WEATHER MONITORING SYSTEM

Design Project

Problem Number 24

Group 92

Prepared for Dr. K.R. Anupama

In partial fulfilment of the requirements of CS/EEE/INSTR F241,
Microprocessor Programming and Interfacing
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SYSTEM TO BE DESIGNED: WEATHER MONITORING SYSTEM

This system monitors weather parameters such as: Air Temperature, Air-Humidity, barometric Pressure, and Displays the average over regular intervals of an hour on a seven-segment display. The Display is continuous. Update of the display is done once in an hour. Weather parameters are sensed at regular intervals of 5 minutes. The display is of the format: “Temperature – Value 0C” and so on.

Other than the regular display, the user can request the display of the weather parameters to be updated at any point of time by pressing a push button key. The accuracy of the parameters monitored has to be up to two decimal points.

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USER REQUIREMENTS & TECHNICAL SPECIFICATIONS

Design a system that displays the current weather conditions on an alphanumeric display.

The technical specifications are as follows

- Temperature range is from -50°C to 50°C
- The Pressure range is from 0.8 to 1.1 Ba
- The Humidity ranges from 0 to 100%
- The parameters are fetched every 5 minutes
- Every one hour the display is updated with the average values of the last 12 parameters fetched.
- An external push button can be used to update the display on demand.

ASSUMPTIONS

1. When the external push button is pressed, the instantaneous value of the sensor is not taken. Instead, only updating takes place on the LCD Display, based on the average value of the past 12 readings.
2. The external push button interrupt and the 5-minute interrupt will not clash. The probability of them clashing practically is quite low, hence it is assumed.
3. EOC Interrupt is given the least priority because Analog to Digital Conversion happens only after the 5 Min Interrupt is raised.

BRIEF WORKING OF THE DESIGN

The following Global Water external weather sensors have been used: WE700 for temperature, WE600 for humidity and WE100 for pressure have been used.

They provide us a current value of 4-20mA, which is then used as input to the respective Current to Voltage Convertor (C2V). This convertor returns a voltage between 0-5V.

This voltage is then further sent to an analog to digital converter ADC0808, which is interfaced to the 8086-microprocessor using 8255.

Every 5 minutes an interrupt is generated using mode 2 of 8254. The values are read from the sensors and once the EOC interrupt from ADC is received, the data is stored in the RAM, after scaling it according to the range of the sensor used.

After every hour, count reaches 12 and the average value of the previous 12 readings is displayed on the 40x2 LCD screen. This screen is interfaced to 8086 using 8255.

An external push button is incorporated in the circuit that sends an interrupt to the microprocessor whenever it is pressed. Then, the average value of the past 12 readings is immediately calculated and updated on the LCD.

INTEGRATED CIRCUITS, DEVICES AND SENSORS USED

Serial No.	Component	Quantity	Description
1.	8086	1	Microprocessor
2.	8255	2	Programmable Peripheral Interface
3.	8254	2	Programmable Timer/Counter
4.	8259	1	Programmable Interrupt Controller
5.	74LS138	2	3x8 decoders
6.	74LS373	3	D-type latch with 3 state outputs
7.	74LS245	2	Octal bus transceivers
8.	2732	2	32K (4Kx8) EPROM
9.	6116	2	16K (2Kx8) Static RAM
10.	ADC0808	1	8-bit Microprocessor Compatible ADC with 8 channel Multiplexer
11	Button	1	Push button
12.	LM018L	1	40x2 Alphanumeric LCD
13.	OR Gate	4	2 input OR gate
14.	Resistor	1	Analog resistor
15.	WE100	1	Barometric sensor
16.	WE600	1	Humidity sensor
17.	WE700	1	Temperature sensor
18.	C2V	3	Combination of two ICs to convert C to V.

MEMORY INTERFACING

We use 2 6116 RAM chips and 2 2732 ROM chips to interface.

