开源硬件入门

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上次回顾

课内讲授

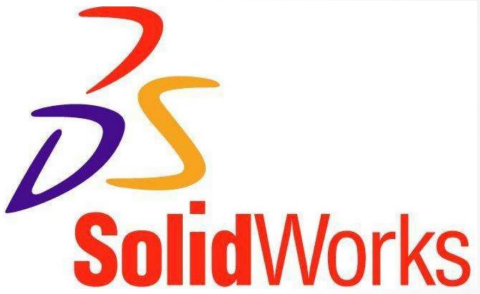
- 开源硬件基本概念
- 本课程使用到的工具简介：Github+电子套件+积木套件

课后完成：

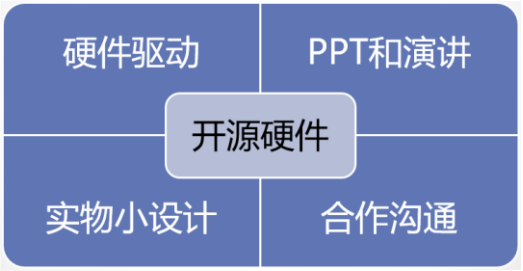
- 自行组队，3人一队，每组自己取一个队名
- Github上传分组信息，并将github的链接发到课程平台
- 了解ardunio开发环境，可以提前在自己电脑上安装软件

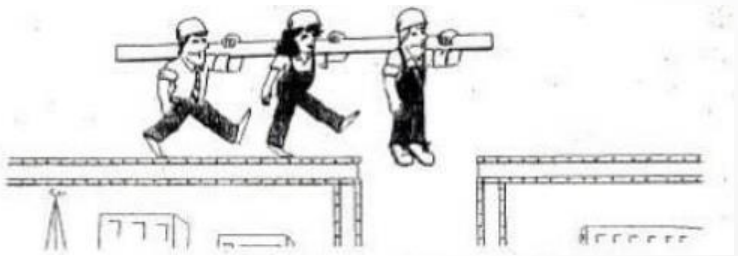
本次要点

- 制作开源项目三大件



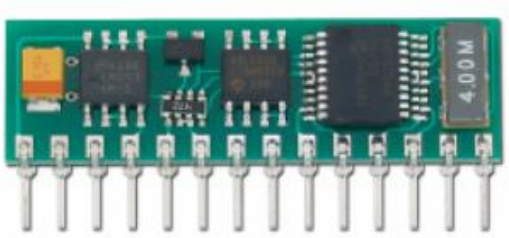
- 团队讨论：利用几何机器人套件（电子+积木）可以完成什么样的小设计？

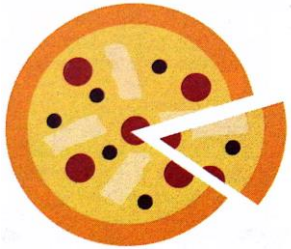


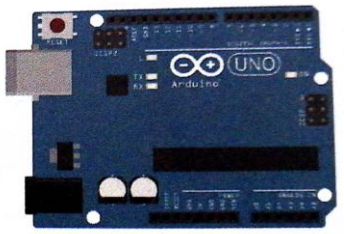


Arduino的诞生

- 软件架构师Massimo Banzi——人机交互课程
- **Basic Stamp——性价比低，只能用于windows**
- 2005年，Banzi联合芯片设计师David Cuartielles和Banzi的学生，自己编写简单便宜的开放工具
- 名字的来源——di Re Arduino酒吧



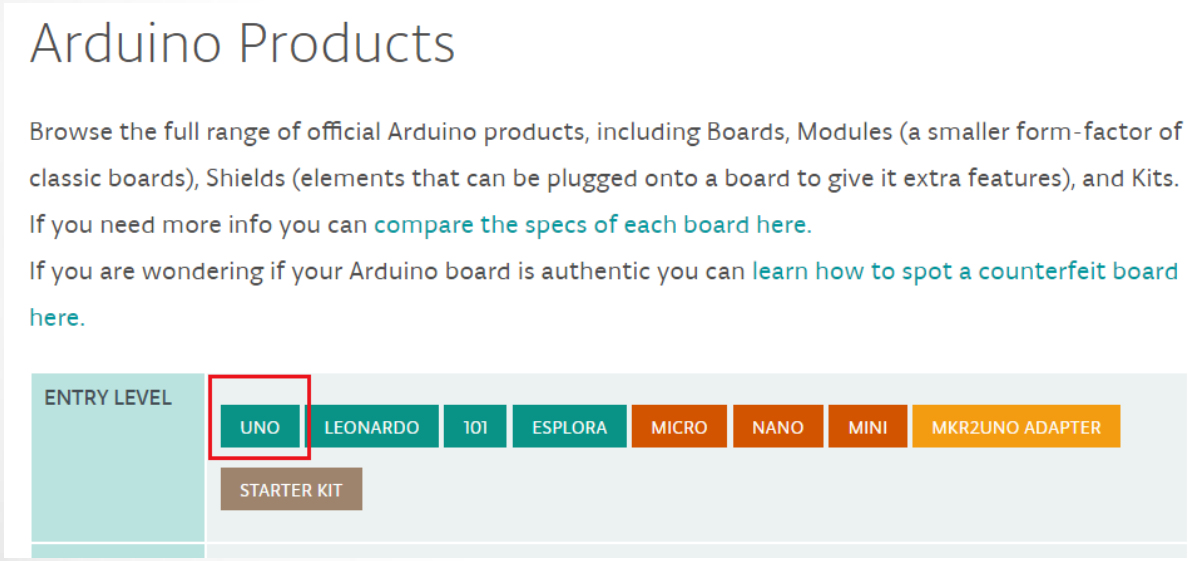




- https://www.ted.com/talks/massimo_banzi_how_arduino_is_open_sourcing_imagination

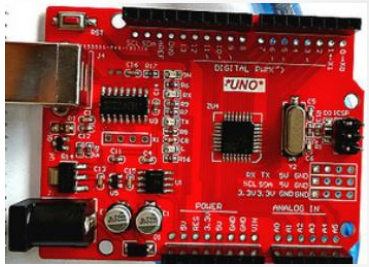
Arduino Uno命名

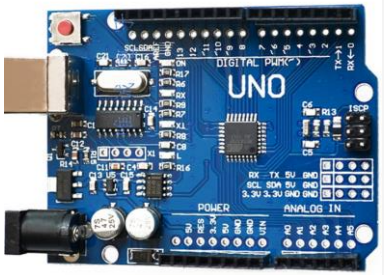
- Arduino家族中最受欢迎的模型
- Uno代表“1”，研发团队有意将其定位标准模型



Arduino Uno系列

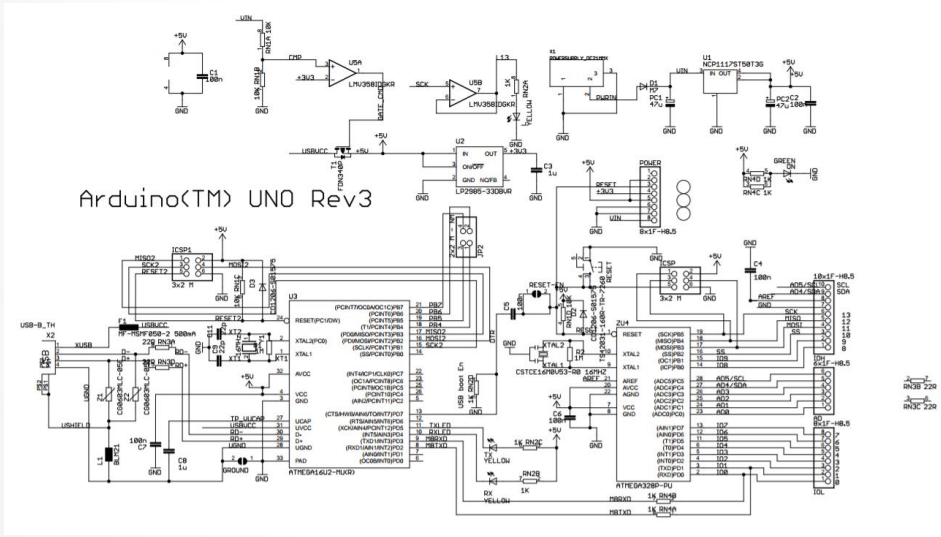
Microcontroller	ATmega328P
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limit)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
PWM Digital I/O Pins	6
Analog Input Pins	6
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328P) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328P)
EEPROM	1 KB (ATmega328P)
Clock Speed	16 MHz
LED_BUILTIN	13
Length	68.6 mm
Width	53.4 mm
Weight	25 g

