Energy Efficient Home Monitoring

A project report submitted in the fulfilment of the requirements for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

COMPUTER SCIENCE ENGINEERING

Submitted by

Gandla Manish-HU21CSEN0200109

Naga Sai Varun-HU21CSN0200041

Sai Venkata Varaprasad-HU21CSEN0200042

S Abhinaya Rahul-HU21CSEN0200134

Under the esteemed guidance of

Dr Sudeepti

Associate Professor,

School Of Technology

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING GITAM

(Deemed to be University)

HYDERABAD

ACKNOWLEDGEMENT

We would like to express our sincere gratitude to all those who contributed to the successful completion of this project. We would like to extend our heartfelt thanks to Dr Sudeepti for their valuable guidance, support, and expertise throughout the project.

Their mentorship and feedback were instrumental in shaping the project's direction.

We would also like to thank the GITAM Hyderabad for providing the necessary resources and facilities to conduct this project.

We are indebted to the fellow colleagues and team members who collaborated on this project, providing their insights and expertise, which greatly enriched the project's outcome.

Lastly, we extend our appreciation to the open-source software community, without whose contributions the project would not have been possible.

CONTENTS

Abstract:

The integration of Bluetooth technology, temperature sensors, and Light Dependent Resistors (LDR) in home automation systems has paved the way for smart and energy-efficient living environments. This abstract provides an overview of a home automation system that leverages these technologies to enhance comfort, security, and energy conservation within residential spaces. The core components of this system include Bluetooth-enabled devices (smartphones, tablets, etc.), temperature sensors, and LDR sensors. Bluetooth serves as the communication interface between users and the home automation system, enabling remote control and monitoring. Temperature sensors continuously measure the ambient temperature, allowing for intelligent climate control and energy optimization. LDR sensors detect changes in ambient light levels, facilitating adaptive lighting schemes that align with natural lighting conditions. Through a dedicated mobile application, users can connect to their home automation system via Bluetooth, providing real-time access to various functionalities. These functionalities include adjusting thermostat settings based on temperature readings, remotely activating lighting system.

CHAPTER – 1

INTRODUCTION

The foremost aim of technology has been to increase efficiency and decrease effort. With the advent of 'Internet of Things' in the last decade, we have been pushing for ubiquitous computing in all spheres of life. It thus is of extreme importance to simplify human interfacing with technology. Automation is one such area that aims that achieves simplicity whilst increasing efficiency. Voice controlled House Automation System aims to further the cause of automation so as to achieve the goal of simplicity .

The primitive man realized that an effective way to communicate with one another is through voice. With minimum effort, ideas could be narrated with relative ease. When the first computers came around, achieving the level of sophistication so as to narrate commands using voice to a machine was only realized in science fiction. However with tremendous breakthroughs in the field, we are at the precipice of truly using voice to interface with devices.

Using this effective yet ingrained form of communication we would humanize technology to a great extent.

Voice controlled House Automation System deploys the use of voice to control devices .The advantages of using voice as an interfacing medium are multifold. Firstly we would do away with or significantly decrease the need of training for operating technology. Secondly, the simplification of services would entail a wider adoption of existing technology and would help people with varied disabilities access the same technology. We have deployed an Android Application as user front end primarily because of the ease at which the platform provides us with means to use complex technology and due to the widespread adoption in the mobile industry. Android is being

used as the operating system for over 80% of the smartphones.Voice controlled House Automation System leverages the power of Arduino to provide a holistic voice controlled automation system. Using Natural Language Processing and the available hardware in most smartphones, it translates voice to be used for controlling electrical devices.

1.1 Introduction of Embedded systems:

An embedded system is a computer system with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a device in common use today. Ninety-eight percent of all microprocessors are manufactured as components of embedded systems.

The Embedded Technology is now in its prime and the wealth of Knowledge available is mind-blowing. Embedded System is a combination of hardware and software. Embedded technology plays a major role in integrating the various functions associated with it. This needs to tie up the various sources of the Department in a closed loop system. This proposal greatly reduces the manpower, saves time and operates efficiently without human interference. This project puts forth the first step in achieving the desired target. With the advent in technology, the existing systems are developed to have in built intelligence.

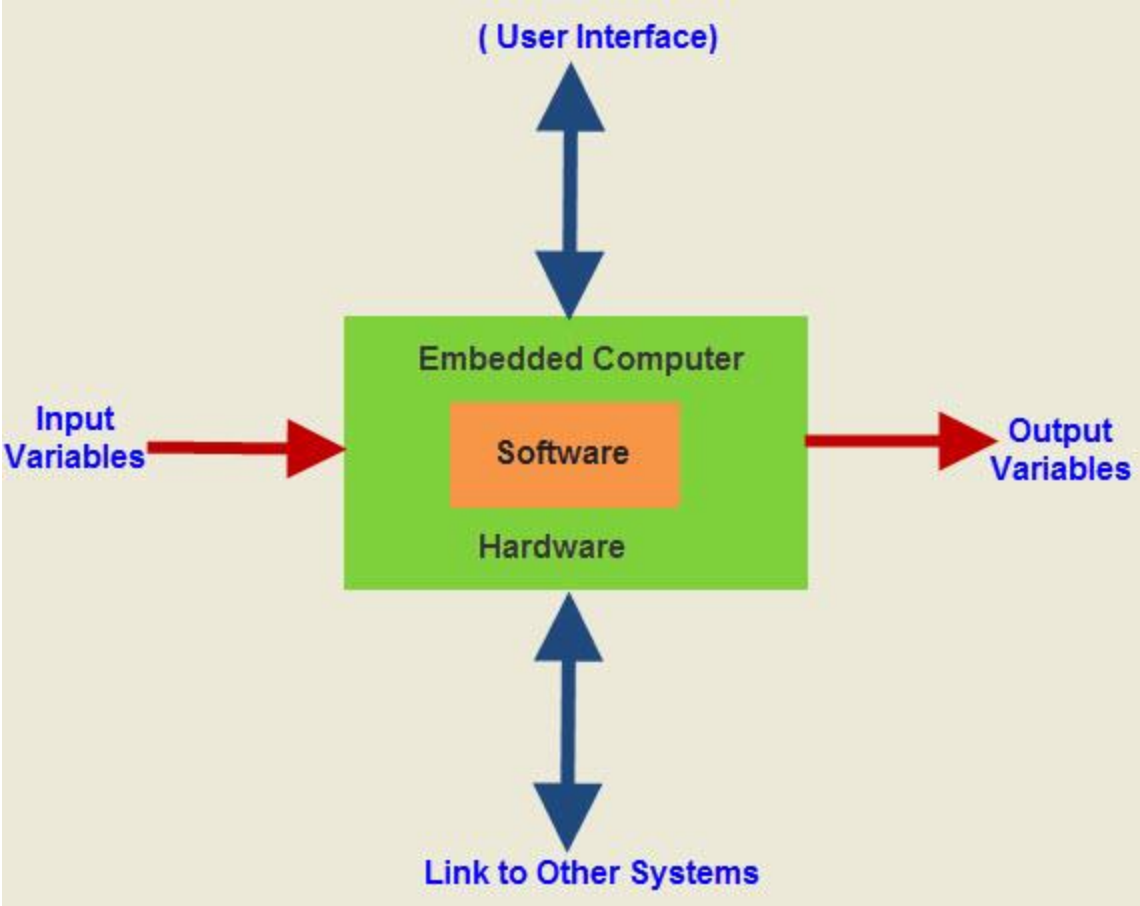

Fig1.1: Structure of Embedded System

An embedded system is not always a separate block very often it is physically built in to the device it is controlling. The software written for embedded systems is often called firmware, and is stored in read only memory or flash convector chips rather than a disk drive. It often runs with limited computer hardware resources: small or no keyboard, screen and little memory.

To perform any application in the embedded system we require microprocessor and microcontroller. In the microprocessor an external memory is connected which increases the size of the microprocessor and multiple operations are being performed by the microprocessor but whereas in the microprocessor the memory is inbuilt and also we can use this controller only for the specific applications where the speed is increased so most probably microcontrollers are used in the different applications in the embedded systems rather than microprocessor.

1.2 Embedded Systems in the Home Environment

Hidden conveniently within numerous household appliances, embedded systems are found all over the house. Consumers enjoy the effort-saving advanced features and benefits provided by these embedded technologies.

As shown in Fig 1.1 embedded systems in the home assume many forms, including security systems, cable and satellite boxes for televisions, home theater systems, and telephone answering machines. As advances in microprocessors continue to improve the functionality of ordinary products, embedded systems are helping drive the development of additional home-based innovations.

Fig 1.2: Embedded systems at home

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1.3 CLASSIFICATION OF EMBEDDED SYSTEMS:

Embedded systems can be classified into different types based on performance, functional requirements and performance of the microcontroller.

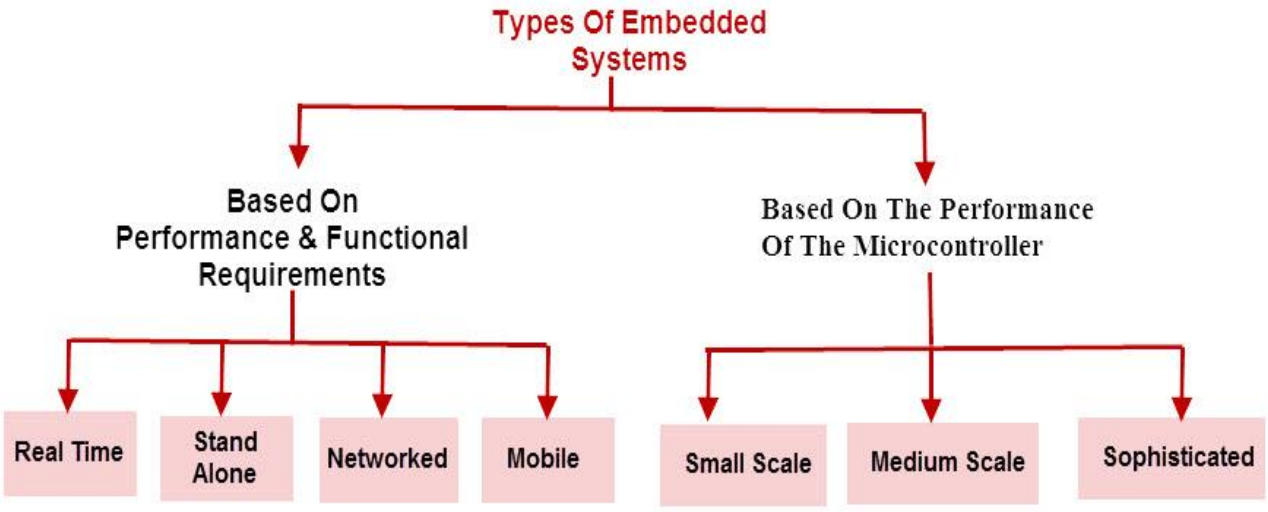


Fig1.3: Types of Embedded systems

CHAPTER – 2

LITERATURE SURVEY

2.1 INTRODUCTION

Home automation is a challenging one not only to the developer but also to the consumer. Developer has to choose the component as per the customer requirement. Due to all the customer demands are not equal hence they have to compromise with the existing products. Through detailed study of “Home Automation Using Internet of Thing” proposed by Shopan Dey, Ayon Roy and Sandip Das, it is found that they have used Raspberry pi module to connect ESP8266-01 module to the internet. Through this module they are controlling various devices through web

