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Mini Home Automation Embedded System Device Using ESP8266

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Abstract- **Home Automation has a wide scope for this Generation. In this wide scope, home automation technology is playing a major role in the world of automation. This article is fully based on low cost and reliable embedded system which can be connected to any appliances and can operate that appliance remotely using Android based Smart phone application. Using this technology the central hub complexity for connection of the server to multiple devices and concealing the wires can be eliminated .And also it would be very helpful by providing a simple plug and play device which can be connected easily to any appliance to fulfill user needs in home. The proposed systems consist of android mobile, ESP 8266 , voltage regulators and a relay circuit. We use Wi-Fi technology to monitor the device because of its accuracy, range and instant connectivity. This device connects the home appliances with a very ease of installation and it is user friendly.**

Keywords **– ESP 8266, WIFI, System on Chip (SoC), Android**

I. INTRODUCTION

Home automation is become more beneficial because of its safety and security. Nowadays; home automation became more advance and precise to monitor all the home appliances. Home automation system become energy efficient and highly approachable smart home technique. It involves basic features to maintain the user satisfaction and comfort. [3] In every paper referred states the main controller located at a particular place and output of the relays connected to the appliances by concealing into the walls. This somehow restricts the future expandability of the system. That is if the user needs to add a new appliance in their house to and connect it to the controller, he will need to conceal the whole wiring for that appliance.

This proposed system is a precise combination of Android smart phone and embedded system device which include ESP 8266, Ac to Dc converter and Relay circuit and voltage converter. [4] In this paper, we develop a device which contains every necessary components and can be individually be connected to appliance and connect wirelessly. An android application is installed in a mobile device i.e. android smart phone and it has inbuilt switch interface of all the appliances separately in it. Through which all the respective devices can be control and monitor individually.

The ESP8266 receives the command from mobile phone and passes to relay circuit. As per the given signal from the user, the relay circuit switched ON/OFF the respective devices. The main purpose of using Wi-Fi wireless technology is to provide a greater extent to range and better feasibility.[2] This paper will provide the future access to control the various home appliances with the help of android smart phone.

1. Home Automation

Home Automation is a unique system that can control and establish communication between nearly all aspects of your house. [1] Home Automation is a term used to describe the working together of all household amenities and appliances. For example, a centrally microcontroller panel can have the capability to control everything from heating, air conditioning, security system, lighting and overall electrical appliances. [3] Home automation can include controlling aspects of our home remotely through a computer or any mobile equipment, programming electronics devices to respond automatically to some conditions or scenarios or centralizing the control of a variety of appliances in our home into a single control center.

For example, Control of lights in and around our house from one central location so there is no need to get out of to that place or go to downstairs if we forgot to turn OFF or ON any appliances, just we can control remotely. [5]. It is essential that the different controllable appliances be interconnected and communicates with each other. The main purpose of Home automation is to control or monitor signals from different appliances, or basic services. A smart phone or web browser can be used to control or monitor the home automation system.[1]

II. LITERATURE SURVEY

1. Implementation of Internet of Things For Home Automation:

Mamata Khatu, Neethu Kaimal, Pratik Jadhav and Syedali Adnan Rizvi [1] they presented a paper on the implementation of Internet of things for home automation. This paper mainly focused on IoT coverage that connects all the variety of objects like smart phone, tablets, digital cameras and sensors in the internet and thus provides many services and huge amount of data and information. They also focused on Cloud computing, Cloud based platform help to connect the things that surrounds as so that we can easily access anything at any time and in any place.

They have illustrated sensing as a service on cloud by using certain application like Augmented Reality, Agriculture, Environment monitoring etc. and finally they have proposed a prototype model for providing sensing as a service on cloud. Security concern is overcome by this model since we are using Wi-Fi Wireless Equivalent Privacy (WEP) and Wi-Fi Protected Access (WPA) are two most used security accesses used in Wi-Fi.

2. Bluetooth Based Wireless Home Automation System Using Fpga:

B.Murali Krishna, V.Narasimha Nayak, K.Ravi Kishore Reddy, B.Rakesh, P.Manoj Kumar and N.Sandhya [2] they presented a paper on the Bluetooth based Wireless Home automation system using FPGA.They primarily focused on Bluetooth technology. With the help of the Bluetooth module (HC-05) and Android Phone, they control the home appliances, which all connected to FPGA board.

Thus, they have mentioned the advantages of the home automation, which not only reduces the human efforts, but it is also energy efficient and time saving. Moreover, they have included that it is also help to the handicapped and old aged people to control the home appliance without any difficulties. We need module so that the range will be high as well as it can operate in different frequencies. This drawback is overcome by our model.Wi-Fi based networks work at 2.4, 3.6 and 5 GHz. In addition, it can extend up to range 100m.