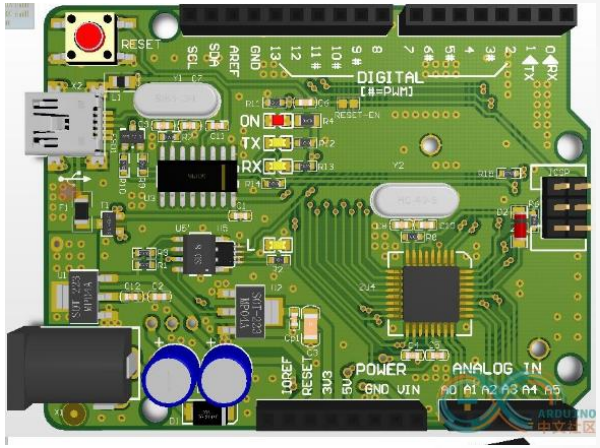


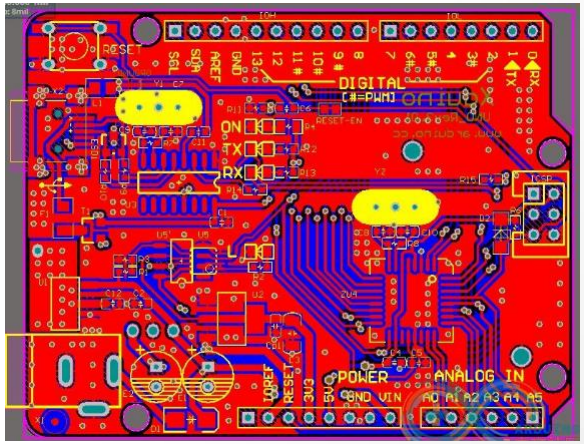


Arduino Uno资料

- 原理图和PCB（印刷电路板）



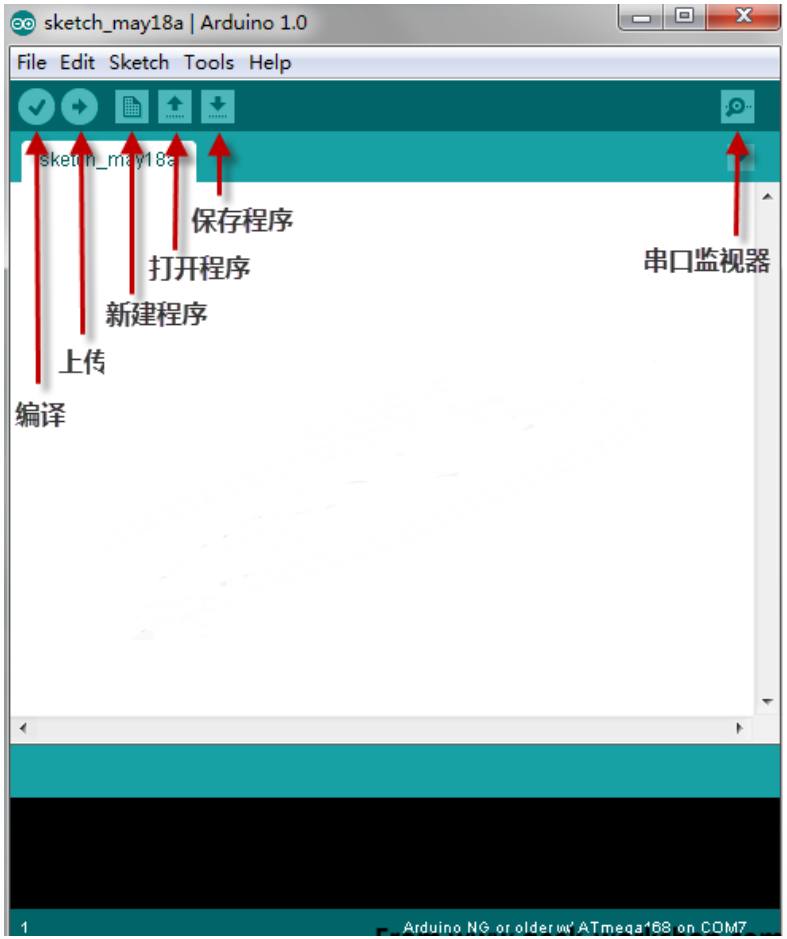




Arduino IDE

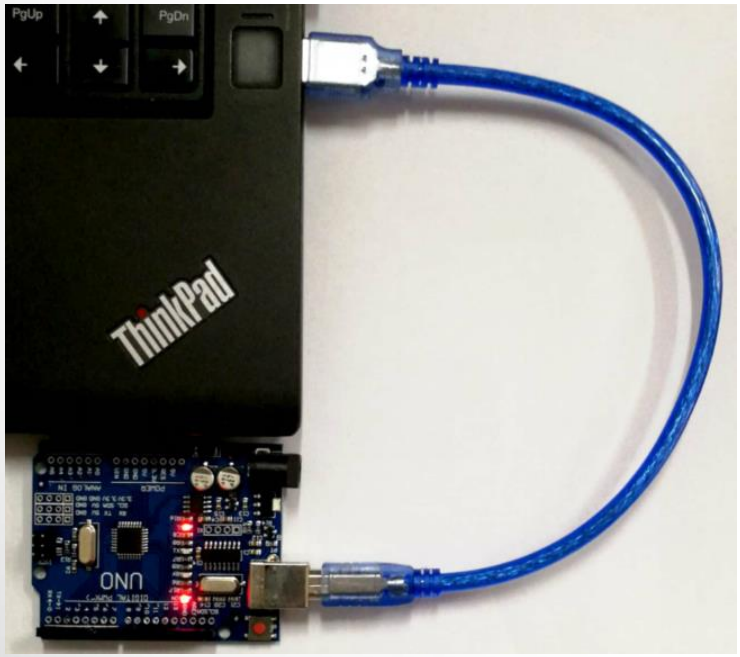
- Integrated Development Environment
- https://www.arduino.cc/en/Main/Software

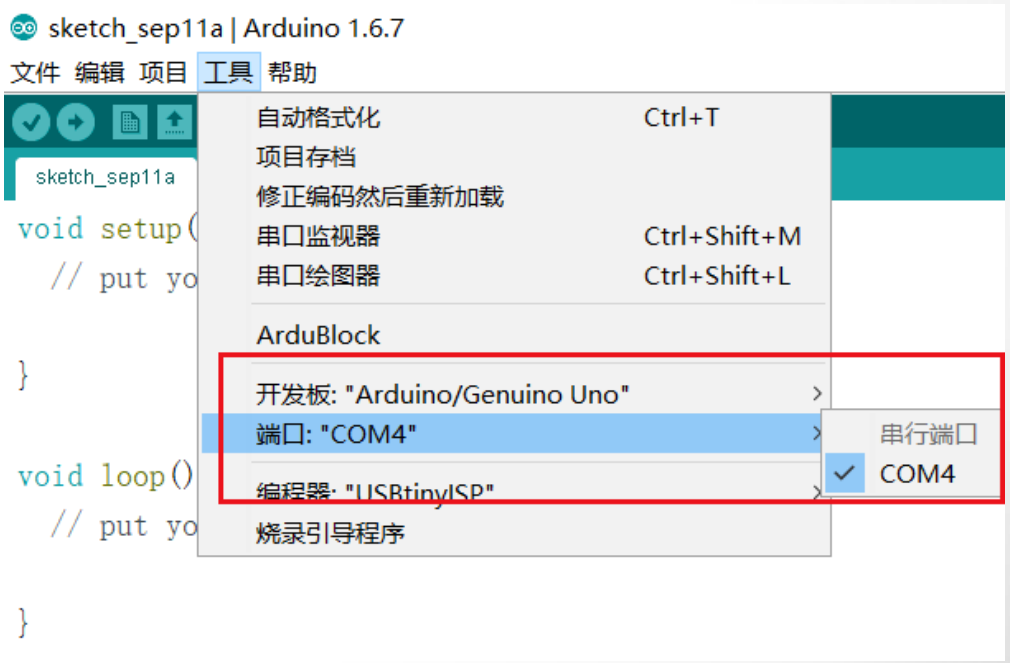
Arduino IDE


sketch_may18a | Arduino 1.0
File Edit Sketch Tools Help
保存程序
打开程序
新建程序
上传
编译
串口监视器
Arduino NG or older w/ ATmega168 on COM7

