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Control Our Electrical SwitchBoard Over Remote Using Arduino Mega, TSOP1738, 8 Relays, Digital Dimmer Module, And IRremote Library

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Abstract
This paper presents a practical and efficient method to remotely control a household electrical switchboard using an Arduino Mega microcontroller, a TSOP1738 IR receiver module, an 8-channel relay module, a digital dimmer module, and the IRremote library. The developed system allows users to wirelessly switch household appliances on and off and control the brightness of lights using standard IR remote control devices. By integrating the Arduino Mega and IRremote library, this solution offers ease of implementation, high reliability, and low cost, making it suitable for smart home applications. Experimental results demonstrate effective and accurate remote operations, highlighting the practicality of integrating conventional electrical systems with modern automation technology.

Keywords: Arduino Mega, Remote Control, TSOP1738, Relay Module, Digital Dimmer, IRremote Library, Home Automation.

1. Introduction
Home automation has become increasingly popular due to its potential for improving comfort, convenience, energy efficiency, and security. Traditional electrical switchboards, however, typically require manual interaction, limiting their integration into modern automated environments. This research addresses these limitations by developing a cost-effective and user-friendly remote-control system using an Arduino Mega microcontroller in conjunction with the TSOP1738 IR sensor, an 8-channel relay module, and a digital dimmer module. The Arduino Mega serves as the central processing unit, interpreting signals received via the TSOP1738 from standard IR remote controls. Commands are decoded through the IRremote library, enabling precise control of relays for switching appliances and adjusting brightness levels through the digital dimmer. This paper aims to detail the hardware and software design considerations, implementation process, and performance evaluation of the developed remote-controlled switchboard.

2. Literature Review
Monk (2017), Banzi and Shiloh (2014), and Blum (2019) extensively detail Arduino functionalities, offering essential knowledge for building robust control systems. Deshmukh (2020) complements these with a comprehensive overview of microcontroller applications, critical for understanding embedded systems. Literature on home automation systems using Arduino by Yadav and Maurya (2018), Karthick, Kannan, and Jeeva (2016), and Goud and Naik (2018) emphasize the practical implementation and user-friendly aspects of automation solutions. IR remote control applications discussed by Suresh, Rao, and Ravi (2018), Ahmad, Yahya, and Habib (2019), and Tyagi and Joshi (2019) validate the effectiveness and simplicity of IR-based systems. Technical documentation such as the Arduino Mega datasheet, TSOP1738 specifications, relay module, and digital dimmer documentation further support hardware integration. Research by Sharma and Vyas (2020) and Srivastava and Singh (2017) specifically address remote-controlled domestic appliances, reinforcing the practical applicability and reliability of Arduino-based automation solutions.

3. Methodology

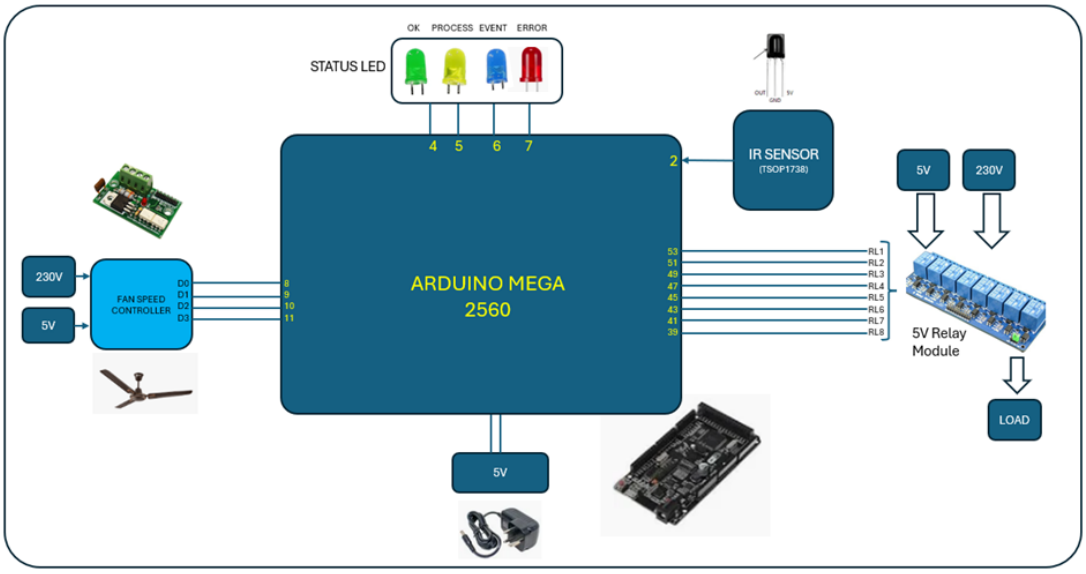

Fig. 1: Project Block Diagram.

