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Revolutionizing Home Living Using Cyberspace Technology

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Abstract— A computerized home integrates technology to automate and oversee various aspects of the household, offering convenience, enhanced energy efficiency, security, and comfort. This setup includes smart devices, sensors, and systems that allow for remote control and scheduling. The system encompasses a variety of components, such as thermostats, lighting controls, security systems, and voice assistants, all of which collaborate to streamline tasks, reduce energy consumption, and bolster security. The process of home computerization results in the creation of intelligent living spaces that cater to a connected lifestyle. The proposed system is designed to computerize homes with an affordable and wireless infrastructure. Its primary focus lies in the development of an Internet of Things (IoT)-based home automation system, facilitating remote control of various components via the internet or automatic programming based on environmental conditions. By leveraging the NodeMCU IoT platform, a firmware is engineered to minimize the need for human intervention, ensuring the efficient operation of electrical devices. Different transmission modes enable seamless communication between the user, NodeMCU, and household appliances. The primary control system utilizes wireless technology, enabling remote access through smartphones via cloud server-based communication. A data transmission network enhances the automation capabilities of the system. With its user-friendly interface and straightforward installation process, this system effectively manages electrical appliances within a household. The proposed system empowers users to exercise internet-based control over any load through the use of an ESP32 Wi-Fi module, resulting in increased independence, safety, convenience, control, comfort, and energy savings.

Keywords— Automation, IoT-based, Energy efficiency, Smart devices, Cyberspace, Security

1. Introduction

The proposed system aims to revolutionize the concept of home computerizing by leveraging the power of cyberspace and digital technologies. With the rapid advancement of technology and the increasing connectivity of devices, the potential for creating a smart and interconnected home environment has become more accessible than ever before. Smart home technology [1] has the potential to significantly enhance energy efficiency by addressing common issues such as appliances being left switched on due to human laziness or negligence. In many instances, occupants may leave a room without turning off lights, fans,or air conditioners. Smart home computerizing systems can intelligently and automatically turn off these appliances without requiring human intervention. The primary objective of this system is to create a comprehensive and user-friendly system that allows homeowners to remotely control and monitor their homes from anywhere in the world. By harnessing the capabilities of cyberspace, homeowners can seamlessly interact with their home's appliances, lighting systems, security cameras, and more through intuitive and convenient digital interfaces.

Moreover, the proposed system aims to enhance the efficiency and convenience of managing a home by incorporating features like voice control, mobile applications, and real- time data analytics. It goes beyond mere physical capabilities and incorporates intelligence to minimize human involvement in various daily tasks, including mechanical, sensory, and mental aspects

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[2]. Through these advancements, homeowners can optimize energy usage, receive instant alerts on security breaches, and access valuable insights into their home's performance and resource consumption.

The implementation of this system involves the integration of various technologies, including wireless communication protocols, internet connectivity, sensor networks, and intelligent algorithms. A recent research study predicts that the worldwide installed base of Internet of Things (IoT) connected devices will surpass 75.44 billion by 2025 [3].

By computerizing the home using cyberspace, this system envisions transformingtraditional houses into intelligent living spaces that adapt to the needs and preferences of the residents. In one of the researches, M. Al-Kuwari and coauthor introduced a smart home computerizing system using IoT based Monitoring and Sensing Platform. The study outlinesa fundamental approach to implementing home computerizing through IoT, showcasing its potential for enhancing residential environments [4]. It opens up a realm of possibilities for enhancing comfort, convenience, and sustainability within the home environment. In 1975, a Scottish company introduced X10, the pioneering smart home technology [5]. In the realm of home and industrial security, the utilization of cutting-edge technological components has become crucial. Numerous research papers focus on showcasing the design and implementation of remote control and home security systems based on GSM (Global System for Mobile) technology [6][7]. This early development marked the inception of smart home systems, paving the way for the advancements and innovations seen in the field today. Control Technology and Information and Communication Technology (ICT) receive significant annual funding due to the numerous benefits they offer. This financial investmentis made to capitalize on the advantages provided by these technologies [8].

