

Experiment 5 (Interfacing Traffic Light System)

Description of Traffic Light Module:

The traffic light module simulates the control and operation of traffic lights at a junction of four roads. The interface provides a set of 6 LED indicators at each of the four corners. Each of these LEDs can be controlled by a port line. The interface allows the user to simulate a variety of traffic situations using appropriate software routines.

The organization of LEDs is identical at each of the four corners. The organization described below is with reference to the LEDs at the **SOUTH – WEST** corner only.

RED	=	SOUTH – RED
A	=	SOUTH – YELLOW
L	=	SOUTH – LEFT
S	=	SOUTH – STRAIGHT
R	=	SOUTH – RIGHT
DL	=	SOUTH – PEDESTRIAN

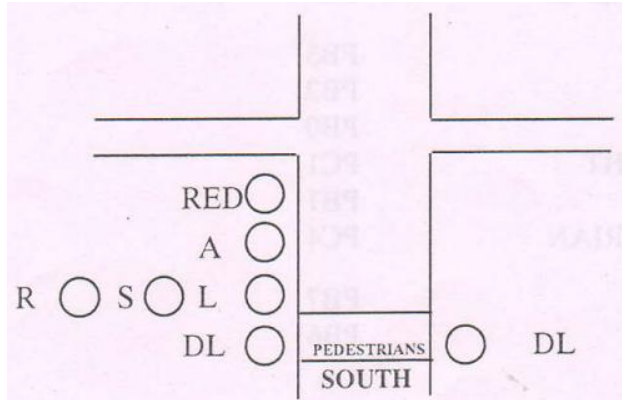


Figure 1: LEDs at SOUTH-WEST corner

The first five LEDs (RED, A, L, S, R) will be ON or OFF depending on the state of the corresponding port line (LED is ON if the port line is logic HIGH and LED is OFF if the port line is logic LOW). The last LED (DL) will be either RED or GREEN depending on the state of the corresponding port line.

The traffic light interface module has a **26-pin connector** at one edge of the card. This is used for connecting the interface to the microprocessor trainer kit with a flat cable connector. Use **connector J2** on the microprocessor trainer kit to connect the traffic light module.

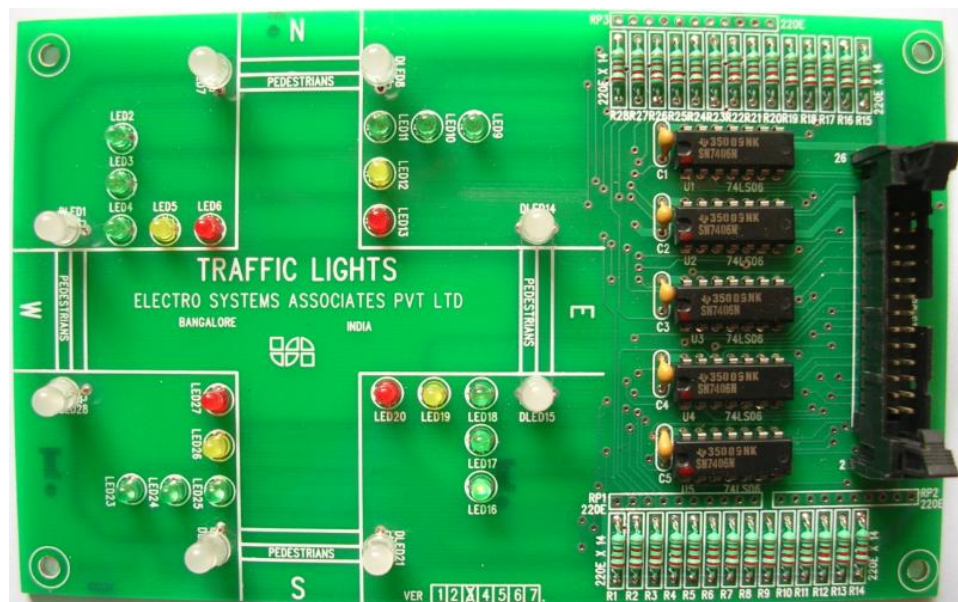


Figure 2: Traffic Light Module

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There are four sets of LEDs and these are controlled by 24 port lines. The 24 LEDs and their corresponding port lines are summarized below:

SOUTH	LED	Port Line
	RED	PA3
	YELLOW	PA2
	LEFT	PA0
	STRAIGHT	PC3
	RIGHT	PA1
	PEDESTRIAN	PC6

EAST	LED	Port Line
	RED	PA7
	YELLOW	PA6
	LEFT	PA4
	STRAIGHT	PC2
	RIGHT	PA5
	PEDESTRIAN	PC7

NORTH	LED	Port Line
	RED	PB3
	YELLOW	PB2
	LEFT	PB0
	STRAIGHT	PC1
	RIGHT	PB1
	PEDESTRIAN	PC4

WEST	LED	Port Line
	RED	PB7
	YELLOW	PB6
	LEFT	PB4
	STRAIGHT	PC0
	RIGHT	PB5
	PEDESTRIAN	PC5

NOTE: Vehicles coming from one direction are controlled by the LEDs at the opposite corner.

