HOME AUTOMATION USING ARDUINO

Bachelor of Engineering Degree in Electrical and Electronics in Engineering

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BONAFIDE CERTIFICATE

This   is   to   certify   that   this   Project   Report   is   the   Bonafide   work   of **P. SARAN**(Reg. No. 39140049), **RAGHUL.S** (Reg. No. 39140044), **I.HAMEED FAZIL** (Reg. No. 39140016) and **A.MATHESH** (Reg. No. 39140030) who carried out the project entitled **"HOME AUTOMATION USING ARDUINO"** under our supervision from February 2022 to April 2022.

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DECLARATION

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ACKNOWLEDGEMENT

ABSTRACT

The main objective of this project is to develop a home automation system using an Arduino board with Bluetooth being remotely controlled by any Android OS smart phone. As technology is advancing so houses are also getting smarter. Modern houses are gradually shiftingfromconventionalswitchestocentralizedcontrolsystem,involving remote controlled switches.Presently,conventionalwallswitcheslocatedindifferentpartsofthehousemakesit difficult for the user to go near them to operate. Even more it becomes more difficult for the elderlyorphysicallyhandicappedpeopletodoso.Remotecontrolledhomeautomationsystem provides a most modern solution with smart phones. In order to achieve this, a Bluetooth moduleisinterfacedtotheArduinoboardatthereceiverendwhileonthetransmitterend,a GUI applicationon the cellphone sends **ON/OFF** commands to the receiver where loads are connected.BytouchingthespecifiedlocationontheGUI,theloadscanbeturned**ON/OFF** remotely through this technology. The loads are operated by Arduino board through opto- isolators and thyristors using**TRIACs**.

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INTRODUCTION

Nowadays,wehaveremotecontrolsforourtelevisionsetsandotherelectronicsystems,which have made our lives real easy. Have you ever wondered about home automation which would givethefacilityofcontrollingtubelights,fansandotherelectricalappliancesathomeusinga remotecontrol?Off-course,Yes!But,aretheavailableoptionscost-effective?Iftheansweris No, we have found a solution to it. We have come up with a new system called Arduino based homeautomationusingBluetooth.Thissystemissuper-costeffectiveandcangivetheuser,the abilitytocontrolanyelectronicdevicewithoutevenspendingforaremotecontrol.Thisproject helps the user to control all the electronic devices using his/her smartphone. Time is a very valuablething.Everybodywantstosavetimeasmuchastheycan.Newtechnologiesarebeing introduced to save our time. To save people's time we are introducing Home Automation system using Bluetooth . With the help of this system you can control your home appliances from your mobile phone. You can turn on/off your home appliances within the range of Bluetooth.

COMPONENTS REQUIRED

1) ARDUINOUNO

2) 1-CHANNELRELAY(5v)

3) BLUETOOTH MODULEHC05

4) POWERSUPPLY

5) LOAD(BULB220V)

6) SWITCH BOARD

7) CONNECTINGWIRES

8) SMARTPHONE(BLUETOOTHENABLED)

<u>DESCRIPTION</u>

ARDUINO UNO

Arduinoisanopensourcecomputerhardwareandsoftwarecompany,project,anduser communitythatdesignsandmanufacturessingle-board microcontrollersandmicrocontrollerkitsforbuildingdigitaldevicesandinteractiveobjectsthat can sense and control objects in the physical and digital world. The project's products are distributed as open-source hardware and software, which are licensed under the GNU LesserGeneral Public License (LGPL) or the GNU General Public License (GPL), permitting the manufacture of Arduino boards and software distribution by anyone. Arduino boards are availablecommerciallyinpreassembledform,orasdo-it-yourself(DIY)kits.

Arduino board designs use a variety of microprocessors and controllers. The boards are equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to variousexpansionboardsorBreadboards(*shields*)andothercircuits.Theboardsfeatureserial communications interfaces, including Universal Serial Bus (USB) on some models, which are also used for loading programs from personal computers. The microcontrollers are typically programmed using a dialect of features from the programming languages C and C++. In additiontousingtraditionalcompilertoolchains,theArduinoprojectprovidesanintegrateddevelopmente nvironment(IDE)basedontheProcessinglanguageproject.

TheArduinoprojectstartedin2003asaprogramforstudentsattheInteractionDesignInstituteIvreainIvrea, Italy,aimingtoprovidealow-costandeasywayfornovicesandprofessionalsto create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motiondetectors.

The name *Arduino* comes from a bar in Ivrea, Italy, where some of the founders of the project used to meet. The bar was named after Arduino of Ivrea, who was the margrave of the March of Ivrea and King of Italy from 1002 to 1014.

Features of the Arduino UNO:

Microcontroller: ATmega328

Operating Voltage: 5V

Input Voltage (recommended): 7-12V

Input Voltage (limits): 6-20V

Digital I/O Pins: 14 (of which 6 provide PWM output)

Analog Input Pins: 6

DC Current per I/O Pin: 40mA

DC Current for 3.3V Pin: 50mA

Flash Memory: 32KB of which 0.5KB used by bootloader

SRAM: 2 KB (ATmega328)

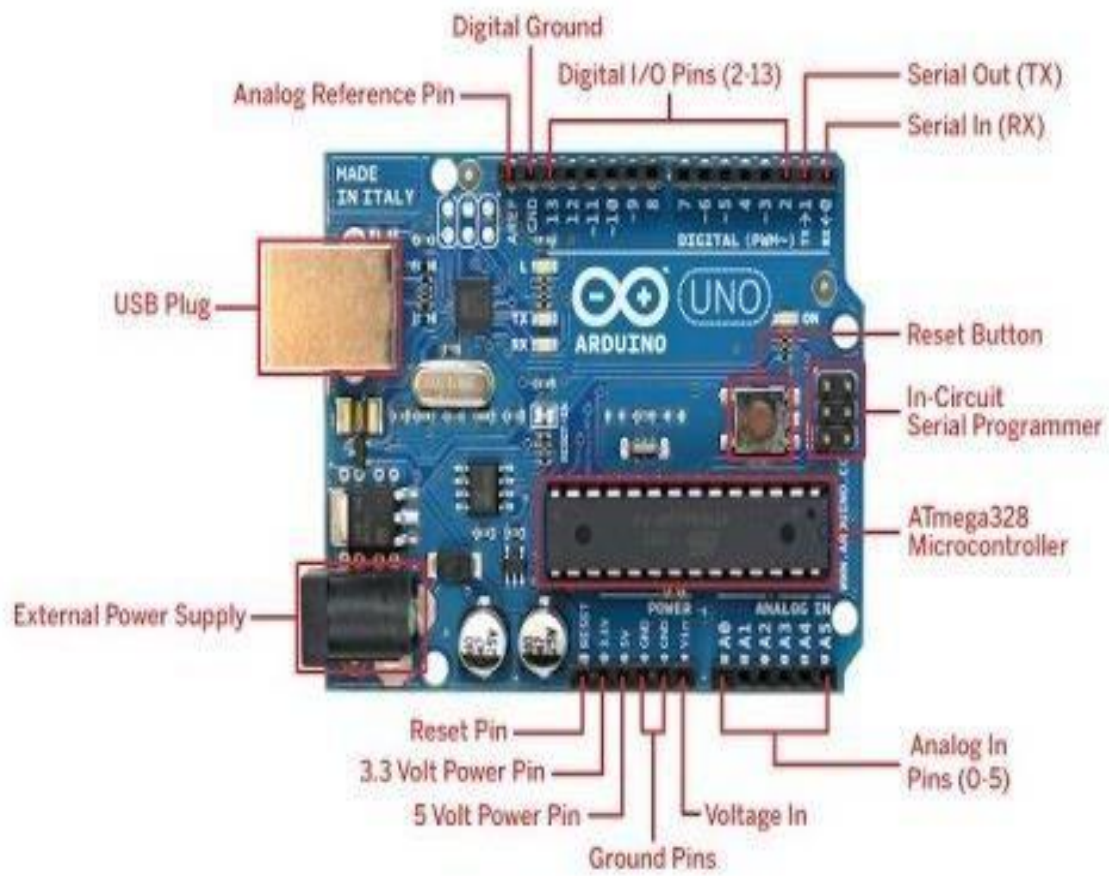EEPROM: 1 KB (ATmega328)

Clock Speed: 16 MHz

FIG 1 ARDUINO UNO R3

ARDUINO HARDWARE PART:-

Arduino is open-source hardware. The hardware reference designs are distributed under aCreativeCommonsAttributionShare-Alike2.5licenseandareavailableontheArduino website.Layoutandproductionfilesforsomeversionsofthehardwarearealsoavailable.

