International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 09 Issue: 04 | April - 2025 SJIF Rating: 8.586 ISSN: 2582-3930

Smart Home Automation

Kodali Manoj[1], Golagana Ajay Kumar[2], Chandaka Vijay Kumar[3], Yedla Vignesh[4], Gopisetti Sai Kireeti[5], Dr G Sateesh[6].

[1,2,3,4,5] B.Tech Student, Department of Computer Science and Information Technology,
[6] Associate Professor, Department of Computer Science and Information Technology.
[1,2,3,4,5,6] Lendi Institute of Engineering and Technology, Vizianagaram, Andhra Pradesh

---

Abstract - The Cadio application is a smart home automation solution that combines IoT technology with AI-powered tools to provide seamless management and monitoring of household equipment. It provides multi-mode management using voice commands with Google Assistant or Amazon Alexa, allowing users to operate appliances locally or remotely via the internet. The solution works with both local Wi-Fi networks and the Cadio cloud, delivering excellent connection stability and quick reaction times.

The Cadio app allows users to plan activities or set timers for autonomous appliance operation, and it may be paired with sensors to provide dynamic reactions based on environmental conditions. The platform generates code using AI, allowing users to setup devices without prior programming knowledge. The system also has safe and dependable security measures, such as pin-code security and EEPROM technology for memory retention after power outages.

Cadio is easy to use, inexpensive, and adaptable, making it an excellent choice for both new and experienced users. It integrates with Google Home and Amazon Alexa for improved interoperability and offers offline functioning via manual switches, assuring reliability even during network disruptions. Overall, the Cadio app demonstrates recent improvements in home automation by combining simplicity and power.

***Key Words*:** CADIO Home Automation Application, Internet of Things (IoT), ESP8266, Wireless Control, Remote Monitoring, Automation System, Smart Devices, Mobile App, Voice Control Integration, Mobile User Interface.

1. INTRODUCTION

Traditional houses are becoming smart homes thanks to the Internet of Things (IoT), which is completely changing how we interact with our living areas. In order to improve inhabitants' comfort, security, energy efficiency, and convenience, IoT-based smart home automation combines a network of interconnected devices, including sensors, cameras, lighting, thermostats, and appliances. Wireless protocols such as Wi-Fi, Bluetooth, Zigbee, or LoRa are used to link these devices, and a central hub or cloud-based platform is frequently used for management.

Sensors and actuators, which gather data in real time and initiate actions like turning on lights, regulating the temperature, or sending alarms, are essential parts and mechanisms. Wireless network communication enables smooth integration and remote access, enabling customers to utilize a voice assistant or smartphone app to manage lights, thermostats, or security cameras from any location.

Automation processes are enabled, device interactions are managed, and sensor data is processed by central hubs or cloud services. Users may plan and control home tasks with the use of user-friendly interfaces offered by platforms like Google Home, Amazon Alexa, and bespoke IoT dashboards. IoT solutions improve security and awareness by providing real-time monitoring and notifications.

Improved security, energy efficiency, comfort and convenience, remote access and control, and personalization are some advantages of IoT-based smart home automation. IoT devices adjust their behavior to offer a more personalized and pleasant living space by learning user preferences and routines.

2. Body of Paper

EXISTING SYSTEMS

Smart Automated Home Application Using IoT with Blynk App. A strong IoT option for smart home automation, the Blynk platform provides scalability, versatility, and user-friendliness. Through physical switches, web dashboards, and mobile applications,

consumers may remotely control and monitor household appliances. Key features include voice control integration with voice assistants like Alexa and Google Home, manual switches for continuous operation, real-time feedback, a large number of compatible devices, automation capabilities, WIFI-based device control, and security features including encryption and over-the-air firmware upgrades. Microcontrollers like the ESP32 or ESP8266 are usually needed for the technical implementation of the Blynk system in order to link hardware components. It is compatible with cellular (GSM/4G/LTE), Ethernet, WIFI, and LoRa WAN connections. Additionally, Blynk offers a no-code UI builder for branded apps, enabling customers to create unique user interfaces for controlling their Internet of Things devices.

