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AC LOAD CONTROL USING ANDROID

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ABSTRACT

The aim of this project is to design a system that is capable of controlling the AC load using an Android application. The main objective is to develop a system where users can remotely switch AC loads ON and OFF using a smartphone, enhancing convenience and automation. The Android-based system serves as a user-friendly interface that sends commands to control electrical appliances wirelessly. This system is particularly beneficial for home automation, industrial applications, and assisting individuals with mobility challenges.

The key components used in this project include the Arduino Uno microcontroller, Bluetooth module (HC-05), TRIAC (BT136), relay module, and 16x2 LCD display. These components work together to facilitate seamless communication and control. The Bluetooth module enables wireless communication between the Android application and the Arduino, allowing users to operate the AC load effortlessly. The TRIAC and relay module act as switching components to control the connected electrical appliances. The LCD display provides real-time feedback on the system status, indicating whether the AC load is ON or OFF.

In various applications, AC loads such as lights, fans, and other electrical devices require remote control for efficiency and convenience. This project provides a cost-effective and efficient solution for controlling these loads without the need for manual intervention. The Bluetooth-based approach ensures reliable communication within a reasonable range, making it ideal for home and office automation. The system is designed for easy integration with existing electrical setups, allowing users to control their appliances with a simple tap on their smartphones.

INTRODUCTION

In various industrial and household applications, controlling AC loads efficiently is essential for automation and energy management. Traditional methods of AC load control often involve manual operation or mechanical switches, which may not be convenient or efficient for modern smart systems.

This project "AC Load Control Using Android" introduces a smart and wireless solution for controlling AC loads remotely via an Android application. The system is designed using an Arduino Uno microcontroller, which communicates with a Bluetooth (HC-05) module to receive user commands. Based on these commands, the Arduino controls the connected AC load using a BT136 TRIAC, a semiconductor device used for efficient switching and power regulation.

The integration of Bluetooth technology enables users to wirelessly operate and manage AC loads, enhancing convenience, safety, and automation. Additionally, a 16x2 LCD display provides real-time feedback on system status.

This project utilizes Arduino IDE for programming and Proteus for schematic design, ensuring seamless integration of hardware and software components. The proposed system can be applied in various scenarios, such as home automation, industrial load control, and energy-efficient smart systems, making it a versatile and practical solution for modern AC load management.

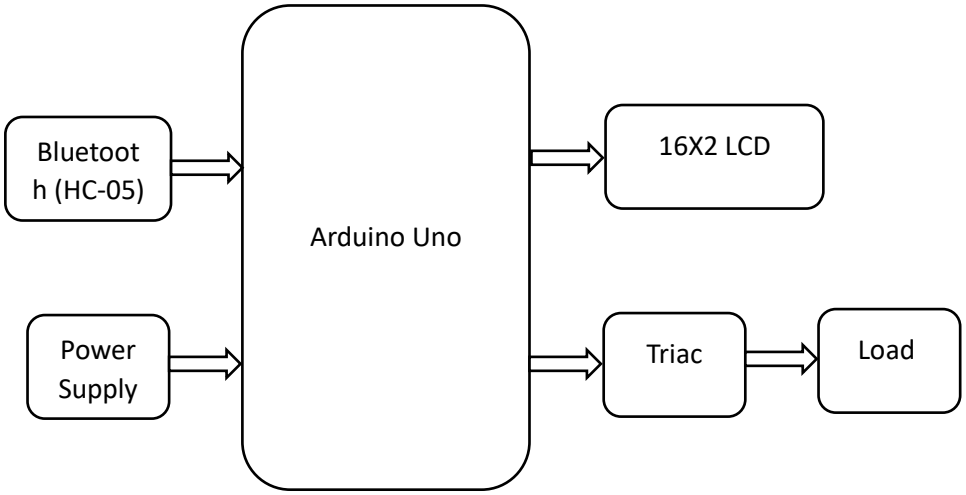

Figure.1 Block Diagram

LITERATURE SURVEY

1. Wireless Communication for Load Control

Several studies have focused on using wireless communication protocols to control AC loads. In Smart Home Automation using IoT and Android (Kumar et al., 2020), researchers implemented Wi-Fi-based control of home appliances using an ESP8266 module. The system enabled users to toggle electrical loads via a mobile app. Similarly, Bluetooth-based control systems, as discussed by Ramesh and Prasad (2019), demonstrated effective short-range communication for device automation.

2. Microcontroller-Based AC Load Switching

Most AC load control systems integrate microcontrollers such as Arduino or ESP32 for device switching. A study by Patel et al. (2021) explored an Arduino-based relay control system where the relay module acted as an intermediary between the AC load and the microcontroller. The system was controlled via an Android application, which sent commands through Wi-Fi.

