DANANG UNIVERSITY
UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF MECHANICAL ENGINEERING

PROJECT BASE LEARNING 5

INTELLIGENT MECHATRONIC SYSTEM

GROUP: 19.04A

TOPIC:
PRODUCT CLASSIFICATION SYSTEM

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INTRODUCTION

Mechatronics is the integration of Mechanical, Electronics, Automation (Control Engineering) and Information Technology into the product design and manufacturing process to increase or optimize usability of the product that product.

To find solutions to the problem of mass production and limited labor, saving costs and time for businesses and individuals. The products selected for research must ensure automaticity and continuity.

The group would like to introduce the Product Classification System. Using a microcontroller, it is possible to program a sequence of commands to control the cylinders and some other sensors to operate automatically and continuously.

To complete the product, the team began to refer to the designs in the market, sketch with Solid, select the cylinder, program the microcontroller and redraw the Relay circuit, and finally install and test the product.

The product of the group is referenced based on the Systems offered in the market. Because of many different factors, the product had to minimize the parts while still ensuring the main function.

The group would like to thank the teachers in the subject, especially Mr. Vo Nhu Thanh for directly guiding the group during the project implementation.

Sincerely thanks!

Danang, September, 03rd, 2022

Signature

Nguyễn Ngọc Khôi

Lê Minh Nhật

Lê Đức Ánh

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CHAPTER 1: INTRODUCTION THE PRODUCT CLASSIFICATION SYSTEM

1.1 Introduction.

Today, along with the development of science and technology, electrical-electronic engineering and automatic control very important role in all fields of science, management, automation industry, supply chain, etc. Therefore, we must capture and apply it effectively in order to contribute to the development of world science and technology in general and in the development of automatic control techniques in particular. With advanced techniques such as microprocessors, PLC, microcontrollers, etc. being applied to the control field, rudimentary mechanical control systems with slow processing speed and less accuracy are replaced by automatic control systems with pre-set program instructions.

In the process of developing e-commerce, online shopping activities are increasingly popular in Vietnam, so the number of orders will become overloaded if people classify goods manually. Saving time in handling goods is an essential need to not delay the delivery schedule as well as save labor for people. Therefore, the industry is growing, companies and enterprises have brought automation into production to facilitate the management of lines and products for the entire system in a reasonable way, which is an essential and economical requirement. Save a lot of time as well as manage easily. To meet that requirement, my team has researched documents, designed and built a model of a product classification system for each region.

1.2 Product classification systems in the market.

1.2.1 Weight products classification.

Figure 1.2.1. Weight products classification

a) Mechanism of action:

- The machine determines the weight of the full load when running through the conveyor balancing the weight sensor and the electronic weighing head
- The PLC control system will compare the weighing value with the set value and then give a signal to control the product sorting machine.
- Combined with the display and signal lights High, Low, siren will help detect defective products easily.

b) Specifications:

- The maximum weighing weight through the weighing conveyor can be up to 1000kg...
- Productivity can be up to 1000 products (containers)/hour depending on the size.
- The conveyor mechanism has a pneumatic cylinder that pushes the defective product to one side.
- Defective products are detected only when the difference between the large setting weight and the small setting weight must be greater than the sum of the errors of all products in the entire package.

1.2.2 Products classification horizontal cross-belt

Figure 1.2.2. Products classification horizontal cross-belt

a) Overview:

- Products classification system Cross-belt is a very popular module nowadays, widely used in industry. Products classificatios and parcels with high-speed sorting of up to 25,000 products (hours)

- Cross-belt can be flexibly customized to the requirements of each customer's available installation space. Ring construction makes it easy to customize the installation of product outlet positions
- This type of classification system can be stacked into several floors to increase capacity and save space.
- System Cross-belt for highest efficiency, tower power consumption, low noise with high operating accuracy.
- Standardized modular design makes maintenance, repair and replacement easy.

b) Feature:

- Reducing sorting labor up to 70%, increasing sorting capacity, thereby reducing huge costs in their Logistics activities;
- The rate of misclassification of parcels is as low as 0.01% which makes your service superior and different
- The rate of defective broken and dented will be reduced thereby improving the service
- The application of new technology including the powertrain, lightweight body helps reduce power consumption by 20%.

1.2.3 Products classification vertical cross-belt

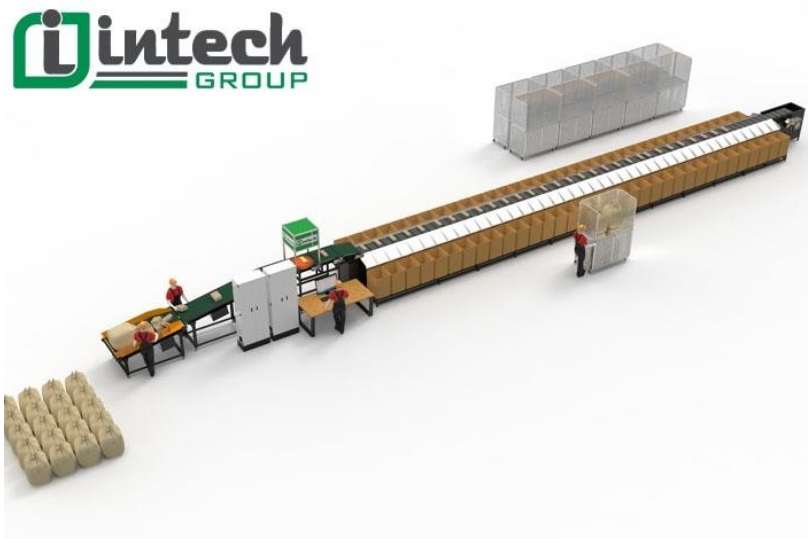


Figure 1.2.3. Products classification vertical cross-belt

a) Overview:

- High-speed sorting capacity up to 10,000 products/hour, the system can operate continuously;
- The highlight of the vertical crossbelt sorting system is that it saves space. Only 2.5 m wide space is enough to install a crossbelt sorting system of this type.

- Like the horizontal crossbelt system this vertical crossbelt system consists of a series of crosbelts distributed in a 90 degree direction according to the vertical circle of the classification system.
- The outlet addresses are configured through the selector software system to make changing the feeder address flexible for each specific selection condition.
- The rate of misclassification of parcels is as low as 0.01%, which makes your service superior and different.
- The rate of defective, broken and dented will be reduced thereby improving service.

b) Feature:

- The highlight of the Vertical Crossbelt system is saves space. Only with compact space with 2.5m width is enough to install a Vertical Crossbelt sorting system of this type.
- Like the Horizontal Crossbelt system, this Vertical Crossbelt system consists of a sequence of distributed Crossbelt vehicles 90^0 in the vertical circle of the system relative to the ground.
- Sorting technology that does not change the orientation of the product during transport ensures safe sorting even with the lightest and most fragile products.
- Output addresses are configurable via a selector software system that makes changing the addresses on the outputs flexible with each selection condition that the customer wants.
- The low degree of temperance helps the working conditions and environment of employees become more friendly.

1.3 Product classification system

1.3.1 Overview

The combination of electrical - electronics and mechanical engineering is an important step in the development of industrial automation. Currently, our country is in the process of development and integration, so the products produced not only meet quality standards, but also require high accuracy in shape, size and shape, size, weight...So since then industrial zones were formed with many modern machinery and equipment lines suitable for production needs, to create higher productivity in the production process. One of those modern equipment and machines is the product classification system. Therefore, we decided to design and construct a model with the topic: "Product classification system" (Figure 1.3.1). This model will help us better understand the structure as well as the operating principle of the equipment lines used in the classification system, and also apply microcontrollers to control the system.

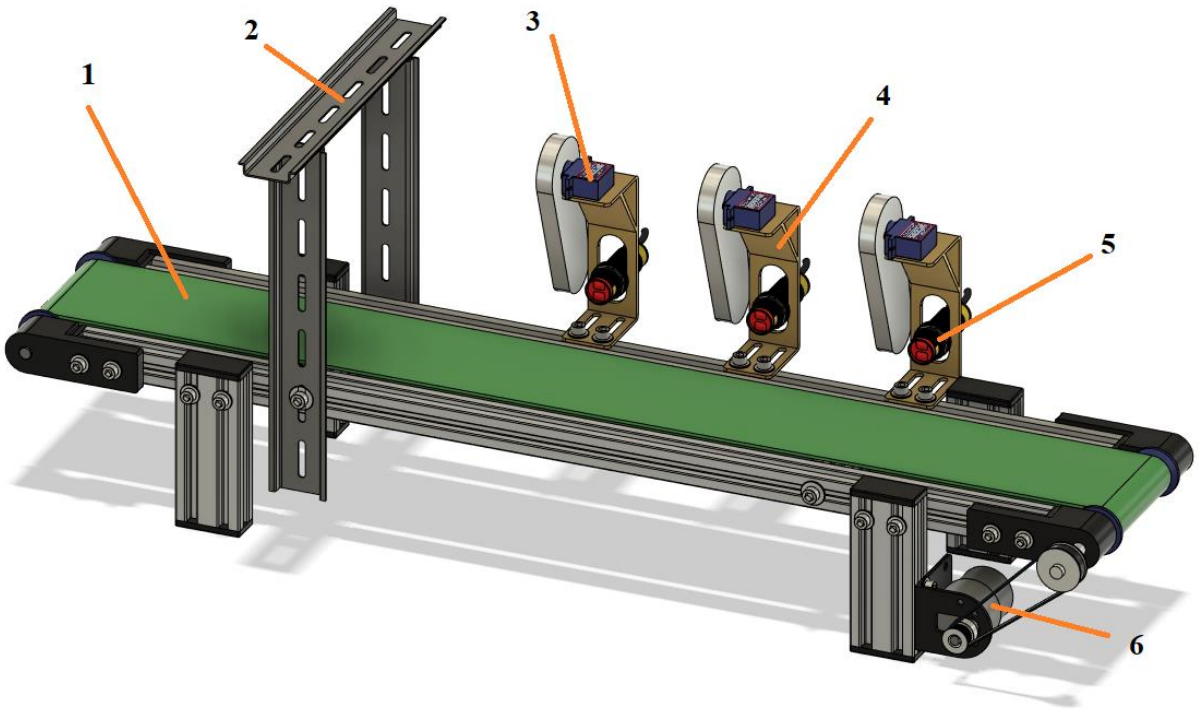


Figure 1.3.1. Preliminary design products classification system

1 - Conveyor
2 - Shelf Camera
3 - Servo
4 - Shelf
5 - Infrared sensor
6 - Geared motor

And the other device: Microcontroller, Relay, Air conductor, Product tray, etc.

