PROBLEM STATEMENT:

P2 System to be Designed - Smart AC System Description:

This system opens/closes four AC vents based upon the current temperature in the Room. The temperature is maintained at a range of 16–35 ºC. The AC vents can be gradually opened / closed. This is done in accordance with the temperature in the room. The room is a fairly large sized room so 4 temperature sensors are placed at different points of the room. Each sensor and AC vent is associated with part of the room. You can assume that the room is broken up into 4 sub-areas each with its own sensor and ac vent.

User Interface: LCD displaying Temperature in 0ºC. Single push button to vary temperature between 16 ºC – 35 ºC.

The duration for which the system is ON can be set by the user in minutes ranging from 30 min. to 6 hours with a granularity of 30 min. Once the defined time has elapsed, the vents are closed.

ASSUMPTIONS

1) ALP is already stored in the ROM in executable form.

2) The temperatures of all parts of the room are independent of each other, as the room is assumed to be big.

3) After system startup, the temperature of each part of the room varies between 16 - 35°C only.

4) When all AC vents are completely open room temperature will be 16°C and when all are completely closed, the room temperature will be 35°C.

5) When the AC is switched off, all the vents are completely closed.

6) Rotation of motor by 90 degree opens/closes the AC vent.

7) The first address of the processor ends out when it is switched on is 01000h. At this location, there is a jump instruction which takes the program control to the beginning of the code.

8) There exists a mechanism which controls the flaps in such a way that it rotates motor just 90 degrees at once, then to 180 for closing, again to 270 for opening & then to 360 for closing the flap and so on.

9) Either of the push button needs to be held for at least one second to get the desired change.

SYSTEM DESCRIPTION

1) Intel 8086 microprocessor.

2) INPUT DEVICE:

(i) 4 temperature sensors.

(ii) 2 push buttons

3) OUTPUT DEVICES:

(i) LCD to display temperature.

(ii) 4 motors to open/close AC vents following assumption 8.

4) Two 8255 (Programmable Peripheral Interface) chips interfaced to 8086.

(i) **8255-A(PORTS_LCD):** Port-A is interfaced to the 8 data lines of LCD driver HD244780. PB0 and PB7 are connected to the RS and R/W of LCD driver, respectively. PC0 is used to vary the mode temperature/timer; PC1 is used for setting the temperature.

(ii) **8255-A(ADC_PORT):** Port-A takes input from ADC0808 which is interfaced with the 4 temperature sensors LM35. Port-C is used to select the input channel on ADC.

5) 8284 clock is used to generate 2.5 MHz clock signal for 8086.

6) 8253 is used to generate stepped down time signals for the given problem statement making use of the 2.5MHz clock signal from 8284.

7) The motors are operated by Darlington pair and controlled in a mechanism as in assumption 8.

HARDWARE DEVICES

CHIP NUMBER(No. of chips)	CHIP	USE
8086	Microprocessor	Central Processing Unit(C.P.U)
6116(2)	RAM-2K	Random Access Memory containing DS and SS segments.
2732(2)	ROM-4K	Read only Memory which contains entire code.
74LS373(3)	8-BIT LATCH	To Latch Address Bus.
74LS245(4)	8-BIT BUFFER	To Buffer Data Bus (BIDIRECTIONAL)
8255(2)	PROGRAMMABLE PERIPHERAL INTERFACE	Connected to Various Input/ Output Devices.
ADC0808(1)	ANALOG TO DIGITAL CONVERTER	CONVERTS ANALOG VOLTAGE SIGNAL V_{ce} TO DIGITAL FORM
8253(1)	CLOCK TIMER	TO KEEP THE TRACK OF TIME FOR WHICH THE PROCESSOR WILL WORK
LM 020	LCD DISPLAY	FOR OPENING/CLOSING AC VENTS TO DISPLAY TEMPERATURE/ TIMER
LM 35(4)	TEMPERATURE SENSOR	TO PRODUCE ANALOG SIGNAL FOR THE TEMPERATURE IN ROOM

