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FACULTY OF ENGINEERING AT SHOUBRA

SMART PHARMACY

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SUPERVISED BY

Dr. Essam M. Shaalan

Benha University
Shoubra Faculty of Engineering
Electrical Power and Machines Department
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Digitalization of Traditional Pharmacy

(SMART PHARMACY)

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PROJECT TEAMWORK

1. Mohamed Ali Mahmoud Saraya
2. Mahmoud Asharf Yasein Mohamed
3. Mennatallah Abdelhaleem Hafiz
4. Kholoud Ibrahim Ahmed
5. Mahmoud Elsaeed Mohamed
6. Moamen Essam Abusrea
7. Abdullah Mohamed Mohamed
8. Asmaa Fawzy Ahmed
9. Abdullah Ahmed Ali
10. Mahmoud Mohamed Sobhy
11. Hossam Mahmoud Ismael

SUPERVISED BY

Dr. Essam M. Shaala

2022/2023 Academic Year

ABSTRACT

Currently, Digitalization is no longer an option; it is necessary Digitalization is the use of digital technologies to change a business model. The business model targeted in this project will be a "pharmacy". The aim of digitalizing such a model is to increase the speed of the whole process of getting a medicine and increase the accuracy of how this medicine is obtained and paid. The pharmacy will be like a machine with an interface to deal with users. The machine will take a prescription written from a doctor in a unique pattern and will contain a barcode that describes the medicine information, like the name, the price, the place where it is stored and finally the expiration date. The machine will take this barcode as an order and goes with the help of three motors beside a gripper to follow a mechanism as shown in (fig1). Technically, the barcode will send the information to Node-RED and then to the PLC that will control the whole operation. The mechanism is a three-axis mechanism that moves in the x y z direction. The payment method is so far achieved with a worker that takes the money from the user according to the price written within the barcode. The future recommendation for this project is to digitalize the payment method of the pharmacy as well, using a Visa card. This project is mainly directed to hospitals to help increase the rate of dispensing medicines to patients, and to create a system that makes the process more automated.

Fig 0-1 Smart Pharmacy

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Abbreviations

AC----------Alternative Current

DC ----------Direct Current

VFD----------Variable Speed Drive

IP---------- Ingress protection

2D----------Two-dimensional space

3D----------Three-dimensional space

PLC----------Programmable Logic Controller

DBMS----------Data Base Management System

SCADA----------Supervisory Control and Data Acquisition

HTML ---------- Hypertext Markup Language

CSS ----------Cascading Style Sheets

PHP----------Hypertext Preprocessor

JS ----------java script

SQL----------Structured Query Language

RDBMS -------- Relational Data Base Management System

MYSQL-------- Structured Query Language

QR----------Quick Response Code

ADS ----------Automated Drug Storage

ID----------Identity document

SLD ----------Single line diagram

IIOT ----------Industrial Internet of Things

MQTT---------Message Queuing Telemetry Transport

OPC UA------Open Platform Communications (Unified Architecture)

I/O----------Input/Output

C° ----------Celsius

Abbreviations

PC----------Personal Computer

CPU----------Central Processing Unit

IP----------Internet Protocol

TCP---------- Transmission Control Protocol

RTU ----------Remote Terminal Unit

ASCII---------- American Standard Code for Information Interchange

RAM----------Random-Access Memory

ROM----------Read-only memory

Chapter 1

INTRODUCTION

Chapter 1

INTRODUCTION

As technology advances, we are seeing a shift in the way pharmacies operate. With the introduction of Smart Pharmacy, the traditional brick and mortar pharmacy is being transformed into a more efficient and patient-centric model. Smart Pharmacy utilizes various automated and digital technologies to improve patient safety and care, while also streamlining internal processes.

One of the key features of Smart Pharmacy is the use of automated dispensing systems. These systems use robotics and AI algorithms to fill prescriptions with a high degree of accuracy and speed. This helps to reduce the risk of medication errors, which can have serious consequences for patients. Additionally, it frees pharmacists to focus on other important tasks, such as patient counseling and education.

Another important aspect of Smart Pharmacy is the integration of digital tools and data analytics. By harnessing the power of electronic health records (EHRs) and other clinical data, pharmacists can identify potential drug interactions or side effects before they become a problem. This allows them to work more closely with other healthcare providers to provide a more comprehensive and coordinated approach to patient care.

Smart Pharmacy also offers benefits to patients, particularly with regards to convenience and accessibility. For example, many pharmacies now offer online ordering and home delivery options, which can be particularly beneficial for patients with mobility issues or those who live in rural areas. Additionally, patients can access medication information and manage their prescriptions through web-based portals and mobile apps – making it easier for them to stay on top of their healthcare needs.

There are also benefits for pharmacies themselves when adopting Smart Pharmacy technologies. By automating certain tasks, such as inventory management and billing, pharmacies can reduce their operating costs and increase efficiency. They can also use data analytics to gain insights into their business performance and make strategic decisions to improve their customer service and profitability.

While there are certainly challenges associated with implementing Smart Pharmacy, the benefits are clear. By leveraging technology and data, pharmacies can improve patient care, streamline their operations, and enhance their bottom line. As the healthcare industry continues to evolve, Smart Pharmacy will undoubtedly play a critical role in shaping the future of pharmacy practice.

1.1 Project Background and Description

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At first, the aim was general as it was just about searching for systems that can be automated and be feasible, desirable, and viable. After searching for different sectors in Egypt, Healthcare was chosen. There are a couple of issues in the healthcare system, but pharmacies specifically are what the project will be about. The concept of smart or automated pharmacy has occupied an important place in the world in the past few years after it had proven highly effective in achieving patient satisfaction through the process of dispensing and distributing medicines through an integrated health system. Smart pharmacies can be included in hospitals and can be a stand-alone system. There are no such systems like that in Egypt. Introducing such a system will improve the pharmacists' access to the right medicine in no time, in a way that ensures that patients receive medicines in a timely manner, while providing greater drug safety and reducing medication errors. This project is at the first place a graduation project and hence it is supervised by the Shoubra faculty of Engineering professors.

Purpose of the project:

1. Digitalizing normal pharmacies.
2. Start our own start-up.

1.2 Scope of Work

The prospective taken for this project is the pharmacy included in hospitals. Pre-scriptions written in the hospitals will contain a QR code that has all the info about the medicines required. The dispensing of medicines is done by the robot that picks up the medicine, and then delivers it to the pharmacy window in a matter of seconds where the robot takes over the technical tasks of dispensing the medicines. The robot dispensing process is paperless as the robot will prepare and dispense the e-prescription as soon as the doctor documents it electronically or as it scans the QR code. The pharmacy will have the feature of storing medicine also, but this feature will not be included in the prototype due to financial prospects. The process will reduce medication errors besides providing high-speed access to medicines.

1.3 Problem Statement

Most if not all the prescriptions given to a patient are hand-written ones, and the percentage of giving a wrong medicine by a pharmacist varies from 11% to 14%, and if the hand-written prescriptions weren't readable, this percent range increases. In known specialized hospitals, people are crowded everywhere even in near phar-macies or in the pharmacy inside the hospital itself, and this leads to more medication

errors besides that medicine dispense will take a considerable amount of time and in a not effective way.

The second main problem is that the whole system isn't digitalized and hence missing all the advantages a digitalized system offers, like efficiency and less com-plexity. Making digitalized pharmacies will not just affect the patients and pharma-cists, but the whole sector.

1.4 Project Objectives

1. Providing innovative solutions to automate work in the pharmacy by providing advanced software solutions for all the obstacles witnessed by the pharmacist in his work, so that he can improve the workflow and raise productivity within f lexible steps and procedures.
2. Reducing the time required to explain the prescription, avoiding errors and distributing medicines, thus saving time and effort for both the patient and the phar-macist.
3. Filling and organizing many medicines without the need for any human intervention and with as few errors as possible.
4. Full analysis of any of the medicines in stock. (Demand rate as an example)

Chapter 2

MECHANICAL SYSTEM

Chapter 2

MECHANICAL SYSTEM

The project's goal is to integrate industry 4.0 technologies into any system. To demonstrate the digital transformation of that system, we chose to build a straight-forward smart pharmacy system prototype. being that it's just a prototype. So, taking this into consideration, we chose a product, whose maximum dimensions are 150X150X100 mm and its maximum weight is 1 kg.

2.1 Main Storage Place

Due to the maximum 150X150X100 mm dimensions of the products that will be stored. The main frame, which will transport the products being stored, is set up as depicted in the picture below, with 25 cells available for storage. with 810x850x300 mm in size (H x L x D).

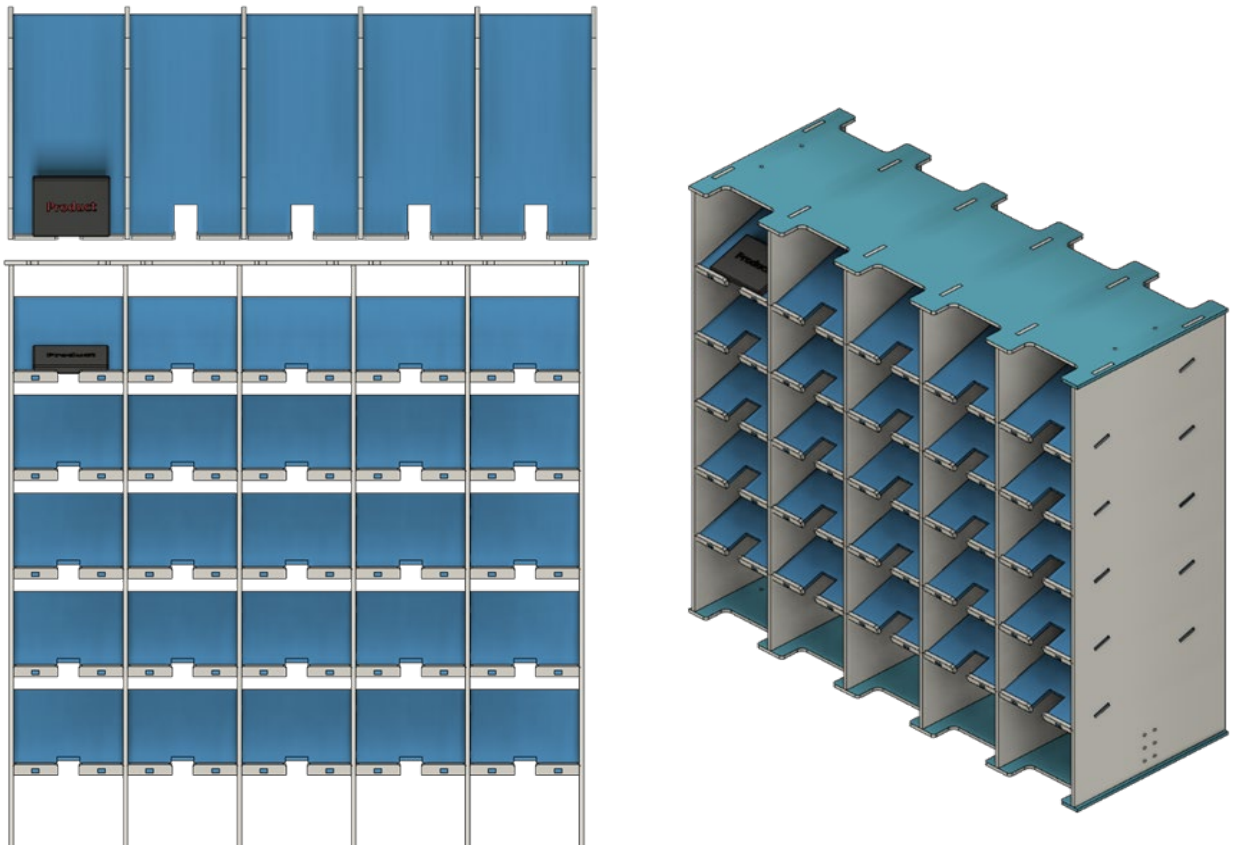

Fig 2-1 Main Cells Storage

A 6mm wood sheet has been chosen for the frame. Considering that the single cell's maximum load is 10 N over 300 mm length. The material is then capable of withstanding this load with a permissible deflection, which, according to manufacturing standards, is 230N with a 0.5mm deflection for that sheet at a length of 30mm. Ad-ditionally, this sheet is simple to put together and change whenever you want.

2.2 Crane

The product will be lifted and removed from a particular cell in the construction of the cell by the crane, a two-axis device. Given that the item's maximum dimen-sions are 150 x 150 x 100 mm. The crane's dimensions are shown in the figure be-low and are 250x820x930 mm.

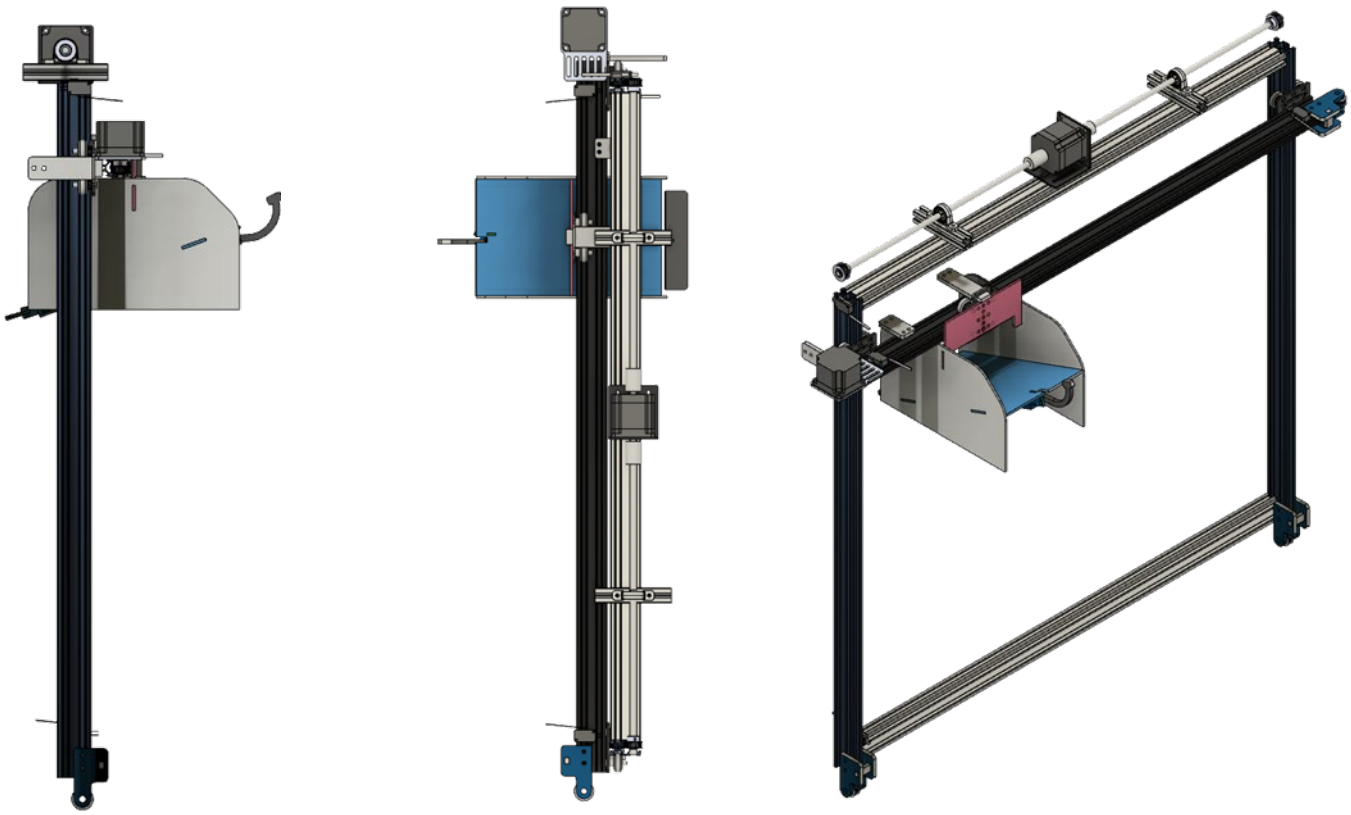

Fig 2-2 Crane Structure

2.3 Axis Load Estimation

- Y-**Axis**

  Because the maximum weight of the product is 1 kg and the weight of the Carriage frame lifting product in the Y axis depicted in the illustration is 0.5 kg. The total weight on the Y axis is then 1.5 kg.

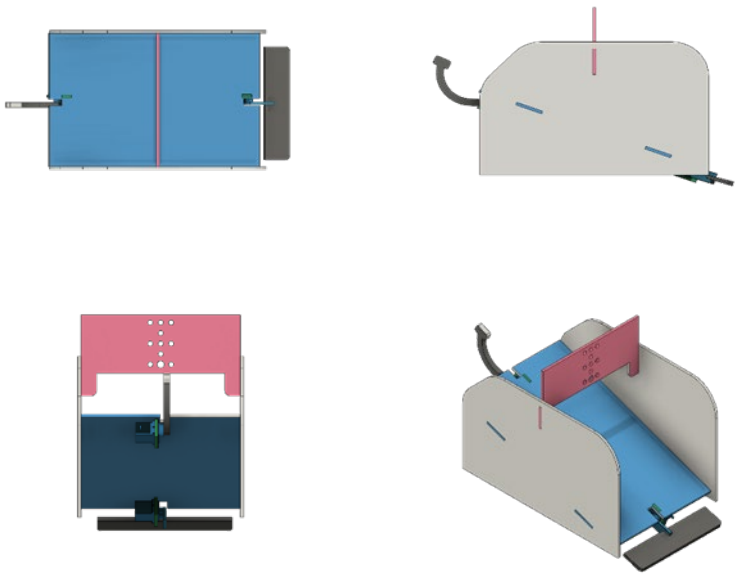

Fig 2-3 Y-Axis Frame

- Z-Axis

  The whole carne is being moved by the Z axis. As a result, the Z axis lifting weight may be calculated as follows:

$$Weight_z = Weight_y + Weight_{y-motor} + crane\ bar$$

2.4 Axis Motor Calculation

All axes use a belt and pulley mechanism, as indicated in the diagram below, with a fixed belt and two pulleys. One is driven, while the other is driven. The motor is directly attached to the driving pulley.

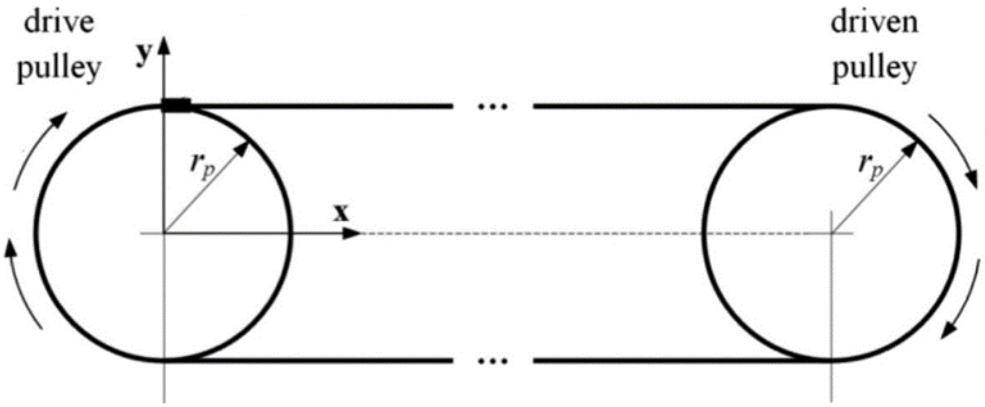

Fig 2-4 Y-Axis Frame

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And the motor's minimum torque requirement is determined by:

$$T_c = \frac{F_a . r}{1000\eta}$$

Where:

Tc = torque required during constant velocity (Nm)

Fa = total axial force (N)

r = radius of drive pulley (mm)

η = efficiency of belt drive system

The minimum torque from each motor may then be calculated using the preceding load estimates:

1. Y-axis Motor
   Total weight in Y-axis is 1.5 Kg. then

$$F_a = 1.5 * 9.8 = 14.7 \text{ N}$$

,r = 8 mm. and efficiency =0.99 then from torque equation

$$T_c = \frac{14.7 * 8}{1000 * 0.99} = 0.118788\ Nm$$

The Y-axis motor is chosen based on the minimal needed torque , and it weighs 0.28 kg.

2. Z-axis Motor

   The weight of aluminum bar which holds crane is equal 0.89Kg/m then, Total weight for 1m bar in Z-axis is 2.67 Kg. then

$$F_a = 2.67*9.8 = 26.166 \text{ N}$$

   ,r = 8 mm. and efficiency =0.99 then from torque equation

$$T_c = \frac{26.166 * 8}{1000 * 0.99} = 0.211\ Nm$$

   The Y-axis motor is chosen based on the minimal needed torque (as proven in Chapter 3), and it weighs 1 kg.

3. Tongue and Gate Motor

   Max. weight of product will be placed in cells equal to 200 g. (0.2 Kg.). In micro servo motor standard, it will be SG-90 which can carry weight of 1.5 Kg/cm.

2.5 Analysis of System Critical Parts

1. Crane

   The crane base is a wood sheet which carries the whole product. Which is a 6mm wood plate.

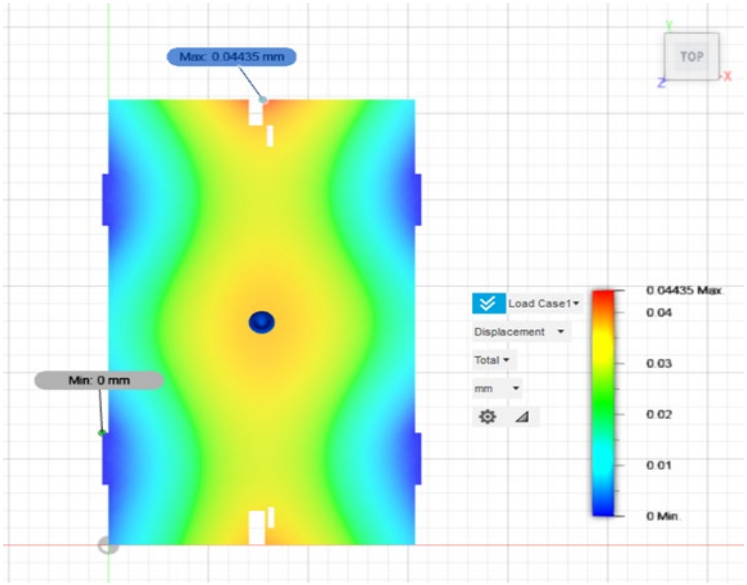

Fig 2-5 Wood Sheet 6mm Thickness Displacement Analysis

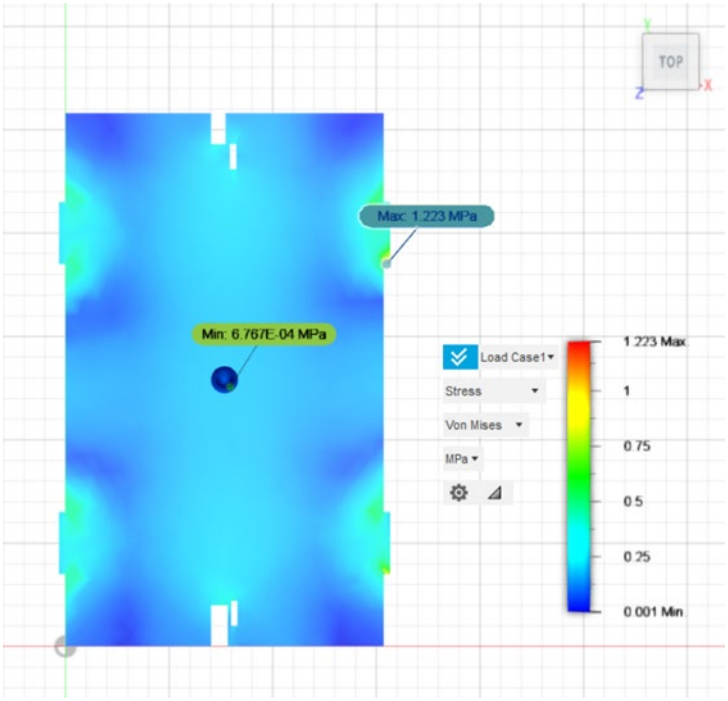

Fig 2-6 Wood Sheet 6mm Thickness Stress Analysis

2. Carriage Bar

The carriage bar is a aluminum 2040 which carry the whole crane

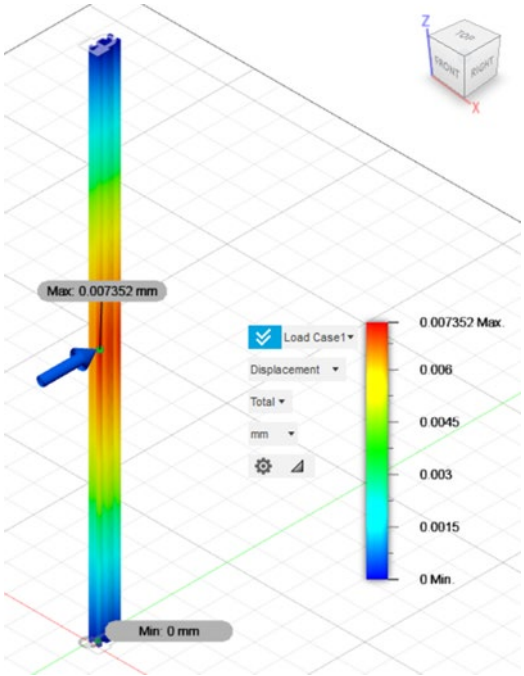

Fig 2-7 Carriage Bar 2040 Aluminum Displacement Analysis

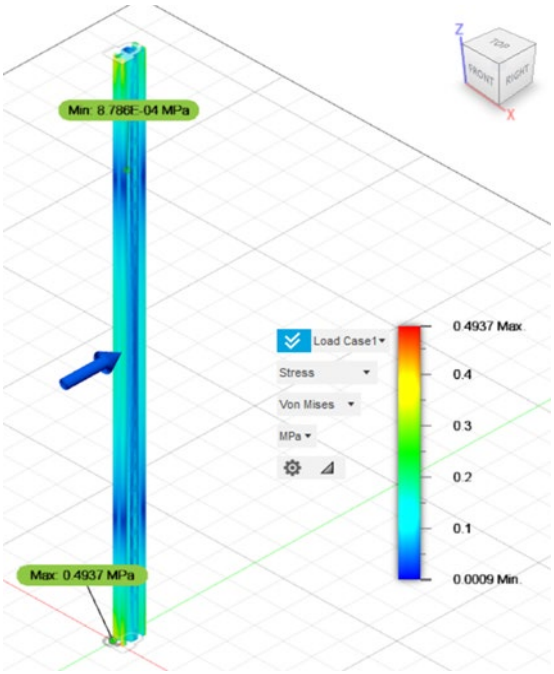

Fig 2-8 Carriage Bar 2040 Aluminum Stress Analysis

2.6 Overall System Drawing

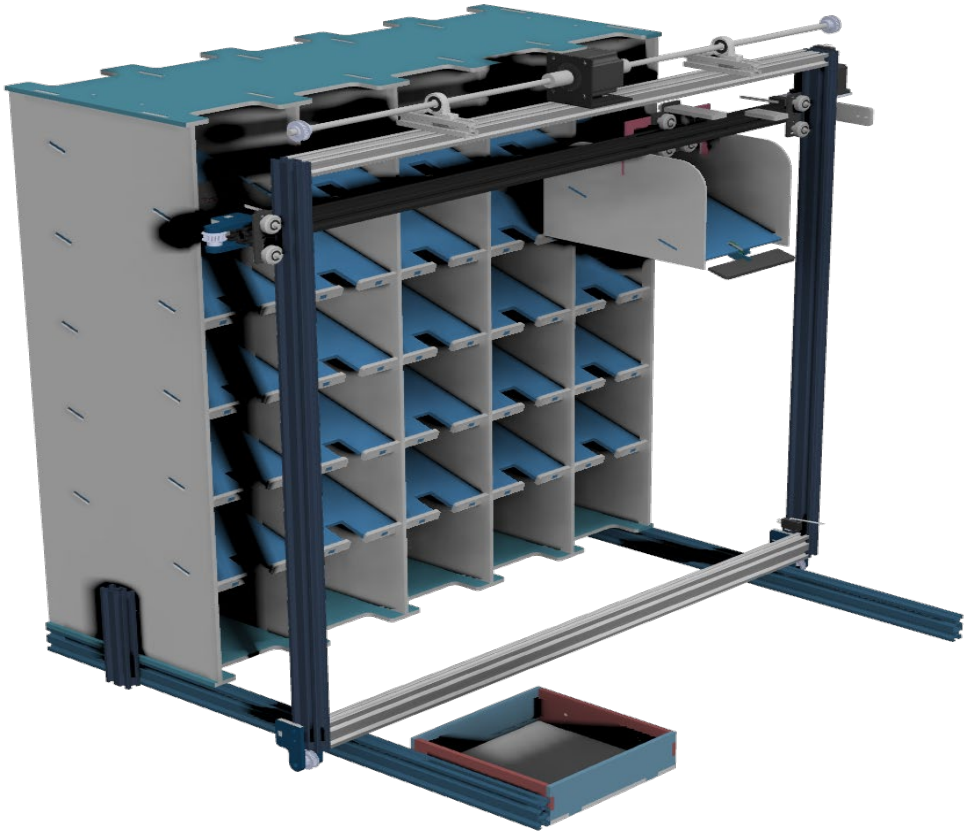

Fig 2-9 Overall System Orthogonal View

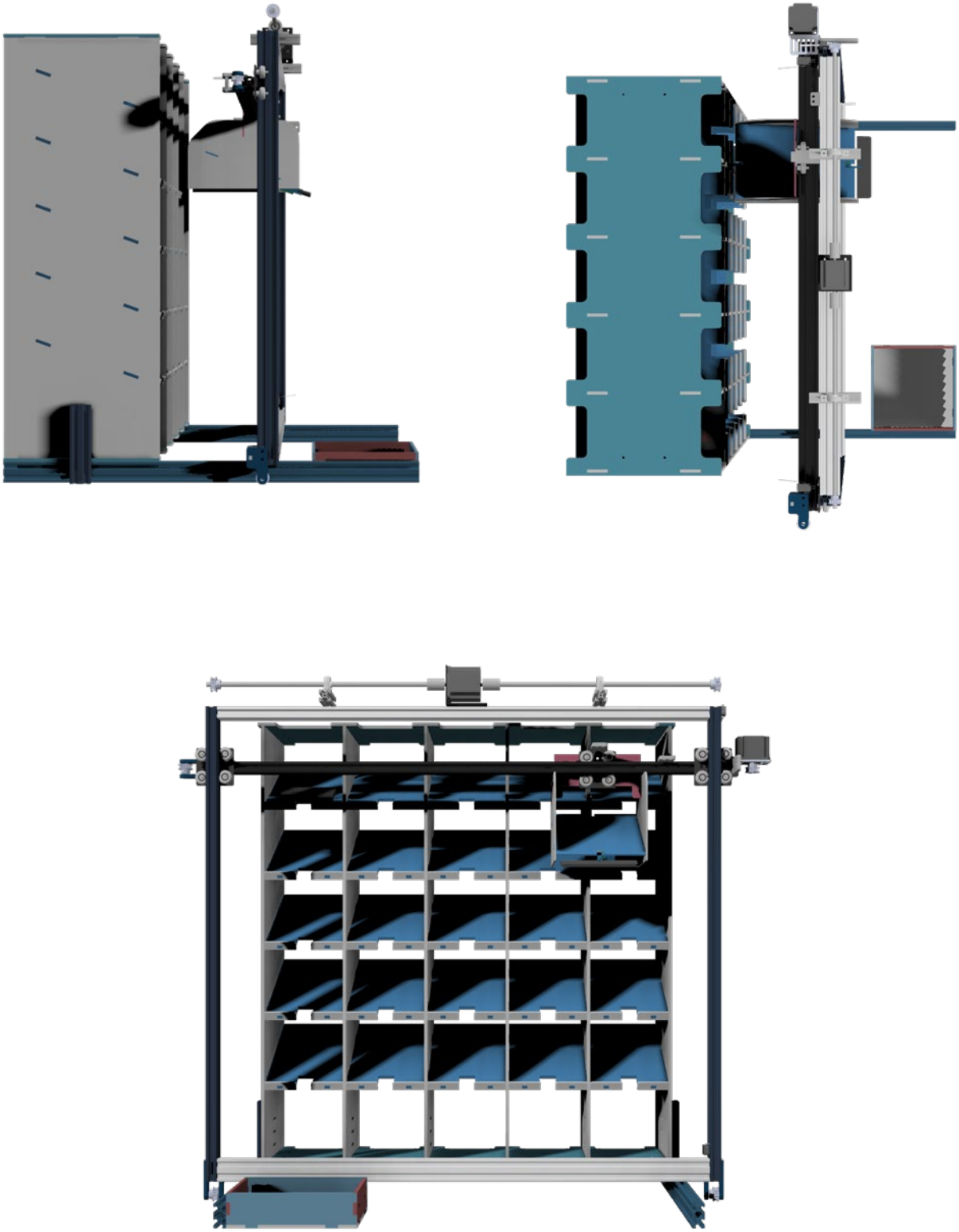

Fig 2-10 Overall System V

Chapter 3

MOTOR CONTROLLER AND DRIVES

Chapter 3

MOTORS CONTROLLER AND DRIVES

3.1 Introduction

An electric motor (or electrical motor) is an electric machine that converts electrical energy into mechanical energy. Most electric motors operate through the interaction between the motor's magnetic field and electric current in a wire winding. This interaction generates a force in the form of torque which is applied to the motor's shaft.