This system represents a significant step towards creating smart and interconnected homes. By harnessing the power of cyberspace and digital technologies, this proposed system aims to revolutionize the way we interact with and manage our living spaces. Through the integration of intelligent systems, secure communication protocols, and intuitive interfaces, homeowners can experience enhanced control, convenience, and efficiency in their daily lives.

2. Proposed System

The aim is to create a design for an interconnected network of home appliances that can be seamlessly integrated into an autonomous HAS. This involves considering each individual appliance and devising ways to computerize and integrate their control within the network, contributing to the overall functionality of the HAS. The objective is to develop an application that enables wireless control of home appliances. This can be achieved throughtwo modes: switch mode, where users can remotely control appliances through the application, and voice mode, where appliances can be controlled using voice commands. By incorporating these features, users can conveniently manage their appliances through the wireless control system. The Proposed system also focuses on providing the capability to monitor the status of home appliances. Through the application, users will be able to view the current status of their appliances, allowing them to keep track of their operation and make informed decisions within the HAS. This feature enhances the overall functionality and convenience of the system. The rise of voice recognition software, exemplified by Amazon Alexa, has generated significant demand for home automation [9].

The proposed voice control system [10] enables remote control of appliances for the elderly and disabled using voice recognition technology. It improves independence and convenience by eliminating the need for physical interaction, benefiting those with limited mobility or dexterity. This system enhances the quality of life, offering a promising solution for effortless appliance control and promoting autonomy.

This is essential to prevent unauthorized access and maintain the integrity of the Home Appliance System (HAS). Secure connections will be established using protocols such as SSL over TCP and SSH, which provide encryption and authentication mechanisms. By implementing these secure protocols, the system will prevent other devices from gaining control over the HAS

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and ensure that only authorized devices with proper authentication can access and control the appliances.

2.1 System Design

The main focus of this proposed system is to establish a system that allows for the control of any load through the Internet network. This is made possible by incorporating an ESP32 Wi-Fi module, which enables remote control of devices via the cloud. One of the significant benefits of implementing such a system is the increased independence it offers to people with disabilities. In the future, the proposed system has the potential to be adapted and modified based on the concepts of the Internet of Everything (IoET) [11]. By providing them with the ability to control various appliances and devices from a remote location, it enhances their overall autonomy and improves their quality of life. Additionally, this proposed system contributes to enhancing safety within the home environment, as users can remotely monitor and manage their appliances, minimizing potential risks. By establishing a cooperative network, stand-alone appliances present at home or in the office can be integrated and connected through wireless communication, as highlighted in [12]. This approach enables the creation of systems that leverage the connectivity of individual devices to form a unified network, enhancing their functionality and cooperation.

Moreover, it provides efficient control over electrical loads, allowing users to manage energy consumption effectively and promote energy savings. Overall, this proposed system not only empowers individuals with disabilities but also addresses key aspects of safety, convenience, control, comfort, and energy efficiency. The different major components used are explained in the successive sessions.

2.2 IR Receiver

An IR receiver, also known as an infrared receiver, is a hardware component that receives and decodes infrared signals from a remote control. When an infrared signal is transmitted from the remote control, the IR receiver captures it and converts it into a code that the device can understand. This code contains specific instructions or commands for the device to perform certain functions or operations. IR receivers are available in a range of models, each offering different specifications such as supply voltage, carrier frequency, transmission distance, and packaging type. Their versatility and widespread usage make them an essential component in numerous consumer electronics, computerized systems, and other industrieswhere remote control capabilities are required.