page and also through android application [2]. K. Venkatesan and Dr. U. Ramachandraiah in their paper have implemented Zigbee module in Arduino mega through which they are controlling devices. They have used various sensors for various purpose. Also they have provided real time notification, feedback on web-server in which customers can see what is happening in their home [1]. With the help of logic gates, a Raspberry pi, 555 timer and flip-flop also the devices are controlled from web app. Paper proposed by Shashank Shiva Kumar Jha, Vishwateja Mudiam Reddy, Tapan Pokharna, Naresh Vinay shows how this is operated and controlled [3].

"Programmable Infrared Accessory Light Switch" by Warsuzarina Mat Jubadi and Normaziah Zulkifli shows how TV remote is used to control room light and other appliances. Here IR remote and one IR receiver is used and programmed in such a way that it stores the frequency of the existing remote and use them directly to control appliances [4]. So, here we introduce Arduino Uno with ESP8266-01 module. This is not only cost-effective but also prove to be the easiest one when it comes in term of programming and also implementation.

CHAPTER 3

PROPOSED METHODOLOGY

3.1 Introduction to Methodology

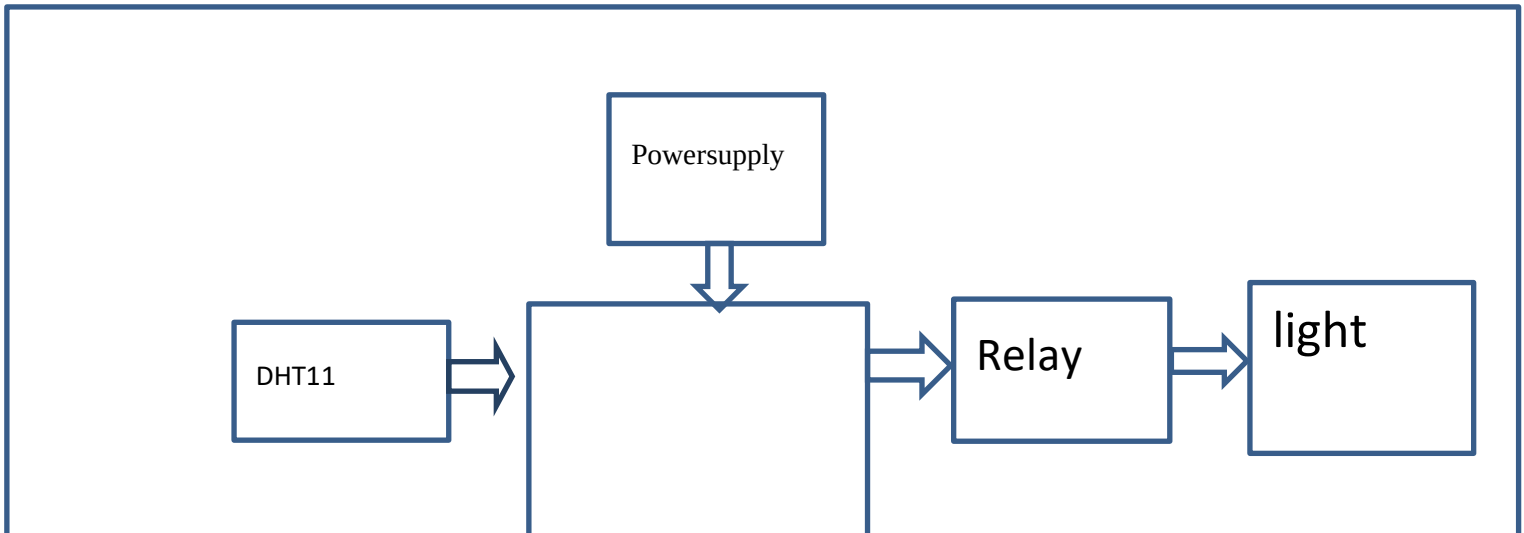
The Smart street light control system adopts a dynamic control methodology. According to the proposed plan, initially when it becomes dark, the street lights automatically glow for a and switches off automatically in day light in busy areas for security concerns. But throughout the night, in some deserted areas When a vehicle passes by, a block of street lights glows and as the vehicle moves forward, the next block of lights starts glowing where the previous block switches off.

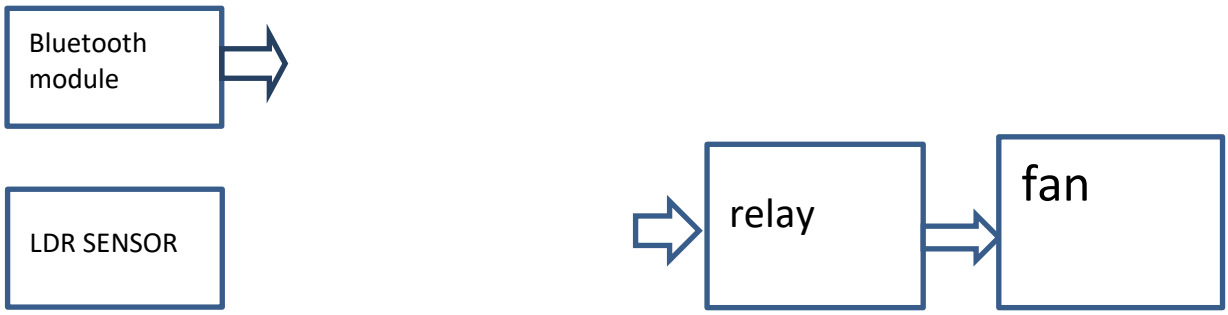
IOT based monitoring of the lights of busy areas.

FEATURES OF PROPOSED SYSTEM

- The system will consist of IR trans-receiver
- Micro controller based circuit design.
- The system consist of a pair of LDR's and Relays
- IOT based monitoring using Esp2866.
- The light will be on till the vechicle passes out and turns off automatically.

Block Diagram:





3.4 MODULES

3.4.1. POWER SUPPLY

The power supply section is the section which provide +5V for the components to work. IC LM7805 is used for providing a constant power of +5V.The ac voltage, typically 220V, is connected to a transformer, which steps down that ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

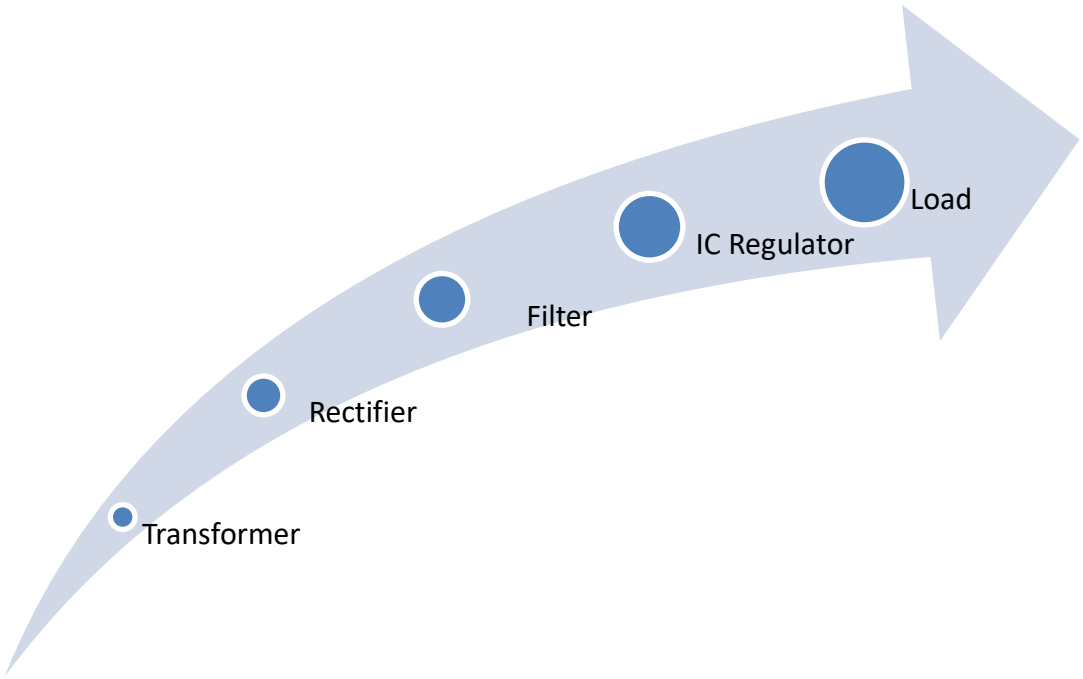


Fig3.3: Block Diagram of Power Supply

3.4.1.1 Transformer

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC. Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage (230V in India) to a safer low voltage.

The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils; instead they are linked by an alternating magnetic field created in the soft-iron core of the transformer. Transformers waste very little power so the power out is (almost) equal to the power in. Note that as voltage is stepped down current is stepped up. The transformer will step down the power supply voltage (0-230V) to (0- 6V) level. Then the secondary of the potential transformer will be connected to the bridge rectifier, which is constructed with the help of PN junction diodes. The advantages of using bridge rectifier are it will give peak voltage output as DC.

