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Fire Fighting Robot Using Embedded Systems

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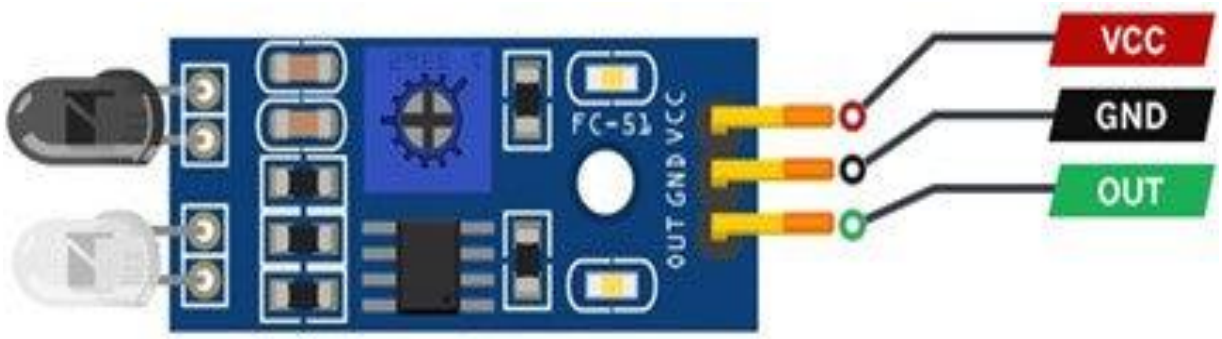
Abstract:
One of the most important parameters in fire disaster is life, i.e. lives lost in saving someone else life. It is sometimes impossible for fire-fighters personnel to access the site of a fire because of explosive materials, smoke, and high temperatures. A fast response to detect the fire can avoid many disastrous things. From the given statics (Fig.1), it is observed that fire can take place at domestic as well as at industrial level. A normal spark can generate a massive fire breakout. Not only lives of industrial people but also the lives of domestic's people are at risk because of poor fire management system. But it can be avoided using proper fire controlling methods.

Keywords
FIRE FIGHTING ROBOT, ARDUINO

INTRODUCTION

WHAT IS FLAME SENSOR?



A flame sensor is a type of sensor that responds most strongly to ambient light. This sensor module is utilized in flame alarms as a result. This sensor picks up flames coming from the light source with wavelengths between 760 and 1100 nm. High temperatures have the potential to easily harm this sensor. So, a specific distance from the flame can be chosen for this sensor's placement. The flame can be detected from a distance of 100 cm. This sensor outputs either an analogue signal or a digital signal. These sensors serve as a flame alert in firefighting robots.

FLAME SENSOR W WORKING PRINCIPLE:

Flame sensors identify flames using UV (Ultraviolet), IR (Infra-Red), or UV-IR technology. Simply detecting UV rays is how the UV flame sensor operates. Most fires produce UV radiation near the point of ignition, therefore in the event of a fire, the sensor would become aware of it and produce a series of pulses that are altered by the detector and produce an alarm

APPLICATIONS:

- Industrial applications
- Automatic control systems
- Hospital management

TECHNICAL SPECIFICATIONS:**HARDWARE:**

Micro controller : ATMega328
Crystal : 11.0592 MHz
LCD : 16X2
LED : 5mm Red LED
Line driver IC : L293D
SERVO MOTOR
12V RELAY 12V WATER PUMP.

POWER SUPPLY:

Transformer : 12V step down
Filter : 1000uf/25V
Voltage Regulator : 7805 / 7812.

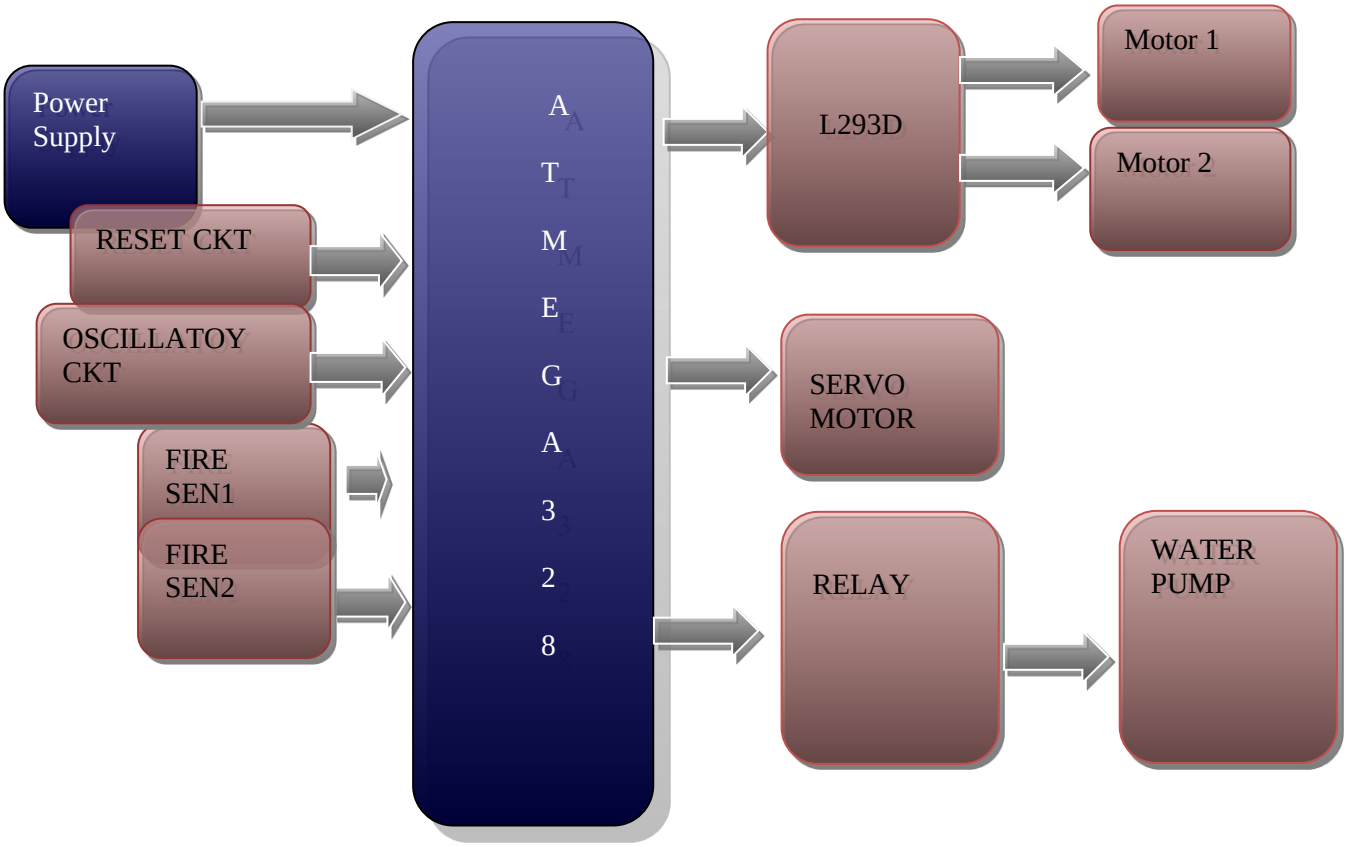
SOFTWARE:AURDINO.