(16/8) = 2K chip x 2= 4K RAM

(32/8) = 4K chip x 2= 8K ROM

Memory Addressing:

ROM= 00000h - 01FFFh

RAM= 02000h - 02FFFh

A13 &A14 are used as the select lines. The use of even and odd banks has been incorporated in the design

ROM-

A_{19}	A_{18}	A_{17}	A_{16}	A_{15}	A_{14}	A_{13}	A_{12}	A_{11}	A_{10}	A_9	A_8	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1

RAM-

A_{19}	A_{18}	A_{17}	A_{16}	A_{15}	A_{14}	A_{13}	A_{12}	A_{11}	A_{10}	A_9	A_8	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0
0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	1	1	1	1

I/O INTERFACING

The following I/O devices need to be interfaced to address lines:

- 8259
- Two 8255s (8255a and 8255b)
- 8254

The addressing is:

- 8259 (Interrupt controller) - 04000h
- 8255a (for LCD operations) - 04010h
- 8255b (for ADC operations) - 04020h
- 8253a (5 min timer) - 04030h
- 8253b (1hr timer) - 04040h

SENSOR SPECIFICATIONS

Temperature Sensor

Output	4-20mA
Range	-50° to 50°C
Accuracy	±0.1° C
Operating Voltage	10-36V DC
Warm up Time	3 seconds minimum
Operating Temperature	-50° to 100°C

Pressure Sensor

Output	4-20mA
Range	800-1100 millibars
Accuracy	< ±3 mb
Operating Voltage	10-36V DC

Warm Up Time	3 seconds minimum
Operating Temp	-40° to +55°C

Humidity Sensor

Output	4-20mA
Range	0-100% RH
Accuracy	± 2% RH
Operating Voltage	10-36V DC
Current Draw	3 mA plus sensor output
Warm up time	3 seconds minimum

SCALING ADC INPUTS TO DETERMINE READING

The ADC used in the design produces a voltage between 0 and 255d for the sensors. To scale it to the values for Pressure, Temperature and Humidity, we use a scaling function that employs the following formulae:

Pressure: The sensor range is 800 to 1100 millibars

Pres = ((ADC value/255) *(1100-800)) + 800 millibars

Temperature: The sensor range is -50° to 50°C

Temp = ((ADC value/255) *(50-(-50))) + (-50) °C

Humidity: The sensor gives a range of 0-100%

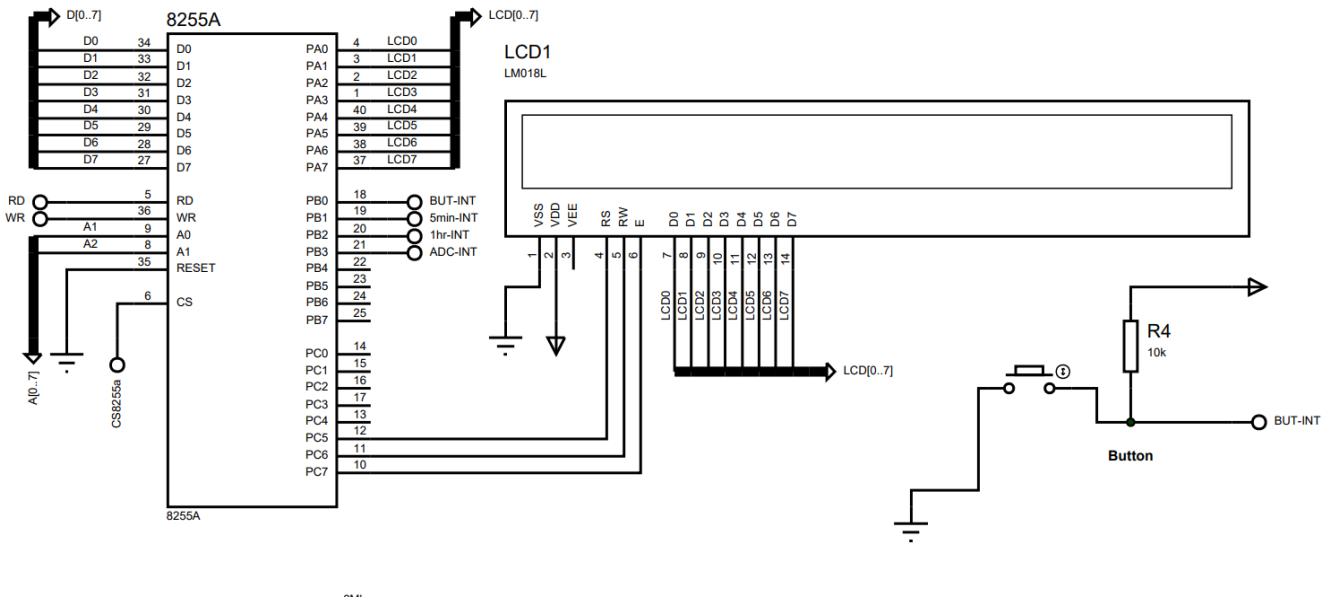
Relative Humidity = (ADC value/255) *(100-0) %

