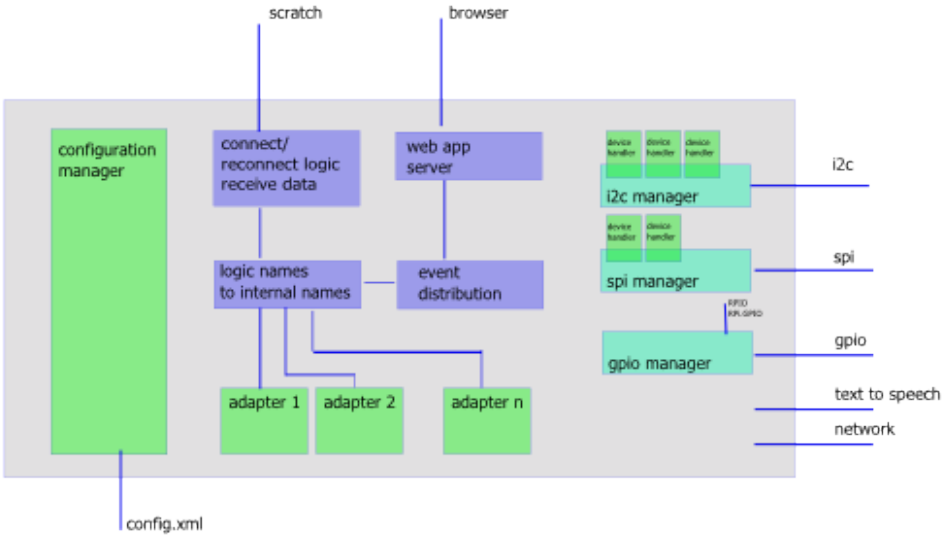
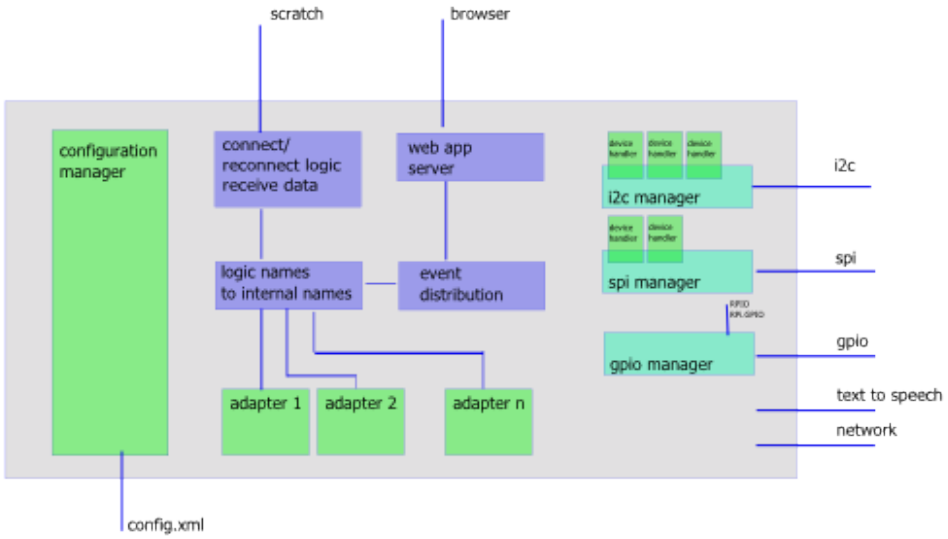
ScratchClient



Gerhard Hepp

ScratchClient:



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Chapter 1. Summary

This document describes software connecting scratch to hardware on Raspberry Pi.

The goal is to have a flexible approach where hardware setup is basically configured instead of programmed.

There are ready to use adapters for basic IO capabilities, as buttons, switches, stepper driver, photointerrupters, PWM-driving outputs. SPI based devices are available for ADC, DAC and LED-Stripes.

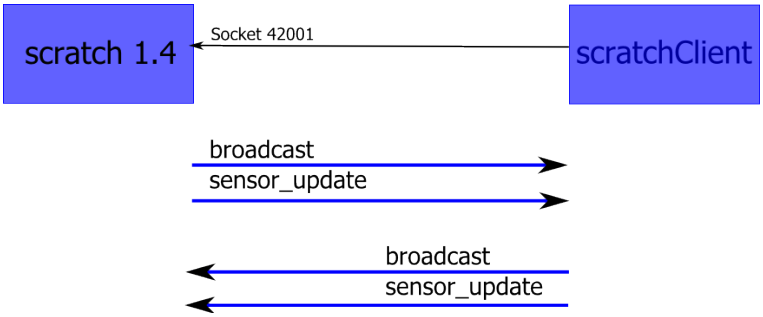
Functionality is not only limited to hardware IO. Other examples are a Text to Speech interface or remote scratch-to-scratch-connection.

Chapter 2. Introduction

Scratch does not allow direct interfacing to hardware.

For scratch version 1.4, as available on RaspberryPi raspbian, the 'Remote Sensor Protocol' allows to attach external processes which then interface to hardware.

When activated, scratch acts as a server on socket port 42001 and clients can connect to this socket.



The 'Remote Sensor Protocol' is descibed in /rsp/. It is not limited to sensors, but can also be used for controlling actors, write to files and many more functionalities.

Clients do not need to be located on the same computer with scratch, but could also be remote on a network.

The sensor protocol is generally usable on different computer platforms, and not limited to Raspberry Pi. The Raspberry Pi offers easy to be attached GPIO (general purpose Input Output), which leads to simple and low cost implementations in controlling hardware.

The data exchange are

- broadcast events from scratch to client. Broadcasts are used for simple commands like 'start' or 'stop'.
- sensor-updates from scratch to client. Sensor-updates are similiar to broadcasts, but carry an addititional value.
- sensor-updates from client to server
- broadcast events from client to scratch.

Sensor-updates are used to carry additional values like voltage measurements, speed values, or pin state like '0' or '1'.

There are some client implementations available for this protocol. See /simon/ and /silent/, there are many if you search the net.

For an afterschool workschop for 7th class programming novices, I needed a flexible approach to have hardware attached to scratch. The available implementations are either too specialized or lack some flexibility in configuration.

The code provided here is partially based on code from /simon/, which was basically reorganized, modularized and extended.

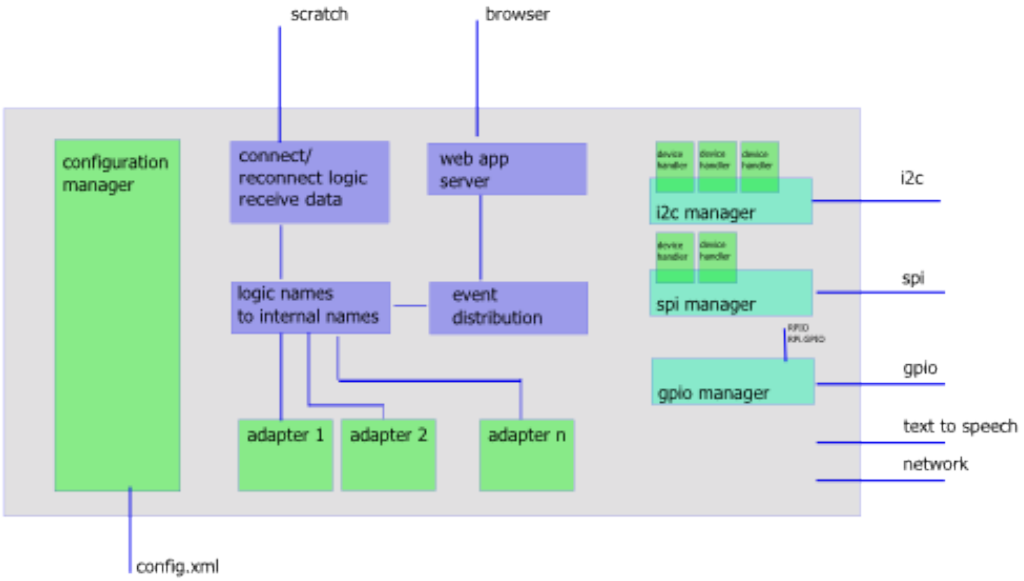
The implementation has the following goals:

- Modularization of Software (server connection, data model, configuration, monitoring)
- Configuration in XML for various adapter-settings; versioning of config files.
- html based GUI for monitoring and simulation, also providing some documentation on the current configuration.
- dynamic mapping of broadcast names and variable names to the scratch world
- internal GPIO-Numbering is BCM style. Configuration allows for BCM, board or other names.
- Till 2015-01-02, there was a feature to use different GPIO-libraries. This was removed, as RPIO did no longer support Pi2-hardware, and as software was too complex by this feature. A local patch to RPIO, named 'RPIO2', is used instead.

Performance was not a primary goal. If you need to squeeze out a few cpu-cycles, then head for a C++ based implementation.

The scratchClient is designed to run on Raspberry Pi, raspbian. Scratch will in general run on the same machine, although it could run on other platforms too.

Chapter 3. Architecture



Building blocks of scratchClient

Configuration manager. Reads config file, instantiates adapters and populates the logic to internal names conversion tables.

Logic names to internal names. Scratch is working with 'logic' or business related names. Examples are 'light on', 'distance Y' or 'red button pressed'. These are mapped to internal technical names.

Connect/reconnect logic. Connecting to scratch, reconnecting if needed.

Web app server. Provides view of configuration; monitoring, controlling the adapters.

Event distribution. Scratch signals, signals from/to web app and signals from the adapters need to be distributed between the objects inside the scratchClient.

SpiManager, i2cManager, gpiomanager. These modules manage the access to the Rpi resources; 'device handlers' to handle popular devices.

And adapters. These are the main building blocks, encapsulating the business logic. An adapter is a module, which performs a dedicated operation like a button-adapter, a relais adapter or a stepper.

Scratch applications typically will not use a large number of adapters. My typical applications use up to 10 GPIO pins and one or two adc channels. This yields to 10, possibly 20 adapters involved.

Basically, adapters have a high level command input interface like 'on' or 'off' for a relais, or value inputs like 'direction left/right' or 'speed 2.32' for a stepper control. Adapters can provide value output, as a switch-adapter (state=on/off) does or an AD-Converter. An adapter can use multiple inputs, values and outputs.

Configuration parameters are inputs only used during initialization by the ConfigurationManager. These values are immutable during runtime.

TODO: image of adapter with data flow, life cycle.

The adapters are designed with reuse in mind. If you reuse an adapter, you need to map the inputs or outputs to different commands or variables in scratch. This mapping is done by configuration.

The names in the broadcasts from scratch and the names in the sensor-updates are mapped to the names the adapters are using. These mappings are defined by configuration.

GPIO are assigned to the adapters by configuration. One GPIO pin can only be assigned to one adapter. The configuration checks for correct assignment of GPIO, which means that pins are not double used or not existing pin numbers are assigned.

Adapters do not directly control the GPIO, there is a GPIOManager which controls GPIO. This construction was choosen to allow for different GPIO implementing libraries, which imposes the need of modularization.

Adapters are not limited to GPIO input or output. Serial line or SPI, network connections, file access and others are possible. Aside from this, gpio-in/output will be the primary purpose for most projects.

3.1. Architectural Decisions

Programming language is python. Although the complexity would require programming techniques as static types, interfaces, enumerations and private fields, python is easy to learn and is widely adopted in the Raspberry-Community.

GUI is web based. As the client could be run in background, web based access is quite easy to use. Cherrypy with mako templates are used to implement the server side. On the fly graphics are svg-based. Event notifications are used to update the web client. This technique is supported by midori, epiphany and most browsers (not IE).

Configuration files are XML Widely adopted in industry, easy to read, can be automatically formatted. Allows inline comments.

Configuration files are versioned. Versioning allows to implement backward compatibility through releases.

GPIO names are BCM internal GPIO-scheme. External names are mapped to internal numbers, allowing for flexibility. This mapping is configurable.

Chapter 4. Scratch remote sensor protocol

When 'remote sensor connections' in scratch are enabled, scratch opens a port 42001 and waits for clients to connect. Connections are made by tcp-sockets. Communication packets start with 4 byte binary length information (MSB first) and then plain data string. Length is length of data string only.

Scratch sends:

- broadcast [name] whenever scratch issues a `broadcast [name]` or `broadcast [name] and wait`
- sensor-update "[name]" [value] sensor-update "[name]" "[value]" on communication startup once for each 'global variable' (defined for all sprites); whenever a 'global variable' is changing. Numeric values are transmitted without the double quotes around the value. String values are quoted. Names or values containing quotes result in two consecutive quotes.

Scratch receives

- broadcast [name] in scratch, you can react on this with 'when I receive [name]'
- sensor-update "[name]" [value] this is acessible from the sensor values in 'sensing'

List variables in scratch are not sent to client. Values are 'text encoded', so integers, floats are transmitted not in binary, but in their string format. String values are double quoted and in utf-8 charset.

Chapter 5. Configuration

Configuration for the adapter definitions is provided by xml-Files. Default config file is 'config.xml', but name of the file can be set by command line. Online configuration change is NOT possible. Usual procedure is to stop the client, do some wiring on the hardware and restart client.

5.1. Config file Syntax

Basic frame for all configurations is the xml-preamble and the config tag.

```
<?xml version='1.0' encoding='utf-8' ?>
<config version='1.0'>
    <description>Basic empty configuration</description>
</config>
```

The config-tag is the 'frame' for more content. The description-tag contains some information about the project, purpose or whatever else might be needed to clearly identify the target system purpose of configuration.

In the samples in ./config, there are schema references for validation purposes. When the data are read by scratchClient, no validation is used (but they need to be xml-compliant).

Feel free to add xml-comments `<!-- comment -->` whereever you want to have more information.

5.2. GPIO Output

```
<?xml version='1.0' encoding='utf-8' ?>
<config version='1.0'>
    <description>Sample configuration</description>

    <adapter class='adapter.gpio.GpioOutput'  name='relais'>
        <description>Sample GPIO, here assumed to be a relais output</description>

        <gpio port='GPIO25'>
            <default dir='OUT' pull='PUD_OFF' default='low' />
            <active dir='OUT' pull='PUD_OFF' default='low' />
        </gpio>

        <input name='low'>
            <broadcast name='pin25low'/>
            < broadcast name='pin10off'/>
        </input>
        <input name='high'>
            < broadcast name='pin25high'/>
            < broadcast name='relaisOn'/>
        </input>
    </adapter>

</config>
```

The `<adapter/>` tag has the attributes

@class: python class name of the implementing code, mandatory

@name: a short name, identifying this adapter. Name is mandatory, needs to be unique in the configuration.

The `<adapter/>` tag has the child elements `<description/>` a description for the adapter, purpose, technical details or alike. `<gpio/>` each port pin adapter is using is listed here. Here, GPIO10 (this numbering is always BCM-related) is used, configured as an output. More on this later. `<input/>` Each input of an adapter needs a separate `<input/>` tag (when used, not used inputs do not need to be listed). The @name-Attribute is mandatory and corresponds to the method name of the adapter code.

`<gpio/>` uses elements `<active/>` and `<default/>` .

Active is the initial state the code sets the pin when initiated. Default is the state the code leaves the pin when the code is gracefully shut down. This is done by pressing ctrl-C in console, or sending SIGINT in linux.

5.3. Inputs, outputs and scratch names.

The inputs an adapter exposes are mapped to broadcast events from scratch. These mappings are provided by `<broadcast@name/>` -Tags inside the input. The @name of the `<broadcast/>` is used as 'text' in the scratch broadcast blocks. In most cases, there will be only one command element, as the purpose is pretty clear.

The <broadcast@name/> can occur multiple times in one <config/> file, triggering multiple adapters by one broadcast from scratch. This feature can be used for a 'startAll' or 'stopAll'-feature for some adapers.

The broadcast names will be in most projects logical names, like 'relaisOn', 'led_green_off'.

The names are case sensitive, so 'relaisOn' and 'RelaisOn' are different. Be sure to use exactly the same spelling on scratch and adapter side, otherwise commands are discarded. At runtime, information on mapping of scratch broadcasts to adapters is printed to the console when the '-v', the verbose switch in the command line is applied.

The configuration class in the system checks for errors in the configuration and will provide (hopefully) meaningful hints on how to correct problems.

The following 'stepper' example shows some advanced features.

```
<adapter class='adapter.stepper.Stepper' name='x-direction' >

     <description>Stepper class uses w0 for coil 0,
                     w1 for coil 1 etc</description>

     <gpio port = 'GPIO14' alias='w0' >
         <default dir='OUT' pull='PUD_OFF' default='low' />
         <active dir='OUT' pull='PUD_OFF' default='high' />
     </gpio>
     <gpio port = 'GPIO15' alias='w1' >
         <default dir='OUT' pull='PUD_OFF' default='low' />
         <active dir='OUT' pull='PUD_OFF' default='high' />
     </gpio>
     <gpio port = 'GPIO17' alias='w2' >
         <default dir='OUT' pull='PUD_OFF' default='low' />
         <active dir='OUT' pull='PUD_OFF' default='high' />
     </gpio>
     <gpio port = 'GPIO18' alias='w3' >
         <default dir='OUT' pull='PUD_OFF' default='low' />
         <active dir='OUT' pull='PUD_OFF' default='high' />
     </gpio>

     <input name='start'>
         <broadcast name='startA'/>
     </input>
     <input name='stop'>
         <broadcast name='stopA'/>
     </input>
     <input_value  name='speed'>
         <variable name='speedA'/>
         <variable name='speed'/>
     </value>
 </adapter>
```

As the adapter uses four GPIO Pins, these <gpio/> -tags get an @alias-attribute to assign these pins to functionality inside the adapter.stepper.Stepper-class.

The <input/> tags are pretty clear, the <value/> -tag is providing configuration for values beeing sent from scratch to the adapter. In scratch 1.4, global variables are sent to the adapters. These names are defined with <variable /> tags similiar to inputs.

Adapters with output values (which should be transmitted to scratch) are using the <output_value/> -tag. A button sample is:

```
<adapter class='adapter.gpio.GpioInput' name='button 22'>
     <!-- no description, urgg -->
     <gpio port = 'GPIO22'>
         <default dir='IN' pull='PUD_OFF' />
         <active dir='IN' pull='PUD_OFF'/>
     </gpio>
     <output_value name='button'>
         <sensor name='button22'/>
     </output>

     <parameter name='poll.interval' value='0.5' />

 </adapter>
```

The <output/> tag maps a logical name to a scratch sensor-update-name, here 'button22'. Here a 1-1 relation between output and command is assumed, as it is not useful to send one value to different variables in scratch.

5.3.1. Other features: parameters

Adapter can have parameter-tags, specifying constant config values. These are adapter specific, see adapter docs on which ones are needed and what default values are.

```
<parameter name='poll.interval' value='0.5' />
```

5.3.2. Other features: webserver websocket plugin, html plugin

For one of the adapters (websocket), there was the need to have the embedded webserver to support custom websocket code and html pages.

To make this flexible, a plugin mechanism was implemented.

```
<webserver>
    <!-- implement a web page  -->
    <route name='pendel' route='/adapter/pendel' />
    <html name='pendel'
          path='websocket/pendel.html'
          comment='positional sensor from a smartphone' />
</webserver>
```

Tag `<webserver/>` groups the entries.

Tag `<route/>` defines the absolute path for the webapplication server to the websocket.

Tag `route/@name` a descriptive name

Tag `route/@route` an absolute path for the entry point of the websocket

The websocket protocol class is provided by the adapter and does not need configuration.

Tag `<html/>` defines the location of additional web pages. Links to these pages are added to main page.

Tag `html/@name` a descriptive name

Tag `html/@path` a relative path for the page. Place these pages to htdocs/static/html/..

Tag `html/@comment` a descriptive comment. May be empty.

The needed html pages are to be placed in `htdocs/static/html/[html@path]`.

This is the 'injected' web link to the main page.

5.3.3. Adapter lifecycle

Adapters get created (instantiated) by the configuration manager when reading the xml-file. When no errors occur, the configManager keeps the instance in a list of adapters for later reference.

Then parameters are set.

Adapters are started one after the other by setActive (True). There is no particular order within the adapters to get this event.

If your application needs adapter 'A' to be startet after 'B', then most possibly you need a special implementation 'AB' which combines the two.

When set to active, adapters should start regular work. This means to setup the GPIO, starting threads and whatever else might be needed. Setting the GPIO can be done by using the base adapter class' methods.

Adapters stop operation by setActive(False). Then threads should be stopped in a timely manner (less than 0.1 sec), and GPIO should be reset to default state. The adapters base class provides mechanisms to setup GPIO. These can be overwritten to achieve other behaviour.

There is no live after setActive(False). The adapters will be destroyed later and the code stops to work.

CPU load Adapters should not poll and send values too often. Faster than some 20 to 50 updates per second are a challenge for the system, as the socket connection and also scratch on the receiving end needs cpu-cycles to perform work. Currently, each sensor-update is send separately.

5.3.4. Simulation mode

[TODO: not yet implemented] There are scenario where the code is run on a system with no GPIO access or deactivated GPIO access. Examples are: - a scratch code is developed on a Non-Pi system, with later deployment on Pi. - gpio-peripherals are available, but intentionally switched to inactive, as the hardware wiring is not yet complete or malfunctioning code would damage hardware. Think of a scratch-raspberry controlled soft ice machine, running cracy and vending never ending streams of sweet delight you have to dive in and find the emergency switch. - during test, some fancy input pattern are too difficult or too time consuming to be set up in real world. Simulation mode is started by setting operation state to 'simulation' by setSimulation(). This is optionally before setActive(True). In simulation mode, GPIO are not activated. Threads should be run as usual, bit GPIO will ignore any setting/getting value-commands.

Chapter 6. Adapter Types

6.1. GPIO Adapter

For the GPIO-Types, different libraries can be used: RPi.GPIO (default) or RPIO. RPIO has the ability to PWM drive the GPIO with DMA, producing stable pulses.

GPIO Pins are named in BCM-Notation (e.g. GPIOnn), Pin headers (e.g. P1-13V2 for Version2) or other (for a specific adapter, IKG.IO.3 is used). The naming configuration is in /scratchClient/config/portMapping.xml

6.1.1. GPIO Adapter, input

Input type adapters read Buttons, switches and other type of binary signals.

- adapter.gpio.GpioInput (sends value 0 for low, 1 for high input levels)

- adapter.gpio.GpioValueInput (sends configurable values for low, high input levels)

  On startup or whenever a value change is detected, the adapter sends configurable values. The level assignments can be changed.

- adapter.gpio.GpioButtonInput (deprecated, use GpioEventInput; sends events on button pressed, button released)
- adapter.gpio.GpioEventInput (sends events on button pressed, button released)

A nice application is the marshmallow button: two wires through a marshmallow form a contact: when squeezed, the button is pressed. See config/marshmallow.xml .

6.1.2. GPIO Adapter, output

- adapter.gpio.GpioOutput

- adapter.gpio.GpioOutputPWM, pwm is 0 to 100%

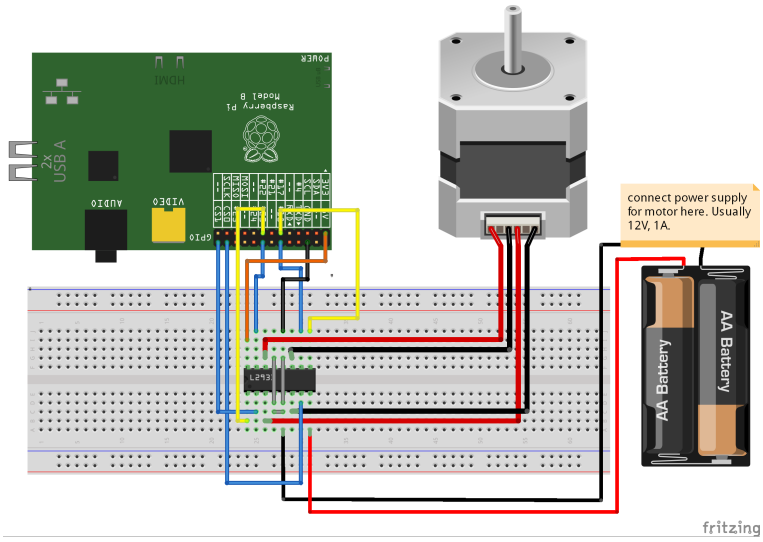
6.1.3. GPIO Adapter, output for Servo motors

- adapter.gpio.GpioOutputPWMServo, pwm is 1ms (0 input value) to 2ms(100 input value), period length 20ms. The PWM adapter uses rpi.gpio library with soft-pwm. This causes jitter for the signals.

  The output of this adapter can be inverted by configuration. This is needed if a simple (inverting) transistor level shifter is used.

6.1.4. GPIO Adapter, output for Stepper motors

- bipolar stepper driver adapter.stepper.BipolarStepper



Bipolar Stepper with L293D-Chip

- unipolar stepper driver adapter.stepper.UnipolarStepperStep adapter.stepper.UnipolarStepperModule

6.1.5. GPIO Adapter, output for PWM controlled Motor

- hbridge motor driver driver (e.g. L293, two half bridges separately controlled) adapter.gpio.GpioMotorPWM sample configuration is config/config_hbridge_motor.xml

6.1.6. GPIO Adapter, various

- rotary encoder, using two photointerrupters adapter.encoder.GPIOEncoder

- seven segment driver adapter.encoder.Gpio7segment

An adapter designed to monitor the connection state with scratch is adapter.gpio.GpioStateOutput. When the scratchClient is started, the output is set to 'high'. When connection to scratch is established, the output blinks at 0.6 sec cycle time. Please note the naming of the port: these names are configurable as described in Section 9.2, “GPIO Names” .

```
<adapter class='adapter.gpio.GpioStateOutput'  name='state'>
    <description>State display on IKG.IO.9</description>

    <gpio port='IKG.IO.9' alias='state'>
        <default dir='OUT'  default='low' />
        <active  dir='OUT'  default='low' />
    </gpio>
</adapter>
```

SHT015 humidity Sensor is using a 'wire' protocol, driven by GPIO. The protocol is not time critical. Adapter is adapter.wire_gpio.Wire_SHTx

6.2. SPI based Adaper

SPI is a communication protocol for various devices. A concept of 'device handlers' is used to generalize the usage. When in a device multiple similiar data points are used, this is called 'channels'; used in e.g. ADC-devices.

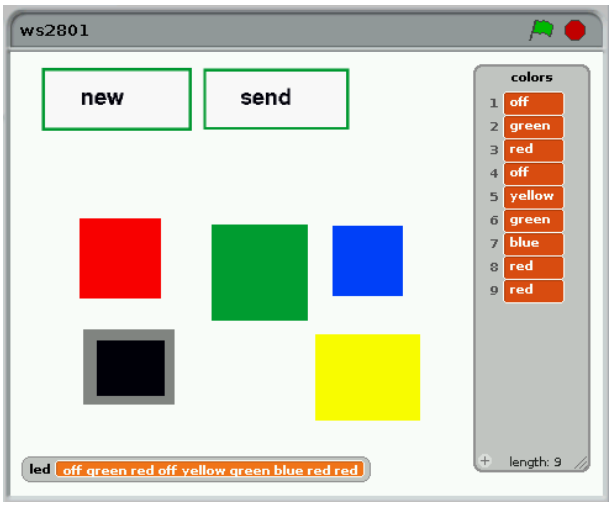
6.2.1. WS2801 LED Stripe

SPI can be used to emulate a shift register, as needed by a LED Strip with WS2801-Chip. The adapter is adapter.spiadapter.WS2801_Adapter.

In the distribution, there is a sample scratch program for the WS2801-stripe.

Start scratch with command

```
scratch ~/scratchClient/scratch/ws2801/ws2801.sb
```

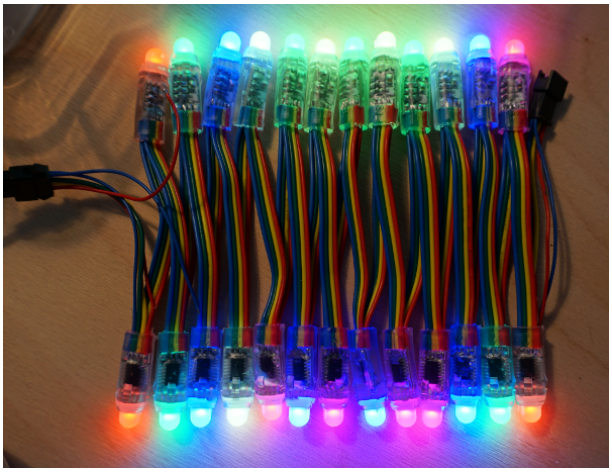


The program provides some colored fields which can be clicked and add their color name to a list. When the data shall be send to the stripe, press 'send'. The list is converted to a variable 'led' then.

The scratchClient adapter converts color names to RGB-values and sends them out to the SPI-hardware.

start scratchClient

```
cd ~/scratchClient
sudo python src/scratchClient.py -config scratch/ws2801/config_spi_ws2801.xml
```



For the hardware connection, see your vendors documentation on the stripe.

6.2.2. ADC MCP3202

- Adapter adapter.adc.ADC_MCP3202_10_Input 10 bit resolution.
- Adapter adapter.adc.ADC_MCP3202_12_Input 12 bit resolution, providing an optional low pass filter

6.2.3. ADC MCP3008

- Adapter adapter.adc.ADC_MCP3008_10_Input 10 bit resolution.

  8 channel single ended input operation of this device.

