Chocolate Vending Machine

Submitted by: Group 85

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Date:- 19.04.2021

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Problem statement

This automatic machine vends three different types of chocolates.
Perk: Rs. 5.00
Five-Star: Rs10
Dairy Milk: Rs20.

The currency has to be given in terms of 5 Rupee coins. A weight sensor is used to detect whether the coin is an Rs5 coin or not. There are three buttons available for the selection of the chocolate. After the chocolate has been selected the user has to put the correct currency into the coin slot. When the user has dropped the entire amount into the slot, the machine dispenses the correct chocolate. LED's are used as indicators to show if any of the chocolates being vended are not available.

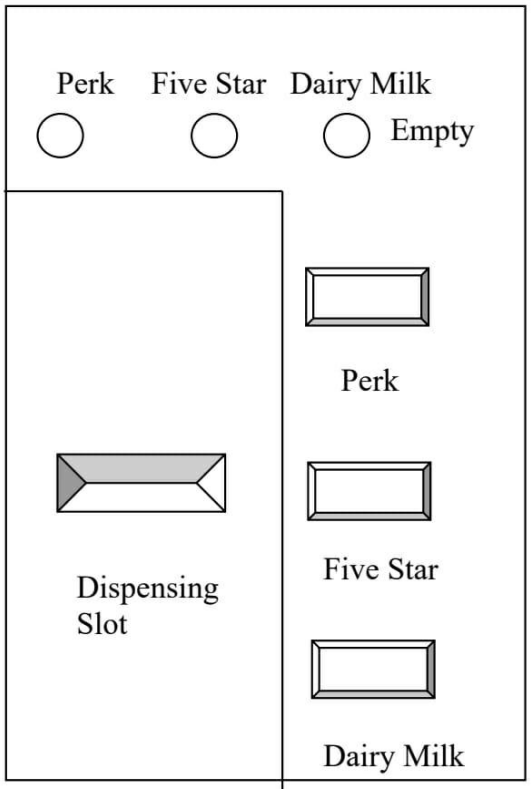


Table of Contents:

User Requirements

1. The system is a vending machine that gives chocolate of three types i.e., Dairymilk, Perk, 5Star.
2. The prices of the chocolates are as follows:

- Dairy Milk- Rs.20
- 5Star- Rs.10
- Perk- Rs.5

3. The user presses the button for chocolate selection and then puts in money (currency in terms of 5 Rupee coin only).

Technical Specifications

1. 3 LEDs are used to indicate if chocolate is available in the machine. Each LED is 5 Volt.
2. The motor is used to dispense the correct chocolate.
3. A pressure sensor (with a conversion factor of 1KPa = 20 mV) is used to sense the pressure of the input coin.
4. Analog To Digital Converter is used to digitize the reading taken by a pressure sensor. The resolution of the ADC is 5V/255 = 19.607mV≅20mV
5. A unipolar Stepper Motor is used to serve the purpose of the dispensing slot.

Assumptions

1. User can only press one key at a time:
    - Perk
    - 5 Star
    - Dairy Milk
2. Users can put at most 4 coins, over 4 coins is considered invalid.
3. User puts in the coin one by one, after every 10 sec.
4. Users can put only Rs.5 coins as no other denominations are considered valid.
5. A maximum of 100 Dairy Milk, Perk, and 5star are available.
6. In each transaction, the user can only get one chocolate of a particular type.
7. The pressure of a Rs.5 coin is 1KPa which gives a 20 mV voltage.

Justifications

None.

Components used with Justification

- **8086**
- **8284**
- **ADC 0808** → Single Analog input.
- **8255(1)** → To Interface ADC, 3 input switches (used for selecting the chocolate) and 3 LED's (which glow when a chocolate is unavailable).
- **8255(2)** →To Interface the stepper motor (used to dispense the required chocolate or invalid number of coins).
- **8254** →To generate an ADC clock of 1Mhz from the 5Mhz clock available and to generate the 10s interrupt (time given to the user to place a coin).
- **8259** →Interrupt of 10s given from the timer.
- **2716** → 4 nos. The smallest ROM chip available is 2K and as we need to have even and an odd bank and ROM is required at reset address which is at FFFF0H and 00000H - where there is the IVT.
- **LS138** → 2 decoders (one for memory decoding and one for the decoding of the ports), LS373 and LS245.
- **Stepper motor**→ Used to dispense chocolates.
- **6116** → 2 nos. Smallest RAM chip available is 2 K and we need an odd and even bank. We need RAM for stack and temporary storage of data.

Sequence1	1	0	1	0
Sequence2	1	0	0	1
Sequence3	0	1	0	1
Sequence4	0	1	1	0
Sequence5	1	0	1	0

- **MPX4250, pressure sensor specifications**→ MPX4250 is a silicon pressure sensor designed for a wide range of applications, particularly to interface with microcontroller or microprocessor with A/D inputs.