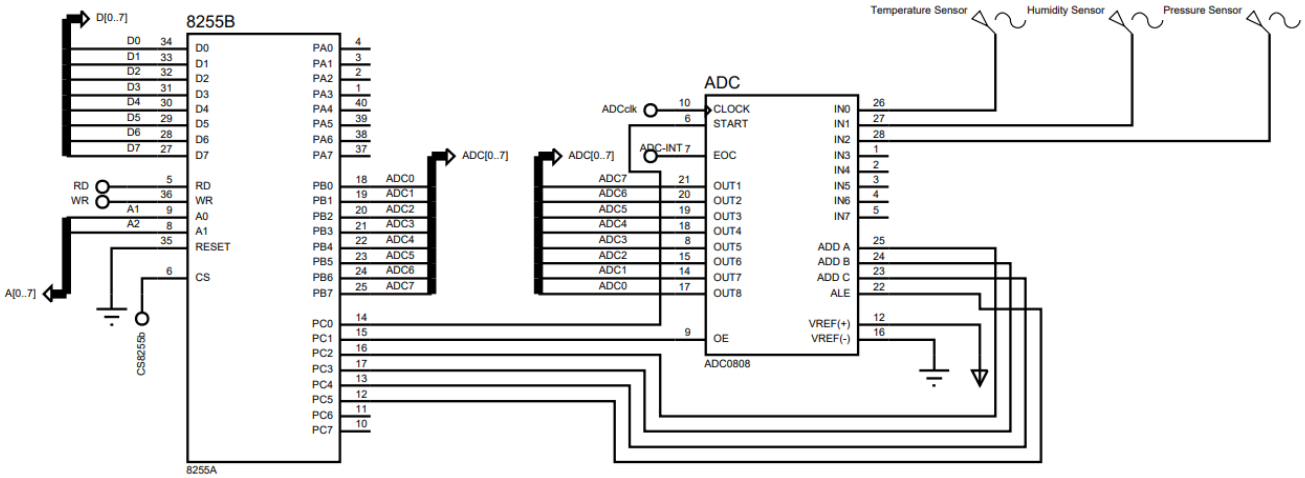
These hex values are then converted to decimal for viewing on the LCD.

DESIGN

The complete design pdf and proteus project have been attached.

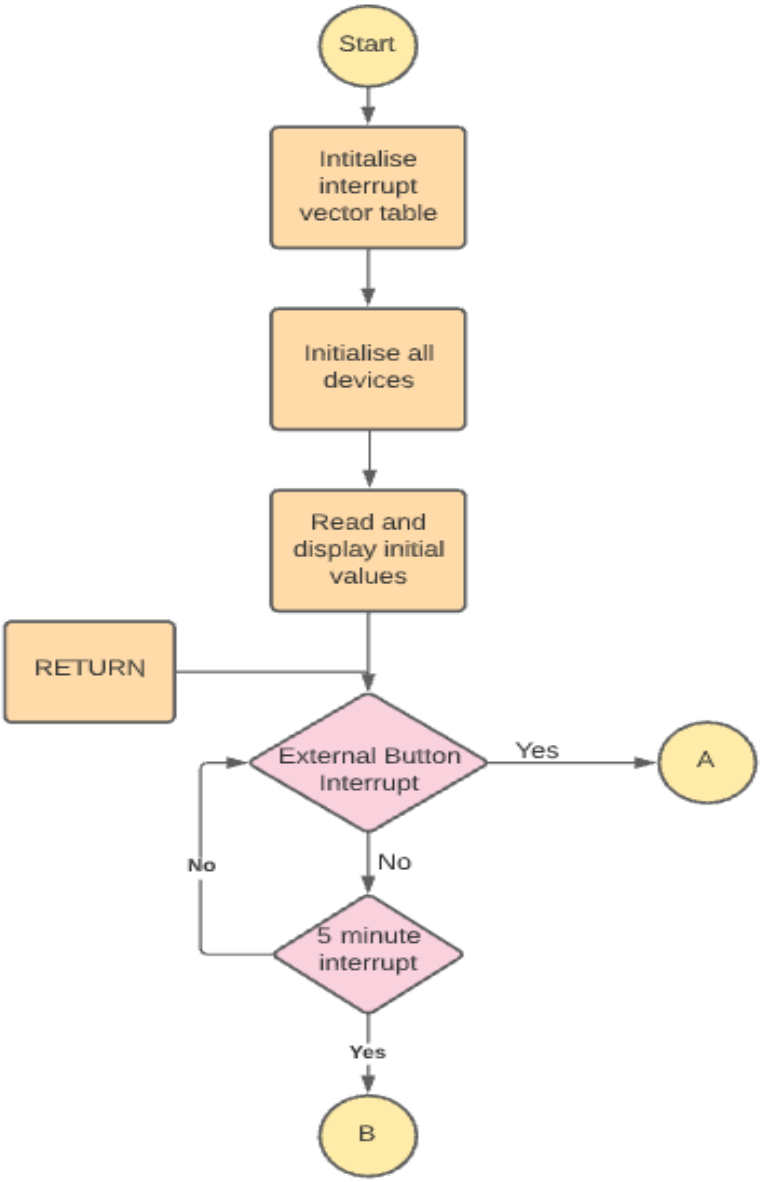
The following are snippets of the design:



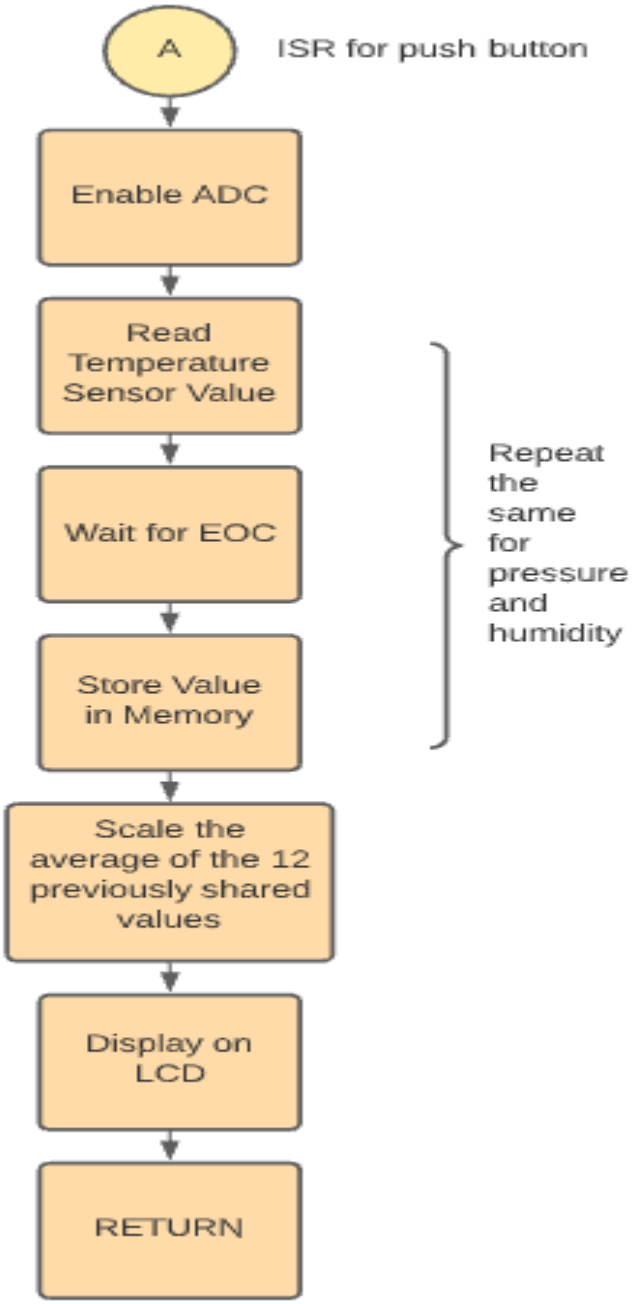


FLOW CHART

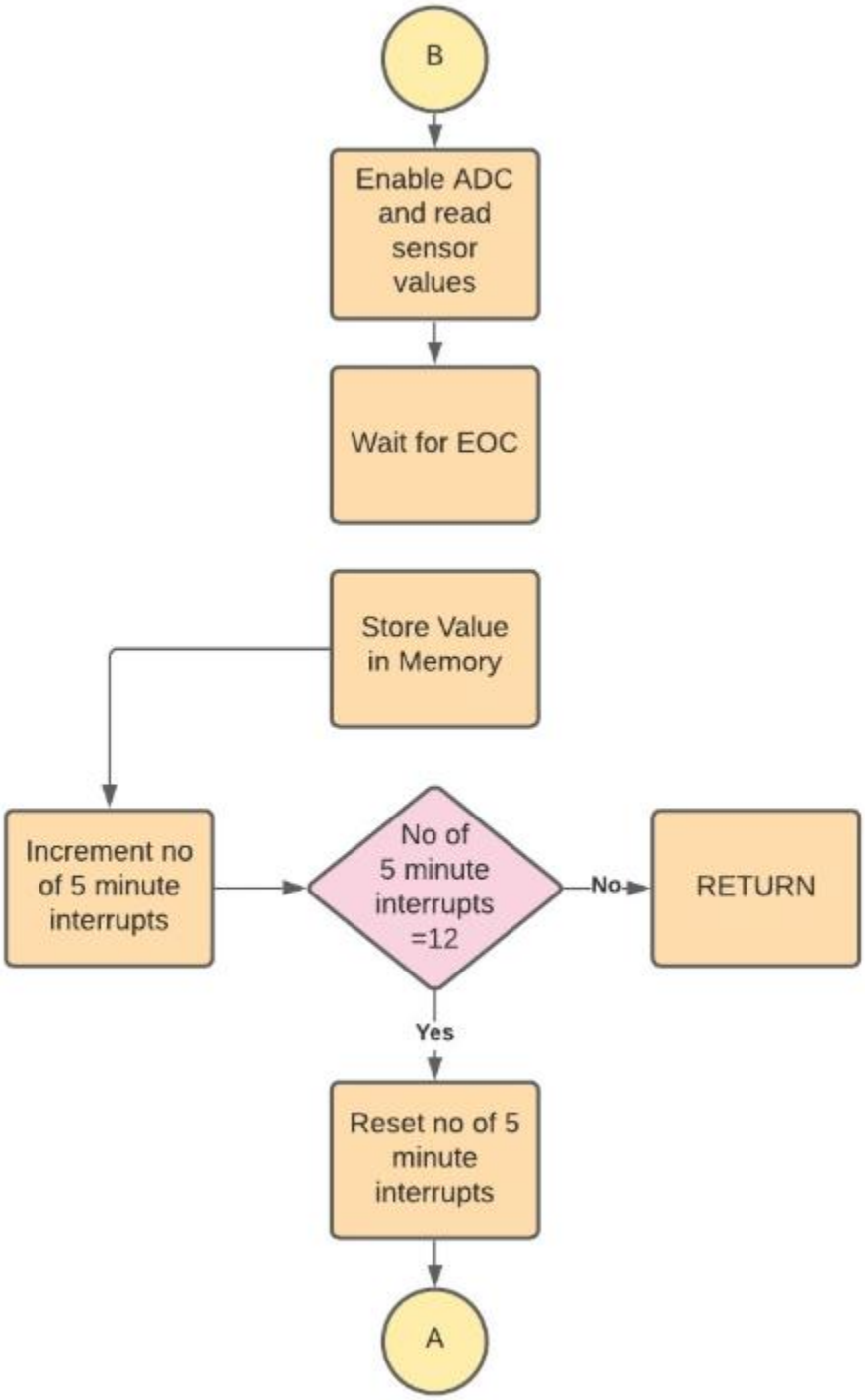
Main program



Push Button / 1Hour ISR



5 Minute ISR


B
Enable ADC and read sensor values
Wait for EOC
Store Value in Memory
Increment no of 5 minute interrupts
No of 5 minute interrupts =12
No
RETURN
Yes
Reset no of 5 minute interrupts
A

Variations in Proteus Implementation with Justification

1. We use 8253 in the place of 8254 since the latter is not available in Proteus

2. Temperature Sensor WE700 is not available in Proteus, hence we replace it with a DC voltage source giving voltage

3. Humidity Sensor WE600 is not available in Proteus, hence we replace it with a DC voltage source giving voltage

4. Pressure Sensor WE100 is not available in Proteus, hence we replace it with a DC voltage source giving voltage

LIST OF ATTACHMENTS

1. Complete hardware Real World Design -
2. Manuals
    - 2 input OR gate
    - LM0180L
    - 2732 ROM
    - ADC0808
    - 8086
    - 74LS138 - 3x8 decoder
    - 74LS373 - D type latch
    - 74LS245 - Octal bus transceiver
    - 6116 RAM
    - 8259
    - WE100 - Barometric Sensor
    - 8254
    - 8255
    - WE700 - Temperature Sensor
    - WE600 - Humidity sensor
    - Current to Voltage Converter
3. Proteus File -
4. EMU8086 ASM File -
5. BIN File after assembly