4-Bit Password Security System

Digital Electronics Laboratory - Group 3

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Acknowledgement

We would like to express our heartfelt gratitude to all those who supported and guided us throughout the successful completion of our project, “4-bit Password Based Security System.

First and foremost, we are deeply thankful to our project guide **Dr. Manas Rakshit** for their invaluable guidance.

Their mentorship helped us gain practical knowledge and a strong understanding of digital logic systems.

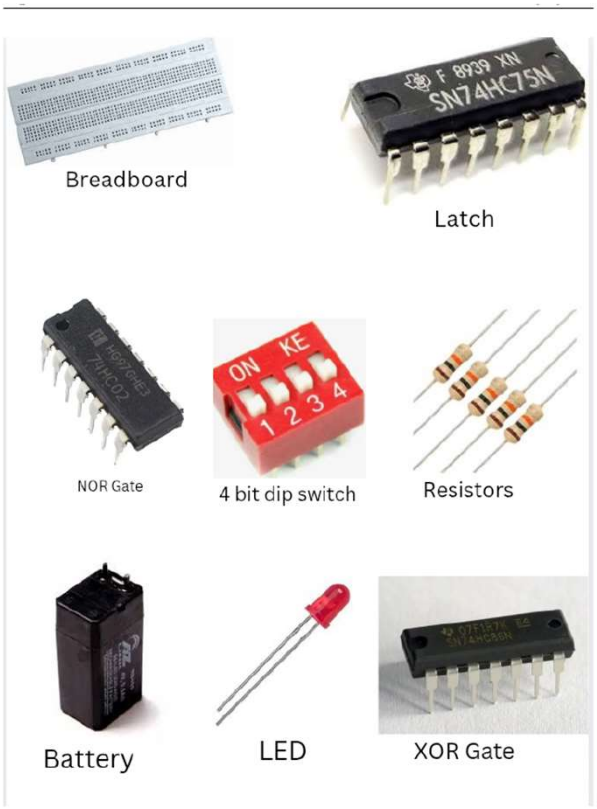
We also extend our sincere thanks to our classmates and peers for their constructive feedback and collaborative spirit, which greatly contributed to the improvement of our project. Working together as a team on this project has been an enriching experience, and we are proud of the knowledge and skills we have gained through this collaborative effort.

4-bit Password Security system (using Latch , XOR & NOR);

This idea is of this system is that 2 Dip switches used one Dip Switch **“Key Code Switch”** to enter/change fixed password (correct password) and other Dip Switch **“Data Entry Switch”** use to enter the password to unlock the lock. The “Key code switch” enter the password to **Latch** where password get stored when enable of Latch is at **HIGH** and when enable is LOW then Latch uses stored password even if “key code switch” value gets change. Here we use XOR Gate which compares both password and gives output. If someone is trying to open the lock enters the code at “Data Entry Switch” which is similar to the stored password of Latch then **Green LED** will light up and the lock will open while, if he enters the wrong password then the **RED LED** will light up which is an indication that some wrong person is unlocking the lock.

Materials Required :

- 7475 Latch
- 7486 XOR Gate
- 7402 NOR Gate
- Two four – position DIP Switches
- Two Light Emitting Diode(Red ,Green)
- Four 1N914 Diode
- Four 1KΩ Resistor
- Four 10KΩ Resistor
- Keylock switch
- 4V Battery
- Breadboard
- Male-male Jumper wires



Jumper wires

Keylock switch

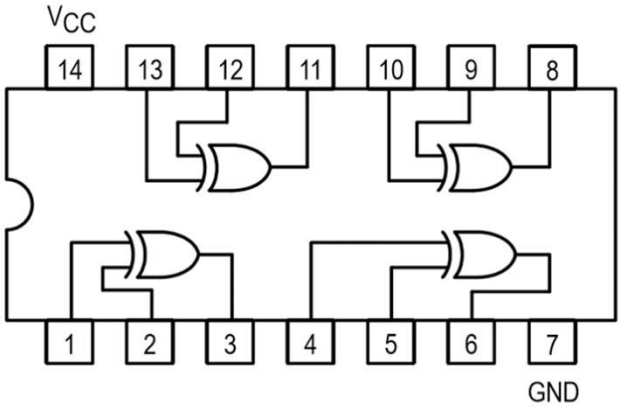
Truth Table & Pin Diagram

1. XOR Gate (Exclusive OR Gate)

Symbol: ⊕

Function: Output is **HIGH (1)** if the inputs are d**ifferent**, else it is **LOW (0)**.