连接和安装UNO

- 下载线一头接电脑，一头接控制板
- 直接运行CH340驱动文件夹里面的CH341SER
- 点击安装，安装完成后可以IDE中查看





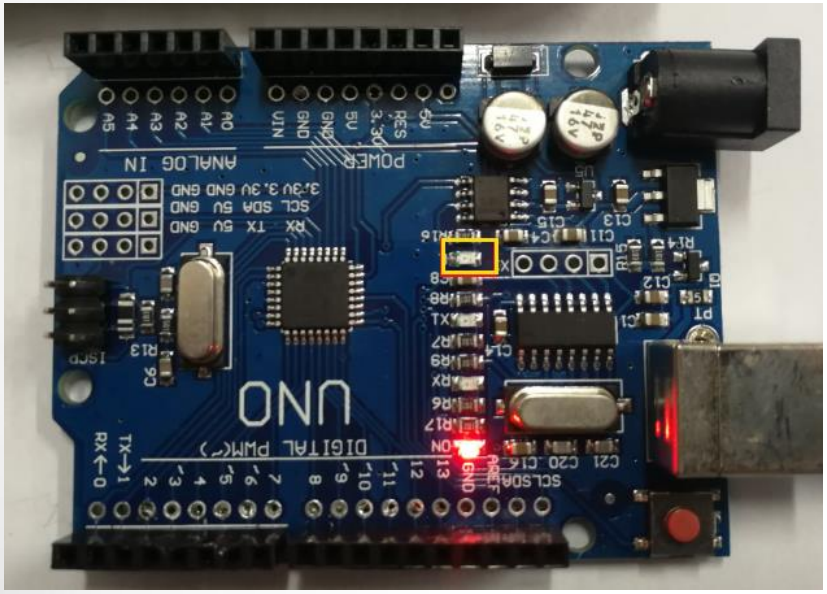
IDE中的Example

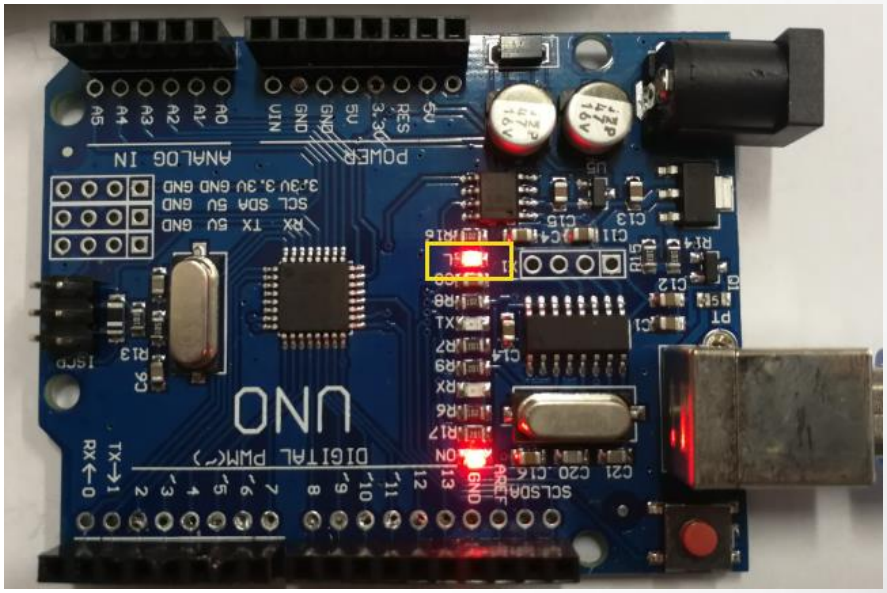
- 主板程序运行顺序：setup >>> loop


```
void setup() {
  // initialize digital pin 13 as an output.
  pinMode(13, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(13, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);              // wait for a second
  digitalWrite(13, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);              // wait for a second
}
```

闪灯程序

- 依次点击文件——示例——01.Basic——Blink，打开闪灯例程
- 点击上传，观察板上灯的闪烁





IDE实验：串口通信

- Arduino发送“Hello world！”

```
void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
}

void loop() {
  // put your main code here, to run repeatedly:
  Serial.println("Hello world");
  delay(1000);
}
```

IDE实验：串口通信

- PC发送“a”，Arduino回复“A”

```
void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
}

void loop() {
  // put your main code here, to run repeatedly:
  if(Serial.available()){
    char c = Serial.read();
    if(c == 'a'){
      Serial.println("A");
      }
    }
}
```

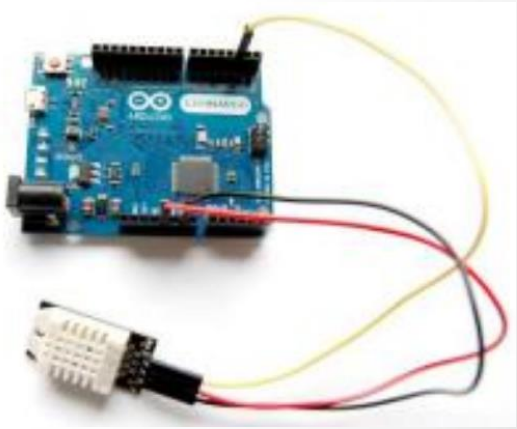
IDE实验：串口通信

- PC发送“I am XXX”，Arduino回复“OK”

```
String comdata = "";
void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
}
void loop() {
  // put your main code here, to run repeatedly:
  while (Serial.available() > 0){
        comdata += char(Serial.read());
        delay(2);
    }
  if (comdata.length() > 0 && comdata == "I am alben"){
      Serial.println(comdata);
  }
  comdata = "";
}
```

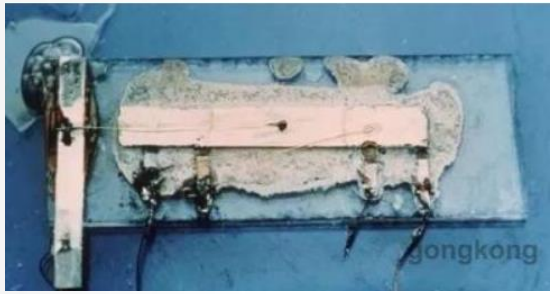
硬件连接-杜邦线

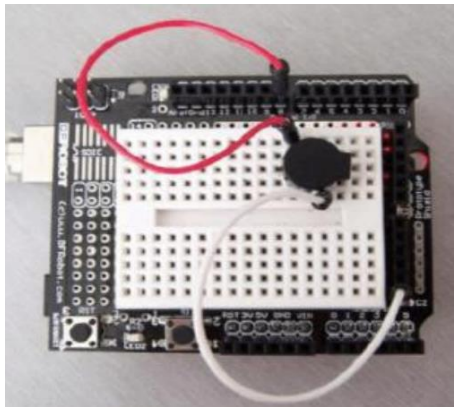
- 美国杜邦公司最先生产
- 电子行业杜邦线可用于实验板的引脚扩展无需焊接，可以快速进行电路试验。