Fig3.4: Step down Transformer

3.4.1.2 Rectifier

There are several ways of connecting diodes to make a rectifier to convert AC to DC. The bridge rectifier is the most important and it produces full-wave varying DC. A full-wave rectifier can also be made from just two diodes if a centre-tap transformer is used, but this method is rarely used now that diodes are cheaper. A single diode can be used as a rectifier but it only uses the positive (+) parts of the AC wave to produce half-wave varying DC

Bridge Rectifier

When four diodes are connected as shown in figure, the circuit is called as bridge rectifier. The input to the circuit is applied to the diagonally opposite corners of the network, and the output is taken from the remaining two corners. Let us assume that the transformer is working properly and there is a positive potential, at point A and a negative potential at point B. the positive potential at point A will forward bias D3 and reverse bias D4.

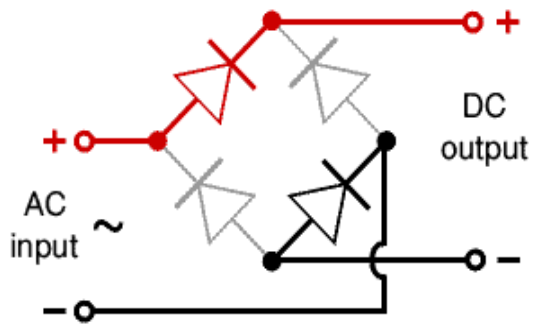


Fig3.5: Bridge Rectifier

The negative potential at point B will forward bias D1 and reverse D2. At this time D3 and D1 are forward biased and will allow current flow to pass through them; D4 and D2 are reverse biased and will block current flow.

One advantage of a bridge rectifier over a conventional full-wave rectifier is that with a given transformer the bridge rectifier produces a voltage output that is nearly twice that of the conventional full-wave circuit.

i. The main advantage of this bridge circuit is that it does not require a special centre tapped transformer, thereby reducing its size and cost.

ii. The single secondary winding is connected to one side of the diode bridge network and the load to the other side as shown below.

iii. The result is still a pulsating direct current but with double the frequency.

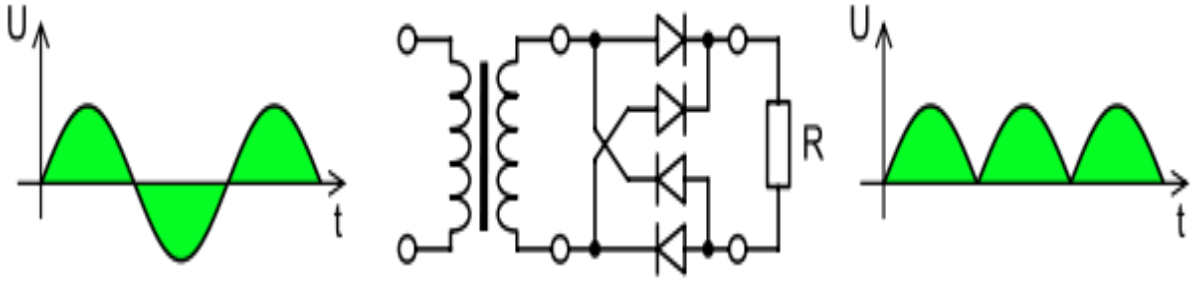


Fig3.6: Output Waveform of DC

3.4.1.3 Smoothing

Smoothing is performed by a large value electrolytic capacitor connected across the DC supply to act as a reservoir, supplying current to the output when the varying DC voltage

from the rectifier is falling. The capacitor charges quickly near the peak of the varying DC, and then discharges as it supplies current to the output.

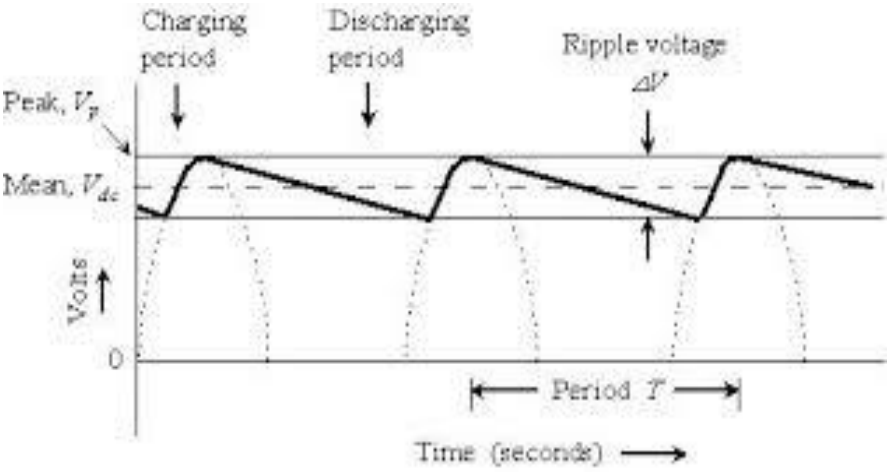


Fig3.7: Smoothing waveforms

3.4.1.4 Voltage Regulators

Voltage regulators comprise a class of widely used ICs. Regulator IC units contain the circuitry for reference source, comparator amplifier, control device, and overload protection all in a single IC. IC units provide regulation of either a fixed positive voltage, a fixed negative voltage, or an adjustably set voltage. The regulators can be selected for operation with load currents from hundreds of milli amperes to tens of amperes, corresponding to power ratings from milli watts to Tens of watts.

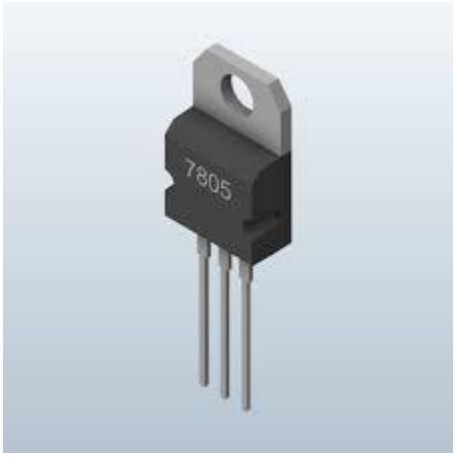


Fig3.8: 7805 voltage Regulator

A fixed three-terminal voltage regulator has an unregulated dc input voltage, Vi, applied to one input terminal, a regulated dc output voltage, Vo, from a second terminal, with the third terminal

connected to ground. The series 78 regulators provide fixed positive regulated voltages from 5 to 24 volts. Similarly, the series 79 regulators provide fixed negative regulated voltages from 5 to 24 volts. Voltage regulator ICs are available with fixed (typically 5, 12 and 15V) or variable output voltages. They are also rated by the maximum current they can pass. Negative voltage regulators are available, mainly for use in dual supplies. Most regulators include some automatic protection from excessive current ('overload protection') and overheating ('thermal protection').

Many of the fixed voltage regulator ICs has 3 leads and look like power transistors, such as the 7805 +5V 1Amp regulator. They include a hole for attaching a heat sink if necessary.

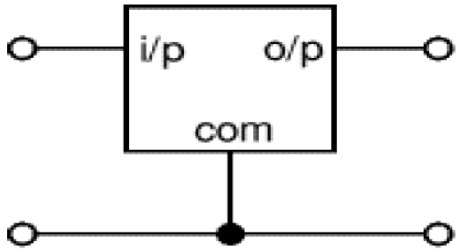


Fig3.9: voltage Regulator

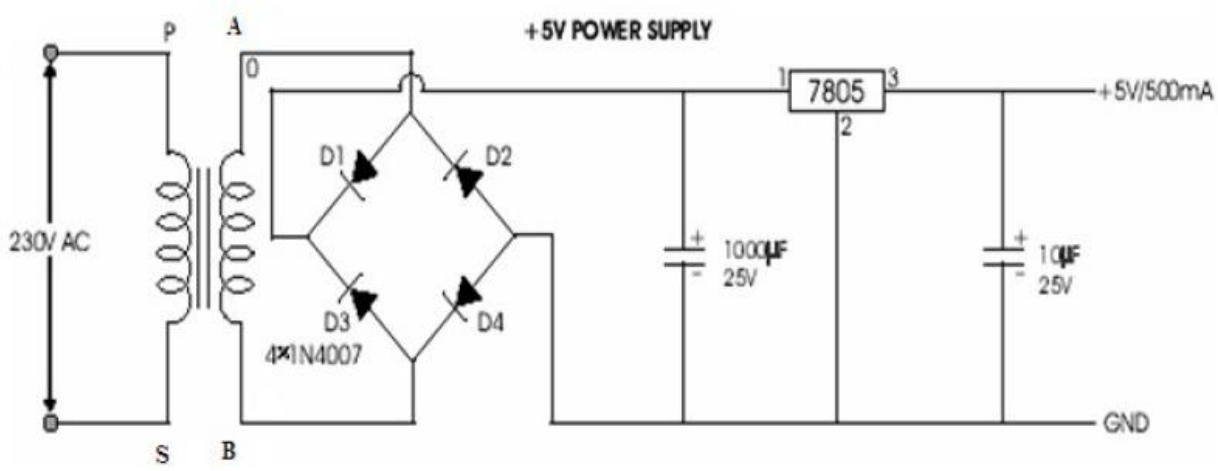


Fig3.10: Circuit Diagram of 5V DC Power Supply

3.5 Microcontroller

A microcontroller is a small computer (SoC) on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM, NOR flash or OTP ROM is also often included on chip, as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in

contrast to the microprocessors used in personal computers or other general purpose applications consisting of various discrete chips.

The microcontroller incorporates all the features that are found in microprocessor. The microcontroller has built in ROM, RAM, Input Output ports, Serial Port, timers, interrupts and clock circuit. A microcontroller is an entire computer manufactured on a single chip.

Microcontrollers are usually dedicated devices embedded within an application.

The DHT11 sensor is a low-cost, basic digital temperature and humidity sensor commonly used in various electronic projects and IoT (Internet of Things) applications. It is a simple and easy-to-use sensor that provides real-time temperature and humidity data. Here are some key characteristics and features of the DHT11 sensor:

Measurement Parameters:

Temperature: The DHT11 sensor can measure temperatures ranging from 0°C to 50°C (32°F to 122°F) with an accuracy of approximately ±2°C.

Humidity: It can measure relative humidity ranging from 20% to 80% with an accuracy of approximately ±5%.
Digital Output: The DHT11 sensor provides digital output, which means it communicates temperature and humidity data in a digital format that can be easily read by microcontrollers, such as Arduino or Raspberry Pi, via a single-wire interface.

Single-Wire Interface: It uses a single wire (data pin) for both data input and output. This makes it straightforward to connect to microcontrollers with limited pins.

Low Cost: The DHT11 is known for its affordability, making it a popular choice for hobbyists, students, and DIY projects.