3.2 The Principle of Operation

The working of an electric motor is based on the fact that a current carrying conductor produces a magnetic field around it. To better understand, imagine the following situation. Take two bar magnets and keep the poles facing each other with a small space in between. Now, take a small length of a conducting wire and make a loop. Keep this loop in between the space between the magnets such that it is still within the sphere of influence of the magnets. Now for the last bit. Connect the ends of the loop to battery terminals.

Once electricity flows through your simple circuit, you will notice that your loop "moves." So why does this happen? The magnetic field of the magnets interferes with that produced due to electric current flowing in the conductor. Since the loop has become a magnet, one side of it will be attracted to the north pole of the magnet and the other to the south pole. This causes the loop to rotate continuously. This is the principle of working of electric motor.

3.3 Types of Electric Motors (Servo and Stepper)

Electric motors come in many different forms depending on the type of current flow they use, the design of their coils (windings), and how they generate a magnetic field. Accordingly, they can be categorized in many ways. The following describes two types of electric motors commonly used in industry.

3.3.1 Servo Motor

A servo motor is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you want to rotate an object at some specific angle or distance, then you use a servo motor. It is just made up of a simple motor which runs through a servo mechanism. If a motor is powered by a DC power supply is called DC servo motor, and

if it is AC-powered motor then it is called AC servo motor. For this tutorial, we will be discussing only the DC servo.

Fig 3-1 Servo Motor

motor working. Apart from these major classifications, there are many other types of servo motors based on the type of gear arrangement and operating characteristics. A servo motor usually comes with a gear arrangement that allows us to get a very high torque servo motor in small and light weight packages. Due to these features, they are being used in many applications like toy cars, RC helicopters and planes, Robotics, etc.

Servo motors are rated in kg/cm (kilogram per centimeter) most hobby servo motors are rated at 3kg/cm, 6kg/cm, or 12kg/cm. This kg/cm tells you how much weight your servo motor can lift at a particular distance. For example: A 6kg/cm Servo motor should be able to lift 6kg if the load is suspended 1cm away from the motors shaft, the greater the distance the lesser the weight carrying capacity. The position of a servo motor is decided by electrical pulse and its circuitry is placed beside the motor.

3.3.1.1 Types of Servo Motors

Types of Servo Motors are classified into diverse types based on their application, such as the AC servo motor, and DC servo motor. There are three main considerations to evaluate servos motors. First based on their current type of AC or DC, and secondly on the type of Commutation used, whether the motor uses brushes, and the third type of consideration is the motor's rotating field, the rotor, whether the rotation is synchronous or asynchronous. Let us discuss the first servo consideration. AC or DC consideration is the most basic classification of a motor based on the type of current it will use. The difference at it from a performance standpoint, the primary difference between AC and DC motors is in the inherited ability to control speed. With a DC motor, the speed is directly proportional to the supply voltage with a constant load. And in an AC motor, speed is determined by the frequency of the applied voltage and the number of magnetic poles. While both AC and DC motors are used in servo systems, AC motors will withstand higher current and are more commonly used in servo applications

such as with robots, in-line manufacturing and other industrial applications where high repetitions and high precision are required.

Fig 3-2 Servo Motor Types

A DC Servo Motor is commutated mechanically with brushes, using a commutator, or electronically without brushes. Brushed motors are less expensive and simpler to operate, while brush less designs are more reliable, have higher efficiency, and are less noisy.

Fig 3-3 Servo Motor Commutation

A commutator is a rotary electrical switch that periodically reverses the current direction between the rotor and the drive circuit. It consists of a cylinder composed of multiple metal contact segments on the rotor. Two or more electrical contacts called “brushes” made of a soft conductive material such as carbon press against the commutator, making a sliding contact with segments of the commutator as it rotates. While the majority of motors used in servo systems are AC brushless designs, brushed permanent magnet motors are sometimes employed as servo motors for their simplicity and low cost. The most common type of brushed DC motor used in servo applications is the permanent magnet DC motor.

Brushless DC motors replace the physical brushes and commutator with an electronic means of achieving commutation, typically using Hall effect sensors or an encoder. AC motors are brushless, although there are some designs such as the

universal motor, which can run on either AC or DC power, which do have brushes and are mechanically commutated.

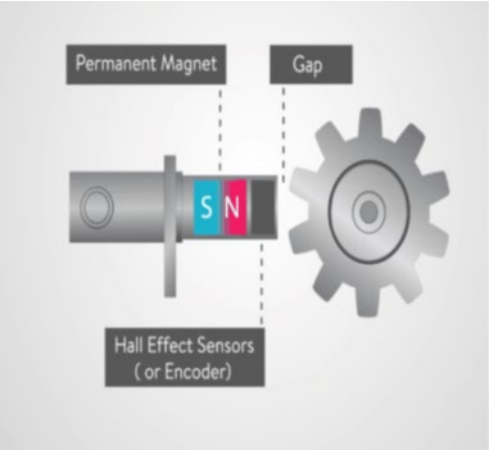

Fig 3-4 Servo Motor Electronic Commutation

And the final classification to consider is whether the servo motor application. will use a synchronous or asynchronous rotating field. While DC motors are categorized as brushed or brushless, AC motors are more often differentiated by the speed of their rotating synchronous or asynchronous field. If we recall from the AC-DC consideration, that in an AC motor, speed is determined by the frequency of the supply voltage and the number of magnetic poles. This speed is referred to as synchronous speed. Therefore, in a synchronous motor, the rotor rotates at the same speed as the stator's rotating magnetic field. However, in an asynchronous motor, normally referred to as an induction motor, the rotor rotates at a speed slower than the stator's rotating magnetic field. However, the speed of an asynchronous motor can be varied utilizing several control methods such as changing the number of poles and changing the frequency just to name a couple.

3.3.2 Stepper Motor

Stepper motors are DC motors that move in discrete steps. They have multiple coils that are organized in groups called "phases". By energizing each phase in sequence, the motor will rotate, one step at a time. With computer-controlled stepping you can achieve very precise positioning and/or speed control. For this reason, stepper motors are the motor. of choice for many precision motion control applications. Stepper motors come in many different sizes and styles. and electrical characteristics. In this section we ex-plain in detail what You need to know to pick the right motor for the job.

Fig 3-5 Stepper Motor

A stepper motor is an electric motor whose main feature is that its shaft rotates by performing steps, that is, by moving by a fixed number of degrees. This feature is obtained thanks to the internal structure of the motor and allows to know the exact angular position of the shaft by simply counting how many steps have been performed, with no need for a sensor. This feature also makes it fit for a wide range of applications.

3.4 Motor Controllers and Drives

They are electric or electronic devices used to regulate motor speed, Torque, acceleration, deacceleration and targeted position. The function of the motor drive is to draw electrical energy from the electrical source and supply electrical energy to the motor, such that the desired mechanical output is achieved. Typically, this is the speed of the motor, torque, and the position of the motor shaft. Figure below shows the block diagram of most of the motor drivers.

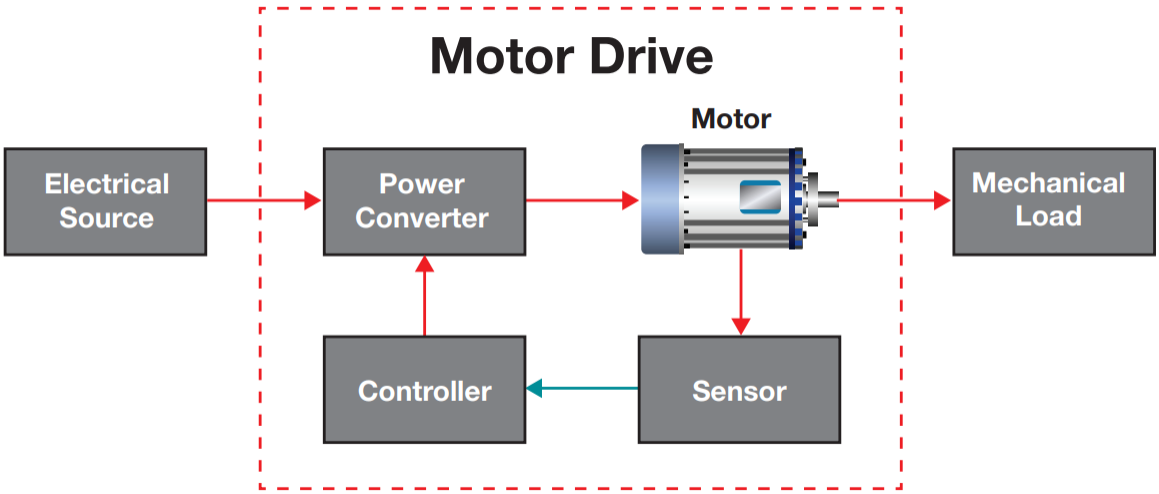

Fig 3-6 Motor Drive Block Diagram

The main function of the Circuit above is to:

1. Control Electrical Energy input from supply to the motor by changing frequency of waveform or voltage to the desired current, voltage, current and frequency to achieve desired mechanical load.
2. Then, the controller will regulate flow of electrical power as it gets its feedback from Sensor which could be encoder, current sensor, or tachometer.
3. Finally, the controller tells the converter what it needs to do. A closed-loop feedback system is the method of comparing what is happening to what the motor should be outputting, then adjusting the output accordingly to maintain the desired output.

3.4.1 Servo Motor Drive

We will start with schneider lexium 28 with have all features in schneider lexium 26 and with the addition of CANopen communication protocol.as shown below here is the front of the drive

Fig 3-6 Schneider Lexium 28 Description

Below here we have table which indicate for the name of each part at the front interface of the drive.

Table 3-1 Schneider Lexium 28 Description

Item	Description
1	Connector for safety function STO (Safe Torque Off)
2	Slot for application name plate
3	HMI: 7-segment display, 5 buttons, and 2 status LED
4	Terminal for motor connection
5	Terminal for braking resistor connection
6	DC-bus connector with status LED
7	Terminal for connecting the power supply
8	Screw terminal for protective ground (protective earth)
9	QR code for access to technical data
10	RJ45 connector for Modbus serial link (commissioning interface)
11	Connector for the encoder of the motor
12	2 x RJ45 connectors for integrated CANopen connection (only in lexium 28)
13	Device Reference
14	Input/output connector

3.4.2 Stepper Motor Control & Drive

Stepper Motor Drive is the main part of our project as it is the part responsible for the motion of our crane and optimization of motion curve and time of each trip, so it is important in Time management and motion control. We have seen previously that the motor coils need to be energized, in a specific sequence, to generate the magnetic field with which the rotor is going to align. Several devices are used to supply the necessary voltage to the coils, and thus allow the motor to function properly. Starting from the devices that are closer to the motor we have:

1. A transistor bridge is the device physically controlling the electrical connection of the motor coils. Transistors can be seen as electrically controlled interrupters, which, when closed allow the connection of a coil to the electrical supply and thus the flow of current in the coil. One transistor bridge is needed for each motor phase.
2. A pre-driver is a device that controls the activation of the transistors, providing the required voltage and current, it is in turn controlled by an MCU.
3. An MCU is a microcontroller unit, which is usually programmed by the motor user and generates specific signals for the pre-driver to obtain the desired motor behavior.

fig 3-7 Motor Control Basic Scheme shows a simple representation of a stepper motor control scheme. The pre-driver and the transistor bridge may be contained in a single called a driver.

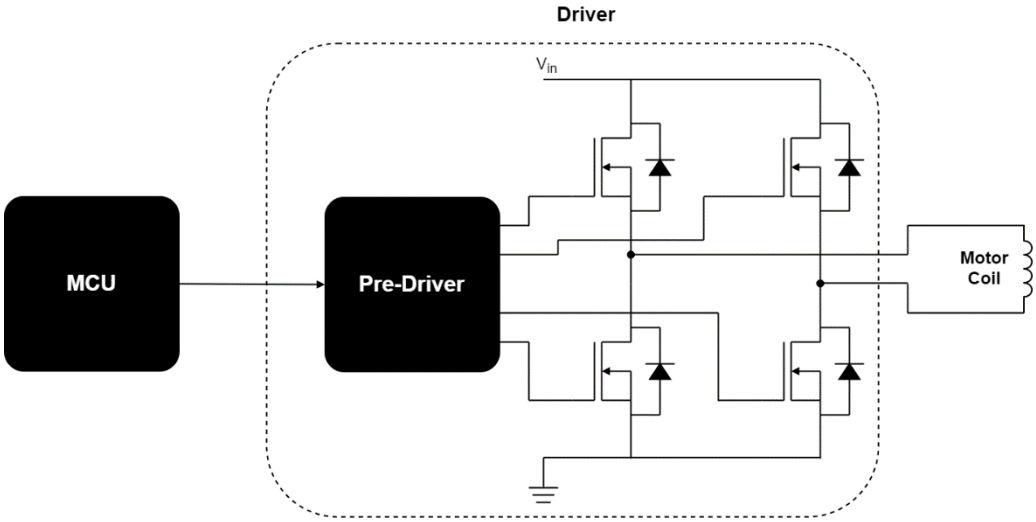

Fig 3-7 Motor Control Basic Scheme

3.4.2.1 TB6600 Stepper Motor Driver

Stepper motor drivers are small pin-compatible modules designed particularly to drive stepper motors capable of continuously rotating with precise position control without the need for a feedback system. The stepper motor drivers have built-in converters that offer multi-stage resolution and variable current control that allows control of step-per motors with simple step and direction inputs. These modules are usually the main carrier boards for various stepper driver ICs that provide low level interfaces such as inputs to initiate each step directly. A quick way to control a stepper motor is to use a stepper motor driver (controller) TB6600. This section gives a brief description of the TB6600 stepper motor driver module.

The TB6600 stepper motor driver IC is a very easy, effective, and professional device that can drive 2-phase stepper motors. Compatible with any type of microcontroller and Arduino to generate 5V digital output pulse signals. The TB6600 stepper motor driver has a wide input power range, (9-42VDC) of power supply, and generates 4 Amps peak current, supporting direction control and speed that is sufficient for most stepper motors.

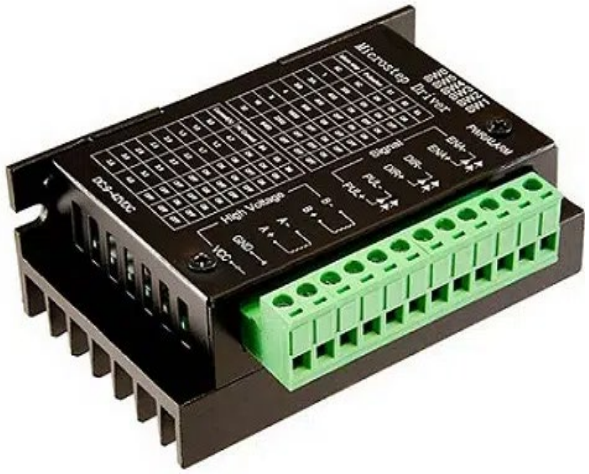

Fig 3-9 TB6600 Stepper Motor Driver Module

The main benefit of using the TB6600 stepper motor driver IC is controlling the position and speed and is widely used for a small number of stepper motors. This type of driver allows you to minimize code and references. It is used in high level applications. All the terminals of the driver provide the ability of anti high frequency opto coupler isolation and can drive 2-phase stepper motors, 4-phase stepper motors, and hybrid stepper motors. Another benefit of using this driver is, it uses the bipolar H-bridge configuration for voltage and current control of the 2-phase and 4-phase step-per motors.

3.4.2.2 Features of TB6600:

The following are the features of the TB6600 stepper motor driver :

1. It is a Bipolar H-bridge DC driver.
2. 8 output current types are optional up to 4 Amps. (0.5A to 3.5A)
3. Divides up to 32 selectable 6 subdivision modes.
4. Provides 8 kinds of micro steps (1, 2/A, 2/B, 4, 8, 16, 32).
5. Provides high-speed photoelectric separation of the input signal.
6. Full standard single pulse interface. > Offline hold function.
7. Used in harsher environments due to a semi-enclosed body.
8. Provides a semi-automatic power lock function with energy saving.

3.4.2.3 TB6600 Pin Configuration/Pin Diagram

The TB6600 stepper motor driver module pin configuration/pin diagram is described below. There are 2 types of TB6600 driver modules such as 4A type and 4.5A type as shown below, with similar functions and pin configuration.

Fig 3-8 TB6600 Stepper Motor Driver 4A Module

Pin 1: ENA- (ENA): This pin refers to the negative enable pin of the module.

Pin 2: ENA+(+5V): This pin refers to the positive enable pin, which is the +5V pin of the module.

Pin 3: DIR-(DIR): This pin refers to the negative direction of the motor.

Pin 4: DIR+(+5V): This pin refers to the positive direction of +5V.

Pin 5: PUL-(PUL): This pin refers to the negative pulse. (For controlling rotations steps of the motor)

Pin 6: PUL+(+5V): This pin refers to the positive pulse of the motor.

Pin 7: B-: This pin refers to the negative lead stepper motor coil wire 2.

Pin 8: B+: This pin refers to the position lead of stepper motor coil wire 2.

Pin 9: A-: This pin refers to the negative lead of stepper motor coil wire 1.

Pin 10: A+: This pin refers to the positive lead stepper motor coil wire 1.

Pin 11: GND: This pin refers to the common ground connection of the module.

Pin 12: VCC: This pin refers to the input supply voltage for the stepper motor driver module, which is 9V-42V.

The in-built control/driver switches SW1, SW2, SW3, SW4, SW5, and SW6 are used to control the resolution of micro steps and used to limit the driver current. Switching of SW1, SW2, and SW3 changes the micro-step resolution from full step to 1/32 step. Switching of dip switches SW4, SW5, and SW6 ON Or OFF adjusts current (0.7 to 4Amps) during the continuous motor run.

3.4.2.4 TB6600 Technical Specifications:

The technical specifications of the TB6600 stepper motor driver module is given below.

1. The operating voltage ranges from 9-40V DC.
2. The output current of the module is 0.7A-4.0A and it is selected in 8 steps through DIP switches.
3. The input pulse frequency is up to 20KHz.
4. Input signal suitable for – 5V signal levels.
5. Pulse per revolution is 200-6400.
6. The logic signal current is 8A-15A.
7. It is suitable for 2-phase and 4-phase stepper motors.
8. It provides protection from overcurrent over-heating.
9. Inputs are isolated optically.
10. Insulation resistance is 500 megohms.
11. It can support PUL/FIR mode.
12. It is low cost.

3.5 stepper motor vs servo motor

3.5.1 Motor Selection

The two main factors to consider when choosing between servo motors and stepper motors are of course performance and cost. We can evaluate the performance of a motor by looking at its torque density, inertia, dynamic performance, and how easily it can be controlled by a VFD. For your motor application, you will want to get the best performance at the lowest possible cost.

3.5.2 Servo Motor Advantages

1. Permanent magnet motors, or servo motors, have been used in applications in the machine tool industry due to their easy motion control for both rotary and linear motion, as well as their high maximum speeds and short acceleration times.
2. The torque density is also a highlighting feature of the servo motor solution. Servo motors can produce between 40 and 60% higher torque capacity than the equivalent sized. Induction motor. The motor compactness is particularly advantageous for machines. Where weight and footprint size are critical.
3. The rotor size of a servo motor is typically smaller in diameter than that of its equivalent induction motor counterpart, leading to smaller inertia. This makes servo motors particularly attractive for dynamic motion control profiles where fast cycle times are desired.
4. Servo motors will provide full torque at zero speed. This is not the case with a line started induction motor. Applications that require full load at zero speed like a dynamo meter or winder will benefit from this operating characteristic.
5. Advancements in servo drive technology have allowed for the increase in usage of servo motors because now manufacturers can offer drives with the capability to do complex current calculations and rotor pole identification in real-time. Since Servo motors typically do not use a fan, they usually carry a higher ingress protection rat-ing, often IP55 or IP65 as standard. This is a higher IP rating than traditional ODP or TEFC motors that are going to be IP44 or IP54.

3.5.3 Servo Motor Disadvantages

1. As far as costs go, servo motors have traditionally been more expensive due to the permanent magnet material cost. But the cost gap between servo and stepper motors has been shrinking for years. It used to be that a servo system was twice the cost of a stepper motor system. That difference has now shrunk to 10-40%.
2. In some applications the servo motor advantages become disadvantages. Machines like a crusher might benefit from a higher inertia motor that can ride through torque impulses. Also, applications that do not require speed or position feedback can be

more easily solved with a line start induction motor. There are some line-fed PM servos out there, but a majority will require the use of a servo drive or amplifier.

3.5.4 Stepper Motor Advantages

1. Due to their internal structure, stepper motors do not require a sensor to detect the motor position. Since the motor moves by performing "steps," by simply counting these steps, you can obtain the motor position at a given time.
2. In addition, stepper motor control is simple. The motor does need a driver but does not need complex calculations or tuning to work properly. In general, the control effort is lower compared to other motors. With micro stepping, you can reach high position accuracy, up to approximately 0.007°.
3. Stepper motors offer good torque at low speeds, are great for holding positions, and tend to have a long lifespan.

3.5.5 Stepper Motor Disadvantages

1. They can miss a step if the load torque is too high. This negatively impacts the control since there is no way to know the real position of the motor. Using micro stepping makes stepper motors even more likely to experience this issue.
2. These motors always drain maximum current even when still, which makes efficiency worse and can cause overheating.
3. Stepper motors have low torque and become noisy at high speeds.
4. Finally, stepper motors have low power density and a low torque-to-inertia ratio.

3.5.6 Selected Servo Motor not Stepper Motor

1. Servo Motors

   Fast, high torque, accurate rotation within a limited angle, a high-performance alternative to stepper motors, but more complicated setup with PWM tuning. Suited for robotic arms/legs or rudder control etc.

2. Stepper Motors

   Slow, precise rotation, easy set up & control – Advantage over servo motors in positional control. Where servos require a feedback mechanism and support circuitry to drive positioning, a stepper motor has positional control via its nature of rotation by fractional increments. Suited for 3D printers and similar devices where position is fundamental.

- Despite that, we will use in this project a stepper motor and not a servo motor due to the cost and also because this project is only a prototype and not the actual project

3.6 Selected Motors

Project has two types of motors: -

1. First, two stepper motors responsible for the movement in the horizontal direction and the vertical direction.
    - Nema 23 single core (horizontal direction)
    - Nema 23 double core (vertical direction)
2. Second, two mini servo motors Responsible for operating both the gate and the drug withdrawal tongue (MG90S).
3. To summarize, stepper motors are good when you need an inexpensive, easy-to-control solution and when efficiency and high torque at high speeds are not necessary.

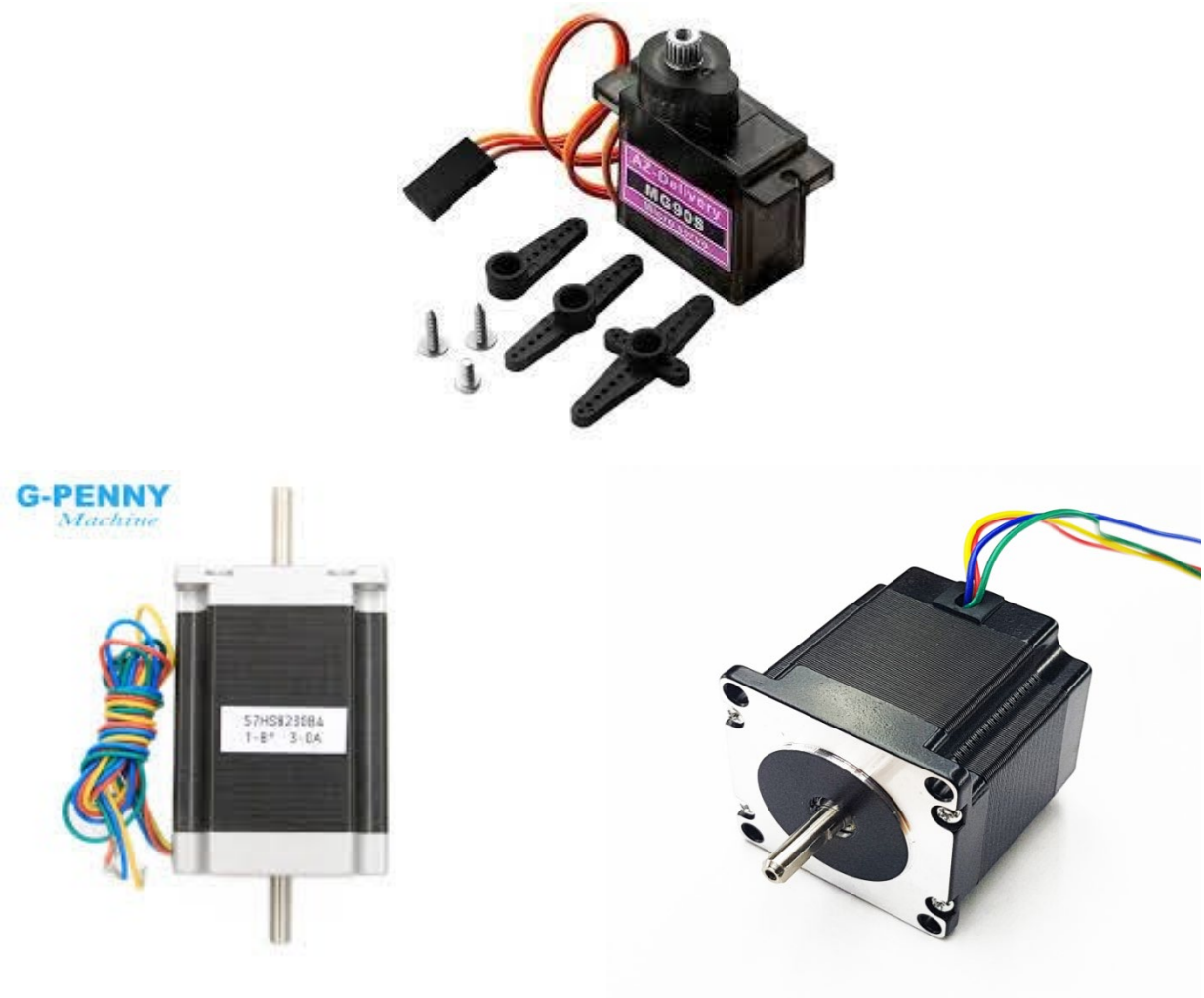

Fig 3-10 Motors used in Pharmacy.

Chapter 4

CONTROL SYSTEM

Chapter 4

CONTROL SYSTEM

4.1 Programmable Logic Controller (PLC)

PLC stands for programmable logic controller. Often utilized in the industrial sector, a PLC is a programmable computing device that regulates electromechanical processes. Another moniker for a PLC is an industrial PC, which describes a PLC's principal function as a specialized industrial computer device. PLCs monitor the status of an input device, such as the signals from a light switch, to determine the next state of an output device, such as turning on or off a light. PLCs are also used to send data from equipment in factories or from offsite locations to centralized applications, which usually run on PCs. PLCs are widely used to monitor hardware, report hardware faults with tools and industrial machinery, and diagnose hardware problems.

Fig 4-1 Programmable-Logic-Controller

4.1.1 PLC Components: -

A typical PLC has a central processing unit (CPU), a mounting rack, read-only memory (ROM), random access memory (RAM), input/output (I/O) modules, a power supply, and a programming tool. It is powered by an external power source. I/O and other specialized modules slip into a PLC rack thanks to the modular nature of PLCs PLC modules are also known as cards.

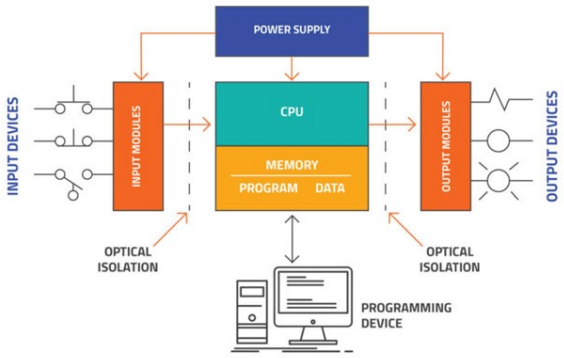

Fig 4-2 Schematic Diagram of PLC

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Rack: - A PLC rack is comparable to the chassis of a car, to which other parts are connected. The CPU, several I/O modules, and the power sources are the three categories into which the connected components in a PLC rack are divided. We will show each part in rack individually:

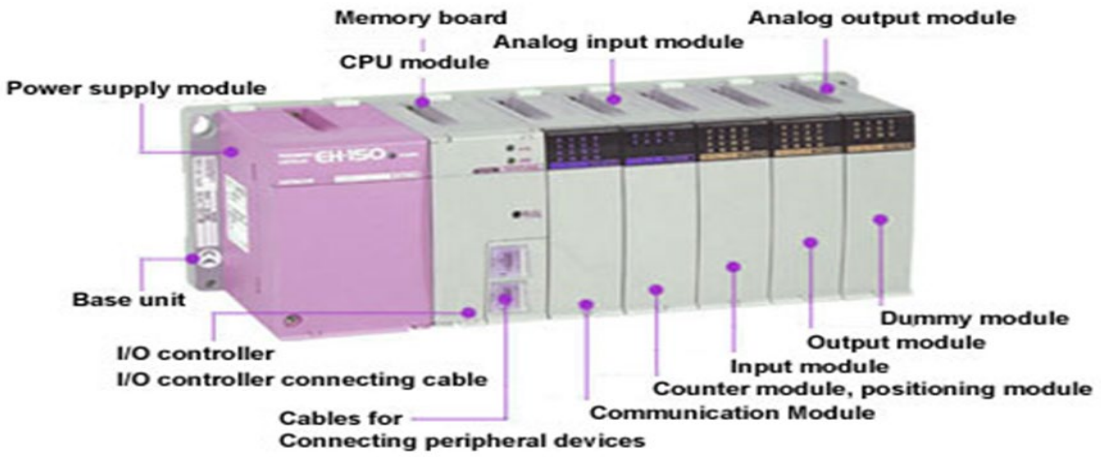

Fig 4-3 PLC-Elements

1. Power supply: -

   Direct current (DC) is produced by the power supply from alternating current (AC) (DC). The CPU and I/O components use DC.

2. CPU: -

   The CPU is the brain of a PLC, like a PC. Programming mode and run mode are the two operational modes of the CPU. When in programming mode, the CPU downloads logic in the form of PC user-created programming instructions. The CPU performs the logic execution in run mode. All PLC operations are managed by the CPU in accordance with the programming instructions that are stored in memory. Information is sent to and received from the CPU via a control bus system.

