
Voice Controlled Room Automation using IoT and Sensors in Wireless Mesh Networks

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ABSTRACT:

Nowadays, the world moving fast pace so are people who lead to negligence on saving energies like electricity and the big problem with wastage of energy but it will affect our future generations. This paper proposes a novel approach to control the appliances like lights, fans, etc., through voice control with help of Google Assistance for the efficient use of energy. This design provides a hardware implementation using microcontroller based embedded Arduino to control the end devices through wireless IoT based on the information provided by the Wi-Fi routers and software platform using “If This Than That” (IFTTT) and eWeLink apps for configuring the system features and security aspects. The integration of other networks like cellular, sensors and cloud with the wireless mesh network (WiMesh) can be accomplished by routers bridging function for extending the range of coverage around the world. Thus, a lot of human effort is simplified to control the appliances smartly through voice commands from anywhere around the world. It is concluded that the proposed voice controlled room automation is very effective and high performance system.

Keywords: Google Assistance, IoT, voice control, Wi-Fi, Wireless mesh network.

INTRODUCTION

The habituated of human beings towards leaving the rooms without switching the lights, fans etc., which leads to unnecessary consumption of energy. It is a difficult task for turning of appliances in big buildings. It requires heavy budgets for energy efficiency and security persons are needed to monitor the rooms in order to prevent wastage of energy. It needs a lot of physical work and time taking process [1,2]. Wireless technologies are becoming more popular around the world and wireless lifestyle relieves the wired difficulties [3]. A home automation system was proposed based on Bluetooth technology allowing different kind of devices to be controlled with minimum modifications to its base. Password protection allows authenticated users to access the appliances at home and it adds a protection from unauthorized users [4]. The ZigBee protocol supports a number of applications like building automation networks, home security systems, industrial control networks, remote metering and PC peripherals etc. However, ZigBee based system faces some challenges like limited range, resources constraint- sensors (node) used in system, and interference with other wireless system [5]. The Home Automation system divides basically into three layers. The first layer is the input, which can be from switches, sensors, limit switches, or any other equivalent devices. The second layer is control unit which reads the inputs and performs actions with respect to the input based on user specified program. Last is the actuator layer which receives commands from the control unit and responsible for enabling the real-world systems such as lights, fans, etc. [6].

As various wireless networks evolve into the next generation to provide better services, a key technology, wireless mesh networks (WiMesh), has emerged recently. The nodes of WiMesh are comprised of mesh routers and mesh clients [7]. In this mesh network, information is provided to routers and the routers will route the information to the end devices. The architecture of WiMesh can be classified into three main groups based on the functionality of the nodes. Hybrid network type architecture of WiMesh is the combination of the infrastructure and the client meshing [8]. Mesh clients can access the network through mesh routers as well as directly meshing with other mesh clients. While the infrastructure provides connectivity to other networks such as the Internet, Wi-Fi, Wi-MAX, cellular, and sensor networks, the routing capabilities of clients provide

improved connectivity and coverage inside the WiMesh. Automation process is proposed for reducing human efforts in controlling appliances and the cost and to save the electricity [9]. The automation is done by several techniques such as Bluetooth modules, Zig-BEE modules. The range of coverage, sensitivity, availability of resources and network capacity are serious issues to be considered in such system designs [10].

To overcome this problem, innovativeroom automation design is developed in this paper using voice control through Google Assurances and wireless IoT modules to control the appliances build around the WiMesh network. This design provides a hardware implementation using microcontroller based Embedded Arduino and software platform using “If This Than That” (IFTTT) and eWeLink Android applications for user friendly interface and accurate and real time feedback control. In addition, it also provides a security feature to prevent unauthorized entry while the user is away.

SYSTEM DESCRIPTION

The block diagram shows the hardware platform for proposed voice controlled room automation build around the WiMesh network as in Fig. 1. The following important modules configures the proposed system with a lot of interfaces,

-) Interfacing PIR sensor to the microcontroller board.
-) Generating alerts from the microcontroller using GSM module to a registered mobile phone.
-) Message is displayed on mobile phone from where command is carried using Google Assistance to the IoT (Soneoff) module via WiMesh network.

