Intelligent Humidistat

Submitted by: Group 67

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User Requirements

P 23: System to be designed – Intelligent Humidistat

System Description: A humidistat is supposed to be reset according to the outside temperature – as the outside temperature falls the humidity level inside the house should be set lower. The purpose of this project is to develop a humidistat which senses the outside temperature and adjusts the humidity accordingly. Two sensors are required: outside temperature and inside humidity. Output is provided via a simple relay with the humidifier (presumably on the furnace) being on or off. Also readings from the humidity and temperature sensors must be displayed on LCD display. The entire system can be turned on or off using a single switch.

Technical Specifications:

1. Measurement of external Temperature in and % internal relative humidity.
2. Design suited to a room of approximate dimensions of 9 X 7 X 4.5 (L X B X H in meters).
3. Adjusting of the humidity in the room based on the external temperature; this is done with the help of a humidifier.
4. The output to switch on/off the humidifier is given via a simple relay to indicate the state (on/off) of the humidifier.
5. Displaying the temperature (in °C) and relative humidity (in %) on the LCD every 1 minute.
6. The resolution of the temperature sensor WE700 is 1 °C.
7. Range of the temperature sensor (-50°C – 50°C)

Assumptions:

1) The temperature outside ranges from 0°C to 50°C and the relative humidity inside the room ranges from 25 % to 55 %.
2) We find the temperature and the average humidity of the room via the help of a number of sensors.
3) The temperature sensors is located as follows:
    - One on the outer wall.
4) The humidity sensors are located as follows:
    - One on each corner of the ceiling. (4 sensors)
5) Chart for optimal humidity ranges at given temperature range

Temperature (in deg C)	**Relative Humidity**
0-5	27%-30%
5-10	30%-33%
10-15	33%-35%
15-20	35%-38%
20-25	38%-40%
25-30	40%-43%
30-35	43%-45%
35-45	45%-48%
45-50	48%-50%

Components used with justification wherever required

1. Microprocessor 8086
2. Octal 8-bit buffer -74LS245 (x2) [to separate data bus]
3. Octal 8-bit latch - 74LS373(x3) [to separate address bus]
4. Temperature Sensors – WE700 (x1)
   [High Quality, rugged instrument, precision RTD, wall mountable, temperature range which suits our design]
5. Humidity Sensors – HIH4030 (x7)
   [Very accurate, low response time, stable, cost effective, resistant to dust and other chemicals]
6. Humidifier (x1) [controls inside relative humidity]
7. LCD – LM016L (x1) [Displays outside temperature and inside RH]
8. Programmable Peripheral Interface – 8255(x2)
   [Interfaces ADC & LCD]
9. Decoder- 74LS138(x2) [Memory, I/O Addressing]
10. Programmable Interval Timer – 8253(x1) [provides clock to ADC]
11. Programmable Interrupt Controller – 8259(x1) [raises an interrupt to 8086 every one minute]
12. 74LS32 IC containing 4 OR gates. (x1)
13. NOT ICs – 7404 (x4)
14. ROM chips (4K each) – 2732 (x4)
    [ROM required at reset address FFFF0h and at 00000h (IVT location)]
15. RAM chips (2K each) – 6116 (x2)
    [For stack and temporary storage of data]
16. Simple Relay(x1) [Controls switching ON/OFF the humidifier]
17. Clock Generator – 8284 (x1) [Provide clock to 8086]
18. Analog to Digital Convertor – 0808 (x2)
    [Converts analog inputs from sensors to digital values]

ADC Specifications:

1) No of analog inputs = 8
2) No of ADCs used = 2
3) Size of ADC = 8 bit
4) Resolution of ADC = 5 V / 256 = 19.532 mV

Sensor specifications

- **Temperature Sensor WE700:**

WE700 – Analog Temperature sensors

Output = 4 to 20 mA

Operating voltage = 10-36 V_{DC}

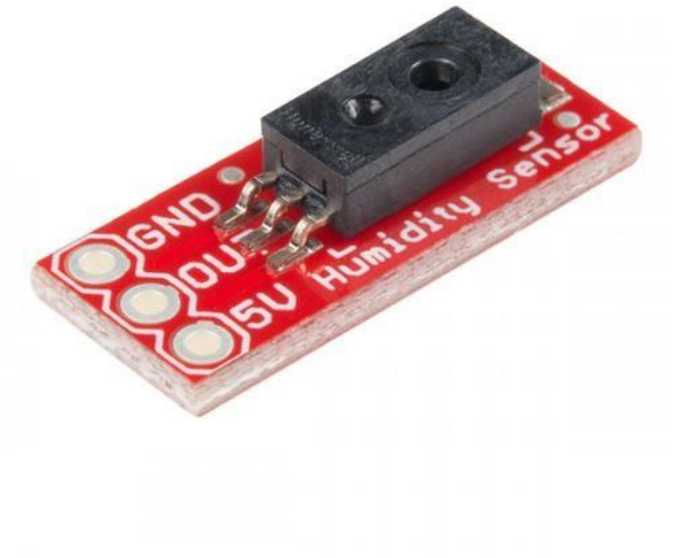
Range = −50°C to 50°C

Accuracy: ±0.1°C

Current drawn : same as sensor output

Warm up time = 3 secs

- **Humidity Sensor HIH 4030/31 series:**



HIH-4030/31 Series (Honeywell) including a SMD (surface mount device)

Accuracy = ± 3.5 % RH

Response time = 5 s (average)

Settling time = 70 ms (max)

Input Voltage supply = 4 – 5.8 V (DC)

Input Current supply = 0 – 500 µA

%RH value for a given value of V_{out} = $\frac{Vout - Zero\ offset}{Slope} = \frac{Vout - 0.9}{\frac{58}{0.0307}}$