3. I/O modules: -

   A PLC accepts or detects data from input devices such keyboards, level meters, timers, counters, console lights, electric motors, and temperature and pressure switches as well as proximity and photoelectric sensors. The term "sensing data" describes the type of input data that PLCs receive, which are electronic signals. Discrete signals, such as on/off signals, are handled by digital input cards. Voltage is translated into numbers that the CPU can interpret using analogue input cards. Valve, starter motor, drive, actuator, solenoid, alarm, control relay, printer, and pump outputs are examples of PLC outputs. Devices, such as lights, can be turned on and off using digital output cards. To control machinery, for instance, analogue output cards transform digital numbers to voltage. PLCs are capable of processing input data and transferring it to an output device, among other logical judgements and actions based on the input data they receive. A programming device conducts the processing of supplied data. For instance, a temperature switch may periodically relay data from a cooling plant's temperature sensor to a printer in a factory.

4. Programming device: -

   Often, the programming tool is a laptop, gaming console, or portable proprietary device. I/O modules send input signals to the CPU of a PLC, which generates output signals. A programming device-implemented application software determines the output data's format.

5. Memory and storage: -

The operating system data and drivers are stored in the ROM. RAM records the status of input and output data, as well as information about application applications.

6. Communication: -

I/O modules oversee exchanging data between the PLC and communication networks. PLCs employ the serial communication standard Recommended Standard 232 (RS-232) to connect with external devices. RS-232 reads and writes data in the American Standard Code of Information Interchange (ASCII) format using binary code. PLCs connect with field components at the physical level at the control level, employing a variety of communication protocols depending on the component. PLCs also connect with wireless devices and networks using various communication protocols. Modbus RTU is a serial communication protocol that is commonly used to transport data across long distances in industrial communication networks. Serial communication methods, on the other hand, fall short of the performance and speed of Ethernet protocols. PLCs employ Ethernet protocols like Ethernet TCP/IP, Modbus TCP/IP, and ProfNet to connect to plant networks and the internet. Custom protocols can be tailored to specific devices. To communicate with drivers and printers, USB protocols are employed. Bluetooth protocol can be used for wireless devices.

4.1.2 PLC Working Principal

There are four basic steps in the operation of all PLCs: Input Scan, Program Scan, Output Scan, and Housekeeping. These steps continually take place in a repeating loop.

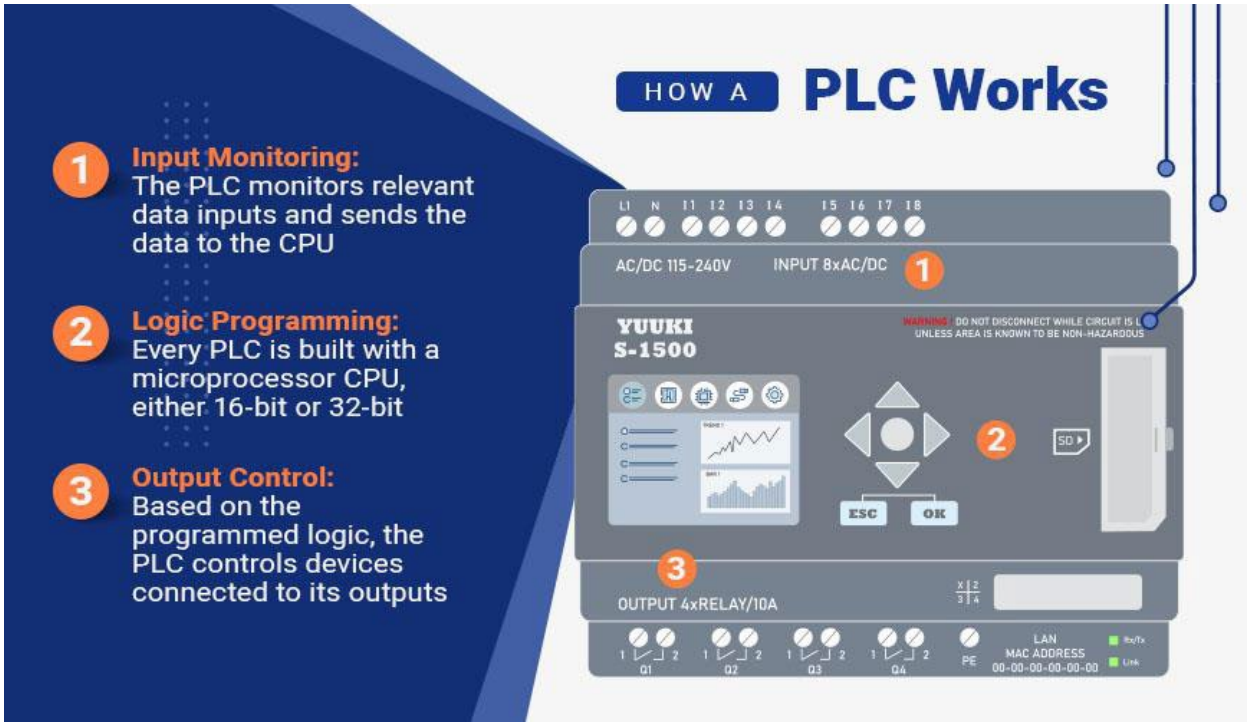

Fig 4-4 How-a-PLC-Works

Three Steps in The PLC Operations:

1. Input Scan

   Detects the state of all input devices that are connected to the PLC.

2. Program Scan

   Executes the user created program logic

3. Output Scan

   Energizes or de-energize all output devices that are connected to the PLC.

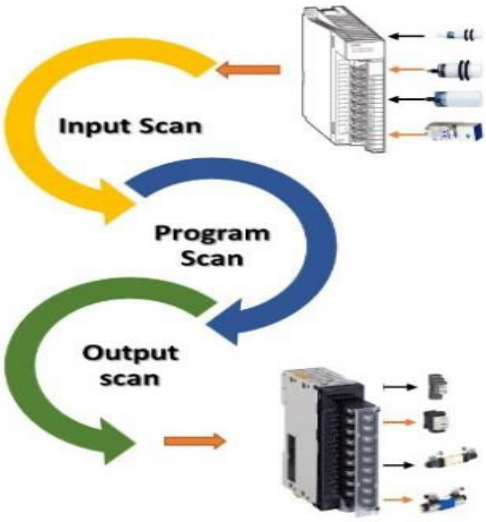

Fig 4-5 PLC Scan Cycle

4.1.3 Advantage of PLCs

The benefits of PLCs arise mostly from the elimination of traditional hard-wired logic control systems. PLCs are easier to create, install, maintain, and alter than older logic control systems. Because the control logic is done by software, PLC components do not require complicated connections. Changes and updates are simple to do simply submitting a new ladder logic programmed. Changes can be made remotely rat Ladder logic coding enables the rapid creation of complicated logical expressions. PLC programming is very straightforward, and because PLC systems are modular in design, they may be implemented in a variety of physical configurations and are readily scaled with a variety of input and output devices.

PLCs are specialized devices designed to survive difficult environmental conditions such as high cold and heat, as well as dusty and humid situations in factories. her than manually, as with relay logic systems. PLC contains a real-time operating system that performs some housekeeping chores but does not require the supplemental utilities that PCs employ, such as antivirus software or registry cleaners. PLC execution times are faster than relay logic control systems, which contain several mechanical parts since they are microprocessor-based.

4.1.4 PLCs Disadvantage

1. Since they are task focused rather than event driven, classic PCs are frequently more suited to managing complex programming code than PLCs.
2. Although ruggedly dependable, PLC-based systems typically require external displays to present data in a user-friendly manner.
3. When they fail, PLCs may necessitate lengthy troubleshooting by PLC professionals.

4.1.5 Selection Suitable PLC

Many factors will influence your choice when it comes to specifying a PLC model for your application. Some key considerations include:

Fig 4-6 Keys for Choosing PLC.

1. Electrical Capacity: PLCs have different voltage requirements for their power supplies, so check to ensure that your selection is compatible with your electrical system. Processing Speed: Check a PLC model's CPU speed to determine whether it meets your application's needs.
2. Compatibility: Ensure that your PLC model is compatible with any new or existing system hardware, whether that's power supplies or DIN rails.
3. Temperature Tolerance: Most PLCs are designed for safe operation within the range of 0 to 60°C. However, some specialized PLC models can operate at extreme temperatures, which is important for facilities with unusually hot or cold manufacturing conditions.
4. Memory: A PLC needs sufficient ROM and RAM to execute the processes it's intended to automate. The controller uses ROM to store its operating system and instructions and RAM to execute its functions.

5. Connectivity: Make sure your PLC has enough input and output ports, and make sure it is able to connect to the type of peripherals that your system requires.
6. Analog I/O: Although PLCs are primarily used for discrete functions, some models also have analog inputs and outputs that can control processes with continuous variables.

4.1.6 Selected PLC

The following figure shows the different components of the logic controller M200 24 IO transistor Source+ Ethernet (TM200CE24T)

Fig 4-7 TM200CE24T

Table 4-1 PLC Table Information

Main	
Range of product	Easy Modicon M200
Product or component type	Logic controller
[Us] rated supply voltage	24 V DC
Discrete I/O number	24
Discrete input number	I2...I5: 4 fast inputs I0, I1, I6, I7: 4 high speed input I8...I13: 6 regular inputs
Discrete output number	Q0...Q1: 2 fast output (PLS/PWM/PTO mode) Q2...Q9: 8 transistor output
Discrete input voltage	24 V
Discrete input voltage type	DC
Discrete input current	7 mA for input
Discrete input logic	Sink or source (positive/negative) type 1 conforming to EN/IEC 61131-2
Discrete output voltage	24 V DC
Discrete output current	0.5 A
Discrete output type	Transistor
Discrete output logic	Positive logic (source)
Power consumption in W	16 W at 24 V DC (with max I/O)
Complementary	
Maximum number of I/O expansion module	4 with 64 discrete output(s) for relay output 4 with 138 discrete output(s) for transistor output
Supply voltage limits	20.4…28.8 V
Inrush current	35 A
Voltage state 1 guaranteed	>= 15 V for input

Voltage state 0 guaranteed	<= 5 V for input
Input impedance	3.3 kOhm for discrete input
Response time	4 with 64 discrete output(s) for relay output 4 with 138 discrete output(s) for transistor output
Maximum number of I/O expansion module	20.4…28.8 V
Supply voltage limits	35 A
Inrush current	1 ms turn-on, Q0...Q9 terminal(s) for output 1 ms turn-off, Q0...Q9 terminal(s) for output 5 µs turn-off, I0, I1, I6, I7 terminal(s) for high-speed input 5 µs turn-on, I0, I1, I6, I7 terminal(s) for high speed input 100 µs turn-off, I2...I5 terminal(s) for fast input 35 µs turn-on, I2...I5 terminal(s) for fast input 100 µs turn-off, I8...I13 terminal(s) for regular input 35 µs turn-on, I8...I13 terminal(s) for regular input
Configurable filtering time	0 ms for input 3 ms for input 12 ms for input
Maximum current per output common	2 A at COM 0 3 A at COM 1

Output frequency	100 kHz for fast output (PWM/PLS mode) at Q0...Q1
Maximum leakage current	0.1 mA for transistor output
Maximum voltage drops	<1 V
Maximum tungsten load	<12 W for output and fast output
Protection type	Overload and short-circuit protection at 2 A
Reset time	1 s automatic reset
Memory capacity	512-byte internal flash for backup of programs
Data storage equipment	32 GB micro-SD card (optional)
Battery type	BR2032 Li-CFx (Lithium-Carbon Monofluoride), battery life: 5 year(s)
Backup time	3 years at 25 °C (by interruption of power supply)
Execution time for 1 Construction	0.3 ms for event and periodic task
Execution time per instruction	0.2 µs Boolean
Exact time for event task	60 µs response time
Clock drift	<= 90 s/month at 25 °C
Regulation loop	Adjustable PID regulator up to 14 sim-ultaneous loops
Positioning functions	PWM/PLS 2 channel(s) at 100 kHz
Control signal type	Quadrature (x1, x2, x4) at 100 kHz for fast input (HSC mode) Pulse/direction at 100 kHz for fast in-put (HSC mode) Single phase at 100 kHz for fast input (HSC mode)

	CW/CCW at 100 kHz for fast input (HSC mode)
Counting input number	4 fast inputs (HSC mode) at 100 kHz 32 bits
Integrated connection type	USB port with mini–B USB 2.0 connector Non isolated serial link serial 1 with terminal block connector and RS485 interface Non isolated serial link serial 2 with terminal block connector and RS232/RS485 interface Ethernet Modbus TCP/IP Ethernet with RJ45 connector and 1 Ethernet port 10/100BASE-T interface Isolated serial link serial 2 with terminal block connector and RS485 interface
Transmission rate	1.2...115.2 kbit/s (115.2 kbit/s by default) for bus length of 15 m for RS485 1.2...115.2 kbit/s (115.2 kbit/s by default) for bus length of 3 m for RS232 12 Mbit/s for USB 10/100 Mbit/s for bus length of 100 m for Ethernet Modbus TCP/IP
Communication port protocol	USB port: USB - SoMachine-Network Non isolated serial link: Modbus master/slave - RTU/ASCII or SoMachine-Network

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	Ethernet Modbus TCP/IP: Modbus TCP/IP client/server
Local signaling	1 LED (green) for PWR 1 LED (green) for RUN 1 LED (red) for module error (ERR) 1 LED (green) for SD card access (SD) 1 LED (red) for BAT 1 LED (green) for SL1 1 LED per channel (green) for I/O state 2 LEDs (green) for communication (LK/ACT 10/100)
Electrical connection	Mini B USB 2.0 connector for a programming terminal RJ45 connector for connecting Ethernet network removable screw terminal block for inputs removable screw terminal block for outputs removable screw terminal block, 3 terminal(s) for connecting the 24 V DC power supply. removable screw terminal block, 4 terminal(s) for connecting the serial link1
Maximum cable distance between devices	Unshielded cable: <50 m for input Shielded cable: <10 m for fast input. Shielded cable: <10 m for high-speed input. Unshielded cable: <150 m for output

Insulation	Non-insulated between inputs Between input and internal logic at 500 V AC Between fast input and internal logic at 500 V AC Between input groups at 500 V AC Between output and internal logic at 500 V AC Between output groups at 500 V AC Between supply and internal logic at 500 V DC
Marking	CE
Mounting support	Top hat type TH35-15 rail conforming to IEC 60715 Top hat type TH35-7.5 plate or panel with fixing kit conforming to IEC 60715
Height	90 mm
Depth	70 mm
Width	130 mm
Net weight	0.424 kg

Usage of PLC in the Project

PLC used to give the signal to the stepper motor to know the place where the drug is and get it to start place. Places are known from the SCADA system which gets data from database then gives information to plc to give right direction and right place of this drug.

PLC Code: - in the end of book **APPENDIX. A**

4.2 Arduino

Arduino is a free and open-source electronics platform with simple hardware and software. Arduino boards can read inputs such as a light on a sensor, a finger on a button, or a Twitter tweet and convert them into outputs such as operating a motor, turning on an LED, or posting anything online. You may direct your board by delivering a series of instructions to the board's microcontroller. You utilize. the Arduino programming language (based on Wiring) and the Arduino Software (IDE) (based on Processing) to do this.

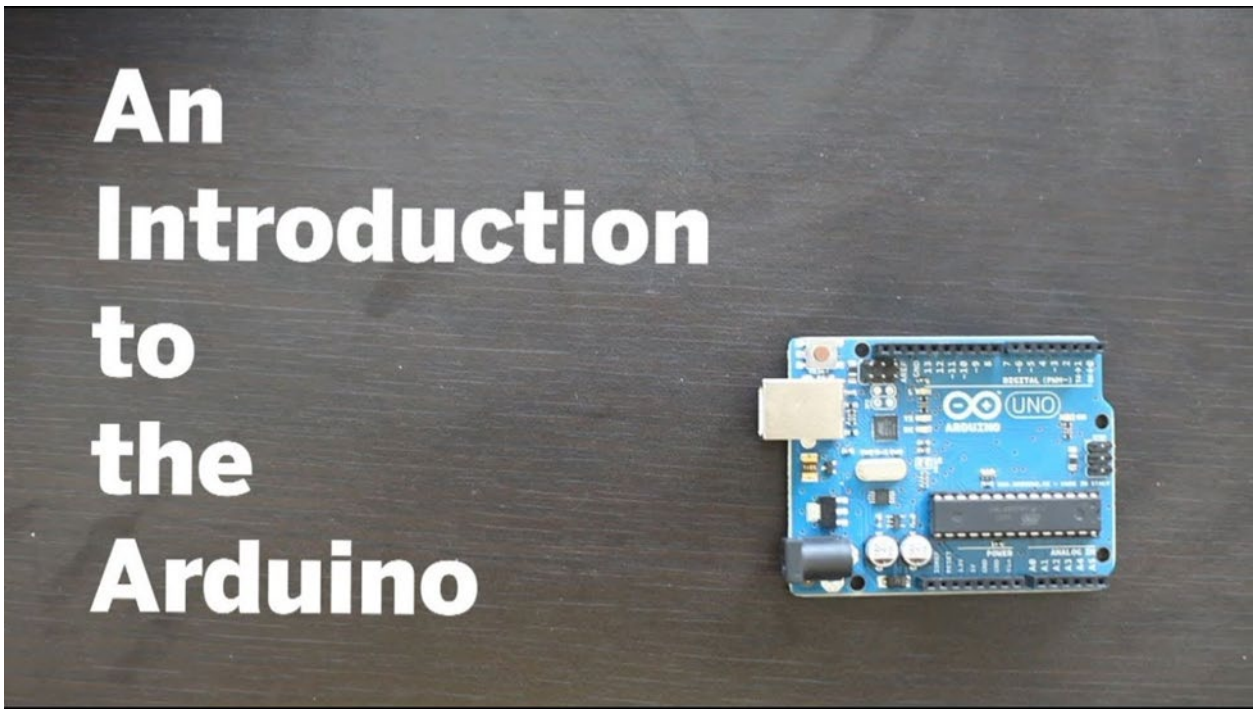

Fig 4-8 What-is-Arduino.

Throughout the years, Arduino has served as the brain of hundreds of projects, ranging from simple household products to complicated scientific equipment. A global community of makers - students, amateurs, artists, programmers, and professionals - has collected around this open-source platform, and their contributions have built up to an astounding quantity of accessible information that may be of tremendous assistance to both novices and specialists.

4.2.1 Hardware structure of Arduino

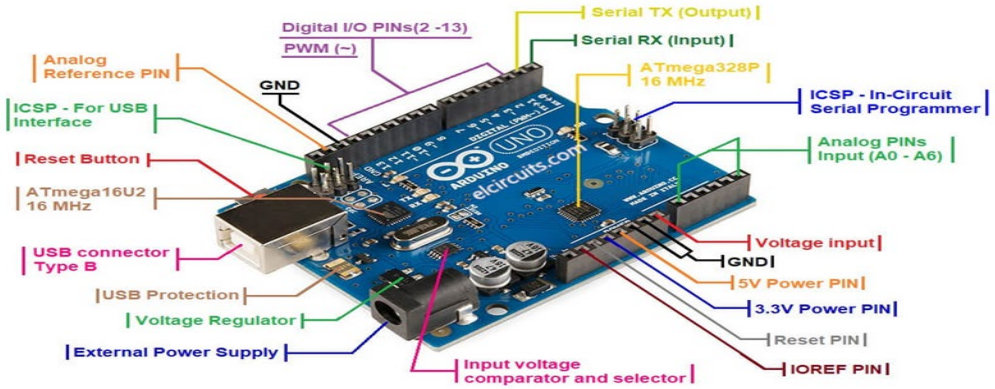

Fig 4-9Arduino Construction

1. Microcontroller:

   The Arduino core processing unit is a microcontroller.

2. Digital Pins:

   The Arduino Uno has no. of digital pins that may be linked to components like as LEDs, LCDs, and so on.

3. Analog Pins:

   has no. of analogue pins. Because all sensors have analogue values, these pins are commonly utilized to link sensors. The majority of the input components are linked here.

4. Power Supply:

   Because all sensors have analogue values, the power supply pins IOREF, GND, 3.3V, 5V, and Vin are utilized to connect sensors. Most of the input components are linked here.

5. Power Jack:

   The Uno board may be powered by an external source as well as a USB connection.

6. The USB port:

   It is used to program the board or upload the program. The Arduino IDE and a USB cable are required to upload the software to the board.

7. The Reset Button:

   allows you to restart the uploaded software.

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4.2.2 Selected Arduino (Arduino Uno)

The ATmega328P-based Arduino Uno is a microcontroller board. It contains 14 digital input/output pins, 6 analogue inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power connector, an ICSP header, and a reset button. It comes with everything you need to support the microcontroller; simply connect it to a computer through USB or power it is using an AC-to-DC converter or battery to get started. You may tamper with your Uno without fear of breaking it; if something goes wrong, you can replace the chip for a few bucks and start over.

The name "Uno" means "one" in Italian and was selected to commemorate the launching of the Arduino Software (IDE) 1.0. The Uno board and Arduino Software (IDE) version 1.0 were the reference versions of Arduino, which have since progressed to later releases. The Uno board is the first of a series of USB Arduino boards and the reference model for the Arduino platform; see the Arduino index of boards for a comprehensive list of current, historical, and obsolete boards.

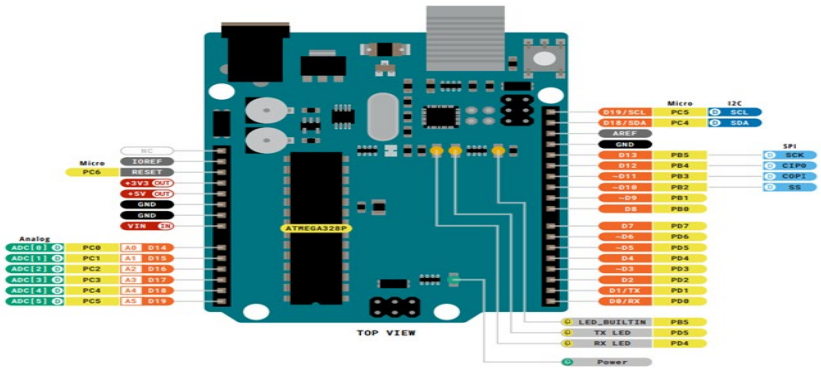


Fig 4-10 Arduino Uno

Table 4-2 Arduino UNO Table Information

Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)

LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g
Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V

Usage of Arduino in the Project

Using Arduino to control the servo motor which is used at gate and tongue to get drug or release it.

Arduino Code: - in the end of book **APPENDIX.B**

Chapter 5

DATABASE, WEB PAGE AND SCADA

Chapter 5

DATABASE, WEBPAGE AND SCADA

5.1 Database

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. Data within the most common types of databases in operation today is typically modeled in rows and columns in a series of tables to make processing and data querying efficient. The data can then be easily accessed, managed, modified, updated, controlled, and organized. Most databases use structured query language (SQL) for writing and querying data. Databases and spreadsheets (such as Microsoft Excel) are both convenient ways to store information. The primary differences between the two are:

1. How the data is stored and manipulated.
2. Who can access the data.
3. How much data can be stored.

Spreadsheets were originally designed for one user, and their characteristics reflect that. They're great for a single user or small number of users who don't need to do a lot of incredibly complicated data manipulation. Databases, on the other hand, are designed to hold much larger collections of organized information, massive amounts, sometimes. Databases allow multiple users at the same time to quickly and securely access and query the data using highly complex logic and language.

5.1.1 What is a MySQL database?

MySQL is an open-source relational database management system based on SQL It was designed and optimized for web applications and can run on any platform. As new and different requirements emerged with the internet, MySQL became the platform of choice for web developers and web-based applications. Because it's designed to process millions of queries and thousands of transactions, MySQL is a popular choice for ecommerce businesses that need to manage multiple money transfers. On-demand flexibility is the primary feature of MySQL.

5.1.2 Database design:

Database design is a collection of steps that help create, implement, and main-tain a business's data management systems. The primary purpose of designing a

database is to produce physical and logical models of designs for the proposed database system.

A well-designed database is one that:

1. Distributes your data into tables based on specific subject areas to decrease data redundancy.
2. Delivers the database the information needed to link the data in the tables.
3. Provides support and guarantees the precision and reliability of data.
4. Caters to your information processing and reporting requirements.
5. Functions interactively with the database operators.

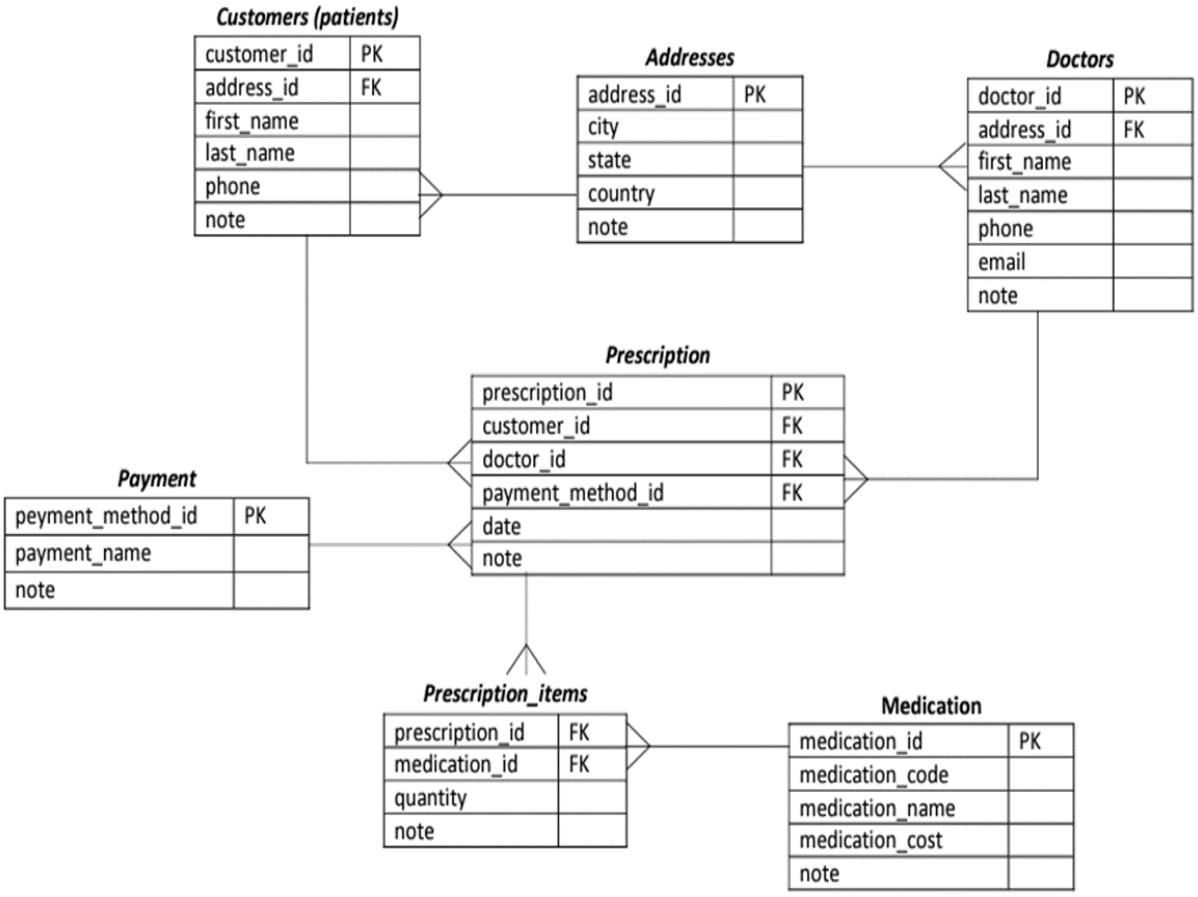


Fig 5-1 Pharmacy Database Structure

The database structure show in the previous figure mainly consists of 7 primary tables:

1. Customers:

   This table has all the information related to a given customer. It has his first name, second name, address, and phone number. The customer id is the primary key in the table, and it has a foreign key as well which will be linked with the addresses table.

2. Doctors:

   This table has all the information related to a given doctor. It has his first name, second name, address, email, and phone number. The doctor's id is the primary key in the table and as well it has a foreign key which will be linked with the addresses table.

3. Addresses:

   This table has all the information about an address. It has cities, states, and country. The address id is the primary key in the table.

4. Prescription:

   This table identifies the real prescription that will be written to a given customer and by a given doctor. The customer id, doctor id and payment method are linked with other tables with primary keys.

5. Prescription Items:

   This contains the medicine required by a customer as well as the quantity of that medicine.

6. Medication:

   This table contains all the necessary information about a given medicine whether it is the name, the cost, or even the code of the medicine.

7. Payment Method:

   It simply contains the type of payment applied to a given prescription.

- Samples:

customer_id	address_id	first_name	second_name	phone	note	age
1	1	Mahmoud	Elsaeed	01156295490	NULL	18
2	1	Momen	Essam	01152248129	NULL	23
3	1	Mahmoud	Ashraf	01158009041	NULL	22
4	1	Mohamed	Sraya	01206968815	NULL	22
5	1	Abdullah	Ahmed	01091820903	NULL	22
6	2	Abdullah	Mohamed	01153605543	NULL	22
7	2	Asmaa	Fawzy	01128482378	NULL	22
8	2	Hossam	Mahmoud	01028581757	NULL	22
9	2	Kholoud	Elsbagh	01208081790	NULL	22
10	2	Mahmoud	Sobhy	01157049061	NULL	22

Fig 5-2 Customer Table

doctor_id	address_id	first_name	second_name	phone
1	1	Azzam	kholy	01156295490
2	2	Magdy	Yaacoub	01156295490
NULL	NULL	NULL	NULL	NULL

Fig 5-3 Doctors Table

address_id	city	state	country	note
1	Giza	NULL	Egypt	NULL
2	Cairo	NULL	Egypt	NULL

Fig 5-4 Addresses Table

medication_id	medication_code	medication_name	medication_cost	note	picture_link	x_position	y_position	capacity	available
1	C10AA05	atorvastatin	150.00	NULL	/system/webdev/Care-hospital/pictures/A1	1	1	5	1
2	N02BE01	paracetamol	100.00	NULL	/system/webdev/Care-hospital/pictures/A3	1	2	5	1
3	N02BE51	panadol	90.00	NULL	/system/webdev/Care-hospital/pictures/A2	1	3	5	100
4	A02BC01	omeprazole	100.00	NULL	/system/webdev/Care-hospital/pictures/A5	1	4	5	100
5	M01AE01	ibuprofen	200.00	NULL	/system/webdev/Care-hospital/pictures/A6	1	5	5	100
6	M02AA15	diclofenac	100.00	NULL	/system/webdev/Care-hospital/pictures/A7	2	1	5	100
7	C02DC01	minoxidil	60.00	NULL	/system/webdev/Care-hospital/pictures/A11	2	2	5	100
8	A02BA02	ranitidine	50.00	NULL	/system/webdev/Care-hospital/pictures/A8	2	3	5	100
9	R01BA02	congestal	40.00	NULL	/system/webdev/Care-hospital/pictures/A9	2	4	5	100
10	N06AB04	citalopram	30.00	NULL	/system/webdev/Care-hospital/pictures/A10	2	5	5	100
11	N06AB45	astrovin	110.09	NULL	/system/webdev/Care-hospital/pictures/A4	3	1	5	100
12	NULL	selenium ace	30.40	NULL	/system/webdev/Care-hospital/pictures/A12	3	2	5	100
13	NULL	c retard	110.09	NULL	/system/webdev/Care-hospital/pictures/A13	3	3	5	100
14	NULL	norgesic	110.09	NULL	/system/webdev/Care-hospital/pictures/A14	3	4	5	100
15	NULL	decancit	110.09	NULL	/system/webdev/Care-hospital/pictures/A15	3	5	5	100
16	NULL	zinctron	110.09	NULL	/system/webdev/Care-hospital/pictures/A16	4	1	5	100
17	NULL	vitlux plus	110.09	NULL	/system/webdev/Care-hospital/pictures/A17	4	2	5	100
18	NULL	lutein omega-3	110.09	NULL	/system/webdev/Care-hospital/pictures/A18	4	3	5	99

Fig 5-5 Medication Table

prescription_id	customer_id	doctor_id	payment_method_id
1	1	1	1
2	2	1	1
3	3	1	1
4	4	1	1
5	5	1	1
6	6	2	2
7	7	2	2
8	8	2	2
9	9	2	2
10	10	2	2

Fig 5-6 Prescription Table

5.2 Webpage:

Two pages have been developed,

1. The page for writing prescriptions by doctors:

The first of which is used by doctors only to write prescriptions electronically. This is to avoid errors that may occur when the pharmacist reads the prescription incorrectly or takes a substitute medication that may affect the patient's health. The patient's information, such as name, age, and hospital specific code, is recorded on the page, and the doctor selects the medications. The page helps the doctor choose the medication quickly, and there is a group of medications specific to each doctor to prevent the doctor from prescribing medications outside their specialty. When the doctor selects a specific med-ication, they can modify its name or the required quantity and write instructions for taking the medication.

