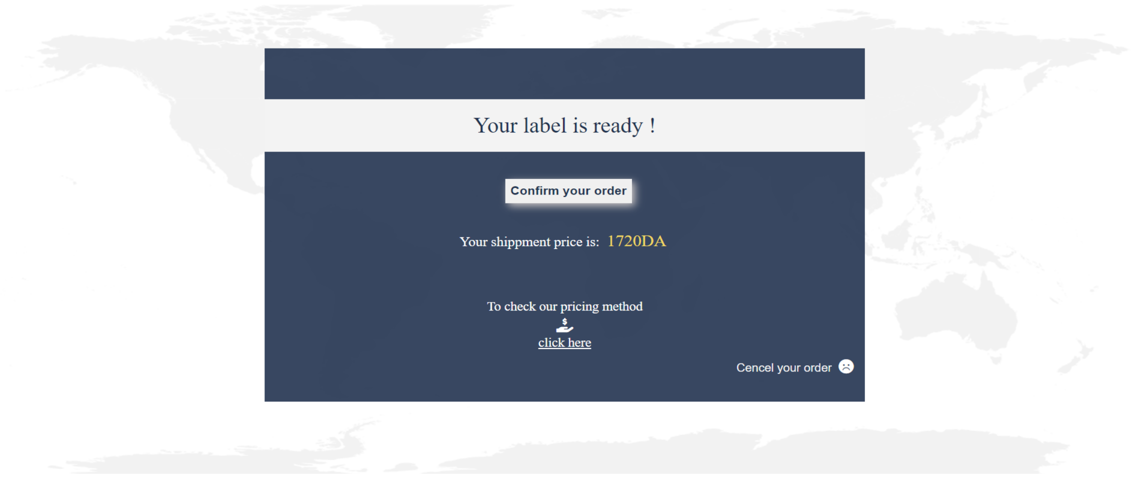
The longer the distance the heigher the price, we first estimated the distance between the two end points in KM

Once the two factors are determined we use this formula Price =(DIMweight*100da) + (distance*100da)

Figure 3.6: Delivery steps and pricing method section

2.Label page
When the consumer has finished filling out the form in figure 3.4, the following figure shows. The customer has the ability to:

- Check the price of his order
- Confirm and Download his order's label
- Check the pricing method
- Cancel his order



Your label is ready !

Your shippment price is: 1720DA

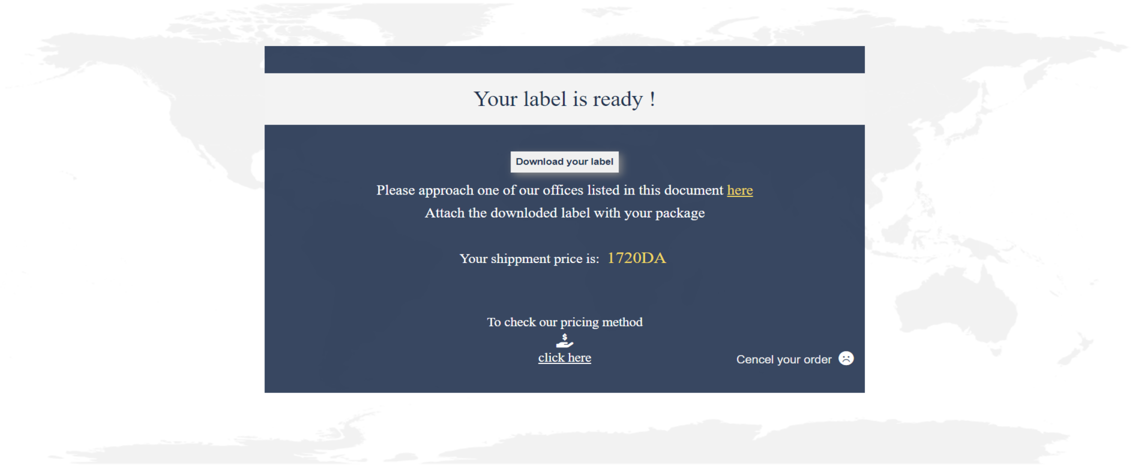
To check our pricing method

click here

Cencel your order

Figure 3.7: The Confirmation section

When the confirm label is pressed, the download option appears, along with a document that shows the location of our offices.



Your label is ready !

Please approach one of our offices listed in this document here

Attach the downloded label with your package

Your shippment price is: 1720DA

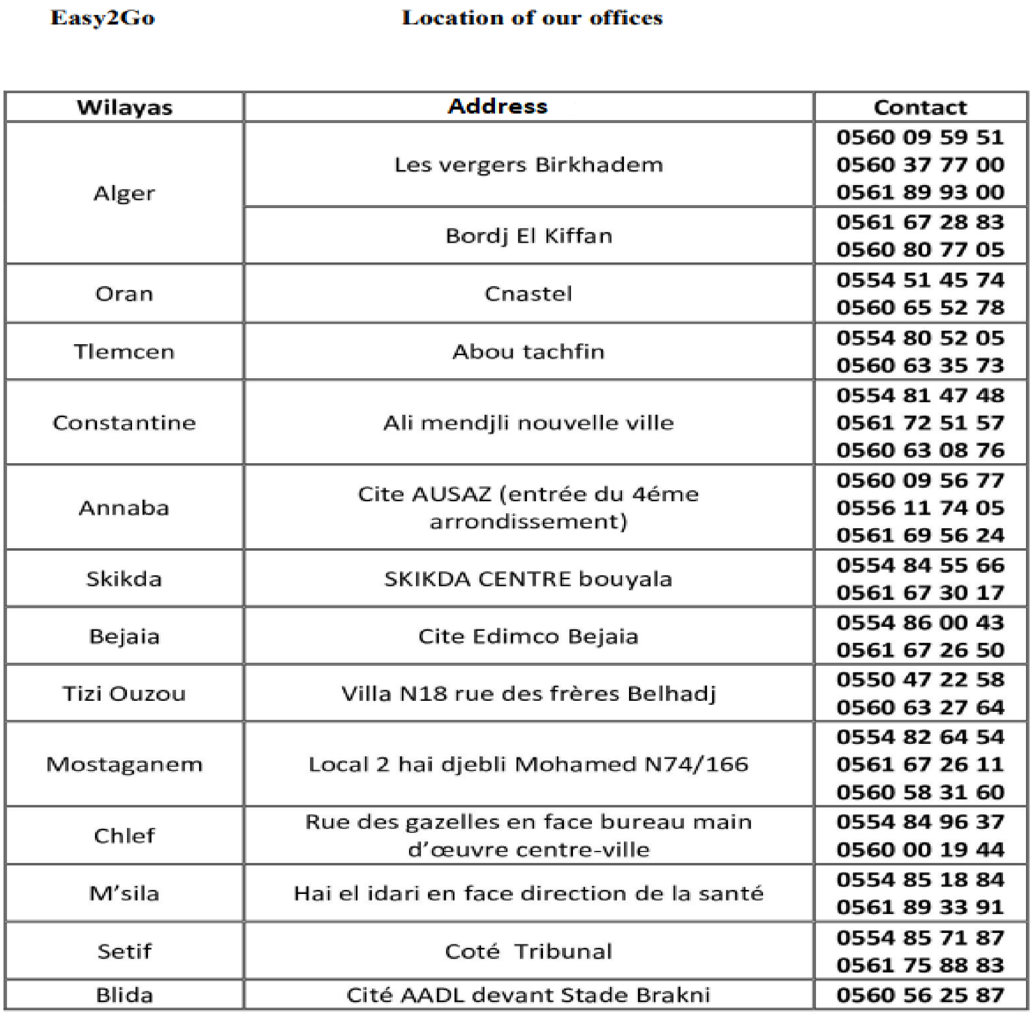
To check our pricing method

click here

Cencel your order

Figure 3.8: The label section

The location of the agency's offices is presented in the figure below. Note that the data shown here was taken from a legitimate delivery agency for demonstration reasons.



Easy2Go **Location of our offices**

Wilayas	Address	Contact

Alger	Les vergers Birkhadem	0560 09 59 51
		0560 37 77 00
		0561 89 93 00

	Bordj El Kiffan	0561 67 28 83 0560 80 77 05
Oran	Cnastel	0554 51 45 74 0560 65 52 78
Tlemcen	Abou tachfin	0554 80 52 05 0560 63 35 73

Constantine	Ali mendjli nouvelle ville	0554 81 47 48
		0561 72 51 57
		0560 63 08 76

Annaba	Cite AUSAZ (entrée du 4éme arrondissement)	0560 09 56 77
		0556 11 74 05
		0561 69 56 24

Skikda	SKIKDA CENTRE bouyala	0554 84 55 66 0561 67 30 17
Bejaia	Cite Edimco Bejaia	0554 86 00 43 0561 67 26 50
Tizi Ouzou	Villa N18 rue des frères Belhadj	0550 47 22 58 0560 63 27 64

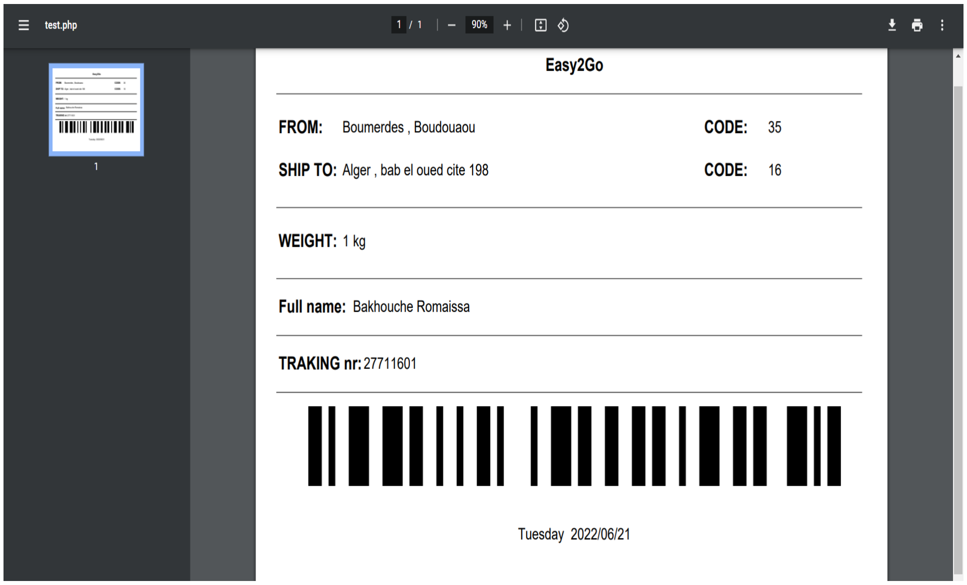
Mostaganem	Local 2 hai djebli Mohamed N74/166	0554 82 64 54
		0561 67 26 11
		0560 58 31 60

Chlef	Rue des gazelles en face bureau main d'œuvre centre-ville	0554 84 96 37 0560 00 19 44
M'sila	Hai el idari en face direction de la santé	0554 85 18 84 0561 89 33 91
Setif	Coté Tribunal	0554 85 71 87 0561 75 88 83
Blida	Cité AADL devant Stade Brakni	0560 56 25 87

Figure 3.9: The location of the agency's offices

3.The label

Once the download button is clicked a PDF file containing a label of the customer's order is presented.This label must be attached to the customer's package when it is submitted to the office, since the barcode carries all of the information about the customer's details and the target location and will be used in the next stage of the process which is the automatic sorting of packages. The next sections will provide more details.



