Objective:

The primary objective of this project was to design and develop a six-way switch system, enabling the control of a single light bulb through multiple switching points, thereby facilitating the ability to turn the light on and off from any of the six designated switches.

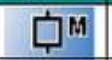
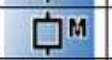
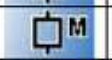
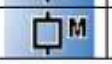
Interface:

The interface consists of: six input switches, four configurable functions, and one output.

Physical inputs

No	Symbol	Function	Lock	Parameters	Location of (L/C)	Comment
I1		Discrete inputs	---	No parameters	(1/1) (2/1)	
I2		Discrete inputs	---	No parameters	(1/2) (2/2)	
I3		Discrete inputs	---	No parameters	(3/2) (4/2)	
I4		Discrete inputs	---	No parameters	(5/2) (6/2)	
I5		Discrete inputs	---	No parameters	(7/2) (8/2)	
I6		Discrete inputs	---	No parameters	(9/2) (10/2)	

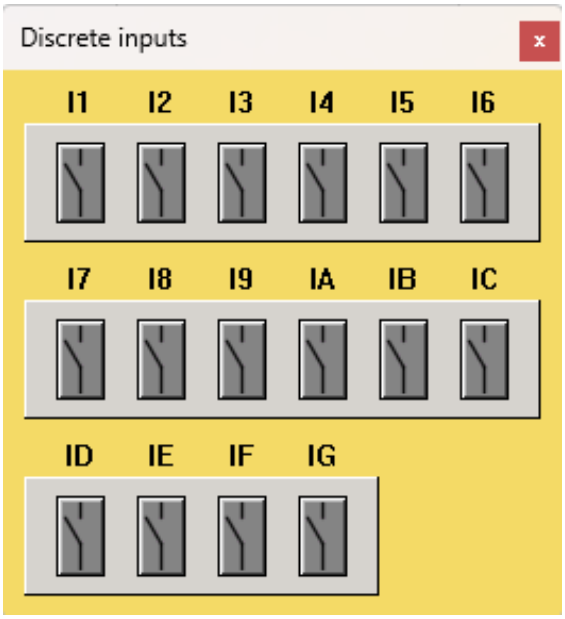
Configurable functions

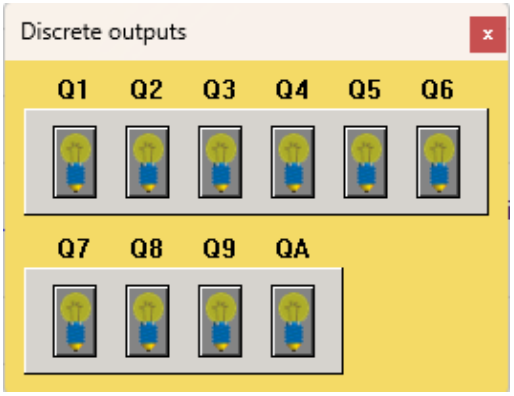
No	Symbol	Function	Lock	Latching	Parameters	Location of (L/C)	Comment
M1		Auxiliary relays	---	No	No parameters	(1/6) (3/1) (4/1)	
M2		Auxiliary relays	---	No	No parameters	(3/6) (5/1) (6/1)	
M3		Auxiliary relays	---	No	No parameters	(5/6) (7/1) (8/1)	
M4		Auxiliary relays	---	No	No parameters	(7/6) (9/1) (10/1)	

Physical outputs

No	Symbol	Function	Latching	Location of (L/C)	Comment
Q1		Discrete outputs	No	(9/6)	

In the simulation, every input is depicted as a switch, and each output is symbolized by a light bulb, as illustrated below.