INPUT		OUTPUT
A	B	C
0	0	0
0	1	1
1	0	1
1	1	0

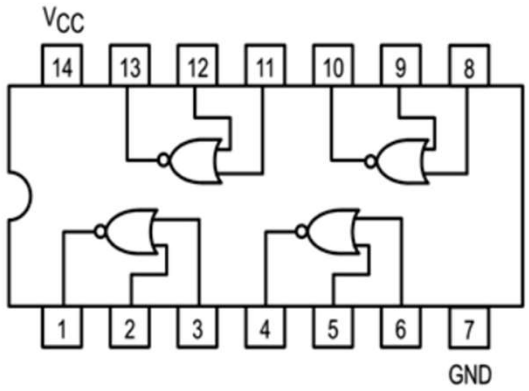


2. NOR Gate (NOT-OR Gate)

Symbol: OR gate with a small circle (inversion bubble) at the output.

Function: Output is **HIGH (1)** only when **all inputs are LOW (0)**.

Input	Input	Output
A	B	Y
0	0	1
0	1	0
1	0	0
1	1	0



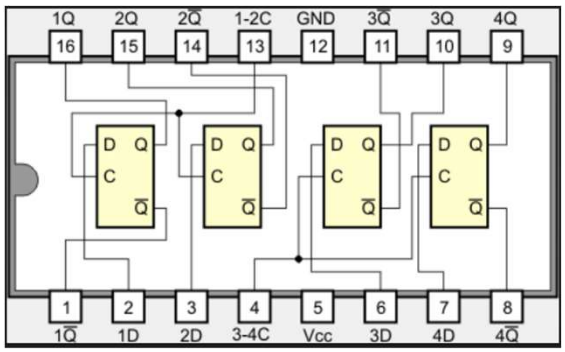
3. D Latch

Type: A latch is a **basic memory element** — it stores 1 bit of data.

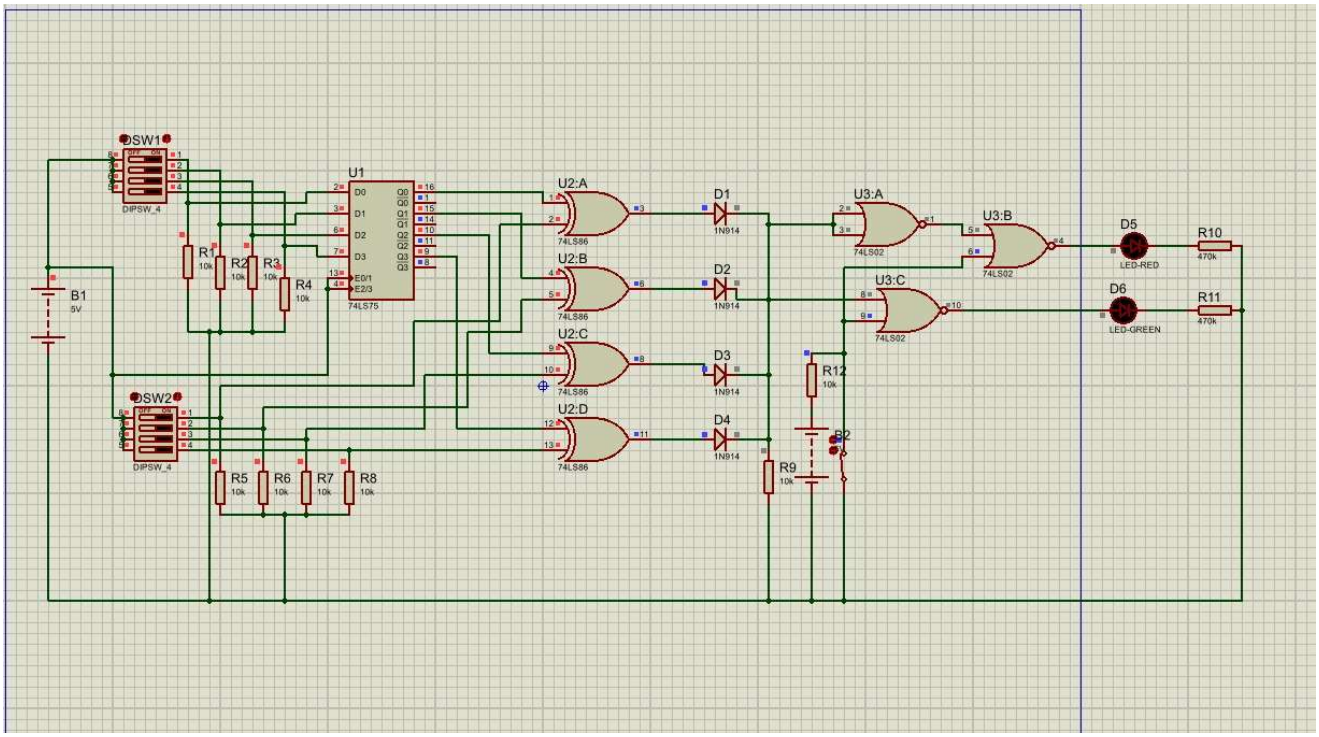
Common Types: SR Latch (Set-Reset), D Latch, JK Latch

