Microprocessor Programming and
Interfacing
Design Assignment

Smart Overhead Tank

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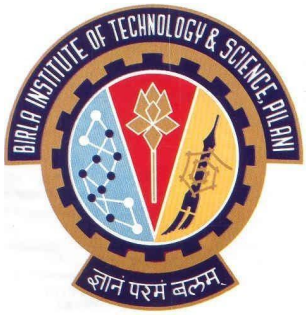
Group No: **1**

CS/ECE/EEE/ENI - F241: MICROPROCESSOR PROGRAMMING AND INTERFACING



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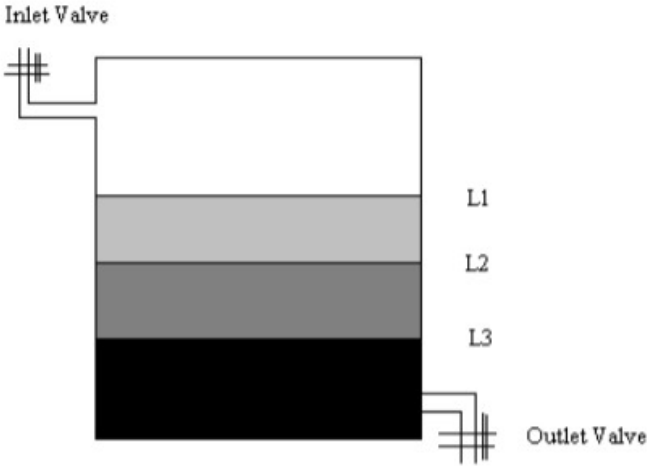
Problem Statement

17.Smart Overhead Tank

Description: This is a tank system in which the water level is maintained according to the time of the day. The water level should be maintained at three different values according to the time of the day.

Peak Hours: Maximum Level of Tank Peak Hours is between 6:00 AM to 10:00 AM in the Morning and 5:00-7:00 PM in the evening

Low Hours: Minimum level. The rest of the time it is maintained at a nominal level. Low hours is between 12:00 Midnight and 5:00 AM in the morning



The inlet valve draws water from the main-tank system and the outlet valve sends the surplus water back to the main tank. The water in the main tank must be maintained at a constant value, if the level drops the motor must be turned on.

The water tank is used for supplying water to bathrooms and kitchen – sensors used must be non-contact.

User Requirements

1. **Overhead Tank:** Water level to be maintained at different values (3 levels) according to the time of the day. This tank supplies water to the household.

Time	Water Level
12 Midnight - 5 AM	Level 1
5 AM - 6 AM	Level 2
6 AM - 10 AM	Level 3
10 AM - 5 PM	Level 2
5 PM - 7 PM	Level 3
7 PM - 12 Midnight	Level 2

2. **Main Tank:** Water level has to be maintained at a constant level. Water is drawn from the reservoir, and any excess water is let back into the reservoir.

3. **Sensors:** Must be non-contact so as not to contaminate the drinking water.

Technical Specifications

1. **Overhead Tank**
    - Total Capacity: 1000L
    - Level 1: 900 L
    - Level 2: 600 L
    - Level 3: 400 L

2. **Main Tank**
    - Total Capacity: 5000 L
    - Constant Level: 4500 L

3. **Non-Contact Water Level Sensor**
    - Response Time: 500 ms
    - Sensitivity Range: 0 - 20 mm

Assumptions

1. The tank is initialized at 12 midnight.
2. The water level is ≈L3 when the tank is initialized.
3. No power cuts occur.
4. The motor is of sufficient power to fill the tank till L1 within an hour.

Justifications

1. No inlet valve is required in the overhead tank. As the overhead tank is above the main tank, water is filled into the tank only via the motor.

Components Used

1. Motor

- Quantity : 2
- Crompton Mini Crest I 1HP Self Priming Water Pump 1HP
- Voltage : 180 - 240V
- Power : 0.75 kW

Input of the motors connected to the 230 V AC output of the relay.

2. Valve

- Quantity : 1
- RS PRO 5/2 Pneumatic Solenoid Valve
- Voltage : 230V AC
- Max flow rate : 1250 L/min

Input of the valve is connected to the 230 V AC output of the relay.

3. Sensor

- Quantity : 4
- XKC-Y25 PNP Intelligent Non-Contact Water Level Sensor
- Voltage
- : 5 - 24V DC

The sensor operates at 20 V and gives an output 20 V if it detects water, else it gives an output of 0V. Output is then connected to the DC/DC convertor which converts 20V to 5V.

4. Water Tanks

- Syntex Reno (WSCC-0100-01)
- Overhead Tank : 1000 L
- Main Tank : 5000 L

5. Relay

- Quantity - 1
- Panasonic ALZN1F24W

5V DC output of 8255 is connected to the relay which converts it to the required 230 V AC output for the motor and valve to work.

