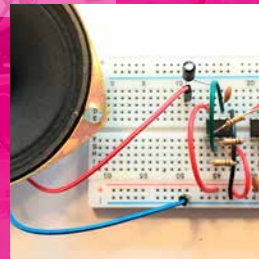
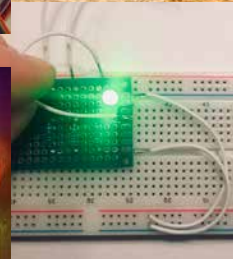
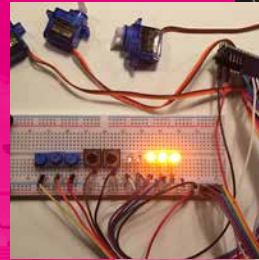


Workshop Creative Tech Prototyping

school labs
hackatons
business teams

[competencies 21st Century Skills]

research creativity
technology light sensors
soldering 3D sound VR coding





creativehubs.nl

Sensors, mini-computers, robots and the Internet of Things are now for sale for everyone and play an increasingly important role in combination with creative and interactive applications.

Think of screens that communicate a message as soon as you walk past it. Mixed Reality that relieves us of our fears or trains us. Sensors that convert your movement into a game. Spatial video projections on buildings. Interaction in Escape rooms. Or robots that help us in our daily lives.

The workshop starts with the basis of a computer, the FlipFlop and the first bit of memory. Discover how you

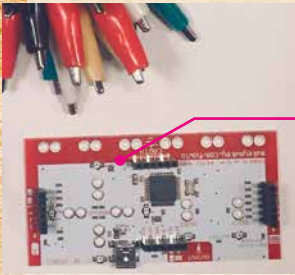
link sensors to computers, how you can control lights or motors. Learn programming, soldering or get started with solar panels, Virtual Reality Google AIY or a 3D printer.

In addition to this practical knowledge, you will be guided in the development of your ideas regarding sustainability, energy and health and we can help you build a network in these sectors.

This booklet provides basic knowledge and tips that you can use to build on your own ideas. This knowledge is part of the 21st Century Skills.

The goal is to inspire each other on a voluntary basis

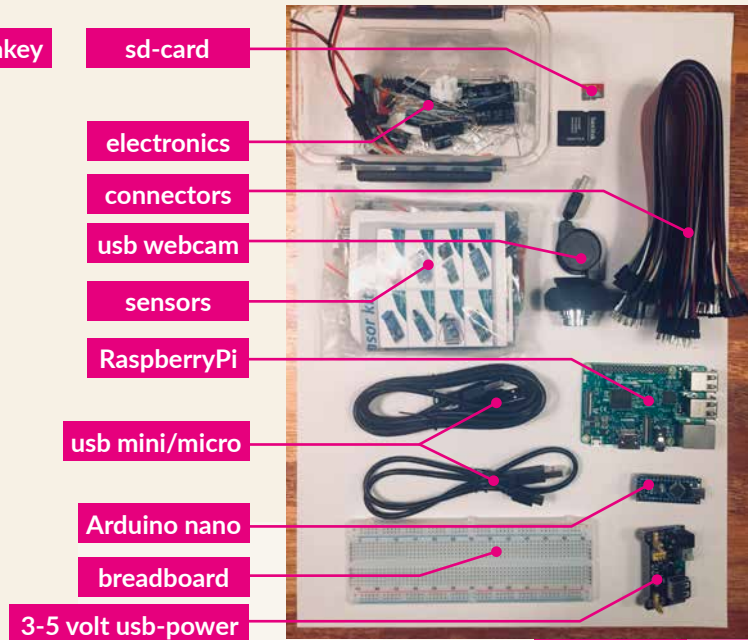
FYI. This booklet is part of the Creative Tech Workshop from CreativeHubs.nl. During this workshop you will be guided and you will have all the electronics and materials to make the tutorials. You can also work with it yourself :)



MakeyMakey

and to find practical answers to questions from our society from a creative-technical angle. You prefer to work with others.

Raoul Postel, the author of this booklet, is a self-motivated builder and creator. He has a large amount of knowledge in various areas / specializations. He also has a network that can be addressed during these workshops in consultation.



sd-card

electronics

connectors

usb webcam

sensors

RaspberryPi

usb mini/micro

Arduino nano

breadboard

3-5 volt usb-power

from the first bit of memory to an
Arduino microprocessor & RaspberryPi robot...

CONTENT & TUTORIALS

Download workshop-files via:
creativ hubs.nl/workshop_content.zip

- The FlipFlop: first bit of memory, the basis for the computer chip
- Learn to Solder
- The Siren: Making Midi sounds with a FlipFlop (IC 555)
- Arduino microprocessor: LED matrix & LED strip
- Robotic arm with Arduino
- RaspberryPi, the mini computer
- Programming with Scratch and Python
- Driving car: engine control with multiple FlipFlips (H-bridge)
- Solar panel with battery charger
- 3D printing (SketchUp, Cura)
- Virtual Reality & Google AI Projects & LoRa

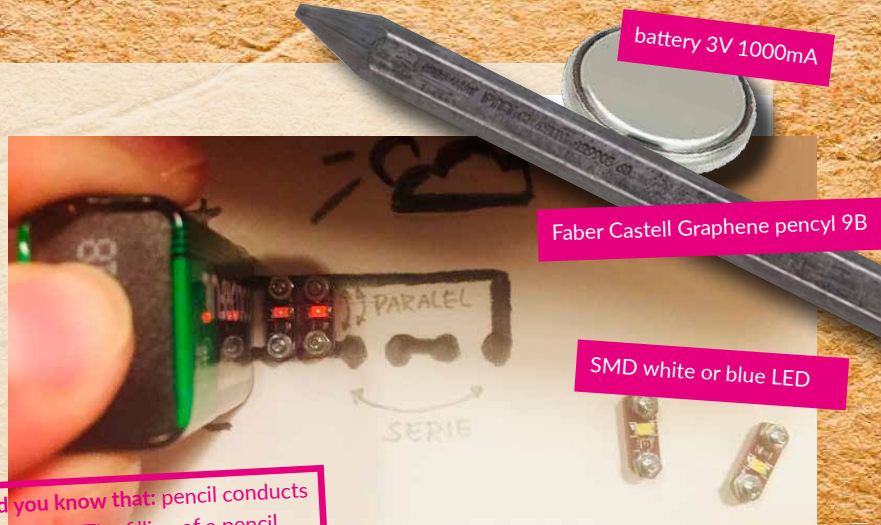
*All parts in this book are
purchased from Aliexpress.*

ELECTROTECHNICS

For the making of Robots, Internet of Things and other new tech, knowledge of electronics is certainly useful. Think of:

- the difference between AC voltage and DC voltage
- the difference between voltage (Volts) and current (Amps = power)
- the function of a rectifier and a voltage regulator
- the operation of small electronics, such as LEDs, resistors and transistors

Explanation of current and voltage:
learn.sparkfun.com/tutorials/voltage-current-resistance-and-ohms-law/all



battery 3V 1000mA

Faber Castell Graphene pencil 9B

SMD white or blue LED

Did you know that: pencil conducts electricity? The filling of a pencil contains graphene. That conducts electricity. You can do it with a graphite pencil, a battery, an LED light and paper test this yourself! Create thick lines ...

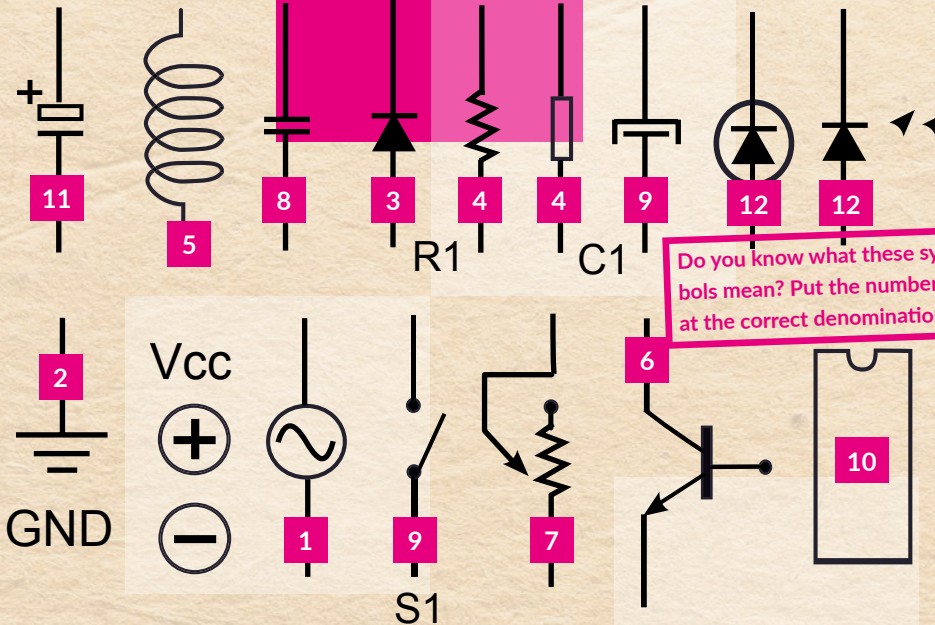
Above you see a signed flow chart with two important ways to connect tronica:

Switch SERIES or PARALLEL

With lights that are in **SERIES**, the last light will be the weakest with respect to the power source.

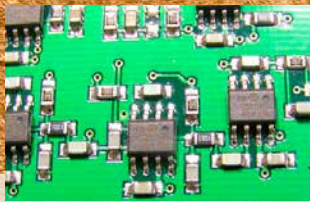
The lights that are in **PARALLEL** light will all be equally strong. The strength depends on the amount of lights.

DIY

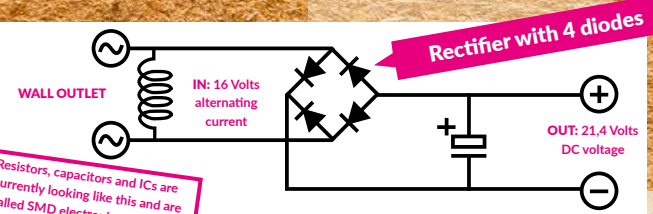


- resistor
- capacitor
- transistor
- led
- elco
- diode
- alternating current
- ic (integrated circuit)
- potentiometer
- switch
- ground
- transformer

Do you know what these symbols mean? Put the numbers at the correct denomination!



Resistors, capacitors and ICs are currently looking like this and are called SMD electronics. So small, too difficult to experiment with.



measuring electronics with Multimeter

FLIPFLOP LED (a-stable multivibrator)

This is the basis of our computer: the first bit of memory. For 1 letter on a computer screen you need 8 of these FlipFlops: 8 bits or 1 byte.