6.2.4. MAX31855 Thermocouple

The adapter adapter.spiAdapter.MAX31855_Adapter provides three output values: temp_intern, float value, scaled to °C temp_wire, float value, scaled to °C the error bits of the device are converted to a string value. temp_error, string value,

- '' empty string, no error
- 'SCV: short to Vcc'
- 'SCG: short to GND'
- 'OC: open circuit'

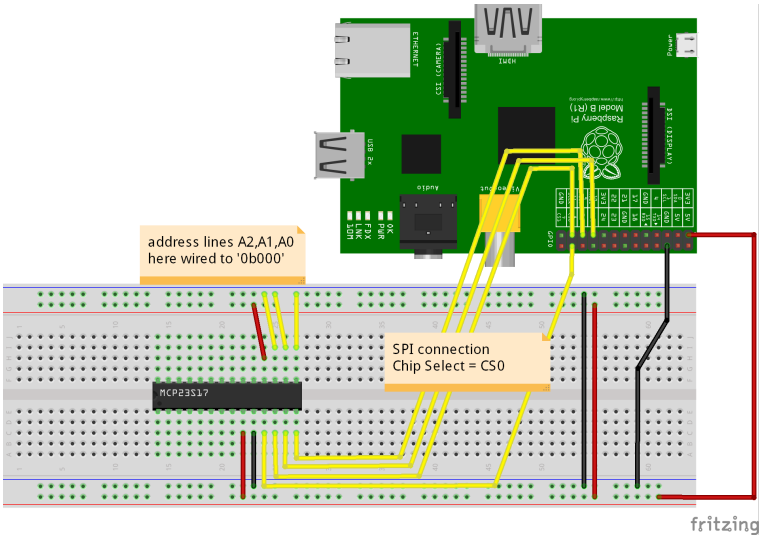
start scratchClient

```
cd ~/scratchClient
sudo python src/scratchClient.py -config config/config_max31855.xml
```

6.2.5. MCP23S17 16-Bit IO Expander; PIFACE board

The MCP23S17 is a SPI connected port expander with 16 GPIO pins. The adapter adapter.mcp23s17.MCP23S17_Adapter controls this device.

6.2.5.1. Setup on a breadboard



6.2.5.2. PiFace board

The MCP23S17 is used on the PiFace board. The sample configuration config/config_mcp23s17.xml can be used to drive this board. When using piFace, then do NOT use GPIO25 (this is INTB in MCP23S17)

In scratch, create variables 'out_0', 'out_1' .. 'out_7' to drive the outputs. Values are '0', '1', 'true', 'false'. For the relais, the variables 'relais_0', 'relais_1' can be used. The variable 'all' sets all outputs in parallel.

scratchClient sends sensor values 'inp_0', 'inp_1', .. 'inp_7'; the values are '0' and '1'.

In the configuration file, the scratch names can be changed to be more useful. If for example a 'forwardMotor' is attached to relais_0, just rename 'relais_0' to 'forwardMotor'.

6.2.5.3. Configuration details

The device 23s17 allows to have up to 8 devices 'in parallel' on one SPI chip select. These devices have hardwired distinct slave adresses. In the configuration, this slave address must be given by the parameter '23s17.addr'.

```
<parameter name='spi.bus' value='0' />
<parameter name='spi.device' value='0' />

<!-- slave address must match the hard wired slave address
     on the device [0..7] -->

<parameter name='23s17.addr' value='0' />
```

The IO direction for the port pins is defined by <io/>-tags.

```
<io id='GPA0' dir='out' />
<io id='GPA1' dir='out' />
<io id='GPA2' dir='out' />
<io id='GPA3' dir='out' />

<io id='GPA4' dir='out' />
<io id='GPA5' dir='out' />
<io id='GPA6' dir='out' />
<io id='GPA7' dir='out' />

<io id='GPB0' dir='in' pullup='weak' />
<io id='GPB1' dir='in' pullup='weak' />
<io id='GPB2' dir='in' pullup='weak' />
<io id='GPB3' dir='in' pullup='weak' />

<io id='GPB4' dir='in' pullup='weak' />
<io id='GPB5' dir='in' pullup='weak' />
<io id='GPB6' dir='in' pullup='weak' />
<io id='GPB7' dir='in' pullup='weak' />
```

It is generally a good idea to define all of the port pins. Technically it is needed to define those which are used in the application. The id-values are predefined and must be used as seen here.

For ports defined as dir='out' outputs, the corresponding adapter input methods can be used:

```
<input_value name='inputGPA4'>
    <!-- variable name is the name of the scratch variable
         which is send out to the adapter. -->
    <variable name='input_4'/>
</input_value>
```

For ports defined as dir='in' inputs, the corresponding adapter output methods can be used:

```
<output_value name='outputGPB2'>
    <sensor name='output_2'/>
</output_value>
```

The variables send out from scratch are '0', '1' to set the output pin of the 23s17 to low, high.

The sensor values received from scratch are '0', '1' for the input pin of the 23s17 receiving low, high.

6.2.5.4. Start scratchClient

scratchClient startup does not need special considerations.

```
cd ~/scratchClient
sudo python src/scratchClient.py -C config/config_mcp23s17.xml
```

The file config/config_mcp23s17.xml is an example of a full functional configuration.

6.3. I2C-Adapters

6.3.1. ADS1015 ADC Converter

The Adapter adapter.i2cAdapter.ADC_ADS1015_Input reads values from an ADS1015. The company adafruit sells a breakout board with this chip.

See sample configuration scratchClient/config/config_adc_ads1015.xml.

6.3.2. BH1750 Luminosity Sensor

The Adapter adapter.i2cAdapter.Luminosity_BH1750_Input reads values from a BH1750. Values are luminosity in lux (lx).

See sample configuration scratchClient/config/config_luminosity_bh1750.xml.

6.3.3. BMP085 barometric pressure sensor

The Adapter adapter.i2cAdapter.Pressure_BMP085_Input reads values from a BMP085. Values are pressure and temperature.

See sample configuration scratchClient/config/config_pressure_bmp085.xml.

6.3.4. PCA9685 16-channel, 12-bit PWM LED controller

The Adapter adapter.i2cAdapter.PWM_PCA9685 controls this device.

See sample configuration scratchClient/config/config_PCA9685.xml

In scratch, create variables 'channel_0', 'channel_1', .. 'channel_11'. The values are 0..100. Value 0 is no signal; 100 is full cycle filled.

In scratch, create variables 'servo_0', 'servo_1', .. 'servo_11'. The values are 0..100. Value 0 is 1ms; 100 is 2ms in a 20ms period.

The PCA9865 has 12 bit resolution, which is not challenged with values from scratch in range 0..100. This value is choosen for consistency with other adapters.

6.3.5. SN3218 LED controller, piGlow board

The Adapter adapter.i2cAdapter.PWM_SN3218 controls the SN3218-chip. This chip is used on piGlow board.

The usual i2cdetect-command does not report this chip. Use the -q-switch for this device.

```
root@raspberrypi:/home/pi# i2cdetect -y -q 1
     0  1  2  3  4  5  6  7  8  9  a  b  c  d  e  f
00:          -- -- -- -- -- -- -- -- -- -- -- -- --
10: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
20: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
30: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
40: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
50: -- -- -- -- 54 -- -- -- -- -- -- -- -- -- -- --
60: -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- --
70: -- -- -- -- -- -- -- --
root@raspberrypi:/home/pi#
```

The sample configuration uses some 'common variables. 'all' is used for all LED in sync. The 'branch_0', 'branch_1', 'branch_2' are for the three branches for the piGlow board. The individual LED are addressed with hex numbers, like 'channel_0A' or 'channel_11'. These names are case sensitive.

```
cd ~/scratchClient
sudo python src/scratchClient.py -c config/config_SN3218.xml
```

See scratchClient/scratch/SN3218/piglow.sb for a sample scratch program.

6.4. GPIO Wire adapter, w1-gpio, DS1820

Temperature sensor DS1820 needs one gpio pin for the connection. The timing is quite strict, but a kernel driver is available.

Adapter `adapter.w1_gpio.W1_DS1820` uses 'w1-gpio' kernel driver.

Connect ds1820 signal line to GPIO4, pullup needed 4k7 Ohm to 3.3V.

The adapter configuration sample is `config/config_temperature_ds1820.xml` . In this file, you need to configure the address of your ds1820.

- Connect DS1820 to raspberry pi, dataline is (usually) GPIO4. Add a resistor 4k7 from data to 3.3V.
- Start kernel driver: For PI2, add a line to /boot/config.txt

  `dtoverlay=w1-gpio,gpiopin=4`

  Needs a reboot to take effect.
- The driver creates a directory in `/sys/bus/w1/devices` , which contains subfolders for each DS1820 connected. The name of the folder is composed of a family code and the unique device id. DS1820 und DS18S20 have familycode 10, DS18B20 use 28 and DS1822 use 22. check the directory name and configure in `config/config_temperature_ds1820.xml`. Example:

  `<parameter name='w1.device' value='10-0008023b57b9'`

The sample configurations contain a config file for this device. Start scratchClient with

```
cd ~/scratchClient
python src/scratchClient.py -c config/config_temperature_ds1820.xml
```

For this special purpose, no root permission is needed. The file written by the kernel driver is public for reading.

6.5. Remote Communications Adapter

The adapter class adapter.remote.CommunicationAdapter provides scratch to scratch communication. There is a server process needed on the network [host, port=42002].

```
python src/scratchCommunicationServer.py
```

It is recommended to install scratchCommunicationServer on a machine with a fixed ip address. It can run in parallel to scratchClient on a machine.

The adapters are assigned to groups, so within one network the communication server keeps different groups separate from each other. Sample configuration is /scratchClient/config/config_remote_0.xml or config_remote_1.xml

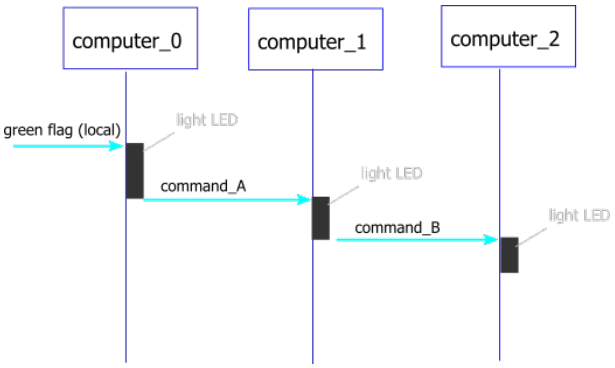
Groups are useful when in a classroom environment where pairs of two exercise a communication sample, but only one scratchCommunicationServer is running. Then each group gets its own name, and interferences are avoided.

Broadcast signals defined as inputs to the adapter are propagated to all other registered adapters (except the one it came from). Outputs of the adapter are propagated towards local scratch.

6.5.1. How to setup configuration files.

A simple szenario is used for the explanation: In a school class, three computers with scratch should perform a chain reaction. 'computer_0' lights a LED and sends 'command_A' to 'computer_1'. When 'computer_1' receives this event, it lights a LED and sends 'command_B' to 'computer_2', which lights a LED.

With an UML sequence diagram, the process gets clear.



Good planning is needed for a successful setup.

For 'computer_0', there is only one outgoing event.

```
<remote type='forward'>
    <broadcast name='command_A'/>
</remote>
```

For 'computer_1', there is one incoming event and one outgoing event.

```
<remote type='forward'>
    <broadcast name='command_B'/>
</remote>
<remote type='receive'>
    <broadcast name='command_A'/>
</remote>
```

Finally for 'computer_2', there is one incoming event.

```
<remote type='receive'>
    <broadcast name='command_B'/>
</remote>
```

For each computer, prepare the appropriate config file and start scratchClient with it.

6.5.2. Sample Application 'railway control'

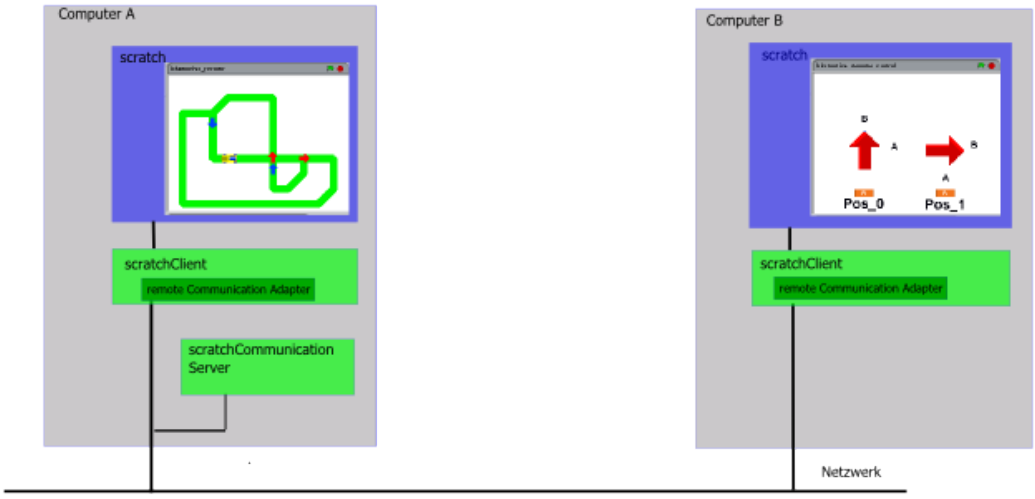
There is a sample implementation of a remote controllable railway track available. To operate this, you need two computers A and B on a network. It is not possible to have this running on one system only, as two scratch instances are needed and the server ports 42001 can't be adjusted. A screencast of this sample is available on youtube [http://youtu.be/o-A9yyL5ugE]

Adjust hostaddress in scratch/remote/config_lokomotive_remote.xml and scratch/remote/config_lokomotive_remote_control.xml, it should contain IP-address or hostname of Computer A.

```
<parameter name="server" value="192.168.2.102" />
```

Distribute this file to Computer A and Computer B.

6.5.2.1. Context Diagram



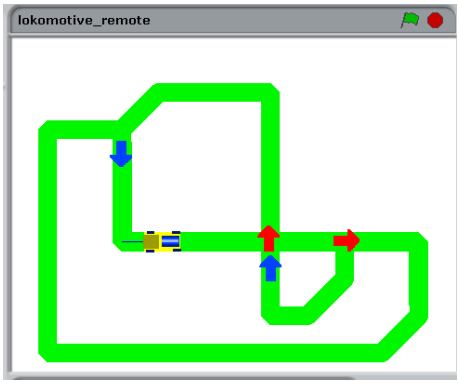
6.5.2.2. Computer A

start scratch

```
scratch ~/scratchClient/scratch/remote/lokomotive_remote.sb
```

start scratchClient, in a terminal window.

```
cd ~/scratchClient
sudo python src/scratchClient.py -c scratch/remote/config_lokomotive.xml
```



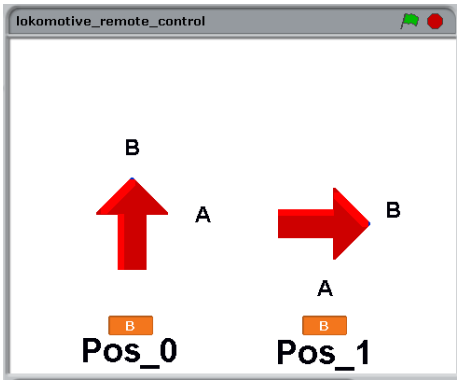
start server process in a terminal window:

```
cd ~/scratchClient
python src/scratchCommunicationServer.py
```

6.5.2.3. Computer B

start scratch

```
scratch ~/scratchClient/scratch/remote/lokomotive_remote_control.sb
```



Clicking on the arrows should set the corresponding track directions. But scratchClient needs to be started first. start scratchClient in a terminal window:

```
cd ~/scratchClient
sudo python src/scratchClient.py -config scratch/remote/config_lokomotive_control.xml
```

Commands from control panel on computer B scratch instance are transferred to computer A.

6.6. Operation System Adapters

6.6.1. Text To Speech Adapter

Adapters are not limited to GPIO or SPI based devices, but can control applications on the computer as well. Ad hoc speech synthesis is available with 'festival' or 'pico2wave' text to speech applications, There are audio outputs available in scratch, but only prerecorded snippets. Text to speech allows arbitrary text to be produced. You need to have the tools installed.

Sample configuration is config/config_texttospeech_festival.xml

Sample configuration is config/config_texttospeech_pico2wave.xml

Speech output is quite slow. The adapter queues the incoming data up to a length given by the parameter 'queue.max'. When queue size is exceeded, new entries are discarded and a warning log message is issued.

Comment

Keep in mind that scratch sends values only on changes. Repeating the same text multiple times works only if the text is (silently) modified, e.g. by appending blanks and removing blanks in turn. Festival is well suited for english language. German text will sound a little bit strange. pico2wave has better quality output.

6.6.2. Broadcast Adapter

Sending broadcast events from adapter to scratch when remote communications is established. Use this to start a script automatically.

adapter.broadcast.ScratchStartclickedAdapter

```
    <adapter class='adapter.broadcast.ScratchStartclickedAdapter'  name='startClick'>

        <output name='command'>
            <broadcast name='scratch-startclicked'/>
        </output>
        <description>Send startclicked</description>
    </adapter>
```

sends scratch-startclicked when remote communication is established. This is a 'green flag' event for scratch 1.4.

6.6.3. System Time Adapter

Scratch 1.4 has no system time available. This adapter provides current system time to scratch.

adapter.broadcast.TimeAdapter

See configuration file config/config_time.xml for a sample.

6.6.4. Operating system commands

Control applications on the computer with this adapter. It will execute a os-command configured.

Sample configuration is config/config_linux.xml

```
<adapter class='adapter.linux.Linux_Adapter'  name='sample'>
        <description>linux os command exectution</description>

        <input name='trigger'>
            <!-- scratch event name -->
            <broadcast name='execute'/>
```

```
        </input>

        <parameter name="os.command" value="ls -l"  />
        <parameter name="queue.max" value="5"  />
    </adapter>
```

Start sample configuration

```
cd ~/scratchClient
python src/scratchClient.py -c config/config_linux.xml
```

Sample scratch code

Programs executed should not run long time.

The adapter queues the incoming data up to a length given by the parameter 'queue.max'. When queue size is exceeded, new entries are discarded and a warning log message is issued.

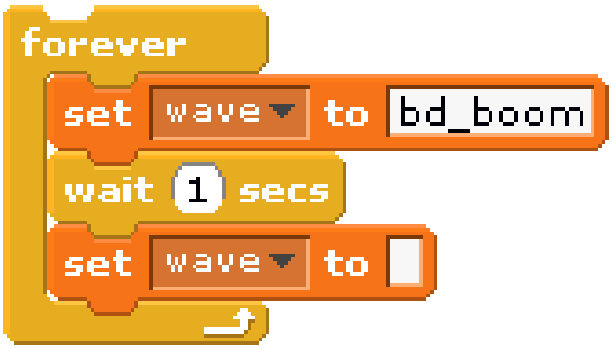
The commands executed are configured in configuration file. These commands are execute in the context of the user who started scratchClient. Avoid starting scratchClient as root when in doubt.

6.6.5. Linux 'aplay' adapter

Play wav-files using linux aplay command. This adapter allows some more flexibility than the scratch build in audio replay, as the ALSA-device can be defined. On USB-adapters, higher quality can be achieved.

The linux command used is 'aplay -D device dir/file'.

Place the files to play in file system directory. Or use the already available files in e.g. /opt/sonic-pi/etc/samples. These files are NOT included in the scratch code. So when you move your scratch application to another computer, you need to move your files too.



The code snipped shows how to play one sound repeatedly. As scratch only transmits variables when the value changes, the file name is set to 'blank' in between.

6.6.6. Linux 'arecord' adapter

Record wav-files using linux arecord command. This adapter allows some more flexibility than the scratch build in recording,and is run time controllable by scripts

The linux command used is 'arecord -D device dir/file'.

Set file name first.

Start recording with an event, and stop with an event. There is a timeout provided in case scratch misses to send the stop event. This timeout feature limits space consumption in file system.

These files are NOT included in the scratch code. So when you move your scratch application to another computer, you need to move your files too.

Protect privacy: do not record personal communication without permission.

6.6.7. Linux speech recognition adapter

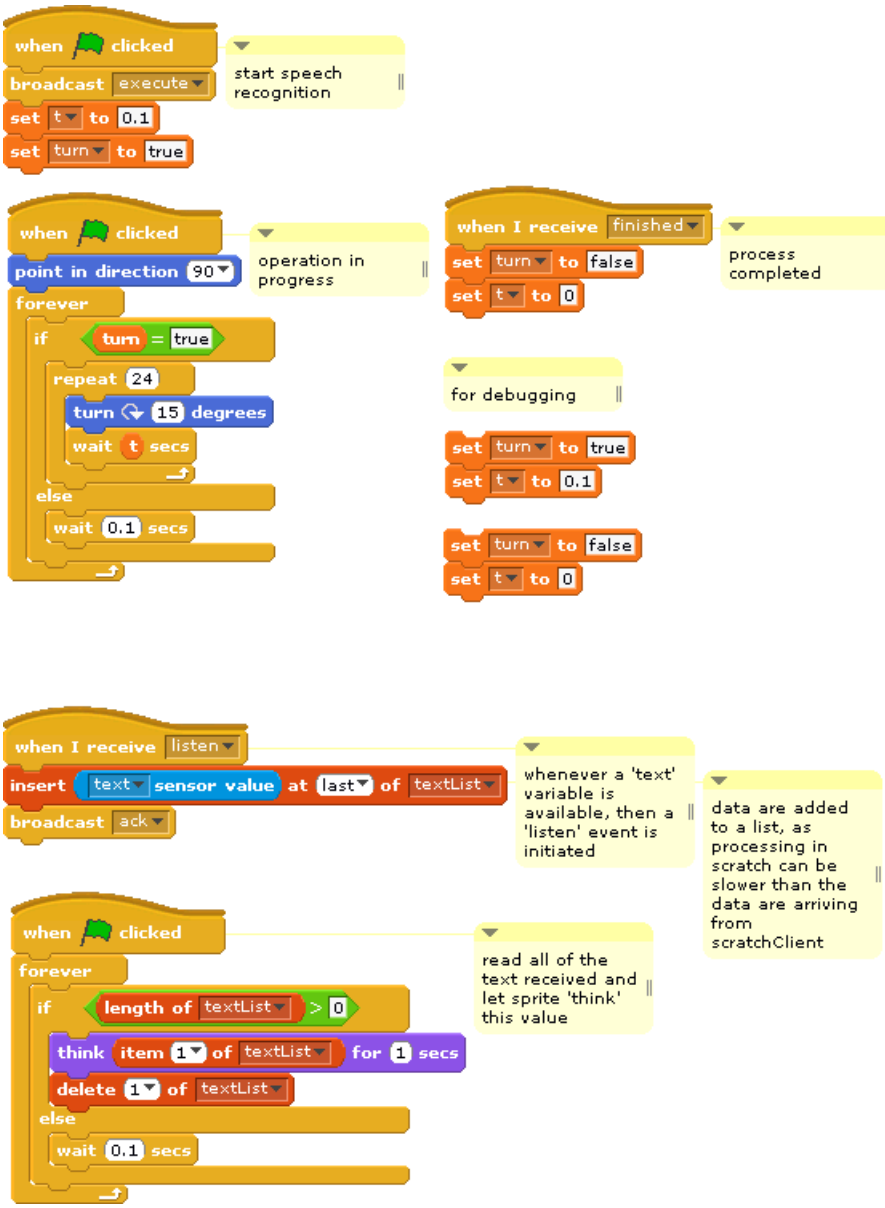
There are speech recognition systems available which run on raspberry pi. Pocketsphinx is an example.

Pocketsphinx needs a quite complicated installation procedure. It is described in installation instruction [https://wolfpaulus.com/journal/embedded/raspberrypi2-sr/].

Running pocketsphinx in countinuous mode needs quite a lot of CPU power. So I decided to run it in batch mode. This is convenient for short sequences of speech. Use the arecord-adapter to record sound snippets, and process these by the recognition adapter.

For sending text from scratchClient to scratch a protocol is implemented. ScratchClient sets the 'text'-variable, and then sends an event 'textAvailable' (or whatever is configured in the adapter xml). When data are processed in scratch, then scratch sends an acknowledge 'textAcknowledge' to scratch client.

See a scratch sample code in `scratch/linux/speechRecognition.sb`



The data received from scratchClient are added to a list. Another script takes these data from the list and displays then with a 'think'-action. Perhaps there are more useful things which could be controlled.

Adjust the command line given in the adapter config file according to your needs and check this first in a terminal window.

```
<parameter name ='command.line'
           value='pocketsphinx_continuous -hmm /usr/local/share/pocketsphinx/model/en-us/en-us  \
                                          -lm 0609.lm -dict 0609.dic -samprate 16000/8000/48000 \
                                          -logfn /dev/null                                      \
                                          -infile ${sound.dir}/${sound.file}' />
```

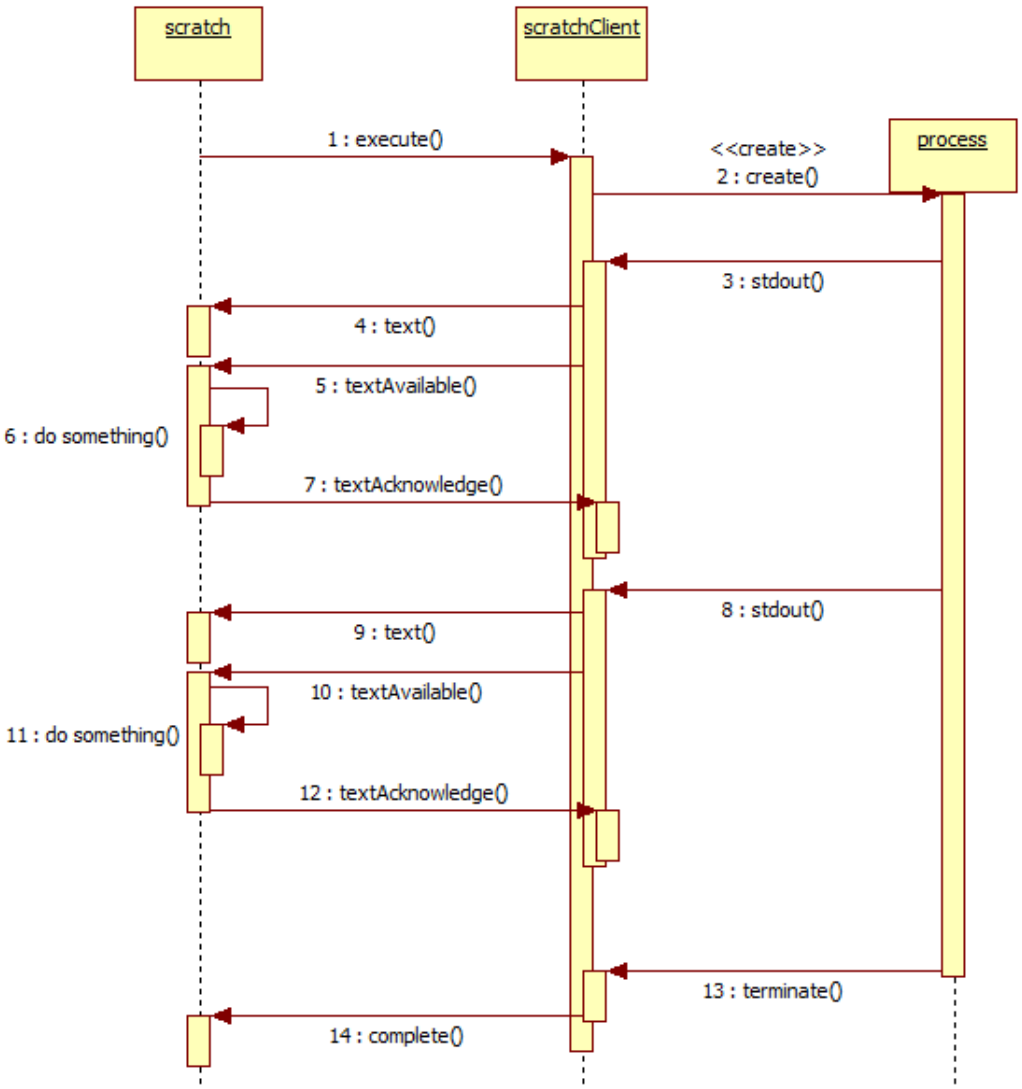
Please note that this command line is from a developement system. The dictionary '0609' was set up for some numbers and commands. This needs adjustment for each environment.

Start this sample with scratchClient

```
python src/scratchClient.py -c config/config_linux_a_ASR.xml
```

pocketsphinx prints recognized text line by line; fast spoken words are in one line. Silence breaks cause new lines to be produced.

An UML sequence diagram best explains the sequence of commands and the protocol.



(1,2) The processing is started by an 'execute' event. The linux process is created.

(3..7) A line of text from the process is read into scratchclient and written to a sensor variable 'text'. Then a textAvailable Event is issued and scratch should process the data. When processing is complete, a textAcknowledge event to scratchClient is sent.

(8..12) Just another example of a text sent.

(13,14) If the process terminates, a 'complete'-Event is sent towards scratch.

This adapter is not limited to speech recognition; it can be used with any process which outputs lines of text to stdin.

6.7. Telephone Dial Plate Adapter

A dialplate as seen here has two switches.

- Contact 'nsi' is delivering pulses.
- Contact 'nsa' is closed when the plate is turned.

The adapter adapter.encoder.GPIODialPlateEncoder is handling the plate. It needs two GPIO pins. Polling interval is changing for this adapter. When not used (contact 'nsa'), the polling interval is 0.2 sec. When active the polling interval is 5ms.

