JEATSA JOURNAL
JOURNAL OF ENGINEERING ADVANCES AND TECHNOLOGIES FOR SUSTAINABLE APPLICATIONS
Volume 1, Issue 4 (Oct, 2025)
Print ISSN: 3062-5629 Online ISSN: 3062-5637
Open Access
https://jeats.journals.ekb.eg/

Wi-Fi Smart Home Based on Internet of Things

[1]Ibrahim S. Ibrahim, [1]Mennatallah S. Gad, [1]Mustafa M. Sallam, [2]Nora A. Ali
[1]Communications and Electronics Engineering Department, Giza Engineering Institute (GEI), Giza, Egypt
[2]Egyptian Chinese Collage for Applied Technology, ECCAT, Suez Canal University- Giza Engineering Institute (GEI), Giza, Egypt

[1]ibrahim.20200010@gei.edu.eg, [1]mennaallah.20200159@gei.edu.eg, [1]Mustafa.Sallam@gei.edu.eg, [2]noraali.eccat@suez.edu.eg, [2]nora.mahmoud@gei.edu.eg

Received 1-09-2024
Revised 15-10-2024
Accepted: 1-11-2024
Published: Oct-2025

Print ISSN: 3062-5629
Online ISSN: 3062-5637

Abstract- Human life is becoming increasingly efficient due to rapid advances in automation. Automated systems are now preferred over non-automated systems. As the number of Internet users' increases, the Internet of Things (IoT) has become an increasingly important technology, greatly impacting daily life and education by providing information and completing tasks while users focus on other activities. This paper presents a prototype of Wi-Fi Smart Home based on automation system, which demonstrates how effective it is at managing power, controlling home devices, and improving security within Wi-Fi coverage. By managing power usage more efficiently, enabling precise control of household devices, and bolstering security within Wi-Fi coverage, the system enhances convenience and safety for users, ultimately contributing to the growing trend of smarter and more efficient living spaces.

Keywords- IoT; Home Automation; Wi-Fi; Smart Home; Sensors; Microcontroller

I. INTRODUCTION

The "Home Automation" describes the use of computers and information technology to easily control household appliances. Those who would otherwise be dependent on nursing staff or institutional care can achieve a higher quality of life with home automation for older and disabled people [1]. Since home automation is now much more affordable and easier thanks to smartphone and tablet connectivity, it has become increasingly popular lately. The idea behind the IoT is that every device is assigned an Internet Protocol (IP) address that allows anyone to identify the device online [1, 2]. The mechanical and digital machines assigned Unique Identifiers (UIDs) and network data transfer functions, eliminating the need for human-to-human or human-to-computer interaction [1, 2]. Studies have predicted that the number of "Things" or devices connected to the internet will increase dramatically. The resulting network is defined as the IoT [3]. Recent technological advances have enabled the use of wireless control environments such as Bluetooth and Wi-Fi, allowing various devices to be connected together [3]. This indirectly reduces system costs. Each connection has different requirements and uses.

Home automation systems can manage lights, fans, appliances and eating-Ventilation-Air-Conditioning (HVAC) systems and is accessible via web-enabled devices at a reasonable cost [1,3]. The aim of this paper is to provide a comprehensive analysis of IoT smart home based on automation system prototype, focusing on its architecture, implementation, advantages and challenges, while examining future trends in smart home development [3-6]. Home automation systems automate the control of home appliances using microcontrollers, IoT sensors, and communication devices. This allows remote control via mobile devices, laptops or internet.

This paper is organized as follows: Section I introduces the paper, Section II presents the work overview, Section III states the problem, Section IV proposes system architecture, and Section V provides the system operations and finally Section VI concludes the paper.