74154	4:16 DECODER	TO PRODUCE THE CHIP SELECT SIGNALS FOR IO DEVICES
74138	3:8 DECODER	TO PRODUCE CHIP SELECT SIGNALS FOR ROM AND RAM
DC MOTOR(4)	12V MOTOR	CONNECTED TO DARLINGTON PAIR ARRAY
ULN2003A	DARLINTON PAIR ARRAY	TO SIMULATE THE OPENING AND CLOSING OF VENTS IN PROTEUS BY CONNECTING IT TO THE MOTOR

MEMORY INTERFACING

This system uses 4KB of RAM (as 2x2KB chips for even and odd banks respectively) and 4KB of ROM (as 2x4KB chips for even and odd banks respectively). The memory is divided into even and odd banks because 8086 has a 16 bit data bus while memory is byte organized.

Random Access Memory (RAM) –6116

RAM 01E (Even Bank) Start: 00000h End: 00FFEh	RAM01: Starting Address:00000h Ending Address:00FFFh
RAM 01O (Odd Bank) Start: 00001h End: 00FFFh	

	A1	A18	A17	A16	A15	A14	A13	A12	A11	A_{10}	A_9	A_8	A_7	A_6	A_5	A_4	A_3	A_2	A_1	A_0
SA	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
EA	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1

Read Only Memory (ROM) –2732

ROM 01E (Even Bank) Start: 01000h End: 03FFEh	ROM01: Starting Address:01000h Ending Address:03FFFh
ROM 01O (Odd Bank) Start: 01001h End: 03FFFh	

	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
SA	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
EA	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1

I/O MAPPING

8255- 1:

SR.No.	Port Name	Starting Address
1	Port A	10H
2	Port B	12H
3	Port C	14H
4	CR(Control Register)	16H

8255-2 :

SR.No.	Port Name	Starting Address
1	Port A	20H
2	Port B	22H
3	Port C	24H
4	CR(Control Register)	26H

TIMER:

SR.No.	Port Name	Starting Address
1	COUNTER 1	30H
2	COUNTER 2	32H
3	COUNTER 3	34H
4	CR(Control Register)	36H

WORKING

1) All vents are completely opened upon starting, and the room temperature is 25°C. The duration for which the system is ON has a granularity of 30 minutes.

2) There are 2 push buttons. One to set the timer, and one to set the temperature.