Easy usage, scalability, offline capabilities, configurable automations, security, and dependability are some benefits of utilizing Blynk for smart home automation. Automating everyday chores like watering plants or running appliances is one use. Other uses include controlling lights, HVAC systems, locks, ambient conditions, and security features like motion detectors and gas leak sensors. Customers may design a highly personalized and effective smart home environment that meets their demands by utilizing Blynk's strong IoT architecture.

CONCEPT OF DEVELOPMENT

The idea behind the "Smart Home Automation Circuit Diagram" is to automate the switching of AC appliances in the home by utilizing an ESP8266 microcontroller as the main control unit. Features like remote control, scheduled operation, and interaction with other smart home systems or sensors are made possible by this microcontroller-based automation.

Since appliances run on high AC voltage and the ESP8266 runs on low DC voltage, combining low-voltage control with high-voltage loads is difficult. In order to solve this, a 2-Channel 5V 10A Relay Module serves as a bridge, enabling low-voltage signals from the ESP8266 to regulate the electromagnetic switches (relays) that switch high-voltage AC circuits. To ensure user safety, optocouplers on the relay module offer electrical isolation between the low-voltage side of the microcontroller and the AC power side.

The idea behind the "Smart Home Automation Circuit Diagram" is to automate the switching of AC appliances in the home by utilizing an ESP8266 microcontroller as the main control unit. Features like remote control, scheduled operation, and interaction with other smart home systems or sensors are made possible by this microcontroller-based automation.

Since appliances run on high AC voltage and the ESP8266 runs on low DC voltage, combining low-voltage control with high-voltage loads is difficult. In order to solve this, a 2-Channel 5V 10A Relay Module serves as a bridge, enabling low-voltage signals from the ESP8266 to regulate the electromagnetic switches (relays) that switch high-voltage AC circuits. To ensure user safety, optocouplers on the relay module offer electrical isolation between the low-voltage side of the microcontroller and the AC power side.

METHODOLOGY

The smart home automation system that allows users to remotely control electrical devices using a laptop or smartphone via WiFi. The system is divided into two main sections: Client Side and Server and Main Controller Side. The Client Side includes devices that serve as user interfaces for controlling home appliances, communicating wirelessly with the main controller using a dedicated application called "CADIO."

The Server and Main Controller Side includes a WiFi network that acts as the communication medium between the client devices and the main controller (ESP8266). The ESP8266 is a microcontroller with built-in WiFi capability that receives commands from the client devices via WiFi and processes them. It is powered by an external power supply, which supplies the necessary electrical power to the ESP8266 and possibly the relay modules.

The system uses relays to control high-voltage appliances safely. Relay 1 controls the lighting system (bulbs) and Relay 2 controls the fan system (table fan or ceiling fan). The system can be extended to provide status feedback to the user.
The working principle involves user interaction, command transmission, processing and control, device operation, and optional status feedback. The system enables convenient, remote, and wireless control of home electrical devices, enhancing automation and user comfort.

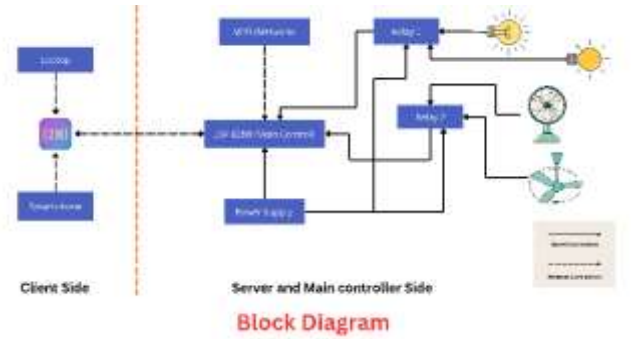

Fig 1: Block Diagram

ALGORITHM'S DESIGN

The CADIO platform is a smart home automation system that blends a strong technological architecture with an intuitive design. It guarantees availability even in the event of internet disruptions by supporting both local and cloud-based control. System startup, application activation, authentication protocol, dashboard initialization, device control interface, command execution flow, status synchronization, and session termination are all initiated by the user in the context of the smart home ecosystem.