II. WORK OVERVIEW

In order to address energy efficiency and prevent power outages, the project in this paper uses renewable solar energy by installing solar panels on the house, connected to batteries making solar energy the primary power source. This approach not only solves energy-related issues but also reduces costs and promotes sustainability. Additionally, the project includes a water conservation solution by recycling

JEATSA JOURNAL
JOURNAL OF ENGINEERING ADVANCES AND TECHNOLOGIES FOR SUSTAINABLE APPLICATIONS
Volume 1, Issue 4 (Oct, 2025)
Print ISSN: 3062-5629 Online ISSN: 3062-5637
Open Access
https://jeats.journals.ekb.eg/

household wastewater to irrigate garden plants, thereby minimizing water consumption. Figure 1 shows an illustration of the main stages of the proposed system.

Figure (1): Project Main Stages

III. PROBLEM STATEMENT

Conventional home automation systems are difficult for average households to implement because they are often costly, complicated, and difficult to access remotely [1-6]. The aim of the Wi-Fi smart home based on automation system is to address these issues by providing a cost-effective, user-friendly solution that can be accessed remotely via a smartphone application. The system uses the ESP8266 microcontroller and Flutter framework to streamline the automation process, reduce complexity and increase accessibility. This allows users to control all household appliances efficiently and economically from a single platform.

IV. THE PROPSED SYSTEM ARCHITECTURE

The hardware and software are the two main components of the proposed system. The devices are controlled by an ESP8266 microcontroller, which is part of the hardware components. A cross-platform application to control the devices is developed using the Flutter framework, which is part of the software components. The function of each component in the proposed system model is explained in detail as follows: the ESP8266 microcontroller is a hardware component that serves as the Central Processing Unit (CPU) of the system. It is a low-cost Wi-Fi enabled microcontroller that is easy to be programmable using Arduino IDE. The ESP8266 uses a variety of protocols including Radio Frequency (RF) and Infrared (IR) to communicate with home appliances. The ESP8266 is connected to a relay board that is used to control the devices by turning them on and off in response to user components. The devices are connected to the relay board, which is connected to the ESP8266 via GPIO pins. The software component of the system is the Flutter framework, which is used to create a cross-platform application to manage the appliances. Using the open-source Flutter framework, developers can create aesthetically pleasing and high-performance applications for the iOS and android operating systems. The application's user-friendly interface is designed to allow users to easily control the program. Figure 2 shows the main components of the proposed system model.

Figure (2): The Main Components of The Proposed System

The hardware architecture and the system layout design are as shown in Figure 3 and Figure 4, respectively.

Figure (3): System Hardware Architecture

Figure (4): System Layout Design

V. THE SYSTEM OPERTIONS

The operations of the system can be classified into three categories, as follows: energy saving, wastewater recycling and IoT integration. Each category has its hardware components that implement its function as follows:

Hardware components for energy saving operation:

- Solar Panels: Installed on rooftops to generate DC power from sunlight.
- Inverter: Converts the DC power generated by the solar panels into usable AC power.
- Battery Storage: Stores excess solar energy for nighttime or cloudy periods when solar production is low.
- Smart Meters: Measure real-time energy consumption and production.
- Grid Connection (Optional): If the home is grid-connected, excess energy can be fed into the grid, and the home can draw power from the grid when solar energy is insufficient.
- Energy Management System (EMS): Optimizes energy usage by managing the sources (solar, battery, or grid power) based on availability.
- Smart Appliances: Linked to the EMS, they adjust their energy usage according to solar energy availability.

Wastewater recycling operation:

- Grey water Collection System: Collects wastewater from sinks, showers, and washing machines
- Filtration and Treatment System: IoT-enabled sensors monitor water quality and trigger filtration when necessary.
- Reclaimed Water Storage Tank: Stores treated greywater for reuse in non-potable applications like irrigation and toilet flushing
- Rainwater Harvesting System: Collects rainwater from roof gutters, filters it, and stores it separately for later use.
- Smart Irrigation System: Uses moisture sensors to determine when to irrigate the garden, utilizing recycled grey water or rainwater.