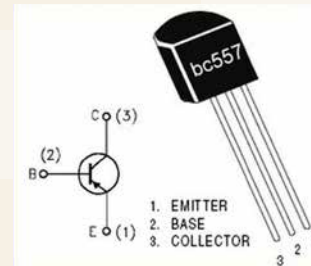
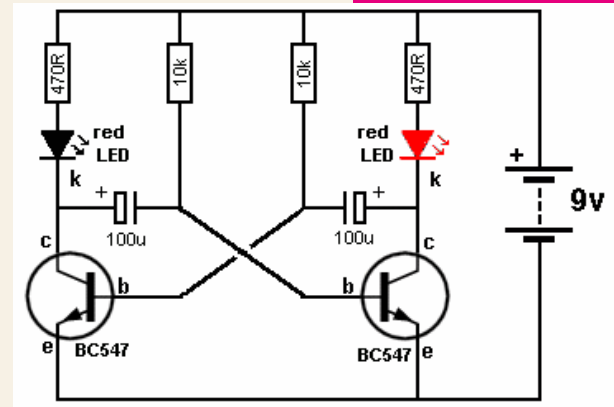
This circuit is also the basis of many electronics circuits and occurs billions of times in the processor of your smartphone. Below an instruction from the FlipFlop.

Materials:

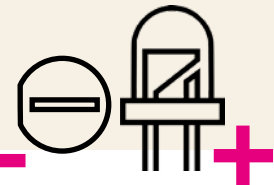
- 2 x resistor 470 Ohm
- 2 x resistor 10 Kiloohm
- 2 x electrolytic capacitor 100 Micro Farad (u)
- 2 x LED
- 2 x resistor bc574
- power 5-9 volt & breadboard

Explanation of FlipFlop operation:

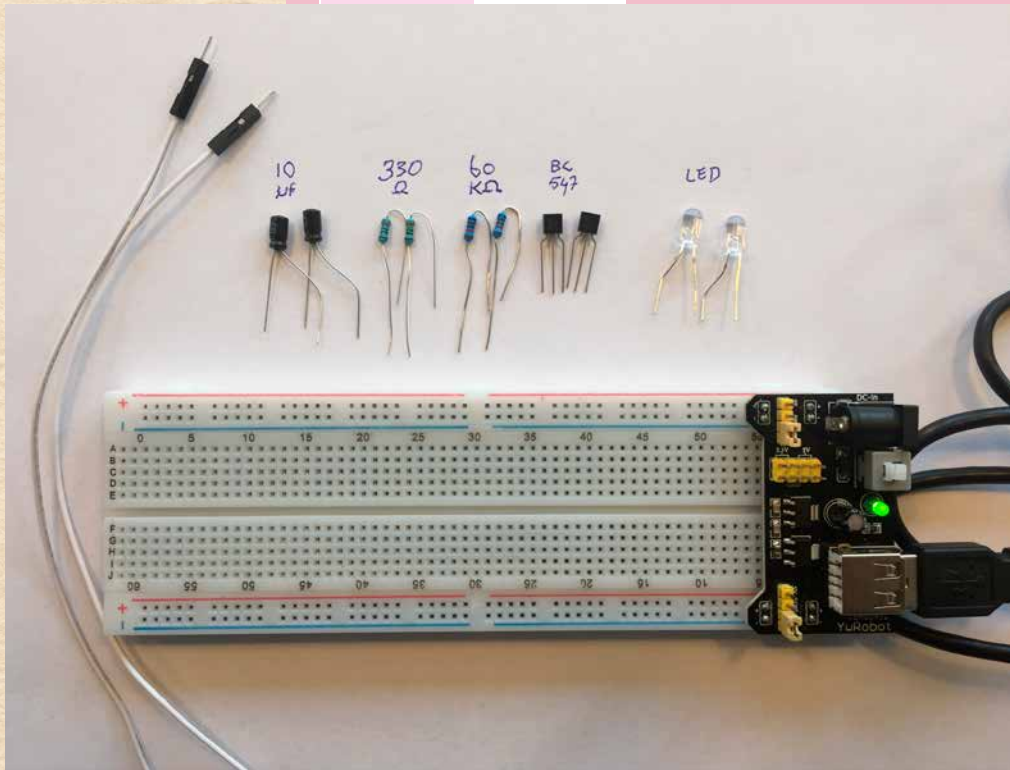
talkingelectronics.com/projects/5-Projects/Projects16.html



topview | sideview



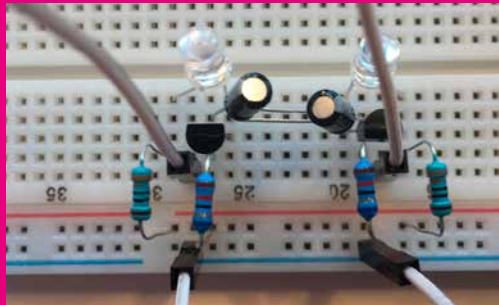
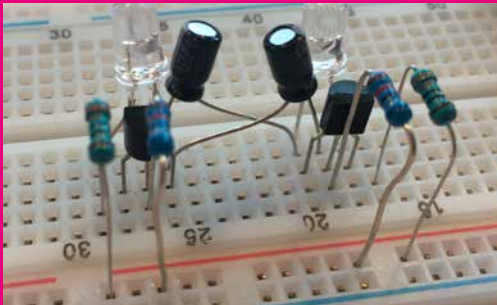
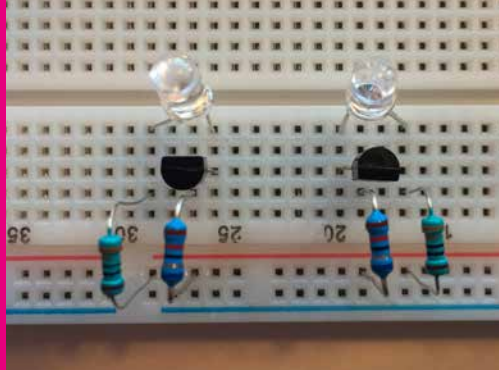
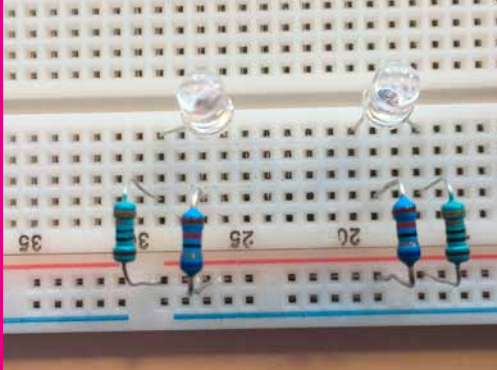
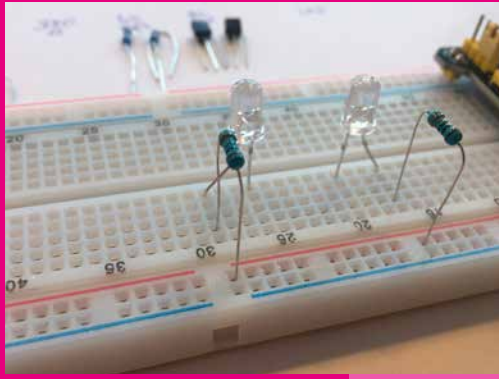
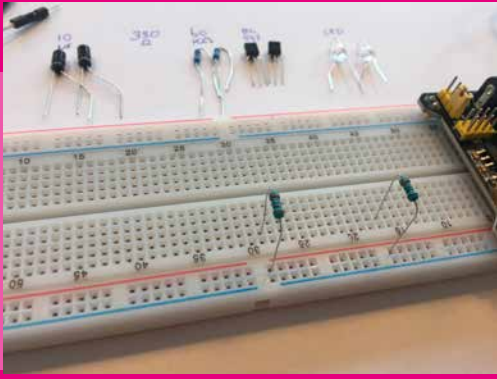
A resistor has no plus and minus. A LED and an Electrolytic Capacitor do. A ceramic capacitor is not. A transistor and IC have multiple connections. Incorrect connection usually means: PATS / PIECE / BROKEN

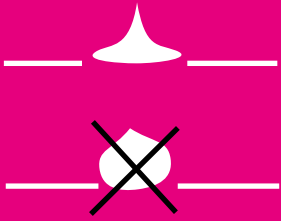


FlipFlop = 1 Bit

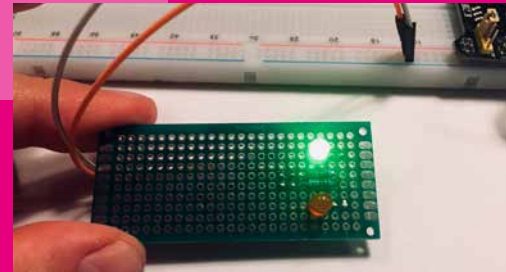
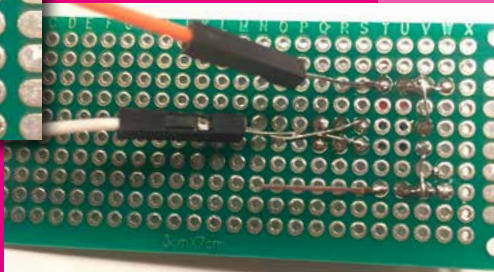
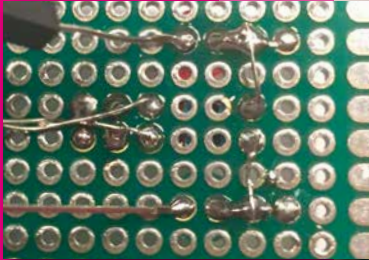
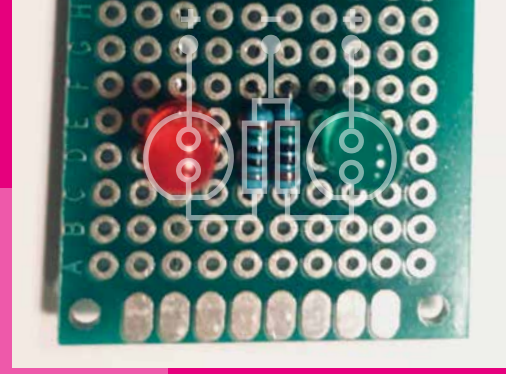
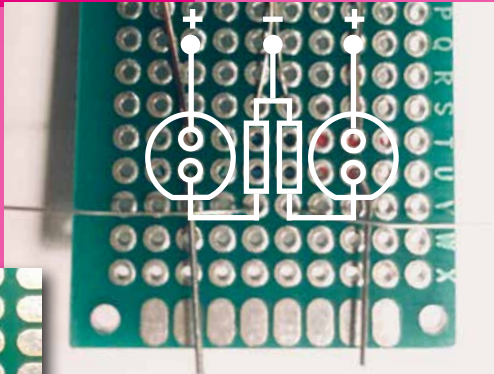
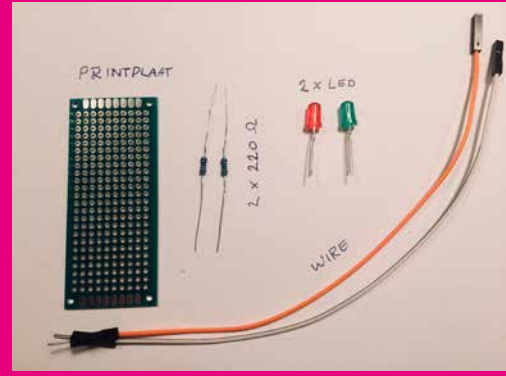
1 letter
on a screen =
8 Bit or 1 Byte







A soldering iron between 20 and 40 watts is more than enough for soldering small electronics.



