Raspberry Pi Toolkit 0.0.3

a somewhat MATLAB compatible Raspberry Pi toolkit for GNU Octave.

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Distribution

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To download a copy of the GNU Octave raspi package, please visit `https://sourceforge.net/projects/octave-raspberrypi/`.

Table of Contents

1 Installing and loading

The Raspberry Pi toolkit must be installed and then loaded to be used.

It can be installed in GNU Octave directly from octave-forge, or can be installed in an off-line mode via a downloaded tarball.

> **NOTE**
> The toolkit has a dependency on the instrument-control package, so it must be installed in order to successfully install the Raspberry Pi toolkit

The toolkit must be then be loaded once per each GNU Octave session in order to use its functionality.

1.1 Online Direct install

With an internet connection available, the Raspberry Pi package can be installed from octave-raspi website using the following command within GNU Octave:

```
pkg install https://sourceforge.net/projects/octave-raspberrypi/files/v0.0.3/raspi-0.0
```

The latest released version of the toolkit will be downloaded and installed.

1.2 Off-line install

With the raspi toolkit package already downloaded, and in the current directory when running GNU Octave, the package can be installed using the following command within GNU Octave:

```
pkg install raspi-0.0.3.tar.gz
```

1.3 Loading

Regardless of the method of installing the Raspberry Pi toolkit, in order to use its functions, the toolkit must be loaded using the pkg load command:

```
pkg load raspi
```

The toolkit must be loaded on each GNU Octave session.

2 Hardware setup

The raspi packages uses pigpio on the Raspberry Pi hardware to communicate with the board.

In order to use the raspi hardware with the toolkit, it must have the pigpiod server installed and running on the Raspberry Pi board.

2.1 Raspberry Pi OS

The raspi toolkit is tested using the official Raspberry Pi Lite OS (https://downloads.raspberrypi.org/raspios_lite_armhf_latest), but should also work with the full version.

The image needs to be loaded to the Pi SD card and the pi booted successfully before installing the additional software required by the raspi toolkit.

The network should be configured so that access to the pi can be obtained and the ssh service enabled.

The additional software can be installed using a simple install script that comes with toolkit or can be setup manually for more control.

2.2 Quick setup

To use the quick set up, copy the raspi_setup_hw.sh from the pkg bin directory to the raspberry pi.

1. Using ssh, login to the Pi and cd to the directory on the pi that contains the setup.
2. Run the setup as sudo. ie: sudo ./raspi_setup_hw.sh
3. Reboot the Pi ie: sudo reboot
4. Attempt to connect to the Pi using the toolkit.

2.3 Manual setup

Manual setup is the list of command that are done normally using the setup script.

1. Install pigpiod i2c-tools avahi-daemon openssh-server and any dependancies

```
> sudo apt-get install pigpiod i2c-tools avahi-daemon openssh-server
```

2. Run the raspi-config tool

```
> sudo raspi-config
```

In the interface options, enable ssh, rgpio, i2c, spi, serial

3. Add pigpio access to directories in /opt/piggpio/access

At a minimum read/write to /tmp is required.

Defaults used in the installer:

```
/home/pi/* u

/tmp/raspi-* u

* r
```

4. Enable avahi for mDNS

```
> systemctl enable avahi-daemon
```

Optionally, also set the host name in /etc/hostname, especially if more than one pi will be used.

5. Copy the cgi scripts from the raspi tool kit repo to /opt/pigpio/cgi/
6. Optionally use raspi-config to turn off startup of the GUI.

3 Connecting to a raspi

To control an raspi device, a connection must be made to it by creating an raspi object.

```
r = raspi("192.168.1.100")
```

Instead of an IP address, the name of the pi can be used.

```
r = raspi("raspberrypi.local")
```

4 Basic Input and Output Overview

Basic input and output can be performed on a connected raspi device using by calling the read and write functions for a specific gpio pin on the Raspberry Pi.

A list of available pins can get found from the AvailableDigitalPins property of the connected raspi object.

```
r = raspi();
% get the pins
pins = r.AvailableDigitalPins
```

4.1 Performing Digital I/O

A pin's digital logic value can be true (1) or false (0) and can be set using the writeDigitalPin function.

