A REPORT ON

AN INTELLIGENT HUMIDISTAT

BY

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CS F241: Microprocessors, Programming & Interfacing (MPI)

Under the guidance of

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We would also like to thank our seniors for guiding us all along till the completion of this report.

LIST OF COMPONENTS USED

Model Number	Component	Quantity	Specifications	Purpose
8086	Microprocessor	1	• Size: 16-bit • Memory: 1MB	Central Processing unit for the design.
LM020L	LCD Alphanumeric 16×1	1	• Display: 16 characters in 1 line • Power Supply for LCD Drive • Operating temperature: 0 - 50 °C • Power supply current (Vdd = 5V): 1 - 3 mA	Display temperature and humidity readings.
WE700	Global Water WE700/WQ101 Temperature Sensor	1	• Output: 4-20mA • Range: -50 to +50° C • Resolution: 2° F or 1° C • Operating Voltage: 10-36VDC • Warm-Up Time: 5 seconds • Operating Temperature: -50 to +100°C	Used to measure the outside temperature and provide temperature readings
WE600	Global Water WE600 Humidity Sensor	1	• 4-20 mA output • Accuracy: ±2% RH • Operating Voltage: 10-36V DC • Temp: -40 to 55°C	Sense, measure and report the relative humidity (**RH**) of air.
8255	PPI	2	• Programmable Peripheral Interface.	Provides I/O ports for other devices.
6116	SRAM - 2K	2	• Static Random Access Memory.	Used to store temporary data (such as temperature values, humidity values, stack, etc.). Contains Data and Stack Segment.
2732	EPROM - 4K	2	• Erasable Read-Only Programmable Memory	Code resides here.
74LS373	Octal Latch	3	• Supply voltage V_{CC}=4.75-5.25 V • Operating Ambient Temperature Range: 0-70°C	To latch address bus

74LS245	8-Bit Buffer	4	• Supply voltage V_{CC}= 4.75-5.25 V • Free Air Operating Temperature: 0-70°C	To buffer data bus (bi-directional)
74LS138	2	3x8 Decoder		Used for selecting signals
74LS244	1	Unidirectional buffer		Buffering the control lines
Logic Gates	Multiple	OR, NOT, NOR logic Gates		Used for building decoding logic for memory interfacing and I/O interfacing.

PROBLEM STATEMENT

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 lower. This project aims to develop a humidistat that senses the outside temperature and adjusts the humidity accordingly. Two sensors are required: outside temperature and inside moisture. 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 an LCD. The entire system can be turned on or off using a single switch.

ASSUMPTIONS

- ALP is stored in the ROM in executable format.
- The outside temperature is between 10° C and 40° C.

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%
45-55	48%-50%
55-60	50%-53%

- When the humidifier is switched on, it decreases the humidity.

- The humidifier circuit is represented in the design via an LED, which turns on when the LED glows, and consequently, the humidifier turns off when the LED stops glowing.

JUSTIFICATIONS

- Temperature and relative humidity (RH) are already stored in the DS, and a one-degree change in temperature corresponds to one unit change in RH.

ADDRESS MAPPING

i. MEMORY MAPPING

The system uses 8kb of ROM and 4kb of RAM.
Both consist of 2 chips of 4KB and 2KB size, respectively. They are organised into odd and even banks to facilitate both byte and word size data transfers.

Random Access Memory (6116):

Even Bank:

• *Starting Address:* 08000H
• *Ending Address*: 08FFEH

Odd Bank:

• *Starting Address:* 08001H
• *Ending Address*: 08FFFH

Read-Only Memory (2732):

• *Starting Address*: 00000H
• *Ending Address*: 01FFFH

The assembly code resides in the ROM and begins at address 00000H.
The address loaded as soon as the system is switched on is FFFF0H.

ii. I/O MAPPING

The input and output devices such as temperature & humidity sensor and LCD are connected using 8255. Both 8255 are used in Input-Output mode.

Pinout for **8255 (A)**

Control Word: 10000000b
Port A is used to generate the control signal of LCD
Port B is used to give input to the LCD
PC7 is used to turn on the humidifier.