Although the hardware and software designs are freely available under copyleft licenses, the developers have requested the name *Arduino*to be exclusive to the official product and not be usedforderivedworkswithoutpermission.TheofficialpolicydocumentonuseoftheArduino name emphasizes that the project is open to incorporating work by others into the official product.SeveralArduino-compatibleproductscommerciallyreleasedhaveavoidedtheproject namebyusingvariousnamesendingin-*duino*.

Most Arduino boards consist of an Atmel 8-bit
AVR microcontroller (ATmega8, ATmega168, ATmega328, ATmega1280, ATmega2560) with varying amounts of flash memory, pins, and features. The 32-bit Arduino Due, based on the Atmel SAM3X8E was introduced in 2012. The boards use single or double-row pins or female headersthatfacilitateconnectionsforprogrammingandincorporationintoothercircuits.These mayconnectwithadd-onmodulestermed*shields*.Multipleandpossiblystackedshieldsmaybe individually addressable via an I²C serial bus. Most boards include a 5 V linear regulator and a 16MHzcrystaloscillatororrceramicresonator.Somedesigns,suchastheLilyPad,runat8MHz anddispensewiththeonboardvoltageregulatorduetospecificform-factorrestrictions.

Arduino microcontrollers are pre-programmed with a boot loader that simplifies uploading of programs to the on-chip flash memory. The default bootloader of the Arduino UNO is the optiboot bootloader. Boards are loaded with program code via a serial connection to another computer. Some serial Arduino boards contain a level shifter circuit to convert between RS-232 logic levels and transistor–transistor logic(TTL) level signals. Current Arduino boards are programmed via Universal Serial Bus (USB), implemented using USB-to-serial adapter chips suchastheFTDIFT232.Someboards,suchaslater-modelUnoboards,substitutetheFTDIchip with a separate AVR chip containing USB-to-serial firmware, which is reprogrammable via its own ICSP header. Other variants, such as the Arduino Mini and the unofficial Boarduino, use a detachableUSB-to-serialadapterboardorcable,Bluetoothorothermethods.Whenusedwith

traditional microcontroller tools, instead of the Arduino IDE, standard AVR in-systemprogramming (ISP) programming is used.

The Arduino board exposes most of the microcontroller's I/O pins for use by other circuits. The *Diecimila*, *Duemilanove*, and current *Uno* provide 14 digital I/O pins, six of which can produce pulse-width modulated signals, and six analog inputs, which can also be used as six digitalI/Opins.Thesepinsareonthetopoftheboard,viafemale0.1-inch(2.54mm)headers. Severalplug-inapplicationshieldsarealsocommerciallyavailable.TheArduinoNano,and Arduino-compatible Bare Bones Board and Arduino boards may provide male header pins on the underside of the board that can plug into solderless breadboards.

Many Arduino-compatible and Arduino-derived boards exist. Some are functionally equivalent to an Arduino and can be used interchangeably. Many enhance the basic Arduino by adding output drivers, often for use in school-level education, to simplify making buggies and small robots. Others are electrically equivalent but change the form factor, sometimes retaining compatibility with shields, sometimes not. Some variants use different processors, of varying compatibility.

IDE

The Arduino integrated development environment (IDE) is a cross-platform application (for Windows, macOS, Linux) that is written in the programming language Java. It originated from the IDE for the languages *Processing* and *Wiring*. It includes a code editor with features such as text cutting and pasting, searching and replacing text, automatic indenting, bracematching, and syntax highlighting, and provides simple *one-click* mechanisms to compile and uploadprogramstoanArduinoboard.Italsocontainsamessagearea,atextconsole,atoolbar withbuttonsforcommonfunctionsandahierarchyofoperationmenus.Thesourcecodeforthe IDEisreleasedundertheGNUGeneralPublicLicense,version2.

The Arduino IDE supports the languages C and C++ using special rules of code structuring. The Arduino IDE supplies a software library from the Wiring project, which provides many commoninputandoutputprocedures.User-writtencodeonlyrequirestwobasicfunctions,for starting the sketch and the main program loop, that are compiled and linked with a program stub*main( )*intoanexecutablecyclicexecutiveprogramwiththeGNUtoolchain,alsoincluded with the IDE distribution. The Arduino IDE employs the program *avrdude*to convert the executablecodeintoatextfileinhexadecimalencodingthatisloadedintotheArduinoboard byaloaderprogramintheboard'sfirmware.

Sketch

A program written with the Arduino IDE is called a *sketch*.[58] Sketches are saved on the developmentcomputerastextfileswiththefileextension.*ino*.ArduinoSoftware(IDE)pre-1.0 savedsketcheswiththeextension.*pde*.

A minimal Arduino C/C++ program consist of only two functions:

setup():Thisfunctioniscalledoncewhenasketchstartsafterpower-uporreset.Itisusedto initializevariables,inputandoutputpinmodes,andotherlibrariesneededinthesketch.

loop():After*setup()*hasbeencalled,function*loop()*isexecutedrepeatedlyinthemainprogram. Itcontrolstheboarduntiltheboardispoweredofforisreset.

Blink example

Most Arduino boards contain a light-emitting diode (LED) and a load resistor connected between pin 13 and ground, which is a convenient feature for many tests and program functions.AtypicalprogramforabeginningArduinoprogrammerblinksaLEDrepeatedly. Thisprogramusesthefunctions*pinMode()*,*digitalWrite()*,and*delay()*,whichareprovidedbythe internallibrariesincludedintheIDEenvironment.Thisprogramisusuallyloadedintoanew Arduinoboardbythemanufacturer.

RELAY:

A relay is an electrically operated switch. Many relays use an electromagnet to mechanically operateaswitch,butotheroperatingprinciplesarealsoused,suchassolid-staterelays.Relays are used where it is necessary to control a circuit by a separate low-power signal, or where severalcircuitsmustbecontrolledbyonesignal.Thefirstrelayswereusedinlong distancetelegraphcircuitsasamplifiers:theyrepeatedthesignalcominginfromonecircuitand re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and earlycomputerstoperformlogicaloperations.

Atypeofrelaythatcanhandlethehighpowerrequiredtodirectlycontrolanelectricmotoror otherloadsiscalledacontactor.Solid-staterelayscontrolpowercircuitswithnomovingparts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristicsandsometimesmultipleoperatingcoilsareusedtoprotectelectricalcircuitsfrom overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protectiverelays".

Magneticlatchingrelaysrequireonepulseofcoilpowertomovetheircontactsinonedirection, andanother,redirectedpulsetomovethemback.Repeatedpulsesfromthesameinputhaveno effect.Magneticlatchingrelaysareusefulinapplicationswhereinterruptedpowershouldnot beabletotransitionthecontacts.

Magnetic latching relays can have either single or dual coils. On a single coil device, the relay will operate in one direction when power is applied with one polarity, and will reset when the polarityisreversed.Onadualcoildevice,whenpolarizedvoltageisappliedtotheresetcoilthe contacts will transition. AC controlled magnetic latch relays have single coils that employ steeringdiodestodifferentiatebetweenoperateandresetcommands.

Atypeofrelaythatcanhandlethehighpowerrequiredtodirectlycontrolanelectricmotoror otherloadsiscalledacontactor.Solid-staterelayscontrolpowercircuitswithnomovingparts, instead using a semiconductor device to perform switching. Relays with calibrated operating characteristicsandsometimesmultipleoperatingcoilsareusedtoprotectelectricalcircuitsfrom overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protectiverelays".

The Arduino Relay module allows a wide range of microcontroller such as Arduino, AVR ,PIC, ARM with digital outputs to control larger loads and devices like AC or DC Motors, electromagnets, solenoids, and incandescent light bulbs. This module is designed to be integrated with relays that it is capable of control 2 relays.The relay shield use one QIANJI JQC-3Fhigh-qualityrelaywithratedload7A/240VAC,10A/125VAC,10A/28VDC.Therelay output state is individually indicated by a light-emitting diode.