Relative Humidity Sensor: It contains a capacitive humidity sensor component, which measures humidity by detecting changes in capacitance due to moisture in the air.

Thermistor for Temperature: A thermistor is used to measure temperature by detecting the change in resistance with temperature.

Fixed Resolution: The DHT11 sensor provides temperature and humidity data with a fixed resolution of 1°C for temperature and 1% for humidity.

Low Power Consumption: It has relatively low power requirements, which makes it suitable for battery-powered devices.

Sampling Rate: The sensor typically takes readings every 2 seconds.

Operating Voltage: The DHT11 operates on a voltage supply in the range of 3.5V to 5.5V.

Library Support: Various libraries are available for popular microcontroller platforms like Arduino and Raspberry Pi, simplifying the interfacing and data retrieval process.

Applications of the DHT11 sensor include weather stations, home automation systems, environmental monitoring, and various IoT projects where monitoring temperature and humidity is important. However, it's essential to note that while the DHT11 is cost-effective and easy to use, it may not be the best choice for applications that require high accuracy and precision in temperature and humidity measurements. For more precise measurements, other sensors like the DHT22 or more advanced sensors may be preferred

or example, microcontrollers are used as engine controllers in automobiles and as exposure and focus controllers in cameras.

In order to serve these applications, they have a high concentration of on-chip facilities
Such as serial ports, parallel input output ports, timers, counters, interrupt control,
Analog-to-digital converters, random access memory, read only memory, etc. The I/O, memory, and on-chip peripherals of a microcontroller are selected depending on the specifics of the target application.
Since microcontrollers are powerful digital processors, the degree of control and programmability they provide significantly enhances the effectiveness of the application.

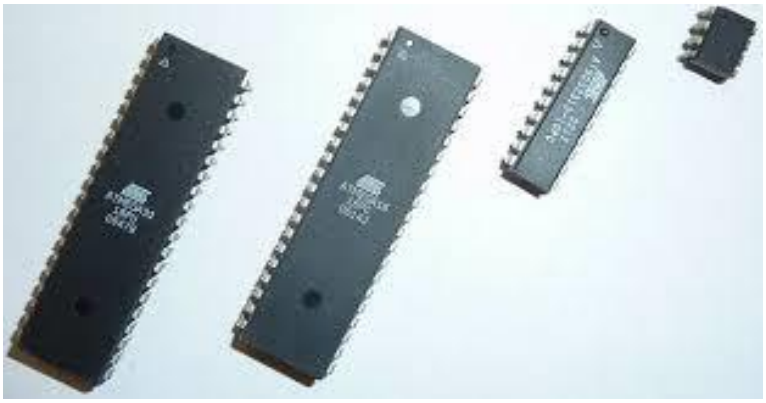


Fig3.11: Micro Controllers

3.5.1 Types of Microcontroller:

Microcontrollers are divided into categories according to their memory, architecture, bits and instruction sets. So let's discuss types of microcontrollers:-

- **i.** 8051 microcontroller
- **ii.** PIC Microcontroller
- **iii.** AVR Microcontroller
- **iv.** AMR Microcontroller

3.5.2 Difference between microcontroller andmicroprocessor

It is very clear from figure that in microprocessor we have to interface additional circuitry for providing the function of memory and ports, for example we have to interface external RAM for data storage, ROM for program storage, programmable peripheral interface (PPI) 8255 for the

Input Output ports, 8253 for timers, USART for serial port. While in the microcontroller RAM, ROM, I/O ports, timers and serial communication ports are in built. Because of this it is called as "system on chip". So in micro-controller there is no necessity of additional circuitry which is interfaced in the microprocessor because memory and input output ports are inbuilt in the microcontroller. Microcontroller gives the satisfactory performance for small applications. But for large applications the memory requirement is limited because only 64 KB memory is available for program storage. So for large applications we prefer microprocessor than microcontroller due to its high processing speed.

3.5.3 Criteria for selection of a microcontroller in embedded system

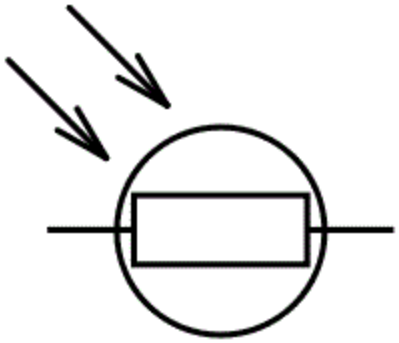
Criteria for selection of microcontroller in any embedded system are as following:

(a) Meeting the computing needs of task at hand efficiently and cost effectively

- Speed of operation
- Packing
- Power consumption
- Amount of RAM and ROM on chip
- No. of I/O pins and timers on chip
- Cost.

LDR Sensor

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation. Hence, they are light sensitive devices. They are also called as photo conductors, photo conductive cells or simply photocells. They are made up of semiconductor materials having high resistance. There are many different symbols used to indicate a LDR, one of the most commonly used symbol is shown in the figure below. The arrow indicates light falling on it.



Working Principle of LDR

A light dependent resistor works on the principle of photo conductivity.Photo conductivity is an optical phenomenon in which the materials conductivity is increased when light is absorbed by the material. When light falls i.e. when the photons fall on the device, the electrons in the valence band of the semiconductor material are excited to the conduction band. These photons in the incident light should have energy greater than the band gap of the semiconductor material to make the electrons jump from the valence band to the conduction band. Hence when light having enough energy strikes on the device, more and more electrons are excited to the conduction band which results in large number of charge carriers. The result of this process is more and more current starts flowing throgh the device when the circuit is closed and hence it is said that the resistance of the device has been decreased. This is the most common working principle of LDR.

Characteristics of LDR

LDR's are light dependent devices whose resistance is decreased when light falls on them and that is increased in the dark. When a light dependent resistor is kept in dark, its resistance is very high. This resistance is called as dark resistance. It can be as high as 1012 Ω and if the device is allowed to absorb light its resistance will be decreased drastically. If a constant voltage is applied to it and intensity of light is increased the current starts increasing. Figure below shows resistance vs. illumination curve for a particular LDR.

Photocells or LDR's are non linear devices. There sensitivity varies with the wavelength of light incident on them. Some photocells might not at all response to a certain range of wavelengths. Based on the material used different cells have different spectral response curves.

When light is incident on a photocell it usually takes about 8 to 12 ms for the change in resistance to take place, while it takes one or more seconds for the resistance to rise back again to its initial value after removal of light. This phenomenon is called as resistance recovery rate. This property is used in audio compressors. Also, LDR's are less sensitive than photo diodes and photo transistor. (A photo diode and a photocell (LDR) are not the same, a photo-diode is a p-n junction semiconductor device that converts light to electricity, whereas a photocell is a passive device, there is no p-n junction in this nor it "converts" light to electricity). Types of Light Dependent Resistors: Based on the materials used they are classified as:

Intrinsic photo resistors (Un doped semiconductor): These are made of pure semiconductor materials such as silicon or germanium. Electrons get excited from valance band to conduction band when photons of enough energy fall on it and number charge carriers is increased.

Extrinsic photo resistors: These are semiconductor materials doped with impurities which are called as dopants. Theses dopants create new energy bands above the valence band which are filled with electrons. Hence this reduces the band gap and less energy is required in exciting them. Extrinsic photo resistors are generally used for long wavelengths.

Construction of a Photocell

The structure of a light dependent resistor consists of a light sensitive material which is deposited on an insulating substrate such as ceramic. The material is deposited in zigzag pattern in order to obtain the desired resistance and power rating. This zigzag area separates the metal deposited areas into two regions. Then the ohmic contacts are made on the either sides of the area. The resistances of these contacts should be as less as possible to make sure that the resistance mainly changes due to the effect of light only. Materials normally used are cadmium sulphide, cadmium selenide, indium antimonide and cadmium sulphonide. The use of lead and cadmium is avoided as they are harmful to the environment.

Arduino Uno

The most common version of Arduino is the Arduino Uno. This board is what most people are talking about when they refer to an Arduino. The Uno is one of the more popular boards in the Arduino family and a great choice for beginners. There are different revisions of Arduino Uno, below detail is the most recent revision (Rev3 or R3).

The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, 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 an AC-to-DC adapter or battery to get started.

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	:	40 mA

DC Current for 3.3V Pin	:	50 mA
Flash Memory	:	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	:	2 KB (ATmega328)
EEPROM	:	1 KB (ATmega328)
Clock Speed	:	16 MHz
Length	:	68.6 mm
Width	:	53.4 mm