The PIR sensors are placed in respective rooms where the appliances have to be controlled. PIR sensors sense the presence of persons in the room and send the information to Arduino microcontroller. Arduino process the information according to the program given to it and send the information to GSM module for sending a text message to the smart phone. The user decides whether the lights and fans should be switched OFF or ON the appliances using Google assistance in smart phone and this data is send to cloud with the help of mobile data. The command for control can be operated from anywhere in the world using the hybrid mesh topology. On the other end, the relay operated end devices of the appliances in the room are controlled by IoT module, called as Soneoff module, where the data from the cloud is accessed through the Wi-Fi router.

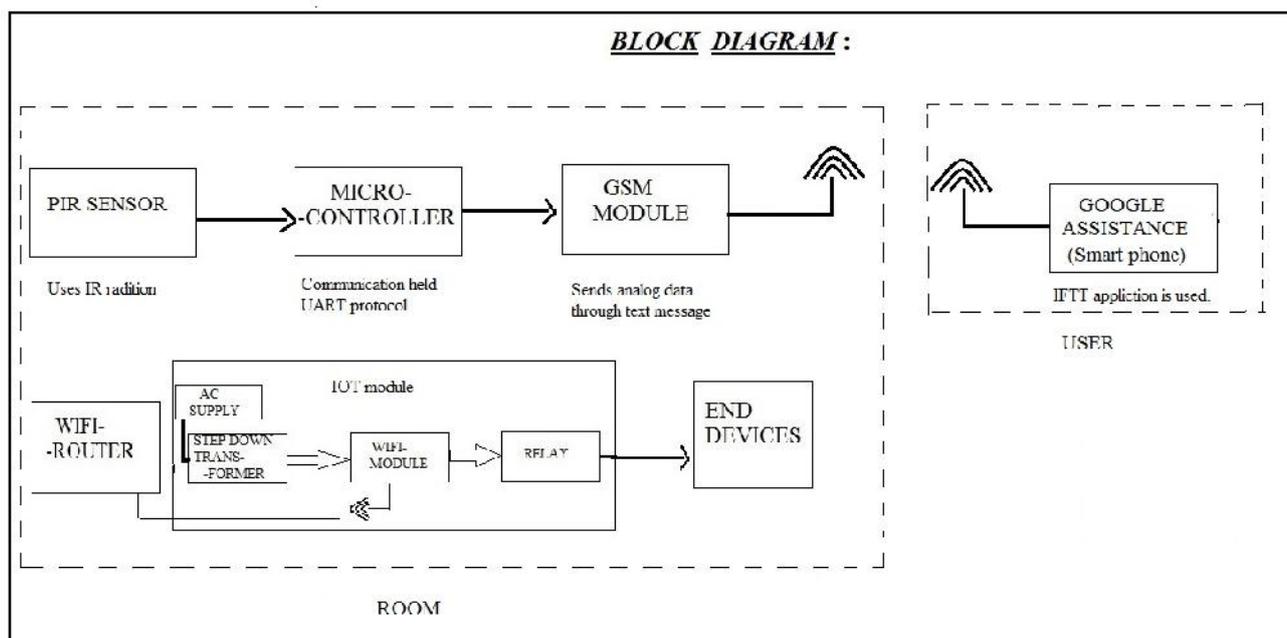


Fig.1 Block Diagram of the proposed design

HARDWARE DESIGN AND SPECIFICATIONS

Arduino Uno

The Arduino Uno is a development board based on the microcontroller ATmega328 [11]. It has PWM outputs, 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, a reset button and supports UART protocol. The ATmega328 has 32 KB out of which 0.5 KB used for the boot loader. It also has 2 KB of SRAM and 1 KB of EEPROM which can be read and written with the EEPROM library.

GSM Module

SIM800 is a complete Quad-band GSM/GPRS solution in a SMT type which can be embedded in the customer applications. SIM800 support Quad-band 850/900/1800/1900MHz and it can transmit voice, SMS and data information with low power consumption. Featuring Bluetooth and Embedded AT, it allows total cost savings and fast time-to-market for customer applications.

PIR Sensor

A passive infrared (PIR) sensor is an electronic sensor that measures infrared radiation being emitted from objects in its field of view. They are most often used in PIR-based motion detectors to sense movement of people, animals and other objects.

