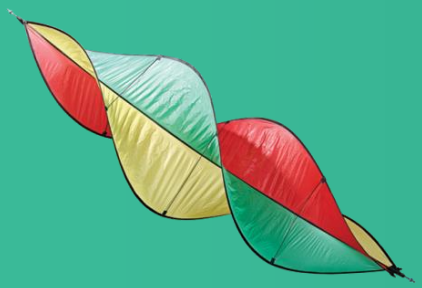

Workshop Raspberry Pi

Steven De Lausnay and Kenneth Labiau
KU Leuven - KAHO Sint-Lieven
February 2014

Part 1

The Raspberry Pi

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What is a Raspberry Pi?

It's tempting to think of the Raspberry Pi as a microcontroller development board like Arduino, or as a laptop replacement. In fact it is more like the exposed innards of a mobile device, with lots of maker-friendly headers for the various ports and functions.

What's on the board (1)

(A) Processor: a 32 bit 700 MHz SoC

(B) SD Card slot: Hard drive

(C) USB ports: USB 2.0

(D) Ethernet port

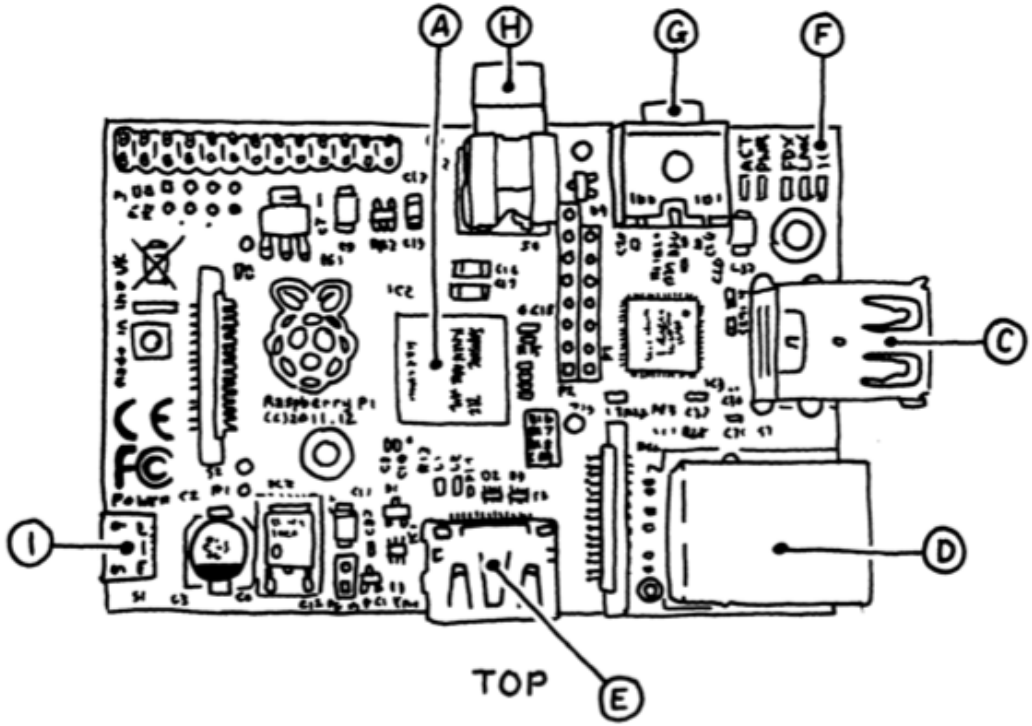
(E) HDMI Connector

(F) Status LEDs

(G) Analog Audio Out: high impedance loads

(H) Composite Video: NTSC or PAL

(I) Power input



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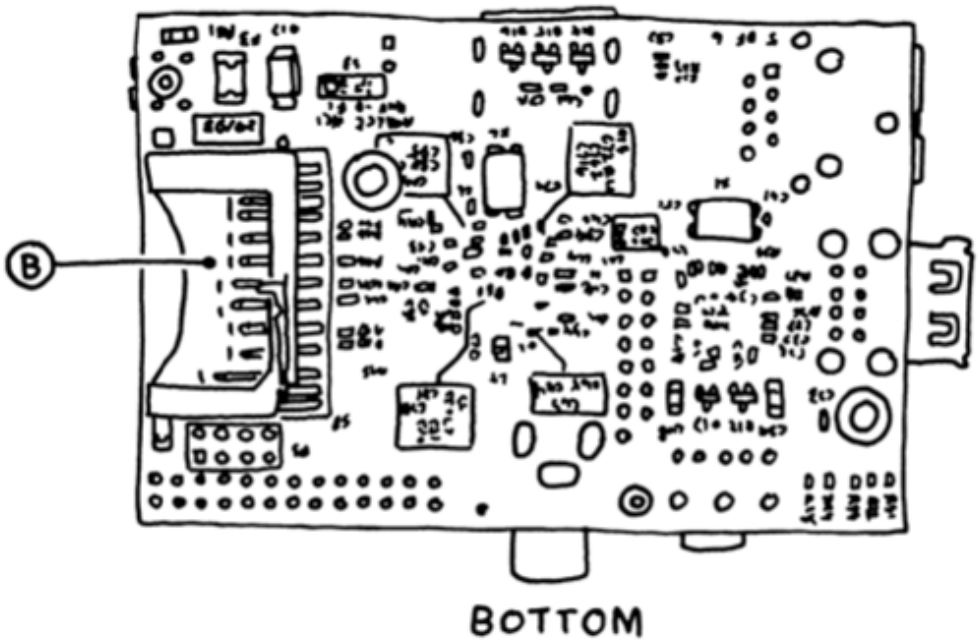

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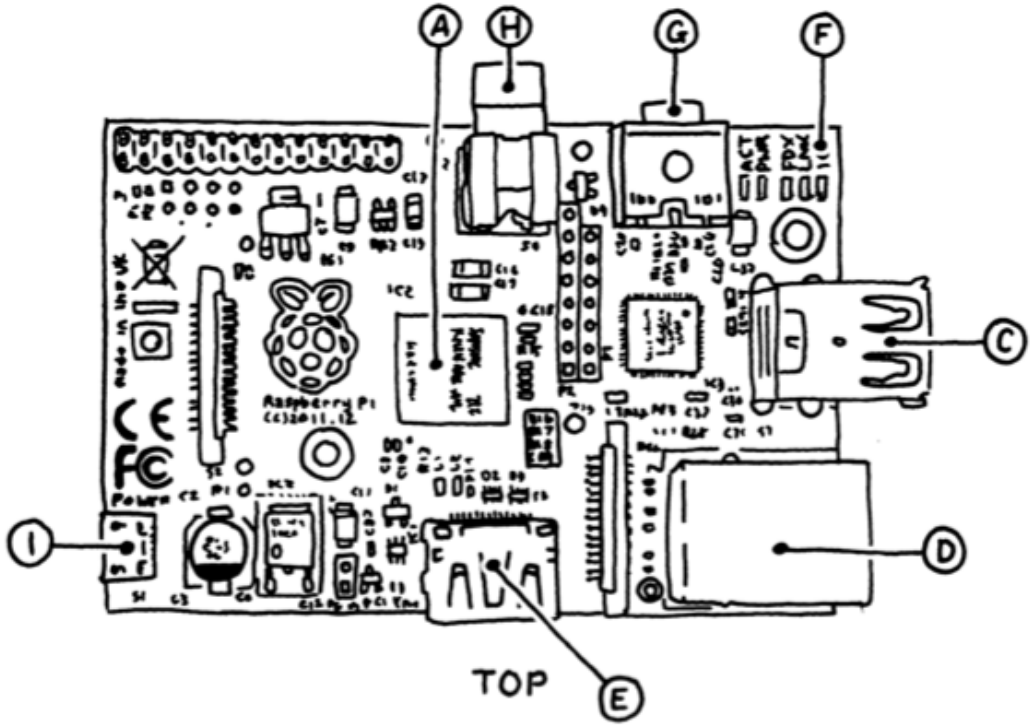

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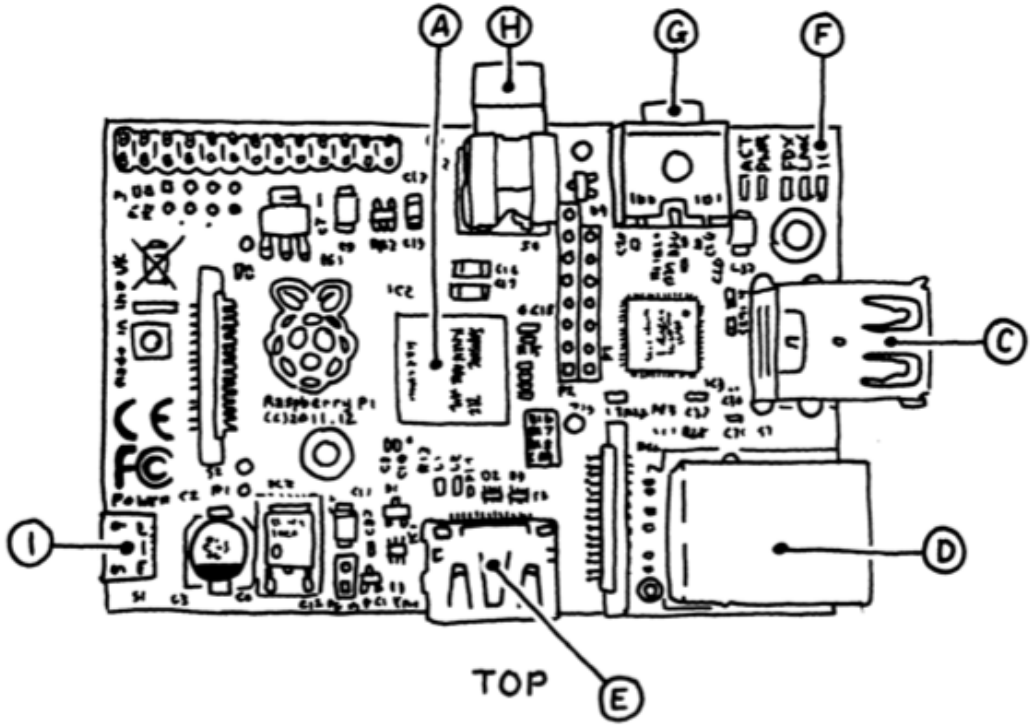