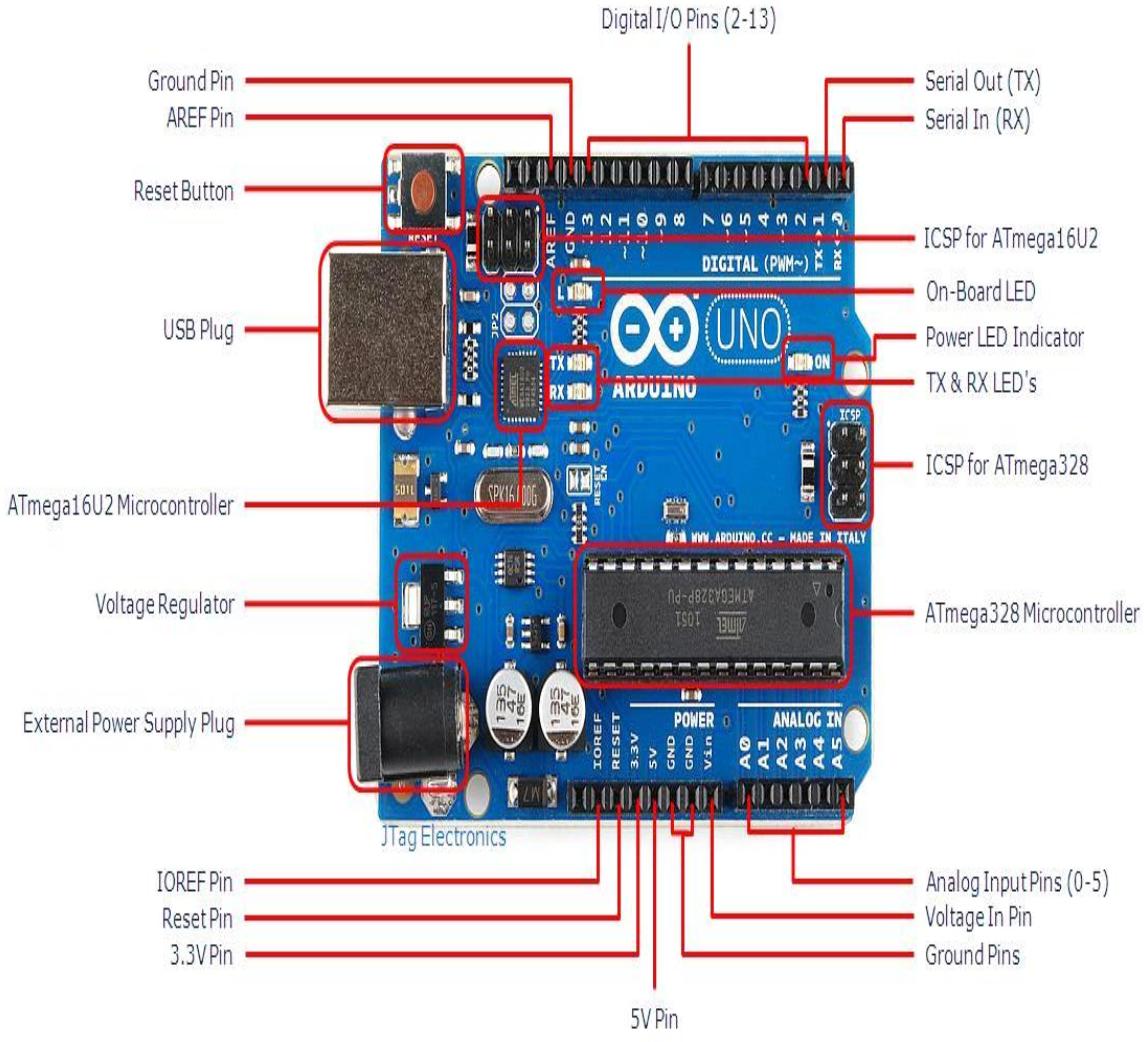


fig 3.1

ArduinoUno R3 Board

- **USB Plug & External Power Supply Plug**

Every Arduino board needs a way to be connected to a power source. The Arduino Uno can be powered from a USB cable coming from your computer or a wall power supply that is terminated in a barrel jack. The power source is selected automatically. The USB connection is also how you will load code onto your Arduino board. Please on my other post on how to program with Arduino can be found in Installing and Programming Arduino.

NOTE: The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V,

however, the 5V pin may supply less than five volts and the board may be unstable.If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts

.

- **Voltage Regulator**

The voltage regulator is not actually something you can (or should) interact with on the Arduino. But it is potentially useful to know that it is there and what it's for. The voltage regulator does exactly what it says – it controls the amount of voltage that is let into the Arduino board. Think of it as a kind of gatekeeper; it will turn away an extra voltage that might harm the circuit. Of course,it has its limits, so don't hook up your Arduino to anything greater than 20 volts.

- **Power Pins**

Voltage In Pin – The input voltage to the Arduino board when it's using an external power source(as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

5V Pin – This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 – 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage your board. It's not recommended.3.3V Pin – A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

- **Ground Pins**

There are several GND pins on the Arduino, any of which can be used to ground your circuit.

- **IOREF Pin**

This pin on the Arduino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs for working with the 5V or 3.3V.

- **Input and Output Pins**

Each of the 14 digital pins on the Uno can be used as an input or output. They operate at 5 volts. These pins can be used for both digital input (like telling if a button is pushed) and digital output (like powering an LED). Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-5k Ohms. In addition, some pins have specialized functions.

- **Serial Out (TX) & Serial In (RX)**

Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

- **External Interrupts**

Pins 2 and 3 can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.

PWM – You may have noticed the tilde (~) next to some of the digital pins (3, 5, 6, 9, 10, and 11). These pins act as normal digital pins, but can also be used for something called Pulse-Width Modulation (PWM). Think of these pins as being able to simulate analog output (like fading an LED in and out).

SPI – Pins 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). SPI stands for Serial Peripheral Interface. These pins support SPI communication using the SPI library.

Analog Input Pins – Labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). These pins can read the signal from an analog sensor (like a temperature sensor) and convert it into a digital value that we can read. By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF Pin (Stands for Analog Reference. Most of the time you can leave this pin alone). Additionally, some pins have specialized functionality:

TWI – Pins A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.

- **Reset Pin**

Bring this line LOW to reset the microcontroller.Typically used to add a reset button to shields which block the one on the board.

- **LED Indicators**

Power LED Indicator – Just beneath and to the right of the word "UNO" on your circuit board, there's a tiny LED next to the word 'ON'. This LED should light up whenever you plug your Arduino into a power source. If this light doesn't turn on, there's a good chance something is wrong. Time to re-check your circuit!

On-Board LED – There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off. This useful to quickly check if the board has no problem as some boards has a pre-loaded simple blinking LED program in it.

TX & RX LEDs – These LEDs will give us some nice visual indications whenever our Arduino is receiving or transmitting data (like when we're loading a new program ontotheboard).

Reset Button: Pushing the reset button temporarily connect the reset pin to ground and restart any code that is loaded on the Arduino. This can be very useful if your code doesn't repeat, but you want to test it multiple times.

3.2 Bluetooth(HC-05)

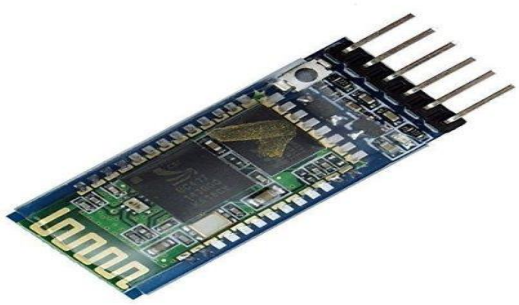
HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. The HC-05 Bluetooth Module can be used in a Master or Slave configuration, making it a great solution for wireless communication. This serial port Bluetooth module is 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 Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

Bluetooth Module HC-05

The Bluetooth module HC-05 is a MASTER/SLAVE module.By default the factory setting is 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 can accept connections.Master module can initiate a connection to other devices.The user can use it simply for a serial port replacement to establish connection between MCU and GPS, PC to your embedded project, etc.Just go through the datasheet for more details.

Software Features

- Slave default Baud rate: 9600, Data bits:8, Stop bit:1,Parity:No parity.
- Auto-connect to the last device on power as default.
- Permit pairing device to connect as default.
- Auto-pairing PINCODE:”1234” as default.



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

ENABLE: When enable is pulled LOW, the module is disabled which means the module will not turn on and it fails to communicate.When enable is left open or connected to 3.3V, the module is enabled i.e. the module remains on and communication also takes place.

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 Bluetooth device,signal goes Low.At this low state,the led flashes continuously which denotes that the module is not paired with other device.When this module is connected to/paired with any other Bluetooth device,the signal goes high.At this high state,the ledblinks with a constant delay say for example 2s delay which indicates that the module is paired.

Program for HC-05 Bluetooth Module

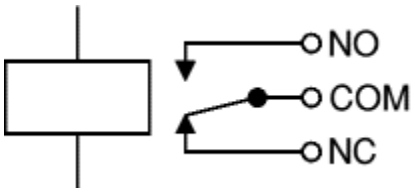
The program given below is the HC-05 Bluetooth module program.This process is quite different from others since we are going to use android mobile to control and communicate with arduino.Here the Bluetooth module acts as an interface between our mobile and Arduinoboard.Before getting into the execution process,follow the given procedure:

- First of all,the user should install an application called **Bluetooth_SPP PRO** the play store which is a free application.
- After installation,pair the Bluetooth module to your mobile as like connecting one device to other using bluetooth.The default pairing code is **1234**.
- Upload the given program to the Arduino Uno board.After uploading the code,unplug the USB from the arduino.
- Now use external power adapter to power the Uno board.

The Bluetooth SPP PRO has three types of communication mode.Here Byte stream mode is used to communicate.So select that mode and give the input as **1**,as soon as the input has given the led will turn on and for **0** led will turn off.

Relay:

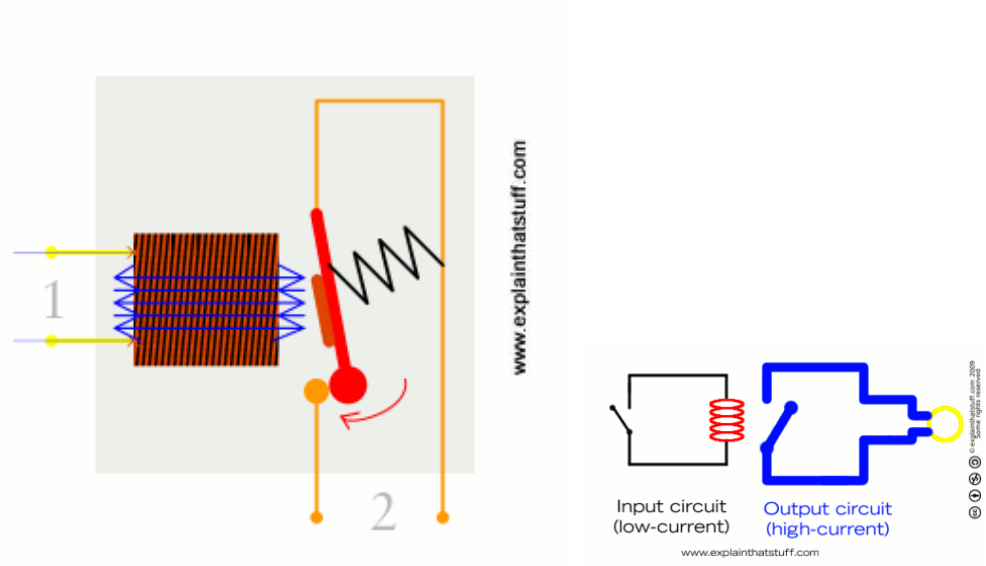
A relay is an **electrically operated switch**. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and most have **double throw**(**changeover**) switch contacts as shown in the diagram.



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 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.