Operating humidity: 0-

100% RH Operating

temperature: -40 to 85 °C

Output voltage at assumed range (25-55 %) = 1.725 – 2.645V

- **LM016L Hitachi LCD module with an inbuilt controller LSI HD44780:**

Display: 16 characters * 2 lines

Power Supply for LCD drive: 0 - 6.5V

Operating Temperature: 0 - 50 °C

Power supply current (V_{DD} = 5 V): 1 – 3 mA

Memory Interfacing

- **ADDRESSING:**

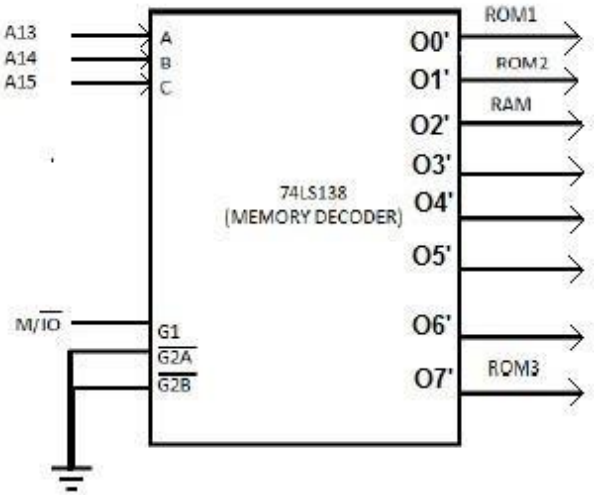
  ROM 1 – 8k: 00000_H – $01FFF_H$

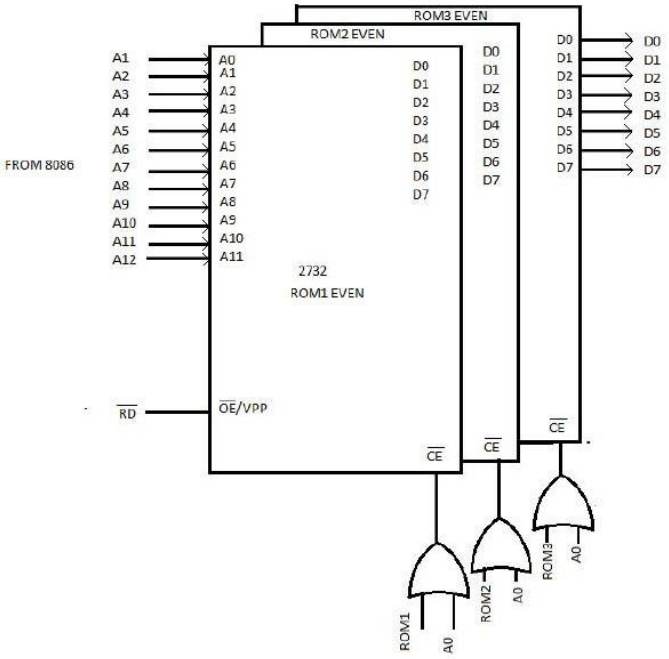
  ROM 2 – 8k: 02000_H – $03FFF_H$

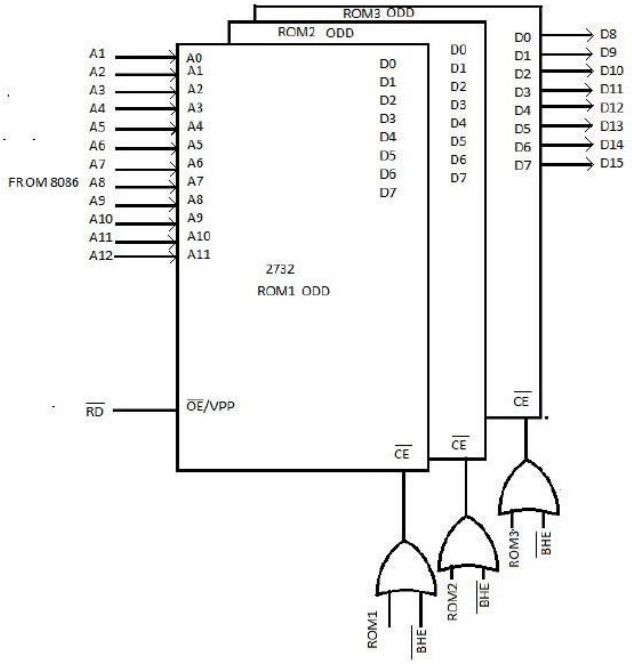
  RAM 1 – 4k: 04000_H – $04FFF_H$

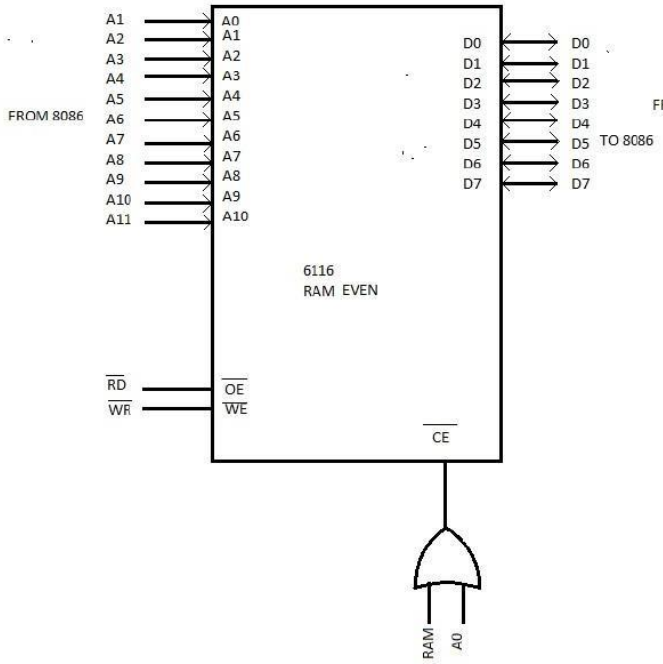
  ROM 3 – 8k: $FE000_H$ – $FFFFF_H$

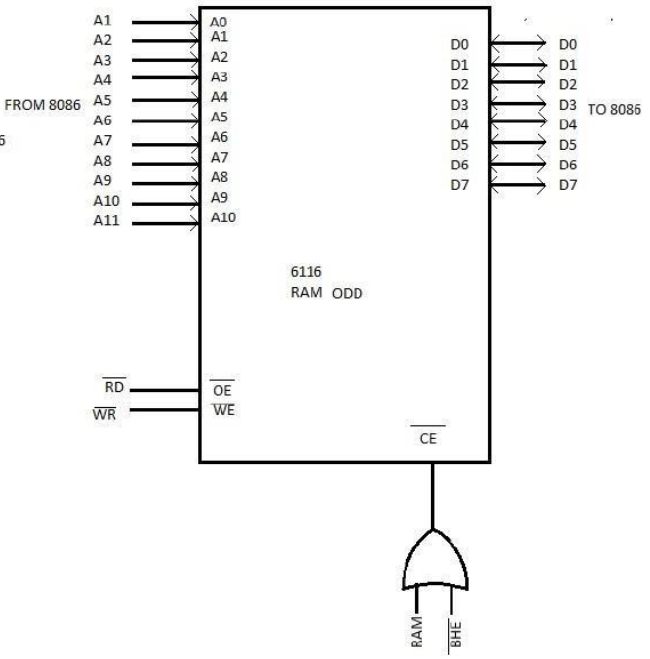
- **DECODING LOGIC:**




ROM3 EVEN
ROM2 EVEN
FROM 8086
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
D0
D1
D2
D3
D4
D5
D6
D7
2732
ROM1 EVEN
RD
OE/VPP
CE
ROM1
ROM2
ROM3
A0


ROM3 ODD
ROM2 ODD
FROM 8086
2732
ROM1 ODD
RD
OE/VPP
CE
D8
D9
D10
D11
D12
D13
D14
D15
ROM1
ROM2
ROM3
BHE


FROM 8086
TO 8086
6116
RAM EVEN
RD
WR
OE
WE
CE
RAM
A0


FROM 8086
TO 8085
6116
RAM ODD
RD
WR
OE
WE
CE
RAM
BHE

I/0 Interfacing (8255(H), 8255(T), 8253)