PORT TYPE	**PORT ADDRESS**	**TYPE**
A	00H	Output
B	02H	Output
C (Lower)	04H	Output
C (Upper)	04H	Output
Control Register	06H	

Pinout for **8255 (B)**

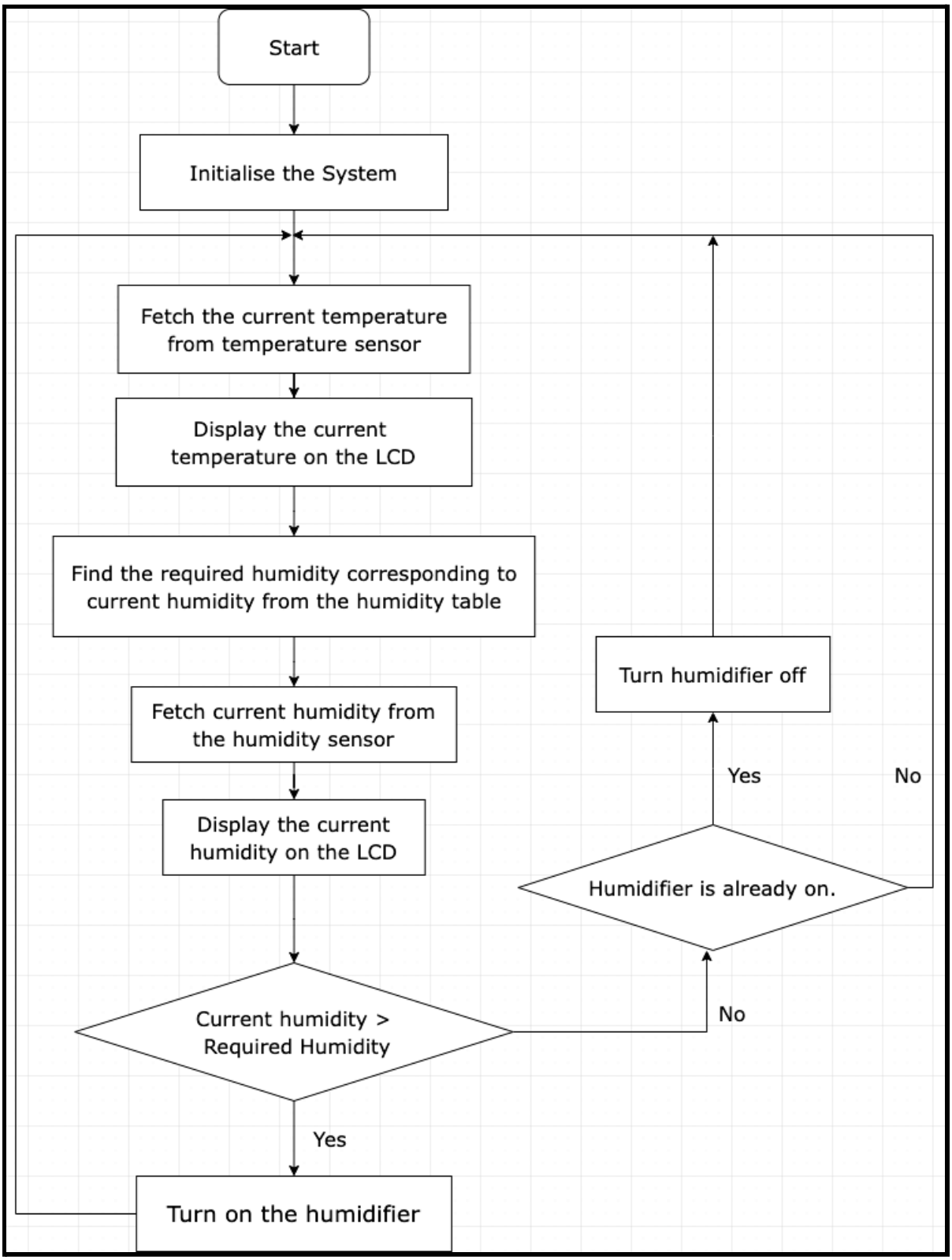
Control Word: 10011010b
Port A is used to take the digital output from ADC
PC0 – PC3 are used to give control input to ADC
PC5 is used to receive the signal of EOC.

PORT TYPE	**PORT ADDRESS**	**TYPE**
A	10H	Input
B	12H	Input
C (Lower)	14H	Output
C (Upper)	14H	Input
Control Register	16H	

iii. MEMORY AND ADDRESS MAPS

CHIP	A19	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	A0
EPROM 2732																				
FROM 000000h	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TO 01FFFh	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1
SRAM 6116																				
FROM 08000h	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TO 08FFFh	0	0	0	0	1	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1

SOFTWARE FLOW-CHART



LIST OF ATTACHMENTS

Temperature and Humidity sensors

Specifications

Humidity Sensor
Type: Capacitance
Output: 4-20 mA
Range: 0 to 100% RH
Accuracy: ±2% RH
Operating Voltage: 10-36 VDC
Current Draw: 3mA plus sensor output
Warm Up Time: 3 seconds minimum
Operating Temp: -40° to +55°C
Sensor Size: 1 1/2" diameter x 7"
Weight: 1/2 lb.

