Domoticz MicroPython Projects

Explore | Build | Share | Reference

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Introduction

Purpose

To explore how to use the MicroPython programming language running on embedded hardware interfacing with the Domoticz Home Automation System.

★ The core of the projects uses the Raspberry Pi Pico W microcontroller, with components like actuators & sensors.
The microcontroller is acting as a web server or MQTT Auto Discovery client communicating with the Domoticz Home Automation System.

The intention is to provide some practical guidance, inspire ideas .. but not to explain Domoticz nor programming languages.

Prerequisites

It is expected to have basic knowledge of

- Domoticz Home Automation System.
- Domoticz Automation Event system dzVents.
- Programming languages Python, MicroPython, Lua.
- Raspberry Pi Pico / Pico W and ESP microcontrollers.
- Thonny Integrated Development Environment.
- JavaScript Object Notation (JSON).
- Message Queuing Telemetry Transport MQTT and MQTT Auto Discovery.
- Bluetooth and Bluetooth Low Energy (BLE).
- Node-RED Low-code programming for event-driven applications.

Remarks

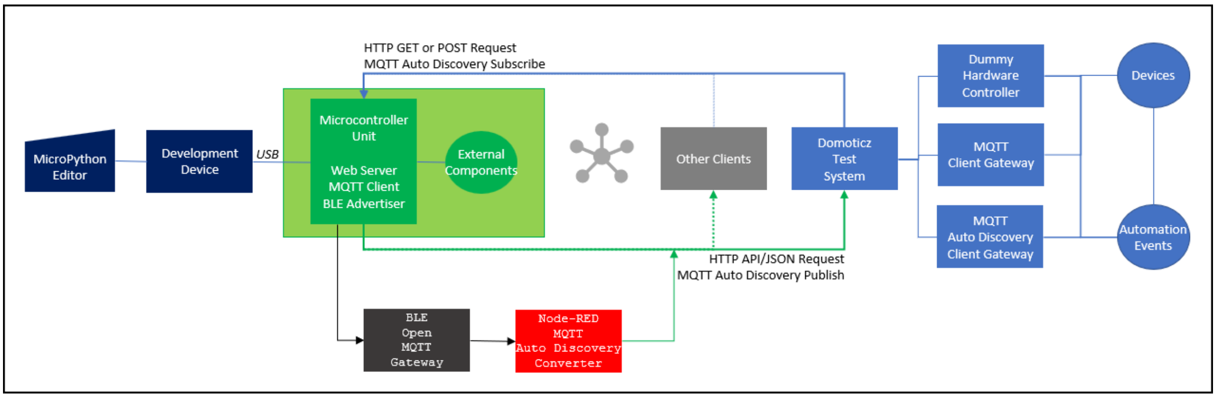
- This is a working document = conceptual changes & new idea's whilst progressing.
- There might be better solutions = changes depend on the author's learning curve.
- To-Do actions are tagged with [TODO] and captured in the file TODO.md.
- Hard- and Software versions are subject to change.
- Circuits are created with Fritzing.
- Sources are included. Get the latest sources from GitHub repository folder src.
- Before you start building a project, make sure that the microcontroller is unplugged from the electricity supply. It is dangerous to work on it if it is connected.

Credits

THANKS to the developers of the Raspberry Pi & ESP microcontroller, Domoticz Home Automation System, MicroPython language/libraries/tools and to all sharing related information. Without these, it would not be possible to write this document.

Licence

Concept



The block diagram starts at the left with the MicroPython editor (Thonny) running on the development device (Notebook with Windows 11).

Connected to the development device is a Microcontroller Unit (MCU) with external components (actuators & sensors).
For the Pico W projects, the Pico Breadboard Kit or the Pico IO Shield is used. These are a rather handy boards, not only for experimenting but also for building prototypes.

The MCU communicates with the Domoticz Test System via HTTP, Bluetooth Low Energy (BLE) or MQTT.

The MCU acts as a
- Web Server by sending HTTP GET/POST requests to connected clients or receiving HTTP GET/POST requests from connected clients,
- MQTT Auto Discovery Client by publishing device configuration or state messages and subscribing to state messages,
- Bluetooth Low Energy (BLE) advertiser by sending messages to an OpenMQTTGateway, which publishes MQTT messages being converted by Node-RED flow to Domoticz MQTT Auto Discovery Message.

The connected clients can be any client (like a Web Browser, Node-RED or Application), but for this book the client connects to a dedicated Domoticz Test System running on a Raspberry Pi 4B 4GB with Raspberry Pi OS version 12 (bookworm).

The Domoticz hardware and related devices are added, either manually via the "Dummy Hardware Controller" or automatic via the "MQTT Auto Discovery Client Gateway with LAN interface" depending on the requirements of the project as described in this book.