Example: SR Latch (using NOR gates)

D	G/EN	Q	Q'
0	0	Q	Q'
1	0	Q	Q'
0	1	0	1
1	1	1	0



Circuit Diagram



Procedure

i. Install the IC's , DIP Switches , resistor neatly on Breadboard .
ii. Wire the pin 7 & 14 of XOR and NOR IC's to Vcc and GND respectively.
iii. Connect pin 4 & 13 of Latch IC to each other and then to Vcc to control enable operation of Latch and pin 5 & 12 to Vcc and GND respectively.
iv. Wire one end of the DIP switchs with Vcc and other end to to Ground through 1KΩ resistor.
v. Now connect the other end of one dip switch to input terminals pin 2,3,6,7 of Latch to store password in Latch.
vi. And connect second DIP switch other terminals to the XOR gate IC to pin 1,4,10,13 .
vii. Connect pin 16,15,10,9 of Latch to other terminal of XOR gate pin 2,5,9,12, respectively.

viii. Now connect XOR gate output at one place through diode and connect it to pin 2,3,5 of NOR gate.
ix. Now connect pin 6,8 of NOR to ground through switch. And output of first NOR gate from terminal 1 to pin 9 of it.
x. Connect output of second and third NOR gate from pin 4 and 10 to the GREEN LED and RED LED respectively and other terminal of LED to ground through resistor.

Working Principle

We are using one DIP switch to give stored/fixed password to Latch. When Latch Enable is HIGH then it gives output as input but when Enable is LOW then it gives output as per stored values irrespective of inputs.

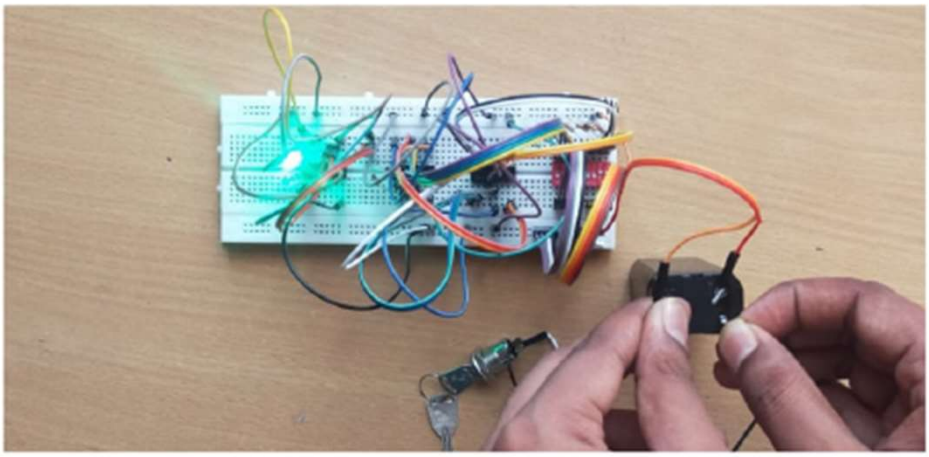
Other DIP switch is used to enter the password which directly give to XOR as input and other input of XOR is from output of Latch. As we know XOR is used for comparator. This application of XOR we use here. If the enter password matches with stored password then XOR give LOW output and if not same then it gives HIGH output as per its Truth Table.