Circuit symbol



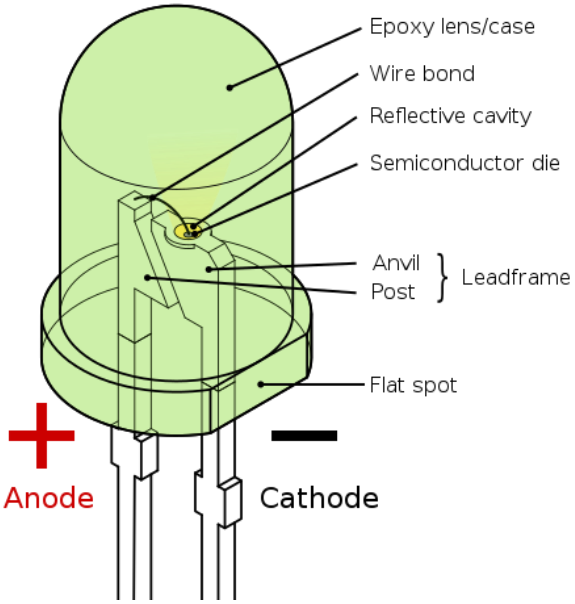
LED

A **light-emitting diode** (**LED**) is a two-lead semiconductor light source. It is a p–n junction diode that emits light when activated. When a suitable current is applied to the leads, electrons are able to recombine with electron holes within the device, releasing energy in the form of photons. This effect is called electroluminescence, and the color of the light (corresponding to the energy of the photon) is determined by the energy band gap of the semiconductor. LEDs are typically small (less than 1 mm^2) and integrated optical components may be used to shape the radiation pattern.

Appearing as practical electronic components in 1962, the earliest LEDs emitted low-intensity infrared light.[9] Infrared LEDs are still frequently used as transmitting elements in remote-control circuits, such as those in remote controls for a wide variety of consumer electronics. The first visible-light LEDs were of low intensity and limited to red. Modern LEDs are available across the visible, ultraviolet, and infrared wavelengths, with very high brightness.

Early LEDs were often used as indicator lamps for electronic devices, replacing small incandescent bulbs. They were soon packaged into numeric readouts in the form of seven-segment displays and were commonly seen in digital clocks. Recent developments have produced LEDs suitable for environmental and task lighting. LEDs have led to new displays and sensors, while their high switching rates are useful in advanced communications technology.

LEDs have many advantages over incandescent light sources, including lower energy consumption, longer lifetime, improved physical robustness, smaller size, and faster switching. Light-emitting diodes are used in applications as diverse as aviation lighting, automotive headlamps, advertising, general lighting, traffic signals, camera flashes, lighted wallpaper and medical devices.[10] They are also significantly more energy efficient and, arguably, have fewer environmental concerns linked to their disposal.[11][12]



Incandescent light bulb

An SEM image of the tungstenfilament of an incandescent light bulb.

An **incandescent light bulb**, **incandescent lamp** or **incandescent light globe** is an electric light with a wire filament heated to such a high temperature that it glows with visible light (incandescence). The filament is protected from oxidation with a glass or fused quartz bulb that is filled with inert gas or a vacuum. In a halogen lamp, filament evaporation is slowed by a chemical process that redeposits metal vapor onto the filament, thereby extending its life.

The light bulb is supplied with electric current by feed-through terminals or wires embedded in the glass. Most bulbs are used in a socket which provides mechanical support and electrical connections.

Incandescent bulbs are manufactured in a wide range of sizes, light output, and voltage ratings, from 1.5 volts to about 300 volts. They require no external regulating equipment, have low manufacturing costs, and work equally well on either alternating current or direct current. As a result, the incandescent bulb is widely used in household and commercial lighting, for portable lighting such as table lamps, car headlamps, and flashlights, and for decorative and advertising lighting.

Incandescent bulbs are much less efficient than other types of electric lighting; incandescent bulbs convert less than 5% of the energy they use into visible light,[1] with standard light bulbs averaging about 2.2%.[2] The remaining energy is converted into heat. The luminous efficacy of a typical incandescent bulb is 16 lumens per watt, compared with 60 lm/W for a compact fluorescent bulb or 150 lm/W for some white LED lamps.[3]

Some applications of the incandescent bulb (such as heat lamps) deliberately use the heat generated by the filament. Such applications include incubators, brooding boxes for poultry,[4] heat lights for reptile tanks,[5] infrared heating for industrial heating and drying processes, lava lamps, and the Easy-Bake Oven toy. Incandescent bulbs typically have short lifetimes compared with other types of lighting; around 1,000 hours for home light bulbs versus typically 10,000 hours for compact fluorescents and 30,000 hours for lighting LEDs.

Incandescent bulbs have been replaced in many applications by other types of electric light, such as fluorescent lamps, compact fluorescent lamps (CFL), cold cathode fluorescent lamps (CCFL), high-intensity discharge lamps, and light-emitting diode lamps (LED). Some jurisdictions, such as the European Union, China, Canada and United States, are in the process of phasing out the use of incandescent light bulbs while others, including Colombia,[6] Mexico, Cuba, Argentina and Brazil,[7] have prohibited them already.

A 4x zoom photo of an ultra-violet LED has been shown in picture.

Unlike a laser, the color of light emitted from an LED is neither coherent nor monochromatic, but the spectrum is narrow with respect to human vision, and for most purposes the light from a simple diode element can be regarded as functionally monochromatic

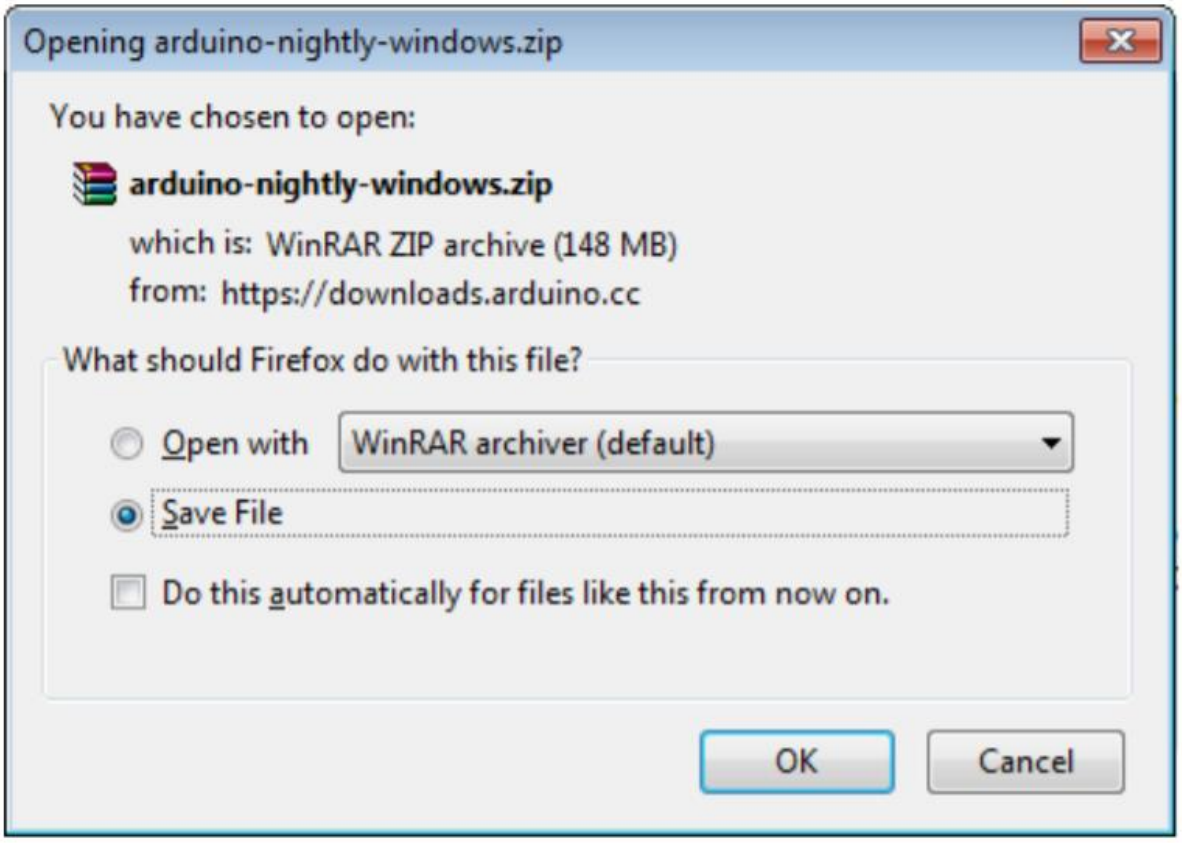
CHAPTER 4

SOFTWARE SPECIFICATION

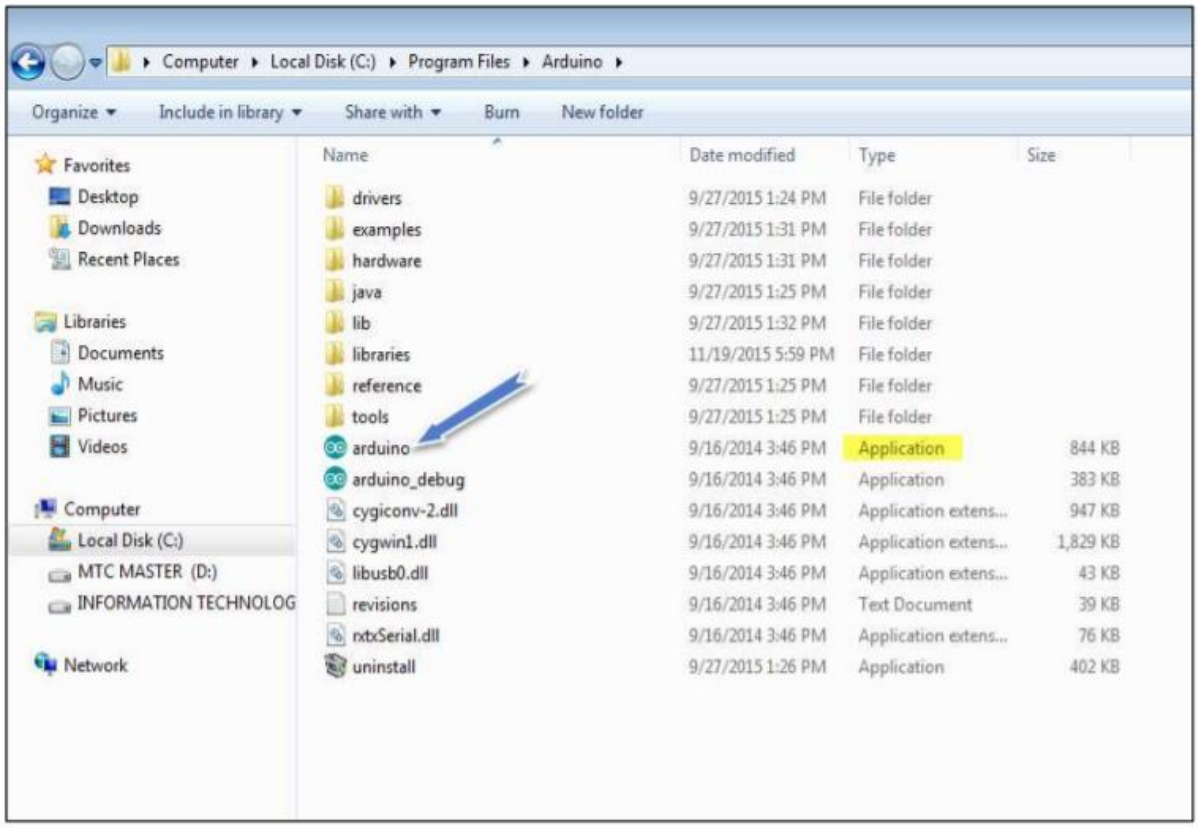
4.1 Introduction

Software introduction:

Arduino IDE Software. You can get different versions of Arduino IDE from the Download page on the Arduino Official website. You must select your software, which is compatible with your operating system (Windows, IOS, or Linux). After your file download is complete, unzip the file.