The architecture of CADIO ensures availability even in the event of internet disruptions by supporting both local and cloud-based control. A hybrid interface that combines local and cloud-connected devices is loaded by the app. Devices are arranged by area or function using a Units/Groups view. With per-device PIN protection for further security, users verify via biometric verification or email/password.

Real-time device statuses obtained via CADIO Cloud and local WiFi are used to configure the dashboard. The device control interface shows sensors for motion, temperature, and humidity as well as basic and sophisticated smart home functions. Command execution flows include distant commands that go over CADIO's encrypted cloud infrastructure and local control that uses ESP8266/ESP32 microcontrollers for instantaneous execution.

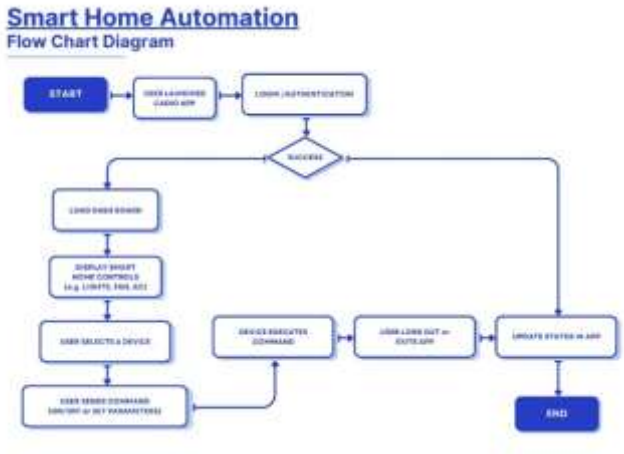

Fig 2: Flow Chart Diagram

Devices communicate confirmation via MQTT for real-time cloud updates and local UDP for WiFi-connected devices thanks to CADIO's status synchronization. Session termination guarantees that background services continue to monitor sensors and that device states are preserved even after an app has been closed.

Voice integration, hybrid control architecture, and automation features like schedules and sensor linking are some of CADIO's technological innovations. This process shows how CADIO addresses convenience and system resilience by fusing dependable smart home control with user-friendly design and strong technical architecture.

CIRCUIT DIAGRAM

A microcontroller, a 2-channel, 5V relay module with an optocoupler for AC loads, and output devices like two AC lamps, a fan, and a green light indication are all part of the process for creating a smart home automation circuit. In the circuit design, digital pins from the ESP8266 are connected to relay module input pins, power connections are made, and proper wiring for AC devices is ensured. Programming includes integrating logic to switch devices on and off depending on user inputs, implementing Wi-Fi networking features, and developing code to regulate relay statuses based on user interactions.

Debugging and testing guarantee that every device reacts to the relays appropriately and that all connections are safe. Following successful testing, the system is put into use in the intended setting, its performance and stability are tracked, and any necessary modifications are made to enhance the user interface or operational

effectiveness. Using insulated cables and components, following safety rules, and making sure relays have enough air are all examples of safety precautions. The ease of remotely operating household appliances is improved by this methodical approach.