To design this page, the following programming languages were used:

1. HTML: Used to write the content of the page.
2. CSS: It was used to make the outer appearance clear to the user.
3. JAVA SCRIPT: It was used to write the code controlling the page, such as giving a value to certain elements.
4. PHP: It is used to send and receive data from the database.

The site consists of:

1. Login Page

The login screen is important for several reasons:

a. Security: It helps to ensure that only authorized users have access to the system or application.
b. User management: The login screen can be used to manage user accounts, including adding and deleting users, resetting passwords, and setting user permissions.
c. Compliance: In some industries, such as healthcare and finance, login screens are required by law to meet certain security and privacy standards

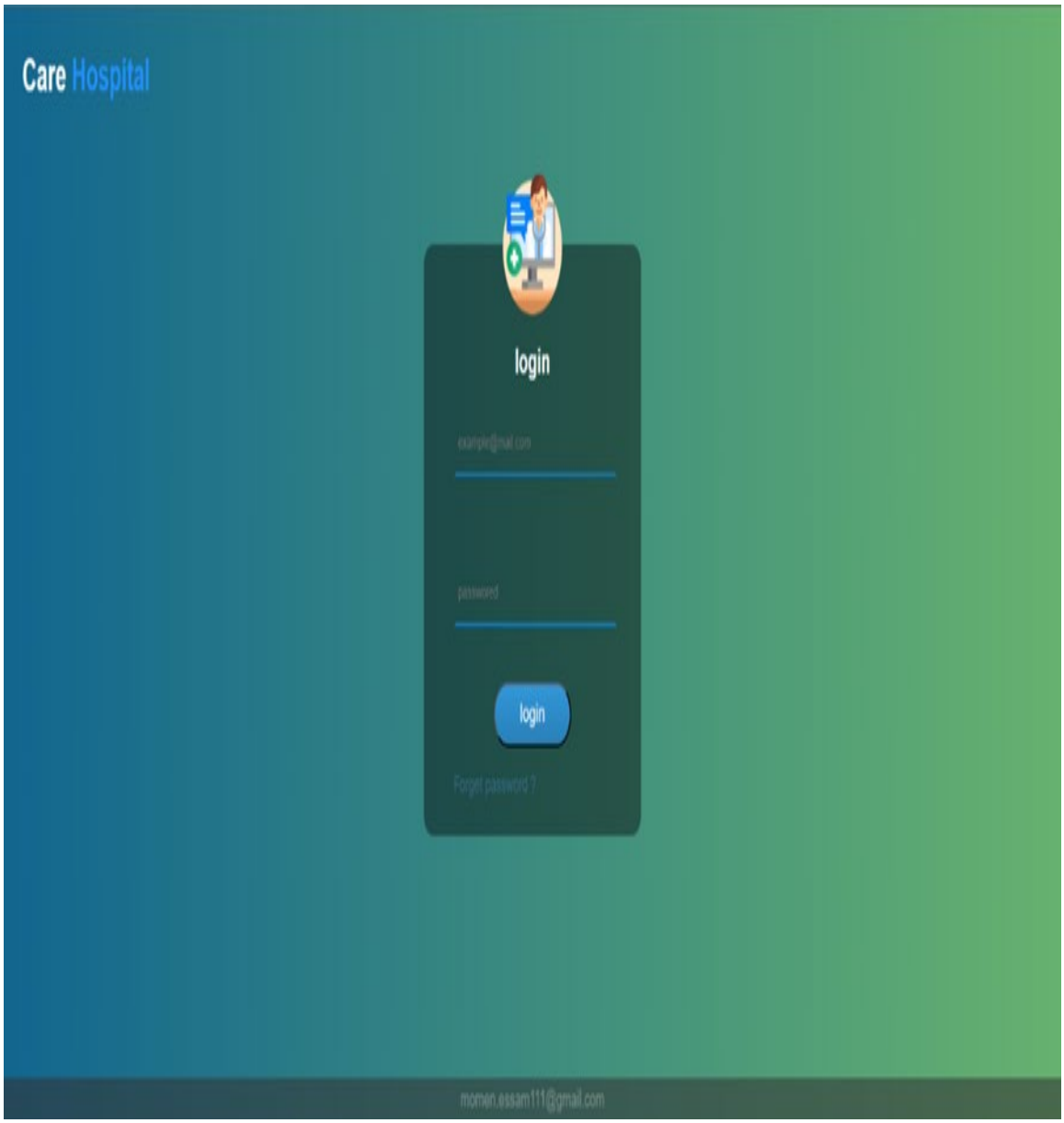


Fig 5-7 Login Page

2. Home Page

On this page, the doctor will write the prescription, and after completing it, it will contain a QR code that distinguishes this prescription from others, and the doctor will be able to print it on paper for the patient to take, and all data will be stored on the doctor's data base, in order to follow up on the patient's condition at a later time. After the doctor finishes writing the prescription, they can then print it in PDF format and hand it to the patient. The patient takes the prescription that contains a QR code which distinguishes it from others. When they go to the pharmacy, the system only reads the QR code to fulfill the patient's request.

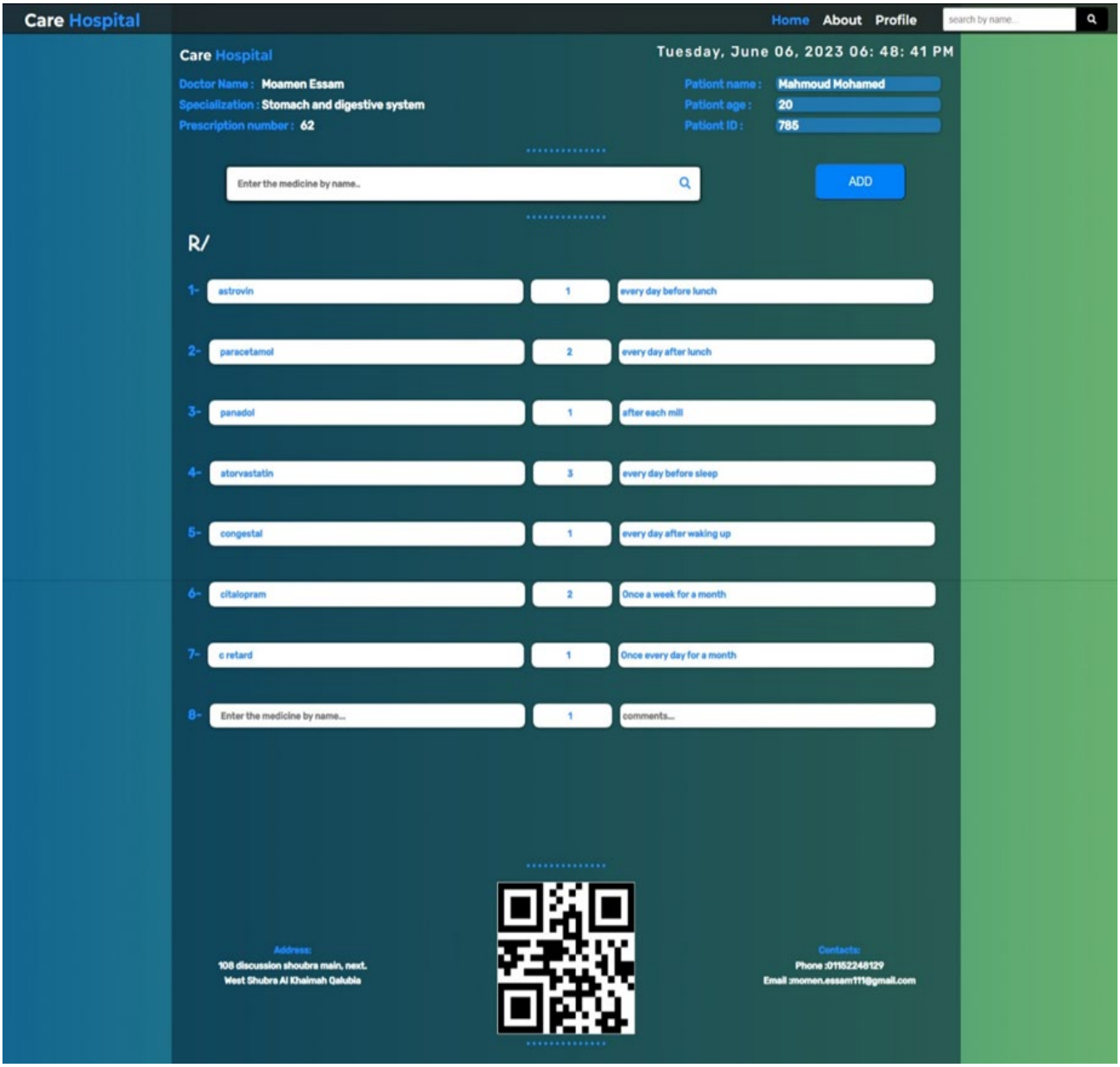


Fig 5-8 Home Page to Write the Prescription.

3. About Page

This page is used to help the doctor recognize the different departments in the hospital, familiarize themselves with other treatment departments, and identify other doctors present in the hospital. All of this makes it easier for the doctor to know about other departments and their staff to help patients by providing suggestions. Additionally, all hospital updates and future are displayed here.

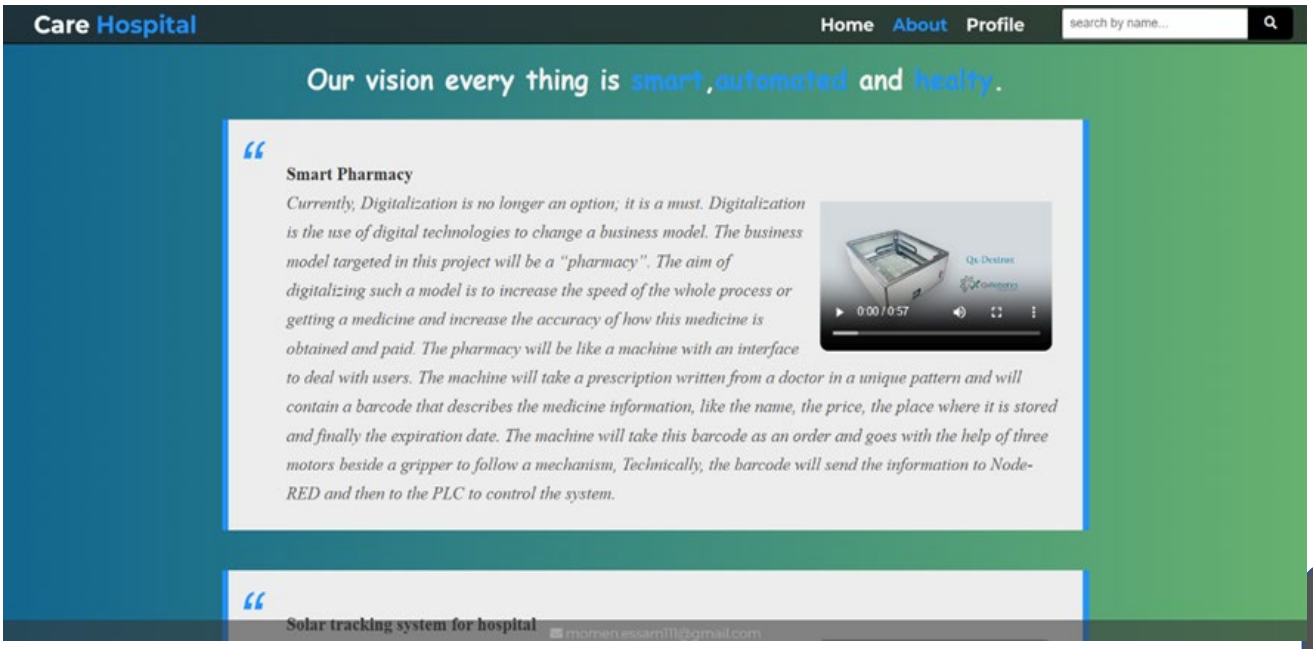


Fig 5-9 About Page

4. profile Page

This page will contain the doctor's personal information that characterizes his specialization and interests.

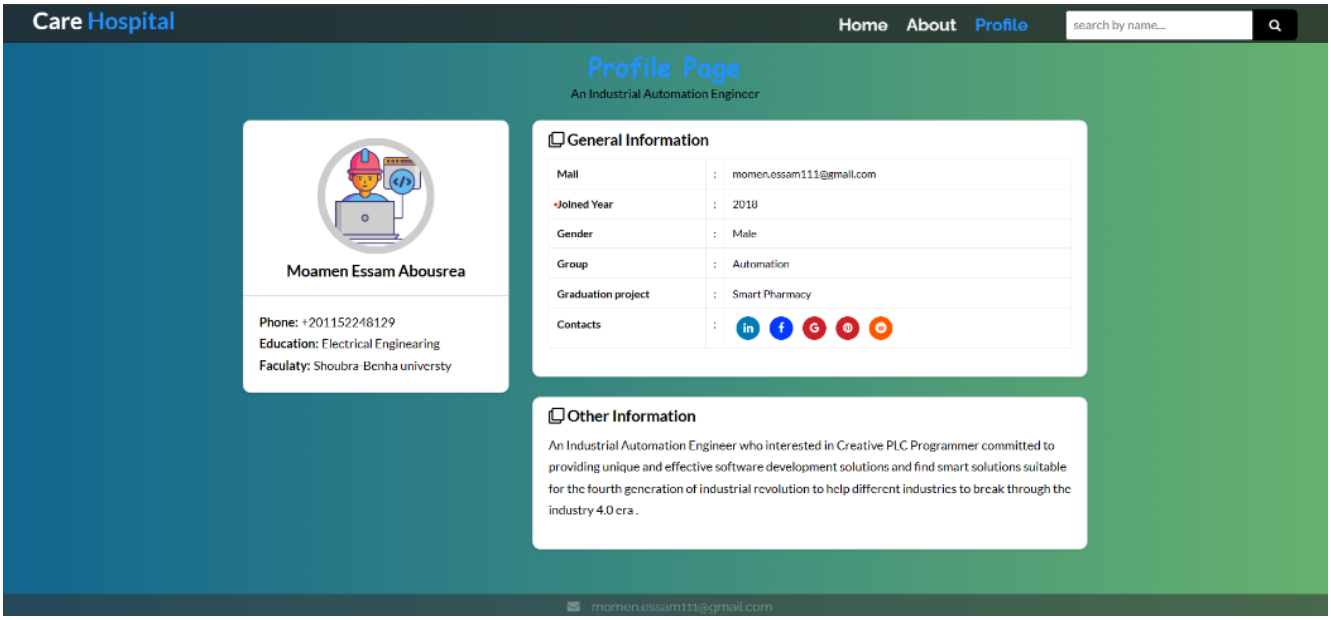


Fig 5-10 Profile Page

5. Feedback Page:

Another page has also been developed and is responsible for collecting patient feedback and their satisfaction with the services provided by the hospital and pharmacy. There will also be a QR code that patients can scan, and it will take them to the feedback website. This way, they can follow up on customer satisfaction with the services provided. An analysis will be conducted on these ratios within the dashboard, especially for feedback that contains specific issues.

To design this page, the following programming languages were used:

a. HTML: Used to write the content of the page.

b. CSS: It was used to make the outer appearance clear to the user.

c. PHP: It is used to send and receive data from the database.

The QR code for patients to scan and be taken to the website.

Fig 5-11 QR Code for Feedback Page

Patient satisfaction will be evaluated, including satisfaction with the treating physician, the speed of receiving medication through the smart pharmacy, and overall service evaluation. This element is mandatory, and the form will not be submitted without it. Patients will be able to send a contact number to reach a solution to their problem and send a message. After the patient submits the form, it will be stored in the database, and the data will be received within the dashboard. Data analysis will be performed using Python language. This analysis will help improve the quality of services provided and identify areas that need improvement and development.

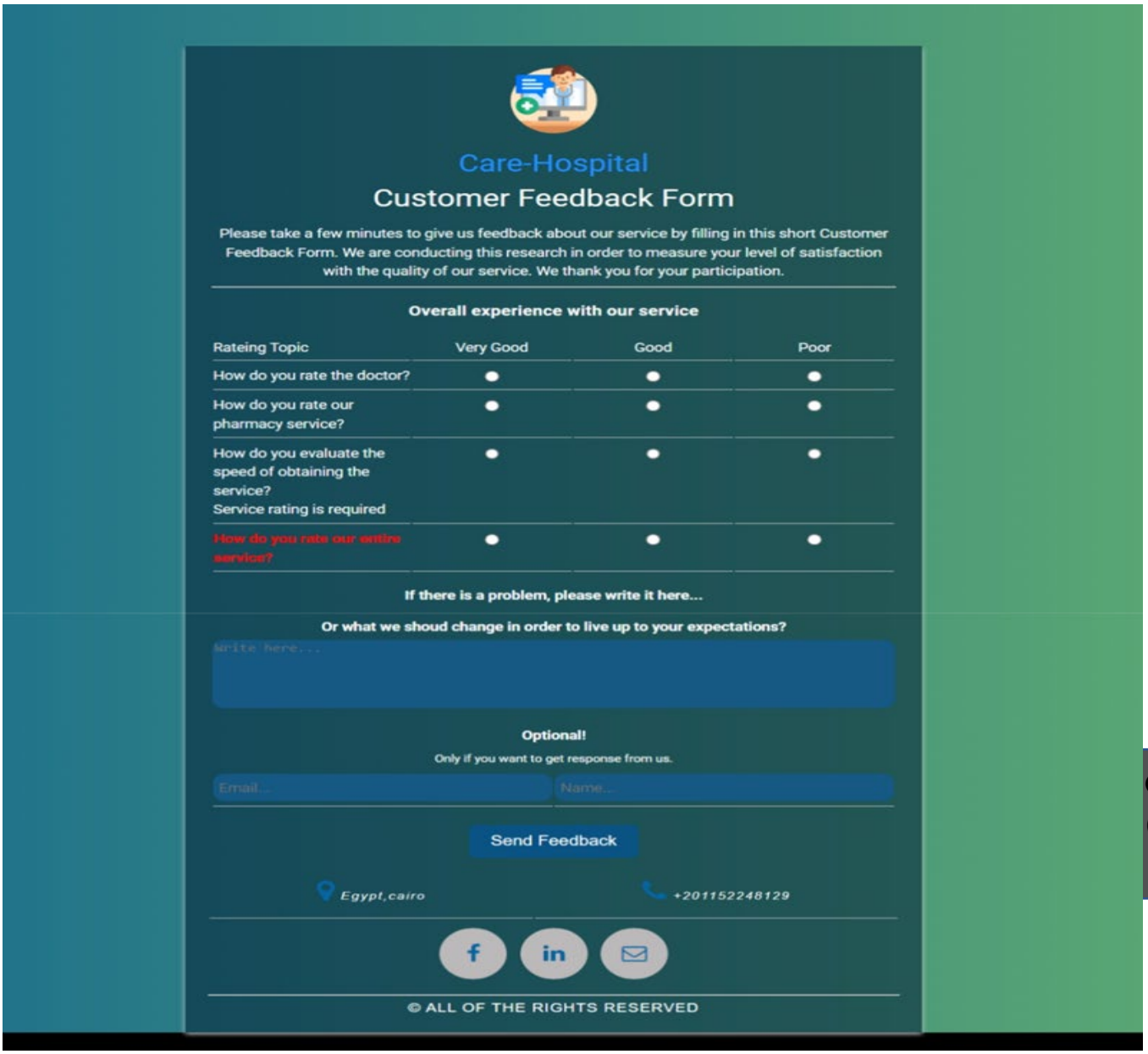


Fig 5-12 Feedback Page

Ch (5)

5.3 SCADA

Let us talk about our Supervisory control and data acquisition (SCADA) in detail.

1. Home View

Fig 5-13 SCADA Home View

a. Air Quality We measure it by electronic sensor via Arduino to display it in the screen in real time because of its importance in ADS.

b. Temperature We measure it by electronic sensor (DHT-22) via Arduino to display it in the screen in real time because of its importance in ADS and its range depending on the product which is storage, and it is important because if it increases above the range, the product will destroy.

c. Humidity We measure it by electronic sensor (DHT-22) via Arduino to display it in the screen in real time because of its importance in ADS and its range is 35-65% RH usually.

d. Dust We measure it by electronic sensor then display it. This makes us able to see if the dust increases, we will notice quickly and act faster than before so the unplanned time for cleaning will be decreased.

e. Today's Sales: This section is dedicated to presenting everything related to the sales that occurred during this day. It shows the total income earned, the number of customers served on this day, the quantities of drugs sold, and the quantities of drugs that are currently out of stock.

f. Pharmacy storge system information in this table, we show the number of regions and the number of cells, and you can also increase them if the system has expanded.

g. Patient Visits by Health Insurance Level: This is to indulge in financial analysis by showing the attendance rates of patients with different health insurance levels at the hospital, as well as the percentage of visits made by uninsured patients.

h. It is possible to operate the interior lighting of the pharmacy, turn on and off the system, and display the remaining time for the shift to end through the SCADA system.

i. Best seller in last Month This parameter comes after analysis on the product's data base to let the user knows the most in-demand product to have a competitive advantage and a good understanding of the market.

j. Online Orders: This section is responsible for displaying the number of online orders, whether through the mobile application or any device.

k. It is possible to operate the interior lighting of the pharmacy, turn on and off the system, and display the remaining time for the shift to end through the SCADA system.

2. <u>Feedback View</u>

Fig 5-14 SCADA Feedback Analysis View

Ch (5)

Referring back to the feedback form that was explained on the website, there was a feedback form that the patient fills out to express their level of satisfaction with the service provided to them. After that, all data is stored in the database, and we perform analytics on it within the SCADA system to display the following:

a. The patient's satisfaction level with the treating physician.
b. The speed of receiving the service.
c. The evaluation of the smart pharmacy.
d. The reception of these forms to identify the customers' desire to deposit their opinion about the pharmacy and the hospital.
e. The overall evaluation of the entire system.
f. Finally, negative comments are displayed to reach a solution to their problems as soon as possible.

3. Order View

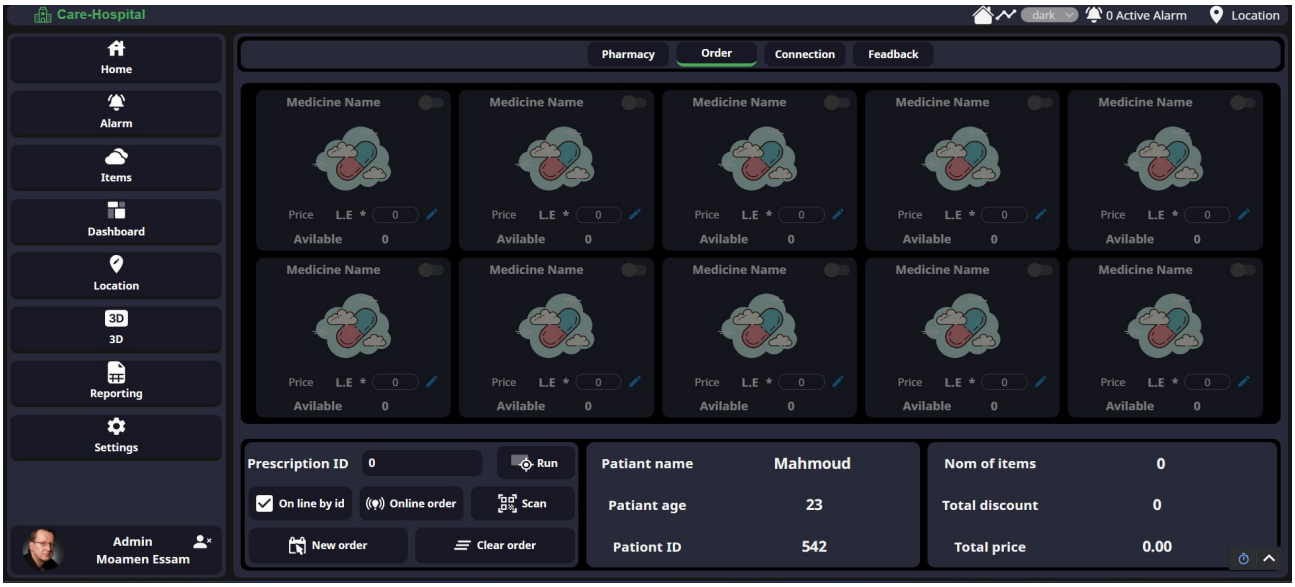


Fig 5-15 SCADA Order Page with Prescription View

This page is responsible for executing a new order. Only the pharmacist enters the prescription number that he wants to execute or scans the QR code on it. Then he clicks on "New Order", and then the complete prescription data is displayed. The pharmacist can cancel any drug or change the quantity according to the customer's desire. Also, there is an opportunity to add a discount for the customer deducted from the total cost.

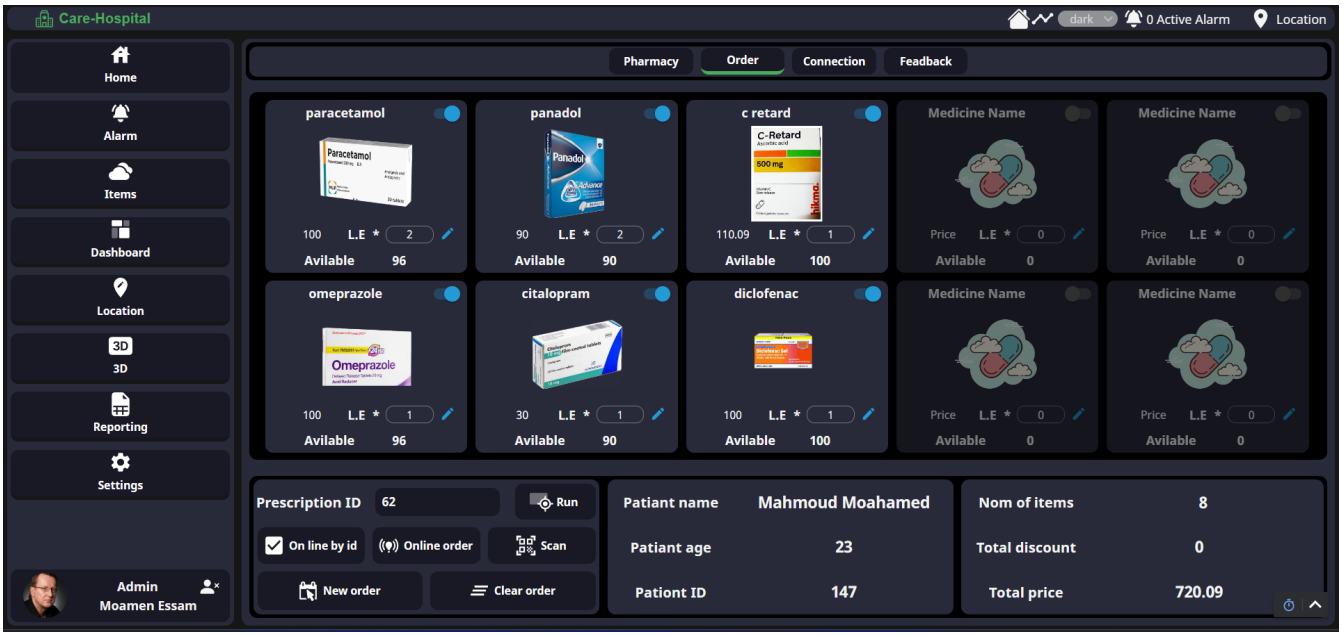


Fig 5-16 SCADA Order Page with Prescription with Order View

If I assume that I will execute prescription number 62, all I need to do is scan the prescription using the camera and it will be read directly inside the SCADA.

4. Prescription Paper

If we go back to the printed prescription through the page responsible for writing the prescription for doctors, we will find a 100% match of the data, which helps in the development of the system. We can also find the prescription number located at the top, which the doctor can write manually or scan the QR code located at the bottom of the prescription.

Fig 5-17 Prescription Printed Paper.

When it comes to executing online orders that come from the mobile application, there are two types of orders: either the patient requests specific medications by selecting them, or the patient requests a complete prescription.

1. Online Order by Prescription ID

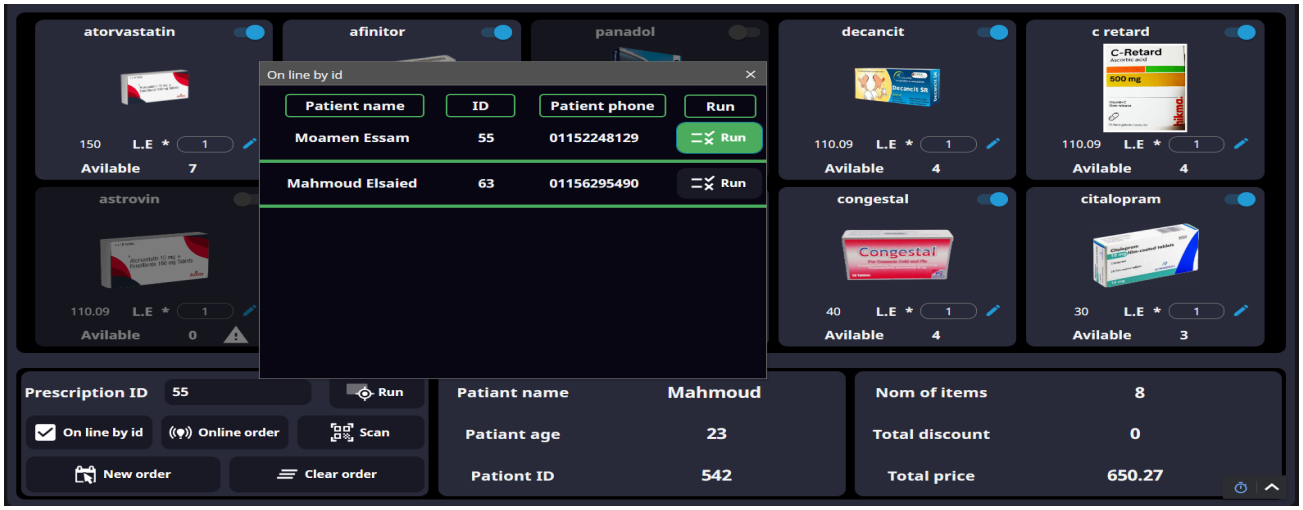


Fig 5-18 Online Order by Prescription ID

Here, an order has been placed with a specific prescription number, and the prescription will be executed in full.

2. Online Order Specific Medications

Fig 5-19 Online Order Specific Medications

Here, the patient can request a set of different medications through the phone, and once the call is made, the system will execute this order.