6.8. Adapters for special purpose Devices

6.8.1. Atmel atmega328 with custom firmware as ADC

When looking for inexpensive, breadboard-friendly AD-Converters the popular Atmel atmega328 can be used. This device has an 8-channel AD-Converter. The controller needs a custom firmware, is interfaced by SPI and provides a switchable LED. A description is available on my website heppg.de, “Atmel 328-Prozessor als AD-Wandler”. The SPI communication is choosen, as it is used to flash the chip and wiring is available. Interfacing this device to scratchClient needs SPI communication and the RESET-Line for the processor. The adapter adapter.atmel328_adapter.Atmel328_ADC_Adapter provides functionality for this setup. It is not generic, but a proof of concept for a SPI/GPIO based setup. Sample configuration is in config_adc_atmel328.xml.

6.8.2. Atmel atmega328 with custom firmware as frequency counter

The firmware in the atmega328 allows for frequency measurement. See 'steckbrett_328_en.pdf' for reference.

Sample configuration is in config_adc_atmel328.xml

The remote coprocessor is connected by SPI.

6.8.3. Atmel atmega328 with custom firmware for DHT22, DHT11

There is a firmware for the DHT22, DHT11 device.

The temperature, humidity sensor DHT22 is a quite inexpensive sensor, well suited for microcontroller applications. It uses same protocol as DHT11. It is connected by a single wire, needs 5ms for a read cycle, but a quite challenging protocol where the pulse width gives '0' or '1' bit values.

This is a typical application for a coprocessor for raspberrypi. For an atmel328, it is not a challenge to handle this protocol.

See documentation for DHT22 [http://heppg.de/ikg/wordpress/?page_id=6]

Sample configuration is in config/config_dht22_atmel328.xml

The remote coprocessor is connected by SPI.

6.8.4. Adapter for SIM800 GSM Modem, SMS support

Receiving and sending SMS text messages is possible with the adapter adapter.serialAdapter.SIM800_Adapter. The hardware ist the adafruit fona SIM800 breakout board. Connection is made from rx, tx to the tx, rx of the RaspberryPi. Follow the instructions from adafruit to setup the module.

For this board, you need

- a SIM card
- Lipoly Battery, 500mA or larger
- micro USB charger for the board in addition to this needed for Raspberry Pi
- antenna

Basic hardware setup, cited from adafruit webpage. Vio - THIS IS THE MOST IMPORTANT PIN! This is the pin that you MUST drive with an external voltage from 3V-5V to set the logic level converter. The converter also buffers the indicator LEDs so NOTHING will appear to work unless this pin is powered! You should set the voltage to whatever voltage your microcontroller uses for logic. A 5V micro (like Arduino) should have it be 5V, a 3V logic micro should set it to 3V. For SMS, I did not use the other connectors. For automated startup, the 'Key' would be nice to use. Rx,Tx are connected to the Raspberry. If you are not sure on wiring, use serial 1kOhm to protect the Pi.

Software installation hints: The /dev/ttyAMA0 must be removed from the /boot/cmdline.txt and /etc/inittab. For python, install pyserial

```
sudo pip install pyserial
```

Edit the configuration file `~/scratchClient/config/config_sim800.xml` :

- provide the phone number to send sms to
- and provide the pin for the sim card.

```
        <parameter name='sim.pin' value='NNNN' />
        <parameter name='remote.number' value='NNNNNNNNNNN' />
```

Start the scratchClient with

```
cd ~/scratchClient
sudo python src/scratchClient -c config/config_sim800.xml -d
```

The debug switch is highly recommended, as error output is available only in the log file.

Manually start the modem by pressing the button on the breakout board. This is by purpose not automated, in order to have control on cost by sending sms. In scratch, the variable sim_out is used to transmit the sms send request. Empty (blank) strings will not be transmitted. The sensor value sim_in receives the values from the modem.

Please be aware that sending sms causes cost. Sending rate with programs can be quite high, so carefully check the logic. For this reason, no automatic startup of the modem is provided, which allows some control on when the modem is available.

6.8.5. Test Adapter

For testing purposes, there is the need for looking into details of the communication protocol, and sending values to scratch without the need for attached hardware.

`adapter.test.TestAdapter` sends values towards scratch, changing each cycle.

When only this adapter is configured, then scratchClient does run also on windows or other hardware than raspberry pi.

Values send every second.

- iValue, integer values, incremented
- sValues, string values with 'umlaut' utf-8 chars `['apfel', 'apfeläöü', 'äöü' ]`
- fValues, different decimal places, including 19.0 `[18.8, 18.9, 19.000, 19.123, 19.2]`

Values send only once at startup

- test22, integer value 1; use the web interface at localhost:8080 to edit and send values as needed.

Events

- event 'testEvent'

Start of scratchClient:

```
cd ~/scratchClient
python src/scratchClient.py -c config/config_test.xml -d
```

No superuser rights are needed for this setup, as no hardware specific drivers are connected. When running scratch on a different host, use command line switch `-host [ip]` to connect to a remote scratch instance.

6.8.6. Servoblaster

Servoblaster is software to DMA-control servo units with pulses from 1 to 2ms, frequency 50 Hz.

It can also be used to full scale pwm control signals to drive LED or alike, but current implementation of the adapter only supports servo signals.

See servoblaster at github [https://github.com/richardghirst/PiBits/tree/master/ServoBlaster]

The software is controlled by writing commands to /dev/servoblaster; example is

```
echo '5=1200us' > /dev/servoblaster
```

The adapter adapter.servoblaster.ServoBlaster is controlling 8 channels, see config file config/config_servoblaster.xml for a sample configuration.

Please note that the integration into the GPIO-system of other adapters is not available, so duplicate use of GPIO will not be detected.

Scratch can send values from 0..100, which corresponds with 1ms to 2ms servo signals.

The adapter writes to /dev/servoblaster, there are checks whether this pipe exists. A reconnect logic handles restarts of servoblaster daemon.

```
#
# start servoblaster daemon separately, it is not started by scratchClient !
#
cd ~/scratchClient
python src/scratchClient.py -c servoblaster
```

The config file sample is `config/config_servoblaster.xml` .

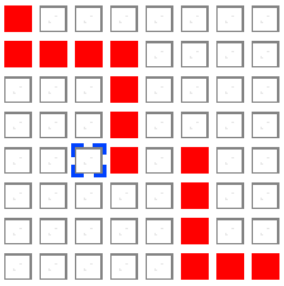
6.8.7. Raspberry Pi SenseHat

Sense Hat provides many different sensors and a LED matrix.

This board needs special installation procedure, see pythonhosted.org/sense-hat [https://pythonhosted.org/sense-hat/]

LED matrix single pixel, sensors and orientation is supported.

Sample code is in `scratchClient/scratch/senseHat`



With cursor keys, move the selector border to a led. With blank key toggle the LED to a lolor or dark.

Scratch sample code: `scratchClient/scratch/senseHat/sense_hat_led.sb`

scratchClient config file: `scratchClient/scratch/senseHat/config_senseHat.xml`

In order to keep the scratch code simple, this special adapter uses a special pattern for parameter passing to sense-hat function call: variables sent are stored in adapter and used for function events later.

The advantage of this pattern is that code is clear, but this pattern can only be applied when setting the parameter values is not done in multiple places.

To set single pixel values it is needed to set x_pos, y_pos and color first before broadcast setPixel_xy.

To clear single pixel values it is needed to set x_pos, y_pos first before broadcast clearPixel_xy.

Alternative way would be to use 'composite broadcasts', where command and parameters are joined to one event.

6.8.8. Pimoroni PianoHat

PianoHat is a cpacitive button board.

This board needs special installation procedure, see Getting started with Piano HAT [http://learn.pimoroni.com/tutorial/piano-hat/getting-started-with-piano-hat]

Sample configuration is `scratch/pianoHat/config_pianohat.xml`

Scratch sample code: `scratch/pianoHat/piano.sb`

6.9. Smartphone positional sensor for scratch

6.9.1. Overview

In a quite popular computer magazine, c't 2015-03-07 (heise verlag), there is a nice article about how to connect a smartphone's positional sensors to a remote server by using a web page, some javascript and websockets.

Starting from this, there was the idea to connect this to scratch (what else ?).

The basic roadmap was

- add a html-page to my scratchClient's web server, with javascript

```
var addr = "ws://" + window.location.hostname + ":" + window.location.port +
           "/pendel";
var websocket = new WebSocket( addr );

function handleOrientation(event) {
       var x = event.beta%90;
        var y = event.gamma;
        x += 90;
        y += 90;
        try {
              websocket.send(JSON.stringify( { x:x, y:y }));
        }
        catch(err) {
             // console.log( err.message );
        }
}
window.addEventListener('deviceorientation', handleOrientation);
```

- in scratchClient, there is cherrypy used to serve the web pages. WebSocket was a new feature to be added there.
- an adapter needed to be written adapter.websocket.WebsocketXY_Adapter, receiving the messages and converting them to scratch variable updates.

Installation of scratchClient now needs ‘ws4py’ in addition to cherrypy. See the installation description.

6.9.2. Start scratchClient

```
cd ~/scratchClient
sudo python src/scratchClient.py -c config/config_websocket_pendel.xml -guiRemote
```

The guiRemote-switch is needed to allow remote browsers connecting to scratchClient.

6.9.3. Smartphone

In a smartphone browser, navigate to your pi’s address. Of course you need a (wireless) network connection between smartphone and raspberry. In my network, the RaspberryPi’s address is 192.168.2.90, most possibly different for your PI. Use ‘ifconfig’ to look it up.

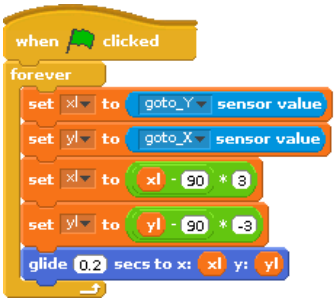
```
http://192.168.2.90:8080
```

Navigate to “Smartphone as Sensor” browser

You should see rectangle with a red/green dot moving around. This is as proposed by the c’t-article.

6.9.4. Scratch

In scratch, enable remote sensor connections and provide the following script. gotoX and gotoY are sensor values provided by the scratchClient. The xl and yl-Variables are local variables in scratch.



The x and y-values are getting exchanged and the y-value gets inverted to match the coordinates of the smartphone to scratch stage.

6.10. USB barcode scanner

Barcode scanners are USB-connected devices.

These scanners typically can send codes by emulating HID-class devices. This makes usage from programs quite easy, but you loose input when the program goes to background and other programs get the focus.

Connecting these devices can be don eusing pyusb library. This library allows access to usb devices and, very important, can grab devices to be used exclusively by one program.

6.10.1. Install pyusb

Here I found a problem. The usual install did not workwith „pip install pyusb“. This resulted in a 'backend not found' exception and „undefined symbol: libusb_strerror“

When I tried to download walac-pyusb-50b1490 from https://github.com/walac/pyusb, this worked, but I had to uninstall the pip-installed code first „sudo pip uninstall pyusb“.

The needed backend packages are already available in raspbian, you can check this with

apt-cache pkgnames | grep libusb

You should find libusb-1.0-0 in the list.

6.10.2. Setup Scanner for USB and CR-suffix

A few preparations are needed with the scanner to enable HID mode. With my scanner I got a handbook with a huge amount of programming codes. You start programming with a 'start programming' code, scan the appropriate setup code and exit programming with an 'end programming' code.

For my sample, I have setup HID mode, and added exit code/suffix CR. This is needed to detect complete sequences. The adapter in scratchClient relies on this.

6.10.3. Configure idVendor and idProduct

Another preparation is the configuration of idVendor and idProduct in the adapter's config file. Use the utility enum.py to list the devices available

```
cd ~/scratchClient
python tools/usb/enum.py
```

Here the output for my scanner

```
DEVICE ID 0c2e:0200 on Bus 001 Address 007 =================
bLength : 0x12 (18 bytes)
bDescriptorType : 0x1 Device
bcdUSB : 0x110 USB 1.1
bDeviceClass : 0x0 Specified at interface
bDeviceSubClass : 0x0
bDeviceProtocol : 0x0
bMaxPacketSize0 : 0x8 (8 bytes)
idVendor : 0x0c2e
idProduct : 0x0200
bcdDevice : 0x5881 Device 88.81
iManufacturer : 0x1 Honeywell Scanning and Mobility
iProduct : 0x2 Honeywell Scanning and Mobility Scanner
iSerialNumber : 0x0
bNumConfigurations : 0x1
CONFIGURATION 1: 300 mA==================================
bLength : 0x9 (9 bytes)
bDescriptorType : 0x2 Configuration
wTotalLength : 0x22 (34 bytes)
bNumInterfaces : 0x1
bConfigurationValue : 0x1
iConfiguration : 0x3 HID Keyboard
bmAttributes : 0x80 Bus Powered
bMaxPower : 0x96 (300 mA)
INTERFACE 0: Human Interface Device ====================
bLength : 0x9 (9 bytes)
bDescriptorType : 0x4 Interface
bInterfaceNumber : 0x0
bAlternateSetting : 0x0
bNumEndpoints : 0x1
bInterfaceClass : 0x3 Human Interface Device
bInterfaceSubClass : 0x1
bInterfaceProtocol : 0x1
iInterface : 0x0
ENDPOINT 0x81: Interrupt IN ============================
bLength : 0x7 (7 bytes)
bDescriptorType : 0x5 Endpoint
bEndpointAddress : 0x81 IN
bmAttributes : 0x3 Interrupt
wMaxPacketSize : 0x8 (8 bytes)
bInterval : 0xa
```

What you also should check is the iConfiguration to be a HID Keyboard.

For verification open a text editor like leafpad: when scanning a code, this should be entered into the editor as a text string.

Edit config/config_barcode.xml and adjust the vendor/product id there.

In my environment, I use a powered USB hub to connect the scanner.

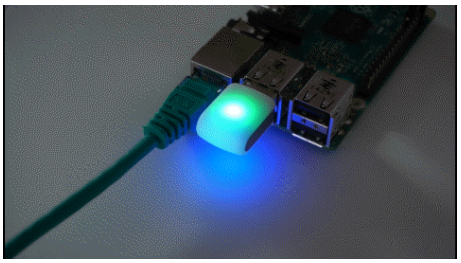
6.10.4. Start scratchClient

```
cd ~/scratchClient
```

```
sudo python src/scratchClient.py -c config_barcode
```

The file config/config_barcode.xml is a starting point for a project. Add other adapters as needed. When scanning barcodes, these are send to scratch. Do not forget to enable remote sensor connections.

6.11. USB blink(1)



Blink is a small, USB based device with two RGB-LED.

Connecting this devices can be done using pyusb library. This library allows access to usb devices and, very important, can grab devices to be used exclusively by one program.

See chapter 'install pyusb' in barcode scanner chapter' for installation .

6.11.1. Start scratchClient

```
cd ~/scratchClient
sudo python src/scratchClient.py -c config_blink
```

In scratch, create variables led_1, led_2 and led_all. Set values to 'red', 'green' or other color names, or rgb-values like #2A2A2A.

6.12. RFID Adapter

The adapter is adapter.serialAdapter.RFID_Reader_Adapter, a sample config file is in config/config_ID12LA.xml.

RFID-Readers are available for 125kHz and 13.56MHz. For the 125kHz there are reader modules available from Innovations which contain also the antenna.

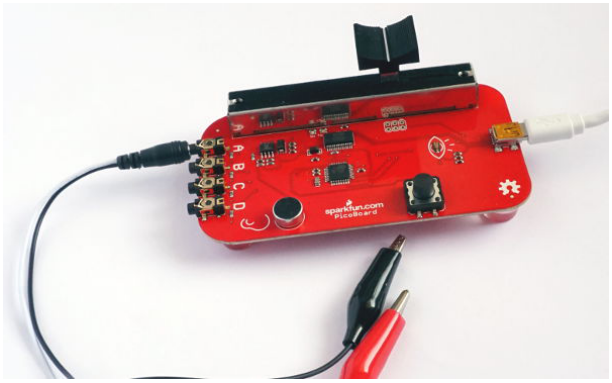
Connect the device to 3.3V and set format to ASCII. The data output goes to Rx-Input of Raspberry Pi.

The adapter sends an event when data are received from RFID-reader. This allows to trigger scripts in scratch when the same card or tag is used twice.

6.13. ScratchBoard, PicoBoard Adapter

The adapter is adapter.serialAdapter.PicoBoard_Adapter, a sample is available in /config/config_picoBoard.xml.

Picoboard, available from sparkfun, is a USB/serial connected device which contains some sensors and a slider.



The serial protocol is using polling. Scratch or the adapter in scratchClient sends out a 0x01 to start data aquisition and transfer. The board responds by 9 datapackets.

- channel 15, softwareversion 0x04

- channel 0, sensorD
- channel 1, sensorC
- channel 2, sensorB
- channel 3, button, open = 1023, 0 pressed
- channel 4, sensorA
- channel 5, light sensor, bright 0, dark 1023
- channel 6, sound sensor, loud 1023, silent 0
- channel 7, slider sensor, 0..1023

As polling is used, the tx and rx-LED should flicker frequently.

Table 6.1. datapacket structure

Byte	Bit	Content
byte 0	7	'1'
byte 0	6..3	channel
byte 0	2..0	high 3 bytes of value
byte 1	7	'0'
byte 1	6..0	low 7 bytes of value

This board is supported by scratch, so usually there is no need to use scratchClient.

There are situations where support by scratchClient is useful:

- When you need more than one board.
- You want to see the native values delivered by picoBoard.

The sample configuration file config/config_picoBoard.xml uses the scratch names used from ScratchBoard.

If you need more than one picoboard, then

- duplicate the `<adapter/>` section in config/config_picoBoard.xml.
- rename adapter/@name from 'picoboard' to 'picoboard_0', 'picoboard_1' (or to any unique name you like)
- rename the adapter/output_value/sensor/@name values to unique names to make these separate for each adapter.

  e.g. adapter/output_value/sensor[@name='slider'] [1] /@name to 'slider_0'; adapter/output_value/sensor[@name='slider'] [2] /@name to 'slider_1'
- rename parameter [@name='serial.device'] to match each picoboard, most probably /dev/ttyUSB0, /dev/ttyUSB1

6.14. Arduino UNO Adapter

Arduino UNO has an USB connection, which supports serial connection to a host computer. The arduino can be used as a IO expander, connecting digital io lines, pwm, or adc-inputs directly to scratchClient. It also supports servo signals (pwm 50Hz, 1 to 2ms pulses).

The adapter and arduino sketch will also work with arduino nano, atmel328 processor.

With the USB-connection, the UNO provides 5V-compatible inputs/outputs. This is an advantage in some constellations. But do not connect these outputs to Raspberry Pi inputs directly.

The functionality presented here is not a bridge to mesh network, propagating events and sensor updates into the arduino. There is a custom arduino sketch needed which only exposes the IO resources, but does not allow for additional logic in arduino.

Configuration of the io-pins (direction, pullup, pwm, servo) and adc-pins (whether used or void) is controlled by scratchClient through configuration.

The scratch names used are configurable in configuration too. This is common functionality of the framework.

The code for the arduino, a sample configuration and a sample scratch project are contained in the scratchClient distribution.

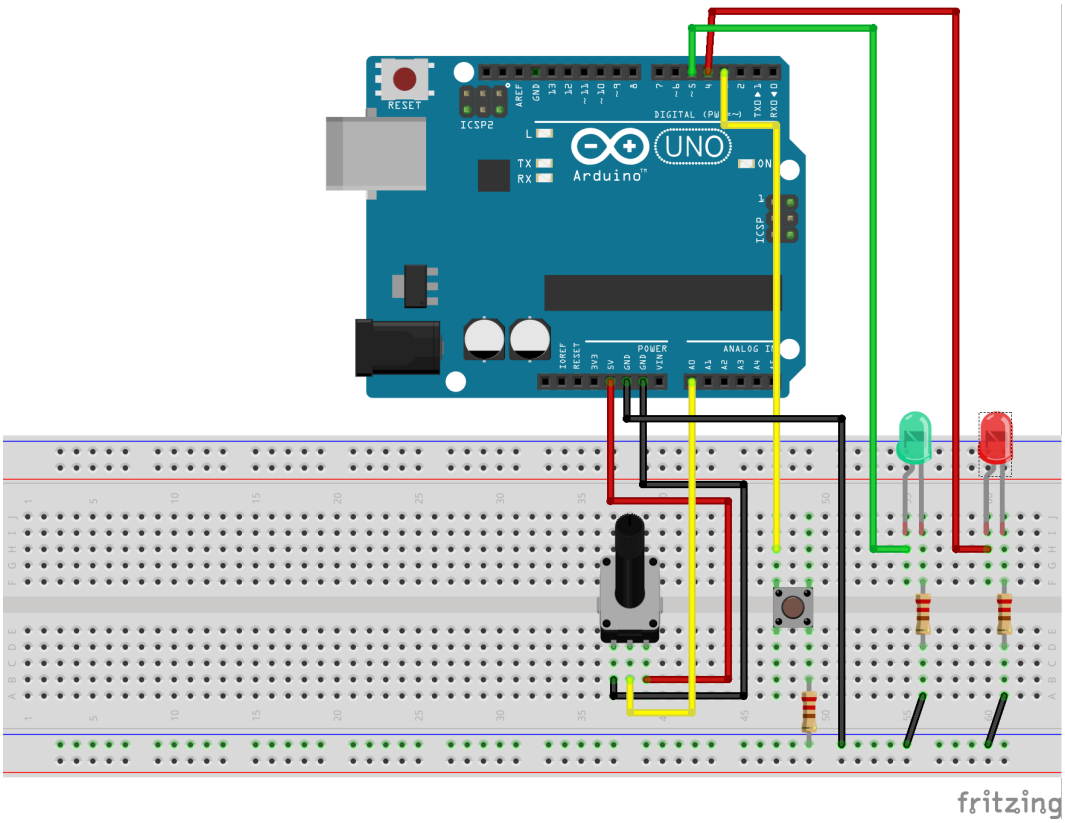
6.14.1. Step 1, program the firmware to arduino UNO

Start arduino software, load arduino/arduinoUno/arduinoUno.ino and program it into the UNO.

The LED13 on the arduino should blink at 5Hz, quite fast. This indicates that the firmware did not yet receive configuration.

6.14.2. Step 2, Sample hardware setup.

This setup is a sample for what is possible with this setup. The configuration file allows for almost all the flexibility the atmel controller allows.



The hardware uses a potentiometer (2k to 10k are ok) on AD0. On D3, there is a button connected. The other side is having a 1k-Resistor to GND (just in case the output is configured as an output, this prevents damage to the IO).

Two LED are for output. The green LED is on a PWM-Output D5, so it can be dimmed.

This setup is a sample. The functionality of all the inputs and outputs are defined by configuration in scratchClient.

6.14.3. Step 3, connect arduino with USB-Line to RaspberryPi or windows computer.

On raspberry, lookup /dev /tty* connections and configure the UNO serial device in config/config_arduino_uno.xml-File.

For windows, you see the COMn-Device used in deviceManager.

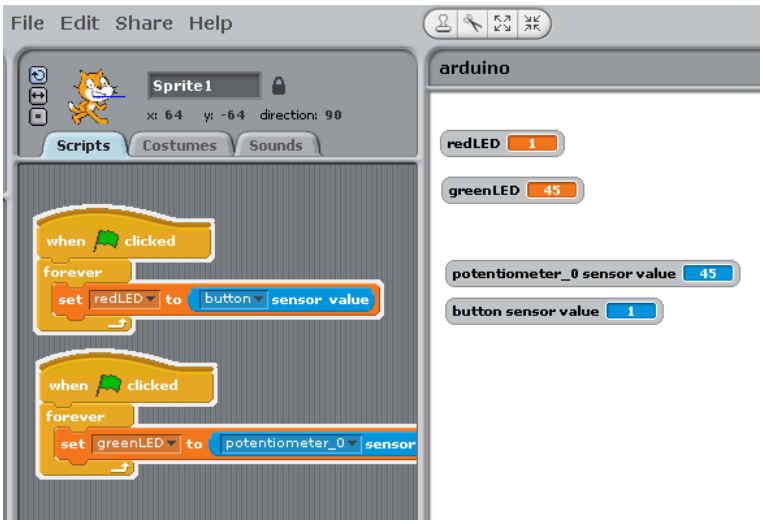
6.14.4. Step 4, start scratchClient with configuration

```
cd ~/scratchClient
python src/scratchClient -c config/config_arduino_uno.xml
```

After a short while, the LED13 should start blinking at 1Hz, quite slow. This indicates that configuration was downloaded and operation is ready to be used.

6.14.5. Step 5, start scratch with sample program

There is a sample program in scratch/arduinoUno/arduino.sb



The program takes the button input and controls the red LED with it.

The value from the potentiometer is used to set the pwm-rate and dim the green LED.

6.14.6. Constraints

The adc-channel needs to be limited to 10Hz updates. There is averaging for three samples per value transmitted. Without a limit to 10Hz, a noisy input could flood the communication line with data and cause excessive cpu usage on a raspberry pi.

The adc-channels on Port A allow for analog inputs, digital inputs or for digital output.

PWM pulses are created with analog_write on the digital pins. According to the arduino reference, analogWrite() works on pins 3, 5, 6, 9, 10, and 11. Input values for pwm are 0..255.

Servo pulses are created with Servo-library. See limitations of this library in Arduino Servo [https://www.arduino.cc/en/reference/servo] . Input values for servo are 0..180.

Current implementation is experimental or a 'proof of concept'. Configuration is not persisted in the arduino; there is no interface for custom logic (for fast sensors).

Configuration is requested to be sent from RaspberryPi or windows to arduino on reset of arduino. If scratchClient configuration is changing, then a reset on arduino is needed to make this active. As in most cases a hardware change is made with arduino disconnected from power (either USB cable or power plug), this is only a small limitation.

One of the advantages is that e.g. windows scratch 1.4 with scratchClient on windows allows for IO connections.

6.14.7. Advanced Features

The communication between arduino and host computer on the serial file is in a human readable protocol.

Configure arduino IDE serial console to 115200Bd, 8N1, newline (LF, 0x0a) to use the low level interface for the arduino.

On reset, the arduino starts to request for configuration

```
arduino sending@115200 Bd
arduinoUno, version 2016-11-13
config?
config?
config?
```

Available commands are reported by sending 'help' to the arduino.

```
arduino requests configuration with 'config?' on reset

configuration commands start with 'c'
 cdebug:<data> debug settings, data are hex (0,1,2,3)
 cr: dummy request, just get a newline and clean buffer
 cversion? request version string
 cerr?     request error count for parser
 cident?   request idcode
 cident:<char16> write idcode

 cdin:<data> digital inputs, data are hex
 cdinp:<data> digital inputs, pullup enabled, data are hex
```

```
 cdout:<data> digital outputs, data are hex
 cdpwm:<data> digital pwm, data are hex
 cdservo:<data> digital servo, data are hex
 caain:<data> analog line, data are hex [a0..a5]
 cadin:<data> analog line, digital input [a0..a5]
 cadinp:<data> analog line, digital input, pullup [a0..a5]
 cadout:<data> analog line, digital output
data give bit patterns for IO pins, Bits 1,2,3... are used

Commands to set values in arduino
 o:<port>,<value>     write output, shortcut
 p:<port>,<value>     write pwm, shortcut
 s:<port>,<value>     write servo, shortcut

Values reported from arduino to host
 v:<version>       arduino reports version
 ident:<char16>    arduino reports ident from EEPROM
 e:<errors>        arduino reports number of errors (decimal)
 a:<port>,<value>  arduino reports analog input
 i:<port>,<value>  arduino reports digital input
 ai:<port>,<value> arduino reports digital input
```

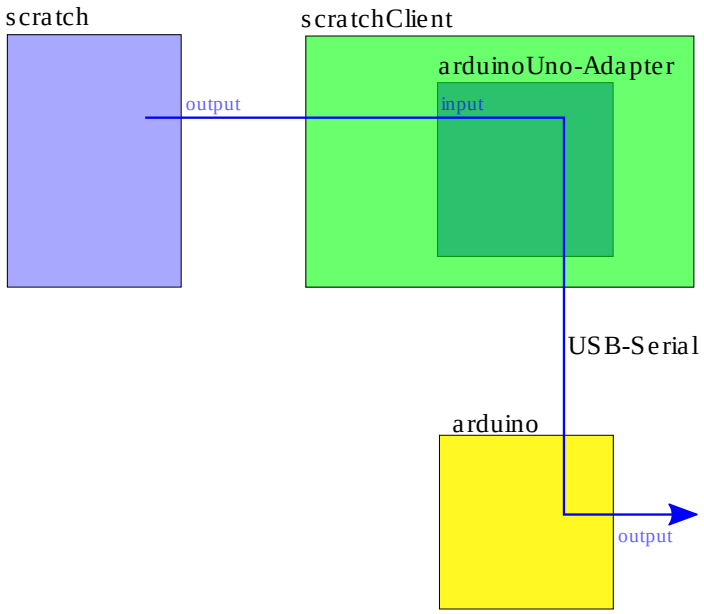
It is possible to flash an ident code to the arduino using eeprom. This ident code can be requested from host; this allows to provide dedicated configuration for special devices. E.g. in a school setup, some arduino could be attached to special equipment and the host computer could provide only the matching configuration. This reduces the risk of configuration errors.

The debug settings are not for productive use. If set, then reset the processor for a clean restart.

6.14.8. Configuration Remarks

The input/output relations of the various components involved need some explanation.

When scratch writes to an output of arduino, the data flow is



From scratch point of view, data are send to an output.

For scratchClient adapters, the data are received on an input. The arduinoUNO adapter sends these data to arduino.