3. Hand Gesture Based Home Automation For Visually Challenged:

Smitha M, T.Ayesha Rumana and Sutha P [3] published a paper entitled Hand gesture based Home Automation for Visually Challenged People. They have designed a device for the visually challenged people to help them to operating the home appliances. They have used MEMS (Micro electromechanical Systems) accelerometer which is used to sense the accelerations of a hand in corresponding three perpendicular direction that is (x y z) and thus transmit the signal to wireless protocol using Radio frequency. The gesture templates were stored in a microcontroller at the receiver end. The received gesture and the hand gesture were compared by the templates. If the corresponding gesture were matched with the templates then accordingly home appliances were controlled. In addition, these devices were help for the old aged person too. Since they have used four types of gesture and stored in the microcontroller and it processed further. However, we need the system to be automated without the use of gesture. We do not need the gesture to be stored in the controller. Nowadays, the application can be used by any means of people by the option "TALKBACK" in the android application.

4. E-Mail Interactive Home Automation System

Sirisilla Manohar and D.Mahesh Kumar [4] presented a paper on E-mail interactive Home automation system. They have enlightened on a basic home automation application on the public domain through the subject of E-mail ID .The switching action were done by LED indication. They provide a basic application of home automation using GVT app, which can be easily implemented and used as efficiently. The coding which they provide is generic and flexible in user-friendly manner and can be controlled in any application like power control, surveillance etc easily. In addition, all the results were generated by a series of E-mail sent to the user of G-mail account. For each and every interrupts one email will generated and will send to the user of the Gmail account, which again a tedious process. We can easily control the appliances instead of going through such process.

5. Esp 8266: A Breakthrough In Wireless Sensor Networks And Internet Of Things:

Manan Mehta [5] presented a paper on wireless sensor data using ESP 8266 and connection of ESP to act as server and client. ESP 8266 has onboard Wi-Fi module and hence it doesn't require external hardware for communication through Wi-Fi. Since ESP works on very low voltage the power consumed by circuit will be less. So ESP controllers are reliable for embedded system applications

III.PROPOSED SCHEME

Home Automation embedded system device usually comprises of three main parts:

- AC to DC converter.
- Voltage regulator.
- Controller.
- Interfaces.
- Control methods.

1. Main Automation Device

1.1 ESP 8266- ESP 8266 is a 32 bit microcontroller with on chip Wi-Fi module. It has a RISC CPU of 80 Mhz. Maximum power supply is 3.3 volts and contains ceramic antenna. It provides 2.4 GHz Wi-Fi capabilities, general-purpose input/output (16 GPIO), Inter-Integrated Circuit (I²C), analog-to-digital conversion (10-bit ADC), Serial Peripheral Interface (SPI), I²S interfaces with DMA (sharing pins with GPIO), UART (on dedicated pins, plus a transmit-only UART can be enabled on GPIO2), and pulse-width modulation (PWM).

1.2 AC to DC converter- Since this device directly connects to the mains supply, high AC voltage should be converted to low DC voltage to run internal microcontroller circuit. To convert 240v to 5v we need an AC to DC converter.

1.3 Voltage regulator- Microcontroller we are using has the operating voltage as 3.3v. AC to DC convert 240V to 5V. To further convert 5v to 3.3 volt to drive ESP 8266 we need voltage regulator.

1.4 Interfaces- An Interface is the way we interact with the Home automation controller. There are many types of interfaces like Touch Panels, Keypads, Remotes, Mobile Devices and Internet .In this proposal, we used a Mobile device (Android smart phone).Nowadays it is a very common device for every user. We need to install an appliance controller application in it. In addition, within the mobile interface it can be able to control all the respected appliances of the home.

1.5 Control Methods

Interfaces is to interact with the controller, and sensors that tell the controller what things are occurring in the house. Controllers can communicate and control the many devices of a Home Automation System in a variety of ways. Some of these are IP (Internet Protocol sp), Wi-Fi, Bluetooth, Zig-bee, IR, Serial Data, and Relays (for motorization).but in our system we use WIFI.

2. Wi-Fi technology

Wi-Fi is a great option when you cannot get Ethernet wiring to desired locations. It is a good medium for communicating to different locations in the house, and will allow large bits of information to be passed back and forth with no wires. It is always best if we can get a wire to the location you are trying to control, but sometimes this is not possible or would be cost prohibitive.

Advantage of using Wi-Fi technology:

- Equipment can be placed almost
- anywhere
- No unsightly cords running through
- your home
- No need for additional Ethernet output
- Provide wide range and more efficient.