- **ADDRESSING:**

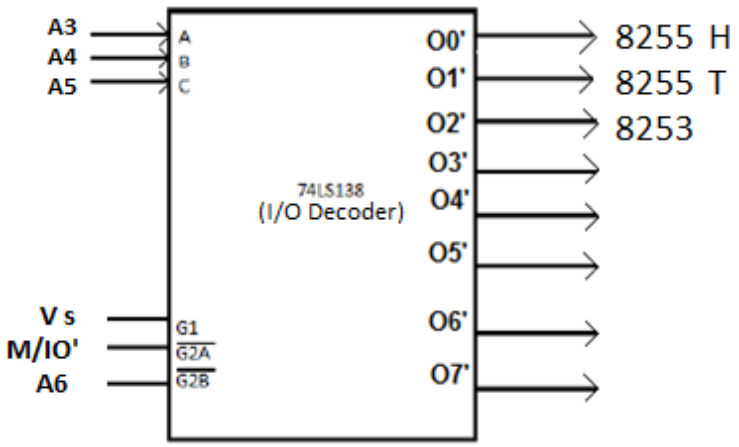
8255(H): 00_H – 06_H

8255(T): 08_H – $0E_H$

8253: 10_H – 16_H

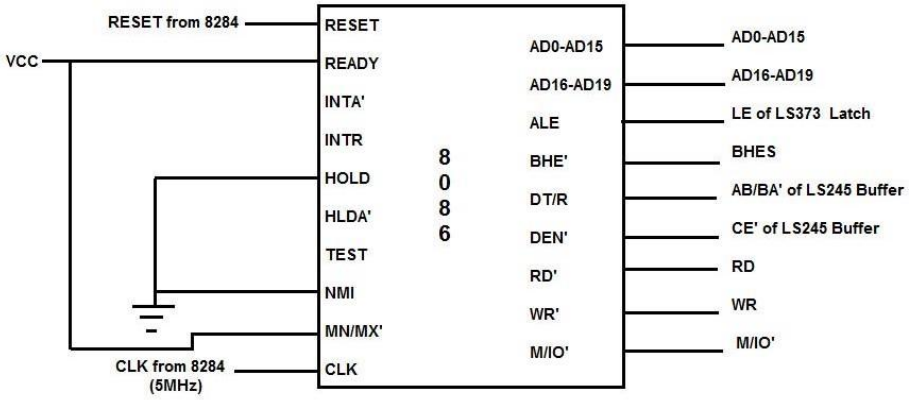
8259: 18_H – $1A_H$

- **DECODING LOGIC:**

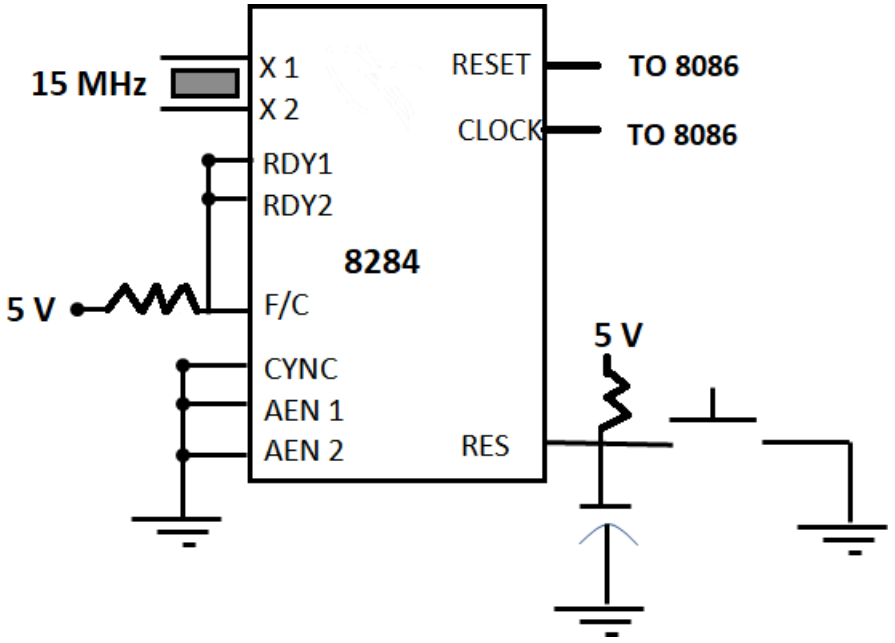


Design Components

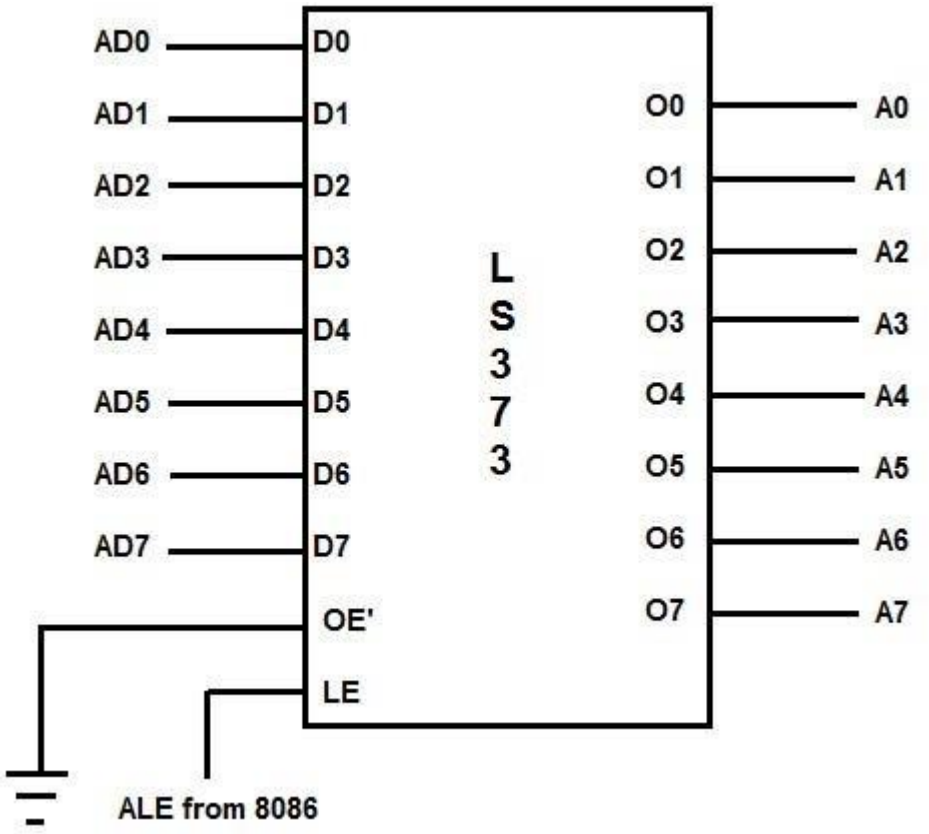
- **Connections to 8086 microprocessor**

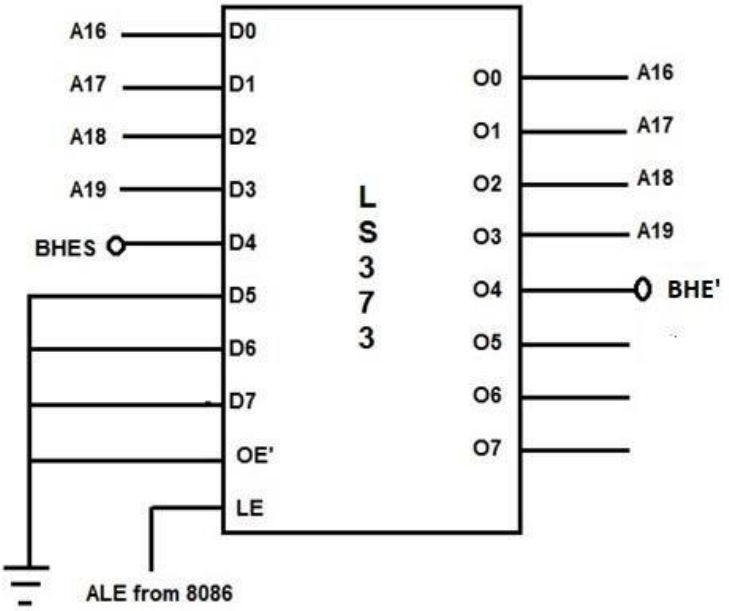


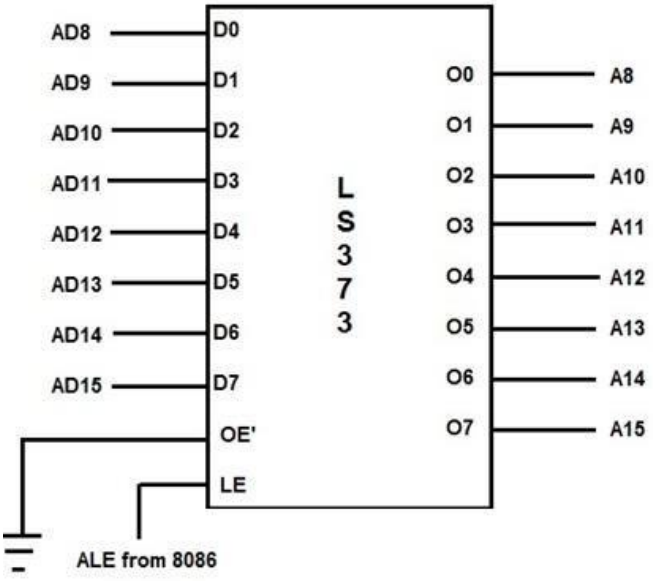
- **Connections to 8284 Clock generator**