1.3.2 Working principle

- The camera on the conveyor belt helps to scan the codes by area of the order

The conveyor belt rotates by the motor shaft to bring the order to the place where it needs to be sorted

- Sensor 1 located next to servo 1 detects that the order has reached the correct position in the sorting area 1

- Servo 1 with the function of bringing the order to the order box position of the 1 classification area

+ Servo 1, 2, 3 are in the initial position of 0, sensors 1, 2, 3=0.

+ When sensor 1 = 1 with the condition that the order is classified area 1 ==> Servo 1 pushes out, after the end of the stroke

+ When sensor 2=1 with the condition that the order is classified area 2 ==> Servo 2 pushes out, after the end of the stroke

+ When sensor 3=1 with the condition that the order is classified area 3 ==> Servo 3 pushes out, after the end of the stroke

1.3.3 The issue raised

The purpose is to research and manufacture: The product classification system by region has compact design, easy to install, maintain and repair.

To design, we need to mechanically design and control the motor and the system to operate automatically based on microcontroller programming. There are also other issues such as: model materials, supplies, detailed parameter calculation...

Issues that need to be addressed are:

- Mechanical problem: analysis, calculation and selection of materials, specifications of details to satisfy the requirements of the topic: small, compact, lightweight, durable, highly aesthetic, easy to install install and repair.
- Control problem: fully automatic control.
- Safety issue: ensure the safety of the user and the product is not damaged.

1.3.4 Limit range

Product classification system is a topic that has been researched and developed for a long time. Currently, in factories and enterprises, there are many complete systems in both quality and aesthetics. However, within the scope of a research project, with the limitations of knowledge, time and funding, the topic is limited by the following features:

- Dimensions: (Length × Width × Height) 700 × 500 × 300 (mm)
- Mass: 5(Kg)
- Control system: Microcontroller.
- Product push mechanism: Servo Motor
- Motion transmission motor: DC motor + Deceleration.
- Drive system: Conveyor belt.
- Supply voltage: AC voltage 220V and DC voltage 24V.
- Type commodity: Soft commodity, clothes
- Estimated number of classification: 30 product/minute
- Mass of product: Under 1 Kg
- Dimensions of product: 6x6

1.4 Electronic components and mechanical parts

1.4.1 Microcontroller PIC16F877A.

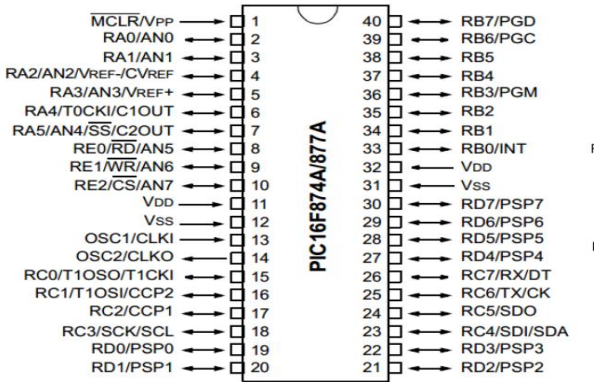


Figure 1.4.1A. Mirocontroller PIC16F877A

- Belong to PIC16Fxxx family with instruction set has 35 instructions
- The execution time is the same for almost all instructions, and lasts 4 clock cycles which is stabilized by a quartz crystal. It can operate up to **20MHz frequency**
- Flash program memory with capacity of 8K × 14 bit.
- RAM Memory size of 368 byte.
- Supply power: 5 VDC
- EEPROM Memory:
  + Size of 256 byte
  + Can be read and written up to 1.000.000 times
  + Data can be stored up to 40 years
- 5 I/O ports with 33 pins, namely A, B, C, D, E
- SLEEP mode for saving power usage
- 10-bit Analog-to-Digital Module have 8 input channels
- Have 2 Analog Comparators

* Simulation Circuit PIC16F877A

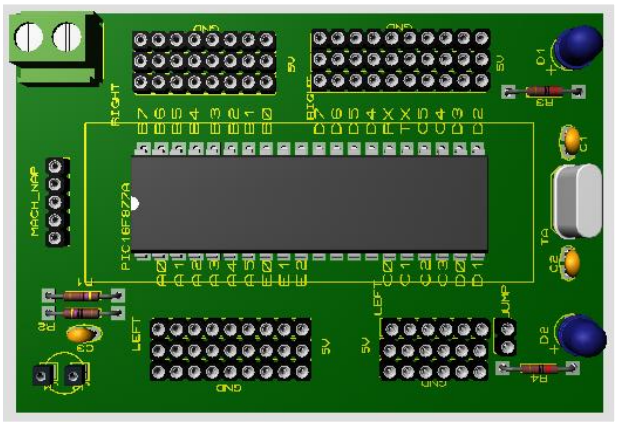


Figure 1.4.1B. Simulation Circuit Mirocontroller PIC16F877A

⁕ Actual Circuit PIC16F877A

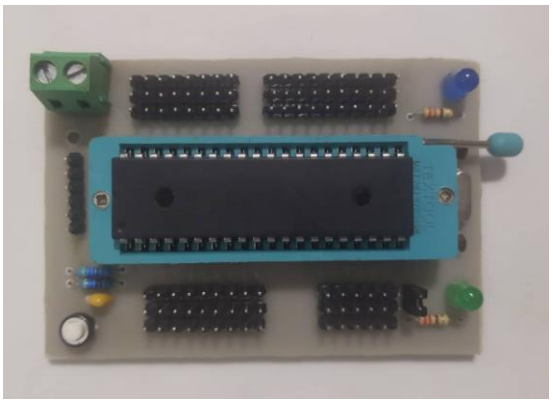


Figure 1.4.1C. Actual Circuit Mirocontroller PIC16F877A

1.4.2 Voltage stabilizer circuit 5v

⁕ Simulation Circuit Voltage stabilizer circuit 5v

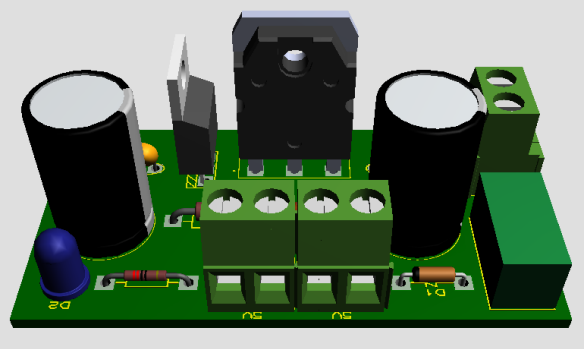


Figure 1.4.2A. Simulation Circuit Voltage stabilizer circuit 5v

⁕ Actual Circuit Voltage stabilizer circuit 5v

Figure 1.4.2B. Actual Circuit Voltage stabilizer circuit 5v

1.4.3 Micro Servo SG90

What is the Servo SG90?

Servo is a special type of electric motor. Unlike conventional motors, which are plugged in and rotated continuously, servos only rotate when controlled (by PPM pulses)

with a rotation angle ranging from 0o to 180o. Each type of servo has different size, weight and construction

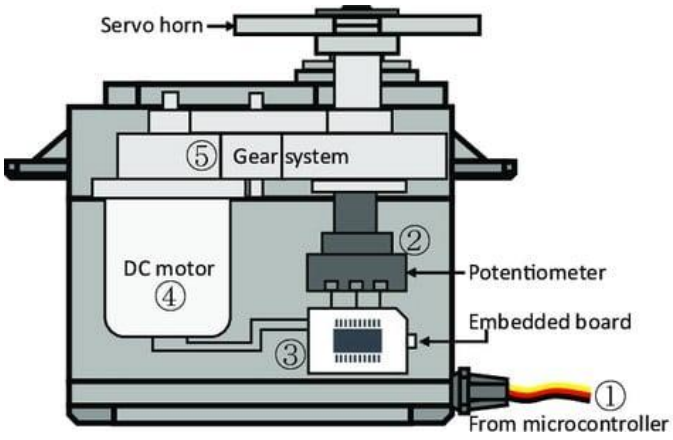


Figure 1.4.4 Structure of servo

1.4.4 Infrared Sensor.

a) What is the Infrared Sensor?

Infrared sensor (IR Sensor) is an electronic device that emits or receives infrared radiation in its surroundings. When the object emits a temperature above 35 degrees Celsius, it will emit infrared radiation that cannot be seen by humans.

Figure 1.4.5 Infrared sensor

b) Infrared sensor classification

- Proactive Infrared Sensor: When the object is close, the infrared rays emitted by the device will hit the objects and reflect back, from which the sensor recognizes the object.

- Passive Infrared Sensor: Does not emit infrared by itself, but will automatically detect and receive infrared rays from thirsty objects.

In this project, we use a Proactive Infrared Sensor.

1.4.5 Working principle of infrared sensor

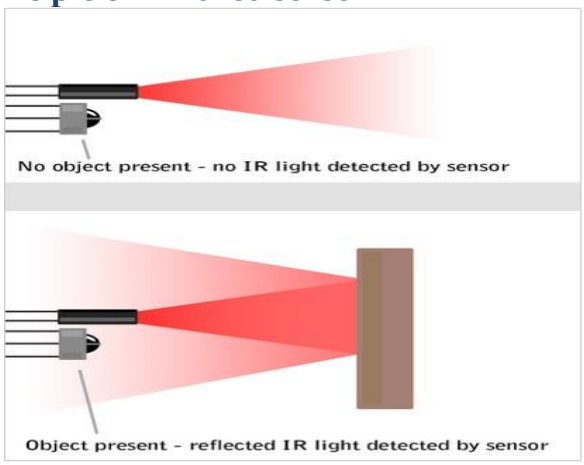


Figure 1.4.6 Working principle of infrared sensor

a) Proactive Infrared Sensor: Consists of two components: an infrared source that uses an LED bulb to emit infrared waves and an infrared sensor. When it encounters an object, the infrared ray bounces back and enters the infrared sensor

b) Passive Infrared Sensor: Simply a thermoelectric sensor, an infrared filter and a Fresnel lens to detect the infrared emitted by an object.

1.4.6 Intergrated Camera

Webcam 720P HD USB Camera is used to read scan QRCode that are very popular today through CMOS image sensor, data transmission circuit to Micro control or computer easily via USB or UART communication

Figure 1.4.7 Webcam 720P HD USB Camera

1.4.7 Motor Control Circuit Module BTS7960

Because the system uses conveyors to transport and the geared motor needs at least 12V to operate stably. The PIC16F877A only outputs 5V and cannot be supplied directly

to the conveyor, so we use an intermediate driver to directly control the 12V reducer motor for the conveyor, the authors use the BTS7960 Module to control the speed.

Conveyor motor, BTS7960 has anti-overheating, anti-over-voltage, over-current protection and automatic disconnection when the above phenomena occur.

