Joy-Pi

TABLE OF CONTENTS

The login data is:
Username: pi
Password: 12345

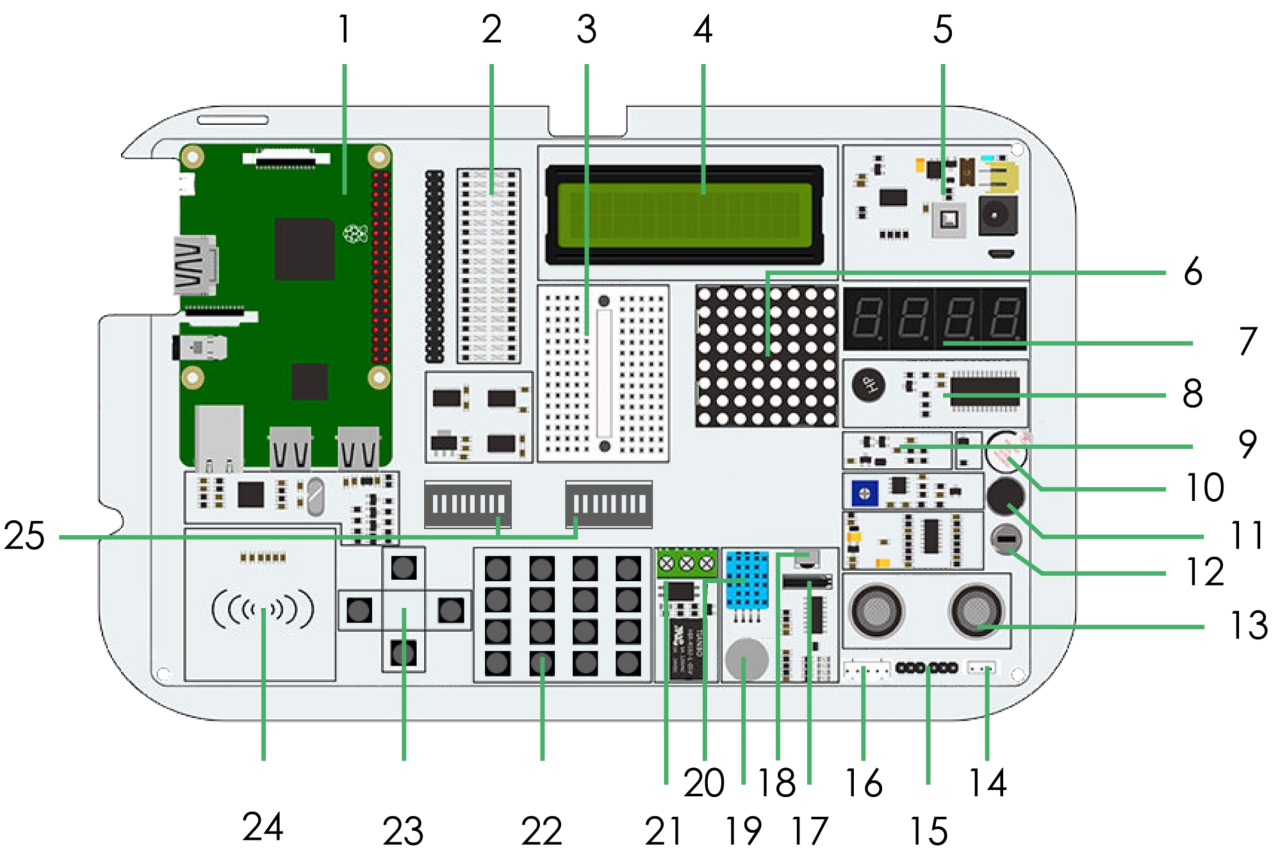
1. OVERVIEW

Dear customer,
Thank you very much for choosing our product. In the following we will show you what has to be observed during commissioning and use. Should you encounter any unexpected problems during use, please feel free to contact us.

The following lessons are designed so that, regardless of how much prior knowledge you already have, you can complete all lessons without any problems. For the different lessons you have to download sample files and run them on the Joy-Pi. How to do this can also be found in this manual.

But these tutorials are only the beginning.
We look forward to seeing what you will do with our Joy-Pi.

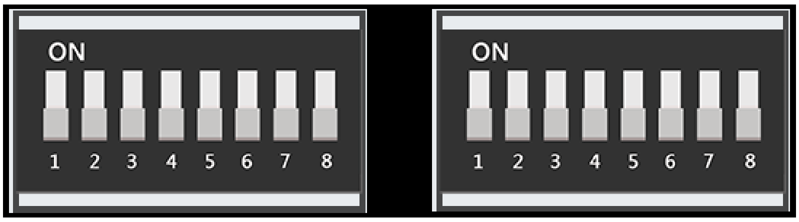
2. DETAILS



1	Raspberry Pi
2	GPIO LED Display
3	Breadboard - for creating custom curciuts with external modules
4	16x2 LCD Module (MCP23008)
5	Power supply
6	8x8 LED Matrix (MAX7219)
7	7 Segment LED display (HT16K33)
8	Vibration module
9	Light sensor - to measure the light intensity (BH1750)
10	Buzzer - to generate alarm tones
11	Sound sensor
12	Motion sensor (LH1778)
13	Ultrasonic sensor - Used for distance measurement
14 / 15	Servo interfaces - for connecting servo motors
16	Stepper motor interface
17	Tilt sensor (SW-200D)
18	Infrared sensor
19	Touch sensor
20	DHT11 Sensor - for measuring humidity and temperature
21	Relay - for opening and closing electronic circuits
22	Key matrix
23	Independent keys
24	RFID module - for reading and writing data via RFID/NFC (MFRC522)
25	Switch - for switching between sensors and modules

3. CHANGING MODULES AND USING THE GPIOS

CHANGING MODULES

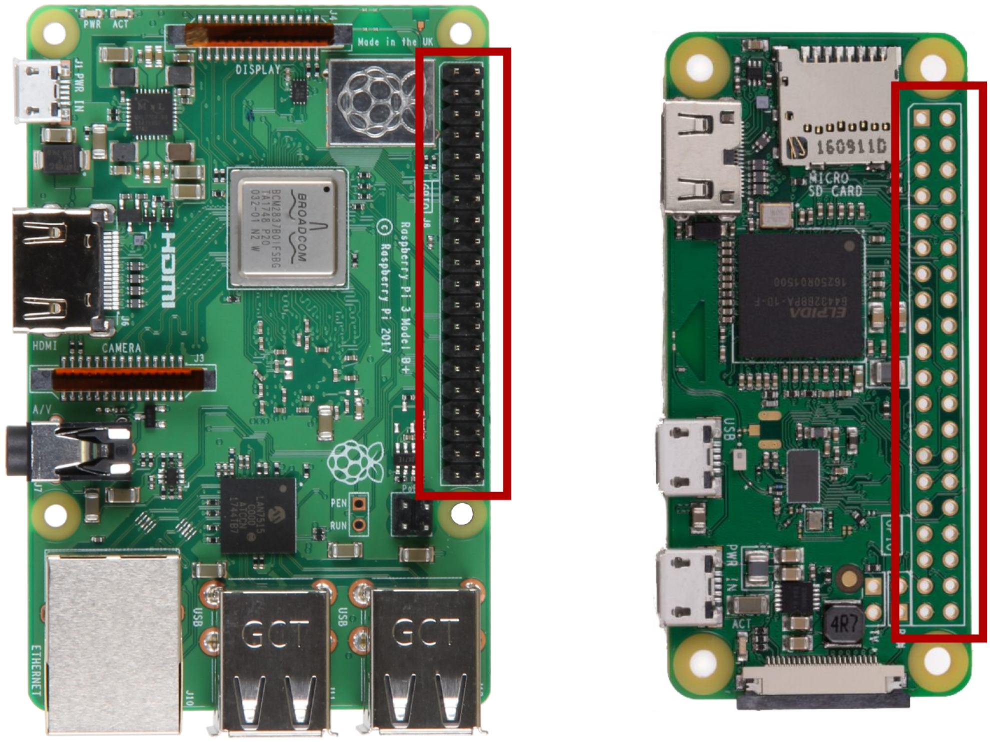


The Joy-Pi board contains 2 switching units. Each unit contains 8 switches. The switches make it possible to switch between the use of sensors and modules. Since the Raspberry Pi has only a limited number of GPIO pins, we need the switches to be able to use more sensors.

Sensors / Modules	Switching Unit	Switches
Key array	Left	1 - 8
Button matrix	Left	1 - 8
Vibration module	Right	1
Tilt sensor	Right	2
Stepper motor	Right	3, 4, 5, 6
Servomotor	Right	7, 8

USING THE GPIOS

In the following we will explain in more detail what GPIO's are, how they work and how they are controlled.



GPIO stands for: "General-purpose input / output" (universal input / output).
GPIO pins have no specific purpose. They can be configured as either input or output and have a general purpose. This depends on what you want to achieve.

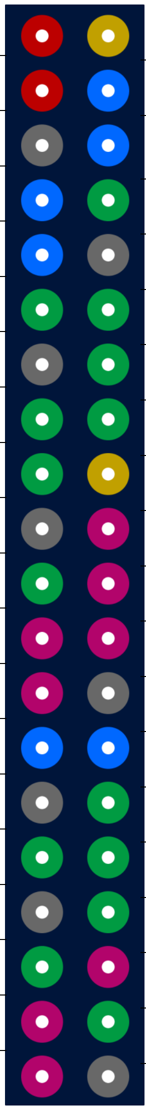
Input pin example: Button
If the Button is pressed, the Signal will transfered through the input pin to the RaspberryPi

Output pin example: Buzzer
Send a signal through the output pin to control the buzzer.

The GPIO pins are located on the right side of the Raspberry Pi board if you start from the Joy-Pi perspective.

There are 2 possible Raspberry Pi GPIO schemes: **GPIO-BOARD** and **GPIO-BCM**
The GPIO-BOARD option indicates that you are referring to the pins by the pin number. This means that the pin numbers listed below will be used.

The GPIO.BCM option means that you refer to the pins of the "Broadcom SOC Channel". These are the numbers after "GPIO" .



GPIO-Board Number:		GPIO-Board Number:	
1	3.3V DC	2	5V DC
3	GPIO 2 (SDA1, I2C)	4	5V DC
5	GPIO 3 (SCL1, I2C)	6	Ground
7	GPIO 4	8	GPIO 14 (TXD0)
9	Ground	10	GPIO 15 (RXD0)
11	GPIO 17	12	GPIO 18
13	GPIO 27	14	Ground
15	GPIO 22	16	GPIO 23
17	3.3V	18	GPIO 24
19	GPIO 10 (SPI, MOSI)	20	Ground
21	GPIO 9 (SPI, MISO)	22	GPIO 25
23	GPIO 11 (SPI, CLK)	24	GPIO 8 (SPI)
25	Ground	26	GPIO 7 (SPI)
27	ID_SD (I2C, EEPROM)	28	ID_SC
29	GPIO 5	30	Ground
31	GPIO 6	32	GPIO 12
33	GPIO 13	34	Ground
35	GPIO 19	36	GPIO 16
37	GPIO 26	38	GPIO 20
39	Ground	40	GPIO 21

ASSIGNMENT OF THE GPIO PINS ACCORDING TO GPIO.BOARD SCHEME

GPIO-Board Number:	Used sensors and modules:
1	3.3V
2	5.0V
3	I2C, SDA1 (Licht Sensor, LCD Display, 7 Segment Display)
4	5.0V
5	I2C, SCL1 (Light Sensor, LCD Display, 7 Segment Display)
6	Ground
7	DHT11 Sensor
8	TXD0
9	Ground
10	RXD0
11	Touch Sensor
12	Buzzer
13	Button matrix (ROW1), Vibration motor
14	Ground
15	Button matrix (ROW2), Tilt sensor
16	Motion sensor
17	3.3V
18	Sonic sensor
19	SPI
20	Ground
21	SPI
22	Servo2, Button matrix (COL1), Left Button
23	SPI
24	RFID Modul
25	Ground
26	LED-MATRIX
27	ID_SD (I2C, EEPROM(Electrically Erasable Programmable Read-only Memory))
28	ID_SC
29	Stepper Motor (STEP1), Button matrix (ROW3)
30	Ground
31	Stepper Motor (STEP2), Button matrix (ROW4)
32	Ultrasonic sensor (Echo)
33	Stepper Motor (STEP3), Buttonmatrix (COL4), Down Button
34	Ground
35	Stepper Motor (STEP4), Buttonmatrix (COL3), Right Button
36	Ultrasonic sensor (TRIG)
37	Servo1, Button matrix (COL2), Up Button
38	Infrared sensor
39	Ground
40	Relais

In our examples we use Python language to control the GPIO pins. In Python there is a library called "RPi.GPIO". This is a library that helps to control the pins programmatically with Python.

Take a look at the following example and the comments in the code to better understand how it works.

The first step will be to import the library by typing the command "**RPi.GPIO as GPIO**", then the "time" library comes with the command "**import time**".
Then we set the GPIO mode to GPIO.BOARD. We declare the input pin as pin number 11 for our example and the output pin as pin 12 (the input is the touch sensor and the output is the buzzer). We send a signal to the output pin, wait 1 second and then turn it off. Then, to confirm the input, we go through a loop until the **GPIO.input** input signal is received. We print "**Input Given**" to make sure that the click was confirmed, clean up the GPIO with **GPIO.cleanup ()** and finish the script.

```
import RPi.GPIO as GPIO
import time                                                    #import lybraries
import signal

TOUCH = 11                                                     #Declaring variables
BUZZER = 12                                              #and connecting pins

def setup_gpio():                                              #Definition of in and outputs
    GPIO.setmode(GPIO.BOARD)
    GPIO.setup(TOUCH, GPIO.IN, pull_up_down=GPIO.PUD_UP)
    GPIO.setup(BUZZER, GPIO.OUT)

def do_smt(channel):                                           #class for buzzer output and
    print("Touch detected")                              #detected touch
    GPIO.output(BUZZER, GPIO.HIGH)                             #Signal output
    time.sleep (1)                                             #Wait 1 second
    GPIO.output(BUZZER, GPIO.LOW)                              #Stop signal Output

def main():
    setup_gpio()
    try:                                                       #Checking if touch is detected
        GPIO.add_event_detect(TOUCH, GPIO.FALLING, callback=do_smt, bouncetime=200)
        signal.pause()
    except KeyboardInterrupt:                                  #CTRL+C is closing the script
        pass
    finally:
        GPIO.cleanup()

if __name__ == '__main__':
    main()
```

To learn more about the purpose and use of GPIO, we recommend that you read the official documentation on the topic of GPIO pins written by the Raspberry Pi foundation.

https://www.raspberrypi.org/documentation/usage/gpio/

GETTING THE PREINSTALLED OPERATING SYSTEM

For the First Step you have to Download the image file with the Joy-Pi operating system.
You can find the file on our website at https://joy-pi.net/downloads/.