We connect all outputs of XOR gate at one pint through diode. The use of Diode here is to prevent reverse flow of current. As we have 4-bit pass word let 1^{st} , 2^{nd} and 3^{rd} bit matched with stored data but 4^{th} bit not so 4^{th} XOR having output HIGH where as other have LOW so if we don't use diode then each expect 4^{th} XOR others have same voltage at same point which not possible so we use diode so it get reverse biased in this condition and our circuit works correctly.

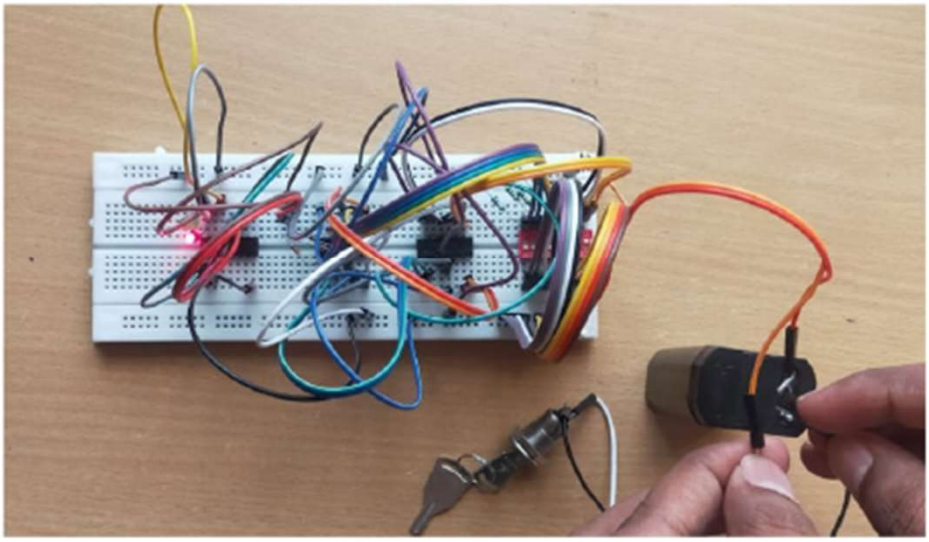
Now using NOR gate we glow our desired output as per correct or incorrect of password.

We use resistor at DIP switch to prevent floating values for latch and XOR gate input.