Figure 1.4.8 Module BTS7968

CHAPTER 2: MECHANICAL DESIGN CALCULATION

2.1 Detailed size for system.

2.1.1 Dimension of conveyor

We design a model frame with dimensions of 800x80x80 as follows:

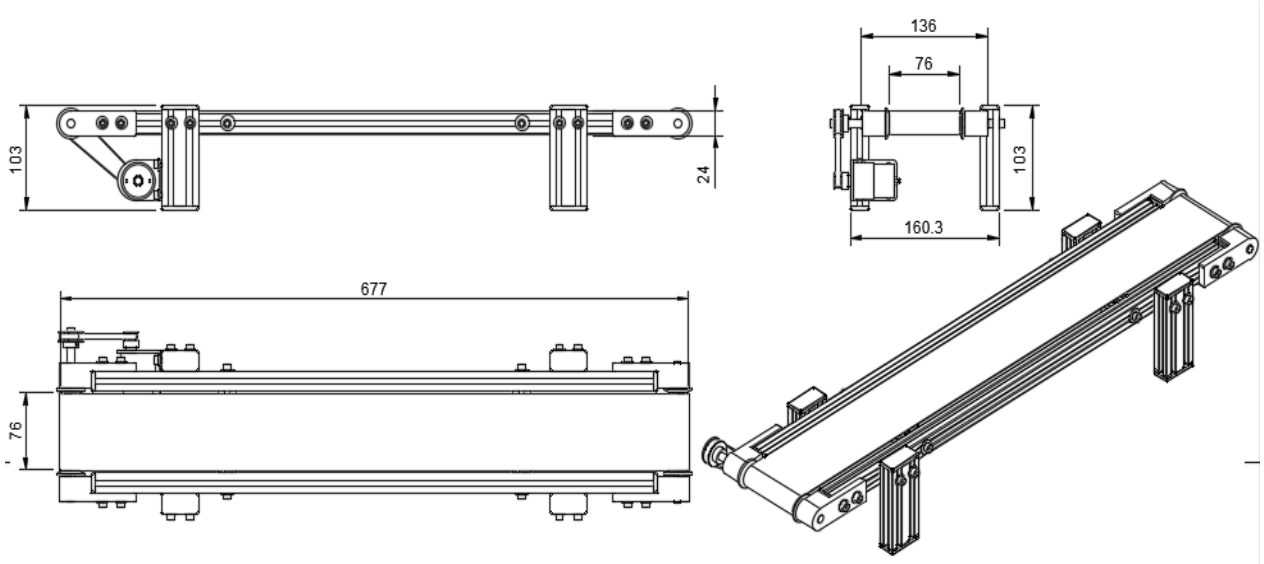


Figure 2.1.1 Dimension of conveyor

2.1.2 The location of the cargo box

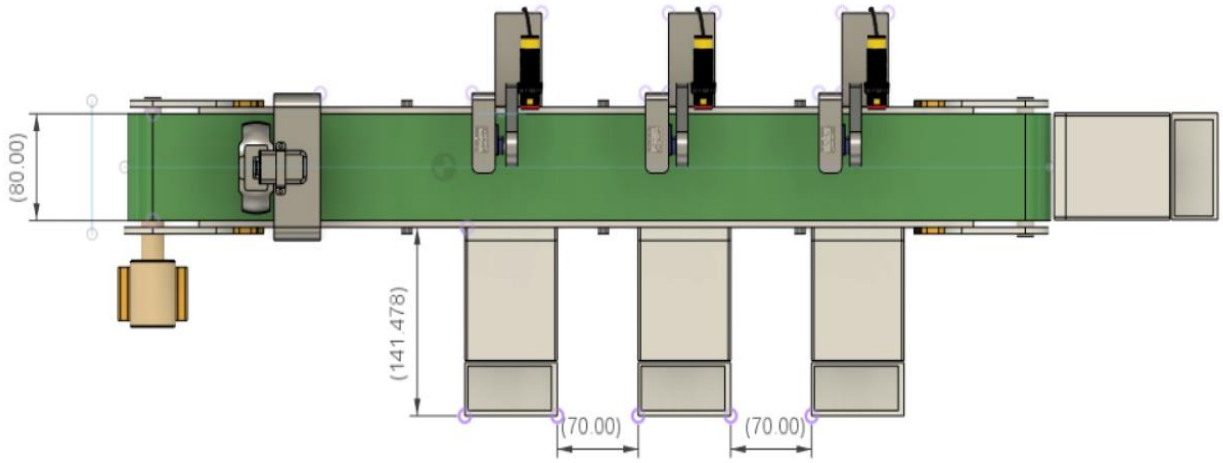


Figure 2.1.2 The location of the cargo box

2.1.3 The location of the sensors

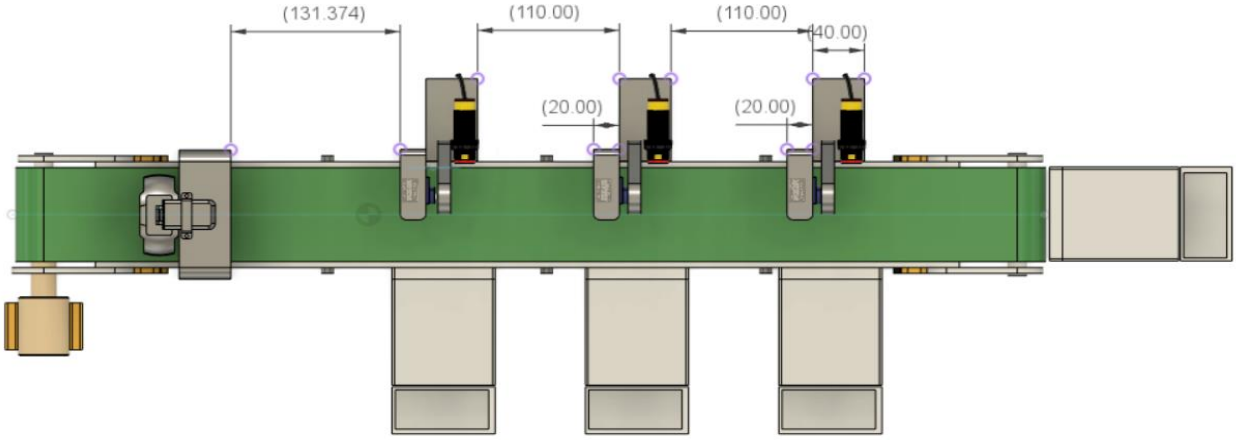


Figure 2.1.3 The location of the sensors

2.2 Calculation of conveyor motor parameters.

2.2.1 Parameters that we have

- Conveyor length: 600mm
- Object mass: 1000g
- Work productivity: 30 product / 1 minute
- Diameter roller: 40 mm
- Conveyor speed: ? (we calculating in 2.1.2).

2.2.2 Calculation of conveyor speed.

- Diameter roller: 40mm

→ Perimeter roller = 2.π.R = 2.π.20 = 125,6mm

→ 1 Round = 125.6mm

- That we wanna 30 Products / 1 minute.

- Each product is about 200mm apart → Need 200 x 30 = 6000mm/1 minute to achieve 30 Products / 1 minute

- So a number of round to run 6000mm: 6000/125,6 = 47,77 ≈ 48 round/1 minute

↔ 0,8 round / 1 second

→ 1 Round = 125.6mm

↔ 0,8 Round ≈ 100 mm => Conveyor speed = 0,1m /s

2.2.3 Calculation of capacity of motor

- When calculating the capacity of the conveyor motor, we usually calculate the following components:

+ Calculate the capacity P1 required for the conveyor to move the object

+ We calculate the capacity P2 required for the resistance caused by friction

+ Calculate capacity P3 to lift the load (if the conveyor is tilted) P3 = 0.

- First, we calculate the force required for the conveyor to move the object

$$F_1 = L.\sigma.k_1.g.\cos\beta$$

In there: - β: Conveyor belt tilt angle (β = 0)

- L: Conveyor length

- σ sigma : Material mass per conveyor (1000 g)

- k_1 : Calculation coefficient when moving material (k_1 = 0,05)

$$F_1 = 0{,}6.1000.0{,}05.10 = 300N$$

- Next, we calculate the capacity required for the conveyor to move the object

$$P_1 = F_1.V = 300.0.1 = 30W$$

- Next, we calculate the resistance caused by friction

$$F_2 = 2.L.\sigma_b.k_2.g.\cos\beta$$

In there: - β: Conveyor belt tilt angle (β = 0)

- L: Conveyor length

- σ sigma : Conveyor mass per conveyor (1000 g)

- k_2 : Coefficient resistance no load (k_2 = 0,005)

$$F_2 = 2.0{,}6.500.10.0{,}005 = 30N$$

- Next, we calculate the capacity required for the resistance caused by friction

$$P_2 = F_2.V = 30.0.1 = 3W$$

- Static capacity of conveyor

$$P = P_1 + P_2 + P_3 = 30 + 3 + 0 = 33W$$

- Conveyor drive motor Capacity is calculated according to the following formula

$$P_{dc} = k_3 . \frac{P}{\eta}$$

In there: - k3: Capacity reserve factor (1.2-1.25)

- η (eta) : Transmission efficiency

- Get data from table (2-1) page 27 [Document Thiết kế chi tiết máy, Nguyễn Trọng Hiệp, Nguyễn Văn Lẫm, NXB giáo dục, 1999] to calculation η

$$\eta = \eta_x . {\eta_{br}}^2 . {\eta_{ol}}^4 . \eta_{kn}$$

Hiệu suất của bộ truyền đai (để hở): $\eta_x = 0{,}95$

Hiệu suất của cặp bánh răng trụ (được che kín): $\eta_{br} = 0{,}98$

Hiệu suất của cặp ổ lăn: $\eta_{ol} = 0{,}995$

Hiệu suất của khớp nối trục: $\eta_{kn} = 1$

$$\eta = \eta_x . {\eta_{br}}^2 . {\eta_{ol}}^4 . \eta_{kn} = 0{,}95 . 0{,}98^2 . 0{,}995^4 \times 1 = 0{,}894$$