The following example attempts to set the GPIO 17 pin of the connected raspi object "r" to true, waits 5 seconds and then sets it to false:

```
writeDigitalPin (r,  17, true);
pause 5
writeDigitalPin (r,  17, false);
```

Using the readDigitalPin will read the current logic state of the pin.

```
value = readDigitalPin (r,  17);
```

4.2 I2C Devices

The SPI device addresses connected to the Raspberry can be queried using the scanI2Cbus function.

```
r = raspi();
devs = scanI2Cbus(r);
```

I2C devices are created using the i2cdev object, providing the i2c bus and i2c address.

```
r = raspi();
i2c = i2cdev(r, 0, 0x40);
```

After creating an I2C device, the device can be communicated to using the read, write, readRegister and writeRegister functions.

4.3 SPI Devices

A spi device can be created using the spidev object.

```
r = raspi();
spi = spidev(r, "ce0");
```

Once created, the device can be communicated to using the writeRead function.

4.4 Serial Devices

Serial devices can be accessed using the serial dev function.

```
r = raspi();
ser = serialdev(r, "/dev/serial0", 9600);
```

A serial device can be communicated to using the read and write functions.

4.5 Servos

A servo can be controlled be creating a servo object.

```
r = raspi();
ser = servo(r, servo(p, 17, 'MinPulseDuration', 1e-3, 'MaxPulseDuration', 2e-3)
```

Once created, the servo can be moved between 0 to 180 degrees, corresponding to the min and max pulse duration using the writePosition function.

5 Examples

A number of basic example scripts are provided to demonstrate the raspi toolkit functionality. The scripts are installed in the examples directory of the pkg and include:

examples/example_blink_led.m
: Demonstrate blinking one of the builtin LEDs on the Raspberry Pi.

examples/example_dio_blink_led.m
: Demonstrate blinking a LED connected to a pin on the Raspberry Pi.

examples/example_i2c_si721_temp.m
: Demonstrate I2C functionality by reading a Si7021 temperature sensor.

examples/example_serial_gps.m
: Demonstrate serial device usage for a GPS unit connected to the pi.

examples/example_servo.m
: Demonstrate control of a servo connected to the pi.

examples/example_spi_bme280.m
: Demonstrate use of spi functionality for a BME-280 temperature sensor connected to the pi.

6 Function Reference

The functions currently available in the Raspberry Pi toolkit are described below:

6.1 General Functions

6.1.1 israspi

retval = `israspi` (*obj*)

Check if input value is an raspi object

Function is essentially just a call of `retval = isa(obj, "raspi");`

Inputs

obj - The object to check

Outputs

retval is true, if obj is an raspi object, false otherwise.

See also: raspi.

6.1.2 pigpio

retval = `pigpio` ()
retval = `pigpio` (*ipaddress*, *portnumber*)
retval = `pigpio` (*ipaddress*, *portnumber*, *timeout*)

Connect to pigpio server on a raspberry pi board using the pigpio daemon interface.

Inputs

ipaddress - ip or host name of the raspberry PI pigpio server. If omitted, a default of "127.0.0.1" is used.

portnumber - port number the server is running on. If omitted, a port of 8888 is used.

timeout - Timeout value.

Outputs

retval - a pigpio object.

See also: http://abyz.me.uk/rpi/pigpio/pdif2.html.

retval = `get_hardware_revision` (*p*)

Get the raspberry pi hardware version

Inputs

p - the connected pigpio object.

Outputs

retval - hardware version number.

See also: pigpio.

retval = `get_pigpio_version` (*p*)

Get the pigpio software version

Inputs

p - the connected pigpio object.

Outputs

retval - version number.

See also: pigpio.

`retval = get_current_tick (p)`
Get the a tick value in milliseconds

Inputs

p - the connected pigpio object.

Outputs

retval - tick value.
Note that as the tick value is a int32, the value will wrap every 17 minutes.

See also: pigpio.

`retval = get_mode (p, pin)`
Get the mode a pin is set to.

Inputs

p - the connected pigpio object.
pin - the pin to query.

Outputs

retval - pin mode.

See also: pigpio.

`retval = set_mode (p, pin, mode)`
Set the mode a pin is set to.

Inputs

p - the connected pigpio object.
pin - the pin to query.
mode - mode to.

Outputs

retval - 0 on success.

See also: pigpio.

6.2 Audio Functions

6.2.1 @raspi/audioplayer

`retval = audioplayer (piobj, devname)`
`retval = audioplayer (piobj, devname, propertyname, propertyvalue)`
Create a audio output object to a raspberry pi

Inputs

piobj - a connected raspberry pi raspi object.
devname - name of the audio livice to output to.
propertyname, *propertyvalue* - Optional property name/value pairs.

Outputs

retval - returns a audioplayer object.

