lua-sense

Raspberry Pi project

Microprocessor Systems

Professor

Versavia Ancusa

Student

Nashwan Azhari

Polytechnic University of Timisoara
Faculty of Automation and Computers
Information Technology and Computers, English spec.

Project summary

Our project consists of obtaining the environment temperature and humidity level, displaying them on an LCD and triggering appropriate LEDs.

In order to achieve this, we have used the following hardware:

- Raspberry Pi B+ model
- SHT11 Temperature and humidity sensor
- Shield LCD 16x2
- LEDs

Raspberry Pi B+ model specifications

Chip	Broadcom BCM2835 SoC
Core architecture	ARM11
CPU	700 MHz Low Power ARM1176JZFS Applications Processor
GPU	Dual Core VideoCore IV® Multimedia Co-Processor
Memory	512MB SDRAM
Dimensions	85 x 56 x 17mm
Power	Micro USB socket 5V, 2A

Connectors:

Ethernet	10/100 BaseT Ethernet socket
Video Output	HDMI (rev 1.3 & 1.4) Composite RCA (PAL and NTSC)
Audio Output	3.5mm jack, HDMI
USB	4 x USB 2.0 Connector
GPIO Connector	40-pin 2.54 mm (100 mil) expansion header: 2x20 strip Providing 27 GPIO pins as well as +3.3 V, +5 V and GND supply lines
Camera Connector	15-pin MIPI Camera Serial Interface (CSI-2)
JTAG	Not populated
Display Connector	Display Serial Interface (DSI) 15 way flat flex cable connector with two data lanes and a clock lane
Memory Card Slot	SDIO

Chip and memory

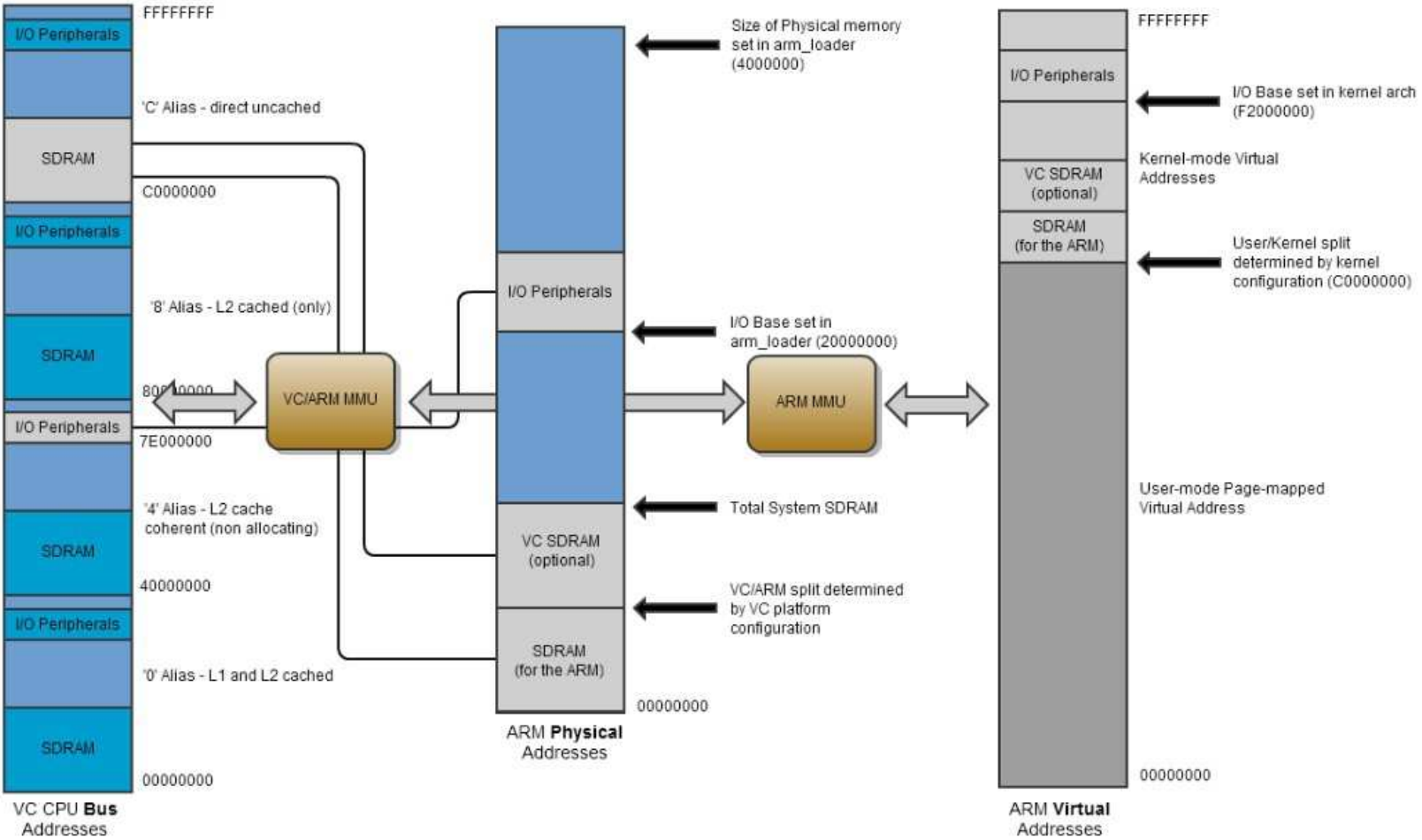
The Raspberry Pi uses a Broadcom BCM2835 system on a chip.

