



DESIGN AND IMPLEMENTATION OF GESTURE, VOICE AND (IOT) INTERNET OF THINGS BASED HOME AUTOMATION FOR PHYSICALLY CHALLENGED

Aswathi A¹, Gokula vanishree E², Pavithra S³, Sridevi A⁴, Veena B⁵
^{1,2,3}UG Student, Dept of EEE, Dr. TTIT, KGF

⁴Assistant Professor, ⁵Associate Professor Dept of EEE, Dr. TTIT, KGF

Abstract

Home automation allows us to focus on getting our work done without worrying about the safety and security of our home, while enabling us to control the appliances in our home on the go. All of our devices and appliances are networked together to provide us with a seamless control over all aspects of our home and more. Home automation has been around from many decades in terms of lighting and simple appliance control, and only recently has technology caught up for the idea of the interconnected world, allowing full control of our home from anywhere, to become a reality.

This system makes use of gesture command for controlling the home appliances, the concept of controlling home appliances using human voice is also designed such that people who are physically challenged who cannot move their limbs effectively can make use of Voice command in controlling home appliances.

The system also makes use of IOT; IOT is a world, where real, virtual and digital environments combine to create a smart environment which makes life easy. It is a new era of computing technology in which machines interact and communicate with other machines, objects and environment. This new technology has unlimited potential to improve our lives by using a “command-and-control” strategy. The ultimate goal of IOT applications is to automate systems rather than using manual systems, to improve the quality of living.

With home automation, we dictate how a device should react, when it should react, and why it should react. Home automation is a necessity these days as it helps save up on power consumption, makes our homes more secure, provides a way to monitor our home when we are away, and makes our home secure in every way possible.

I. INTRODUCTION

Home automation allows us to focus on getting our work done without worrying about the safety and security of our home, while enabling us to control the appliances in our home on the go. All of our devices and appliances are networked together to provide us with a seamless control over all aspects of our home and more. Home automation has been around from many decades in terms of lighting and simple appliance control, and only recently has technology caught up for the idea of the Interconnected world, allowing full control of our home from anywhere, to become a reality. With home automation, we dictate how a device should react, when it should react, and why it should react. Home automation is a necessity these days as it helps save up on power consumption, makes our homes more secure, provides a way to monitor our home when we are away, and makes our home secure in every way possible.

Rehabilitation engineering is the application of engineering sciences and technology to improve the quality of life for the people with disabilities. A device is designed for the physically challenged people to aid them in operating the home appliances individually. Gesture is defined as a motion of limbs or any other body part which is made to emphasize speech. It can also

be defined as an act or a remark made as a sign of attitude. A Micro-electro-mechanical-Systems (MEMS) accelerometer is used to sense the accelerations of hand in motion in two perpendicular directions that is (X & Y) and transmitted to wireless protocol using Radio Frequency (RF). Which is received by an RF receiver and the information is decoded and the home appliances are turned ON or OFF respectively depending on the commands received from the controller and transmitter unit. In addition to gesture the concept of controlling home appliances using human voice is also designed such that people who are physically disabled who cannot move their limbs effectively can make use of Voice command in controlling home appliances.

The system also makes use of IOT; IOT is a world, where real, virtual and digital environments combine to create a smart environment which makes life easy. It is a new era of computing technology in which machines interact and communicate with other machines, objects and environment. This new technology has unlimited potential to improve our lives by using a “command-and-control” strategy. It is a revolution of the Internet in which objects make themselves recognizable. Objects can communicate information among them and can take necessary decisions whenever required. Communication has been extended via internet to all things around us. When objects can communicate with each other, via the internet, we need to take complete advantage of remote access. The ultimate goal of IOT applications is to automate systems rather than using manual systems, to improve the quality of living.

II. PROBLEM OBJECTIVES

1. The main aim of our project is to build a perfect companion for elderly and physically challenged who are at home, controlling home appliances either by voice or by gesture and provide Global access to home appliance via IOT

2. Thereby to improve the quality of life for the people with physically challenged and provide them with independent life.