Object Properties

Known properties are:

DeviceName
: The name of device to us.

SampleRate
: The samplerate to use

Parent
: Raspi object of the audioplayer.

See also: raspi, listAudioDevices.

`play (`*`audobj`*`, `*`data`*`)`
Play the input data on the audioplayer

Inputs

audobj - the audioplayer object.
data - the data to write to the device (int16).

Outputs

None

See also: spidev.

6.2.2 @raspi/listAudioDevices

`retval` `= listAudioDevices (`*`p`*`, `*`audioType`*`)`
Query the available audio devices on the Raspberry Pi.

Inputs

p - Raspi to query.

audioType - type of audio device to query. Valid options 'playback' or 'capture'

Outputs

devices - a List of structs for the available devices. with the struct containing Name, Device, Channels and SamplingRate.

See also: raspi, audioplayer.

6.3 Servo Functions

6.3.1 @raspi/servo

`retval` `= servo (`*`piobj`*`, `*`pin`*`)`
`retval` `= servo (`*`piobj`*`, `*`pin`*`, `*`propertyname`*`, `*`propertyvalue`*` ...)`
Create a servo object on the specified raspberry pi board pin.

Inputs

piobj - a connected raspberry pi raspi object.
pin - the GPIO pin number the servo is connected to.
propertyname, *propertyvalue* - property name/value pairs for additional servo properties

Known properties are:

MinPulseDuration
: The minimum pulse duration in seconds.

MaxPulseDuration
: The maximum pulse duration in seconds.

Outputs

retval - returns a servo object.

Examples

Create a servo object with min and max pulses on pin 17.

```
p = raspi("raspberrypi.local");
s = servo(p, 17, 'MinPulseDuration', 1e-3, 'MaxPulseDuration', 2e-3)
```

See also: raspi.

`writePosition (`*`servoobj`*, *`angle`*`)`
Command the servo to an angle value.

Inputs

servoobj - the servo object.
angle - the angle (0 - 180) to command the servo to.

The angle is translated 0 being the min pulse width value and 180 being the max pulse width value.

Outputs

None

See also: servo.

6.4 I2C Functions

6.4.1 @raspi/i2cdev

`retval` `= i2cdev (`*`piobj`*, *`busnum`*, *`address`*`)`
Create an I2C object on the specified raspberry pi board pin.

Inputs

piobj - a connected raspberry pi raspi object.
busnum - the I2C bus 0 or 1 or bus name 'i2c-0' or 'i2c-1'.
address - the I2C device address.

Known properties are:

Bus The Bus the device is on. (read only)

I2CAddress
: The I2C address the device is om (read only)

Outputs

retval - returns a i2cdev object.

See also: raspi.

`write (i2cobj, data)`
`write (i2cobj, data, dataprecision)`
Write data to a i2cdev object.

Inputs

i2cobj - the i2cdev object.
data - data to write to the i2cdev object. *dataprecision* - data to precision for the input data.

Outputs

None

See also: i2cdev, read.

`data = read (i2cobj, cnt)`
`data = read (i2cobj, cnt, dataprecision)`
Read data from a i2cdev object.

Inputs

i2cobj - the i2cdev object.
cnt - number of values to read from device. *dataprecision* - data to precision for the data.

Outputs

data - the data read from the device

See also: i2cdev, write.

`writeRegister (i2cobj, register, data)`
`write (i2cobj, register, data, dataprecision)`
Write data to a register on a i2cdev object.

Inputs

i2cobj - the i2cdev object.
register - register to write the data to on the i2cdev object.
data - data to write to the i2cdev object. *dataprecision* - data to precision for the input data.

Outputs

None

See also: i2cdev, readRegsiter.

`data = readRegister (i2cobj, register, cnt)`
`data = readRegister (i2cobj, register, cnt, dataprecision)`
Read data from a register on a i2cdev object.

Inputs

i2cobj - the i2cdev object.
register - register to read the data from on the i2cdev object.
cnt - number of values to read from device. *dataprecision* - data to precision for the data.

Outputs

data - the data read from the device

See also: i2cdev, write.

6.4.2 @raspi/scanI2Cbus

retval = scanI2Cbus (*piobj*)
retval = scanI2Cbus (*piobj*, *bus*)

Scan pi for devices on the I2C bus.

Inputs

piobj - raspi object connected to a Raspberry Pi board.

bus - bus number to scan I2C devices, when multiple buses are available. If the bus is not specified, it will default to 0.

Outputs

retval - cell array of addresses as strings in format of "0xXX".

