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Smart Automation System and Control Using Raspberry PI and ESP 8266

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Abstract –Automation is a technique or system of controlling a processor by electronic devices with reducing human involvement to a minimum. This paper presents a design of monitoring andcontrolling home automation system from an android application based on Raspeberry Pi. A system uses Wi-Fi technology as a communication protocol to connect system components.   A home automation system consist of two main components; the first part is android application that can give orders to units that one wishes to control by locally or remotely and the second part is RaspberryPi that has an appropriate interface to sensors and appliances of a home automation system and communicates with android application through wireless technology . The home automation system can have a vital role in reducing the total energy consumed by home appliances.

Keywords – IOT, Smart home, Raspberry Pi, Android application, Sensors, Wi-Fi.

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I.   INTRODUCTION

Home Automation or Domestics is the automation of household activities for the comfort and security of its residents. Home automation includes centralized control of appliances, lighting, HVAC (Heating, Ventilation, and Air Conditioning), resource management (water and energy) systems and security systems. Home automation may also include additional functions like automatic plant watering and pet feeding and automatic home care for the elderly or disabled people etc. There has been a significant increase in home automation in recent years due to reduced expenditure, higher affordability and advancement in Smart phones and tablets technologies which allows vast connectivity. Emerging concepts like Internet of Things (IoT) [1], Cloud Computing and Big data are also incorporated with home automation to provide more advanced services and products in the field of Domestics [1].

In simple sense Home automation means to connect all electrical devices in the home to a central control system that control those devices according to user inputs. The concept of Internet of Things (IoT) can turns the automated home into a smart home. IoT connects everyday objects to the internet, enabling those objects to communicate with each other and complete tasks with the help of sensors and actuator with less user intervention. A smart home can be easily controlled through internet using a Smartphone, Tablet or Computer [1].

II.   SYSTEM ARCHITECTURE

This paper presents a smart home system based on Raspberry Pi and an android device with use of the wireless router. The objective of smart home automation is to provide comfortable, a convenient user interface be sensing and controlling home environment and to improve the energy efficiency by monitoring and controlling the appliances [2].
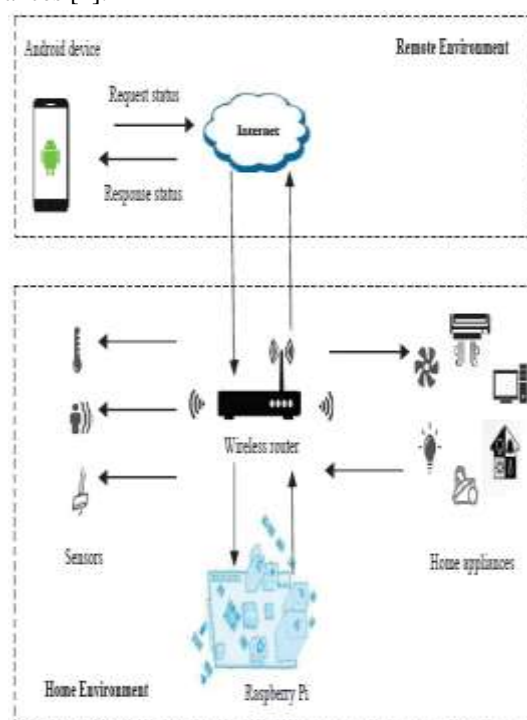
Fig.1 Project Layout

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III.   DESIGN COMPONENTS

The system contains both hardware & software components which are classified as follows:

1. **HARDWARE COMPONENTS :**
   a. **RASPBERRY Pi 3**
   b. **AVR MICROCONTROLLER ATmega16**
   c. **L293D AMPLIFIER**
   d. **JHD162ALCD**
   e. **ESP 8266**

a. RASPBERRY Pi 3 :

Raspberry Pi is a credit card sized single board computer developed in the UK by Raspberry Pi foundation. It is used to eliminate the use of a personal desktop keeping the cost of the overall system to a Minimum Raspberry Pi is used to control flow between android device and sensors. Raspbian OS is used on Raspberry Pi and the server running on Raspberry Pi device is written in Python. Raspberry Pi has Python already installed on it [2].
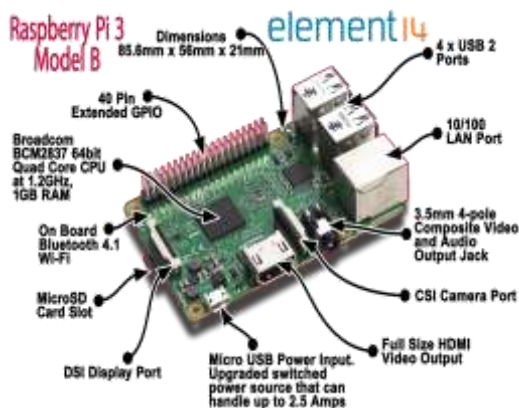
Fig.Raspberry Pi 3

b. AVR MICROCONTROLLER ATmega16 :