III. METHODOLOGIES ADOPTED

1. Interfacing Speech recognition kit and train it to recognize voice commands
2. Getting accelerometer connected to the microcontroller
3. Customizing BLYNK Google play application for globally accessing of information.
4. Interfacing ESP8266 to microcontroller for providing Wi-Fi link to access internet
5. Sending and receiving the data over RF for relay control
6. Designing and implementing a Driver circuit to drive relays which in turn control the AC load

IV. SYSTEM REQUIREMENTS AND SPECIFICATIONS

Hardware requirements

1. Arduino MEGA-2560 – 8 bit Advance Virtual RISC Microcontroller based development board
2. Accelerometer
3. Speech recognition kit
4. ESP8266 – Wi-Fi adapter
5. 433MHz RF transmitter and Receiver
6. Decoder
7. Encoder
8. Driver
9. AC Single pole Relay
10. Rechargeable battery
11. Power supply

Software requirements

1. BLYNK – Smartphone Google play Application for IOT
2. Sketch IDE – Programming Arduino MEGA-2560

V. BLOCK DIAGRAM

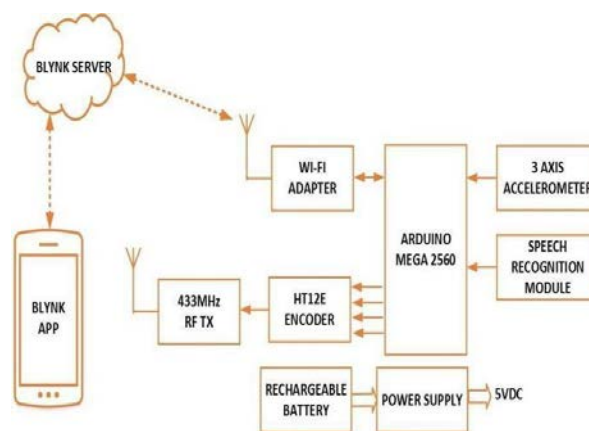


Figure 1: BLOCK DIAGRAM OF CONTROLLER AND TRANSMITTER UNIT

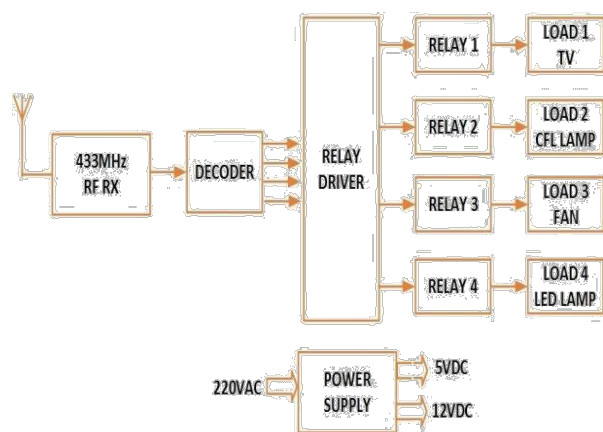


Figure2: BLOCK DIAGRAM OF RECEIVER AND HOME APPLIANCE UNIT

1. ARDUINO MEGA-2560

Arduino is a tool for making computers that can sense and control more of the physical world than your desktop computer. It's an open-source physical computing platform based on a simple microcontroller board, and a development environment for writing software for the board.

Arduino can be used to develop interactive objects, taking inputs from a variety of switches or sensors, and controlling a variety of lights, motors, and other physical outputs. Arduino projects can be stand-alone, or they can be communicating with software running on your computer (e.g. Flash, Processing, Max MSP.) The boards can be assembled by hand or purchased preassembled; the open-source IDE can be downloaded for free. The Arduino programming language is an implementation of Wiring, a similar physical computing platform, which is based on the Processing multimedia programming environment. Example of different arduino boards

1. Arduino Diecimila
2. Arduino Duemilanove
3. Arduino UNO
4. Arduino Leonardo
5. Arduino Mega
6. Arduino Mega ADK
7. Arduino Nano
8. Arduino Pro-Mini
9. Arduino Due (ARM-based)

2. ACCELEROMETER

An accelerometer is a device that measures proper acceleration. The proper acceleration measured by an accelerometer is not necessarily

the coordinate acceleration (rate of change of velocity). Instead, the accelerometer sees the acceleration associated with the phenomenon of weight experienced by any test mass at rest in the frame of reference of the accelerometer device. Another term for the type of acceleration that accelerometers can measure is g-force acceleration.