Temperature Sensor
Type: Precision RTD
Output: 4-20 mA
Range: -50°C to +50°C
Accuracy: ±0.2°F or ±0.1°C
Operating Voltage: 10-36 VDC
Current Draw: Same as sensor output
Warm Up Time: 5 seconds minimum
Operating Temp: -50° to +100°C
Sensor Size: 3/4" diameter x 4 1/2"
Weight: 1/2 lb.

LCD Display Specifications

LM020L·LM020XMBL

- 16 character x 1 line
- Controller LSI HD44780 is built-in (See page 79).
- +5V single power supply
- Display color: LM020L : Gray
  LM020XMBL : New-gray

MECHANICAL DATA (Nominal dimensions)

Module size . . . . . 80W x 36H x 12T (max.) mm
Effective display area . . . . . 64.5W x 13.8H mm
Character size (5 x 7 dots) . . . . . 3.07W x 5.73H mm
Character pitch . . . . . 3.77 mm
Dot size . . . . . 0.55W x 0.75H mm
Weight . . . . . about 25 g

ABSOLUTE MAXIMUM RATINGS

	min.	max.	
Power supply for logic ($V_{DD}-V_{SS}$)	0	7.0	V
Power supply for LCD drive ($V_{DD}-V_O$)	0	13.5	V
Input voltage (Vi)	V_{SS}	V_{DD}	V
Operating temperature (Ta)	0	50 40*	°C
Storage temperature (Tstg)	–20	70 60*	°C

* Shows the value of type LM20XMBL.

ELECTRICAL CHARACTERISTICS

Ta = 25°C, V_{DD} = 5.0 V ± 0.25 V
Input "high" voltage (V_{IH}) . . . . . 2.2 V min.
Input "low" voltage (V_{IL}) . . . . . 0.6 V max.
Output high voltage (V_{OH}) ($-I_{OH}$ = 0.2 mA) . 2.4 V min.
Output low voltage (V_{OL}) (I_{OL} = 1.2 mA) . . . 0.4 V max.
Power supply current (I_{DD}) (V_{DD} = 5.0 V) . . 1.0 mA typ.
2.0 mA max.

POWER SUPPLY FOR LCD DRIVE (Recommended) (V_{DD}-V_O)

Duty = 1/16
Range of $V_{DD}-V_O$ . . . . . 1.5~5.25 V
Ta = 0°C . . . . . .4.6 V typ.
Ta = 25°C . . . . . 4.4 V typ.
Ta = 50°C . . . . . 4.2 V typ.

OPTICAL DATA . . . . . See page 7

INTERNAL PIN CONNECTION

Pin No.	Symbol	Level	Function	
1	V_{SS}	–	0V	Power supply
2	V_{DD}	–	+5V	
3	V_O	–	–	
4	RS	H/L	L: Instruction code input H: Data input	
5	R/W	H/L	H: Data read (LCD module→MPU) L: Data write (LCD module←MPU)	
6	E	H, H→L	Enable signal	
7	DB0	H/L	Data bus line Note (1), (2)	
8	DB1	H/L		
9	DB2	H/L		
10	DB3	H/L		
11	DB4	H/L		
12	DB5	H/L		
13	DB6	H/L		
14	DB7	H/L		

Notes:

In the HD44780, the data can be sent in either 4-bit 2-operation or 8-bit 1-operation so that it can interface to both 4 and 8 bit MPU's.

(1) When interface data is 4 bits long, data is transferred using only 4 buses of DB_4~DB_7 and DB_0~DB_3 are not used. Data transfer between the HD44780 and the MPU completes when 4-bit data is transferred twice. Data of the higher order 4 bits (contents of DB_4~DB_7 when interface data is 8 bits long) is transferred first and then lower order 4 bits (contents of DB_0~DB_3 when interface data is 8 bits long).

(2) When interface data is 8 bits long, data is transferred using 8 data buses of DB_0~DB_7

REFERENCES

1. https://www.ysi.com/we600
2. https://www.digchip.com/datasheets/parts/datasheet/000/LM020L-pdf.php