SOLDERING

Soldering is a simple technique where you connect two pieces of copper / metal with the aid of liquid tin. The tin is liquefied using a soldering iron.

The trick for a good solder connection:

1. keep the two copper / metal parts together
2. briefly heat (1 sec) both parts
3. add the tin

So: first heat briefly (1 sec), then melt with it.

A good solder connection is a small, terminated (gravity) soldering tip. Drop shape. A round ball is not a good sign. Do you still have a ball, melt the ball again with the soldering iron. Then it usually drops the second time.

TIP 1: (old) tin can remain on the soldering tip. He no longer soldered properly. Beat your soldering iron from time to time by tapping it briefly on the table. The tin then falls off. You can also use a damp sponge for this.

TIP 2: It helps to pre-solder the parts to be connected individually. As soon as the connection is made you will almost no longer need tin.

ATTENTION: electronic components can only endure the high temperature of a soldering iron for a short time. Will not be able to make the connection, making the part very hot, let it cool down in the meantime.

Practice soldering via the following assignment:

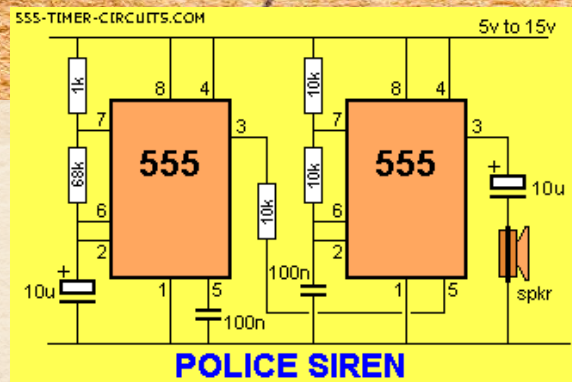
1. take a blank circuit board
2. connects 3 different resistors with the min
3. each connects the other side of the 3 resistors with a wire
4. connects an LED with the plus
5. on the other side (minus) of the LED, make a solder contact point on the PCB

Now connect the plus and minus to the power supply (5v) and touch the LED contact point one by one with one of the 3 wires. You see the LED on an other re strength ... You have now soldered a simple switch!

SIRENE

With a few flipflops combined in an IC, adjustable resistors (potentiometers) and a speaker, you can produce and amplify electronic sounds.

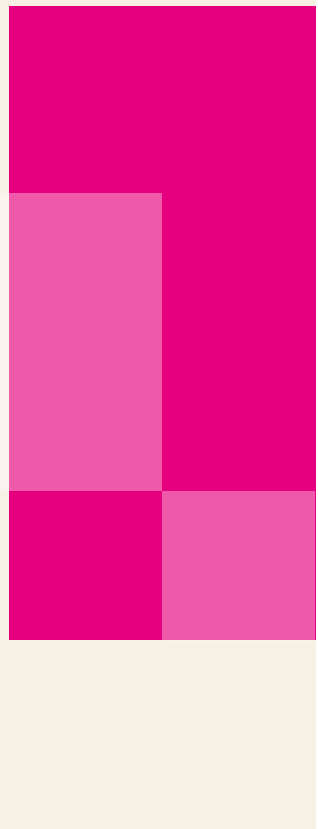
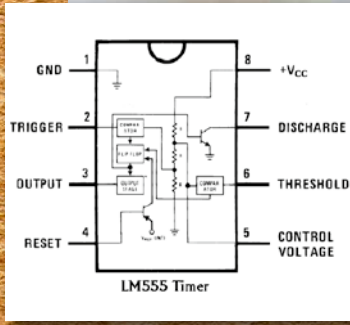
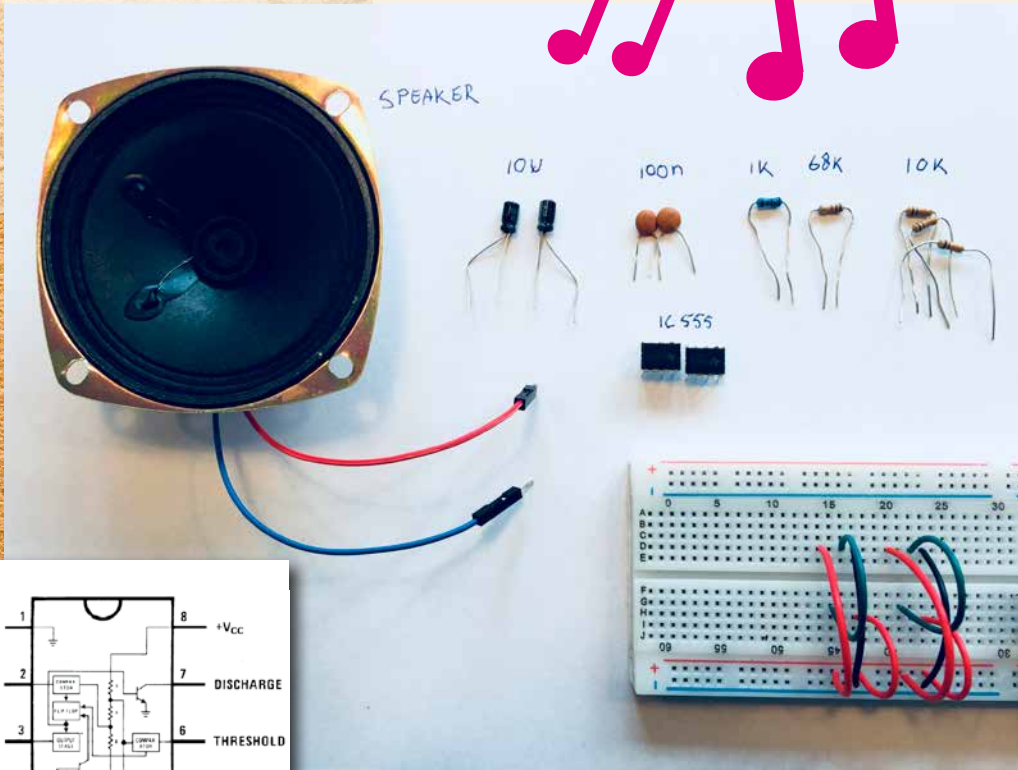
Where the flipflop switches on and off 1 x (I / O), the pulse can be accelerated to a vibration via a series of FlipFlops. The faster the vibration, the higher the sound. And with this you have the basis for a synthesizer or MIDI instrument. In the meantime this technology has mainly been translated into software and no more electronics are involved. But nice to know where our digital sound comes from ...



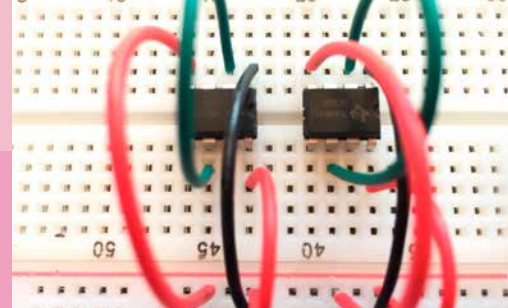
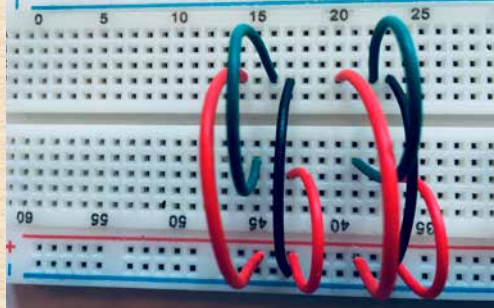
Tutorial: [instructables.com/id/555-Siren](https://www.instructables.com/id/555-Siren)

Materials:

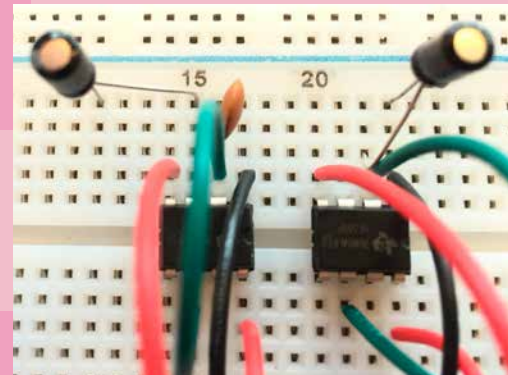
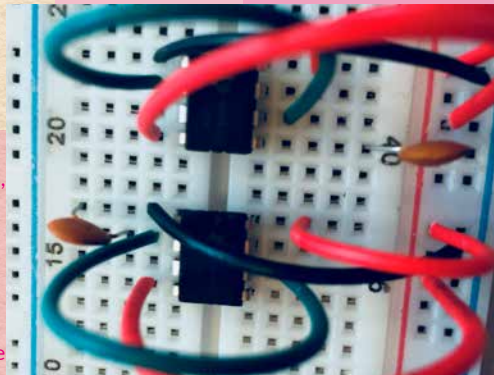
- 3 x resistor 10 KiloOhm
- 1 x resistor 1 KiloOhm
- 1 x resistor 68 KiloOhm
- 2 x electrolytic capacitor 10 Micro Farad (u)
- 2 x keramic capacitor 100 Nano Farad (n)
- 2 x IC 555
- 1 x speaker 2W / 4 Ohm
- power & breadboard



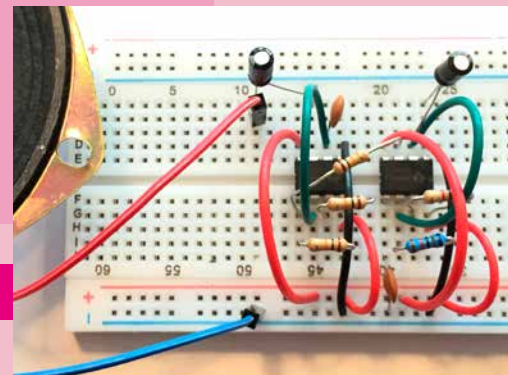
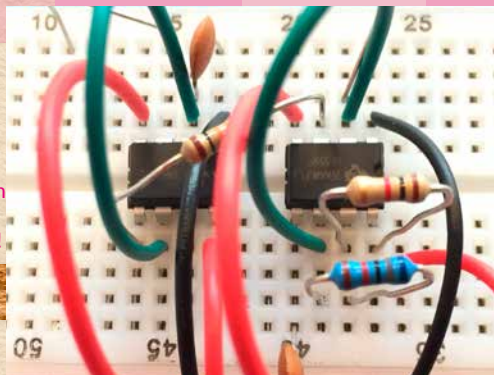
First place the different wires.
Insert the two IC 555's.
The legs of an IC are numbered. In this case 1 to 8. The numbering always starts at the bottom with the notch on the left.