Image of Implementation Work

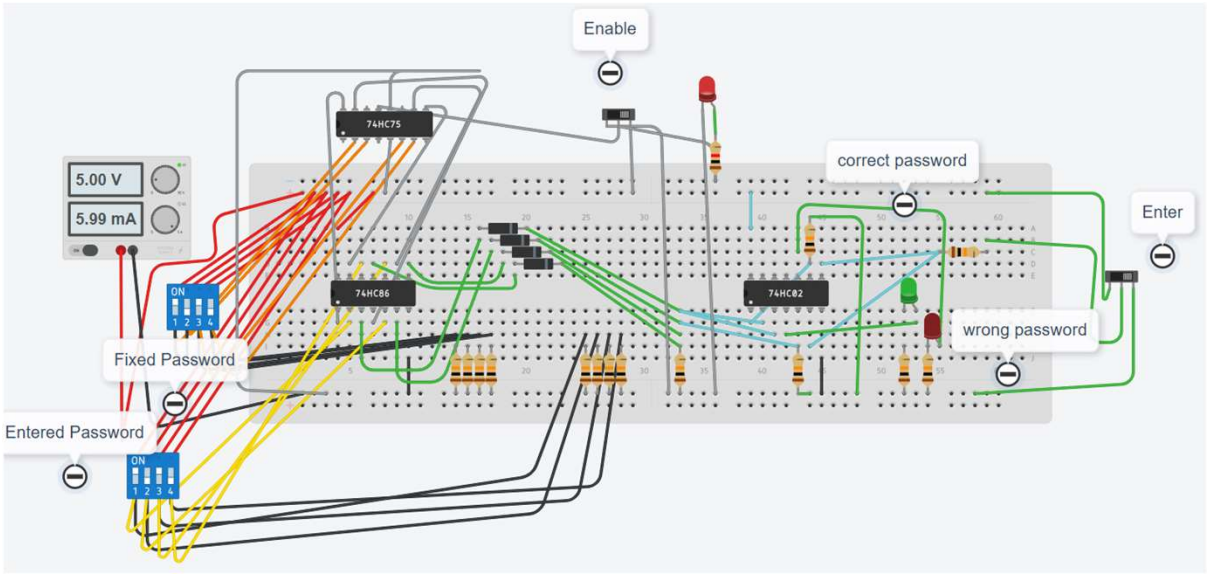


When both passwords are same

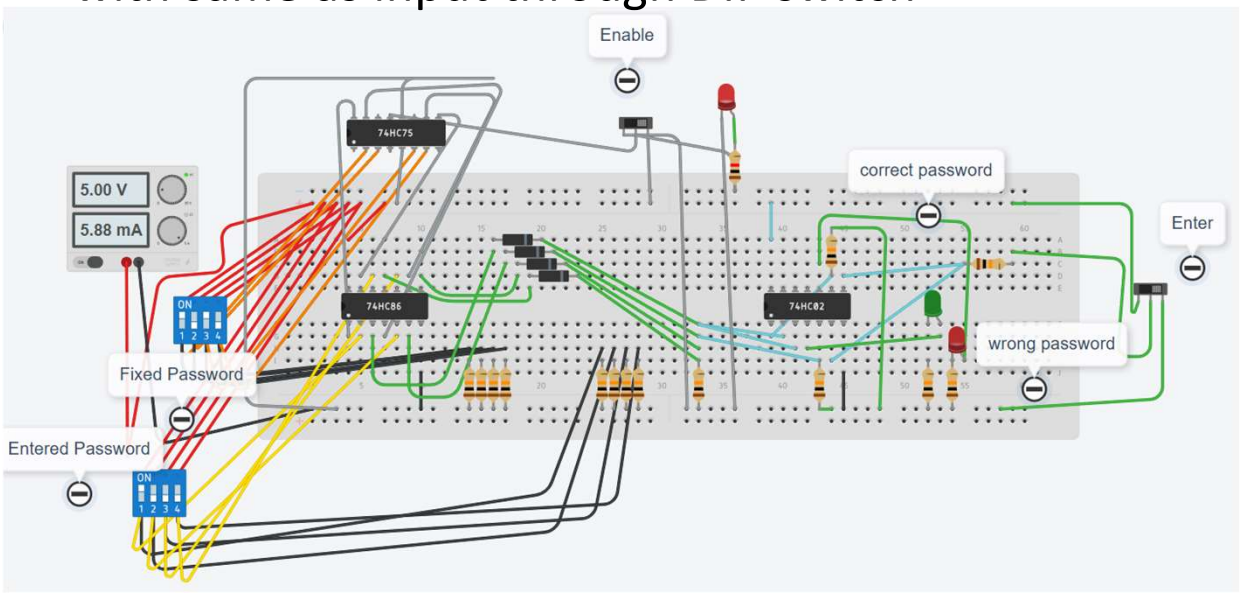