1 channel relay features:

Number of Relays:1

Control signal: TTL

level

Ratedload:7A/240VAC10A/125VAC10A/28VDC

Contact action time: 10ms/5ms

Types:-

1)   *Coaxial relay*

Whereradiotransmittersandreceiversshareoneantenna,oftenacoaxialrelayisusedasaTR (transmit-receive)relay,whichswitchestheantennafromthereceivertothetransmitter.This protectsthereceiverfromthehighpowerofthetransmitter.Suchrelaysareoftenused in transceivers which combine transmitter and receiver in one unit. The relay contacts are designednottoreflectanyradiofrequencypowerbacktothesource,andtoprovidevery highisolationbetweenreceiverandtransmitterterminals.Thecharacteristicimpedanceofthe relayismatchedtothetransmissionlineimpedanceofthesystem,forexample,50ohms.

2)   *Contactor*

A contactor is a heavy-duty relay with higher current ratings, used for switching electric motors and lighting loads. Continuous current ratings for common contactors range from 10 amps to several hundred amps. High-current contacts are made with alloys containing silver. The unavoidable arcing causes the contacts to oxidize; however, silver oxide is still a good conductor. Contactors with overload protection devices are often used to start motors.

3)   *Force-guided contacts relay*

A 'force-guided contacts relay' has relay contacts that are mechanically linked together, so that when the relay coil is energized or de-energized, all of the linked contacts move together. If one set of contacts in the relay becomes immobilized, no other contact of the same relay will be able to move. The function of force-guided contacts is to enable the safety circuit to check the status of the relay. Force-guided contacts are also known as "positive-guided contacts", "captive contacts", "locked contacts", "mechanically linked contacts", or "safety relays".

These safety relays have to follow design rules and manufacturing rules that are defined in one main machinery standard EN 50205 : Relays with forcibly guided (mechanically linked) contacts. These rules for the safety design are the one that are defined in type B standards such as EN 13849-2 as Basic safety principles and Well-tried safety principles for machinery that applies to all machines.

Force-guided contacts by themselves cannot guarantee that all contacts are in the same state, however they do guarantee, subject to no gross mechanical fault, that no contacts are in opposite states. Otherwise, a relay with several normally open (NO) contacts may stick when energised, with some contacts closed and others still slightly open, due to mechanical tolerances. Similarly, a relay with several normally closed (NC) contacts may stick to the unenergised position, so that when energised, the circuit through one set of contacts is broken, with a marginal gap, while the other remains closed. By introducing both NO and NC contacts, or more commonly, changeover contacts, on the same relay, it then becomes possible to guarantee that if any NC contact is closed, all NO contacts are open, and conversely, if any NO contact is closed, all NC contacts are open. It is not possible to reliably ensure that any particular contact is closed, except by potentially intrusive and safety-degrading sensing of its circuit conditions, however in safety systems it is usually the NO state that is most important, and as explained above, this i reliably verifiable by detecting the closure of a contact of opposite sense.

Force-guided contact relays are made with different main contact sets, either NO, NC or changeover, and one or more auxiliary contact sets, often of reduced current or voltage rating, used for the monitoring system. Contacts may be all NO, all NC, changeover, or a mixture of these, for the monitoring contacts, so that the safety system designer can select the correct configuration for the particular application. Safety relays are used as part of an engineered safety system

4) *Latching relay*

A *latching relay* (also called "impulse", "bistable", "keep", or "stay" relays) maintains either contact position indefinitely without power applied to the coil. The advantage is that one coil consumes power only for an instant while the relay is being switched, and the relay contacts retain this setting across a power outage. A latching relay allows remote control of building lighting without the hum that may be produced from a continuously (AC) energized coil.

In one mechanism, two opposing coils with an over-center spring or permanent magnet hold the contacts in position after the coil is de-energized. A pulse to one coil turns the relay on and a pulse to the opposite coil turns the relay off. This type is widely used where control is from simple switches or single-ended outputs of a control system, and such relays are found in avionics and numerous industrial applications.

Another latching type has a remanent core that retains the contacts in the operated position by the remanent magnetism in the core. This type requires a current pulse of opposite polarity to release the contacts. A variation uses a permanent magnet that produces part of the force required to close the contact; the coil supplies sufficient force to move the contact open or closed by aiding or opposing the field of the permanent magnet. A polarity controlled relay needs changeover switches or an H bridge drive circuit to control it. The relay may be less expensive than other types, but this is partly offset by the increased costs in the external circuit.

In another type, a ratchet relay has a ratchet mechanism that holds the contacts closed after the coil is momentarily energized. A second impulse, in the same or a separate coil, releases the contacts. This type may be found in certain cars, for headlamp dipping and other functions where alternating operation on each switch actuation is needed.

A stepping relay is a specialized kind of multi-way latching relay designed for early automatic telephone exchanges.

An earth leakage circuit breaker includes a specialized latching relay.

Veryearlycomputersoftenstoredbitsinamagneticallylatchingrelay,suchasferreedorthe laterremreedinthe1ESSswitch.

Someearlycomputersusedordinaryrelaysasakindoflatch—theystorebitsinordinarywire springrelaysorreedrelaysbyfeedinganoutputwirebackasaninput,resultinginafeedback loop or sequential circuit. Such an electrically latching relay requires continuous power to maintainstate,unlikemagneticallylatchingrelaysormechanicallyrachetingrelays.

Incomputermemories,latchingrelaysandotherrelayswerereplacedbydelaylinememory, whichinturnwasreplacedbyaseriesofever-fasterandever-smallermemorytechnologies.

5) *Machine toolrelay*

A machine tool relay is a type standardized for industrial control of machine tools, transfer machines,andothersequentialcontrol.Theyarecharacterizedbyalargenumberofcontacts (sometimesextendableinthefield)whichareeasilyconvertedfromnormallyopentonormally closedstatus,easilyreplaceablecoils,andaformfactorthatallowscompactlyinstallingmany relays in a control panel. Although such relays once were the backbone of automation in such industries as automobile assembly, the programmable logic controller (PLC) mostly displaced themachinetoolrelayfromsequentialcontrolapplications.

Arelayallowscircuitstobeswitchedbyelectricalequipment:forexample,atimercircuitwith arelaycouldswitchpoweratapresettime.Formanyyearsrelayswerethestandardmethodof controllingindustrialelectronicsystems.Anumberofrelayscouldbeusedtogethertocarryout complexfunctions(relaylogic).Theprincipleofrelaylogicisbasedonrelayswhichenergize andde-energizeassociatedcontacts.Relaylogicisthepredecessorofladderlogic,whichis commonlyusedinprogrammablelogiccontrollers.

6) *Mercury relay*

Amercuryrelayisarelaythatusesmercuryastheswitchingelement.Theyareusedwhere contacterosionwouldbeaproblemforconventionalrelaycontacts.Owingtoenvironmental considerationsaboutsignificantamountofmercuryusedandmodernalternatives,theyare now comparativelyuncommon.

7) *Mercury-wetted relay*

A mercury-wetted reed relay is a form of reed relay in which the contacts are wetted with mercury. Such relays are used to switch low-voltage signals (one volt or less) where the mercury reduces the contact resistance and associated voltage drop, for low-current signals where surface contamination may make for a poor contact, or for high-speed applications where the mercury eliminates contact bounce. Mercury wetted relays are position-sensitive and must be mounted according to the manufacturer's specifications to work properly. Because of the toxicity and expense of liquid mercury, these relays are now rarely used.

The mercury-wetted relay has one particular advantage, in that the contact closure appears to be virtually instantaneous, as the mercury globules on each contact coalesce. The current rise time through the contacts is generally considered to be a few picoseconds, however in a practical circuit it will be limited by the inductance of the contacts and wiring. It was quite common, before the restrictions on the use of mercury, to use a mercury-wetted relay in the laboratory as a convenient means of generating fast risetime pulses, however although the rise time may be picoseconds, the exact timing of the event is, like all other types of relay, subject to considerable jitter, possibly milliseconds, due to mechanical imperfections.