Place the two 100nF capacitors. In contrast to the electrolytic variant, these have no plus and minus side.



Then place the two Electrolytic Capacitors (Elco) of 10uF (plus and minus!). The left one of which will be connected to the speaker later.



Then place the 10K resistor from leg 3 IC left to leg 5 IC right. Then the resistance from 1K to leg 8 to leg 7 of the right IC. And the resistance from 68K on leg 7 to leg 6 of the right IC. Finally the two resistors from 10K to IC left.

Connect the speaker with the plus to the minus of the left Elco. And testing!



ARDUINO TUTORIALS

Now that the basics of electronics have been tried out, we will use computers that are much more flexible and faster than the above circuits. The so-called MicroControllers. Then we can offer a lot of functionality arrange through software.

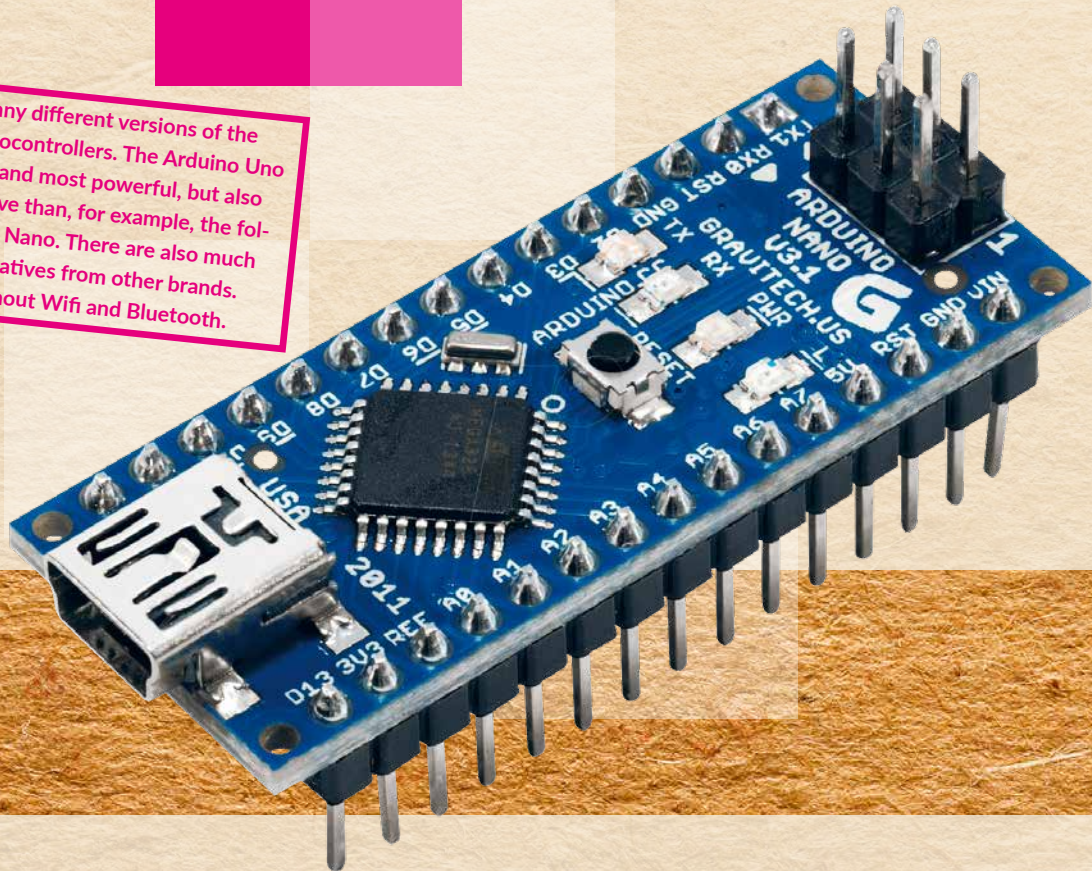
We use the Arduino, a microprocessor, which, just like the FlipFlop, can give On and Off signals. Through software you tell which function must take place. You place an Arduino C ++ code through your laptop. Your function will then be performed

by the Arduino. So no operating system runs on an Arduino and is therefore not a real computer, but a MicroController. For example, the Arduino is widely used for Robots and Internet of Things solutions.

In this Workshop you work with a cheap Chinese Arduino variant with the CH34x Chipset. These Arduino versions are unfortunately not always compatible with the standard Arduino software. An additional driver may have to be installed.

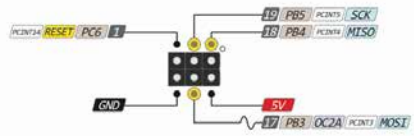
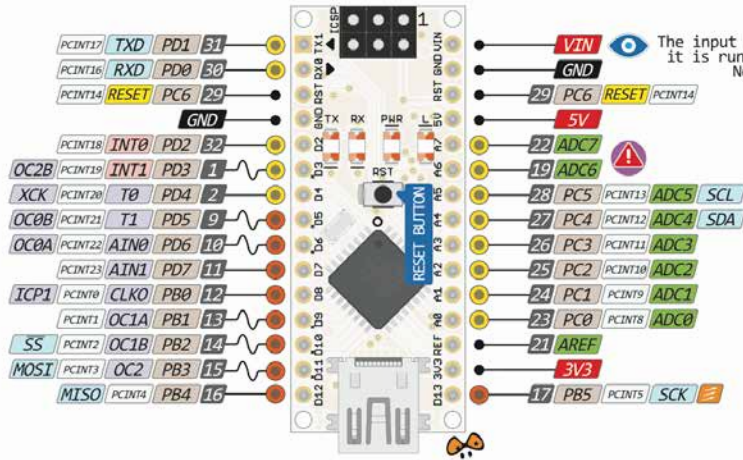
Arduinos work with the C ++ programming language. This language is widely used in Robotics, but also in smartphones and software.

There are many different versions of the Arduino microcontrollers. The Arduino Uno is the largest and most powerful, but also more expensive than, for example, the following Arduino Nano. There are also much cheaper alternatives from other brands. With- and without Wifi and Bluetooth.



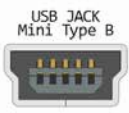
NANO PINOUT

- 1
- 0
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 10
- 11
- 12



The input voltage to the board when it is running from external power. Not USB bus power.

- Absolute MAX per pin 40mA recommended 20mA
- Absolute MAX 200mA for entire package



Analog exclusively Pins

The power sum for each pin's group should not exceed 100mA

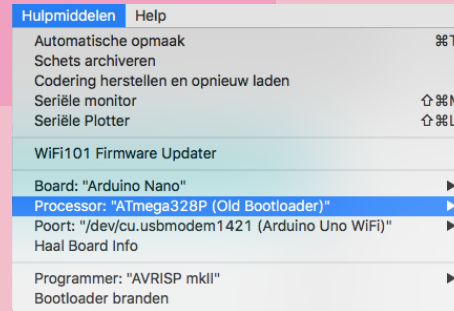
Legend:

- Power
- GND
- Serial Pin
- Analog Pin
- Control
- INT
- Physical Pin
- Port Pin
- Pin function
- Interrupt Pin
- PWM Pin
- Port Power

Download and install (not the web version!) the Arduino software to your computer, with which you can put (compile) code on the Arduino.

1. After installation, connect the Arduino to the computer via the USB port
2. Go to the Tools menu and choose:
Board: Arduino Nano
3. Processor: **ATmega823P**
4. (possibly Old Bootloader)
5. **Port:** your usb serial port
6. Get Board info. **
7. Go to the File / Files menu and choose: **Examples / Basics / Blink**
8. Compile and Upload the code to
9. the Arduino

** If you are unable to connect to the Arduino, this may be due to your USB cable. Some cables only transmit 5 Volts, but no data. That is necessary. The problem may also lie with the driver of the Arduino chip. It may not have been installed yet. In the case of the Arduino Nano that we use, this is also the case. Download and install this driver for this



LEDs, resistors and capacitors can also be connected to the Arduino linked. In combination with sensors, motors, LED strips and displays, you can do a lot of experiments!

Explanation of many sensors:

[instructables.com/1d/Arduino-37-in-1-Sensors-Kit-Explained](https://www.instructables.com/1d/Arduino-37-in-1-Sensors-Kit-Explained)

106 Sensor projects with Arduino:

create.arduino.cc/projecthub/projects/tags/sensor

café Arduino.....

The founders of Arduin often spoke in Café Arduino
It also means: First king of Italy ...

ARDUINO LED MATRIX

Matrix VCC on Arduino pin +5V /
Matrix GND on Arduino pin GND
Matrix DIN on Arduino pin D12
Matrix CS on Arduino pin D10
Matrix CLK on Arduino pin D11

Our WorkshopKit also has an LED Matrix of 8x8 = 64 red LEDs. With this, patterns and small animations can be visualized. Think of a simple animated logo or a short text.

Materials:

- 1 x Arduino Nano
- 1 x MAX7219 8x8 dot matrix

Take an Arduino and an LED Matrix and connect it as follows:

Connect the Arduino to your computer via the USB cable.

Copy the script from the Workshop folder: **scripts_arduino / Ledmatrix / Ledmatrix** to your own Arduino Library folder on your computer. You will find this by default in the folder: **(My) Documents / Arduino / Library**

You need to install a special library for this script. This applies to many Arduino scripts.

Go to:

Sketch / Library Use / Manage libraries

In the search bar choose:

LedControl and click on install

Compile and Upload the script to the Arduino. The LEDMatrix now leaves the LEDs row burn one by one.