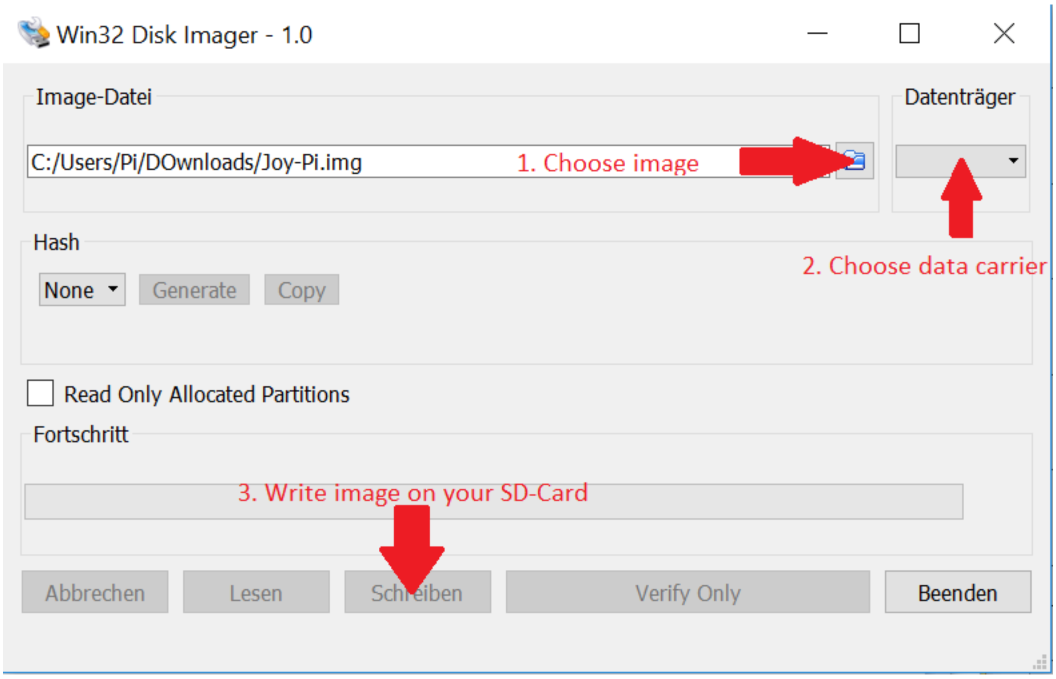
1. Load the .Zip file onto your computer and unzip it to any folder you like. You should receive a .ISO file

2. Connect a MicroSD card to your computer with the attached MicroSD card reader.

3. Now format the MicroSD card with the program „SD Formatter“

4. Start the Program „Win32DiskImager“ and choose the unziped .Iso file, then click on the „Write“ button to copy the image onto your MicroSD card.

5. Now the MicroSD card is ready for use, you can put it in your Raspberry Pi now.

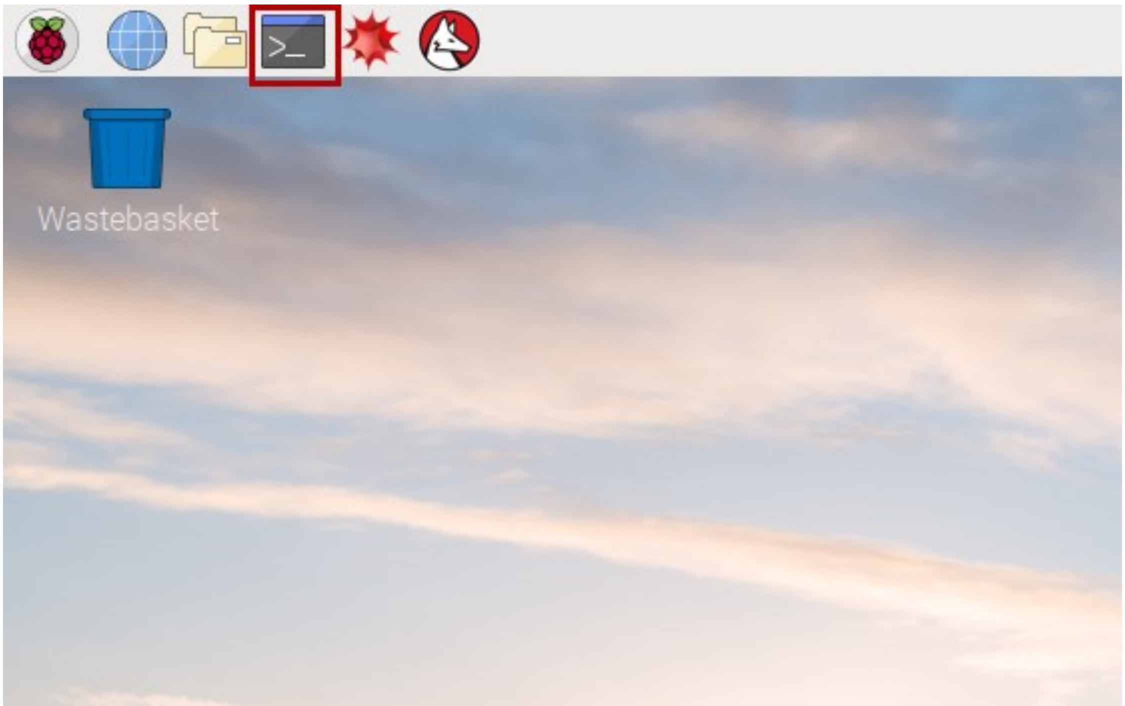


4. USE OF PYTHON AND LINUX

This step is optional, but makes it easier to execute scripts without having to create them individually.

The scripts used in this guide can be downloaded directly from a package. Simply follow the instructions below:

1. Open the "**Terminal**". We use this to run most of our Python scripts and download extensions and scripts.



2. After successfully opening the terminal, we need to download the script archive to the desktop with the following commands:

```
cd Desktop/
wget http://anleitung.joy-it.net/wp-content/uploads/2019/01/Joy-Pi.zip
```

3. Press "Enter" on your keyboard. Now all you have to do is unpack the archive:

```
unzip JoyPi.zip
```

4. Press "Enter" and wait until the process is completed.

5. With the command "cd" we change to the correct directory so that we can use the scripts that are in it:

```
cd Joy-Pi
```

Attention! Every time you restart your terminal, you have to repeat the steps of changing the directory.

EXECUTING PYTHON SCRIPTS

After we successfully downloaded our script, we would like to execute it. Open the terminal again and follow the instructions below to run the script:

Write the command "**sudo python** <**script name**>" to execute a Python script.
For example:

```
sudo python buzzer.py
```

The sudo command gives us root permissions (admin permissions), which are later required by the GPIO library. We write "python" to tell the system that we want to execute the command with Python. At the end, we write the script name as we put it on the desktop. Make sure to always be in the right folder when you execute the command.

5. LESSONS

5.1 LESSON 1: USING THE BUZZER FOR WARNING SOUNDS

In the previous explanation, we learned how to use the GPIO pin both as output and input. To test this now, we go ahead with a real example and apply our knowledge from the previous lesson. The module we will use is the "Buzzer".

We will use the GPIO output to send a signal to the buzzer and close the circuit to generate a loud buzz. Then we will send another signal to turn it off.

The buzzer is located on the right side of the Joy-Pi-Board and is easily recognized by the loud noise that it will make when activated. When you use your Raspberry Pi for the first time, the buzzer may have a protective sticker on it. Make sure this sticker has been removed before using the Buzzer.

Just like in the previous example, we have prepared a special script with detailed comments that will explain how the whole buzzer process works, and how we can control the buzzer with the GPIOs.

First we import the **RPi.GPIO library** and the **time** library. Then we configure the buzzer. At **pin 12** we set the GPIO mode to **GPIO BOARD** and the pin as **OUTPUT**.

We output a signal for 0.5 seconds and then turn it off.

Buzzer code example:

```
#!/usr/bin/python
# -*- coding: utf-8 -*-

import RPi.GPIO as GPIO    #import librarys
import time

buzzer_pin = 12            #define buzzer pin

GPIO.setmode(GPIO.BOARD)
GPIO.setup(buzzer_pin, GPIO.OUT)

# Make buzzer sound
GPIO.output(buzzer_pin, GPIO.HIGH)
#wait 0.5 seconds
time.sleep(0.5)
# Stop buzzer sound
GPIO.output(buzzer_pin, GPIO.LOW)

GPIO.cleanup()
```

Execute the following commands and try it yourself:

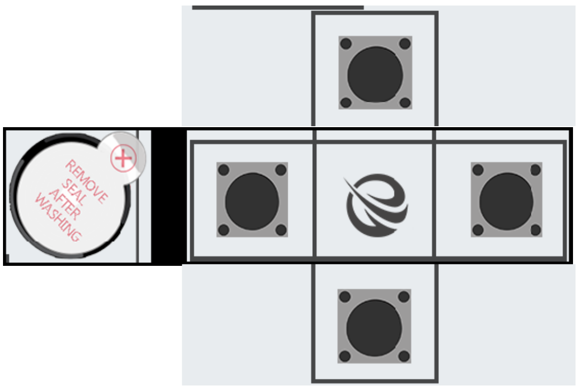
```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python buzzer.py
```


5.2 LESSON 2: CONTROLLING THE BUZZER WITH KEY INPUTS

After successfully demonstrating how to turn the buzzer on and off, it's time to make things a little more exciting. In this lesson, we'll combine a button with the buzzer so that the buzzer is only turned on by pressing the button.

This time we will use 2 GPIO setups. One will be the **GPIO.INPUT**, which takes the button as an input, another will be the **GPIO.OUTPUT**, which sends a signal to the buzzer to output a sound.



Attention! For this example you have to switch between the modules. Turn switch number 5, 6, 7 and 8 on the left switching unit ON. All the other switches should be turned OFF.

In our example we use the upper of the 4 keys on the lower left side. Theoretically, however, any of the 4 keys can be used. If you still want to use another key, you have to change the pin assignment accordingly.

GPIO37	Upper button
GPIO27	Lower button
GPIO22	Left button
GPIO35	Right button

For this part of our tutorial we need to use 2 GPIO settings. One input and one output. The GPIO input is used to determine when a key was pressed and the GPIO output is used to activate the buzzer when that key is pressed.

As you can see in the example below, we have defined 2 pins called **buzzer_pin** and **button_pin**. The program runs until CTRL + C is pressed.

When you press the key on your Joy-Pi, the buzzer does a sound! Release the key and the Buzzer stops.

Example code:

```
#!/usr/bin/python
# -*- coding: utf-8 -*-

import RPi.GPIO as GPIO
import time

# configure both button and buzzer pins
button_pin = 37
buzzer_pin = 12

# set board mode to GPIO.BOARD
GPIO.setmode(GPIO.BOARD)

# setup button pin as input and buzzer pin as output
GPIO.setup(button_pin, GPIO.IN, pull_up_down=GPIO.PUD_UP)
GPIO.setup(buzzer_pin, GPIO.OUT)

try:
    while True:
        # check if button pressed
        if(GPIO.input(button_pin) == 0):
            # set buzzer on
            GPIO.output(buzzer_pin, GPIO.HIGH)
        else:
            # it's not pressed, set button off
            GPIO.output(buzzer_pin, GPIO.LOW)
except KeyboardInterrupt:
    GPIO.cleanup()
```

Execute the following commands and try it yourself:

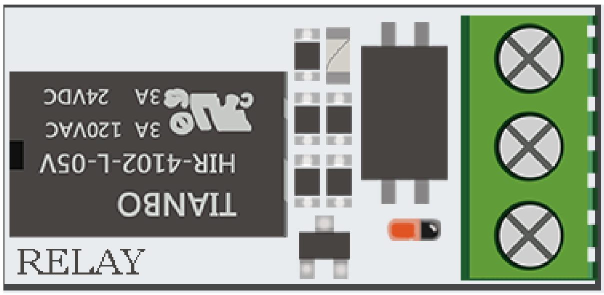
```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python button_buzzer.py
```


5.3 LESSON 3: HOW A RELAY WORKS AND HOW TO CONTROL IT

Now that we know everything we need to know about the buzzer, it's time for the next lesson. Now we'll learn how to use the relay, what the function of the relay is and how to control it.

Relays are used to control a circuit by a separate low power signal, or when several circuits need to be controlled by one signal. If you connect you wires to „**NC**“ and „**COM**“ and you send a GPIO.HIGH signal the relay will close and deactivate your custom circuit. If you stop the signal the relay will open and will activate your custom circuit.



The relay is located in the middle, lower part of the board, next to the key matrix. It has 3 inputs of which we will use 2 in this example.
„**NC“** means „normally closed“, „**NO**“means „normally open“ and „**COM**“ means „commom“.
Common in this case means common ground.
When the common circuit is de-energised (GPIO.LOW) the „**NC**“ circuit is closed.
When the common circuit gets energized (GPIO.HIGH) the relay will close the circuit for „**NO**“.
When using „**NO**“ and „**COM**“ everything is reversed.
When „**COM**“ is off (GPIO.LOW) the relay circuit is open.
When „**COM**“ is on (GPIO.High) the relay circuit is closed.

Attention! It is very important not to try to connect high voltage devices to the relay (e.g. table lamp, coffee machine etc.). This could result in electric shock and serious injury.

Now that we have understood what a relay is and how it works, we take a look at the code:

```
#!/usr/bin/python
# -*- coding: utf-8 -*-

import RPi.GPIO as GPIO
import time

# define relay pin
relay_pin = 40

# set GPIO mode as GPIO.BOARD
GPIO.setmode(GPIO.BOARD)
# setup relay pin as OUTPUT
GPIO.setup(relay_pin, GPIO.OUT)

# Open Relay
GPIO.output(relay_pin, GPIO.LOW)
# Wait half a second
time.sleep(0.5)
# Close Relay
GPIO.output(relay_pin, GPIO.HIGH)
GPIO.cleanup()
```

Execute the following commands and try it for yourself:

```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python relay.py
```

5.4 LESSON 4: SENDING A VIBRATION SIGNAL

Have you ever wondered how your phone vibrates when someone calls you or when you receive a message? We built exactly the same module into our Joy-Pi and now we will learn how to use it.

The vibration module is located on the right side of the LED matrix and below the segment LED. When it is on, it is difficult to tell where the vibration is coming from because it feels like the whole Joy-Pi board is vibrating.

The vibration module uses a **GPIO.OUTPUT**-signal just like the Buzzer and other modules previously used. When sending an output signal the module will start vibrating.
When you stop the signal with **GPIO.LOW** the vibration will stop.

You can adjust the vibration length with different **time.sleep()** intervals.

