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PROBLEM STATEMENT

P23: System to be designed: **An Intelligent Humidistat**

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 an LCD display. The entire system can be turned on or off using a single switch.

ASSUMPTIONS

The following assumptions have been made regarding the system:

1) The outside temperature is between 0 and 85 degree celsius

2) Room is big enough, hence 4 sensors will be required

3) Resolution of 1 degree celsius and 1.118% is required in temperature and humidity sensors

4) The humidifier turns on when the LED Glows and consequently, the humidifier turns off when the LED stops glowing

5) There is a Linear relationship between temperature and humidity, i.e. for an increase in temperature by 1%, increase in relative humidity should be 1.118% and at 0 degree celsius, the relative humidity should be 0%. For example, if the temperature is 50 degree celcius,
   Relative humidity will be 55.9%.

6) We have used potentiometers in proteus for simulating the temperature and humidity sensors. In real-life implementation RH-BTA model by Vernier Systems could be used as humidity and Global Water's WE700/WQ101 can be used as temperature sensor.

SYSTEM DESCRIPTION

The humidistat is supposed to change the humidity level inside a room according to the outside temperature. If the current humidity is less than the ideal humidity which is meant for the current outside temperature, the humidifier should be turned on. The role of a humidifier is to increase the humidity inside the room. After attaining the ideal humidity, if the outside temperature increases, then also the humidifier is tuned on. For this, two sensors are required: Outside Temperature Sensor and Inside Humidity Sensor

For this, two sensors are required: Outside Temperature Sensor and Inside Humidity Sensor.

The temperature sensors are mounted outside the room and are open to the atmosphere. The humidity sensors are mounted inside the room. The humidity sensor measures the humidistat in % Relative Humidity. The sensors give analog output. These outputs are converted to digital form through A/D converters. ADC is set such that the output received from the ADC ranges from 00h to 64h, where an increase in temperature by 1°C, or with an increase in RH by 1%, results in an increase in the output by 01h.

Digital Output	Corresponding Temperature	Corresponding RH
00h	0 ° C	0%
01h	1 ° C	1.118%
02h	2 ° C	2.236%
03h	3 ° C	3.354%
.	.	.
.	.	.
.	.	.
55h	85 ° C	95%

LIST OF COMPONENTS USED

Chip No	Qty	Chip	Purpose
8086	1	Microprocessor	Central Processing Unit
2732	2	EPROM	Erasable Programmable Read Only Memory; in which the code resides
6116	2	SRAM	Used to store the temporary data (like temperature values, stack, etc.)
74138	2	3x8 Decoder	To select among the two PPIs (8255), 8253; and for memory interfacing
8255	2	Programmable Peripheral Interface	Provides I/O ports for the other devices
8259	1	Programmable Interrupt Controller	Combines multi interrupt input source into a single interrupt output
ADC0808	1	Analog to Digital Converter	Converts the analog voltage to its digital equivalent
RH-BTA	4	Humidity Sensor	Detects humidity
WE700/WE101	1	Temperature Sensor	Measures Temperature
74LS373	3	8-bit Octal Latches	Latching the address bus
74LS245	2	8-bit bidirectional buffer	Buffering Data Bus
8253	1	Programmable Interval Timer	To generate clock input for ADC
LM016L	1	16x2 alphanumeric LCD	Displays the current temperature and humidity

OTHER HARDWARE USED

1)Logic Gates: For building decoding logic for memory interfacing and I/O interfacing.

2)Solid-State Relay: Used as a switch to power on high voltage devices

3)LED: Used to show turning off/on of the humidifier

4)Potentiometers: Used to simulate input from sensors

5)Switches: They are used to power off/on the system and the LCD

Memory Organization

Memory is divided into odd and even banks for word and byte transfer

ROM(2 required, each of size 4 KB)

EVEN: 00000h - 01FFEh

ODD: 00001h - 01FFFh

RAM(2 Required, each of size 2KB)

EVEN: 02000h - 02FFEh

ODD: 02001h - 02FFFh

The code resides in the ROM and begins at address 0000h. The address loaded as soon as the system starts is FFFF0h

MEMORY AND ADDRESS MAPS

CHIP	$A_{19}A_{18}A_{17}A_{16}$	$A_{15}A_{14}A_{13}A_{12}$	$A_{11}A_{10}A_9A_8$	$A_7A_6A_5A_4$	$A_3A_2A_1A_0$
EPROM 2732					
00000h	0000	0000	0000	0000	0000
01FFFh	0000	0001	1111	1111	1111
SRAM 6116					
02000h	0000	0010	0000	0000	0000
02FFFh	0000	0010	1111	1111	1111