5. Dashboard View.

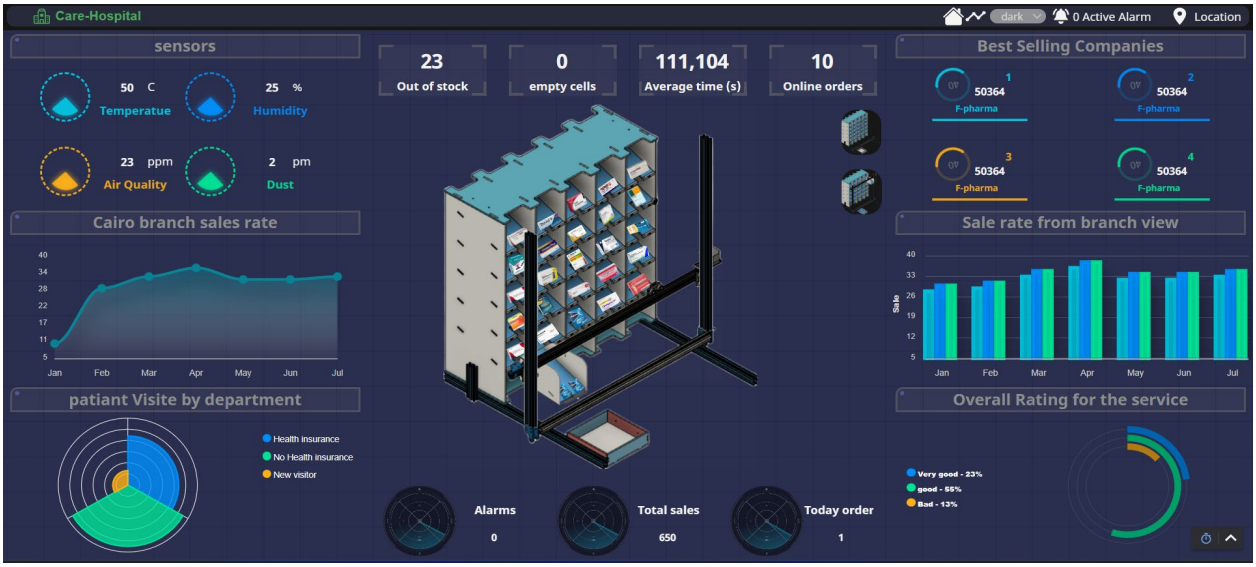


Fig 5-20 SCADA Dashboard View

The dashboard page is directly responsible for displaying information about the pharmacy in real-time, including temperature, humidity, air purity level, and dust level. The dashboard page also displays statistics about the pharmacy's sales and compares them with other branches to determine the pharmacy's progress. This includes comparing sales numbers, revenue, and profits with other branches. The dashboard page also includes a 2D model that simulates the movement of the system in real-time. This helps the pharmacist to monitor the progress of the smart pharmacy's order execution and to know how close it is to completing the current order.

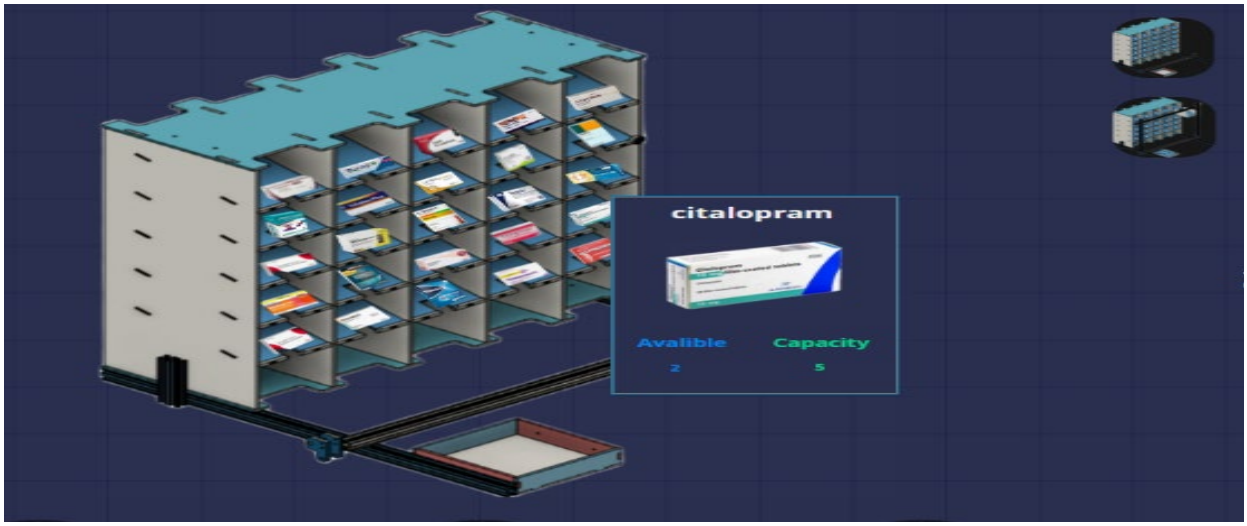


Fig 5-21 3D Simulation Model

The 3D model also helps to know the quantities of medication available in each cell and the capacity compatible with this type of medication. If one of the cells runs out of the available medication, its image will disappear completely. This is to quickly alert the pharmacist that it needs more medication.

When the pharmacist stands on a specific medication in the SCADA, a message will appear showing the medication information for that cell, such as the medication name, available quantity.

6. Single Line Diagram (SLD) View.

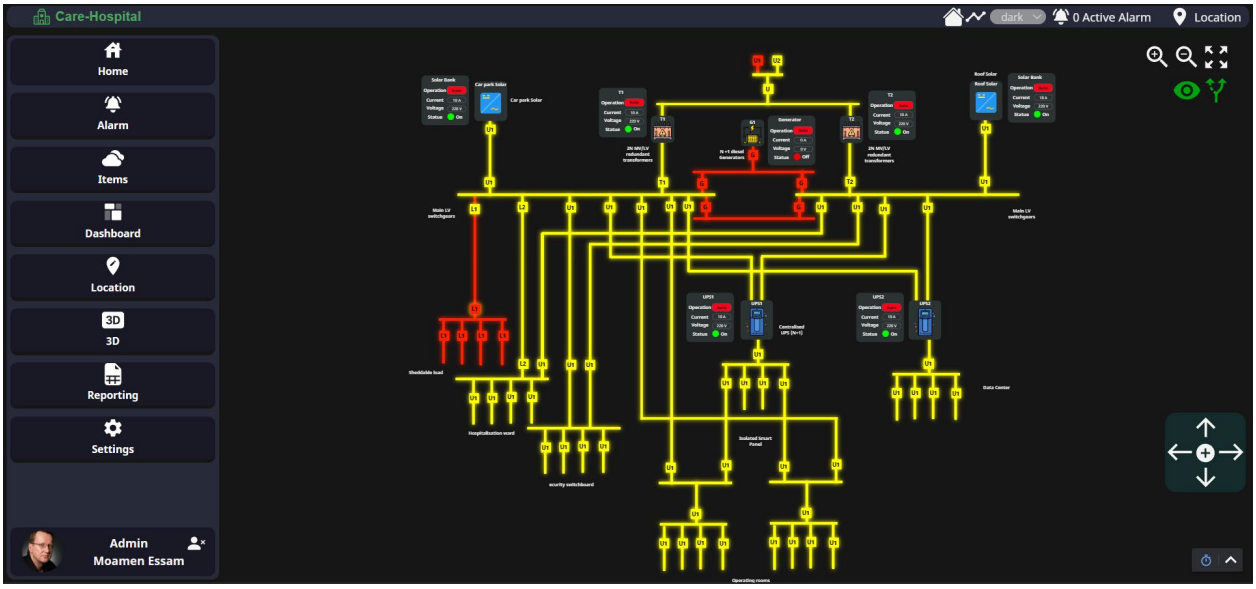


Fig 5-22 Single Line Diagram (SLD) View

This page is only for displaying a single-line diagram for the consumer and controlling the consumed electricity source. It is also used to ensure that the consumption is running smoothly. Zooming in on any part of the screen is possible as shown, and any source can be disconnected or turned on.

7. New Prescription and Direct Order:

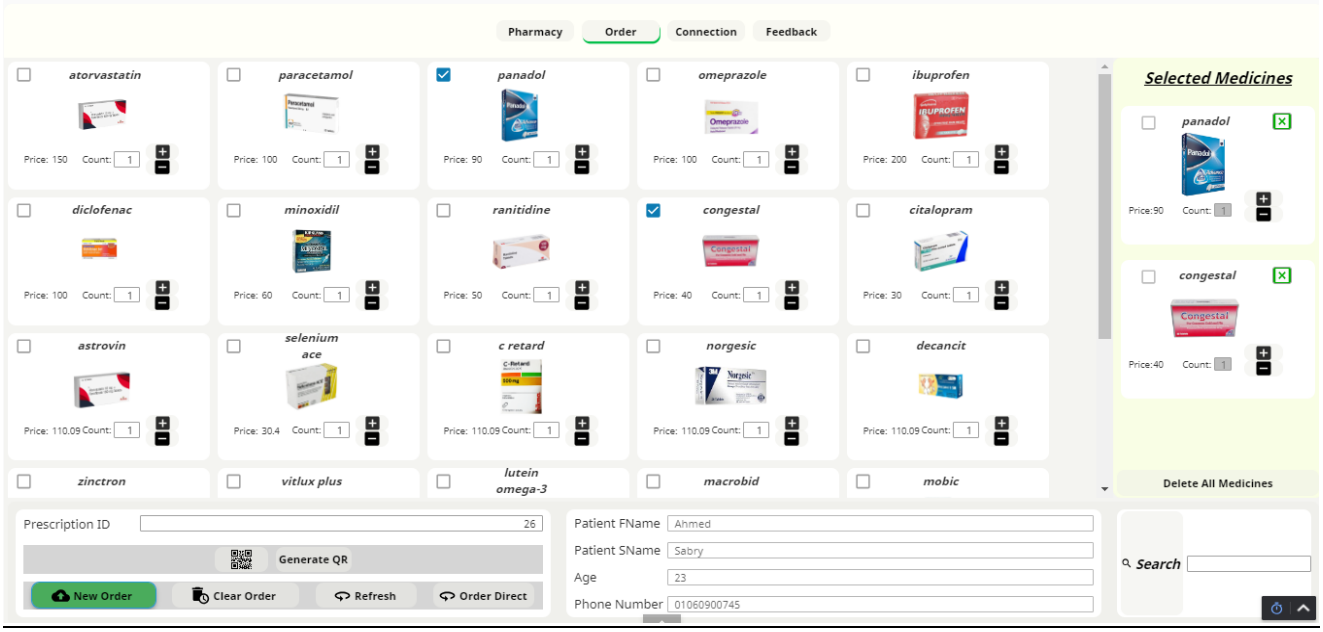


Fig 5-23 New Prescription and Direct Order

1. New Order Button:

   The button saves all the data shown in the view and creates a prescription with a QR code of prescription id. The prescription is shown in the figure below. The selected medicines on the right of the view shows all of the selected medicines in the left of the view with the quantities specified.

2. Delete All Medicines Button:

   The button action removes all the medicine instances in the (selected medicine) as well as the medicines chosen on the left of the view.

3. Clear Order Button:

   The button action clears everything including the name, the age, and the phone number of the customer.

4. Order Direct Button:

   It orders the medicines specified directly by writing a new prescription in the database.

Fig 5-24 Medicine Out of Stock

If any medicine is out-of-stock the out-of-stock sign will appear on the medicine as a guide to the doctor or the pharmacist. The same occurs if the number of orders for a specific medicine is larger than the number of available medicines of that type.

8. Prescription:

The QR shown on the pdf can be scanned by any pharmacy on the system and the order will be applied by another view

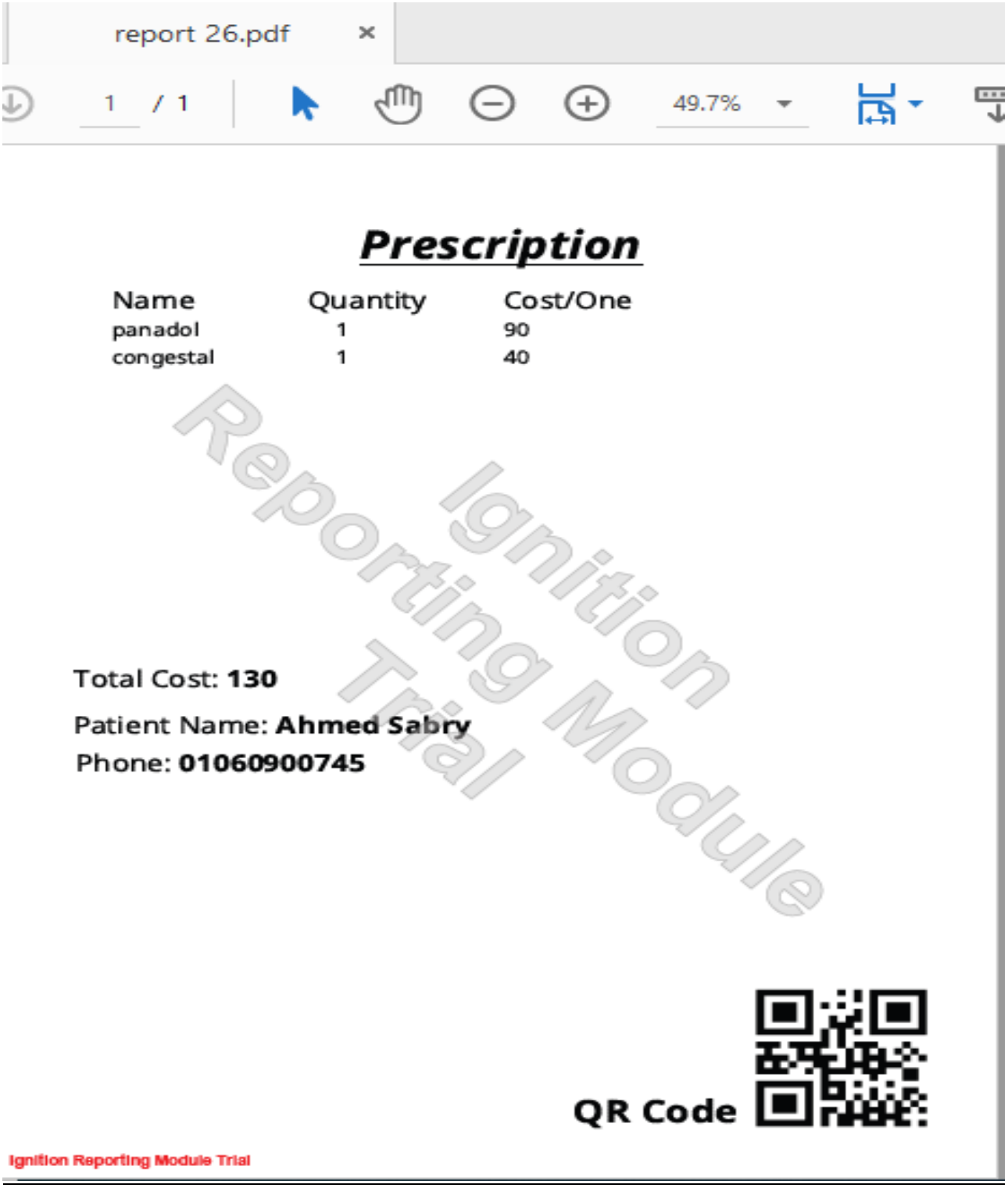


Fig 5-25 Prescription pdf

9. Scan View:

This view is from a phone as the QR code will be scanned from any mobile device that is connected to the system through Wi-Fi. The "Order Now" button orders the prescription immediately if no errors exist. If some of the medicines required are out-of-stock or even the available amount is less than required, a table of these issues will appear to the user for a demonstration of the situation.

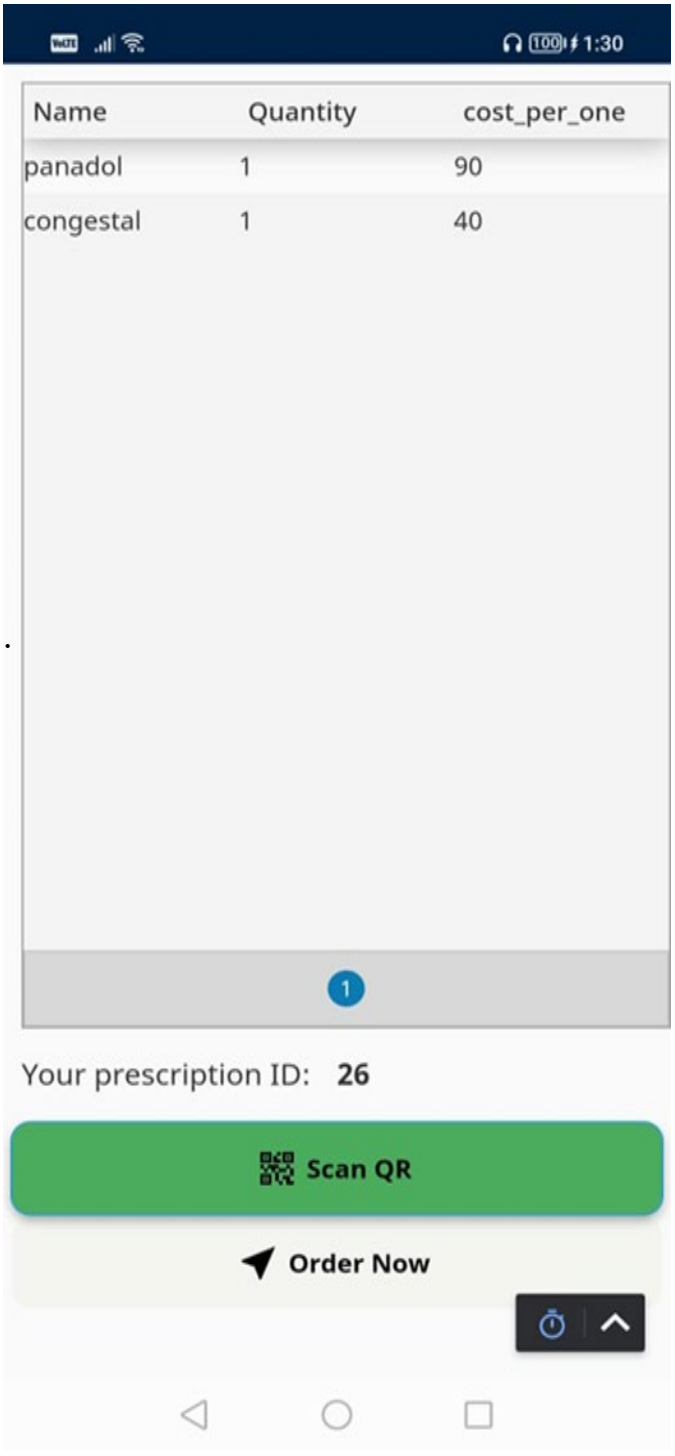


Fig 5-26 Scan View

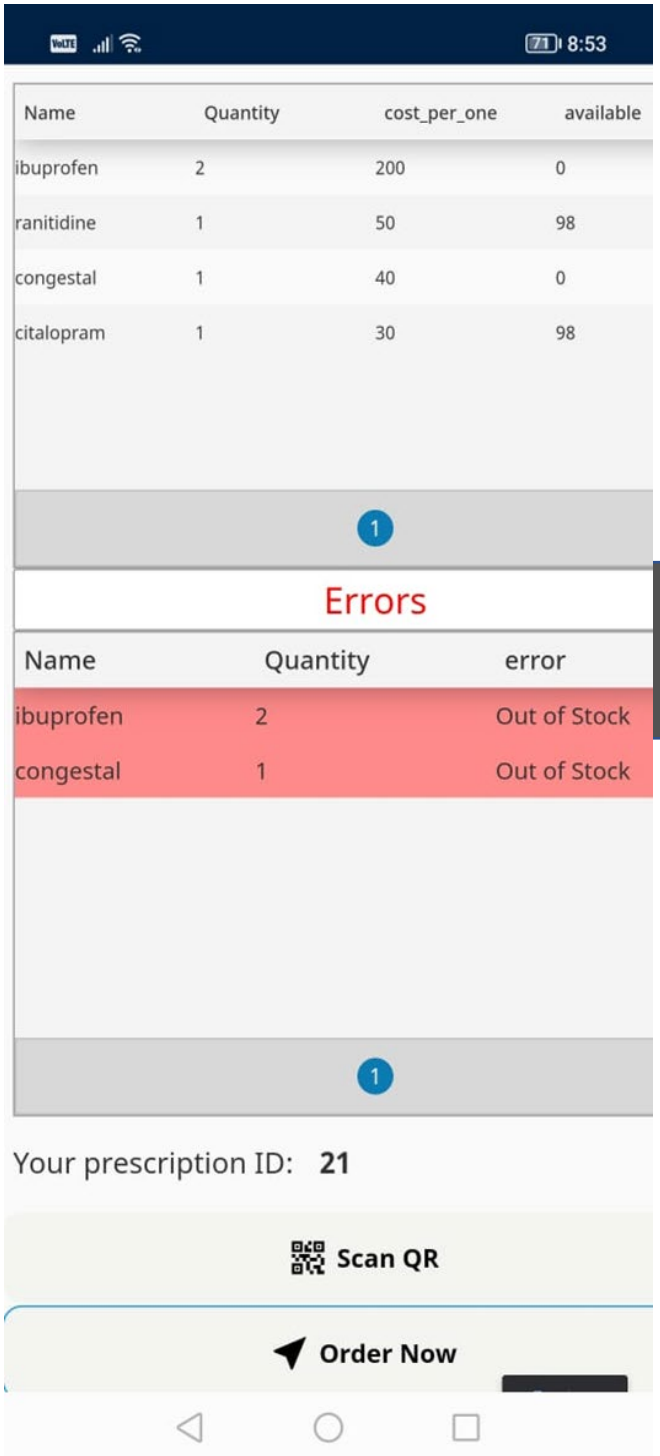


Fig 5-27 Scan View Errors

Ch (5)

10. App Connection:

ID	username	phone	medic	posx	posy	quantity	medication_id
3	momen	01152248129	tenormin	5	4	1	24
5	kholod	01208081790	vitlux plus	4	2	3	17
6	hossam	01128284443	tadalafil	5	3	1	23
7	saeed	01156295490	tenormin	5	4	2	24
8	saeed	01156295490	tadalafil	5	3	2	23
10	hossam	01128284443	astrovin	3	1	4	1

Fig 5-28 Booking Table

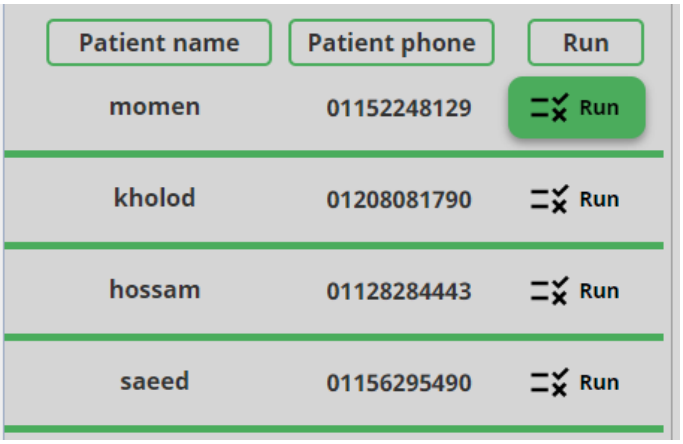


Fig 5-29 Online Order Layout

This view will be controlled by the pharmacist as he will be able to order the prescription at any time available. The pharmacist just needs to click on the run button to do so.

Chapter 6

HUMAN MACHINE INTERFACE (HMI)

Chapter 6

HUMAN MACHINE INTERFACE (HMI)

6.1 Introduction

A human-machine interface or man-machine interface is a combination of software and hardware which will help the operator to communicate between systems and machines. The HMI system is inevitable in most industries. The automation system is not completed without an HMI. With the help of an HMI, the operator can check the plant operation in real-time. The HMI can alarm the operator if there is any fault. So basically, the HMI can be considered as the user interface in manufacturing or process control system. The HMI will give a graphic based visualization of industrial control and monitoring system. With the help of HMI, we can increase productivity in a plant with the help of a centralized control center. While the term can technically be applied to any screen that allows a user to interact with a device, HMI is most used in the context of an industrial process.

6.2 Needing of Human Machine Interface

1. It can do the visual display of the data and it can find out the production faults too.
2. It can determine the production time, trends, and tags.
3. Improved efficiency and production.
4. It would sound the alarm if there were any faults.
5. By using the HMI, the operator can give instructions to the machine.
6. By using HMI, we can control, manage, and visualize the device process in an industry. This will allow the user to determine and respond to abnormal conditions.

6.3 Human Machine Interface Working Principal

The HMI consists of a monitoring screen, operating panel, and communication ports. The HMI can be integrated into our process with the help of a PC, and it is done by using certain software and then the program will be transferred to the HMI and the HMI will run the program. The devices in the factory can be connected to the HMI like the machinery in a production line and the input-output sensors and these sensors will give the data to the PLC. The monitoring screen in HMI will allow the user to interact with the HMI. The HMI has an operating panel and by this, the operator can do the required functions. The communication ports in the HMI are to program the HMI to communicate with other devices so the devices in a factory can communicate with HMI.

6.4 Difference Between SCADA and HMI

Supervisory Control and Data Acquisition (SCADA) and HMI are closely related, and often referred to in the same context since they are both part of a larger industrial control system, but they each offer different functionality and opportunities. While HMIs are focused on visually conveying information to help the user supervise an industrial process, SCADA systems have a greater capacity for data collection and control-system operation, the SCADA system consists of RTU, sensors, and PLC's. Unlike SCADA systems, HMIs do not collect and record information or connect to databases and they cannot be connected to several processes. Rather, HMI provides an effective communication tool that functions as part of, or alongside, a SCADA system. For more information on SCADA.

6.5 Advantages of HMI

1. Productivity can be Improved:

   By using the HMI, we can improve the efficiency of a machine which performs a task, so now with the help of HMI we can do more work in less time.

2. Data Saving:

   The HMI has the data saving feature, it can record the data. So, all we must do is to type the command into the HMI then it will connect to the device automatically and the data will be recorded. This data could be useful for troubleshooting and clearing mechanical faults.

3. Internet of Things:

   IOT can be considered as the collection of the devices, the HMI is also connected to the internet and because of this the remote controlling and network monitoring is possible.

4. Data Translation:

   The HMI would convert the data from the industrial control system into under standable data for the operator mostly it will be a visual representation and by this, the operator would be able to see the graphical representation of the system and it can be controlled.

5. Hardware Cost can be Decreased:

   By using the HMI, we are reducing the industrial costs by eliminating or reducing the consoles, panels, cables, etc.

6.6 Applications of HMI

HMI technology is used by almost all industrial organizations, as well as a wide range of other companies, to interact with their machines and optimize their industrial processes.

1. In industrial automation HMI is inevitable, so it is widely used in industrial automation.
2. HMI is used in vehicles; it is used in advanced driver assistant systems.
3. It is used in the medical field.
4. It is used in manufacturing industries.
5. Oil & gas.
6. Power.
7. Recycling.
8. Food processing.
9. Health care.
10. Broadcast.
11. Robotics.
12. Military and aerospace.

The most common roles that interact with HMIs are operators, system integrators, and engineers, particularly control system engineers. HMIs are essential resources for these professionals, who use them to review and monitor processes, diagnose problems, and visualize data.

6.7 Human Machine Interface used in the Project (HMIGXU3500).

Fig 6-1 HMI Panel

6.8 Package Contents

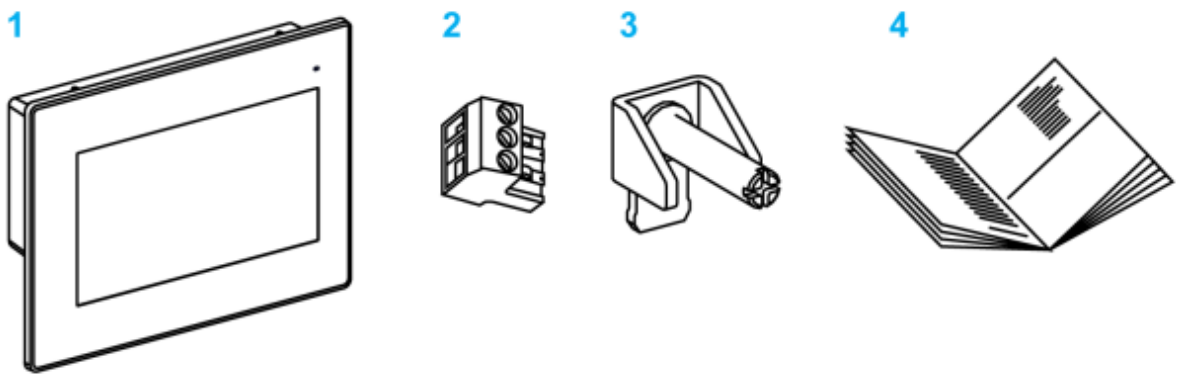
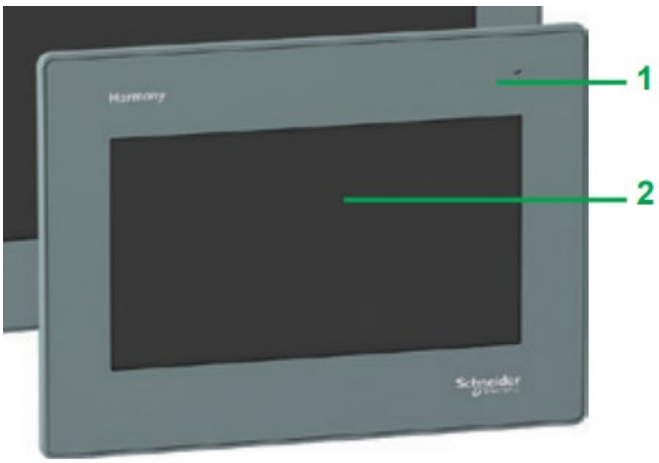


Fig 6-2 HMI Package Content

1. Panel
2. DC power connector
3. Screw installation fasteners
4. HMIGXU Installation guide

6.9 Parts Identification and Functions

6.9.1 Front View



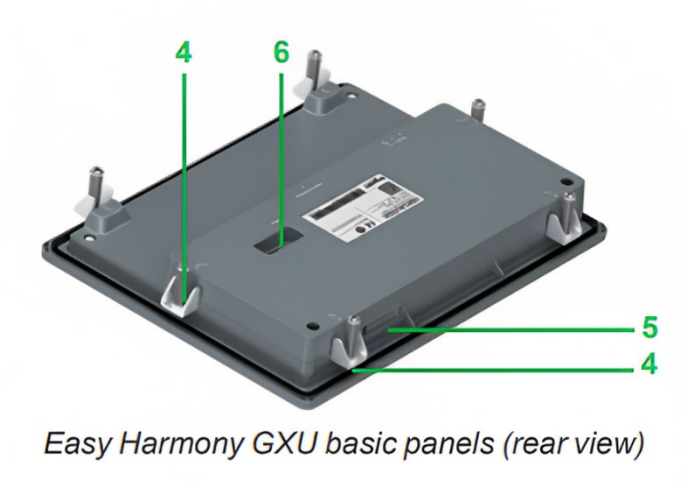
On the front panel

1. LED on/off indicator
2. A 7” Wide color touch screen

Ch (6)

Fig 6-3 HMI Front View

6.9.2 Rear View

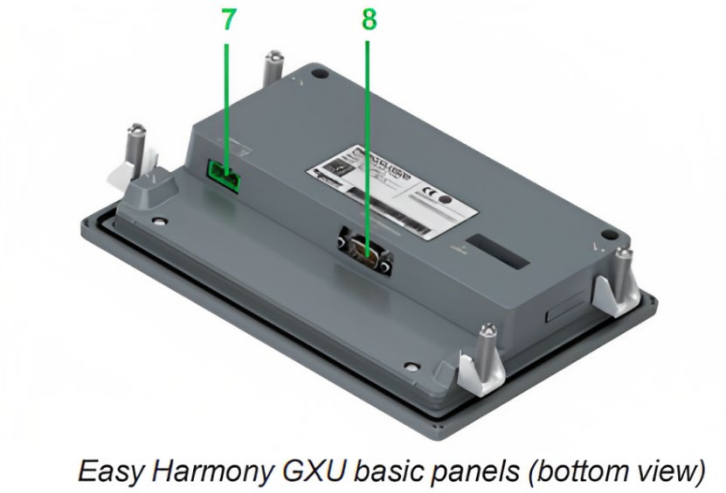


On the rear panel

4. Screw fixings supplied with the panels: 4 fixing points for HMIGXU3500.
5. A slide-open compartment containing a replaceable battery to power the embedded real-time clock.
6. A USB Mini-B port

Fig 6-4 HMI Rear View

6.9.3 Bottom View



On the underside

7. A 24 V c power supply connector supplied with the panels.
8. A 9-way male SUB-D connector for RS - 422/RS - 485 serial link (COM1 port)

Fig 6-5 HMI Bottom View

6.10 Configuration Software

Vijeo Designer Basic develops applications to be transferred to the HMI

Fig 6-6 6 Vijeo Designer Basic Logo

6.11 Connection Accessories

6.11.1 USB Cable for PC Connection (USB type A/USB Mini-B)

Enables connection of a PC (USB type A port) to Harmony GXU panels (USB Mini-B port, all models) in order to transfer applications developed with Vijeo Designer Limited Edition.