⚠ For this example you have to switch between the modules. Set switch number 1 of the right-hand switching unit to ON. All the other switches should be turned OFF.

```
#!/usr/bin/python
# -*- coding: utf-8 -*-

import RPi.GPIO as GPIO
import time

# define vibration pin
vibration_pin = 13

# Set board mode to GPIO.BOARD
GPIO.setmode(GPIO.BOARD)

# Setup vibration pin to OUTPUT
GPIO.setup(vibration_pin, GPIO.OUT)

# turn on vibration
GPIO.output(vibration_pin, GPIO.HIGH)
# wait 4 seconds
time.sleep(4)
# turn off vibration
GPIO.output(vibration_pin, GPIO.LOW)
# cleanup GPIO
GPIO.cleanup()
```

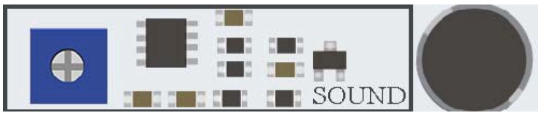
Execute the following commands and try it yourself:

```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python vibration.py
```


5.5 LESSON 5: DETECTING NOISES WITH THE SOUND SENSOR

In this lesson, we will learn how to use the sound sensor to make inputs, detect loud noises and react accordingly. So you can build your own alarm system that detects loud noises or turn on an LED by clapping!



The sound sensor consists of two parts: a blue potentiometer, which regulates the sensitivity, and the sensor itself, which detects the input of sounds. The sound sensor can be easily recognized by the blue potentiometer and the sensor itself is located on the right under the buzzer.

With the help of the potentiometer we can regulate the sensitivity of the sensor. For our script to work, we must first learn how to control the sensitivity. To adjust the sensitivity you have to turn the small screw on the potentiometer with a screwdriver to the left or right. The best way to test the sensitivity is to run the script. Clap your hands and see if the device is receiving a signal. If no signal is received this means that the sensitivity of the sensor is not set high enough. This can be easily corrected by turning the potentiometer.

```
#!/usr/bin/python
# -*- coding: utf-8 -*-

import RPi.GPIO as GPIO
import time

# define sound pin
sound_pin = 18
# set GPIO mode to GPIO.BOARD
GPIO.setmode(GPIO.BOARD)
# setup pin as INPUT
GPIO.setup(sound_pin, GPIO.IN, pull_up_down=GPIO.PUD_UP)

try:
    while True:
        # check if sound detected or not
        if(GPIO.input(sound_pin)==GPIO.LOW):
            print('Sound Detected')
            time.sleep(0.1)
except KeyboardInterrupt:
    # CTRL+C detected, cleaning and quitting the script
    GPIO.cleanup()
```


Execute the following commands and try it yourself:

```
cd /home/pi/Desktop/Joy-Pi/
```

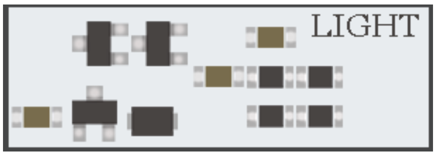
```
sudo python sound.py
```

First we define our pin, **GPIO18**. Then we set a **while loop** to run this script permanently. We check if we have received an input from the sound sensor indicating that loud noises have been detected and then we print "Sound Detected".

If **Ctrl + C** is pressed, the program is quit.

5.6 LESSON 6: DETECTING BRIGHTNESS WITH THE LIGHT SENSOR

The light sensor is one of our favorites. It is extremely useful in many projects and situations, e.g. with lamps that switch on automatically as soon as it gets dark. With the light sensor we can see how bright the module surface is.



The light sensor is difficult to detect because it consists of very small parts. The sensor is to the left of the buzzer. If you cover it with your finger, the output of the light sensor should be close to zero, as no light can reach it.

It's time to test it in real time and see how it works. However, the light sensor is a little different from other sensors because it works with I2C and not with the normal GPIOs as we learned in the lessons befo-re.

In this script we use a function to communicate with the sensor, this way we can get the brightness. The higher the number, the higher is the surrounding.

```
#!/usr/bin/python
# -*- coding: utf-8 -*-
# Author: Matt Hawkins
# Author's Git: https://bitbucket.org/MattHawkinsUK/
# Author's website: https://www.raspberrypi-spy.co.uk

import RPi.GPIO as GPIO
import smbus
import time

 # Find the right revision for bus driver
if(GPIO.RPI_REVISION == 1):
    bus = smbus.SMBus(0)
else:
    bus = smbus.SMBus(1)

class LightSensor():

    def __init__(self):

        # Define some constants from the datasheet

        self.DEVICE = 0x5c # Default device I2C address

        self.POWER_DOWN = 0x00 # No active state
        self.POWER_ON = 0x01 # Power on
        self.RESET = 0x07 # Reset data register value

        # Start measurement at 4lx resolution. Time typically 16ms.
        self.CONTINUOUS_LOW_RES_MODE = 0x13
        # Start measurement at 1lx resolution. Time typically 120ms
        self.CONTINUOUS_HIGH_RES_MODE_1 = 0x10
        # Start measurement at 0.5lx resolution. Time typically 120ms
        self.CONTINUOUS_HIGH_RES_MODE_2 = 0x11
        # Start measurement at 1lx resolution. Time typically 120ms
        # Device is automatically set to Power Down after measurement.
        self.ONE_TIME_HIGH_RES_MODE_1 = 0x20
        # Start measurement at 0.5lx resolution. Time typically 120ms
        # Device is automatically set to Power Down after measurement.
        self.ONE_TIME_HIGH_RES_MODE_2 = 0x21
```



```
        # Start measurement at 1lx resolution. Time typically 120ms
          # Device is automatically set to Power Down after measurement.
          self.ONE_TIME_LOW_RES_MODE = 0x23

    def convertToNumber(self, data):

          # Simple function to convert 2 bytes of data
          # into a decimal number
          return ((data[1] + (256 * data[0])) / 1.2)

    def readLight(self):

          data = bus.read_i2c_block_data
(self.DEVICE,self.ONE_TIME_HIGH_RES_MODE_1)
          return self.convertToNumber(data)

def main():

    sensor = LightSensor()
    try:
        while True:
            print "Light Level : " + str(sensor.readLight()) + " lx"
            time.sleep(0.5)
    except KeyboardInterrupt:
        pass

if __name__ == "__main__":
               main()
```

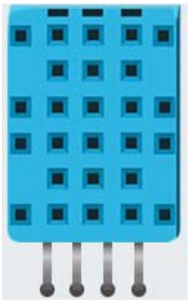
Execute the following commands and try it yourself:

```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python light_sensor.py
```

5.7 LESSON 7: DETECTING THE TEMPERATURE AND THE HUMIDITY

The DHT11 is a very interesting sensor, because it has not only one function, but two! It contains both a humidity sensor and a temperature sensor, both of which are very accurate. Ideal for any weather station project, or if you want to check the temperature and humidity in the room!



The DHT11 sensor is very easy to recognize. A small blue sensor with many small holes. It is located to the right of the relay and above the touch sensor. Working with the DHT11 sensor is very easy, thanks to the Adafruit_DHT library. The library is used to output temperature and humidity as values without having to perform complicated mathematical calculations.

```
#!/usr/bin/python
# Copyright (c) 2014 Adafruit Industries
# Author: Tony DiCola

import sys
import Adafruit_DHT

# set type of the sensor
sensor = 11
# set pin number
pin = 4

# Try to grab a sensor reading.  Use the read_retry method which will retry up
# to 15 times to get a sensor reading (waiting 2 seconds between each retry).
humidity, temperature = Adafruit_DHT.read_retry(sensor, pin)

# Un-comment the line below to convert the temperature to Fahrenheit.
# temperature = temperature * 9/5.0 + 32

# Note that sometimes you won't get a reading and
# the results will be null (because Linux can't
# guarantee the timing of calls to read the sensor).
# If this happens try again!
if humidity is not None and temperature is not None:
    print('Temp={0:0.1f}*  Humidity={1:0.1f}%'.format(temperature, humidity))
else:
    print('Failed to get reading. Try again!')
sys.exit(1)
```

Execute the following commands and try it yourself:

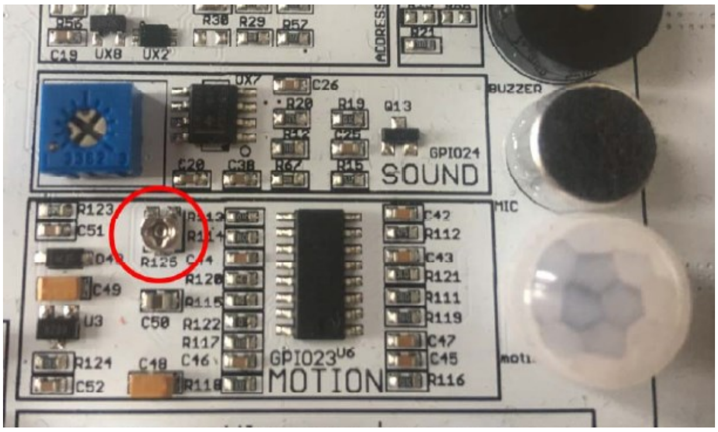
```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python dht11.py
```

5.8 LESSON 8: DETECTING MOVEMENTS

The motion sensor is one of the most useful and frequently used sensors. It can be used, for example, to build an alarm system. When the sensor detects a movement, it can send a signal to the buzzer, which then sounds a loud alarm.

The motion sensor is located directly under the sound sensor and is covered by a small, transparent cap. The cap helps the sensor to detect more movements by refracting the infrared light of the environment. The sensitivity of the motion sensor, like that of the sound sensor, is controlled with a potentiometer. This is located below the potentiometer of the sound sensor, but is much smaller. By using a screwdriver, you can set the distances, over which the motion sensor should react.



The motion sensor is controlled by the GPIO pins. When motion is detected, the motion sensor will send a signal. This will stop for some time and then stop again until the sensor detects the next movement.

```
#!/usr/bin/python
# -*- coding: utf-8 -*-

import RPi.GPIO as GPIO
import time

# define motion pin
motion_pin = 16

# set GPIO as GPIO.BOARD
GPIO.setmode(GPIO.BOARD)
# set pin mode as INPUT
GPIO.setup(motion_pin, GPIO.IN)

try:
    while True:
       if(GPIO.input(motion_pin) == 0):
             print "Nothing moves ..."
       elif(GPIO.input(motion_pin) == 1):
             print "Motion detected!"
       time.sleep(0.1)
except KeyboardInterrupt:
    GPIO.cleanup()
```

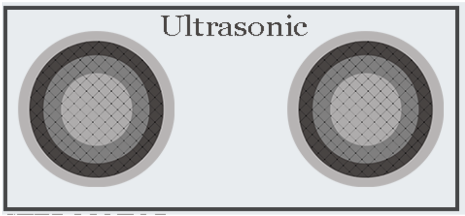
Execute the following commands and try it yourself:

```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python motion.py
```

5.9 LESSON 9: MEASURING DISTANCES WITH THE ULTRASONIC SENSOR

Now we will learn how to use the ultrasonic sensor to measure distances and display them on the Joy-Pi screen. By the way, cars use the same method to measure distances.



The ultrasonic sensor is located at the bottom right of the Joy-Pi board, directly above the stepper motor and servo interfaces. It is easily recognizable by the two large circles. We will move our hands over the distance sensor to measure the distance between our hands and the Joy-Pi.

The distance sensor works with **GPIO INPUT**, but it is slightly different from what we used in our previous lessons. The sensor needs a certain interval to be able to detect the distance in an accurate way. It sends an ultrasonic signal and with a built-in sensor it receives the echo reflected by an obstacle. From the time difference between sending the signal and receiving the echo, the distance is calculated.

```
#!/usr/bin/python
# -*- coding: utf-8 -*-
# Author : www.modmypi.com
# Link: https://www.modmypi.com/blog/hc-sr04-ultrasonic-range-sensor-on-the-
raspberry-pi

import RPi.GPIO as GPIO
import time

GPIO.setmode(GPIO.BOARD)

TRIG = 36
ECHO = 32   #Declare variables

print "Distance Measurement In Progress"  #Console output

GPIO.setup(TRIG,GPIO.OUT) #Using TRIG as output
GPIO.setup(ECHO,GPIO.IN)  #Using ECHO as Input

GPIO.output(TRIG, False)
print "Waiting For Sensor To Settle" #Console output
time.sleep(2)  #Wait 2 seconds

GPIO.output(TRIG, True)  #Start sending a signal
time.sleep(0.00001)      #Wait for 0.00001 seconds
GPIO.output(TRIG, False) #Stop sending a Signal

while GPIO.input(ECHO)==0:
  pulse_start = time.time()

while GPIO.input(ECHO)==1:
  pulse_end = time.time()

pulse_duration = pulse_end - pulse_start #measurement for distance

distance = pulse_duration * 17150 #Calculation for distance

distance = round(distance, 2) #rounded to 2 decimal places

print "Distance:",distance,"cm" #Output distance in console

GPIO.cleanup()
```

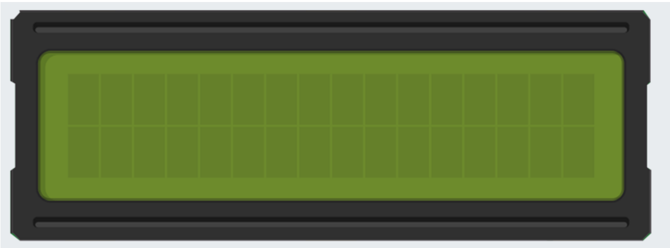
Execute the following commands and try it yourself:

```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python distance.py
```

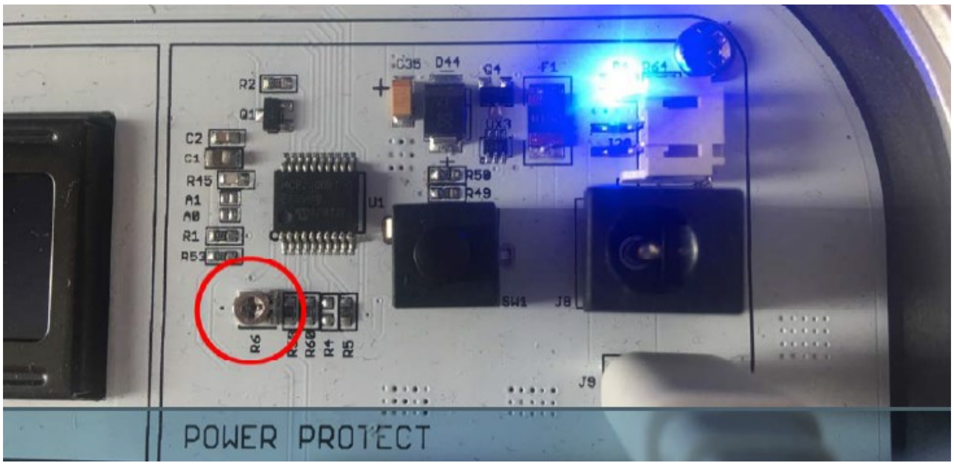

5.10 LESSON 10: CONTROLLING THE LCD DISPLAY

With the Joy-Pi you can display the LCD data that you collect with your sensors and update it in real time depending on the changes that the modules go through. For example, in conjunction with the temperature sensor - always display the current temperature and humidity on the LCD.



The LCD screen takes up a large part of the Joy-Pi board - it is located at the top center of the Joy-Pi, to the right of the GPIO LED display. As soon as the demo script and the examples are executed, the display turns on. Thanks to the integrated backlight you can read data on the display even in complete darkness.