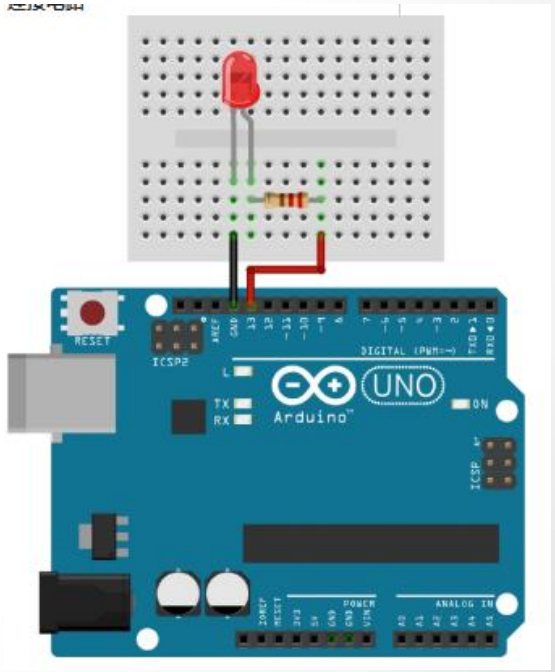


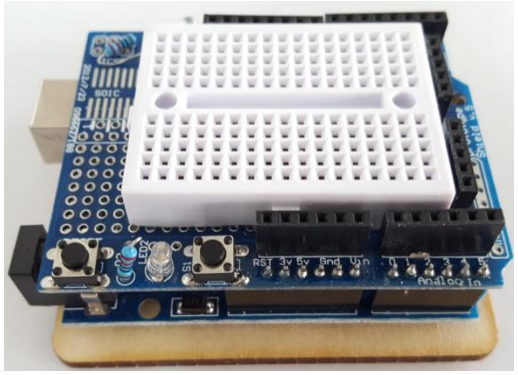
硬件连接-面包板

- 真空管电路的年代，当时电路元器件大都体积较大，人们通常通过螺丝和钉子将他们固定在一块切面包用的木板上进行连接。

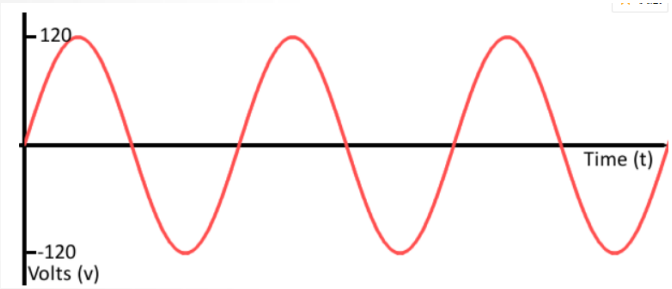


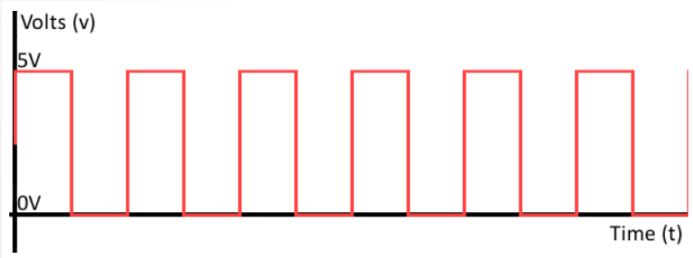






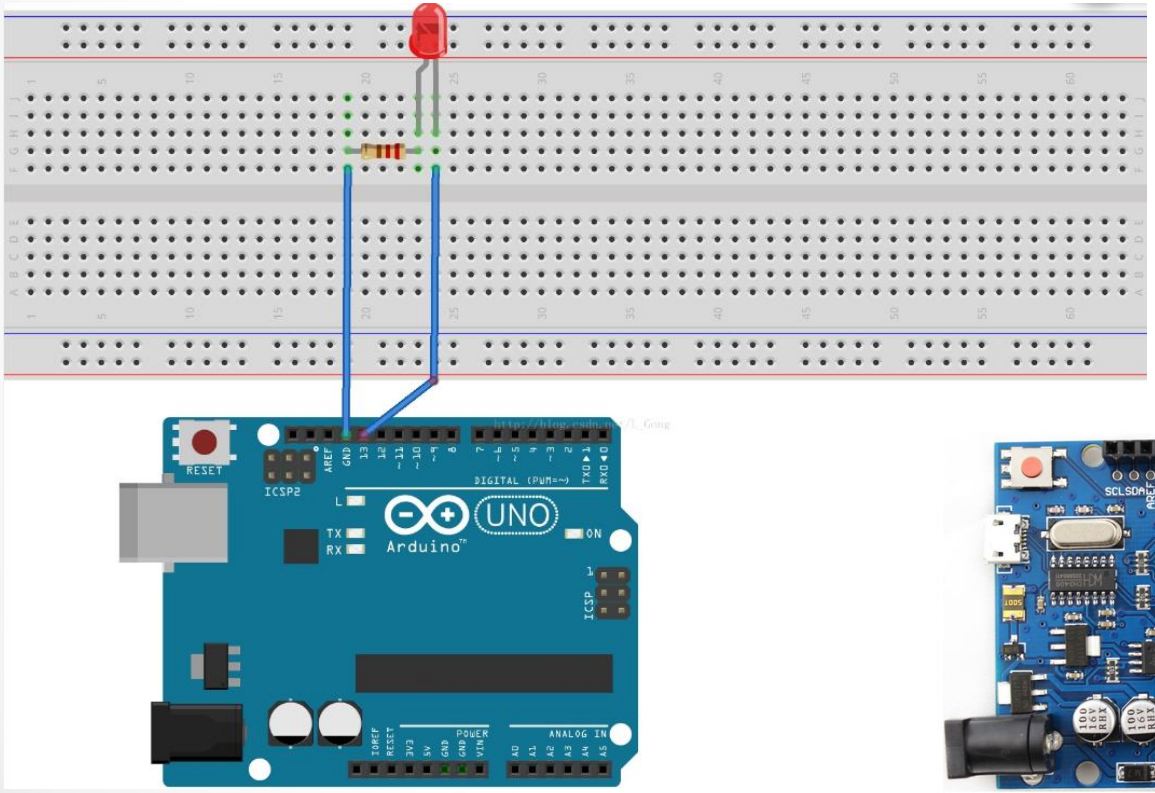
数字和模拟

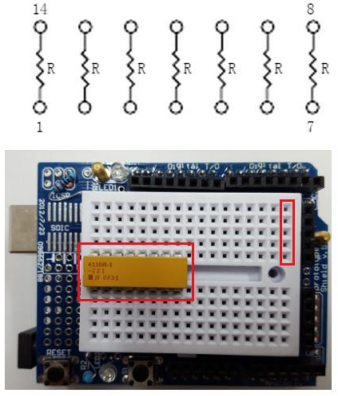


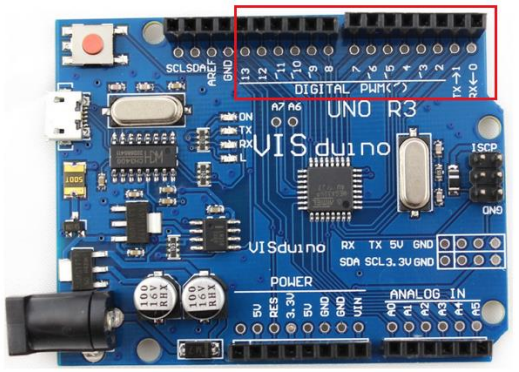


数字输入输出口

- 0和1两种状态，间断的变化

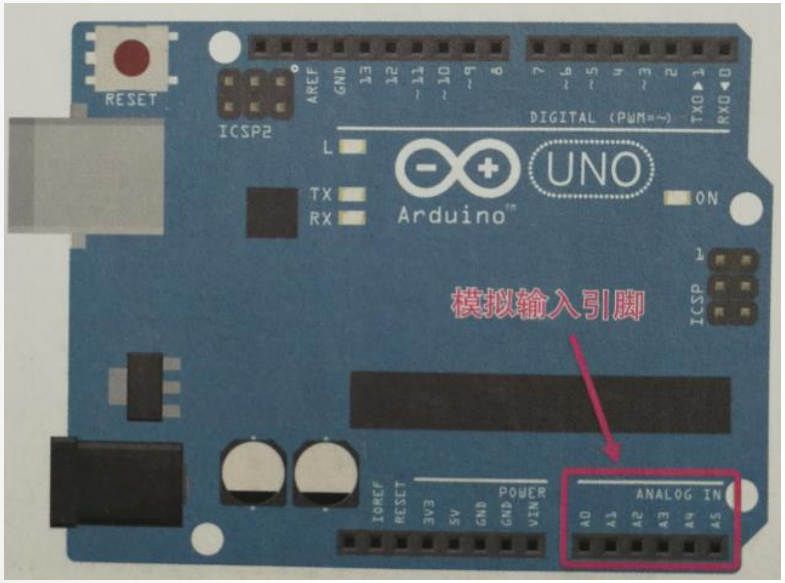