When both passwords are different

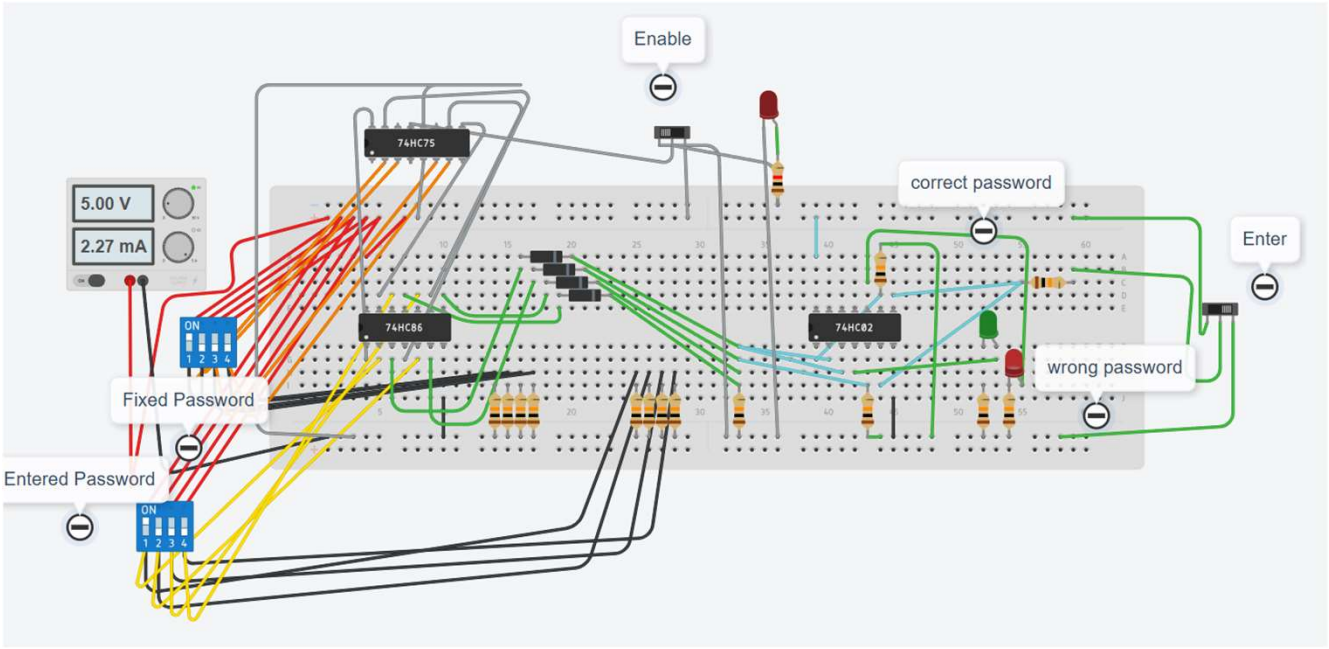
Online Simulation Result(Tinkerkad)



