Weather Monitoring System

Submitted To

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Microprocessor and Interfacing : CS/ECE/EEE/INSTR F241

BITS Pilani

Submitted By: **Group - 24**

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Acknowledgment

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Group-24

Problem Statement

System Description

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 0 C” 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.

Specifications

- The analog input for the system is received from the sensors which are connected to an 8-bit parallel ADC(0808) . These sensor modules generate current values ranging from 4 mA-20 mA which is converted into equivalent 1.25 V-6.25 V using the MAX472. This can be scaled to 0 V-5 V range. MAX472 is a bidirectional high-side Current-Sense Amplifier which has a current output that can be converted into a ground referred voltage with a single resistor, allowing a wide range of battery voltages.
- There is an 8259 Programmable Interrupt controller device that accepts four interrupts from various sources, namely the timers, an external button and an EOC interrupt from the ADC. The IVT for the 8259 is stored in the ROM at a vector address of 80h onwards (corresponding to a memory address 80h*4=00200h). There are two timer IC’s (8253) generating interrupts every 5 minutes and every one hour.
- Every five minutes, an interrupt is generated and an ISR is invoked in which the ADC value is read and this digital data is stored in the RAM. It is as though an array of twelve elements is maintained for each sensor, where after the twelfth reading of data, the next value is stored in the first position. Therefore, the past 12 readings are always maintained.

- Every one hour, there is an interrupt generated that invokes an ISR that averages the values for the past hour. For the first hour, averaging is done for only the number of values available. After averaging, the values are scaled according to the specifications of the sensors. This scaled and average value is displayed.
- There is also an external button which on pressing, generates an interrupt which takes the current reading and displays it immediately. This displays value on the LCD as per the request of the external button.

Assumptions

Some assumptions are being made in consideration for the design:

1. The Sensor is operating in °C mode hence all the data is also stored in that value.
2. We are scaling the computed value by 100 and doing the division operation on this scaled value in order to avoid floating point operations which is not supported in 8086.
3. The button press does not clash with the 5-minute interrupt in normal usage. This is a fair assumption to make as the probability for the same is very small in real-time usage of the weather monitoring station.
4. In case of clash during operation (highly unlikely), and non-servicing of button interrupt, a second press will ensure the servicing of the interrupts, without affecting the 5 minute interrupt-servicing.

Components Used

Sensors

Temperature:
WE700 - This covers the required temperature range with required resolution.

Sensing Temperature	- 50°C ~ 50°C
Operating Voltage	10-36 VDC
Output	4-20mA
Accuracy	±0.1°C
Warm Up Time	3 seconds minimum

Humidity:
WE600 - This covers the required humidity range with required resolution.

Humidity Range	0% ~ 100% RH
Operating Temperature	-40°C ~ 55°C
Output	4-20mA
Operating Voltage	10-36 VDC
Accuracy	± 2% RH
Warm Up Time	3 seconds minimum

Pressure:
WE100 - This covers the required pressure range with required resolution

Pressure range	800 to 1100 mbar, 23.6 to 32.5 inHg
Operating Temperature	40° to +55°C
Output	4 - 20 mA
Accuracy	± 1% full scale
Operating Voltage	10 to 36 VDC
Warm-up Time	3 seconds minimum

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Integrated Circuits And Devices Used

Sr. No.	Components Used	Quantity	Purpose
1.	6116	2	RAM for the Memory
2.	2716	4	EPROM
3.	74LS373	3	Latching the Bus
4.	74LS245	2	Bi-Directional Buffer
5.	8086	1	Central Processor
6.	8284A	1	Clock Generator
7.	8259	1	Program Interrupt Controller
8.	8255A	2	PPI for LCD PPI for ADC
9.	74LS138	2	Address Decoder
10.	8253A	1	Programmable Interval Timer
11.	ADC0808	1	Analog to Digital Convertor
12.	Push Button	2	Raise Manual Interrupt Used in 8284
13.	LCD2004	1	LCD (20x4) Display
14.	74LS32	3	Odd even memory interfacing
15.	MAX472	1	Current to voltage convertor
16.	MAX951	1	Current to voltage convertor
17.	Resistors	3.6k, 249(2), 10, 3.89k(2), 100k(2)	Current to voltage convertor
18.	Capacitors	100n(2)	Current to voltage convertor
19.	SPDT switch	1	Used to Reset 8086
20.	Potentiometer	1	Display brightness in LCD Panel