It features a VideoCore 4 GPU and a 700 MHz ARM1176JZF-S core (ARM11 family, ARMv6 instruction set).

The ARM core manages to provide a real world performance of 0.041 GFLOPS while the GPU is capable of 24 GFLOPS performance or 1 Gpixel/s in terms of graphics processing.

It has 512 MB of shared SDRAM (no dedicated video memory).

BCM2835 ARM Address map



Interfacing with the board

The SHT11 sensor, the display and the LEDs are connected using the 40 GPIO (General Purpose Input/Output) pins of the Raspberry Pi B+ Model.

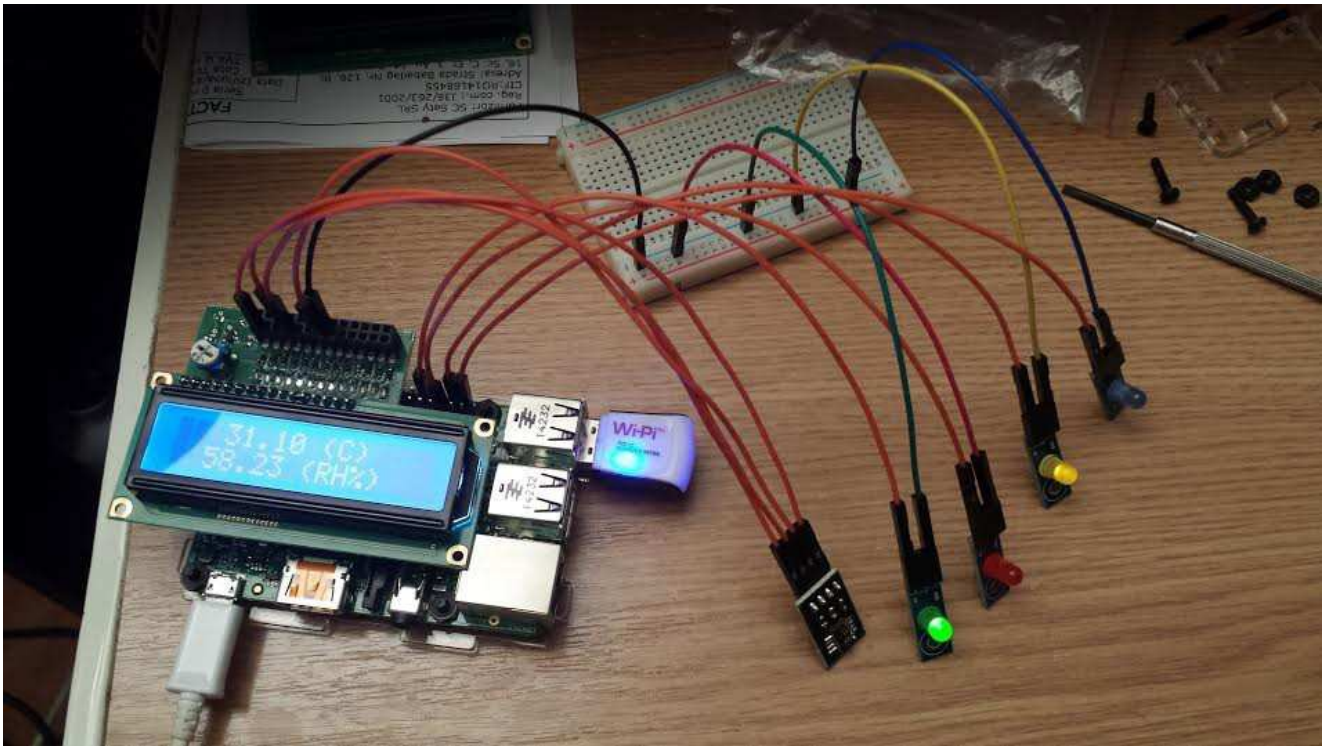
These pins have kernel drivers for all major Operating Systems and pre-made libraries for multiple programming languages (BASIC, C/C++, Java, Perl, Python).