The same coalescence process causes another effect, which is a nuisance in some applications. The contact resistance is not stable immediately after contact closure, and drifts, mostly downwards, for several seconds after closure, the change perhaps being 0.5 ohm.

8)   Multi-voltage relays
Multi-voltage relays are devices designed to work for wide voltage ranges such as 24 to 240 VAC and VDC and wide frequency ranges such as 0 to 300 Hz. They are indicated for use in installations that do not have stable supply voltages.

9)   Overload protection relay

Electric motors need overcurrent protection to prevent damage from over-loading the motor, or to protect against short circuits in connecting cables or internal faults in the motor windings. The overload sensing devices are a form of heat operated relay where a coil heats a bimetallic strip, or where a solder pot melts, releasing a spring to operate auxiliary contacts. These auxiliary contacts are in series with the coil. If the overload senses excess current in the load, the coil is de-energized.

This thermal protection operates relatively slowly allowing the motor to draw higher starting currents before the protection relay will trip. Where the overload relay is exposed to the same ambient

temperature as the motor, a useful though crude compensation for motor ambient temperature isprovided.

Theothercommonoverloadprotectionsystemusesanelectromagnetcoilinserieswiththe motorcircuitthatdirectlyoperatescontacts.Thisissimilartoacontrolrelaybutrequiresa ratherhighfaultcurrenttooperatethecontacts.Topreventshortovercurrentspikesfrom causingnuisancetriggeringthearmaturemovementisdampedwithadashpot.Thethermal andmagneticoverloaddetectionsaretypicallyusedtogetherinamotorprotectionrelay.

Electronicoverloadprotectionrelaysmeasuremotorcurrentandcanestimatemotorwinding temperatureusinga"thermalmodel"ofthemotorarmaturesystemthatcanbesettoprovide moreaccuratemotorprotection.Somemotorprotectionrelaysincludetemperaturedetector inputs for direct measurement from a thermocouple or resistance thermometersensor embedded in thewinding.

10) Polarizedrelay

Apolarizedrelayplacesthearmaturebetweenthepolesofapermanentmagnettoincrease sensitivity.Polarizedrelayswereusedinmiddle20thCenturytelephoneexchangestodetect faintpulsesandcorrecttelegraphicdistortion.

11) Reedrelay

Areedrelayisareedswitchenclosedinasolenoid.Theswitchhasasetofcontactsinside   an evacuated or inert gas-filled glass tube which protects the contacts against atmosphericcorrosion;thecontactsaremadeofmagneticmaterialthatmakesthemmove undertheinfluenceofthefieldoftheenclosingsolenoidoranexternalmagnet.

Reed relays can switch faster than larger relays and require very little power from the control circuit. However, they have relatively low switching current and voltage ratings. Though rare, thereedscanbecomemagnetizedovertime,whichmakesthemstick'on'evenwhennocurrent ispresent;changingtheorientationofthereedswithrespecttothesolenoid'smagneticfieldcan   resolve thisproblem.

Sealedcontactswithmercury-wettedcontactshavelongeroperatinglivesandlesscontact chatterthananyotherkindofrelay.

12) *Safetyrelays*

Safetyrelaysaredeviceswhichgenerallyimplementsafetyfunctions.Intheeventofahazard, thetaskofsuchasafetyfunctionistouseappropriatemeasurestoreducetheexistingrisktoan acceptablelevel.

13) *Solid-statecontactor*

Asolid-statecontactorisaheavy-dutysolidstaterelay,includingthenecessaryheatsink,used wherefrequenton-offcyclesarerequired,suchaswithelectricheaters,smallelectricmotors, andlightingloads.Therearenomovingpartstowearoutandthereisnocontactbouncedueto vibration.TheyareactivatedbyACcontrolsignalsorDCcontrolsignalsfromprogrammablelogicco ntrollers(PLCs),PCs,transistor-transistorlogic(TTL)sources,orothermicroprocessor and microcontrollercontrols.

14) *Solid-staterelay*

Asolid-staterelay(SSR)isasolidstateelectroniccomponentthatprovidesafunctionsimilarto an electromechanical relay but does not have any moving components, increasing long-term reliability. A solid-state relay uses a thyristor, TRIAC or other solid-state switching device, activatedbythecontrolsignal,toswitchthecontrolledload,insteadofasolenoid. Anoptocoupler(alight-emittingdiode(LED)coupledwithaphototransistor)canbeusedto isolate control andcontrolled circuits.

15) *Staticrelay*

Astaticrelayconsistsofelectroniccircuitrytoemulateallthosecharacteristicswhichare achievedbymovingpartsinanelectro-magneticrelay.

16) *Time delayrelay*

Timingrelaysarearrangedforanintentionaldelayinoperatingtheircontacts.Averyshort(a fractionofasecond)delaywoulduseacopperdiskbetweenthearmatureandmovingblade assembly.Currentflowinginthediskmaintainsmagneticfieldforashorttime,lengthening releasetime.Foraslightlylonger(uptoaminute)delay,adashpotisused.Adashpotisa pistonfilledwithfluidthatisallowedtoescapeslowly;bothair-filledandoil-filleddashpots areused.Thetimeperiodcanbevariedbyincreasingordecreasingtheflowrate.Forlonger timeperiods,amechanicalclockworktimerisinstalled.Relaysmaybearrangedforafixed timingperiod,ormaybefieldadjustable,orremotelysetfromacontrolpanel.Modern microprocessor-basedtimingrelaysprovideprecisiontimingoveragreatrange.

Some relays are constructed with a kind of "shock absorber" mechanism attached to the

armature which prevents immediate, full motion when the coil is either energized or de-energized. This addition gives the relay the property of time-delay actuation. Time-delay relays can be constructed to delay armature motion on coil energization, de-energization, or both.

Time-delay relay contacts must be specified not only as either normally open or normally closed, but whether the delay operates in the direction of closing or in the direction of opening. The following is a description of the four basic types of time-delay relay contacts.

First we have the normally open, timed-closed (NOTC) contact. This type of contact is normally open when the coil is unpowered (de-energized). The contact is closed by the application of power to the relay coil, but only after the coil has been continuously powered for the specified amount of time. In other words, the direction of the contact's motion (either to close or to open) is identical to a regular NO contact, but there is a delay in closing direction. Because the delay occurs in the direction of coil energization, this type of contact is alternatively known as a normally open, on-delay.

17) *Vacuum relay*
A sensitive relay having its contacts mounted in a highly evacuated glass housing, to permit handling radio-frequency voltages as high as 20,000 volts without flashover between contacts even though contact spacing is but a few hundredths of an inch when open.

Pole and throw[edit]

Since relays are switches, the terminology applied to switches is also applied to relays; a relay switches one or more *poles*, each of whose contacts can be *thrown* by energizing the coil.
Normally open (NO) contacts connect the circuit when the relay is activated; the circuit is disconnected when the relay is inactive. Normally closed (NC) contacts disconnect the circuit when the relay is activated; the circuit is connected when the relay is inactive. All of the contact forms involve combinations of NO and NC connections.

The National Association of Relay Manufacturers and its successor, the Relay and Switch Industry Association define 23 distinct electrical contact forms found in relays and switches.[23] Of these, the following are commonly encountered:

SPST-NO (Single-Pole Single-Throw, Normally-Open) relays have a single *Form A* contact or *make* contact. These have two terminals which can be connected or disconnected. Including two for the coil, such a relay has four terminals in total.

SPST-NC (Single-Pole Single-Throw, Normally-Closed) relays have a single *Form B* or *break* contact. As with an SPST-NO relay, such a relay has four terminals in total.

SPDT (Single-Pole Double-Throw) relays have a single set of *Form C*, *break before make* or *transfer* contacts. That is, a common terminal connects to either of two others, never connecting to both at the same time. Including two for the coil, such a relay has a total of five terminals.

DPST – Double-Pole Single-Throw relays are equivalent to a pair of SPST switches or relays actuated by a single coil. Including two for the coil, such a relay has a total of six terminals. The poles may be *Form A* or *Form B* (or one of each; the designations *NO* and *NC* should be used to resolve the ambiguity).

DPDT – Double-Pole Double-Throw relays have two sets of *Form C* contacts. These are equivalent to two SPDT switches or relays actuated by a single coil. Such a relay has eight terminals, including the coil

The *S* (*single*) or *D* (*double*) designator for the pole count may be replaced with a number, indicating multiple contacts connected to a single actuator. For example, 4PDT indicates a four-pole double-throw relay that has 12 switching terminals.