Accelerometers have multiple applications in industry and science. Highly sensitive accelerometers are components of inertial navigation systems for aircraft and missiles. Accelerometers are used to detect and

monitor vibration in rotating machinery. Accelerometers are used in tablet computers and digital cameras so that images on screens are always displayed upright.

Single- and multi-axis models of accelerometer are available to detect magnitude and direction of the proper acceleration (or g-force), as a vector quantity, and can be used to sense orientation (because direction of weight changes), coordinate acceleration (so long as it produces g-force or a change in g-force), vibration, shock, and falling in a resistive medium (a case where the proper acceleration changes, since it starts at zero, then increases).

Micro machined accelerometers are increasingly present in portable electronic devices and video game controllers, to detect the position of the device or provide for game input. Pairs of accelerometers extended over a region of space can be used to detect differences (gradients) in the proper accelerations of frames of references associated with those points.

These devices are called gravity gradiometers, as they measure gradients in the gravitational field. Such pairs of accelerometers in theory may also be able to detect gravitational waves.

3. VOICE RECOGNITION MODULE-V3

Advancement in technology has developed an intelligent man-machine interface technique that facilitates computers or machines or robots to be operated using the voice commands of human without using any input systems, such as keyboards or mouse. This human-machine interface (HMI) can be achieved using voice

recognition modules. In this article, we will discuss about the voice recognition modules along with their working procedure and applications.

Voice recognition is a technique that facilitates natural and convenient human-machine interface using the voice recognition module. It extracts and analyses voice features of human delivered to a machine or

computer through the mic. Voice recognition technique is classified into many types based on different criteria such as scope of the users, number of words used for recognition, naturalness of speaking. If the voice recognition level is more than 95%, then only the voice recognition is practically used.

ELECHOUSE Voice Recognition Module is a compact and easy-control speaking recognition board. This product is a speaker-dependent voice recognition module. It supports up to 80 voice commands in all. Max 7 voice commands could work at the same time. Any sound could be trained as command. Users need to train the module first before let it recognizing any voice command.

This board has 2 controlling ways: Serial Port (full function), General Input Pins (part of function). General Output Pins on the board could generate several kinds of waves while corresponding voice command was recognized.

Parameter

1. Voltage: 4.5-5.5V
2. Current: <40mA
3. Digital Interface: 5V TTL level for UART interface and GPIO
4. Analog Interface: 3.5mm mono-channel microphone connector + microphone pin interface
5. Size: 31mm x 50mm
6. Recognition accuracy: 99% (under ideal environment)

Features

1. Support maximum 80 voice commands, with each voice 1500ms (one or two words speaking)
2. Maximum 7 voice commands effective at same time
3. Arduino library is supplied
4. Easy Control: UART/GPIO

5. User-control General Pin Output

4. ESP8266- WiFi Adapter

ESP8266 delivers highly integrated Wi-Fi SoC solution to meet user's continuous demands for efficient power usage, compact design and reliable performance in the Internet of Things industry. With the complete and self-contained Wi-Fi networking capabilities, ESP8266 can perform either as a standalone application or as the slave to a host MCU. When ESP8266 hosts the application, it promptly boots up from the flash. The integrated high-speed cache helps to increase the system performance and optimize the system memory.

Also, ESP8266 can be applied to any microcontroller design as a Wi-Fi adaptor through SPI / SDIO or I2C / UART interfaces. ESP8266EX integrates antenna switches, RF balun, power amplifier, low noise receive amplifier, filters and power management modules. The compact design minimizes the PCB size and requires minimal external circuitries.

5(A). TX433MHZ (RF Transmitter Module)

Serial Data from the Encoder HT12E is given to the Data Input pin of the Tx433MHz RF Transmitter module. This module converts the Data to RF and

Transmits to air, which has a coverage area of 200mtrs.

The TX433Mhz Transmitter module offers a miniature hybrid modular RF transmitter providing on-off keyed modulation (ASK) which can be used to transmit data from any standard CMOS/TTL source up to 1200 baud. The module is very simple to operate, requiring only two connections. The module is also very efficient, using only 2.3mA which means that it may be driven directly from an encoder I/C or microcontroller.