Easy2Go

FROM: Boumerdes , Boudouaou **CODE:** 35

SHIP TO: Alger , bab el oued cite 198 **CODE:** 16

WEIGHT: 1 kg

Full name: Bakhouche Romaissa

TRAKING nr:27711601

Tuesday 2022/06/21

Figure 3.10: The label

4.The package status page

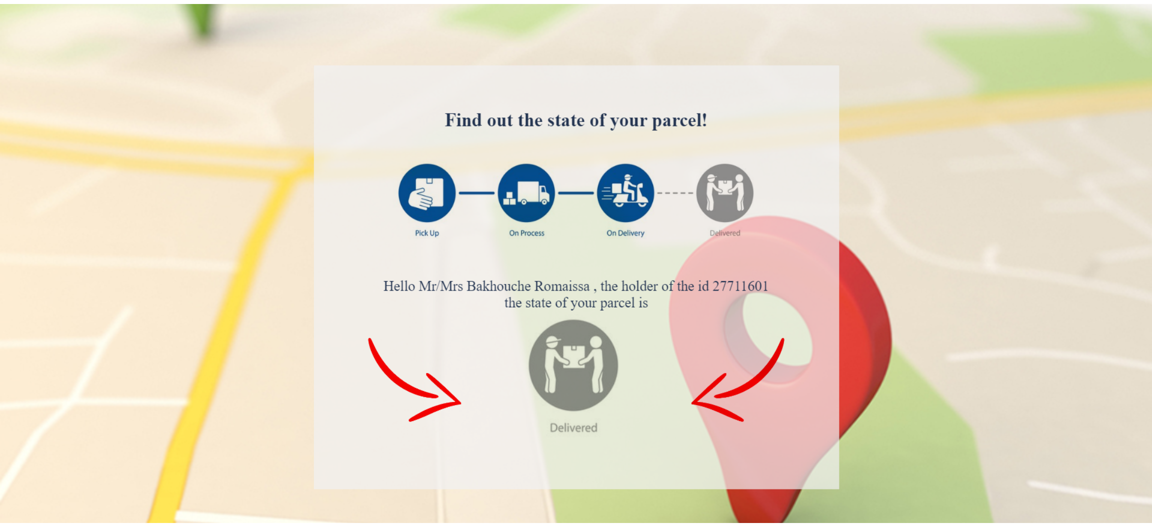
The consumer will be able to see the status of his package once the tracking number has been entered, as seen in the following figure. Beginning with when the package is submitted to the office, there are four possibilities:pick up,on process,on delivery,delivered .

Pick up:this is the initial state, the package is set as pick up once the customer receives his receipt meaning the package has been successfully collected by the workers of the office

On process:meaning the package has been sorted correctly and it's ready to be sent to the destination warehouse. At this stage the package is still in the source area, it has just been grouped with other packages going to the same destination .

On delivery :the package has arrived to the destination warehouse and it is ready to to be picked up by the customer directly or to be sent by one of the workers to the mentioned address, this is done according to customer's request

Delivered:this is the final state, it means the package has successfully arrived to its final destination.



Find out the state of your parcel!

Hello Mr/Mrs Bakhouche Romaissa , the holder of the id 27711601
the state of your parcel is

Figure 3.11: Package status page

5.Admin page

5.1. Authentication interface

This page is accessed by administrators only for the sake of viewing the list of customers and downloading their respective receipt. As seen in the figure there is no sign up option since it restricted for administrators only and there are no privileges given for one admin over another, the access information (admin name and password) are provided to the authorised admins by the supervisor himself.

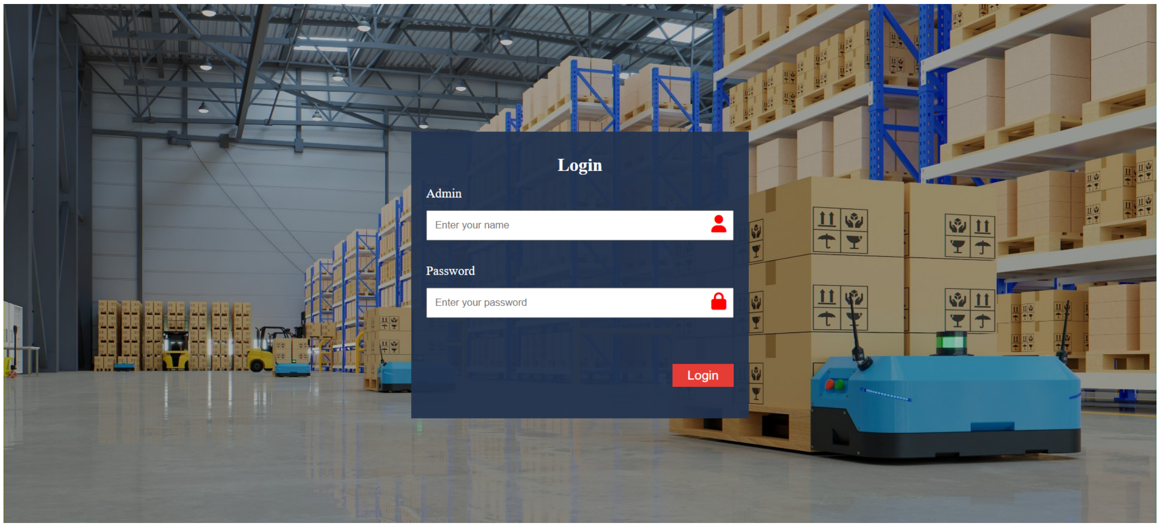
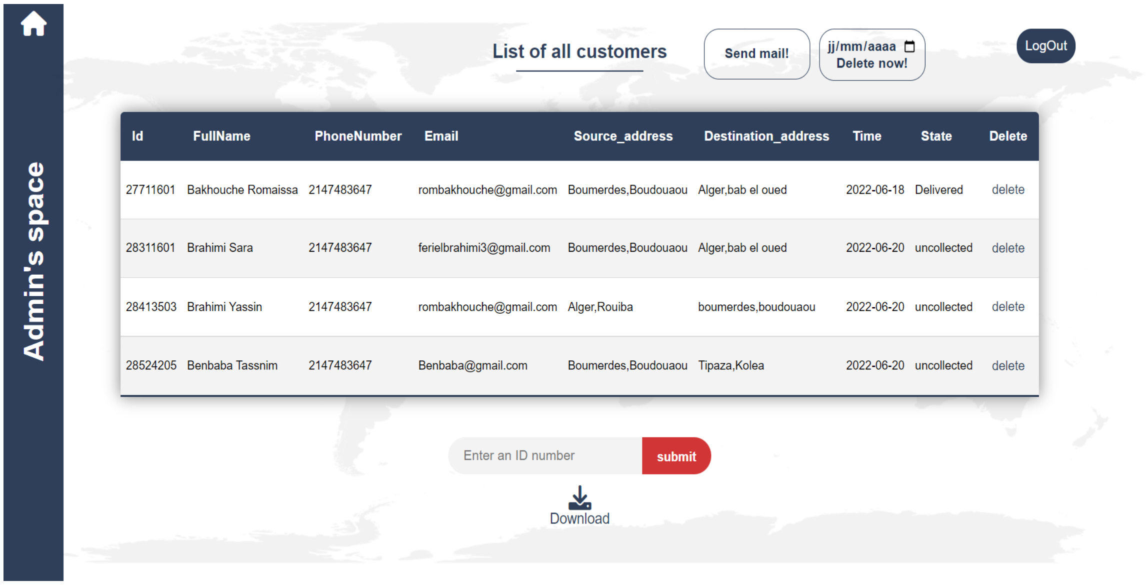


Figure 3.12: The login page

5.2.Admin space

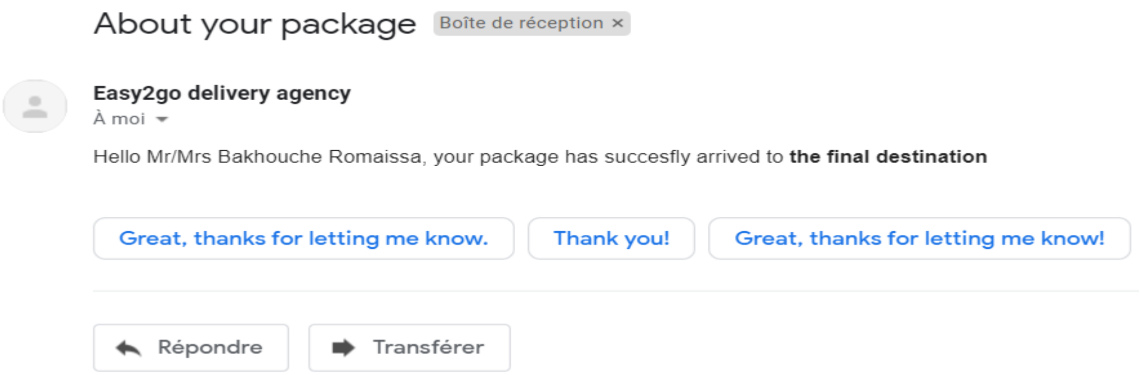
Here the admin is able to view the entire list of customers and download their receipt once the customer's id is inserted, He also has the ability to delete the history and send emails, as shown in the following figures



List of all customers

Id	FullName	PhoneNumber	Email	Source_address	Destination_address	Time	State	Delete
27711601	Bakhouche Romaissa	2147483647	rombakhouche@gmail.com	Boumerdes,Boudouaou	Alger,bab el oued	2022-06-18	Delivered	delete
28311601	Brahimi Sara	2147483647	ferielbrahimi3@gmail.com	Boumerdes,Boudouaou	Alger,bab el oued	2022-06-20	uncollected	delete
28413503	Brahimi Yassin	2147483647	rombakhouche@gmail.com	Alger,Rouiba	boumerdes,boudouaou	2022-06-20	uncollected	delete
28524205	Benbaba Tassnim	2147483647	Benbaba@gmail.com	Boumerdes,Boudouaou	Tipaza,Kolea	2022-06-20	uncollected	delete

Figure 3.13: The admin page


Boîte de réception ×
Great, thanks for letting me know.
Thank you!
Great, thanks for letting me know!
Répondre
Transférer

About your package

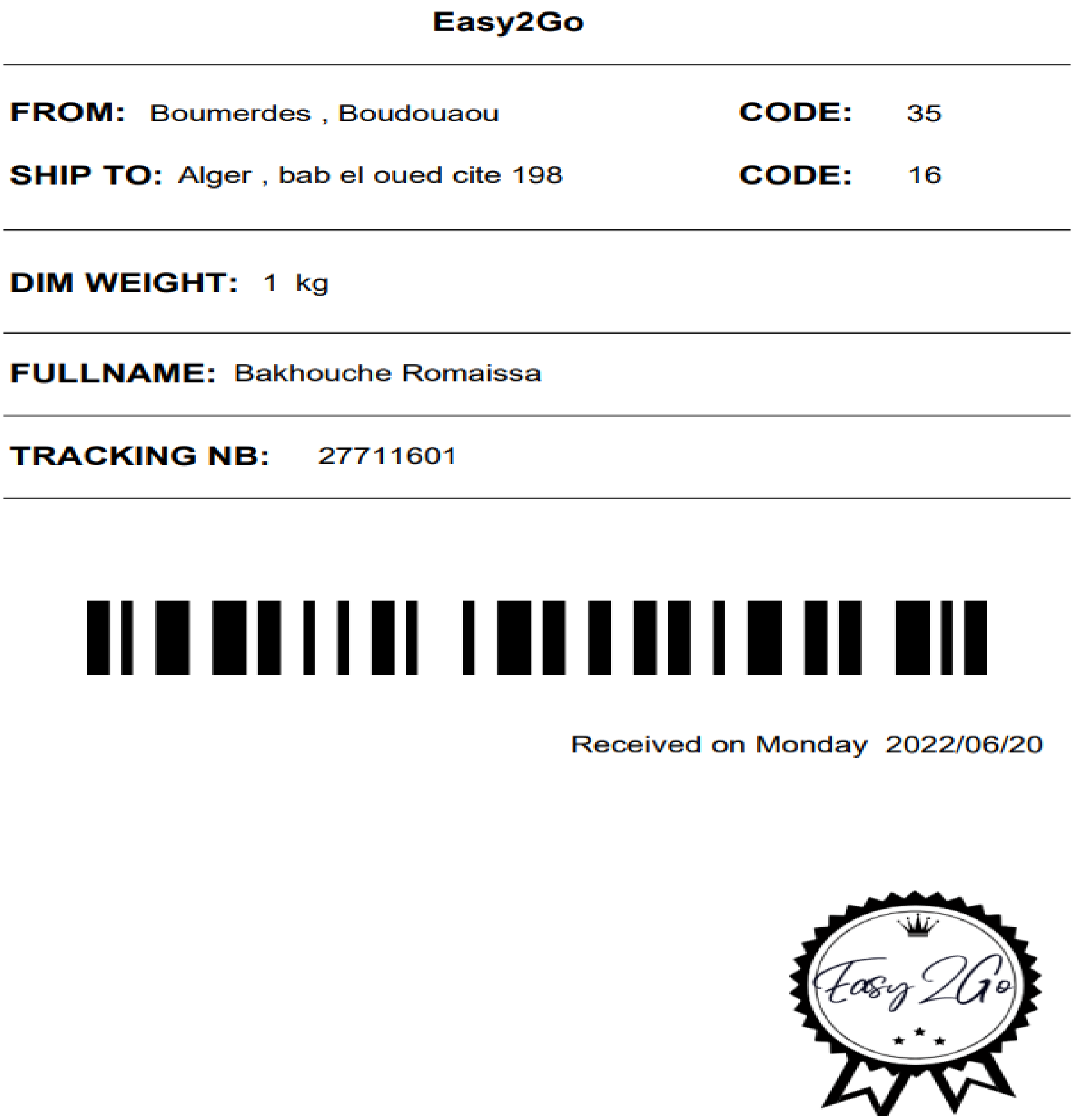
Easy2go delivery agency
À moi

Hello Mr/Mrs Bakhouche Romaissa, your package has succesfly arrived to **the final destination**

Figure 3.14: Tracking email

5.3.Customer's receipt

The receipt is given to the customer once the package is brought to the office.



