D. Y. PATIL COLLEGE OF ENGINEERING AND TECHNOLOGY, KOLHAPUR

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A

PROJECT REPORT ON

Automatic Staircase Lighting

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PROJECT GUIDE

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INTRODUCTION –

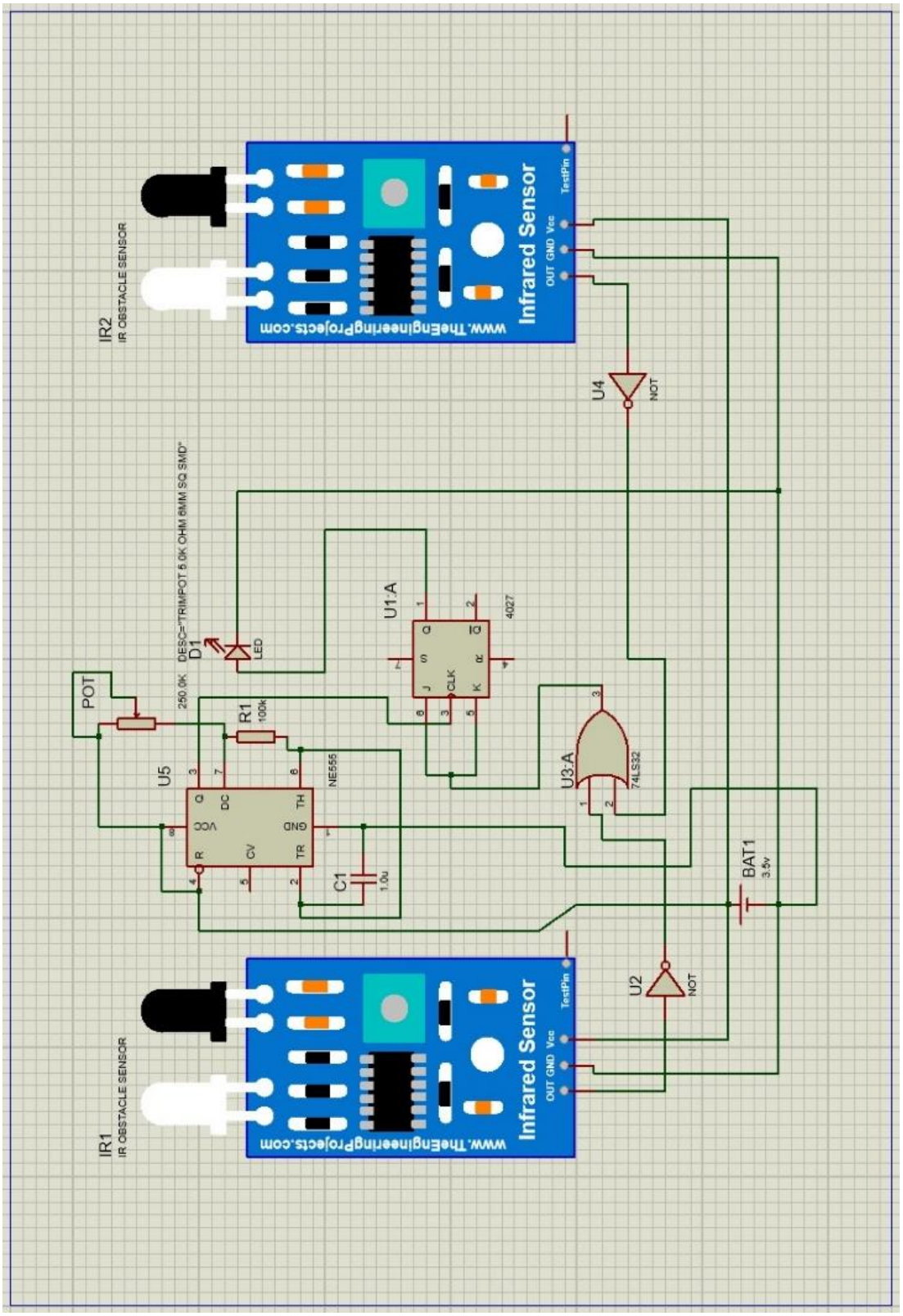
In modern homes and buildings, energy efficiency, safety, and convenience have become key priorities. One innovative solution that addresses all three is the Automatic Stair Light System. This project aims to develop a system that automatically illuminates stairways when someone approaches or begins to ascend or descend the stairs, and switches off the lights when not needed.

