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Low Cost Multipurpose Android Controlled Automation System Using ESP8266

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***Abstract*: In this project we are proposing a real-time automated system through which we can handle the electronic appliances with the help of Android smart phones or PC's. In the existing system the automation is done with through Bluetooth, which has distance limitations. In our project we are going to overcome this limitation with the help of Wi-Fi module ESP866. Using this we will be able to control lights, electric fan and other electronic appliances through a web browser using our mobile or PC. These AC mains appliances will be connected to relays which are controlled by the ESP8266. ESP8266 is the one of the most popular and low cost Wi-Fi module available in the market today. The proposed system is better from the scalability and flexibility point of view than the commercially available automation systems.**

***Keywords*: Automation, Wi-Fi, ESP8266, Relay, Android, Sensors.**

1. Introduction

The popularity of automation has been increasing greatly in recent years due to considerable affordability and simplicity through smart phone and tablet connectivity. The automation system integrates electrical devices with each other. Devices may be connected through a network to allow control by a personal computer and may allow remote access from the internet. Through the integration of information technologies with the environment, system and appliances can communicate in an integrated manner which results in convenience, energy efficiency and safety benefits. This project forwards the design of real-time automation and security system using the Wi-Fi module ESP8266. The ESP8266 Wi-Fi Module is a self-contained System on Chip (SOC) with integrated Transmission Control Protocol/Internet Protocol (TCP/IP) protocol stack that can give any microcontroller access to your Wi-Fi network. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor. The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community. Electronic appliances are connected to the input/output ports of ESP8266 along with the power strip and their status is passed to the ESP8266. The android running OS in any phone connected to a network can access the status of the home appliances via an application. It presents the design and implementation of automation system that can monitor and control the appliances via phone or PC.

2. Design propose system

ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability. It is a chip which is a highly integrated Wi-Fi SoC solution where in the Internet of Things industry, the users overcomes the efficient power usage efficiently, designs and performance also provides networkable foundation for facilitating end-point IOT developments. ESP8266 is a system-on-chip (SoC) which integrates a 32-bit Tensilica microcontroller, standard digital peripheral interfaces, antenna switches, RF balun, power amplifier, low noise receive amplifier, filters and power management modules into a small package. The figure 1 shows the block diagram of the Automation System Design. Here ESP8266 is connected with

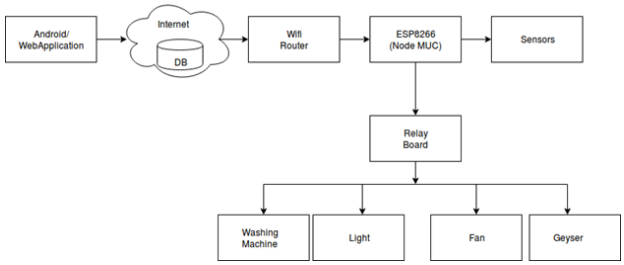

Fig. 1. The Diagram of automation system design

Intelligent automation system reduces the human efforts and saves time by overcoming the traditional methods of detecting the faults in home appliances and fixing it by using sensors. Microcontroller sends digital values to the server through the wireless sensor. Here we are using two wireless sensors one for the sender and another is for receiver. Server is handling all the system after receiving the sensors value it will check or compare these value to the actual value which is already store in the database as well cloud. Here we are using a private cloud for the backup. If the receive value is greater than the actual value it will send the alert message to the particular shop or the agency as well as the admin.

A. Automation

In this paper we are going to use ESP8266, which will be easy to use in the switch board and two components such as a sensor module and the controller. We will be able to control the small home automation system anywhere in the world.

B. Power supply

ESP8266 operates at 3.3V and consumes around 100mAmp current, for designing of its power supply you can use LM1117-3.3V Low drop out (LDO) linear regulator which is having current capacity of 800mAmp. Remember that, this regulator is low drop out regulator. It is better to give 5V as input to the regulator to avoid over heating of regulator.

C. Arduino

Arduino is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical and digital world.

D. Characteristics of ESP8266

- Direct Wi-Fi support.
- 802.11 b/g/n/e/i support.
- P2P Discovery, P2P GO (Group Owner) mode, GC (group Client) mode and P2P Management of Power.
- Security features such as 802.11i which provides pre-authentication, and TSN.
- Seamless roaming support.

E. Local device

A device want to connect to the router by ESPTOUCH, the server-side is deactivated. The Fig. 1, device is used to accessible over Wi-Fi network but not over to the cloud.

F. Cloud device

A device want to connect to the router by ESPTOUCH,the server-side is activated. The Fig. 2, the device is connected with the cloud platform and accessed through cloud status, online status, and offline status.