Wi-Fi module (SONEOFF)/Router/Relay

The Soneoff module is a Wi-Fi based wireless switch that can connect to a wide range of appliances. It transmits the data to a cloud platform through the Wi-Fi router, which enables users to remotely control all the connected appliances, via the mobile application of eWeLink and the cloud server of Amazon AWS global server. As long as the mobile has a network, users can remotely control the appliances from anywhere at any time. The Espressif of ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability [12]. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. Espressif systems released a software development kit (SDK) that allowed the chip to be programmed and remove the need for a separate microcontroller. A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operate a switch, but other operating principles are also used, such as optic-couple and solid-state relays. Optic-coupler is a device which is used to transfer electrical signal between two isolated circuits by using light. It is also called as photo coupler, and this also used to prevent high voltages from affecting the system receiving the signal. The router is used to route the signal to end devices and other routers in a WiMesh network as mentioned before. The routers are backbone of wireless networks which are self-organized and the access the signals with a specified IP address for the devices.

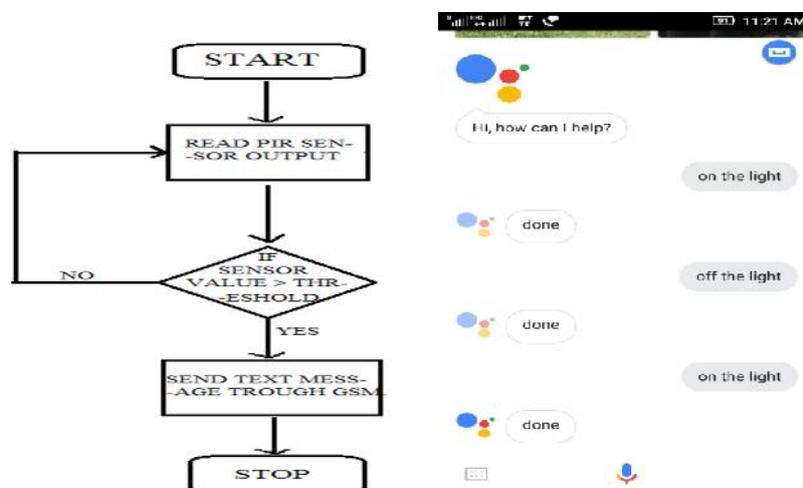


Fig. 2 Flowchart of design algorithm and snap of result

SOFTWARE DESIGN and ALGORITHMS

The design algorithm is developed using the Arduino Code, Google assistance and IFTTT and eWeLink applications. The design programs for Arduino as transmitter and receiver as explained in system description is performed using C and C++ languages and shown in Flowchart as in Fig. 2. “If This Then That” (IFTTT) is a free web-based service to create chains of simple conditional statements, called applets. An applet is triggered by changes that occur within other web services such as Gmail, Facebook, Telegram, and Instagram. eWeLink is a smart home control application that can control all home automation devices and cooperated products. It allows remote control function and manages favourite smart devices of different brands in a single application. Google assistant is a user and system interface where the commands through a voice of a person are taken and given to the respective application or web based on the requirement. It is a virtual personal assistant developed by Google that is primarily available on mobile and smart home devices. Unlike Google Now, the Google Assistant can engage in two-way conversations.

RESULTS

The design for voice controlled room automation is implemented using software and hardware platforms and tested. The control of appliances are observed using Google assisted voice command when persons in a particular room. The full functionality and performances are verified.

CONCLUSION

This paper gives the design and implementation of voice controlled room automation using microcontroller ATmega328 and Google Assistance build around WiMesh network. The capability of self-organized WiMesh network reduces the complexity and maintenance of network deployment and provides the access from anywhere in the world to control the appliances. The full functionality and performance are verified by a voice command in a particular room to control the appliances from any place. It is evident that the proposed work simplifies a lot of human work and saves time and also, it can be very useful to physically challenged persons. The IFTTT and eWeLink applications secure the end device through Wi-Fi enabled IoT module with aid of authorized password. This design evidences to be cost-effective for the building automation networks, home security systems, etc. The further enhancement can be appreciated using existing hardware and software for dangerous places like surroundings of nuclear reactors, etc., to control the nodes.

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