The system typically uses motion sensors or infrared (IR) sensors to detect movement and control the lighting accordingly. By ensuring the lights are only on when required, it significantly reduces unnecessary energy consumption. Moreover, it enhances safety by preventing accidents in dark staircases, especially for children, the elderly, or during power outages.

This project not only demonstrates the practical use of sensor-based automation but also highlights the importance of integrating smart technology into everyday infrastructure for a more sustainable and user-friendly environment.

The automatic stair light system is designed to turn ON lights automatically when a person approaches the stairs and turn them OFF after a set time. It uses two infrared (IR) sensors to detect motion at the top and bottom of the staircase. When motion is detected, the signal is processed through logic gates and a 555 timer circuit, which controls the lighting duration. A JK flip-flop helps manage the ON/OFF state of the light. This system improves safety in low-light conditions and saves energy by ensuring the light is only ON when needed.

CIRCUIT DIAGRAM –



CIRCUIT DISCRIPTION –

Circuit Description of Automatic Stair Light System:

The circuit is designed to automatically turn ON and OFF stairway lights using infrared (IR) sensors and basic logic components. It ensures energy efficiency and enhances user safety by detecting motion at the stair entrance and exit.

Main Components Used:

1. IR Sensors (IR1 and IR2): Detects motion at the bottom and top of the staircase. These are obstacle detection sensors that output a signal when someone passes.

2. NE555 Timer (U5): Configured in monostable mode to provide a timed pulse when triggered by the IR sensor. This controls how long the light stays ON after motion is detected.

3. Potentiometer (POT): Adjusts the time delay of the 555 timer.

4. LED (D1): Represents the stair light; it turns ON when motion is detected.

5. JK Flip-Flop (4027 - U1:A): Acts as a memory element to control the ON/OFF state of the light.

6. Logic Gate (OR Gate - 74LS32 U3:A): Combines the outputs from both sensors to provide a single control signal.

7. NOT Gates (U2, U4): Inverters used for signal conditioning.

8. Capacitor (C1) and Resistor (R1): Used to set the timing interval for the 555 timer.

9. Battery (BAT1): Powers the entire circuit with 3.5V.

WORKING –

Working Principle:

When a person is detected at either end of the stairs (via IR1 or IR2), the sensor sends a LOW signal.

This signal is inverted by the NOT gate (U2), triggering the NE555 timer (U5).

The timer generates a pulse which turns ON the LED (simulating the stair light) for a specific duration.

The flip-flop (U1:A) helps maintain the LED state until the timer finishes its pulse or motion is no longer detected.

The OR gate (U3:A) ensures that input from either IR sensor will activate the light.

Once the person moves away, and no motion is detected, the system turns OFF the light automatically after the delay.

Steps for Working of Automatic Stair Light System –

1. Power Supply ON
The circuit is powered by a 3.5V battery, which energizes all components including the IR sensors and logic ICs.

2. Motion Detection by IR Sensors
When a person is detected at the top (IR2) or bottom (IR1) of the stairs, the respective IR sensor outputs a LOW signal.

3. Signal Inversion
The LOW signal from the IR sensor is inverted to HIGH using a NOT gate (U2 or U4) to properly trigger the timer circuit.

4. 555 Timer Activation
The HIGH pulse triggers the NE555 timer (U5), which is configured in monostable mode to generate a time-controlled output.

5. Light Turns ON
The timer output is connected to a JK Flip-Flop (U1:A) and LED (D1). When triggered, it turns ON the LED (representing stair light).

6. OR Gate Control
The OR gate (U3:A) combines signals from both sensors to ensure the light turns ON if either sensor detects motion.

7. Time Delay Countdown
The light remains ON for a duration set by the potentiometer (POT) and timing components (R1, C1).

8. Automatic Turn OFF
After the set time, the 555 timer output goes LOW, and the flip-flop resets the LED state, turning OFF the stair light.