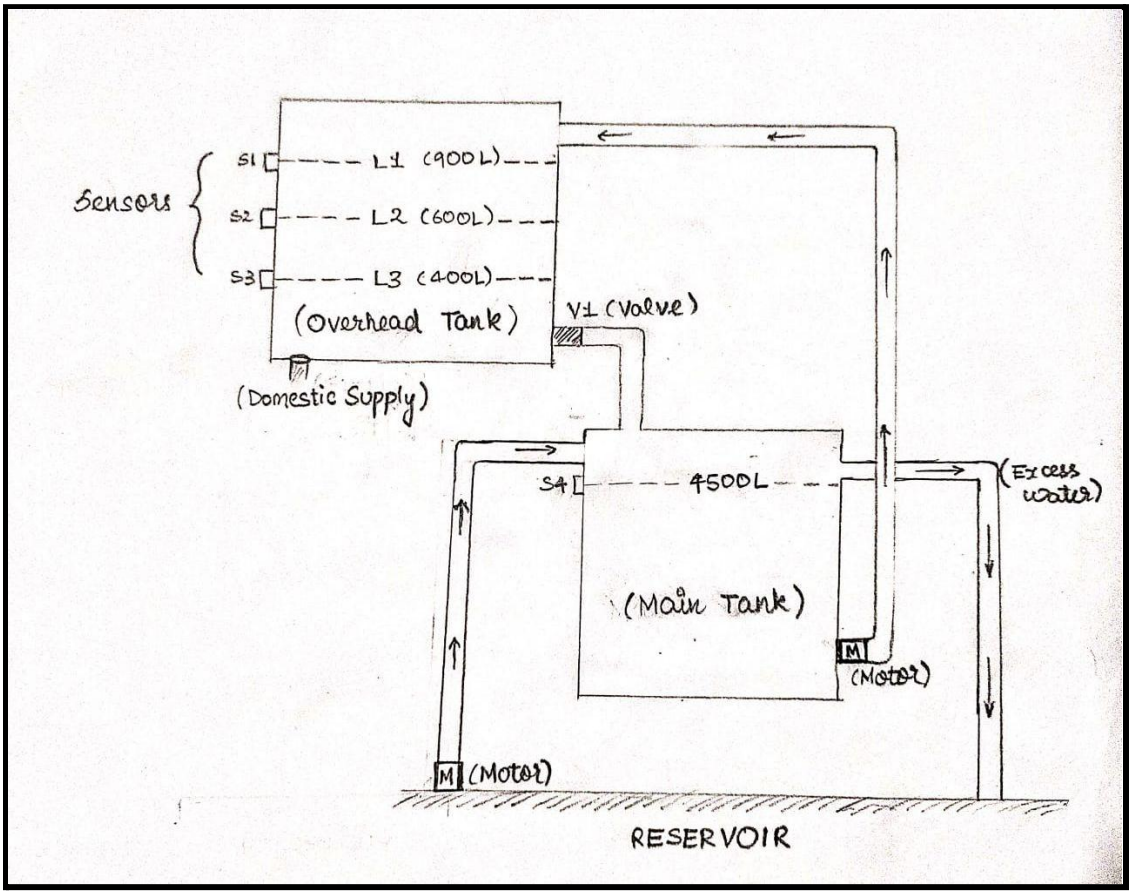
Chip	Quantity	Chip Name	Purpose
8086	1	Central Processing Unit	Central Processing Unit
8284	1	Clock Generator	Generates the clock signal for microprocessor and timer, generates the reset signal for all the chips
74LS373	3	8 bit Latch	Latches the Address Bus
74LS245	2	BiDirectional Buffer	Buffers the Data Bus
LS244	1	UniDirectional Buffer	Buffers the Control Bus
LS138	2	3:8 Decoder	Used for Memory and I/O interfacing
6116	2	2k RAM Chip	Stores the variables. Need to have at least two chips because of banking
2716	4	2k ROM Chip	Stores the code and IVT. Need to have at least two chips because of banking. Two ROM Chips for the IVT and two for the Reset Address (FFFF0H)
8259	1	Programmable Interrupt Controller	Handle interrupts by the timer and the sensors
8255	1	Programmable Peripheral Interface	Interfaces the I/O devices with the processor
8253	1	Programmable Interval Timer	Generates a 1-hour timing signal
LM2596	4	Step Down Voltage Regulator	Converts the Sensor outputs to a lower voltage
7432	2	Quadruple 2 input positive OR gates	Used in combinational logic for memory interfacing
7404	1	Hex Inverting gates	Used in generating timer and inverting sensor outputs for 8259

