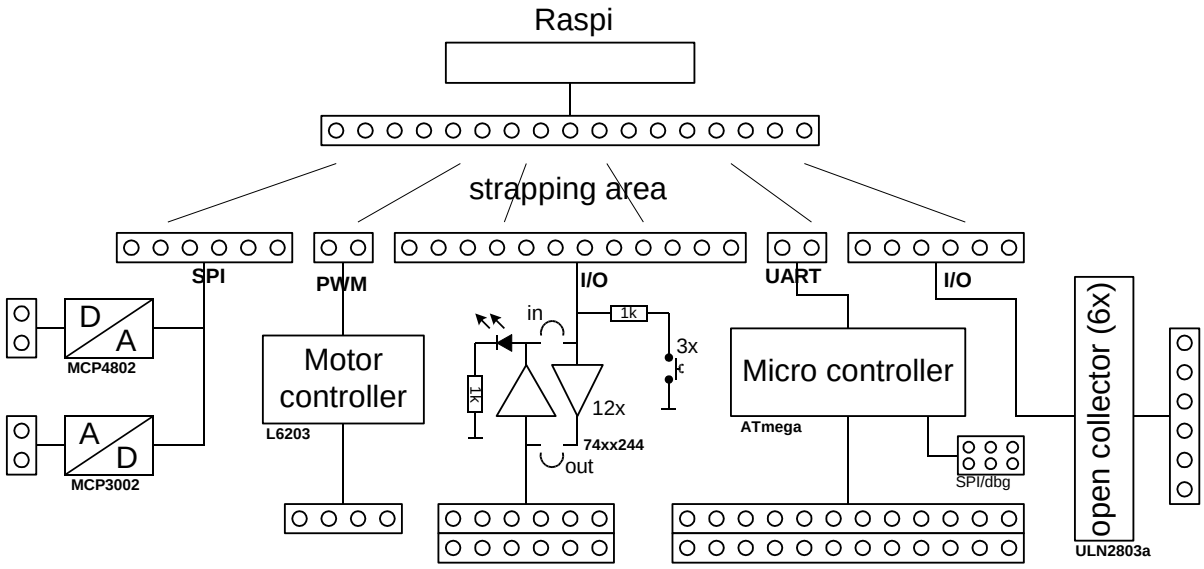
Gertboard overview

A lot of people want to know more details about the Gertboard. So I decided to release this text which will be part of the Gertboard manual.

Principle diagram Gertboard.



Above is a principle diagram[1] of the Gertboard.

Each 'circle' in the diagram above is a header pin. That gives you access to a wide range of control combinations. To start off you would probably use the strapping area to connect various components to the Raspberry-Pi. However there is nothing which prevents you from connecting the motor controller PWM pins to the ATmega device. The ATmega device has a separate 6-pin header compatible with the JTAGIce pins. Again you can connect these to the Raspberry-Pi SPI interface to program the device straight from the Linux environment. (Requires SPI drivers & software which are need to be provided by Linux volunteers).

The major building blocks are:

- 12x buffered I/O
- 3x push button
- 6x Open collector driver (50V, 0.5A)
- 48V, 4A motor controller
- 28-pin dual in line ATmega device
- 2-channel 8/10/12 bits Digital to Analogue converter.
- 2-channel 10 bits Analogue to Digital converter.

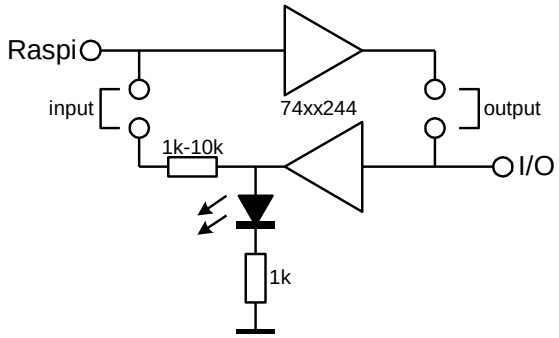
Buffered I/O.

12 pins which can be used as input or output.

Each buffer can be set to input or output mode using a jumper.

[1] A 'principle diagram' is a coarse overview of the most important parts of the system. It is not correct in all details. For that you must look at the board schematics.

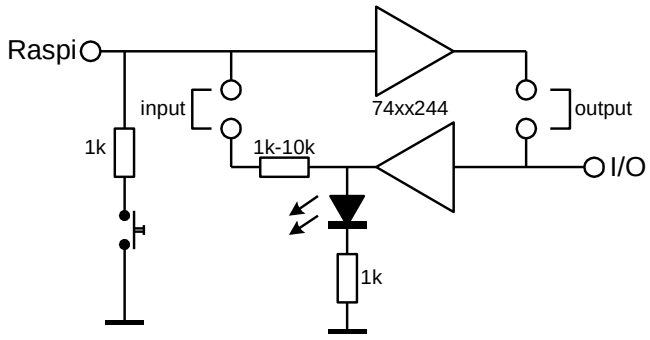
I/O ports 4-12 look like this:



In order to make the port function as input you have to place the ‘input’ jumper.
In order to make the port function as output you have to place the ‘output’ jumper.
You can place both jumpers but the port will not function well in that case.
In both the input and output mode the LED will tell you what the logic level is on the I/O pin. The LED will be **on** when the level is **high** and it will be **off** when the level is **low**.
Depending on the type of 74xx244 buffer chosen the LED might show random behaviour if the port is not driven. In that case it may also go on or off on the smallest of electronic changes.
There is a third option: If neither the input nor output jumper is placed the I/O pin can be used as a simple ‘logic’ detector. You can connect the I/O pin to some other logic (3V3) point and use the LED to check if the connect point is seen as high or low.
There is a series resistor between input buffer and the GPIO port. This is to protect the BCM2835 if the user programs the GPIO as output but also leaves the ‘input’ jumper in place. The BCM2835 input is a high impedance input and thus even a 10K series resistor will not produce a noticeable change in behaviour when it is used as input.