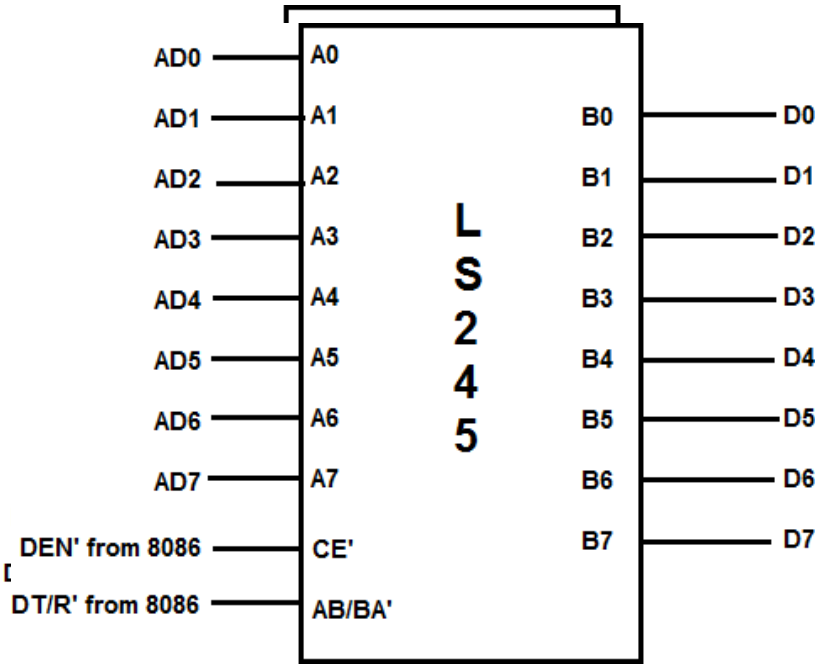
- **Connections to 74LS373 Octal Latches**



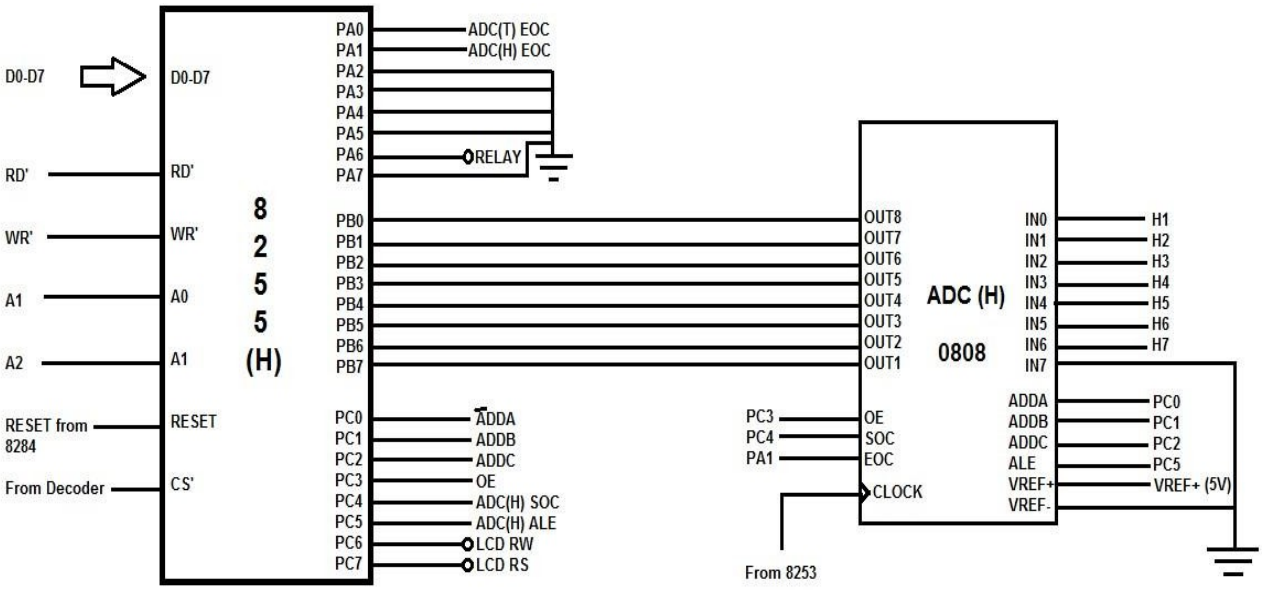

A16
A17
A18
A19
BHES
D0
D1
D2
D3
D4
D5
D6
D7
OE'
LE
LS373
O0
O1
O2
O3
O4
O5
O6
O7
A16
A17
A18
A19
BHE'
ALE from 8086


AD8
AD9
AD10
AD11
AD12
AD13
AD14
AD15
D0
D1
D2
D3
D4
D5
D6
D7
OE'
LE
LS373
O0
O1
O2
O3
O4
O5
O6
O7
A8
A9
A10
A11
A12
A13
A14
A15
ALE from 8086

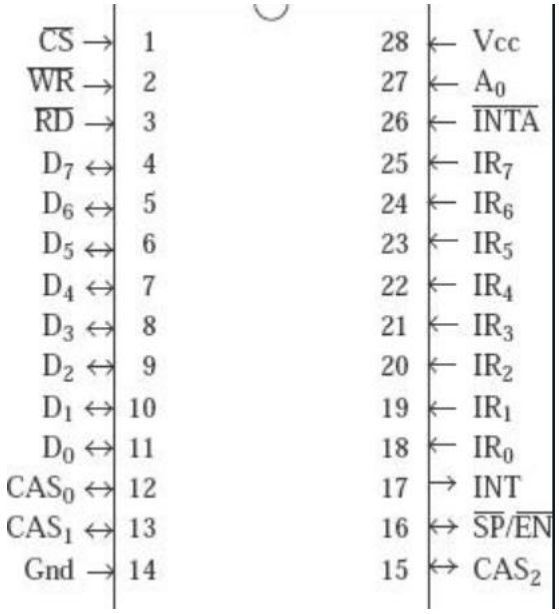
- **Connections to 74LS245 Octal Buffers**