IV.PROPOSED BLOCK DIAGRAM

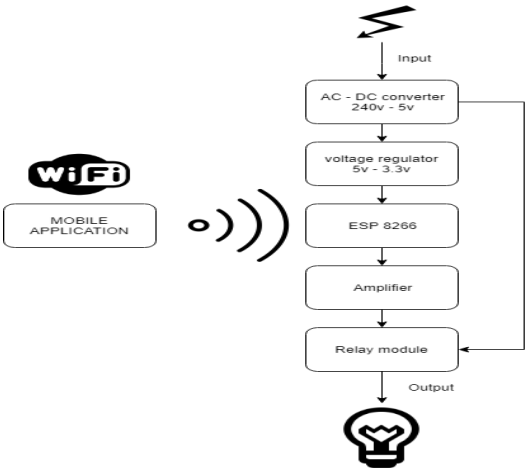

Figure .1. Block diagram.

In this system, we are going to make a home automation system using ESP8266. With the help of this module, we will be able to control lights, electric fan and other home appliances through a Wi-Fi application using our Android Smart phone. The whole device is a SoC with ESP 8266 as its controller and relays for switching. The input to the device is 240 volts mains supply which is stepped down to 5V Dc. 5V is then converted to 3.3 V using voltage regulator so as to power ESP 8266 .ESP has an integrated TCP/IP stack, which may help access a Wi-Fi network.

It can act as both Wi-Fi Server as well as a Wi-Fi client. Since operating voltage of ESP is 3.3 V the output of the controller is 3.3V. To increase the voltage so as to drive a relay which works on 5V we need an amplifier. Amplifier converts 3.3v to 5v and hence delivers it to relay for switching operation. We us a Darlington transistor IC as an amplifier which has low power consumption and can operate at 1 Amp. Here a Darlington transistor IC is connected which is used as relay driver. Then AC appliance connected to relay output to ON/OFF the AC devices.The application installed in the smart phone will contain all the features to add a new device or to remove device. This will give flexibility to the user to automate only those devices which he wants.

V. IMPLEMENTATION

For implementation of our model we need to build a circuit diagram and simulate in software. The basic circuit implementation of the device is as shown in figure below.

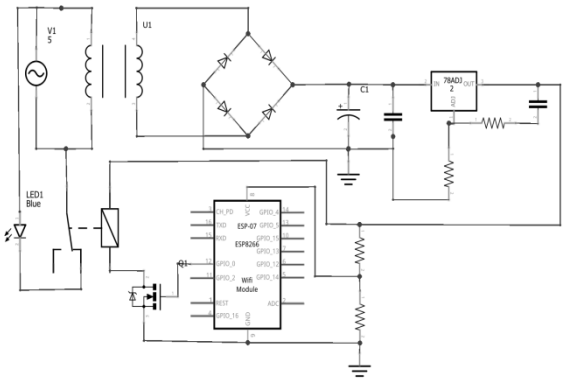

Figure .2 Circuit Diagram.

The circuit contains all the necessary components as required in proposed block diagram. Led in the diagram can be replaced by any appliance which need to be automated. 78Adj is a voltage converter to convert dc voltage form a rectifier to 5V. Further 5v is converted to 3.3v and connected to ESP power supply pin. Output of ESP is amplified by a transistor and relay is switch on or off as per the command given by ESP. When the user sends the command through his smart phone, ESP Checks for the keyword received and compares with its own keyword.

If the keyword matches then the ESP turns on the appliance else it passes the keyword to other ESP devices. Here the ESP acts as Server and other ESPs as clients. Since there are number of appliances in our house each ESP cannot be connected to the WIFI network. Here we use super mesh network to communicate between multiple ESPs. The simple block diagram of working super mesh system is as shown.

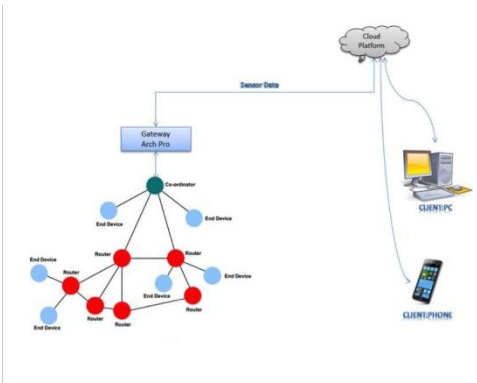

Figure.3 Super mesh network

Using this approach all ESP need not be connected to the same WIFI network. A single ESP can have 16 clients and so if you need to connect more than 17 appliances we can make 2 servers and connect other ESPs as clients. User can have full access to choose the master ESP and client ESPs and hence increases the future expandability of the Home automation System.

VI. CONCLUSION

The increase in home appliances day by day and increasing home automation technology, predicting the number of new appliances that could be installed in the house is very difficult. This article is about mini home automation device that can be installed on every appliance that the user thinks to automate. It is a plug and play device which can be easily removed and installed. It is fantastic low cost system that can be installed and is easy to test. The main advantage of this system is it communicates wirelessly and there is no need to conceal the main controller server in the house. User can control the devices using a smart phone and has full authority to add or subtract the device so that he can operate the appliances manually.

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