IoT integration operation:

- Water Quality Sensors: Monitor parameters like turbidity and pH in recycled water to ensure it meets safety standards.
- Water Level Sensors: Track the amount of recycled water stored in tanks
- Usage Monitoring Sensors: Provide real-time data on water consumption and optimizing conservation efforts.
- Smart Irrigation System: Automatically adjusts watering schedules based on weather and water availability through an IoT central hub
- Water Dashboard: Displays recycling statistics and consumption data on a mobile application for user monitoring.
- Smart Sensors Temperature & Humidity Sensors: Used to monitor indoor climate.
- Motion Detectors: Detects movement, often used for security and lighting automation.
- Door/Window Sensors: Alerts when doors or windows are opened.

JEATSA JOURNAL
JOURNAL OF ENGINEERING ADVANCES AND TECHNOLOGIES FOR SUSTAINABLE APPLICATIONS
Volume 1, Issue 4 (Oct, 2025)
Print ISSN: 3062-5629 Online ISSN: 3062-5637
Open Access
https://jeats.journals.ekb.eg/

- Smart Cameras: Monitor surroundings and provide security footage.
- Smart Lights: To control the lighting system remotely or via voice commands.
- Smart Thermostats: Adjust home temperature based on user preferences or presence detection.
- Smart Locks: To control and monitor door locks remotely.
- Smart Plugs/Outlets: Turn ordinary devices on or off through automation.
- Smart Speakers/Displays: Google Home (Alexa/Siri), these devices act as the primary interface for controlling the smart home using voice commands. They connect to google assistant and provide feedback to users.
- Microcontrollers/Modules ESP8266/ESP32: Wi-Fi-enabled microcontrollers for connecting sensors and actuators
- Bluetooth Low Energy (BLE): Useful for short-range, low-power communication between devices.
- Message Queuing Telemetry Transport (MQTT): Lightweight protocol used in IoT for real-time communication between the devices and the server.

VI. CONCLUSION & FUTURE WORK

Wi-Fi smart home based on automation systems using IoT can be considered as viable solution for those who want to automate their homes and manage their devices via a smartphone application. Users can create custom schedules and control settings as well as remotely control their devices by integrating the ESP266 microcontroller into a relay board and using the Flutter framework to develop a smartphone application. Thanks to the modular design of the system, the smartphone application and the microcontroller can easily communicate wirelessly, which also makes scaling and maintenance easier. Increasing comfort, enhancing energy efficiency and more control over the household appliances are just some of the benefits of the proposed system. Additionally, it offers the opportunity for later improvements such as power monitoring, voice control and machine learning. Our future scope is to extend the mobile platform to the iPhone Operating System (iOS), since most systems do not support Android applications due to incomplete hardware board platform support.

VII. REFERENCES

[1] Hossain, N., Hossain, M. A., Sultana, R., & Lima, F. A., "A Security Framework for IOT based Smart Home Automation System", Global Journal of Computer Science and Technology: E Network, Web & Security, 2018, 18(3).

[2] Kousalya, S., Priya, G. R., Vasanthi, R., & Venkatesh, B., "IOT based smart security and smart home automation", International journal of engineering research & technology (ijert), 2018, 7(04), pp. 43-46.

[3] Preethi, J., & Sowmiya, S., "Emotion recognition from EEG signal using ISO-FLANN with firefly algorithm", International Conference on Communication and Signal Processing (ICCSP), (2016, April), (pp. 1932-1936). IEEE.

[4] Raju, S. H., Rao, M. N., Sudheer, N., & Kavitharani, P., "IOT Based Home Automation System with Cloud Organizing", International Journal of Engineering & Technology, 2018, (2.32), 412-415.

[5] Likhitha, K., Malineni, S., Jampani, N., & Prasanna, N. L., "Home security system using PIR sensor-IoT", International Journal of Scientific Research in Computer Science, Engineering and Information Technology, 2019, pp. 497-500.

[6] Kodali, R. K., Jain, V., Bose, S., & Boppana, L., "IoT based smart security and home automation system", International Conference on Computing, Communication and Automation (ICCCA), (2016, April) (pp. 1286-1289).