



# WIFI BASED HOME AUTOMATION SYSTEM

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## ABSTRACT

The Wifi Based Home Automation System enables users to operate home appliances through a dedicated application which operates Wi-Fi for home automation. The system uses Internet of Things (IoT) technology to connect home appliances through Wi-Fi which maintains a constant connection to a central controller that operates on ESP32 microcontroller. Users can operate the system with its simple design which can grow to handle increasing system demands while maintaining energy efficiency. The system provides essential home device control to regular users while delivering extra benefits to users who experience physical challenges and to elderly users. The system operates safely through its real-time data feedback, multi-device support and built-in security features. System control enables users to operate the system through voice commands and through a dedicated system application which communicates with the microcontroller using Wi-Fi. Users control lights and fans and all other electrical devices by speaking to their voice assistant or through their mobile application which offers simple control. The app enables users to manage their home functions by sending real-time commands through the internet which allows them to control their home system from any location. The system shows a budget-friendly solution which helps smart homes operate through IoT and wireless technology while AI-based voice assistance systems enhance home management and personal living.

**Keywords:** Wi-Fi automation, Smart Home, Home Automation System, ESP32, Remote access.

## I. INTRODUCTION

In today's world the utmost important thing in life of a human being is time and it has influenced human life to a greater extent. Technology plays a vital role in saving time for humans. The system- clearly aims to save time and energy. The developing countries like India are very high energy consumption nations so with the increase in consumption of energy and population, there is a grave need to conserve energy in every way possible. The inability to access and control the appliances from remote locations is one of the major reasons for energy loss. All existing systems have only one operator in the home; the other family members don't have access to remotely control the automation at home, in the existing system the only one family members can control the electric appliances remotely so this is a major drawback with other automation systems. In the proposed system, we are trying to connect all the family members to share the dashboard and remotely control all the electric appliances by their phone. In this way, more energy can be saved because in this current world electric energy is like fuel to operate this digital world and saving this for our future generation is our priority.

Now days, home automation is one of the major applications of WI-FI and other wireless technology there are a number of ways access control through PC or mobile which provides security and the emergency activated the system. It takes advantage of wireless communication between device and authentication to perform the identification. In this project, we propose a home automation system that can control home appliances from a PC or mobile phone using Wi-Fi and in this, we present a low cost secure, flexible home automation system. The systems which are already there from more than a decade now are usually wired. KNX and Lon Works are a few examples of these types of well-established systems. The wired system does not happen to be a problem if the installation of the system was pre planned, but installing it on a pre-built building may pose a problem as it requires wiring and cabling which results in increase of cost and effort.

A Wi-Fi-based home automation system enables users to control home appliances and devices through internet-based wireless power control. The system uses a microcontroller or development board which connects to Wi-Fi to function as its main control unit. Users can control all electrical devices in their home through the system by using either their smartphone application or web interface. Users and devices communicate through Wi-Fi technology which removes the necessity for complicated wiring systems. Sensors can be added to the system which automatically activates lights when movement occurs and controls temperature based on current environmental conditions thus improving home intelligence and energy efficiency.

## II. LITERATURE REVIEW

Joynarayan Patra, *et.al.* had presented a work on Wi-Fi-based home automation systems gained significant attention due to their ability to provide remote control and monitoring of household appliances. Recent studies have focused on the technical evaluation of wireless control modules, analysing installation complexity, communication performance and energy consumption. These studies suggest that while Wi-Fi modules offer ease of installation and eliminate the need for extensive wiring, they tend to consume more energy than low-power alternatives such as ZigBee or BLE. The Wi-Fi home automation system requires power management optimization together with standby power reduction to achieve its eco-friendly operational goals. [1]

Dr. Abdul Lateef Haroon, *et.al.* have compared Wi-Fi with other wireless communication protocols to determine the most suitable technology for smart homes. Wi-Fi is preferred for its high data transmission rate, universal compatibility with existing home routers and ability to support multiple devices simultaneously. Research shows that Wi-Fi networks encounter three main problems which include interference, latency issues and congestion when multiple devices connect to the network in areas with high user activity. To solve these problems, experts suggest using network planning methods which involve creating separate network segments for IoT devices and establishing dedicated SSIDs and improving router performance to achieve better network stability and communication reliability. [2]

Yinyan Chen, *et.al.* had presented a work of Wi-Fi-based home automation systems been widely explored using microcontrollers such as ESP8266 and ESP32. The system allows users to operate lights and fans and other devices through their smartphones and web-based controls. The testing in real environments shows that Wi-Fi modules enable effective device control while delivering sufficient response times. Multiple room setups experience two main problems which include signal degradation and longer delays when multiple commands are executed at once. The study results demonstrate that researchers must take actual network conditions into consideration when they create Wi-Fi-based smart home systems. [3]