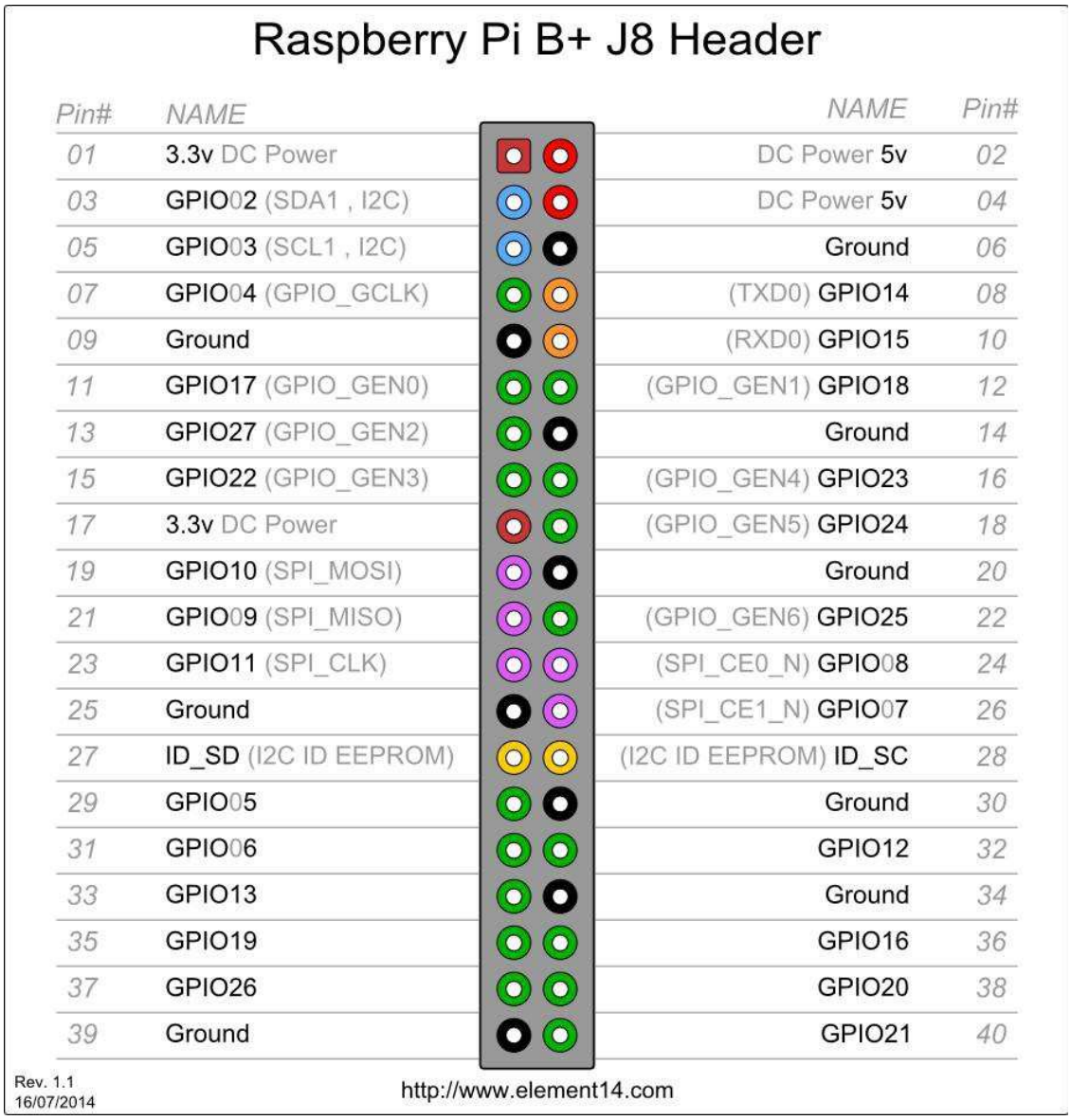
The LCD is connected using 6 pins in total: 1 mode selector, 1 serial clock and 4 data pins.
The mode pin is toggled between command (0) and data (1) and the serial clock is used to coordinate reading of the 4 bits from the 4 data pins.