Like the sound and motion sensors, the LCD also has an associated potentiometer. With this potentiometer you can adjust the brightness of the backlight of the display. If you turn it counterclockwise the brightnes gets higher and if you turn it clockwise it will get lowered.
Rotate the potentiometer counterclockwise to increase the contrast, rotate it clockwise to decrease the contrast.



The LCD and some other sensors do not work with GPIO technology. Therefore we use "**I2C**". We use the **address 21** for the LCD by establishing a connection to this I2C address. So we can send commands such as writing text, switching on the backlight of the LCD, activating the cursor, etc.
We use the **Adafruit_CharLCDBackpack** library to control the display.

```
#!/usr/bin/python
# -*- coding: utf-8 -*-

# Example using a character LCD backpack.
import time
import Adafruit_CharLCD as LCD

# Define LCD column and row size for 16x2 LCD.
lcd_columns = 16
lcd_rows    = 2

# Initialize the LCD using the pins
lcd = LCD.Adafruit_CharLCDBackpack(address=0x21)

try:
    # Turn backlight on
    lcd.set_backlight(0)

    # Print a two line message
    lcd.message('Hello\nworld!')

    # Wait 5 seconds
    time.sleep(5.0)

    # Demo showing the cursor.
    lcd.clear()
    lcd.show_cursor(True)
    lcd.message('Show cursor')

    time.sleep(5.0)

    # Demo showing the blinking cursor.
    lcd.clear()
    lcd.blink(True)
    lcd.message('Blink cursor')

    time.sleep(5.0)

    # Stop blinking and showing cursor.
    lcd.show_cursor(False)
    lcd.blink(False)

    # Demo scrolling message right/left.
    lcd.clear()
```

```
    message = 'Scroll'
    lcd.message(message)
    for i in range(lcd_columns-len(message)):
        time.sleep(0.5)
        lcd.move_right()
    for i in range(lcd_columns-len(message)):
        time.sleep(0.5)
        lcd.move_left()

    # Demo turning backlight off and on.
    lcd.clear()
    lcd.message('Flash backlight\nin 5 seconds...')
    time.sleep(5.0)
    # Turn backlight off.
    lcd.set_backlight(1)
    time.sleep(2.0)
    # Change message.
    lcd.clear()
    lcd.message('Goodbye!')
    # Turn backlight on.
    lcd.set_backlight(0)
    # Turn backlight off.
    time.sleep(2.0)
    lcd.clear()
    lcd.set_backlight(1)
except KeyboardInterrupt:
    # Turn the screen off
    lcd.clear()
               lcd.set_backlight(1)
```

To control the LCD we use the **Adafruit_CharLCDBackpack** library.

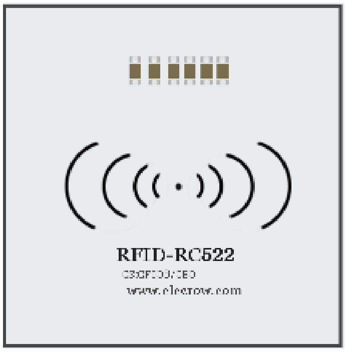
Execute the following commands and try it yourself:

```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python lcd.py
```

5.11 LESSON 11: READING AND WRITING RFID CARDS

In this lesson you will learn how to control the RFID module. The RFID module is a very interesting and useful module. It is used worldwide in a variety of solutions such as: Intelligent door locks, employee IDs, business cards and even dog collars.



The RFID module is located directly under the Raspberry Pi and looks like a small Wifi symbol. This symbol means wireless connectivity. To use it, we need to take the chip, or card, that comes with the Joy-Pi and hold it over the Joy-Pi RFID chip area. It must be close enough for our script to be recognized. 2-4cm should be close enough. Just try it out!

To use the RFID RC522 Shield we need the SPI Bus. We have to modify the config file otherwise the kernel couldn‘t start, to get acces to the config file we use the following command:

```
sudo nano /boot/config.txt
```

The following lines have to be attached to the end of the file:

```
device_tree_param=spi=on
dtoverlay=spi-bcm2708
```

We save the file with CTRL+O and then pressing Enter, after saving the file we can close the editor with CTRL+X. Finally we have to activate SPI so we use the following command to modify the settings:

```
sudo raspi-config
```

Now we go to „Interfacing options“ then activate „SPI“ and click on „OK“ we restart the Raspberry pi and the configuration part for the RFID module is done.

To navigate to the folder for the RFID scripts you have to use the following command:

```
cd /home/pi/Desktop/Joy-Pi/MFRC522-python
```

If you want to write on the chip or card you can use the following command:

```
sudo python Write.py
```

You can change the data that is getting written on the RFID chip or card by changing the program code:

```
        # Select the scanned tag
        MIFAREReader.MFRC522_SelectTag(uid)

        # Authenticate
        status = MIFAREReader.MFRC522_Auth(MIFAREReader.PICC_AUTHENT1A, 8, key, uid)
        print "\n"

        # Check if authenticated
        if status == MIFAREReader.MI_OK:

            # Variable for the data to write
            data = [99, 11, 55, 66, 44, 111, 222, 210, 125, 153, 136, 199, 144, 177, 166, 188]

            # Fill the data with 0xFF
            for x in range(0,16):
                data.append(0xFF)
```

To modify the data you have to change the number sequence in the square brackets, but the numbers cannot be below 0 or above 255.

If you want to read the number sequence you have to use the following command:

```
sudo python Read.py
```

Now you can put the chip or the card on the RFID-reader and it will show you something like this:

```
Card detected
Card read UID: 107,144,78,115
Size: 8
Sector 8 [99, 11, 55, 66, 44, 111, 222, 210, 125, 153, 136, 199, 144, 177, 166,
188]
```

The number sequence next to sector 8 is the one we saved on the chip or card now.

Example code RFID-Read:

```
#!/usr/bin/env python
# -*- coding: utf8 -*-
import RPi.GPIO as GPIO
import MFRC522
import signal
continue_reading = True
# Capture SIGINT for cleanup when the script is aborted
def end_read(signal,frame):
    global continue_reading
    print "Ctrl+C captured, ending read."
    continue_reading = False
    GPIO.cleanup()
# Hook the SIGINT
signal.signal(signal.SIGINT, end_read)
# Create an object of the class MFRC522
MIFAREReader = MFRC522.MFRC522()
# Welcome message
print "Welcome to the MFRC522 data read example"
print "Press Ctrl-C to stop."
# This loop keeps checking for chips.
# If one is near it will get the UID and authenticate
while continue_reading:
    # Scan for cards
    (status,TagType) = MIFAREReader.MFRC522_Request(MIFAREReader.PICC_REQIDL)
    # If a card is found
    if status == MIFAREReader.MI_OK:
        print "Card detected"
    # Get the UID of the card
    (status,uid) = MIFAREReader.MFRC522_Anticoll()
    # If we have the UID, continue
    if status == MIFAREReader.MI_OK:
        # Print UID
        print "Card read UID: %s,%s,%s,%s" % (uid[0], uid[1], uid[2], uid[3])
        # This is the default key for authentication
        key = [0xFF,0xFF,0xFF,0xFF,0xFF,0xFF]
        # Select the scanned tag
        MIFAREReader.MFRC522_SelectTag(uid)
        # Authenticate
        status = MIFAREReader.MFRC522_Auth(MIFAREReader.PICC_AUTHENT1A, 8, key, uid)
        # Check if authenticated
        if status == MIFAREReader.MI_OK:
            MIFAREReader.MFRC522_Read(8)
            MIFAREReader.MFRC522_StopCrypto1()
        else:
            print "Authentication error"
```

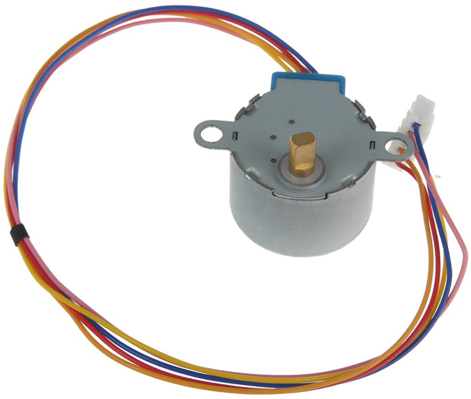

Example code RFID-Write:

```
#!/usr/bin/env python
# -*- coding: utf8 -*-
import RPi.GPIO as GPIO
import MFRC522
import signal

continue_reading = True

# Capture SIGINT for cleanup when the script is aborted
def end_read(signal,frame):
    global continue_reading
    print "Ctrl+C captured, ending read."
    continue_reading = False
    GPIO.cleanup()

# Hook the SIGINT
signal.signal(signal.SIGINT, end_read)

# Create an object of the class MFRC522
MIFAREReader = MFRC522.MFRC522()

# This loop keeps checking for chips. If one is near it will get the UID and au-
thenticate
while continue_reading:

    # Scan for cards
    (status,TagType) = MIFAREReader.MFRC522_Request(MIFAREReader.PICC_REQIDL)

    # If a card is found
    if status == MIFAREReader.MI_OK:
        print "Card detected"

    # Get the UID of the card
    (status,uid) = MIFAREReader.MFRC522_Anticoll()

    # If we have the UID, continue
    if status == MIFAREReader.MI_OK:

        # Print UID
        print "Card read UID: %s,%s,%s,%s" % (uid[0], uid[1], uid[2], uid[3])

        # This is the default key for authentication
        key = [0xFF,0xFF,0xFF,0xFF,0xFF,0xFF]

        # Select the scanned tag
        MIFAREReader.MFRC522_SelectTag(uid)
```

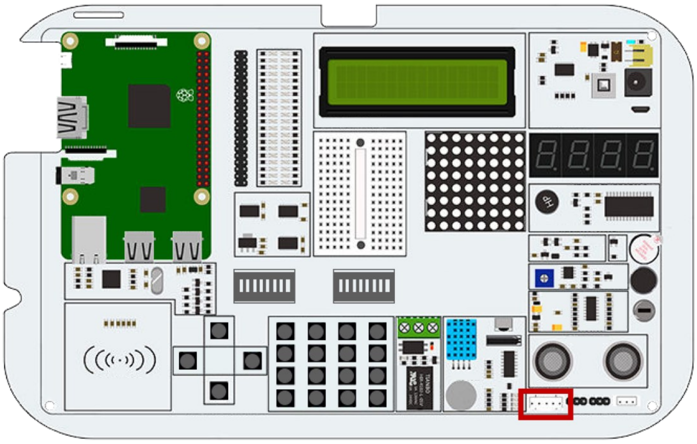
Continuation RFID-Write code:

```
# Authenticate
status = MIFAREReader.MFRC522_Auth(MIFAREReader.PICC_AUTHENT1A, 8, key, uid)
print "\n"
# Check if authenticated
if status == MIFAREReader.MI_OK:

    # Variable for the data to write
    data = [99, 11, 55, 66, 44, 111, 222, 210, 125, 153, 136, 199, 144, 177, 166, 188]

    # Fill the data with 0xFF
    for x in range(0,16):
        data.append(0xFF)

    print "Sector 8 looked like this:"
    # Read block 8
    MIFAREReader.MFRC522_Read(8)
    print "\n"

    print "Sector 8 will now be filled with 0xFF:"
    # Write the data
    MIFAREReader.MFRC522_Write(8, data)
    print "\n"

    print "It now looks like this:"
    # Check to see if it was written
    MIFAREReader.MFRC522_Read(8)
    print "\n"

    # Stop
    MIFAREReader.MFRC522_StopCrypto1()

    # Make sure to stop reading for cards
    continue_reading = False
else:
    print "Authentication error"
```


5.12 LESSON 12: USING STEPPER MOTORS



The stepper motor is an independent module that you will have to connect to the board. We need to take the stepper motor that came with the kit and connect it to our Joy-Pi.
Simply connect the stepper motor to the following connector on the Joy-Pi board:



The module may heat up during use. This is due to technical reasons and is not unusual.

For this example you have to switch between the modules. Set switch numbers 3, 4, 5 and 6 on the right-hand switching unit to ON. All the other switches should be turned OFF.

The stepper motor is connected to 4 GPIO pins, which are switched on quickly one after the other. This causes the stepper motor to "push" forward and take one step. Any number of steps can be executed with the **turnSteps** function. The t**urnDegrees** function rotates the motor by a certain angle.

You can find the Example code on the next page.

Example code stepper motor:

```
#!/usr/bin/python
# -*- coding: utf-8 -*-
# Author : Original author ludwigschuster
# Original Author Github: https://github.com/ludwigschuster/RasPi-GPIO-Stepmotor
import time
import RPi.GPIO as GPIO
import math
class Stepmotor:
	def __init__(self):
		# set GPIO mode
		GPIO.setmode(GPIO.BOARD)
		# These are the pins which will be used on the Raspberry Pi
		self.pin_A = 29
		self.pin_B = 31
		self.pin_C = 33
		self.pin_D = 35
		self.interval = 0.010
		# Declare pins as output
		GPIO.setup(self.pin_A,GPIO.OUT)
		GPIO.setup(self.pin_B,GPIO.OUT)
		GPIO.setup(self.pin_C,GPIO.OUT)
		GPIO.setup(self.pin_D,GPIO.OUT)
		GPIO.output(self.pin_A, False)
		GPIO.output(self.pin_B, False)
		GPIO.output(self.pin_C, False)
		GPIO.output(self.pin_D, False)
	def Step1(self):
		GPIO.output(self.pin_D, True)
		time.sleep(self.interval)
		GPIO.output(self.pin_D, False)
	def Step2(self):
		GPIO.output(self.pin_D, True)
		GPIO.output(self.pin_C, True)
		time.sleep(self.interval)
		GPIO.output(self.pin_D, False)
		GPIO.output(self.pin_C, False)
	def Step3(self):
		GPIO.output(self.pin_C, True)
		time.sleep(self.interval)
		GPIO.output(self.pin_C, False)
	def Step4(self):
		GPIO.output(self.pin_B, True)
		GPIO.output(self.pin_C, True)
```

```
            time.sleep(self.interval)
            GPIO.output(self.pin_B, False)
            GPIO.output(self.pin_C, False)

      def Step5(self):

            GPIO.output(self.pin_B, True)
            time.sleep(self.interval)
            GPIO.output(self.pin_B, False)

      def Step6(self):

            GPIO.output(self.pin_A, True)
            GPIO.output(self.pin_B, True)
            time.sleep(self.interval)
            GPIO.output(self.pin_A, False)
            GPIO.output(self.pin_B, False)

      def Step7(self):

            GPIO.output(self.pin_A, True)
            time.sleep(self.interval)
            GPIO.output(self.pin_A, False)

      def Step8(self):

            GPIO.output(self.pin_D, True)
            GPIO.output(self.pin_A, True)
            time.sleep(self.interval)
            GPIO.output(self.pin_D, False)
            GPIO.output(self.pin_A, False)

      def turn(self,count):
            for i in range (int(count)):
                  self.Step1()
                  self.Step2()
                  self.Step3()
                  self.Step4()
                  self.Step5()
                  self.Step6()
                  self.Step7()
                  self.Step8()

      def close(self):
            # cleanup the GPIO pin use
            GPIO.cleanup()

      def turnSteps(self, count):
            # Turn n steps
            # (supply with number of steps to turn)
            for i in range (count):
                  self.turn(1)
```



