

# Smart Home Automated Emulator

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## ABSTRACT

The smart home automated emulator low cost wireless prototype. Here the embedded gateway is used for remote home control and through internet. In general home automation means to connect all electrical devices in the home to a central control system that control those devices according to user inputs. A smart home can be easily controlled through internet using a smart-phone, tablet or computer. In the proposed prototype the data is transferred between the user and home appliances through internet. The system uses Wi-Fi transceiver to send data to the cloud. The proposed prototype automates the existing home appliances at low cost. The system does not require external memory storage as it uses low cost embedded devices and cloud as its main storage.

**Keywords:** Automation, ESP8266 Wi-Fi transceiver, relay module, Arduino UNO.

## I. INTRODUCTION

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 connected electrical devices are intelligent in a sense that a programmable microcontroller with varies sensors can be attached with them to improve the automatic functioning. The concept of Internet of Things (IoT) can turn 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 with less user intervention.

Internet of Things (IoT) term represents a general concept for the ability of network devices to sense and collect data from around the world, and then share that data across the Internet where it can be processed and utilized for various interesting purposes. The IoT is comprised of smart machines interacting and communicating with other machines, objects, environments and infrastructures. Now a days every persons are connected with each other using lots of communication way. Where most popular

communication way is internet so in another word we can say internet which connect peoples.

Cloud computing is a complete new technology. It is the development of parallel computing, distributed computing grid computing, and is the combination and evolution of Virtualization, Utility computing, Software-as-a-Service (SaaS), Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS).

There are a few applications of cloud computing as follows:

- 1) Cloud computing provides dependable and secure data storage center.
- 2) Cloud computing can realize data sharing between different equipment.
- 3) The cloud provides nearly infinite possibility for users to use the internet.

The concept of smart home can be viewed as an improvement in the home automation concept by incorporating the concepts like Internet of Things (IoT), cloud computing and big data. The global connectivity of home environment is an important feature of smart home. The proposed system consists of a prototype low cost wireless embedded gateway for remote home

control and monitoring system that allows interaction between mobile client and legacy things through internet. In the proposed prototype model, it is focused on the wireless embedded home gateway which provides internet connectivity to the home automation.

## II. EXISTING SYSTEM

The concept of home automation was done using Bluetooth, GSM, DTMF GPRS, where the prototype uses a host controller implemented on PC, which is connected to a microcontroller based sensor and device controllers. The device controllers are connected to the electronic devices through the I2C bus. The system allows more than one device controller to be connected to the host controller.

### DRAWBACKS OF EXISTING SYSTEM

The major drawbacks of the existing system are the equipment and installation costs are high. Automation of the home is widely related to the financial costs. System crashes due to any damage in the interconnection:

If there is any damage due to rupturing of cables or the fibers, the entire system gets crashed. The wiring of the system results in crash in most of the systems. If the human does not handle the kit safely human errors may occur which leads to destruction of the module.

Reliability is the major drawback. In very rare cases the reliability of home automated devices varies (decreases). The reliability of the system depends mostly on the technology used. Battery drains fast during the operation of the system. The battery in the gadgets starts to decrease when the Bluetooth remains in ON state in the gadget. Throughout all devices, while using Bluetooth the connection runs very slow. Bluetooth is not highly suggested in many cases. Installation of the system is a tedious process.

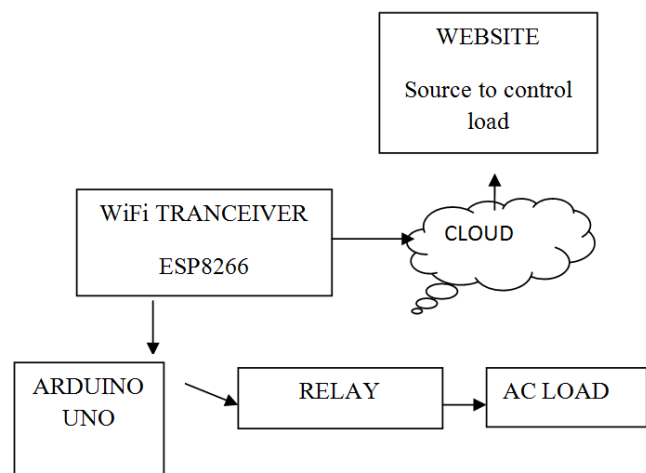
Bluetooth has a maximum communication range of 100m in ideal condition. More may be needed in a home environment. It has high power consumption, so the batteries of devices need to be frequently recharged or replaced. For every SMS paying is needed an extra charges is paid to the organizations. Security and network issues may occur sometimes. If anybody wants

information, message has to be sent, for every new information message is sent again and again to system.