The output impedance has been designed to give optimum performance when coupled with a small antenna such as a tuned loop or short whip. The modules are compatible with the AM Receiver modules. The transmitter module is type approved for use in general telemetry and telecommunications product.

Features

- Miniature module
- Saw controlled frequency stability
- No adjustable components
- Transmitting range up to 200 meters
- CMOS/TTL compatible input
- Current consumption 2.5ma (Type)
- Single supply voltage 5VDC.
- Compatible with R.F. AM receiver.

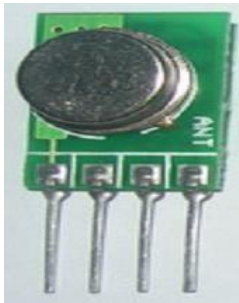


Figure 3: TX433MHZ (RF Transmitter module)

5(B). RX433 RF RECEIVER MODULE

By definition, a module is “a self-contained component of a system, which has a well-defined interface to the other components” RF Module Packaging or System in Package (SiP) are terms used to describe the functional integration of semiconductor devices (elemental and/or compound), Surface Mount Devices (SMDs), Integrated Passive Devices (IPDs), substrate, SAW filters, and even EMI shields. This compact radio frequency (RF) receiver module is suitable for remote control or telemetry applications. The double sided circuit board is pre-populated with Surface Mount Devices (SMD) and is tuned to 433MHz. No module assembly or adjustments are required. RF receiver module RX433 receives RF control signals from the RF transmitter Tx433 RF receiver module RX433 is a highly sensitive passive design that is easy to implement with a low external parts count.

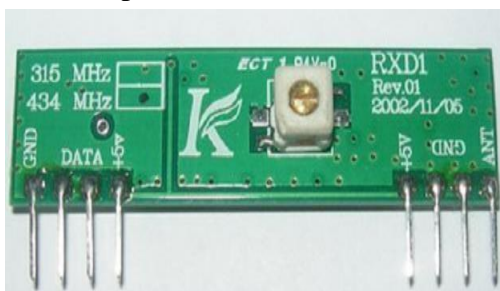


Figure 4: RX433 (RF Receiver module)

RF Receiver Module Features

- No RF receiver module adjustments required
- stable output
- suitable for RF remote controls, telemetry

Specification

- RF receiver frequency: 433MHz
- receiver range: 220 yards (200m) in open air
- modulation: AM
- modulate mode: ASK
- sensitivity: $3\mu\text{Vrms}$
- power supply: 4.5 - 5.5V DC
- data rate: 4800 bps
- digital and linear output
- RF receiver module pin numbers

Pin configuration

- 1: GND
- 2: DIGITAL OUTPUT
- 3: LINEAR OUTPUT
- 4: VCC
- 5: VCC
- 6: GND
- 7: GND
- 8: ANTENNA: (50cm - 75cm)

6. ENCODER

An encoder is a device, circuit, transducer, software program, algorithm or person that converts information from one format or code to another, for the purposes of standardization, speed, secrecy, security, or saving space by shrinking size.

The encoder used here is HT12E, processed Data containing both details about Temperature and heart beat from the microcontroller is sent from pin No 3,11,12,13 , and is connected to the D0,D1, D2,D3 (Pin 10,11,12,13) of the encoder HT12E. The encoder converts this Data to serial format and is got at pin No 17 which is given to Tx433 transmitter module for RF transmission.

HT12E:

The HT12E encoders are a series of CMOS LSIs for remote control system applications.

They are capable of encoding information which consists of N address bits and 12-N data bits. Each address/data input can be set to one of the two logic states. The programmed addresses/data are transmitted together with the header bits via an RF or an infrared transmission medium upon receipt of a trigger signal.

Features

Operating voltage: 5V DC (+/- 20%)

- Low power and high noise immunity CMOS technology
- Low standby current: 0.1_A (typ.) at VDD=5V
- 38kHz carrier for infrared transmission medium
- Minimum transmission word: Four words
- Built-in oscillator needs only 2 external resistors
- Data code has positive polarity
- Minimal external components
- Pair with Holtek' s 212 series of decoders
- 18-pin DIP pa Miniature module
- Saw controlled frequency stability
- No adjustable components
- Transmitting range up to 200 meters
- CMOS/TTL compatible input
- Current consumption 2.5ma (type)
- Single supply voltage 5VDC
- Compatible with R.F. AM receiver

7.DECODER

A decoder is a device which does the reverse of an encoder, undoing the encoding so that the original information can be retrieved. The same method used to encode is usually just reversed in order to decode. In

digital electronics, a decoder can take the form of a multiple-input, multiple- output logic circuit that converts coded inputs into coded outputs, where the input and output codes are different. Enable inputs must be on for the decoder to function, otherwise its outputs assume a single "disabled" output code word. Decoding is necessary in applications such as data multiplexing, 7 segment display and memory address.