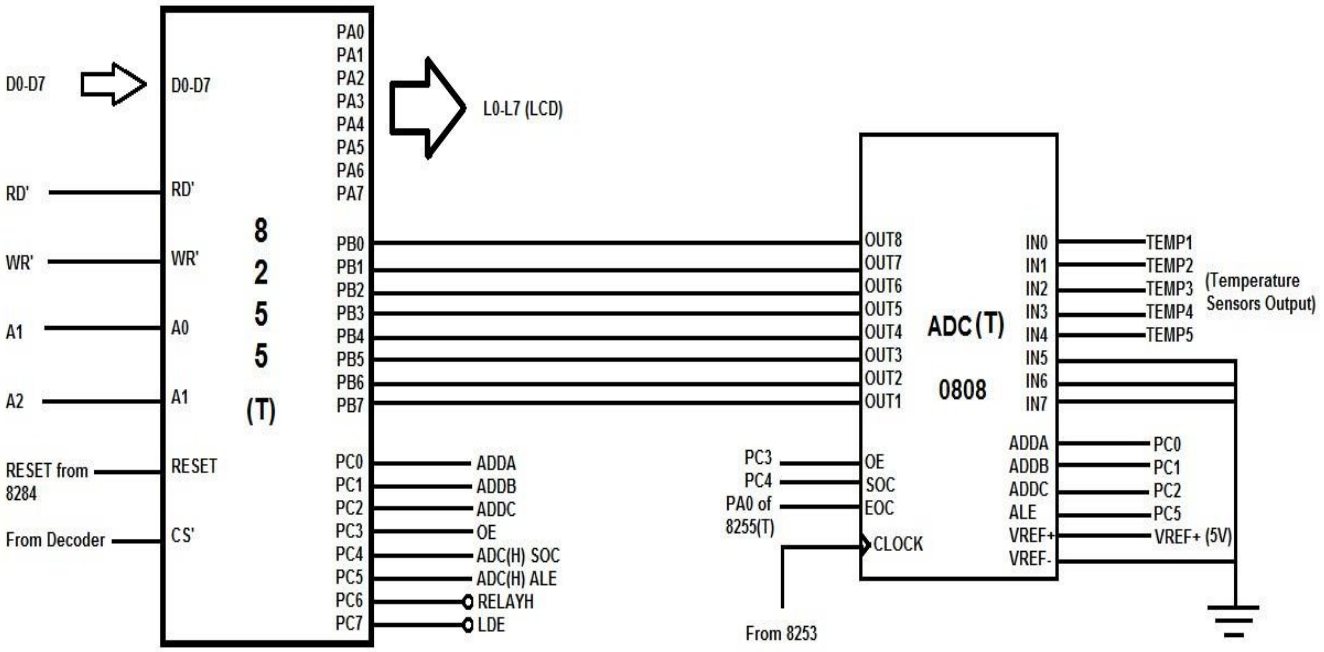
- **Interfacing of ADC(H) with 8255(H)**



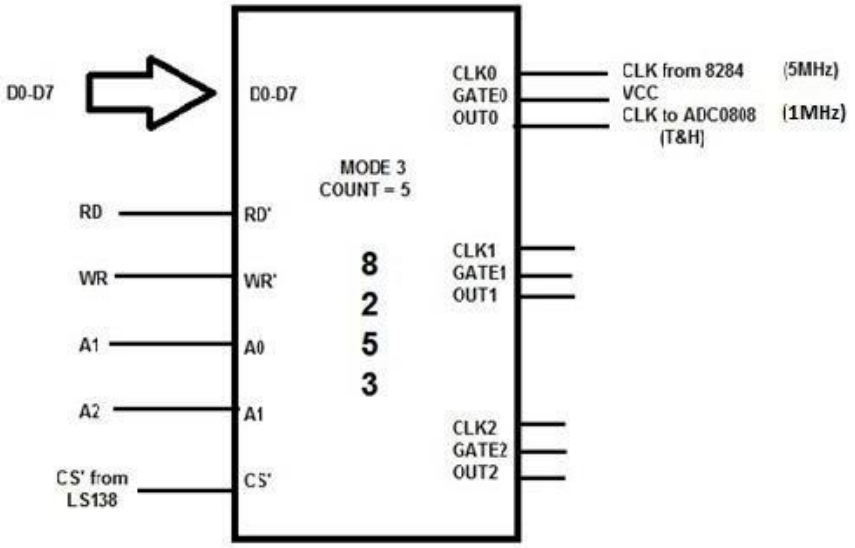
- **Interfacing of 8259 with 8253**



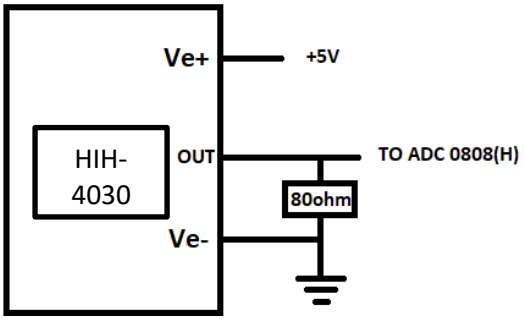
- **Interfacing of ADC(T) with 8255(T)**

