

IoT based Monitoring and Control System for Home Automation

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Abstract:

The "IOT based Interactive Controlling and Monitoring System for home automation" is a new technological advancement which can control and monitor devices not only for home automation but any real life appliances remotely. It provides facility to have control over a wide range of home appliances and ensure securities. It also permits open access to a wide range of control of digital service. In this paper we propose design of a web based home automation system using IOT that can control home appliances.

The proposed system makes use of ESP 8266 Wi-Fi module, an Arduino board ,temperature sensor and a web application. Optimization of power of home appliances can be monitored and controlled using IOT based a Classification algorithm. Depending on the change of temperature the appliances are monitored and automated in order to save the energy consumption. This design proposes a efficient power optimization and an efficient control of home appliances based on internet application.

I. INTRODUCTION

Smart home or Home Automation is also known as Domotics or Domotica. Home and Building automation systems are used more and more now a days. These automation systems not only increase the comfort but also provide a centralized control system of lighting, air condition etc..in private homes as well as in commercial buildings. Home appliances need high energy which make our homes one among systems that show significant impact on energy consumption. This automation system aims at planning a system that reduces energy wastes from houses and other commercial buildings thereby contributing to energy conservation which has a great need today. Basic light switch includes practicality and simplicity within its scope. Function of this light switch is automated by the home automation system and also introduce fundamental benefit of comfort without losing practicality and simplicity. Smart home consists of network, controlling device and home automation.[1]

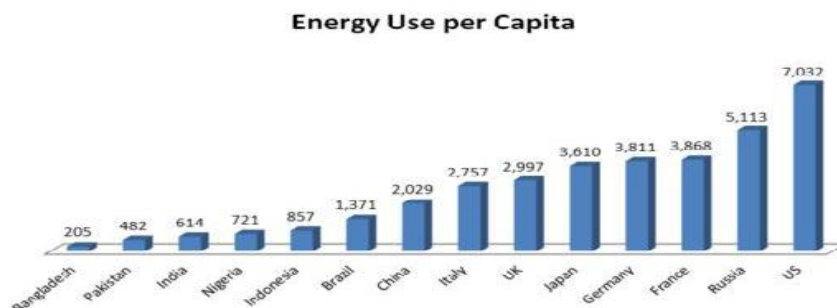


Fig. 1. Energy Use per capita in various countries of the world

II. History

- 1) Labour-saving machines was the beginning of Home automation in 1900s with the introduction of electrical power distribution.
- 2) X10, the first general purpose home automation network technology was developed in 1975.
- 3) According to ABI research in United States, about 1.5 million home automation systems were installed by 2012.
- 4) Three generations of Home automation was introduced in 2016.
 -) First generation: Wireless technology with proxy server.
 -) Second generation: Electronic devices controlled by artificial intelligence.
 -) Third generation: Robots that interact with humans.

III. INTERNET OF THINGS

Kevin Ashton coined the term "Internet Of Things" in 1999 at Proctor & Gamble but it came into light through RFID journal in 2009. The concept of IoT has potential to impact the way we live and also the way we work. The inter-networking of the physical devices, buildings, vehicles etc.. is called Internet Of Things (IoT). It aims to offer advanced connectivity between devices, systems and services and also include various protocols, domains and applications so that these devices can communicate with each other and complete specific tasks without any intervention of user. The three major benefits of Internet of things are:

Communication: Information of state and health of equipment can be communicated to systems and people using IoT. Data retrieved from various signal sensors that can keep track of a person's vital sign can also be communicated to the concerned person or system. In hospitals IoT can help to keep track of various things from wheelchairs to cardiac defibrillators that provide a great help to surgeons. In the industry of transportation, real-time tracking and condition of parcels and pellets can be done by business authorities. For example automobile industry can track the status of manufacture by employing some sensors which send the data at particular schedules.