Address Map:

1. **Memory Map**
    - **ROM 1 :** 00000h – 00FFFh
    - **RAM 1 :** 01000h – 01FFFh
    - **ROM 2 :** FF000h – FFFFFh

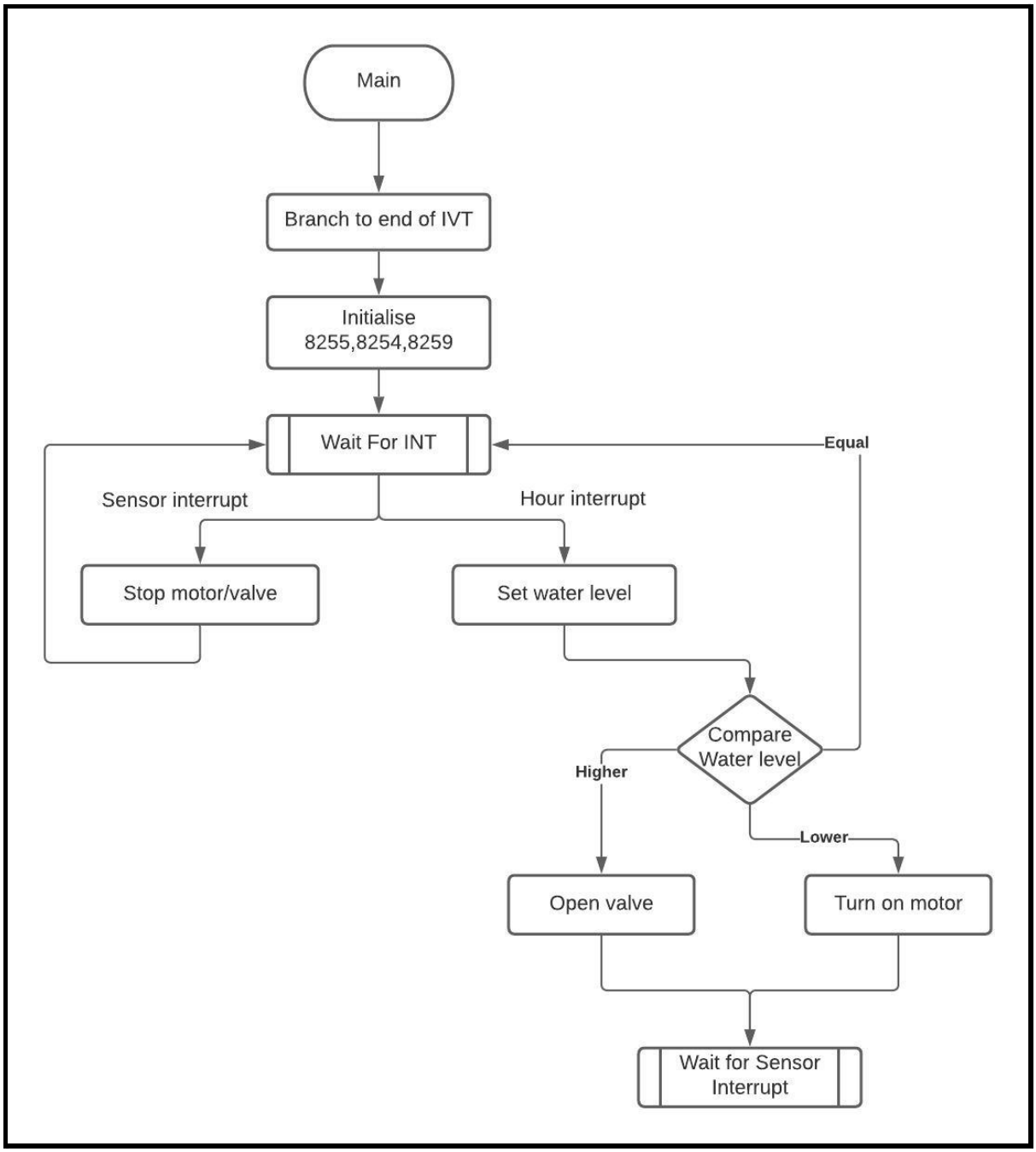
2. **I/O Map**
    - **8255 :** 00 – 06h
    - **8253 :** 08 – 0Eh
    - **8259 :** 10 – 12h

Design:

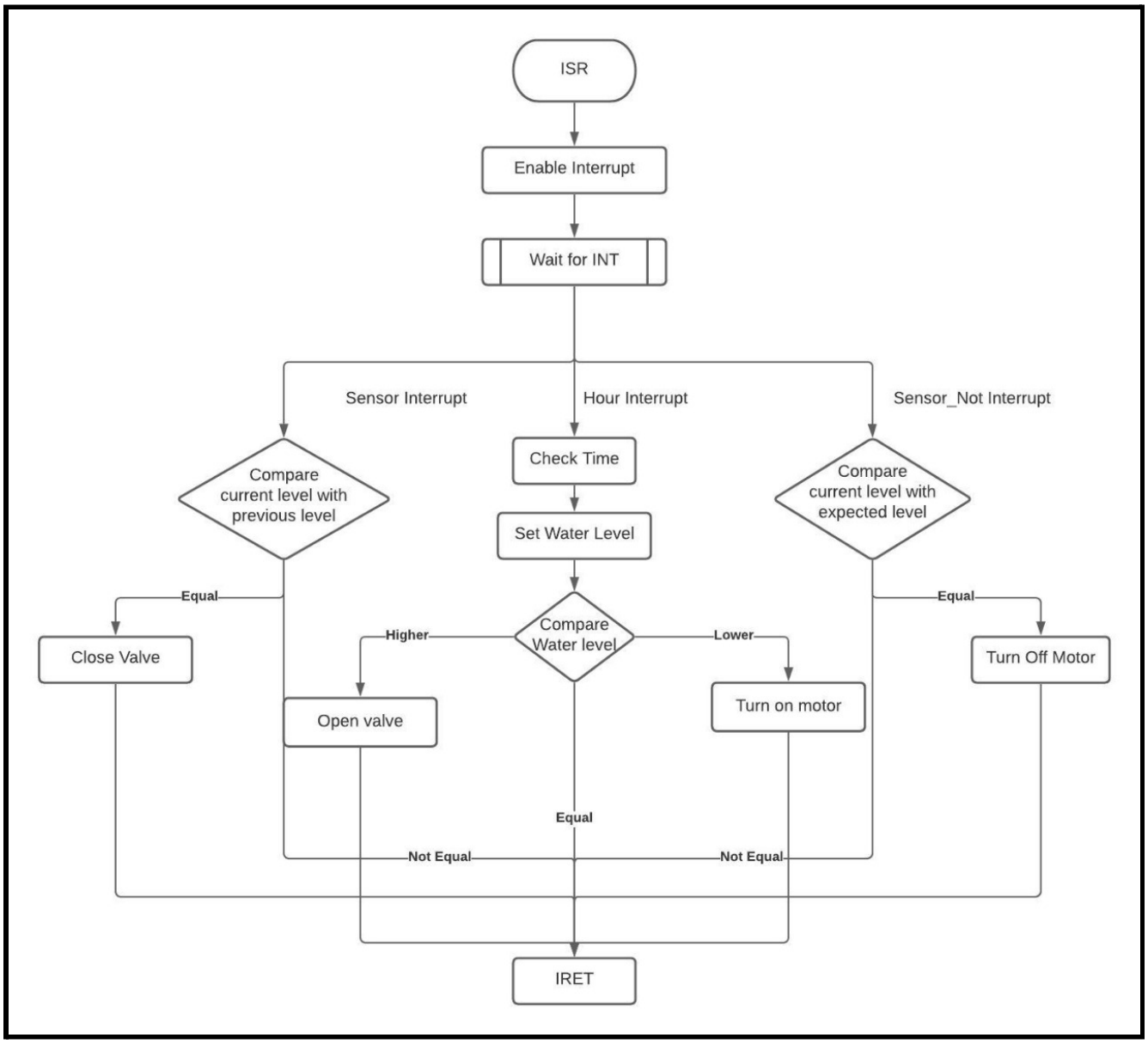


Flow Chart:

Main program :



ISR :


ISR
Enable Interrupt
Wait for INT
Sensor Interrupt
Hour Interrupt
Sensor_Not Interrupt
Compare current level with previous level
Check Time
Compare current level with expected level
Set Water Level
Equal
Compare Water level
Equal
Higher
Lower
Close Valve
Open valve
Turn on motor
Turn Off Motor
Equal
Not Equal
Not Equal
IRET

Variations in Proteus Implementation with Justification :

1. ROM in only 00000 – as proteus allows to change reset address.
2. 2732 is used instead of 2716 (Not available in Proteus)
3. Using a gate-based circuit for memory – does the same as LS 138 here.
4. Water Level Sensor – replaced by a switch [Low : 0V ; High : 5V]
   (Not available in Proteus)
5. Motors and valves are represented by LEDS (State of LED represents state of motor/valve)
6. Relays are not required in proteus implementation as we are using LEDs.

List of Attachments :

1. Complete Hardware Real World Design – “Complete Hardware Design.pdf”
2. Manuals / Datasheets
3. Proteus File – Proteus.dsn
4. EMU8086 ASM File – Code.asm
5. Binary File after assembly – Code.bin