Example

```
# create pi connection.
p = raspi('raspberrypi.local');
# scan for devices on the I2C bus
scanI2Cbus (p, 1)
# output is each detected I2C address as a string
ans =
{
 [1,1] = 0x50
}
```

See also: raspi, i2cdev.

6.5 SPI Functions

6.5.1 @raspi/spidev

retval = spidev (*piobj*, *channel*)
retval = spidev (*piobj*, *channel*, *mode*, *speed*, *bitsperword*)

Create a spi object on the specified raspberry pi board pin.

Inputs

piobj - a connected raspberry pi raspi object.
channel - channel name 'ce0' or 'ce1' or number 0 or 1.
mode - the spi mode.
speed - spi speed.
bitsperword - spi speed.

Outputs

retval - returns a spidev object.

Object Properties

Known properties are:

Channel The channel used. channel name 'CE1' or 'CE1'.

Mode SPI mode used.

Speed SPI speed.

BitsPerWord
Bits per word used for read write of data

Parent Raspi object of the spidev.

See also: raspi.

`outdata = writeRead (spiobj, data)`
Write data to SPI and read back data of same length.

Inputs

spiobj - the spidev object.
data - the data to write to the device.

Outputs

outdata - data read from device in response to write.

See also: spidev.

6.6 Serial Functions

6.6.1 @raspi/serialdev

`retval = serialdev (piobj, port)`
`retval = serialdev (piobj, port, baudrate, databits, parity, stopbits)`
Create a serial object on the specified raspberry pi port.

Inputs

piobj - a connected raspberry pi raspi object.
port - The name of the serial port to connect to for example, '/dev/serial0'.
baudrate - the baudrate (default 115200).
databits - the number of data bits 5,6,7,8 (default), 9.
parity - parity of 'none' (default), 'odd' or 'even'.
stopbits - number of stop bits 1 (default) or 2.

Outputs

retval - returns a serialdev object.

Object Properties

Known properties are:

Port The port used (read only).

BaudRate Baud rate used (readonly).

DataBits Databits used (readonly).

Parity	Parity used (readonly).
StopBits	Stopbits used (readonly).
Timeout	Timeout value for read.
Parent	Rasppi object of the serialdev. (readonly)

See also: raspi.

`write (`*`serialobj`*`, `*`data`*`)`
`write (`*`serialobj`*`, `*`data`*`, `*`precision`*`)`
Write *data* using the *precision* datatype.

Inputs

serialobj - the serialdev object.
data - the data to write. *precision* - the data type to convert from when writing.

Outputs

None

See also: serialdev.

`outdata`` = read (`*`serialobj`*`, `*`count`*`)`
`outdata`` = read (`*`serialobj`*`, `*`count`*`, `*`precision`*`)`
Read at most *count* values using the *precision* datatype.

Inputs

serialobj - the serialdev object.
count - the number of values to read. *precision* - the precision of the data to read.

Outputs

outdata - data read from device.

See also: serialdev.

6.7 Linux Functions

6.7.1 @raspi/deleteFile

`deleteFile (`*`obj`*`, `*`filename`*`)`
Delete a file from the connected pi.

Inputs

obj - connected raspi object.

filename - file name to delete, or wildcard string.

See also: raspi, getFile, putFile.

6.7.2 @raspi/getFile

`getFile (`*`obj`*`, `*`filename`*`)`
`getFile (`*`obj`*`, `*`filename`*`, `*`destination`*`)`
Transfer a file from the raspberry pi to local computer.

Inputs

obj - connected raspi object.

filename - file name to get.

destination - destination to save the file. If destination is a directory, the file will be saved to the directory, otherwise the file will be saved to the destination filename.

See also: raspi, putFile.

6.7.3 @raspi/putFile

`putFile (obj, filename)`
`putFile (obj, filename, destination)`

Transfer a file from local computer to the raspberry pi.

Inputs

obj - connected raspi object.

filename - file name to transfer.

destination - destination to save the file.

See also: raspi, getFile.

6.7.4 @raspi/system

`output = system (obj, cmd)`
`output = system (obj, cmd, sudo)`

Control an on board led.

Inputs

obj - connected raspi object.

cmd - command string to execute

sudo - string 'sudo' to run command as sudo.

Outputs

output - output from running the command

See also: raspi.

6.8 Raspi Functions

6.8.1 @raspi/configurePin

`currmode = configurePin (pi, pin)`
`configurePin (obj, pin, mode)`

Set/Get pin mode for a specified pin on a raspi connection.

configurePin (*pi*, *pin*) will get the current mode of the specified pin.

configurePin (*pi*, *pin*, *mode*) will attempt set the pin to the specified mode if the mode is unset.