Control and Automation: In a world of technology, a business always has a perceptibility into a device's working condition. Today, a device is being remotely controlled by many businesses and consumers. For example, one can control temperature in a climate controllable environment or can turn on or off specific device remotely. Moreover, a consumer can use IoT to start and stop electrical appliances like washing machines, microwave ovens, televisions etc... One can also lock or unlock their vehicles using the technology of IoT. After the range of measurements derived from performance under typical operating conditions, if acceptable performance is recorded, a process can send alerts for aberrations and provide a automated response. For example, if the engine of a truck is about to fail, the automation system can deliver this information to the company and create automatically a schedule for servicing and maintenance of the truck. [2]

Cost Saving: Now a days, to save money many companies are employing IoT. Performance baselines provide not only the estimates but also actual health span of the device and performance information. By allowing a company to organize a scheduled maintenance in order to reduce equipment failure, IoT is saving a lot of money of the company. Driving behaviour and speed of the vehicle can be tracked and maintained to control the fuel expenses and wear and tear on its various parts like tyres, engine etc.. To help people understand opportunities in cost saving and energy consumption, new smart energy consumption meters are employed in homes and other corporate buildings. [7]

IV. TECHNOLOGY IN SMART HOME

A. Network

Smart home may consists of either wired network or wire-less network or both. In wired network, power supply is directly connected to the devices through a wire. Data is sent to these devices to activate or deactivate through these wires. Wiring system may be new wire (Twisted pairs, optical cables), Busline, Powerline etc...

Devices are connected to the internet through this wiring system. Wireless networks[5] connect different network nodes using wireless connection. Wireless network is making integrated network a reality and is bringing fundamental changes to data networking and telecommunication. Components of wireless network are Transmitter and Receiver. Wi-Fi, Bluetooth, IEEE 802.11 etc... are examples of wireless communication between devices.[4]

B. Controller

Devices that are used to control the actuators for managing various systems by sending data or signals are the smart home controllers . These controllers can be web browsers ,short message service(SMS).Smartphone , tablets ext. Type of control system decide the type of home automation system. Types of control systems are as follows:

Individual Control System:

In early days,Individual Control Systems were the first to get launched in the market.These systems include devices like room heater or air conditioner that have controllers established which function independently.

Distributed Control System:

Control parameters of various collateral can be changed with the help of these systems. Emergency shutdown of devices is the important feature of these systems.Example for this system is Thermostat with ON/OFF timings for room heaters

Central Control System:

Several functions of activities like Home lighting,watering of gardens,doors, room heaters etc..are handled by these programmed systems.Connection to these control systems can be established from mobile phones or internet from any part of the world.[9]

C. Home Automation

Doors and windows of the room can be opened and closed with the help of home automation system.Home Automation system can turn on the television or radio to any channel or turn on the stereo system for playing music.Lights can be switched on or off automatically and also extent of brightness can be adjusted.Lawn sprinklers will be activated according to the de-signed schedule by using Automation systems.[10]

Security:If the alarm goes off, concerned authorities can be alerted by a message that is sent by the system automatically.

V. VARIOUS DEVICES USED

1) IOT Device:ESP8266 Wi-Fi

It is a ready-made open-source development board with ESP8266-12E chips which runs on ESP8266 WifiSoC from Expressive systems. Modules embedded on it are: ADC, HTTP, MQTT, Wi-Fi, Web socket, SPI, bit etc.. It works on supply voltage of 3.3 volts. It has hardware similar to that of Arduino but has some extra features. It is simple, smart, interactive, open source, easy to program, Wi-Fi enabled IOT device.Esp8266 Wi-Fi module present on Arduino Uno is self-contained SOC with integrated TCP/IP protocol stack that provide access to your Wi-Fi network by any microcontroller.ESP8266 can either host an application or offload all functions of Wi-Fi networking by another application processor.[5]

Building the firmware:

There are three ways to build Nodemcu firmware: Cloud build service, Docker image, Linux build environment. For building it manually default configuration in C header file(user modules.h, user config.h)is designed and made to run on all ESP modules including ESP-01(512 KB Modules)and also includes general purpose interface modules which require a maximum of two GPIO pins..