Easy2Go

FROM: Boumerdes , Boudouaou **CODE:** 35

SHIP TO: Alger , bab el oued cite 198 **CODE:** 16

DIM WEIGHT: 1 kg

FULLNAME: Bakhouche Romaissa

TRACKING NB: 27711601

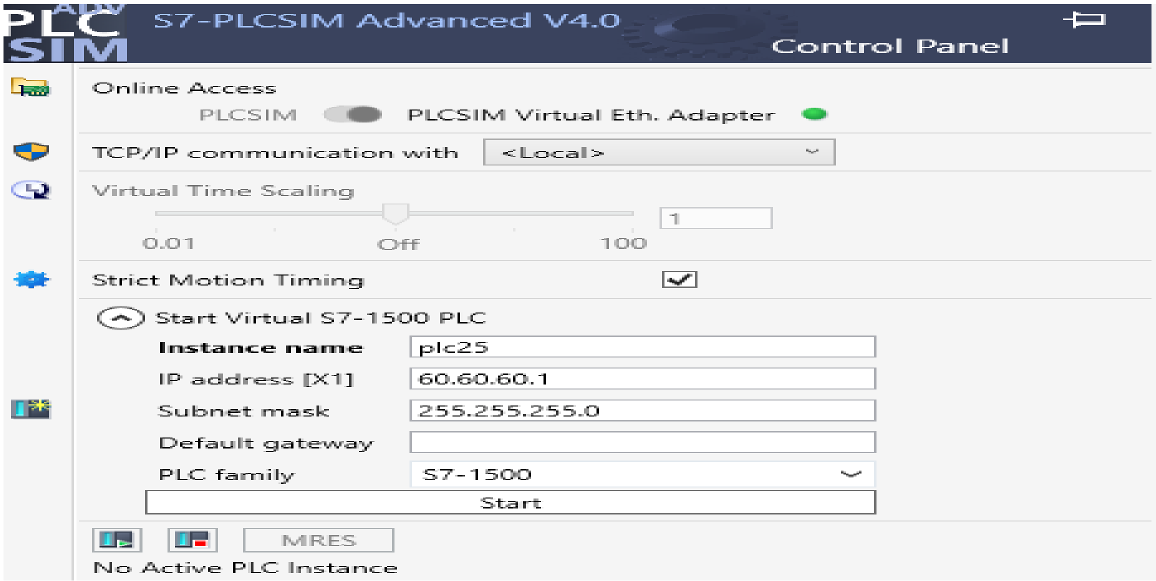
Received on Monday 2022/06/20

Figure 3.15: Customer's receipt

3.3 Automatic Sorting Simulation Part

3.3.1 PLC simulation

Siemens offers S7-PLCSIM Software along with TIA Portal that is used to create a virtual PLC using which we can test and simulate our programs, the use of PLCSIM offers numerous advantages like improving quality of automation projects by early error detection, avoid costs for hardware in simulation environments, reduced response times and reduce risk for commissioning.
PLCsim advanced was used in our work which allows us to simulate our CPU programs on a virtual controller. We do not need any real controllers for this. We can configure our CPU with STEP 7 in the TIA Portal, program our application logic and then load the hardware configuration and the program into the virtual controller. From there we can run our program logic, observe the effects of simulated inputs and outputs and adapt our programs.
In addition to communicating via Softbus, PLCSIM Advanced provides a full Ethernet connection and can thus also communicate distributed[24].



PLCSIM ● PLCSIM Virtual Eth. Adapter ●

TCP/IP communication with <Local>

Virtual Time Scaling: 1

Strict Motion Timing ☑

Instance name: plc25

IP address [X1]: 60.60.60.1

Subnet mask: 255.255.255.0

Default gateway:

PLC family: S7-1500

No Active PLC Instance

Figure 3.16: PLCSIM advanced v4.0

A second main OB block called ”animation of the supervision” was added in our program in order to observe simulation result of the process, We download the program software to the device through the TIA PORTAL after running plcsim, then click on GO Online to link the plcsim and the TIA program as below.