Address Mapping

Memory Mapping For RAM and ROM

Rom 1

19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	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	0	1	1	1	1	1	1	1	1	1	1	1	1

Ram

19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
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	1	1	1	1	1	1	1	1	1	1	1	1

Rom 2

19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1	1	1	1	1	1	1	1	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	1	1	1	1	1	1	1

I/O mapping

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

- 8259
- Two 8255s (labelled 8255a and 8255b)
- 8253

The type of addressing used is variable addressing as follows:

- 8259 (Interrupt controller) - 08000h – 08002h
- 8255a (for LCD operations) – 08010h – 08016h
- 8255b (for ADC operations) – 08020h – 08026h
- 8253 (5 min timer) – 08030h – 08036h

Calculations for Scaling

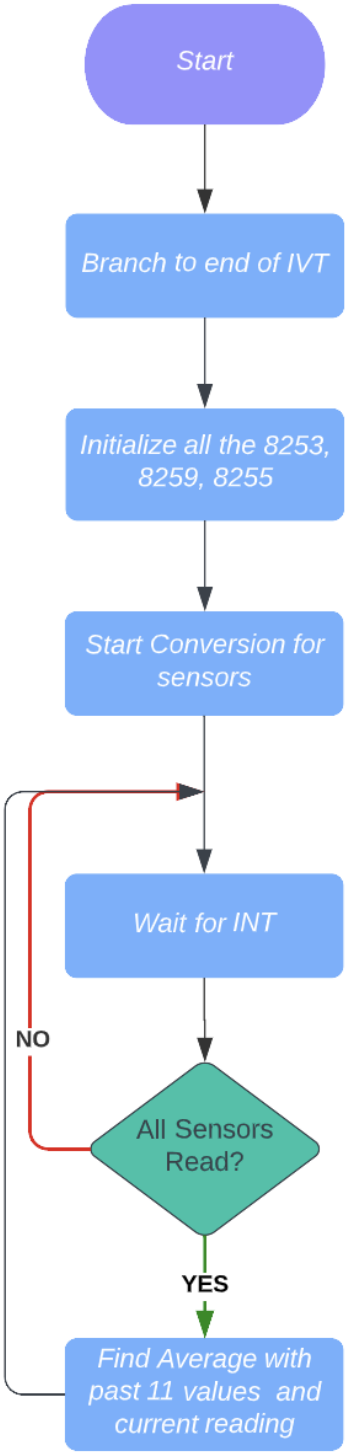
The ADC used in the design produces a voltage between 0 and 255d for the sensors. To scale it to the values for Pressure, Temperature and Humidity, we use a scaling function that employs the following formulae:

Pressure: (800 to 1100 mbar) Hex value is obtained by: ADC value * 12Ch / 0FFh
Temperature: (-50°C to +50°C): ADC value * 64h / 0FFh
Humidity: (0-99%): ADC value * 63h / 0FFh

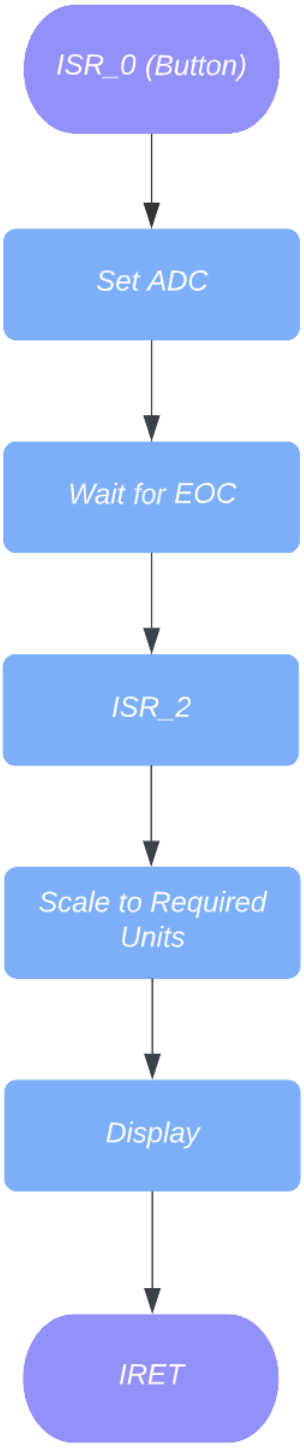
These hex values are then converted to decimal for viewing on the LCD.

