Birla Institute of Technology and Science

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A REPORT ON

Smart Lighting System



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GROUP NO: 106 PROBLEM NO: 14

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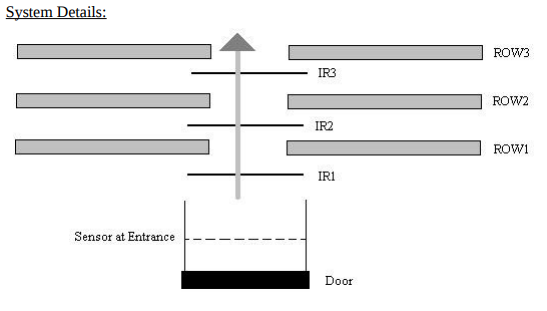
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PROBLEM STATEMENT

Problem statement 14:

System to be Designed: Smart Lighting System

Description: This is a lighting system for a conference room. On detection of a person the door is automatically opened/closed. As the seats get filled the light should be turned on. The rows are filled from row1 onwards. There are 3 lights per row. As each row begins to get filled the lights get turned on as each rows empties completely the light gets turned off. You can assume there are atleast 6 rows. The system should also display the number of people in the room on a LCD display.



ASSUMPTIONS

1. There is only entry door to the conference room.
2. The same door is used for exit as well.
3. Only one person can enter at a time.
4. Only one person can exit at a time.
5. There is a gap of ~5 seconds between any two people’s movements across the door.
6. There are 2 sensors on either side of the door.
7. Each row has 3 lights .
8. If the row has even a single person all the lights should still turn on.
9. People get seated from row 1 onwards and exit from only last occupied row. i.e. a person cannot exit from nth row if (n+1)th row has a person.
10. If there are people present in the nth row that means all n rows are lighted up.
11. Maximum capacity of the conference room is 30; 6 rows with each row capable of seating 5 people.

BRIEF USER GUIDE

This system design is meant to be extremely simple in terms of user interaction. There are only 2 inputs to the system. On each side of the sliding door to the conference room, there is a pressure plate the user will step over (modelled as push buttons in the model circuit). After stepping on the exterior pressure plate the sliding door will open within a 1-2 second interval. After the sliding door opens, the user will be allowed to step in and over the interior pressure plate (within about 2-3 seconds) which will confirm that the user entered. After a 5 second delay the door will then close, following which another user may enter or leave. Exiting follows a similar procedure but with the user stepping on the interior pressure plate first, then the exterior pressure plate.

LIST OF HARDWARE COMPONETS USED

|  |  |  |
| --- | --- | --- |
| CHIP / DEVICE | QUANTITY | USE |
| 8086 Microprocessor | 1 | Central processing unit. |
| 6116 – Ram 2K | 2 | Random access memory which contains [DS,SS] |
| 2732 – ROM 4K | 2 | Read only memory which contains entire code [CS] |
| 74LS373 OCTAL LATCH | 1 | For latching the address provided by the 8086. |
| 74LS138 | 1 | 3-to-8 Decoder/Demultiplexer. |
| 8255 PPI | 2 | PPI for connecting to peripheral components. |
| LED | 18 | Used for lighting up rows. |
| L293D | 1 | The driver for the bipolar stepper motor. [<http://www.ti.com/lit/ds/symlink/l293.pdf>] |
| 7 SEG-COM-CATHODE | 2 | Used for displaying number of people in the room. |
| BIPOLAR STEPPER MOTOR | 1 | Used for controlling opening and closing of door. |
| 4511 BCD to 7SEG DECODER | 2 | Decoders for the 7 segment displays. |
| NAND | 1 | Logic. |
| OR | 9 | Logic. |
| NOT | 5 | Logic. |
| AND | 1 | Logic. |
| 100 ohm RESISTANCE | 2 | Logic. |
| PUSH BUTTONS | 2 | These are the two sensors on either side of the door |

ADDRESS MAPPING OF DEVICES

MEMORY MAPPING:

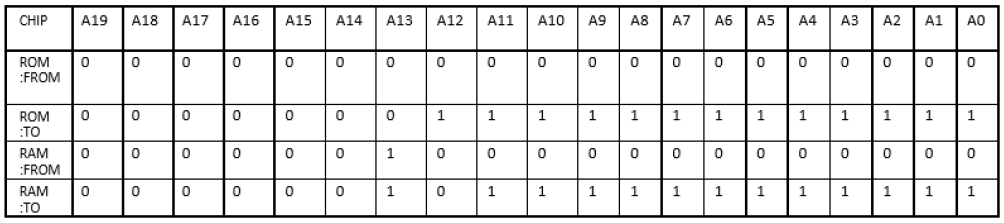
The system uses 4KB of RAM and 8KB of ROM. RAM consists of two 2K chips and ROM

consists of 4K chips. They are organized into odd and even bank to facilitate both byte and word

size data transfers.