APPLICATIONS:

- Automobiles
- OEMS
- Transport companies

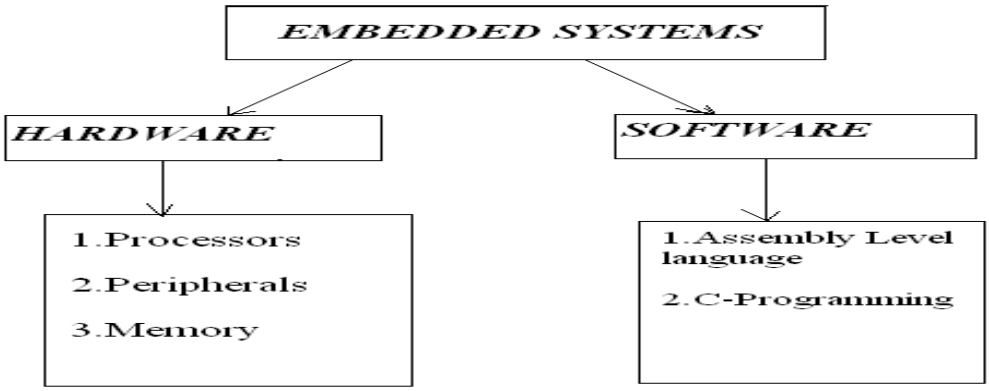
POWER SUPPLY BLOCK DIAGRAM:

BLOCK DIAGRAM:



INT INTRODUCTION TO EMBEDDED SYSTEM

Embedded systems are a system is which performs aspecific or a pre-defined task. It is the combinations of hardware and software. It is nothing but a computer inside a product. It is a programmable hardware design nothing but an electronic chip.



ARDUINO

Arduino interface boards provide the engineers, artists, designers, hobbyists and anyone who tinker with technology with a low-cost, easy-to-use technology to create their creative, interactive objects, useful projects etc. A whole new breed of projects can now be built that can be controlled from a computer.

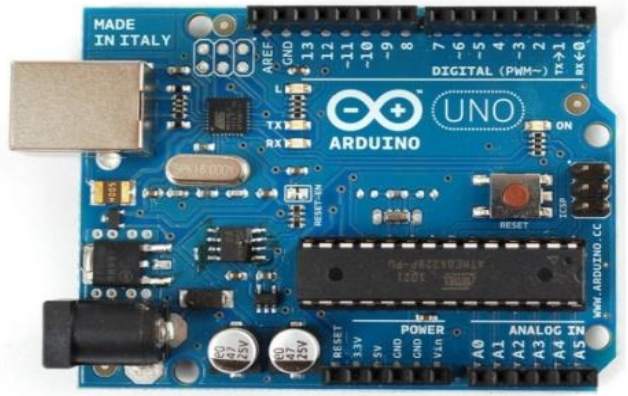


Figure 1.1 ARDUINO UNO

Arduino is an open source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. It's an open-source physical computing platform based on a microcontroller board, and a development environment for writing software for the board.

Microcontroller

Microcontroller can be described as a computer embedded on a rather small circuit board. To describe the function of a microcontroller more precisely, it is a single chip that can perform various calculations and tasks, and send/receive signals from other devices via the available pins. Precisely what tasks and communication with the world it does, is what is governed by what instructions we give to the Microcontroller. It is this job of telling the chip what to do, is what we refer to as programming on it.

ATmega8(Microcontroller)

- **16 MHz**
- **8 Kbyte Flash RAM(**1K taken by the boot loader)
- **1 Kbyte RAM(**eg.for auto/local variables and stack).