The research work of Abdulhafz Ahmed Mustofa and his colleagues focused on combining voice control technology with sophisticated user interface systems in their development of Wi-Fi home automation systems. Users gain hands-free control over their appliances through voice assistant integration with Wi-Fi microcontrollers which benefits particularly elderly and disabled users by improving their access to technology. Home automation through Wi-Fi can be implemented successfully in regular homes according to research which shows that budget-friendly solutions enable this technology to operate without needing costly equipment or major system changes. The systems enhance user experience according to research findings yet their performance depends on three critical areas which require improvements, namely latency issues and recognition accuracy problems and network reliability challenges. [4]

C. Irugalbandara, *et.al.* had presented a work on Wi-Fi-based systems to include energy monitoring and home security functions. The system enables users to monitor appliance operations while they maintain energy efficiency and protect their network connected devices from unauthorized access. People use Wi-Fi as their

primary home automation system but its implementation creates problems with network range, device connection capacity and security system management. The research demonstrates that Wi-Fi provides a successful platform for smart home automation yet there exist multiple ways to improve energy saving, system growth, network performance and safety.[5]

### III. METHODOLOGY

The home automation system uses Wi-Fi technology to enable users to control and monitor their home appliances through internet access. The system uses smart devices together with microcontrollers and sensors and Wi-Fi modules to build a smart home system which users can control from their smartphones and tablets and computers.

The system enables users to operate their household lights and fans and air conditioners and security systems and all other appliances which results in better energy efficiency and convenience and stronger protection. The system provides energy monitoring capabilities together with scheduling functions which let users monitor the power use of each device while they set times for appliance operation. This feature helps electricity consumption become more efficient by decreasing unnecessary energy usage.

Wi-Fi-based systems enable users to expand their network by adding new appliances and smart devices which requires minimal modifications to their current system design. The Wi-Fi-based home automation system delivers remote access and automated home management and energy-saving capabilities and advanced home security protection through its unified system platform.

The system becomes an optimal modern smart home solution because its user-friendly interface enables scalability and uses accessible Wi-Fi networks to support IoT technology applications in daily activities.

### IV. DEVELOPED SYSTEM

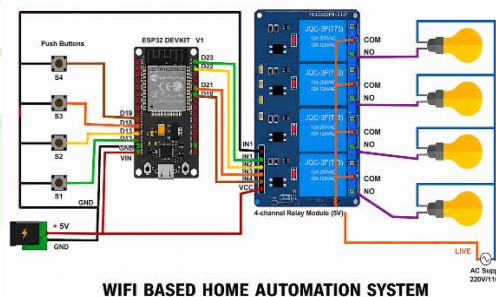


fig.: wifi based home automation system

The ESP32 module is equipped with an integrated microcontroller, a relay module, a power supply, and the Wi-Fi module to control the Wi-Fi home automation system. The ESP32 system controller handles input signals by processing them to control electrical appliances for command execution. The system functions as a contemporary smart home system which enables users to control their devices through mobile applications and cloud-based services because the ESP32 Wi-Fi capability. The relay module enables direct connection between low-voltage control signals and high-voltage AC appliances. The ESP32 GPIO pins connect to each relay channel through its input pins which are IN1 to IN4. The relay activates when the ESP32 sends a signal to the relay input which closes the circuit between Common (COM) and Normally Open (NO) terminals. The current path to the connected device has been established which enables electrical power to flow to the appliance. The appliance turns OFF when the circuit gets interrupted by the relay deactivation. The system maintains safety through electrical isolation which separates control mechanisms from load operations.

The system needs 5V power supply for its operation which powers both the ESP32 through its VIN connection and the relay module through its VCC connection. A common ground (GND) is maintained across all components to ensure proper operation. The AC mains supply (220V/110V) connects to the appliances through the relay contacts which serve as the load side connection. The load receives power through the relay which powers the live wire while the neutral wire directly links to the load. The system detects input through

two methods which use push buttons or Wi-Fi commands to receive signals. The ESP32 processes these inputs and sends appropriate signals to the relay module to control the appliances. Users can operate the system through two methods which include manual switch operation and remote control through IoT platforms. The system provides added user convenience while it improves energy efficiency and supports better user comfort. The circuit system shows an actual smart home automation system which uses ESP32 technology together with relays for its operation. The system operates through hardware controls and wireless communication to manage home appliances which lead to a reliable and expandable home automation system for contemporary homes.

## V. CONCLUSION

The home automation system which uses Wi-Fi technology provides users with three benefits through its ability to control home appliances from remote locations using low-cost microcontrollers and their existing Wi-Fi networks. The system provides users with simple expansion capabilities while its network reliability problems and cybersecurity threats and increased power consumption issues create operational difficulties. The design of the systems enables designers to create secure environments which transform conventional houses into smart homes. The upcoming developments will solve three main areas: AI integration and security advancements and creation of energy-efficient modules that support sustainable smart living.

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