2.3 DHT-11 Sensors

The DHT11 is a widely used sensor for measuring temperature and humidity. It utilizes an NTC (Negative Temperature Coefficient) thermistor for precise temperature detection and an 8-bit microcontroller to generate serial data output, delivering accurate temperature and humidity values.The convenience of the DHT11 lies in its factory calibration, which simplifies the process of integrating it with other microcontrollers or systems. The DHT-11 sensor boasts impressive reliability and long-term stability, as supported by research findings [13]. This sensor is capable of accurately measuring temperature within the range of 0°C to 50°C and humidity between 20% and 90%. It offers an accuracy of ±2°C for temperature readings and ±5% for humidity readings. If your application falls within these temperature and humidity ranges. The DHT11 sensor is available in two forms: as a standalone sensor oras a module. Regardless of the form, both versions deliver the same level of performance.The sensor is equipped with three pins, facilitating easy connectivity to your system or microcontroller.

2.4 ESP32

The ESP32 is an advanced microcontroller module specifically designed for Internet of Things (IoT) applications. It features a dual-core Tensilica LX6 microprocessor, providing enhanced processing power and multitasking capabilities. With its versatile capabilities, the ESP32 can

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operate independently or serve as a subordinate device to a host MCU. Thisflexibility minimizes communication stack overhead on the main application processor, optimizing performance [14]. Additionally, the ESP32 is furnished with a CP2102 chip, allowing it to directly interface with a computer for programming tasks. This eliminates the necessity of employing an extra FTDI programmer provided by Future Technology Devices International (FTDI) [15]. Operating within a voltage range of 2.2V to 3.6V, it accommodates various power sources, providing compatibility and versatility. With 4MB of flash memory, the ESP32 provides ample storage space for program code and data, contributing to its reliability and efficiency. The ESP32 provides a wide range of applications, such as the ability to implement a position control system [16] or a smart surveillance system [17].

2.5 Methodology

For designing the prototype involves several key steps to achieve wireless remote control over a network of home appliances.

- *Requirement Analysis*: The first step is to identify the requirements and functionalities desired in the prototype. This includes determining the types of appliances to be controlled, the modes of control (switch mode, voice command), and the ability to view device status on the Android application.
- *System Design*: Once all the requirements are defined, the next step would be to design the system architecture. This involves selecting appropriate hardware components such as microcontrollers, wireless communication modules (e.g., Wi- Fi), and sensors. The system design also includes designing the Android application interface for user interaction and control.
- *Hardware Implementation*: In this phase, the selected hardware components are integrated to create the prototype. The microcontroller is programmed to communicate with the appliances, and the wireless communication module is configured to establish a network connection.
- *Android Application Development*: The Android application is developed to provide a user-friendly interface for controlling the appliances. It includes features like switch mode control and voice command control, allowing users to interactwith the appliances remotely.
- *Testing and Validation*: The prototype is thoroughly tested to ensure proper functionality and reliability. It undergoes various scenarios to validate its performance, including different modes of control and monitoring the status ofdevices on the application.
- *Refinement and Optimization*: Based on the test results, the prototype is refinedand optimized to improve its efficiency, responsiveness, and user experience. Feedback from users is also considered to make necessary adjustments and enhancements.

The block diagram of this proposed system using IoT consists of several interconnected components that work together to enable remote control and monitoring of various home devices. At the core of the system is the IoT gateway, which serves as the central hub for data communication and integration. The gateway is responsible for collecting and transmitting data between the devices and the cloud server.as shown in Figure 1.

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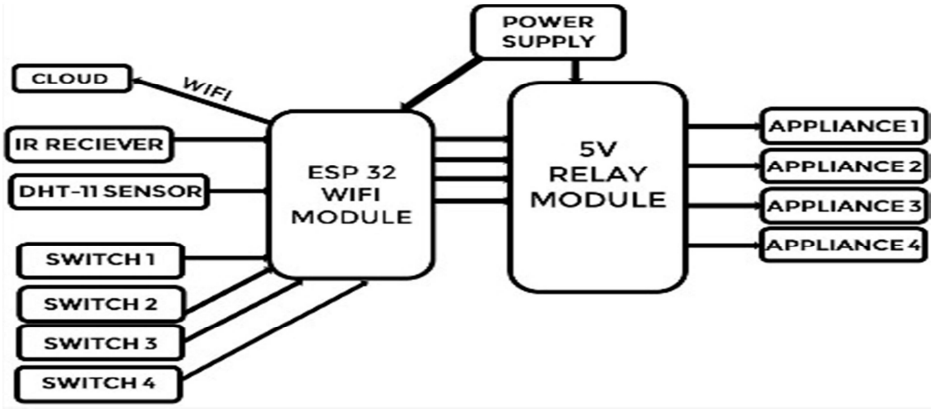