G. Hardware & software requirements

- Hardware Requirements
- ESP8266
- Relay
- Android Phone
- Temperature and Humidity Sensors(DTH)
- Gas Leakage Sensors
- Software Requirements
- Java
- Spring and hibernate
- C/Python
- MySQL

1) DHT sensor

DHT sensor is used to measure the temperature and humidity, we use the DHT11 sensor with the sensor board. It is a low cost temperature and humidity sensor. It is cheap in price, makes it useful for experimenting or projects where you do not require new readings multiple times a second. The device requires only three connections to the Pi, +3.3V, ground and one GPIO pin. The device itself has four pins but one of them is not used. The modules have three pins and are easy to connect directly to the Pi's GPIO header

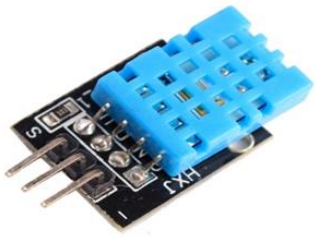

Fig. 2. DHT sensor

2) Passive infrared sensor (PIR)

A passive infrared sensor is an electronic sensor that measures infrared light radiating from objects in its field of view. They are most often used in PIR-based motion detectors. The PIR sensor itself has two slots in it, each slot is made of a special material that is sensitive to IR.

Fig. 3. Passive infrared sensor

3) Relay

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 solid-state relays.

Fig. 4. Relay

3. External interface requirements

A. User interfaces

The user interface will feature the use of meaningful icons, which will allow the user to easily identify options available. The buttons and functions by which the user is able to interact with the Home Automation System are described below.
The different stages that are visible to the User and Administrator are:

- *Website:* The user will be able to access the main website from any web browser.

- *Login:* Here the user has to enter username and password. If the password is wrong or the username doesn't exist, the user is notified.
- *Main Menu:* Once the user logs in, a navigation menu will allow the user to select the options available. The main menu should provide the following functionality;
- *Device Status:* The user can look at the device status. This will indicate whether a device is already on or off. E.g. a lamp may be already switched on and therefore can only be turned off by the user.
- *Turn On/Off Device:* The user turns on/off device.
- *Log Out:* The user logs out. The user is now prevented from interacting with the Home Automation System. This makes it impossible to press the back button on the browser and try to return to the main page. The following items will be visible to the Administrator:
- *Add / Remove Device:* This page allows the administrator to add/remove devices
- *Add / Remove Users:* Here the Administrator is able to add users and determine their level of access to devices

B. Hardware interfaces

The hardware forms the Client Premises Equipment (CPE) which provides the appropriate interfaces to sensors and actuators in the home. These modules are coordinated by a 32-bit ESP8266 system-on-chip running a firmware written in C++ programming language. It is required that the CPE provides control of lightings, appliances, security locks and others, as well as monitoring of the house environments such as the room temperature, humidity and light status. It must also provide interfaces for user interactions as well as Internet connectivity. As a result, the embedded hardware is further divided into: controller, power device actuators and integrated sensors.

C. Software interfaces

Customer workstation shall have the latest Java Virtual Machine (JVM) installed. Customer workstation shall be internet capable with at least one internet browser available. Customer mobile device shall be internet capable with an internet browser.

D. Communications interfaces

Web socket is found to be the most suitable for real-time bi-directional, full-duplex, persistent connection from a web browser to a server. The Web Application Communication Protocol (WAMP) is an open standard Web socket sub protocol which provides application routing that works with different 26 languages. WAMP allows a distributed system with loosely coupled applications components communicate in soft real-time. It is built over Web socket communication protocol and JSON data serialization. JSON is an open, language-independent, human-readable, data interchange format to ideally inter-operate, store, and transfer data between systems. It is designed to be simple, generic, structured, human and machine readable, and used over the Internet. It uses a textual data format with Unicode encoding and it is fat free as opposed to its XML counterpart.

4. Future development of the project

This project can be enhanced to control the speed of the fan or volume of the buzzer etc. Device controlling can be done using Internet of Things-IoT technology. We can use GSM module so that we can achieve device controlling by sending SMS using GSM module.

5. Conclusion

The prime objective of this paper is to use the Smartphone to control the electronic appliances effectively. The technologies used in this project are Android Studio, Java and Python. These platforms are Free Open Source Software. So the overall implementation cost is low and can be easily configured. User can easily interact with system using android phone/tablet. This automation system has been experimentally proven to work satisfactorily by connecting sample appliances to it and the appliances were successfully controlled form a wireless mobile device. Thus a low-cost automation system was successfully designed, implemented and tested.

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