The sensor is connected using a total of 4 pins: a Vcc pin, a ground pin, a data pin and a serial clock pin.

A command of 1 byte, whether 0x03 for temperature or 0x05 for humidty is read 1 bit per cycle. The corresponding 2 byte result is then returned, again 1 bit per cycle, along with an additional CRC Checksum byte, the use of which is optional with us choosing to abandon it.

The LEDs are connected using 2 pins each: a ground pin and an “IN” pin connected to a GPIO. An LED is turned on and off by turning the corresponding GPIO on or off.





Pin mapping

LCD pins

1 mode selector	GPIO25 or #22
1 serial clock pin	GPIO24 or #18
4 data pins	GPIO17 or #11
	GPIO22 or #15
	GPIO18 or #12
	GPIO23 or #16

Sensor pins

1 data pin	GPIO27 or #13
1 serial clock pin	GPIO04 or #7

LED pins

Red LED	GPIO19 or #35
Yellow LED	GPIO20 or #38
Blue LED	GPIO21 or #40
Green LED	GPIO12 or #32

How is it all coded

Each component has it's own Python class. The WeatherStation class initiates a Display object, a Sensor object, and 4 LED objects using the parameters from the example.conf file. It then queries the sensor for temperature and humidity, writes the returned values on the LCD and triggers the approapriate LEDs.

Bibliography

http://en.wikipedia.org/wiki/ARM11
http://en.wikipedia.org/wiki/Raspberry_Pi
http://elinux.org/RPi_Low-level_peripherals
http://www.raspberrypi.org/wp-content/uploads/2012/02/BCM2835-ARM-Peripherals.pdf
http://www.sensirion.com/fileadmin/user_upload/customers/sensirion/Dokumente/Humidity/Sensirion_Humidity_SHT1x_Datasheet_V5.pdf
http://www.adafruit.com/datasheets/TC1602A-01T.pdf
https://learn.adafruit.com/downloads/pdf/drive-a-16x2-lcd-directly-with-a-raspberry-pi.pdf