PLATFORM

HARDWARE

ARDUINO Board Layout

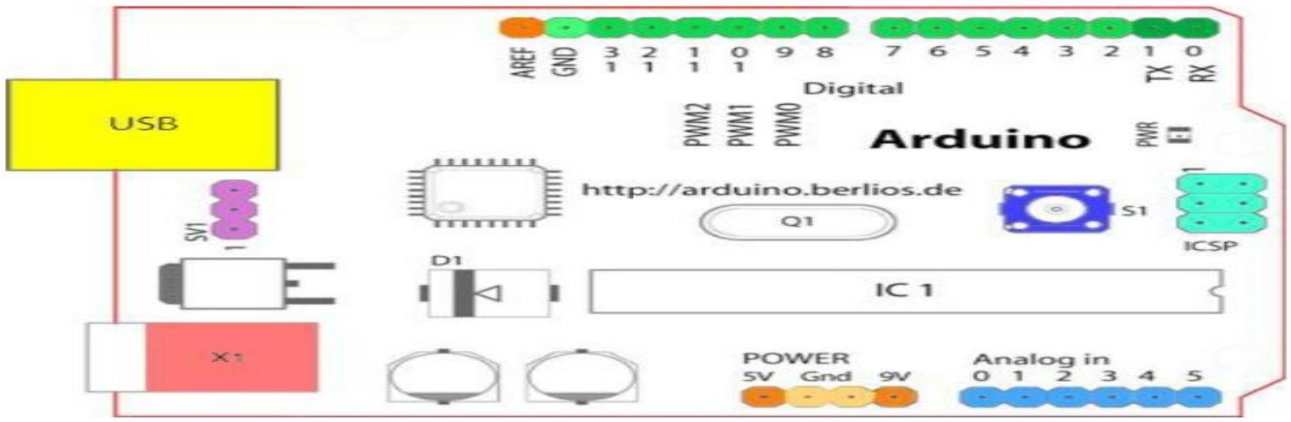
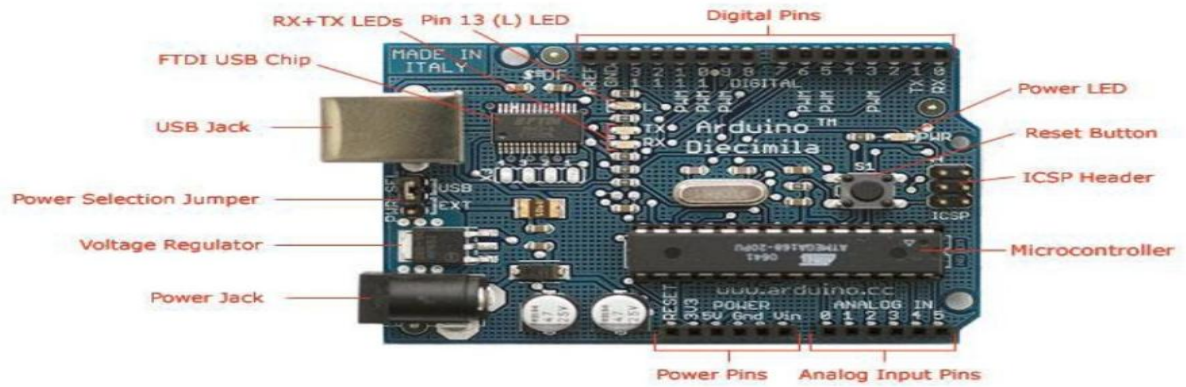
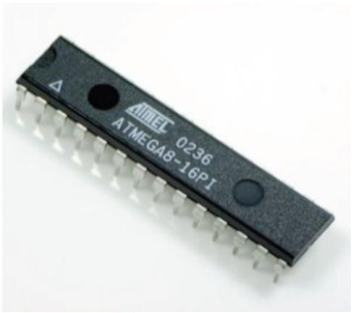


Figure 2 ARDUINO board layout

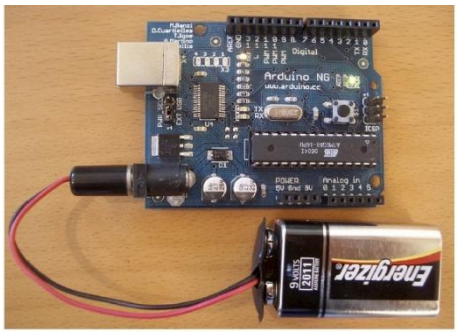
ARDUINO Pin Diagram:



ATmega8(Microcontroller)



Single chip USB to async Serial data transfer interface



USB 2.0 compatible

- **Transmit and receive LED frive signals**
- **256 Byte receive,128 Byte transmit buffer**
- **Data transfer rate from 300bits/sec to 2 Mb/sec**

Android Software Architecture

EXTERNAL power

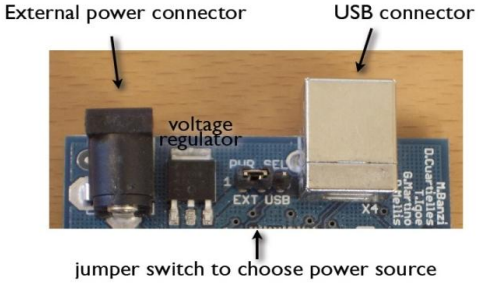


Figure 3 AC adapter can be used

The power requirement for ARDUINO is 9 to 12V DC,250mA or more,2.1mm plug,centre pin positive.

The OFF-the shelf adapter

- must be a DC adapter (i.e. it has to put out DC, not AC)
- should be between 9V and 12V DC
- must be rated for a minimum of 250mA current output, although you will likely want something more like 500mA
- must have a 2.1mm power plug on the Arduino end, and

CURRENT RATING:

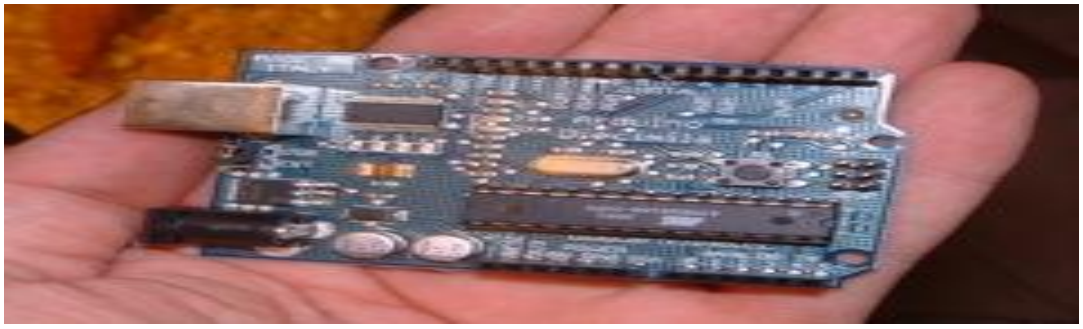
Since you'll probably be connecting other things to the Arduino (LEDs, LCDs, servos) you should get an adapter that can supply at least 500mA, or even 1000 mA (1 ampère). That way you can be sure you have enough juice to make each component of the circuit function reliably. The Arduino's on-board regulator can actually handle up to 20V or more, so you can actually use an adapter that puts out 20V DC.