Flow Chart

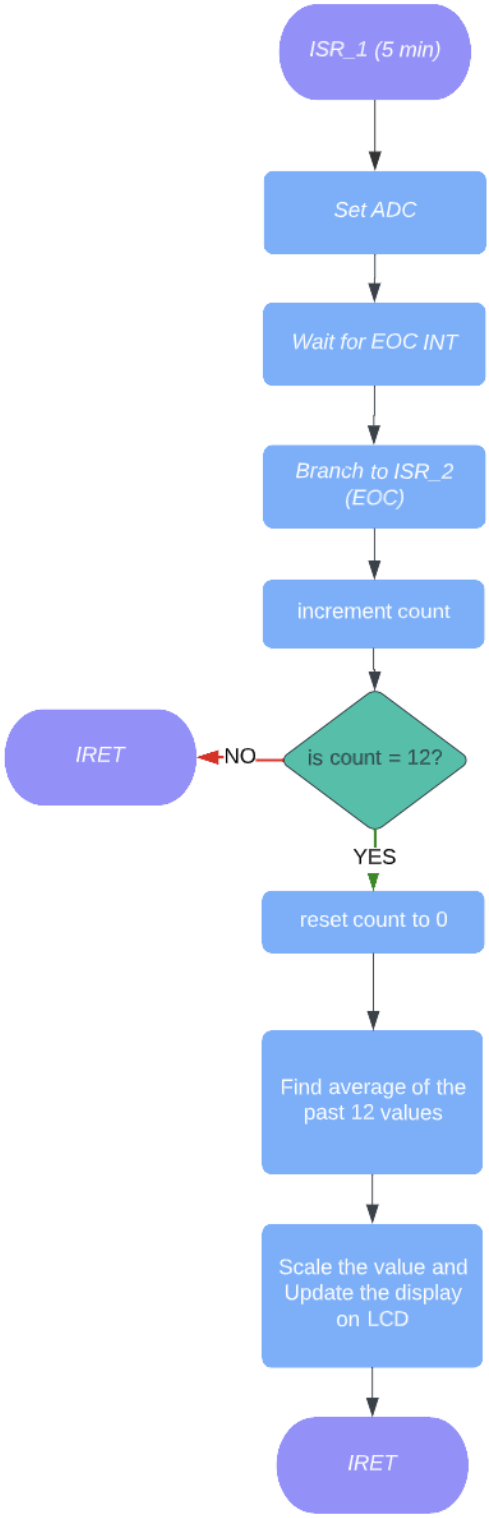
Main Program



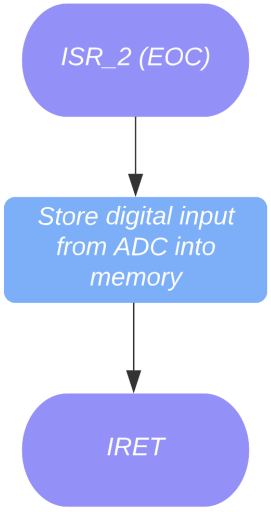
ISR_0 for Button Press



ISR_1 for 5 minute interrupt



ISR_2 for End of Conversion



References and Sources

- Manuals

1. ADC0808
2. WE600 (humidity sensor)
3. WE700 (Temperature sensor)
4. WE100 (pressure sensor)
5. MAX472
6. MAX951
7. LCD2004