EN 50005 are among applicable standards for relay terminal numbering; a typical EN 50005-compliant SPDT relay's terminals would be numbered 11, 12, 14, A1 and A2 for the C, NC, NO, and coil connections, respectively.[24]

DIN 72552 defines contact numbers in relays for automotive use;

85 = relay coil -

86 = relay coil +

87 = common contact

87a = normally closed contact

87b = normally open contact

APPLICATIONS OF RELAY:-

Relaysareusedwhereveritisnecessarytocontrolahighpowerorhighvoltagecircuitwitha lowpowercircuit,especiallywhengalvanicisolationisdesirable.Thefirstapplicationofrelays was in long telegraph lines, where the weak signal received at an intermediate station could controlacontact,regeneratingthesignalforfurthertransmission.High-voltageorhigh-current devicescanbecontrolledwithsmall,lowvoltagewiringandpilotsswitches.Operatorscanbe isolated from the high voltage circuit. Low power devices such as microprocessors can drive relaystocontrolelectricalloadsbeyondtheirdirectdrivecapability.Inanautomobile,astarter relay allows the high current of the cranking motor to be controlled with small wiring and contacts in the ignitionkey.

Electromechanical switching systems including Strowgerand Crossbar telephone exchanges made extensive use of relays in ancillary control circuits. The Relay Automatic Telephone Companyalsomanufacturedtelephoneexchangesbasedsolelyonrelayswitchingtechniques designedbyGotthilfAnsgariusBetulander.Thefirstpublicrelaybasedtelephoneexchangein theUKwasinstalledinFleetwoodon15July1922andremainedinserviceuntil1959.

Theuseofrelaysforthelogicalcontrolofcomplexswitchingsystemsliketelephoneexchanges wasstudiedbyClaudeShannon,whoformalizedtheapplicationofBooleanalgebratorelay circuitdesigninASymbolicAnalysisofRelayandSwitchingCircuits.Relayscanperformthe basicoperationsofBooleancombinatoriallogic.Forexample,thebooleanANDfunctionis realisedbyconnectingnormallyopenrelaycontactsinseries,theORfunctionbyconnecting normallyopencontactsinparallel.Inversionofalogicalinputcanbedonewithanormally closed contact. Relays were used for control of automated systems for machine tools and production lines. The Ladder programming language is often used for designing relaylogicnetworks.

Early electro-mechanical computers such as the ARRA, Harvard Mark II, Zuse Z2, and ZuseZ3usedrelaysforlogicandworkingregisters.However,electronicdevicesprovedfasterand easier touse.

Because relays are much more resistant than semiconductors to nuclear radiation, they are widely used in safety-critical logic, such as the control panels of radioactive waste-handling machinery.Electromechanicalprotectiverelaysareusedtodetectoverloadandotherfaultson electricallinesbyopeningandclosingcircuitbreakers.

SINGLE CHANNEL RELAY MODULE

Overview

Wecancontrolhighvoltageelectronicdevicesusingrelays.ARelayisactuallyaswitchwhich iselectricallyoperatedbyanelectromagnet.Theelectromagnetisactivatedwithalowvoltage, forexample5voltsfromamicrocontrolleranditpullsacontacttomakeorbreakahighvoltage circuit.

FIG 2 CHANNEL RELAY


Single-Channel Relay Module Specifications

- Supply voltage – 3.75V to 6V
- Quiescent current: 2mA
- Current when the relay is active: ~70mA
- Relay maximum contact voltage – 250VAC or 30VDC
- Relay maximum current – 10A

SINGLE CHANNEL RELAY MODULE PIN DESCRIPTION

PIN NUMBER	PIN NAME	DESCRIPTION
1	Relay Trigger	Input to activate the relay

| 2	Ground	0V reference
3	VCC	Supply input for powering the relay coil
4	Normally Open	Normally open terminated of the relay
5	Common	Common terminal of the relay
6	Normally Closed	Normally closed contact of the relay

HOW DOES A RELAY WORK?
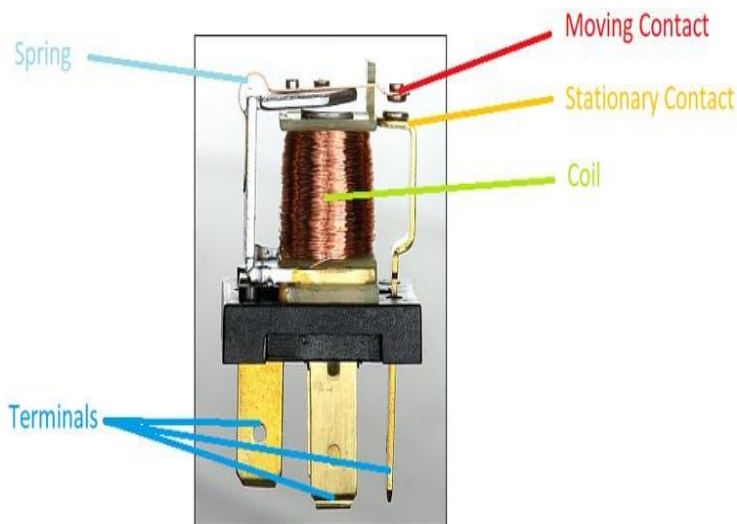
The relay uses an electric current to open or close the contacts of a switch. This is usually done using the help of a coil that attracts the contacts of a switch and pulls them together when activated, and a spring pushes them apart when the coil is not energize

There are two advantages of this system – First, the current required to activate the relay is much smaller than the current that relay contacts are capable of switching, and second, the coil and the contacts are galvanically isolated, meaning there is no electrical connection between them. This means that the relay can be used to switch mains current through an isolated low voltage digital system like a microcontroller

INTERNAL CIRCUIT DIAGRAM FOR SINGLE CHANNEL RELAY
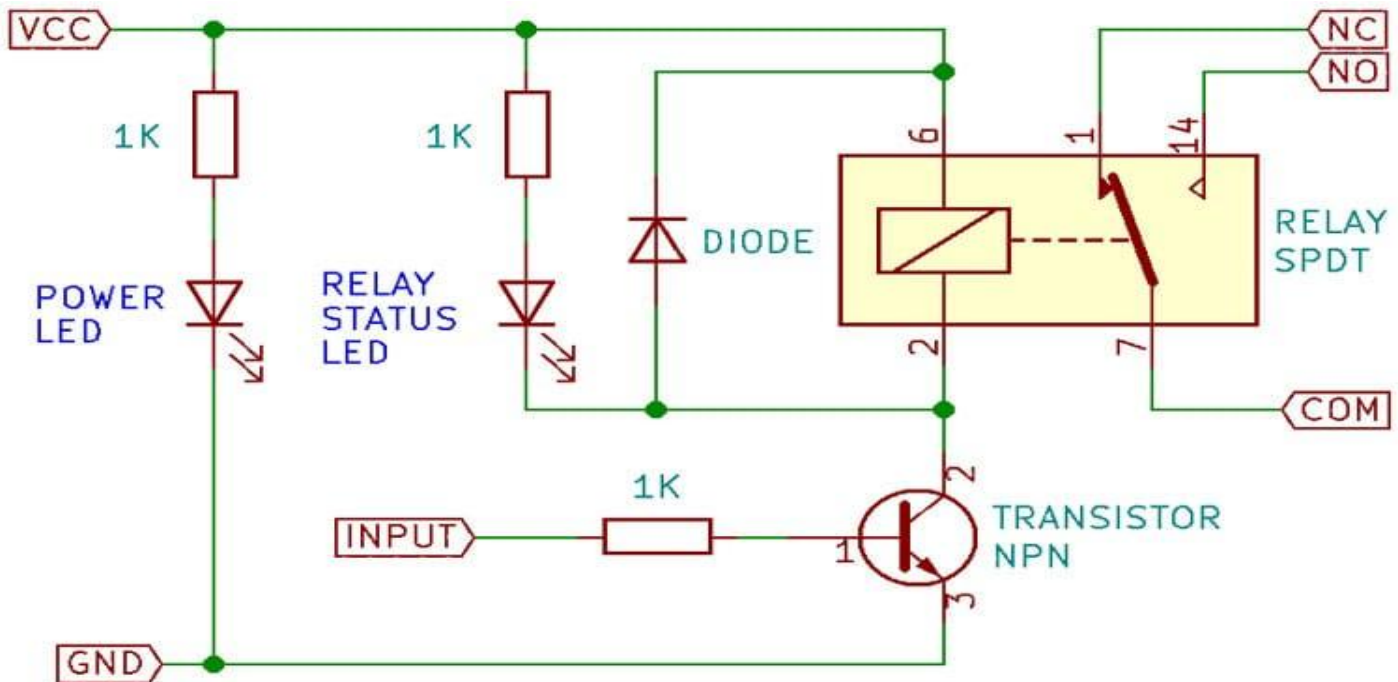
Relay Module Basic Schematic