ARDUINO MEGA 2560:

ARDUINO MEGA 2560:

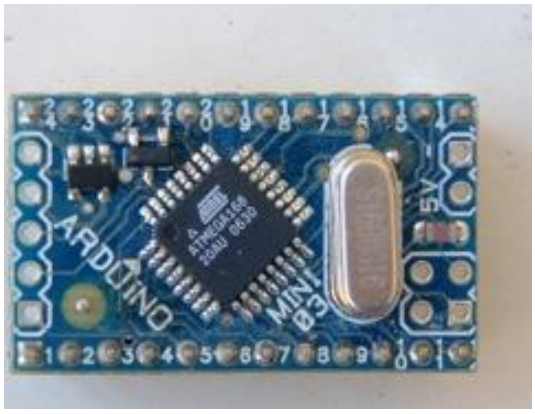
A larger ,more powerful Arduino board. Has extra digital pins, PWM pins, analog inputs, serial ports, etc. The version of the Mega released with the Uno, this version features the Atmega2560, which has twice the memory, and uses the ATMega 8U2 for USB-to-serial communication.

ARDUINO FIO:



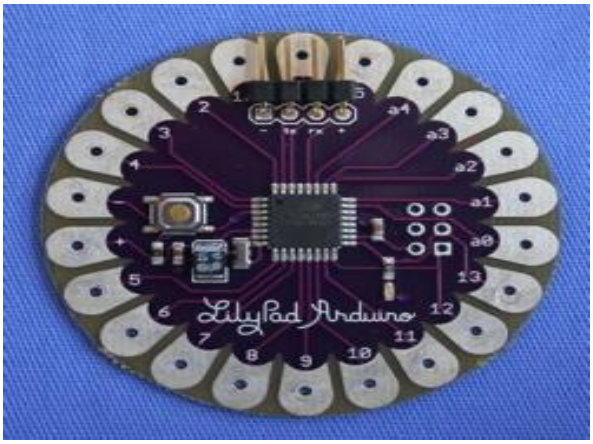
ARDUINO DIECIMILA:

The main change in the Arduino Diecimila is that it can be reset from the computer, without the need to physically press the reset button on the board. The Diecimila uses a low dropout voltage regulator which lowers the board's power consumption when powered by an external supply (AC/DC adapter or battery).



LILYPAD ARDUINO 03

This revision has a 6-pin programming header that's compatible with FTDI USB cables and the Spark fun FTDI Basic Breakout. It adds support for automatic reset, allowing sketches to be uploaded without pressing the reset button on the board. The header is surface mounted, meaning that the board has no pokey bits.



ARDUINO EXTREME

The Arduino Extreme uses many more surface mount components than previous USB Arduino boards and comes with female pin headers. It also has RX and TX LEDs that indicate when data is being sent to or from the board.

ARDUINO MINI 04

On this version of the Arduino Mini, two of the pins changed. The third pin became reset (instead of ground) and fourth pin became ground (instead of being unconnected). These boards are labelled "Mini 04".

Still there are, Arduino Serial, Arduino Serial v2.0,Arduino Nano 3.0,Arduino Nano 2.x,Serverino(S3V3),Arduino Stamp 02,Mini USB adapter 03,Mini USB Adapter, Arduino Blue

Arduino development environment (based on processing)

Processing

Processing is an open source programming language and environment for people who want to create images, animations, and interactions. Initially developed to serve as a software sketchbook and to teach fundamentals of computer programming within a visual context, Processing also has evolved into a tool for generating finished professional work. Today, there are tens of thousands of students, artists, designers, researchers, and hobbyists who use Processing for learning, prototyping, and production.

Software

The software used by the arduino is Arduino IDE.

he Arduino IDE is a cross-platform application written in Java, and is derived from the IDE for the Processing programming language and the Wiringproject. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click.

Figure 4 A screenshot of the Arduino IDE showing the "Blink"program,a simple biginner program

A typical first program for a microcontroller simply blinks a LED on and off. In the Arduino environment, the user might write a program like this:

```
#define LED_PIN 13
 void setup () {
   pinMode (LED_PIN, OUTPUT);    // enable pin 13 for digital output
}
 void loop () {
   digitalWrite (LED_PIN, HIGH);  // turn on the LED
```

```
  delay (1000);              // wait one second (1000 milliseconds)
  digitalWrite (LED_PIN, LOW);   // turn off the LED
  delay (1000);              // wait one second
}
```