I/O Interfacing

The input and output devices of the system are connected to the processor using 8255 Programmable Peripheral Interface controllers, and 8253 Programmable Interval Timer is used to provide clock signals to ADC. Here we connect A0 and A1 of 8255s and 8253 to A1 and A2 of 8086's address bus. The CS of 8255s and 8253 are connected to the corresponding outputs of decoder 74138 for selecting the chips. Addresses for the chips are as follow (All have been given even address space as data lines D0 – D 7 are used)

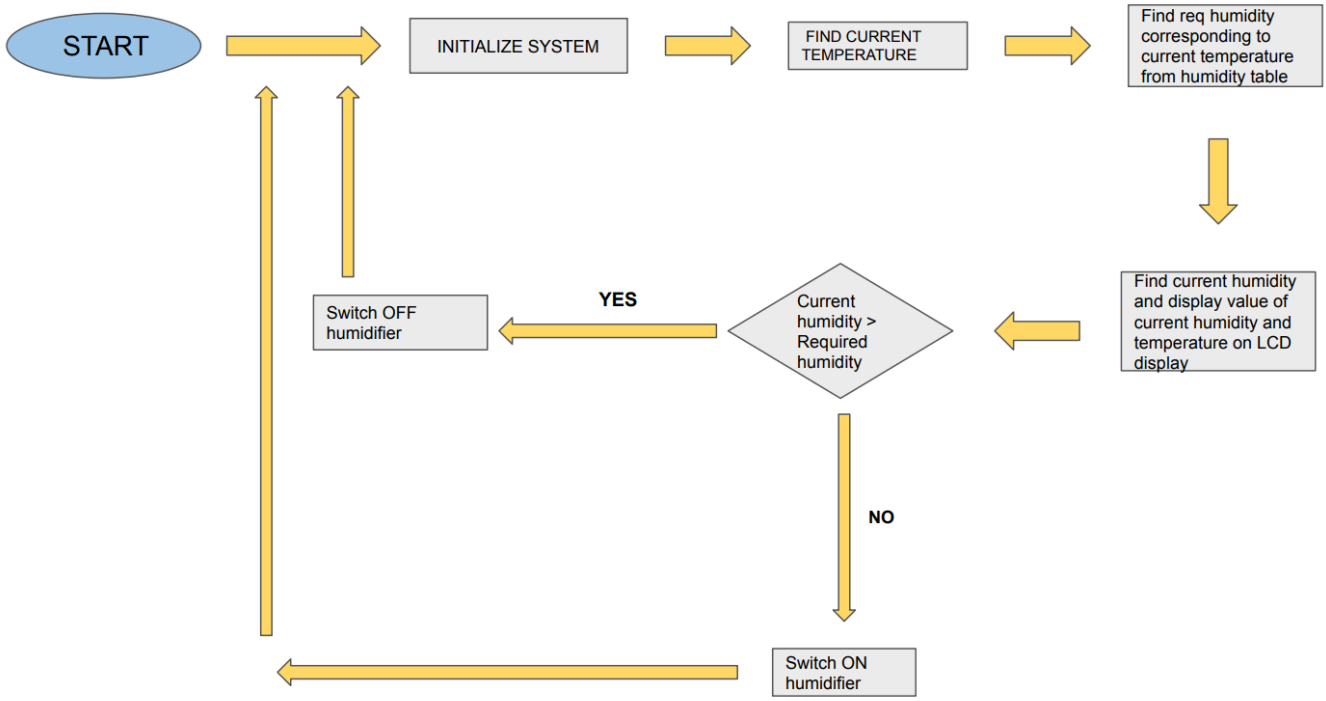
I/O Mapping

Address of 8255_1 Port-A :	00h
Address of 8255_1 Port-B :	02h
Address of 8255_1 Port-C :	04h
Address of 8255_1 Control Register :	06h
Address of 8255_2 Port-A :	08h
Address of 8255_2 Port-B :	0Ah
Address of 8255_2 Port-C :	0Ch
Address of 8255_2 Control Register :	0Eh
Address of 8253 Counter-0 :	10h
Address of 8253 Counter-1 :	12h
Address of 8253 Counter-2 :	14h
Address of 8253 Counter Register :	16h

PORT ADDRESS MAPS

CHIP	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0
8255_1								
00h	0	0	0	0	0	0	0	0
06h	0	0	0	0	0	1	1	0
8255_2								
08h	0	0	0	0	1	0	0	0
0Eh	0	0	0	0	1	1	1	0
8253								
10h	0	0	0	1	0	0	0	0
16h	0	0	0	1	0	1	1	0

SOFTWARE FLOWCHART



APPENDIX

Complete Design Drawing