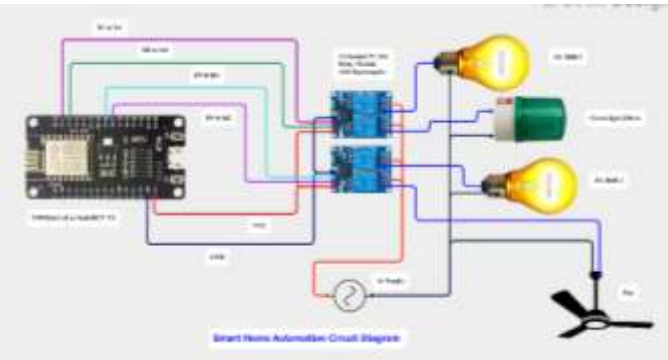

Fig 3: Circuit Diagram

The system consists of a connected system for smart home control or automation. The microcontroller board, likely an ESP8266 or ESP32, is the "brain" of the operation, running code, connecting to Wi-Fi, and sending signals to control other components. The breadboard is a solderless white plastic board used for prototyping electronic circuits.

There are two blue relay modules at the bottom, each containing two relays. The microcontroller sends low-voltage signals to the relay module, which uses the relay to switch a higher voltage/current circuit on or off. Red LEDs on the relay modules indicate when a relay is active or has power. Different colored wires connect the output pins of the microcontroller board to the input signal pins of the relay modules. A white USB cable is connected to the microcontroller board, providing power to it.

The smartphone app interface shows four icons shaped like light bulbs labeled L1, L2, L3, and L4. These correspond to the four relay channels available from the two relay modules on the left. Tapping these icons in the app would send a command via Wi-Fi to the microcontroller.

A prominent banner indicates that this unit has a limited trial license and offers an option to "GET THE PERMANENT LICENSE". This suggests that the software or firmware running on the microcontroller or the app itself operates on a trial basis with potential limitations or time restrictions unless a full license is purchased. Additional features include options like "UNITS", "GROUPS", a microphone icon, and modes like "BOOST" and "NORMAL". The overall system function is a simple Internet of Things (IoT) project where the user interacts with the smartphone app. When the user taps a button, the app sends a command over the local Wi-Fi network, which the microcontroller board processes and sends the appropriate electrical signal to the corresponding channel on one of the relay modules.

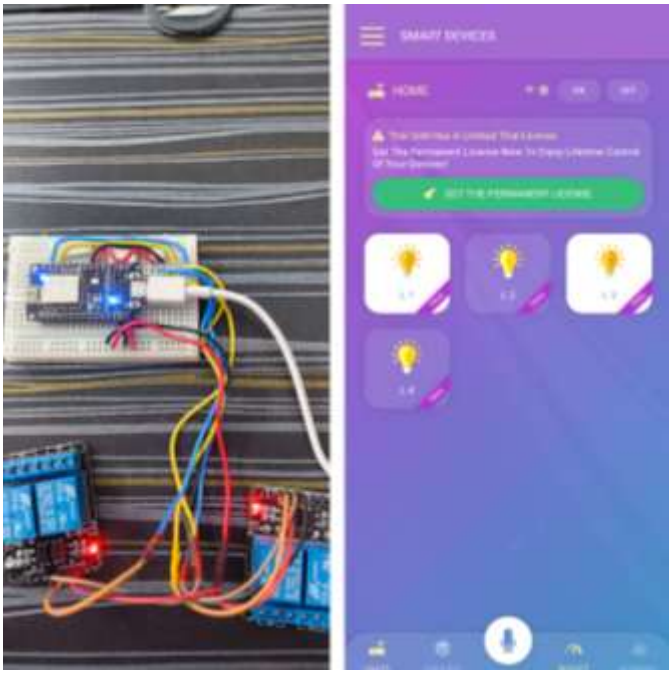

Fig 4 : Output

CADIO

Fig 4: CADIO Application

A Comprehensive Analysis of the No-Code IoT Home Automation Platform (CADIO) is a comprehensive home automation platform designed to simplify the process of building and controlling smart home devices. It stands out in the IoT ecosystem by offering a no-code approach, eliminating the need for programming knowledge while providing robust functionality for creating sophisticated home automation systems. The platform operates with a hybrid architecture that enables device control through both local WiFi networks and

cloud connectivity, ensuring users can maintain control of their devices even during internet outages.