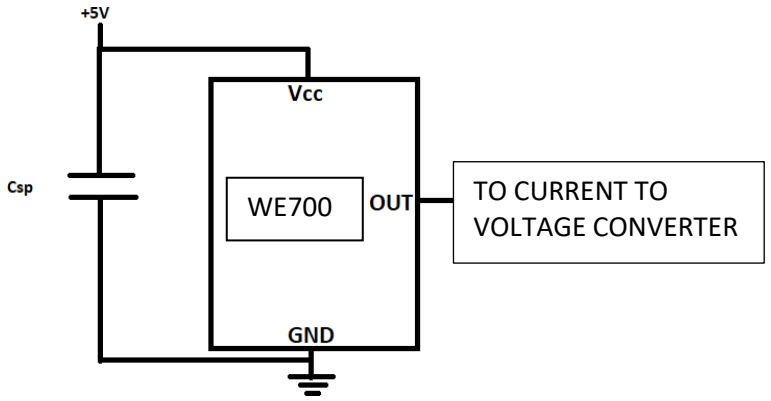


- **Interfacing of 8253 with ADC0808(T) and ADC0808(H)**

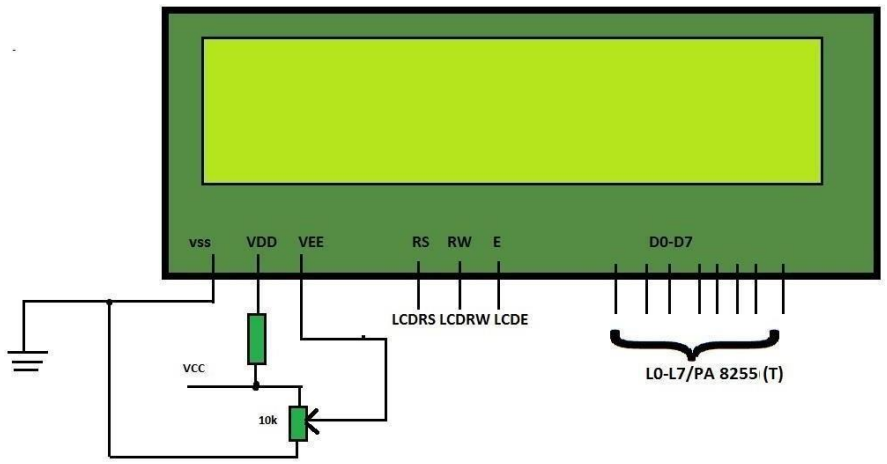


- **Connections to Temperature sensor LMT85 and Humidity sensor HIH4030**

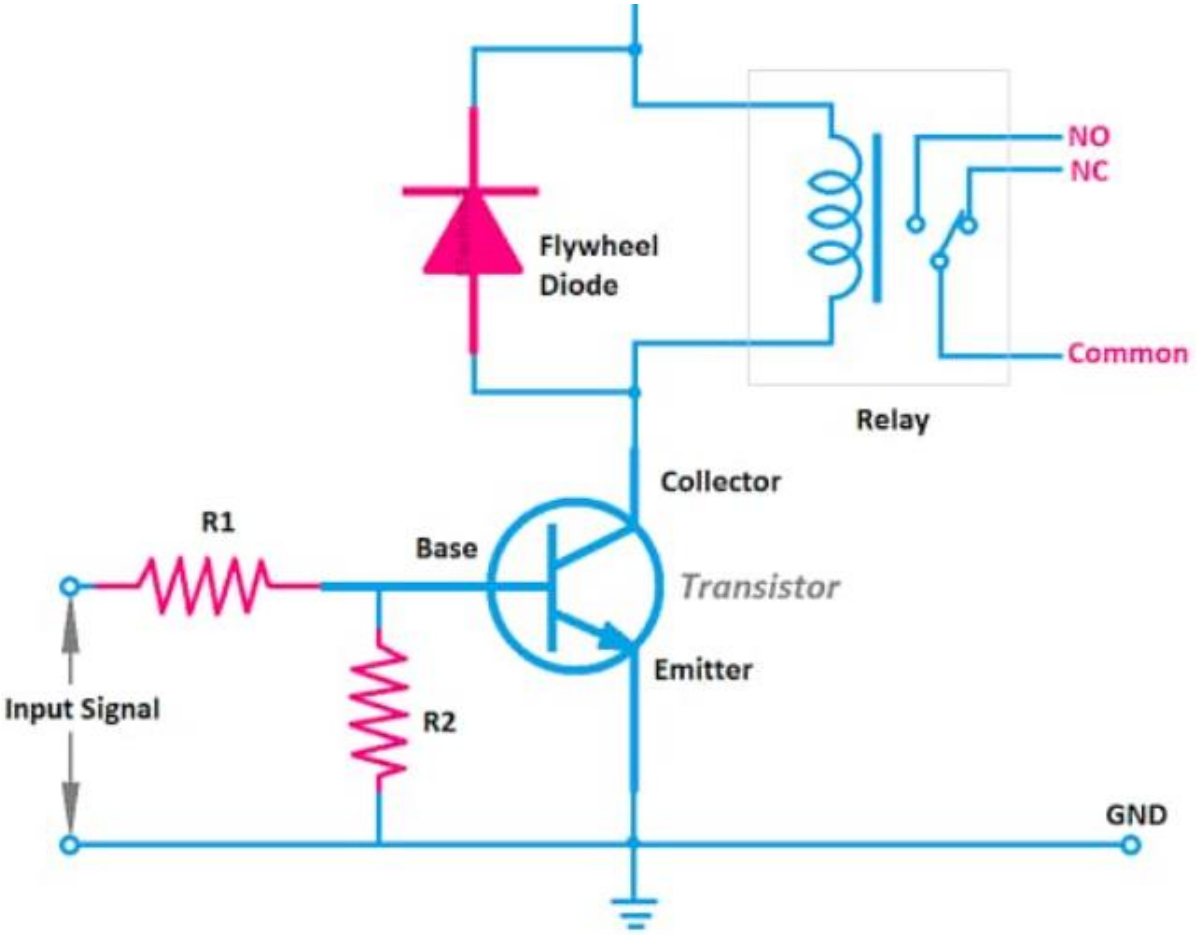




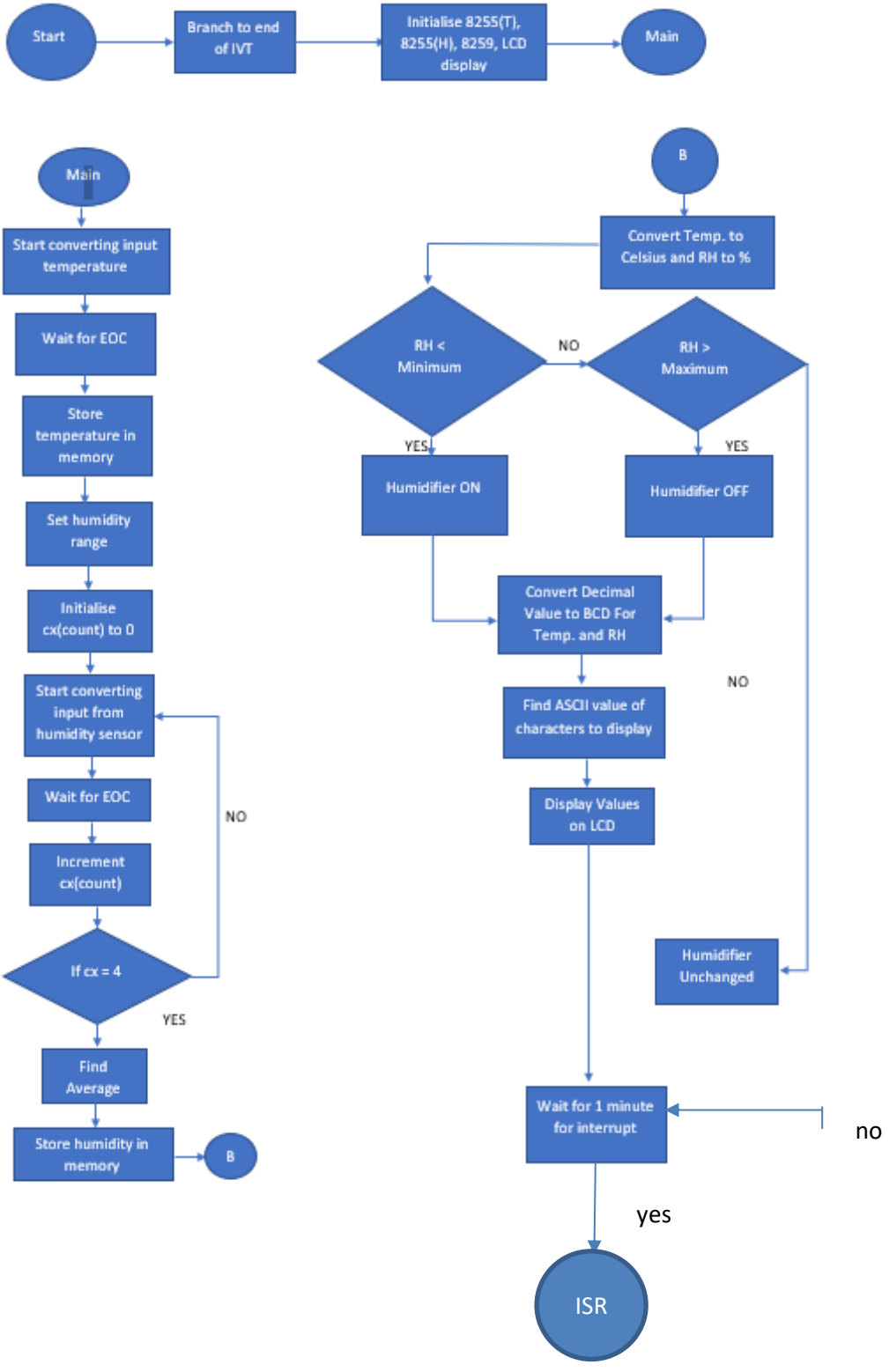
- **Interfacing of LCD with 8255(H) and 8255 (T)**