Read Only Memory: Starting Address: 00000h, Ending Address: 01FFFh

Random Access Memory: Starting Address: 02000h, Ending Address: 02FFFh



I/O MAPPING:

PPI1 – Pressure Plates (Push Buttons), Bipolar Stepper Motor Control, 7SEG Display

PORTA - 0000h

PORTB - 0002h

PORTC - 0004h

CONTROL REGISTER - 0006h

PPI2 – Lighting Array

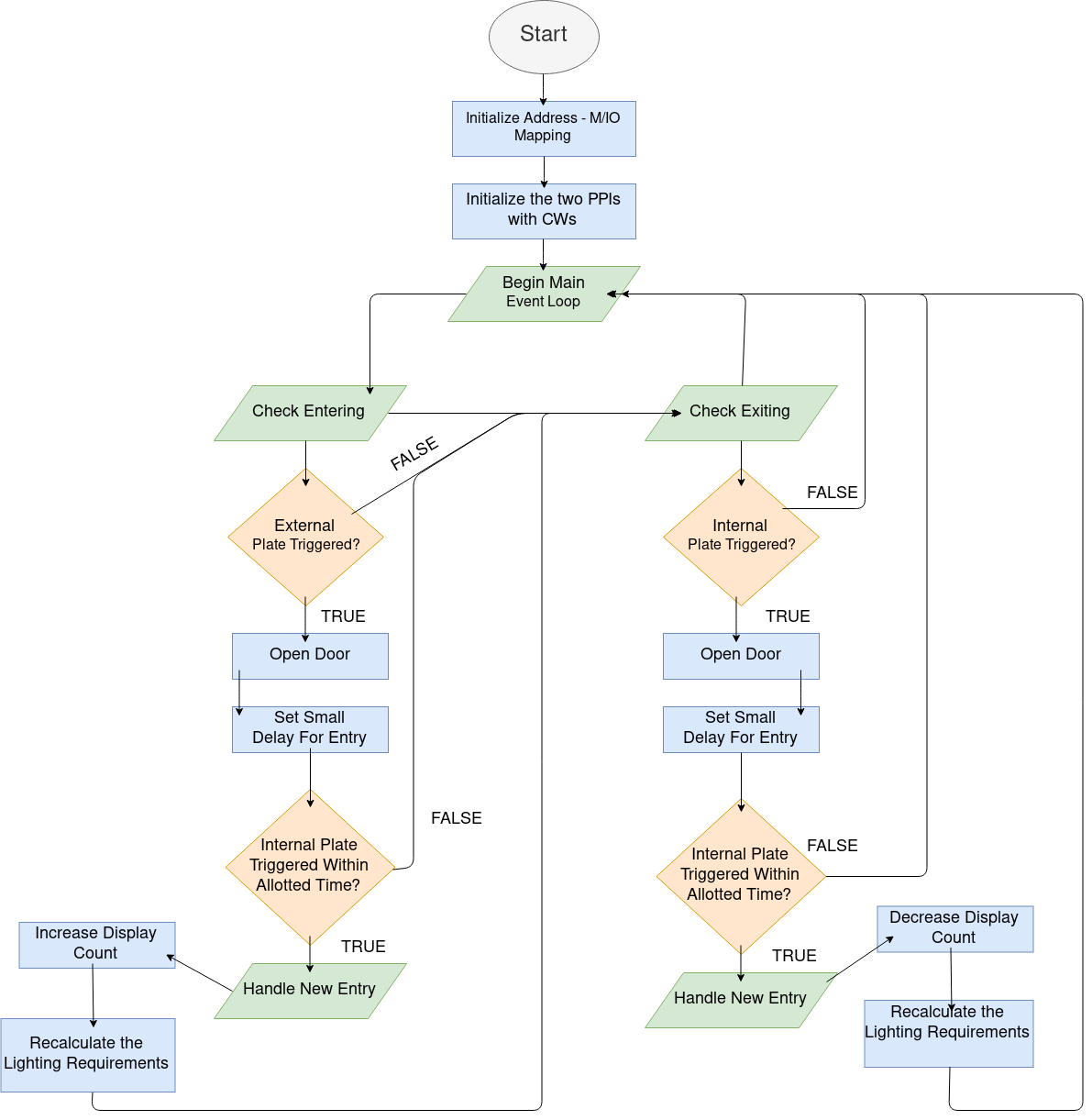
PORTA - 0001h

PORTB - 0003h

PORTC - 0005h

CONTROL REGISTER - 0007h

FLOWCHART



CODE

.MODEL TINY

.DATA

PORTA1 equ 0000h

PORTB1 equ 0002h

PORTC1 equ 0004h

CWREG1 equ 0006h

PORTA2 equ 0001h

PORTB2 equ 0003h

PORTC2 equ 0005h

CWREG2 equ 0007h

.CODE

.STARTUP

init:

ORG 0000h

; This register will serve as internal memory and store the number of people in the room.