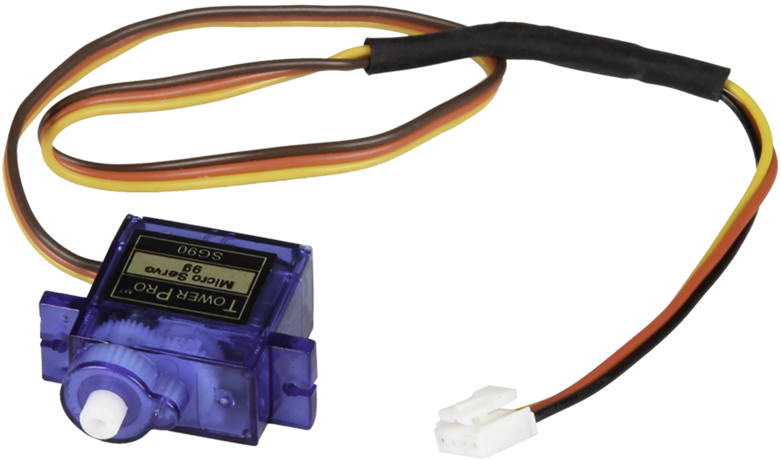
```
	def turnDegrees(self, count):
		# Turn n degrees (small values can lead to inaccuracy)
		# (supply with degrees to turn)
		self.turn(round(count*512/360,0))

	def turnDistance(self, dist, rad):
		# Turn for translation of wheels or coil (inaccuracies involved
		# e.g. due to thickness of rope)
		# (supply with distance to move and radius in same metric)
		self.turn(round(512*dist/(2*math.pi*rad),0))

def main():

	print("moving started")
	motor = Stepmotor()
	print("One Step")
	motor.turnSteps(1)
	time.sleep(0.5)
	print("20 Steps")
	motor.turnSteps(20)
	time.sleep(0.5)
	print("quarter turn")
	motor.turnDegrees(90)
	print("moving stopped")
	motor.close()

if __name__ == "__main__":
		main()
```

Führen Sie die folgenden Befehle aus und versuchen Sie es selbst:

```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python stepmotor.py
```

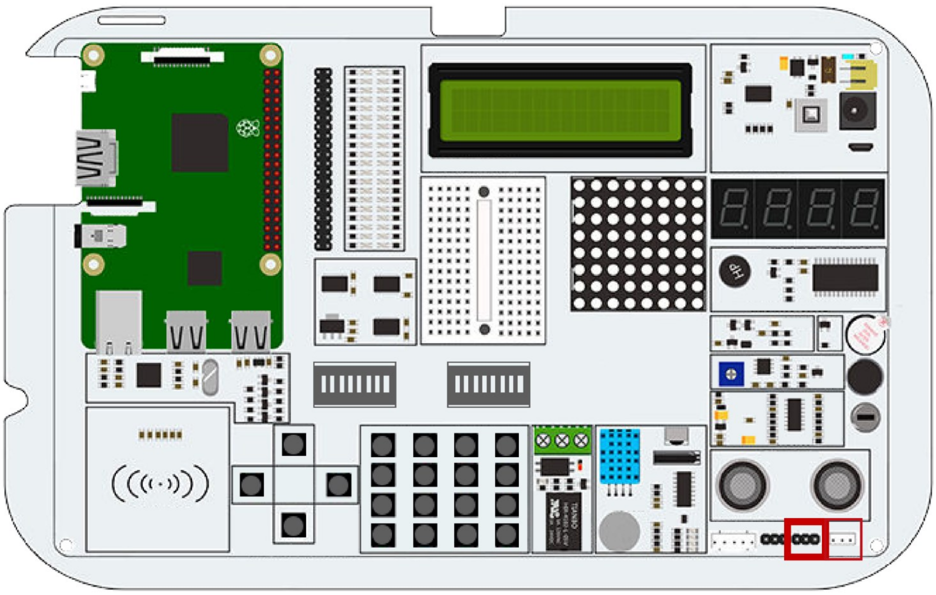
5.13 LESSON 13: CONTROLLING SERVO MOTORS



With the help of the servo motor, devices can be mechanically controlled and parts can be moved. For example, intelligent waste bins, a box with an intelligent opening and closing door and many other interesting projects can be created.

The Joy-Pi has two servo interfaces, both of which can be used to control servo motors. In this tutorial we will use interface number two, which is marked as "Servo2". Of course you can also use the other servo interface, but you have to adapt the script to the correct GPIO's for this.

The servomotor needs three pins: positive, negative, and the data pin. The positive pin is the red cable, the negative pin is the black cable (also called ground) and the data cable is yellow.



For this example you have to switch between the modules. Set switches number 7 and 8 on the right-hand switching unit to ON. All the other switches should be turned OFF.

Cable	Pin
Red	Middle pin of Servo2
Black	Right pin of Servo2
Colored	Left pin of Servo2

Let's take a look at our example code to understand it better:
The servo uses the GPIO.board pin number 22. Each time the script will set the direction of the servo motor to rotate. We can use positive degrees to rotate left and negative degrees to rotate right. Just change the degrees and see how the rotation of the motor changes.

```
#!/usr/bin/python
# -*- coding: utf-8 -*-
# Author : Original author WindVoiceVox
# Original Author Github: https://github.com/WindVoiceVox/Raspi_SG90

import RPi.GPIO as GPIO
import time
import sys                 #Import librarys

class sg90:

  def __init__( self, pin, direction ):

    GPIO.setmode( GPIO.BOARD )          #set pinlayout to GPIO.BOARD
    GPIO.setup( pin, GPIO.OUT )         #declare output
    self.pin = int( pin )
    self.direction = int( direction )
    self.servo = GPIO.PWM( self.pin, 50 )
    self.servo.start(0.0)

  def cleanup( self ):

    self.servo.ChangeDutyCycle(self._henkan(0))
    time.sleep(0.3)
    self.servo.stop()                   # stop servomotor
    GPIO.cleanup()                      #Clean GPIOs for other uses

  def currentdirection( self ):

    return self.direction

  def _henkan( self, value ):

    return 0.05 * value + 7.0
```

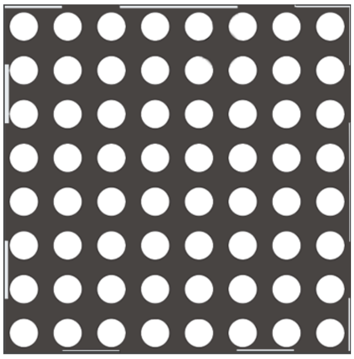
```
  def setdirection( self, direction, speed ):

    for d in range( self.direction, direction, int(speed) ):
      self.servo.ChangeDutyCycle( self._henkan( d ) )
      self.direction = d
      time.sleep(0.1)
    self.servo.ChangeDutyCycle( self._henkan( direction ) )
    self.direction = direction

def main():

    servo_pin = 22              #give servo_pin GPIO.BOARD pin 22
    s = sg90(servo_pin,0)

    try:
        while True:
            print "Turn left ..."          #console output
            s.setdirection( 100, 10 )
            time.sleep(0.5)                #wait 0.5 seconds
            print "Turn right ..."
            s.setdirection( -100, -10 )
            time.sleep(0.5)                #wait 0.5 seconds
    except KeyboardInterrupt:
        s.cleanup()

if __name__ == "__main__":
               main()
```

Execute the following commands and try it yourself:

```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python servo.py
```

5.14 LESSON 14: CONTROLLING THE 8X8 LED-MATRIX



The LED matrix plays an important role in many flashing LED projects. Even if you don't see it at first glance, the LED matrix can do much more than just blink red. It can be used to display information, text, emojis and even Chinese characters. Perfect for displaying information in fun and unique ways and maybe even a game like Snake or a countdown timer!

The LED matrix module is a large square module located on the left side of the segment LED and just below the LCD. It can easily be recognized by the small white dots that are the LEDs. Do not be fooled by the small size of the LEDs. This LED matrix can light up a dark place with ease!

In this example, we display a short text. In the script, we create a string with a message and use the **show_message()** function to display the message on the matrix display.

We can control properties, such as delays, that make the message faster or slower. For example, **scroll_delay 0** will be quite fast, while a delay of 0.1 will make the
message flow slows down a bit. The Matrix LED, unlike other modules, uses an SPI interface from which it can be controlled. Try several examples and change the code to see what happens.

```
#!/usr/bin/env python
# -*- coding: utf-8 -*-
# Copyright (c) 2017-18 Richard Hull and contributors
# License: https://github.com/rm-hull/luma.led_matrix/blob/master/LICENSE.rst
# Github link: https://github.com/rm-hull/luma.led_matrix/

# Import all the modules
import re
import time
from luma.led_matrix.device import max7219
from luma.core.interface.serial import spi, noop
from luma.core.render import canvas
from luma.core.virtual import viewport
from luma.core.legacy import text, show_message
from luma.core.legacy.font import proportional, CP437_FONT, TINY_FONT, SIN-
CLAIR_FONT, LCD_FONT
```

```
def main(cascaded, block_orientation, rotate):

    # create matrix device
    serial = spi(port=0, device=1, gpio=noop())
    device = max7219(serial, cascaded=cascaded or 1,
block_orientation=block_orientation, rotate=rotate or 0)
    # debugging purpose
    print("[-] Matrix initialized")

    # print hello world on the matrix display
    msg = "HELLO WORLD"
    # debugging purpose
    print("[-] Printing: %s" % msg)
    show_message(device, msg, fill="white", font=proportional(CP437_FONT),
scroll_delay=0.1)


if __name__ == "__main__":

    # cascaded = Number of cascaded MAX7219 LED matrices, default=1
    # block_orientation = choices 0, 90, -90, Corrects block orientation when
wired vertically, default=0
    # rotate = choices 0, 1, 2, 3, Rotate display 0=0°, 1=90°, 2=180°, 3=270°,
default=0

    try:
        main(cascaded=1, block_orientation=90
, rotate=0)
    except KeyboardInterrupt:
                   pass
```

Execute the following commands and try it yourself:

```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python matrix_demo.py
```

5.15 LESSON 15: CONTROLLING THE 7-SEGMENT DISPLAY

The segment LED is a very useful display when it comes to numbers and data. It can show us the time, count how many times we have done certain things. The segment display is also used in many industrial solutions, such as elevators.

The segment display is located directly above the vibration sensor and next to the LED matrix. When it is off, 4 eights are visible. As soon as you have activated the segment display module the dark colour becomes a shiny, bright red.

In our example we demonstrate a clock. We will use the time and date modules to get the Raspberry Pi system time, which we display using the **segment.write_display()** function. The **set_digit()** function, in combination with the numbers 0,1,2 and 3, sets the position on the display where the number should be shown.

Since the current system time is retrieved in this example, it is necessary to configure the Raspberry Pi to the correct time zone first. Open a terminal window and enter the following command:

```
sudo dpkg-reconfigure tzdata
```

A window opens in which you can select your current time zone. After you have selected the correct time zone, confirm with the OK button and press Enter again to confirm.

```
#!/usr/bin/python

import time
import datetime
from Adafruit_LED_Backpack import SevenSegment

# ===========================================================================
# Clock Example
# ===========================================================================
segment = SevenSegment.SevenSegment(address=0x70)

# Initialize the display. Must be called once before using the display.
segment.begin()
print "Press CTRL+C to exit"
# Continually update the time on a 4 char, 7-segment display
try:
  while(True):
    now = datetime.datetime.now()
    hour = now.hour
    minute = now.minute
    second = now.second

    segment.clear()
    # Set hours
    segment.set_digit(0, int(hour / 10))     # Tens
    segment.set_digit(1, hour % 10)          # Ones
    # Set minutes
    segment.set_digit(2, int(minute / 10))   # Tens
    segment.set_digit(3, minute % 10)        # Ones
    # Toggle colon
    segment.set_colon(second % 2)              # Toggle colon at 1Hz

    # Write the display buffer to the hardware.  This must be called to
    # update the actual display LEDs.
    segment.write_display()

    # Wait a second.
    time.sleep(1)
except KeyboardInterrupt:
    segment.clear()
               segment.write_display()
```

Execute the following commands and try it yourself:

```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python segment.py
```

5.16 LESSON 16: RECOGNIZE TOUCHES

The touch sensor is very useful when it comes to key functions. Many products on the market use touch instead of pressing a button, such as smartphones and tablets.
The touch sensor is located directly below the DHT11 sensor and to the right of the relay.
The easily accessible positioning on the Joy-Pi allows easy operation.

The touch sensor works like any other key module. The only difference is that it only needs to be touched instead of pressed. By touching the touch sensor, the module closes a circuit because the computer detects that the sensor has been touched. The touch sensor uses GPIO Board Pin 11.

```
from RPi import GPIO
import signal

TOUCH = 11
def setup_gpio():
    GPIO.setmode(GPIO.BOARD)
    GPIO.setup(TOUCH, GPIO.IN, pull_up_down=GPIO.PUD_UP)
def do_smt(channel):
    print("Touch wurde erkannt")

def main():
    setup_gpio()
    try:
        GPIO.add_event_detect(TOUCH, GPIO.FALLING, callback=do_smt, bounceti-
me=200)
        signal.pause()
    except KeyboardInterrupt:
        pass
    finally:
        GPIO.cleanup()

if __name__ == '__main__':
               main()
```

```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python touch.py
```

5.17 LESSON 17: DETECTING TILTS WITH THE TILT SENSOR

The tilt sensor allows us to detect an inclination to the right or left. It is used in robotics and other industries to ensure that things are held straight. It's a small, elongated, black sensor that lies between the DHT11 sensor and the ultrasonic sensor and can easily be detected by the sound it makes when you tilt the board a little.
You could easily think that something inside the Joy-Pi-Board is damaged when you hear this noise, but this noise is completely normal. When the tilt sensor is tilted to the left, the circuit is activated and a GPIO HIGH signal is sent. If the tilt sensor is tilted to the right, the circuit is deactivated and a GPIO LOW signal is sent.

For this example you have to switch between the modules. Set switch number 2 of the right-hand switching unit to ON. All the other switches should be turned OFF.