CADIO supports an extensive range of device types and functionalities that cover most home automation needs. The platform can handle standard ON/OFF devices, dimmers for light control, RGB devices for color management, shutter controls, and fan speed regulators. More specialized capabilities include infrared (IR) device control, which allows the platform to interact with traditional remote-controlled appliances like air conditioners and televisions.

For environmental monitoring, CADIO supports digital humidity and temperature devices, enabling users to track home environmental conditions. The platform also accommodates various sensor types, including digital sensors and 433MHz wireless sensors, expanding the range of automation possibilities.

CADIO incorporates several security features, including pin-code protection for individual devices and overheat protection mechanisms that can trigger alarms when abnormal conditions are detected. It allows unlimited device addition, making it scalable for homes of any size. Organization features like Units/Groups view help users manage larger collections of devices efficiently. The CADIO app, available for both Android (Google Play Store) and iOS (Apple App Store) devices, serves as the primary interface for system configuration and control. The interface is designed with user-friendliness in mind, allowing for intuitive navigation and control.

CADIO includes scheduling and timing features that enable automated device operation based on time conditions. Users can set up recurring schedules for regular automation needs, such as turning on lights at sunset or adjusting temperature at specific times of day. CADIO also supports synchronization with physical power switches, providing flexibility in control methods, allowing users to operate their smart devices through conventional wall switches in addition to app and voice controls.

CADIO works with popular microcontroller platforms, most notably ESP32 and ESP8266 development boards, making hardware acquisition straightforward for users wanting to build their own devices. The implementation process begins with flashing CADIO firmware onto compatible microcontrollers like ESP32, which requires basic technical competence but is designed to be accessible to users without programming experience.

CADIO maintains a documentation center and developers' documentation that provide comprehensive information about the platform, technical specifications, and implementation guides. CADIO is a no-code platform that simplifies the development process of IoT and home automation, making it accessible to a wider audience. It offers comprehensive device support, multiple control methods, sophisticated automation capabilities, and integration with major voice assistants. CADIO eliminates the need for programming skills, making it a middle-ground solution for non-developers interested in creating customized smart home solutions. Its dual focus on local and cloud control, performance, and stability addresses reliability concerns in IoT implementations. As home automation continues to grow, platforms like CADIO that simplify the development process while maintaining robust functionality will likely play a crucial role in expanding adoption beyond technically-oriented early adopters.

5V 10A 2-Channel Relay Module

Fig 5: 5V 10A 2-Channel Relay Module

A multipurpose electronic component, the Generic 5V 10A 2-Channel Relay Module Shield is made to work with microcontrollers such as Arduino, ARM, PIC, AVR, DSP, and others to operate high-current devices. It is appropriate for both AC and DC applications, supports up to 10A of current, and enables independent control of two devices or circuits. The module offers electrical isolation between the control circuit and relay circuit, operates at low trigger operation, and functions at TTL signal levels (3.3V or 5V).

The ON/OFF status of each relay is shown via an LED indication. Additionally, the module has screw terminals

for Common (COM), Normally Closed (NC), and Normally Open (NO) connections for simple wiring. The microprocessor is
shielded from voltage spikes brought on the relay switching by flyback diode protection.
Easy installation is made possible by the module's small size and 3mm diameter mounting holes. It is appropriate for tasks involving robotics, industrial automation, home automation, and prototyping. Details of the module's connections include IN1/IN2 for each relay's control signal inputs, DC+ (VCC) for the positive power supply, and DC- (GND) for the ground connection.

This module's benefits include electrical isolation, a small design with simple screw terminals for fast wiring configuration, dependable switching performance with LED indications for status monitoring, and the ability to serve both AC and DC loads with high current capacities.

NodeMCU ESP8266

Fig 6: NodeMCU ESP8266

The ESP8266 Wi-Fi System-on-Chip (SoC), produced by Espressif Systems, serves as the foundation for the open-source NodeMCU ESP8266 IoT development board. Because of its inexpensive cost, small size, and integrated Wi-Fi, it is frequently used for Internet of Things and home automation applications. The Tensilica Xtensa LX106 32-bit RISC CPU, 4 MB flash, 64 KB SRAM, and EEPROM are all features of the board. Its clock speed is 80 MHz. Eleven of its seventeen GPIO pins may be used to interface with sensors and actuators.