ADVANTAGES –

1. Energy Saving: Lights are only ON when needed, reducing electricity consumption.

2. Improved Safety: Automatically illuminates stairs, preventing accidents in dark areas.

3. Hands-Free Operation: No need for manual switches; especially helpful for children, elderly, or when hands are occupied.

4. Smart Automation: Integrates basic electronic components to create a cost-effective home automation solution.

5. Longer Light Lifespan: Reduces unnecessary usage, extending the lifespan of lights.

6. User Convenience: Automatically adapts to movement, offering a more comfortable living environment.

DISADVANTAGES –

1. Limited Range of Sensors: IR sensors may not detect motion accurately if the person is too far or moving too slowly.

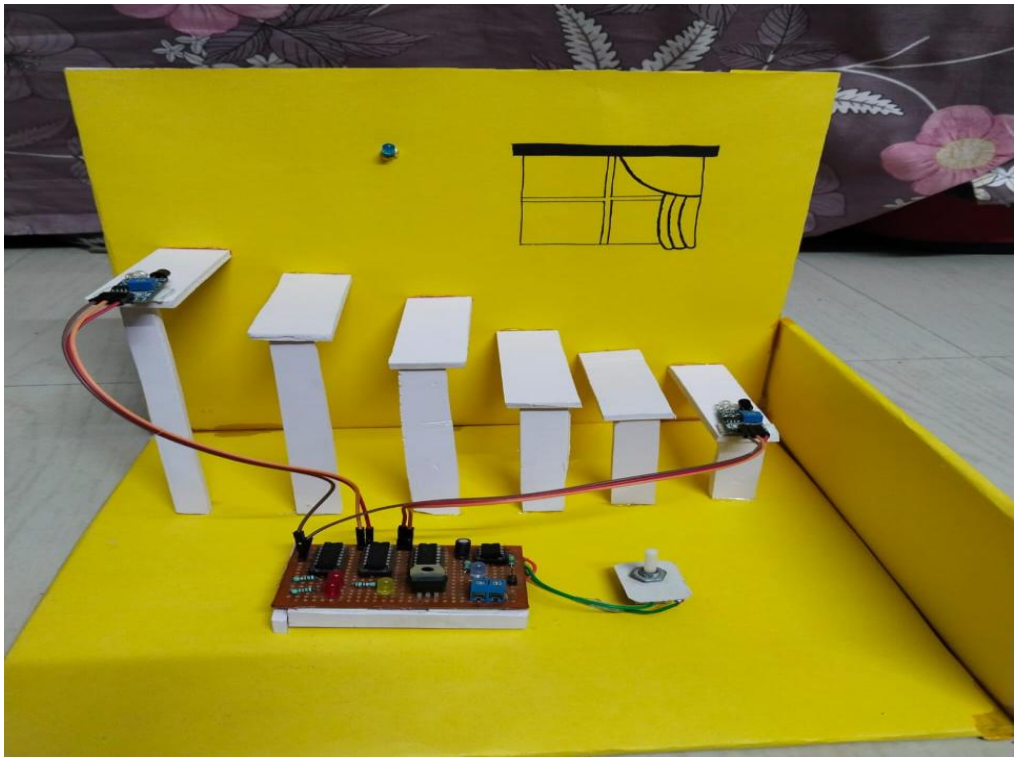
2. False Triggering: Sensors might activate the light due to pets, insects, or nearby movement not related to stair use.

3. Power Dependency: System won't work during power failure unless backed by a battery or inverter.

4. Initial Cost: Slightly higher initial setup cost compared to a regular manual switch.

5. Component Sensitivity: Sensors and circuits can be affected by dust, sunlight, or moisture, requiring occasional maintenance.

FINAL SETUP OF PROJECT –



Conclusion –

The Automatic Stair Light System is a practical and efficient solution for enhancing both safety and energy conservation in homes and buildings. By using IR sensors, timers, and logic circuits, the system ensures that stair lights operate only when needed, reducing electricity wastage and providing convenience. It demonstrates a simple yet effective application of automation in daily life, making stair navigation safer—especially in low-light conditions. Overall, this project reflects how basic electronic components can be combined to create smart and user-friendly systems for modern living.