$$P_{dc} = k_3 . \frac{P}{\eta} = 1{,}2 . \frac{33}{0.894} \approx 44.3\ W$$

CHAPTER 3: FLOWCHARTS OF ALGORITHMS AND SIMULATIONS

3.1 Algorithm flowchart

3.1.1 QR code encryption algorithm

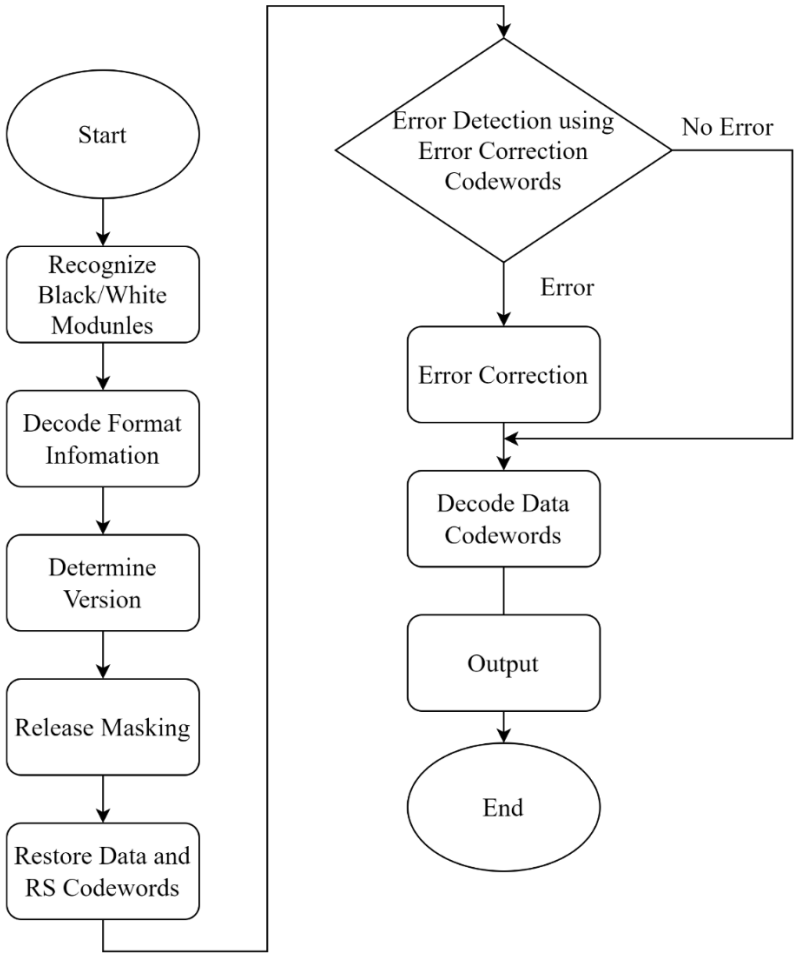


Figure 3.1.1 QR code encryption algorithm

3.1.2 System operation algorithm

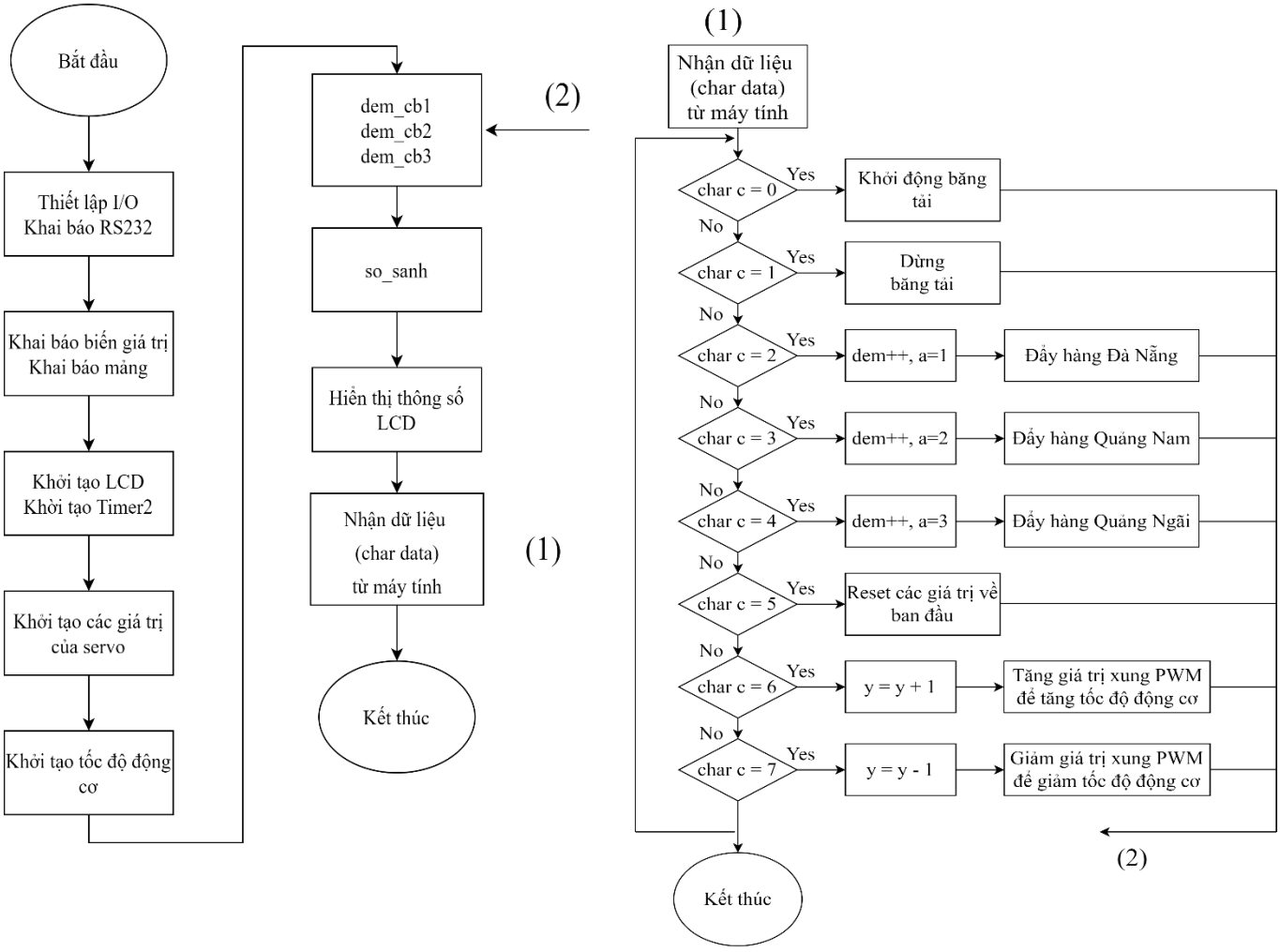


Figure 3.1.2 System operation algorithm

3.1.3 Wiring diagram:

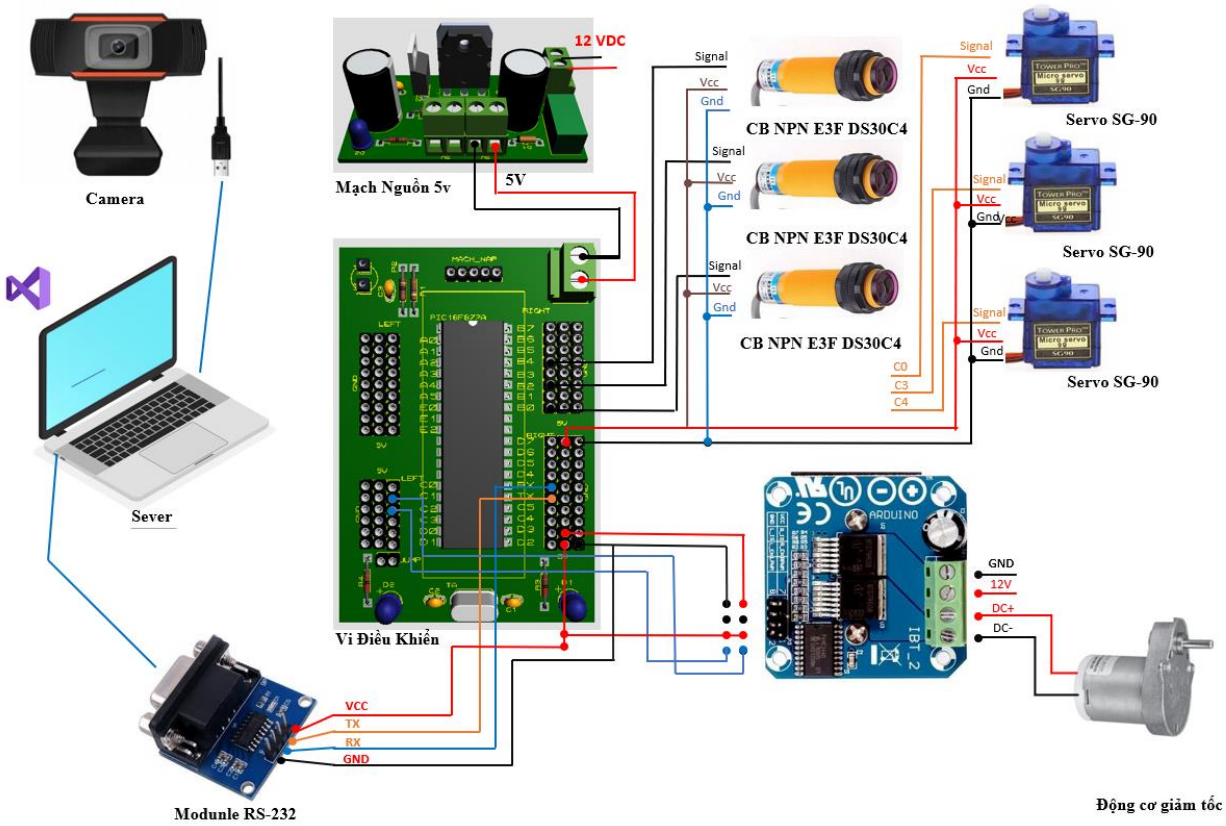


Figure 3.1.3 Wiring diagram of systems

3.2 System interface :

3.2.1 Window form for c# in Visual Studio

- To comunication Computer with PIC16F877A, we use the COM Port to transmit data from Computer and microcontroller.
- The COM Port is use with Driver MAX232 to transmit data
- MAX232 connected to PINS RC7 and RC6 (Rx and Tx) of PIC16F877A

Figure 3.2.1A COM Port and MAX232

- In Visual Studio, declare command to transmit data in C# is Serial Port
- This is the WindowForm to control microcontroller from COM Port