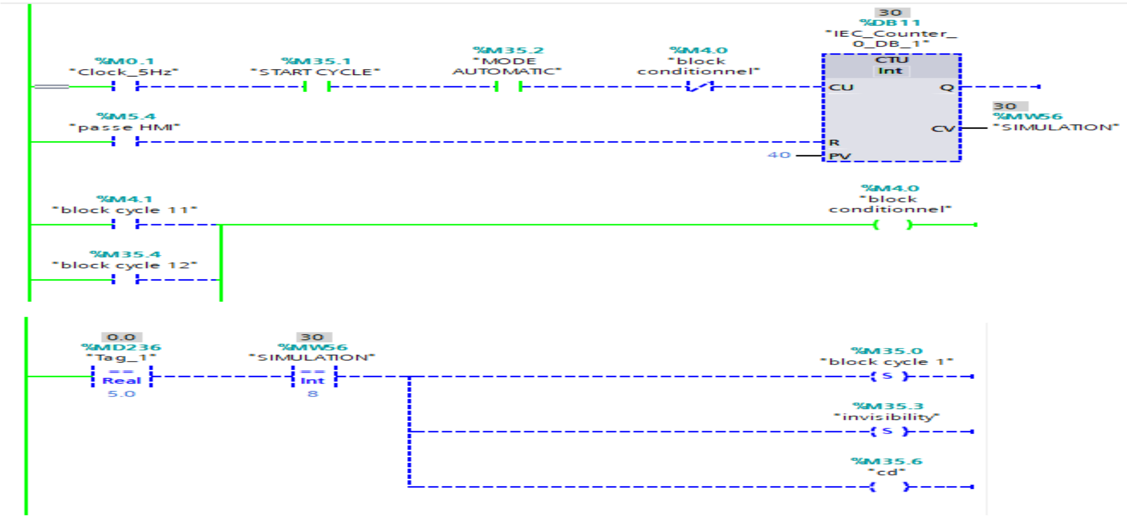


Figure 3.17: Cycle1 program part A

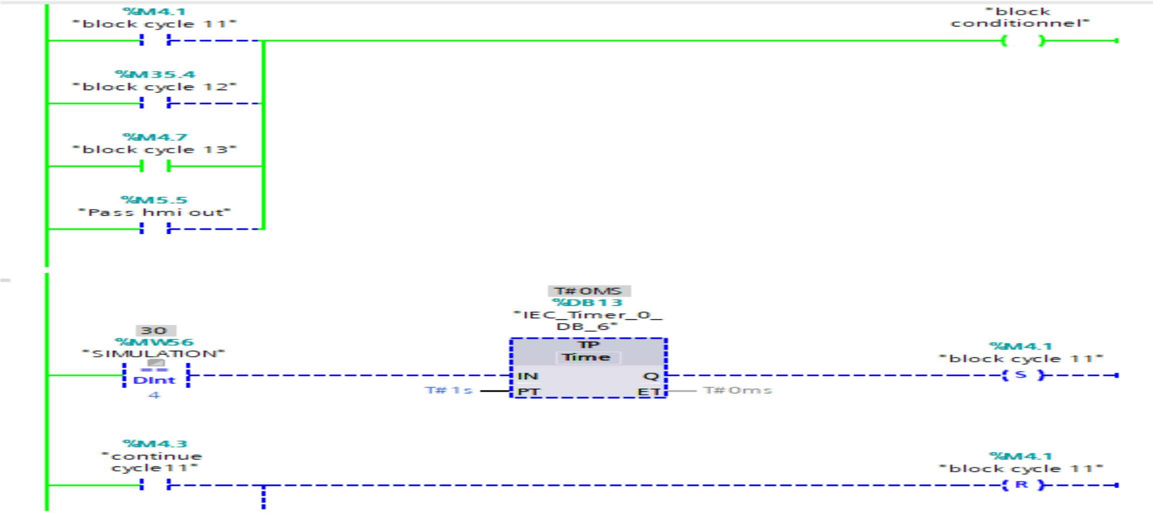


Figure 3.18: Cycle1 program part B

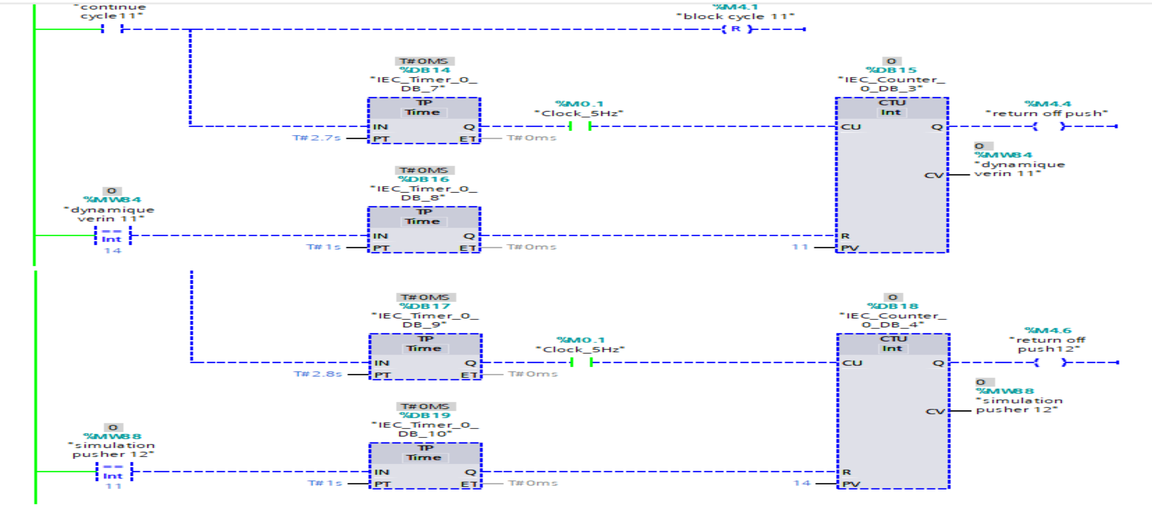


Figure 3.19: Cycle1 program part C

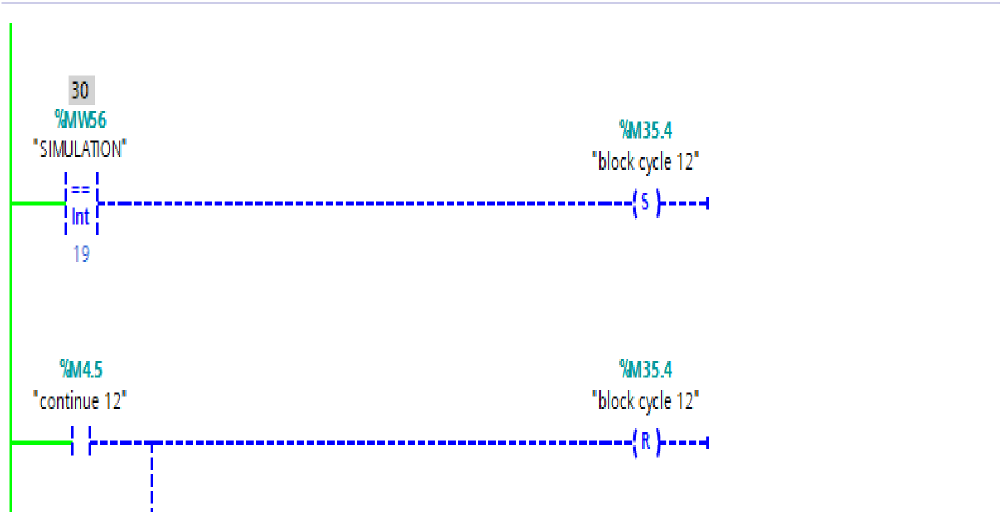


Figure 3.20: Cycle1 program part D

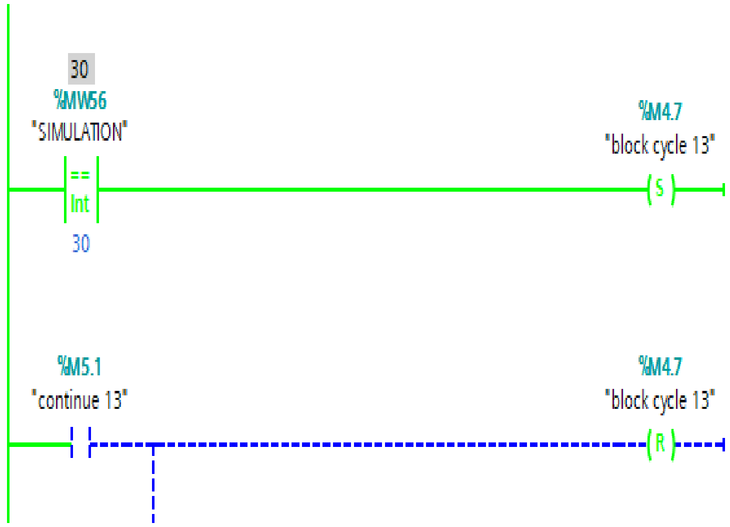
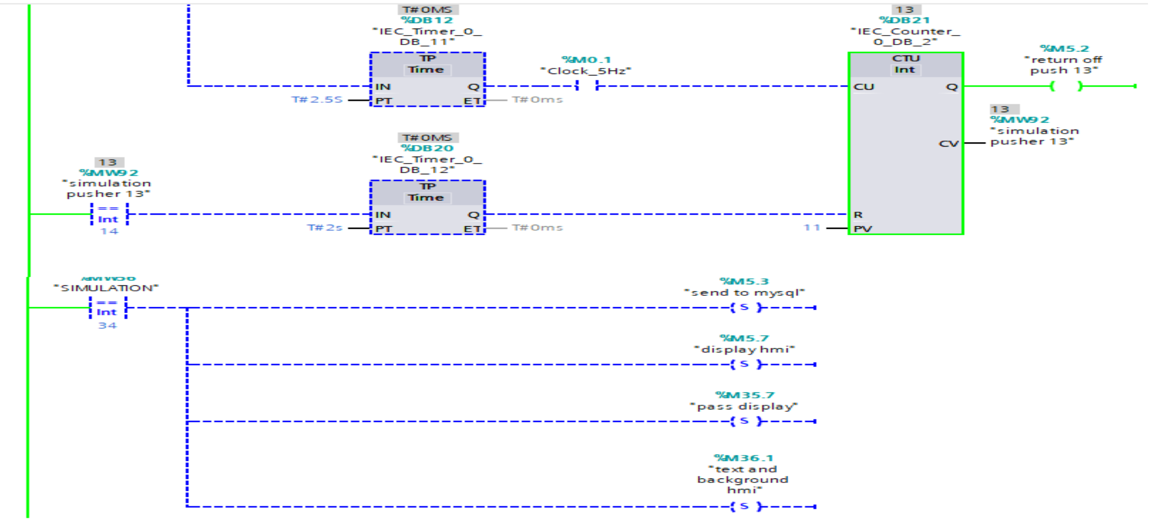