The extra components apart from the relay are there since it would not be possible to drive the relay directly from the pins of a microcontroller. digital logic or a sensor. This is because although the coil consumes much less current than the currents it can switch, it still needs relatively significant current – low power relays consume around 50mA while higher power relays consume around 500mA. The coil is also an inductive load, so when the coil is switched off, a large flyback voltage is developed which can damage the device turning it on and off. For this reason, a flyback diode is added anti-parallel to the relay coil to clamp the flyback voltage.

LEDs can be added to this basic circuit to act as indicators, and sometimes even optical isolation is added to the input to further improve the isolation

HOW TO USE SINGLE-CHANNEL RELAY MODULE

Relay modules like this one are commonly used to drive mains loads from a microcontroller like the Arduino or a sensor. In cases like this, the common circuit diagram would be as follows.

Normally Powered Load

Normally Unpowered Load
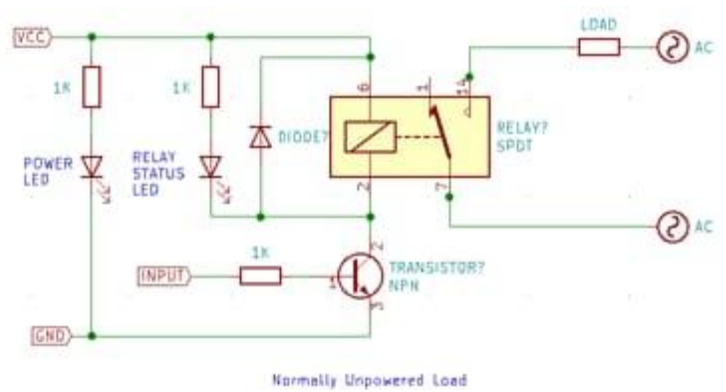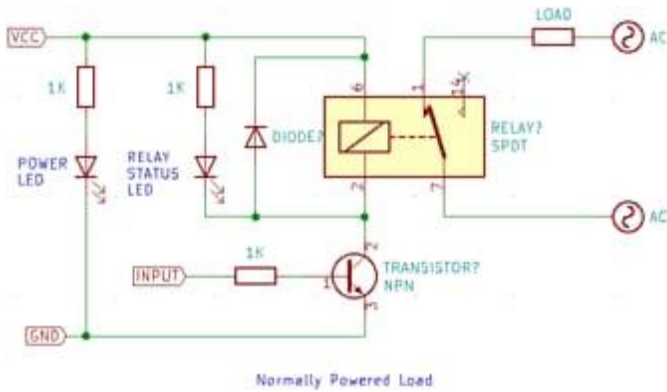
For simple on/off applications, the relay can be connected as shown above. One terminal of mains is connected to common, and the other is connected to NO or NC depending on whether the load should be connected/disconnected when the relay is active.

BLUETOOTH MODULE(HC-05 Bluetooth Module)

HC-05 Specification:

Bluetoothprotocal:BluetoothSpecificationv2.0+EDR

Frequency: 2.4GHz ISMband

Modulation: GFSK(Gaussian Frequency Shift

Keying) Emission power: ≤4dBm, Class 2

Sensitivity: ≤-84dBm at 0.1% BER

Speed: Asynchronous: 2.1Mbps(Max) / 160 kbps, Synchronous: 1Mbps/1Mbps

Security: Authentication and encryption

Profiles: Bluetooth serial port

Power supply: +3.3VDC 50mA

Working temperature: -20 ~ +75Centigrade

Dimension: 26.9mm x 13mm x 2.2 mm

Overview

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module,designed for transparent wireless serial connection setup.The HC-05 Bluetooth Module can be used in a MasterorSlaveconfiguration,makingitagreatsolutionforwirelesscommunication.Thisserial port bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate)3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Rluetooth system with CMOS technology and with AFH (Adaptive Frequency HoppingFeature).

Bluetooth Module HC-05

TheBluetoothmoduleHC-05isa**MASTER/SLAVE**module.Bydefaultthefactorysettingis SLAVE.The Role of the module (Master or Slave) can be configured only by AT COMMANDS.The slave modules cannot initiate a connection to another Bluetooth device, but canacceptconnections.Mastermodulecaninitiateaconnectiontootherdevices.Theusercan useitsimplyforaserialportreplacementtoestablishconnectionbetweenMCUandGPS,PCto your embedded project,etc.

FIG 3:BLUETOOTH MODULE
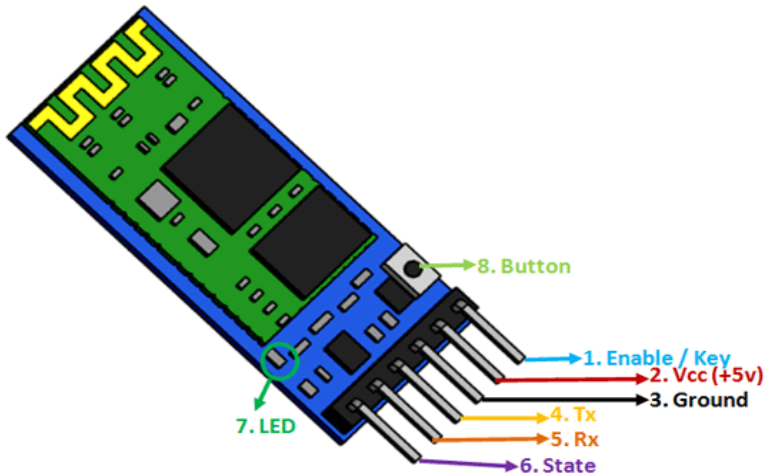
PIN DESCRIPTION OF BLUETOOTH MODULE

Pin Description:-

The HC-05 Bluetooth Module has 6pins. They are as follows:

ENABLE:

WhenenableispulledLOW,themoduleisdisabledwhichmeansthemodulewill notturn onanditfailstocommunicate.Whenenableisleftopenorconnectedto3.3V,themoduleis enabledi.ethemoduleremainsonandcommunicationalsotakesplace.

Vcc:

Supply Voltage 3.3V to 5V

GND:

Ground pin

TXD & RXD:

These two pins acts as an UART interface for communication

STATE:

It acts as a status indicator.When the module is not connected to paired with any other bluetoothdevice,signalgoesLow.Atthislowstate,theledflashescontinuouslywhichdenotes thatthemoduleisnotpairedwithotherdevice.Whenthismoduleisconnectedto/pairedwith

anyotherbluetoothdevice,thesignalgoesHigh.Atthishighstate,theledblinkswithaconstant delaysayforexample2sdelaywhichindicatesthatthemoduleispaired.