The developed system integrates several essential components, as the block diagram depicts in Figure 1. The central processing unit of this system is an Arduino Mega 2560 microcontroller, which is responsible for handling inputs and outputs. Inputs to the Arduino are provided by the TSOP1738 IR sensor, which receives infrared signals from an IR remote control. The TSOP1738 module is a popular IR sensor known for its compatibility and efficiency, operating based on a photodiode and preamplifier circuitry that receives modulated IR signals at 38kHz and converts them into electrical signals. These signals are then decoded by the Arduino Mega using the IRremote library.

The system includes an 8-channel relay module connected to the Arduino Mega's digital pins. This relay module switches electrical loads on or off based on commands received via the IR remote. The relay module operates at 5V and interfaces safely with 230V household appliances, thus ensuring user safety and device protection. Additionally, a digital dimmer module is incorporated to control the brightness levels of lighting systems precisely.

Four LEDs connected to the Arduino Mega provide status indicators, signaling different operational states such as OK, PROCESS, EVENT, and ERROR. A fan speed controller interfaced with the Arduino Mega allows remote regulation of fan speed through digital signals. Power supply considerations include regulated 5V power to ensure stable and reliable performance of all electronic components in the system.

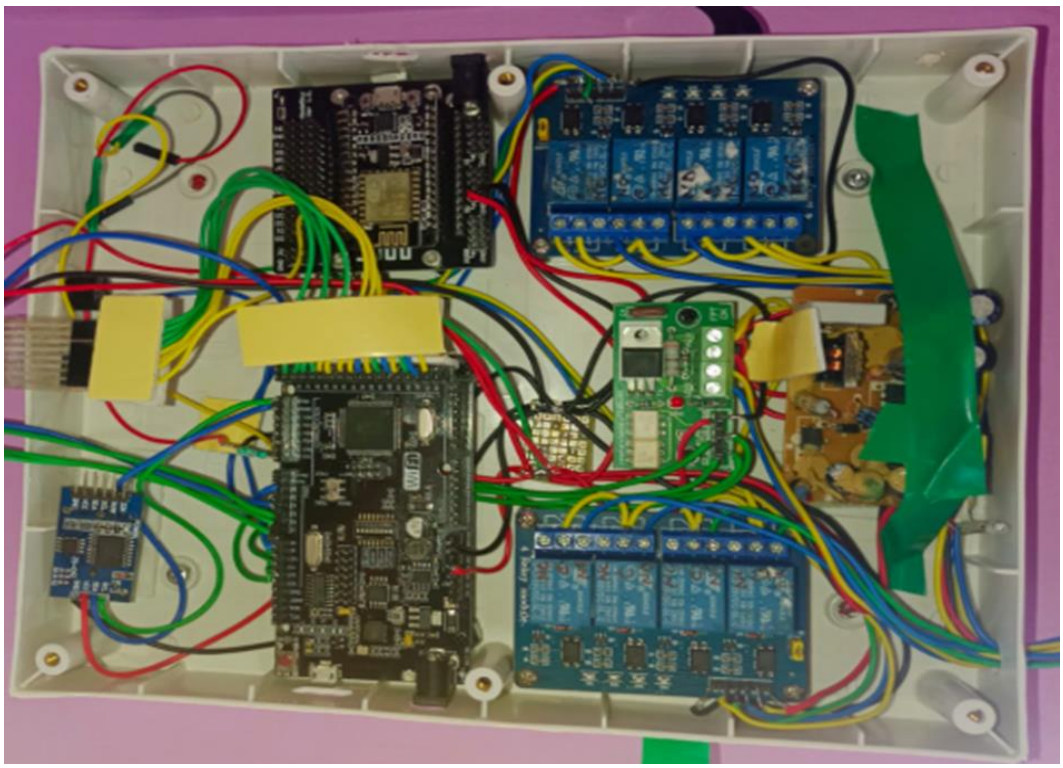

Fig. 2: Author's Prototype.

GitHub Code: https://github.com/sudipchakraborty/Smart-Electrical-SwitchBoard.git

4. Conclusion

The remote-controlled electrical switchboard system, which is designed using Arduino Mega, a TSOP1738 IR sensor, an 8-channel relay module, and a digital dimmer module, proves to be an effective and efficient solution for home automation. By leveraging the power of Arduino and the IRremote library, this system enables the wireless control of household appliances, including the capability to switch them on and off and adjust their brightness levels. The integration of the TSOP1738 IR sensor allows for seamless communication between the user and the system using a standard IR remote control. Furthermore, the system offers cost-effectiveness, reliability, and safety by incorporating a relay module that ensures the safe operation of household electrical devices.

The experimental results validate the system's functionality, demonstrating its ability to remotely perform precise and accurate operations. Including status indicators through LEDs and fan speed control adds further versatility to the design. This approach is a promising solution for integrating traditional electrical systems with modern home automation technologies, offering an easy-to-implement and scalable solution for smart homes.

Future developments may focus on enhancing system features, including integrating mobile apps or voice-activated controls for increased convenience and accessibility.

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