Figure 3.21: Cycle1 program part E



n

Figure 3.22: Cycle1 program part F

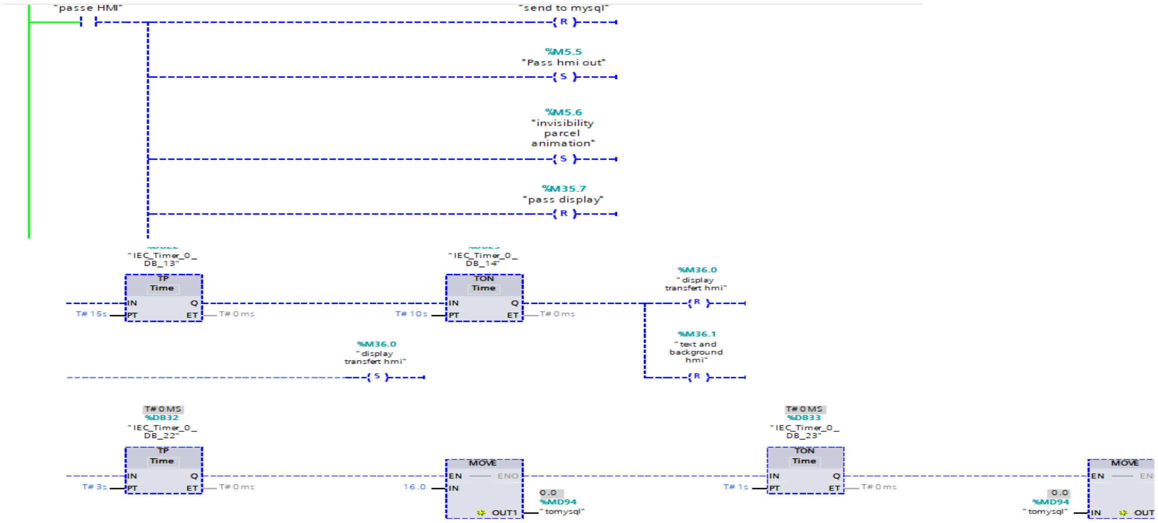


Figure 3.23: Cycle1 program part G

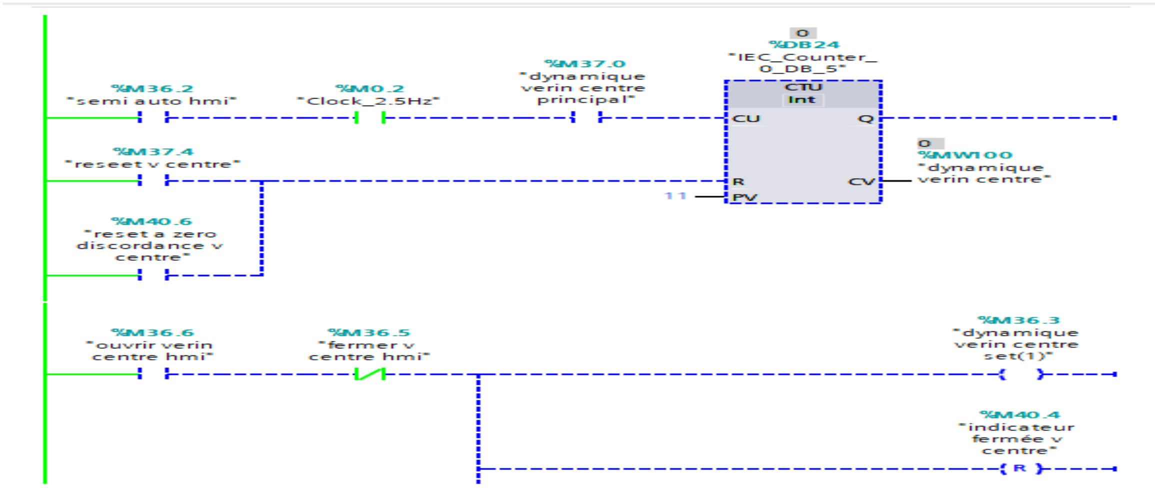


Figure 3.24: Cycle1 program part H

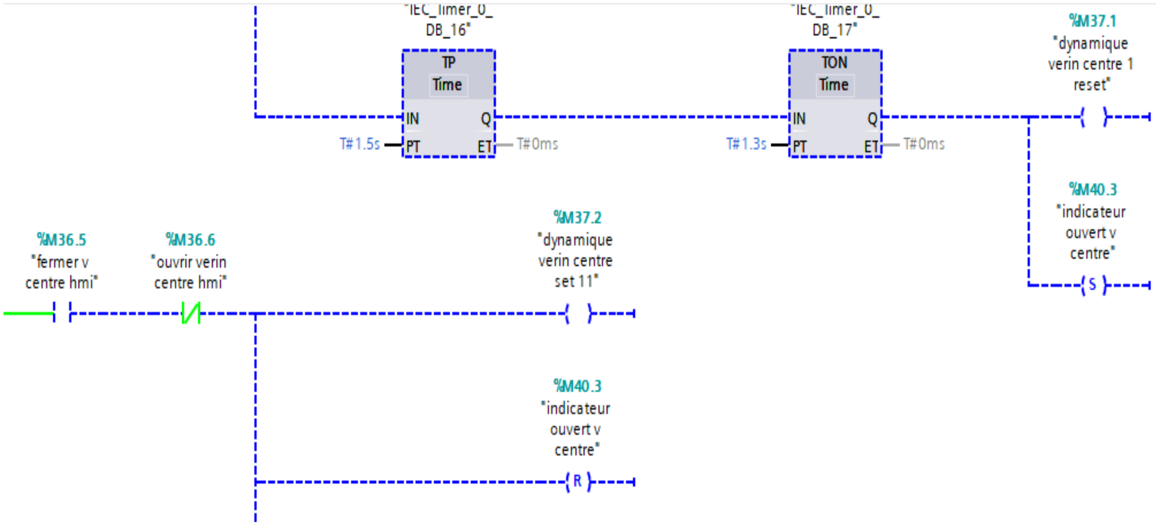


Figure 3.25: Cycle1 program part I

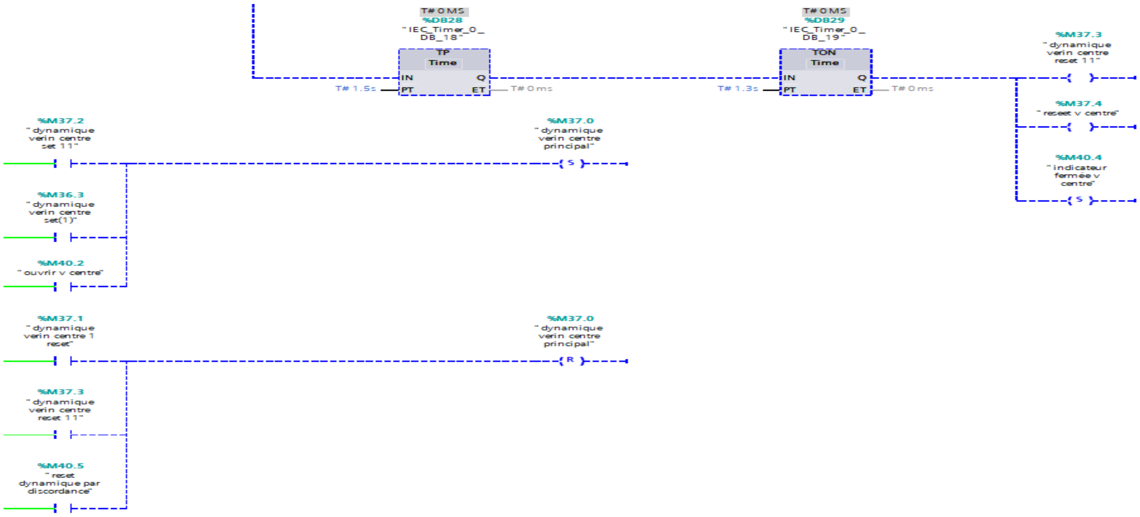


Figure 3.26: Cycle1 program part J

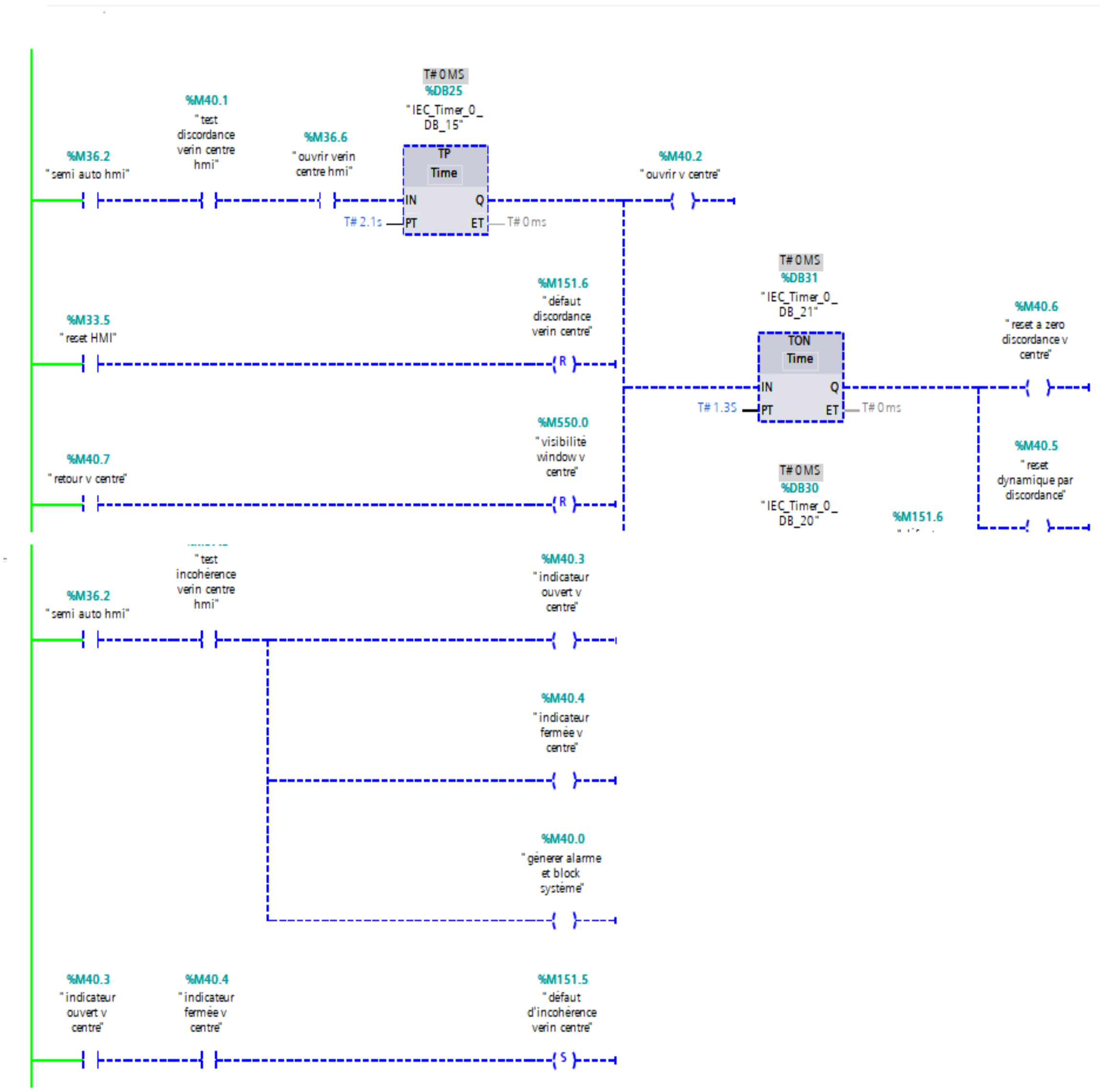

T# 0 MS
%DB25
"IEC_Timer_0_DB_15"
TP
Time
IN
Q
PT
ET
T# 2.1s
T# 0 ms
%M36.2
"semi auto hmi"
%M40.1
"test discordance verin centre hmi"
%M36.6
"ouvrir verin centre hmi"
%M40.2
"ouvrir v centre"
%M151.6
"défaut discordance verin centre"
R
%M33.5
"reset HMI"
T# 0 MS
%DB31
"IEC_Timer_0_DB_21"
TON
Time
IN
Q
PT
ET
T# 1.3S
T# 0 ms
%M40.6
"reset a zero discordance v centre"
%M550.0
"visibilité window v centre"
R
%M40.7
"retour v centre"
T# 0 MS
%DB30
"IEC_Timer_0_DB_20"
%M151.6
%M40.5
"reset dynamique par discordance"
"test incohérence verin centre hmi"
%M36.2
"semi auto hmi"
%M40.3
"indicateur ouvert v centre"
%M40.4
"indicateur fermée v centre"
%M40.0
"génerer alarme et block système"
%M40.3
"indicateur ouvert v centre"
%M40.4
"indicateur fermée v centre"
%M151.5
"défaut d'incohérence verin centre"
S

Figure 3.27: Cycle1 program part K

Program explanation

When we select automated mode from the HMI and press the ”on process” button, which signifies the start of the cycle (start cycle instruction), the counter in the HMI begins counting the animation points and can be reset by pressing the ”pass HMI” button. The counter is stopped using the block conditional normally closed instruction, whereas the continue instruction enables it to keep running, The pusher will be activated when the parcel reaches a specified point.

The pusher will go to the off position after activating the continue button, and this will happen for every pusher operating during cycle 1. After reaching the end point of animation, the tracking section begins, and all of the steps are presented in HMI in the sequence of the process.

A program has been written to test the alarm system for incoherence on the first pusher; if both open/close indications are on, an alert will be generated and the system will be blocked; this fault can be reset by pressing the reset HMI button.

3.4 Simulation and Supervision Results

3.4.1 Elements of SKTOOL Sofware

Menu and toolbars

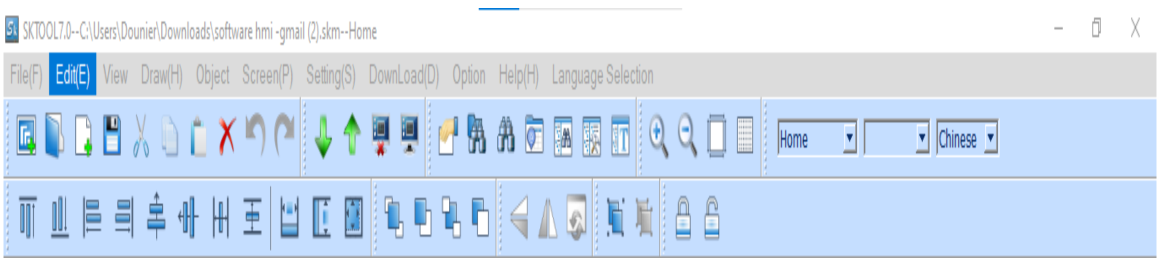


Figure 3.28: SKTOOL menu and toolbars

The tool box contains all necessary components (function elements, base elements), whereas the project window standard list contains the list of screens, windows, and system settings.With the help of the gallery picture list and other libraries, both the tool box and the project window are utilized to construct a system in the work area.

Tool box and window

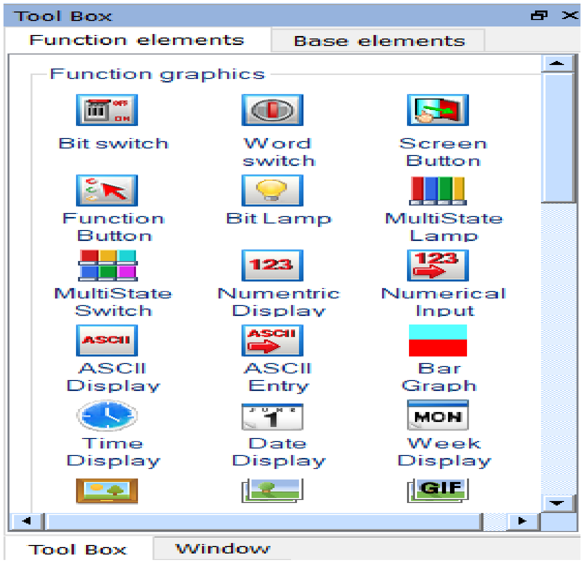


Figure 3.29: Tool box

We developed a home screen for our project using the preceding components, which includes the most important buttons that provide access to other windows, as shown in the next image.

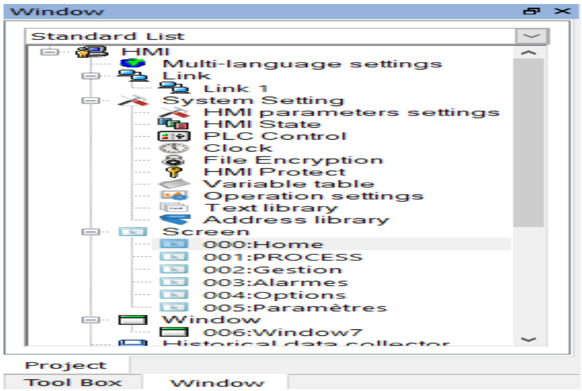
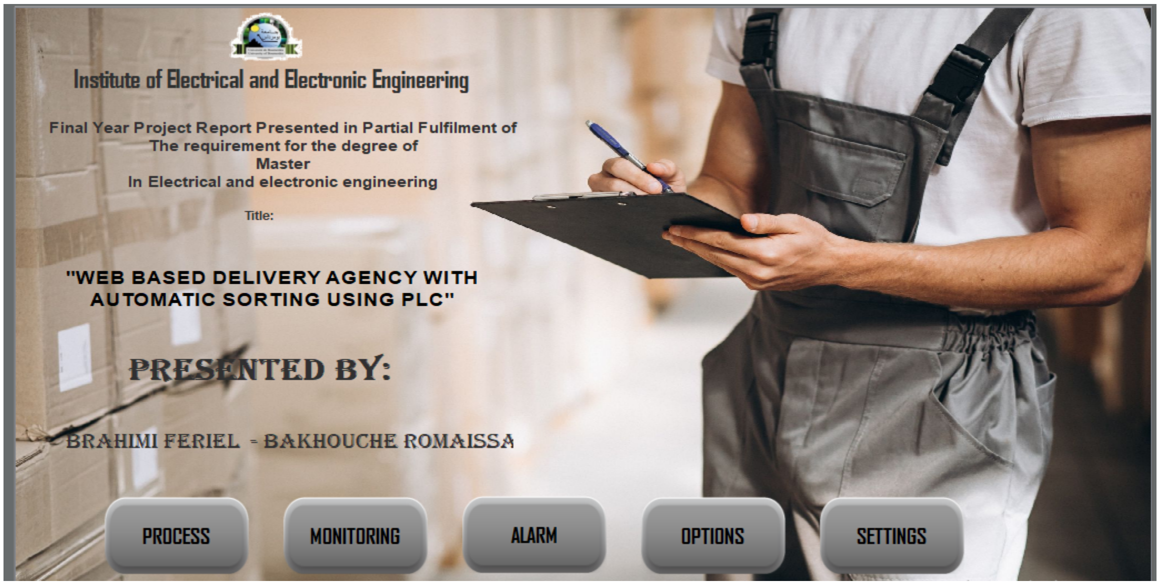


Figure 3.30: Project window



Institute of Electrical and Electronic Engineering

Final Year Project Report Presented in Partial Fulfilment of
The requirement for the degree of
Master
In Electrical and electronic engineering

Title:

"WEB BASED DELIVERY AGENCY WITH
AUTOMATIC SORTING USING PLC"

PRESENTED BY:

BRAHIMI FERIEL - BAKHOUCHE ROMAISSA

Figure 3.31: HMI Home screen

3.4.2 Sorting

Now, let's examine the results of our simulation after choosing a sorting scenario(cycle1). According to the parcel's barcode **"27711601"**, the parcel should be sorted to region 1,Wilaya of ALGIERS then Daira of BABLOUED as the following figure shows