This continuous repeating of this pattern is called a FOR-Loop. By making an adjustment in the code, you can control each LED separately and you can actually make a flipflop again:

`lc.setLed(0,col,row,true);` change to

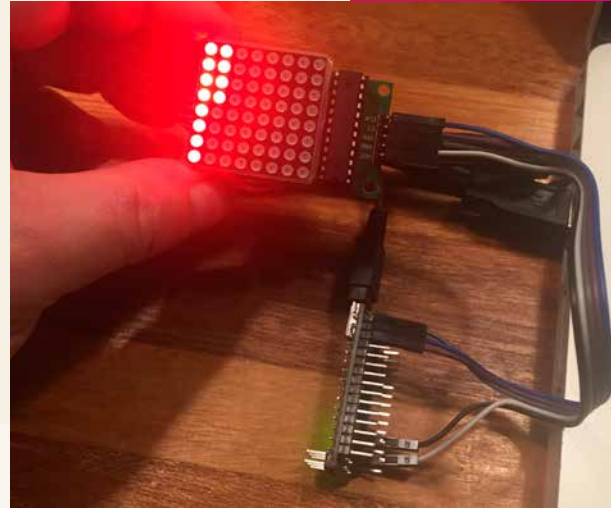
`lc.setLed(0,3,5,true);`

`lc.setLed(0,col,row,false);` change to

`lc.setLed(0,3,5,false);`

You can also handle multiple matrices link each other. You change the amount of matrices in the Arduino Script:

`LedControl lc=LedControl(12,11,10,1);`
`LedControl lc=LedControl(12,11,10,3);`
(with 3 matrixes)





ARDUINO LEDSTRIP

In addition to an LED matrix, you can also control an LED STRIP of 24 full-color LEDs. These LED strips are available in various variants. We have the full color (RGB) version that you can control digitally via 1 pin.

Note: the longer the strip, the more LEDs and the heavier the use. For longer strips (for example 60 LEDs) you will have to use a separate power supply (5V). Our strip is quite short (24 LEDs) and we can feed it without problems with the 5V output pin from the Arduino.

So there are many different LED strips available, but not all can be controlled in full color or digitally. If you buy an LED strip that you want to program yourself, choose for example: WS2813.

Note: You can only connect one LED strip on one side: DIn (Digital In). After all, they are diodes, so the current only flows through one side.

Materials:

- 1 x Arduino Nano
- 1 x Digital RGB Ledstrip WS2812/13

Build your own lightparty

Take the Arduino and an LED Strip and connect it as follows:

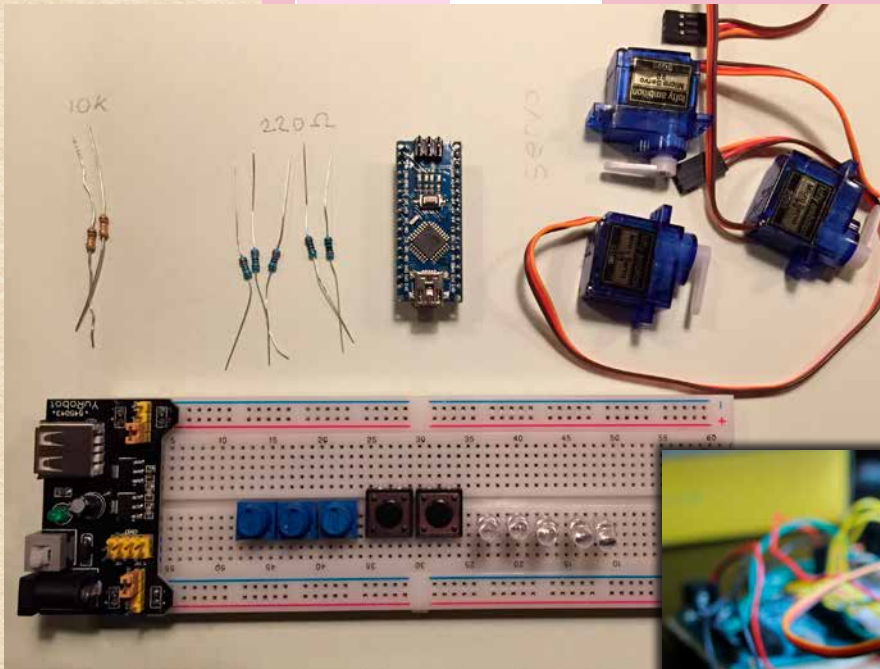
Strip VCC on Arduino pin +5V
Strip GND on Arduino pin GND
Strip DIN on Arduino pin D6

Connect the Arduino via the USB cable with your computer. Copy the script from the Workshop folder:

scripts_arduino / Adafruit_NeoPixel / examples / strandtest / strandtest.ino to the Arduino Library on your own computer. Install the library: **Adafruit_NeoPixel.h**

Compile and Upload the script to the Arduino The LED strip will now have a pattern make color combinations.





ARDUINO ROBOTARM

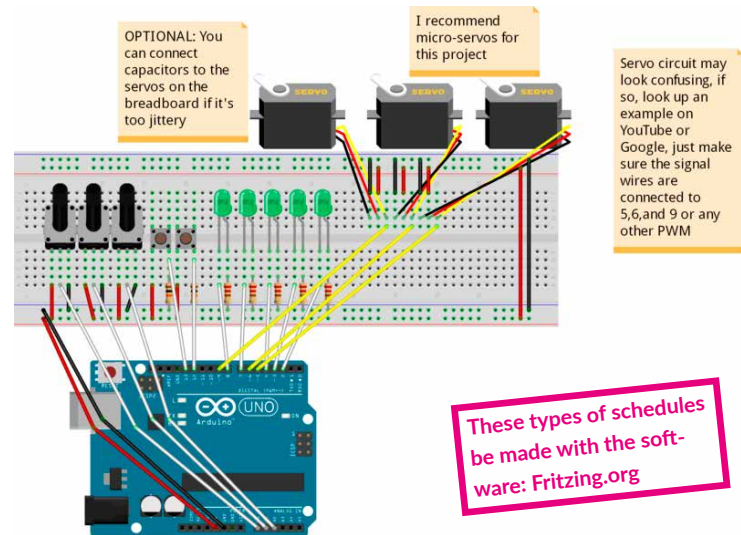
NOTE: For this tutorial you need cardboard, tape, cutting and measuring tools.

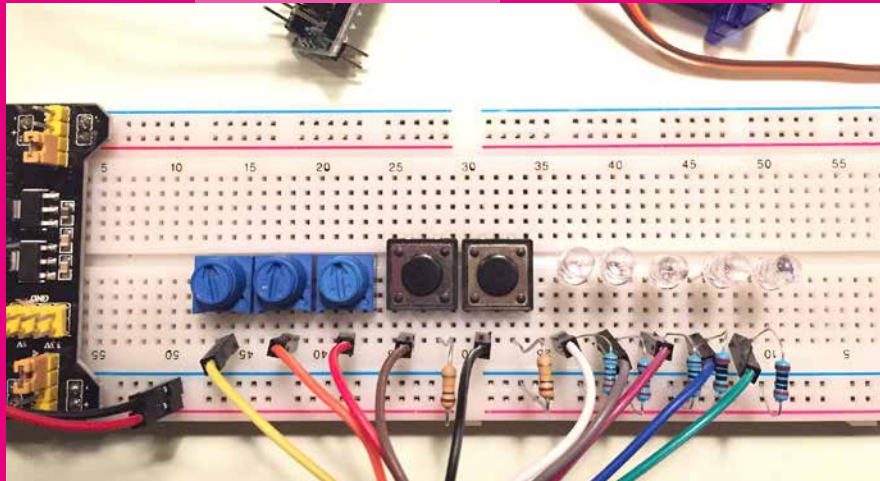
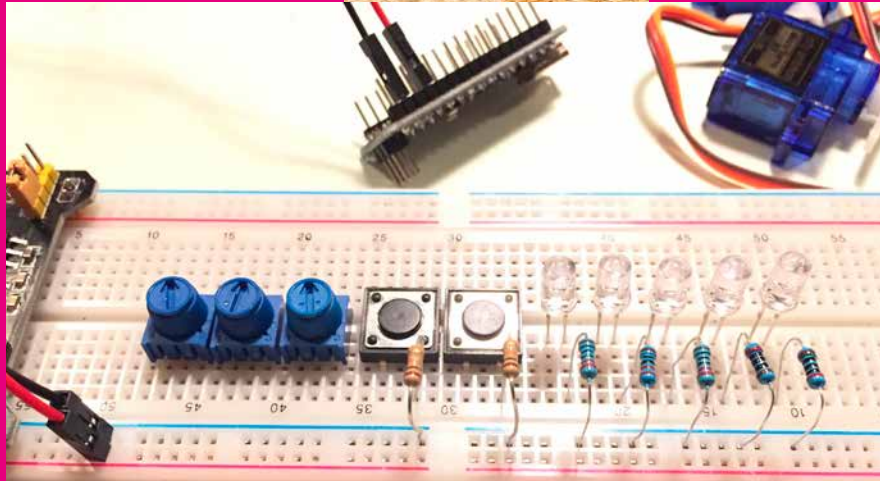
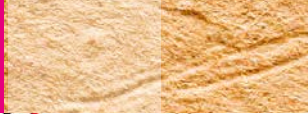
create.arduino.cc/projecthub/ChanR19/simple-programmable-robotic-arm-bd28a0

Materials:

- 2 x resistor 10 KiloOhm
- 5 x resistor 220 Ohm
- 5 x LED
- 3 x potentiometer 10 KiloOhm
- 2 x pressure-switch
- 3 x 180° servo motor
- power & breadboard

PLEASE NOTE: in the diagram below the LEDs are connected with their plus leg to the minus of the breadboard. Turn the LEDs over in relation to this diagram, otherwise they will not work





First place the 3 potentiometers, 2 buttons and 5 LEDs over the middle lane of the breadboard.

Put a resistor of 220 ohms between the LEDs and the minus. And place a resistance of 10K to the min per button. Now connect all components via wires to the Arduino.