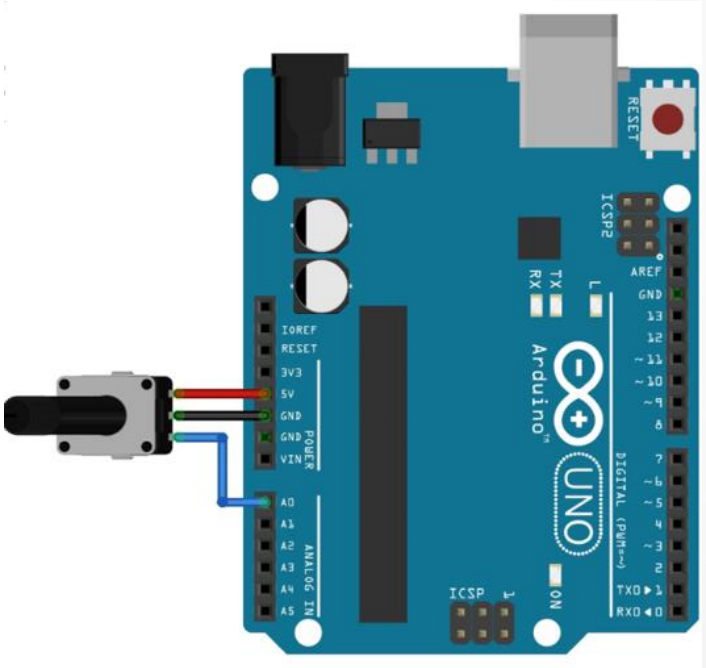




模拟输入口

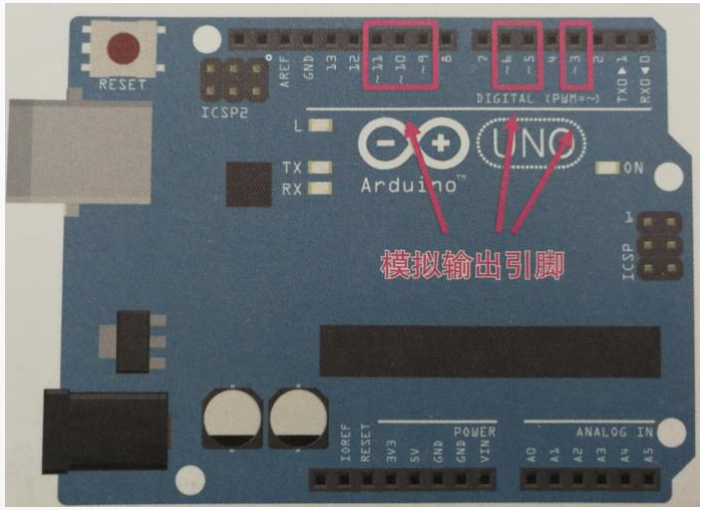
- 读取连续不间断的信号，如：读取电压

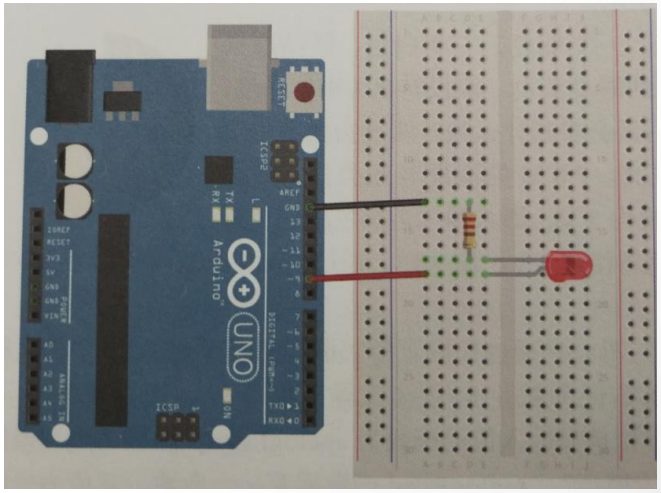




模拟输出口

- 连续不间断的输出，如：呼吸灯，控制伺服电机（舵机）

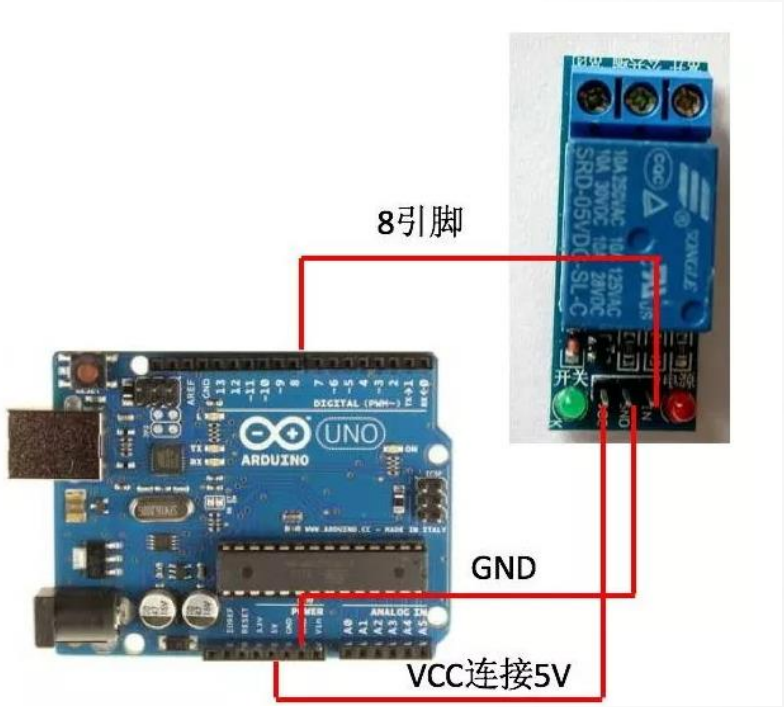




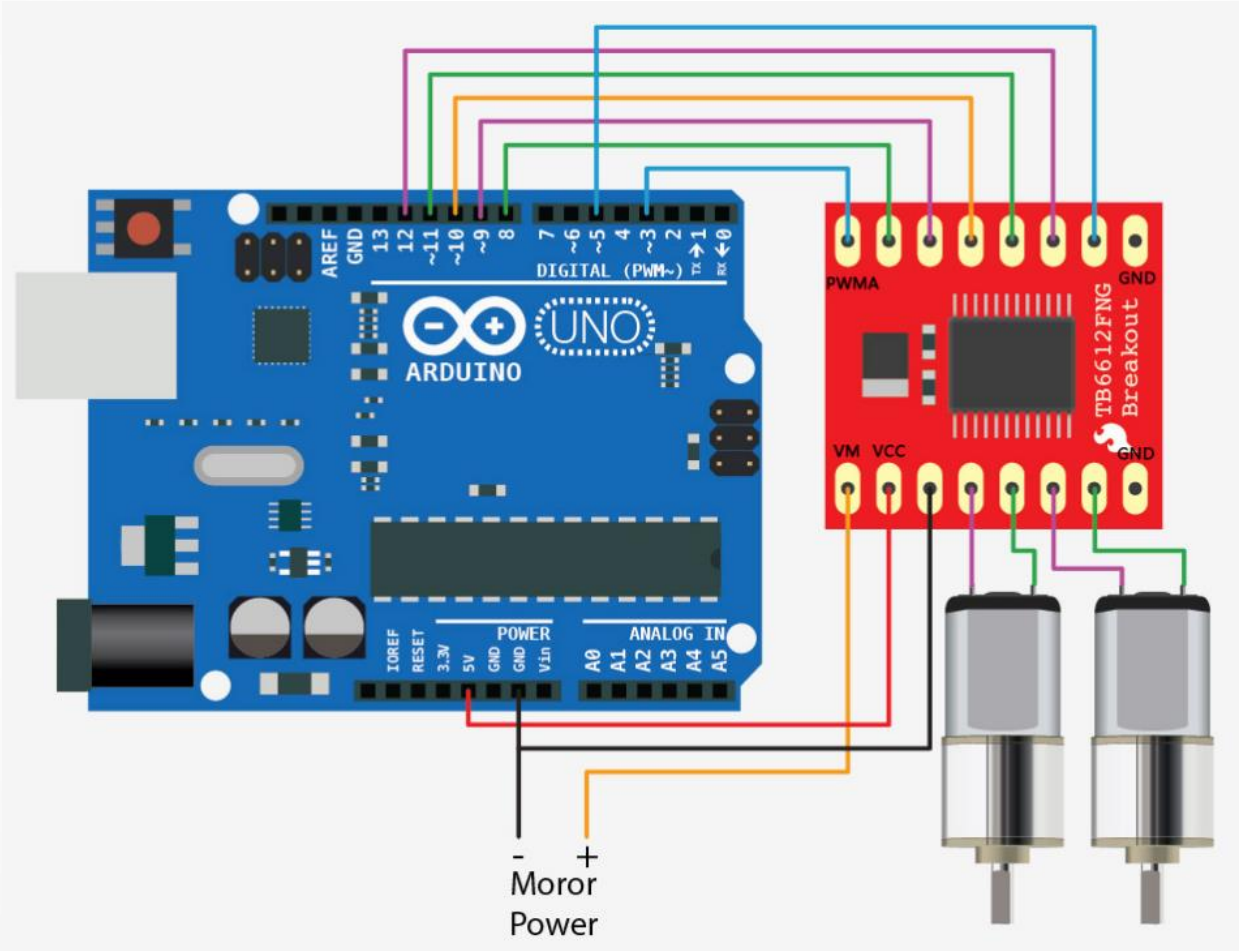
弱电和强电

- 强电：一般是电力系统中的电，比如说220v的照明电，以及千伏级别的工业用电等，用来**驱动大功率**的电力设备，比如说电动机，电灯等用电设备。
- 弱电：相对于强电而言，几乎所有的电子产品中都存在弱电，弱电是指**传递信号**所需要的电流和电压。