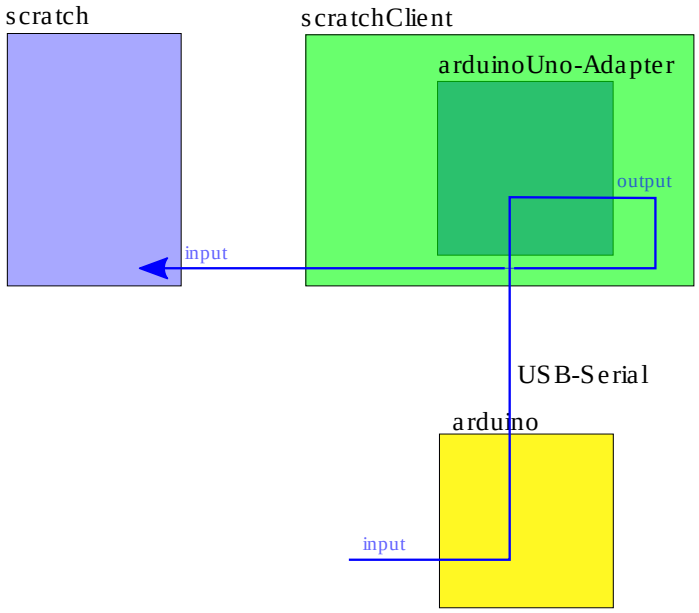
For the arduino, the data are then written to an output (digital io, pwm, servo).

A config file for this scenario is (reduced to the bare minimum)

```
    <!-- an output on arduino is an input on adapter ! -->

    <adapter class='adapter.arduino.UNO_Adapter' name='UNO'>

        <input_value name='inputD4'>
```

```
        <variable name='redLED' />
    </input_value>

    <io id='D4' dir='out' />

</adapter>
```

When arduino transmits an input value from a digital line or adc value, the data flow is



For the arduino, the data are read from an input (digital io, adc).

The scratchClient adapter gets a notification through the USB serial line and sends these data through one of its outputs.

From scratch point of view, data are an input value, either a sensor value or a broadcast.

A config file for this scenario is (reduced to the bare minimum)

```
<!-- an input on arduino is an output on adapter ! -->
<adapter class='adapter.arduino.UNO_Adapter' name='UNO'>

    <output_value name='outputA0'>
        <sensor name='potentiometer_0' />
    </output_value>

    <analog id='A0' dir='analog_in'  />

</adapter>
```

6.15. Arduino UNO Adapter for Neopixel

Neopixel use WS2812-chip wich contain driver logic and RGB LED. There is only one wire needed to control the chip. As timing is critical, there is no possibility to contro this directly by raspberry pi. With the help of an arduino (328, uno, nano or alike) and 'adafruit neopixel' library, it is possible to control these.

Arduino UNO has an USB connection, which supports serial connection to a host computer. There is a sketch needed for these mirocontrollers, see `scratchClient/arduino/arduinoNeopixel/arduinoNeopixel.ino`

With the USB-connection, the UNO provides 5V-compatible inputs/outputs. This is an advantage in some constellations. But do not connect these outputs to Raspberry Pi inputs directly.

In the sketch, adjust the RGB alignment, speed and number of chips and recompile.

```
// -----------------------------------------
// Adjust for your neopixel array

#define PIN 7
```

```
#define NUM_LEDS 144
#define BRIGHTNESS 50

Adafruit_NeoPixel strip = Adafruit_NeoPixel(NUM_LEDS, PIN, NEO_GRB + NEO_KHZ800);
// ----------------------------------------
```

Communication from arduino to host is done by using USB serial with 115200bd.

Commands are ascii readable. Type 'help' in serial console to see options.

```
all red  : red
all green: green
all blue : blue
set pixel: s,NNN,RRR,GGG,BBB in dezimals e.g. s,029,000,000,255
show     : show

clear    : clear
help     : help
echo     : echo
```

The 'all red', 'all green', 'all blue' commands set all LED to respective values. This is used to check RGB alignment.

Set pixel sets a single pixel. A 'show'-command is needed to activate the settings.

Show 'show' displays pixel values.

Clear immediately clears all pixels.

Echo is used to validate connection to arduino.

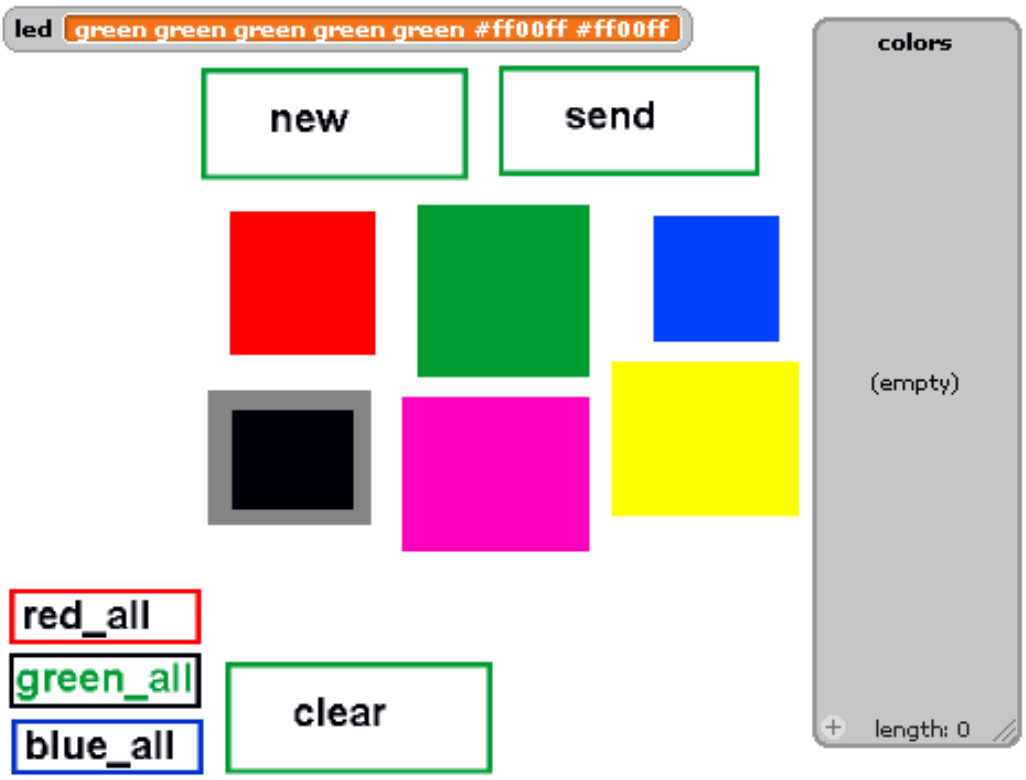
All commands are terminated by \n (LF). When a command is executed, the command string is echoed back. Commands can be max 64 chars, extra trailing chars are silently ignored.

6.15.1. start scratchClient with configuration

```
cd ~/scratchClient
python src/scratchClient -c scratch/neopixel/neopixel.xml
```

6.15.2. start scratch with sample program

There is a sample program in scratchClient/scratch/neopixel/neopixel.sb



The scratch program maintains an array with color values. 'new' clears the list, 'send' sends to arduino. The colored rectangles add descriptive names to the list (or hex rgb values like #ff00ff).

The red_all etc commands and the clear button are used to debug the connection and arduino code.

6.16. Arduino UNO_POWERFUNCTIONS_Adapter

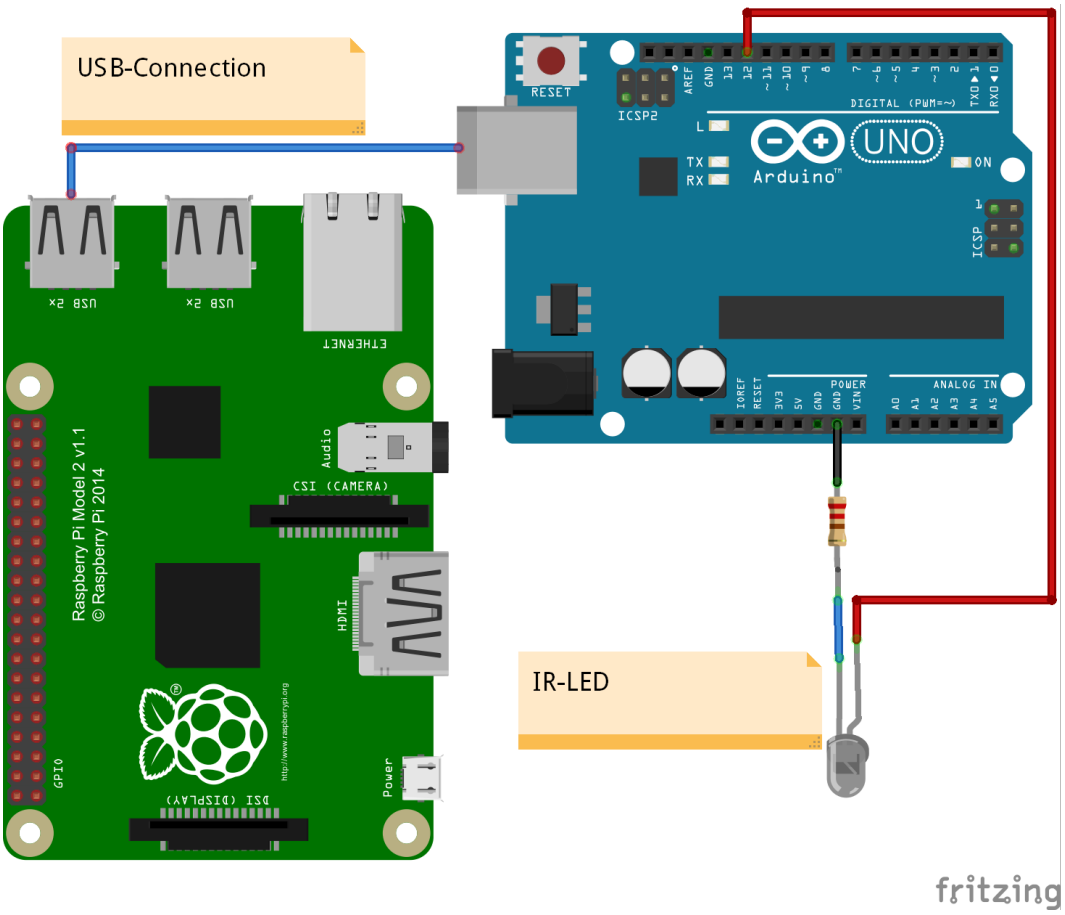
LEGO powerfunctions provide an infrared controlled receiver with the possibility to connect to motors, lights and others. With an IR-LED connected to an arduino which is connected to a RPi which is connected (or hosting) scratch), it is possible to control these receivers with scratch.

Arduino UNO has an USB connection, which supports serial connection to a host computer.

The adapter and arduino sketch will also work with arduino nano, atmel328 processor.

With the USB-connection, the UNO provides 5V-compatible inputs/outputs. This is an advantage in some constellations. But do not connect these outputs to Raspberry Pi inputs directly.

An IR-LED (940nm wavelength) is needed, a resistor 220 Ohm limits current. This allows for short distance connections.



With a transistor like 2n2222 and a base resistor of 680Ohm, the power on the LED can be increased.

The scratch names used are configurable in configuration files. See the config file config/config_arduino_powerfunctions.xml

The arduino code for arduino IDE and configuration needed for scratchClient is in the scratchClient distribution.

6.16.1. Step 1, program the firmware to arduino UNO

Start arduino software, load arduino/power_functions/power_functions.ino and program it into the UNO.

6.16.2. Step 2, Hardware setup.

Connect LED to Arduino

See the plan included above. This connection allows for currents up to 20mA. Most IR-LED support higher currents, but then a transistor is needed to drive the LED.

6.16.3. Step 3, connect arduino with USB-Line to RaspberryPi or windows computer.

On raspberry, lookup /dev/tty* connections and configure the UNO serial device in config/config_arduino_powerfunctions.xml-File.

For windows, you see the COMn-Device used in deviceManager.

6.16.4. Step 4, start scratchClient with configuration

```
cd ~/scratchClient
python src/scratchClient -c config/config_arduino_powerfunctions.xml
```

6.16.5. Step 5, start scratch and create scratch Program

There is a sample program in scratch/arduinoUno/lego_powerfunctions.sb

The variables are connected to different channels, A and B are the two channels available on the LEGO receiver

The program takes the button input and controls the red LED with it.

The value from the potentiometer is used to set the pwm-rate and dim the green LED.

6.16.6. Constraints

Thee software can send signals for Channel1 to Channel 4. You need to adjust the receiver to the channel used.

6.17. Twitter_Adapter

Twitter has an API which can be used by scratchClient. The adapter browses twitter for direct messages or by a hashtag and forwards these results to scratch.

Install python-twitter in python environment "sudo pip install python-twitter".

You need to obtain 'key' and 'secret' from twitter to access the API. Edit config/config_twitter.xml and insert values there.

Polling rate for twitter can be adjusted, but twitter.com imposes a rate limit. 60 sec are a good starting point.

It is configurable whether the adapter retrieves user message or searches messages for a term or both.

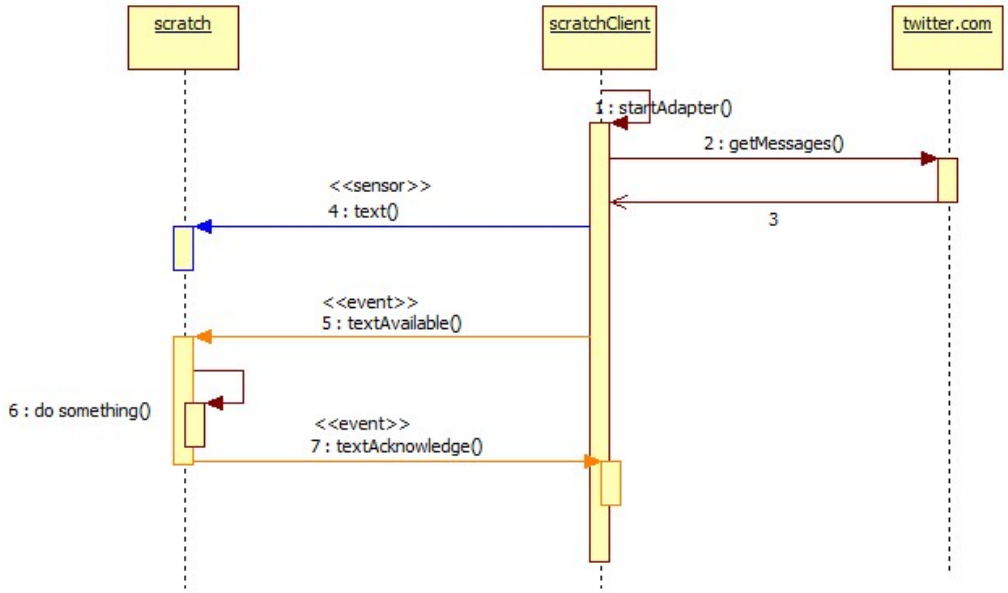
A properties file written by the adapter allows to retrieve only new messages. The messageId of last message read is persisted in this file. The file is in data folder, filename is configurable in config file.

Start scratchClient

```
cd ~/scratchClient
python src/scratchClient -c config/config_twitter.xml
```

A scratch sample is in scratch/twitter/twitter.sb

Messages from twitter can arrive at a faster rate than scratch can process, or messages can be identical, which makes them indistinguishable for scratch. To handle this situation a protocol is implemented between the twitter adapter and scratch: all messages are queued inside the adapter. For each message, the text is places in a sensor variable 'text' and a 'textAvailable' event is published. When scratch receives this event, it processes the data and answeres with a 'textAcknowledge' event.



6.18. Openweathermap_Adapter

Openweathermap has an API which can be used by scratchClient. The adapter browses the api for weather data.

Install python module 'pyowm' in python environment "sudo pip install pyowm".

You need to obtain an API 'key' from http://openweathermap.org/appid to access the API. Edit config/config_openweatherapi.xml and insert values there.

Polling rate for openweathermap can be adjusted, but depending on key type there is a rate limit. 600 sec are a good starting point.

Start scratchClient

```
cd ~/scratchClient
python src/scratchClient -c config/config_openweatherapi.xml
```

6.19. LEGO WeDo 2.0 Adapter

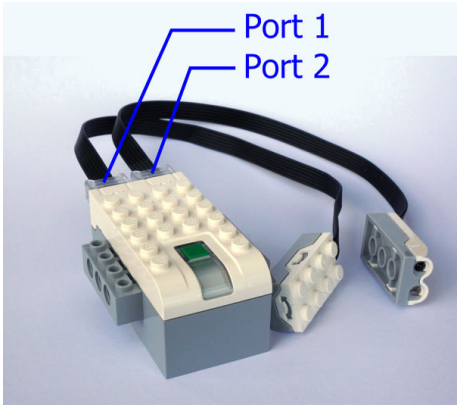
LEGO education offers a concept for primary schools which consists of hardware, software and educational patterns. The electronics part are

- 'Wedo 2.0 Smarthub', connected by Bluetooth Low Energy to a computer. Will be named 'hub' in this chapter.
- 'Wedo 2.0 Tilt Sensor', will be named 'tilt sensor' here.
- 'Wedo 2.0 Motion Sensor', will be named 'motion sensor' here.
- 'Wedo 2.0 Medium Motor', will be named 'motor' here.

It is important to name the devices with the WeDo 2.0 prefix, as the connector style is different from connectors used for other Lego products.

The hub offers two connectors, where the sensors or motors can be connected.

The hub connections are named as shown. This is important in 'advanced' setup.



Lego wedo2 port names.

The software offered by Lego is an easy to use 'scratch style' IDE. The command set is very limited, appropriate to primary school. There is a 'while' block, but no decisions.

With the software, it is possible to use the sensors in their default mode.

There is a SDK available from Lego, which demonstrates the more advanced features of the hub and the sensors. Based on the SDK, the integration into scratchClient was developed.

6.19.1. Hub features

- Button. Used to start the bluetooth connection sequence.

  During operation it acts as a push button which can be used by host software.

- RGB LED. Used as status feedback. White flashing during bluetooth connection, blue when connected. Orange flashing in case of high current when a motor is blocked.

  The scratchClient software - when connected - initiates a short red-green-blue animation and changes the color then to green.

  The colors can be set by host software.

- Piezo. Used as status feedback. Initiates some beeps while connecting.

  Piezo can be used to play tones.

- Voltage. Measures battery voltage.

  The values in millivolts are available to host. Can not be set, of course.

- Current. Measures current from the battery.

  The values in milliamperes are available to host. Usual values are around 80 to 90 mA, some 100 mA higher when a motor is used.

- Low Voltage Alert.

- High Current Alert.

The hub also controls the connect/ disconnect of motors and sensors reports this to the host. The host can set operation mode for the devices. The hub can use notifications to report value changes.

6.19.2. Motor Features

There can be one or two motors connected to the hub. With WeDo software, these are operated 'in parallel', there is no possibility to address them separately.

The hub internally allows to address the motors based on the port to wich these are connected. scratchClient allows to operate two motors separately.

Motor can be powered by values [1..100] forward, [-1..-100] reverse. Value [0] is drift mode. A special value [127] is used for brake mode. The scratchClient adapter uses broadcast events for drift and brake.

6.19.3. Motion sensor Features

Motion sensor offers two operation modes.

- Mode 0, DETECT: Distance measurement. Values are from 0..9 for very near to very far which is prox 20cm.

  The mode 0 is set as default.

- Mode 1, COUNT: Counts the number of 'beam brake events'. Can be used to count parts passing by. Values are from 0..100. Counter can be reset by a broadcast event.

6.19.4. Tilt Sensor Features

Tilt sensor offers three operation modes.

- Mode 0, ANGLE: Gives two angle measurements in degrees -45.0 to +45.0.
- Mode 1, TILT: Similiar to ANGLE, but value is restricted to tilt directions. This provides '0' for no tilt, and '3', '5', '7', '9' for each direction.

  The mode 1 is set as default.

- Mode 2, CRASH: Counts the number of crash events. This gives the number of bumps in x, y and z-direction. There is a reset signal available for the counter.

6.19.5. Installation

The adapter was devloped and tested on a Raspberry Pi 3 which provides a bluetooth 4 device. The software to operate is already included in raspbian. No special setup procedures have been needed to configure bluetooth.

The scratchClient adapter needs additional software to run. This is the python module needed for the bluetooth stack.

Install python module 'bluepy' for python environment.

```
sudo pip install bluepy
```

Do not automatically connect the hub with bluetooth. The scratchClient adapter will not be able to connect when other connections are already established.

6.19.6. Connection Options

The bluetooth connection can be build based on the MAC-address of the hub, or based on the device name.

For the connection based on MAC-address, edit the config file as follows:

```
<!-- discover option by 'address' -->
<parameter name='btle.policy' value='address' />
<parameter name='btle.address' value='a0:e6:f8:6d:0e:67' />
```

Use this setup when there are many hubs around and one dedicated device needs to be connected.

For the connection based on device name, edit the config file as follows:

```
<!-- discover option, by 'name' (needs root permission) -->

<parameter name='btle.policy' value='name' />
<parameter name='btle.name' value='LPF2 Smart Hub 2 I/O' />
```

Use this setup when only one hub is around, or the configuration effort is too high. Root peromission is needed to start scratchClient in this case. With many devices, the scratchClient adapter will connect with the first device found.

6.19.7. Connection Sequence

Start scratchClient.

Start scratch and establish 'remote sensor connection'.

Press the green button on the wedo2 hub. The LED will blink and there is an audible beep from the device. When connection is established, the LED turns to blue. After prox 3 to 5 seconds, the LED runs a short sequence red,green,blue and finally the LED remains green.

The connection is established.

6.19.8. Basic setup

With lego wedo2 education software, a subset of the hub's features can be used. It is assumed, that only one motor or only one sensor of a type are connected. It is not important on which connector the devices are plugged in.

Motion-Sensor mode is 'distance'. Values provided are '0.0' for very close and '9.0' for 'very far away.'

Tilt-Sensor mode is 'tilt'.

To operate the hub in this mode, a 'basic' setup configuration is provided `config/config_wedo2_basic.xml` .

This basic configuration is a subset of the available options of the adapter.

In the configuration, the 'strict' parameter is set to 'false'. This ignores the position of a connected sensor/actor.

```
<parameter name='mode.strict' value='false' />
```

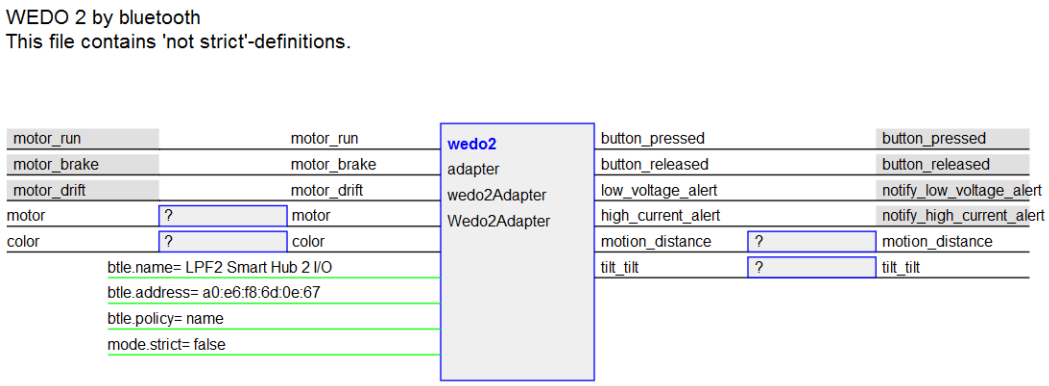
Typically, a motor is adressed by 'motor'.

When two motors are connected, these will operate in parallel. But two sensors of one type will produce wrong data.

Start scratchClient in basic mode.

```
cd ~/scratchClient
 sudo python src/scratchClient.py -c config_wedo2_basic
```

The scratchClient monitoring gives a graphical view of the inputs and outputs of an adapter configuration.



Lego wedo2 adapter connections in basic mode.

The mode set values are removed from this config file. Piezo commands are not used. Voltage, current values are removed. This configuration is close to the scenario used in WeDo software.

6.19.9. Advanced setup

In advanced operation mode it is possible to handle the connected motor or sensors individually. Two motors can be controlled separately, or two same sensors can be read.

To operate the hub in this mode, an 'advanced' setup configuration is provided `config/config_wedo2_advanced.xml` .

This advanced configuration is a subset of the available options of the adapter.

The motor and sensor values have names with the port indicator '1', '2' included. For example the motion sensor values are named 'motion1_distance', 'motion2_distance'.

For the sensors, the values used are depending on the mode set. For the motion sensor, there is a 'motion1_distance' and a 'motion1_count' sensor value. When mode is changed, the last value reported in other sensor variables is not reset or changed.

In the configuration, the 'strict' parameter is set to 'true'. This allows to address sensor/actor by port position.

```
<parameter name='mode.strict' value='false' />
```

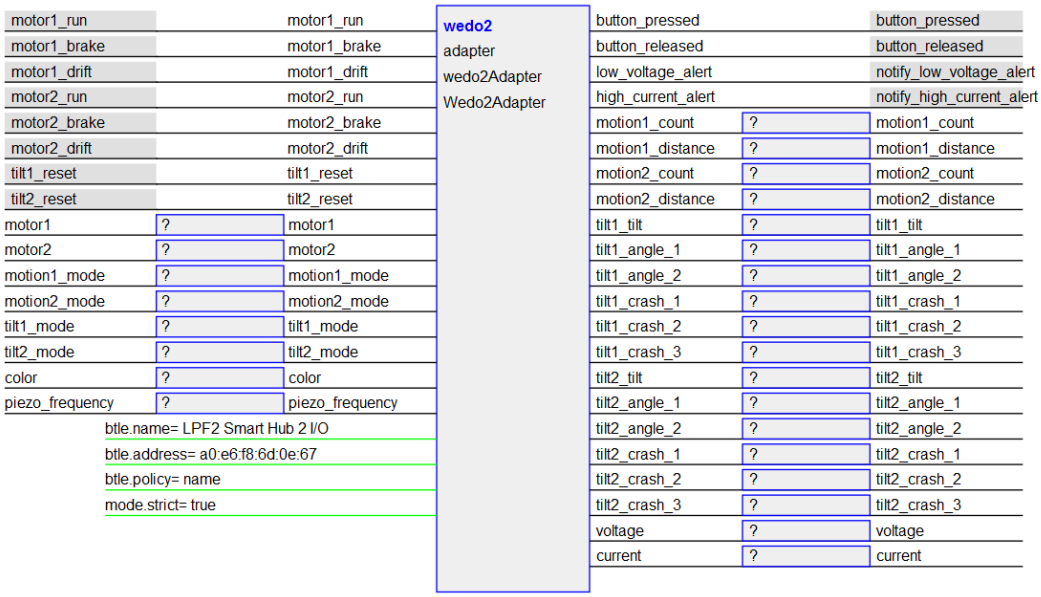
Typically, a motor is adressed by 'motor1' or 'motor2'.

Start scratchClient in advanced mode.

```
cd ~/scratchClient
 sudo python src/scratchClient.py -c config_wedo2_advanced
```

The scratchClient monitoring gives a graphical view of the inputs and outputs of an adapter configuration.

WEDO 2 by bluetooth
This file contains 'strict'-definitions.



Lego wedo2 adapter connections in advanced mode.

6.19.10. Complete setup

A full blown config file with all options is available. The main purpose is for test and development.

To operate the hub in this mode, an 'complete' setup is provided `config/config_wedo2_complete.xml` .

In the configuration, the 'strict' parameter is set to 'true'. This allows to address sensor/actor by port position.

```
<parameter name='mode.strict' value='true' />
```

Start scratchClient in complete mode.

```
cd ~/scratchClient
 sudo python src/scratchClient.py -c config_wedo2_complete
```

The scratchClient monitoring gives a graphical view of the inputs and outputs of an adapter configuration.

WEDO 2 by bluetooth
This file contains both 'strict' and 'not strict'-definitions.

motor_brake		motor_run	wedo2	button_pressed		button_pressed
motor_brake		motor_brake	adapter	button_released		button_released
motor_drift		motor_drift	wedo2Adapter	low_voltage_alert		notify_low_voltage_alert
motor1_run		motor1_run	Wedo2Adapter	high_current_alert		notify_high_current_alert
motor1_brake		motor1_brake		motion_count	?	motion_count
motor1_drift		motor1_drift		motion_distance	?	motion_distance
motor2_run		motor2_run		motion1_count	?	motion1_count
motor2_brake		motor2_brake		motion1_distance	?	motion1_distance
motor2_drift		motor2_drift		motion2_count	24	motion2_count
motion_reset		motion_reset		motion2_distance	2.0	motion2_distance
motion1_reset		motion1_reset		tilt_tilt	?	tilt_tilt
motion2_reset		motion2_reset		tilt_angle_1	?	tilt_angle_1
tilt_reset		tilt_reset		tilt_angle_2	?	tilt_angle_2
tilt1_reset		tilt1_reset		tilt_crash_1	?	tilt_crash_1
tilt2_reset		tilt2_reset		tilt_crash_2	?	tilt_crash_2
motor	74	motor		tilt_crash_3	?	tilt_crash_3
motor1	-1	motor1		tilt1_tilt	9	tilt1_tilt
motor2	-39	motor2		tilt1_angle_1	-4.0	tilt1_angle_1
motion_mode	0	motion_mode		tilt1_angle_2	15.0	tilt1_angle_2
motion1_mode	0	motion1_mode		tilt1_crash_1	17	tilt1_crash_1
motion2_mode	0	motion2_mode		tilt1_crash_2	4	tilt1_crash_2
tilt_mode	?	tilt_mode		tilt1_crash_3	11	tilt1_crash_3
tilt1_mode	2	tilt1_mode		tilt2_tilt	?	tilt2_tilt
tilt2_mode	?	tilt2_mode		tilt2_angle_1	?	tilt2_angle_1
color	#5a6ebe	color		tilt2_angle_2	?	tilt2_angle_2
btle.name= LPF2 Smart Hub 2 I/O				tilt2_crash_1	?	tilt2_crash_1
btle.address= a0:e6:f8:6d:0e:67				tilt2_crash_2	?	tilt2_crash_2
btle.policy= name				tilt2_crash_3	?	tilt2_crash_3
mode.strict= true				voltage	?	voltage
				current	?	current

Lego wedo2 adapter connections in complete mode.