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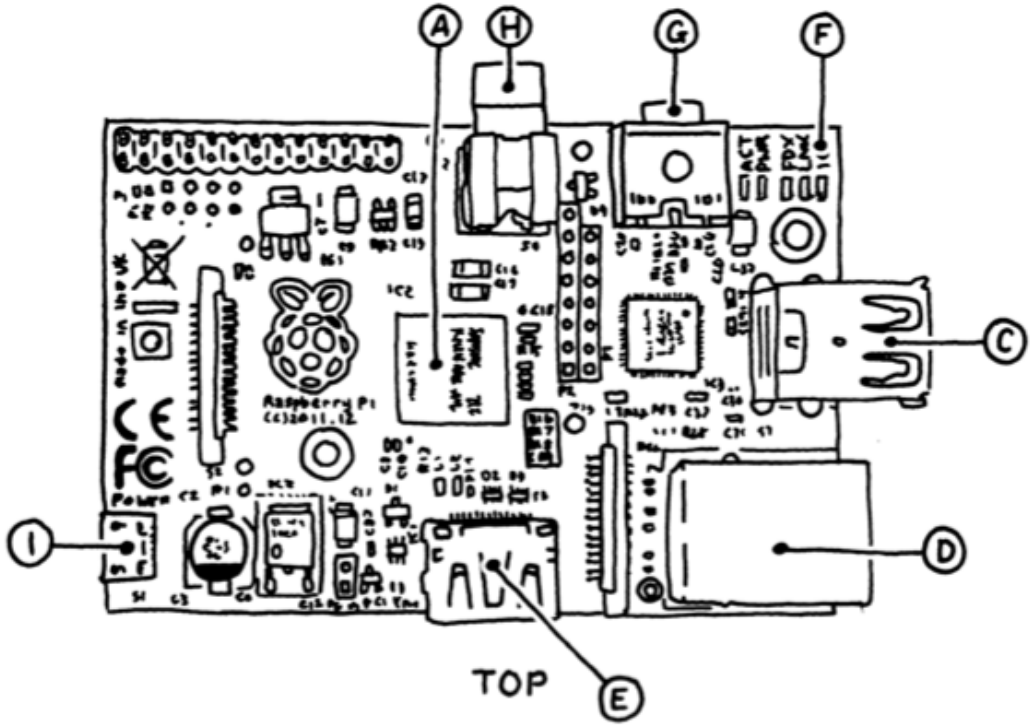

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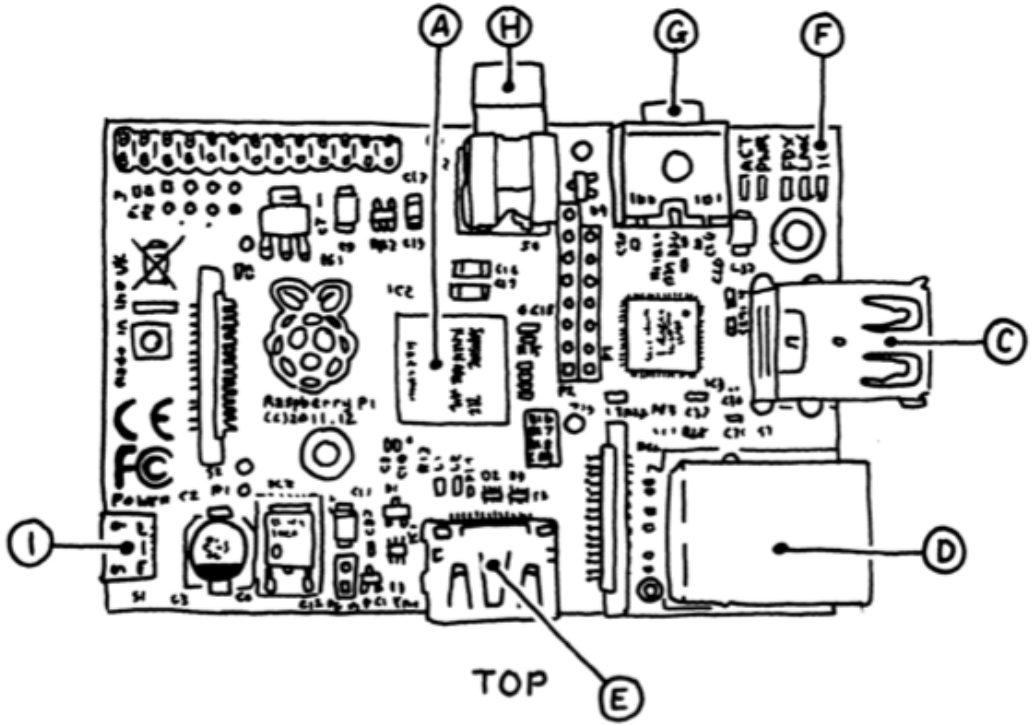

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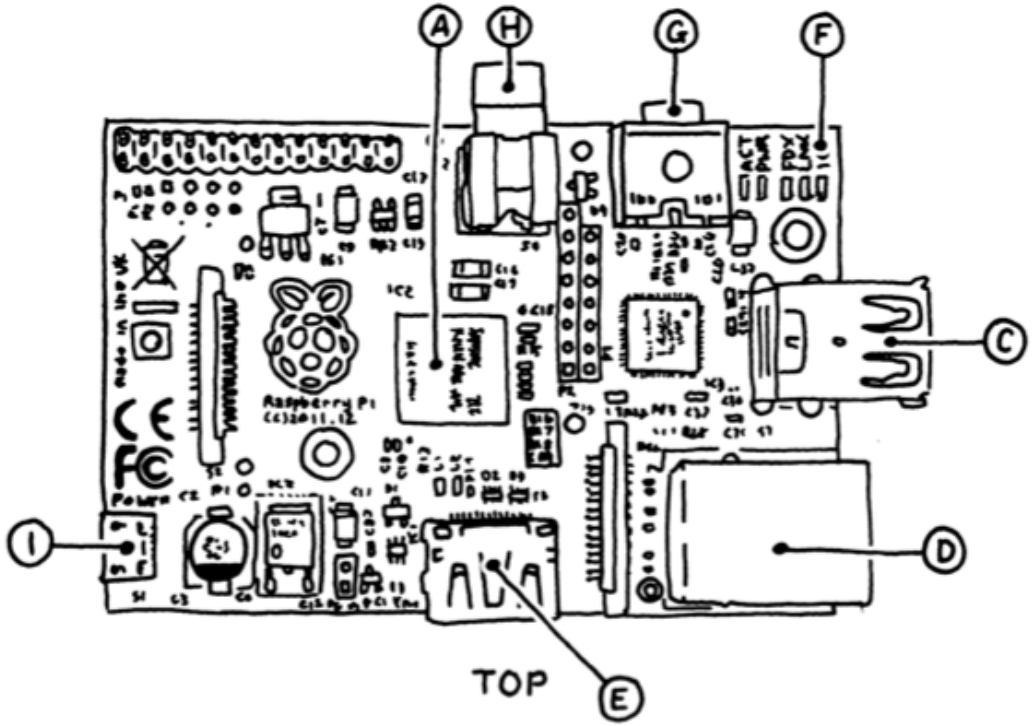

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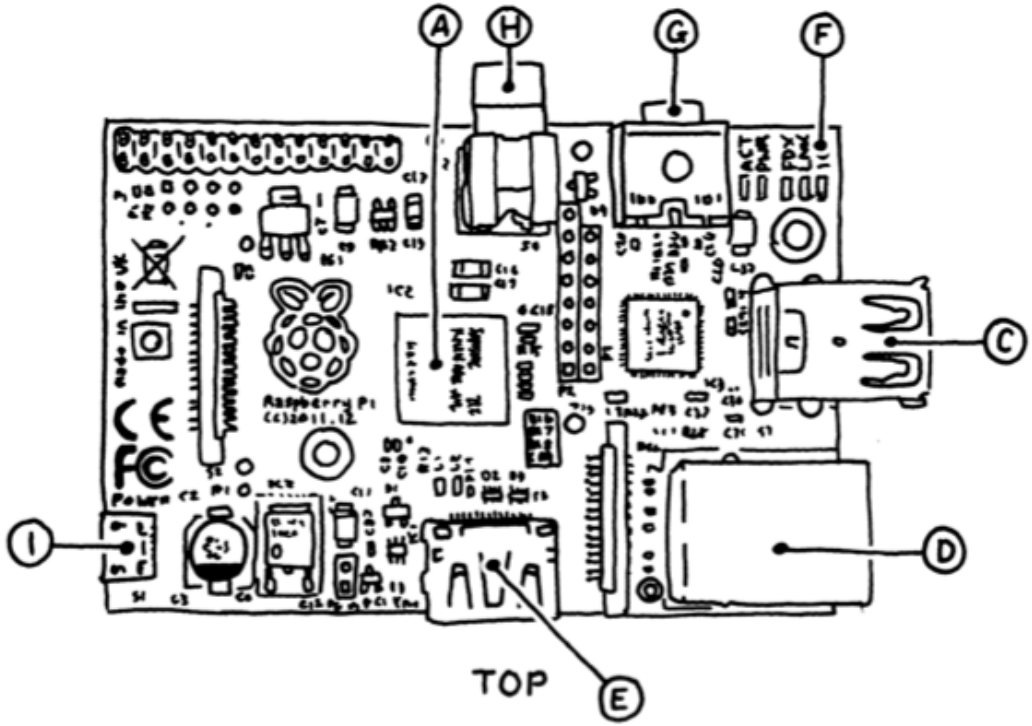

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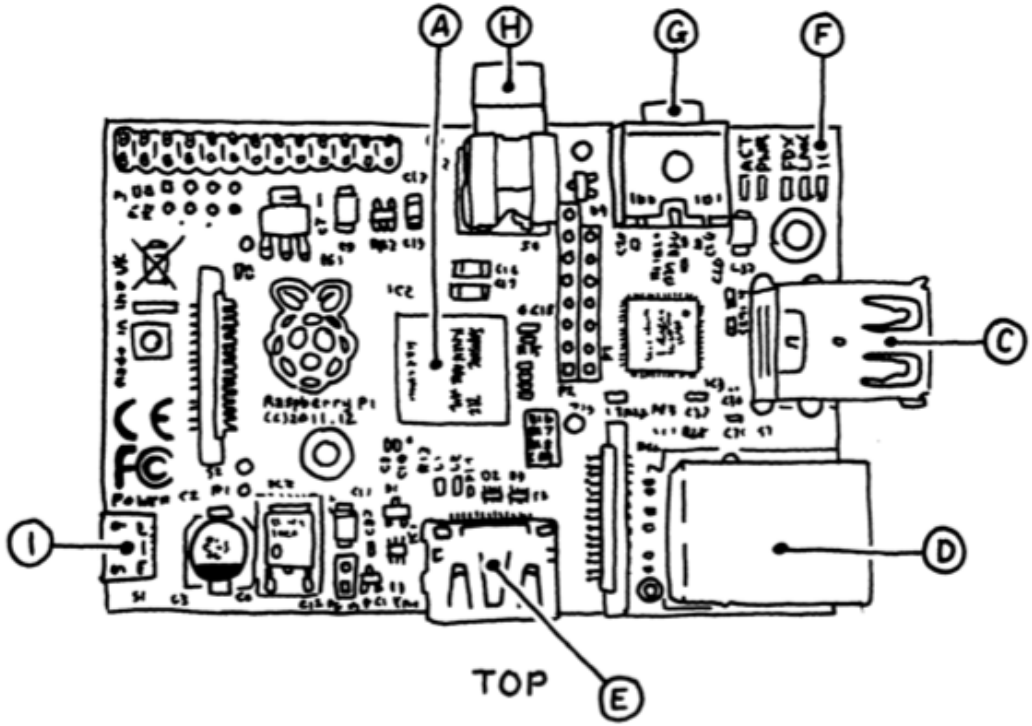