Figure. 1. Block Diagram of the proposed system

3. Result and Discussion

We designed an affordable computerized system utilizing the ESP32 module and an IR receiver. This system successfully enabled precise control of appliances and provided real- time feedback through various means such as a mobile app, IR remote, manual switches, and voice control. With the integration of Internet connectivity, it became possible to remotely control all the appliances from anywhere in the world. Additionally, accurate temperature and humidity readings were seamlessly transmitted to a server through WiFi and made accessibleon the mobile app. The system proved to be dependable and cost-effective, holding great potential to enhance the quality of life for individuals with disabilities and the elderly. Withits affordable design and versatile functionality, our computerized system opened up new possibilities for smart home computerization. The integration of the ESP32 module and IR receiver provided a scalable and flexible platform for expanding the system's capabilities and integrating additional IoT devices and sensors. This expandability allowed users to tailor the system to their specific needs and preferences, making it adaptable to evolving technologiesand future advancements. Overall, our computerized system utilizing the ESP32 module andan IR receiver demonstrated the potential to revolutionize home computerization for individuals with disabilities and the elderly. By offering precise control, real-time feedback, remote accessibility, and intelligent computerization, it provided a comprehensive solution to enhance comfort, convenience, and energy efficiency in homes. As technology continues to advance, our system lays a strong foundation for further innovation in the realm of smart home computerization and IoT applications.

3.1 Completed Prototype

The circuitry has been specifically designed to address the identified problem and has been thoroughly tested in different scenarios to validate its functionality. The overview of the proposed system is given below in Figure-2.

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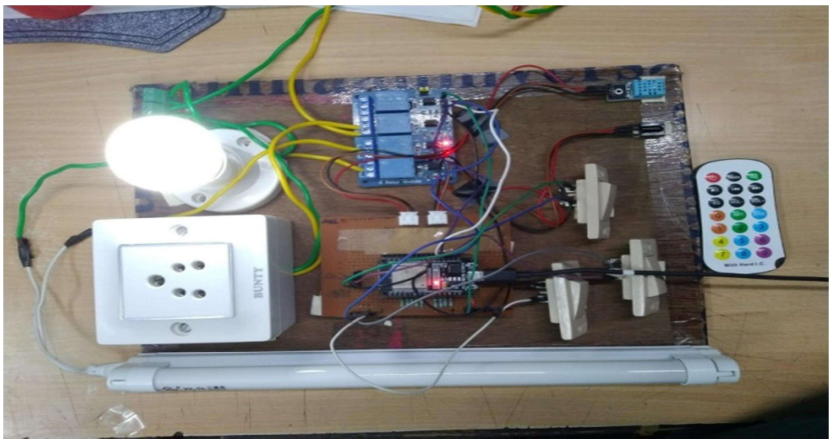

Figure. 2. Overview of the proposed system

3.2 Visual outputs displayed on Cloud IOT Dash board

Cloud IoT dashboards provide a platform to display visual outputs of data. These dashboards are hosted on cloud servers and offer a user-friendly interface to monitor and analyze data collected from IoT devices. The visual representations on the cloud IoT dashboard enhance data visualization, making it easier to interpret and make informed decisions based on the collected data. The visual representations on the cloud IoT dashboard play a crucial role in enhancing data visualization. Through charts, graphs, maps, and other visual elements, complex data sets can be presented in a clear and concise manner. This simplifies the interpretation of the data and enables users to derive meaningful insights. By visualizing the data, trends, patterns, and anomalies can be easily identified, empowering users to make informed decisions and take appropriate actions based on the collected data. The visual outputs act as a visual aid, facilitating a deeper understanding of the information at hand. Figure.3 illustrates the appearance of the dashboard on the mobile application when the system is online.