Fig 6-7 USB Type A/USB Mini-B Cable

6.11.2 Cables for Connecting Easy Harmony GXU Panels to Schneider Electric Products

Physical link (panels port) RS – 485 Type of connector (automation product end) RJ45 Protocol Modbus

Fig 6-8 RS – 485 Cable

6.12 Panel Screens

6.12.1 Security Panel

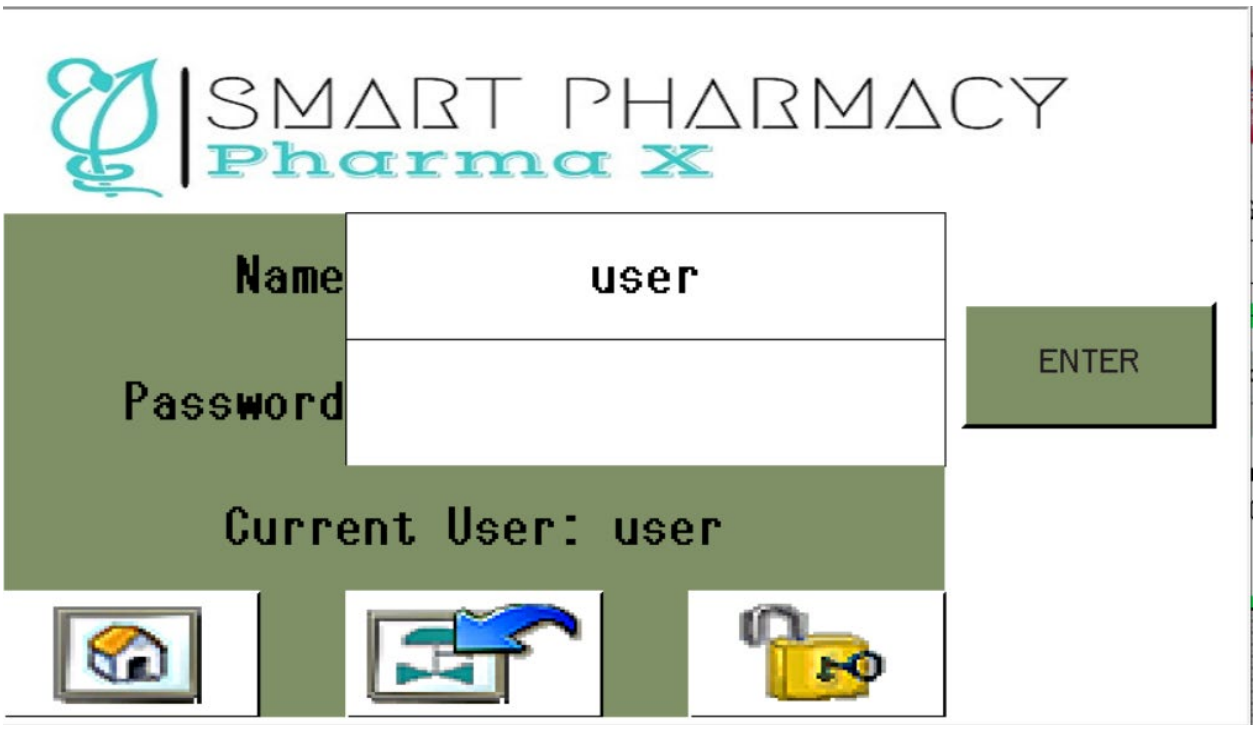


Fig 6-9 HMI Security Panel

6.12.2 HMI Ordering Method Panel

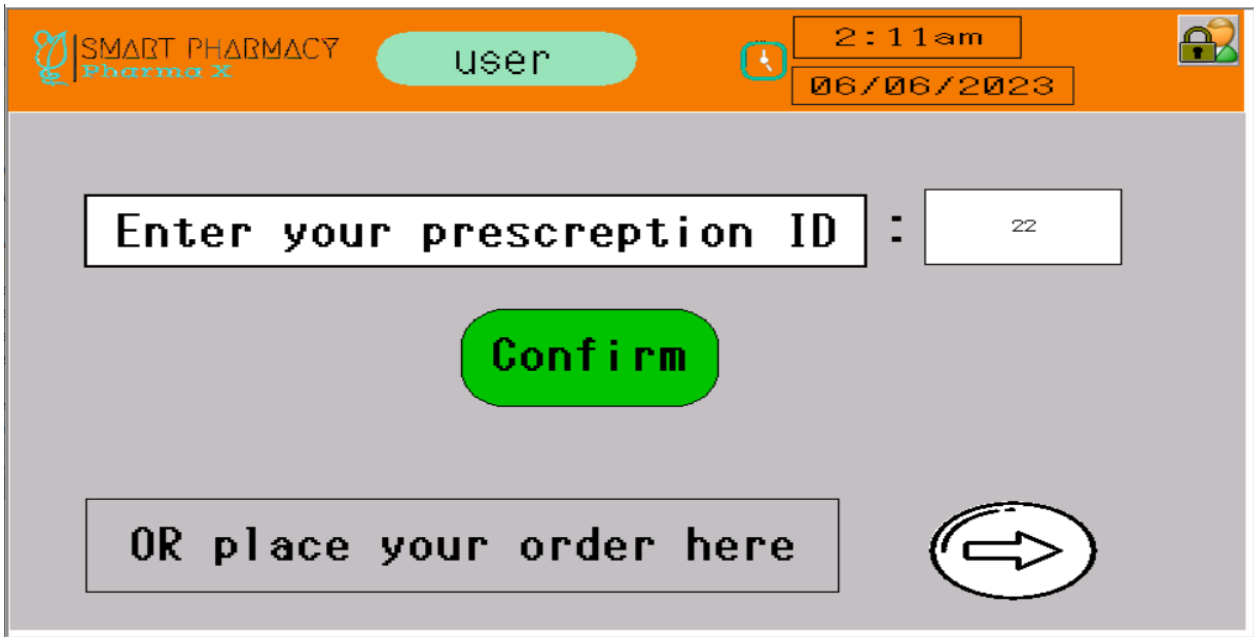


Fig 6-10 HMI Ordering Method Panel

6.12.3 Placing a New Order Panel:

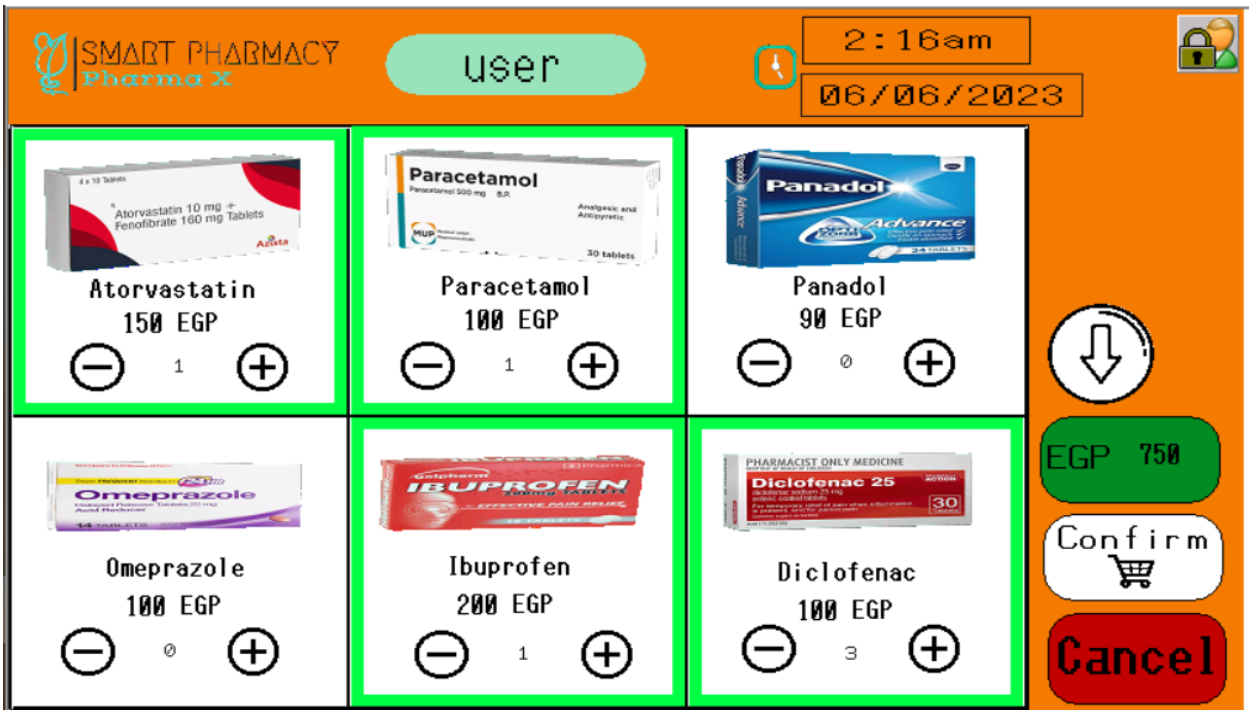


Fig 6-11 HMI Placing a New Order Panel (1)

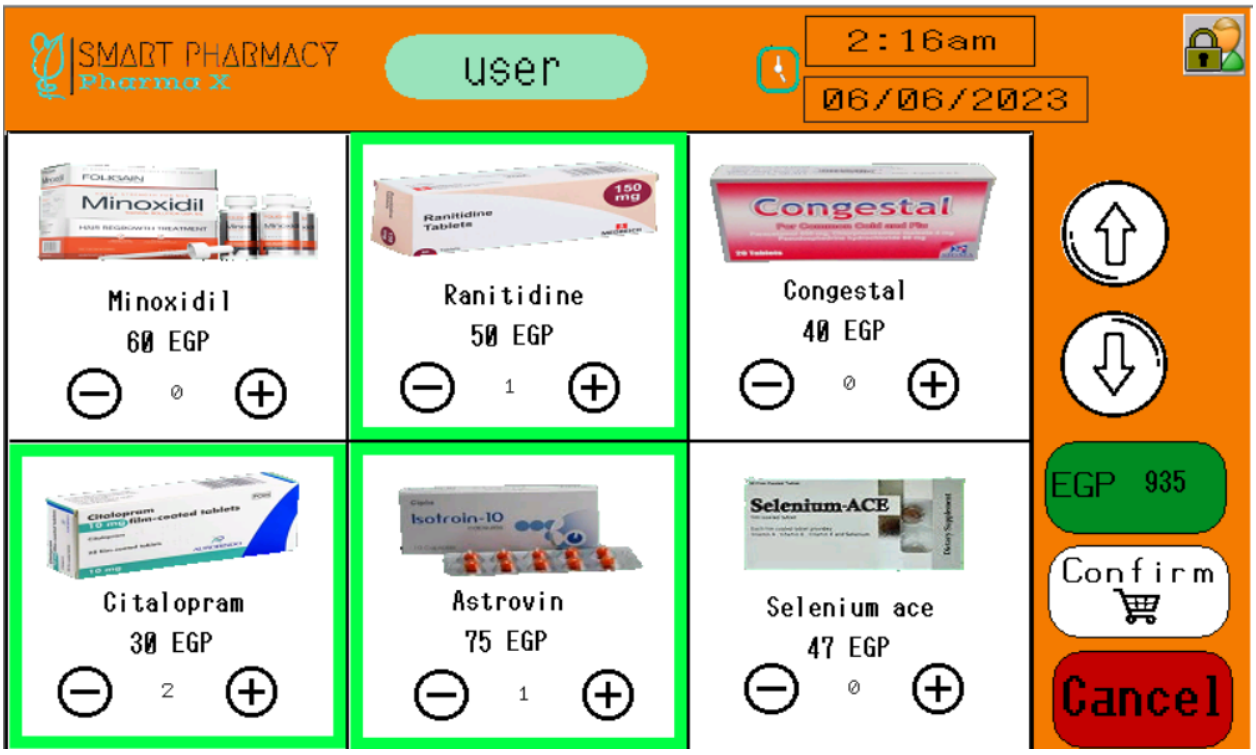


Fig 6-12 HMI Placing a New Order Panel (2)

Ch (6)

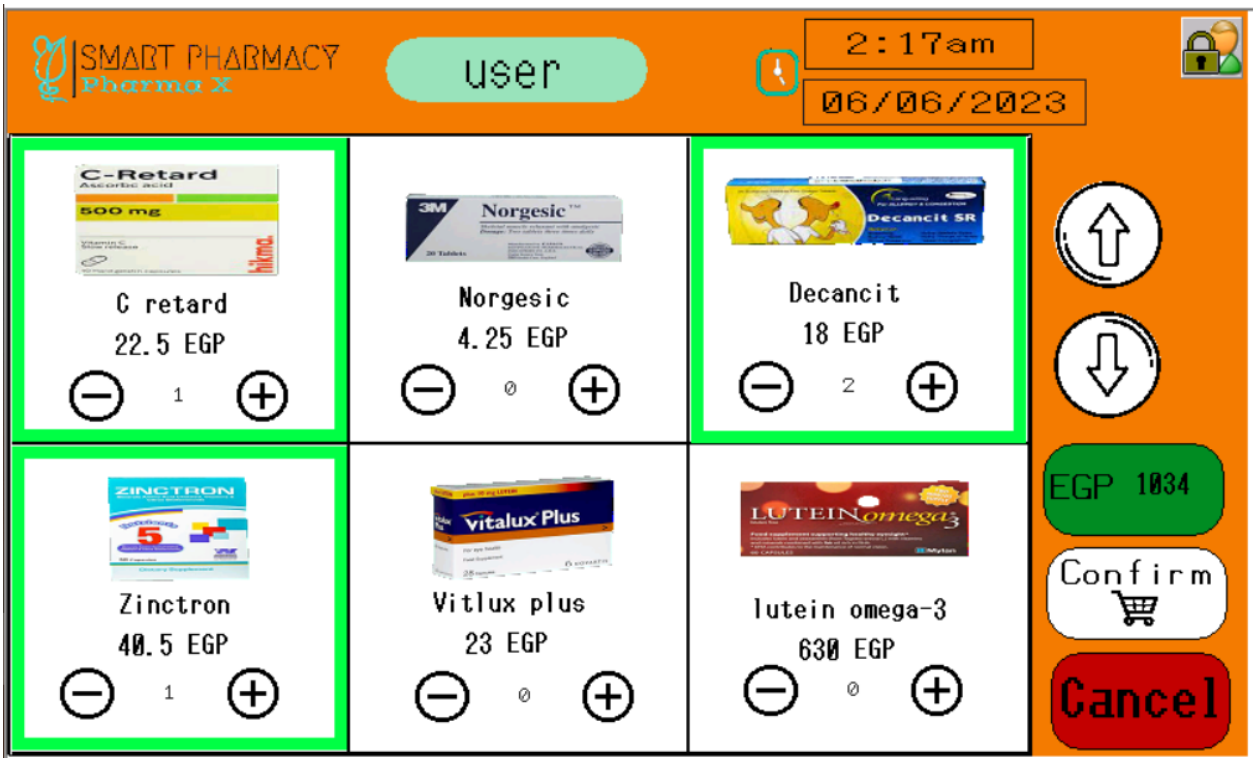


Fig 6-13 HMI Placing a New Order Panel (3)

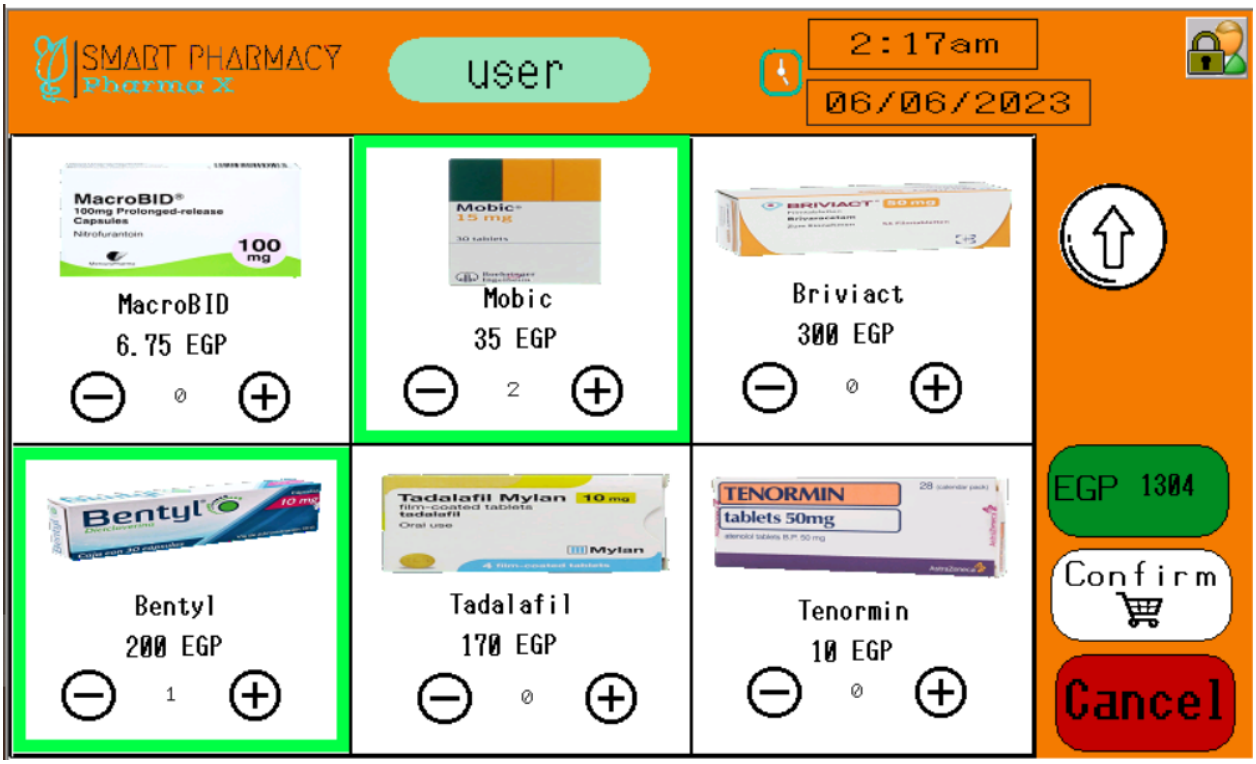


Fig 6-14 HMI Placing a New Order Panel (4)

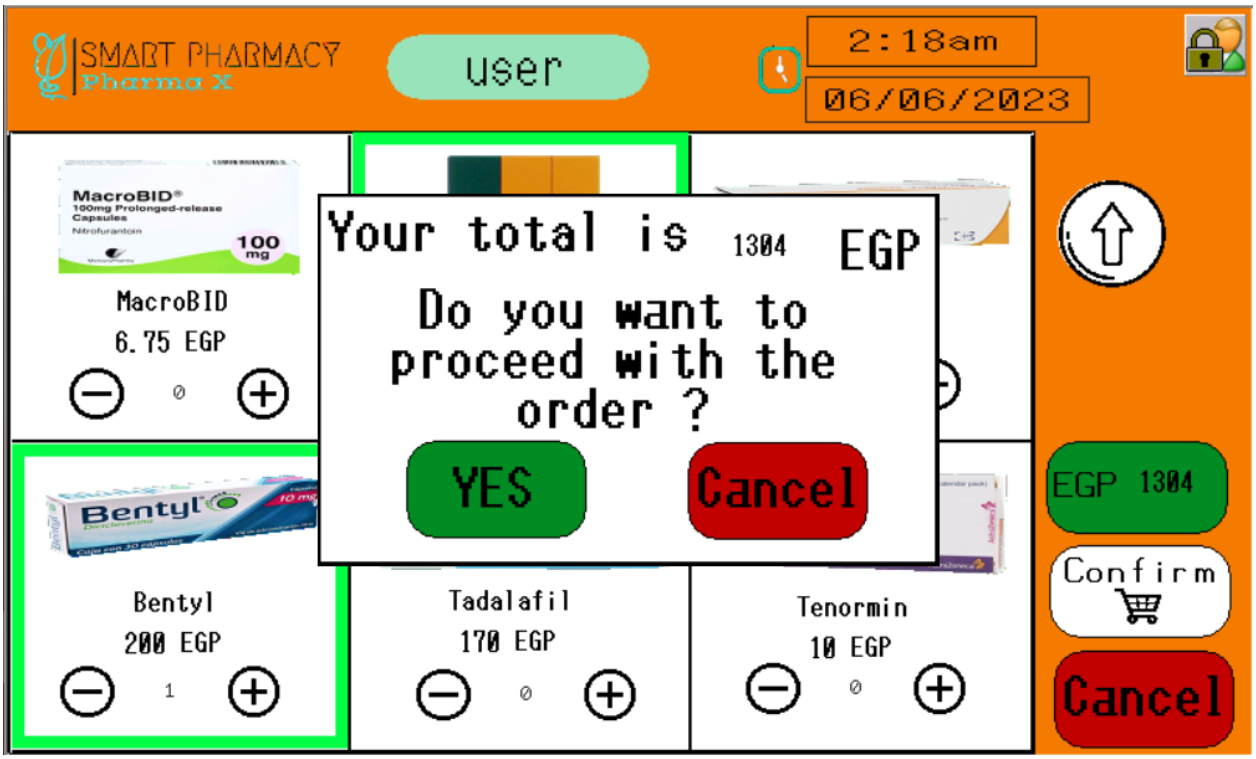


Fig 6-15 HMI Placing a New Order Panel (5)

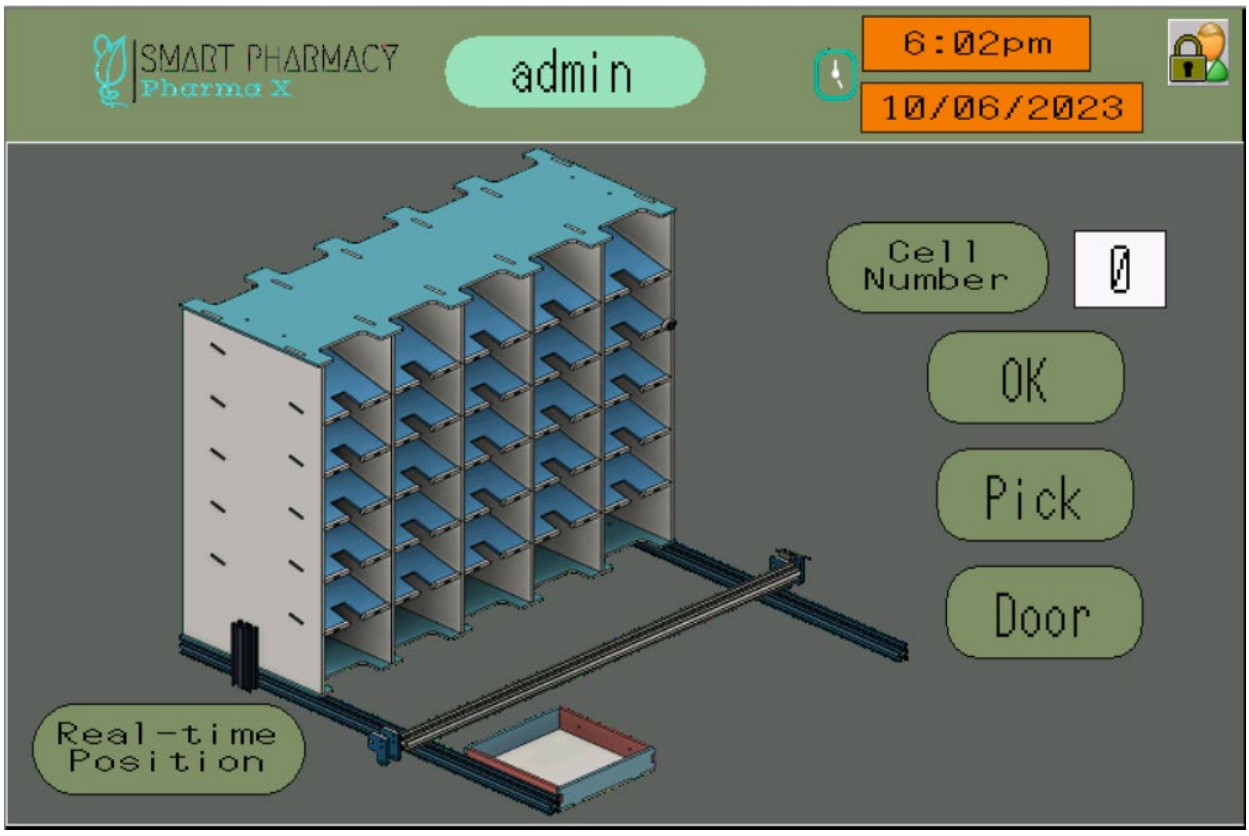


Fig 6-16 HMI Manual Panel

Ch (6)

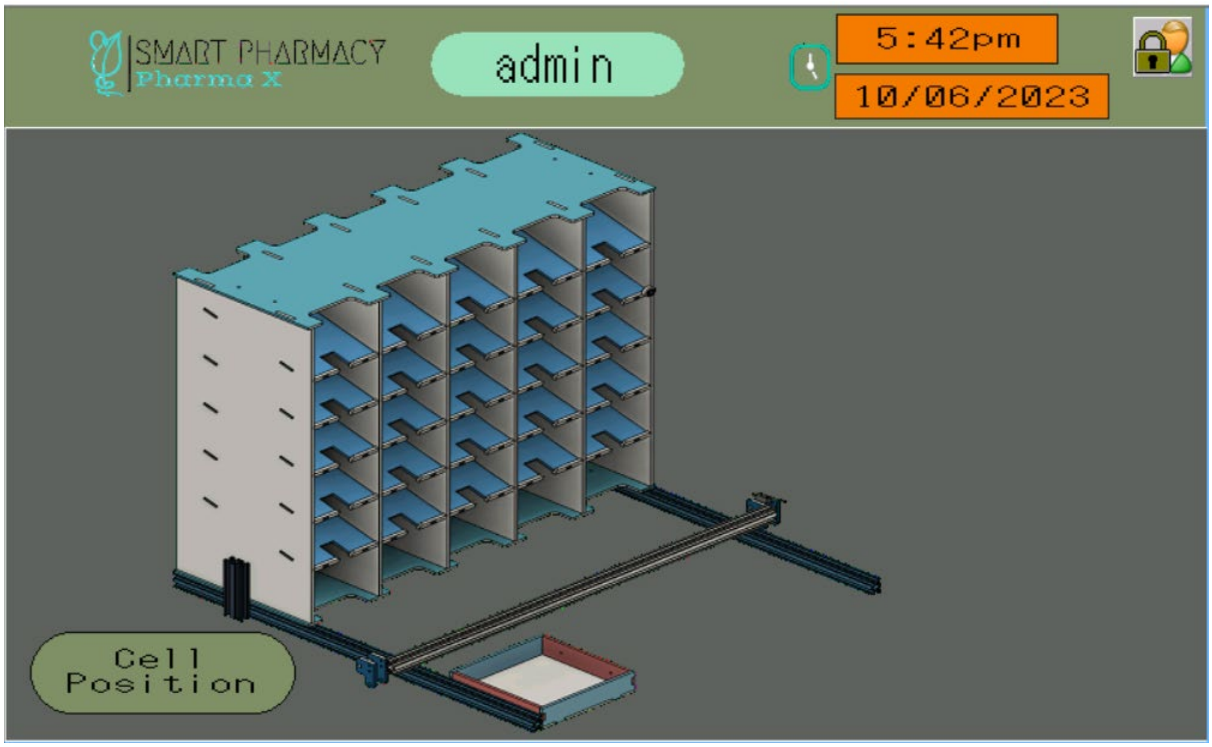
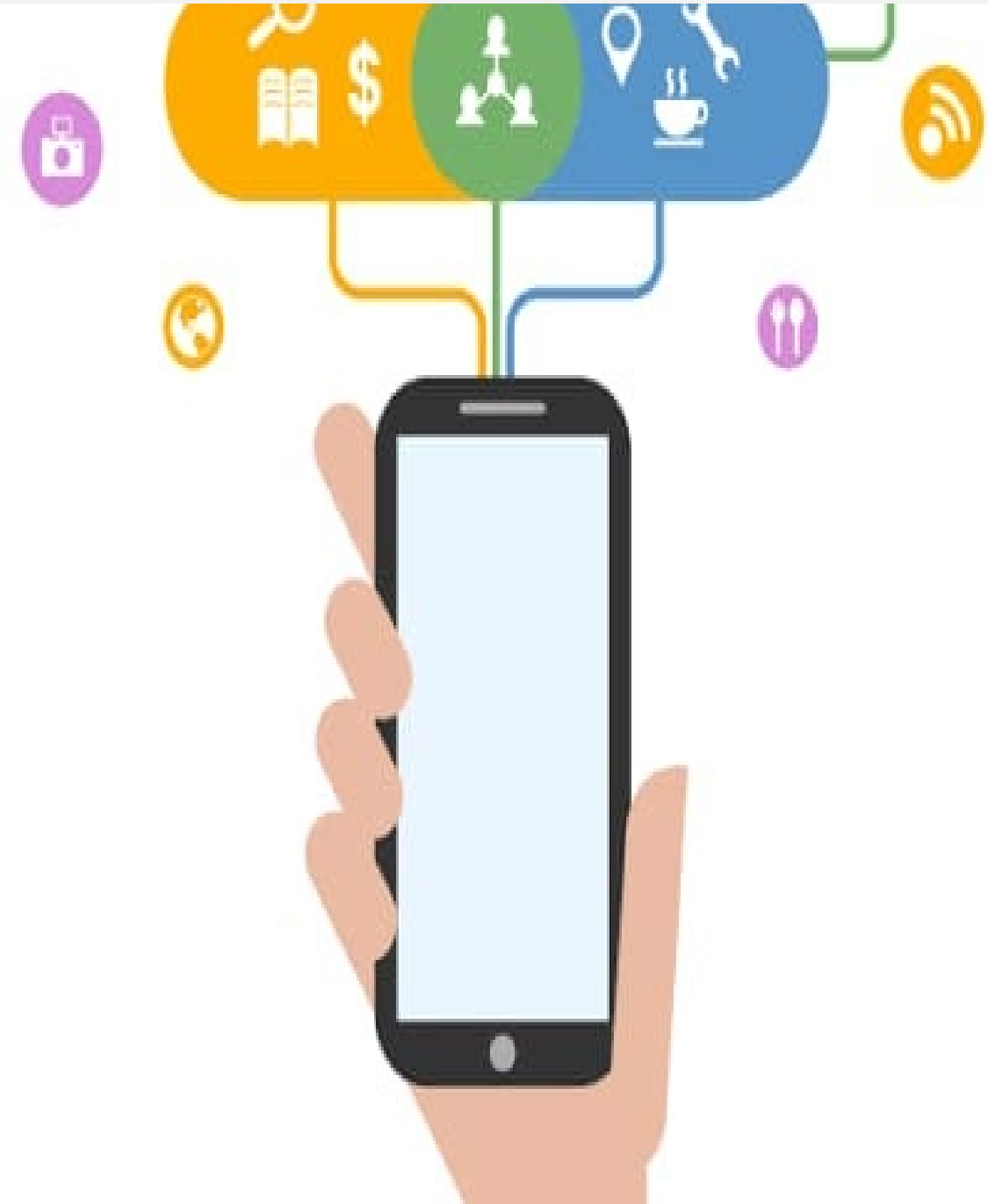


Fig 6-17 HMI Real-Time Position Panel

Chapter 7
MOBILE APPLICATION
AND
INDUSTRIAL INTERNET OF THINGS (IIOT)



Chapter 7

MOBILE APPLICATION AND INDUSTRIAL INTERNET OF THINGS

7.1 Introduction

As a smart pharmacy, it is essential that we have a dedicated mobile application designed specifically for the pharmacy. This application enables customers to easily order the medications they need from the comfort of their own homes, which is particularly beneficial for elderly or chronically ill patients who may have difficulty traveling to the pharmacy. By using the application, patients can order their medications and have them delivered right to their doorstep, eliminating the need to physically go to the pharmacy. Additionally, the application reduces waiting times and the effort required to obtain medications.