Building the file system

To store files in the flash chip, SPIFFS filesystem is used.Technically SPIFFS configuration has 256 byte page,8k blocks,4k sectors supported by SDK.Flashing the firmware and uploading the code Code can written

and flashed into its firmware using the software "Arduino IDE" i.e. Arduino Integrated Development Environment.

2)Resistors

A resistor is a passive electrical component that implements electrical resistance as circuit element.It consists of two terminals.It is used to reduce current flow,to divide voltages,adjust signal levels, terminate transmission lines,bias active elements and has many more applications.

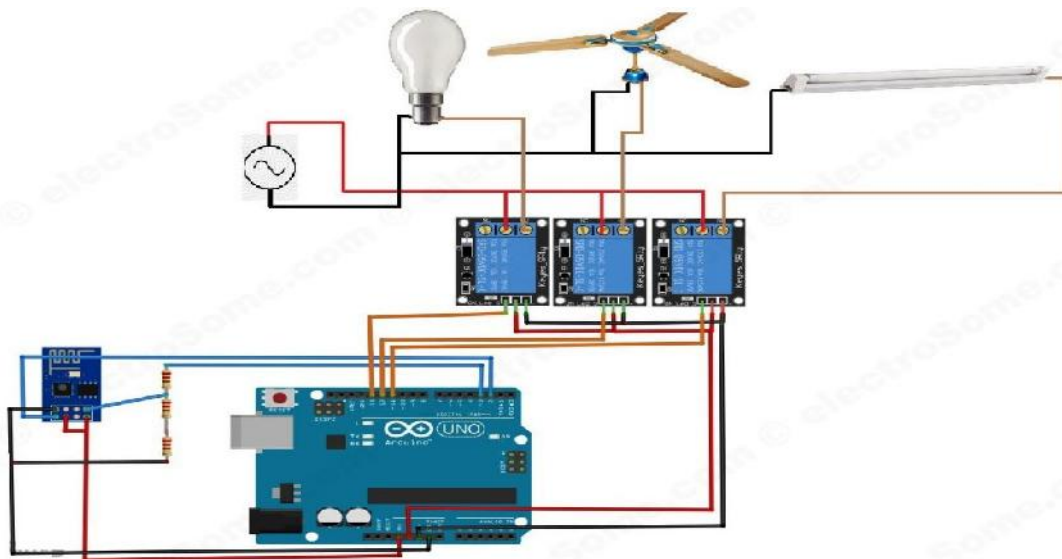
3)Transistors

A transistor is fundamental building block of modern electronic devices.It consists of two p-n junctions.It is formed by wither p-type or n-type between a pair of opposite types.Three terminals of transistors are Emitter, Base and Collector.Transistors are of two types depending upon the arrangement of p and n-type semi-conductors.They are NPN transistor and PNP transistor.Transistor can be used as a switch and an amplifier.

4)Relays

A relay is an electromagnetic device that electrically separates two circuits and magnetically connects them. Electronic circuit that works at low voltage can be inter-faced with the electrical circuit working at high voltage using a relay.It has mainly two sections namely: Input section where magnetic field is produced by the coil when a small voltage called operating voltage is given from the electronic device and Output section where the three contactors(Normally Open(NO),Common(COM) and Normally Closed(NC)) mechanically make or break a connection. Coil present in relay is energized on application of operating voltage and contact is changed from COM to NO.

VI. IMPLEMENTATION



In this paper we are going to make a home automation system using ESP8266 Wi-Fi module and Uno. Arduino Integrated Development Environment i.e. ArduinoIDE:All the programs or codes that are written using this software are known as Sketches that are saved with the file extension of .into. It has a text editor for composing and compiling the code, a text console to display the text form of output of the code compiled and also corresponding error and warning messages, a message area, a toolbar with sequence of menus and also options to select various functions like verify and upload of program, to open or create new sketches and also

save them. This software establish a connection to the hardware and facilitate uploading of the code composed in the text editor into the hardware. In this way it can communicate with the hardware.

Using this we will be able to control lights, electric fan and other home appliances through a web browser using your PC or mobile. These AC mains appliances will be connected to relays which are controlled by the Arduino. ESP8266 and Arduino together acts as a Web Server and we will send control commands through a Web Browser like Google Chrome or Mozilla Firefox. ESP8266 is the one of the most popular and low cost Wi-Fi module available in the market today. You can ready more about it here, ESP8266 – Wi-Fi.