The status LEDs

ACT	Green	Lights when the SD card is accessed (marked OK on earlier boards)
PWR	Red	Hooked up to 3.3V power
FDX	Green	On if network adapter is full duplex
LNK	Green	Network activity light
100	Yellow	On if the network connection is 100Mbps (some early boards have a 10M misprint)

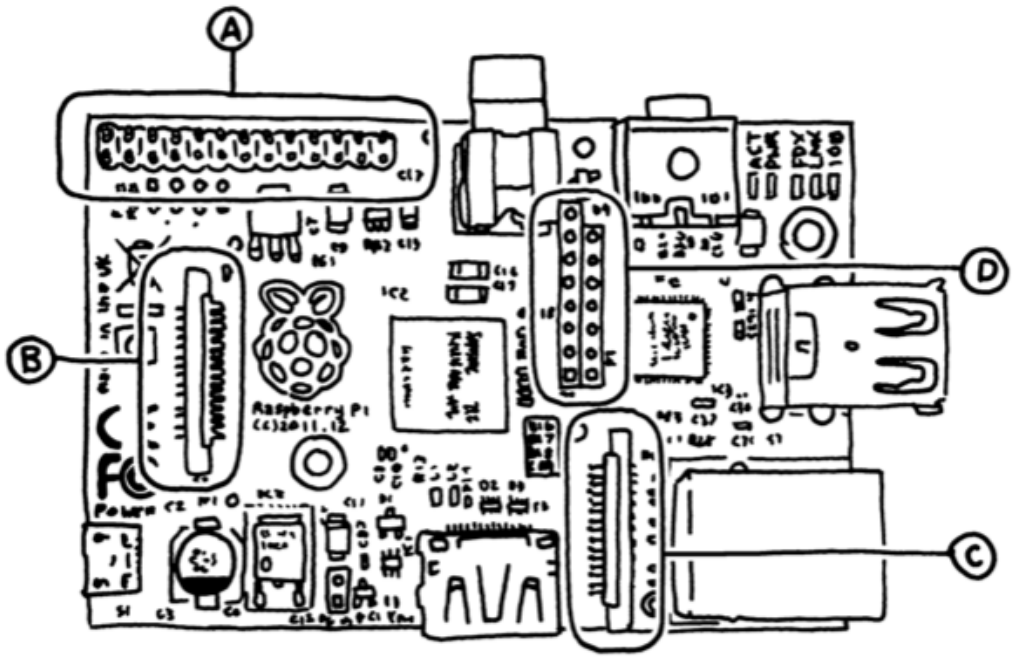
What's on the board (2)

(A) General Purpose Input Output (GPIO): read buttons and switches and control LEDs, relays or motors

(B) Display Serial Interface (DSI) connector: Communication with LCD or OLED display

(C) Camera Serial Interface (CSI) connector

(D) JTAG testing header for the Broadcom chip and the LAN9512 networking chip



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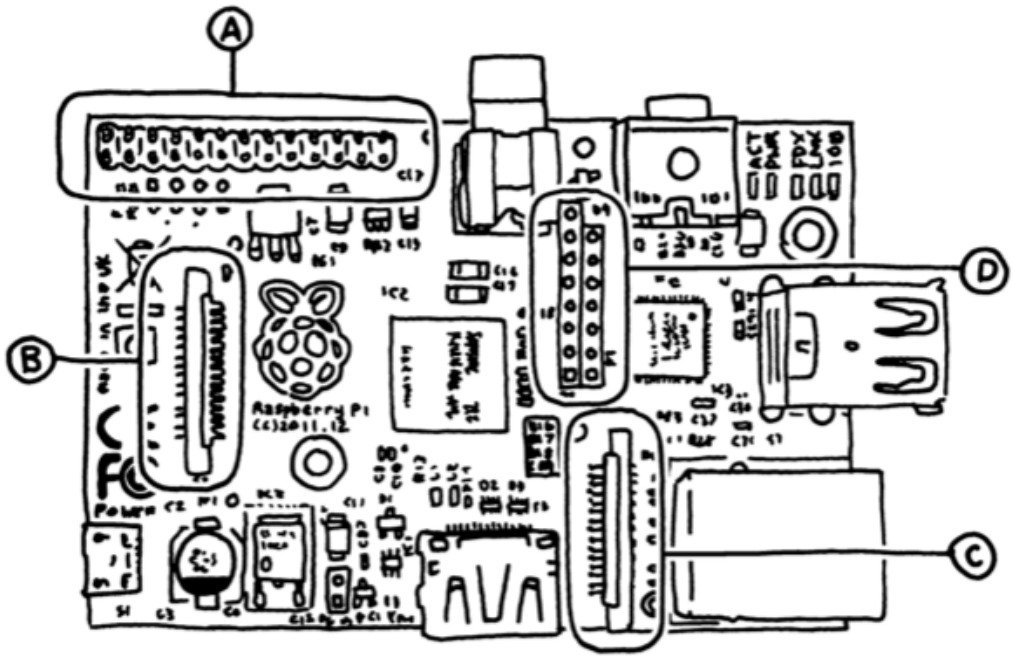

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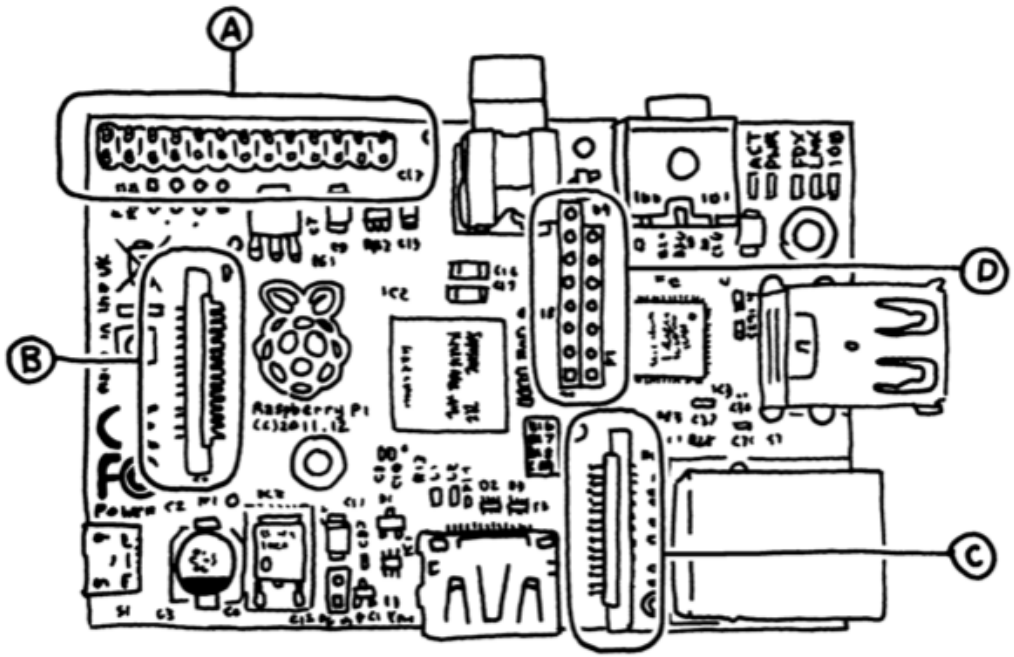

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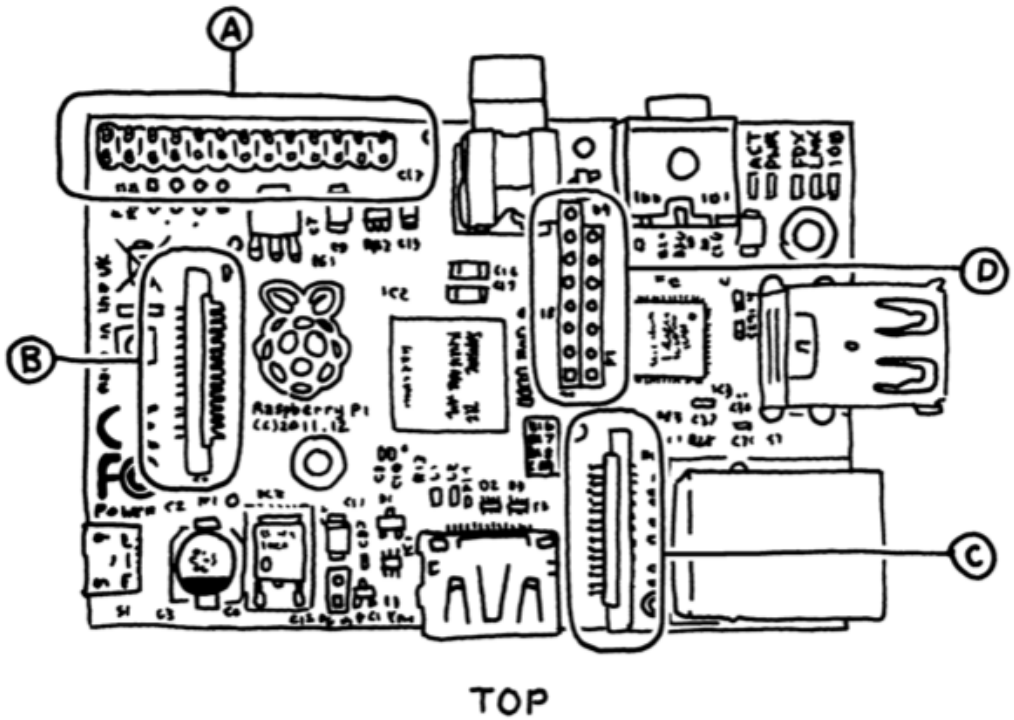
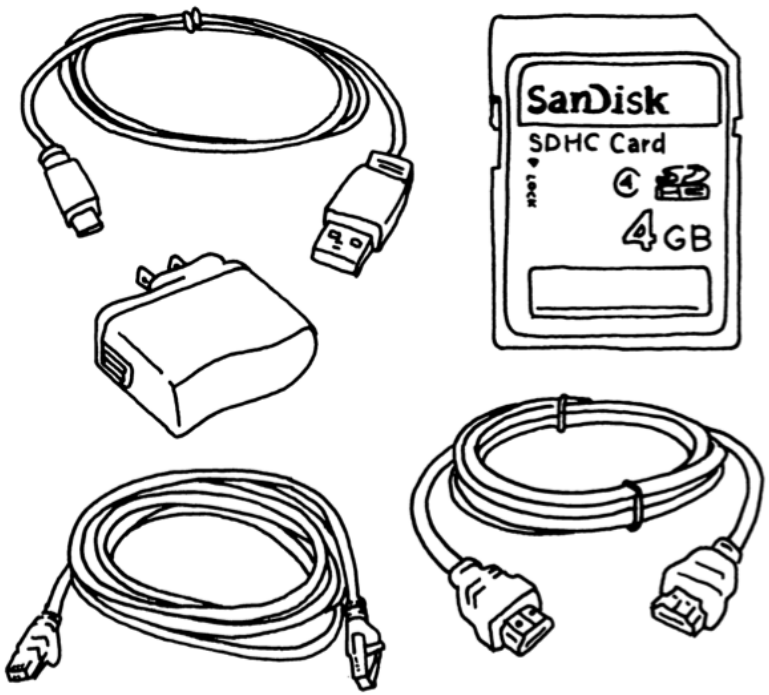