MOV dl, 00h

; Set up the first PPI to read from Port A and write to Port B and Port C.

MOV al, 10010000b

OUT CWREG1, al

; Set up the second PPI to write to Port C [each output line is a row of 3 lights].

MOV al, 10010010b

OUT CWREG2, al

; "main" serves as our event loop and the functions check\_entry and check\_exit will handle the rest.

main:

CALL check\_entry

CALL check\_exit

JMP main

delay PROC NEAR

; A small timed delay. The caller should set CX before calling.

delay1:

NOP

DEC cx

JNE delay1

RET

delay ENDP

update\_display PROC NEAR

; Update the 2 7SEGs to display the number of people in the room.

MOV bl, 10d

MOV ax, dx

DIV bl ; al: quotient, ah: remainder

MOV bl, ah

SHL ax, 4

ADD al, bl

OUT PORTC1, al

RET

update\_display ENDP

incr\_cnt PROC NEAR

; Increase the count value and update the display.

INC dl;

CALL update\_display;

CALL light\_rows

RET

incr\_cnt ENDP

decr\_cnt PROC NEAR

; Decrease the count value and update the display.

DEC dl;

CALL update\_display;

CALL light\_rows

RET

decr\_cnt ENDP

open\_door PROC NEAR

; Open the door by turning the stepper motor to 180deg.

MOV al, 00000001b

OUT PORTB1, al

RET

open\_door ENDP

close\_door PROC NEAR

; Close the door by turning the stepper motor to 0deg.

MOV al, 00000010b

OUT PORTB1, al

RET

close\_door ENDP

check\_entry PROC NEAR

; Check to see if the external pressure sensor has been triggered.

IN al, PORTA1

CMP al, 00000001b

JNE check\_entry4

; Open the door once the external pressure sensor has been triggered.

CALL open\_door

MOV cx, 0FFFFh

CALL delay

; Check to see if the internal pressure sensor has been triggered. Provide a small window of time for entry.

MOV cx, 0FFFFh

check\_entry1:

IN al, PORTA1

CMP al, 00000010b

JE check\_entry2

DEC cx

JNZ check\_entry1

JMP check\_entry3

check\_entry2:

; If the person entered then the count should be incremented.

CALL incr\_cnt

check\_entry3:

; Close the door.

CALL close\_door

check\_entry4:

RET

check\_entry ENDP

check\_exit PROC NEAR

; Check to see if the external pressure sensor has been triggered.

IN al, PORTA1

CMP al, 00000010b

JNE check\_exit4

; Open the door once the external pressure sensor has been triggered.

CALL open\_door

MOV cx, 0FFFFh

CALL delay

; Check to see if the internal pressure sensor has been triggered. Provide a small window of time for entry.

MOV cx, 0FFFFh

check\_exit1:

IN al, PORTA1

CMP al, 00000001b

JE check\_exit2

DEC cx

JNZ check\_exit1

JMP check\_exit3

check\_exit2:

; If the person exited then the count should be decremented.

CALL decr\_cnt

check\_exit3:

; Close the door.

CALL close\_door

check\_exit4:

RET

check\_exit ENDP

light\_rows PROC NEAR

; Check to see how many people are in the room (using the value in dl),

; then accordingly determine the number of rows that need to be lit up.

; start filling from ROW1 onwards.

; Our assumption is that the rows seat 5 people each.

; Thus the total capacity of the conference room is 5\*6 = 30 people.

MOV al, 00d

CMP dl, 25d

JLE light\_rows1

INC al

light\_rows1:

SHL al, 1 ; Moving this up by one line would slightly improve speed (heuristic).

CMP dl, 20d

JLE light\_rows2

INC al

light\_rows2:

SHL al, 1

CMP dl, 15d

JLE light\_rows3

INC al

light\_rows3:

SHL al, 1

CMP dl, 10d

JLE light\_rows4

INC al

light\_rows4:

SHL al, 1

CMP dl, 05d

JLE light\_rows5

INC al

light\_rows5:

SHL al, 1

CMP dl, 00d

JE light\_rows6

INC al

light\_rows6:

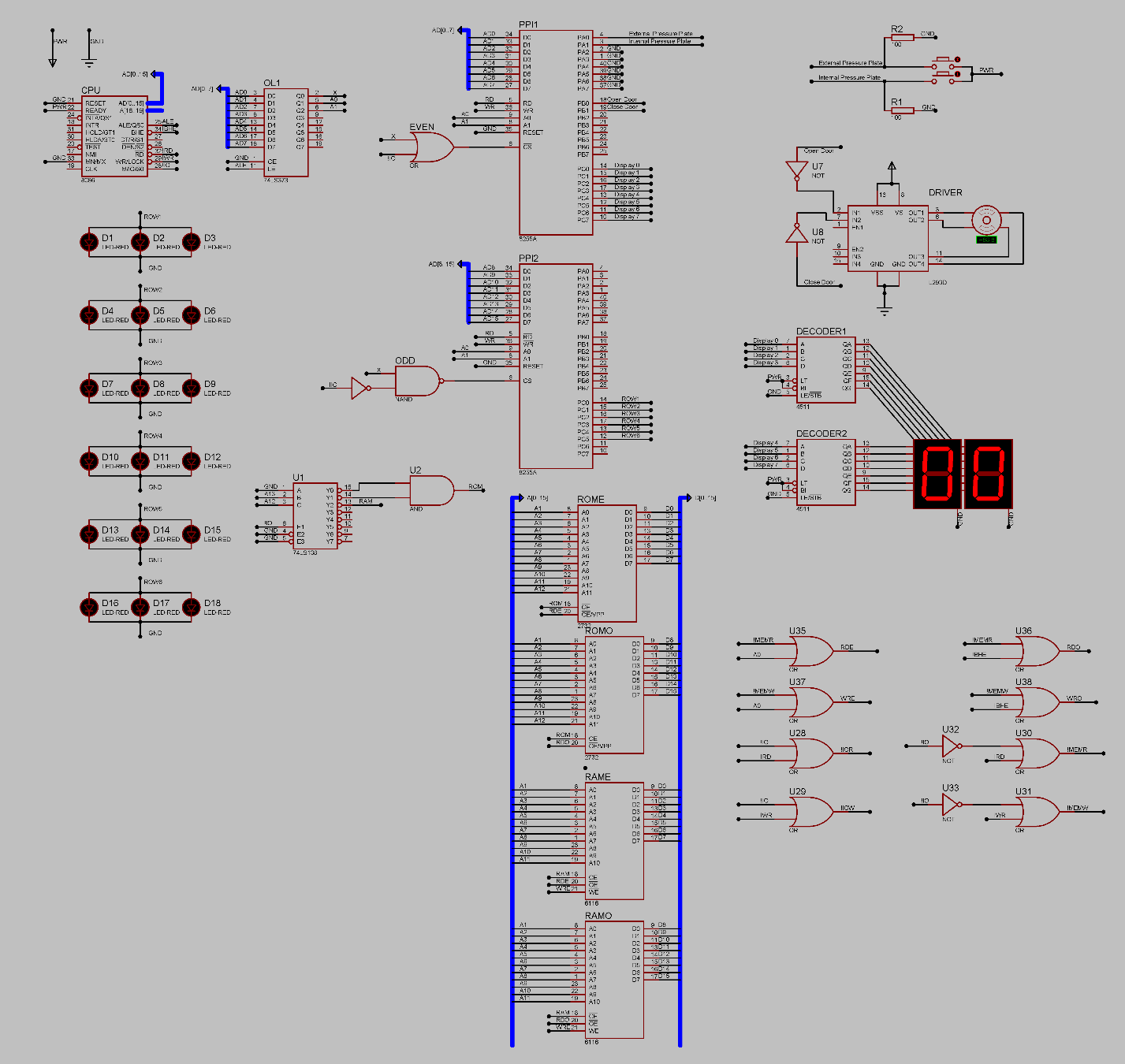
OUT PORTC2, al

RET

light\_rows ENDP

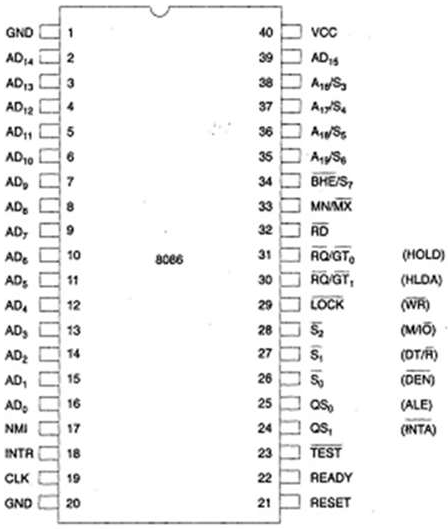
END

CIRCUIT DIAGRAM



EXTRA REFERENCES

8086 PINOUT DIAGRAM:



STEPPER MOTOR:

The data sheet and other information for the driver for the bipolar stepper motor can be found in the following link:

<http://www.ti.com/lit/ds/symlink/l293.pdf>