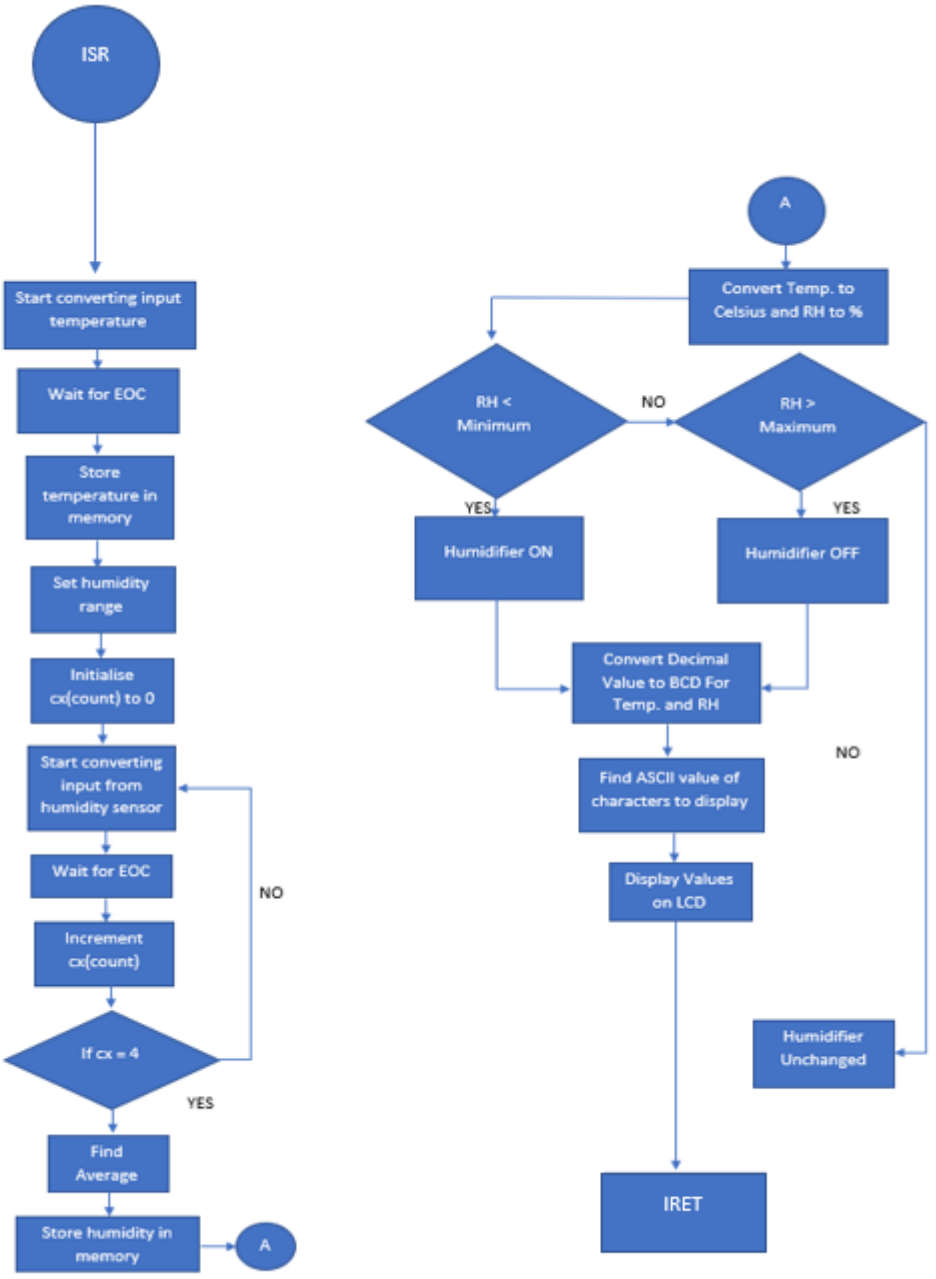


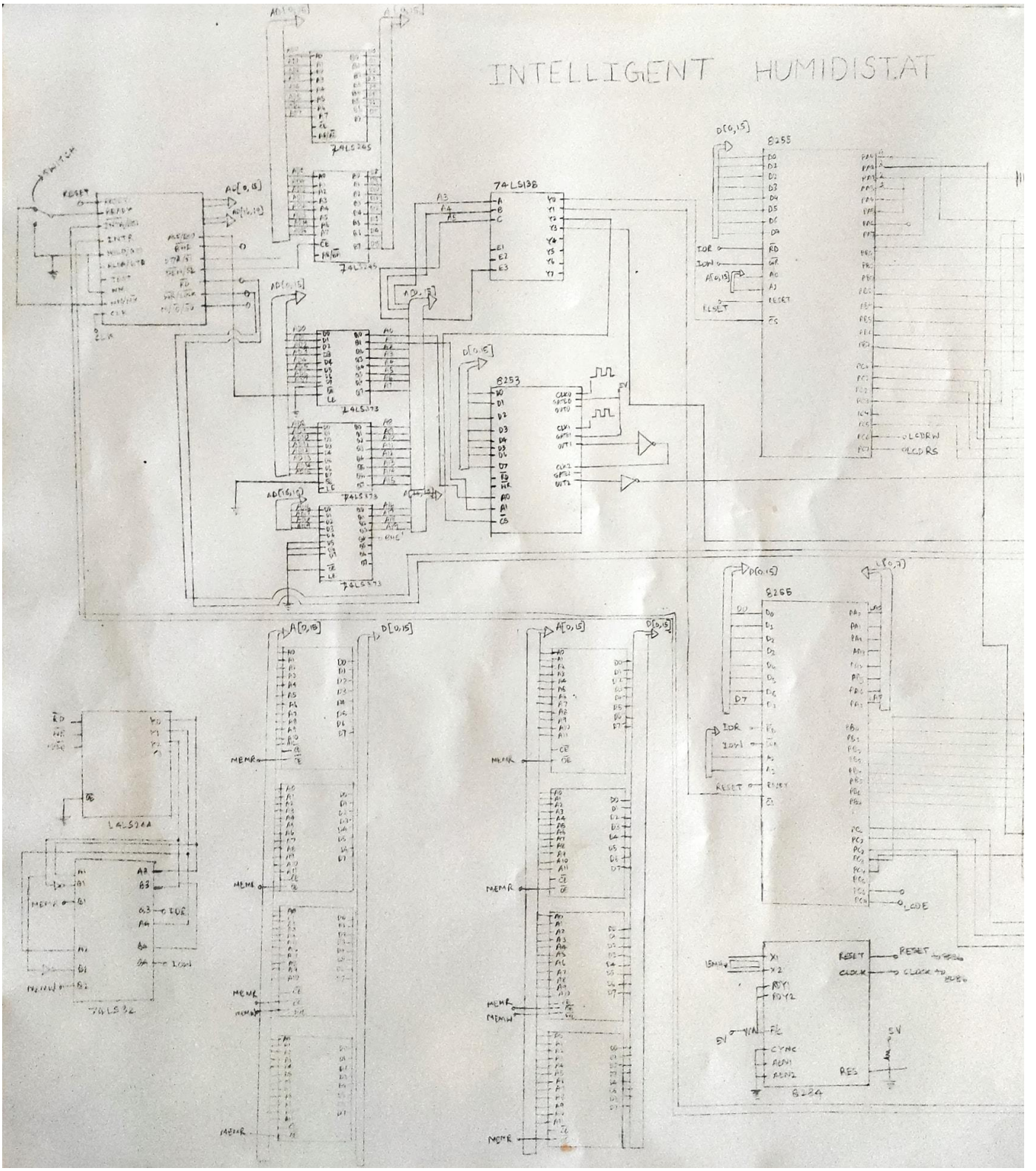
- **Simple Relay Interfaced with RELAYH(PC6) from 8255 (T)**



Software Flowchart




ISR
Start converting input temperature
Wait for EOC
Store temperature in memory
Set humidity range
Initialise cx(count) to 0
Start converting input from humidity sensor
Wait for EOC
Increment cx(count)
If cx = 4
NO
YES
Find Average
Store humidity in memory
A
A
Convert Temp. to Celsius and RH to %
RH < Minimum
NO
RH > Maximum
YES
Humidifier ON
YES
Humidifier OFF
Convert Decimal Value to BCD For Temp. and RH
NO
Find ASCII value of characters to display
Display Values on LCD
Humidifier Unchanged
IRET