6.19.11. Sample scratch Program

A sample scratch program is provided in `scratch/wedo2/wedo2_sample.sb` .

Use the 'green flag' to start the program.

This scratch program can be used with basic, advanced or full configuration files.

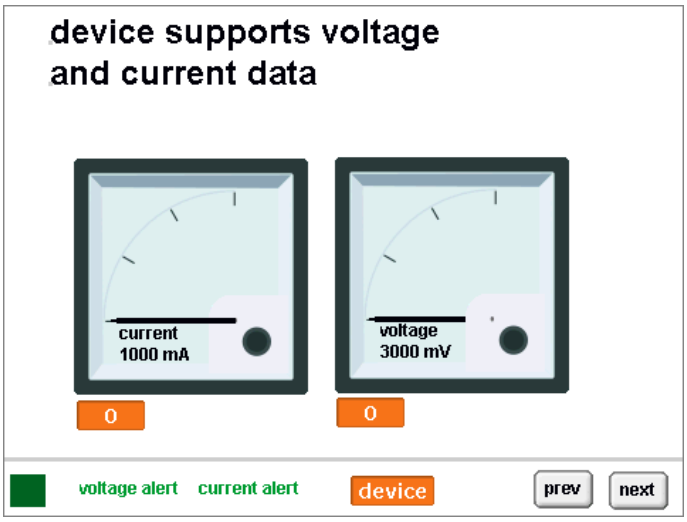
Sample scratch program, start screen.

In the status line, the green sprite displays the button press events.

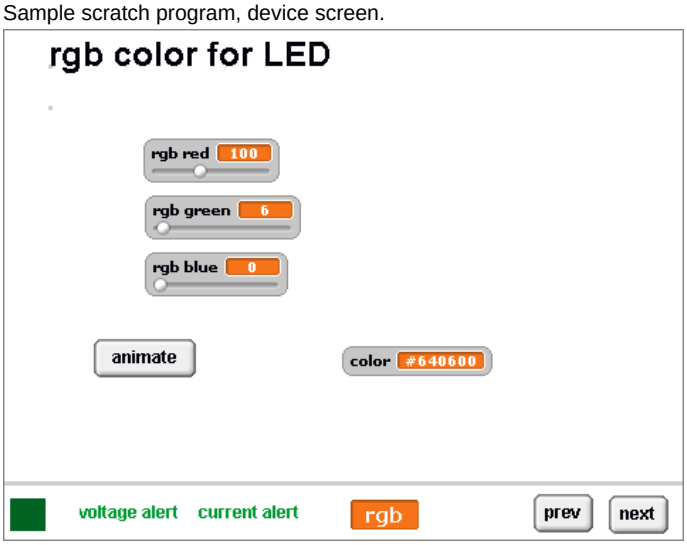
Alerts for voltage or current should be green. When alerts arrive, these turn to red and change to orange 5 secs later.

The current screen name is displayed.

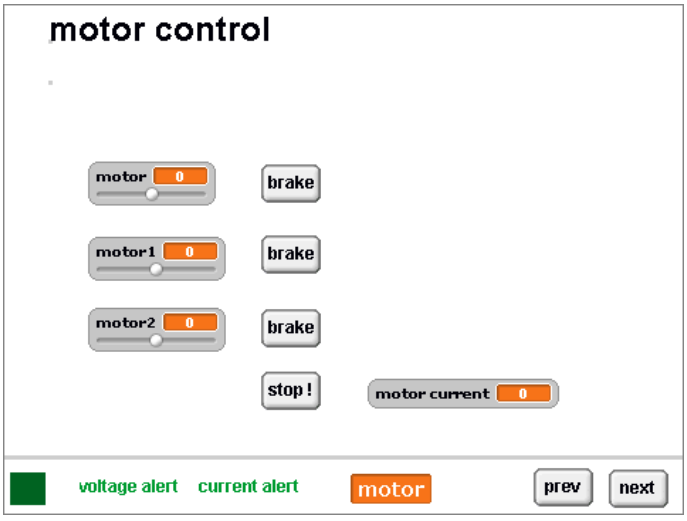
The previous and next-Buttons are used to navigate to the other screens.



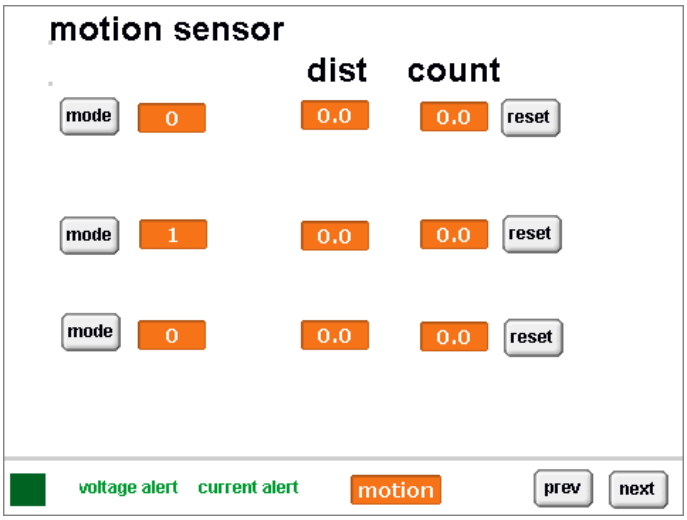
Sample scratch program, device screen.



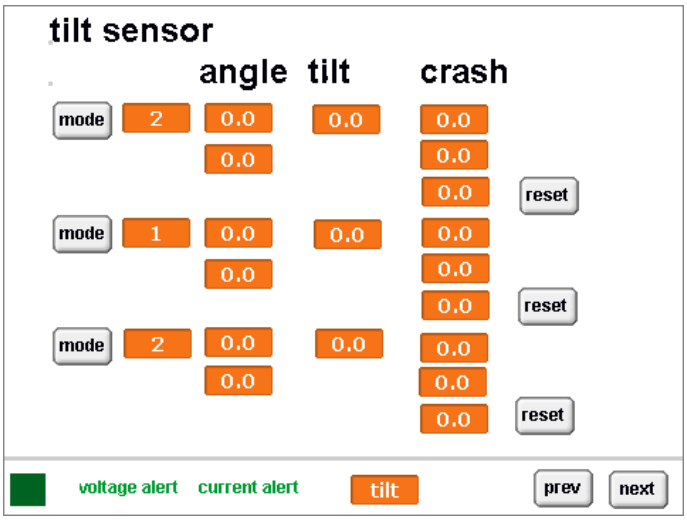
Sample scratch program, rgb screen.



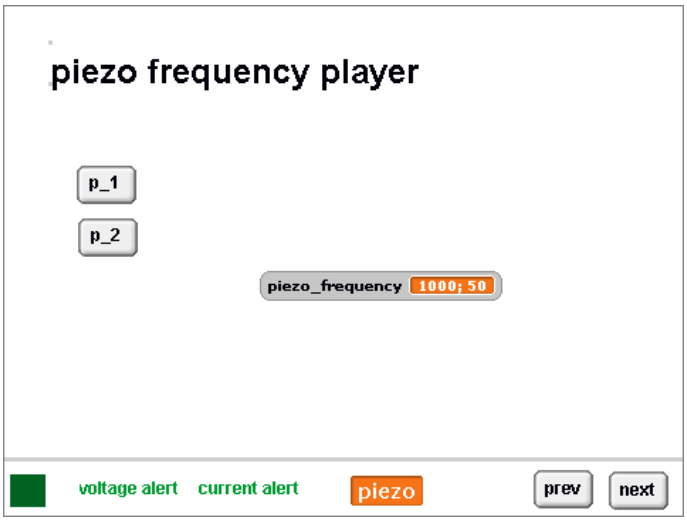
Sample scratch program, motor screen.



Sample scratch program, motion screen.



Sample scratch program, tilt screen.



Sample scratch program, piezo screen.

6.20. Adapters using pigpiod-Daemon

6.20.1. Ultrasonic Distance Sensor HC-SR04 by pigpiod-Daemon

HC-SR04 is a quite inexpensive ultrasonic distance sensor. The pulse output can be measured using pigpio daemon and python library.

The device needs a trigger connection and an echo connection. As the operating voltage for the device is 5V, there is the need for voltage adjustment for the echo line. Use a voltage divider or level shifter.

The GPIO pins used are configured in the config file. Any pins can be used.

Multiple sensors can be configured.

Installation

The python library for pigpio access needs to be installed.

```
sudo apt-get install python-pigpio
```

The daemon code is available in raspbian (2016-08-19).

Start Daemon

The daemon can be started by raspi-config. Or start by

```
sudo pigpiod
```

A basic configuration is is `config/config_hcsr04_pigpiod.xml` .

Start scratchClient.

```
cd ~/scratchClient
python src/scratchClient.py -c config_hcsr04_pigpiod
```

The values transferred to scratch are 'time' in seconds. To calculate the distance use the formula

distance [cm] = time [s] * 340 [m/s] / 2 * 100 [cm /m])

The speed of sound in air is assumed to be 340 [m/s], which changes with temperature.

Chapter 7. GUI, Web Interface for Monitoring

There is a web based user interface for the tool. By default, the scratchClient opens the port only for local connections. When remote access is needed, this needs to be enabled by command line switch 'guiRemote'.

The url in browser is for local access http://localhost:8080

For remote access, you need to have the hostname in the network, or the ip-address of the machine. http://[hostname]:8080

7.1. GUI Functions

The functionality is

- show config file
- display graphical view of adapters
- monitor events
- trigger events
- set values

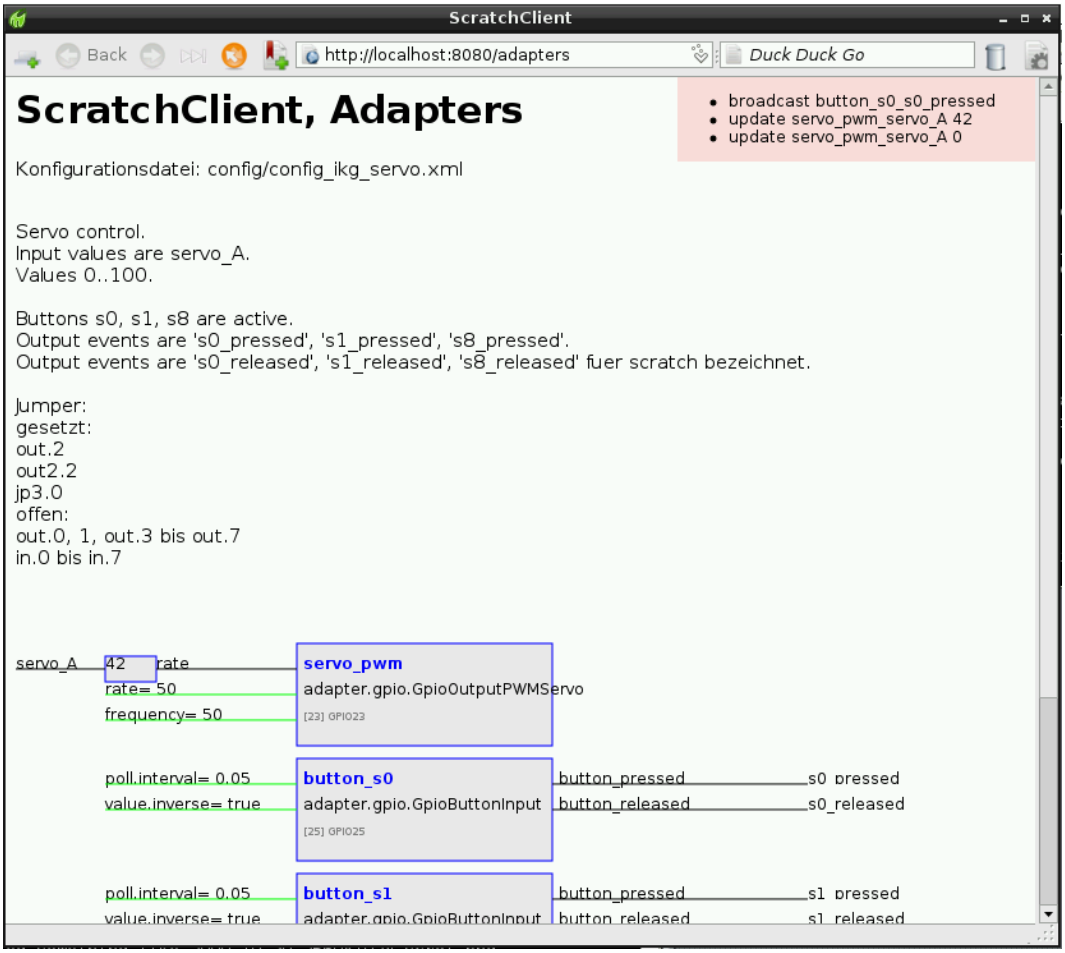
7.1.1. Monitoring, Controlling

The adapter view receives updates from scratchClient. When broadcasts arrive, the connectors are highlighted. Values change are displayed. Most current events are listed on screen in a text list.

Broadcasts (input or output) can be stimulated by clicking to the connectors. Input broadcasts are sent to the adapter, output broadcasts are sent to scratch.

Values can be edited and send. Click on the connector, an input box will open and values are sent when enter key is pressed.

Input values are sent to the adapter, output values are sent to scratch. The web interface is build based on configuration.



The sample screen shot shows a servo adapter and two button adapters. 'servo_A' is a value sent from scratch to the adapter. Double click in this name opens an editor window for the value. 's0_pressed' is a broadcast sent from the button-adapter to scratch. Double clicking this name sends the broadcast to scratch.

7.2. Compatibility

The interface was verified to work with Midori, Firefox and Chrome.

Chapter 8. Installation, Operation

8.1. Quick Installation

The following installation procedure is for the impatient people. Open a terminal and execute the following lines.

```
cd ~
wget http://heppg.de/ikg/administration/pi/scratchClient/download/scratchClient.tar.gz
tar xzf scratchClient.tar.gz
chmod +r -R scratchClient/

sudo apt-get update
sudo apt-get install python-pip python-dev
sudo pip install cherrypy routes mako ws4py spidev
```

The install steps are explained in more detail in the following sections.

8.2. Step by Step Installation

The following sections guide through the installation steps.

8.2.1. Base Packages Installation

There are a few operating system packages and a few python modules needed.

When installing new packages, it is generally a good idea to have current versions of the packages available. For this, the 'apt-get update' is used.

```
sudo apt-get update
sudo apt-get install python-pip python-dev
sudo pip install cherrypy routes mako ws4py spidev
```

If you want to use python3, then the following additional commannds are needed

```
sudo apt-get install python3-pip python3-dev
sudo pip3 install cherrypy routes mako ws4py spidev
```

8.2.2. ScratchClient Software Installation

scratchClient is a python program and requires no special compile step. The files are unpacked to a local directory.

The chmod command ensures that the files are readable also for other users.

On the download page, there are usually some version hints. download page [http://heppg.de/ikg/wordpress/?page_id=6]

The files are downloaded to user home directory, usually /home/pi.

```
cd ~
wget http://heppg.de/ikg/administration/pi/scratchClient/download/scratchClient.tar.gz
tar xzf scratchClient.tar.gz
chmod +r -R scratchClient/
```

Verification of installation.

You should have /home/pi/scratchClient/src/scratchClient.py and other files.

Start scratchClient

```
cd ~/scratchClient
python src/scratchClient.py -h
```

Expected output is a list of command line options.

8.2.3. SPI install

Some devices are connected by SPI. When such devices are needed, SPI drivers are needed.

On raspberryPi, you can enable SPI by using raspi-config.

```
sudo raspi-config
```

To install it manually, edit raspi-blacklist

```
sudo leafpad /etc/modprobe.d/raspi-blacklist.conf
```

The following entry must be available:

```
#blacklist spi-bcm2708
```

Delete all other lines which contain spi-bcm2708

Reboot recommended.

Validation

Validate installed drivers. 'lsmod' lists installed drivers.

```
lsmod | grep -e spi_bcm2708
```

8.2.4. I2C install

For using I2C, additional software needs to be installed.

```
sudo apt-get install python-smbus
```

On raspberryPi, you can enable I2C by using raspi-config.

```
sudo raspi-config
```

In addition to this driver, there is i2c-dev needed. Starting this manually is

```
sudo modprobe i2c-dev
```

To manually enable the I2C-Driver: edit raspi-blacklist

```
sudo leafpad /etc/modprobe.d/raspi-blacklist.conf
```

The following entry must be available, or no entry at all:

```
#blacklist i2c-bcm2708
```

Delete all other lines which contain i2c-bcm2708

In /etc/modules , add a line with i2c-dev. This makes i2c-dev permanent.

Reboot recommended.

Validation Validate installed drivers. 'lsmod' lists installed drivers.

```
lsmod | grep -e i2c
```

Result should contain

```
i2c_dev                 6709  2
i2c_bcm2708             6200  0
```

In folder /dev, there is a directory /dev/i2c-1 available.

It is recommended to install

```
sudo apt-get install i2c-tools
```

In these tools, i2cdetect helps to find out connected devices with their adress.

8.2.5. Text to speech install

When using the text to speech adapter 'festival', the package 'festival' is needed.

```
sudo apt-get install festival
```

When using the text to speech adapter 'pico2wave', the package 'pico2wave' is needed.

```
sudo apt-get install libttspico-utils
```

8.2.6. DMA library support (RPIO2)

For DMA based adapters, a DMA-library is needed. In scratchClient releases prior to 2016-01-02, the RPIO.PWM-library was used. As this RPIO.PWM-library did not support Raspberry Pi2 or Pi2, a local patch 'RPIO2.PWM' was created.

This RPIO2.PWM library needs additional installation

```
cd ~/scratchClient/RPIO2
sudo sh install.sh
```

8.3. Start scratchClient

In scratch, enable the 'remote network connection'. This is needed once for a project; this setting is persisted in the project file. Start with (user pi)

```
cd ~/scratchClient
sudo python src/scratchClient.py -config [config_file_name.xml]
```

For gpio access, SPI, I2C-adapters, it is usually required to run the program with root permissions. Some adapters run with 'normal' permissions, e.g. the text-to-speech adapter, websocket adapters or alike.

scratch needs to be started separately. Create a shell script if you need both programs scratchClient and scratch to be started with one command.

The code generates a 'scratchClient.pid'-File, which may remain in base directory. There for, start up in a dedicated home directory (~/scratchClient) is recommended.

On one machine, the process may only be started once. If the process starts up, but quits after some 30 to 60 sec, then possibly another instance is running.

Use command line '-h' to see options.

```
cd ~/scratchClient
 python src/scratchClient.py -h

-host <ip>           Scratch Host ip or hostname, default 127.0.0.1
-port <number>       Port number, default 42001

-c <configfile>
-config <configfile> Name of config xml-file, default config.xml
                     There is a lookup strategy used (add xml extension when needed,
                     literal, then config/, ../config; then add 'config_' to
                     filename and then literal, config/, ../config

-C <configfile>      Name of config xml-file, default config.xml
                     There is NO lookup strategy used, only literal.

-gpioLib             set the gpiolibrary, default 'RPi_GPIO_GPIOManager'
                     deprecated, will be ignored.

web gui switches

-nogui               do not show GUI
-guiRemote           allows remote access to GUI web page,
                     default is local access only

debug and test switches

-forceActive         force active mode, even if GPIO library is
                     not available.
-validate            Validate config and terminate.

-h
-help                print command line usage and exit
-v                   verbose logging
-d                   debug logging
-license             print license and exit.
```

```
-changes            print changes list
```

Most of the commands are quite self-explaining. If you want to see more information on screen, use verbose switch. Debugging switch shows even more, but then logging uses a lot of CPU.

config: For config file lookup, there is a lookup policy available. The first file found wins the game:

add xml extension when not available.

- check file name given literally.
- look in ./config/
- look in ../config/

add prefix 'config_' to filename if no path is given.

- check file name given literally.
- look in ./config/
- look in ../config/

With this policy, file names can be abbreviated.

host: if scratch is located on a different computer, then give the target address here.

port: generally not needed to use a different port.

nogui: does not start the web app server inside scratchClient. Less memory usage.

guiRemote: allows remote access to web gui.

validate: check the config file for correctness.

8.4. Stop scratchClient

Stop with ctrl-c in console. Takes up to a minute till all background threads quit.

If for any reason the code refuses to quit, get the processId and kill the process

```
sudo ps -ef | grep python
sudo kill -9 [processId]
```

8.5. Problems running scratchClient

Some common problems in running scratchClient are, that no sensor inputs are arriving in scratch. Check the following list for possible problems.

- is scratchClient started? It might stop running due to problems in configuration file. Check console log for details.
- is scratchClient started? It might stop running due to a previous instance leaving a scratchClient.pid-File. Delete this file.
- multiple instances of scratchClient started ? Check with `ps -ef | grep python` and stop other instances with `kill -9 <pid>`
- multiple instances of scratch ? Only one instance of scratch is allowed having the remote sensor protocol started. Stop other instances.

Scratch will read inputs from scratchClient faster than these are processed internally. The effect is that scratch is displaying old data. In this case, decrease update rates of polling sensors and work on performance of scratch code.

8.6. Scratch Autostart

When auto start for scratch is needed, there are things to execute

- start scratch into presentation mode
- enable remote connections (without user interaction)
- issue a 'green flag' event.

Starting scratch and scratchClient can be in any order. Starting does not need to be manual, but can be from init.d or other

8.6.1. Start scratch into presentation mode

Starting scratch into presentation mode can be done on RaspberryPi by adding the 'presentation' keyword to the command line.

```
scratch presentation [scriptname]
```

When starting scratch from a background process then add the X display

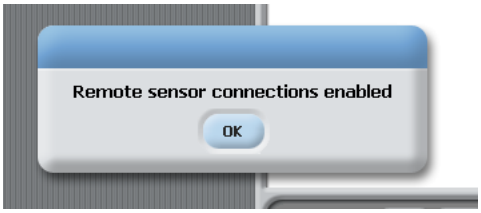
```
scratch presentation [scriptname] -display :0
```

This will be needed when you 'remote login' to a linux system.

Starting with 'presentation'-flag also issues a green-flag-event.

8.6.2. Enable remote connection (without user interaction)

When a project uses remote connection, this is stored in the project file and enabled again when project is reloaded. Unfortunately, there is some user interaction needed to enable it.



In newer scratch releases for raspberry (e.g. 2015-11-11), there is a config file setting which bypasses this dialog.

```
remoteconnectiondialog = 0
```

Look for file home/pi/.scratch.ini and add this statement. If this file is not available, just create it.

Files starting with '.' are hidden files in linux.

With filemanager, enable 'show hidden files' in order to see this file.

8.6.3. Green Flag Event

When scratch ist started from the command line with the 'presentation'-flag, then there is also a green-flag-event issued.

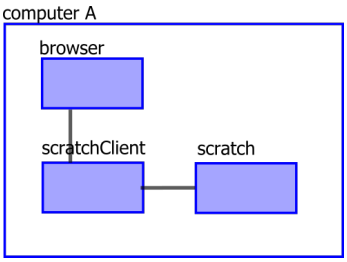
When a green flag event is needed when scratchClient is started, then use adapter.broadcast.ScratchStartclickedAdapter.

8.7. scratchClient usage scenario

ScratchClient and scratch usually run on same machine, but other scenario are possible.

8.7.1. Local setup

In general, scratchClient and scratch will run on same machine.



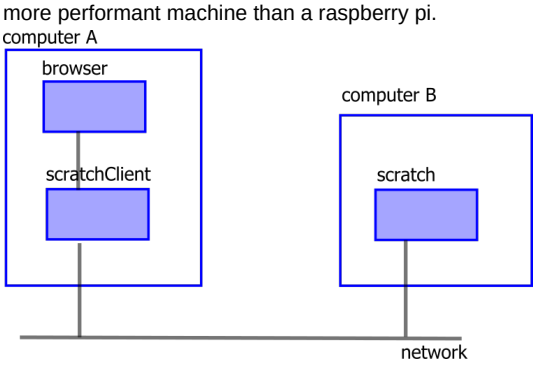
No special command line switches are needed to support this scenario.

Table 8.1. Firewall settings

Module	Port	computerA
NA	NA	NA

8.7.2. Distributed setup A

scratchClient and scratch can run on different machines. I use this scenario, when debugging scratch code on a more performant machine than a raspberry pi.



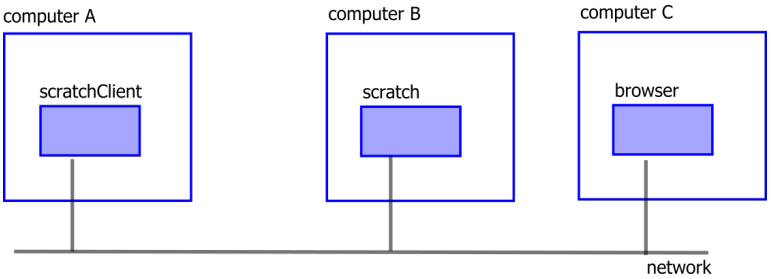
When starting scratchClient, use the '-host'-command line parameter and add the ip-address (or hostname) of the machine where scratch is located. Of course, these two machines need to be connected by a network.

Table 8.2. Firewall settings

Module	Port	computerA	computerB
scratch	42001	out	in

8.7.3. Distributed setup B

scratchClient and scratch can run on different machines. The browser used to look into the monitoring gui of scratchClient can be used from a third machine.



When starting scratchClient, use the '-host'-command line parameter and add the ip-address (or hostname) of the machine where scratch is located. Use '-guiRemote' to allow remote access for browser. Of course, these machines need to be connected by a network.

Table 8.3. Firewall settings

Module	Port	computerA	computerB	computerC
scratch	42001	out	in	
browser	8080	in		out

Chapter 9. Extending Functionality

9.1. Hacking the code

When you need a new adapter, not provided in the list. Add a new file to Directory 'adapter' named myadapter.py (choose the name according to the functionality). Place a class there named MyAdapter (again, choose your functional name). Derive it from adapter.Adapter, and place __init__ and command methods, as well as the output methods. Produce the xml-configuration for this, and give it a try. Testing new Adapters: add your adapter config to an xml-file, start the code in simulation mode with gui. If configurationManager reads the config successfully, you will be able to place commands and values to the input side, and see what happens to the simulated gpio.

Then stop and restart in real live mode. This will attach the gpios and drive whatever is attached there.

Using other gpio-driver as Rpi.GPIO

There are people using Wiring, or other python libraries to access Gpio on the pi. Copy RPiGpio.py, which is a wrapper for the RPI-GPIO, and copy to a 'MyGPio.py'-File. In the new file, modify the imports and the method content to whatever is needed to run your library. On the command line, use -gpio [yourGpioPath], for this example it is „adapter.MyGpio“. Generally, as this is running as a standalone client, with most probably no other code in parallel, this will be rarely needed.

9.2. GPIO Names

GPIO names used are configurable in config/portMapping.xml. This file maps the gpioNumbers from BCM numbering to other names, either GPIO-, PIN-numbers or whatever else needed. GPIO08 is GPIO numbering in BCM style.

```
<port gpioNumber='8' name='GPIO08' />
```

IKG.IO.3 is used for a special adapter-board.

```
<port gpioNumber='18' name='IKG.IO.3' />
```

Pin header names. The version-ambiguities are resolved by appending the version number to the port name

```
<port gpioNumber='0' name='P1-03V1' />
<port gpioNumber='2' name='P1-03V2' />
```

The mapped names can be used in config files.

9.3. Python Compatibility

The code is developed and tested in python 2.7.3.

Some checks have been performed with python3 and pypy. If there are problems in these environment, then please let me know.

External libraries are

- Rpi.GPIO 0.5.3a or 0.5.4a
- RPIO
- cherrypy 3.2.4 for the web gui
- route
- mako

SPI, I2C, TextToSpeech as needed.

Scratch is Version 1.4, as there the remote sensor protocol is available. As of now (juli 2013), I do not know about plans to have this sensor network in scratch 2.0.

9.4. License

GNU General Public License

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Chapter 10. Adapter Documentation

Technical description of adapters, input, output values and events and config snippets.

10.1. ADC_ADS1015_Input

AD-Interface for ADS1015.

AD-Interface for ADS1015.

Class

adapter.i2cAdapter.ADC_ADS1015_Input

Output Values

adc	intType [106]	ADC value

Parameter (mandatory)

adc.channel	intType [106]	the adc-channel
i2c.address	intOrHexType [106]	address is '0x48' for adafruit ADS1015-breakout
i2c.bus	intType [106]	bus is '1' for RPi Release 2
poll.interval	floatType [106]	poll interval in secs, e.g. 0.05

Sample configuration

```
<adapter class='adapter.i2cAdapter.ADC_ADS1015_Input'  name='adc_A2'>
    <description>ADC-Value from ADS1015 (single ended)</description>
    <output_value name='adc'>
        <sensor name='adc_A2'/>
    </output_value>

    <parameter name='poll.interval' value='0.05' />

    <!-- bus is '1' for RPi Release 2 -->
    <parameter name='i2c.bus' value='1' />

    <!-- address is '0x48' for adafruit ADS1015 -->
    <parameter name='i2c.address' value='0x48' />

    <parameter name='adc.channel' value='2' />
</adapter>
```

10.2. ADC_MCP3008_10_Input

ADC interface MCP3008, 8 channel ADC

Interface to adc MCP3008, 10bit.