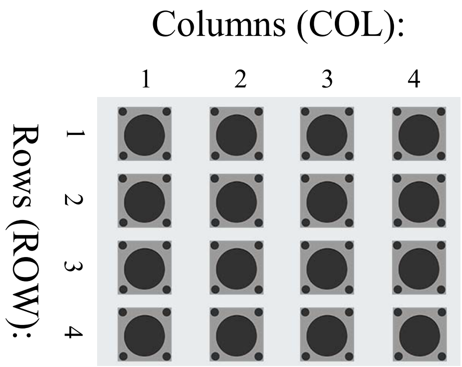
```
#!/usr/bin/python
# -*- coding: utf-8 -*-

import time
import RPi.GPIO as GPIO

# define tilt pin
tilt_pin = 15

# set GPIO mode to GPIO.BOARD
GPIO.setmode(GPIO.BOARD)
# set pin as input
GPIO.setup(tilt_pin, GPIO.IN)

try:
    while True:
        # positive is tilt to left negative is tilt to right
        if GPIO.input(tilt_pin):
            print "[-] Left Tilt"
        else:
            print "[-] Right Tilt"
        time.sleep(1)
except KeyboardInterrupt:
    # CTRL+C detected, cleaning and quitting the script
               GPIO.cleanup()
```

Execute the following commands and try it yourself:

```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python tilt.py
```

5.18 LESSON18: USING THE BUTTON MATRIX



The button matrix is a module with 16 independent buttons that can be used for many projects such as a keyboard or a memory game. The great possibilities of the keys allow you to do almost anything.

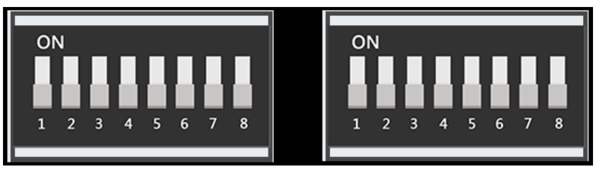
The button matrix is located at the bottom center of the Joy-Pi board, to the right of the relay. It is easily recognizable by the 16 individual buttons. The excellent positioning on the board allows easy operation of the keys while still providing a good overview of all other sensors.

The button matrix consists of four columns and rows. We configure the matrix rows and columns with their GPIO pins and initialize the **ButtonMatrix()** object as a button variable. Then we can press any button of the matrix and see which one has been pressed.

In our example, after recognizing a keystroke, we activate the function **activateButton()**, which displays the number of the pressed button. You can of course edit this module to do anything you can imagine.

The example code is on the next 2 sites.

For this example you have to switch between the modules. Set **ALL** switches of the left switching unit to **ON**. All the other switches should be turned OFF.



```
#!/usr/bin/python
# -*- coding: utf-8 -*-
# Author : original author stenobot
# Original Author Github: https://github.com/stenobot/SoundMatrixPi

import RPi.GPIO as GPIO
import time

class ButtonMatrix():

    def __init__(self):

        GPIO.setmode(GPIO.BOARD)

        # matrix button ids
        self.buttonIDs = [[4,3,2,1],[8,7,6,5],[12,11,10,9],[16,15,14,13]]
        # gpio inputs for rows
        self.rowPins = [13,15,29,31]
        # gpio outputs for columns
        self.columnPins = [33,35,37,22]

        # define four inputs with pull up resistor
        for i in range(len(self.rowPins)):
            GPIO.setup(self.rowPins[i], GPIO.IN, pull_up_down = GPIO.PUD_UP)

        # define four outputs and set to high
        for j in range(len(self.columnPins)):
            GPIO.setup(self.columnPins[j], GPIO.OUT)
            GPIO.output(self.columnPins[j], 1)

    def activateButton(self, rowPin, colPin):
        # get the button index
        btnIndex = self.buttonIDs[rowPin][colPin] - 1
        print("button " + str(btnIndex + 1) + " pressed")
        # prevent button presses too close together
        time.sleep(.3)

    def buttonHeldDown(self,pin):
        if(GPIO.input(self.rowPins[pin]) == 0):
            return True
        return False

def main():

    # initial the button matrix
    buttons = ButtonMatrix()
    try:
```

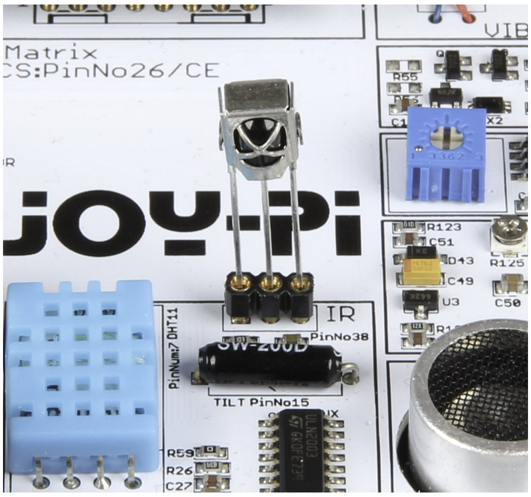
```
        while(True):
            for j in range(len(buttons.columnPins)):
                # set each output pin to low
                GPIO.output(buttons.columnPins[j],0)
                for i in range(len(buttons.rowPins)):
                    if GPIO.input(buttons.rowPins[i]) == 0:
                        # button pressed, activate it
                        buttons.activateButton(i,j)
                        # do nothing while button is being held down
                        while(buttons.buttonHeldDown(i)):
                            pass
                # return each output pin to high
                GPIO.output(buttons.columnPins[j],1)
    except KeyboardInterrupt:
        GPIO.cleanup()

if __name__ == "__main__":
    main()
```

Execute the following commands and try it yourself:

```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python button_matrix.py
```

5.19 LESSON 19: CONTROLLING AND USING THE IR-SENSOR



In this lesson, we will learn how to use the infrared receiver and how to receive IR codes from a remote control. The use of this method is extremely useful because we can use different define actions for different buttons. With a remote control we can switch on different LEDs or control the servo motor each time the button is pressed.

The IR sensor will be delivered with the Joy-Pi but is not pre-installed.
You have to plug it in the slot as shown in the picture above.
The IR sensor is located to the right of the DHT11 sensor and above the tilt sensor. It looks like a small LED with 3 pins. We also need the IR remote control, which is included in the Joy-Pi-Kit.

The IR receiver uses a library called **LIRC** and **Python-LIRC** to receive and understand the codes we send with the IR remote control. The Out variable contains the key we pressed. Using if queries, we can check whether certain keys have been pressed. This information allows us to execute the appropriate commands.

The example code is on the next site.

⚠ Important!!! Remove the IR-sensor before you close the Joy-Pi case

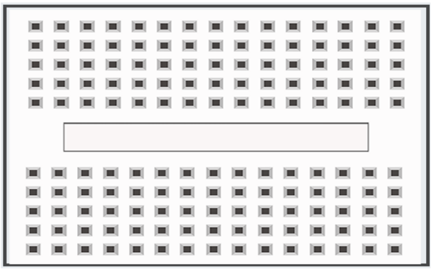
```
#!/usr/bin/env python
# -*- coding: utf-8 -*-
import socket, signal
import lirc, time, sys
import RPi.GPIO as GPIO
from  array import array

GPIO.setmode(11)
GPIO.setup(17, 0)
GPIO.setup(18, 0)
PORT = 42001
HOST = "localhost"
Socket = socket.socket(socket.AF_INET, socket.SOCK_STREAM)

Lirc = lirc.init("keys")
#lirc.set_blocking(False, Lirc)       # Un-Comment to stop nextcode() from
# waiting for a signal ( will return empty array when no key is pressed )

def handler(signal, frame):
      Socket.close()
      GPIO.cleanup()
      exit(0)

signal.signal(signal.SIGTSTP, handler)

def sendCmd(cmd):
    n = len(cmd)
    a = array('c')
    a.append(chr((n >> 24) & 0xFF))
    a.append(chr((n >> 16) & 0xFF))
    a.append(chr((n >> 8) & 0xFF))
    a.append(chr(n & 0xFF))
    Socket.send(a.tostring() + cmd)

while True:

      Out = lirc.nextcode()
      print Out[0]
```

Execute the following commands and try it yourself:

```
cd /home/pi/Desktop/Joy-Pi/
```

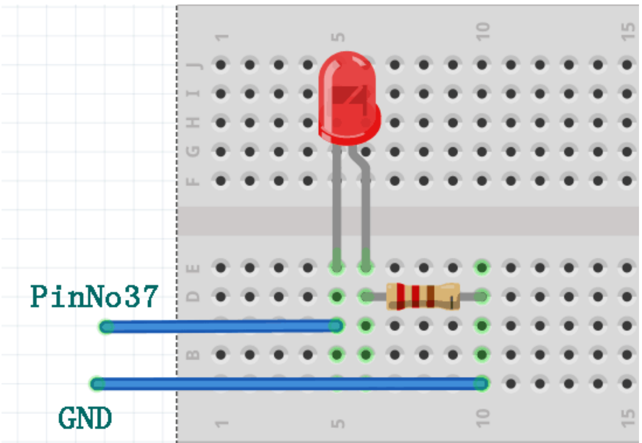
```
sudo python IR.py
```


5.20 LESSON 20: OWN CIRCUITS WITH THE BREADBOARD



The breadboard is an extremely useful part of the Joy-Pi that allows us to create our own circuits and functions. Now that we've learned how to use all the sensors, it's time to create our own. In this lesson you will create your first custom circuit using a flashing LED example. The breadboard is located in the middle of the Joy Pi board. It is a small, white, board with many small holes.

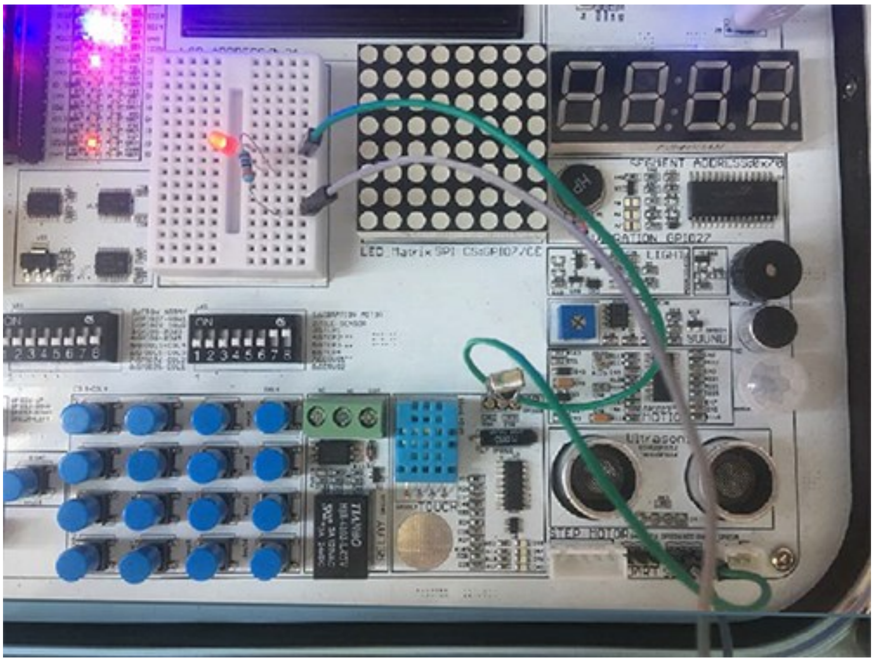
We will create a custom circuit with the function to make an LED blink. To do this, we need to use GPIO as output and GND, as we already did in earlier lessons. We will connect the **servo interface** (SERVO1 interface) to **GPIO 37**.



You can use this picture as a guide to create your circuit on the plug-in board.
Remember that pin number 37 is on the GPIO port and GND is on the GND port of the SERVO1 interface.

For this example you have to switch between the modules because the servo pins are used. Set the switches **7** and **8** of the right switching unit to **ON**. All the other switches should be turned OFF.

We must use a resistor and connect it to the negative side of the LED (the negative side of the LED is the one with the shorter leg). We will connect the other side of the resistor directly to the GND pin on the SERVO1 interface using the cable. Connect the positive side of the LED to the GPIO37 pin of the SERVO1 interface.



After you build the circuit ist time to write the code that will controll the LED.
The plan is to send **GPIO.HIGH** to the GPIO37 Pin then wait 0.2 seconds and cut the signal with **GPIO.LOW**. This will be looped and the LED will start blinking.
You can stop the programm by clicking CTRL+C.

The example code is on the next side.

Important: The resistor, the LED and the cables are not included.

```
#!/usr/bin/python
# -*- coding: utf-8 -*-

import time
import RPi.GPIO as GPIO

# define LED pin
led_pin = 37

# set GPIO mode to GPIO.BOARD
GPIO.setmode(GPIO.BOARD)
# set pin as input
GPIO.setup(led_pin, GPIO.OUT)

try:
    while True:
        # turn on LED
        GPIO.output(led_pin, GPIO.HIGH)
        # Wait half a second
        time.sleep(0.2)
        # turn off LED
        GPIO.output(led_pin, GPIO.LOW)
        # Wait half a second
        time.sleep(0.2)
except KeyboardInterrupt:
    # CTRL+C detected, cleaning and quitting the script
           GPIO.cleanup()
```

Execute the following commands and try it yourself:

```
cd /home/pi/Desktop/Joy-Pi/
```

```
sudo python blinking_led.py
```

5.21 LESSON 21: PHOTOGRAPHING WITH THE RASPBERRY PI CAMERA

The Raspberry Pi camera is extremely useful and can be used for a variety of projects. For example for security cameras, face recognition and much more. In the following lesson we will introduce you to the basics of using the Raspberry Pi camera. This will teach you how to take a picture.
The camera is located centrally above the Joy-Pi's screen and is connected directly to the Raspberry Pi with a USB cable.

First, install the fswebcam package:
(you dont have to install it if you use our ready to use image)

```
sudo apt-get install fswebcam
```

Enter the command fswebcam followed by a filename and a picture will be taken using the webcam, and saved to the filename specified:

```
fswebcam image.jpg
```

Our webcam has a resolution of 1280x1024 so to specify the resolution we want we will use the –r flag:

```
fswebcam -r 1280x1024 image2.jpg
```

If we want to remove the timestamp we have to use the --no-banner flag:

```
fswebcam -r 1280x1024 --no-banner image3.jpg
```

To capture a video we use the following command:

```
ffmpeg -f v4l2 -r 25 -s 780x480 -i /dev/video0 example.avi
```

You can change the resolution if you want to.
After capturing you can navigate to the save folder with the „cd“ command and play the video with the following command:

```
omxplayer example.mp4
```

The video will play in fullscreen if you want to close the video press CTRL+C.

6. INFORMATION AND TAKE-BACK OBLIGATIONS

Symbol on electrical and electronic equipment

This crossed-out dustbin means that electrical and electronic equipment does not belong in the household waste. You must return the old appliances to a collection point. Before handing over waste batteries and accumulators that are not enclosed by waste equipment must be separated from it.

Return options
As an end user, you can return your old appliance (which essentially fulfils the same function as the new appliance purchased from us) free of charge for disposal when you purchase a new appliance. Small appliances with no external dimensions greater than 25 cm can be disposed of in normal household quantities independently of the purchase of a new appliance.

Possibility of return at our company location during opening hours
Simac GmbH, Pascalstr. 8, D-47506 Neukirchen-Vluyn

Possibility of return in your area
We will send you a parcel stamp with which you can return the device to us free of charge. Please contact us by e-mail at Service@joy-it.net or by telephone.

Information on packaging
If you do not have suitable packaging material or do not wish to use your own, please contact us and we will send you suitable packaging.