What is needed to get it up and running

- A power supply: microUSB adapter which provides 5 V (5,2 V) at 1 A
- An SD Card: at least 4 GB Class 4
- An HDMI cable
- Ethernet Cable: alternative is a USB WiFi adapter

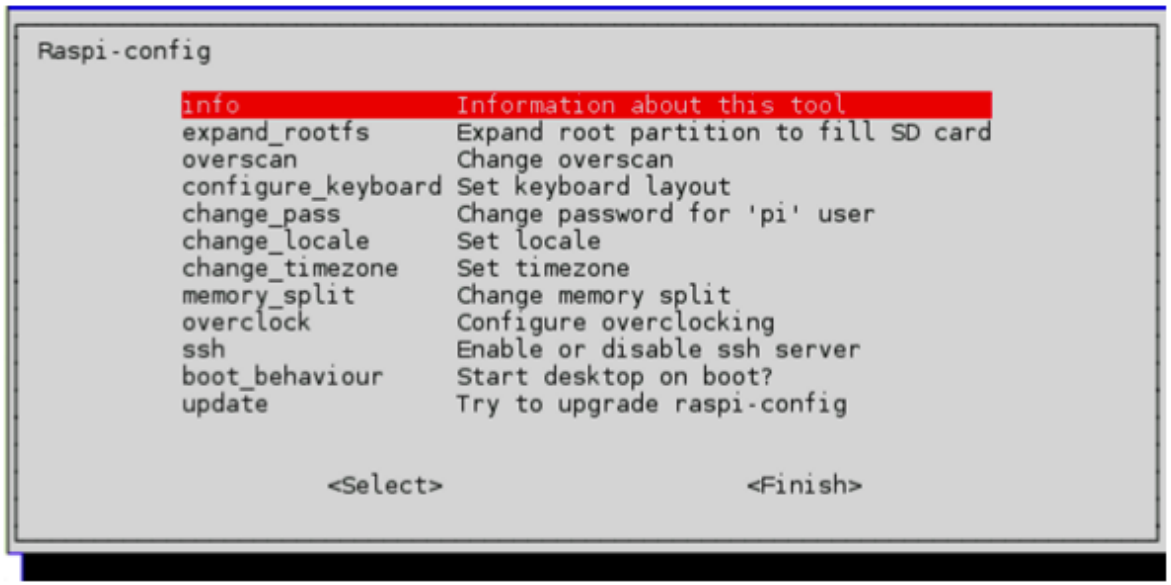


Operating System

- Runs Linux as an operating system (Kernel)
- A variety of flavors or distributions of the OS Linux have evolved over the years like Ubuntu, Debian, Fedora, etc.
- The Raspberry Pi has a Mobile based chipset, other software is required than for desktop computers
- Special distributions for Raspberry Pi
  - Raspbian (Officially Recommended)
  - Adafruit Raspberry Pi Educational Linux
  - Arch Linux
  - Xbian (XMBC media center)
  - QtonPi
  - etc
- Copy the OS on the SD Card using a disk image utility

Lets get started

- Connect keyboard, mouse and HDMI cable.
- Check the SD card
- Plug in the power supply
- A bunch of startup log entries appear on the screen
- When it is the first time start up you'll be presented with a few raspi-config settings (sudo raspi-config)

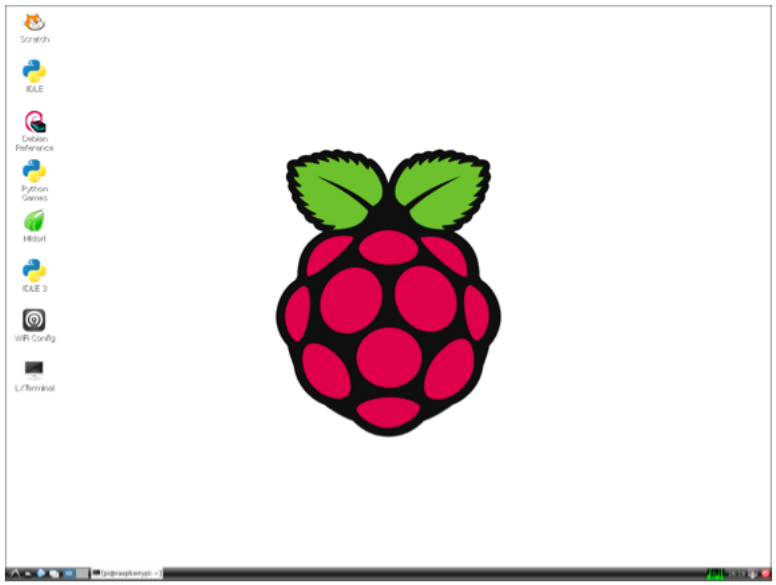


Start the Desktop Behavior

Log in:

```
raspberrypi login: pi
Password: raspberry
pi@raspberrypi ~ $ startx
```

Raspbian comes with the Lightweight X11 Desktop Environment (LXDE) graphical desktop environment installed.



Part 2

Linux

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Introduction

- If you're going to get the most out of your RPi, you'll need to learn a little Linux
- It's quite difficult to determine which commands we should learn you, because there are so much commands in the Linux world.
- In what follows we try to give you the basics.

Opening a terminal

- There are 2 possibilities:
  - Using the GUI: The desktop icon

  - By command: `Alt + F2` → type `rxvt` → press `Enter`
- You have now a command prompt in a GUI
- You can leave the command prompt by typing `exit` or `CTRL-d`

Important!

- Once booted, be carefull. There is no button for powering off the system.
- Do not eliminate the power when the system is running. You can damage the file system on the SD-card.
- You can shutdown the system from the command prompt by typing `sudo shutdown -h now`
- sudo stands for '**s**uper **u**ser **do**'. You have to be root for executing some Linux commands. For instance for:
  - update the system: `sudo apt-get update`[1]
  - upgrade the system: `sudo apt-get upgrade`
  - installing software: `sudo apt-get install mysoftware`
  - removing files/software: `sudo apt-get remove myfile/software`
  - ...

[1] apt-get is the command-line tool for working with APT software packages.

Opening a terminal

- When you open the terminal, you will be dropped in your home directory
- Your prompt will look like this: `pi@raspberrypi ~ $`
- `pi@(1)raspberrypi(2) ~(3) $(4)`
  1. Your username followed by the @ - symbol
  2. The name of your computer (raspberrypi default)
  3. The current directory of the shell. You always start out in your home directory (`/home/pi`) or ~
  4. This is the shell prompt. Any text you type will appear to the right of it. Press Enter or Return to execute each command you type.

Change directory - List files

- Use the `cd` (change directory) command to move around the file system.
- Changing to the home directory for the user pi:
  - `cd`
  - (`cd /home/pi`)
  - (`cd ~`)
- Once you've changed to a directory, use the `ls` command to list the files there.
  - `ls`

Make your own directory - Rename a file

- To create a new directory use `mkdir`
  - `cd` - Change directory to the home directory
  - `mkdir test1` - Create new directory
  - `mkdir test2` - Create new directory
  - `ls` - Listing up the files under our home directory
- To rename a file or directory use `mv`
  - `mv test2 Piprograms` - Rename directory 'test2' to 'Piprograms'
- To remove an **empty** directory use `rm`
  - `rm test1`
  - `ls`
- To remove a directory which isn't empty use `rm -r`
- Note: be careful with the remove commands! (Linux is a butler, not a nanny.)

'Forbidden' shortcuts under Linux

- They are not really forbidden, but for Windows users is adaptation
- `CTRL-z` - undo a last action under Windows but under Linux it moves a running proces to the background (You can bring a process in the background to the foreground by `fg`.)
- `CTRL-s` - saving under Windows but stopping the output under Linux (You can undo a `CTRL-s` by `CTRL-q` (= continue))
- `CTRL-c` - interrupts a program abruptly
- So, be attentive

Part 3

Programming In- and Outputs with Python

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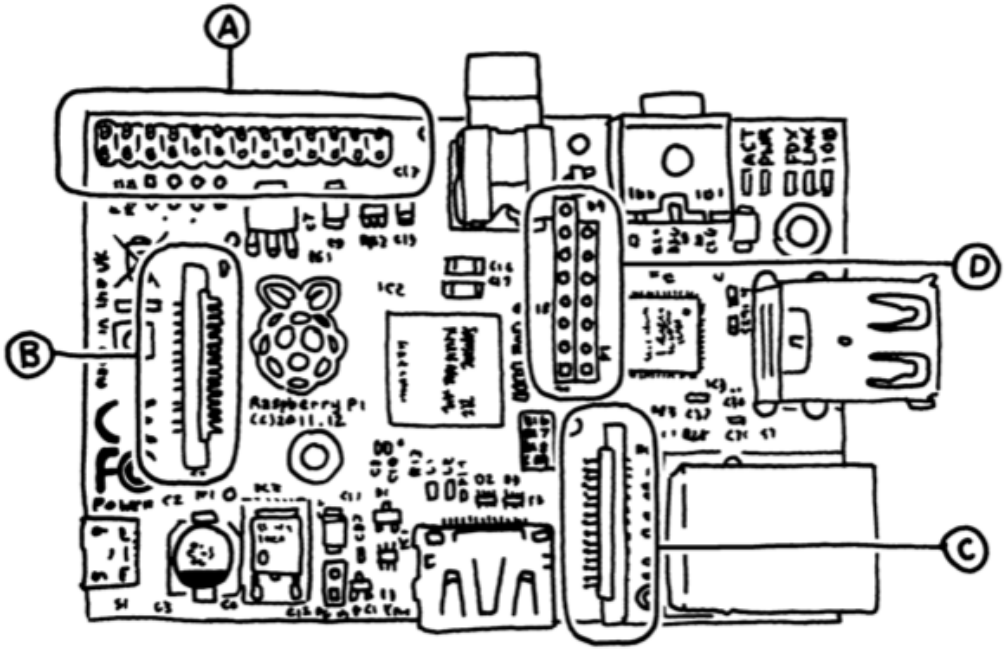
Introduction GPIO

- In essence, the RPi is a very inexpensive Linux computer
- There are a few things that distinguish it from laptop and desktop machines that we usually use for:
  - Writing emails
  - Browse the web
  - Word processing
  - ...
- One of the main differences is that the RPi can be used directly in electronic projects
- It has GPIO (General purpose input output) pins
- Interesting as stand-alone project

Introduction GPIO

(A) General Purpose Input Output (GPIO): read buttons and switches and control LEDs, relays or motors



Introduction GPIO

- GPIO pins can be accessed for controlling hardware such as LEDs, Motors, . . . which are examples of outputs.
- As for inputs, your RPi can read the status of buttons, switches, . . . and can read sensors like temperature, light, motion, . . .