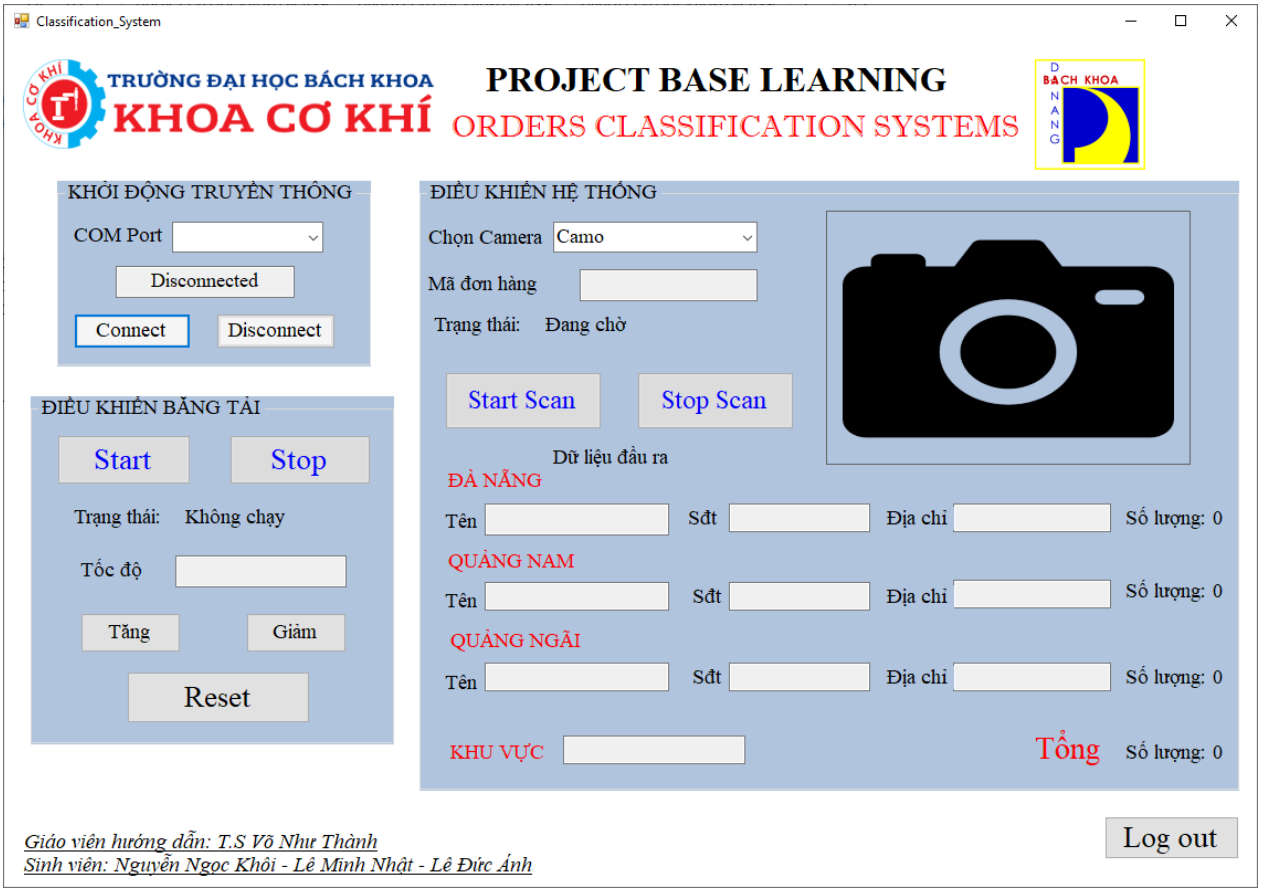


Figure 3.2.1B WindowForm to control microcontroller

3.2.2 Function of the group box.

a) Connect comunication of microcontroller with Computer

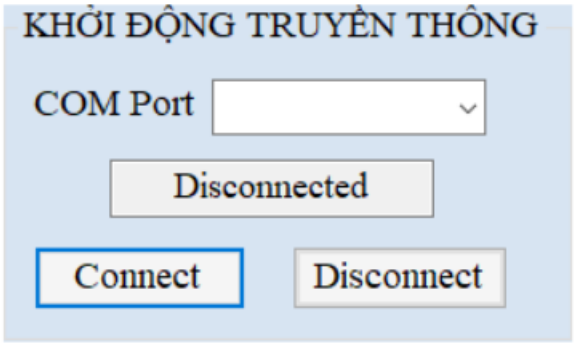


Figure 3.2.2A Group box to connect microcontroller with Computer

b) Conveyor control

Figure 3.2.2B Conveyor control

- This group box is calculated by microcontroller to the quantity of incoming goods

c) Main operation of the system

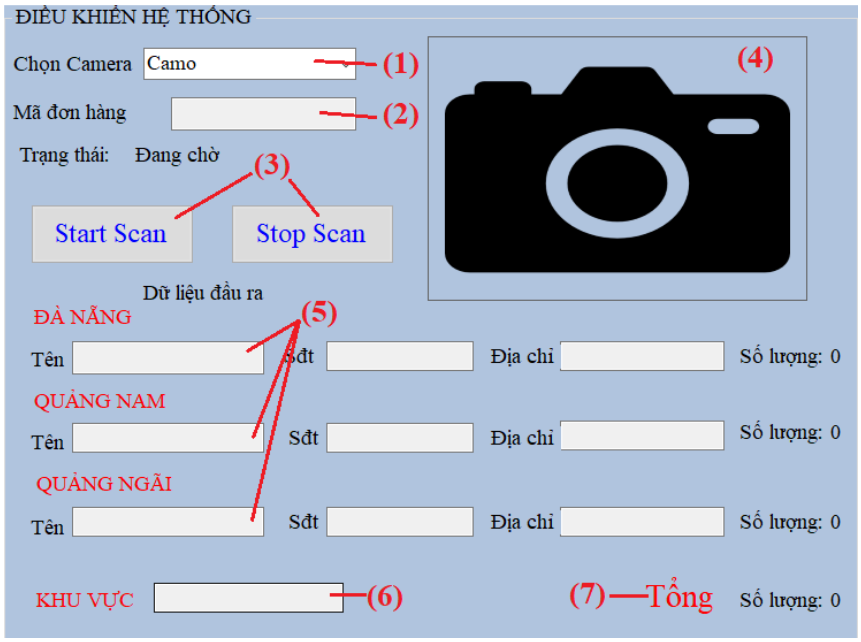


Figure 3.2.2C Main operation of the system

1. Choose the wedcam
2. ID input
3. Start/Stop Conveyor
4. Display wedcam
5. Display infomation
7. Total amount packet have been classificated

3.2.3 Simulation System

- Step 1: Choose COM port and connect COM port

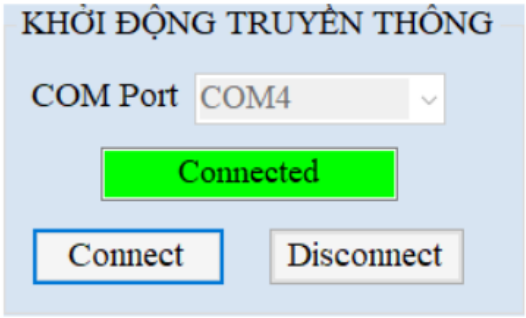


Figure 3.2.3A Connect COM port

- Step 2: choose the wedcam and click “Start Scan” and we have a display like image below

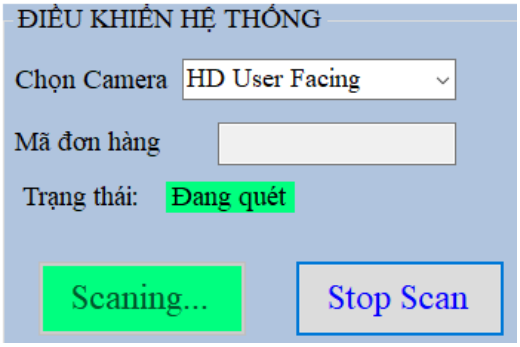
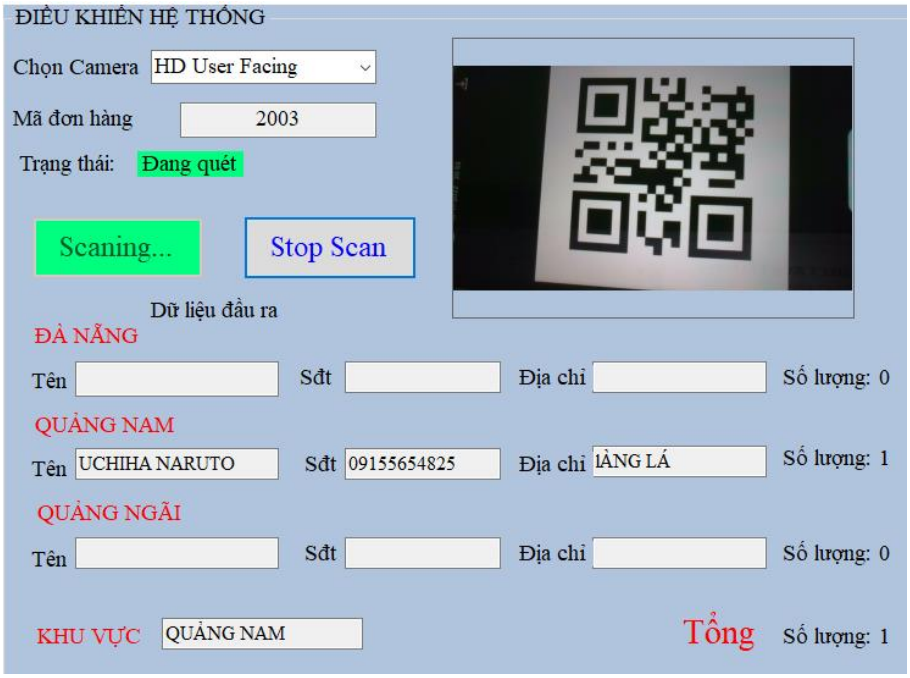