7. Copyright informations

This product contains software wich are available under the terms of an open content licence of the type GNU General Public License, Version 2 (GPL) or X11 License (also named MIT). The complete licence texts will you see on the following sites. You can find more detailed informations at http://www.gnu.org/licenses/old-licenses/gpl-2.0 and https://www.gnu.org/licenses/license-list.html.

As this is free software, there is no warranty, as far as permitted by law. Details hierzu finden Sie in der GNU General Public License und der X11 License. Please note that the warranty for the hardware of course is not affected and exists in full

Furthermore we will provide the source code in machine-readable form, calculated only the manufacturing cost of the medium. The request schould be sent to service@joy-it.net.

Weitere Fragen beantworten wir Ihnen gerne unter service@joy-it.net.

GNU GENERAL PUBLIC LICENSE

Version 2, June 1991

Copyright (C) 1989, 1991 Free Software Foundation, Inc.

51 Franklin Street, Fifth Floor, Boston, MA 02110-1301, USA

Everyone is permitted to copy and distribute verbatim copies

of this license document, but changing it is not allowed.

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change free software--to make sure the software is free for all its users. This General Public License applies to most of the Free Software Foundation's software and to any other program whose authors commit to using it. (Some other Free Software Foundation software is covered by the GNU Lesser General Public License instead.) You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs; and that you know you can do these things.

To protect your rights, we need to make restrictions that forbid anyone to deny you these rights or to ask you to surrender the rights. These restrictions translate to certain responsibilities for you if you distribute copies of the software, or if you modify it.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must give the recipients all the rights that you have. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

We protect your rights with two steps: (1) copyright the software, and (2) offer you this license which gives you legal permission to copy, distribute and/or modify the software.

7. Copyright informations

Also, for each author's protection and ours, we want to make certain that everyone understands that there is no warranty for this free software. If the software is modified by someone else and passed on, we want its recipients to know that what they have is not the original, so that any problems introduced by others will not reflect on the original authors' reputations.

Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that redistributors of a free program will individually obtain patent licenses, in effect making the program proprietary. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

The precise terms and conditions for copying, distribution and modification follow.

TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

0. This License applies to any program or other work which contains a notice placed by the copyright holder saying it may be distributed under the terms of this General Public License. The "Program", below, refers to any such program or work, and a "work based on the Program" means either the Program or any derivative work under copyright law: that is to say, a work containing the Program or a portion of it, either verbatim or with modifications and/or translated into another language. (Hereinafter, translation is included without limitation in the term "modification".) Each licensee is addressed as "you".

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running the Program is not restricted, and the output from the Program is covered only if its contents constitute a work based on the Program (independent of having been made by running the Program). Whether that is true depends on what the Program does.

1. You may copy and distribute verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and give any other recipients of the Program a copy of this License along with the Program.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

2. You may modify your copy or copies of the Program or any portion of it, thus forming a work based on the Program, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:

a) You must cause the modified files to carry prominent notices stating that you changed the files and the date of any change.

b) You must cause any work that you distribute or publish, that in whole or in part contains or is derived from the Program or any part thereof, to be licensed as a whole at no charge to all third parties under the terms of this License.

c) If the modified program normally reads commands interactively when run, you must cause it, when started running for such interactive use in the most ordinary way, to print or display an announcement including an appropriate copyright notice and a notice that there is no warranty (or else, saying that you provide a warranty) and that users may redistribute the program under these conditions, and telling the user how to view a copy of this License. (Exception: if the Program itself is interactive but does not normally print such an announcement, your work based on the Program is not required to print an announcement.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Program, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Program, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

7. Copyright informations

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Program.

In addition, mere aggregation of another work not based on the Program with the Program (or with a work based on the Program) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

3. You may copy and distribute the Program (or a work based on it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you also do one of the following:

> **a)** Accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,
>
> **b)** Accompany it with a written offer, valid for at least three years, to give any third party, for a charge no more than your cost of physically performing source distribution, a complete machine-readable copy of the corresponding source code, to be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,
>
> **c)** Accompany it with the information you received as to the offer to distribute corresponding source code. (This alternative is allowed only for noncommercial distribution and only if you received the program in object code or executable form with such an offer, in accord with Subsection b above.)

The source code for a work means the preferred form of the work for making modifications to it. For an executable work, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the executable. However, as a special exception, the source code distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

If distribution of executable or object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place counts as distribution of the source code, even though third parties are not compelled to copy the source along with the object code.

4. You may not copy, modify, sublicense, or distribute the Program except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense or distribute the Program is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

5. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Program or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Program (or any work based on the Program), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Program or works based on it.

6. Each time you redistribute the Program (or any work based on the Program), the recipient automatically receives a license from the original licensor to copy, distribute or modify the Program subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties to this License.

7. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Program at all. For example, if a patent license would not permit royalty-free redistribution of the Program by all those who receive

7. Copyright informations

copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Program. If any portion of this section is held invalid or unenforceable under any particular circumstance, the balance of the section is intended to apply and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system, which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

8. If the distribution and/or use of the Program is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Program under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

9. The Free Software Foundation may publish revised and/or new versions of the General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of this License, you may choose any version ever published by the Free Software Foundation.

10. If you wish to incorporate parts of the Program into other free programs whose distribution conditions are different, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY

11. BECAUSE THE PROGRAM IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

12. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

7. Copyright informations

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

one line to give the program's name and an idea of what it does. Copyright (C) yyyy name of author

This program is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation; either version 2 of the License, or (at your option) any later version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.

You should have received a copy of the GNU General Public License along with this program; if not, write to the Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301, USA.

Also add information on how to contact you by electronic and paper mail.

If the program is interactive, make it output a short notice like this when it starts in an interactive mode:

Gnomovision version 69, Copyright (C) year name of author Gnomovision comes with ABSOLUTELY NO WARRANTY; for details type `show w'.  This is free software, and you are welcome to redistribute it under certain conditions; type `show c' for details.

The hypothetical commands `show w' and `show c' should show the appropriate parts of the General Public License. Of course, the commands you use may be called something other than `show w' and `show c'; they could even be mouse-clicks or menu items--whatever suits your program.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the program, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest in the program `Gnomovision'(which makes passes at compilers) written by James Hacker.

signature of Ty Coon, 1 April 1989

Ty Coon, President of Vice

7. Copyright informations

Preamble

The GNU General Public License is a free, copyleft license for software and other kinds of works.

The licenses for most software and other practical works are designed to take away your freedom to share and change the works. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change all versions of a program--to make sure it remains free software for all its users. We, the Free Software Foundation, use the GNU General Public License for most of our software; it applies also to any other work released this way by its authors. You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for them if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs, and that you know you can do these things.

To protect your rights, we need to prevent others from denying you these rights or asking you to surrender the rights. Therefore, you have certain responsibilities if you distribute copies of the software, or if you modify it: responsibilities to respect the freedom of others.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must pass on to the recipients the same freedoms that you received. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

Developers that use the GNU GPL protect your rights with two steps: (1) assert copyright on the software, and (2) offer you this License giving you legal permission to copy, distribute and/or modify it.

For the developers' and authors' protection, the GPL clearly explains that there is no warranty for this free software. For both users' and authors' sake, the GPL requires that modified versions be marked as changed, so that their problems will not be attributed erroneously to authors of previous versions.

Some devices are designed to deny users access to install or run modified versions of the software inside them, although the manufacturer can do so. This is fundamentally incompatible with the aim of protecting users' freedom to change the software. The systematic pattern of such abuse occurs in the area of products for individuals to use, which is precisely where it is most unacceptable. Therefore, we have designed this version of the GPL to prohibit the practice for those products. If such problems arise substantially in other domains, we stand ready to extend this provision to those domains in future versions of the GPL, as needed to protect the freedom of users.

Finally, every program is threatened constantly by software patents. States should not allow patents to restrict development and use of software on general-purpose computers, but in those that do, we wish to avoid the special danger that patents applied to a free program could make it effectively proprietary. To prevent this, the GPL assures that patents cannot be used to render the program non-free.

The precise terms and conditions for copying, distribution and modification follow.

7. Copyright informations

TERMS AND CONDITIONS

0. Definitions.

“This License” refers to version 3 of the GNU General Public License.

“Copyright” also means copyright-like laws that apply to other kinds of works, such as semiconductor masks.

“The Program” refers to any copyrightable work licensed under this License. Each licensee is addressed as “you”. “Licensees” and “recipients” may be individuals or organizations.

To “modify” a work means to copy from or adapt all or part of the work in a fashion requiring copyright permission, other than the making of an exact copy. The resulting work is called a “modified version” of the earlier work or a work “based on” the earlier work.

A “covered work” means either the unmodified Program or a work based on the Program.

To “propagate” a work means to do anything with it that, without permission, would make you directly or secondarily liable for infringement under applicable copyright law, except executing it on a computer or modifying a private copy. Propagation includes copying, distribution (with or without modification), making available to the public, and in some countries other activities as well.

To “convey” a work means any kind of propagation that enables other parties to make or receive copies. Mere interaction with a user through a computer network, with no transfer of a copy, is not conveying.

An interactive user interface displays “Appropriate Legal Notices” to the extent that it includes a convenient and prominently visible feature that (1) displays an appropriate copyright notice, and (2) tells the user that there is no warranty for the work (except to the extent that warranties are provided), that licensees may convey the work under this License, and how to view a copy of this License. If the interface presents a list of user commands or options, such as a menu, a prominent item in the list meets this criterion.

1. Source Code.

The “source code” for a work means the preferred form of the work for making modifications to it. “Object code” means any non-source form of a work. A “Standard Interface” means an interface that either is an official standard defined by a recognized standards body, or, in the case of interfaces specified for a particular programming language, one that is widely used among developers working in that language.

The “System Libraries” of an executable work include anything, other than the work as a whole, that (a) is included in the normal form of packaging a Major Component, but which is not part of that Major Component, and (b) serves only to enable use of the work with that Major Component, or to implement a Standard Interface for which an implementation is available to the public in source code form. A “Major Component”, in this context, means a major essential component (kernel, window system, and so on) of the specific operating system (if any) on which the executable work runs, or a compiler used to produce the work, or an object code interpreter used to run it.

The “Corresponding Source” for a work in object code form means all the source code needed to generate, install, and (for an executable work) run the object code and to modify the work, including scripts to control those activities. However, it does not include the work's System Libraries, or general-purpose tools or generally available free programs which are used unmodified in performing those activities but which are not part of the work. For example, Corresponding Source includes interface definition files associated with source files for the work, and the source code for shared libraries and dynamically linked subprograms that the work is specifically designed to require, such as by intimate data communication or control flow between those subprograms and other parts of the work.

The Corresponding Source need not include anything that users can regenerate automatically from other parts of the Corresponding Source.

The Corresponding Source for a work in source code form is that same work.

7. Copyright informations

2. Basic Permissions.
All rights granted under this License are granted for the term of copyright on the Program, and are irrevocable provided the stated conditions are met. This License explicitly affirms your unlimited permission to run the unmodified Program. The output from running a covered work is covered by this License only if the output, given its content, constitutes a covered work. This License acknowledges your rights of fair use or other equivalent, as provided by copyright law.
You may make, run and propagate covered works that you do not convey, without conditions so long as your license otherwise remains in force. You may convey covered works to others for the sole purpose of having them make modifications exclusively for you, or provide you with facilities for running those works, provided that you comply with the terms of this License in conveying all material for which you do not control copyright. Those thus making or running the covered works for you must do so exclusively on your behalf, under your direction and control, on terms that prohibit them from making any copies of your copyrighted material outside their relationship with you.
Conveying under any other circumstances is permitted solely under the conditions stated below. Sublicensing is not allowed; section 10 makes it unnecessary.
3. Protecting Users' Legal Rights From Anti-Circumvention Law.
No covered work shall be deemed part of an effective technological measure under any applicable law fulfilling obligations under article 11 of the WIPO copyright treaty adopted on 20 December 1996, or similar laws prohibiting or restricting circumvention of such measures.
When you convey a covered work, you waive any legal power to forbid circumvention of technological measures to the extent such circumvention is effected by exercising rights under this License with respect to the covered work, and you disclaim any intention to limit operation or modification of the work as a means of enforcing, against the work's users, your or third parties' legal rights to forbid circumvention of technological measures.
4. Conveying Verbatim Copies.
You may convey verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice; keep intact all notices stating that this License and any non-permissive terms added in accord with section 7 apply to the code; keep intact all notices of the absence of any warranty; and give all recipients a copy of this License along with the Program.
You may charge any price or no price for each copy that you convey, and you may offer support or warranty protection for a fee.
5. Conveying Modified Source Versions.
You may convey a work based on the Program, or the modifications to produce it from the Program, in the form of source code under the terms of section 4, provided that you also meet all of these conditions:

a) The work must carry prominent notices stating that you modified it, and giving a relevant date.
b) The work must carry prominent notices stating that it is released under this License and any conditions added under section 7. This requirement modifies the requirement in section 4 to “keep intact all notices”.
c) You must license the entire work, as a whole, under this License to anyone who comes into possession of a copy. This License will therefore apply, along with any applicable section 7 additional terms, to the whole of the work, and all its parts, regardless of how they are packaged. This License gives no permission to license the work in any other way, but it does not invalidate such permission if you have separately received it.
d) If the work has interactive user interfaces, each must display Appropriate Legal Notices; however, if the Program has interactive interfaces that do not display Appropriate Legal Notices, your work need not make them do so.

A compilation of a covered work with other separate and independent works, which are not by their nature extensions of the covered work, and which are not combined with it such as to form a larger program, in or on a volume of a storage or distribution medium, is called an “aggregate” if the compilation and its resulting copyright are not used to limit the access or legal rights of the compilation's users beyond what the individual works permit. Inclusion of a covered work in an aggregate does not cause this License to apply to the other parts of the aggregate.
6. Conveying Non-Source Forms.
You may convey a covered work in object code form under the terms of sections 4 and 5, provided that you also convey the machine-readable Corresponding Source under the terms of this License, in one of these ways:

a) Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by the Corresponding Source fixed on a durable physical medium customarily used for software interchange.
b) Convey the object code in, or embodied in, a physical product (including a physical distribution medium), accompanied by a written offer, valid for at least three years and valid for as long as you offer spare parts or customer support for that product model, to give anyone who possesses the object code either (1) a copy of the Corresponding Source for all the software in the product that is covered by this License, on a durable physical medium customarily used for software interchange, for a price no more than your reasonable cost of physically performing this conveying of source, or (2) access to copy the Corresponding Source from a network server at no charge.
c) Convey individual copies of the object code with a copy of the written offer to provide the Corresponding Source. This alternative is allowed only occasionally and noncommercially, and only if you received the object code with such an offer, in accord with subsection 6b.
d) Convey the object code by offering access from a designated place (gratis or for a charge), and offer equivalent access to the Corresponding Source in the same way through the same place at no further charge. You need not require recipients to copy the Corresponding Source along with the object code. If the place to copy the object code is a network server, the Corresponding Source may be on a different server (operated by you or a third party) that supports equivalent copying facilities, provided you maintain clear directions next to the object code saying where to find the Corresponding Source. Regardless of what server hosts the Corresponding Source, you remain obligated to ensure that it is available for as long as needed to satisfy these requirements.
e) Convey the object code using peer-to-peer transmission, provided you inform other peers where the object code and Corresponding Source of the work are being offered to the general public at no charge under subsection 6d.