Introduction Python

- Python is a great first programming language; it's clear and easy to get up and running.
- There are a lot of other users to share code with and ask questions from on fora.
- Python presents itself as an interpreted language, which means that you can write a program or script and execute it immediately. (Each time you run a script the code is compiled to byte-code)
- You don't have to tell explicitly whether a variable is a number, a list or a string. The interpreter figures out the data types when you execute the script. Which is one of the side benefits.
- The Python interpreter can be run in two ways:
  - As an interactive shell to execute individual commands
  - As an command line program to execute standalone scripts

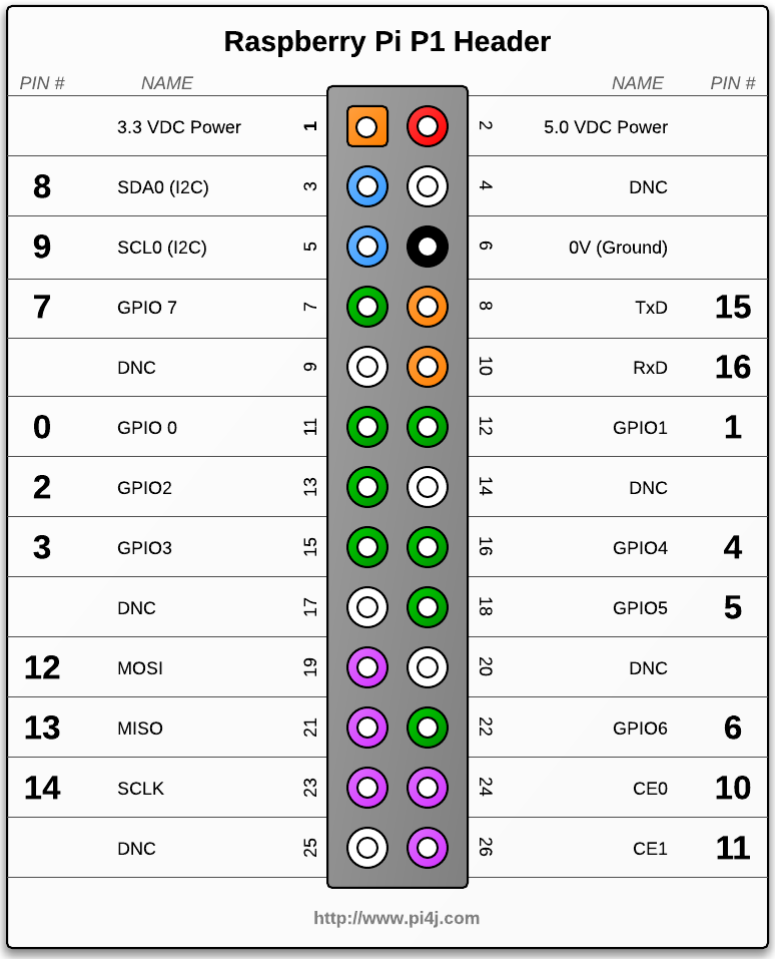
Introduction Python

- The Python interpreter can be run in two ways:
  - As an interactive shell to execute individual commands
  - As an command line program to execute standalone scripts

- The icon marked as `IDLE` on your desktop, is the integrated development environment for Python 2.0, the icon marked as `IDLE 3` is for Python 3
- In what follows we will use Python 2

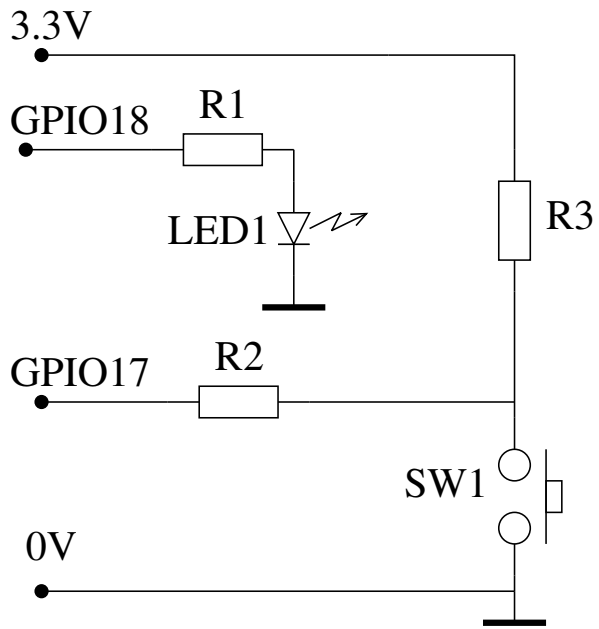
BOARD versus BCM numbering

- There are two numbering schemes used for the GPIO pins:
  - BOARD numbering - which is based on the physical pin numbering
  - BCM numbering - which refers to the channel numbering on the Broadcom-chip itself
- In what follows we will use the BCM numbering



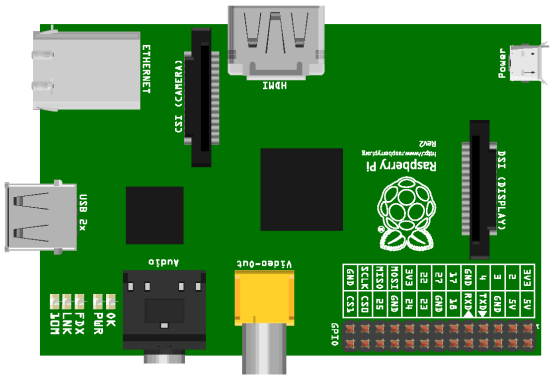
Electrical scheme

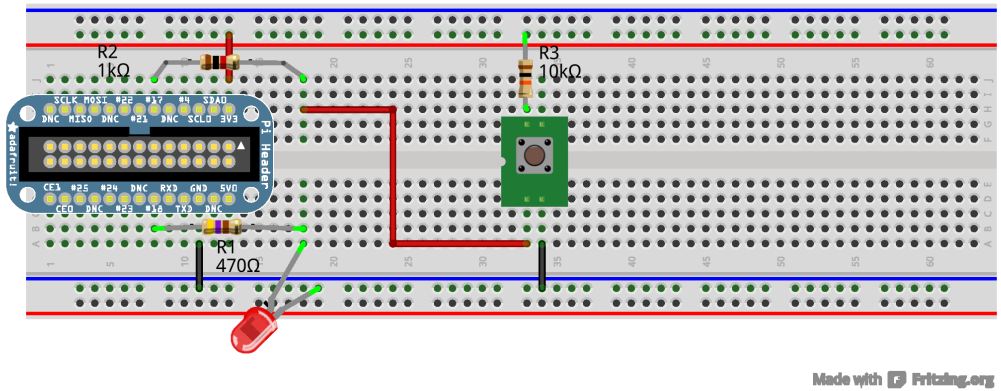
- We will make some exercises now
- Breadboard the electrical scheme as shown below



Implementation practical scheme

- The pratical implementation is shown below





RPi Cobbler

- To make an easy connection betweem the GPIO pins of the RPi and the breadboard, we will use an RPi Cobbler.

- Our connection between the RPi and the Breadboard will look like this:

- Remark: The white stripe = pin 1

First program in Python

- Program a Blinking LED
- The commands which have to be entered
  - `#!/usr/bin/python`
  - `import time`
  - `import RPi.GPIO as gpio`
  - `gpio.setmode(gpio.BCM)`
  - `gpio.setup(18,gpio.OUT)`
  - `while true:`
  - `gpio.output(18,1)`
  - `time.sleep(3)`
  - `gpio.output(18,0)`
  - `time.sleep(3)`

Listingfile 1

```
#!/usr/bin/env python
import RPi.GPIO as gpio
import time
gpio.setmode(gpio.BCM)
gpio.setup(18,gpio.OUT)
while True:
    gpio.output(18,True)
    time.sleep(1)
    gpio.output(18,False)
    time.sleep(1)
```

Programming first listingfile

- Save the program and give it the name `blinkingled.py` under the folder `Piprograms`
- To run the program:
  - `Run`
  - `Run Module`
- The program can also be started from commandline:
  `sudo python blinkingled.py`
- To stop the program make following key combination: `CTRL - C`

Programming first listingfile

- Everything after the # will be seen as comment in our program
- Except, `#!` in the first line, `#!/usr/bin/python` this is called `a shebang`
- The presence of `the shebang` ensure the system knows that it is a python script which must be opened by Python.
- We can make our program executable:
  `sudo chmod +x blinkingled.py`
- Our program can now be started from the command line:
  `sudo ./blinkingled.py`

Listingfile 2

- Reading the state of our push button and when pressed: turn the LED off

```
#!/usr/bin/env python
import RPi.GPIO as gpio
#import time
gpio.setmode(gpio.BCM)
gpio.setup(17,gpio.IN)
gpio.setup(18,gpio.OUT)
while 1:
    if gpio.input(17):
        gpio.output(18,0)
    else:
        gpio.output(18,1)
```

Programming second listingfile

- Save the program and call it `buttonled.py` under the folder `Piprograms`
- Run the program - Test it - Close it
- Open the program from commandline - Close it
- Make the program executable
- Open the program from commandline - Test it - Close it

Extra excercises

- Program a python script that when you press a push button the state of it will be printed. Use the `print statement`.
- Program a python script that when you press the push button, the LED blinks 3 times, otherwise the LED is on. Use the `for loop`.
- Program a die with a LED. You'll need a push button and a LED. When you press the push button, it's like you throw a die. The result will be represented by blinking your LED randomly between 1 and 6. The values of a real die. Use the `random` function.

For all these exercises the same electrical scheme can be used as in the examples.

Part 4

VNCserver - VNCviewer

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Introduction

- The RPi is an very interesting system, but there is a lot of extra hardware required. Like a keyboard, mouse, screen, UTP cable, power cable, etc.
- You can eliminate a lot of hardware after you're RPi is configured the first time
- There is a possibility to login on your RPi from another computer. Therefore you must install a VNCserver on your Pi and a VNCviewer on your computer.

Introduction

- VNC $\rightarrow$ Virtual Network Computing
- It's a graphical desktop sharing system
- Another computer can be managed remotely
- It transmits keyboard and mouse events from an computer to another
- The graphical screen updates back in the other direction, over a computernetwork

Installation VNCserver (allready done)

- Install the VNCserver on your RPi, type following command: `sudo apt-get install tightvncserver`
- Once installed, take care that the VNCserver will automatically start up everytime the RPi will be booted.
- Make VNCserver a "service"
  - Open a terminal
  - Type: `sudo nano /etc/init.d/tightvncserver`
  - Copy the text -you'll find on the website- in the editor
  - Save the file: `CTRL-o` followed by `CTRL-x`

Installation VNCserver (allready done)

- Make the program executable:
  `sudo chmod 755 /etc/init.d/tightvncserver`
- Start the VNCserver a first time:
  `sudo /ect/init.d/tightvncserver start`
- VNC will ask once only after a password: `raspberry`
- On the question
  `'would you like to enter a view-only password (y/n)?'`
  Answer no (`n`)

Installation VNCserver (allready done)

- Add the script to our start-up scripts of the RPi: `update-rc.d tightvncserver defaults`
- Reboot the RPi
- The VNCserver will now automatically start up
- When you know the IP-number of you RPi, you can login from another computer with a VNCviewer
- No idea? `/sbin/ifconfig |grep inet` (write it down)

Installation VNCviewer

- Install VNCviewer on your Windows computer
  - Search a download file on the web and install it
- Install VNCviewer on your Linux computer
  - `sudo apt-get install xtightvncviewer`
  - Open xtightvncviewer: `xtightvncviewer`
  - A popup window will appear
  - Enter the IP-address of your RPi followed by the portnumber (5901), ex.: `12.123.12.12:5901`
  - A new popup window will emerg for entering your password
- Test it.