Figure 3.2.3B Connect camera

- Step 3: we start scan each Qrcode and we have the output data like image below



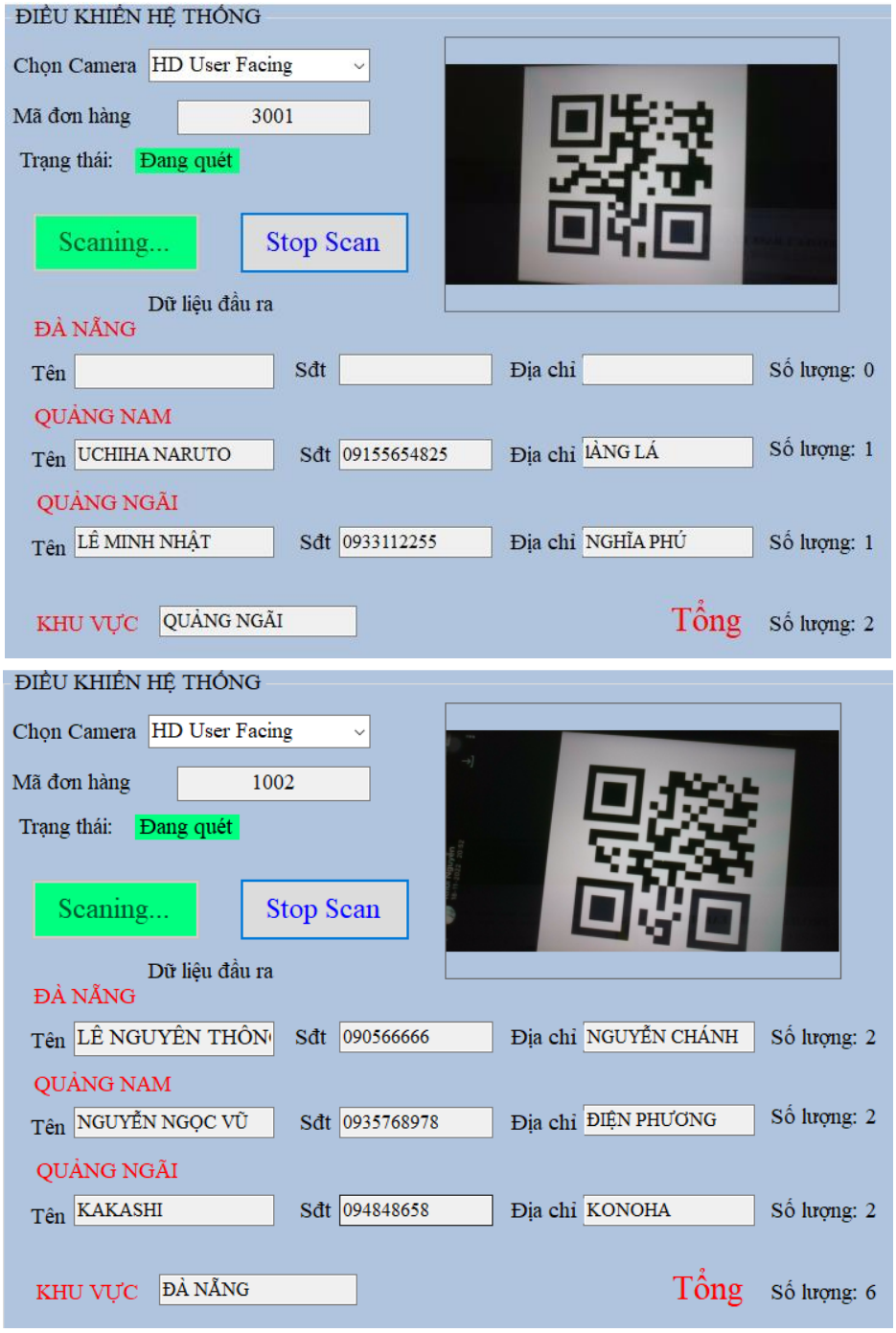


Figure 3.2.3C Data output after scan

CHAPTER 4: STATISTICAL RESULTS OF THE PRODUCT

4.1 Target and tasks in the product manufacturing process

- The goal that the group sets itself is:
  + Estimated number of classification: 30 product/minute
  + Accurately classify the location of areas continuous without interruption
  + The ability to recognize qrcode correctly
- The mission:
  + Research classification algorithms to optimize product operations
  + Learn how to recognize QRcode to get information on packet
  + To make sure the qrcode is recognized correctly, we need to display the camera on the clearest frame
  + Select the conveyor speed to suit the code scanning process and freight

4.2 Results during test run

	PWM(0~255)	Time	The number of packet have been classification
1st Time	130	60 second	25
2nd Time	135	60 second	32
3rd Time	145	60 second	41

- Rate of accurate scanning of order information: 100%
- Rate of scanning in transit: 80% *(Depends on camera,sensor count error, and conveyor speed)*

⇒ **Conclusion:** The product meets the requirements that the team has given.

CHAPTER 5: CONCLUSION

During the process of making the Mechatronic System project with the topic: "Oder classification system by QRCode" helped the team better understand theoretical and practical issues, in order to consolidate the knowledge learned in the past time and less confusing in the actual process later.

With the guidance and help of PhD. Vo Nhu Thanh, the support from friends and seniors as well as the efforts of the group itself, the following tasks have been completed:

- Learn about sensor selection and mounting methods
- Learn about use Microcontroller
- Learn about the steps to program an actual model.
- Learn about design thinking, problem solving, product model optimization
- Actual results after finishing the product

However, due to the limited time and knowledge of the group, Project still has some limitations as follows:

- The cylinder system to push the product has not been used yet
- The conveyor speed has not been adjusted correctly and appropriately

Solution of group:

- Use servos to replace pneumatic cylinders
- Create buttons to increase/decrease the conveyor motor speed accordingly

Once again, the group would like to thank PhD. Vo Nhu Thanh for helping us during the project.

Due to limitations in research time and qualifications of individuals, the project still has shortcomings. The group looks forward to receiving suggestions from teachers and friends to improve the group's project.

Sincerely thanks!

REFERENCES

[1] Giáo trình Lập trình kĩ thuật vi điều khiển PIC và thiết bị ngoại vi (TS. Đặng Phước Vinh)

[2] Document Thiết kế chi tiết máy, Nguyễn Trọng Hiệp, Nguyễn Văn Lẫm, NXB giáo dục, 1999

[3] https://luanvan.net.vn/luan-van/de-tai-tinh-chon-cong-suat-dong-truyen-cho-bang-tai-47126/

[4] https://nvtienanh.info/giao-tiep-rs232-voi-vi-dieu-khien-pic16f877a/

[5] www.academia.edu/32406613/Tong_hop_code_ccs_cho_pic16f877a_picvietnam?email_work_card=title

PROGRAM TO LOAD CODE FOR THE SYSTEM

Code ccs.h

```
#include <16F877A.h>
#device ADC=16

#FUSES NOWDT
#FUSES NOBROWNOUT
#FUSES NOLVP
#FUSES HS
#use delay(crystal=4MHz)
#use RS232(baud=9600, xmit=PIN_C6, rcv=PIN_C7)

#define  cb1     input(pin_b0)
#define  cb2     input(pin_b2)
#define  cb3     input(pin_b4)

#define led1(x) output_bit(PIN_b7,x);
#define led2(x) output_bit(PIN_b6,x);
#define LCD_ENABLE_PIN  PIN_E0
#define LCD_RS_PIN      PIN_E1
#define LCD_RW_PIN      PIN_E2
#define LCD_DATA4       PIN_D4
#define LCD_DATA5     PIN_D5
#define LCD_DATA6     PIN_D6
#define LCD_DATA7     PIN_D7
```