BUTTON SWITCH:

This is used to switch the module into AT command mode.To enable AT command mode,press the button switch for a second.With the help of AT commands,the user can change the parameters of this module but only when the module is not paired with any other BT device.the module is connected to any other bluetooth device, it starts to communicate with that device and fails to work in AT command mode.
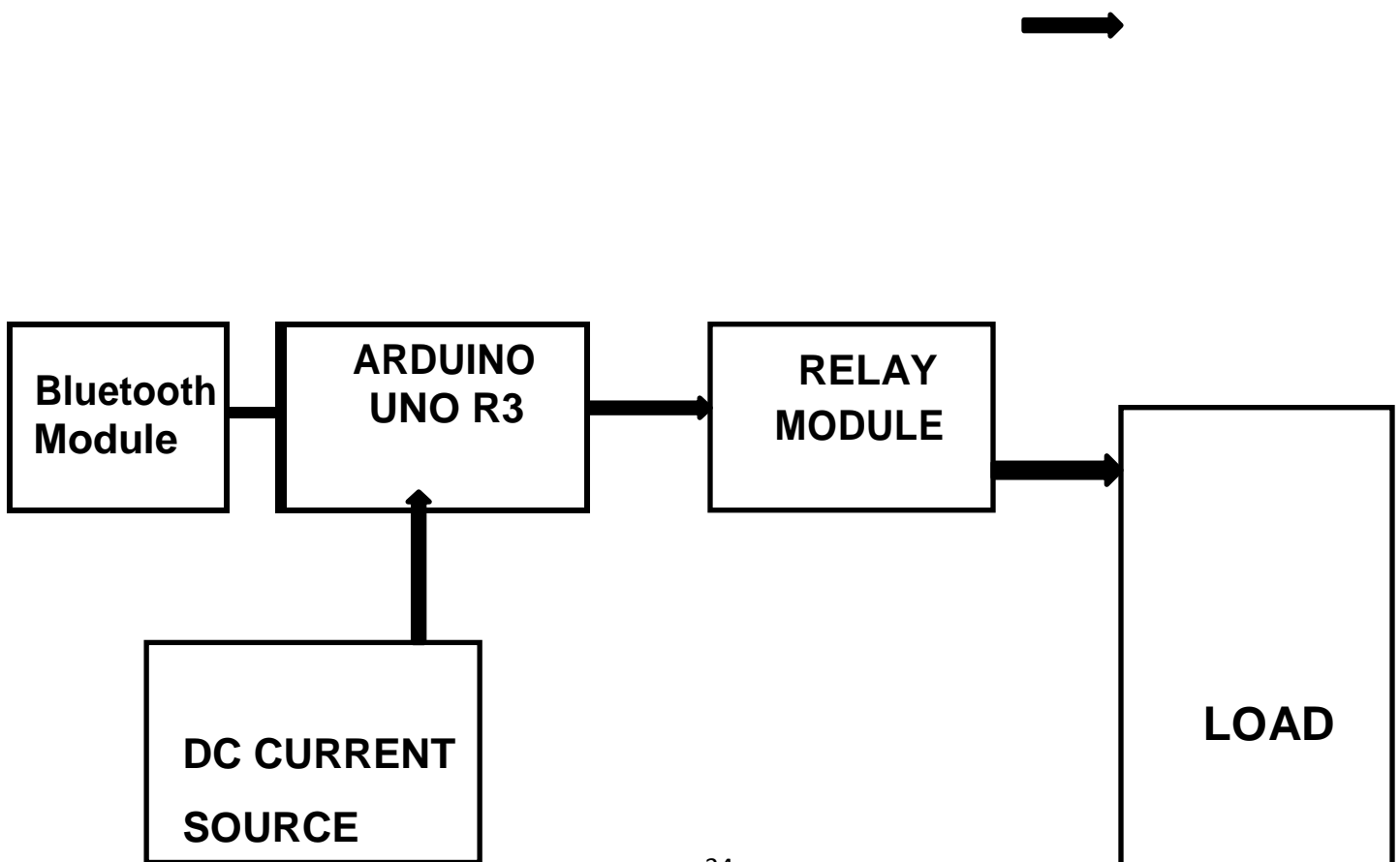
HC-05 Default Settings:-

Default Bluetooth Name: ‚HC-05' Default Password: 1234 or 0000 Default Communication: Slave Default Mode: Data Mode

Data Mode Baud Rate: 9600, 8, N, 1

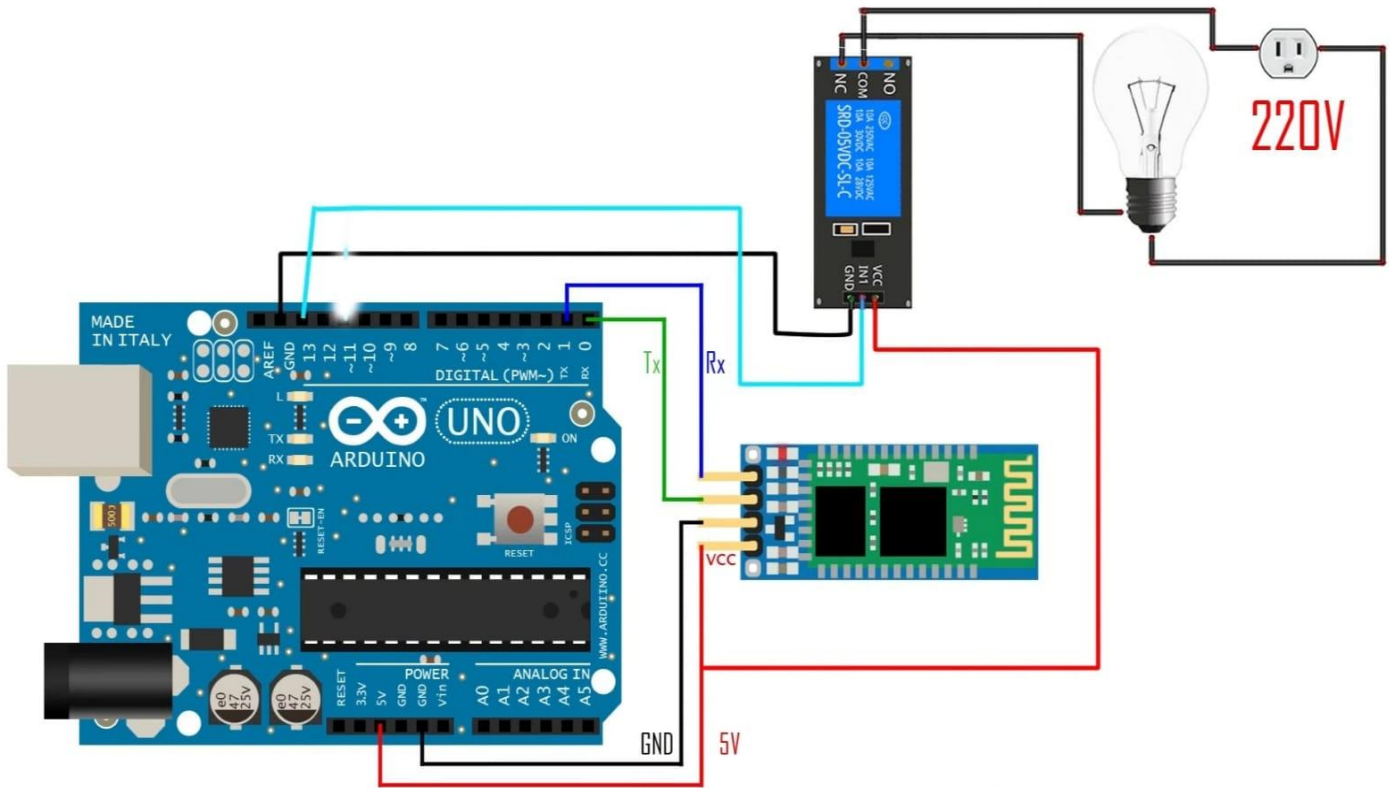Command Mode Baud Rate: 38400, 8, N, 1 Default firmware: LINVOR

BLOCK DIAGRAM

```
┌────────────┐      ┌────────────┐      ┌────────────┐      ┌────────────┐
│ Bluetooth  │─────▶│  ARDUINO   │─────▶│   RELAY    │─────▶│            │
│  Module    │      │  UNO R3    │      │  MODULE    │      │            │
└────────────┘      └─────▲──────┘      └────────────┘      │            │
                          │                                  │   LOAD     │
                    ┌─────┴──────┐                           │            │
                    │ DC CURRENT │                           │            │
                    │            │                           │            │
                    │  SOURCE    │                           └────────────┘
                    └────────────┘
```

POWER

SOURCE(220

LOCKDIAGRAMOFHOMEAUTOMATIONSYSTEMUSINGARDUINOAND
BLUETOOTHMODULE

CIRCUIT DIAGRAM

**CIRCUITDIAGRAMOFHOMEAUTOMATIONSYSTEMUSINGARDUINOA
ND BLUETOOTHMODULE**

CODE

```
char val;


void setup() {

pinMode(13,OUTPUT);
Serial.begin(9600);
digitalWrite(13,HIGH);


}

void loop() {

if(Serial.available()){
val = Serial.read();
Serial.println(val);
}
if(val=='1'){
digitalWrite(13,LOW);


}
else if(val=='2'){
digitalWrite(13,HIGH);


}


Delay(100)
}
```

APPLICATIONS

Home Is Where the Smart Is

Evmachine-to-machine communication, and you understand you're not the most tech-savvy consumer, it's impossible that you've missed the abundance of home automation products fillingtheshelvesandadsofeveryhomeimprovementstore.Suddenlyanordinaryerrandfor light bulbs will leave you wondering if your lamp could send you a message alerting you that the light bulb needs to be replaced. Furthermore, if your lamp is talking to you, could your refrigeratorandsprinklersystembetoo?Expertssay:Yes,thepossibilitiesareendless.Ifthat's thecase,wheredoyoubegin?