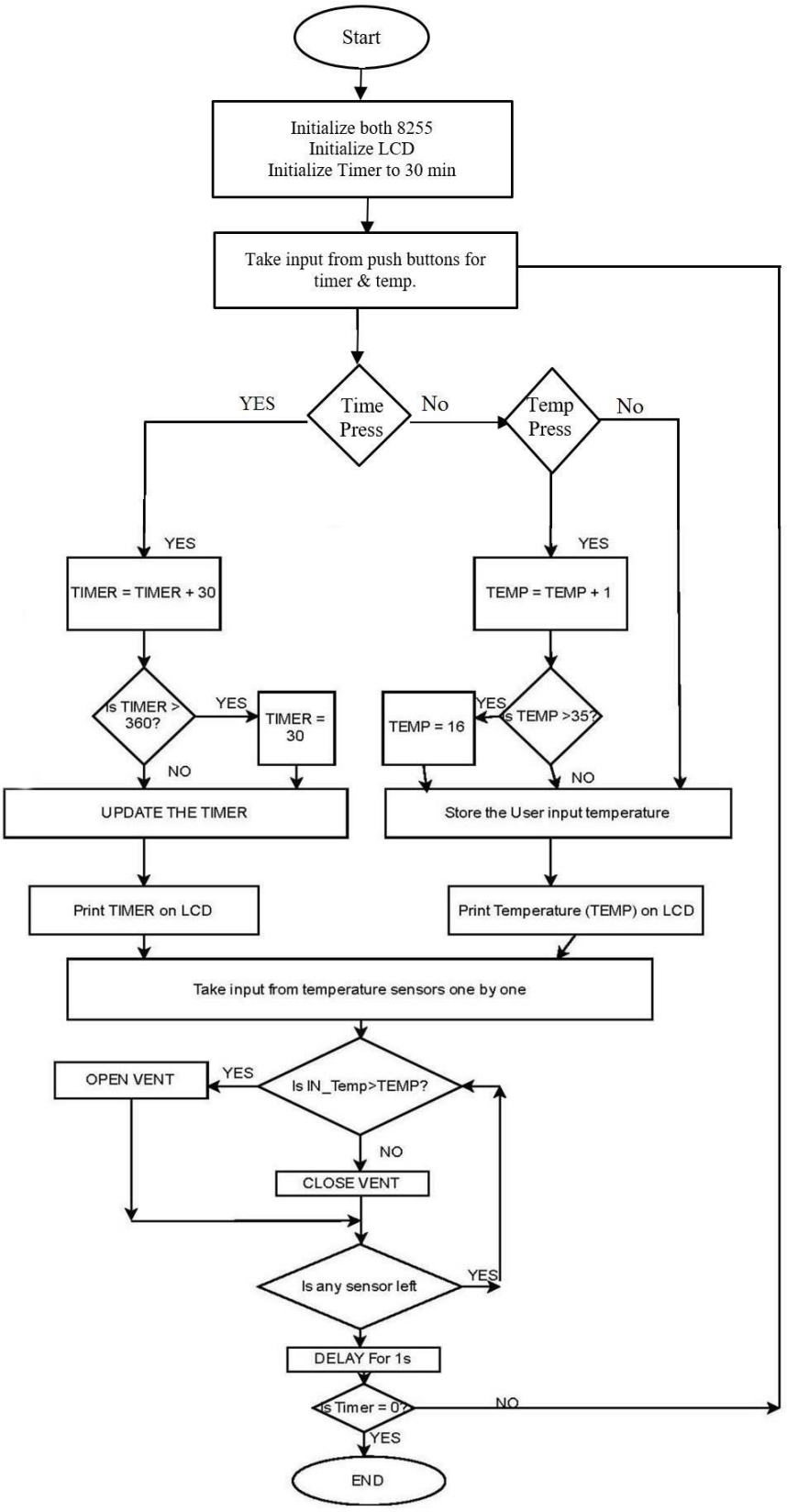
3) By setting the timer, the user can set the duration for which the AC system is ON, ranging from 30 minutes to 6 hours, one push increasing the timer by 30 minutes. If the time to be set goes beyond 360 min., it is reset to 30 minutes.

4) The temperature to be maintained is set ranging from 16°C to 35°C by pressing the second push button, one push increasing the temperature by 1°C. If temperature exceeds 35°C, it is reset to 16°C.

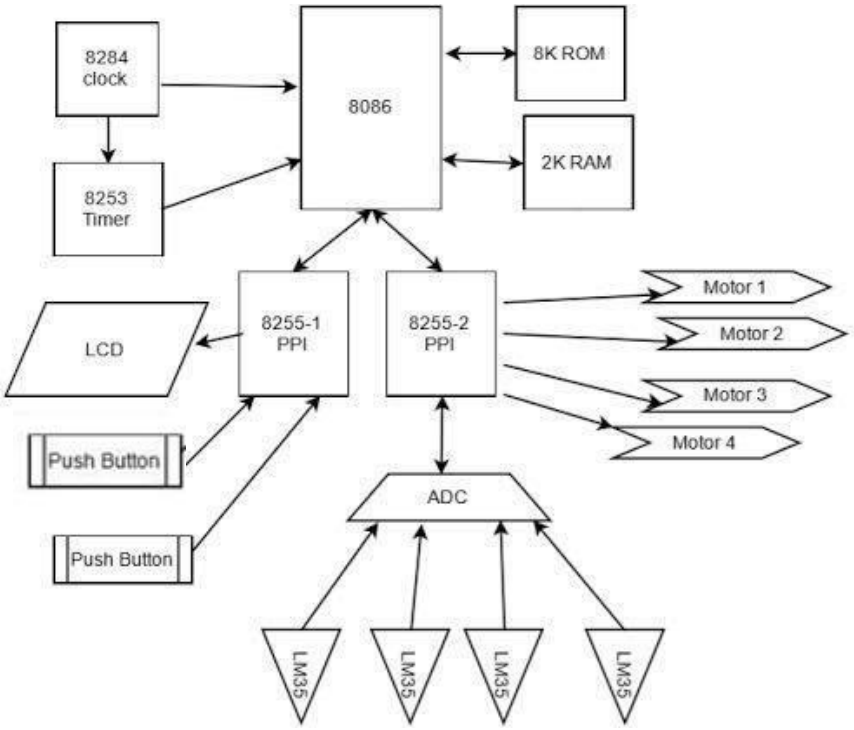
4) The temperature as sensed by the sensor is updated after certain interval (approximately 1sec.) This temperature is compared with the temperature required to be set. If there is a difference, the AC valve is opened or closed depending on whether it is higher or lower than the input temperature. (In Proteus, a motor is used to simulate that behavior.)