Inputs

pi - the raspi object of the connection to an raspi board.

pin - string name of the pin to set/get the mode of.

mode - string mode to set the pin to.

Outputs

mode - string current mode of the pin.

Valid modes can be:

- DigitalInput - Acquire digital signals from pin
- DigitalOutput - Generate digital signals from pin
- PWM - Specify pin to use a pulse width modulator
- Unset - Clears pin designation. The pin is no longer reserved and can be automatically set at the next operation.

See also: raspi.

6.8.2 @raspi/display

`display (pi)`

Display the raspi object in a verbose way

Inputs

pi - the raspi object.

See also: raspi.

6.8.3 @raspi/get

struct = `get (obj)` [Function File]
field = `get (obj, property)` [Function File]

Get the properties of raspi object.

Inputs

serial - instance of *raspi* class.
property - name of property.

Outputs

When *property* was specified, return the value of that property.
otherwise return the values of all properties as a structure.

See also: raspi.

6.8.4 @raspi/raspi

retval = `raspi ()`
retval = `raspi (ipaddress)`
retval = `raspi (ipaddress, username, password)`
retval = `raspi (hostname, username, password)`
retval = `raspi (___, "Timeout", time)`

Connect to raspberry pi board

Inputs

ipaddress - ip address that the raspberry pi is on.
hostname - resolvable hostname that the raspberry pi is on.
username, *password* - currently not used, but for matlab compatability.
timeout - Optional timeout value (default 12.5) for communication to aRaspbeery Pi.

Outputs

retval - the connected raspi object.

6.8.5 @raspi/readDigitalPin

`value = readDigitalPin (obj, pin)`
Read digital value from a digital I/O pin.

Inputs

ar - connected raspi object.

pin - string name of the pin to read.

Outputs

value - the logical value (0, 1, true false) of the current pin state.

Example

```
pi = raspi ();
pinvalue = readDigitalPin (pi, 17);
```

See also: raspi, writeDigitalPin.

6.8.6 @raspi/showLEDs

`showLEDs (obj)`
Show the LEDs on the raspi

Inputs

obj - connected raspi object.

See also: raspi.

6.8.7 @raspi/showPins

`showPins (obj)`
Show the locations of pins on the raspi.

Inputs

obj - connected raspi object.

See also: raspi.

6.8.8 @raspi/writeDigitalPin

`writeDigitalPin (obj, pin, value)`
Write digital value to a digital I/O pin.

Inputs

pi - connected raspi object.

pin - pin number to write to.

value - the logical value (0, 1, true false) to write to the pin.

If pin was unconfigured before using, pin is set into digital mode.

Example

```
a = raspi();
writeDigitalPin(a,17,1);
```

See also: raspi, readDigitalPin.

6.8.9 @raspi/writeLED

`writeLED` (*obj*, *led*, *value*)
Control an on board led.

Inputs

obj - connected raspi object.

led - string name of the led to write to.

value - the logical value (0, 1, true false) to write to the led.

See also: raspi, showLEDs, writeDigitalPin.

6.8.10 @raspi/writePWMDutyCycle

`writePWMDutyCyle` (*ar*, *pin*, *value*)
Set pin to output a square wave with a specified duty cycle.

Inputs

ar - connected raspi object

pin - pin to write to.

value - duty cycle value where 0 = off, 0.5 = 50% on, 1 = always on.

Example

```
p = raspi();
writePWMDutyCycle(p, 17, 0.5);
```

See also: raspi, writePWMVoltage.

6.8.11 @raspi/writePWMFrequency

`writePWMFrequency` (*ar*, *pin*, *freq*)
Set pin to output a square wave with a specified frequency

Inputs

ar - connected raspi object

pin - pin to write to.

frequency - n.

See also: raspi, writePWMVoltage, writePWMFrequency.

6.8.12 @raspi/writePWMVoltage

`writePWMVoltage (ar, pin, voltage)`
Emulate an approximate voltage out of a pin using PWM.

Inputs

ar - connected raspi object

pin - pin to write to.

voltage - voltage to emulate with PWM, between 0 - 5.0

Example

```
a = raspi();
writePWMVoltage(a,17,1.0);
```

See also: raspi, writePWMDutyCycle.

Appendix A GNU General Public License

Version 3, 29 June 2007

Preamble

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Index