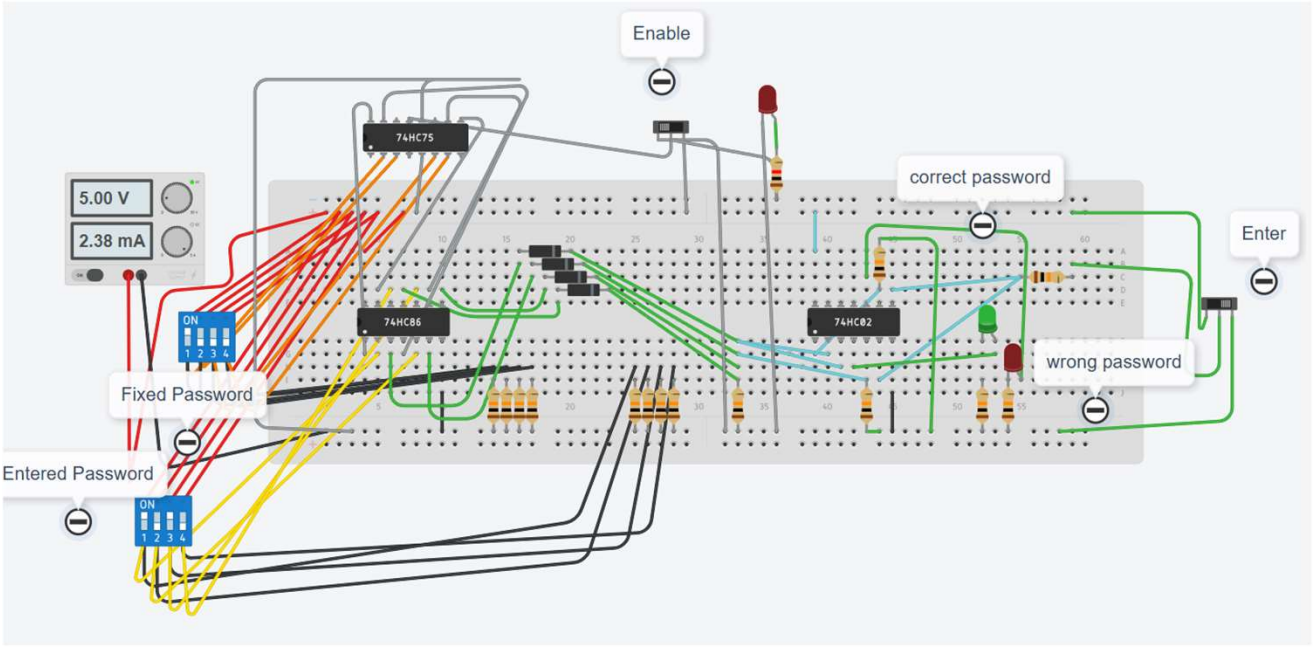
Entered Password Matched with Stored Password (GREEN LED glows) as enable is ON so compared with same as input through DIP switch



Entered Password not Matched with stored password (RED LED Glows) as enable is ON so compared with same as input through DIP switch



Entered password not matches with previous stored password as enable OFF so it compare with store data instead of changing DIP switch value of Fixed password



Entered password matches with previous stored password as enable OFF so it compare with store data instead of changing DIP switch value of Fixed password

Application

1. Locker Security Systems

Used in personal lockers in schools, gyms, or offices where high-level security is not essential.

2. **Home Appliance Access Control**

Can be used to control access to small devices (e.g., kids' control over a home appliance like a microwave or small personal gadgets).

3. **Toolbox Lock**

•Protects toolboxes or small storage units in workshops from unauthorized access.

4. **Entry Access for Shared Resources**

•Access control for shared computers, printers, or other shared resources in non-critical environments.

5. **Garage Door Control (Prototype)**

•Used in prototype models of garage door openers for simple open/close control via password input.

Conclusion

Working on the "4-bit Password Based Security System" as a group has been a valuable and enriching experience for all of us. This project not only allowed us to apply theoretical knowledge of digital electronics but also taught us the importance of teamwork, communication, and problem-solving in practical implementation.

We successfully designed a logic-based system that uses a 7475 latch to store a 4-bit password and compares it with user input via XOR gates. By smartly combining diode logic and NOR gates, we created a reliable verification system that accurately detects whether the entered password matches the stored one. The use of LEDs to indicate correct (green) or incorrect (red) passwords made the system user-friendly and clear in its functionality.

Throughout the project, we learned how to:

- Use DIP switches for user interaction,
- Work with latches to store data temporarily,
- Implement bitwise comparison using XOR gates,
- Design logic-based decision-making using NOR gates and diodes,
- Build and test a complete circuit on a breadboard.

This project has laid a solid foundation for more advanced security systems. It can be further improved by increasing password length, adding microcontrollers for dynamic passwords, integrating keypads or LCDs, and improving physical protection.

Overall, this project helped us strengthen our fundamentals in digital logic design and encouraged us to explore real-world applications of these systems.

Precautions

1. Always check to see that the power switch is OFF before plugging into the outlet. Also, turn instruments or equipment OFF before plugging from the outlet.
2. Check the IC's before using them in the circuit.
3. Don't use battery more than 5 volts or it might result in causing damage to the IC's.
4. Before performing make sure enable of Latch be HIGH to set Password into it.

THANK YOU