5) Depending on the push button pressed, the LCD displays the temperature set or the Time duration set.

FLOWCHART:


Start
Initialize both 8255
Initialize LCD
Initialize Timer to 30 min
Take input from push buttons for timer & temp.
Time Press
YES
No
Temp Press
No
YES
TIMER = TIMER + 30
YES
TEMP = TEMP + 1
Is TIMER > 360?
YES
TIMER = 30
NO
TEMP = 16
YES
Is TEMP >35?
NO
UPDATE THE TIMER
Store the User input temperature
Print TIMER on LCD
Print Temperature (TEMP) on LCD
Take input from temperature sensors one by one
OPEN VENT
YES
Is IN_Temp>TEMP?
NO
CLOSE VENT
Is any sensor left
YES
DELAY For 1s
Is Timer = 0?
NO
YES
END

CIRCUIT DIAGRAM:



REFERENCES:

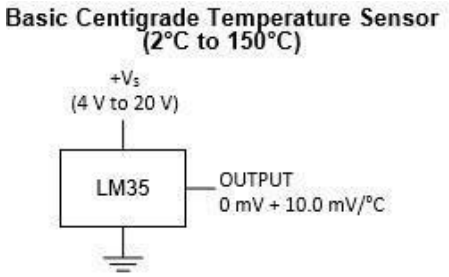
LM35 (Temperature sensor)

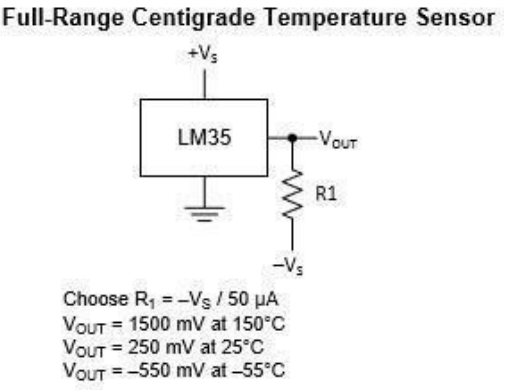
Range: -55 ^{o}C to 150 ^{o}C

Vin: 4V to 20V

For 0^{o}C: OUTPUT = 0mV

Increment 10mV/^{o}C



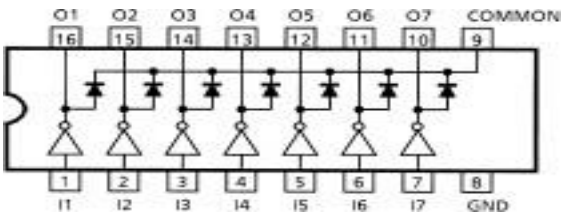


ULN2003A (Darlington pairarray)

Vin = 30V
Vout = 50V

Source: Texas Instruments Datasheet
http://www.ti.com/lit/ds/slrs027o/slrs027o.pdf accessed on 23th April 2019.

Internal Schematic



Pin-out