Registered customers can place orders for medications using the application in two ways. First, they can scan the QR code on the prescription or medication box using their smartphones. Second, they can search for the medication by typing its name in the search box and then selecting the desired quantity of medication.

The application was developed using the Java programming language and the Android Studio application, which are common tools for developing Android applications. The MySQL language was used to create the application's databases, which store customer profile information, medication lists, and order history.

In the upcoming sections, we will delve into the application's details, including how the different pages were created and the role of each page in the application's functionality. We will also discuss how data is transferred between the application and the SCADA system, which is responsible for monitoring and controlling pharmacy operations. This comprehensive discussion will provide a thorough understanding of the application's features and functionality.

7.2 Designing of The Mobile APP

In this section, we will discuss the different screens within the application, their benefits, and how the customer navigates through the application to order medication. When the user opens the application, they are presented with the opening screen as shown in Fig 5.1, and the customer needs to log in to their account to be able to order medication. If they do not have an account, they can create one by clicking on the 'profile' option at the bottom right of the screen.

When clicking on 'profile', the user is taken to this page where their personal information is displayed, and they can log in by clicking on 'sign in' as shown in **fig 7-1** Opening Screen .

Fig 7-2 Opening Screen

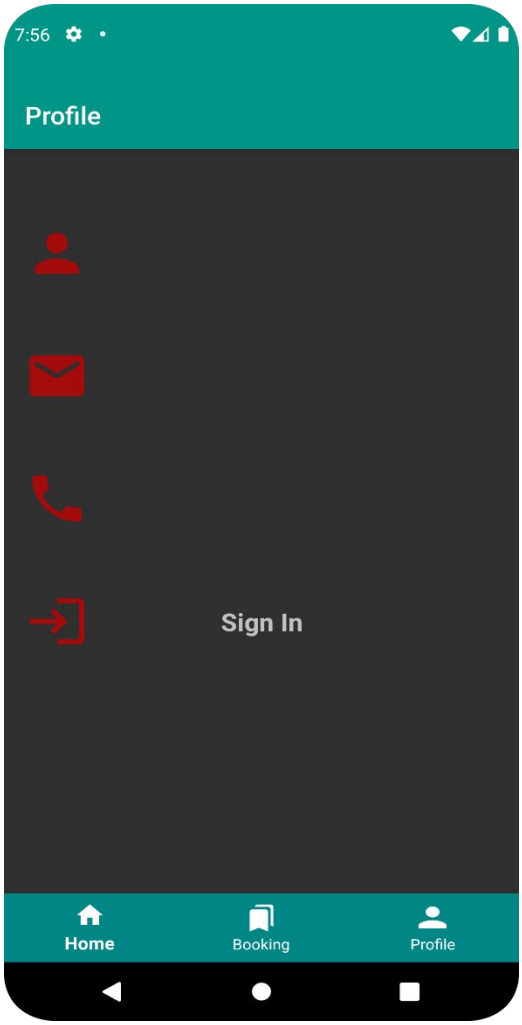


Fig 7-1 profile Screen

Ch (7)

On this screen, the user can log in using their email and password if this is not their first time using the application, with the option to enable the application to remember their login credentials as shown in **fig 7-4 Login Screen**. If this is the user's first time using the application, they can select the 'register' option and will be taken to another page where they can create an account. When creating an account, the user typi-cally needs to provide some personal information to register successfully. This infor-mation includes their full name, email address, a secure password, mobile phone number and gender as shown in **fig 7-3**. The email address is often used as the primary means of communication between the user and the application, and the mobile phone number may be used for verification purposes or to send notifications and updates related to the user's account and orders.

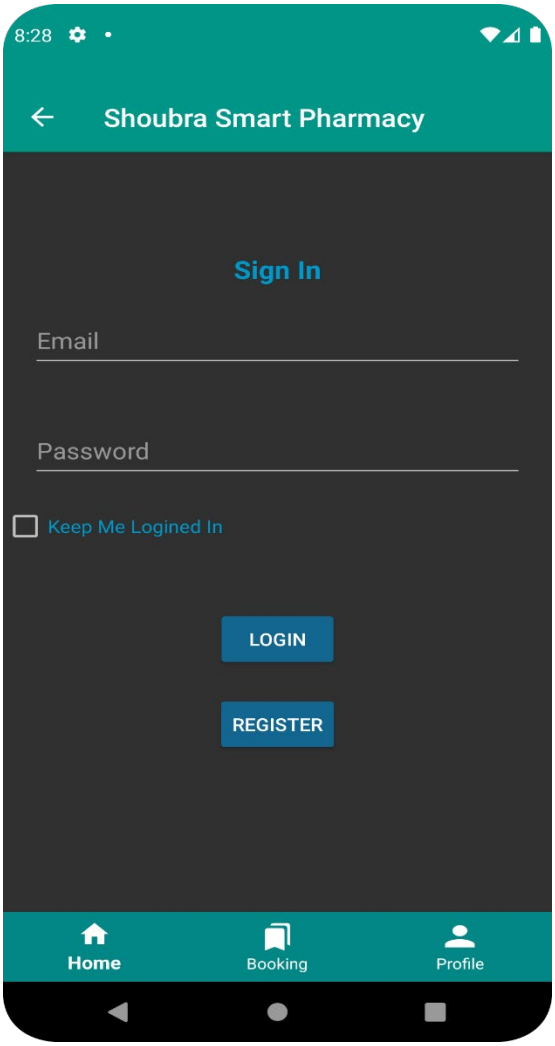


Fig 7-4 Login Screen

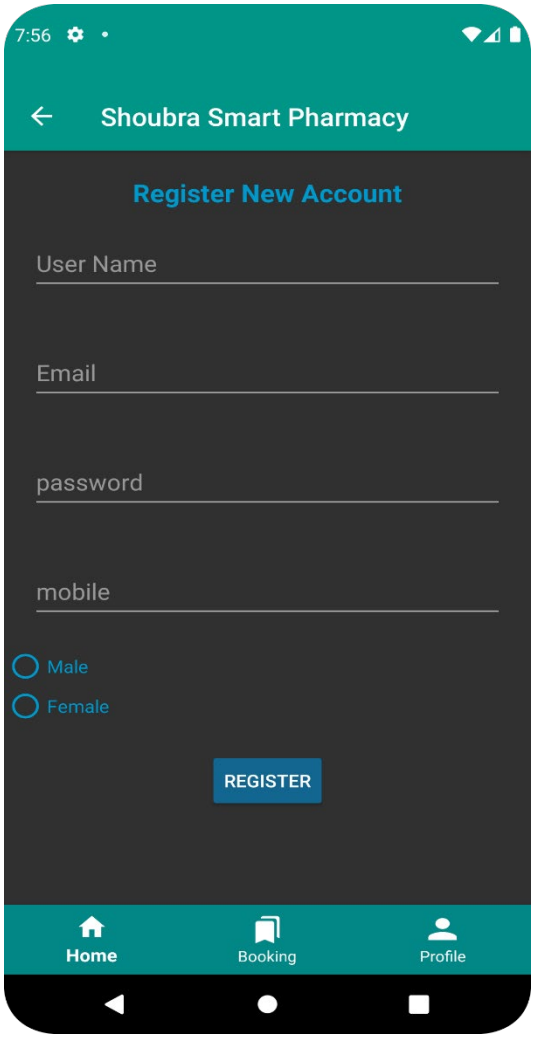


Fig 7-3 Registration Screen

This information is typically stored securely in the application's database and is only accessible by the user who owns the account and authorized personnel. Users may also have the ability to update or edit their personal information within the application as needed. After creating an account, the user may be redirected to the login screen to enter their email and password to access their account and start using the application. When the user taps the 'home' button located at the bottom right of the screen, they will be redirected to the application's main page, where they can start the process of ordering the desired medication. On this page, the user can order the medication they want either by searching for it by name or by scanning the QR code on the prescription or medication box using their smartphone as shown in **fig 7-5**.

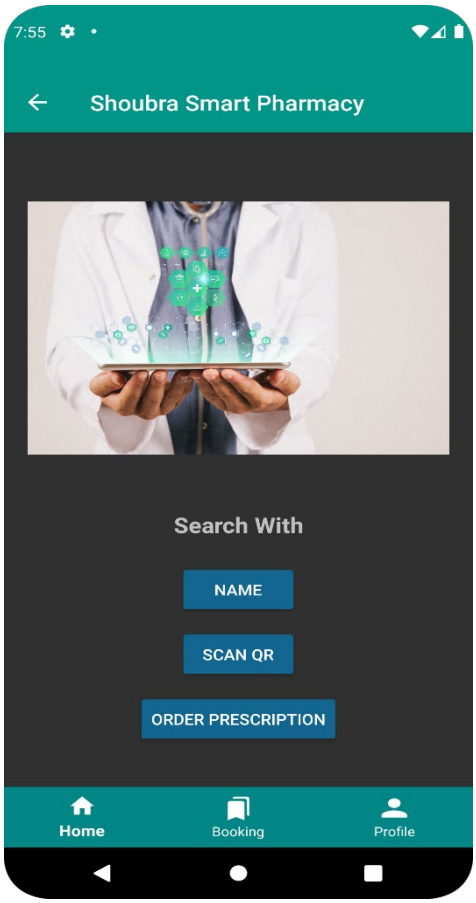


Fig 7-5 Home Screen

When the user clicks on the word 'name', they will be directed to this page as shown in **fig 7-,** where they can search for the medication, they want by typing its name in the search box. If the user chooses to request the medication by scanning a QR code, they can do so by clicking on the word "scan QR" as shown in **fig 0-5**.

When the user clicks on "Scan QR", they will be directed to the next page as shown in **fig 7-**, where they will be prompted to grant permission to access their phone's camera so that they can perform the scan of QR code from the prescription or the medication box.

Fig 7-6 Search Box Screen

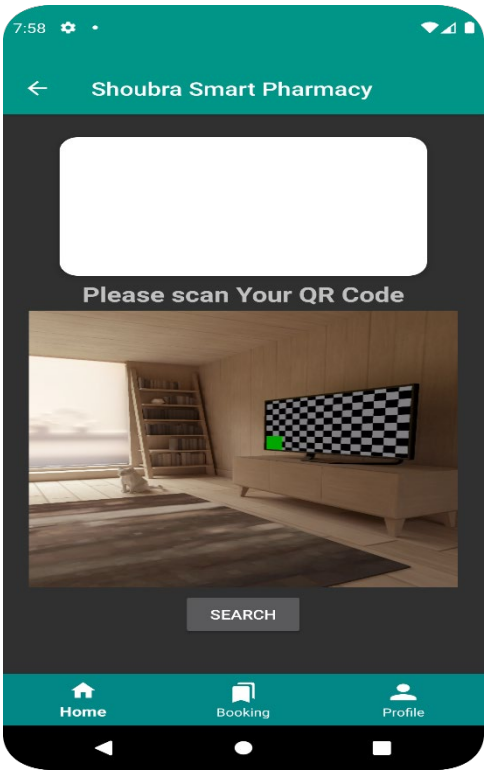


Fig 7-7 QR Scanning Screen

When the user clicks on the word "Booking" in the middle of the navigation bar at the bottom of the screen, they will be directed to the booking page where the type and quantity of medications that have been booked and their respective prices will be displayed as shown in **fig 0-6** .

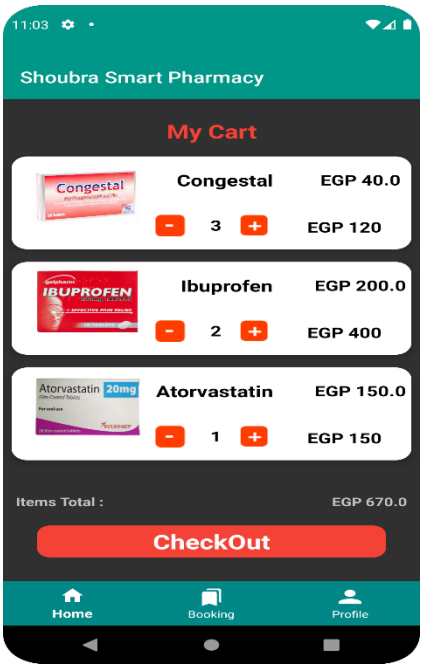


Fig 7-6 Booking Screen

7.3 Connection of Android Application with MYSQL Database

In this section, we are going to explain how you can integrate PHP and MYSQL with our android application. This is very useful in case you have a webserver, and you want to access its data on your android application.

MYSQL is used as a database for the webserver and PHP is used to fetch data from the database. Our application will communicate with the PHP page with necessary parameters and PHP will contact MYSQL database and will fetch the result and return the results to us.

To connect our android application with MYSQL database two things:-

1. MySQL Database Hosting.
2. Website Hosting.

We need MySQL Database Hosting to make online server to create a remote MYSQL database.

A web server is a computer that stores, processes, and delivers website files to web browsers, we will use **FreeSQLdatabase**, Free SQL database is a web-based service to provide sql database functionality for free.

Website Hosting hosts for PHP files and run it, we will use **000WebHost** .

000WebHost is a legit hosting company offering real hosting free of charge.

http://freesqldatabase.com

https://www.000webhost.com/free-php-hosting

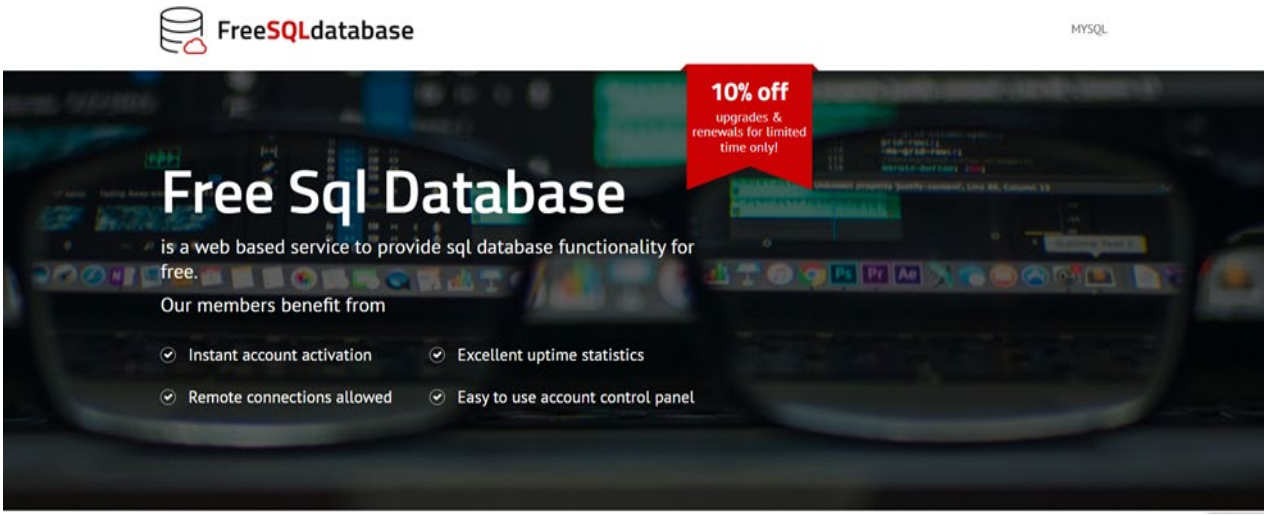


Fig 7-7 Free SQL Database

Ch (7)

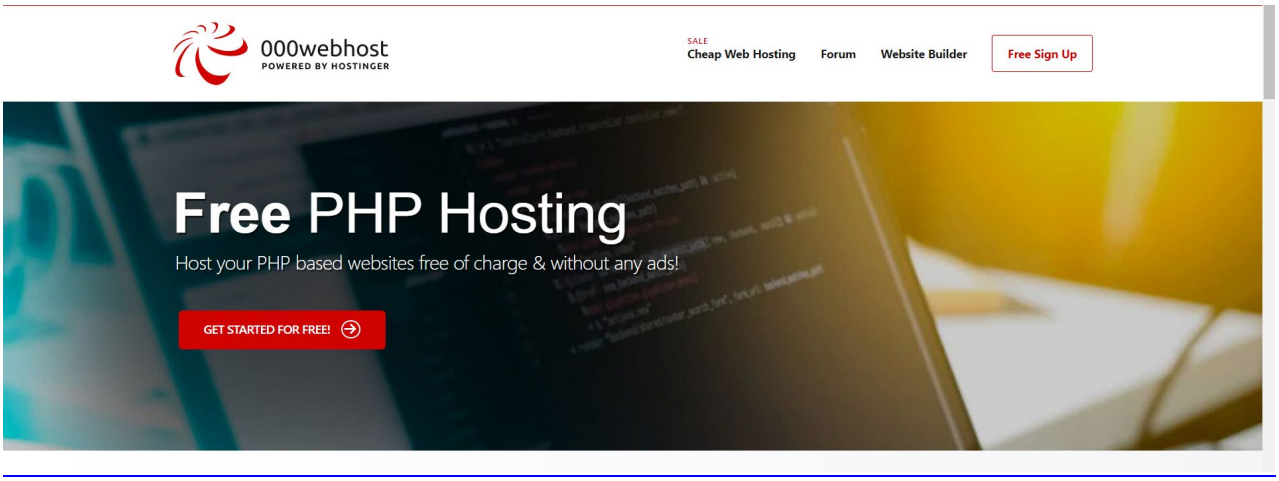


Fig 7-8 000WebHost

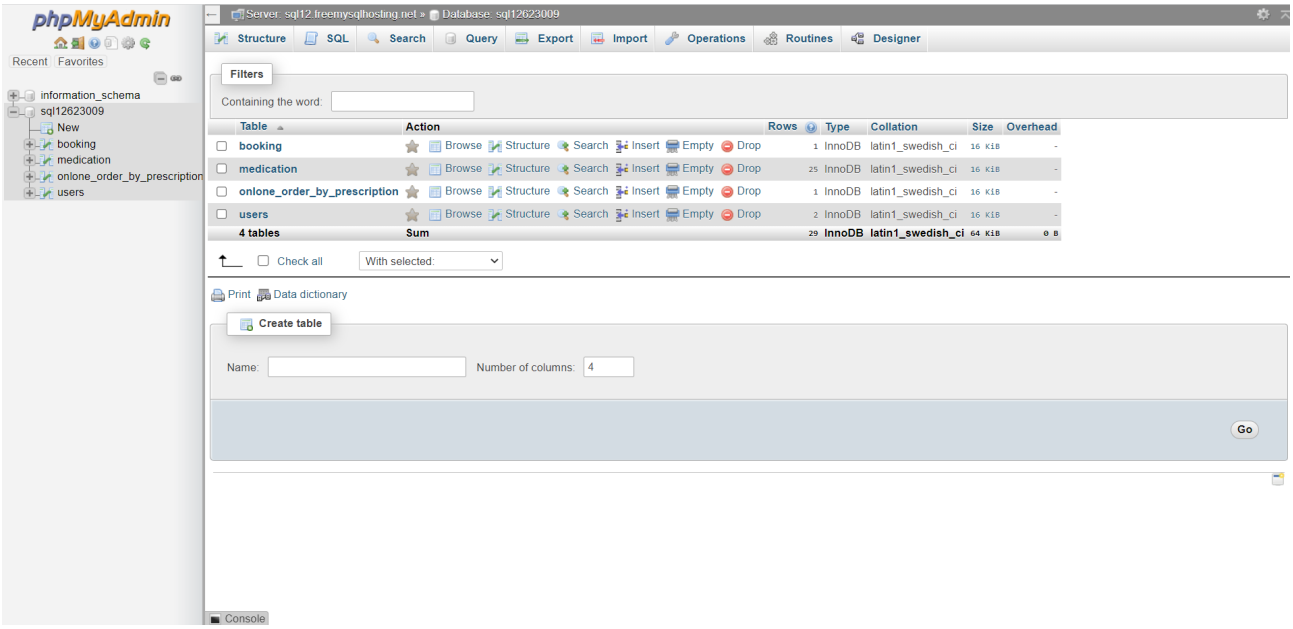


Fig 7-9 MySQL Database

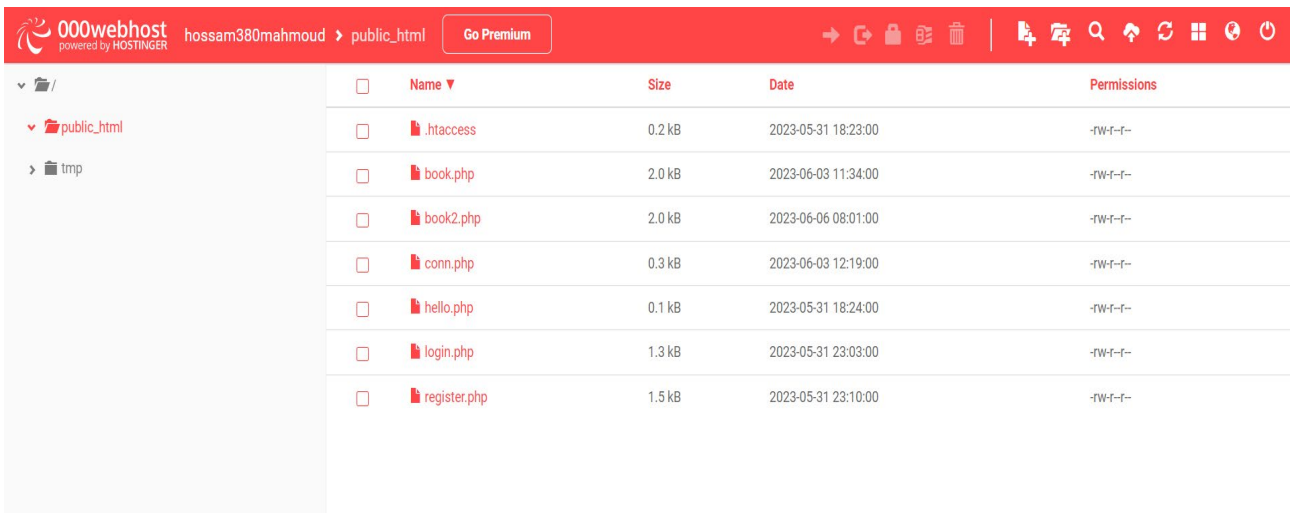


Fig 7-10 PHP Files

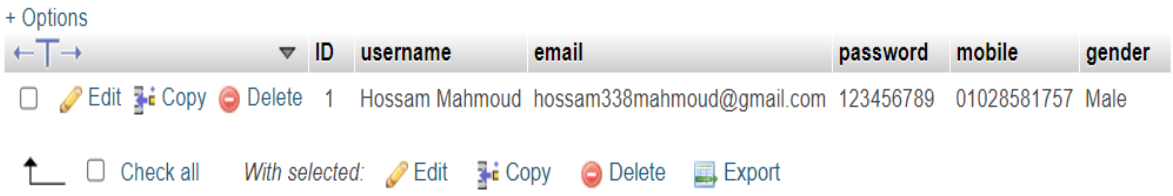


Fig 7-11 User Info

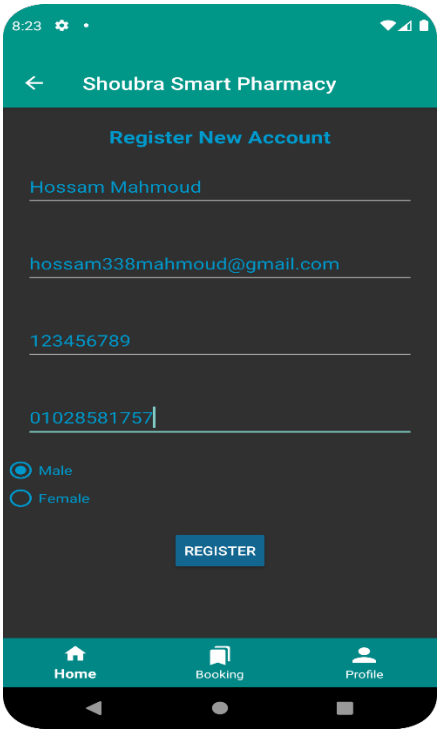


Fig 7-12 Registration

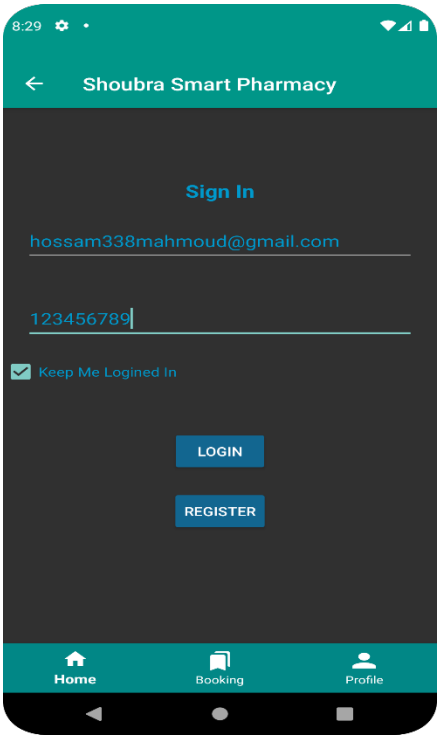


Fig 7-15 User Info

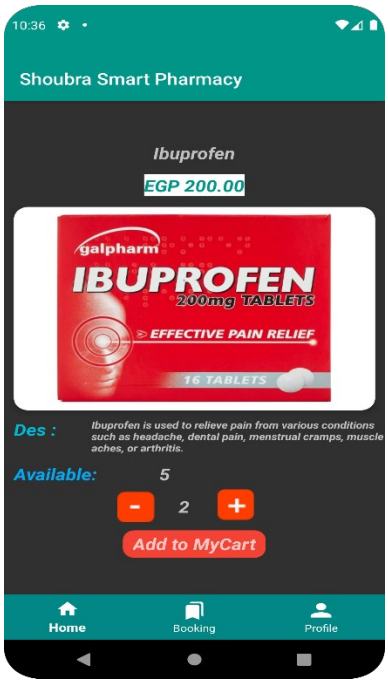


Fig 7-13 Orders

Ch (7)

+ Options

	ID	username	phone	medic	posx	posy	quantity	medication_id
Edit Copy Delete	1	hossam33mahmoud	01028581757	Omeprazole	1	4	1	4
Edit Copy Delete	2	hossam33mahmoud	01028581757	Ibuprofen	1	5	2	5
Edit Copy Delete	3	hossam33mahmoud	01028581757	Ranitidine	2	3	1	8

Check all With selected: Edit Copy Delete Export

Fig 7-14 Booking Table

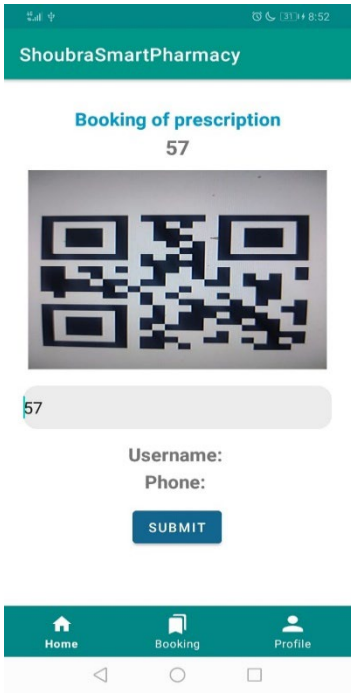


Fig 7-16 Order Prescription

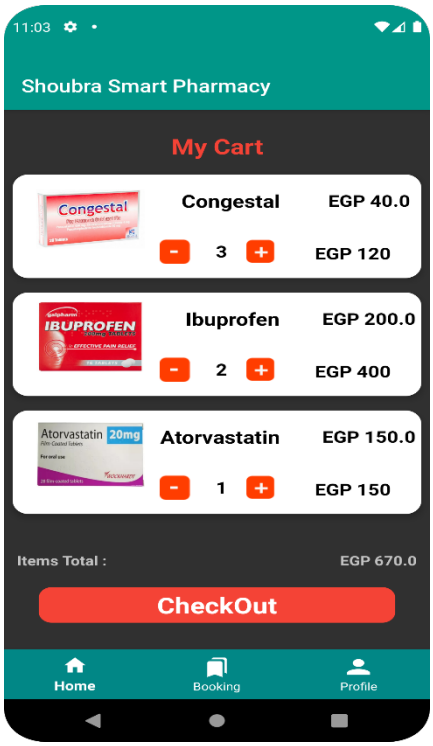


Fig 7-15 User Cart

+ Options

	purchase_number	date_of_purchase	nane	phone	prescription_id	statue
Edit Copy Delete	1	2023-06-07	hossam33mahmoud	1028581757	2	0

Check all With selected: Edit Copy Delete Export

Fig 7-18 Order Prescription Table

7.4 Industrial Internet of Things (IIOT):

7.4.1 QR Code Scanner:

As a pharmacy customer, you can benefit greatly from QR codes, which provide you with vital medication information. By scanning the QR code printed on your medication packaging using your smartphone, you can access important details such as dosage instructions, possible side effects, and drug interactions. This is especially useful if you take multiple medications or have a complex medication regimen, as it allows you to have all the necessary information in one easily accessible location.

In our project we need to scan QR either for medication or for prescription, so we have to have QR scanner, to do this we have four options:

1. QR Scanner

Fig 7-19 QR Scanner

2. QR Code Scanner using Arduino.

Fig 7-20 QR Code Scanner Using Arduino

3. QR Scanner using Ignition

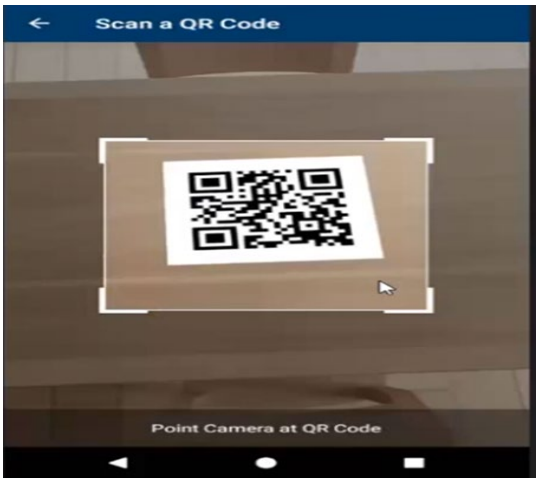


Fig 7-21 QR Scanner Using Ignition.

4. Python QR code reader

Fig 7-22 Python QR Code Reader

Ch (7)

The disadvantage of the first and second option in the high cost so we don't these options. The disadvantage of third option is the need for internet. Finally, we used the fourth option because don't need cost or internet.

7.4.2 Python QR Code Reader:

7.4.2.1 Scanning QR Code with Python Using Laptop Camera:

- The first step is to write a Python code that uses the laptop's camera to scan the QR code. This can be done using a library like OpenCV, which provides functions for capturing video from a camera and processing it to detect QR codes. Once the QR code is detected, the data from the code can be extracted using a QR code decoding library like pyzbar.

Fig 7-23 MQTT and Python

7.4.2.2 Sending data to Node-RED using MQTT protocol:

Once the data is extracted from the QR code, it needs to be sent to Node-RED for further processing. This can be done using MQTT, a lightweight messaging protocol that is commonly used in IoT applications. First, set up an MQTT broker, which is a server that handles communication between devices. Then, in Python code, can use an MQTT client library like paho-mqtt to connect to the broker and publish the data from the QR code.