Part 5

Copying Files: Local $\Longleftrightarrow$ Remote

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Introduction WinSCP

- For Windows users
- WinSCP is a free open-soure SFTP, FTP and SCP client for Microsoft Windows
  - FTP : File Transfer Protocol
  - SFTP : Secure File Transfer Protocol
  - SCP : Secure CoPy
- It's main function is secure file transfer between a local and remote computer

Installation

- Take care that the SSH server is installed on your RPi: `sudo apt-get install openssh-server`
- Search a WinSCP download file on the web and install it
- Open WinSCP
- Enter your:
  - IP-address: Which you have noticed previously
  - Username: pi
  - Password: raspberry
  - Portnumber: 22

Introduction gFTP

- For Linux users
- For copying files over SSH it's neccessary installing an SSH server on the RPi: `sudo apt-get install openssh-server`
- SSH is a cryptographic network protocol for secure data communication, remote command-line login, remote command execution, and other secure network services between two networked computers that connects, via a secure channel over an insecure network, a server and a client.

Installation gFTP

- Install gFTP: `sudo apt-get install gftp`
- Open gFTP: `gFTP`
  - Host: IP-address RPi
  - Port: 22
  - Username: pi
  - Password: raspberry
  - Last tab: SSH2

Part 6

Remote login over SSH

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Remote login over SSH

- Sometimes it isn't necessary or possible to connect the RPi with a display/screen.
- Then you can login on your RPi by means of SSH: `ssh pi@IpAdres`
- That's a manner to work by commandprompt
- Suppose that the Graphical environment crashes, you still have a possibilty to shutdown the RPi, from another pc, whitout damaging the file system.

Part 7

RPi as Web server

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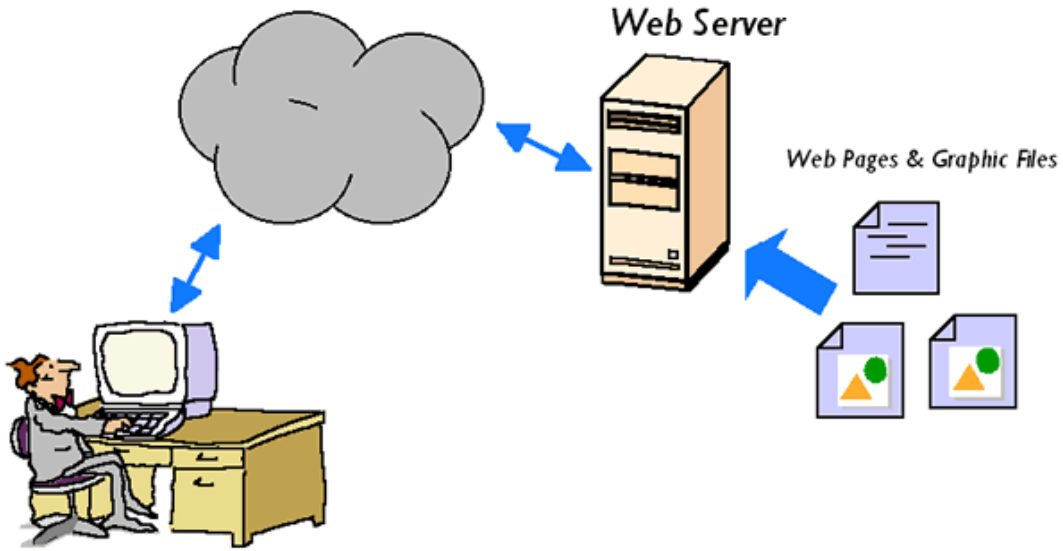
What is a web server?

The primary function of a web server is to deliver web pages to clients. The communication between client and server takes place using the HyperText Transfer Protocol (HTTP). Pages delivered are most frequently HTML documents, which may include images, style sheets and scripts in addition to text content.



What do we need?

A web site is like a restaurant, ...

... it should be a dynamic site where visitors can choose what they want to see. For this, you would have to install tree services on your RPi namely Apache, MySQL and PHP (AMP platform).

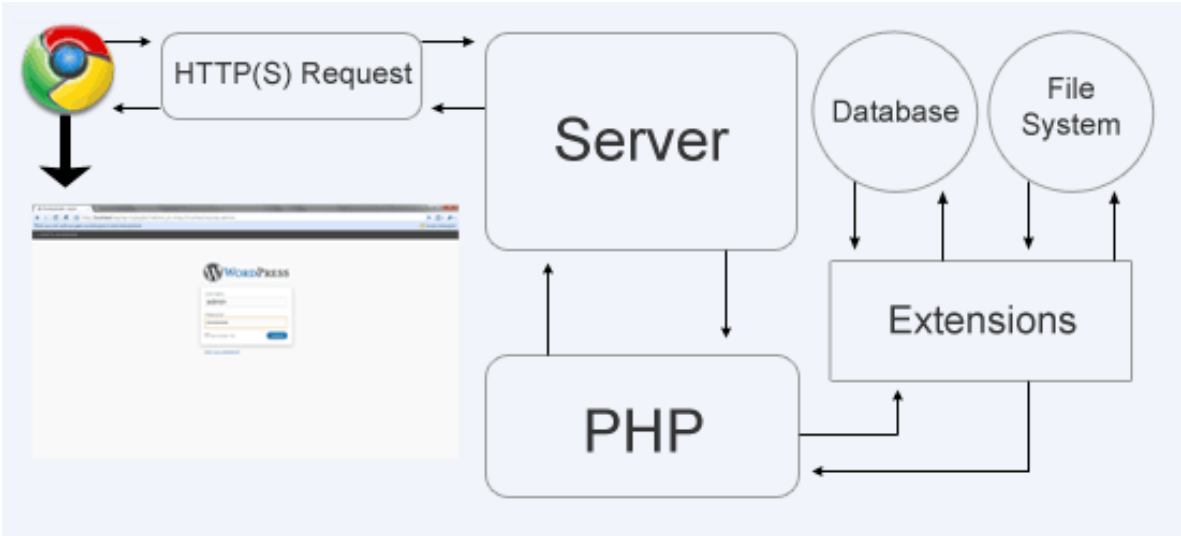
What do we need?

You can characterize the components of the AMP platform as follows:

- PHP (Hypertext Preprocessor): Whatever people ask for, your highly trained master of culinary arts, the chef, prepares it without complaint. She is quick, flexible, and able to prepare a multitude of different types of foods. PHP acts in much the same way as it mixes and matches dynamic information to meet the request for fresh web pages.
- MySQL: Every chef has a well-stocked stockroom of ingredients. In this case, the ingredients used by PHP are records of information stored in MySQLs databases.
- Apache: This is the waiter. He gets requests from the costumers and relays them back to the kitchen with specific instructions about how the meal should be prepared. Then he serves the meal once it is complete.

What do we need?

When a customer (web site visitor) comes to your restaurant (web site), he or she sits down and orders a meal with specific requirements (requests a particular page or resource), such as a steak served medium well. The waiter (Apache) takes those specific requirements back to the kitchen and passes them off to the chef (PHP). The chef then goes to the stockroom (MySQL) to retrieve the ingredients (data) to prepare the meal and presents the final dish (web page) back to the waiter, who in turn serves it to the customer exactly the way he or she ordered it.



Install AMP on RPi

- Before installing any more software packages, update your system fully by executing the following:

```
sudo apt-get update
sudo apt-get upgrade
```

- Then execute the following command to obtain and install the Apache2 web server:

```
apt-get install apache2
```

- Apache2 will be running after installation, but if you need to start or stop it, the commands are:

```
service apache2 start
service apache2 stop
```

Install AMP on RPi

- Execute the following command to obtain and install the PHP programming environment version 5:

```
sudo apt-get install php5 libapache2-mod-php5
```

- Restart your Apache2 service

```
service apache2 stop
service apache2 start
```

- Check the IP adres of your RPi

```
ifconfig
```

- Enter the IP adres in a web bowser on your computer

Install AMP on RPi

- To install MySQL, install a few packages with the following command:

```
sudo apt-get install mysql-server mysql-client
sudo apt-get install php5-mysql
```

- During the installation, you will be invited to enter a password for the top level MySQL user. The username is commonly root, but the password is up to you.
- Restart your Apache2 service

```
service apache2 stop
service apache2 start
```

- You can test your MySQL installation by logging in to MySQL.

```
mysql -u root -p
```

The -u parameter signifies that the next item is a username, and the -p parameter tells MySQL to expect a password. When prompted, enter the root password created earlier, and MySQL will respond with an Oracle copyright notice and the mysql prompt. Exit MySQL by typing `exit`.

Install AMP on RPi

- phpMyAdmin is one of the most useful tools for working with the MySQL database management system. It is a web-based control panel, but it is not only that. It also includes support for creating and amending your database tables, for entering data into them, and for designing and executing queries.
- Execute the following command to obtain and install phpMyAdmin:

```
sudo apt-get install libapache2-mod-auth-mysql
php5-mysql phpmyadmin
```

- When asked if phpMyAdmin should configure a MySQL database for itself, select yes.
- When asked, enter the password of the root MySQL user, so as to authenticate yourself on MySQL. Once authenticated on MySQL you will be asked to create and confirm a password for phpMyAdmin.
- Then you will be asked which server on which to install it: select Apache2.

Install AMP on RPi

- There are two adjustments to the configurations necessary before you can use phpMyAdmin.
  - First edit the php.ini file to include a MySQL library:

    ```
    nano /etc/php5/apache2/php.ini
    ```
  - Then type the following text into the Dynamic Extensions section about two thirds down the page:

    ```
    Shellextension=mysql.so
    ```
  - As things stand, there is no provision for showing the phpMyAdmin pages from your default web page directory. Therefor create an entry and make a symbolic link in the Apache2 data directory, as follows:

    ```
    cd /var/www
    ln -s /usr/share/phpmyadmin
    ```
  - Now from a workstation, you will be able to navigate to:

    ```
    http://[ipadres]/phpmyadmin
    ```
- Lets go and make a new database!