Anyday-to-day,repeatableprocessisautomatablewithsmarthomeapplications.Thegreater the control and flexibility of these processes, the more energy and cost savings the resident experiences,whicharefactorsanyonewhopaysutilitiesstrivestomoderate.Thesmarthome revolution is likely to be more of an evolution, with the incorporation of one or two home systemsatatime,graduallyautomatingourhouseholdsthroughsmartmobiledevices. However,withtheseelementsofefficiencycomesthequestionofeaseofuse.Willitbringyou enjoyment or exasperation? With so many brands and models already available in an ever-growingmarket,howdoyouknowwhichisbestforyou?

Lighting Control: Leaving the Dark Ages and Stepping Into the Light

Smart lighting allows you to control wall switches, blinds, and lamps, but how intuitive is a lightingcontrolsystem?Itturnsout,quite;itscapabilitiesareextensive.You'reabletoschedule the times lights should turn on and off, decide which specific rooms should be illuminated at certaintimes,selecttheleveloflightwhichshouldbeemitted,andchoosehowparticularlights react through motion sensitivity, as seen with Belkin's WeMo Switch + Motion, which is both affordableandeasytousewithitsplug-and-playsimplicity.

HVAC Regulation: No Longer Burned by Your Heating Bill

As fuel costs rise and the availability and sustainability of our resources becomes a greater concern, heating/cooling our homes efficiently is less a budgetary bonus and more of a necessity.Overthepastyear,smartthermostatsandautomatedhomeheatingsystemshave becomemorereadilyavailableandeasilyincorporateintoanyhome.Heatingandcoolingour

homes consumes an average of 50% of energy costs yearly, making daily HVAC regulation progressively rewarding. Maintaining a substantial lead among the nearly non-existent

competition,theNestLearningThermostat,learnsyourheatingandcoolingpreferencesover time,eliminatingtheneedforprogrammingandisaccessiblefromyoursmartphoneapp.With automatedHVACyouareabletoreducetheheatwhenaroomisunoccupied,andincreaseor decreaseitatspecifictimesbasedonyourscheduleandoccupancy.

Lawn Irrigation Systems: The Grass is Always Greener

Alushandhealthylawnisasourceofprideformosthomeowners,buttheweatherdoesn't alwayscooperateandprovidetheadequateelementsforaflourishinglandscape.Fordecades we'vereliedonsprinklersystemstokeepouryardsatpeakpresentation,butatwhatcost?The average American home spends approximately 30% of their daily water usage on lawn and gardenmaintenance.Nearlyhalfofthatamountiswastedduetoinefficiency.Ifyouapplythat statistictothenationalaverage,upto4.5billiongallonsofwateriswastedperdaythrough ineffectivewateringmethods.Ifwereflectuponthemonetaryimpactofthis,itresultsin Americansspendingoverathousanddollarsayearinwater,withaportionofthatbeingwaste. Theglobaleffectsareevengreaterwhenyouconsiderthegrowingconcernoverclimatechange and the dramatic decrease in agricultural natural resources. However, sprinkler control systems,likeSkydrop,areprovidingwaterregulationthroughreal-timecommunicationwith localweatherdata.Ifarainstormdevelopsanddepositstwoinchesofrainwateronyourlawn, theautomatedsprinklerdetectsthesaturationanddisablesitsscheduledwatering.Conversely, thesystemwillbealertedtodryconditionsandsupplythenecessaryamountofnourishment, withoutover-watering.

Smart Appliances: What's for Dinner?

Will smart kitchen appliances actually make you a better cook? Maybe. Smart refrigerators, such as LG's Smart ThinQ, allow you to scan grocery store receipts and keep an inventory of youritems,andalertsyouifanitemisabouttoexpire.Moreimpressively,itsuggestsrecipes basedonyourrefrigerator'scontentsandletsyouknowwhenyouneedtoreplaceitems.Smart ovenssynchwithyoursmartphoneandautomaticallypreheattothecorrecttemperaturebased onarecipeselectedfromyourdatabase.Whiletheseapplianceoptionsseemabitsuperficial and convenience based, there is a conservation factor as well. By automating your kitchen appliance and making them accessible from your smart device, you're able to sever the

electricitysuppliedtounusedappliancesandreduceyourenergyconsumptionandcosts. Considering the number of appliances the average household owns; this could save a substantial amount of money over time.

Security Systems: Knock, Knock…

Who's there? The Internet of Things. While efficiency and conservation are certainly IoT benefits, its potential to have improved control over home security is a primary focus. Smart locks, like Kwikset's Kevo, a Bluetooth enabled electronic deadbolt, and various connected home security systems, such as iSmartAlarm, offer a variety of features including door and windowsensors,motiondetectors,videocamerasandrecordingmechanisms.Allofwhichare connectedtoamobiledeviceandaccessibleviathecloud,thusenablingyoutoaccessreal-time information on the security status of your home. Naturally, there is a great deal of scrutiny regardingtheleveloftrustincontrollingyourhome'ssecuritysystemviaamobiledevice,but itbegsearnestexplorationwhenweighingthepotentialbenefitsandpeaceofminditprovides homeowners.

CONCLUSION

The system as the name indicates, 'Home automation' makes the system more flexible and providesattractiveuserinterfacecomparedtootherhomeautomationsystems.Inthissystem we integrate mobile devices into home automation systems. A novel architecture for a home automation system is proposed using the relatively new communication technologies. The system consists of mainly three components is a BLUETOOTH module, Arduino microcontrollerandrelaycircuits.WIFIisusedasthecommunicationchannelbetweenandroid phoneandtheArduinomicrocontroller.Wehidethecomplexityofthenotionsinvolvedinthe home automation system by including them into a simple, but comprehensive set of related concepts.Thissimplificationisneededtofitasmuchofthefunctionalityonthelimitedspace
offered by a mobile device's display. This paper proposes a low cost, secure, ubiquitously accessible,auto-configurable,remotelycontrolledsolution.Theapproachdiscussedinthepaper is novel and has achieved the target to control home appliances remotely using the WiFi technology to connects system parts, satisfying user needs and requirements. WiFi technology capable solution has proved to be controlled remotely, provide home security and is cost- effective as compared to the previously existing systems. Hence we can conclude that the required goals and objectives of home automation system have been achieved. The system design and architecture were discussed, and prototype presents the basic level of home appliance control and remote monitoring has been implemented. Finally, the proposed system isbetterfromthescalabilityandflexibilitypointofviewthanthecommerciallyavailablehome automationsystems.

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2. WirelessSensorNetworks:Concepts,Applications,ExperimentationandAnalysis.2016. p. 108. ISBN 9811004129. The use of standardized, with open standards over proprietary protocolsprovidestheindustrywiththefreedomtochoosebetweensupplierswithg uaranteed interoperability. Standardized solutions usually have a much longer lifespan than proprietary solutions.

3. Jumpup^"ResearchandMarkets:GlobalHomeAutomationandControlMa rket2014-2020- Lighting Control, Security & Access Control, HVAC Control Analysis of the $5.77 Billion Industry".Reuters.2015-01-19.Archivedfromtheoriginalon2016-05-05.

4. Home Automation & Wiring (1 ed.). New York: McGraw-Hill/TAB Electronics. 1999-03- 31. ISBN9780070246744.