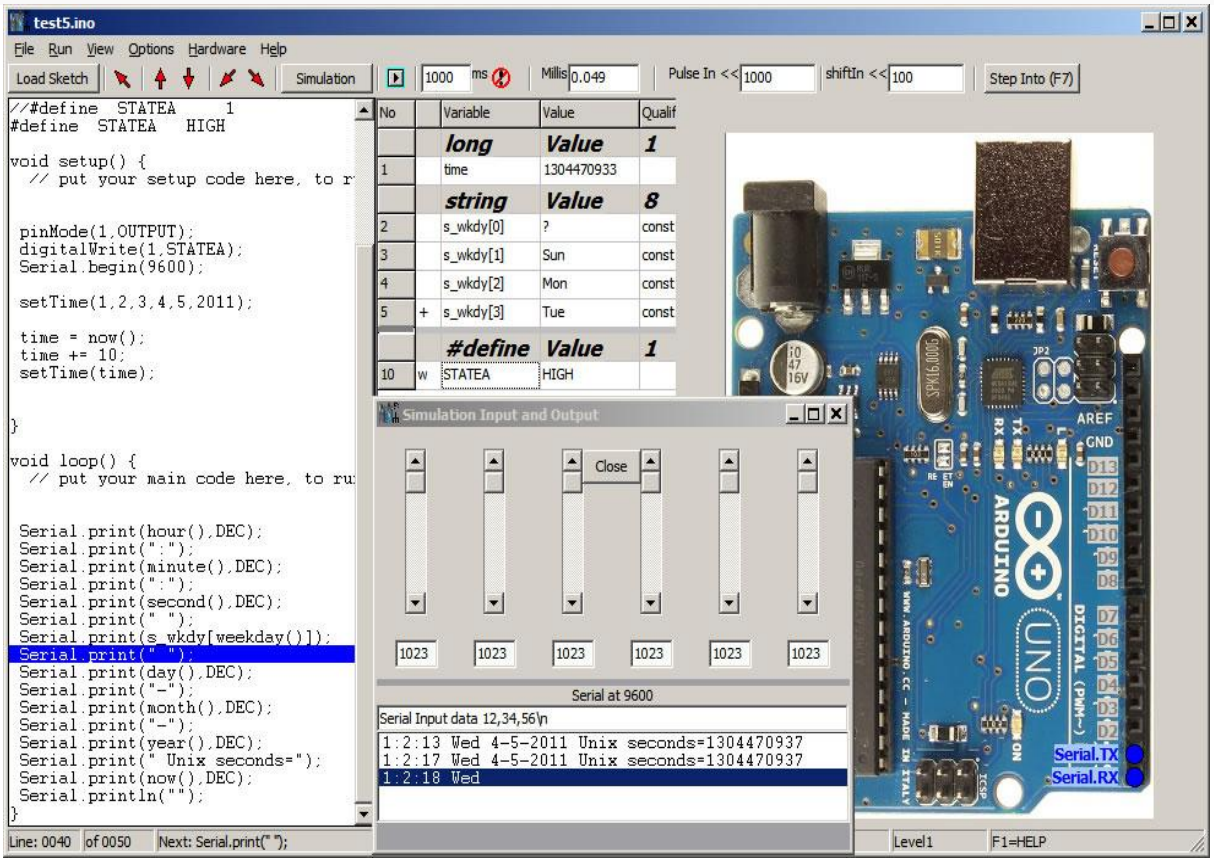


Figure 9 screenshot of ARDUINO simulator

SPECIFICATIONS:

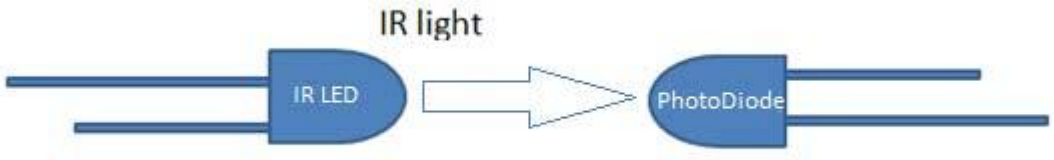
IR TX RX size: 5mm diameter package
IR LED current rating: 30mA nominal, 600mA pulse loading at 1% duty cycle
IR LED wavelength: 940Nm
Photodiode peak response wavelength: 940nM.

DESCRIPTION:

This infrared transmitter and receiver are called as IR TX-RX pair. Colour of IR transmitter and receiver is different. However, you may come across pairs which appear exactly same or even has opposite colours and it is not possible to distinguish between TX and RX visually. In case you will have to take help of multimeter.

IR BASED SECURITY ALARM CIRCUIT

IR sensor consist an IR LED and photodiode, in which IR LED emits IR radiation and photodiode detects the radiation. Photodiode conducts current in reverse direction, whenever light falls on it, and voltage across it changes, this voltage change is sensed by voltage comparator (like LM358) and generates output accordingly. [Also check: IR Sensor Circuit]



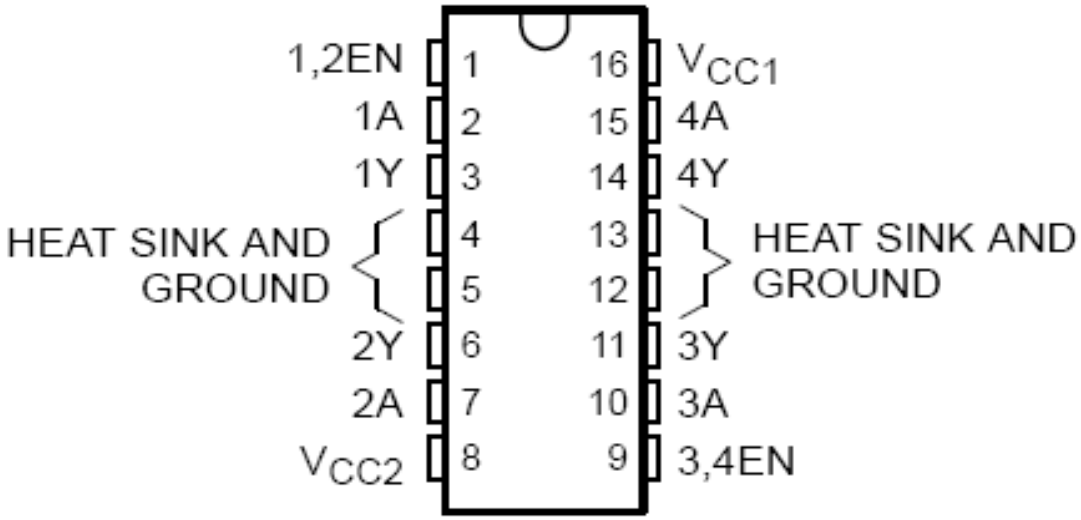
This kind of Alarm can also be build Laser light, (like Laser Security Alarm Circuit) but the benefit of using IR sensor is that IR light in invisible while Laser is visible. Although both are useful and have different scope.