7. Copyright informations

A separable portion of the object code, whose source code is excluded from the Corresponding Source as a System Library, need not be included in conveying the object code work.
A “User Product” is either (1) a “consumer product”, which means any tangible personal property which is normally used for personal, family, or household purposes, or (2) anything designed or sold for incorporation into a dwelling. In determining whether a product is a consumer product, doubtful cases shall be resolved in favor of coverage. For a particular product received by a particular user, “normally used” refers to a typical or common use of that class of product, regardless of the status of the particular user or of the way in which the particular user actually uses, or expects or is expected to use, the product. A product is a consumer product regardless of whether the product has substantial commercial, industrial or non-consumer uses, unless such uses represent the only significant mode of use of the product.
“Installation Information” for a User Product means any methods, procedures, authorization keys, or other information required to install and execute modified versions of a covered work in that User Product from a modified version of its Corresponding Source. The information must suffice to ensure that the continued functioning of the modified object code is in no case prevented or interfered with solely because modification has been made.
If you convey an object code work under this section in, or with, or specifically for use in, a User Product, and the conveying occurs as part of a transaction in which the right of possession and use of the User Product is transferred to the recipient in perpetuity or for a fixed term (regardless of how the transaction is characterized), the Corresponding Source conveyed under this section must be accompanied by the Installation Information. But this requirement does not apply if neither you nor any third party retains the ability to install modified object code on the User Product (for example, the work has been installed in ROM).
The requirement to provide Installation Information does not include a requirement to continue to provide support service, warranty, or updates for a work that has been modified or installed by the recipient, or for the User Product in which it has been modified or installed. Access to a network may be denied when the modification itself materially and adversely affects the operation of the network or violates the rules and protocols for communication across the network.
Corresponding Source conveyed, and Installation Information provided, in accord with this section must be in a format that is publicly documented (and with an implementation available to the public in source code form), and must require no special password or key for unpacking, reading or copying.

7. Additional Terms.

“Additional permissions” are terms that supplement the terms of this License by making exceptions from one or more of its conditions. Additional permissions that are applicable to the entire Program shall be treated as though they were included in this License, to the extent that they are valid under applicable law. If additional permissions apply only to part of the Program, that part may be used separately under those permissions, but the entire Program remains governed by this License without regard to the additional permissions.
When you convey a copy of a covered work, you may at your option remove any additional permissions from that copy, or from any part of it. (Additional permissions may be written to require their own removal in certain cases when you modify the work.) You may place additional permissions on material, added by you to a covered work, for which you have or can give appropriate copyright permission.

7. Copyright informations

Notwithstanding any other provision of this License, for material you add to a covered work, you may (if authorized by the copyright holders of that material) supplement the terms of this License with terms:

a) Disclaiming warranty or limiting liability differently from the terms of sections 15 and 16 of this License; or

b) Requiring preservation of specified reasonable legal notices or author attributions in that material or in the Appropriate Legal Notices displayed by works containing it; or

c) Prohibiting misrepresentation of the origin of that material, or requiring that modified versions of such material be marked in reasonable ways as different from the original version; or

d) Limiting the use for publicity purposes of names of licensors or authors of the material; or

e) Declining to grant rights under trademark law for use of some trade names, trademarks, or service marks; or

f) Requiring indemnification of licensors and authors of that material by anyone who conveys the material (or modified versions of it) with contractual assumptions of liability to the recipient, for any liability that these contractual assumptions directly impose on those licensors and authors.

All other non-permissive additional terms are considered “further restrictions” within the meaning of section 10. If the Program as you received it, or any part of it, contains a notice stating that it is governed by this License along with a term that is a further restriction, you may remove that term. If a license document contains a further restriction but permits relicensing or conveying under this License, you may add to a covered work material governed by the terms of that license document, provided that the further restriction does not survive such relicensing or conveying.

If you add terms to a covered work in accord with this section, you must place, in the relevant source files, a statement of the additional terms that apply to those files, or a notice indicating where to find the applicable terms.

Additional terms, permissive or non-permissive, may be stated in the form of a separately written license, or stated as exceptions; the above requirements apply either way.

8. Termination.

You may not propagate or modify a covered work except as expressly provided under this License. Any attempt otherwise to propagate or modify it is void, and will automatically terminate your rights under this License (including any patent licenses granted under the third paragraph of section 11).

However, if you cease all violation of this License, then your license from a particular copyright holder is reinstated (a) provisionally, unless and until the copyright holder explicitly and finally terminates your license, and (b) permanently, if the copyright holder fails to notify you of the violation by some reasonable means prior to 60 days after the cessation.

Moreover, your license from a particular copyright holder is reinstated permanently if the copyright holder notifies you of the violation by some reasonable means, this is the first time you have received notice of violation of this License (for any work) from that copyright holder, and you cure the violation prior to 30 days after your receipt of the notice.

Termination of your rights under this section does not terminate the licenses of parties who have received copies or rights from you under this License. If your rights have been terminated and not permanently reinstated, you do not qualify to receive new licenses for the same material under section 10.

9. Acceptance Not Required for Having Copies.

You are not required to accept this License in order to receive or run a copy of the Program. Ancillary propagation of a covered work occurring solely as a consequence of using peer-to-peer transmission to receive a copy likewise does not require acceptance. However, nothing other than this License grants you permission to propagate or modify any covered work. These actions infringe copyright if you do not accept this License. Therefore, by modifying or propagating a covered work, you indicate your acceptance of this License to do so.

7. Copyright informations

10. Automatic Licensing of Downstream Recipients.
Each time you convey a covered work, the recipient automatically receives a license from the original licensors, to run, modify and propagate that work, subject to this License. You are not responsible for enforcing compliance by third parties with this License.
An “entity transaction” is a transaction transferring control of an organization, or substantially all assets of one, or subdividing an organization, or merging organizations. If propagation of a covered work results from an entity transaction, each party to that transaction who receives a copy of the work also receives whatever licenses to the work the party's predecessor in interest had or could give under the previous paragraph, plus a right to possession of the Corresponding Source of the work from the predecessor in interest, if the predecessor has it or can get it with reasonable efforts.
You may not impose any further restrictions on the exercise of the rights granted or affirmed under this License. For example, you may not impose a license fee, royalty, or other charge for exercise of rights granted under this License, and you may not initiate litigation (including a cross-claim or counterclaim in a lawsuit) alleging that any patent claim is infringed by making, using, selling, offering for sale, or importing the Program or any portion of it.
11. Patents.
A “contributor” is a copyright holder who authorizes use under this License of the Program or a work on which the Program is based. The work thus licensed is called the contributor's “contributor version”.
A contributor's “essential patent claims” are all patent claims owned or controlled by the contributor, whether already acquired or hereafter acquired, that would be infringed by some manner, permitted by this License, of making, using, or selling its contributor version, but do not include claims that would be infringed only as a consequence of further modification of the contributor version. For purposes of this definition, “control” includes the right to grant patent sublicenses in a manner consistent with the requirements of this License.
Each contributor grants you a non-exclusive, worldwide, royalty-free patent license under the contributor's essential patent claims, to make, use, sell, offer for sale, import and otherwise run, modify and propagate the contents of its contributor version.
In the following three paragraphs, a “patent license” is any express agreement or commitment, however denominated, not to enforce a patent (such as an express permission to practice a patent or covenant not to sue for patent infringement). To “grant” such a patent license to a party means to make such an agreement or commitment not to enforce a patent against the party.
If you convey a covered work, knowingly relying on a patent license, and the Corresponding Source of the work is not available for anyone to copy, free of charge and under the terms of this License, through a publicly available network server or other readily accessible means, then you must either (1) cause the Corresponding Source to be so available, or (2) arrange to deprive yourself of the benefit of the patent license for this particular work, or (3) arrange, in a manner consistent with the requirements of this License, to extend the patent license to downstream recipients. “Knowingly relying” means you have actual knowledge that, but for the patent license, your conveying the covered work in a country, or your recipient's use of the covered work in a country, would infringe one or more identifiable patents in that country that you have reason to believe are valid.
If, pursuant to or in connection with a single transaction or arrangement, you convey, or propagate by procuring conveyance of, a covered work, and grant a patent license to some of the parties receiving the covered work authorizing them to use, propagate, modify or convey a specific copy of the covered work, then the patent license you grant is automatically extended to all recipients of the covered work and works based on it.
A patent license is “discriminatory” if it does not include within the scope of its coverage, prohibits the exercise of, or is conditioned on the non-exercise of one or more of the rights that are specifically granted under this License. You may not convey a covered work if you are a party to an arrangement with a third party that is in the business of distributing software, under which you make payment to the third party based on the extent of your activity of conveying the work, and under which the third party grants, to any of the parties who would receive the covered work from you, a discriminatory patent license (a) in connection with copies of the covered work conveyed by you (or copies made from those copies), or (b) primarily for and in connection with specific products or compilations that contain the covered work, unless you entered into that arrangement, or that patent license was granted, prior to 28 March 2007.
Nothing in this License shall be construed as excluding or limiting any implied license or other defenses to infringement that may otherwise be available to you under applicable patent law.
12. No Surrender of Others' Freedom.
If conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot convey a covered work so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not convey it at all. For example, if you agree to terms that obligate you to collect a royalty for further conveying from those to whom you convey the Program, the only way you could satisfy both those terms and this License would be to refrain entirely from conveying the Program.
13. Use with the GNU Affero General Public License.
Notwithstanding any other provision of this License, you have permission to link or combine any covered work with a work licensed under version 3 of the GNU Affero General Public License into a single combined work, and to convey the resulting work. The terms of this License will continue to apply to the part which is the covered work, but the special requirements of the GNU Affero General Public License, section 13, concerning interaction through a network will apply to the combination as such.
14. Revised Versions of this License.
The Free Software Foundation may publish revised and/or new versions of the GNU General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.
Each version is given a distinguishing version number. If the Program specifies that a certain numbered version of the GNU General Public License “or any later version” applies to it, you have the option of following the terms and conditions either of that numbered version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of the GNU General Public License, you may choose any version ever published by the Free Software Foundation.
If the Program specifies that a proxy can decide which future versions of the GNU General Public License can be used, that proxy's public statement of acceptance of a version permanently authorizes you to choose that version for the Program.
Later license versions may give you additional or different permissions. However, no additional obligations are imposed on any author or copyright holder as a result of your choosing to follow a later version.

7. Copyright informations

15. Disclaimer of Warranty.
THERE IS NO WARRANTY FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.
16. Limitation of Liability.
IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MODIFIES AND/OR CONVEYS THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.
17. Interpretation of Sections 15 and 16.
If the disclaimer of warranty and limitation of liability provided above cannot be given local legal effect according to their terms, reviewing courts shall apply local law that most closely approximates an absolute waiver of all civil liability in connection with the Program, unless a warranty or assumption of liability accompanies a copy of the Program in return for a fee.
END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Programs
If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.
To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively state the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

<one line to give the program's name and a brief idea of what it does.>
Copyright (C) <year> <name of author>
This program is free software: you can redistribute it and/or modify
it under the terms of the GNU General Public License as published by
the Free Software Foundation, either version 3 of the License, or
(at your option) any later version.
This program is distributed in the hope that it will be useful,
but WITHOUT ANY WARRANTY; without even the implied warranty of
MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the
GNU General Public License for more details.
You should have received a copy of the GNU General Public License
along with this program. If not, see <https://www.gnu.org/licenses/>.

Also add information on how to contact you by electronic and paper mail.
If the program does terminal interaction, make it output a short notice like this when it starts in an interactive mode:

<program> Copyright (C) <year> <name of author>
This program comes with ABSOLUTELY NO WARRANTY; for details type `show w'.
This is free software, and you are welcome to redistribute it
under certain conditions; type `show c' for details.

The hypothetical commands `show w' and `show c' should show the appropriate parts of the General Public License. Of course, your program's commands might be different; for a GUI interface, you would use an "about box".
You should also get your employer (if you work as a programmer) or school, if any, to sign a "copyright disclaimer" for the program, if necessary. For more information on this, and how to apply and follow the GNU GPL, see <https://www.gnu.org/licenses/>.

The GNU General Public License does not permit incorporating your program into proprietary programs. If your program is a subroutine library, you may consider it more useful to permit linking proprietary applications with the library. If this is what you want to do, use the GNU Lesser General Public License instead of this License. But first, please read <https://www.gnu.org/licenses/why-not-lgpl.html>.

7. Copyright informations

Compile and install from the repository

First download the library source code from the GitHub releases page, unzipping the archive, and execute:
Python 2:
cd Adafruit_Python_DHT

Python 3:
cd Adafruit_Python_DHT

You may also git clone the repository if you want to test an unreleased version:
git clone https://github.com/adafruit/Adafruit_Python_DHT.git

Usage

See example of usage in the examples folder.

Author

Adafruit invests time and resources providing this open source code, please support Adafruit and open-source hardware by purchasing products from Adafruit!
Written by Tony DiCola for Adafruit Industries.
MIT license, all text above must be included in any redistribution

DEPRECATED LIBRARY. Adafruit Python CharLCD

This library has been deprecated! We are leaving this up for historical and research purposes but archiving the repository.
We are now only supporting the use of our CircuitPython libraries for use with Python.
Check out this guide for info on using character LCDs with the CircuitPython library: https://learn.adafruit.com/character-lcds/python-circuitpython

Adafruit_Python_CharLCD

Python library for accessing Adafruit character LCDs from a Raspberry Pi or BeagleBone Black.
Designed specifically to work with the Adafruit character LCDs ----> https://learn.adafruit.com/character-lcds/overview
For all platforms (Raspberry Pi and Beaglebone Black) make sure you have the following dependencies:
sudo apt-get update

For a Raspberry Pi make sure you have the RPi.GPIO library by executing:
sudo pip install RPi.GPIO

For a BeagleBone Black make sure you have the Adafruit_BBIO library by executing:
sudo pip install Adafruit_BBIO

Install the library by downloading with the download link on the right, unzipping the archive, navigating inside the library's directory and executing:
sudo python setup.py install

See example of usage in the examples folder.
Adafruit invests time and resources providing this open source code, please support Adafruit and open-source hardware by purchasing products from Adafruit!
Written by Tony DiCola for Adafruit Industries.
MIT license, all text above must be included in any redistribution

7. SUPPORT

We also support you after your purchase. If there are any questions left or if you encounter any problems, please feel free to contact us by mail, phone or by our ticket-system on our website.

E-Mail: service@joy-it.net
Ticket-System: http://support.joy-it.net
Telefon: +49 (0)2845 98469 – 66 (11- 18 Uhr)

For further information please visit our website:

www.joy-it.net