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Program your website on remote PC with FTP

- We will now install FTP to allow transferring files to and from your Raspberry Pi
- Take ownership of the web root:

```
sudo chown -R pi /var/www
```

- Next, install vsftpd:

```
sudo apt-get install vsft
```

- Edit your vsftpd.conf file:

```
sudo nano /etc/vsftpd.conf
```

  Make the following changes:
  - Change `anonymous_enable=YES` to `anonymous_enable=NO`
  - Uncomment `local_enable=YES and write_enable=YES`
  - then go to the bottom of the file and add `force_dot_files=YES`
- Now save and exit the file. (CTRL + x)
- Now restart vsftpd:

```
sudo service vsftpd restart
```

Program your website on remote PC with FTP

- Make a user to acces the files
- You can add a group upload to your system

  ```
  groupadd upload
  ```
- Add a user for the upload to /var/www. This user is in our example steven

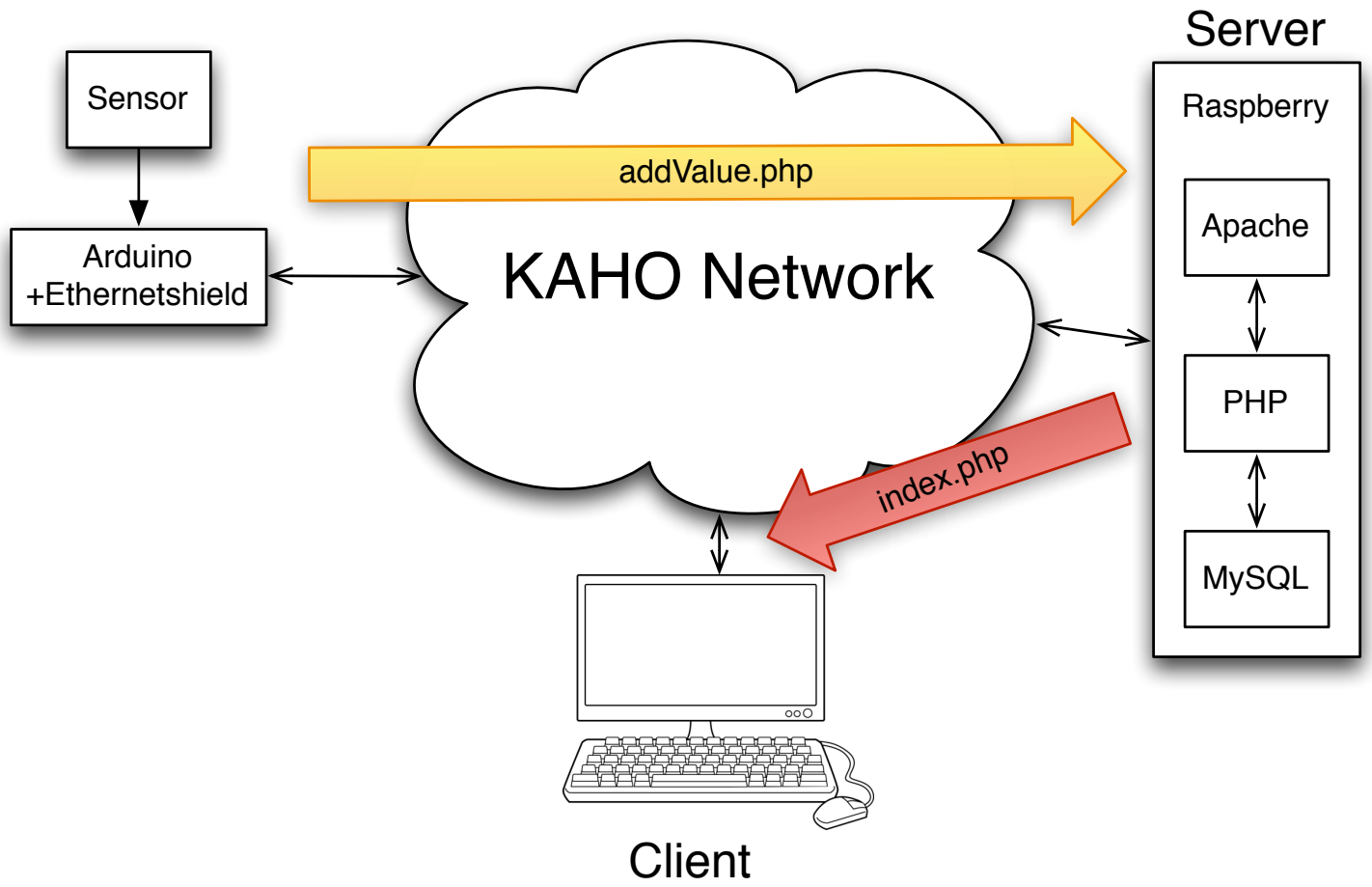
  ```
  useradd -d /var/www -s /bin/bash steven
  ```
- User needs a password

  ```
  passwd steven
  ```
- Now change the permissions on the /var/www directory

  ```
  sudo chown -R root.upload /var/www
  chmod 775 /var/www/
  ```
- Add user steven to the group upload

  ```
  usermod -G upload steven
  ```
- Now you can access the /var/www root directory with filezilla or Dreamwaever to edit the webserver.

Program your website



Program your website

What should the Arduino do?

- Send measured values to the server to store into a database.

How?

- Set up an UDP connection
- Read in a sensor on an analog pin
- Calculate the actual measured value
- Build up the package
- Make a request to the addValue.php file on the server

Program your website

```
#include <Ethernet.h>
#include <SPI.h>
#include <stdlib.h>

// Mac adres of your Arduino Ethernet Shield
byte mac[] = { 0x90,0xA2,0xDA,0x00,0x55,0x8D};
EthernetClient client;
const int analogIn = A0;

float temperature = 0;
String data;

// Interval of monitoring (ms)
int interval = 1000;

void setup()
{
Ethernet.begin(mac);
}
```

Program your website

```
void loop(){
data="sample=";
temperature = analogRead(analogIn);
temperature = (5/1024.0) * temperature;
// Build up string to send
char test[4];
dtostrf(temperature, 2, 2, test);
data += test;

// Post Data to MYSQL Database
if (client.connect("ip_adres_RPi",80)) {
client.println("POST /addValue.php HTTP/1.1");
client.println("Host: ip_adres_RPi");
client.println("Content-Type: application/x-www-form-urlencoded");
client.println("Connection: close");
client.print("Content-Length: ");
client.println(data.length());
client.println();
client.print(data);
client.println();

}

client.stop();
delay(interval);
}
```

Program your website

What is on the RPi?

- Go to the www folder

  ```
  cd /var/www/
  ```

- Check the folder

  ```
  ls
  ```

- You should have two folders namely phpmyadmin and jpgraph
- You should have four files namely index.php, plotfig.php, clear.php and database_login.php

Lets take a look at database_login.php:

```
sudo nano database_login.php
```

Program your website

```
<?php
$host="localhost"; // Host name
$username="steven"; // Mysql username
$password="steven"; // Mysql password
$db_name="test"; // Database name

// Connect to server and select database.
mysql_connect("$host", "$username", "$password")or die("cannot connect server
    ");
mysql_select_db("$db_name")or die("cannot select DB");
?>
```

Program your website

Create the addValue.php file:

```
sudo nano addValue.php
```

```
<?php
ob_start();

include('database_login.php');

$sample = mysql_real_escape_string($_POST['sample']);
$postdate = date("d/m/Y H:i:s");
$postdate = preg_replace('#(\d{2})/(\d{2})/(\d{4})\s(.*)#', '$3-$2-$1 $4', $postdate);

$sql="INSERT INTO meetwaarden(value,time) VALUES ('$sample','$postdate');";
$result=mysql_query($sql)or die("Geen resultaat");

$gaNaarPagina="Location: index.php";
header($gaNaarPagina);
ob_end_flush();
?>
```

Program your website

Change the index.php file:

```
sudo nano index.php
```

```
<html>
<head>
<meta charset="utf-8">
<title>Meetwaardes</title>
</head>

<body>
<?php
phpinfo();
?>
</body>

</html>
```

Program your website

Create a table

```
<html>
<head>
<meta charset="utf-8">
<title>Meetwaardes</title>
</head>

<body>
<table border="1">
    <thead>
     <tr>
          <th scope="col">Datum</th>
          <th scope="col">Waarde</th>
       </tr>
    </thead>
    <tbody>

   </tbody>
</table>
</body>
</html>
```

Program your website

Get the measurements from the database

```
<html>
<head>
<meta charset="utf-8">
<title>Meetwaardes</title>
</head>

<body>
<?php
include 'database_login.php';
$sql="SELECT * FROM meetwaarden";
$result=mysql_query($sql)or die("Geen resultaat");
?>
<table border="1">
    <thead>
     <tr>
          <th scope="col">Datum</th>
          <th scope="col">Waarde</th>
        </tr>
    </thead>
    <tbody>
<?php
while($row = mysql_fetch_array($result)) {
echo "<tr>";
echo '<td>'.$row["time"].'</td>';
echo '<td>'.$row["value"].'</td>';
echo "</tr>";
}?>
</tbody>
</table>
</body>
</html>
```