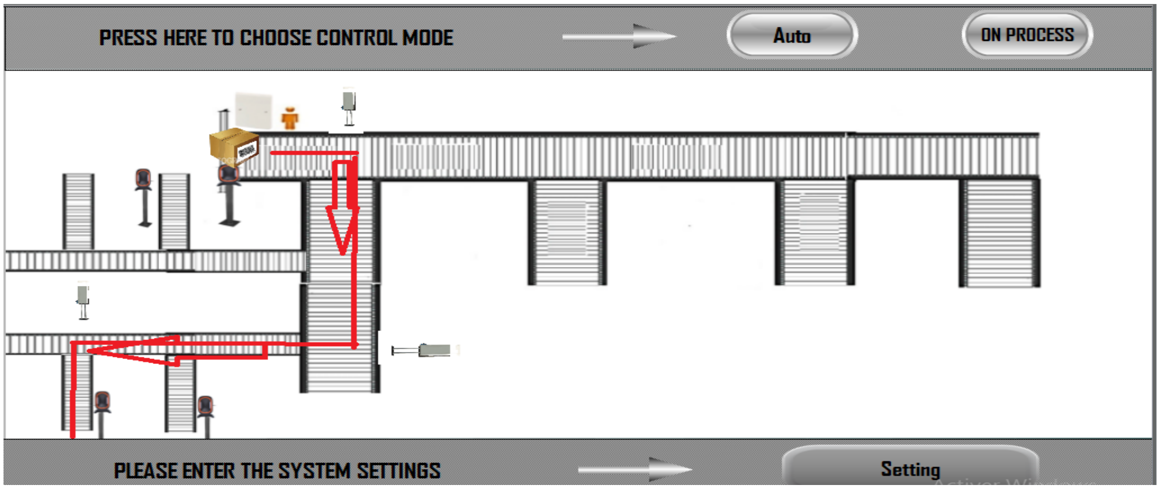
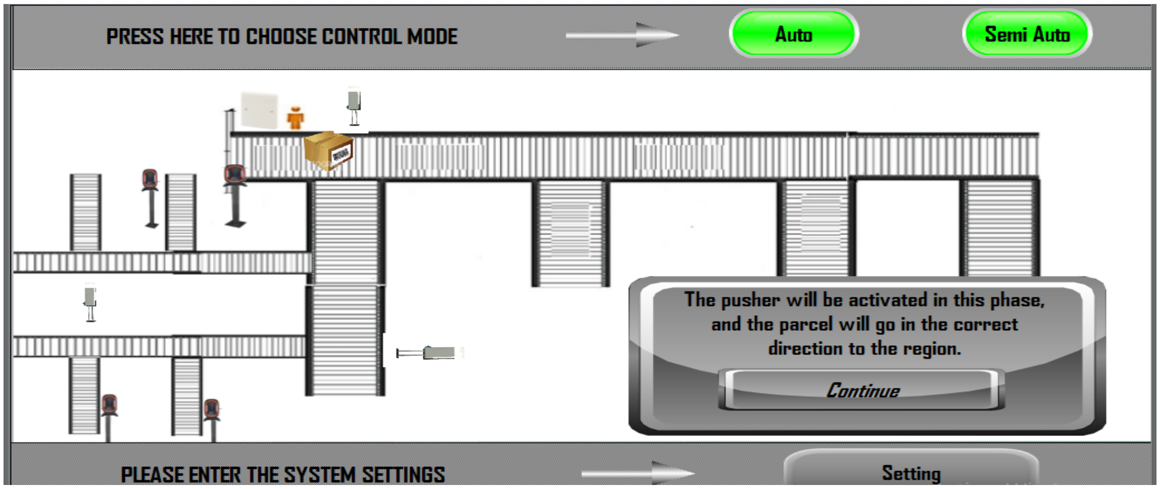

PRESS HERE TO CHOOSE CONTROL MODE
Auto
ON PROCESS
PLEASE ENTER THE SYSTEM SETTINGS
Setting

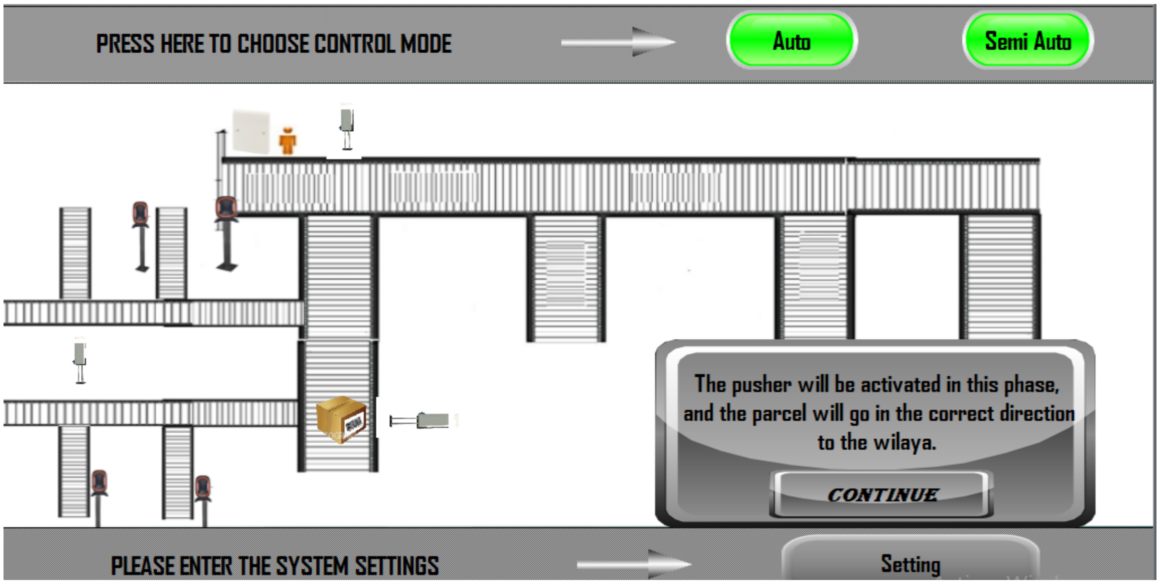
Figure 3.32: HMI process window before choosing the control mode

We select the control mode by pushing the ”AUTO” button, then press the ”on process” button to begin the conveying system and package movement.
We observe a change in the parcel’s path to region1 after reading the barcode. This occurs with the help of pusher1.


PRESS HERE TO CHOOSE CONTROL MODE
Auto
Semi Auto
Continue
PLEASE ENTER THE SYSTEM SETTINGS
Setting

The pusher will be activated in this phase, and the parcel will go in the correct direction to the region.

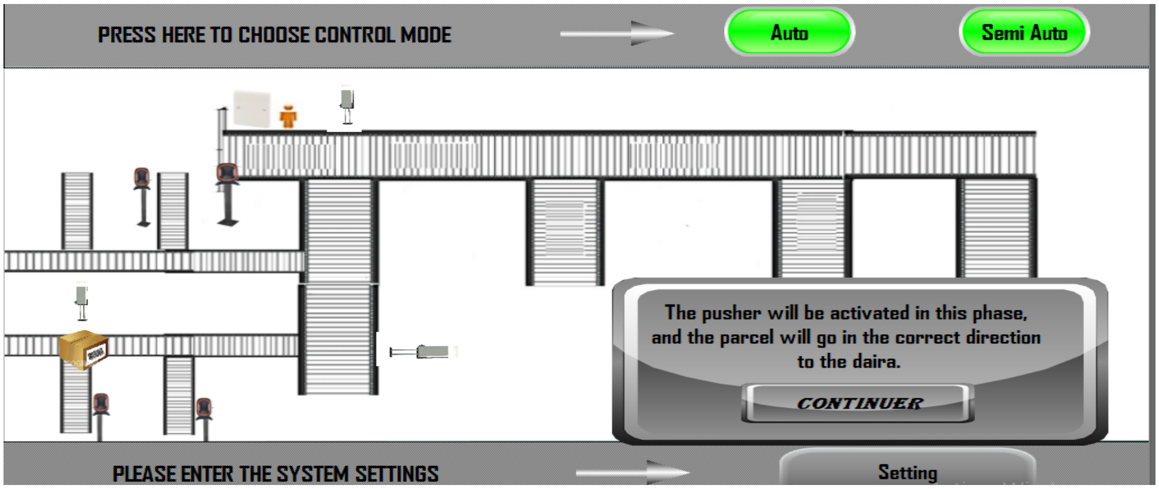
Figure 3.33: HMI process window after selecting mode auto and press on process


PRESS HERE TO CHOOSE CONTROL MODE
Auto
Semi Auto
CONTINUE
PLEASE ENTER THE SYSTEM SETTINGS
Setting

The pusher will be activated in this phase, and the parcel will go in the correct direction to the wilaya.

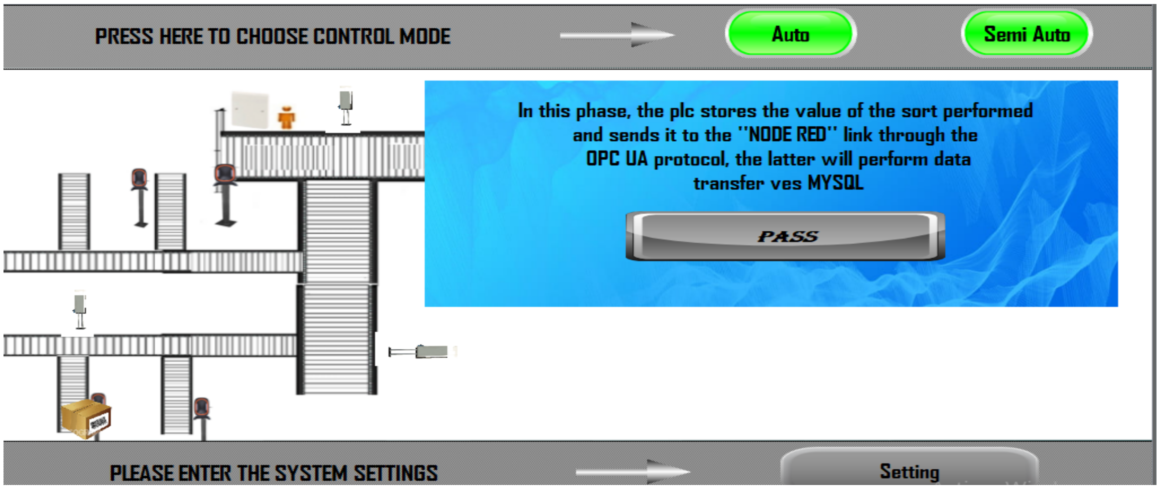
Figure 3.34: Parcel's direction to region1

This process is repeated with pushers 2 and 3 as illustrated in the following figures until the parcel reaches its final destination.


PRESS HERE TO CHOOSE CONTROL MODE
Auto
Semi Auto
CONTINUER
PLEASE ENTER THE SYSTEM SETTINGS
Setting

The pusher will be activated in this phase, and the parcel will go in the correct direction to the daira.

Figure 3.35: Parcel's direction to Wilaya(ALGIERS)


PRESS HERE TO CHOOSE CONTROL MODE
Auto
Semi Auto
PASS
PLEASE ENTER THE SYSTEM SETTINGS
Setting

In this phase, the plc stores the value of the sort performed and sends it to the "NODE RED" link through the OPC UA protocol, the latter will perform data transfer ves MYSQL

Figure 3.36: Parcel's direction to Daira(BAB LOUED)

3.4.3 Alarm Testing

In this section, we will test the alarm system by forcing a fault alarm(incoherence) of the first pusher, where both indicators (on/off) are lit which indicates a fault and the pusher will stuck in one position.