L293D HALF H-DRIVERS

6.1 DESCRIPTION:

The L293 and L293D are quadruple high-current half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 36 V. The L293D is designed to provide bidirectional drive currents of up to 600-mA at voltages from 4.5 V to 36 V.

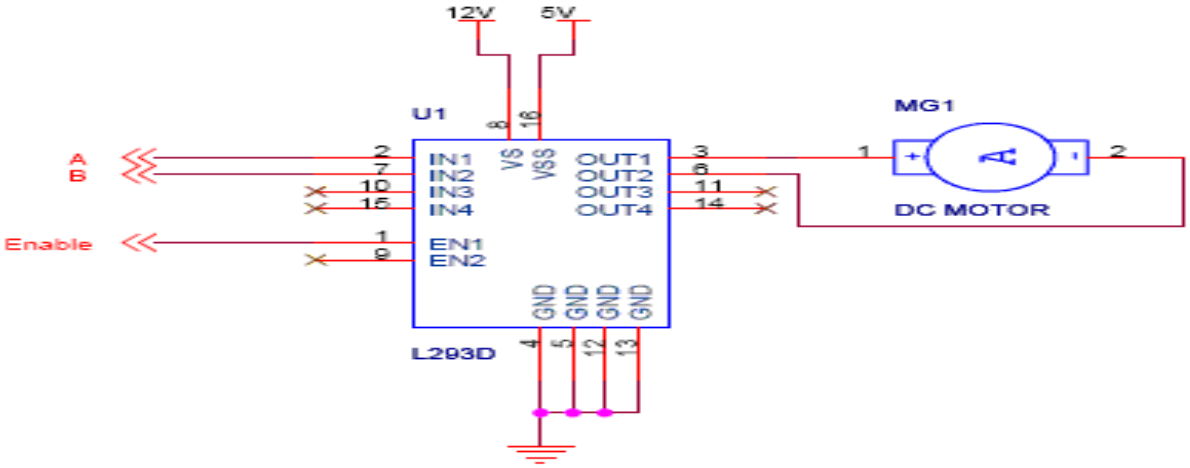
PIN DIAGRAM



FIGUR L293D Dual H-Bridge Motor Driver

L293D is a dual H-Bridge motor driver, so with one IC we can interface two DC motors which can be controlled in both clockwise and counter clockwise direction and if you have motor with fix direction of motion you can make use of all the four I/Os to connect up to four DC motors.

A simple schematic for interfacing a DC motor using L293D is shown below.



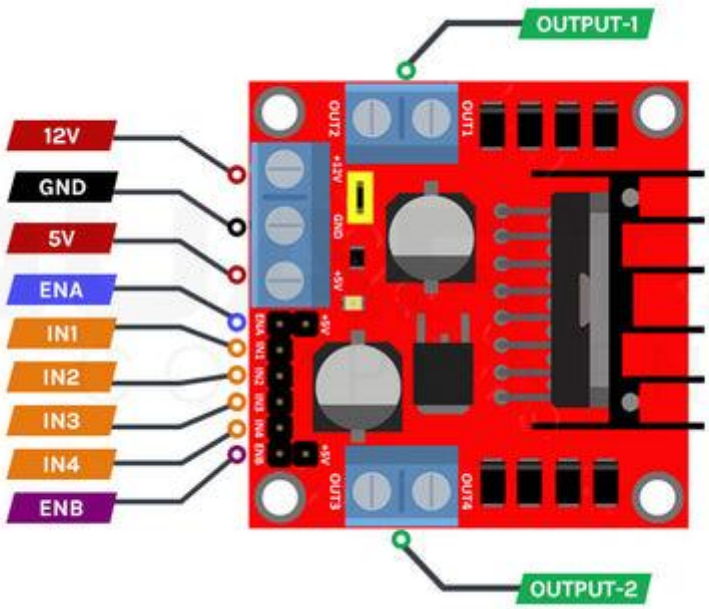
Truth Table

A	B	Description
0	0	Motor stops or Breaks
0	1	Motor Runs Anti-Cloclwise
1	0	Motor Runs Clockwise
1	1	Motor Stops or Breaks

For above truth table, the Enable has to be Set (1). Motor Power is mentioned 12V, but you can connect power according to your motors.

As you can see in the circuit, three pins are needed for interfacing a DC motor (A, B, Enable). If you want the o/p to be enabled completely then you can connect Enable to VCC and only 2 pins needed from controller to make the motor work.

L298N PINOUT

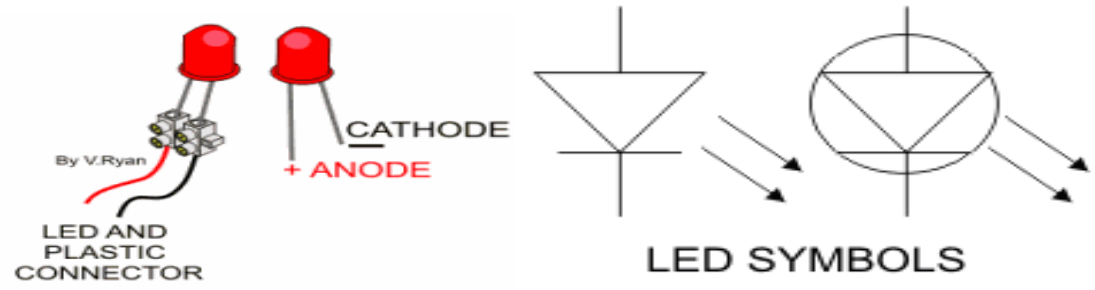


DATASHEET

Motor controller	L298N, drives 2 DC motors
Operating Voltage	5- 35V
Logic voltage	4.5 – 7 V
Max current	2A per channel
Voltage Regulator	78M05
Module dimensions	43 x 43 x 28 mm
Junction operating temperature	-25 to 130 º Celsius