Code ccs.c

```
// Code writen by LE MINH NHAT - 19CDTCLC1 //
#include <Phan_loai_sp.h>
#include <lcd.c>
char data;
int giatri1,giatri2,giatri3;
int gtmacdinh1=1,gtmacdinh2=1,gtmacdinh3=1;
int dem;
int dem1,dem2,dem3;
int a=0,up=0;
int t=0;
int y=0,g=0,h=0;
int don_hang[3]={0,0,0};
void coi(int8 hoi,int8 tieng){
    int8 i, j;
    for(i = 0; i < hoi; i ++){
        for(j = 0; j < tieng; j ++){
            output_high(pin_d1);
            delay_ms(50);
        }
        output_low(pin_d1);
        delay_ms(50);
  }
}
void dem_cb1(){
  if(cb1==1){giatri1=1;}else{giatri1=0;}
  if(giatri1 != gtmacdinh1){
    if(giatri1==0){
      dem1++;
      }
    gtmacdinh1 = giatri1;
    }
}
void dem_cb2(){
  if(cb2==1){giatri2=1;}else{giatri2=0;}
  if(giatri2 != gtmacdinh2){
    if(giatri2==0){
      dem2++;
      }
    gtmacdinh2 = giatri2;
    }
}
```

```
void dem_cb3(){
  if(cb3==1){giatri3=1;}else{giatri3=0;}
  if(giatri3 != gtmacdinh3){
    if(giatri3==0){
      dem3++;
    }
    gtmacdinh3 = giatri3;
    }
}

void servo1_0(){for(int
i=0;i<50;i++){output_high(pin_c0);delay_us(450);output_low(pin_c0);delay_us(19550);}}
void servo1_90(){for(int
i=0;i<50;i++){output_high(pin_c0);delay_us(1450);output_low(pin_c0);delay_us(18550);}}
void servo2_0(){for(int
i=0;i<50;i++){output_high(pin_d2);delay_us(450);output_low(pin_d2);delay_us(19550);}}
void servo2_90(){for(int
i=0;i<50;i++){output_high(pin_d2);delay_us(1450);output_low(pin_d2);delay_us(18550);}}
void servo3_0(){for(int
i=0;i<50;i++){output_high(pin_c4);delay_us(450);output_low(pin_c4);delay_us(19550);}}
void servo3_90(){for(int
i=0;i<50;i++){output_high(pin_c4);delay_us(1450);output_low(pin_c4);delay_us(18550);}}

void dc_up(){
    for(y=90;y<110;y++){
        set_pwm2_duty(0);
        set_pwm1_duty(y);
        lcd_gotoxy(14,1);
        printf(lcd_putc,"%u ",y);
        delay_ms(150);
        }
    if(y==110){coi(1,1);}
}
void dc_stop(){
  set_pwm1_duty(y);
  set_pwm2_duty(y);
}
void servo_1(){servo1_90();servo1_0();}
void servo_2(){servo2_90();servo2_0();}
void servo_3(){servo3_90();servo3_0();}

void init_lcd(){
  lcd_gotoxy(6,1);
  lcd_putc("SL:");
```

```
  lcd_gotoxy(1,1);
  printf(lcd_putc,"%u ",don_hang[0]);
  lcd_gotoxy(2,1);
  printf(lcd_putc,"%u ",don_hang[1]);
  lcd_gotoxy(3,1);
  printf(lcd_putc,"%u ",don_hang[2]);
  lcd_gotoxy(11,1);
  lcd_putc( "DC:" );
  lcd_gotoxy(0,2);lcd_putc( "D1:" );
  lcd_gotoxy(6,2);lcd_putc( "D2:" );
  lcd_gotoxy(11,2);lcd_putc( "D3:" );
  lcd_gotoxy(9,1);printf(lcd_putc, "%u " ,dem);
  lcd_gotoxy(4,2);printf(lcd_putc, "%u " ,dem1);
  lcd_gotoxy(9,2);printf(lcd_putc, "%u " ,dem2);
  lcd_gotoxy(14,2);printf(lcd_putc, "%u " ,dem3);
  }

void reset(){
  led1(1);led2(1);delay_ms(200);led1(0);led2(0);
  lcd_init();
  lcd_putc( "\f" );
  init_lcd();
  setup_timer_2(T2_DIV_BY_1,255,1);
  setup_ccp1(CCP_PWM);
  setup_ccp2(CCP_PWM);
  set_pwm1_duty(0);
  set_pwm2_duty(0);
  up=0;
  dem=0;a=0;t=0;g=0;
  dem1=0;dem2=0;dem3=0;
  don_hang[0]=0;don_hang[1]=0;don_hang[2]=0;
  servo1_0();
  servo2_0();
  servo3_0();
  coi(2,1);
  led1(1);
}

void gan_giatri(){
don_hang[t] = a;t++;
}

void sosanh1(){
    if(dem==1){
```

```
            if (don_hang[0]==1 && don_hang[1]==0 && don_hang[2]==0 && dem1==1) {
                servo_1();  dem--;dem1=0;dem2=0;dem3=0;t--;don_hang[0]=0;
      else if(don_hang[0]==2 && don_hang[1]==0 && don_hang[2]==0 && dem2==1){
                servo_2();dem--;dem1=0;dem2=0;dem3=0;t--;don_hang[0]=0;
     else if(don_hang[0]==3 && don_hang[1]==0 && don_hang[2]==0 && dem3==1){
                servo_3();dem--;dem1=0;dem2=0;dem3=0;t-- ;don_hang[0]=0;
    }
}

void sosanh2(){
if(dem==2){g=0;
       if(don_hang[0]==1 && don_hang[1]==1 && don_hang[2]==0){
         if(dem1==1){
           servo_1();
           dem--;dem1=0;don_hang[0]=0;
           t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;
         }
       }
       else if(don_hang[0]==1 && don_hang[1]==2 && don_hang[2]==0){
         if(dem1==1){
           servo_1();
            dem--;dem1--;don_hang[0]=0;
           t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;
         }
         if(dem2==1){
           servo_2();
           dem--;dem2--;don_hang[1]=0;
           t--;don_hang[1]=don_hang[2];don_hang[2]=0;
         }
       }
       else if(don_hang[0]==1 && don_hang[1]==3 && don_hang[2]==0){
         if(dem1==1){
           servo_1();
           dem--;dem1=0;don_hang[0]=0;
           t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;
           }
         if(dem3==1){
           servo_3();
           dem--;dem1=0;dem2=0;dem3=0;don_hang[1]=0;
           t--;don_hang[1]=don_hang[2];don_hang[2]=0;
           }
       }
       else if(don_hang[0]==2 && don_hang[1]==1 && don_hang[2]==0){
         if(dem1==2){
```

```
      servo_1();
      dem--;dem1=0;don_hang[1]=0;
      t--;don_hang[1]=don_hang[2];don_hang[2]=0;
    }
    if(dem2==1){
      servo_2();
      dem--;dem1=0;dem2=0;don_hang[0]=0;
      t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;
    }
  }
  else if(don_hang[0]==2 && don_hang[1]==2 && don_hang[2]==0){
    if(dem2==1){
      servo_2();
      dem--;dem1=0;dem2=0;don_hang[0]=0;
      t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;
    }
  }
  else if(don_hang[0]==2 && don_hang[1]==3 && don_hang[2]==0){
    if(dem2==1){
      servo_2();
      dem--;dem1=0;dem2=0;don_hang[0]=0;
      t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;
     }
    if(dem3==1){
      servo_3();
      dem--;dem1=0;dem2=0;dem3=0;don_hang[1]=0;
      t--;don_hang[1]=don_hang[2];don_hang[2]=0;
    }
  }
  else if(don_hang[0]==3 && don_hang[1]==1 && don_hang[2]==0){
    if(dem1==2){
      servo_1();
      dem--;dem1=0;don_hang[1]=0;
      t--;don_hang[1]=don_hang[2];don_hang[2]=0;
    }
    if(dem3==1){
      servo_3();
      dem--;dem1=0;dem2=0;dem3=0;don_hang[0]=0;
      t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;
    }
  }
  else if(don_hang[0]==3 && don_hang[1]==2 && don_hang[2]==0){
    if(dem2==2){
      servo_2();
```

```
            dem--;dem1=0;dem2=0;don_hang[1]=0;
            t--;don_hang[1]=don_hang[2];don_hang[2]=0;
            }
          if(dem3==1){
            servo_3();
            dem--;dem1=0;dem2=0;dem3=0;don_hang[0]=0;
            t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;
          }
        }
        else if(don_hang[0]==3 && don_hang[1]==3 && don_hang[2]==0){
          if(dem3==1){
            servo_3();
            dem--;dem1=0;dem2=0;dem3=0;don_hang[0]=0;
            t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;
          }
        }
      }
}

void sosanh3(){
    if(dem==3){
      if(don_hang[0]==1 && don_hang[1]==1 && don_hang[2]==1){
        if(dem1==1){
          servo_1();
          dem--;dem1=0;t--;don_hang[0]=0;
          don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
        }
      }
      else if(don_hang[0]==1 && don_hang[1]==1 && don_hang[2]==2){
        if(dem1==1){
          servo_1();
          dem--;dem1=0;t--; don_hang[0]=0;
          don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
        }
        if(dem2==1){
          servo_2();
          dem--;dem1--;dem2=0;t--;don_hang[2]=0;printf("a");
        }
      }
      else if(don_hang[0]==1 && don_hang[1]==1 && don_hang[2]==3){
        if(dem1==1){
          servo_1();
          dem--;dem1=0;t--; don_hang[0]=0;
          don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
```

```
  }
  if(dem3==1){
    servo_3();
    dem--;dem1--;dem2--;dem3=0;t--;don_hang[2]=0;printf("a");
  }
}
else if(don_hang[0]==1 && don_hang[1]==2 && don_hang[2]==1){
  if(dem1==1){
    servo_1();
    dem--;dem1=0;t--;don_hang[0]=0;
    don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
  }
  if(dem2==1){
    servo_2();
    dem--;dem1--;dem2=0;t--;don_hang[1]=0;
    don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
  }
}
else if(don_hang[0]==1 && don_hang[1]==2 && don_hang[2]==2){
  if(dem1==1){
    servo_1();
    dem--;dem1=0;t--;don_hang[0]=0;
    don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
  }
  if(dem2==1){
    servo_2();
    dem--;dem1=0;dem2=0;t--;don_hang[1]=0;
    don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
  }
}
else if(don_hang[0]==1 && don_hang[1]==2 && don_hang[2]==3){
  if(dem1==1){
    servo_1();
    dem--;dem1=0;t--;don_hang[0]=0;
    don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
  }
  if(dem2==1){
    servo_2();
    dem--;dem1=0;dem2=0;t--;don_hang[1]=0;
    don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
  }
  if(dem3==1){
    servo_3();
    dem--;dem1=0;dem2=0;dem3=0;t--;don_hang[2]=0;printf("a");
```

```
    }
  }
  else if(don_hang[0]==1 && don_hang[1]==3 && don_hang[2]==1){
    if(dem1==1){
      servo_1();
      dem--;dem1=0;t--;don_hang[0]=0;
      don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
    if(dem3==1){
      servo_3();
      dem--;dem1=0;dem2=0;dem3=0;t--;don_hang[1]=0;
      don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
  }
  else if(don_hang[0]==1 && don_hang[1]==3 && don_hang[2]==2){
    if(dem1==1){
      servo_1();
      dem--;dem1=0;don_hang[0]=0;
      t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
    if(dem2==1){
      servo_2();
      dem--;dem1=0;dem2=0;t--;don_hang[2]=0;printf("a");
    }
    if(dem3==1){
      servo_3();
      dem--;dem1=0;dem2=0;dem3=0;don_hang[1]=0;
      t--;don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
  }
  else if(don_hang[0]==1 && don_hang[1]==3 && don_hang[2]==3){
    if(dem1==1){
      servo_1();
      dem--;dem1=0;t--;don_hang[0]=0;
      don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
    if(dem3==1){
      servo_3();
      dem--;dem1=0;dem2=0;dem3=0;t--;don_hang[1]=0;
      don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }

  }
  else if(don_hang[0]==2 && don_hang[1]==1 && don_hang[2]==1){
```

```
    if(dem1==2){
      servo_1();
      dem--;dem1--;t--;don_hang[1]=0;
      don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
      }
    if(dem2==1){
      servo_2();
      dem--;dem1--;dem2=0;t--;don_hang[0]=0;
      don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
  }
  else if(don_hang[0]==2 && don_hang[1]==1 && don_hang[2]==2){
    if(dem1==2){
      servo_1();
      dem--;dem1=0;don_hang[1]=0;
      t--;don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
      }
    if(dem2==1){
      servo_2();
      dem--;dem1=0;dem2=0;t--;don_hang[0]=0;
      don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
  }
  else if(don_hang[0]==2 && don_hang[1]==1 && don_hang[2]==3){
    if(dem1==2){
      servo_1();
      dem--;dem1--;t--;don_hang[1]=0;
      don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
      }
    if(dem2==1){
      servo_2();
      dem--;dem1--;dem2--;t--;don_hang[0]=0;
      don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
  }
  else if(don_hang[0]==2 && don_hang[1]==2 && don_hang[2]==1){
    if(dem2==1){
      servo_2();
      dem--;dem1--;dem2--;t--;don_hang[0]=0;
     don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
  }
```

```
else if(don_hang[0]==2 && don_hang[1]==2 && don_hang[2]==2){
  if(dem2==1){
    servo_2();
    dem--;dem1--;dem2=0;t--;don_hang[0]=0;
    don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
  }
}
else if(don_hang[0]==2 && don_hang[1]==2 && don_hang[2]==3){
  if(dem2==1){
    servo_2();
    dem--;dem1=0;dem2=0;don_hang[0]=0;
    t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
  }
}
else if(don_hang[0]==2 && don_hang[1]==3 && don_hang[2]==1){
  if(dem2==1){
    servo_2();
    dem--;dem1--;dem2=0;don_hang[0]=0;
    t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
  }
}
else if(don_hang[0]==2 && don_hang[1]==3 && don_hang[2]==2){
  if(dem2==1){
    servo_2();
    dem--;dem1=0;dem2=0;t--;don_hang[0]=0;
    don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
  }
}
else if(don_hang[0]==2 && don_hang[1]==3 && don_hang[2]==3){
  if(dem2==1){
    servo_2();
    dem--;dem1=0;dem2=0;t--;don_hang[0]=0;
    don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
  }
}
else if(don_hang[0]==3 && don_hang[1]==1 && don_hang[2]==1){
  if(dem3==1){
    servo_3();
    dem--;dem1=0;dem2=0;dem3=0; t-- ; don_hang[0]=0;
   don_hang[0]=don_hang[1]; don_hang[1]=don_hang[2]; don_hang[2]=0;printf("a");
  }
  if(dem1==2){
    servo_1();
    dem--;dem1--;t--;don_hang[1]=0;
```

```
      don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
  }
  else if(don_hang[0]==3 && don_hang[1]==1 && don_hang[2]==2){
    if(dem3==1){
      servo_3();
      dem--;dem1--;dem2=0;dem3=0; t--; don_hang[0]=0;
      don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
    if(dem1==2){
      servo_1();
      dem--;dem1=0;don_hang[1]=0;
      t--;don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
  }
  else if(don_hang[0]==3 && don_hang[1]==1 && don_hang[2]==3){
    if(dem3==1){
      servo_3();
      dem--;dem1=0;dem2=0;dem3=0;don_hang[0]=0;
      t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
    if(dem1==2){
      servo_1();
      dem--;dem1=0;don_hang[1]=0;
      t--;don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
  }
  else if(don_hang[0]==3 && don_hang[1]==2 && don_hang[2]==1){
    if(dem1==3){
      servo_1();
      dem--;dem1=0;don_hang[2]=0;
      t--;printf("a");
    }
    if(dem3==1){
      servo_3();
      dem--;dem1=0;dem2=0;dem3=0;don_hang[0]=0;
      t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
    if(dem2==2){
      servo_2();
      dem--;dem1=0;dem2=0;don_hang[1]=0;
      t--;don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
  }
```

```
  else if(don_hang[0]==3 && don_hang[1]==2 && don_hang[2]==2){
    if(dem3==1){
      servo_3();
      dem--;dem1=0;dem2=0;dem3=0; t--; don_hang[0]=0;
      don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
    if(dem2==2){
      servo_2();
      dem--;dem1=0;dem2=0;don_hang[1]=0;
      t--;don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
  }
  else if(don_hang[0]==3 && don_hang[1]==2 && don_hang[2]==3){
    if(dem3==1){
      servo_3();
      dem--;dem1=0;dem2--;dem3=0; t--; don_hang[0]=0;
      don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
    if(dem2==2){
      servo_2();
      dem--;dem1=0;dem2=0;don_hang[1]=0;
      t--;don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
  }
  else if(don_hang[0]==3 && don_hang[1]==3 && don_hang[2]==1){
    if(dem3==1){
      servo_3();
      dem--;dem1--;dem2=0;dem3=0; t--; don_hang[0]=0;
      don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf(("a");
    }
    if(dem1==3){
      servo_1();
      dem--;dem1=0;t=0;don_hang[2]=0;
      t--;printf("a");
    }
  }
  else if(don_hang[0]==3 && don_hang[1]==3 && don_hang[2]==2){
    if(dem3==1){
      servo_3();
      dem--;dem1=0;dem2=0;dem3=0;don_hang[0]=0;
      t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
    }
    if(dem2==3){
      servo_2();
```

```
            dem--;dem1=0;dem2=0;don_hang[2]=0;
            t--;printf("a");
          }
        }
        else if(don_hang[0]==3 && don_hang[1]==3 && don_hang[2]==3){
          if(dem3==1){
          servo3_90();servo3_0();
          dem--;dem1=0;dem2=0;dem3=0;don_hang[0]=0;
          t--;don_hang[0]=don_hang[1];don_hang[1]=don_hang[2];don_hang[2]=0;printf("a");
          }
        }
        else if(don_hang[0]==0 && don_hang[1]==0 && don_hang[2]==0){
          h=0;
        }
      }
}

void main(){
  set_tris_e(0);
  set_tris_d(0);
  output_d(0);
  port_b_pullups(1);
  output_b(0);
  led1(1);led2(1);delay_ms(200);led1(0);led2(0);
  lcd_init();
  lcd_putc( "\f" );
  init_lcd();
  setup_timer_2(T2_DIV_BY_1,255,1);
  setup_ccp1(CCP_PWM);
  setup_ccp2(CCP_PWM);
  set_pwm1_duty(0);
  set_pwm2_duty(0);
  up=0;
  dem=0;a=0;t=0;
  dem1=0;dem2=0;dem3=0;
  servo1_0();
  servo2_0();
  servo3_0();
  coi(2,1);
  led1(1);
  while(TRUE)
  {
    if(don_hang[0]==0 && don_hang[1]==0 && don_hang[2]==0){h=0;}
    if(h==1){dem_cb1();dem_cb2();dem_cb3();}
```

```
    init_lcd();
    if(up==1){lcd_gotoxy(14,1);lcd_putc( "ON " );}else{lcd_gotoxy(14,1);lcd_putc( "OFF" );}
    if( t==3 && g==0){printf( "t" );g++;}
    sosanh1();
    sosanh2();
    sosanh3();
    if(kbhit()){
      data = getc();
      switch(data){
      case '0': led1(1);led2(0);coi(1,1);dc_stop();up=0;break;
      case '1': led1(0);led2(1);coi(1,1);dc_up();up=1;break;
      case '2': dem++;a=1;h=1;don_hang[t]=a;t++;coi(1,1);break;
      case '3': dem++;a=2;h=1;don_hang[t]=a;t++;coi(1,1);break;
      case '4': dem++;a=3;h=1;don_hang[t]=a;t++;coi(1,1);break;
      case '5': reset();h=0;break;
      case '6': y=y+2;set_pwm1_duty(y);coi(1,1);lcd_gotoxy(14,1);printf(lcd_putc,"%u ",y);
                delay_ms(450);break;
      case '7': y=y-2;set_pwm1_duty(y);coi(1,1);lcd_gotoxy(14,1);printf(lcd_putc,"%u ",y);
                delay_ms(450);break;
      }
    }
  }
}
```