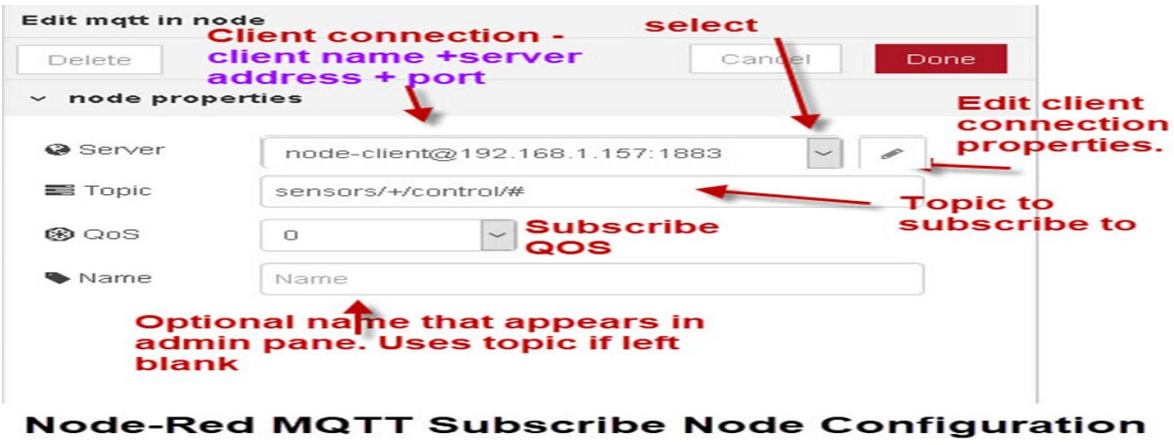


Fig 7-24 MQTT Configuration

7.4.2.3 Reading data in Ignition software:

Finally, read the data from the QR code in Ignition software. set up a Node-RED flow that subscribes to the MQTT topic where the data is being published. When new data is received, the flow can process it and send it to Ignition using a protocol like OPC-UA. In Ignition, create tags that read the data from the OPC-UA server and use it in application.

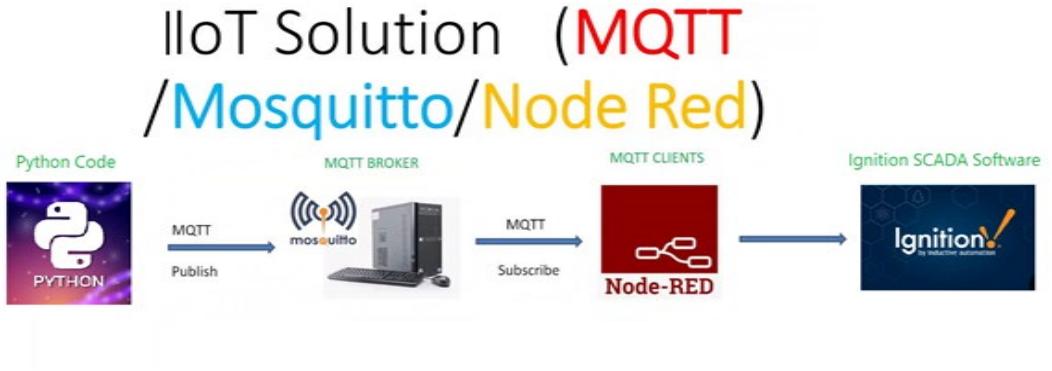


Fig 7-25 Communication Sequence

Overall, this process involves using Python to capture and extract data from a QR code, MQTT to send the data to Node-RED, and OPC-UA to read the data in Ignition software. With these tools, you can create a flexible and scalable system for capturing and processing data from QR codes.

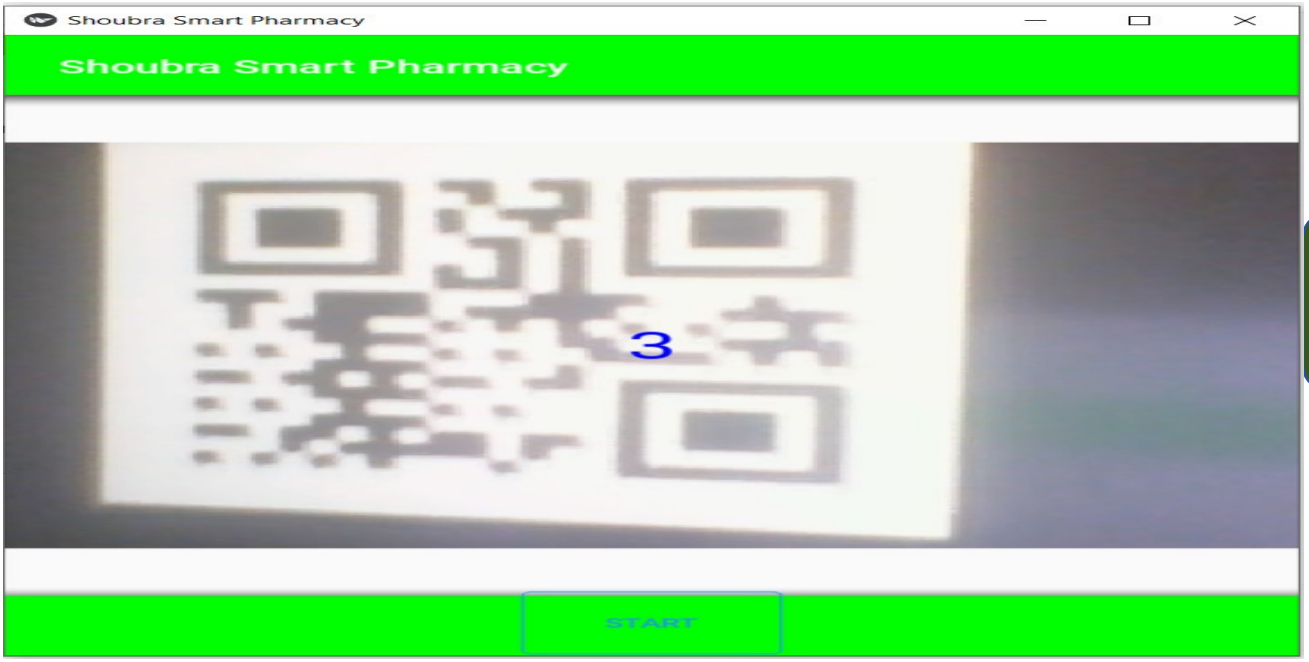


Fig 7-26 QR scanner

Ch (7)

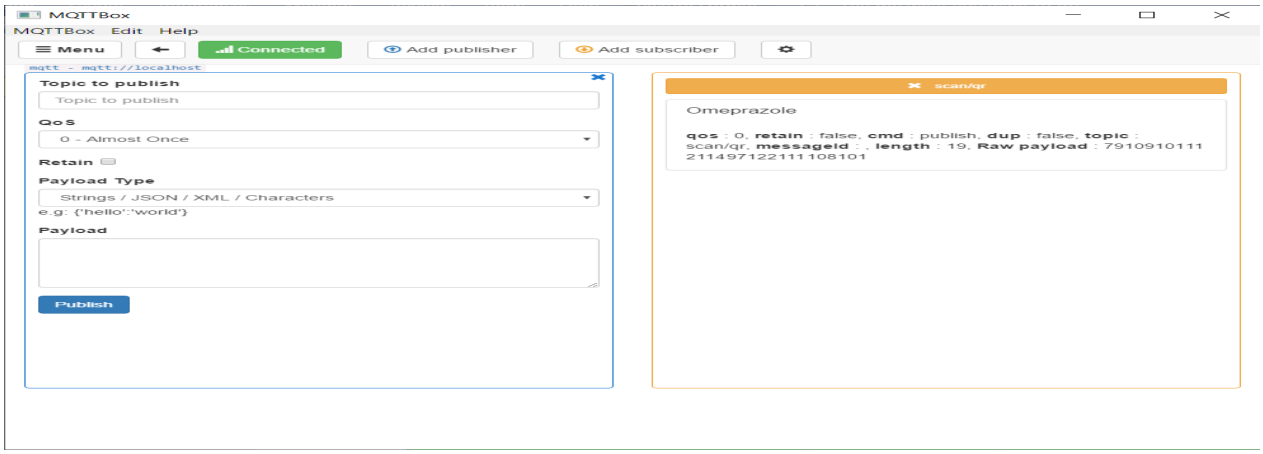


Fig 7-27 MQTT Virtual Box

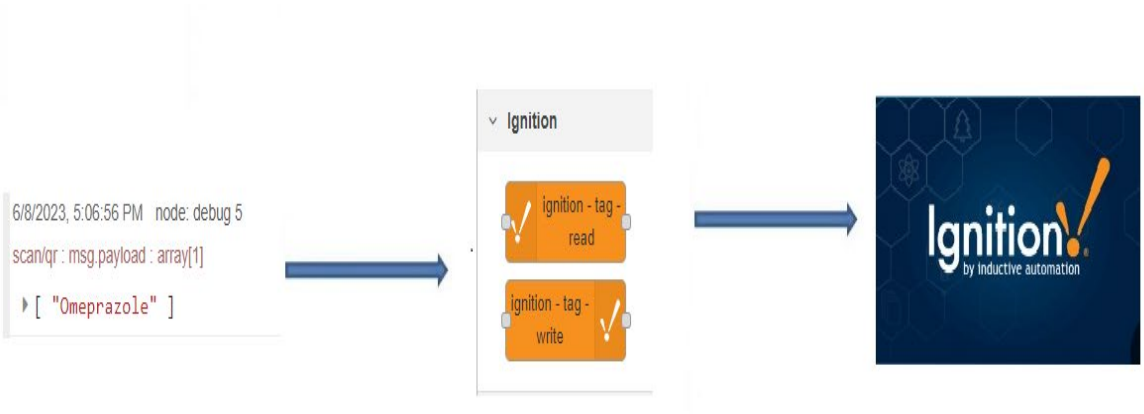


Fig 7-28 Received Data in Node-Red

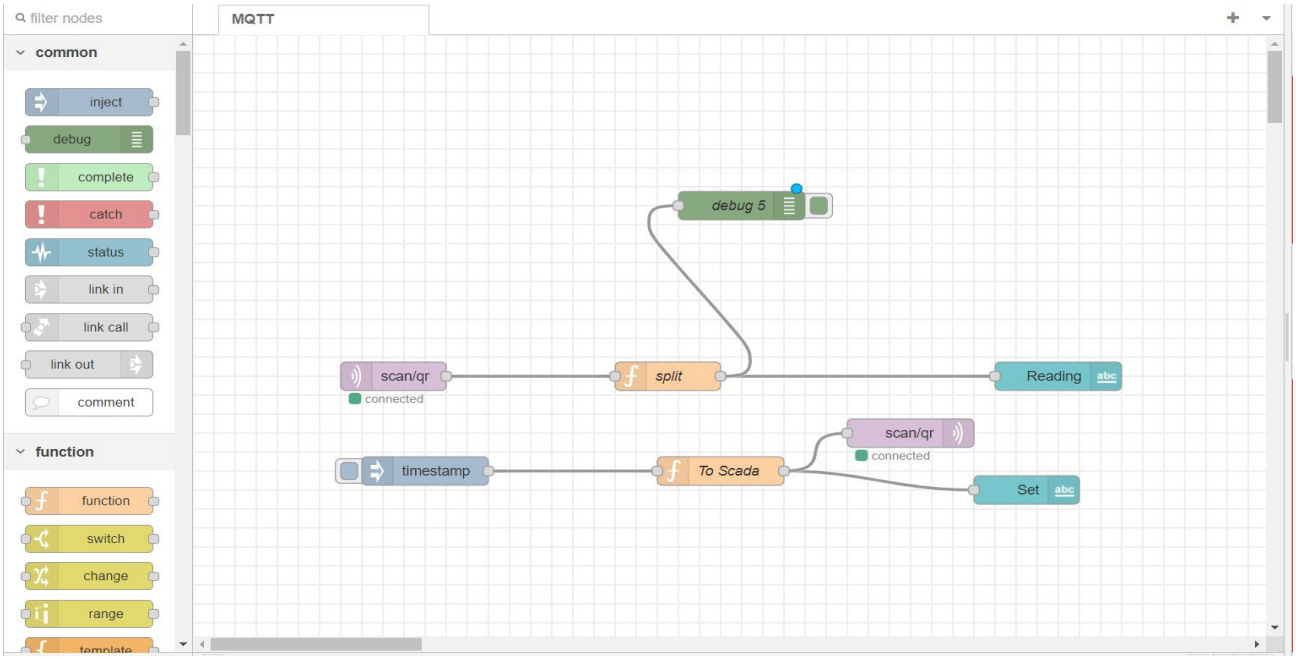


Fig 7-29 Connect MQTT to Node-Red

Chapter 8

CONCLUSION AND FUTURE IMPROVEMENT

Chapter 8

CONCLUSION AND FUTURE IMPROVEMENT

8.1 Introduction:

The healthcare sector in Egypt is one of the largest in the Middle East and North Africa (MENA) region, serving a population of over 100 million people. However, it faces a number of challenges, including outdated systems, long waiting times, and a shortage of qualified medical staff. One area that has seen little innovation is the pharmacy sector, which is still largely reliant on manual processes and outdated technology. This report outlines our intention to take our graduation project a smart pharmacy system and turn it into a startup that can address these challenges and improve the efficiency and convenience of pharmacy operations in Egypt.

8.2 Background:

Our graduation project involved the development of a smart pharmacy system that utilized automation using PLC, a SCADA system using Ignition software, and a mobile application. This system aimed to streamline pharmacy operations by automating the dispensing process, reducing waiting times, and providing patients with a convenient way to manage their medication. After successfully completing the project, we realized that our system had the potential to make a significant impact in the healthcare sector in Egypt.

8.3 Market Analysis:

The pharmacy sector in Egypt is a large and growing market, with over 50,000 pharmacies serving a population of more than 100 million people. However, the sector is facing several challenges, including a shortage of qualified pharmacists, long waiting times, and a lack of transparency in drug pricing. Our smart pharmacy system can address these challenges by providing a more efficient and convenient way for patients to access their medication.

8.4 Competitive Analysis:

While there are some existing pharmacy automation systems in Egypt, these tend to be expensive and complex, making them inaccessible to many pharmacies. Our system, on the other hand, is designed to be affordable and easy to use, making it accessible to a wider range of pharmacies. Additionally, our mobile application provides patients with a convenient way to manage their medication, something that is not currently available with most existing systems.

8.5 Marketing Strategy:

To market our startup, we plan to target independent pharmacies, which make up most of the pharmacy market in Egypt. We will highlight the benefits of our system, including increased efficiency, reduced waiting times, and improved patient satisfaction. Additionally, we will leverage social media and online advertising to reach a wider audience and build brand awareness.

8.6 Conclusion:

The healthcare sector in Egypt needs innovative solutions to address its many challenges, and our smart pharmacy system has the potential to make a significant impact. By turning our graduation project into a startup, we hope to improve the efficiency and convenience of pharmacy operations in Egypt, while also creating new opportunities for ourselves and our team. Our system is affordable, easy to use, and provides patients with a convenient way to manage their medication - all factors that we believe will make it a success in the Egyptian market.

8.6.1 Mechanical Design:

The first step in creating a smart pharmacy is designing the mechanical components that will be used. This involves designing the structure of the pharmacy and the placement of the different components such as the dispensing machines, storage units, and other equipment. You would have likely followed industry standards and best practices to ensure the design is efficient and user-friendly.

8.6.2 Electrical and Automation Design:

The next step is designing the electrical and automation components of the pharmacy. This involves selecting the appropriate PLC and sensors to control the different machines and equipment in the pharmacy. You would have likely designed the wiring and circuit diagrams to ensure proper connections and safety.

8.6.3 Software Design:

Once the mechanical and electrical designs are complete, the software design phase can begin. This involves creating a SCADA system using Ignition software, which will provide real-time monitoring and control of the pharmacy. The SCADA system would display information such as inventory levels, sales data, and machine status. You would have likely created a user-friendly interface that enables the pharmacy staff to easily manage the pharmacy operations.

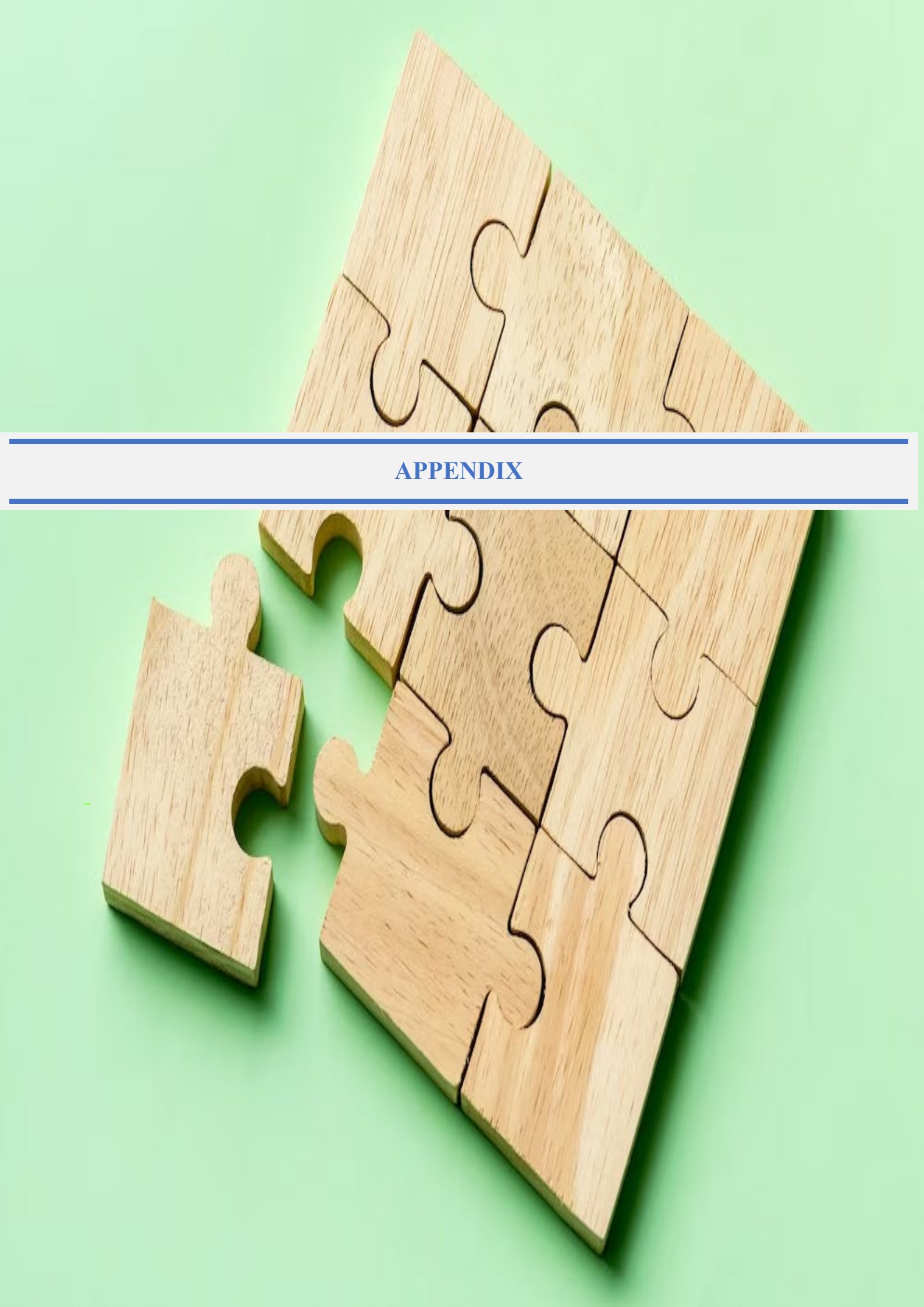
8.6.4 Mobile Application:

As a final step, you have created a mobile application for the pharmacy. This app would allow customers to view the pharmacy's inventory, place orders, and receive notifications when their order is ready for pickup. This app would also allow the

pharmacy staff to manage the orders and inventory levels, providing a seamless experience for both customers and staff. In conclusion, your smart pharmacy project is an excellent example of the integration of mechanical, electrical, and software systems. The project demonstrates the successful use of PLCs and SCADA systems to automate and manage pharmacy operations. The mobile application provides an added layer of convenience for customers and staff, making the pharmacy experience more efficient and user-friendly. Overall, your project has shown the potential for technology to improve the pharmaceutical industry and enhance the customer experience.

8.7 Future Recommendations

1. The availability of drug history of patients for medicines reconciliation (the process of identifying the drug history and comparing that list to the current list in use, to identify and document any intentional changes) which is an effective tool to minimize the risk of medication errors.
2. Providing the pharmacy with a payment method so that it can operate totally independent of any pharmacists and becomes like vending machines but for medicines.
3. Encouraging pharmacies and hospitals to consider an automated system and overlook the price of the unit, installing and integrating such a system.
4. Facilitating legislation since there are strict regulatory and compliance requirements for any pharmacy and there will be limitations on which types of automation are permitted.
5. Accessibility of medicine prescription in the form of QR code.
6. implementing an in-body machine inside the pharmacy making it easier for customers to know some basic knowledge about his or her body with just simple interfacing with the pharmacy.



APPENDIX

Appendix

A. PLC Code: -

In software book only

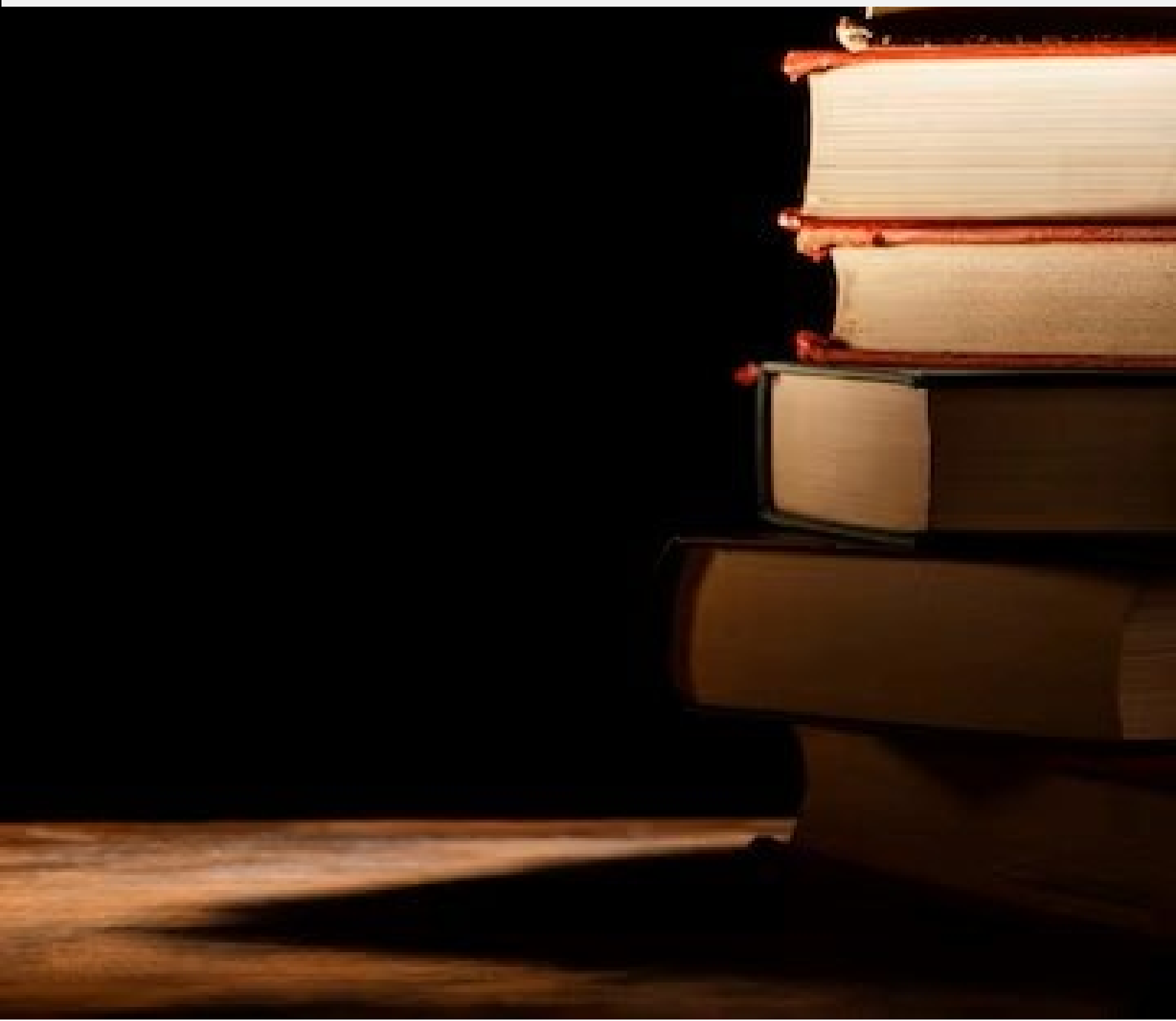
B. Arduino Code: -

In software book only

C. Mechanical Drawing: -

In software book only

REFERENCES



REFERENCES

1. Guo, G.," Design and Implementation of Smart Campus Automatic Settlement PLC Control System for Internet of Things", IEEE Access, 6, 62601-62611,(2018).
2. Asensio, J.A., Ortuño, F.M., & Damas, M., ...etal ., " Industrial Automa-tion Programming Environment with a New Translation Algorithm " ., IEC 61131-3 Languages Based on the TC6-XML Scheme. Journal of Automation and Control Engineering., (2013).
3. Rzonca, D., Stec, A., & Trybus, B. " Control Program Development in CPDev Using SFC Language, HMI and Runtime Environment. AUTOMATION".,IEEE Access., (2013).
4. Chen, T.," Smart campus and innovative education based on wireless sensor ". Microprocess. Microsystems, 81, 103678., (2021).
5. Li, J., He, S., Ming, Z., & Cai, S.," An Intelligent Wireless Sensor NetworksSystem with Multiple Servers Communication. International Journal of Distributed Sensor " Networks, 11.,(2015).
6. Jiguang, W., Xin, S., Wenbin, S.,.....etal. ," Design and implemen-tation of energy-saving control system of fan based on PLC "., IEEE Interna-tional Conference on Power and Renewable Energy (ICPRE), 279-283.,(2016)
7. Cardoso, W., Júnior, W.A., Bertosse, J.F., ... etal ., " Digital manufacturing, industry 4.0, cloud computing and thing internet "., Brazilian contex-tualization and reality. Independent Journal of Management & Production, 8, 459-473., (2017).
8. Pereira, Carlos E., & Peter Neumann. " Industrial communication protocols." Springer Handbook of Automation. Springer, Berlin, Heidelberg, (2009).
9. " What is Modbus and how does it work? ".,Schneider Electric USA. www.se.com.(n.d.). Retrieved June 1, (2022), from https://www.se.com/us/en/faqs/FA168406/
10. " Modbus TCP/IP protocol overview. " Real Time Automation, Inc.,(2022, March 14). Retrieved June 1, 2022, from https://www.rtautomation.com/technologies/modbus-tcpip/
11. " What is OPC UA? A practical introduction ". ,System integration with the OPC Router.(2022, May 31). Retrieved June 1, 2022, from https://www.opc-router.com/what-is-opc- ua/
12. " The basics of CANopen "., NI. (n.d.)., Retrieved June 1, 2022, from https://www.ni.com/enlb/innovations/white-papers/13/the-basics-of-canopen.html

13. Sridhar, N.," Power Electronics in Motor Drives " ., Texas instruments., Retrieved (June 2, 2022)., from https://www.ti.com/

14. " AC Drive Working Principle. " ., AC Drive. (n.d.). Retrieved(June 2, 2022)., from http://www.acdrive.org/acdrive-working-principle.html

15. Istiqomah, N.A., Sansabilla, P.F., Himawan, D.,.....etal.," The Implemen-tation of Barcode on Warehouse Management System for Warehouse Efficiency "., Journal of Physics: Conference Series.,(2020).

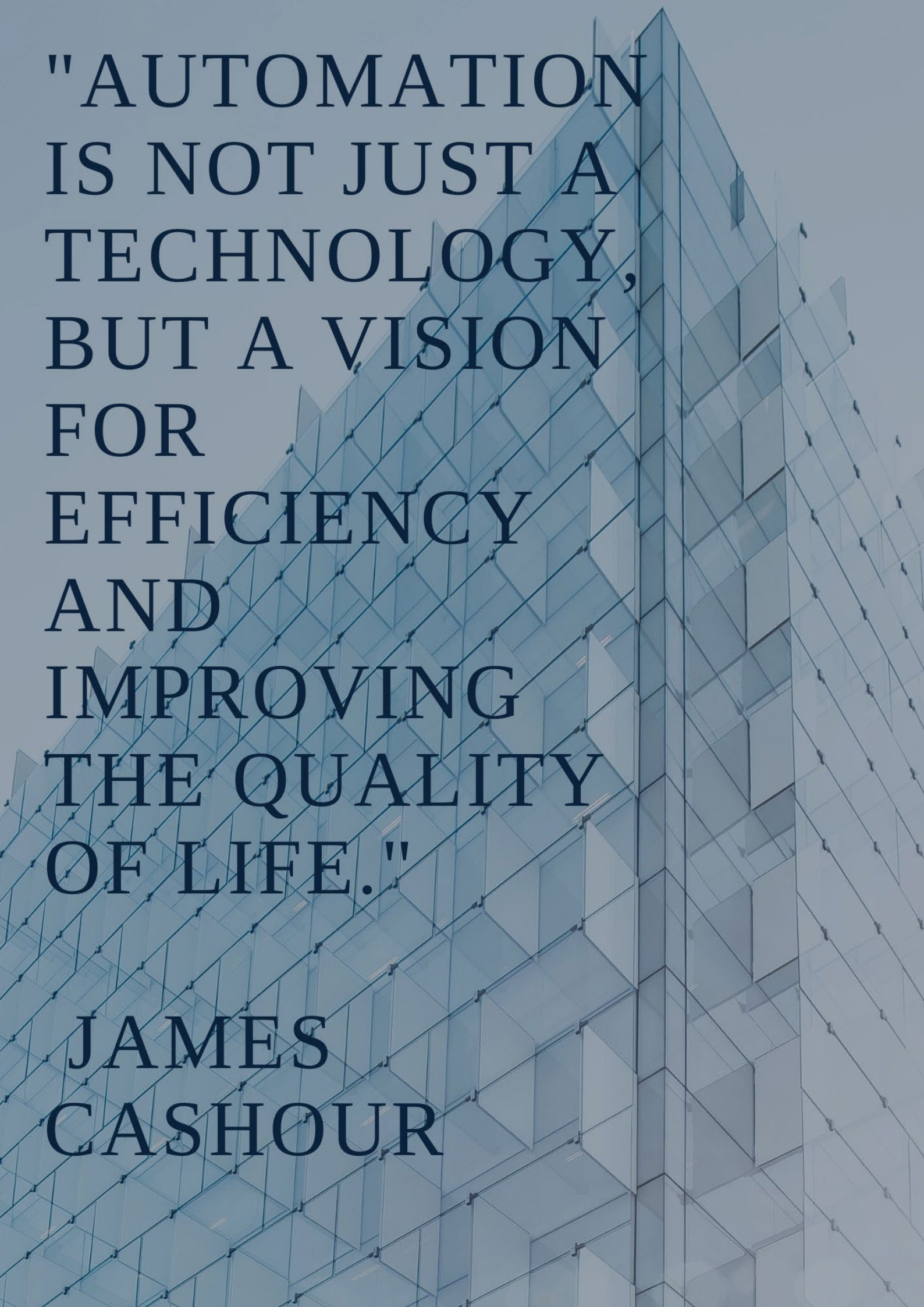
16. Mostafa, N.A., Hamdy, W., & Elawady, H., " An Intelligent Ware houseManagement System Using the Internet of Things " .IEEE Access .,(2020).

17. Choong, C.S., Nasir, A.F., Majeed, A.P.,..... etal., " Automatic Identification and Categorize Zone of RFID Reading in Warehouse Management System " .(2020).

18. Chen, S., Meng, W., Xu, W.,.....etal ., " A Warehouse Man-agement System with UAV Based on Digital Twin and 5G Technologies " . 2020 7th International Conference on Information, Cybernetics, and Computational Social Systems (ICCSS), 864-869.,(2020).

19. Lee, C.K., Lv, Y., Choy, K.L.,.....etal. " Design and application of Internet of things based warehouse management system for smart logistics " .,Inter-national Journal of Production Research, 56, 2753 - 2768.,(2018).

20. Torabizadeh, M., Yusof, N.M., Shaharoun, A.M.....etal., " Identify-ingsustainable warehouse management system indicators and proposing new weighting method "., Journal of Cleaner Production, 248, 119190., (2020).



"AUTOMATION IS NOT JUST A TECHNOLOGY, BUT A VISION FOR EFFICIENCY AND IMPROVING THE QUALITY OF LIFE."

JAMES CASHOUR