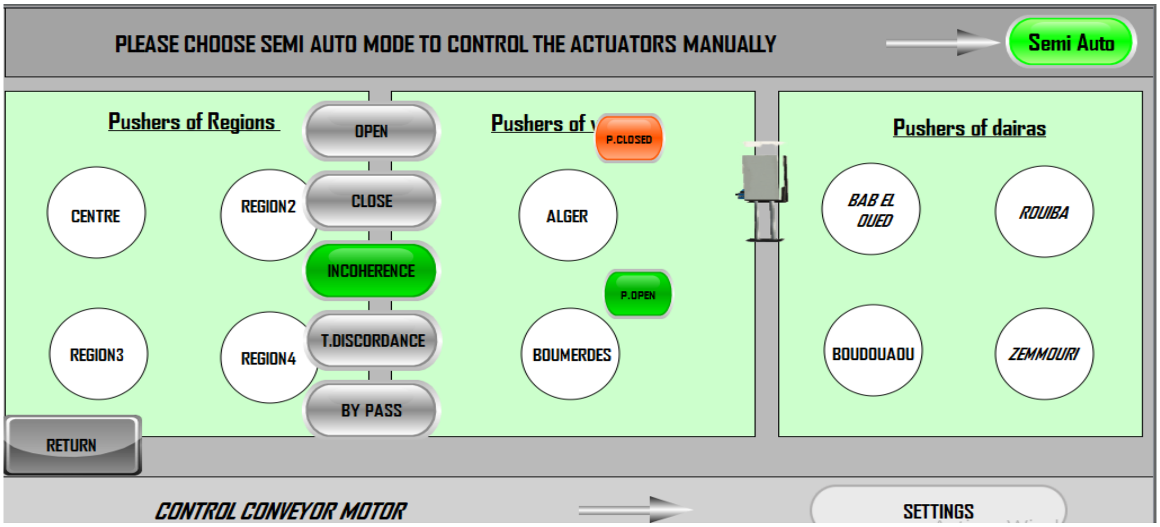
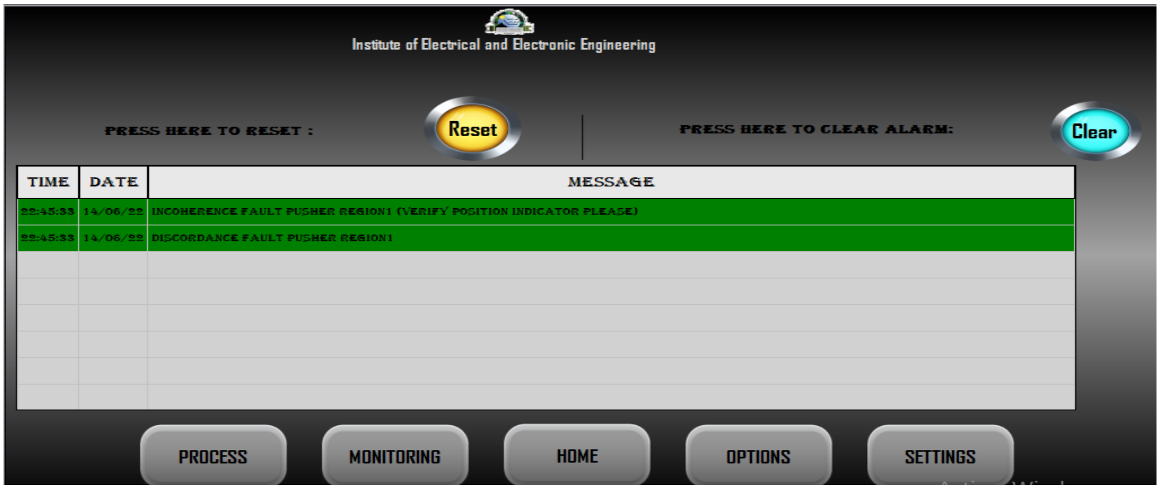


Figure 3.37: Error example of region one's pusher

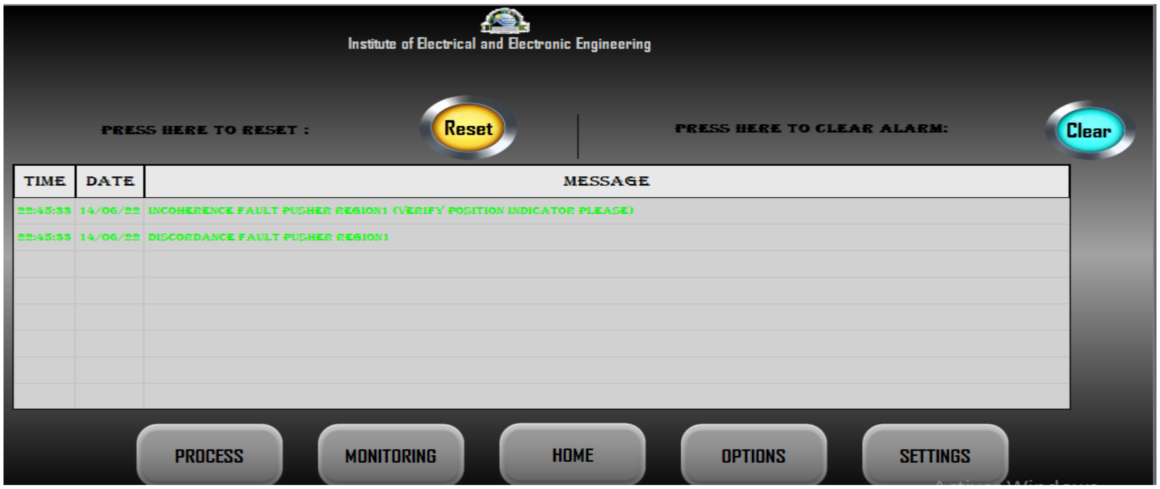
An alarm will be displayed on the HMI alarm screen.


Institute of Electrical and Electronic Engineering
PRESS HERE TO RESET :
Reset
PRESS HERE TO CLEAR ALARM:
Clear
PROCESS
MONITORING
HOME
OPTIONS
SETTINGS

TIME	DATE	MESSAGE
22:45:33	14/06/22	INCOHERENCE FAULT PUSHER REGION1 (VERIFY POSITION INDICATOR PLEASE)
22:45:33	14/06/22	DISCORDANCE FAULT PUSHER REGION1

Figure 3.38: Faults alarm

After the system's errors have been rectified, the latter will be turned green, indicating that the problem has been resolved.


Institute of Electrical and Electronic Engineering
PRESS HERE TO RESET :
Reset
PRESS HERE TO CLEAR ALARM:
Clear
PROCESS
MONITORING
HOME
OPTIONS
SETTINGS

TIME	DATE	MESSAGE
22:45:33	14/06/22	INCOHERENCE FAULT PUSHER REGION1 (VERIFY POSITION INDICATOR PLEASE)
22:45:33	14/06/22	DISCORDANCE FAULT PUSHER REGION1

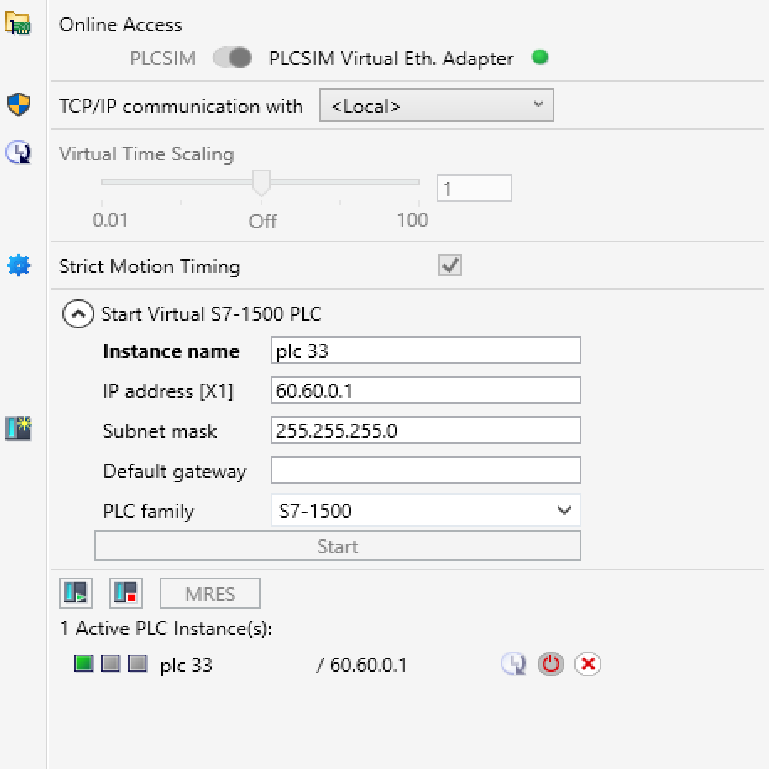
Figure 3.39: Alarm table after fixed faults

3.4.4 Tracking

For our system, we suppose that each wilaya has a wharhouse with a recognized area code, such as 16 in Algiers, which is stored in each PLC program controlling the sorting mechanism. When the parcel is scanned, the PLC saves the barcode number and communicates with the website's database via Node-Red using the OPC-UA protocol to transmit the package's details (barcode number, location, scanned real time).
Considering a scenario where we have a parcel with the following information:

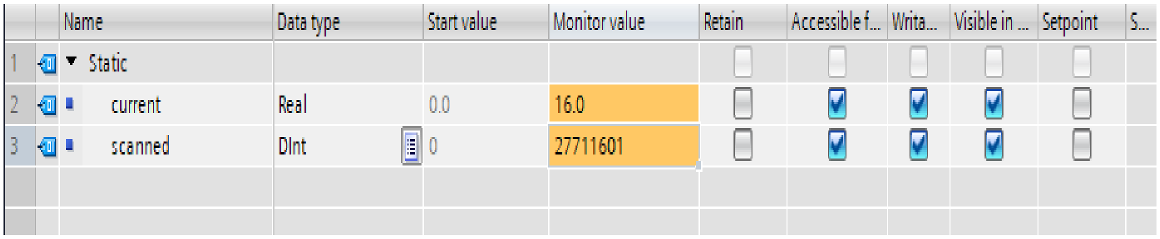
Barcode:"27711601".
Destination:"Algiers".
Source:"Boumerdes".

We'll assume that the sorting happens in a warehouse located in Boumerdes with an area code of "35", the package has been successfully sorted and scanned, the tracking steps were properly followed, the results are displayed in the following figures
1.Connection of PLCSIM ,OPC-UA and Node-Red



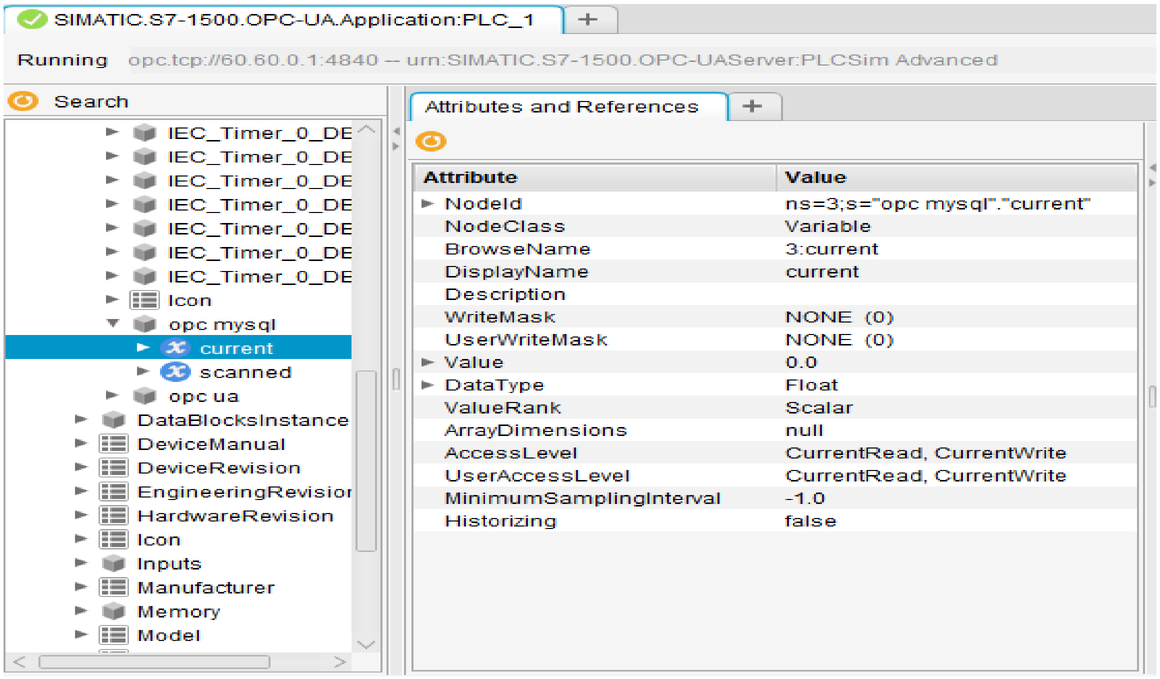
Online Access
PLCSIM PLCSIM Virtual Eth. Adapter ●
TCP/IP communication with <Local>
Virtual Time Scaling 1
Strict Motion Timing ☑
Start Virtual S7-1500 PLC
Instance name plc 33
IP address [X1] 60.60.0.1
Subnet mask 255.255.255.0
Default gateway
PLC family S7-1500
1 Active PLC Instance(s):
plc 33 / 60.60.0.1