The HT12D decoders are a series of CMOS LSIs for remote control system applications. They are paired with Holtek's 212 series of encoders. For proper operation, a pair of encoder/decoder with the same number of addresses and data format should be chosen. The decoders receive serial addresses and data from a programmed 212 series of encoders that are transmitted by a carrier using an RF or an IR transmission medium. They compare the serial input data three times continuously with their local

addresses. If no error or unmatched codes are found, the input data codes are decoded and then transferred to the output pins. The VT pin also goes high to indicate a valid transmission.

Features

- Operating voltage: 5VDC
- Low power and high noise immunity CMOS technology
- Low standby current
- Capable of decoding 12 bits of information
- Pair with Holtek' s HT12E series of encoders
- Binary address setting
- Received codes are checked 3 times
- Address/Data number combination
- 8 address bits and 4 data bits
- Built-in oscillator needs only 5% resistor
- Valid transmission indicator

8. POWER SUPPLY

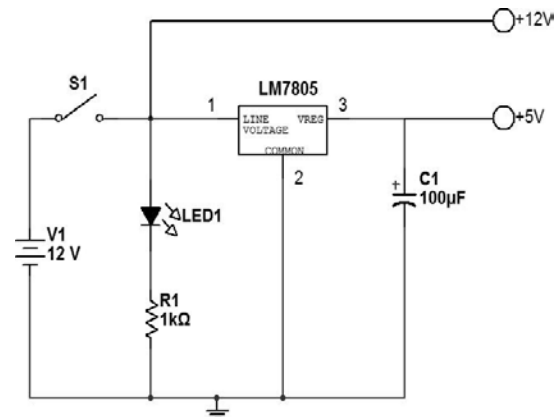


Figure 5: Power supply

The power supply unit consists of a 12V Rechargeable

Battery output from the battery is fed to regulator IC 7805. LED1 glows to indicate the presence of power in the system. Switch S1 is connected to ON/OFF the supply to the circuit. The output of the power supply is given as +VCC (+5V).

LM7805 Three Terminal Positive Voltage Regulator IC

The LM7805 is a Three Terminal Positive Voltage Regulator IC available in TO-220/D-PAK package, making them useful in a wide range of applications. LM7805 employs internal current limiting, thermal shut-down and safe area protection, making it essentially indestructible. If adequate heat sinking is provided, they can deliver over 1A output

current. Although designed primarily as fixed voltage regulators, these devices can be used with external components to obtain adjustable voltages and currents.

9. RELAY

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be ON or OFF so relays have two switch position and they are double throw (changeover) switches.

Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

The coil of a relay passes a relatively large current, typically 30mA for a 12V relay, but it can be as much as 100mA for relays designed to operate from lower voltages. Most ICs (chips) cannot provide this current and a transistor is usually used to amplify the small IC current to the larger value required for the relay coil. The maximum output current for the popular 555 timer IC is 200mA so these devices can supply relay coils directly without amplification.

Relays are usually SPDT or DPDT but they can have many more sets of switch contacts, for example relay with 4 sets of changeover contacts are readily available. Most relays are designed for PCB mounting but you can solder wires directly to the pins providing you take care to avoid melting the plastic case of the relay.



Figure 6: SPDT Relay

10. SKETCH

The Sketch IDE (Integrated Development Environment) is a special program running on your computer that allows you to write sketches for the Arduino board in a simple language modelled after the Processing language.

The magic happens when you press the button that uploads the sketch to the board: the code that you have written is translated into the C language, and is passed to the AVR-GCC compiler, an important piece of open source software that makes the final translation into the language understood by the microcontroller. This last step is quite important, because it's where Arduino makes your life simple by hiding away as much as possible of the complexities of programming microcontrollers.