With an inbuilt antenna, the board may function as a Wi-Fi Access Point (AP) or connect to current networks as a Station (STA), supporting IEEE 802.11 b/g/n standards. For safe connections, it also supports WPA/WPA2 authentication. for notification and display systems. It may be powered by a VIN pin or Micro USB and runs between 2.5 and 3.6 volts.

To communicate with external devices, the board features peripheral interfaces including UART, SPI, I2C, I2S, and SDIO. Additionally, it features an inbuilt ADC and firmware compatibility with MicroPython for programming and the Arduino IDE. Analog input, digital I/O, PWM pins, communication, and interrupts are all part of the board's pinout and connection.

Because of its small size, integrated Wi-Fi, energy economy, programming simplicity, and adaptability, the NodeMCU ESP8266 is incredibly inexpensive for Internet of Things experimentation. Applications include web servers, IoT projects needing cloud connectivity, home automation systems, and remote sensor and device monitoring and control.

3. CONCLUSIONS

Cadio is a user-focused smart home automation solution that combines IoT technology with AI-driven solutions. It offers multi-modal control options, allowing users to use voice assistants like Google Assistant and Amazon Alexa with local and distant internet access. Cadio's reliability is demonstrated by its dual connectivity with the Cadio cloud and local Wi-Fi, ensuring dependable connections and quick reaction times. Its automation capabilities are further enhanced by features like activity scheduling, timing settings, and sensor compatibility for dynamic environmental reactions. The AI-powered code generation democratizes smart home setup, eliminating the need for background programming expertise. The program also features pin-code protection and EEPROM-backed memory retention for user security and system reliability. Cadio's price, versatility, and ease of use make it a desirable choice for a wide range of users, from beginners to seasoned enthusiasts. Its commitment to interoperability and persistent dependability is demonstrated by its integration with popular ecosystems like Google Home and Amazon Alexa, as well as its offline manual operation feature. Cadio skilfully demonstrates the latest developments in home automation by fusing strength and simplicity.

REFERENCES

1. H. Durani, M. Sheth, M. Vaghasia and S. Kotech**, "Smart Automated Home Application using IoT with Blynk App,"** *2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT)*, Coimbatore, India, 2018, pp. 393-397, doi: 10.1109/ICICCT.2018.8473224.

2. N. A. N. M. Ashril, D. P. Dahnil and S. Abdullah, **"Wi-Fi Based Smart Home Prototype Development,"** *2019 International Conference on Electrical Engineering and Informatics (ICEEI)*, Bandung, Indonesia, 2019, pp. 540-543, doi: 10.1109/ICEEI47359.2019.8988871.

3. A. Eleyan and J. Fallon, **"IoT-based Home Automation Using Android Application,"** *2020 International Symposium on Networks, Computers and Communications (ISNCC)*, Montreal, QC, Canada, 2020, pp. 1-4, doi: 10.1109/ISNCC49221.2020.9297320.

4. A. R. Dasgupta, P. Kumari, H. Sahu, S. Amarnath and S. Nanda, **"Smart-Home Automation using AI Assistant and IoT,"** *2021 4th International Conference on Recent Trends in Computer Science and Technology (ICRTCST)*, Jamshedpur, India, 2022, pp. 329-333, doi: 10.1109/ICRTCST54752.2022.9781919.

5. R. Kawchale, S. Deshpande, K. Patil, A. Wajed and V. Somvanshi, **"Home Automation System By Android Application And Voice Control,"** *2024 8th International Conference on Computing, Communication, Control and Automation (ICCUBEA)*, Pune, India, 2024, pp. 1-6, doi: 10.1109/ICCUBEA61740.2024.10774849.