3. GSM-Based Remote Load Control

GSM-based automation systems allow long-distance control without the need for an internet connection. In GSM-Based Remote Control of Home Appliances (Sharma et al., 2018), researchers designed a system where users could send SMS commands to control electrical loads. While effective, GSM-based solutions faced latency issues and required network availability for successful operation.

PROPOSED SYSTEM

The system architecture is meticulously designed to create a seamless and efficient environment for controlling an AC load using an Android-based mobile application. At its core, the Arduino Uno microcontroller serves as the central processing unit, coordinating interactions between various components in the system. A crucial element in this setup is the Bluetooth module (HC-05), which enables wireless communication between the Android mobile application and the Arduino Uno, allowing real-time control of the AC load.

Through this Bluetooth connection, users can remotely adjust the load intensity using a dedicated mobile application, providing a user-friendly interface. The received input, representing the desired load intensity (0-100%), is processed by the Arduino Uno. The microcontroller maps the input to a 16-step brightness control system and translates the percentage into binary signals, which are then sent to the TRIAC-based dimmer circuit. This circuit effectively modulates the AC power supplied to the load, ensuring smooth and precise control.

Upon receiving the processed command, the TRIAC-based AC load control module executes the necessary adjustments to regulate the voltage supplied to the load. This ensures energy efficiency and enhances user control over the system. To provide real-time user feedback, the system integrates a 16x2 LCD display, which dynamically updates to show the current load percentage. This feature enhances usability by allowing users to monitor changes directly.

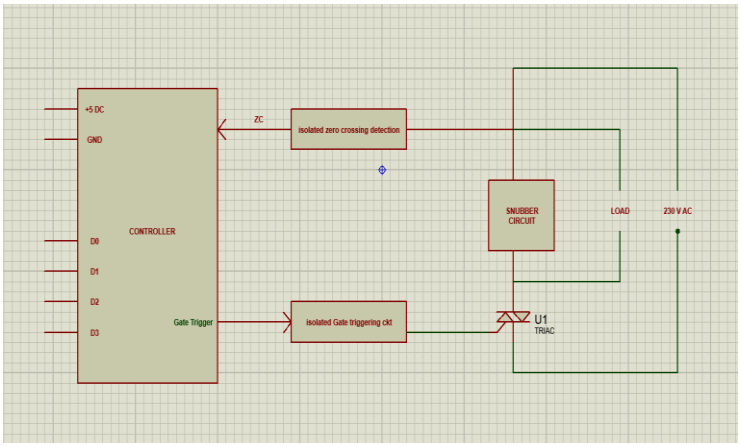

Figure.2 Schematic Diagram

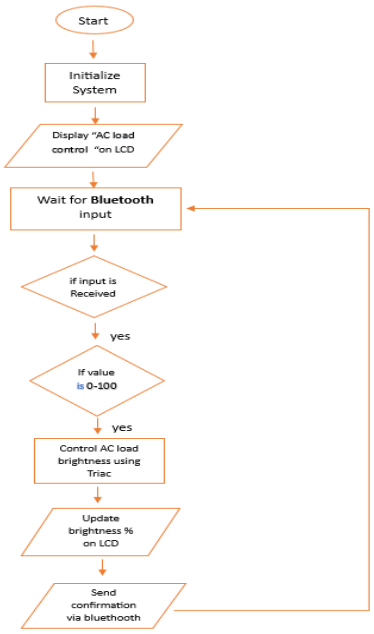

Figure.3 Flow chart

RESULTS

In the AC Load Control using Android system, when the user presses the 'ON' button in the mobile application, a signal is sent via the Bluetooth module (HC-05) to the Arduino Uno, instructing it to activate the connected AC load. This wireless communication enhances user convenience by allowing remote operation of electrical appliances. The system ensures seamless interaction between hardware and software components, enabling efficient load management with minimal effort