Figure 3.40: Connection of PLCSIM advanced with TIA project



	Name	Data type	Start value	Monitor value	Retain	Accessible f...	Writa...	Visible in ...	Setpoint	S...
1	▼ Static				□	□	□	□	□	
2	current	Real	0.0	16.0	□	☑	☑	☑	□	
3	scanned	DInt	0	27711601	□	☑	☑	☑	□	

Figure 3.41: Saved values after the scanning operation



SIMATIC.S7-1500.OPC-UA.Application:PLC_1

Running opc.tcp://60.60.0.1:4840 -- urn:SIMATIC.S7-1500.OPC-UAServer:PLCSim Advanced

Search

- ► IEC_Timer_0_DE
- ► IEC_Timer_0_DE
- ► IEC_Timer_0_DE
- ► IEC_Timer_0_DE
- ► IEC_Timer_0_DE
- ► IEC_Timer_0_DE
- ► IEC_Timer_0_DE
- ► Icon
- ▼ opc mysql
  - ► current
  - ► scanned
- ► opc ua
- ► DataBlocksInstance
- ► DeviceManual
- ► DeviceRevision
- ► EngineeringRevisior
- ► HardwareRevision
- ► Icon
- ► Inputs
- ► Manufacturer
- ► Memory
- ► Model

Attributes and References

Attribute	Value
► NodeId	ns=3;s="opc mysql"."current"
NodeClass	Variable
BrowseName	3:current
DisplayName	current
Description	
WriteMask	NONE (0)
UserWriteMask	NONE (0)
► Value	0.0
► DataType	Float
ValueRank	Scalar
ArrayDimensions	null
AccessLevel	CurrentRead, CurrentWrite
UserAccessLevel	CurrentRead, CurrentWrite
MinimumSamplingInterval	-1.0
Historizing	false

Figure 3.42: Data transmission OPC-UA

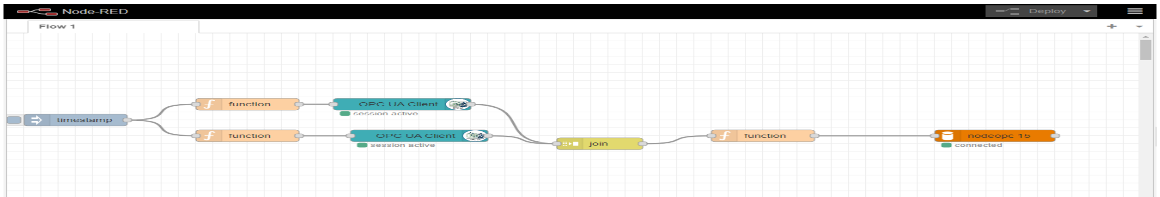
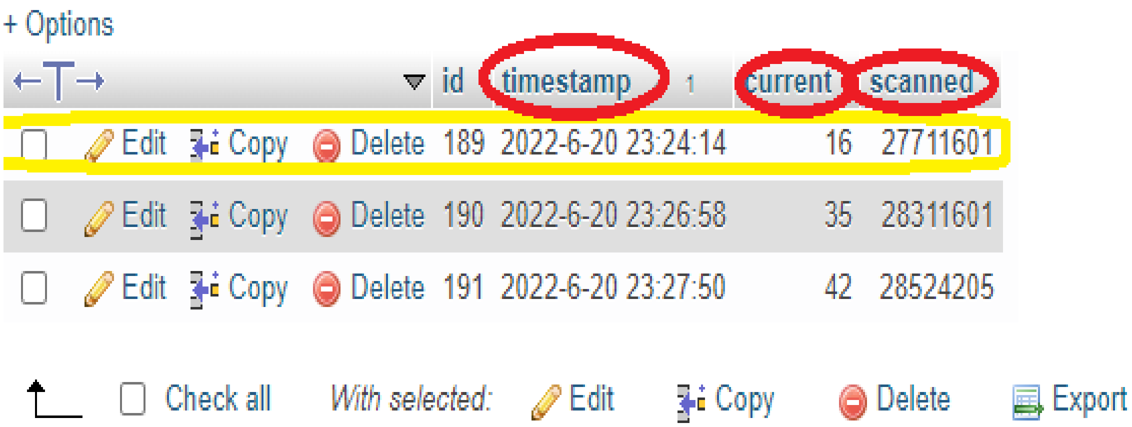


Figure 3.43: Node-Red flow program

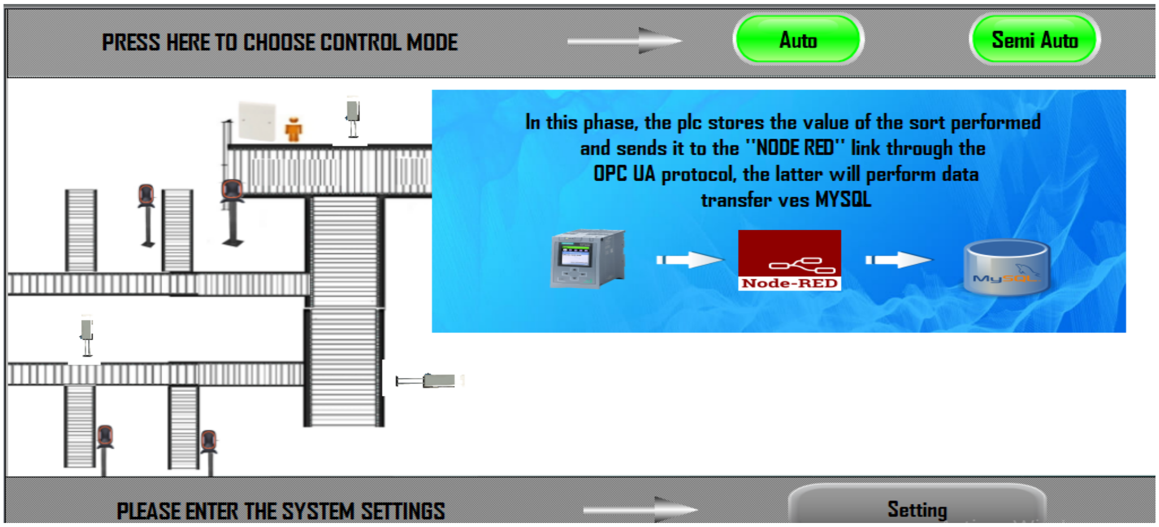
2.The attributes results in the tracking table



				id	timestamp	current	scanned
□	Edit	Copy	Delete	189	2022-6-20 23:24:14	16	27711601
□	Edit	Copy	Delete	190	2022-6-20 23:26:58	35	28311601
□	Edit	Copy	Delete	191	2022-6-20 23:27:50	42	28524205

Figure 3.44: Tracking table

3.HMI display of the communication PLC with Mysql



PRESS HERE TO CHOOSE CONTROL MODE

In this phase, the plc stores the value of the sort performed and sends it to the "NODE RED" link through the OPC UA protocol, the latter will perform data transfer ves MYSQL

PLEASE ENTER THE SYSTEM SETTINGS

Figure 3.45: Communication PLC with Mysql

3.5 conclusion

In this chapter we provided a demonstration of the entire project, starting with the website's graphical user interfaces, it's clear that system actors can use our website in a very simple and straightforward manner, finishing with an automatic sorting simulation in which each step was explained and illustrated under the supervision results .

General Conclusion

Through out this report, we have illustrated the main steps involved in the process of designing and implementing a delivery service agency. We concentrated on creating an interactive, user-friendly website with modern features such as tracking. In addition to establishing an efficient method for sorting packages in a short amount of time.

The project's implementation was a very challenging task for us since it is the combination of two distinct topics: the agency's website and the sorting system. This process required us to figure out the best approach to combine those two parts in a simple and efficient way.

Fortunately, all of the planned work was implemented successfully. For the web application of our system, the most appropriate choices of the design, architecture, and technologies have been selected to end up with a simple to use, interactive, and efficient web application. As for the sorting system, the automation was based on the use of a PLC due to its numerous advantages over the traditional processes.

Our system can be improved more in the future by incorporating certain additional features, such as:

- Creating a delivery service mobile application that goes along with the website
- Replacing barcode technology with RFID technology for a better sorting system
- Some adjustments must be made to the database design in response to the jury's feedback.

Bibliography

[1] Techopedia.com. https://www.techopedia.com/definition/5411/website, august 2020. (accessed: June 3,2022).

[2] The economic times. https://economictimes.indiatimes.com/definition/web-server. (accessed: April 24,2022).

[3] Ionos digitalguide. https://www.ionos.com/digitalguide/websites/web-development/how-are-websites-accessed. (accessed: April 23,2022).

[4] Electrical technology. https://www.electricaltechnology.org/2015/09/what-is-industrial-automation.html. (accessed: April 24,2022).

[5] PLC Handbook. Practical guide to programmable logic controllers. *AutomationDirect. com.*

[6] Techtalk blog. https://www.polycase.com/techtalk/electronics-tips/what-is-a-programmable-logic-controller.html, september 2021. (accessed: April 24,2022).

[7] Word finder. ¡https://findwords.info/term/xampp , December 2016. (accessed: April 25,2022).

[8] Wikipedia. https://en.wikipedia.org/wiki/Visual$_{S}tudio_{C}ode : : text = Visual.(accessed : April25, 2022)$.

[9] Searchoracle. https://www.techtarget.com/searchoracle/definition/MySQL, july 2018. (accessed: April 25,2022).

[10] Encyclopædia britannica. https://www.britannica.com/technology/markup-language . (accessed: April 25,2022).

[11] Css (cascading style sheet) definition. h https://techterms.com/definition/css . (accessed: April 25,2022).

[12] Techopedia.com. https://www.techopedia.com/definition/3929/javascript-js , December 2016. (accessed: April 25,2022).

[13] php. https://www.php.net/manual/en/intro-whatis.php , December 2016. (accessed: April 25,2022).

[14] Saitel Daniela Agudelo-Sanabria and Anshul Jindal. The ifs and buts of the development approaches for iot applications. *arXiv preprint arXiv:2101.09796*, 2021.

[15] Realpars. https://realpars.com/plc-programming-languages/, February 2022. (accessed: April 28,2022).

[16] Ghousia Saeed, André Brown, Mike Knight, and Martin Winchester. Delivery of pedestrian real-time location and routing information to mobile architectural guide. *Automation in Construction*, 19(4):502–517, 2010.

[17] Tom Elavsky. Technical review.

[18] Creately blog. https://creately.com/blog/diagrams/uml-diagram-types-examples, September 2021. (accessed: juin 06,2022).

[19] Craig Larman. *Applying UML and patterns: an introduction to object oriented analysis and design and interative development.* Pearson Education India, 2012.

[20] Visual paradigm. https://www.visual-paradigm.com/learning/handbooks/software-design-handbook/sequence-diagram.jsp: :text=Loop. (accessed: juin 10,2022).

[21] Oracle. https://www.oracle.com/database/what-is-database. (accessed: juin 09,2022).

[22] Properties of rdbmss and nosql databases. https://docs.rackspace.com/support/how-to/properties-of-rdbmss-and-nosql-databases/, February 2018. (accessed: juin 09,2022).

[23] Geeksforgeeks. https://www.geeksforgeeks.org/relational-model-in-dbms/.

[24] Step-by-step help. https://docs.plm.automation.siemens.com/content/
plant$_{s}im_{h}elp/15/plant_{s}im_{a}ll_{i}n_{o}ne_{h}tml/en_{U}S/tecnomatix_{p}lan$
$t_{s}imulation_{h}elp/step_{b}y_{s}tep_{h}elp/step_{b}y_{s}tep_{h}elp.htm.(accessed : juin16, 2022).$