INTELLIGENT HUMIDISTAT
74LS245
74LS138
74LS373
8255
8253
8086
74LS244
74LS32
8284
RESET
READY
INTR
TEST
HOLD
CLK
RD
WR
IOR
IOW
ALE
MEMR
MEMW
RESET
CLOCK
LCDE
LCDRW
LCDRS

PUNEET TYAGI 2020AAPS1598G
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SUCHETAN RS 2020A7PS1760G
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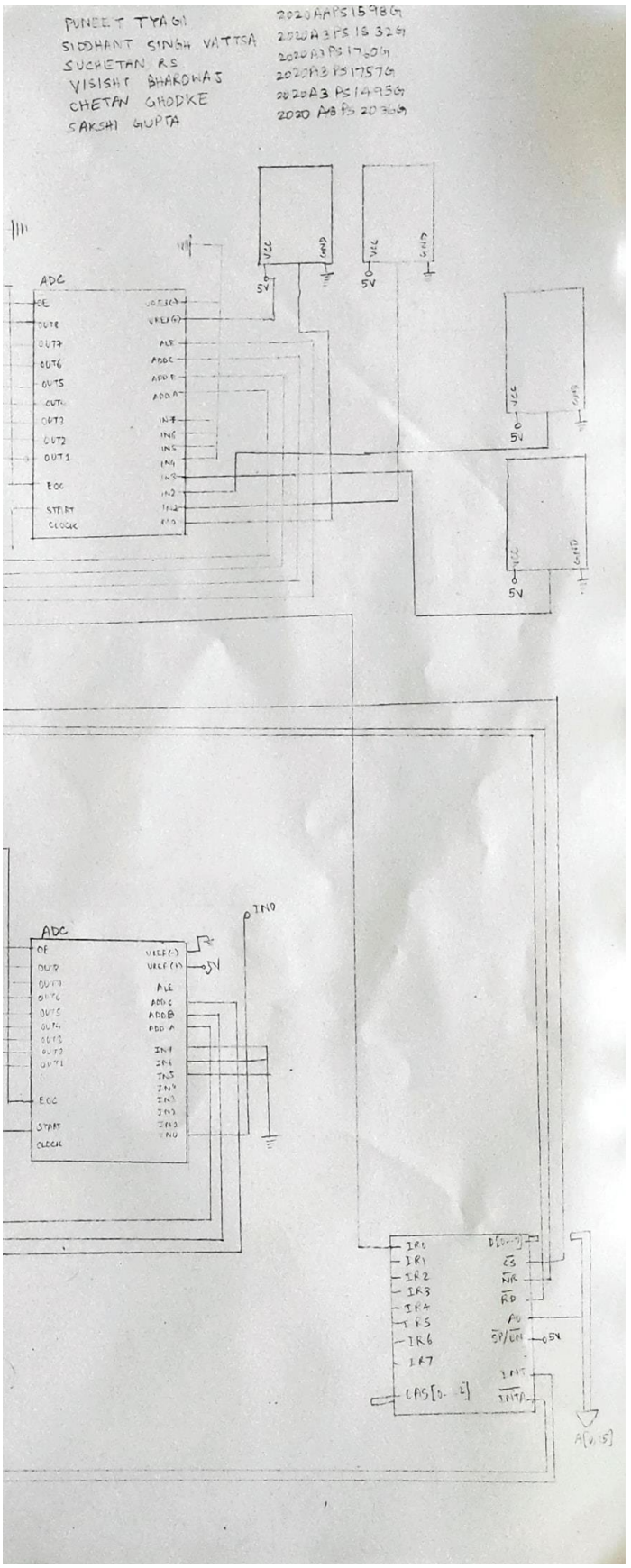

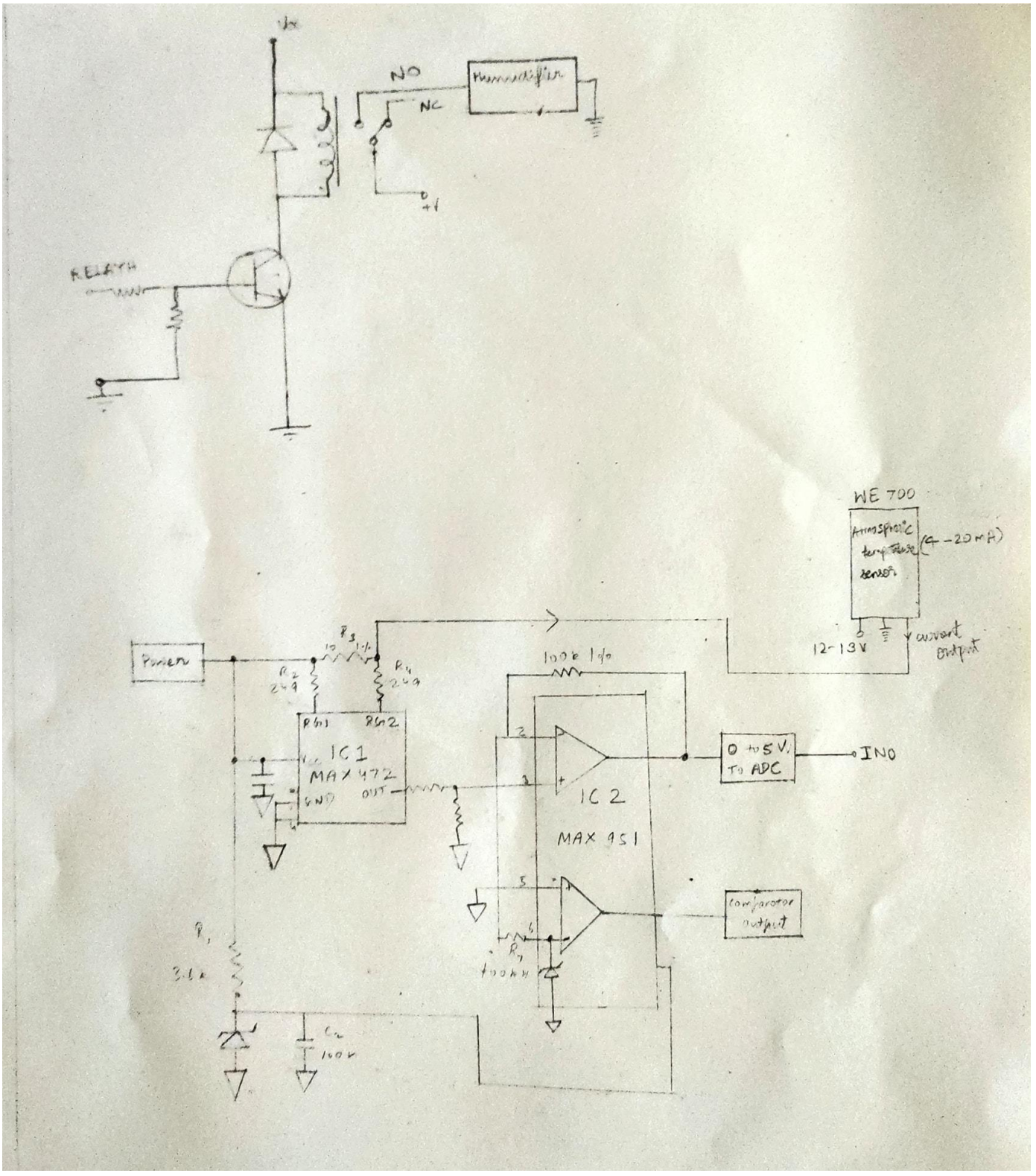
NO
NC
+V
RELAY
WE 700
Atmospheric temperature sensor
(4-20 mA)
12-13 V
current output
Power
100k 1%
IC 1
MAX 472
GND
OUT
IC 2
MAX 951
0 to 5 V. To ADC
IN0
comparator output
100K