The programming cycle on Arduino is basically as follows:

- Plug your board into a USB port on your computers
- Write a sketch that will bring the board to life
- Upload this sketch to the board through the USB connection and wait a couple of seconds for the board to restart
- The board executes the sketch that you wrote

The idea of sketching in code is a way of thinking about writing code as a simple intuitive process, just like drawing in a sketchbook. In this way, an Arduino program is called a sketch and is saved in a folder called a sketchbook. Sketching means we can get our hands dirty and quickly try out a new idea. It is a skill available to all of us.

11. BLYNK

Blynk is designed for the Internet of Things. It can control hardware remotely, it can display sensor data, it can store data, visualize it and do many other cool things.

There are three major components in the platform:

- **Blynk App** - allows to you create amazing interfaces for your projects using various widgets we provide.
- **Blynk Server** - responsible for all the communications between the Smartphone and hardware. You can use our Blynk Cloud or run your private Blynk server locally. Its open-source could easily handle thousands of

devices and can even be launched on a Raspberry Pi.

- **Blynk Libraries** - for all the popular hardware platforms - enable communication with the server and process all the incoming and outgoing commands.

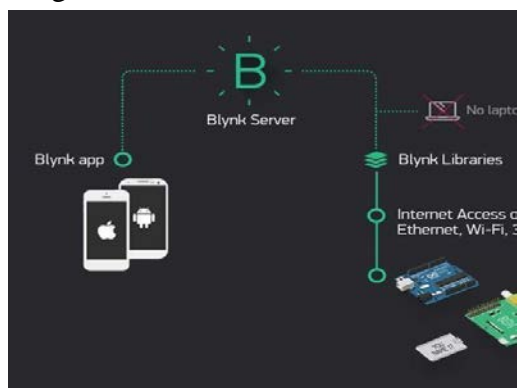


Figure 7: BLYNK Network

Features

- Similar API & UI for all supported hardware & devices
- Connection to the cloud using:
 - o Wi-Fi
 - o Bluetooth and BLE
 - o Ethernet
 - o USB (Serial)
 - o GSM
- Set of easy-to-use Widgets
- Direct pin manipulation with no code writing
- Easy to integrate and add new functionality using virtual pins
- History data monitoring via History Graph widget
- Device-to-Device communication using Bridge Widget

VI. ADVANTAGES AND DISADVANTAGES

Advantages

- Uses either Gesture or Voice or IoT mode of home automation
- The system is reasonably cheap, easy to configure and easy to use
- Doesn't require a PC or Laptop for Voice processing unlike MATLAB
- Need not purchase the cloud or app since it uses free cloud and Google app called

BLYNK

Disadvantages

- Voice and Gesture cannot be made to work in parallel

VII. APPLICATIONS

- Home appliances
- Home automation
- Smart plug and lights
- Mesh network
- Industrial wireless control
- Baby monitor
- IP cameras
- Sensor network
- Wearable electronics
- Wi-Fi location - aware devices
- Security ID tags
- Wi-Fi position system beacons

VIII. CONCLUSION

Implementing voice recognition technique for home control system can make our life easier. This type of control system can be applied to the situations where it is not feasible to manually control the home appliance. It can help physically challenged and elderly living at home. The effectiveness of the system depends on several factors, which are the user pronunciation, the level of noise in the room where the system is set up and the distances between the transmitter and receiver modules. The system could be further improved by using better performance RF transmitter and receiver.

The goal of this project is to design a useful and fully functional real-world product that efficiently movement of the fingers. Our motivation is to help differently able people to control the electronics appliances more easily, controlling devices like fan, television, etc. The proposed method can also be extracted to recognize any number words without modifying the system, just requiring a further training of the network

IX. REFERENCES

1. https://en.wikipedia.org/wiki/Home_automation
2. ieeexplore.ieee.org/document/8067929
3. www.electronicshub.org
4. <https://www.skyfilabs.com/project-ideas/home-automation-system-using-iot-arduino>
5. <https://electrosome.com/home-automation-arduino-esp8266/>
6. <https://www.electroschematics.com/9598/s-pdt-relay-switch/>
7. <https://www.arduino.cc/en/Guide/ArduinoMega2560>