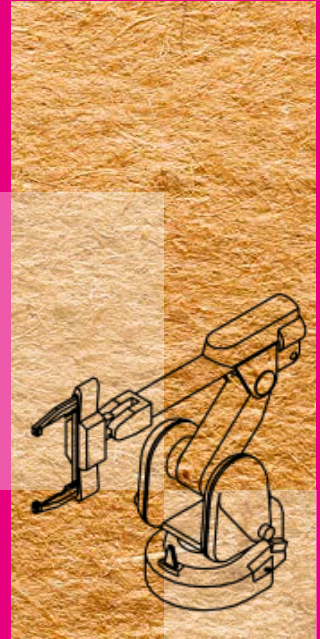
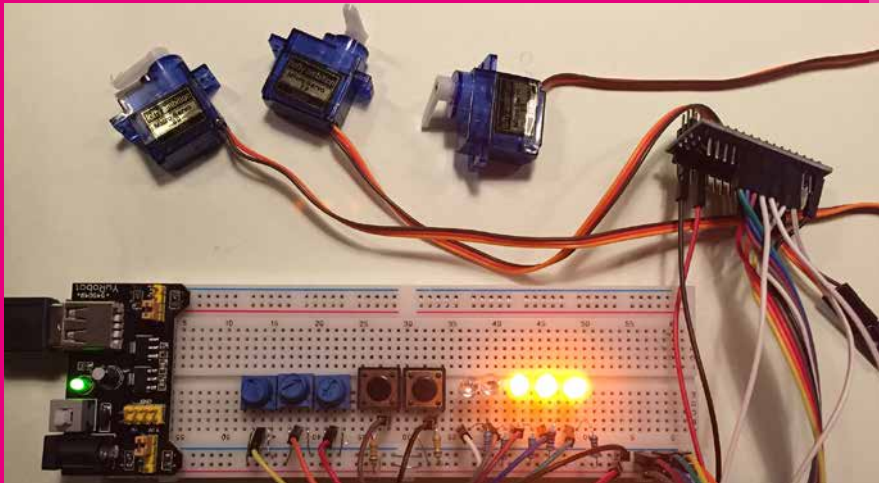
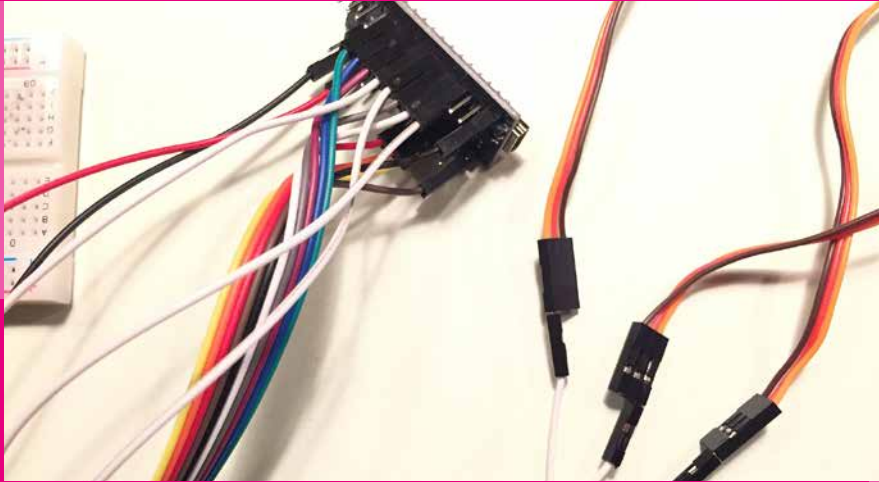
Then connect the servos with the Signal wire (yellow - white) to the Arduino and the other two servo wires to plus and minus on the breadboard.

Wiring servos:

- yellow = signal (after Arduino)
- orange = 5V
- brown = GND (ground)

Now put the power on the breadboard and turn the potentiometers. 1 servo must rotate per potentiometer.

Open the Serial Monitor in the Arduino software so that you can see what the servos do. As soon as you press a button, the last action is saved. There will then be 1 LED lit per stored action. This is actually a small computer program.

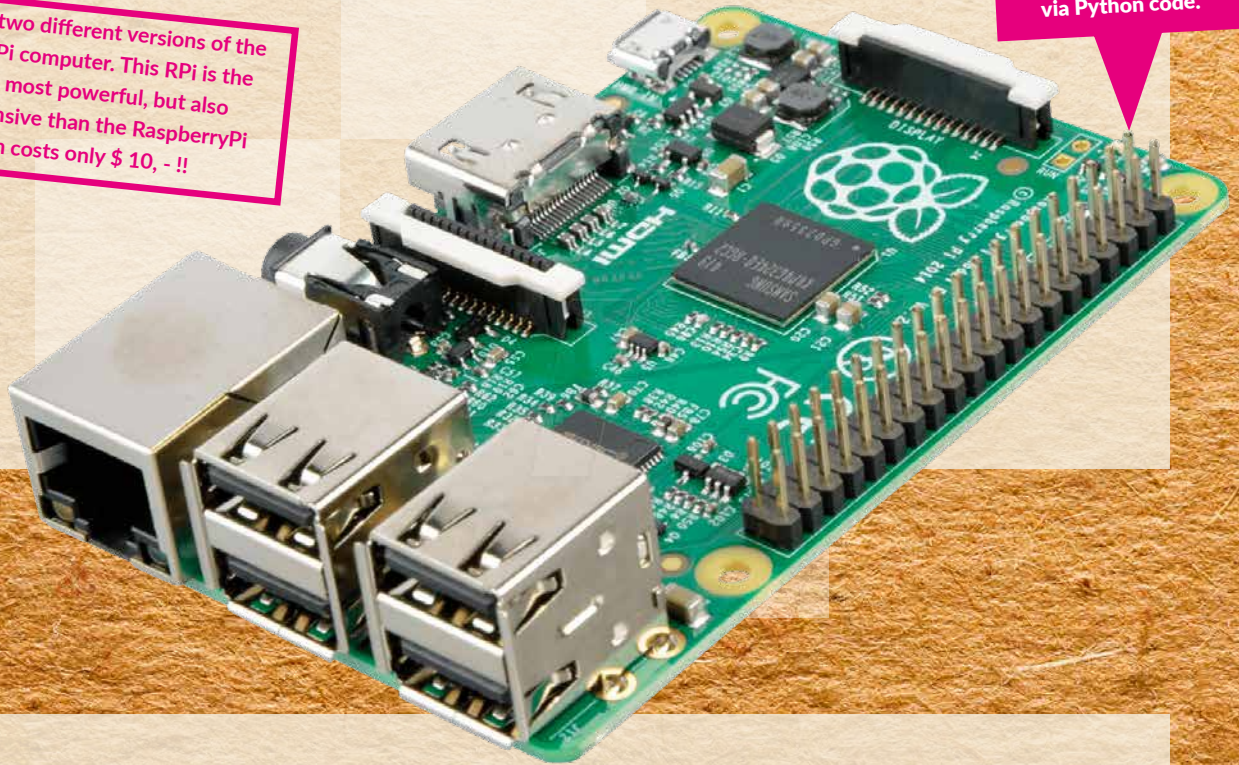


Buildingphoto's of the robot-arm:
imgur.com/a/2zxi1

RASPBERRY PI

There are two different versions of the RaspberryPi computer. This RPi is the largest and most powerful, but also more expensive than the RaspberryPi Zero. Which costs only \$ 10, - !!

GPIO: the 40 pin's on the RaspberryPi on which you can connect electronics and control via Python code.



Pi Model B/B+		
3V3 Power	1 2	5V Power
GPIO2 SDA1 I2C	3 4	5V Power
GPIO3 SCL1 I2C	5 6	Ground
GPIO4	7 8	GPIO14 UART0_TXD
Ground	9 10	GPIO15 UART0_RXD
GPIO17	11 12	GPIO18 PCM_CLK
GPIO27	13 14	Ground
GPIO22	15 16	GPIO23
3V3 Power	17 18	GPIO24
GPIO10 SPI0_MOSI	19 20	Ground
GPIO9 SPI0_MISO	21 22	GPIO25
GPIO11 SPI0_SCLK	23 24	GPIO8 SPI0_CE0_N
Ground	25 26	GPIO7 SPI0_CE1_N
ID_SD I2C ID EEPROM	27 28	ID_SC I2C ID EEPROM
GPIO5	29 30	Ground
GPIO6	31 32	GPIO12
GPIO13	33 34	Ground
GPIO19	35 36	GPIO16
GPIO26	37 38	GPIO20
Ground	39 40	GPIO21



GPIO is numbered in two ways:
 "Board" from top left to bottom right: 1-40
 "BCM" for BroadCom chip numbers/ports

- Need extra:**
- HDMI display
 - 5V / 2A power supply,
 - USB keyboard and mouse

Meet the best known, smallest and cheapest mini computer: The RaspberryPi. A small cheap computer, without screen, keyboard and mouse, which has been developed for education.

The RaspberryPi uses a special version of Linux OS: Raspbian. So it is a complete computer with browser, word processor, image editing, music and more software that you also find on a normal computer.

You can connect electronics via the so-called GPIO. Think of LEDs, sensors and motors. You program the functions with the Python programming language.

Via an Ethernet connection and Remote Desktop software (eg VNC) you can also link a RaspberryPi directly to your computer. Then you do not need a separate screen, mouse and keyboard.

There are mainly two RaspberryPi's: **RPi** (\$ 35, -) and **RPi Zero** (\$ 10, -).

They do not have a screen, keyboard and mouse. Fortunately, you can make a connection with your own laptop via the SSH protocol. Via an FTP program (eg Filezilla) and a so-called Terminal you upload code and files on the RPi.

1. Download a Raspbian image
2. Burn the image on a SD-card with balenaEtcher, for example.
3. Insert the MicroSD card into the RaspberryPi
4. Connect the RaspberryPi to your computer via the microUSB cable.
5. Connect the Ethernet cable between the RaspberryPi and your computer or the router. With an RPi Zero you still need a microUSB hub with an

Ethernet port. With the RPi 3 this is already standard

6. Connect with the RaspberryPi via SSH
WINDOWS: Install PuTTY
raspberrypi.org/documentation/remote-access/ssh/windows.md
server: **raspberrypi.local**
password: **raspberry**
MAC: Open the Terminal (utilities) and type: **ssh pi@raspberrypi.local**
password: **raspberry**
7. If you are okay, you can type code. Here you will find handy Linux commands that you can use in PuTTY / Terminal.
8. If necessary, open an **FTP program** (eg Filezilla) to upload / download files.
9. Do you have **VNC** viewer (Remote Desktop MAC ANDROID) on your computer, you can also work from the desktop of the RaspberryPi.

frambozentaart ^[dutch]

TERMINAL COMMANDS

RPI find via ethernet:
`arp -na | grep -i b8:27:e8`

RPI boot configuration
`sudo raspi-config`

RPI restart / stop:
`sudo reboot -h now`
`sudo halt -h now`

RPI update:
`sudo apt-get update`
`sudo apt-get dist-upgrade`

RPI install program:
`sudo apt-get install [program]`

RPI run script at boot:
`sudo crontab -e`
`@reboot python pi/script.py &`

RPI make new directory:
`sudo mkdir mapnaam`
RPI map verwijderen:
`sudo rm -rf /mapnaam`

RPI cancel write permissions:
`sudo chown pi: root filename`

RPI run python script:
`sudo python script.py`
`sudo kill [processnumber]`

RPI Display settings:
`sudo nano /boot/config.txt`

PROGRAMMING WITH SCRATCH

Scratch is an object-oriented visual programming language developed at the MIT by Lifelong Kindergarten group and the MIT Media Lab. The language is suitable for creating visualisations such as interactive stories, animations, games, music and art, and focuses specifically on young people from 8 years of age.