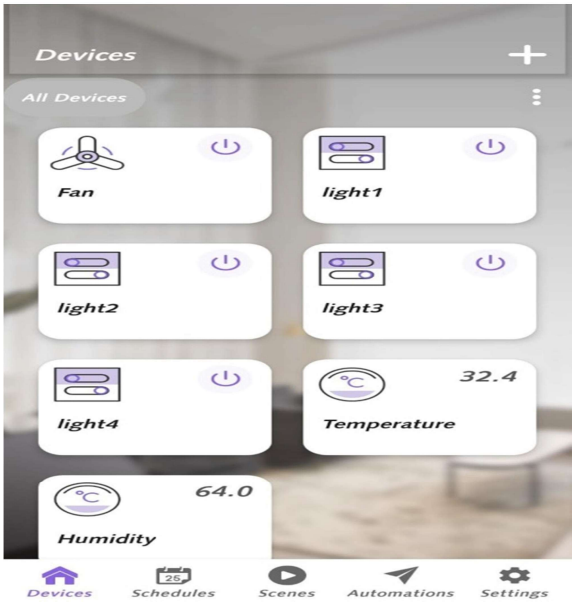

Figure. 3. Mobile Dashboard

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Figure.4 illustrates the appearance of the dashboard on the mobile application when the systemis offline

Figure. 4. Mobile Dashboard

Figure.5 shows the appearance of the dashboard on another mobile application

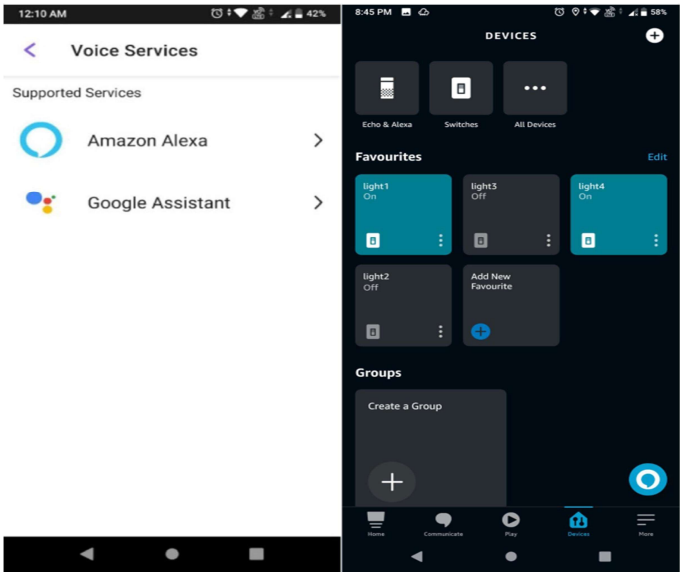

Figure. 6. Amazon alexa Application

4. Conclusion

In conclusion, the proposed computerized home system offers a scalable solution for residential computerization, with the potential to be extended to apartments and larger dwellings. However, it is essential to address security concerns as the system is implementedon a larger

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scale. Measures such as integrating a doorbell alert system can help mitigate security risks and ensure the safety of the occupants. The system allows for the remote control of various appliances, including lighting, fans, coolers, fridges, and air conditioning systems, through internet-enabled devices. The convenience of controlling home doors remotely using portable internet-enabled devices adds to the system's functionality. Thinger.io provides secure account creation, authentication, and authorization features, ensuring that only authorized individuals can control and monitor the system. This enables users to customize and update their home computerization system to suit their needs, making it smarter and more efficient. The experimental implementation of the system has successfully demonstrated its ability to control appliances remotely and store sensor data in the cloud, allowing users to monitor and analyze home parameters anytime, anywhere. The utilization of wireless technology and Android-based applications has significantly enhanced the ease and accessibility of computerized home, contributing to energy savings, time efficiency, and cost reduction. The primary objective of the computerized home system is to enhance people's convenience in controlling their home appliances through mobile applications while promoting energy conservation and cost savings.

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