5.7 LIGHT EMITTING DIODE (LED):

A light-emitting diode (LED) is a semiconductor diode that emits incoherent narrow spectrum light when electrically biased in the forward direction of the pn-junction, as in the common LED circuit. This effect is a form of electroluminescence



COLOR CODING:

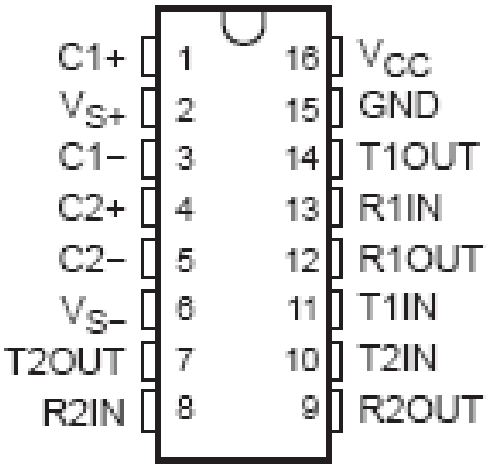
Color	Potential Difference
Infrared	1.6 V
Red	1.8 V to 2.1 V
Orange	2.2 V
Yellow	2.4 V

Green	2.6 V
Blue	3.0 V to 3.5 V

ADVANTAGES:

- LEDs have many advantages over other technologies like lasers. As compared to laser diodes or IR sources
- LEDs have several advantages over conventional incandescent lamps. For one thing, they don't have a filament that will burn out, so they last much longer. Additionally, their small plastic bulb makes them a lot more durable. They also fit more easily into modern electronic circuits.

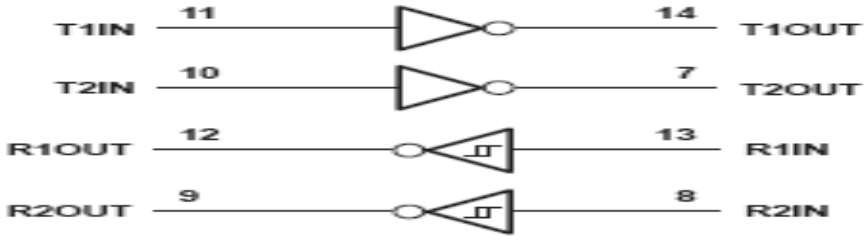
6.1 MAX 232 PIN DIAGRAM:



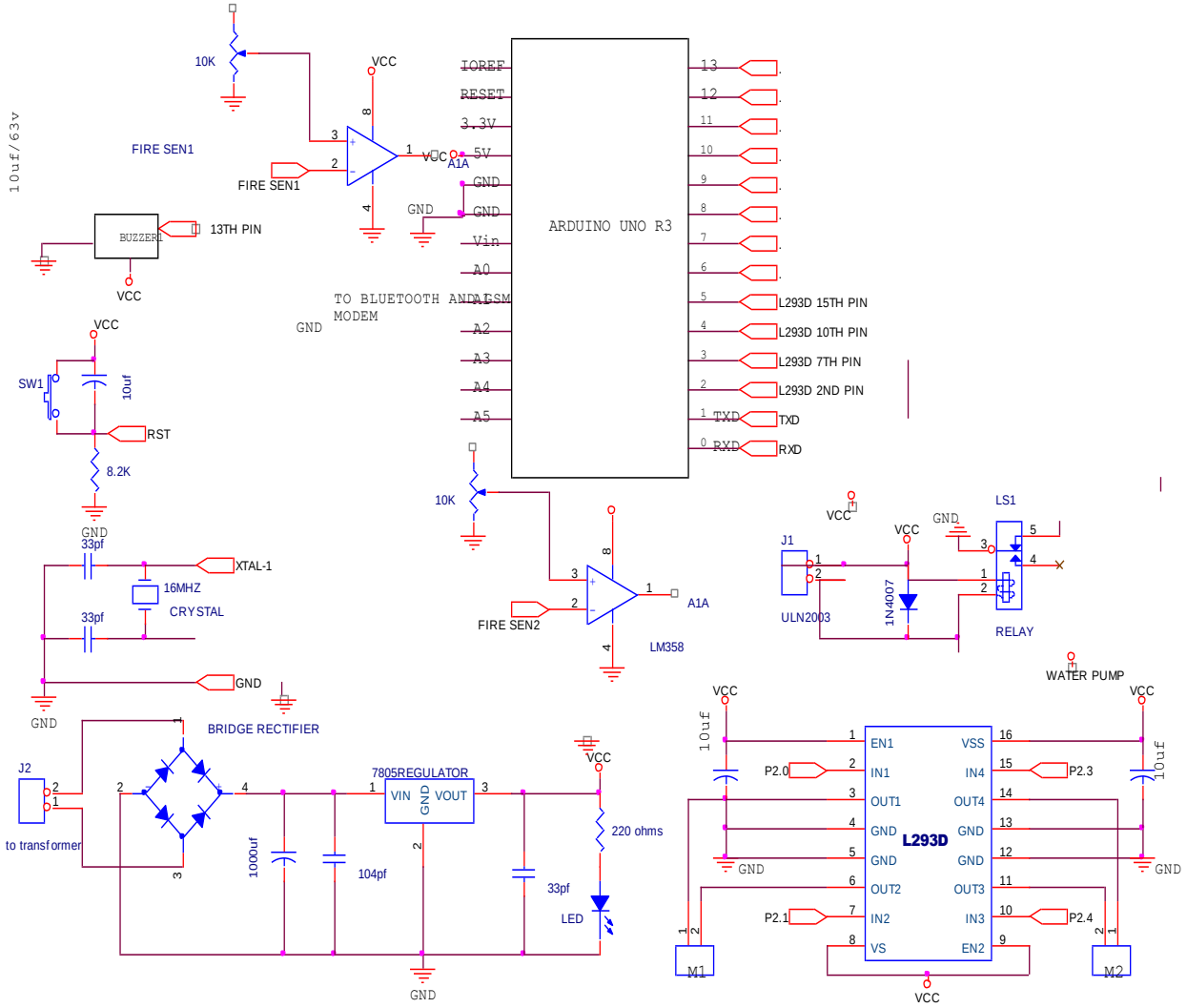
6.2 SPECIFICATIONS:

- Meets or Exceeds TIA/EIA-232-F and ITU Recommendation V.28
- Operates from a Single 5-V Power Supply With 1.0-_F Charge-Pump Capacitors
- Operates up To 120 Kbit/s
- Two Drivers and Two Receivers
- 30-V Input Levels
- Low Supply Current 8 mA Typical
- ESD Protection Exceeds JESD 22
- 2000-V Human-Body Model (A114-A)

LOGIC DIAGRAM:



CIRCUIT DIAGRAM:



PROGRAM CODE:

```
#include <Servo.h>


int servoPin = 9;
int M1 = 14;
int M2 = 15;
int M3 = 16;
int M4 = 17;
int firesen1 =2;
int firesen2 =3 ;

int PUMP = 12;
int alarm = 13;
void setup()
{
 Servo1.attach(servoPin);
```

```
      digitalWrite(M1, LOW);
      digitalWrite(M2, LOW);
      digitalWrite(M3, LOW);
      digitalWrite(M4, LOW);
      pinMode(M1, OUTPUT);
      pinMode(M2, OUTPUT);
      pinMode(M3, OUTPUT);
      pinMode(M4, OUTPUT);
      pinMode(firesen1, INPUT);
      pinMode(firesen2, INPUT);
     // pinMode(firesen3, INPUT);
       pinMode(PUMP, OUTPUT);
       pinMode(alarm, OUTPUT);
      digitalWrite(M1, LOW);
      digitalWrite(M2, LOW);
      digitalWrite(M3, LOW);
      digitalWrite(M4, LOW);
      digitalWrite(firesen1, HIGH);
      digitalWrite(firesen2, HIGH);
       // digitalWrite(firesen3, HIGH);
      digitalWrite(PUMP, LOW);
      digitalWrite(alarm,LOW);


Serial.begin(9600);
}
void loop()
{
   digitalWrite(M1, HIGH);
    digitalWrite(M2, LOW);
    digitalWrite(M3, HIGH);
    digitalWrite(M4, LOW);
 // Servo1.write(0);
  delay(30);
 if (digitalRead(firesen1)==0)
 {
    digitalWrite(PUMP, HIGH);
    delay(200);

  Servo1.write(135);
  delay(30);

     digitalWrite(alarm, HIGH);
    digitalWrite(M1, LOW);
    digitalWrite(M2, HIGH);
    digitalWrite(M3, HIGH);
    digitalWrite(M4, LOW);
    delay(1000);
```

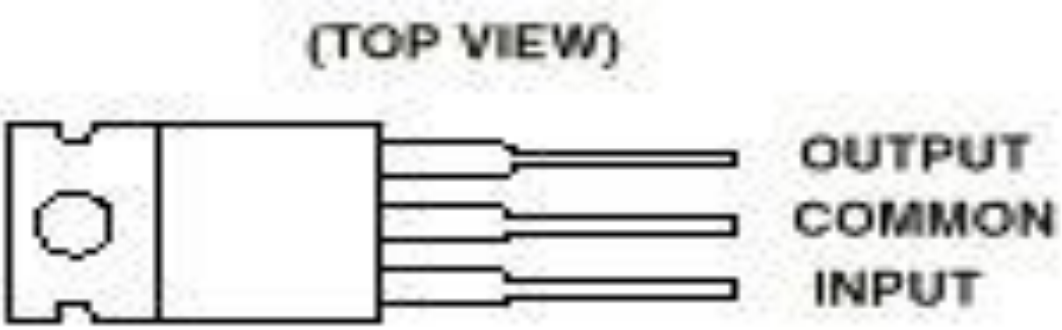
```
   digitalWrite(PUMP, LOW);
   delay(100);

   digitalWrite(M1, LOW);
   digitalWrite(M2, LOW);
   digitalWrite(M3, LOW);
   digitalWrite(M4, LOW);
  digitalWrite(alarm, LOW);
 }
 if (digitalRead(firesen2)==0)
 {
   digitalWrite(PUMP, HIGH);
   delay(200);
  Servo1.write(45);
 delay(30);
    digitalWrite(alarm, HIGH);
   digitalWrite(M2, LOW);
   digitalWrite(M1, HIGH);
   digitalWrite(M3, LOW);
   digitalWrite(M4, HIGH);
   delay(1000);
   digitalWrite(PUMP, LOW);
   delay(100);
   digitalWrite(M1, LOW);
   digitalWrite(M2, LOW);
   digitalWrite(M3, LOW);
   digitalWrite(M4, LOW);
  digitalWrite(alarm,LOW);
 }



}
```

volt power supply is included with the Beginner Kit and the Microcontroller Beginner Kit.). To make a 5-volt power supply, we use a LM7805 voltage regulator IC (Integrated Circuit). The IC is shown below.



The common terminal is in electrical contact with the mounting base.