The special thing about this programming language is that it works with blocks instead of text. This limits syntax errors by making the parts of a program

fit together like lego bricks. If the blocks fit, the program is syntactically correct and can be executed. Programming errors naturally remain possible.

The name scratch comes from the music of the DJ technique scratching. It refers to the possibility of creating new work by remixing the work of others. Every Scratch project that is shared on the website includes the code with which it was created.

The project leader of the Scratch project is Mitch Resnick, whose research has also formed the basis for the development of LEGO Mindstorms, where children can build and program robots.

The nicest
and cheapest
way to learn
programming

...

Program yourself with Scratch?

scratch.mit.edu/projects/editor

FLIPFLOP IN PYTHON

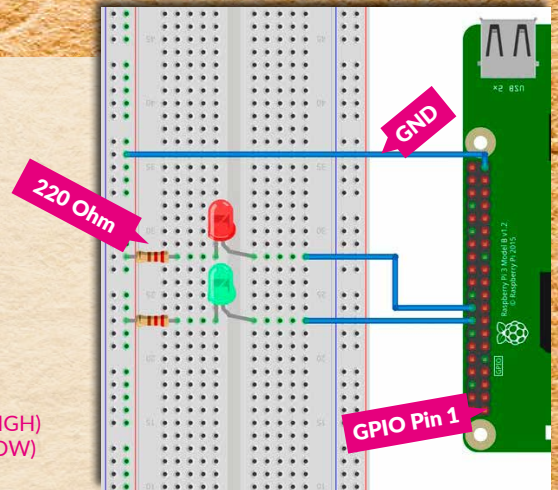
With the GPIO, LEDs and Python you can make LEDs blink. The Python programming language is widely used on the RaspberryPi.

To have two LEDs flash with Python you can program a script and have it executed. Connect the LEDs.

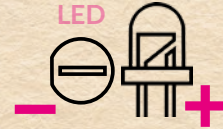
1. Create a new document on the desktop of the RPi (right mouse button --> new)
2. Type the following code:

```
import RPi.GPIO as GPIO
import time
GPIO.setmode(GPIO.BCM)
GPIO.setup(23, GPIO.OUT)
GPIO.setup(24, GPIO.OUT)
while True:
    GPIO.output(23, GPIO.HIGH)
    GPIO.output(24, GPIO.LOW)
    time.sleep(1)
    GPIO.output(23, GPIO.LOW)
    GPIO.output(24, GPIO.HIGH)
    time.sleep(1)
```

3. Save the document as: **blink.py**
4. Open the Terminal and type:
`cd Desktop`
`sudo python blink.py`



topview | sideview



Internet of Things [IoT]

Various sensor projects with the RPi:

raspberrytips.nl/category/sensoren

Everyday objects that are connected to each other and / or to the internet. They exchange data with each other.

WEBSOCKET

But how do you switch the LEDs on and off remotely? Like for example at Home-systems works?

Remote operation of the GPIO operates via a so-called websocket. This is a simple web server with a web page. There is, for example, an On and Off button. If you are in the same WIFI network with your smartphone, you can access this web page and control the LEDs remotely. In addition to LEDs, you can also read the data from a sensor. This is actually an Internet of Things solution!

1. Start from the LED setup from the previous exercise.
2. Install the **Apache Web Server** on your RaspberryPi. This allows your websites to run on your RaspberryPi.
www.raspberrypi.org/documentation/remote-access/web-server/apache.md

3. Download the web socket code -->
4. Upload the code to the RaspberryPi via an FTP program (eg. Filezilla) in a new folder called:
`/var/www/html/websocket`
5. Open the file: **server.py** via a text editor in the websocket folder
6. Change in **server.py** the web socket port from **80 to 8000** and save it.
7. Start the websocket via the Terminal:
`cd /var/www/html/websocket`
`sudo python server.py`

To activate the web server during startup:

Type in a Terminal: `sudo crontab -e`
Scroll down and type:
`@reboot python /var/www/html/websocket/server.py &`
Type: **CTRL + X** , Type: **Y + ENTER**

WEBSOCKET:

`hackster.io/dataplicity/
control-raspberry-pi-
gpios-with-websockets`

IOT TEST

Connect your smartphone to the same WIFI network as the RaspberryPi. Open on the browser and type:

`raspberrypi.local:8000`

You can now control the LEDs via your smartphone!



DRIVING CAR WITH H-BRIDGE IC

For controlling motors we come across an old acquaintance: IC 555 (programmable flipflop), but then packaged in IC L293. Here two IC 555s are opposite each other in mirror image and form a so-called H-bridge. The simplest way to control motors via fast pulses (think of the high vibrating tone of the Sirene tutorial described above). In this IC there are 2 H-bridges for two engines, so 4 x IC555! This IC therefore has 16 connection points.

The motors can be controlled with Arduino and are therefore often used for making robots. It is also possible with the RaspberryPi, through which you can also add interactivity via web code. For

example, control the motors using a web interface. The tutorial below also uses the RaspberryPi and controls the motors via the Python programming language. A widely used language in robotics, but also in web applications, for example.

Make the following tutorial:

business.tutsplus.com/tutorials/controlling-dc-motors-using-python-with-a-raspberry-pi--cms-20051

GPIO 25-Pin 22 > L293D-Pin 1
GPIO 24-Pin 18 > L293D-Pin 2
GPIO 23-Pin 16 > L293D-Pin 7

PLEASE NOTE: a very light, small engine and without load can be run directly via the plus of the RaspberryPi. As soon as the engines are loaded or heavier, they must be fed separately. For example with extra batteries. If you don't, you can damage the GPIO of the RaspberryPi.

NOTE: when connecting of two engines the Python code has an error:

IT SAYS:

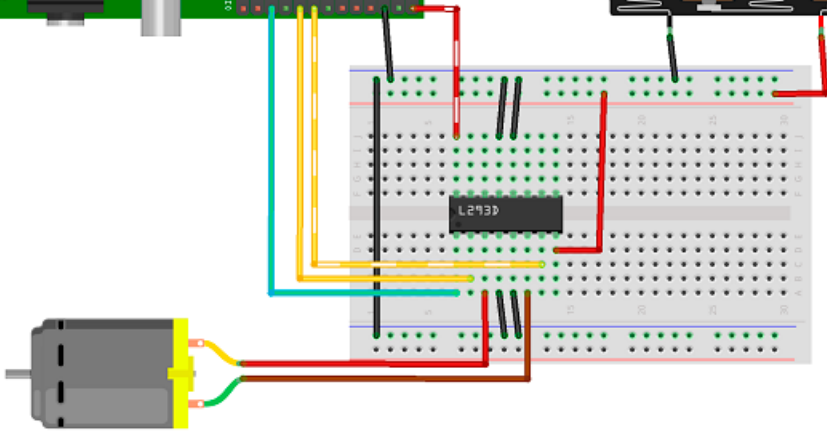
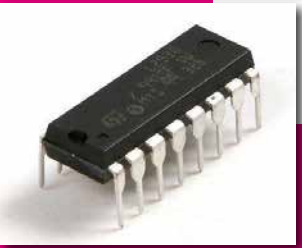
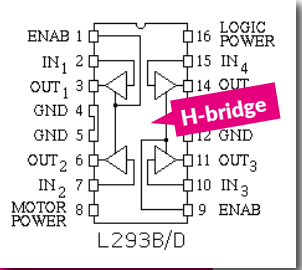
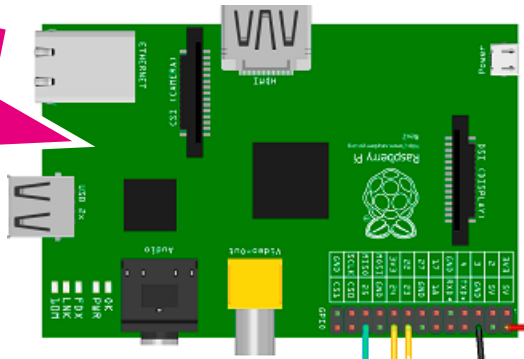
Motor2A = 23
Motor2B = 21
Motor2E = 19

CHANGE THIS IN:

Motor2A = 19
Motor2B = 21
Motor2E = 23

Then the engines run in the right direction.

This is an old RaspberryPi, one of the first. It only had 26 GPIO pins. All RPi's after have 40 pins. The connections are the same in both versions.



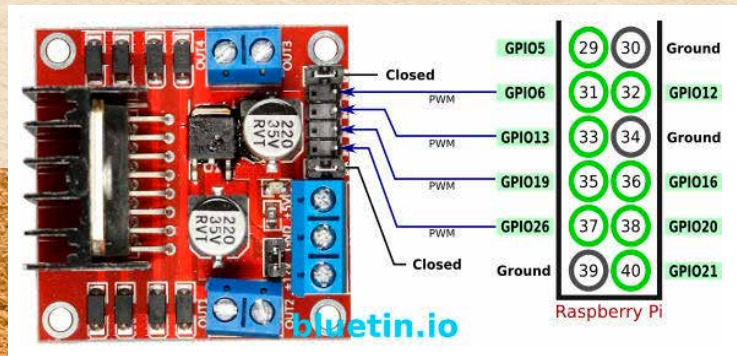
With IC L293 you can therefore run two motors. A variant of this IC is the LM298. This is also an H-bridge, but is available for very little money as a fully connectable circuit. Very useful if you want to build a robot quickly and cheaply.

The GPIOZERO Python library also helps a lot in working speed. This has many robot functions in simple commands built-in. This way you can quickly get results without too much code.

Use the following tutorial for this:
bluetin.io/python/gpio-pwm-raspberry-pi-h-bridge-dc-motor-control

Using a car chassis, a solar battery and a ready-made one motor driver LM298, you can make your own driving car.

TIP: this tutorial makes a bit of a difference more advanced way to use the **GPIOZERO** Python Library. The wheels can also rotate slower and faster. You call this Puls-width Modulation (PWM). Just like the speed of an engine, you control this example also the brightness of an LED.