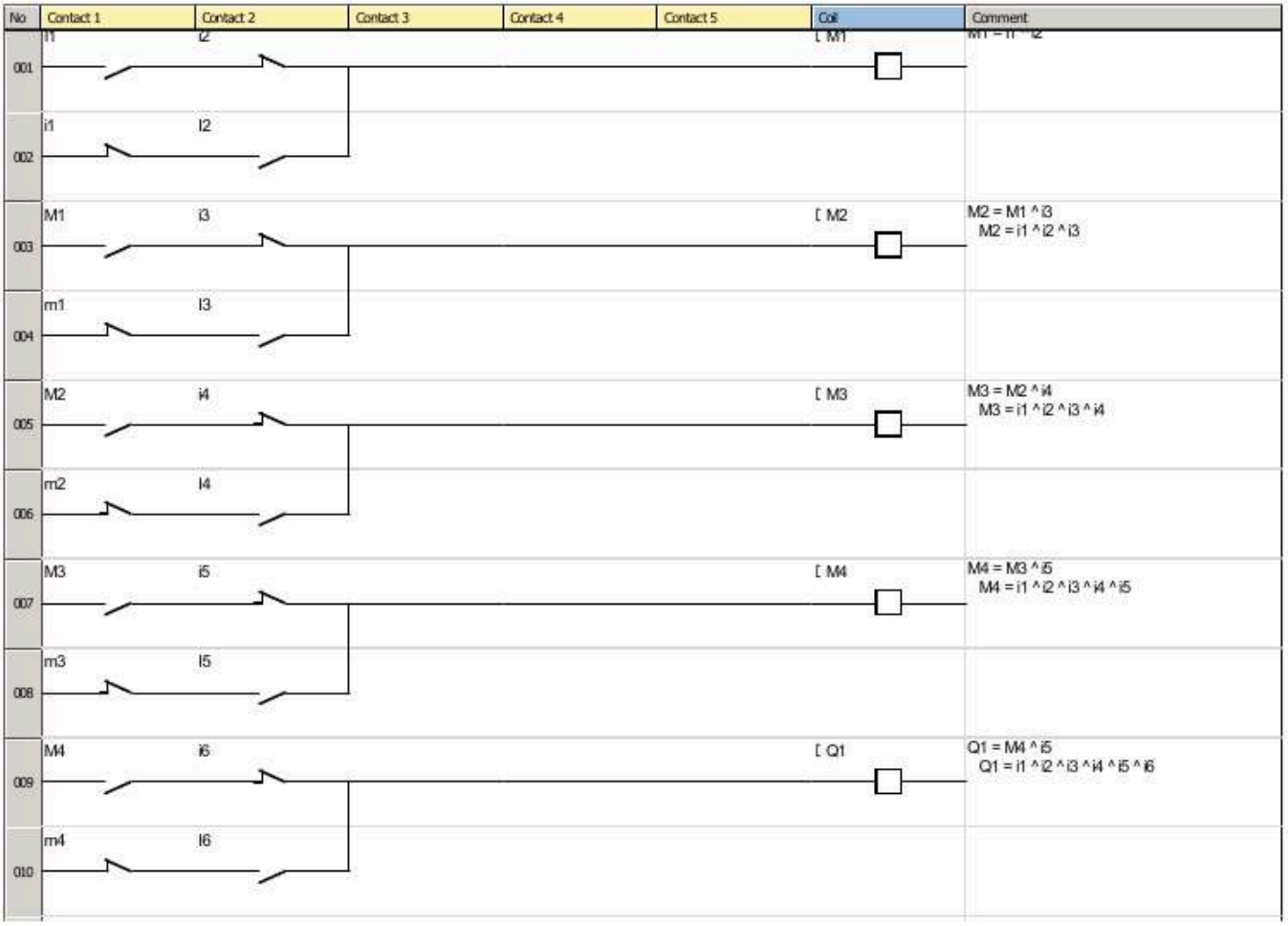




The System:

Below is the system design that fulfills the objective efficiently and adaptably.

Program diagram



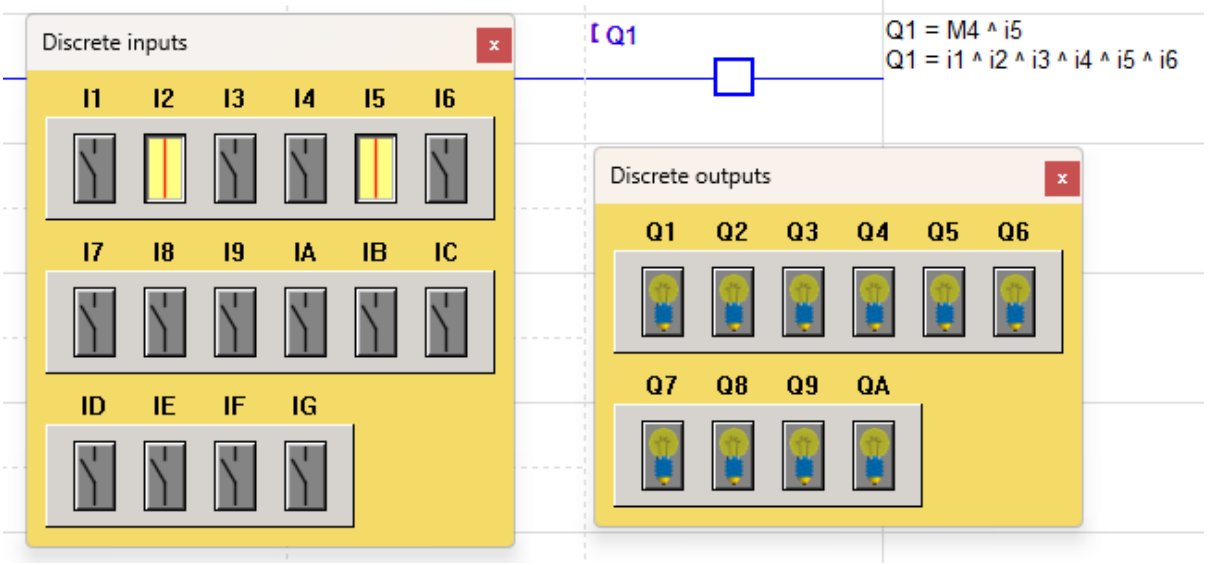
Operational Methodology:

Efficient activation of the output is achieved through the utilization of an XOR gate logic. This implementation ensures that the lamp's status changes when an odd number of switches are engaged. Notably, the lamp's state undergoes inversion when 1, 3, or 5 switches are activated, facilitating a smooth transition between ON and OFF states.

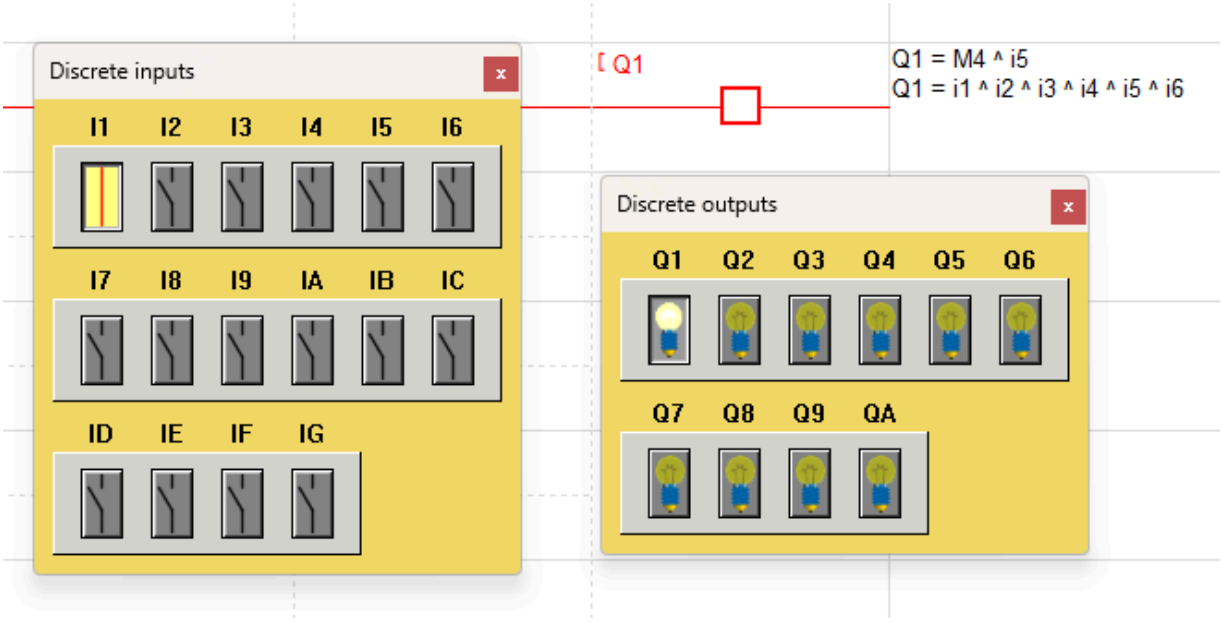
This design affords scalability, as adjusting the number of switches necessitates the addition or removal of two lines and a functional relay, preserving the integrity of the XOR gate's operational logic.

Examples:

When an even number of switches is turned on, the lamp will remain off.



When an odd number of switches is turned on, the lamp will turn on.



Conclusion:

This project presents an optimized solution for controlling a lamp via six switches, utilizing a minimalistic approach that employs only 10 lines of code. This design achieves a balance between cost-effectiveness and efficiency, while maintaining adaptability and scalability. The implementation of the XOR gate logic enables seamless control and manipulation of the lamp, and its modular nature allows for effortless modification to accommodate changes in the number of switches, requiring only the addition or removal of two lines and a relay, respectively, to maintain functionality.