Class

adapter.adc_zone.ADC_MCP3008_10_Input

Output Values

adc	intType [106]	value int 0..1023

Parameter (mandatory)

adc.channel	intType [106]	adc channel (0,7).

poll.band	intType [106]	deadband zone +- last value, only if new value is outside this band it is reported.
poll.interval	floatType [106]	poll rate in seconds, default 0.05.
spi.bus	intType [106]	bus number, 0, 1
spi.device	intType [106]	spi bus selector, 0, 1

Sample configuration

```
<adapter class='adapter.adc.ADC_MCP3008_10_Input'  name='adc_A'>

    <description>ADC-Value</description>

    <output_value name='adc'>
        <sensor name='adcA'/>
    </output_value>

    <parameter name='poll.interval' value='0.066' />
    <parameter name='poll.band' value='2' />
    <parameter name='spi.bus' value='0' />
    <parameter name='spi.device' value='0' />
    <!-- channel 0..7 -->
    <parameter name='adc.channel' value='7' />
</adapter>
```

10.3. ADC_MCP3202_10_Input

ADC interface MCP3202

Interface to adc MCP3202, 10bit.

Class

adapter.adc.ADC_MCP3202_10_Input

Output Values

adc	intType [106]	value 0..1023

Parameter (mandatory)

adc.channel	intType [106]	adc channel (0,1).
poll.interval	floatType [106]	poll rat ein seconds, default 0.05.
spi.bus	intType [106]	bus number, 0, 1
spi.device	intType [106]	spi bus selector, 0, 1

Sample configuration

```
<adapter class='adapter.adc.ADC_MCP3202_10_Input'  name='adc_A'>

    <description>ADC-Value</description>

    <output_value name='adc'>
        <sensor name='adcA'/>
    </output_value>

    <parameter name='poll.interval' value='0.066' />
    <parameter name='spi.bus' value='0' />
    <parameter name='spi.device' value='0' />
    <parameter name='adc.channel' value='0' />
</adapter>
```

10.4. ADC_MCP3202_10_Zone_Input

ADC interface MCP3202, zone value mapping

Interface to adc MCP3202, 10bit. The input values are mapped to zones.

Zone values can be used for threshold values, e.g. 0..511 to 0, 512..1023 to 1023.

Zone values can be used for value mapping, e.g. 0..99 to 'left', 100..923 to 'middle', 924..1023 to 'right'.

Class

adapter.adc_zone.ADC_MCP3202_10_Zone_Input

Output Values

adc	stringType [106]	value int values or string

Parameter (mandatory)

adc.channel	intType [106]	adc channel (0,1).
poll.interval	floatType [106]	poll rate in seconds, default 0.05.
spi.bus	intType [106]	bus number, 0, 1
spi.device	intType [106]	spi bus selector, 0, 1

Sample configuration

```
<adapter class='adapter.adc_zone.ADC_MCP3202_10_Zone_Input'  name='adc_A_Zone'>

    <description>ADC-Value</description>

    <output_value name='adc'>
        <sensor name='adcA_zone'/>
    </output_value>

    <zone from='0' to='99' value='left'/>
    <zone from='100' to='923' value='middle'/>
    <zone from='924' to='1023' value='right'/>


    <parameter name='poll.interval' value='0.066' />
    <parameter name='spi.bus' value='0' />
    <parameter name='spi.device' value='0' />
    <parameter name='adc.channel' value='0' />
</adapter>
```

10.5. ADC_MCP3202_12_Input

ADC interface MCP3202

Interface to adc MCP3202, 12bit.

Supports averaging (filter).

Class

adapter.adc.ADC_MCP3202_12_Input

Output Values

adc	intType [106]	value 0..4095

Parameter (mandatory)

adc.channel	intType [106]	adc channel (0,1).

filter.depth	intType	[106]	0,1: no filtering; 2..10: filtering
poll.interval	intType	[106]	poll rat ein seconds, default 0.05.
spi.bus	intType	[106]	bus number, 0, 1
spi.device	intType	[106]	spi bus selector, 0, 1

Sample configuration

```
<adapter class='adapter.adc.ADC_MCP3202_12_Input'  name='adc_A'>

    <description>ADC-Value</description>

    <output_value name='adc'>
        <sensor name='adcA'/>
    </output_value>

    <parameter name='filter.depth' value='8' />

    <parameter name='poll.interval' value='0.066' />
    <parameter name='spi.bus' value='0' />
    <parameter name='spi.device' value='0' />
    <parameter name='adc.channel' value='0' />
</adapter>
```

10.6. BipolarStepper

Drives a bipolar stepper motor.

Bipolar steppers need four half bridge drivers, e.g. LM293

Class

adapter.stepper.BipolarStepper

Input Events

startMotor	not used
stopMotor	not used

Input Values

speed	floatType	[106]	time between steps. The smaller, the faster the motor will run.
target	floatType	[106]	Target is 'step points' on an absolute scale.

Sample configuration

```
<adapter class='adapter.stepper.BipolarStepper' name='stepper'>

    <description>stepper control</description>

    <gpio port='GPIO25' alias='br0.0'>
        <default dir='OUT' pull='PUD_OFF'  />
        <active dir='OUT' pull='PUD_OFF'/>
    </gpio>
    <gpio port='GPIO24' alias='br0.1'>
        <default dir='OUT' pull='PUD_OFF'  />
        <active dir='OUT' pull='PUD_OFF'/>
    </gpio>

    <gpio port='GPIO23' alias='br1.0'>
        <default dir='OUT' pull='PUD_OFF'  />
        <active dir='OUT' pull='PUD_OFF'/>
    </gpio>
    <gpio port='GPIO18' alias='br1.1'>
        <default dir='OUT' pull='PUD_OFF'  />
        <active dir='OUT' pull='PUD_OFF'/>
    </gpio>
```

```
    <gpio port='GPIO22' alias='en0'>
        <default dir='OUT' pull='PUD_OFF'  />
        <active dir='OUT' pull='PUD_OFF' default='high' />
    </gpio>
    <gpio port='GPIO27' alias='en1'>
        <default dir='OUT' pull='PUD_OFF'  />
        <active dir='OUT' pull='PUD_OFF'  default='high' />
    </gpio>

    <input name='startMotor'>
        <broadcast name='startMotor'/>
    </input>

    <input name='stopMotor'>
        <broadcast name='stopMotor'/>
    </input>

    <input_value name='speed'>
        <variable name='speed'/>
    </input_value>

    <input_value name='target'>
        <variable name='target'/>
    </input_value>

</adapter>
```

10.7. Blink_Adapter

USB adapter for blink-device.

'blink(1)' is a small USB-device with two LED. See https://blink1.thingm.com/

The color commands do not use the device timed fade.

Needs installation of pyusb.

Class

adapter.usbAdapter.Blink_Adapter

Sample configuration

```
<adapter class='adapter.usbAdapter.Blink_Adapter'  name='blink_1'>
    <description></description>

    <!--  led_0 is 'all led' -->
    <input_value name='led_0'>
        <variable name='led_all'/>
        <variable name='led_0'/>
    </input_value>

    <input_value name='led_1'>
        <variable name='led_1'/>
    </input_value>

    <input_value name='led_2'>
        <variable name='led_2'/>
    </input_value>

</adapter>
```

10.8. CommunicationAdapter

Remote communication adapter.

Needs the scratchCommunicationServer to be started.

For the configuration, an adapter-specific syntax is used.

There is a limit on inputs, max 32 commands are supported.

Class

adapter.remote.CommunicationAdapter

Parameter (mandatory)

group	stringType [106]	The scratchCommunicationServer can handle different (isolated) groups. Only scratchClients in same group can communicate.
server	stringType [106]	IP-Address of computer where scratchCommunicationServer is located.

Sample configuration

```
<adapter class='adapter.remote.CommunicationAdapter' name='communication_adapter'>

     <!-- Adapter uses native Syntax -->
     <description>Remote communication adapter. </description>

     <!--  these commands are received from scratch and forwarded to a remote attached scratchCl
     <remote type='forward'>

         <broadcast name='command_B'/>
     </remote>

     <!--  these commands are received from a remote attached scratchClient and sent to local sc
     <remote type='receive'>
         <broadcast name='command_A'/>
     </remote>

     <parameter name="group" value="groupA"  />
     <parameter name="server" value="192.168.2.108" />

 </adapter>
```

10.9. DMA_PWM

DMA based PWM adapter.

Needs installation of RPIO2-package.

Supports 0..100% pwm signals.

Class

adapter.dma_pwm.DMA_PWM

Input Values

rate	floatType [106]	pwm rate [0..100]

Parameter (mandatory)

frequency	floatType [106]	Frequency in [Hz] for the pwm signal.
rate	floatType [106]	initial pwm rate in [%].

Sample configuration

```
<adapter class='adapter.dma_pwm.DMA_PWM'  name='rgb_B'>
      <description>Sample DMA PWM, needs installation of RPIO2-package.</description>

      <gpio port='IKG.IO.5'>
          <default dir='OUT'  default='high' />
          <active dir='RESERVED' />
```

```
        </gpio>

        <input_value name='rate'>
            <variable name='rgb_A_B'/>
        </input_value>

        <parameter name='frequency' value='50' />
        <parameter name='rate' value='50' />
    </adapter>
```

10.10. DMA_PWM_ON_OFF

DMA based PWM adapter with two specific pwm values.

Needs installation of RPIO2-package.

Class

adapter.dma_pwm.DMA_PWM_ON_OFF

Input Events

high	set pwm to default rate.
low	set pwm to 0%.

Parameter (mandatory)

frequency	floatType [106]	Frequency in [Hz] for the pwm signal. Use '50' here.
rate	floatType [106]	initial pwm rate in [%].

Sample configuration

10.11. DMA_PWMServo

DMA based PWM adapter with input range specific for servo.

Needs installation of RPIO2-package.

Supports 50Hz, 1 to 2ms pwm.

Class

adapter.dma_pwm.DMA_PWMServo

Input Values

rate	float100Type [106]	pwm rate [0..100] for 1..2ms pwm pulse.

Parameter (mandatory)

frequency	floatType [106]	Frequency in [Hz] for the pwm signal. Use '50' here.
rate	floatType [106]	initial pwm rate in [%].
value.inverse	booleanType [106]	Output signal inverted (needed if transistor follower is used to boost signal for 5V).

Parameter (optional)

millisecond.max	floatType [106]	Default 2.0 [ms]. Pulses usually are [1..2]ms. High value can be set up to 2.5 [ms].

millisecond.min	floatType [106]	Default 1.0 [ms]. Pulses usually are [1..2]ms. Low value can be set to down to 0.5 [ms].

Sample configuration

```
<adapter class='adapter.dma_pwm.DMA_PWMServo'  name='servo_pwm'>
     <description>Sample DMA PWM, needs installation of RPIO2-package.</description>

     <gpio port='GPIO23'>
         <default dir='OUT'  default='high' />
         <active dir='RESERVED' />
     </gpio>

     <input_value name='rate'>
         <variable name='servo_A'/>
     </input_value>

     <parameter name='frequency' value='50' />
     <parameter name='rate' value='50' />
     <parameter name='value.inverse' value='true' />

     <!--  optional parameter -->

     <!--  millisecond min is 0.5 [ms] minimum, default = 1 [ms] -->
     <!--  millisecond max is 1.5 [ms] minimum, default = 2 [ms] -->
     <parameter name="millisecond.min" value="1.0" />
     <parameter name="millisecond.max" value="2.0" />
 </adapter>
```

10.12. Festival_Adapter

Interface to 'festival'

festival is a text to speech package. It allows to dynamically 'speak out' text.

Class

adapter.textToSpeech.Festival_Adapter

Input Values

value	restrictedStringType [106]	value contains the text for the conversion. For stability reasons, some characters which could mess up the system are removed ['| $\/<>&~*]

Parameter (mandatory)

queue.max	intType [106]	Commands are queued up when triggers arrive faster than scripts terminate.

Sample configuration

```
<adapter class='adapter.textToSpeech.Festival_Adapter'  name='festival'>
     <description>text output</description>

     <input_value name='speech'>
         <variable name='speak'/>
     </input_value>

     <parameter name="queue.max" value="5"  />

 </adapter>
```

10.13. Gpio7segment

Interface for a 7-Segment LED

drives 7 GPIO pins for a 7 segment LED.

Class

adapter.adapters.Gpio7segment

Input Values

seg_a	booleanType [106]	drives output led according to the logical value given
seg_b	booleanType [106]	drives output led according to the logical value given
seg_c	booleanType [106]	drives output led according to the logical value given
seg_d	booleanType [106]	drives output led according to the logical value given
seg_e	booleanType [106]	drives output led according to the logical value given
seg_f	booleanType [106]	drives output led according to the logical value given
seg_g	booleanType [106]	drives output led according to the logical value given
value	char7segmentType [106]	converts input char to a pattern on the LED; supported chars are [0-9AbCcdEFr-]

Sample configuration

```
<adapter class='adapter.gpio.Gpio7segment'  name='s7'>
     <description>7 Segment driver</description>

     <gpio port='GPIO25' alias='a'>
         <default dir='OUT'  default='low' />
         <active  dir='OUT'  default='low' />
     </gpio>
     <gpio port='GPIO24' alias='b'>
         <default dir='OUT'  default='low' />
         <active  dir='OUT'  default='low' />
     </gpio>
     <gpio port='GPIO23' alias='c'>
         <default dir='OUT'  default='low' />
         <active  dir='OUT'  default='low' />
     </gpio>
     <gpio port='GPIO18' alias='d'>
         <default dir='OUT'  default='low' />
         <active  dir='OUT'  default='low' />
     </gpio>
     <gpio port='GPIO22' alias='e'>
         <default dir='OUT'  default='low' />
         <active  dir='OUT'  default='low' />
     </gpio>
     <gpio port='GPIO27' alias='f'>
         <default dir='OUT'  default='low' />
         <active  dir='OUT'  default='low' />
     </gpio>
     <gpio port='GPIO17' alias='g'>
         <default dir='OUT'  default='low' />
         <active  dir='OUT'  default='high' />
     </gpio>

     <input_value name='value'>
         <variable name='siebensegment'/>
     </input_value>

     <input_value name='seg_a'>
         <variable name='seg_A'/>
     </input_value>
     <input_value name='seg_b'>
         <variable name='seg_B'/>
```

```
    </input_value>
    <input_value name='seg_c'>
        <variable name='seg_C'/>
    </input_value>
    <input_value name='seg_d'>
        <variable name='seg_D'/>
    </input_value>
    <input_value name='seg_e'>
        <variable name='seg_E'/>
    </input_value>
    <input_value name='seg_f'>
        <variable name='seg_F'/>
    </input_value>
    <input_value name='seg_g'>
        <variable name='seg_G'/>
    </input_value>
</adapter>
```

10.14. GpioButtonInput

Reads a GPIO pin

Deprecated, use GpioEventInput instead.

Reads a GPIO pin; sends events. Output can be inverted.

Class

adapter.gpio.GpioButtonInput

Output Event

button_pressed	when button press detected
button_released	when button released

Parameter (mandatory)

poll.interval	floatType [106]	poll rate in seconds, default 0.05.
value.inverse	booleanType [106]	'false', 'true'

Sample configuration

```
<adapter class='adapter.gpio.GpioButtonInput' name='button_s0'>
    <!-- no description, urgg -->
    <gpio port='GPIO25'>
        <default dir='IN' pull='PUD_UP'  />
        <active dir='IN' pull='PUD_UP'/>
    </gpio>

    <output name='button_pressed'>
        <broadcast name='s0_pressed'/>
    </output>
    <output name='button_released'>
        <broadcast name='s0_released'/>
    </output>

    <parameter name='poll.interval' value='0.05' />
    <parameter name='value.inverse' value='true' />

</adapter>
```

10.15. GPIODialPlateEncoder

Decodes a legacy rotary telephone dialplate.

the two switches 'nsi', 'nsa' are connected.

The decoding is time dependent.

Class

adapter.encoder.GPIODialPlateEncoder

Output Values

number	digitType [106]	The value from the dial plate decoded.

Sample configuration

```
<adapter class='adapter.encoder.GPIODialPlateEncoder'  name='dial_A'>
     <description>Wählscheibe.
     Anschluss: NSI (Impuls)
                NSA (Drehschalter)
     </description>

     <gpio port='GPIO24' alias='nsi'>
         <default dir='IN' pull='PUD_UP'  />
         <active dir='IN' pull='PUD_UP'   />
     </gpio>
     <gpio port='GPIO18' alias='nsa'>
         <default dir='IN' pull='PUD_UP'  />
         <active dir='IN' pull='PUD_UP'   />
     </gpio>

     <output_value name='number'>
         <sensor name='numberA'/>
     </output_value>

 </adapter>
```

10.16. GPIOEncoder

Decodes a rotary encoder.

initial value is 0; is incremented or decremented.

Class

adapter.encoder.GPIOEncoder

Output Values

position	intType [106]	

Sample configuration

```
<adapter class='adapter.encoder.GPIOEncoder'  name='encoder_A'>
     <description>Drehencoder</description>

     <gpio port='GPIO22' alias='p0'>
         <default dir='IN' pull='PUD_UP'  />
         <active dir='IN' pull='PUD_UP'   />
     </gpio>
     <gpio port='GPIO27' alias='p1'>
         <default dir='IN' pull='PUD_UP'  />
         <active dir='IN' pull='PUD_UP'   />
     </gpio>

     <output_value name='position'>
         <sensor name='positionA'/>
```

```
        </output_value>

        <parameter name='poll.interval' value='0.005' />

    </adapter>
```

10.17. GpioEventInput

Reads a GPIO pin

Reads a GPIO pin; sends events. Output can be inverted.

Class

adapter.gpio.GpioEventInput

Output Event

button_pressed	when button press detected
button_released	when button released

Parameter (mandatory)

poll.interval	floatType [106]	poll rate in seconds, default 0.05.
value.inverse	booleanType [106]	'false', 'true'

Sample configuration

```
<adapter class='adapter.gpio.GpioButtonInput' name='button_s0'>
     <!-- no description, urgg -->
     <gpio port='GPIO25'>
         <default dir='IN' pull='PUD_UP'  />
         <active dir='IN' pull='PUD_UP'/>
     </gpio>

     <output name='button_pressed'>
         <broadcast name='s0_pressed'/>
     </output>
     <output name='button_released'>
         <broadcast name='s0_released'/>
     </output>

     <parameter name='poll.interval' value='0.05' />
     <parameter name='value.inverse' value='true' />

 </adapter>
```

10.18. GpioInput

Read a GPIO pin

Read a GPIO pin; sends values '0' and '1'. Output can be inverted.

Class

adapter.gpio.GpioInput

Output Values

button	binaryType [106]	0, 1 when inverted = false; 1, 0 else.

Parameter (mandatory)

poll.interval	floatType [106]	poll rate in seconds, default 0.05.
value.inverse	booleanType [106]	'false', 'true'

Sample configuration

```
<adapter class='adapter.gpio.GpioInput' name='schalter_s1'>

    <gpio port='GPIO24'>
        <default dir='IN' pull='PUD_UP'  />
        <active dir='IN' pull='PUD_UP'/>
    </gpio>
    <output_value name='button'>
        <sensor name='s1'/>
    </output_value>

    <parameter name='poll.interval' value='0.05' />
    <parameter name='value.inverse' value='true' />
</adapter>
```

10.19. GpioOutput

Output to a GPIO pin

writes to a GPIO pin.

Class

adapter.gpio.GpioOutput

Input Events

high	drives output high
low	drives output low

Sample configuration

```
<adapter class='adapter.gpio.GpioOutput'  name='led0'>
    <description>LED0</description>

    <gpio port='GPIO25'>
        <default dir='OUT'  default='low' />
        <active  dir='OUT'  default='low' />
    </gpio>
    <input name='low'>
        <broadcast name='led0_OFF'/>
    </input>
    <input name='high'>
        <broadcast name='led0_ON'/>
    </input>
</adapter>
```

10.20. GpioOutputPWM

Output to a GPIO pin

outputs a pwm signal to a pin.

Input 'rate' : float, 0.0 to 100.0

Configuration 'frequency': float, [Hz]

Uses soft-pwm with RPI.GPIO.

Class

adapter.gpio.GpioOutputPWM

Input Values

rate	float100Type [106]	sets PWM rate, 0..100

Parameter (mandatory)

frequency	float100Type [106]	frequency in Hz
rate	float100Type [106]	default rate, 0..100

Sample configuration

```
<adapter class='adapter.gpio.GpioOutputPWM'  name='pwm_25'>
 <description>Sample GPIO PWM</description>
 <gpio port='GPIO25'>
     <default dir='OUT'  default='low' />
     <active dir='RESERVED' />
 </gpio>
 <input_value name='rate'>
     <variable name='rate_25'/>
 </input_value>
 <parameter name='frequency' value='30' />
 <parameter name='rate' value='15' />
</adapter>
```

10.21. GpioOutputPWM_ON_OFF

dim an output pin or set it off.

outputs a pwm signal to a pin (rate when high; 0 when low).

Fixed level only.

Class

adapter.gpio.GpioOutputPWM_ON_OFF

Input Events

high	sets PWM rate to [rate]
low	sets PWM rate to 0.0

Parameter (mandatory)

frequency	float100Type [106]	frequency in Hz
rate	float100Type [106]	default rate, 0..100

Sample configuration

```
<adapter class='adapter.gpio.GpioOutputPWM_ON_OFF'  name='led0'>
<description>LED0</description>

<gpio port='GPIO.25'>
```

```
            <default dir='OUT'  default='low' />
            <active  dir='OUT'  default='low' />
        </gpio>
        <input name='low'>
            <broadcast name='led0_OFF'/>
        </input>
        <input name='high'>
            <broadcast name='led0_ON'/>
        </input>
    </adapter>
```

10.22. GpioOutputPWMServo

Output to a GPIO pin

outputs a pwm signal to a pin.

Input 'rate' : float, 0.0 to 100.0

Configuration 'frequency': float, [Hz]

Uses soft-pwm with RPI.GPIO; may produce jitter on signals.

Class

adapter.gpio.GpioOutputPWMServo

Input Values

rate	float100Type [106]	sets PWM rate, 0..100 0 --> 95% 1ms 100 --> 90% 2ms @ 50Hz

Parameter (mandatory)

frequency	float100Type [106]	frequency in Hz, for a servo set 50Hz
rate	float100Type [106]	default rate, 0..100

Sample configuration

```
<adapter class='adapter.gpio.GpioOutputPWMServo'  name='servo_pwm'>
        <description>Sample GPIO PWM</description>

        <gpio port='GPIO23'>
            <default dir='OUT' pull='PUD_OFF' default='low' />
            <active dir='RESERVED' />
        </gpio>

        <input_value name='rate'>
            <variable name='servo_A'/>
        </input_value>

        <parameter name='frequency' value='50' />
        <parameter name='rate' value='50' />
    </adapter>
```

10.23. GpioStateOutput

scratch connection status

displays scratch connection status to a GPIO pin.

scratchclient not started: undefined

scratchclient started: low

no connection: high

connection: blink

Class

adapter.gpio.GpioStateOutput

Sample configuration

```
<adapter class='adapter.gpio.GpioStateOutput'  name='state'>
    <description>State display on GPIO04</description>

    <gpio port='GPIO04' alias='state'>
        <default dir='OUT'  default='low' />
        <active  dir='OUT'  default='low' />
    </gpio>
</adapter>
```

10.24. GpioValueInput

Read a GPIO pin; sends configurable values. Output can be inverted.

Input is polled by 'poll.interval'. When a value change is detected, a value is aquired. The value gets inverted if 'value.inverse'==true. Then the configured definitions for 0 or 1 are applied from 'value.0' or 'value.1'

Class

adapter.gpio.GpioValueInput

Output Values

value	anyType [106]	see value.0, value.1 for values.

Parameter (mandatory)

poll.interval	floatType [106]	poll rate in seconds, default 0.05.
value.0	anyType [106]	can be any string like 'on', 'off', 'active', 'disabled' or numeric values. Whatever a meaningful value for scratch is. do not use same value as value.1
value.1	anyType [106]	can be any string like 'on', 'off', 'active', 'disabled' or numeric values. Whatever a meaningful value for scratch is. do not use same value as value.0
value.inverse	booleanType [106]	'false', 'true'

Sample configuration

```
<adapter class='adapter.gpio.GpioValueInput' name='valueGPIO'>

    <gpio port='GPIO25'>
        <default dir='IN' pull='PUD_UP'  />
        <active dir='IN' pull='PUD_UP'/>
    </gpio>

    <output_value name='value'>
        <sensor name='namedGPIO_A'/>
    </output_value>
```

```
        <parameter name='poll.interval' value='0.08' />
        <parameter name='value.inverse' value='false' />

        <parameter name='value.0' value='switched_OFF' />
        <parameter name='value.1' value='switched_ON' />

    </adapter>
```

10.25. HC_SR04_Adapter

HC-SR04 connection by pigpiod-daemon

Measures time of echo signal.

Provides error value if needed.

Class

adapter.pigpiod.HC_SR04_Adapter

Output Values

error	stringType [106]	error information, empty when no error 'no connection' when pigpiod daemon can't be reached. 'echo pin is high' when at the start of a trigger pulse the echo pin is high, should be low.Typically a connection problem. 'no response' when no pos edge and then neg edge on echo pin is found. Typically a connection problem. 'time too long > 20ms' when measured time is larger than 20ms.
time	floatType [106]	Pulse width of echo-signal in seconds.

Sample configuration

```
 <adapter class='adapter.pigpiod.HC_SR04_Adapter'  name='echo-time'>
        <description>HC-SR04 controller</description>



        <gpio port='GPIO18'   alias='trigger'>
            <default dir='RESERVED' />
            <active dir='RESERVED' />
        </gpio>
        <gpio port='GPIO23' alias='echo'>
            <default dir='RESERVED' />
            <active dir='RESERVED' />
        </gpio>

        <output_value name='time'>
            <sensor name='time'/>
        </output_value>

        <output_value name='error'>
            <sensor name='error'/>
        </output_value>

         <!--  minimal value 0.02 -->
         <parameter name='poll.interval' value='0.5' />
    </adapter>
```

10.26. HIDScanner_Adapter

Read an USB HID device.

Provides scan results from a barcode scanner.

Class

adapter.usbAdapter.HIDScanner_Adapter

Output Values

scan	stringType [106]	scan result

Parameter (mandatory)

usb.idProduct	stringType [106]	
usb.idVendor	stringType [106]	

Sample configuration

```
<adapter class='adapter.usbAdapter.HIDScanner_Adapter' name='barcode scanner'>

    <description>Provides scan results from a barcode scanner.</description>

    <output_value name='scan'>
        <sensor name='barcode'/>
    </output_value>

    <parameter name="usb.idVendor"  value="0x0c2e"  />
    <parameter name="usb.idProduct" value="0x0200"  />

</adapter>
```

10.27. IRDistanceInput

IR Distance sensor

Interface to Sharp GP2Y0A21YK IR Distance sensor on adc MCP3202, 10bit.

Calculates linearization; averaging the last 5 values.

Class

adapter.adc.IRDistanceInput

Output Values

distance	floatType [106]	distance in mm; when open max value is 800.

Parameter (mandatory)

adc.channel	intType [106]	adc channel (0,1).
filter.use	booleanType [106]	boolean value, 1, 0, true, false, yes, no.
poll.interval	floatType [106]	poll rat ein seconds, default 0.05.
spi.bus	intType [106]	bus number, 0, 1
spi.device	intType [106]	spi bus selector, 0, 1

Sample configuration

```
<adapter class='adapter.adc.IRDistanceInput'  name='irDistanceA'>
    <description>IR-Distance Sensor</description>

    <output_value name='distance'>
        <sensor name='distanceA'/>
    </output_value>
```

```
        <parameter name='poll.interval' value='0.066' />
        <parameter name='spi.bus' value='0' />
        <parameter name='spi.device' value='0' />
        <parameter name='adc.channel' value='0' />
        <parameter name='filter.use' value='true' />
        <parameter name='filter.depth' value='5' />

    </adapter>
```

10.28. Linux_Adapter

Interface to linux operation command line

Allows the usage of linux shell scripts.

Class

adapter.linux.Linux_Adapter

Input Events

trigger	Start the script.

Parameter (mandatory)

os.command	stringType [106]	The operating system command.
queue.max	intType [106]	Commands are queued up when triggers arrive faster than scripts terminate.

Sample configuration

```
<adapter class='adapter.linux.Linux_Adapter'  name='sampleB'>
    <description>linux os command execution</description>

    <input name='trigger'>
        <broadcast name='scrot'/>
    </input>

    <parameter name="os.command" value="scrot"  />
    <parameter name="queue.max" value="5"  />
</adapter>
```

10.29. Linux_APLAY_Adapter

Play wav files with aplay.

Linux only.

Class

adapter.linux.Linux_APLAY_Adapter

Input Values

sound	stringType [106]	name of wav file. With or without extension '.wav'

Parameter (mandatory)

aplay.device	stringType [106]	use a device reported by 'aplay -L'.
queue.max	intType [106]	Max queue depth for commands. 5 is a good value.

sound.dir	stringType [106]	Directory where wave files are looked for, e.g /home/pi/temp.