继电器

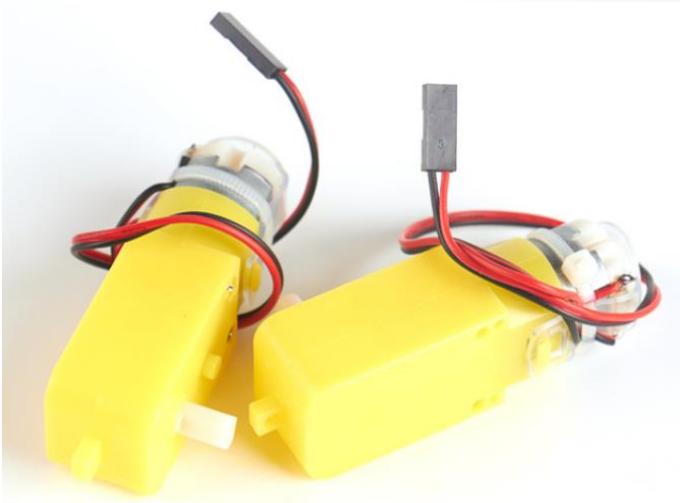


电机驱动模块

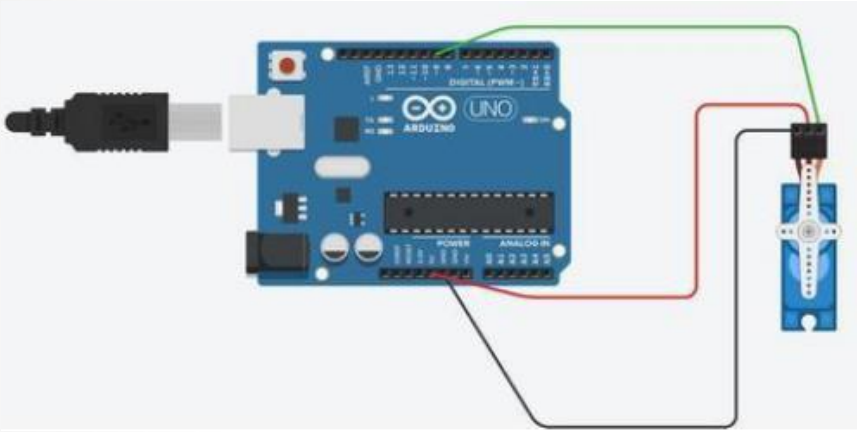

PWMA
GND
TB6612FNG
Breakout
VM
VCC
GND
UNO
ARDUINO
DIGITAL (PWM~)
POWER
ANALOG IN
- +
Moror
Power

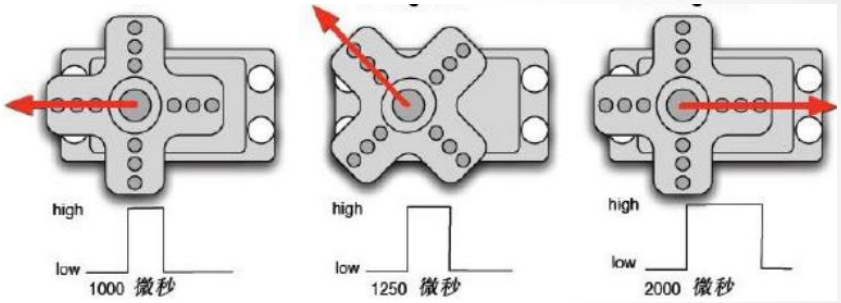
直流电机

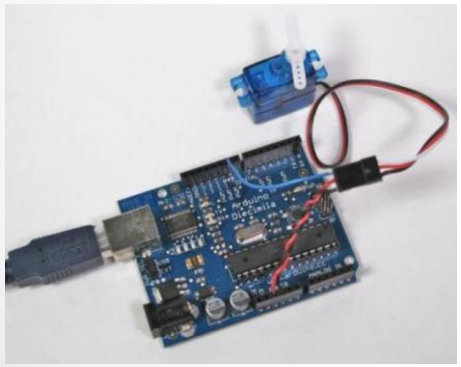
- 可以提供2种型号：单轴和双轴

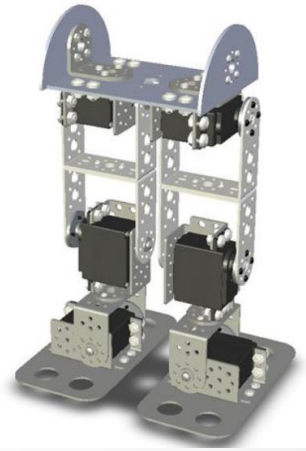


伺服电机（舵机）



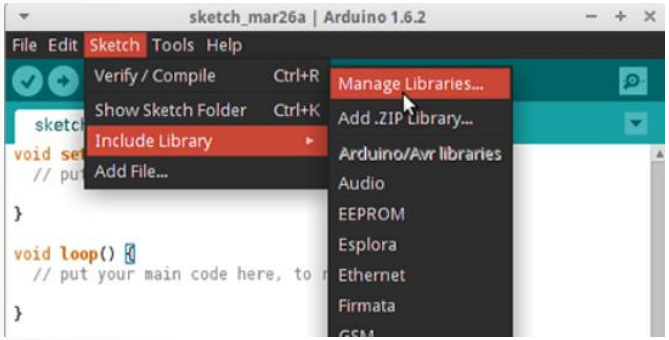


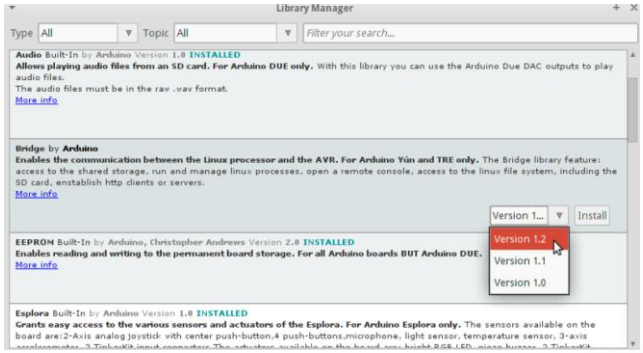




Arduino基本库函数

- https://www.arduino.cc/reference/en/
- 添加库函数
  https://www.arduino.cc/en/Guide/Libraries





- 舵机相关： Servo library
- 输入输出相关： Digital I/O， Analog I/O
- 根据需要加载其他库函数……

Arduino自定义库函数

- https://www.arduino.cc/en/Reference/Libraries
- The Arduino environment can be extended through the use of libraries, just like most programming platforms. Libraries provide extra functionality for use in sketches, e.g. **working with hardware or manipulating data.** To use a library in a sketch, select it from Sk**etch > Import Library.**
- A number of libraries come installed with the IDE, but you can **also download or create your own**. See these instructions for details on installing libraries. There's also **a tutorial on writing your own libraries**. See the **API Style Guide** for information on making a good Arduino-style API for your library.
- API（Application Programming Interface,应用程序编程接口）是一些预先定义的函数，目的是提供应用程序与开发人员基于某软件或硬件得以访问一组例程的能力，而又无需访问源码，或理解内部工作机制的细节。