## III. PROPOSED SYSTEM

The system consists of a prototype low cost wireless embedded gateway for a remote home control and monitoring system through internet. The proposed prototype is focused mainly on low-cost solution for automation of legacy appliances so that to automate the home environment without replacing the existing equipments. The goal is to keep replacement of equipments to minimum and thus to reduce the overall implementation cost. Keeping this in mind the approach is to use a gateway that can act as a mediator between the user and the end devices. The prototype proposes an embedded gateway which can communicate using wireless Wi-Fi transceivers with the end device and connect them to the internet. Any smart-phone with an internet connection can access the home environment through the gateway.

### A. BLOCK DIAGRAM OF THE SYSTEM



**Figure 1.** Block diagram of the Smart Home Automated Emulator

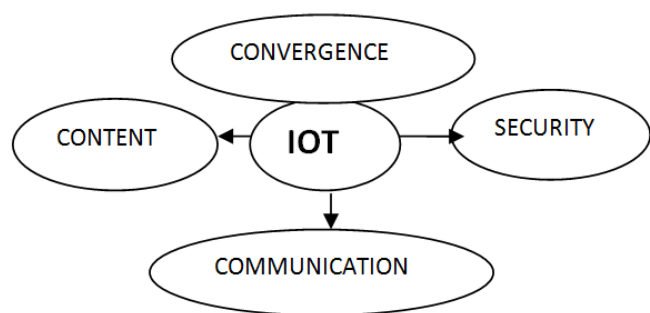
Fig 1 shows the block diagram indicating the main parts of next gen smart emulator. Here the data from the 230v AC devices is controlled with the help of relay and arduino UNO. The data is sent to the cloud with the help of a Wi-Fi transceiver ESP8266. The data is processed in the cloud and the devices are controlled through IOT.

### WEBSITE

A website is a collection of related web pages, including multi-media content, typically identified with a common domain name and published on at least one web server. A website may be accessible via a public Internet Protocol (IP) network, such as the internet, or a private local area network (LAN), by referencing a uniform resource locator (URL) that identifies the site.

## CLOUD

Cloud is a network of remote servers hosted on the internet and used to store, manage and process data in place of local servers or personal computers. Google cloud storage is designed for 99.9% durability. All storage classes offer very high availability. Cloud server is a central server aims on implementing services to other sub modules. The server evaluates the data it takes from the house, sends current status to the smart gadgets and vice-versa. A database is managed by the server and its status gets updated as per the changes done at home end.



**Figure 2.** Objective of IoT

Fig 2. represents the main objective of IoT. IoT plays a major role in communication where the data can be accessed via internet. IoT is also used as a media for computing and storing the data in cloud. The contents can be collected and processed by various protocols that control IoT.

## ESP 8266

ESP 8266 is a system on chip (SoC) with capabilities for 2.4GHz. It is a UART to Wi-Fi module which provides an easy way to connect any small Microcontroller platform like Arduino to internet wirelessly. It also includes 32bit microcontroller which can be programmed to act as a standalone Wi-Fi connected embedded platform.

The module has various variants; ESP8266-xx (01-13). Each module is just a development over the previous in terms of hardware capabilities with ESP8266-01 being the cheapest and the one with minimal features to ESP8266-13 being the most expensive with maximum features. The various features include number of GPIO pins, presence of shield, antenna, type of package (Through-hole or Surface mount), memory and handling external analog signals.

The ESP8266 in contrast can directly connect to the internet without the need for any extra modules in between the hardware and reducing interfacing issues. This means each sensor node can be directly accessed and does not depend on a central system to retrieve its data as far as the node is connected to the internet.

## ARDUINO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.

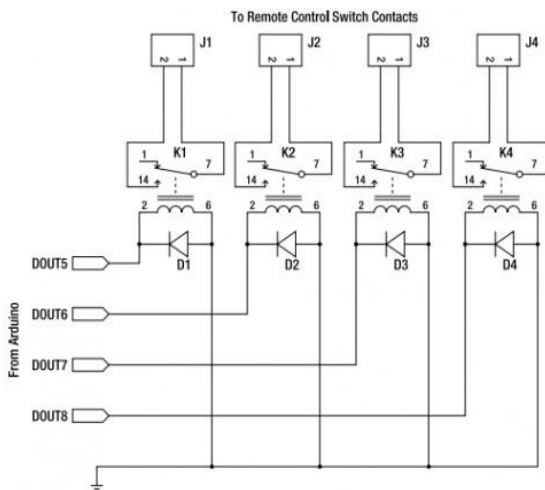


**Figure 3.** Arduino module

Fig1.5 shows the pictorial representation of Arduino module. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

## RELAY

This remote control relay kit includes 12V 4 channel multi-function remote control relay and 4 channels wireless controller. It can be used in home automation or wireless control of any AC device (motor, appliance, light lamps). The remote control relay module is characterized by stable performance, small size and high receiving sensitivity. Mainly used in the field of industrial control and security surveillance.