EXAMPLE – 1: Vehicles coming from NORTH are controlled by LEDs at the SOUTH – WEST corner, as shown below:

- (a) Vehicles coming from NORTH can:
 - Go left (i.e. to EAST) if LED at SOUTH – LEFT is ON
 - Go right (i.e. to WEST) if LED at SOUTH – RIGHT is ON
 - Go straight (i.e. to SOUTH) if LED at SOUTH – STRAIGHT is ON
- (b) The movements in step (a) are allowed only if LED at SOUTH – RED is OFF
- (c) The movements in step (a) are NOT allowed if LED at SOUTH – RED is ON
- (d) Pedestrian crossing on SOUTH is:
 - Allowed when SOUTH – PEDESTRIAN = GREEN
 - Disallowed when SOUTH – PEDESTRIAN = RED
- (e) SOUTH – YELLOW can be turned ON to indicate that SOUTH – RED is about to change its status from OFF to ON

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EXAMPLE – 2: Determine the port values for the following traffic situation:

- (a) Vehicles from WEST are allowed to go NORTH or EAST
- (b) Vehicles from EAST are allowed to go WEST
- (c) Pedestrian crossing is allowed on SOUTH
- (d) No other vehicle movement or pedestrian crossings are allowed

	RED	YELLOW	LEFT (L)	STRAIGHT (S)	RIGHT (R)	PEDESTRIAN (DL)
SOUTH	ON	OFF	OFF	OFF	OFF	GREEN
EAST	OFF	OFF	ON	ON	OFF	RED
NORTH	ON	OFF	OFF	OFF	OFF	RED
WEST	OFF	OFF	OFF	ON	OFF	RED

From the correspondence between the port lines and LEDs, it is possible to determine the logic values for each port line:

SOUTH	LED	Port Line	Status
	RED	PA3	1
	YELLOW	PA2	0
	LEFT	PA0	0
	STRAIGHT	PC3	0
	RIGHT	PA1	0
	PEDESTRIAN	PC6	0

EAST	LED	Port Line	Status
	RED	PA7	0
	YELLOW	PA6	0
	LEFT	PA4	1
	STRAIGHT	PC2	1
	RIGHT	PA5	0
	PEDESTRIAN	PC7	1

NORTH	LED	Port Line	Status
	RED	PB3	1
	YELLOW	PB2	0
	LEFT	PB0	0
	STRAIGHT	PC1	0
	RIGHT	PB1	0
	PEDESTRIAN	PC4	1

WEST	LED	Port Line	Status
	RED	PB7	0
	YELLOW	PB6	0
	LEFT	PB4	0
	STRAIGHT	PC0	1
	RIGHT	PB5	0
	PEDESTRIAN	PC5	1

PA	=	PA7	PA6	PA5	PA4	PA3	PA2	PA1	PA0
18H	=	0	0	0	1	1	0	0	0

PB	=	PB7	PB6	PB5	PB4	PB3	PB2	PB1	PB0
08H	=	0	0	0	0	1	0	0	0

PC	=	PC7	PC6	PC5	PC4	PC3	PC2	PC1	PC0
B5H	=	1	0	1	1	0	1	0	1

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Question – 1: Write a program to simulate the following traffic conditions:

STATE – 1: Vehicles from SOUTH can go NORTH, EAST and WEST
STATE – 2: Vehicles from WEST can go NORTH, SOUTH and EAST
STATE – 3: Vehicles from NORTH can go SOUTH, WEST, and EAST
STATE – 4: Vehicles from EAST can go WEST, NORTH, and SOUTH
STATE – 5: Pedestrians can cross on all roads

- The system moves from one state to another state after a fixed time delay of **five seconds**
- After the last state, the system again moves to the first state
- The sequence states given above repeats **indefinitely** until the RESET key is pressed
- The YELLOW LED is set ON and then OFF (after a delay of **two seconds**), at the appropriate direction when the corresponding red LED changes from OFF to ON state

Note: Movements other than those listed in the sequence above are not allowed

- **Initial report** must contain the derivation of the required **control words**, the **port line values** and **programs** (mnemonics with op-codes)

Question – 2: Write a program to simulate the following traffic conditions:

STATE – 1: Vehicles from SOUTH can go NORTH and WEST
Vehicles from WEST can go NORTH
Vehicles from NORTH can go SOUTH
Pedestrians can cross on EAST

STATE – 2: Vehicles from EAST can go WEST and SOUTH
Vehicles from WEST can go EAST
Vehicles from SOUTH can go WEST
Pedestrians can cross on NORTH

STATE – 3: Vehicles from EAST can go SOUTH
Vehicles from NORTH can go SOUTH and EAST
Vehicles from SOUTH can go NORTH
Pedestrians can cross on WEST

STATE – 4: Vehicles from EAST can go WEST
Vehicles from WEST can go EAST and NORTH
Vehicles from NORTH can go EAST
Pedestrians can cross on SOUTH

STATE – 5: No vehicle movement
Pedestrians can cross on all four roads

- The system moves from one state to another state after a fixed time delay of **five seconds**
- The state transition is indicated by turning ON all the YELLOW LEDs, and all pedestrian red LEDs for a fixed duration of **two seconds**
- The sequence of states given above repeats **indefinitely** until the RESET key is pressed

Note: Movements other than those listed in the sequence above are not allowed

- **Initial report** must contain the derivation of the required **control words**, the **port line values** and **programs** (mnemonics with op-codes)