Sample configuration

```
<adapter class='adapter.linux.Linux_APLAY_Adapter' name='sampleA'>
    <description>linux aplay execution</description>

    <input_value name='sound'>
         <variable name='wave'/>
    </input_value>

    <parameter name="aplay.device" value="sysdefault:CARD=Device"  />
    <parameter name='sound.dir' value='/opt/sonic-pi/etc/samples' />
    <parameter name="queue.max" value="5"  />
</adapter>
```

10.30. Linux_ARECORD_Adapter

record wav files with arecord.

Linux only.

Class

adapter.linux.Linux_ARECORD_Adapter

Input Events

start_record	start recording.
stop_record	stop recording.

Input Values

sound	stringType [106]	name of wav file. Extension '.wav' is not needed.

Parameter (mandatory)

aplay.device	stringType [106]	use a device reported by 'aplay -L'.
aplay.rate	intType [106]	Sampling rate in Hertz. The default rate is 8000 Hertz.
sound.dir	stringType [106]	Directory where wave files are looked for, e.g /home/pi/temp.
timeout	intType [106]	timeout for recording, 60 [sec] is recommended.

Sample configuration

```
<adapter class='adapter.linux.Linux_ARECORD_Adapter' name='sampleA'>
    <description>linux arecord execution</description>

    <input_value name='sound'>
         <variable name='wave'/>
    </input_value>

    <input name='start_record'>
     <broadcast name='start'/>
    </input>

   <input name='stop_record'>
     <broadcast name='stop'/>
    </input>


    <parameter name="aplay.device" value="sysdefault:CARD=Device"  />
    <parameter name="aplay.rate"   value="16000"  />
    <parameter name='sound.dir' value='/home/pi/temp' />
    <parameter name='timeout' value='60' />
</adapter>
```

10.31. Linux_ASR_Adapter

Interface for a specch recognition process.

Linux only. Needs installation of a speech recognition system,e.g. pocketsphinx. This system is writing text to stdout.

The design is to use pocketsphinx in batch mode.

Class

adapter.linux.Linux_ASR_Adapter

Input Events

execute	start process.
textAcknowledge	when a text variable is processed, send acknowledge to receive next text.

Output Event

complete	Process terminated.
textAvailable	A text variable is available in scratch and can be processed.

Output Values

status	stringType [106]	Status information from adapter.
text	stringType [106]	A line from process' stdout is sent.

Parameter (mandatory)

command.line	stringType [106]	process and parameter for linux process. ${sound.dir}/${sound.file} can be used to insert dir/file name of wave file.
sound.dir	stringType [106]	Directory where wave files are looked for, e.g /home/pi/temp.
sound.file	stringType [106]	name of wave file to process
timeout	intType [106]	timeout.

Sample configuration

```
<adapter class='adapter.linux.Linux_ASR_Adapter' name='sampleA'>
     <description>linux speech recoginition with pocketsphinx</description>

     <input name='execute'>
         <broadcast name='execute' />
     </input>

     <output name='complete'>
         <broadcast name='finished' />
     </output>

     <input name='textAcknowledge'>
         <broadcast name='ack' />
     </input>

     <output name='textAvailable'>
         <broadcast name='listen' />
     </output>

     <output_value name='text'>
         <sensor name='text' />
     </output_value>

     <output_value name='status'>
         <sensor name='status' />
     </output_value>
```

```
    <!-- ${sound.dir} is filled from 'sound.dir'; ${sound.file} is filled from 'sound.file' -->
    <parameter
       name='command.line'
       value='pocketsphinx_continuous -hmm /usr/local/share/pocketsphinx/model/en-us/en-us -lm

    <parameter name='sound.dir' value='/home/pi' />
    <parameter name='sound.file' value='sample.wav' />
    <!--
        Text received is internally queued. When queue data are getting too old, these are disc
        Timeout is configured here in sec.
        The timeout is used for scenario, where the acknowledge protocol is not yet implemented
        data are accumulated in internal queue.
    -->
    <parameter name='timeout' value='60' />
</adapter>
```

10.32. Luminosity_BH1750_Input

Interface for Luminosity sensor BH1750

Interface for Luminosity sensor BH1750

Values are in lx (lux)

Class

adapter.i2cAdapter.Luminosity_BH1750_Input

Output Values

luminosity	floatType [106]	brightness in lx

Parameter (mandatory)

i2c.address	intOrHexType [106]	'0x23' for BH1750 '0x5c' for BH1750
i2c.bus	intOrHexType [106]	bus is '1' for RPi Release 2
poll.interval	floatType [106]	poll interval in secs, e.g. 0.05

Sample configuration

```
<adapter class='adapter.i2cAdapter.Luminosity_BH1750_Input'  name='luminosity'>
    <description>Luminosity-Value from BH1750</description>

    <output_value name='luminosity'>
        <sensor name='luminosity'/>
    </output_value>

    <parameter name='poll.interval' value='0.5' />

    <!-- bus is '1' for RPi Release 2 -->
    <parameter name='i2c.bus' value='1' />

    <!-- Depending on address select, the bus address is
         '0x23' for BH1750
         '0x5c' for BH1750
         -->
    <parameter name='i2c.address' value='0x23' />
</adapter>
```

10.33. MAX31855_Adapter

Thermoelement processor MAX31855

Class

adapter.spiAdapter.MAX31855_Adapter

Output Values

temp_error	stringType [106]	error code, empty when no error
temp_intern	floatType [106]	internal temperature in °C
temp_wire	floatType [106]	wire temperature in °C

Parameter (mandatory)

poll.interval	floatType [106]	polling time, e.g. 0.5 seconds
spi.bus	intType [106]	
spi.device	intType [106]	

Sample configuration

```
<adapter class='adapter.spiAdapter.MAX31855_Adapter'  name='thermoelement'>

    <description>Temperatures
    SPI-connected.
    </description>

    <output_value name='temp_wire'>
        <sensor name='temp_ext'/>
    </output_value>

    <output_value name='temp_intern'>
        <sensor name='temp_int'/>
    </output_value>

    <output_value name='temp_error'>
        <sensor name='temp_error'/>
    </output_value>

    <!-- polling time for external device -->
    <parameter name='poll.interval' value='0.5' />

    <parameter name='spi.bus' value='0' />
    <parameter name='spi.device' value='0' />
</adapter>
```

10.34. MCP23S17_Adapter

MCP23S17 Port Expander

Controls MCP23S17 Port expander, as used on piFace-Board.

input_value methods in python are dynamically generated like inputGPA4 for io@dir=out

output_value methods in python are dynamically generated like outputGPB2 for io@dir=in

see the config/config_mcp23s17.xml example for namespace usage in xml.

Class

adapter.mcp23s17.MCP23S17_Adapter

Parameter (mandatory)

23s17.addr	intType [106]	slave address must match the hard wired slave address on the device
poll.interval	floatType [106]	polling interval in seconds, 0.05 sec is a good value.

spi.bus	intType [106]	
spi.device	intType [106]	

Sample configuration

```
<adapter class='adapter.mcp23s17.MCP23S17_Adapter' name='MCP23S17'>

    <!-- this is the setup for piface -->
    <!-- input_value methods in python are dynamically generated like inputGPA4 for io@dir=out

    <input_value name='inputGPA0'>
        <variable name='out_0' />
        <variable name='relais_0' />
        <variable name='all' />
    </input_value>

    <input_value name='inputGPA1'>
        <variable name='out_1' />
        <variable name='relais_1' />
        <variable name='all' />
    </input_value>

    <input_value name='inputGPA2'>
        <variable name='out_2' />
        <variable name='all' />
    </input_value>

    <input_value name='inputGPA3'>
        <variable name='out_3' />
        <variable name='all' />
    </input_value>

    <input_value name='inputGPA4'>
        <variable name='out_4' />
        <variable name='all' />
    </input_value>

    <input_value name='inputGPA5'>
        <variable name='out_5' />
        <variable name='all' />
    </input_value>

    <input_value name='inputGPA6'>
        <variable name='out_6' />
        <variable name='all' />
    </input_value>

    <input_value name='inputGPA7'>
        <variable name='out_7' />
        <variable name='all' />
    </input_value>

    <!-- output_value methods in python are dynamically generated like outputGPB2 for io@dir=in

    <output_value name='outputGPB0'>
        <sensor name='in_0' />
    </output_value>

    <output_value name='outputGPB1'>
        <sensor name='in_1' />
    </output_value>

    <output_value name='outputGPB2'>
        <sensor name='in_2' />
    </output_value>

    <output_value name='outputGPB3'>
        <sensor name='in_3' />
    </output_value>

    <output_value name='outputGPB4'>
        <sensor name='in_4' />
```

```
        </output_value>

        <output_value name='outputGPB5'>
            <sensor name='in_5' />
        </output_value>

        <output_value name='outputGPB6'>
            <sensor name='in_6' />
        </output_value>

        <output_value name='outputGPB7'>
            <sensor name='in_7' />
        </output_value>

        <parameter name='poll.interval' value='0.05' />

        <parameter name='spi.bus' value='0' />
        <parameter name='spi.device' value='0' />
        <!-- slave address must match the hard wired slave address on the device -->
        <parameter name='23s17.addr' value='0' />

        <!-- this is the setup for piface -->

        <io id='GPA0' dir='out' />
        <io id='GPA1' dir='out' />
        <io id='GPA2' dir='out' />
        <io id='GPA3' dir='out' />

        <io id='GPA4' dir='out' />
        <io id='GPA5' dir='out' />
        <io id='GPA6' dir='out' />
        <io id='GPA7' dir='out' />

        <io id='GPB0' dir='in' pullup='weak' />
        <io id='GPB1' dir='in' pullup='weak' />
        <io id='GPB2' dir='in' pullup='weak' />
        <io id='GPB3' dir='in' pullup='weak' />

        <io id='GPB4' dir='in' pullup='weak' />
        <io id='GPB5' dir='in' pullup='weak' />
        <io id='GPB6' dir='in' pullup='weak' />
        <io id='GPB7' dir='in' pullup='weak' />

    </adapter>
```

10.35. NEOPIXEL_Adapter

Interface to ArduinoUNO by USB-connection for WS2812 (neopixel)

Needs an arduino sketch.

Class

adapter.arduino.NEOPIXEL_Adapter

Input Values

led	colorType [106]	blank separated array of color values.

Parameter (mandatory)

led.length	intType [106]	Number of chips connected to arduino.
led.shadow	booleanType [106]	shadow keeps a duplicate of led values in memory and only sends set-led if values have changed. This reduces communication effort to arduino and improves speed.
serial.baud	intType [106]	Default is 115200. This value is used in firmware.

serial.device	stringType [106]	on windows, use COMn, e.g. COM6 on raspberry, use /dev/ttyn, e.g. /dev/ttyUSB0

Sample configuration

```
<adapter class='adapter.arduino.NEOPIXEL_Adapter' name='UNO_NEOPIXEL'>
    <!--  Sample arduino communication. Needs arduino sketch programmed in arduino. -->

    <input_value name='led'>
        <variable name='led'/>
    </input_value>

    <input name='clear'>
        <broadcast name='clear'/>
    </input>

    <input name='red'>
        <broadcast name='red_all'/>
    </input>
    <input name='green'>
        <broadcast name='green_all'/>
    </input>
    <input name='blue'>
        <broadcast name='blue_all'/>
    </input>

    <!-- ================================================== -->
    <!--  on windows, use COMn, e.g. COM6  -->
    <!--  on raspberry, use /dev/ttyn, e.g. /dev/ttyAMA0  -->

    <!--  <parameter name='serial.device' value='/dev/ttyUSB0' />
     -->

    <parameter name='led.length' value='144' />

    <!-- shadow keeps a duplicate of led values in memory and only sends set-led if values
         have changed. This reduces communication effort to arduino and improves
         speed.  -->
    <parameter name='led.shadow' value='true' />

    <parameter name='serial.device' value='COM19' />
    <parameter name='serial.baud' value='115200' />

    <!-- ================================================== -->


</adapter>
```

10.36. Openweathermap_Adapter

Reading openweathermap data.

Read openweathermap data. Needs credentials from http://openweathermap.org to work.

Needs installation of 'pyowm'.

Class

adapter.openweathermapAdapter.Openweathermap_Adapter

Parameter (mandatory)

location	stringType [106]	Location name to get weather for.
openweather.api_key	stringType [106]	Get these from openweathermap for your account
pollrate	intType [106]	pollrate in seconds. The api allows pollrate depending on license status. The free API allows pollrates of 10min == 600

Sample configuration

```
<adapter class='adapter.openweathermapAdapter.Openweathermap_Adapter' name='openweathermap'>
    <description>Retrieve openweathermap data</description>


    <output_value name='location'>
        <sensor name='owm.location' />
    </output_value>

   <output_value name='clouds'>
        <sensor name='owm.clouds' />
    </output_value>

    <output_value name='rainfall'>
        <sensor name='owm.rainfall' />
    </output_value>

    <output_value name='snowfall'>
        <sensor name='owm.snowfall' />
    </output_value>

    <output_value name='temperature'>
        <sensor name='owm.temperature' />
    </output_value>

    <output_value name='humidity'>
        <sensor name='owm.humidity' />
    </output_value>

    <output_value name='pressure'>
        <sensor name='owm.pressure' />
    </output_value>

    <output_value name='wind_speed'>
        <sensor name='owm.wind_speed' />
    </output_value>

    <output_value name='wind_direction'>
        <sensor name='owm.wind_direction' />
    </output_value>

    <parameter name='openweather.api_key' value='b0d1...' />

    <!--  pollrate in seconds
         The api allows pollrate depending on license status.
         The free API allows pollrates of 10min == 600  -->

    <parameter name='pollrate' value='600' />

    <parameter name='location' value='Leinfelden-Echterdingen' />

</adapter>
```

10.37. PianoHat_CAP1188_Adapter

PianoHat Adapter.

Installation procedures for pianohat required.

Supports button presses and releases.

Class

adapter.Cap1188Adapter.PianoHat_CAP1188_Adapter

Output Event

broadcast_00_off	button 00, C
broadcast_00_on	button 00, C

broadcast_01_off	button 01, C#
broadcast_01_on	button 01, C#
broadcast_02_off	button 02, D
broadcast_02_on	button 02, D
broadcast_03_off	button 03, D#
broadcast_03_on	button 03, D#
broadcast_04_off	button 04, E
broadcast_04_on	button 04, E
broadcast_05_off	button 05, F
broadcast_05_on	button 05, F
broadcast_06_off	button 06, F#
broadcast_06_on	button 06, F#
broadcast_07_off	button 07, G
broadcast_07_on	button 07, G
broadcast_08_off	button 08, G#
broadcast_08_on	button 08, G#
broadcast_09_off	button 09, A
broadcast_09_on	button 09, A
broadcast_10_off	button 10, A#
broadcast_10_on	button 10, A#
broadcast_11_off	button 11, B
broadcast_11_on	button 11, B
broadcast_12_off	button 12, c
broadcast_12_on	button 12, c
broadcast_13_off	button 13, octave down
broadcast_13_on	button 13, octave down
broadcast_14_off	button 14, octave up
broadcast_14_on	button 14, octave up
broadcast_15_off	button 15, instrument
broadcast_15_on	button 15, instrument

Parameter (mandatory)

auto_leds	booleanType [106]	Controls the autoled behaviour.

Sample configuration

```
<adapter class='adapter.Cap1188Adapter.PianoHat_CAP1188_Adapter' name='piano_adapter'>

    <description>pimoroni piano hat</description>

    <output name='broadcast_00_on'><broadcast name='button_00'/></output>
    <output name='broadcast_01_on'><broadcast name='button_01'/></output>
    <output name='broadcast_02_on'><broadcast name='button_02'/></output>
    <output name='broadcast_03_on'><broadcast name='button_03'/></output>
    <output name='broadcast_04_on'><broadcast name='button_04'/></output>
    <output name='broadcast_05_on'><broadcast name='button_05'/></output>
    <output name='broadcast_06_on'><broadcast name='button_06'/></output>
    <output name='broadcast_07_on'><broadcast name='button_07'/></output>
    <output name='broadcast_08_on'><broadcast name='button_08'/></output>
    <output name='broadcast_09_on'><broadcast name='button_09'/></output>
    <output name='broadcast_10_on'><broadcast name='button_10'/></output>
    <output name='broadcast_11_on'><broadcast name='button_11'/></output>
    <output name='broadcast_12_on'><broadcast name='button_12'/></output>
    <output name='broadcast_13_on'><broadcast name='button_13'/></output>
    <output name='broadcast_14_on'><broadcast name='button_14'/></output>
    <output name='broadcast_15_on'><broadcast name='button_15'/></output>
```

```
    <output name='broadcast_00_off'><broadcast name='button_00_off'/></output>
    <output name='broadcast_01_off'><broadcast name='button_01_off'/></output>
    <output name='broadcast_02_off'><broadcast name='button_02_off'/></output>
    <output name='broadcast_03_off'><broadcast name='button_03_off'/></output>
    <output name='broadcast_04_off'><broadcast name='button_04_off'/></output>
    <output name='broadcast_05_off'><broadcast name='button_05_off'/></output>
    <output name='broadcast_06_off'><broadcast name='button_06_off'/></output>
    <output name='broadcast_07_off'><broadcast name='button_07_off'/></output>
    <output name='broadcast_08_off'><broadcast name='button_08_off'/></output>
    <output name='broadcast_09_off'><broadcast name='button_09_off'/></output>
    <output name='broadcast_10_off'><broadcast name='button_10_off'/></output>
    <output name='broadcast_11_off'><broadcast name='button_11_off'/></output>
    <output name='broadcast_12_off'><broadcast name='button_12_off'/></output>
    <output name='broadcast_13_off'><broadcast name='button_13_off'/></output>
    <output name='broadcast_14_off'><broadcast name='button_14_off'/></output>
    <output name='broadcast_15_off'><broadcast name='button_15_off'/></output>

    <parameter name="auto_leds" value="true"  />

 </adapter>
```

10.38. Pico2Wave_Adapter

Interface to 'pico2wave'

pico2wave is a text to speech package. It allows to dynamically 'speak out' text.

Install: sudo apt-get install libttspico-utils

Validate: `pico2wave -w lookdave.wav "Look Dave, I can see you're really upset about this." && aplay lookdave.wav`

Class

adapter.textToSpeech.Pico2Wave_Adapter

Input Values

value	restrictedStringType [106]	value contains the text for the conversion. For stability reasons, some characters which could mess up the system are removed ['| $\/<>&~*]

Parameter (mandatory)

queue.max	intType [106]	Commands are queued up when triggers arrive faster than scripts terminate.
tts.lang	stringType [106]	Language 'en-US', 'en-GB', 'de-DE', 'es-ES', 'fr-FR', 'it-IT'.

Sample configuration

```
<adapter class='adapter.textToSpeech.Pico2Wave_Adapter'  name='pico2wave'>
     <description>text output</description>

     <input_value name='speech'>
         <variable name='speak'/>
     </input_value>

     <parameter name="queue.max" value="5"  />
     <parameter name="tts.lang" value="de-DE"  />

 </adapter>
```

10.39. PicoBoard_Adapter

Interface to PicoBoard by USB-connection

PicoBoard is an USB-connected interface board, serial style. It provides a slider, button, sound sensor, light sensor and resistor-measuring inputs.

This board is fairly well supported by scratch directly. Use this adapter, if you need two of them, or need to have a look to raw values.

Class

adapter.serialAdapter.PicoBoard_Adapter

Output Values

button	stringType [106]	button value, in raw, 0 when pressed, 1023 else. "true" when pressed, "false" else.
light	floatType [106]	light value, in raw 0..1023 (bright to dark), else 100..0 (bright to dark).
sensorA	floatType [106]	sensorA value, in raw 0..1023, else 0..100.
sensorB	floatType [106]	sensorB value, in raw 0..1023, else 0..100.
sensorC	floatType [106]	sensorC value, in raw 0..1023, else 0..100.
sensorD	floatType [106]	sensorD value, in raw 0..1023, else 0..100.
slider	floatType [106]	slider value, in raw 0..1023, else 0..100.
sound	floatType [106]	sound value, in raw 0..1023 (quiet to loud), else 0..100.

Parameter (mandatory)

picoBoard.raw	booleanType [106]	If true, the values are transmitted to scratch as send by the board. If false, the values are scaled as for the ScratchBoard.
serial.baud	intType [106]	Default is 38400. This value is used in firmware.
serial.device	stringType [106]	on windows, use COMn, e.g. COM6 on raspberry, use /dev/ttyn, e.g. /dev/ttyUSB0

Sample configuration

```
<adapter class='adapter.serialAdapter.PicoBoard_Adapter'  name='picoboard'>
    <description>Send receive text messages</description>

    <output_value name='slider'>
        <sensor name='slider'/>
    </output_value>

    <output_value name='light'>
        <sensor name='light'/>
    </output_value>

    <output_value name='sound'>
        <sensor name='sound'/>
    </output_value>

    <output_value name='button'>
        <sensor name='button'/>
    </output_value>

    <output_value name='sensorA'>
        <sensor name='resistance-A'/>
    </output_value>

    <output_value name='sensorB'>
        <sensor name='resistance-B'/>
    </output_value>

    <output_value name='sensorC'>
        <sensor name='resistance-C'/>
    </output_value>
```

```
    <output_value name='sensorD'>
        <sensor name='resistance-D'/>
    </output_value>

    <parameter name='serial.device' value='/dev/ttyUSB0' />
    <parameter name='serial.baud' value='38400' />

    <parameter name='picoBoard.raw' value='false' />

</adapter>
```

10.40. Pressure_BMP085_Input

Interface for air pressure sensor BMP085

Environmental sensor air pressure and temperature

Class

adapter.i2cAdapter.Pressure_BMP085_Input

Output Values

pressure	floatType [106]	pressure in pa
temperature	floatType [106]	temperature in °C

Parameter (mandatory)

i2c.address	intOrHexType [106]	Depending on address select, the bus address is '0x77' for BMP085
i2c.bus	intOrHexType [106]	bus is '1' for RPi Release 2
poll.interval	floatType [106]	poll interval in secs, e.g. 0.05

Sample configuration

```
<adapter class='adapter.i2cAdapter.Pressure_BMP085_Input'  name='pressure'>
    <description>Pressure-Value from BMP085
    Connected to I2C-Bus.
    </description>

    <output_value name='pressure'>
        <sensor name='pressure'/>
    </output_value>

    <output_value name='temperature'>
        <sensor name='temperature'/>
    </output_value>

    <parameter name='poll.interval' value='2.5' />

    <!-- bus is '1' for RPi Release 2 -->
    <parameter name='i2c.bus' value='1' />

    <!-- Depending on address select, the bus address is '0x77' for BMP085 -->
    <parameter name='i2c.address' value='0x77' />
</adapter>
```

10.41. PWM_PCA9685

Interface for Luminosity sensor BH1750

16-channel, 12-bit PWM Fm+ I2C-bus LED controller

Class

adapter.i2cAdapter.PWM_PCA9685

Input Values

channel_0	float100Type [106]	input from scratch to adapter, value = 0..100
channel_1	float100Type [106]	input from scratch to adapter, value = 0..100
channel_10	float100Type [106]	input from scratch to adapter, value = 0..100
channel_11	float100Type [106]	input from scratch to adapter, value = 0..100
channel_12	float100Type [106]	input from scratch to adapter, value = 0..100
channel_13	float100Type [106]	input from scratch to adapter, value = 0..100
channel_14	float100Type [106]	input from scratch to adapter, value = 0..100
channel_15	float100Type [106]	input from scratch to adapter, value = 0..100
channel_2	float100Type [106]	input from scratch to adapter, value = 0..100
channel_3	float100Type [106]	input from scratch to adapter, value = 0..100
channel_4	float100Type [106]	input from scratch to adapter, value = 0..100
channel_5	float100Type [106]	input from scratch to adapter, value = 0..100
channel_6	float100Type [106]	input from scratch to adapter, value = 0..100
channel_7	float100Type [106]	input from scratch to adapter, value = 0..100
channel_8	float100Type [106]	input from scratch to adapter, value = 0..100
channel_9	float100Type [106]	input from scratch to adapter, value = 0..100
servo_0	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz
servo_1	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz
servo_10	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz
servo_11	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz
servo_12	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz
servo_13	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz
servo_14	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz
servo_15	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz
servo_2	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz
servo_3	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz
servo_4	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz

servo_5	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz
servo_6	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz
servo_7	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz
servo_8	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz
servo_9	float100Type [106]	input from scratch to adapter, value = 0..100,1 to 2ms pulse with at 50Hz

Parameter (mandatory)

frequency	floatType [106]	frequency in Hz, 50Hz for Servo are recommended
i2c.address	intOrHexType [106]	Depending on address select, the bus address is '0x40' for device
i2c.bus	intOrHexType [106]	bus is '1' for RPi Release 2

Sample configuration

```
<adapter class='adapter.i2cAdapter.PWM_PCA9685' name='16-channel PWM'>
    <description>DEMO for the PCA adapter.</description>


    <!-- the scratch variable names are simply the method names here. Could be more useful... -
    <input_value name='channel_0'>
        <variable name='channel_0' />
    </input_value>

    <input_value name='channel_1'>
        <variable name='channel_1' />
    </input_value>

    <input_value name='channel_2'>
        <variable name='channel_2' />
    </input_value>

    <input_value name='channel_3'>
        <variable name='channel_3' />
    </input_value>

    <input_value name='channel_4'>
        <variable name='channel_4' />
    </input_value>

    <input_value name='channel_5'>
        <variable name='channel_5' />
    </input_value>

    <input_value name='channel_6'>
        <variable name='channel_6' />
    </input_value>

    <input_value name='channel_7'>
        <variable name='channel_7' />
    </input_value>

    <input_value name='channel_8'>
        <variable name='channel_8' />
    </input_value>

    <input_value name='channel_9'>
        <variable name='channel_9' />
    </input_value>

    <input_value name='channel_10'>
        <variable name='channel_10' />
    </input_value>
```

```
    <input_value name='servo_0'>
        <variable name='servo_0' />
    </input_value>

    <input_value name='servo_1'>
        <variable name='servo_1' />
    </input_value>

    <input_value name='servo_2'>
        <variable name='servo_2' />
    </input_value>

    <input_value name='servo_3'>
        <variable name='servo_3' />
    </input_value>

    <input_value name='servo_4'>
        <variable name='servo_4' />
    </input_value>

    <input_value name='servo_5'>
        <variable name='servo_5' />
    </input_value>

    <input_value name='servo_6'>
        <variable name='servo_6' />
    </input_value>

    <input_value name='servo_7'>
        <variable name='servo_7' />
    </input_value>

    <input_value name='servo_8'>
        <variable name='servo_8' />
    </input_value>

    <input_value name='servo_9'>
        <variable name='servo_9' />
    </input_value>

    <input_value name='servo_10'>
        <variable name='servo_10' />
    </input_value>


    <!-- frequency 50Hz is used for servo  -->
    <!-- frequency in range 1526 Hz to 24 Hz  -->

    <parameter name='frequency' value='50' />

    <!-- bus is '1' for RPi Release 2 -->
    <parameter name='i2c.bus' value='1' />

    <!-- Depending on address select, the bus address is
         '0x40' for all address lines low.
         -->
    <parameter name='i2c.address' value='0x40' />

</adapter>
```

10.42. PWM_SN3218

18 channel, 8-bit PWM I2C-bus LED controller

18 channel, 8-bit PWM I2C-bus LED controller PIGLOW board from pimoroni

Class

adapter.i2cAdapter.PWM_SN3218

Input Values

channel_00	float100Type [106]	input from scratch to adapter, value = 0..100
channel_01	float100Type [106]	input from scratch to adapter, value = 0..100
channel_02	float100Type [106]	input from scratch to adapter, value = 0..100
channel_03	float100Type [106]	input from scratch to adapter, value = 0..100
channel_04	float100Type [106]	input from scratch to adapter, value = 0..100
channel_05	float100Type [106]	input from scratch to adapter, value = 0..100
channel_06	float100Type [106]	input from scratch to adapter, value = 0..100
channel_07	float100Type [106]	input from scratch to adapter, value = 0..100
channel_08	float100Type [106]	input from scratch to adapter, value = 0..100
channel_09	float100Type [106]	input from scratch to adapter, value = 0..100
channel_0A	float100Type [106]	input from scratch to adapter, value = 0..100
channel_0B	float100Type [106]	input from scratch to adapter, value = 0..100
channel_0C	float100Type [106]	input from scratch to adapter, value = 0..100
channel_0D	float100Type [106]	input from scratch to adapter, value = 0..100
channel_0E	float100Type [106]	input from scratch to adapter, value = 0..100
channel_0F	float100Type [106]	input from scratch to adapter, value = 0..100
channel_10	float100Type [106]	input from scratch to adapter, value = 0..100
channel_11	float100Type [106]	input from scratch to adapter, value = 0..100

Parameter (mandatory)

i2c.address	intOrHexType [106]	fixed '0x54' for device
i2c.bus	intOrHexType [106]	bus is '1' for RPi Release 2

Sample configuration

```
<adapter class='adapter.i2cAdapter.PWM_SN3218' name='18-channel PWM'>
     <description>DEMO for the SN3218 adapter. This is the device used by the piglow-board</desc


     <input_value name='channel_00'>
         <variable name='channel_00' />
         <variable name='all' />
         <variable name='branch_0' />
     </input_value>

     <input_value name='channel_01'>
         <variable name='channel_01' />
         <variable name='all' />
         <variable name='branch_0' />
     </input_value>
```

```
<input_value name='channel_02'>
    <variable name='channel_02' />
    <variable name='all' />
    <variable name='branch_0' />
</input_value>

<input_value name='channel_03'>
    <variable name='channel_03' />
    <variable name='all' />
    <variable name='branch_0' />
</input_value>

<input_value name='channel_04'>
    <variable name='channel_04' />
    <variable name='all' />
    <variable name='branch_1' />
</input_value>

<input_value name='channel_05'>
    <variable name='channel_05' />
    <variable name='all' />
    <variable name='branch_1' />
</input_value>

<input_value name='channel_06'>
    <variable name='channel_06' />
    <variable name='all' />
    <variable name='branch_1' />
</input_value>

<input_value name='channel_07'>
    <variable name='channel_07' />
    <variable name='all' />
    <variable name='branch_1' />
</input_value>

<input_value name='channel_08'>
    <variable name='channel_08' />
    <variable name='all' />
    <variable name='branch_1' />
</input_value>

<input_value name='channel_09'>
    <variable name='channel_09' />
    <variable name='all' />
    <variable name='branch_1' />
</input_value>

<input_value name='channel_0A'>
    <variable name='channel_0A' />
    <variable name='all' />
    <variable name='branch_2' />
</input_value>

<input_value name='channel_0B'>
    <variable name='channel_0B' />
    <variable name='all' />
    <variable name='branch_2' />
</input_value>

<input_value name='channel_0C'>
    <variable name='channel_0C' />
    <variable name='all' />
    <variable name='branch_0' />
</input_value>

<input_value name='channel_0D'>
    <variable name='channel_0D' />
    <variable name='all' />
    <variable name='branch_2' />
</input_value>
```

```
        <input_value name='channel_0E'>
            <variable name='channel_0E' />
            <variable name='all' />
            <variable name='branch_0' />
        </input_value>

        <input_value name='channel_0F'>
            <variable name='channel_0F' />
            <variable name='all' />
            <variable name='branch_2' />
        </input_value>

        <input_value name='channel_10'>
            <variable name='channel_10' />
            <variable name='all' />
            <variable name='branch_2' />
        </input_value>

        <input_value name='channel_11'>
            <variable name='channel_11' />
            <variable name='all' />
            <variable name='branch_2' />
        </input_value>

        <!-- bus is '1' for RPi Release 2 -->
        <parameter name='i2c.bus' value='1' />

        <!-- address is fixed for this device -->
        <parameter name='i2c.address' value='0x54' />

    </adapter>
```

10.43. RFID_Reader_Adapter

Interface to Innovation ID-2LA, ID-12LA, ID-20LA, by Raspberry serial-connection

Set protocol to ASCII !

