A WIRELESS CONTROLLER FOR ELECTRICAL EQUIPMENTS USING IOT

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ABSTRACT

Internet of things (IoT) is a technology which is capable of efficiently controlling industrial and domestic appliances over the internet resulting in efficient automation systems. In this paper, a wireless communication system monitoring and controlling the electrical devices is proposed. The proposed system uses a NodeMCU which acts as an interface between the user and electrical loads of the system. Using this controller, the devices can be controlled from remote locations either from mobile or laptop. Thus, a cost-effective system is proposed which minimizes the power consumption. The proposed wireless system is implemented in the laboratory and experimental results were obtained.

Key words: IoT, Microcontroller, Wireless Communication, Electrical loads, Relay.

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1. INTRODUCTION

IoT is a network of equipments embedded with controlling devices and network connectivity which enables these equipments to be monitored and controlled remotely. This integrates the physical devices and computer based systems resulting in reduced operational cost and time thereby improving the efficiency of the system. IoT also helps in collecting lots of data for analysing and improving the system design.

From the literature, it was found that IoT is used for many applications. In paper [1], a novel real-time kernel, called Yartek, with low over-head and low footprint is developed for non-visual robotic sensors. A Perception SoC is developed for ultrasonic echography applications in literature. The developed DSP core efficiently integrates all of the necessary ultrasonic B-mode processing modules [2]. A healthcare monitoring system is proposed to detect the hand tremor that is a common symptom of Parkinson’s disease. This system uses wearable wireless sensors which manage to capture hand Motion and differentiate tremor cases from normal cases. [3]. A ceiling view based biometric sensing system is designed and implemented in [4]. In [5], an occupancy-sensitive lighting system is designed. A fall detection system is designed using wireless sensor networks and PIR sensors in [6] & [7].
respectively. A Smart Pedestrian Counting System based on Echo State Networks is proposed in [8].

IoT based information processing services was developed in [9]. In [10] & [11,12], a patient monitoring system and a wireless mesh network communication system is developed respectively. A web-based wireless remote temperature monitoring device for patients is developed in [13].

JPEG encoder architectures for wireless networks is implemented in FPGA [14]. A monitoring low cost thermal system using the Arduino MEGA platform is builded in [15]. Wireless sensor networks can provide valuable information for a lot of measurement, tracking, surveillance, automation, and general-purpose monitoring applications. The proposed partially reliable transmission mechanism can save energy over the network while assuring acceptable quality for sensing and monitoring applications [16]. A review on vehicular cyber-physical systems for avoiding Road collisions is presented in [17].

Thus, in this paper, an IoT system is proposed for controlling and monitoring the electrical devices remotely using mobile. Detailed description and implementation of the system with the experimental results are furnished in this paper.

2. DESCRIPTION OF THE PROPOSED WIRELESS IOT SYSTEM

Figure 1 shows the block diagram of the proposed IoT system. The proposed IoT system consists of electrical loads (Fan and Lamp), mobile, microcontroller, Arduino and relays. Detailed working of the system is explained in this section.

![Figure 1 Block Diagram of the proposed IoT system.](image)

2.1. NodeMCU

NodeMCU is an open source electronic gadget which is most appropriate for IoT applications. The board has 8 GPIO pins viz. D₀ - D₇. It has a little chip that converts the voltage of 5V from USB to 3.3V, 500mA. It functions well in room temperature of 25 degree Celsius. It has a high frequency clock and can be effortlessly tuned to required clock frequency for simple working and subroutine programs.

![Figure 2 NodeMCU ESP8266 WiFi IoT Development Board](image)
Figure 2 Shows the NodeMCU with ESP8266 Wifi IoT development board [18]. NodeMCU embedded with ESP8266 module is used in the proposed IoT system instead of directly using ESP8266 alone. Since ESP8266 module working voltage is 3.3V, additional voltage regulator is necessary for converting the voltage of 5V from USB to 3.3V. Moreover, the NodeMCU is a bread board friendly board in which all the pins perfectly fit into the bread board. Also, processing speed and memory capacity of the NodeMCU is higher than that of ESP8266 module. Hence, NodeMCU is chosen for this proposed IoT System.

2.2. Arduino
Arduino is an open source personal computer equipment and program development platform. General hardware structure of the Arduino board is shown in Figure 3. It is a single board which is a small microcontroller unit for building advanced gadgets and interfacing devices that can detect and control devices in the physical and computerized world.

2.3. Relays
Figure 4 is the hardware relay circuit of the proposed IoT system. This is a top notch 8 channel transfer board that takes a supply at 12V. It can be controlled directly by Microcontroller.

The structure of the proposed IoT system is shown in Figure 5. The system requires the following hardware components: (i) NodeMCU (ii) Arduino (iii) 8 channel relay board (iv) Mobile phone (v) 12V DC fan (vi) AC led bulb. The softwares which are needed for the proposed IoT system are Arduino development platform, Html and Android development platform.
The flow chart of the proposed IoT system is shown in Figure 6. Initially, Mobile Wifi is checked for its status. If Wifi is on, input the SSID and password in the mobile browser window. If login credentials are correct, NodeMCU gets connected to the Mobile. Using the web page opened in mobile, the device can be switched on or off using the mobile keypad itself.

Figure 5 Structure of the proposed IoT system

Figure 6 Structure of the proposed IoT system
3. HARDWARE SETUP AND RESULTS OF THE PROPOSED WIRELESS IOT SYSTEM

The photograph of the hardware setup is shown in Figure 7. After scanning wifi and devices getting connected to mobile through NodeMCU, the browser window in mobile as shown in Figure 8 is operated to switch on or off the lamp and fan through relay board. The lamp is switched on as shown in Figure 9.

![Figure 7 Photograph of the hardware setup](image)

![Figure 8 Screenshot of mobile for operating the connected devices](image)

![Figure 9 Photograph of the hardware setup when lamp is on](image)
4. CONCLUSION AND FUTURE SCOPE

Thus, a cost effective IoT system is proposed and implemented which can control the devices’ switching states remotely from a mobile. The system uses NodeMCU embedded with ESP8266 powered by Arduino. A 8-channel relay circuit controlled by the above microcontroller is used for operating the devices. In future, load data can be uploaded and data analysis can be done to improve the efficiency, reduce the power consumption and increase the speed of the running devices. Moreover, demand side management is trending in IoT based smart automation system which aims to cut down the tariffs during peak hours. Further, Passive Infrared (PIR), temperature, proximity sensors can be connected to monitor the conditions and save power in an efficient way.

REFERENCES