RaspberryPi Zero



LM298

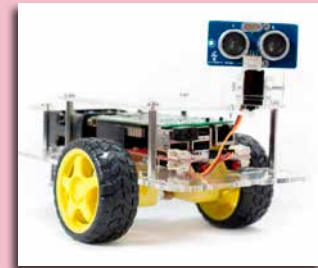


USB 5 Volt
1 x 1 Amp
1 x 2 Amp



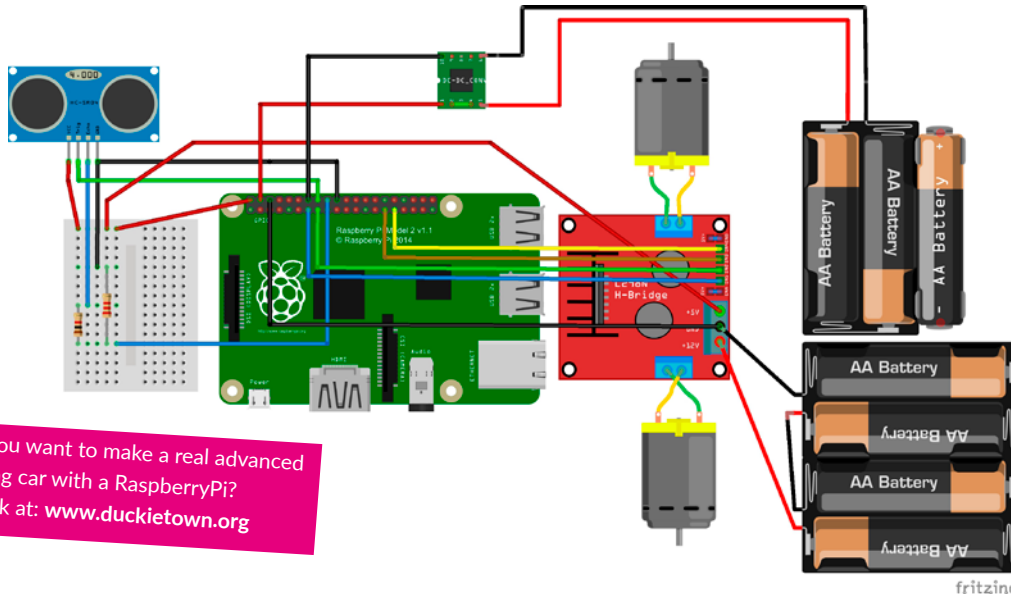
With an Ultrasonic Distance sensor on the previous tutorial, you can create a self-driving car that avoids obstacles. With the above solar battery you do not need the battery and DC step-up module.

- IN+ pin + Raspberry Pi
- IN1 Pin 13 (GPIO 27)
- IN2 Pin 15 (GPIO 22)
- IN3 Pin 29 (GPIO 5)
- IN4 Pin 31 (GPIO 6)



Close the Motor driver on the GPIO as follows from the RaspberryPi to:

hackster.io/super-kid/rover-connected-to-azure-f7bbf2



TIP: Do you want to make a real advanced self-driving car with a RaspberryPi? Take a look at: www.duckietown.org

OTHER RPI TUTS...

RPI PRINTER

pimylifeup.com/raspberry-pi-print-server

RPI WORDPRESS

projects.raspberrypi.org/en/projects/lamp-web-server-with-wordpress

RPI MUSIC SERVER

docs.mopidy.com/en/latest/installation/raspberrypi

GPIOZERO Python library:

gpiozero.readthedocs.io/en/stable

RPI WIFI ACCESSPOINT

raspberrypi.org/documentation/configuration/wireless/access-point.md

RPI OPENCV computervision:

pyimagesearch.com/2016/04/18/install-guide-raspberry-pi-3-raspbian-jessie-opencv-3

MIT-LICENCE

All software and code used in this workshop is covered by the MIT license. Roughly, this means that everyone can use and share this code as long as it is not used for commercial purposes.

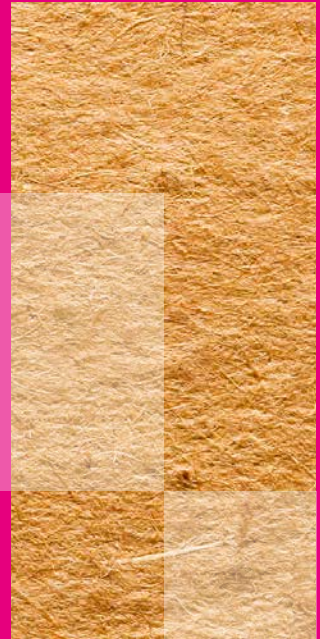
If there is a signature of the maker in the code, you have to leave it. Preferably you mention the source of your code with your own project. Because you can use it for free, a thank you and name is neat ...

Find opensource code and share:

github.com

For all your developers questions:

stackoverflow.com



SOLARPANEL WITH BATTERY CHARGER

Tutorial with solarpanel

[velleman.eu/downloads/0/user/
usermanual_edu02_nl.pdf](http://velleman.eu/downloads/0/user/usermanual_edu02_nl.pdf)

The solar panel from the WorkshopKit is:
300 mA (= 1.5 watts) / 5 volts

A standard AAA battery is
300 mA / 1.2 volts

Fully charging an AA or
AAA battery with this solar panel lasts:

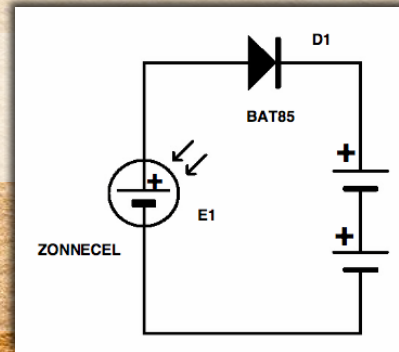
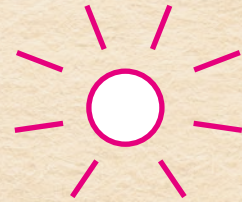
2000 mA x 1.5 volt battery = 3000 mA

// **DIVIDE BY**

Solar panel of 300 mA = 10 hours charging time

NOTE: This is a calculation example.

Always check the actual power (Volts and mA)
of a battery. And only use a rechargeable bat-
tery for this !!





5 Volt 400 mA = 2 Watt

size of these panels
14 cm x 9 cm

With this type of solar
panel you can power
an Arduino.

The Raspberry Pi needs at
least 1 Ampère. Then you
need a larger solar panel ...

climate neutral



actually quite simple

3D PRINTING

3D printing is actually quite a logical process: Print molten material along the length, width up in layers.

How do you do that:

1. Draw the form to be printed in a 3D program. You can draw in free 3D software, such as Blender, SketchUp or Doodle 3D
2. Export the form as a **.STL file**
3. Fill the 3D printer with the desired material. Usually this plastic, or so-called PLA Filament), is available in a certain color and thickness.
4. Convert the .STL file to G-code with "layer / slice" software for a 3D printer. Use for example the

free Ultimaker Software Cura.

5. Choose the right printer and set how thick the PLA is, how fine the print should be and how firm the 3D shape should be. The finer and more robust, the longer it takes to print.
6. Put the file on the SD card.
7. And printing but ...

Blender:

blender.org

Cura:

ultimaker.com/en/products/ultimaker-cura-software

SketchUp (online met account):

sketchup.com/products/sketchup-free

Doodle3D (€ 10,-):

doodle3d.co

Did you know that food too Can 3D be printed? Almost everything that melts when it gets warm and solidifies when it cools can be printed.

But also concrete. Houses and bridges are now also being printed. And prostheses for our body.

There are also printers that form full-color with plaster printing, or pancakes ...



Place shapes as flat as possible on the print bed. So that there are as few overhanging parts as possible.

Hi, Google....

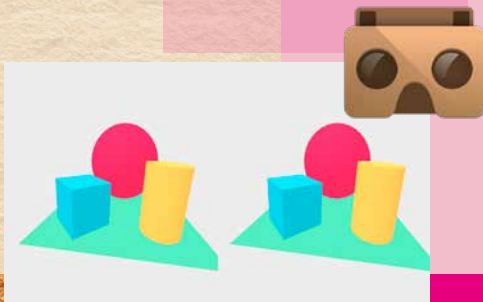
VIRTUAL REALITY

As soon as you want to build a VR environment for yourself, then a Google Cardboard, GearVR or Oculus Go are the cheapest solution. An online VR experience that you simply show via your telephone.

This is possible with A-Frame VR. Some knowledge and understanding of HTML is minimal. JavaScript offers a lot of functionality, so that is also very useful.

View with a Google Cardboard, GearVR or Oculus Go the examples on:

aframe.io

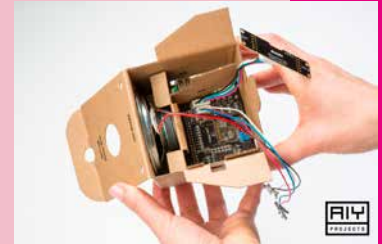


GOOGLE AIY PROJECTS

These Artificial Intelligence projects from Google work with RaspberryPi. Control electronics, games, music and robots with voice commands or with image recognition using a Google API and RaspberryPi program. For example, you can automate your own home.

View the AIY projects on:

aiyprojects.withgoogle.com



GOOGLE PAPER SIGNAL

These Voice & Paper projects from Google work with an Arduino, Servo motors and the Google Assistant mobile app. You can print out and fold paper 3D "signals" yourself. The Paper Signal will move due to voice commands.

View these projects on:

papersignals.withgoogle.com



LoRa

LoRa is a Long Range, Low Power IoT connection. For LoRa you have a Radio (channel) and a Gateway (recipient) required.

One of the largest LoRa facilitators in the Netherlands is: **The Things Network**. They offer a lot of information about LoRa, but are also a large network of Gateways, on which you can share your own data and visualize. You then need a LoRa Radio and an account on The Things Network.

View the LoRa projects on:
thethingsnetwork.org



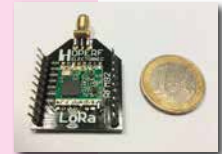
You can also build a Radio + Gateway yourself with:

RaspberryPi + HopeRF95 Radio (Gateway)
Arduino Nano + HopeRF95 Radio. (Radio)

View the tutorial on:

cpham.perso.univ-pau.fr/LORA/RPIgateway.html

Application of LoRa: Collect sensor data from a few kilometers perimeter. For example, free parking spaces in a city, climate per plant in greenhouses, fine dust in the air or full bins at an airport.



collect and share data ==
insight into your environment

understand the future
become a maker!



Author Raoul Postel is the founder of CreativeHubs.nl. He is a teacher and educational developer Crossmedia Design, UX / UI designer / developer and passionate divisor of technology and innovative possibilities in combination with creativity. Strong supporter of the Meaning Economy and Permanent Beta movement.

TOYS FOR...



Program this DJI yourself
TELLO Drone with Scratch!



Program AR yourself with
this MERGE-CUBE via Unity!