Power the device by 3.3V, and use Rx-Input of RaspberryPi

After data have been send, an event is send by the adapter.

Class

adapter.serialAdapter.RFID_Reader_Adapter

Output Event

data_event	when a read event has been performed.

Output Values

data	stringType [106]	10 chars.

Parameter (mandatory)

serial.baud	intType [106]	Use 9600.
serial.device	stringType [106]	on raspberry, use /dev/ttyAMA0

Sample configuration

```
        <adapter class='adapter.serialAdapter.RFID_Reader_Adapter'  name='rfidReader'>
        <description>Read a tag from INNOVATIONS ID-12LA or alike</description>

        <output_value name='data'>
            <sensor name='rfid'/>
        </output_value>
        <output name='data_event'>
            <broadcast name='rfid_available'/>
```

```
        </output>

        <parameter name='serial.device' value='/dev/ttyAMA0' />
        <parameter name='serial.baud' value='9600' />

    </adapter>
```

10.44. ScratchStartclickedAdapter

Send start broadcast event at connection start.

Send start broadcast event at connection start

Can be configured to send arbitrary events on connection start.

Class

adapter.broadcast.ScratchStartclickedAdapter

Sample configuration

```
<adapter class='adapter.broadcast.ScratchStartclickedAdapter'  name='startClick'>
    <output name='command'>
        <broadcast name='scratch-startclicked'/>
    </output>
    <description>Send startclicked</description>
</adapter>
```

10.45. SenseHat_Adapter

Sense-Hat Adapter.

Installation procedures for senseHat required.

Supports LED, sensors and orientation.

setPixel_xy: depends on setting x_pos, y_pos and color values.

clearPixel_xy: depends on setting x_pos, y_pos.

Class

adapter.senseHat_adapter.SenseHat_Adapter

Input Events

clear	calls sense.clear(); clears the LED matrix
clearPixel_xy	shuts off LED pixel on x,y position.
setPixel_xy	sets pixel on x,y position to color. Depends on setting x_pos, y_pos and color first.

Input Values

color	colorType [106]	color for pixel to set.
x_pos	intType [106]	x-pos to address the LED-matrix, [0..7].
y_pos	intType [106]	y-pos to address the LED-matrix, [0..7].

Output Values

humidity	floatType [106]	humidity, rounded to one decimal digit.
orientation_pitch	floatType [106]	orientation_pitch, rounded to one decimal digit.
orientation_roll	floatType [106]	orientation_roll, rounded to one decimal digit.
orientation_yaw	floatType [106]	orientation_yaw, rounded to one decimal digit.
pressure	floatType [106]	pressure, rounded to one decimal digit.

temperature	floatType	[106]	temperature, rounded to one decimal digit.

Parameter (mandatory)

poll.interval	floatType	[106]	poll rate in seconds, default 0.1 sec.

Sample configuration

```
<adapter class='adapter.senseHat_adapter.SenseHat_Adapter' name='astro-pi'>

    <!-- -->

    <description>SenseHat. LED environmental sensors, orientation</description>

    <input name= 'clear'>
        <broadcast name='sense_led_clear'/>
    </input>

    <input name= 'setPixel_xy'>
        <broadcast name='sense_led_xy_on'/>
    </input>

    <input name= 'clearPixel_xy'>
        <broadcast name='sense_led_xy_off'/>
        <!--  there is a flaw in the sample scratch code which
              has partial misspelling of one event, so add this wrong name too -->
        <broadcast name='semse_led_xy_off'/>
    </input>

    <!--  variables for setting pixels -->

    <input_value name='pixelX'>
        <variable name='x_pos'/>
    </input_value>

    <input_value name='pixelY'>
        <variable name='y_pos'/>
    </input_value>

     <input_value name='color'>
        <variable name='color'/>
    </input_value>

    <!--  environmental sensors from adapter to scratch -->

    <output_value name='temperature'>
        <sensor name='temperature'/>
    </output_value>

    <output_value name='pressure'>
        <sensor name='pressure'/>
    </output_value>

     <output_value name='humidity'>
        <sensor name='humidity' />
    </output_value>

    <!--  IMU sensors from adapter to scratch -->

     <output_value name='orientation_pitch'>
        <sensor name='orientation_pitch' />
      </output_value>

     <output_value name='orientation_roll'>
        <sensor name='orientation_roll' />
    </output_value>

     <output_value name='orientation_yaw'>
        <sensor name='orientation_yaw' />
    </output_value>
```

```
        <!-- polling time for external device -->
        <parameter name='poll.interval' value='0.1' />


    </adapter>
```

10.46. ServoBlaster

ServoBlaster driver

Servoblaster runs as daemon servod in the background and needs to be started manually.

See servoblaster doku for assignment of channel index numbers to GPIO pins.

Class

adapter.servoblaster.ServoBlaster

Input Values

servo_0	float100Type [106]	values 0..100
servo_1	float100Type [106]	values 0..100
servo_2	float100Type [106]	values 0..100
servo_3	float100Type [106]	values 0..100
servo_4	float100Type [106]	values 0..100
servo_5	float100Type [106]	values 0..100
servo_6	float100Type [106]	values 0..100
servo_7	float100Type [106]	values 0..100

Parameter (optional)

millisecond.0.max	floatType [106]	default 2 [ms]. Optional max value in range 1.1..2.5 [ms]
millisecond.0.min	floatType [106]	default 1 [ms]. Optional min value in range 0.5..1.9 [ms]
millisecond.1.max	floatType [106]	default 2 [ms]. Optional max value in range 1.1..2.5 [ms]
millisecond.1.min	floatType [106]	default 1 [ms]. Optional min value in range 0.5..1.9 [ms]
millisecond.2.max	floatType [106]	default 2 [ms]. Optional max value in range 1.1..2.5 [ms]
millisecond.2.min	floatType [106]	default 1 [ms]. Optional min value in range 0.5..1.9 [ms]
millisecond.3.max	floatType [106]	default 2 [ms]. Optional max value in range 1.1..2.5 [ms]
millisecond.3.min	floatType [106]	default 1 [ms]. Optional min value in range 0.5..1.9 [ms]
millisecond.4.max	floatType [106]	default 2 [ms]. Optional max value in range 1.1..2.5 [ms]
millisecond.4.min	floatType [106]	default 1 [ms]. Optional min value in range 0.5..1.9 [ms]
millisecond.5.max	floatType [106]	default 2 [ms]. Optional max value in range 1.1..2.5 [ms]
millisecond.5.min	floatType [106]	default 1 [ms]. Optional min value in range 0.5..1.9 [ms]
millisecond.6.max	floatType [106]	default 2 [ms]. Optional max value in range 1.1..2.5 [ms]
millisecond.6.min	floatType [106]	default 1 [ms]. Optional min value in range 0.5..1.9 [ms]
millisecond.7.max	floatType [106]	default 2 [ms]. Optional max value in range 1.1..2.5 [ms]
millisecond.7.min	floatType [106]	default 1 [ms]. Optional min value in range 0.5..1.9 [ms]

Sample configuration

```
<adapter class='adapter.servoblaster.ServoBlaster'  name='servoblaster'>
    <description>servoblaster for 8 channels. See servoblaster doku for
    assignment of channel index numbers to GPIO pins.</description>
```

```
    <!--  looks strange, but could do some renaming for scratch variables here  -->
    <input_value name= 'servo_0'>
        <variable name='servo_0'/>
    </input_value>
    <input_value name= 'servo_1'>
        <variable name='servo_1'/>
    </input_value>
    <input_value name= 'servo_2'>
        <variable name='servo_2'/>
    </input_value>
    <input_value name= 'servo_3'>
        <variable name='servo_3'/>
    </input_value>
    <input_value name= 'servo_4'>
        <variable name='servo_4'/>
    </input_value>
    <input_value name= 'servo_5'>
        <variable name='servo_5'/>
    </input_value>
    <input_value name= 'servo_6'>
        <variable name='servo_6'/>
    </input_value>
    <input_value name= 'servo_7'>
        <variable name='servo_7'/>
    </input_value>
</adapter>
```

10.47. TimeAdapter

Send current system time values (second, minute, hour, day, month, year) to scratch.

System time is not available in scratch 1.4. The adapter provides current system time.

Class

adapter.broadcast.TimeAdapter

Sample configuration

```
<adapter class='adapter.broadcast.TimeAdapter' name='currentSystemTime'>

    <description>System time for Scratch 1.4</description>

    <output_value name='second'>
        <sensor name='time.second'/>
    </output_value>

    <output_value name='minute'>
        <sensor name='time.minute'/>
    </output_value>

    <output_value name='hour'>
        <sensor name='time.hour'/>
    </output_value>

    <output_value name='day'>
        <sensor name='time.day'/>
    </output_value>

    <output_value name='month'>
        <sensor name='time.month'/>
    </output_value>

    <output_value name='year'>
        <sensor name='time.year'/>
    </output_value>

    <parameter name='poll.interval' value='0.2' />
```

```
</adapter>
```

10.48. Twitter_Adapter

Reading twitter messages by 'term' or 'hashname'.

Read twitter messages by hashtag name 'term'. Needs credentials from twitter to work.

Needs installation of 'python-twitter'.

Class

adapter.twitterAdapter.Twitter_Adapter

Input Events

textAcknowledge	when a text variable is processed, send acknowledge to receive next text.

Output Event

textAvailable	A text variable is available in scratch and can be processed.

Output Values

status	stringType [106]	Status information from adapter.
text	stringType [106]	A message from twitter.

Parameter (mandatory)

scratch.timeout	intType [106]	timeout for messages which are aquired by adapter, but not read by scratch.
twitter.access_token_key	stringType [106]	Get these from twitter for your account
twitter.access_token_secret	stringType [106]	Get these from twitter for your account
twitter.consumer_key	stringType [106]	Get these from twitter for your account
twitter.consumer_secret	stringType [106]	Get these from twitter for your account
twitter.datafile	stringType [106]	Write a data file with last message Id. Path needs to be relative. Example 'data/twitter_data.json'
twitter.pollrate	intType [106]	twitter account has limits on polling rate: 15 requests per 15 minutes are allowed. See twitter.com for details. if you see messages 'Rate limit exceeded', then increase this parameter. 60 sec are a good starting point.
twitter.read.direct	booleanType [106]	Read direct messages. One of 'direct' or 'term' needs to be specified.
twitter.read.term	booleanType [106]	Read search messages with 'term'. One of 'direct' or 'term' needs to be specified.
twitter.term	stringType [106]	Get messages with 'term' from twitter. Example '#raspberrytweet'

Sample configuration

```
<adapter class='adapter.twitterAdapter.Twitter_Adapter' name='twitter'>
     <description>text output from twitter messages</description>

     <input name='textAcknowledge'>
         <broadcast name='ack' />
     </input>

     <output name='textAvailable'>
         <broadcast name='listen' />
     </output>

     <output_value name='text'>
         <sensor name='text' />
     </output_value>
```

```
        <output_value name='status'>
            <sensor name='status' />
        </output_value>

        <parameter name='twitter.consumer_key' value='' />
        <parameter name='twitter.consumer_secret' value='' />
        <parameter name='twitter.access_token_key' value='' />
        <parameter name='twitter.access_token_secret' value='' />

        <parameter name='twitter.term' value = '#raspberrytweet' />
        <parameter name='twitter.datafile' value= 'data/twitter_data.json' />

        <!--  twitter account has limits on polling rate
              15 requests per 15 minutes are allowed. See twitter.com for details.
              if you see messages 'Rate limit exceeded', then increase this parameter -->
        <parameter name='twitter.pollrate' value= '60' />

        <parameter name='twitter.read.direct' value= 'true' />
        <parameter name='twitter.read.term' value= 'true' />

        <!-- scratch will ignore those messages received earlier than 'scratch.timeout' -->
        <parameter name='scratch.timeout' value= '60' />

    </adapter>
```

10.49. UnipolarStepperModule

Drives an unipolar stepper motor.

The adapter does all the low level step pattern management and receives target position and speed values from scratch. This achieves faster steps than controlling single step events from scratch.

When a position is reached, a 'stopped' signal is issued.

Class

adapter.stepper.UnipolarStepperModule

Input Events

reset_4	resets position; sets the drive pattern to a '4 step pattern', fast, less smooth
reset_8	resets position; sets the drive pattern to a '8 step pattern', slow, smooth

Input Values

speed	floatType	[106]	float values, time between steps.
target	floatType	[106]	Absolute values. integer values, positive or negative.

Output Event

complete	position reached

Sample configuration

```
    <adapter class='adapter.stepper.UnipolarStepperModule' name='stepper'>

        <description>stepper control for unipolar stepper
        </description>

        <gpio port='GPIO25' alias='br0.0'>
            <default dir='OUT' pull='PUD_OFF' default='low' />
            <active dir='OUT' pull='PUD_OFF' />
        </gpio>
        <gpio port='GPIO24' alias='br0.1'>
            <default dir='OUT' pull='PUD_OFF' default='low' />
            <active dir='OUT' pull='PUD_OFF' />
        </gpio>
```

```
    <gpio port='GPIO23' alias='br1.0'>
        <default dir='OUT' pull='PUD_OFF' default='low' />
        <active dir='OUT' pull='PUD_OFF' />
    </gpio>
    <gpio port='GPIO18' alias='br1.1'>
        <default dir='OUT' pull='PUD_OFF' default='low' />
        <active dir='OUT' pull='PUD_OFF' />
    </gpio>

    <input name='reset_8'>
        <broadcast name='reset_8' />
    </input>

    <input name='reset_4'>
        <broadcast name='reset_4' />
    </input>
    <input_value name='speed'>
        <variable name='speed' />
    </input_value>

    <input_value name='target'>
        <variable name='target' />
    </input_value>

    <!-- signal added 2016-05-08 -->
    <output name='complete'>
        <broadcast name='position_reached'/>
    </output>

</adapter>
```

10.50. UnipolarStepperStep

Drives an unipolar stepper motor.

Driver for an unipolar stepper, where drive patterns are controlled by scratch. This is quite slow, but allows for teaching the basics.

Class

adapter.stepper.UnipolarStepperStep

Input Values

binaryPattern	binary4Type [106]	Binary pattern for all four outputs. Syntax is like "b0000". The digits adress br0.0, br0.1, br1.0, br1.1
br0_0	binaryType [106]	Value '0', '1', switches output br0.0
br0_1	binaryType [106]	Value '0', '1', switches output br0.1
br1_0	binaryType [106]	Value '0', '1', switches output br1.0
br1_1	binaryType [106]	Value '0', '1', switches output br1.1

Sample configuration

```
<adapter class='adapter.stepper.UnipolarStepperStep' name='stepper'>

    <description>stepper control for unipolar stepper
    Allows for discrete switch signals br0.0, br0.1, br1.0, br1.1
    or binary inputs 'pattern', e.g b0001, b0011, ...
    </description>

    <gpio port='GPIO25' alias='br0.0'>
        <default dir='OUT' pull='PUD_OFF' default='low'  />
        <active dir='OUT' pull='PUD_OFF'/>
    </gpio>
    <gpio port='GPIO24' alias='br0.1'>
        <default dir='OUT' pull='PUD_OFF' default='low' />
        <active dir='OUT' pull='PUD_OFF'/>
    </gpio>
```

```
    <gpio port='GPIO23' alias='br1.0'>
        <default dir='OUT' pull='PUD_OFF' default='low' />
        <active dir='OUT' pull='PUD_OFF'/>
    </gpio>
    <gpio port='GPIO18' alias='br1.1'>
        <default dir='OUT' pull='PUD_OFF' default='low' />
        <active dir='OUT' pull='PUD_OFF'/>
    </gpio>

    <input_value name='br0_0'>
        <variable name='br0.0'/>
    </input_value>
    <input_value name='br0_1'>
        <variable name='br0.1'/>
    </input_value>
    <input_value name='br1_0'>
        <variable name='br1.0'/>
    </input_value>
    <input_value name='br1_1'>
        <variable name='br1.1'/>
    </input_value>

    <input_value name='binaryPattern'>
        <variable name='pattern'/>
    </input_value>

 </adapter>
```

10.51. UNO_Adapter

Interface to ArduinoUNO by USB-connection

Inputs and outputs depend on configuration. See comments in sample configuration.

Class

adapter.arduino.UNO_Adapter

Parameter (mandatory)

serial.baud	intType [106]	Default is 115200. This value is used in firmware.
serial.device	stringType [106]	on windows, use COMn, e.g. COM6 on raspberry, use /dev/ttyn, e.g. /dev/ttyAMA0

Sample configuration

```
<adapter class='adapter.arduino.UNO_Adapter' name='UNO'>

    <!-- input and output methods in python are dynamically generated like
         - inputD4  for io@dir=out   [0..1]
         - servoD6  for io@dir=servo [0..180]
         - pwmD6    for io@dir=pwm   [0..255]
         - outputD3 for io@dir=in    [0..1]
    -->
     <!-- digital input values are inputs for the adapter (but outputs for arduino) -->

    <input_value name='inputD4'>
        <variable name='redLED' />
    </input_value>

    <input_value name='inputD5'>
        <variable name='greenLED' />
    </input_value>

    <output_value name='outputD3'>
        <sensor name='button' />
    </output_value>
```

```
        <!-- output_value methods in python are dynamically generated like outputADA0 for analog@di
        <!-- AD-Values are outputs for the adapter (but inputs for arduino) -->

        <output_value name='outputADA0'>
            <sensor name='potentiometer_0' />
        </output_value>

        <!--  on windows, use COMn, e.g. COM6  -->
        <!--  on raspberry, use /dev/ttyn, e.g. /dev/ttyAMA0  -->

        <parameter name='serial.device' value='COM6' />
        <parameter name='serial.baud' value='115200' />

        <!-- this is the setup for an UNO arduino -->

        <!-- do not use D0, D1 (serial  lines)  -->
        <!-- @dir = void, pwm, in, out, servo -->
        <io id='D0' dir='void' />
        <io id='D1' dir='void' />

        <!--  3,5,6,10,11 may be pwm -->
        <io id='D2' dir='out' />
        <io id='D3' dir='in' pullup='on' />

        <io id='D4' dir='out' />
        <io id='D5' dir='pwm' />

        <io id='D6' dir='out' />
        <io id='D7' dir='out' />

        <io id='D8' dir='in' pullup='on' />
        <io id='D9' dir='in' pullup='on' />
        <io id='D10' dir='in' pullup='on' />
        <io id='D11' dir='in' pullup='on' />

        <io id='D12' dir='in' pullup='on' />

        <!--  do not use D13 (onboard LED)  -->

        <io id='D13' dir='void' />

        <analog id='A0' dir='in'  />
        <analog id='A1' dir='void'  />
        <analog id='A2' dir='void'  />
        <analog id='A3' dir='void'  />
        <analog id='A4' dir='void'  />
        <analog id='A5' dir='void'  />
        <!-- on NANO, A6 and A7 are available for analog input -->
        <analog id='A6' dir='void'  />
        <analog id='A7' dir='void'  />

    </adapter>
```

10.52. UNO_POWERFUNCTIONS_Adapter

Interface to ArduinoUNO by USB-connection

Controls LEGO Powerfunctions sending by IR transmitter.

Needs sketch 'arduino/power_functions' on arduino. An infrared LED needs to be connected from PIN12 by a current limiting diode to 5V. When arduino is not on 5V, look for documentation.

The command choosen for powertools have timeout enabled; refresh is handled in adapter.

Values sent are -7 to 7; BRAKE is a special command.

Class

adapter.arduino.UNO_POWERFUNCTIONS_Adapter

Input Values

CHANNEL_1_A	stringType [106]	-7 .. 7, BRAKE
CHANNEL_1_B	stringType [106]	-7 .. 7, BRAKE
CHANNEL_2_A	stringType [106]	-7 .. 7, BRAKE
CHANNEL_2_B	stringType [106]	-7 .. 7, BRAKE
CHANNEL_3_A	stringType [106]	-7 .. 7, BRAKE
CHANNEL_3_B	stringType [106]	-7 .. 7, BRAKE
CHANNEL_4_A	stringType [106]	-7 .. 7, BRAKE
CHANNEL_4_B	stringType [106]	-7 .. 7, BRAKE

Parameter (mandatory)

serial.baud	intType [106]	Default is 115200. This value is used in firmware.
serial.device	stringType [106]	on windows, use COMn, e.g. COM6 on raspberry, use /dev/ttyn, e.g. /dev/ttyAMA0

Sample configuration

```
<adapter class='adapter.arduino.UNO_POWERFUNCTIONS_Adapter' name='UNO'>
     <!--  Sample arduino communication. Needs arduino sketch programmed in arduino. -->


     <input_value name='CHANNEL_1_A'>
         <variable name='c_1_A' />
     </input_value>
    <input_value name='CHANNEL_1_B'>
         <variable name='c_1_B' />
     </input_value>
    <input_value name='CHANNEL_2_A'>
         <variable name='c_2_A' />
     </input_value>
    <input_value name='CHANNEL_2_B'>
         <variable name='c_2_B' />
     </input_value>
    <input_value name='CHANNEL_3_A'>
         <variable name='c_3_A' />
     </input_value>
    <input_value name='CHANNEL_3_B'>
         <variable name='c_3_B' />
     </input_value>
    <input_value name='CHANNEL_4_A'>
         <variable name='c_4_A' />
     </input_value>
    <input_value name='CHANNEL_4_B'>
         <variable name='c_4_B' />
     </input_value>


     <!-- ================================================== -->
     <!--  on windows, use COMn, e.g. COM6  -->
     <!--  on raspberry, use /dev/ttyn, e.g. /dev/ttyAMA0  -->

     <!--
         <parameter name='serial.device' value='/dev/ttyUSB0' />
     -->
          <parameter name='serial.device' value='COM6' />

     <parameter name='serial.baud' value='115200' />


 </adapter>
```

10.53. W1_DS1820

DS1820 and related devices, using w1-gpio driver

Needs w1-gpio driver.

Class

adapter.w1_gpio.W1_DS1820

Output Values

temperature	floatType [106]	value is temperature in °C

Parameter (mandatory)

poll.interval	floatType [106]	Poll interval in seconds, 0.5 or slower is good.
w1.device	stringType [106]	the id on the w1-bus.

Sample configuration

```
<adapter class='adapter.w1_gpio.W1_DS1820'  name='temp_DS1820'>
    <description>Temp values from DS1820</description>

    <output_value name='temperature'>
        <sensor name='ds18b20'/>
    </output_value>

    <parameter name='poll.interval' value='1.0' />

    <!-- start kernel driver g1-gpio
         base dir /sys/bus/w1/devices
    -->
    <parameter name='w1.device' value='10-0008023b57b9' />
</adapter>
```

10.54. WebsocketXY_Adapter

X, Y-Values from an orientation sensor

X, Y-Values from an orientation sensor on a smartphone, sent through some javascript, websocket to RPI. There is the need of a web page providing the javascript too.

Class

adapter.websocket.WebsocketXY_Adapter

Output Event

click	The javascript code sends click-events. These are propagated to scratch.

Output Values

cntValue	intType [106]	
xValue	floatType [106]	x-angle
yValue	floatType [106]	y-angle

Sample configuration

```
<adapter class='adapter.websocket.WebsocketXY_Adapter'  name='XY'>
        <description>X, Y-Values from an orientation sensor</description>

        <output_value name='xValue'>
            <sensor name='goto_X'/>
        </output_value>

        <output_value name='yValue'>
            <sensor name='goto_Y'/>
```

```
    </output_value>

    <output_value name='cntValue'>
        <sensor name='counter'/>
    </output_value>

    <output name='click'>
        <broadcast name='click_event'/>
    </output>

    <webserver>
        <!-- implement a web socket link 'route'  -->
        <route name='pendel' route='/adapter/pendel' />

        <!--  implement a link on start page of web server -->
        <html name='pendel' path='websocket/pendel.html' comment='positional sensor from a smar
    </webserver>

</adapter>
```

10.55. Wire_SHTx

SHT15 or alike humidity sensors

Provides scan results from a barcode scanner.

Class

adapter.wire_gpio.Wire_SHTx

Output Values

humidity	floatType	[106]	relative humidity
temperature	floatType	[106]	temperature in °C

Parameter (mandatory)

poll.interval	floatType	[106]	polling interval in seconds, min 2 sec.

Sample configuration

```
<adapter class='adapter.wire_gpio.Wire_SHTx'  name='Humidity'>
    <description>Humidity-Value from SHT15</description>

    <gpio port='GPIO23' alias='clock'>
        <default dir='IN' pull='PUD_UP'  />
        <active dir='IN' pull='PUD_UP'   />
    </gpio>

    <gpio port='GPIO24' alias='data'>
        <default dir='IN' pull='PUD_UP'  />
        <active dir='IN' pull='PUD_UP'   />
    </gpio>

    <output_value name='humidity'>
        <sensor name='humidity'/>
    </output_value>

    <output_value name='temperature'>
        <sensor name='temperature'/>
    </output_value>

    <!--  poll time min 1 sec (self heating permits max 1 measurement per sec) -->
    <parameter name='poll.interval' value='2' />

</adapter>
```

10.56. WS2801_Adapter

WS2801-LED chain driver

Streaming out Bytes to a WS2801-Device. To keep it simple, the input variable is a concatenated list of color names 'red', 'darkred', 'green', 'blue', yellow', 'pink'. Could also be #rrggbb-hex values, but not implemented for simplicity. Separators are blank.

Class

adapter.spiAdapter.WS2801_Adapter

Input Values

led	colorType [106]	blank-separated color names

Parameter (mandatory)

led.length	intType [106]	Length of LED chain, e.g. 50
spi.bus	intType [106]	
spi.device	intType [106]	

Sample configuration

```
<adapter class='adapter.spiAdapter.WS2801_Adapter'  name='led_stripe'>

    <description>LED Stripe of 50 </description>

    <input_value name='led'>
        <variable name='led'/>
    </input_value>

    <parameter name='led.length' value='50' />

    <parameter name='spi.bus' value='0' />
    <parameter name='spi.device' value='0' />
</adapter>
```

10.57. Adapter Data Types

anyType	[.]	scratch will accept any type for variable/sensor input.
binary4Type	b[01]{4}	binary 4 bits, sample is "b0100"
binaryType	[01]	
booleanType	(1|TRUE|YES|Y|HIGH)|(0|FALSE|NO|N|LOW)	case insensitive
char7segmentType	[0-9AbCcdEFr-]	case sensitive
colorType	[.]	Colors in plain text format ('red', 'green', 'blue', 'darkred', 'darkgreen', 'darkblue', 'yellow', 'pink', 'magenta', 'off', 'white') or hex format r,g,b (e.g. 'ee23a0' or '#ee23a0')
digitType	[0-9]	0..9
float100Type	[0-9]+([.][0-9]*)?	0..100
floatType	[0-9]+([.][0-9]*)?	0..
intOrHexType	([0-9]+)|(0x[0-9A-Fa-f]+)	integer or hex values
intType	[0-9]+	0..
restrictedStringType	[.]	String, except ['|$\/<>&~*]
stringType	[.]	String

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Chapter 12. References

/rsp/ see http://wiki.scratch.mit.edu/wiki/Remote_Sensors_Protocol

/simon/ see http://cymplecy.wordpress.com/2013/04/22/scratch-gpio-version-2-introduction-for-beginners/

/silent/ „SILENT: un’interfaccia tra Scratch e LEGO NXT“, Luca Zenatti