Push buttons.

The Gertboard has three push buttons. They are connected to the BUF1, BUF2 and BUF3 jumpers on the BCM2835 side.
Thus the first three I/O port looks like this:



In order to use a push button the user must do the following:
1/ Do not place the ‘input’ jumper.
2/ Program the GPIO pin to be set to input mode.
3/ Program the GPIO pin to use the internal pull-up resistor.
Optionally you can place the output jumper to show the button state on the LED.

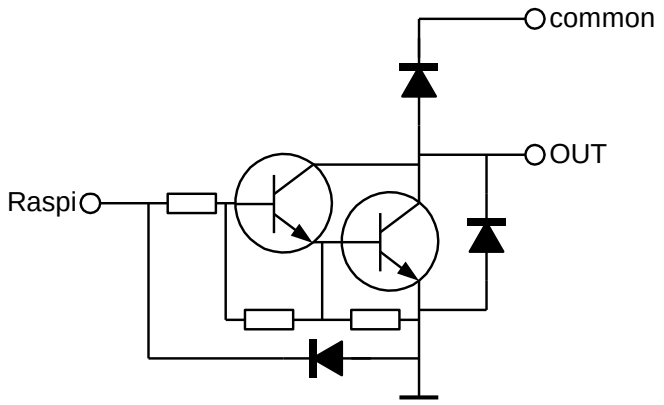
Beware: the push buttons can ***not*** be used on GPIO0 or GPIO1 as those two pins have a 1K8 pull-up resistor on the board. When the button is pressed the voltage on the input will be

3.3*1000/(1000+1800) = 1.1V

That is not an I/O voltage which can reliable seen as low.

Open collector driver.

The Gertboard uses six ports of a ULN2803a for open collector driver. The ULN2803a can withstand up to 50V and drive 500mA on each of its ports. The device has integrated protection diodes.
Each output port looks like this:



The 'common' pin is, as the name states, common for all open collector drivers. It is not connected to any other point on the Gertboard. For more details see the datasheet of the ULN2803a.
As with all I/O devices the open collector drivers can also be connected to the ATmega controller e.g. to drive a number of relays or motors.

Motor controller.

The Gertboard has place for a L6203 (Miniwatt package) motor controller. This is a rather expensive part so not everybody might want to mount that. The motor controller is for brushed DC motors.
The controller has two input pins A and B. The pins can be driven high or low according to the following truth table:

A	B	Motor action
0	0	No movement
0	1	Rotate one way
1	0	Rotate opposite way from above
1	1	No movement

The speed of the motor can be controlled by applying a Pulse-Width-Modulated (PWM) signal to either the A or B pin.

The motor controller has temperature protection but no current protection. The Gertboard holds a fuse to provide that function. Again for more details see the datasheet of the L6203.

ATmega device.

The Gertboard can hold a 28-pin ATmega device. This can be any of ATmega48A/PA, 88A/PA, 168A/PA or 328/P in a 28PIN DIP package. The device has a 12MHz ceramic resonator. So the pins 9 and 10 cannot be used. All other pins are brought out to headers. The

boards has a separate 6-pin header which is compatible with the JtagIce interface. The reset pin (1) has a 10K pull-up resistor. I even slavishly copied the diode in parallel with that pull-up resistor although nobody has been able to tell me what its function is.
The PD0/PD1 pins (ATmega UART TX and RX) are also brought out to pins placed adjacent to the Raspberry-Pi UART pins so you only need to place two jumpers to connect the two devices.
Beware the ATmega devices on the Gertboard operate at 3.3Volts. That is in contrast to the 'Arduino' system which runs at 5V. It is also the reason why the device does not have a 16MHz. Clock. In fact at 3V3 the maximum operating frequency according to the specification is just *under* 12MHz.

Digital to Analogue converter.

The Gertboard uses a MCP48xx digital to analogue converter from Microchip. The device comes in three different types: 8,10 or 12 bits. Each supports 2 channels. The device is controlled by an SPI interface. It is connected to the SPI chip select 1.
For details see the datasheet of the MCP4802

Analogue to Digital converter.

The Gertboard uses a MCP3002 10-bit analogue to digital converter from Microchip. It supports 2 channels with a sampling rate of ~72ksps. The device is controlled by an SPI interface. It is connected to the SPI chip select 0.
For details see the datasheet of the MCP3002.

To make it easier to interface the A/D and D/A converter to the Raspberry-Pi all SPI signals from the two devices are placed adjacent to the Raspberry-Pi SPI interface signal. To connect both devices you have to place 5 jumpers: Clock, Mosi, Miso and the two chip selects. Both A/D and D/A devices chip-select signals have a 10K pull-up so the device will not be accessed if the chips select pin is not connected.