Code C#

- We use the Window class in Window form

```
using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.IO;
using System.IO.Ports;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using System.Windows.Forms;
using static System.Windows.Forms.VisualStyles.VisualStyleElement;
using AForge.Video;
using AForge.Video.DirectShow;
using ZXing;
using System.Xml;
```

- **Connect to COMPORT**

```
private void Form1_Load(object sender, EventArgs e)
       {
            string[] ports = SerialPort.GetPortNames();
```

```
            foreach (string port in ports)
             {
                comboBOX_COMPort.Items.Add(port);
             }
private void btn_Connect_Click(object sender, EventArgs e)
        {
            if (comboBOX_COMPort.Text == "")
            {
                MessageBox.Show("Hãy chọn cổng COM.", "Thông
Báo",MessageBoxButtons.OK, MessageBoxIcon.Information);
            }
            else
            {
                try
                {
                    if (serialPort1.IsOpen)
                    {
                        MessageBox.Show("Cổng COM đã kết nối.", "Thông
Báo",MessageBoxButtons.OK, MessageBoxIcon.Information);
                    }
                    else
                    {
                        serialPort1.Open();

                        textBox1.BackColor = Color.Lime;
                        textBox1.Text = "Connected";
                        comboBOX_COMPort.Enabled = false;
                    }
                }
                catch (Exception)
                {
                    MessageBox.Show("Cổng COM này đã được sử dụng cho thiết bị
khác.", "Thông Báo", MessageBoxButtons.OK, MessageBoxIcon.Information);
                }
            }

          }
private void btn_Disconnect_Click(object sender, EventArgs e)
        {
            try
            {
                if (serialPort1.IsOpen)
                {
                    serialPort1.Close();
                    textBox1.BackColor = Color.Red;
                    textBox1.Text = "Disconnect";
                    comboBOX_COMPort.Enabled = true;

                }
                else
                {
                    MessageBox.Show("Cổng COM đã ngắt kết nối.", "Thông Báo",
MessageBoxButtons.OK, MessageBoxIcon.Information);
                }
            }
            catch (Exception)
            {
          }
```

```
private void comboBOX_COMPort_SelectedIndexChanged(object sender, EventArgs e)
        {
            serialPort1.PortName = comboBOX_COMPort.Text;
          }
```

- Connect Camera to Scan QRCode

```
public PBL5()
        {
            InitializeComponent();
         }
FilterInfoCollection = new FilterInfoCollection(FilterCategory.VideoInputDevice);
            foreach (FilterInfo filterInfo in FilterInfoCollection)
                cbo_Device.Items.Add(filterInfo.Name);
                   cbo_Device.SelectedIndex=0;
private void button2_Click(object sender, EventArgs e)
        {
            if(btn_Quetma.BackColor == Color.SpringGreen)
            {
                MessageBox.Show("Chưa bật cam !", "Thông Báo", MessageBoxButtons.OK,
MessageBoxIcon.Information);
            }
            captureDevice.Stop();
            btn_Quetma.BackColor = Color.SpringGreen;
            btn_Quetma.Enabled = true;
            ptb_Camera.BackColor = Color.LightSteelBlue;
          }
private void btn_Quetma_Click(object sender, EventArgs e)
        {
            captureDevice = new
VideoCaptureDevice(FilterInfoCollection[cbo_Device.SelectedIndex].MonikerString);
            captureDevice.NewFrame += CaptureDevice_NewFrame;
            captureDevice.Start();
            timer1.Start();
            btn_Quetma.BackColor = Color.Red;
            btn_Quetma.Enabled=false;

          }
private void CaptureDevice_NewFrame(object sender, NewFrameEventArgs eventArgs)
        {
            ptb_Camera.Image = (Bitmap)eventArgs.Frame.Clone();
          }
private void Form1_FormClosing(object sender, FormClosingEventArgs e)
        {
            if (captureDevice.IsRunning)
                captureDevice.Start();
          }
private void timer1_Tick(object sender, EventArgs e)
        {
            if (ptb_Camera.Image != null)
            {
                BarcodeReader barcodeReader = new BarcodeReader();
                Result result = barcodeReader.Decode((Bitmap)ptb_Camera.Image);
                if (result != null)
                {
                    txt_QRcode.Text = result.ToString();
```

```
                    timer1.Start();
                    if (captureDevice.IsRunning)
                        captureDevice.Start();
                }

            }
        }
```

- **Start Conveyer:**

```
    private void btn_Start_Click_1(object sender, EventArgs e)
        {
            serialPort1.Write("1");
            btn_Start.BackColor = Color.SpringGreen;
            btn_Start.Enabled = false;
            btn_Start.Text = "Running";
            lb_trangthaibangtai.Text = "Đang hoạt động";
            lb_trangthaibangtai.BackColor = Color.Red;
        }
```

- **Stop Conveyer:**

```
private void button3_Click(object sender, EventArgs e)
        {
            if (btn_Start.BackColor == Color.Gainsboro)
            {
                MessageBox.Show("Chưa bật máy mà!", "Thông Báo",
MessageBoxButtons.OK, MessageBoxIcon.Information);
            }
            else
                {
                serialPort1.Write("0");
                btn_stopbangtai.BackColor = Color.Red;
                timer2.Start();
                btn_Start.BackColor = Color.Gainsboro;
                btn_Start.Enabled = true;
                btn_Start.Text = "Start";
                lb_trangthaibangtai.Text = "Không chạy";
                lb_trangthaibangtai.BackColor = Color.LightSteelBlue;
                }
        }
```