Launch Arduino IDE. After your Arduino IDE software is downloaded, you need to unzip the folder. Inside the folder, you can find the application icon with an infinity label (application.exe). Doubleclick the icon to start the IDE.

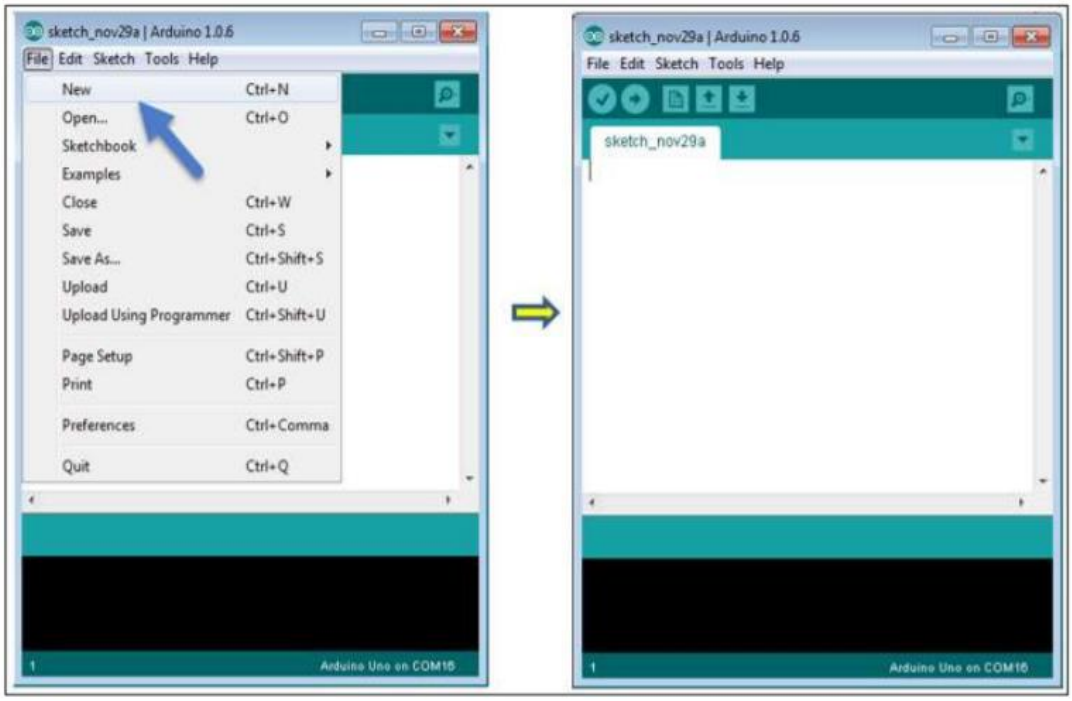


Open your first project. Once the software starts, you have two options:

- Create a new project.

- Open an existing project example.

To create a new project, select File --> New


sketch_nov29a | Arduino 1.0.6
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Sketchbook
Examples
Close Ctrl+W
Save Ctrl+S
Save As... Ctrl+Shift+S
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Print Ctrl+P
Preferences Ctrl+Comma
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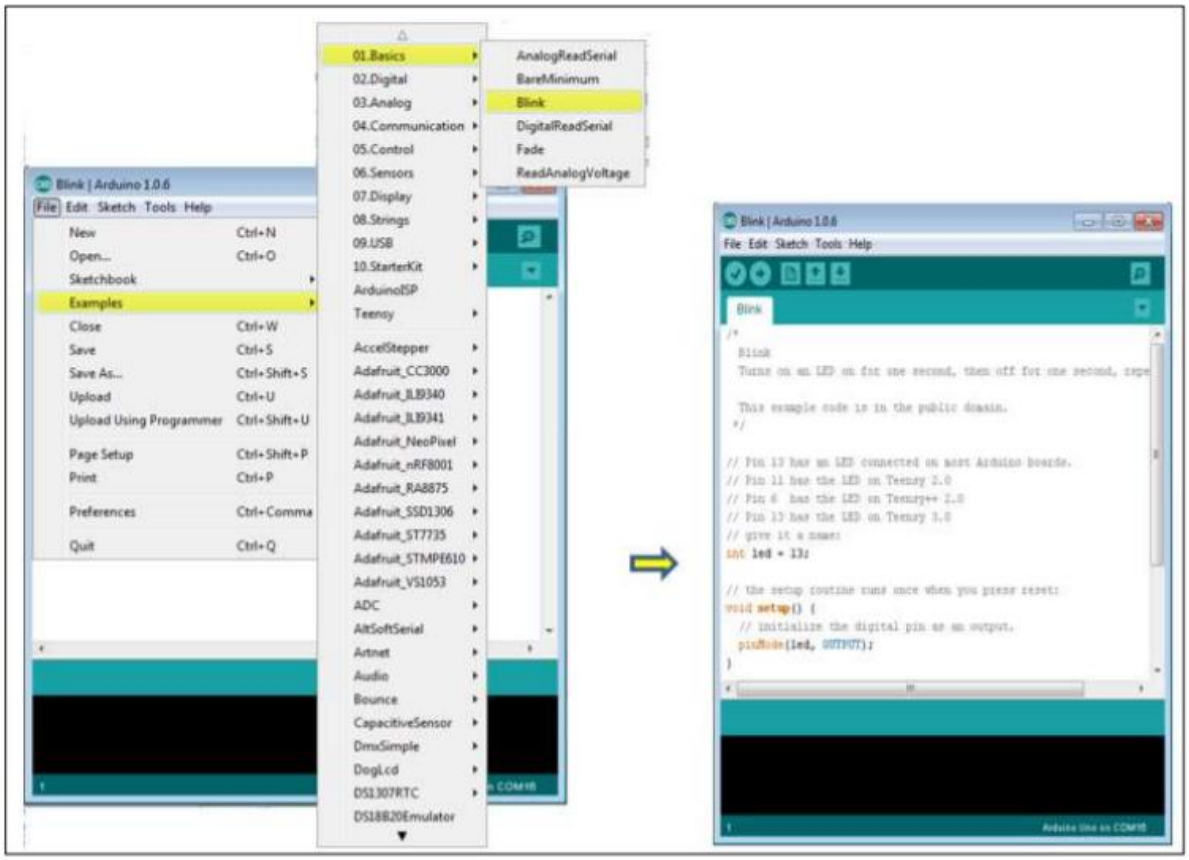
sketch_nov29a
Arduino Uno on COM16


Blink | Arduino 1.0.6
File Edit Sketch Tools Help
New Ctrl+N
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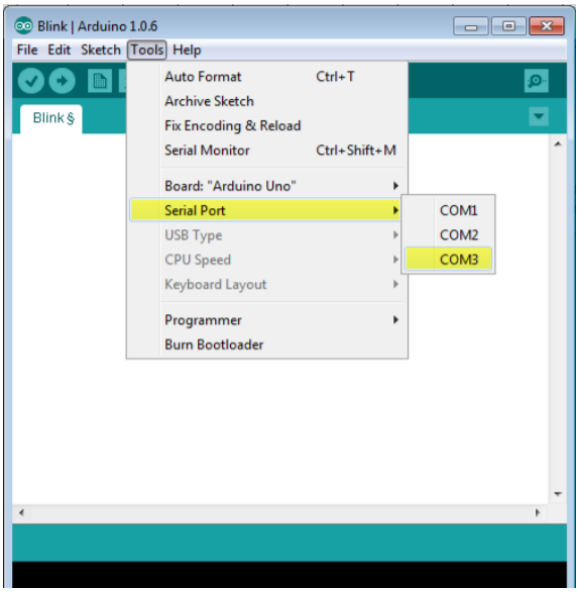
Sketchbook
Examples
Close Ctrl+W
Save Ctrl+S
Save As... Ctrl+Shift+S
Upload Ctrl+U
Upload Using Programmer Ctrl+Shift+U
Page Setup Ctrl+Shift+P
Print Ctrl+P
Preferences Ctrl+Comma
Quit Ctrl+Q
01.Basics
02.Digital
03.Analog
04.Communication
05.Control
06.Sensors
07.Display
08.Strings
09.USB
10.StarterKit
ArduinoISP
Teensy
AccelStepper
Adafruit_CC3000
Adafruit_ILI9340
Adafruit_ILI9341
Adafruit_NeoPixel
Adafruit_nRF8001
Adafruit_RA8875
Adafruit_SSD1306
Adafruit_ST7735
Adafruit_STMPE610
Adafruit_VS1053
ADC
AltSoftSerial
Artnet
Audio
Bounce
CapacitiveSensor
DmxSimple
DogLcd
DS1307RTC
DS18B20Emulator
AnalogReadSerial
BareMinimum
Blink
DigitalReadSerial
Fade
ReadAnalogVoltage
Blink
Blink
Turns on an LED on for one second, then off for one second, repe
This example code is in the public domain.
// Pin 13 has an LED connected on most Arduino boards.
// Pin 11 has the LED on Teensy 2.0
// Pin 6 has the LED on Teensy++ 2.0
// Pin 13 has the LED on Teensy 3.0
// give it a name:
int led = 13;
// the setup routine runs once when you press reset:
void setup() {
// initialize the digital pin as an output.
pinMode(led, OUTPUT);
}

Here, we are selecting just one of the examples with the name Blink. It turns the LED on and off with some time delay. You can select any other example from the list

Select your serial port. Select the serial device of the Arduino board. Go to Tools -> Serial Port menu. This is likely to be COM3 or higher (COM1 and COM2 are usually reserved for hardware serial ports). To find out, you can disconnect your Arduino board and re-open the menu, the entry that disappears should be of the Arduino board. Reconnect the board and select that serial port.