库函数示例

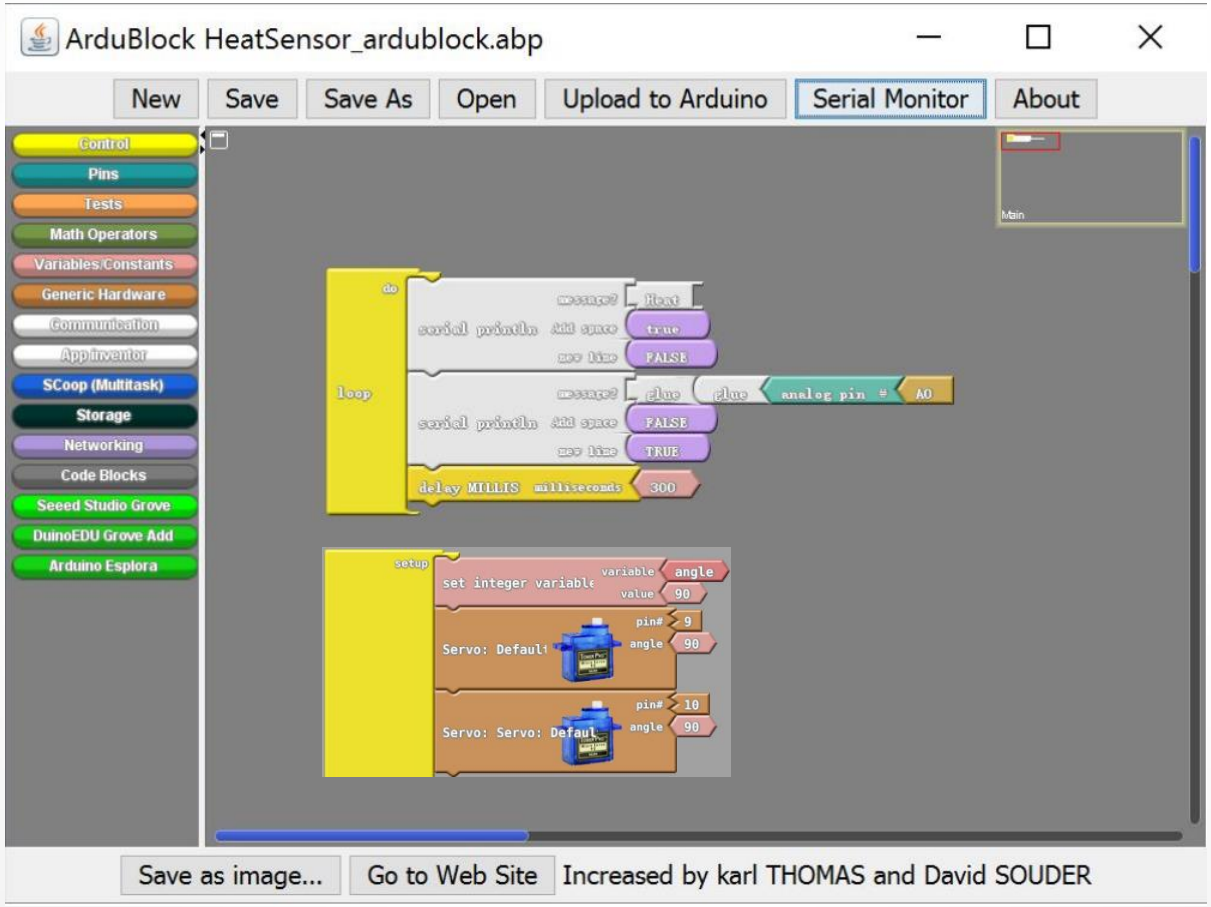
```
void setup() {
  // put your setup code here, to run once:
  Serial.begin(9600);
}

void loop() {
  // put your main code here, to run repeatedly:
  Serial.println("Hello world");
  delay(1000);
}
```

```
#include <Servo.h>

Servo myservo;  // create servo object to control a servo
// twelve servo objects can be created on most boards

int pos = 0;    // variable to store the servo position

void setup() {
  myservo.attach(9);  // attaches the servo on pin 9 to the servo object
}

void loop() {
  for (pos = 0; pos <= 180; pos += 1) { // goes from 0 degrees to 180 degrees
    // in steps of 1 degree
    myservo.write(pos);              // tell servo to go to position in variable 'pos'
    delay(15);                       // waits 15ms for the servo to reach the position
  }
  for (pos = 180; pos >= 0; pos -= 1) { // goes from 180 degrees to 0 degrees
    myservo.write(pos);              // tell servo to go to position in variable 'pos'
    delay(15);                       // waits 15ms for the servo to reach the position
  }
}
```

```
void setup() {
  // initialize digital pin 13 as an output.
  pinMode(13, OUTPUT);
}

// the loop function runs over and over again forever
void loop() {
  digitalWrite(13, HIGH);   // turn the LED on (HIGH is the voltage level)
  delay(1000);              // wait for a second
  digitalWrite(13, LOW);    // turn the LED off by making the voltage LOW
  delay(1000);              // wait for a second
}
```