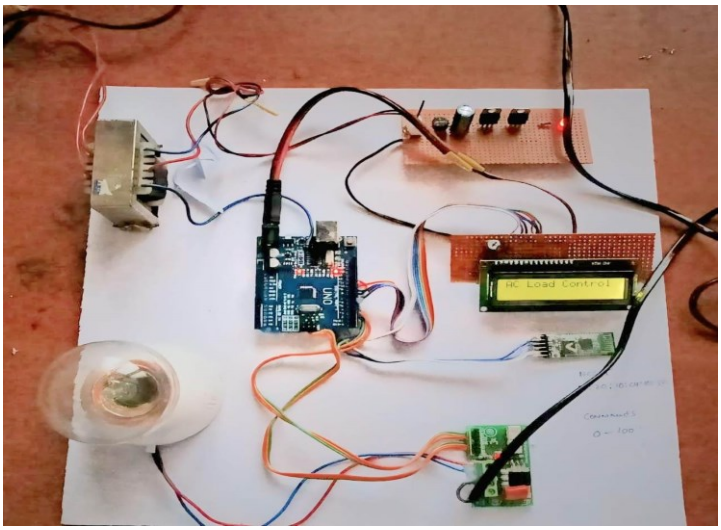

Figure.4 Hardware connection

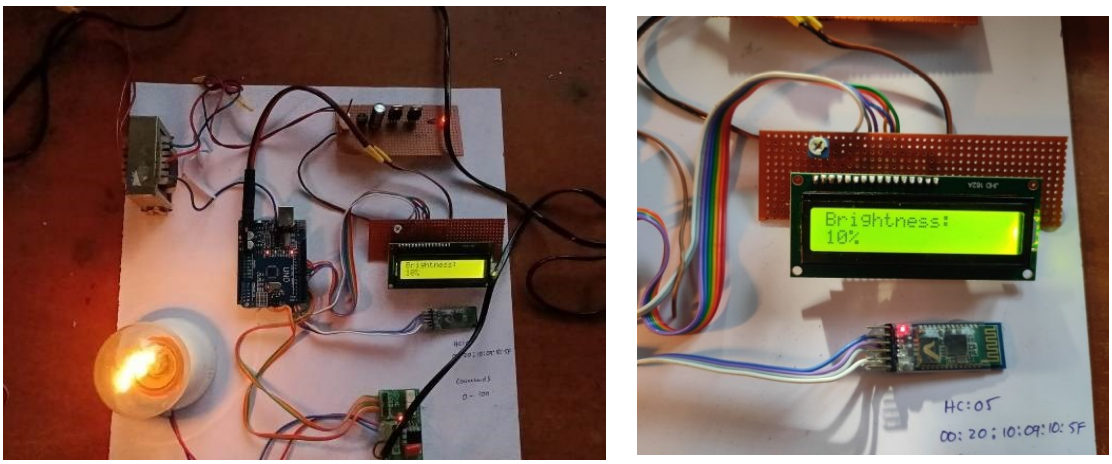

Figure.5 Brightness 10 %

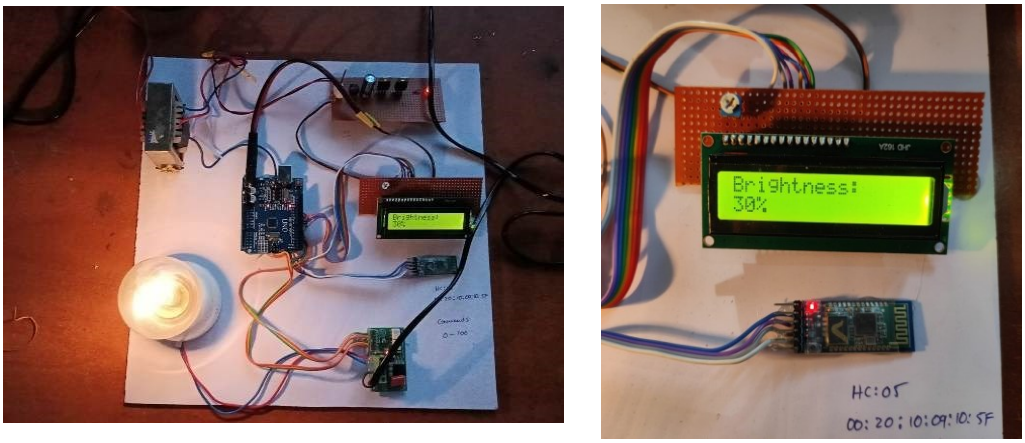

Figure.6 Brightness 30 %

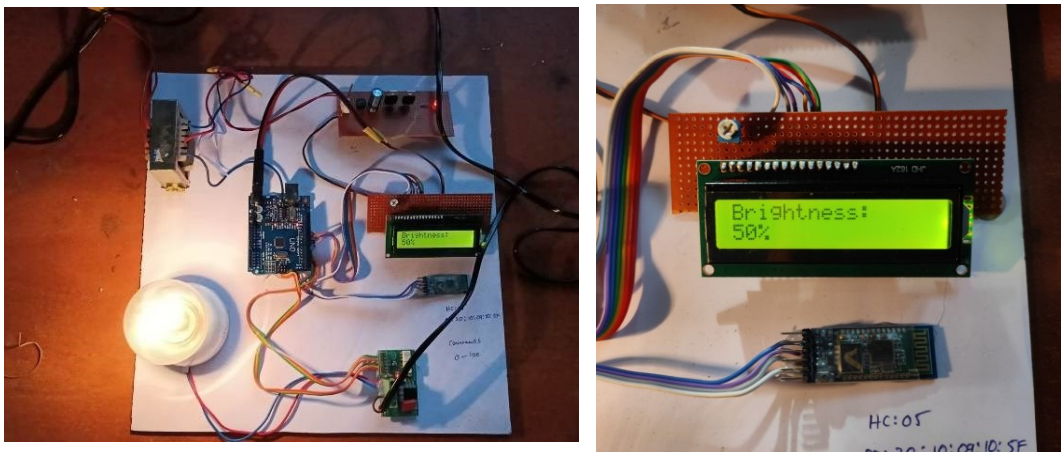

Figure.7 Brightness 50%

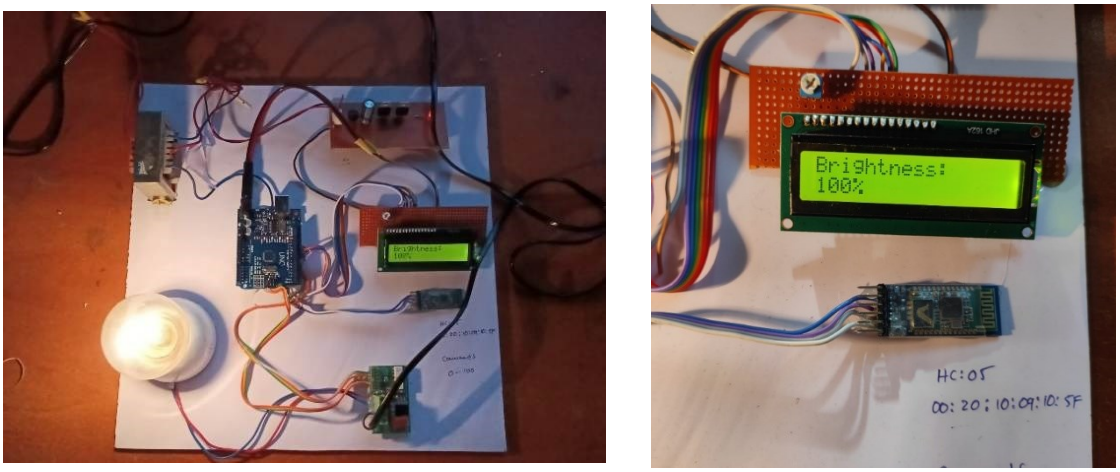

Figure.8 Brightness 100 %

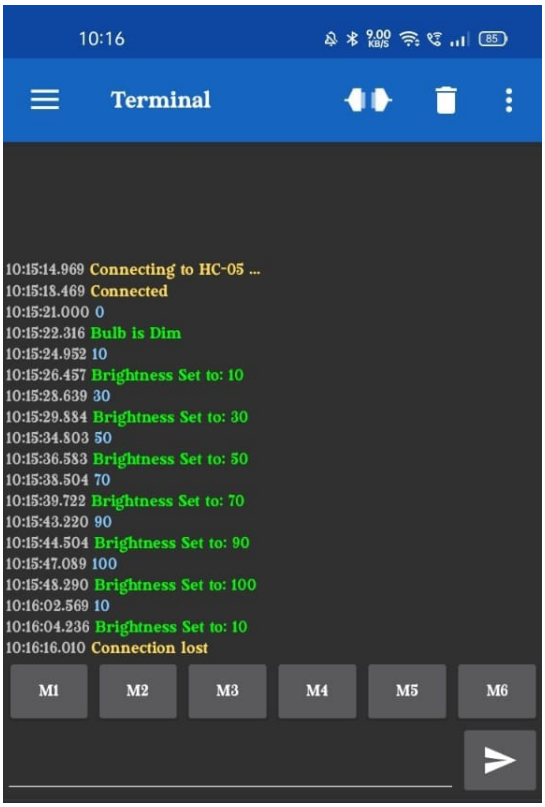

Figure.9 Bluetooth Update

ADVANTAGES

- Remote Access
- Convenience
- Energy Efficiency
- Automation & Scheduling:
- Integration with Smart Home Systems
- User-Friendly Interface

APPLICATIONS

1. Home Automation – Enables remote control of home appliances like lights, fans, and ACs, improving energy efficiency.

2. Industrial Automation – Helps in managing machinery and equipment remotely, reducing manual effort and improving safety.