Part 8

Available material

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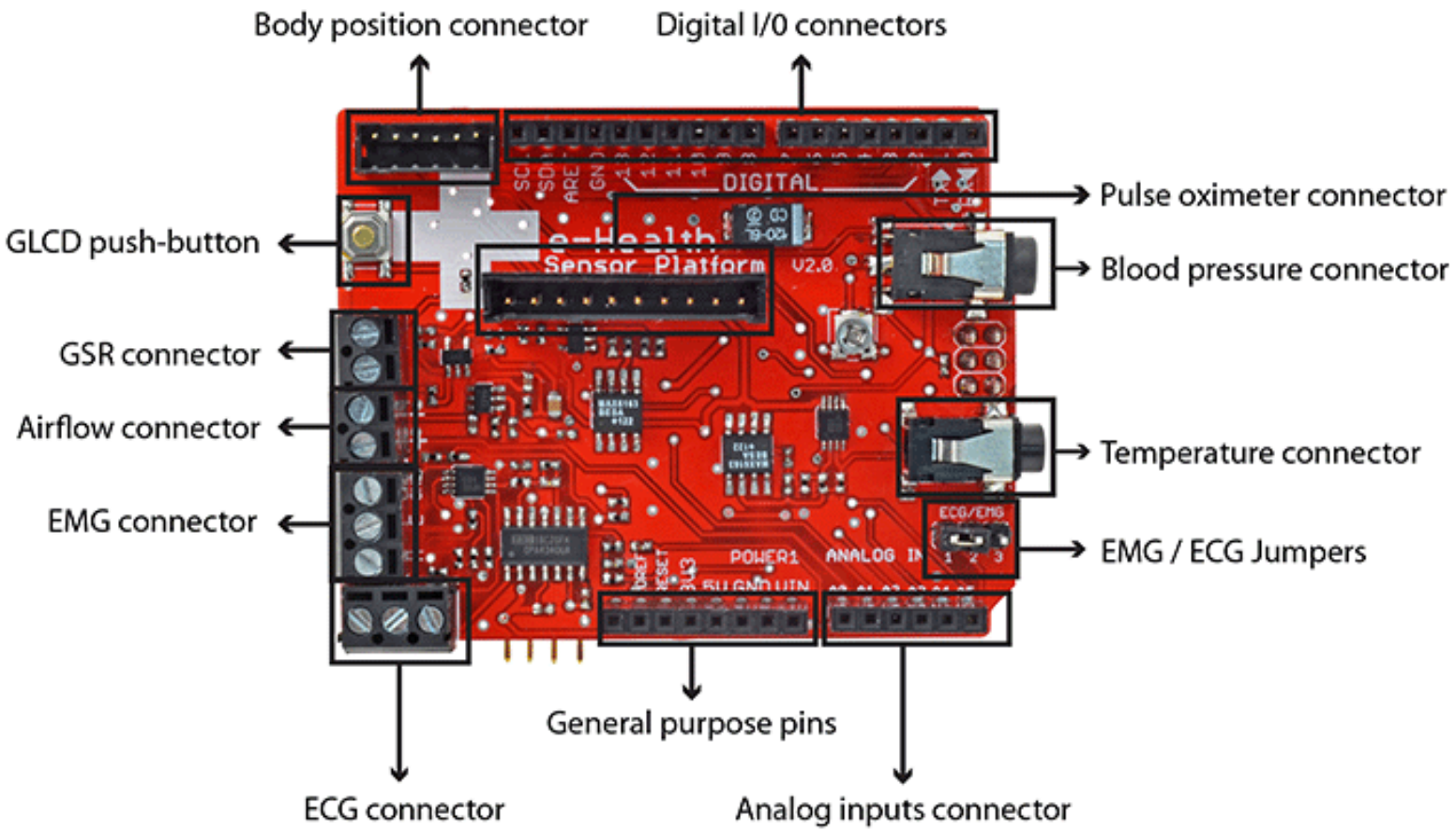
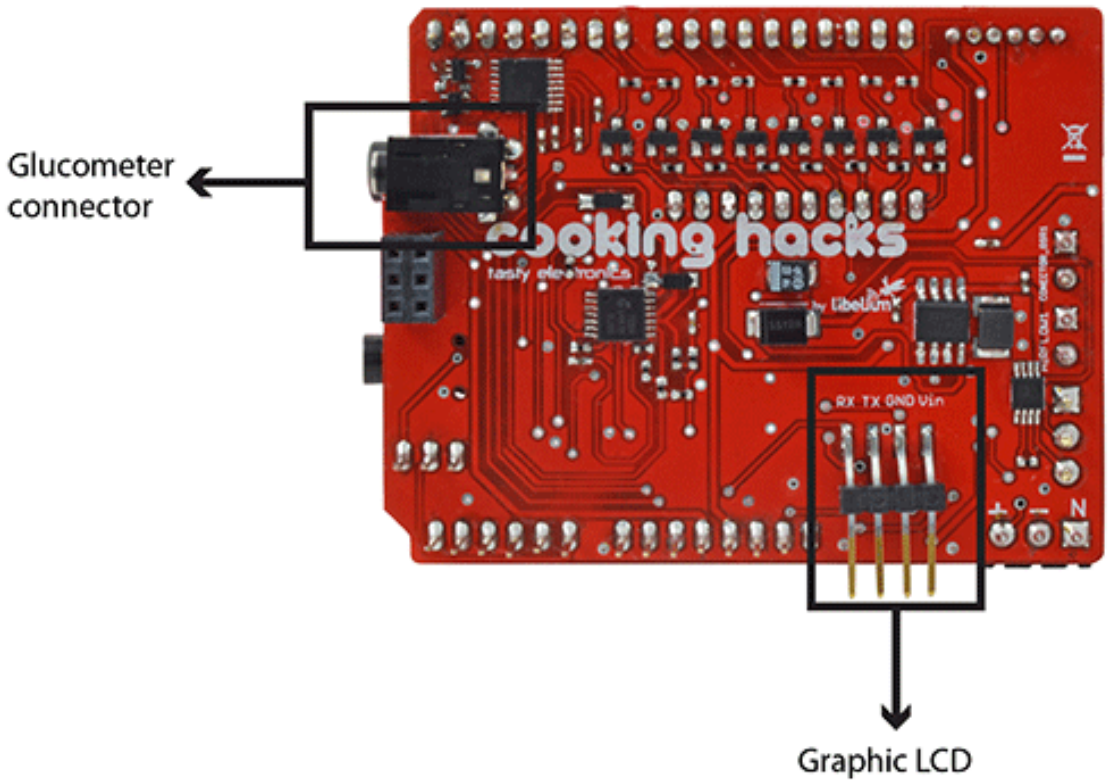
eHealth Sensor kit

eHealth PCB (top view)



eHealth PCB (bottom view)



Pulse and oxygen in blood sensor

Pulse and oxygen in blood sensor

Pulse $\rightarrow$ Heartbeat/minute

Oxygen $\rightarrow$ Monitor a patient's saturation, the amount of attached oxygen to hemoglobin

Hemoglobin $\rightarrow$ Transport of oxygen to the organs

Electrocardiogram

Electrocardiogram

- Measures the electrical activity of the heart

Airflow sensor

Airflow sensor

- A device used to measure the breathing rate in a patient in need of respiratory help or person
- Can provide an early warning of hypoxemia and apnea

Body temperature sensor

Body temperature sensor

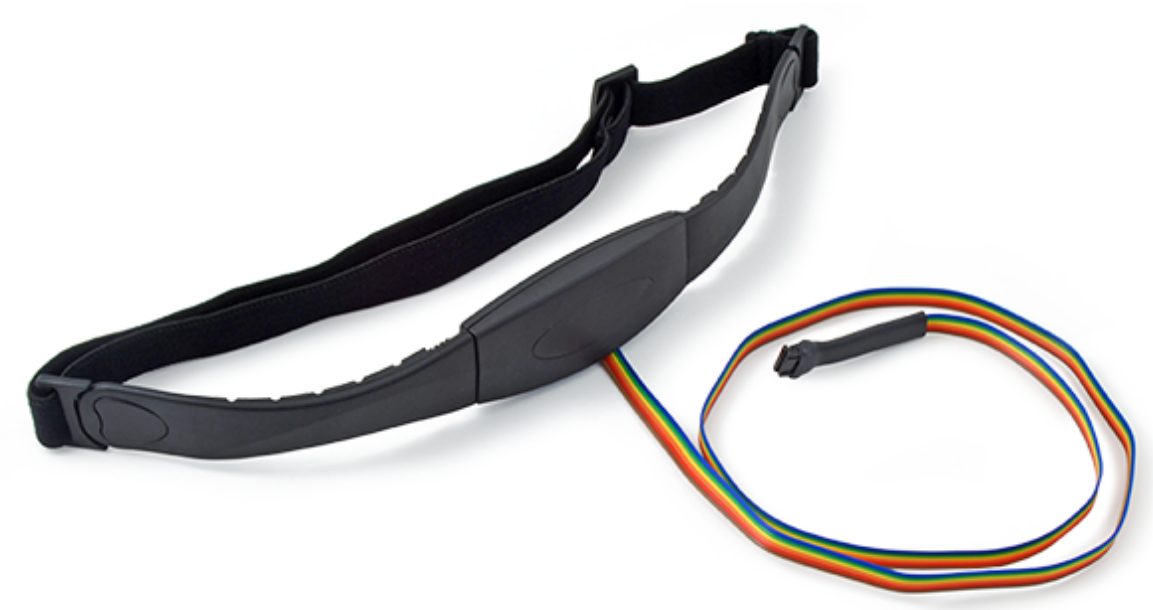
- Body temperature depends upon the place in the body at which the measurement is made, and the time of day and level of activity of the person.
- Different parts of the body have different temperatures.

Blood pressure sensor

Blood pressure sensor

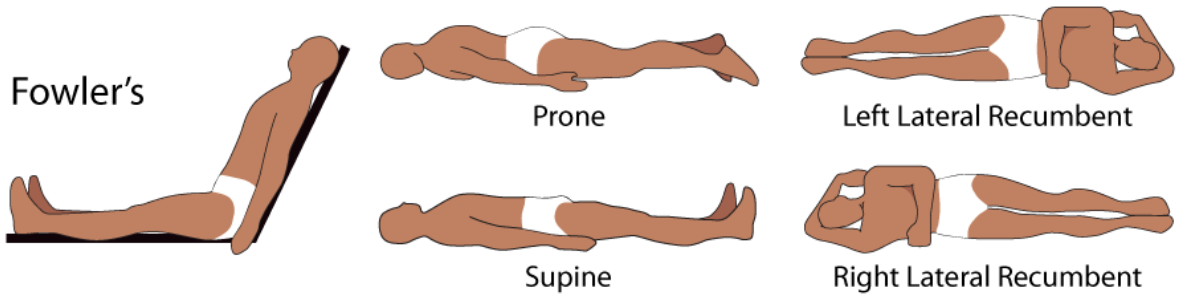
- Used to measure the blood pressure.
- It measures **systolic**, **diastolic arterial pressure** and also the **pulse rate**.

Body position sensor



Body position sensor

- It monitors five different patient positions (standing/sitting, supine, prone, left and right.



Galvanic Skin Response (GSR)

Galvanic Skin Response (GSR)

- Method of measuring the electrical conductance of the skin.
- Skin conductivity is associated with the activity of sweat glands, which are connected to the sympathic nervous system.
- High stress and emotion
- Ex. Used in lie detection

Glucometer

Glucometer

- Measures the concentration of glucose in the blood
- A little needle is used to create a drop of blood which has to be dropped on the strip
- The device shows you the value

Electromyogram sensor (EMG)

Electromyogram sensor (EMG)

- Used to measure the electrical activity of skeletal muscles

Heart beat sensor - Bluetooth

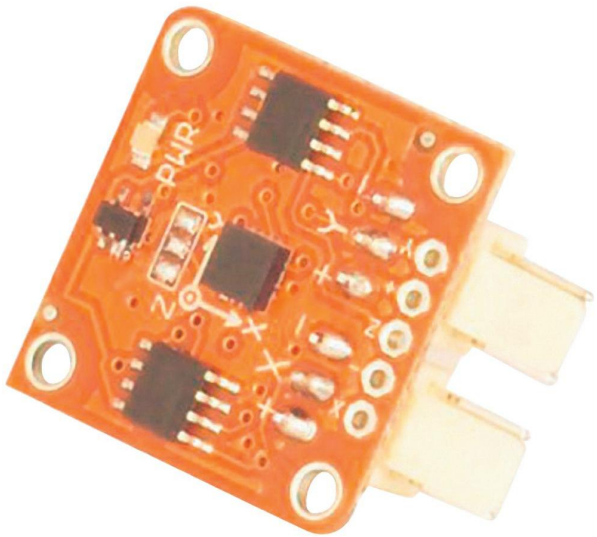
- Smart Bluetooth
- Manufacturer Conrad: ordernumber - 378826

Arduino Servo-module

- Manufacturer Conrad: ordernumber - 95071

Arduino Accelerometer

- Manufacturer Conrad: ordernumber - 92017



Kinect Sensor

- Manufacturer Conrad: ordernumber - 981658

- Alcohol sensors

End

Questions?

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