1. Pressure range - 0-250 KPa
2. Voltage input(DC supply to the pressure sensor)-4.85-5.35 V
3. Typical Voltage- 5.1V
4. Resolution($\Delta V/\Delta P$) ≅ 20 mv/KPa
5. 6 pins input (3 pins are left unused.)

Pin	Signal	Input/Output	Description
1	Vout	Output	Voltage output of the pressure sensed
2	GND	Input	Ground
3	Vcc	Input	Typical voltage supply given to excite the pressure sensor.

Address Map

Memory Map (Both RAM and ROM chips used are 2K)

ROM1→ 00000H – 00FFFH (Even Bank begins at 00000H and ends at 00FFEH and Odd Bank begins at 00001H and ends at 00FFFH)

RAM1→ 01000H – 01FFFH (Even Bank begins at 01000H and ends at 01FFEH and Odd Bank begins at 01001H and ends at 01FFFH)

ROM2→ FF000H – FFFFFH (Even Bank begins at FF000H and ends at FFFFEH and Odd Bank begins at FF001H and ends at FFFFFH)

I/O Map

8255(1)→ 0000 - 0006H (PortA-00H, PortB-02H, PortC-04H, Creg-06H)

8255(2)→ 0008 - 000EH (PortA-08H, PortB-0AH, PortC-0CH, Creg-0EH)

8254→ 0010 - 0016H (Counter0-10H, Counter1-12H, Counter2-14H, Creg-16H)

8259→ 0018 - 001AH

Interrupt 40H is used in the program. Therefore, IP= 00100H (40*4).