Arduino图形化编程

- http://blog.ardublock.com/

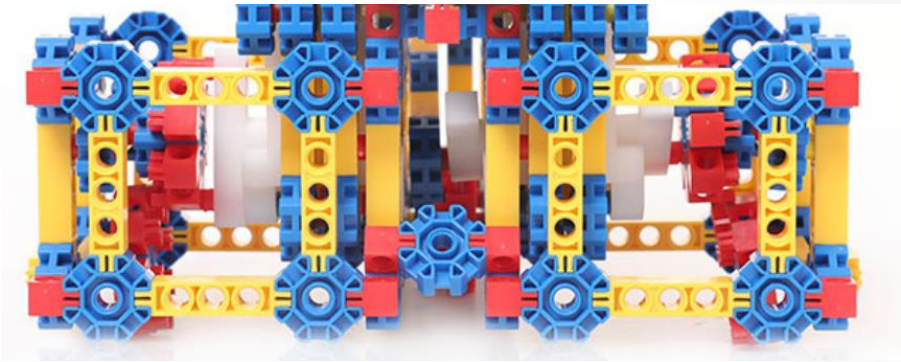


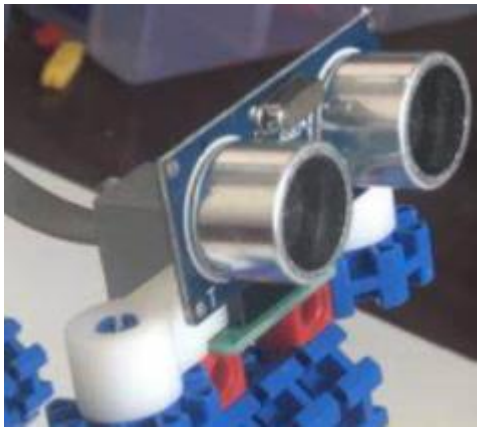
3D建模工具

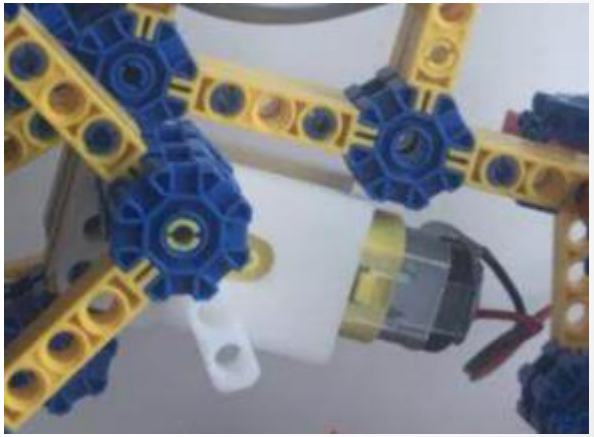

blender™
AUTODESK®
3DS MAX®
FreeCAD
Pro|ENGINEER®
AutoCAD®
SketchUp
SolidWorks

为什么需要3D建模

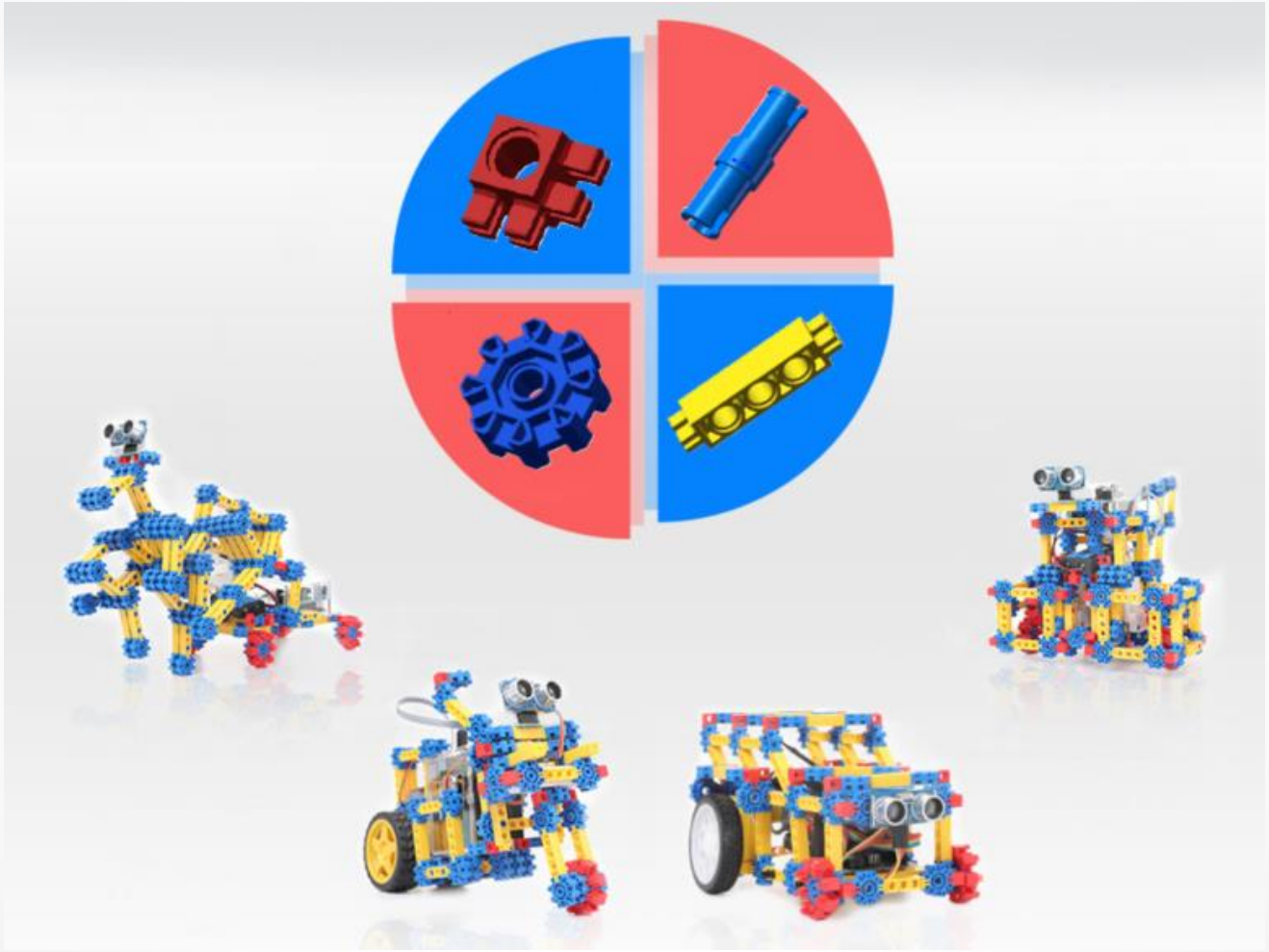
电子和积木结合



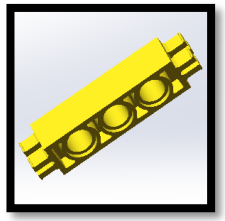


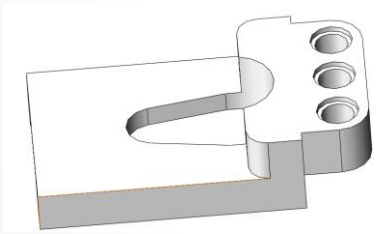


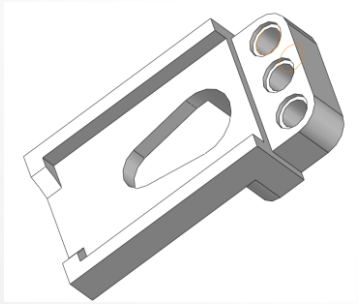
电子和积木结合

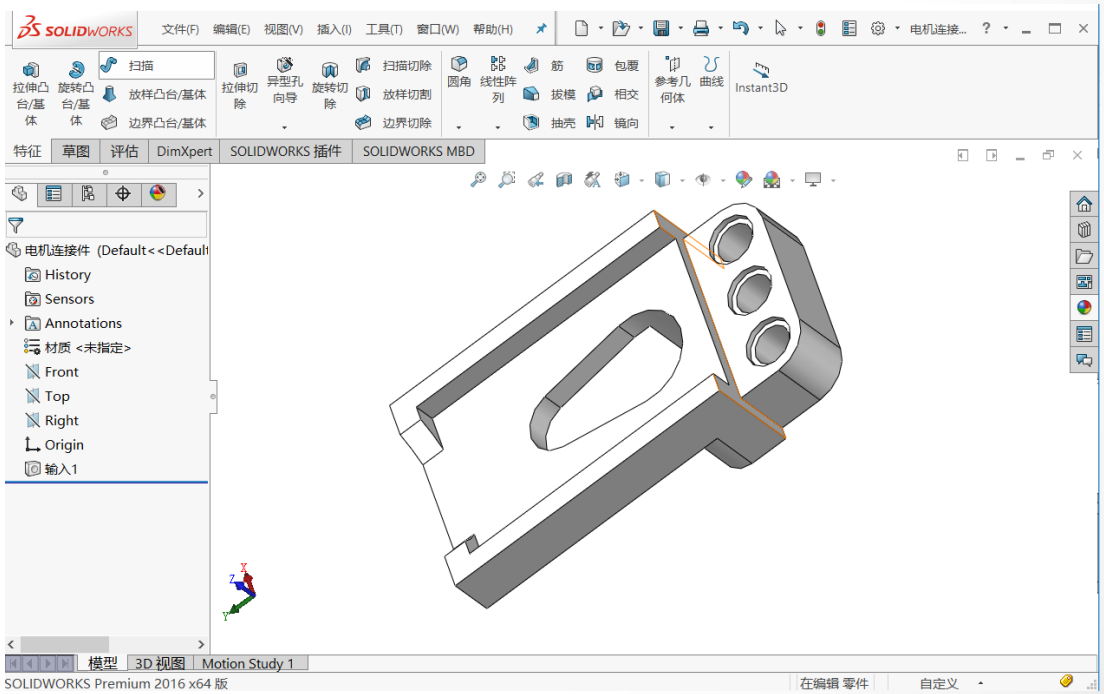


Solidworks

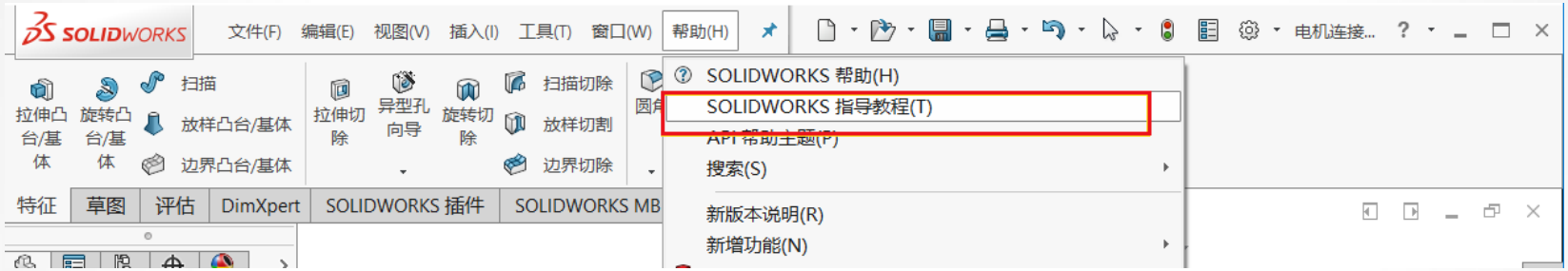




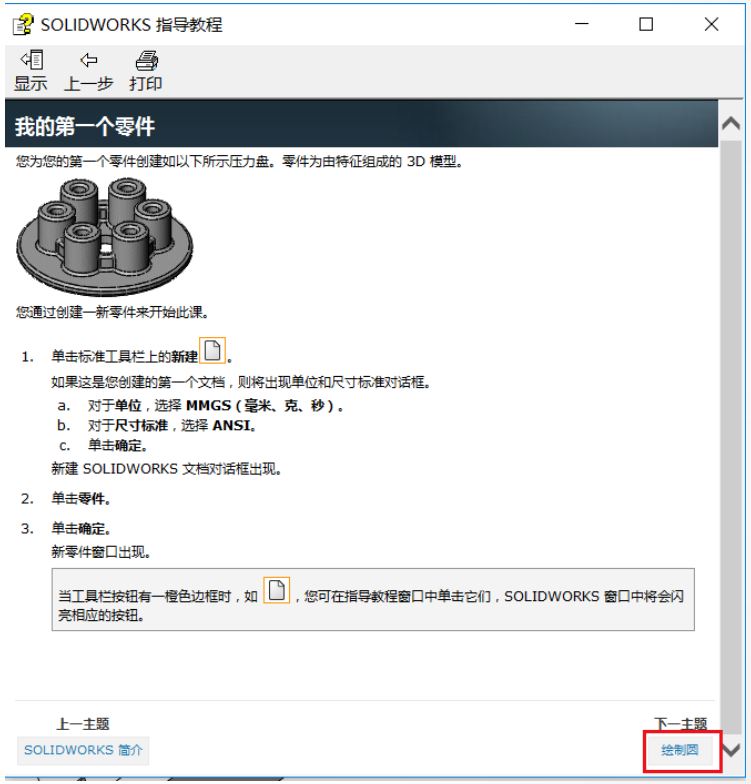



SOLIDWORKS
文件(F) 编辑(E) 视图(V) 插入(I) 工具(T) 窗口(W) 帮助(H)
拉伸凸台/基体
旋转凸台/基体
扫描
放样凸台/基体
边界凸台/基体
拉伸切除
异型孔向导
旋转切除
扫描切除
放样切割
边界切除
圆角
线性阵列
筋
拔模
抽壳
包覆
相交
镜向
参考几何体
曲线
Instant3D
特征
草图
评估
DimXpert
SOLIDWORKS 插件
SOLIDWORKS MBD
电机连接件 (Default<<Default
History
Sensors
Annotations
材质 <未指定>
Front
Top
Right
Origin
输入1
模型
3D 视图
Motion Study 1
SOLIDWORKS Premium 2016 x64 版
在编辑 零件
自定义

Solidworks教程



Solidworks教程



四个实验

- **1）Github+Arduino IDE**
- **2）Arduino应用程序+3D建模工具**
- 3）几何机器人积木套件（百变几何）
- 4）自己编写Arduino库文件（软件基础好的同学，满分10），或调用现成库文件（大部分同学，满分6分）

团队讨论

- 主题：利用几何机器人套件（电子+积木）可以完成什么样的小设计？
- 时间：10-20分钟
- 形式：分组讨论，每组派一个代表讲自己想法

课后工作

- 下次课堂做实验，提前安装Arduino IDE和Solidworks，版本较新即可
- 每组准备可以一个测量长度的工具
- 完善各组小设计方案