ATmega16 is an 8-bit high performance microcontroller of Atmel's Mega AVR family with low power consumption. Atmega16 is with low power consumption. Atmega16 can work on a maximum frequency of 16MHz [3].ATmega16 has 16KB programmable flash memory that is ROM and static RAM of 1KB [3].ATmega16 is a 40 pin microcontroller. There are 32 I/O lines which are divided into four 8-bit ports designated as PORTA, PORTB, PORTC and PORTD [3].Each I/O pin has an alternative task related to in-built peripherals [3].

Fig. AVR Microcontroller ATmega16

c. L293D AMPLIFIER:

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors [4].
L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction [4].
There are 4 input pins for L293D, pin 2,7 on left and pin 15,10 on right . Left input pins will regulate the rotation of motor connected across left and right input for motor on the right hand side[4].

Fig.L293D Amplifier

d. JHD162ALCD:

A **Liquid Crystal Display** commonly abbreviated as **LCD** is basically a display unit built using _Liquid Crystal technology_. When we build real life/real world electronics based projects, we need a medium/device to display output values and messages [5]**.**
Out of all available LCD modules in market, the most commonly used one is **16×2 LCD Module** which can display 16 characters in 1 line [5]**.**
The JHD162A has 16 pins and can be operated in 4-bit mode (using only 4 data lines) or 8-bit mode (using all 8

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data lines). Here we are using the LCD module in 8-bit mode [5].

Fig. JHD162ALCD

e. ESP 8266:

The ESP8266 Wi-Fi Module is a self-contained SOC with integrated TCP/IP protocol stack that can give any microcontroller access to your Wi-Finetwork [6]. The ESP8266 is capable of either hosting an application or offloading all Wi-Fi networking functions from another application processor [6]. Each ESP8266 module comes pre-programmed with an AT command set firmware, meaning, you can simply hook this up to your Arduino device and get about as much Wi-Fi-ability as a Wi-Fi Shield offers (and that's just out of the box)! The ESP8266 module is an extremely cost effective board with a huge, and ever growing, community [6].
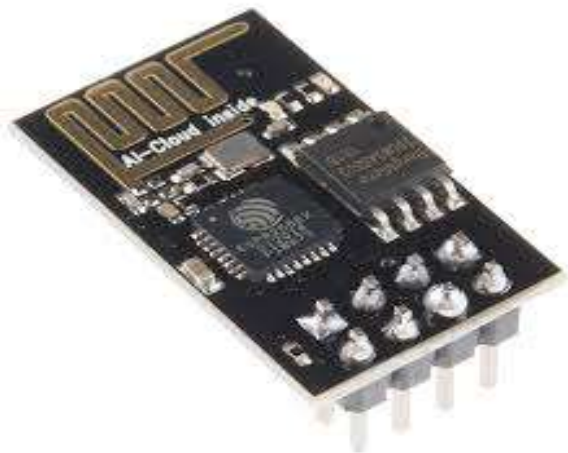
Fig.ESP 8266

2. SOFTWARE COMPONENTS :

   a. **Raspbian OS**
   b. **Android Application**
   c. **WinAVR**
   d. **Python**
   e. **Java**

a. Raspbian OS:

Raspbian is a free operating system based on Debian optimized for the Raspberry Pi hardware. An operating system is the set of basic programs and utilizes that make your Raspberry Pi run.

b. Android Application:

The application has installed on a Smartphone. A remote user can monitor and control the home environment from its android application and communication is done via locally or remotely.

c. WinAVR:

It is a suite of executable, open source software development tools for the Atmel AVR series of RISC microprocessors hosted on the Windows platform. It includes the GNU GCC compiler for C and C++. It is used for creation & embedding of a program for the microcontroller in C.
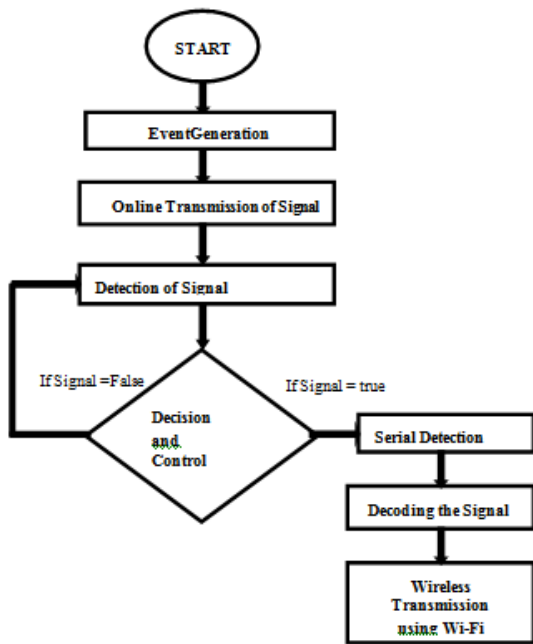
d. Python:

Raspberry Pi device is written in Python. Raspberry Pi has python already installed on it. Python is an interpreted , object-oriented, high-level programming language with dynamic semantics. Its high-level built in data structures, combined with dynamic binding. Python supports modules and packages, which encourages program modularity and code reuse.

e. Java:

Java is a widely used programing language expressly designed for use in the distributed environment of the internet. It is the most popular programming language for Android smartphone applications and is among the most favored for edge device and internet of things development.

IV.   DATA FLOW DIAGRAM

FIGURE :TRANSMITTER DIAGRAM

FIGURE :WiFi Receiver

Advantages of Home automation systems:

In recent years, wireless systems like Wi-Fi have become more and more common in home networking. Also in home and building automation systems, the use of wireless technologies ggives several advantages that could not be achieved using a wired networkonly.

1) Reduced installation costs: First and foremost, installation costs are significantly reduced since no cabling is necessary. Wired solutions require cabling, where material as well as the p professional laying of cables (e.g. into walls) is expensive.

2) System scalability and easy extension: Deploying a wireless network is especially advantageous when, due to new or changed requirements, extension of the network is necessary. In contrast to wired installations, in which cabling extension is tedious. This makes wireless installations a seminal investment.

3) Aesthetical benefits: Apart from covering a larger area, this attribute helps to full aesthetical requirements as well. Examples include representative buildings with all-glass architecture and historical buildings where design or conservatory reasons do not allow lying of cables.

4) Integration of mobile devices: With wireless networks, associating mobile devices such as PDAs and Smartphone's with the automation system becomes possible everywhere and at any time, as a device's exact physical location is no longer crucial for a connection (as long as the device is in reach of the network).For all these reasons, wireless technology is not only an attractive choice in renovation and refurbishment, but also for new installations
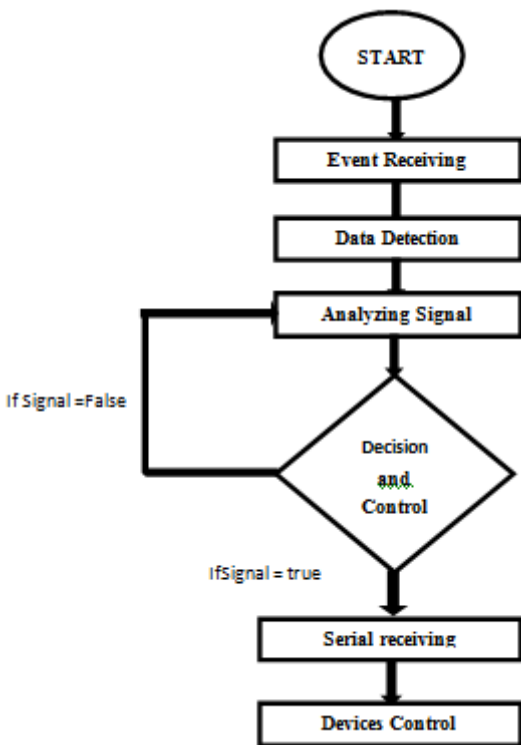
CONCLUSION AND FUTURE WORK

A.Conclusion

The home automation using Internet of Things has been experimentally proven to work satisfactorily by connecting simple appliances to it and the appliances were successfully controlled remotely through internet. The designed system not only monitors the sensor data, like temperature, gas, light, motion sensors, but also actuates a process according to the requirement, for example switching on the light when it gets dark. It also stores the sensor parameters in the cloud (Gmail) in a timely manner. This will help the user to analyze the condition of various parameters in the home anytime anywhere.

B.Future work

Using this system as framework, the system can be expanded to include various other options which could include home security feature like capturing the photo of a person moving around the house and storing it onto the cloud. This will reduce the data storage than using the CCTV camera which will record all the time and stores it. The system can be expanded for energy monitoring or weather stations. This kind of a system with respective changes can be implemented in the hospitals for disable people or in industries where human invasion is impossible

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or dangerous, and it can also be implemented for environmental monitoring.

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