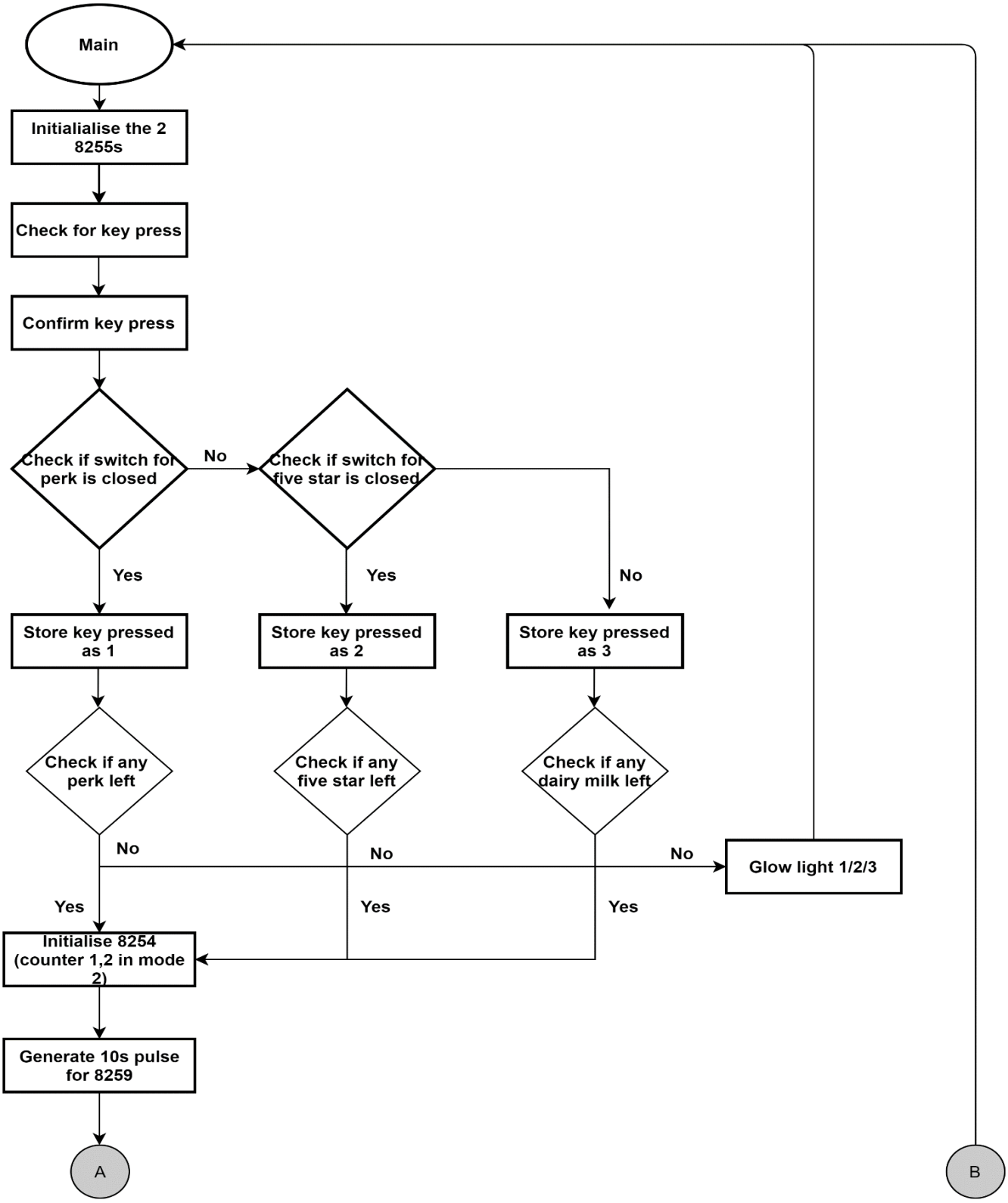
IVT-

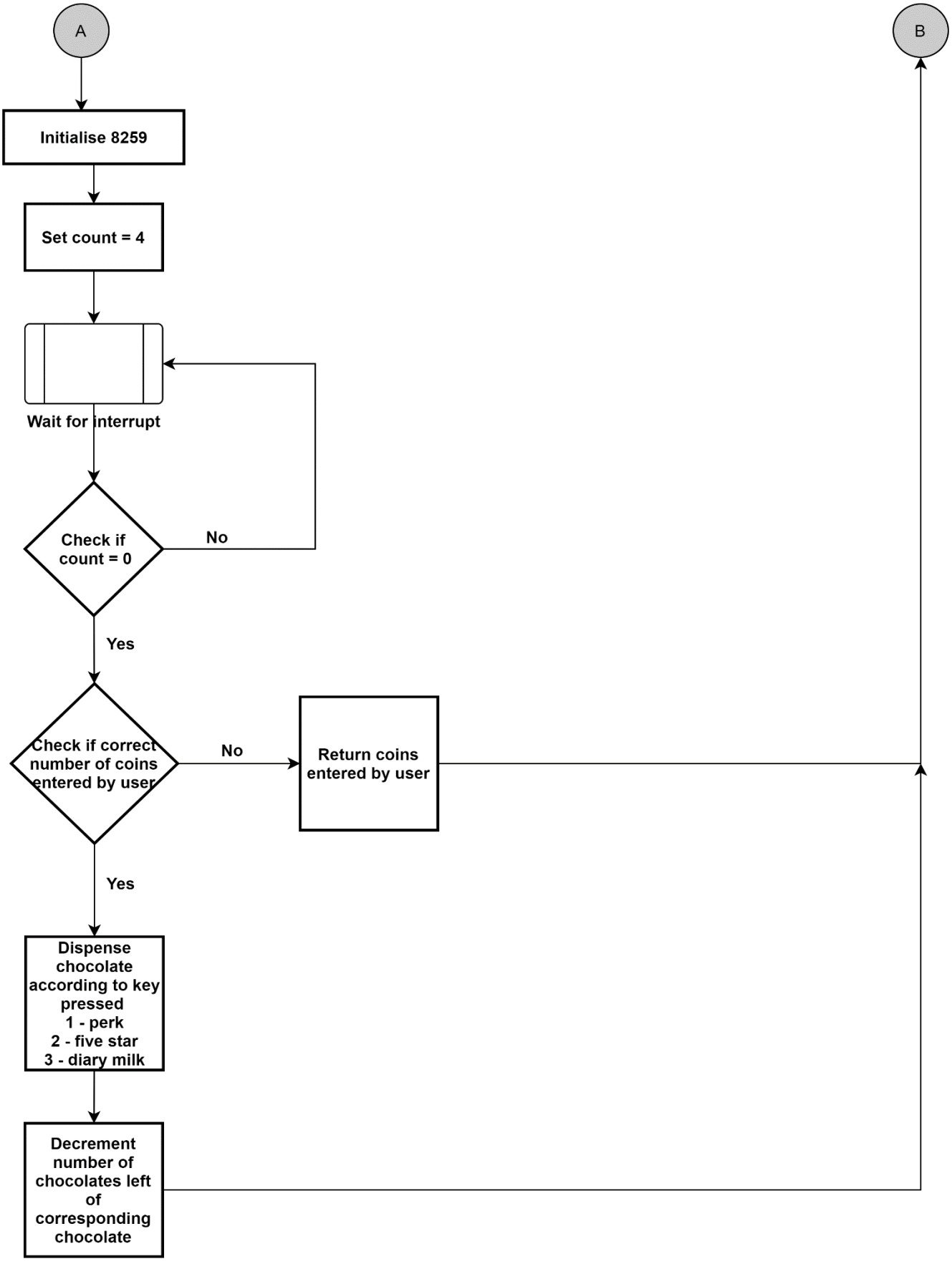
IP	t_isr
CS	0000H

DESIGN

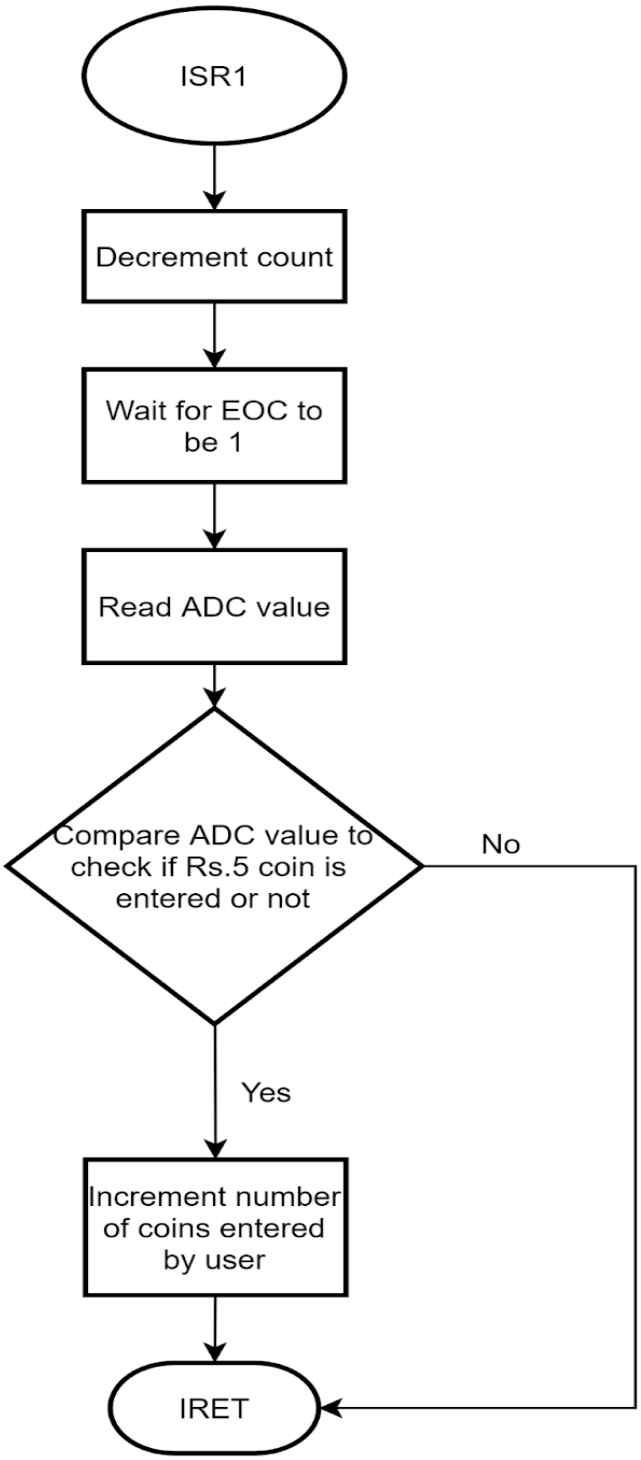
Separate pdf attached- **hardware_design.pdf**

Flow Chart – Main Program




A
B
Initialise 8259
Set count = 4
Wait for interrupt
Check if count = 0
No
Yes
Check if correct number of coins entered by user
No
Return coins entered by user
Yes
Dispense chocolate according to key pressed
1 - perk
2 - five star
3 - diary milk
Decrement number of chocolates left of corresponding chocolate

Flow Chart – ISR



Variation in Proteus Implementation with justification:

1. Using 10s delay as 8259 does not work in proteus – and the Timer Int replaced by software delay as 10s.

2. ROM in only 00000 – as proteus allows to change reset address.

3. Using 8253 – as 8254 not available in Proteus.

4. 2732 is used as 2716 – not available in Proteus.

5. Using a gate-based circuit for memory – does the same as LS 138 here

6. 8259 not there – justification is as per point 1.

Firmware

Implementation using emu8086 attached - **design2.asm**

List of Attachments

1. Complete Hardware real design - **hardware_design.pdf**
2. Manuals -
    a. ADC
    b. 8086
    c. 8255
    d. 8259
    e. 8284
    f. 8253
    g. NEMA 17 (Stepper motor)
    h. MPX4250 (Integrated silicon pressure sensor)
3. Proteus File - **final_design.dsn**
4. EMU 8086 ASM File - **design2.asm**
5. Binary file after assembly - **design.bin**

THANK YOU!