Before explaining how we can upload our program to the board, we must demonstrate the function of each symbol appearing in the Arduino IDE toolbar.

A- Used to check if there is any compilation error.

B- Used to upload a program to the Arduino board.

C- Shortcut used to create a new sketch.

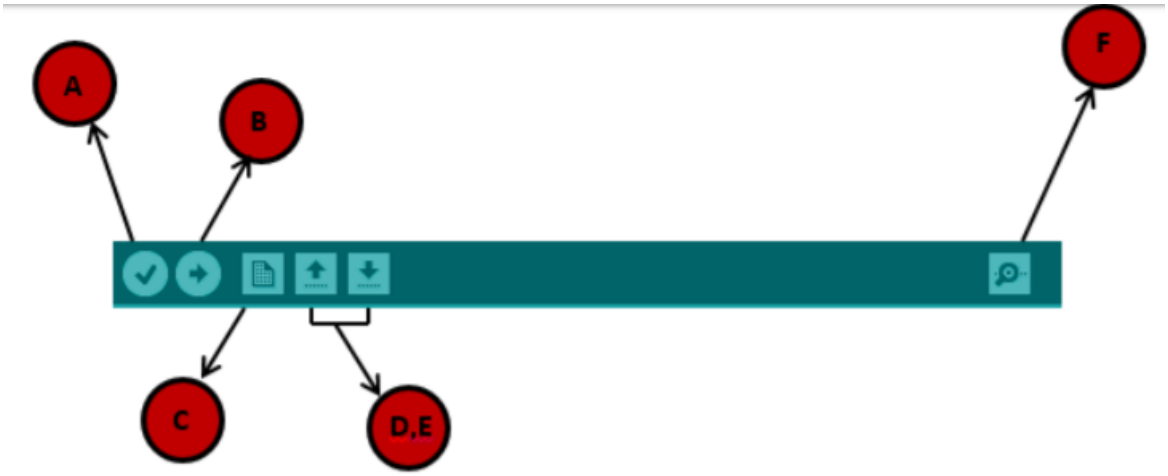
D- Used to directly open one of the example sketch.

E- Used to save your sketch.

F- Serial monitor used to receive serial data from the board and send the serial data to the board.

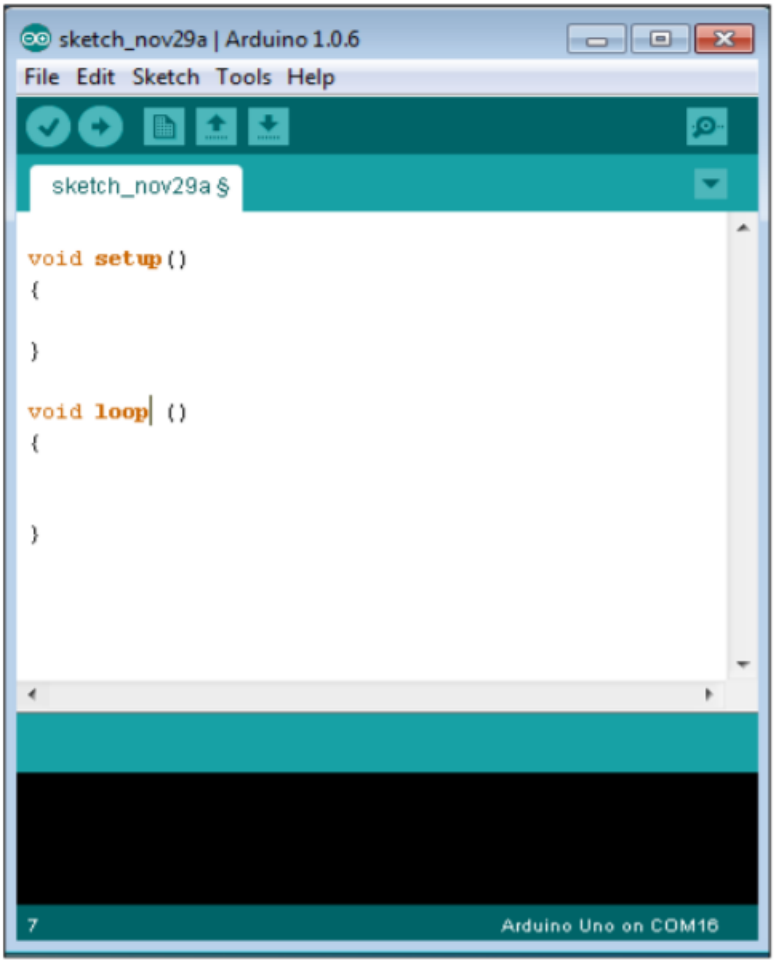
Now, simply click the "Upload" button in the environment.

Wait a few seconds; you will see the RX and TX LEDs on the board, flashing. If the upload is successful, the message "Done uploading" will appear in the status bar.



In this chapter, we will study in depth, the Arduino program structure and we will learn more new terminologies used in the Arduino world. The Arduino software is open-source. The source code for the Java environment is released under the GPL and the C/C++ microcontroller libraries are under the LGPL. Sketch: The first new terminology is the Arduino program called “sketch”. Structure Arduino programs can be divided in three main parts: Structure, Values (variables and constants), and Functions. In this tutorial, we will learn about the Arduino software program, step by step, and how we can write the program without any syntax or compilation error. Let us start with the Structure. Software structure consist of two main functions:

- Setup( ) function
- Loop( ) function



Data types in C refers to an extensive system used for declaring variables or functions of different types. The type of a variable determines how much space it occupies in the storage and how the bit pattern stored is interpreted. The following table provides all the data types that you will use during Arduino programming

Example Programming:

```
#include <LiquidCrystal.h>

const int rs = 13, en = 12, d4 = 11, d5 = 10, d6 = 9, d7 = 8;

LiquidCrystal lcd(rs, en, d4, d5, d6, d7);

const int ir1 = 6;

const int ir2 = 7;
```

```
int status1;
int status2;
int count=0;
void setup() {
  // put your setup code here, to run once:
  lcd.begin(16,2);
lcd.print("Vister Counter");
delay(200);
Serial.begin(9600);
pinMode(ir1,INPUT);
//pinMode(ir2,INPUT);
lcd.clear();
lcd.setCursor(0,0);
  lcd.print("Persons in room:");
  Serial.println("Persons in room:");
  lcd.setCursor(0,1);
  lcd.print(count);
  Serial.println(count);
}

void loop() {
```

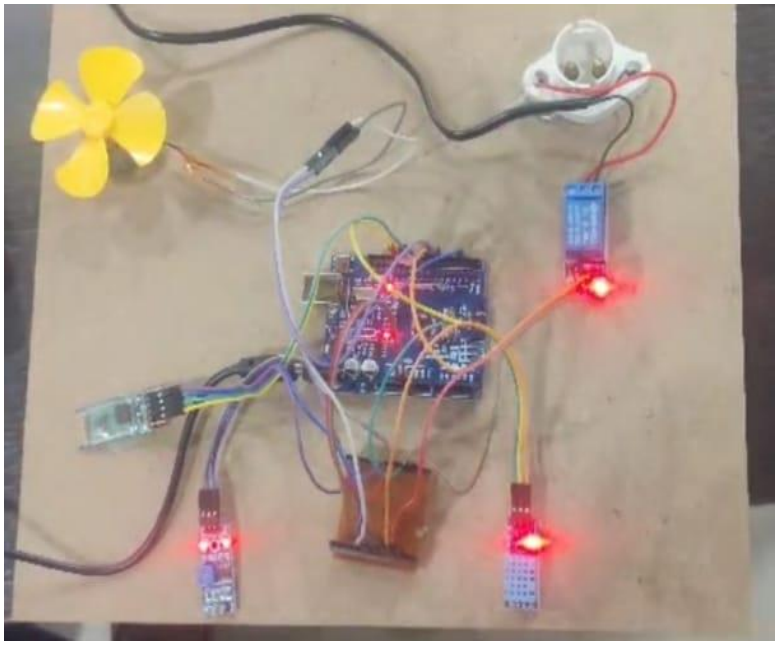
```
  // put your main code here, to run repeatedly:
  status1 = digitalRead(ir1);
  status2 = digitalRead(ir2);
if(status1 == 1)
{
  count++;
  lcd.setCursor(0,1);
  lcd.print(count);
  Serial.println(count);
  delay(600);
}

if(status2 == 1)
{
  count--;
  lcd.setCursor(0,1);
  lcd.print(count);
  Serial.println(count);
  delay(600);
}
}
```

RESULTS:

App Interface

Working Model



CONCLUSION

In conclusion, our mini project focusing on the development of a domestic appliances control system with Android and sensors has proven to be a significant leap towards revolutionizing the way we interact with and manage household devices. This endeavor underscores the potential of automation technology to reshape our daily lives and create more efficient and convenient living environments.

By incorporating a variety of sensors, we've enabled these appliances to respond to their environment intelligently. Temperature, light, motion, and other data collected by these sensors

are utilized to make informed decisions regarding appliance operation. This not only enhances energy efficiency but also contributes to a more sustainable and eco-friendly lifestyle.

The integration of Android as a control interface provides us with unprecedented accessibility and flexibility. With just a few taps on our smartphones or tablets, we can remotely monitor, schedule, and adjust the functioning of our appliances. This not only simplifies daily tasks but also gives us the freedom to manage our homes even when we are not physically present.

Our mini project highlights the profound implications of the Internet of Things (IoT) and smart home technology. It opens the door to a future where our homes are not just places to live but also active, responsive, and adaptive entities. We are witnessing the birth of a new era in domestic living, where our appliances seamlessly communicate with one another and with us, making our lives more comfortable and efficient.

As technology continues to advance, we anticipate further innovations and integrations in this field. The possibilities are boundless, from enhanced security and safety features to intelligent resource management. This mini project serves as a stepping stone towards a world where homes are not merely spaces but intelligent ecosystems designed to cater to our evolving needs, ensuring a more connected, sustainable, and convenient way of living.

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