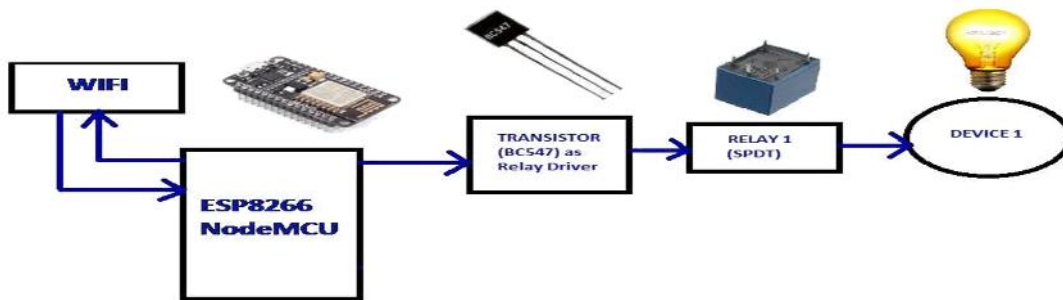


Fig. 3. Block diagram of circuit

VII. RESULT AND ANALYSIS

In this paper the model was developed for home automation and controlling of Lights and fans based on room temperature. The system reads temperature data using LM35 sensor and data recording and storing in Excel sheets. The decision for on and off conditions of lights and fans are based on temperature data.

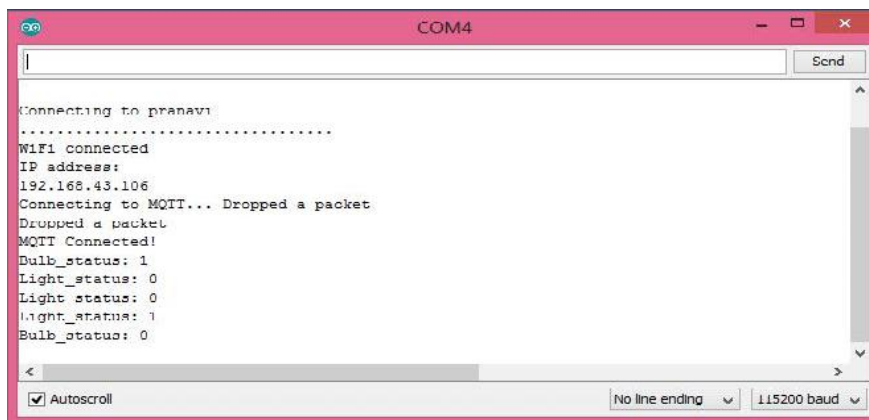


Fig 4.Output

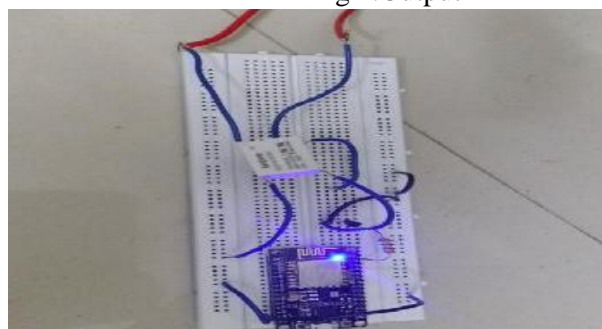


Fig. 5. Circuit connection on breadboard

VIII. CONCLUSION AND FUTURE SCOPE:

In current days Internet of Things is evolved as the image of our connected future. Home Automation hardware components will occupy greater place in field of communication. Increase in the development of innovative electronic devices that possess the ability to act as the highly developed control systems for automating houses is becoming the new trend today. Pace of integration of these control systems will increase in future.

IP Networks will play a greater role to build foundation for communication at homes. In future, there will be increase in the significance of management of IP networks (control over IP, audio over IP etc..) at houses. IP acts as a backbone for the integration of important protocols for home automation.

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