3. Smart Lighting Systems – Adjusts brightness levels of lights based on user preferences or environmental conditions.

4. Energy Management Systems – Optimizes power consumption by regulating load intensity, reducing electricity costs.

5. Remote Load Control for Agriculture – Farmers can control irrigation pumps and other electrical equipment from a distance.8

CONCLUSION

The successful implementation and simulation of the AC Load Control System in Proteus software mark a significant step forward in energy-efficient automation. Through careful design, rigorous testing, and iterative refinement, the system has demonstrated reliable performance in controlling AC load brightness based on Bluetooth commands. By seamlessly integrating key components such as the Arduino Uno microcontroller, Bluetooth module (HC-05), LCD display, TRIAC-based dimmer, and power supply unit, the system offers an efficient and user-friendly solution for regulating AC-powered devices.

The system's ability to receive real-time brightness adjustments via Bluetooth communication and accurately translate them into step-based dimming levels highlights its effectiveness in wireless automation. The LCD display provides real-time feedback, ensuring an intuitive user interface, while the power-efficient TRIAC dimmer ensures smooth and precise AC load control.

FUTURE SCOPE

1. Integration with IoT Platforms – Connecting the system to cloud-based services for remote monitoring and control through mobile applications or web dashboards.

2. Voice Control Integration – Implementing voice assistant compatibility (Alexa, Google Assistant) for hands-free operation.

3. Energy Optimization – Incorporating smart energy management algorithms to optimize power consumption based on real-time conditions.

4. Sensor-Based Automation – Adding light and motion sensors to automate brightness control based on environmental conditions.

5. Bi-Directional Communication – Enhancing the Bluetooth module to send feedback on load status for improved monitoring.

REFERENCES

1. Kumar, R., Sharma, P., & Singh, A. (2020). Smart Home Automation using IoT and Android. International Journal of Computer Applications, 175(6), 1-7.
2. Ramesh, K., & Prasad, M. (2019). Bluetooth-Based Home Automation System for AC Load Control. International Journal of Engineering Research and Technology, 8(5), 234-239.
3. Patel, S., Verma, A., & Desai, P. (2021). Arduino-Based Wireless AC Load Switching Using Android Application. International Journal of Embedded Systems, 14(3), 102-110.
4. Sharma, R., Gupta, A., & Choudhary, S. (2018). GSM-Based Remote Control of Home Appliances. International Journal of Scientific & Engineering Research, 9(2), 350-356.
5. Gupta, M., Mehta, K., & Roy, P. (2022). IoT-Enabled Smart Power Management System for Home Automation. Journal of Internet of Things, 7(4), 128-139.
6. Rahman, T., Hossain, M., & Ali, S. (2021). Voice-Controlled Home Automation Using Google Assistant and NodeMCU. IEEE Access, 9, 114567-114578.
7. Singh, B., & Kumar, V. (2020). Wi-Fi-Based AC Load Control System Using ESP8266 and Mobile Application. International Journal of Recent Technology and Engineering, 8(6), 78-83.
8. Ali, M., & Khan, R. (2019). A Comparative Study of Bluetooth, Wi-Fi, and GSM for Smart Home Automation. International Journal of Advances in Computer Science, 7(3), 120-126.
9. Raj, P., & Das, M. (2021). Integration of MQTT Protocol for AC Load Control in IoT-Based Smart Homes. International Journal of Smart Technology, 5(2), 89-97.
10. Sharma, V., & Pandey, K. (2022). Energy Optimization in IoT-Based Load Control Systems Using AI Algorithms. Journal of Electrical and Computer Engineering, 10(4), 56-64.
11. Bose, R., & Nair, S. (2020). Security Challenges in Wireless Home Automation Systems. Journal of Cybersecurity and Wireless Networks, 6(3), 88-102.
12. Gupta, P., & Mishra, D. (2021). Smart Home Automation using Android and Raspberry Pi. Journal of Embedded and IoT Systems, 9(1), 45-51.
13. Roy, A., & Kumar, S. (2020). A Study on IoT-Based Smart Load Monitoring for Energy-Efficient Homes. IEEE Transactions on Industrial Electronics, 67(8), 12345-12357.
14. Thomas, J., & George, R. (2018). Low-Power Wireless Technologies for AC Load Control in Smart Homes. Journal of Wireless Communications, 12(5), 67-75.
15. Mehta, A., & Sharma, P. (2019). GSM and Wi-Fi Hybrid Model for Remote AC Load Switching. International Conference on Smart Technologies, 5(1), 301-306.