**Figure 3.** Four channel relay module

Fig 3 shows the internal circuit of a four channel relay module. The module consists of four transistors which are connected to the second, third, fourth and fifth pins of the module respectively. The Vcc of the module is given with a DC supply of 5v and the ground pin is earthed. The relay has three pins namely normally open, normally close and common pin.

## WORKING OF RELAY

Self-locking process is done by connecting the JP1 with shorting plug. The non-locking phase is achieved by disconnecting the JP1 and JP2 with shorting plug. Connect JP2 with shorting plug for interlocking. 2 channel interlocking and 2 channel inching is interfaced by establishing connection between JP1 and JP2.

## IV. IMPLEMENTATION

The Arduino UNO operating output pin modes and other libraries needed in the sketch.

Remote control of home automation has voltage is nominally 5.0 VDC and can be powered via two sources: the USB port and an external 2.1 mm DC

connector (recommended input range 7 - 12 VDC, maximum 6 - 20 VDC). An on-board voltage regulator provides the 5 VDC operating voltage. The maximum source/drain current per input/output pin is 20mA. The relay is interfaced with the micro-controller and the 230v AC device.

## A. HARDWARE DESCRIPTION FOR RELAY INTERFACING:

The relay is powered-up through the 5v pin of the Arduino which is connected to the Vcc of the relay. The ground of Arduino and relay module are interlocked. The output pins of the Arduino are given as input to the relay. The positive supply of the AC load is given as an input to the normally open pin and the output is taken from the common pin and is given to the AC socket. The negative supply from the AC load is directly connected to the socket.

## ADVANTAGES

The main advantages of home automation system are:

Fig 1.6 shows the internal circuit

- Managing all home devices from one place being able to keep all of the technology in the home connected through one interface is a massive step forward for technology and home management.
- Flexibility for new devices and appliances. Smart home systems tend to be wonderfully flexible when it comes to the accommodation of new devices in appliances and other technologies.
- Increased energy efficiency.
- The product themselves will reach a plug and play type of usability.

## B.SOFTWARE DESCRIPTION

A minimal arduino c/c++ consists of only two functions. The two functions are setup( ) and loop( ).

**setup( ):** This function is called once when a sketch starts after the power-up or reset. It is used to initialize variables, input and output pin modes.

**loop( ):** After setup( ) has been called, function loop( ) is executed repeatedly in the main program. It controls the board until the board is powered-off or reset.

The code of the module explains the controlling of the 230v AC devices via relay. The code is interfaced to the relay module with the help of Arduino UNO. The

setup( ) code explains the pins to which the devices are connected. In a 4-channel relay module, four types of 230v AC devices are connected and controlled with the help of arduino.cc software. The loop( ) code executes the ON/OFF process of the AC devices with a delay of five seconds. The individual devices can be also controlled independently.

## APPLICATIONS

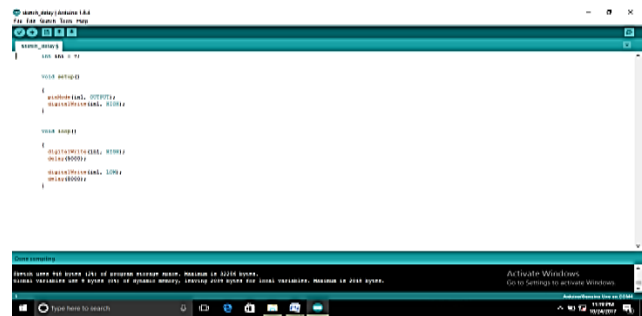
- The power of being able to control the AC devices from a distance.
- The home automation system allows to control AC devices conveniently by switching ON/OFF.
- Repeatable process is automatable with smart home applications. The greater the
- Control and flexibility of the process, the more energy and cost is saved.
- The prototype rely on a communication infrastructure for exchanging information.
- The other important applications involve energy management with less time consumption.

## V. RESULTS

The prototype presents the working module of the devices controlled with an embedded code. The embedded code is coded in such a way to control the relay. The relay is an electronic switch which operates with a 5v DC power supply. The relay in turn controls the AC device. The embedded code can switch from high to low or from low to high as per the requirement.

### A. OUTPUT

In computing, a code segment corresponds to a portion of an object file that contains executable instructions. The embedded code is stored in the object file. The loader places the program into memory, which is then executed. The code in memory is typically read only and has a fixed size. In embedded system the code is usually placed in read only memory (ROM), without the need of loading.

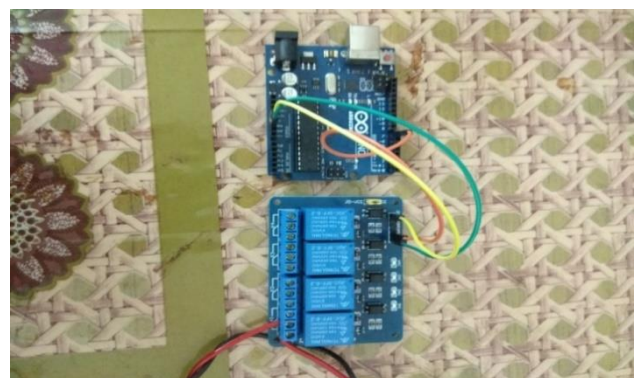


**Figure 4.** Code to control relay

Fig 4 shows the code of the module that explains the control of the 230v AC devices via relay. The code is interfaced to the relay module with the help of Arduino UNO.

The setup( ) code explains the pins to which the devices are connected. In a 4-channel relay module, four types of 230v AC devices are connected and controlled with the help of arduino.cc software. The pin 7 is given high as it indicates the output pin of the Arduino.

The loop( ) code executes the ON/OFF process of the AC devices with a delay of five seconds. The individual devices can be also controlled independently. The code, when it is in high mode the relay is activated and the AC device is turned ON. The code, when it is in low mode the relay is deactivated and the AC device is turned OFF.



**Figure 5.** Arduino and relay connections

Fig 5 explains the connections between the Arduino UNO microcontroller and 4channel relay module. Relay module consists of a Vcc pin, ground pin and four output pins. The relay is to be provided with 5v DC supply and hence the Vcc pin of the relay is connected to the 5v DC supply pin in the Arduino module. The ground pin of the relay module and Arduino UNO are inter-locked. The output pin of the relay module is connected to the pin7 of the Arduino.

The embedded code is coded for the output pin7 and when the microcontroller is uploaded with the code, the output pin is controlled and as a result the relay is controlled.



**Figure 6.** Relay and AC device connection

Fig 6 explains the connections between the relay module and 230v AC device. The earth connection of the AC socket is directly connected to the AC device's negative supply. The positive supply of the AC device is given as an input to the common pin of the relay module. The output is taken from the normally closed pin of the relay module and is connected to the positive supply of the AC socket. The interfacing of the AC device and relay module enables the control of the AC device with the embedded code.

Fig 1.10 shows the implementation of a relay controlled AC devices. The figure explains that although the AC supply is turned ON the the AC device (bulb) does not gets activated, as it is coded with the low mode.



**Figure 7.** Output of relay controlled AC devices

The following figure shows the activation of the AC device, as it is coded with a high mode. This explains the complete control of the AC device with an embedded code and relay module.

## VI. CONCLUSION

The prototype allows low cost home control and monitoring system based on wireless embedded gateway is proposed and implemented. Any android based smart phone can be used to access the home appliances remotely through internet. Using the proposed prototype system the existing home appliances can be completely automated at low cost. The concept is done by extending the protocol model by including all appliances and services that provide notifications, security, energy-saving, automation, telecommunication, computers and thus make a more intelligent home automation system. The incorporation of concepts like cloud computing and big data applications which enhances the intelligent home automation concepts. The advanced features updates user convenience and data collection and analytics which come from the AC devices connected to the internet and ultimately to cloud services.

## VII. FUTURE WORK

The device interfaced with relay which controls the AC devices through the micro-controller, will be extended by connecting the entire module with the Wi-Fi transceiver. The transceiver helps to send the data to the cloud and process the data in the cloud and results in the control of 230v AC devices through smart gadgets. The smart gadgets gain access through an application installed in the gadgets or simply through

the website which access the Wi-Fi transceiver to control the AC devices.

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