Note
Whilst starting to write this book, most of the devices are virtual sensors assigned to the Dummy Hardware Controller, but also gradually start to use the (new) MQTT Auto Discovery feature.

The Automation events are developed in dzVents (Domoticz Easy Events).
Event scripting with dzVents is well integrated in Domoticz and good documentation with many examples is available.

The Domoticz editor (GUI > Setup > More Options > Events) is used to develop and test the scripts (My Automation Scripts).

In addition, Node-RED and MQTT broker mosquitto (with clients mosquitto_pub and mosquitto_sub) are running on the Raspberry Pi.

The software is regularly updated to stay at the latest versions – for Domoticz the release channel Beta 2024.4 (build 15906 or higher) is set (at the time of writing).

Components

- 1x Raspberry Pi 4B Domoticz Test System (running latest Domoticz BETA version).
- 1x Raspberry Pi Pico W 2022.
- 1x Pico Breadboard Kit GeeekPi with LEDs (4 named LED1-4), Pushbuttons (4 named Button K1 - K4), Buzzer (not used for now).
  Hint: If the buzzer is making unexpected noise, connect Pin BEEP to ground.
- 1x Pico IO Shield KEYESTUDIO KS3017.
- 1x DHT22 Temperature & Humidity sensor.
- 1x LCD 20x4 LCD display (I2C) 20 columns & 4 rows.
- 1x LCD 480x320 Waveshare Pico-ResTouch-LCD-3.5.
- 1x TM1637 4-digit 7-segment LED display (I2C).
- 1x Servo Motor Tower Pro Micro Servo 9g SG90.
- 1x RFID-RC522 Reader for MIFARE RFID Cards and Tokens.
- 1x TM1638 LED&KEY 8x 7-segment decimal LED component with 8x individual LEDs and 8x push buttons.
- 1x PIR Motion Sensor.
- 1x Potentiometer.
- 2x DS18B20 1-wire digital thermometers.
- 1x 28BYJ-48 Stepper Motor with ULN2003 motor driver.
- 1x IKEA VINDRIKTNING Air Quality sensor.
- 1x Waveshare display Pico-ResTouch-LCD-3.5.
- 1x ESP32-WROOM-32.
- 1x ESP32-WROOM-32 (OpenMQTTGateway).
- 1x DIYmall ESP32 2.8" TFT Touch Screen Display ESP32-2432S028R.

MicroPython

The MCU program code (scripts) is developed in MicroPython.

As most projects use the Raspberry Pi Pico W, recommend reading Get Started with MicroPython on Raspberry Pi Pico and to explore the MicroPython examples.

Please note, that the author is new to MicroPython. Whilst evolving, solutions can change.

Development Tools

Thonny is used mostly on a Windows 11 notebook to develop the MicroPython scripts running on the MCU.
The MCU is connected to COM11 and uses the latest MicroPython firmware (nightly builds).
The Thonny view files option is active to list the files structure on the development device and the MCU.

Example Thonny IDE Views Files, Editor & Log.
The MicroPython script ds18b20.py is running on a Pico W, which updates in regular intervals the temperature of the Domoticz temperature device via HTTP API/JSON request.

Configuration Script

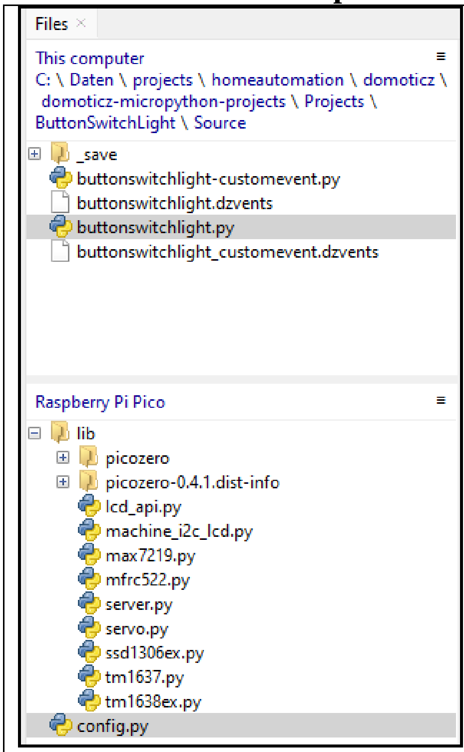
A MicroPython configuration script *config.py* is used by **all projects** shared.

The MicroPython configuration script is stored on the development device in folder Config and is uploaded to the main folder of the MCU.

- ⚠ The *config.py* must be installed on the MCU else the projects running from the development device will fail.

In projects which have their own archives, the config.py is included in the root folder.

Folder Structure Development Device and Pico W - Config



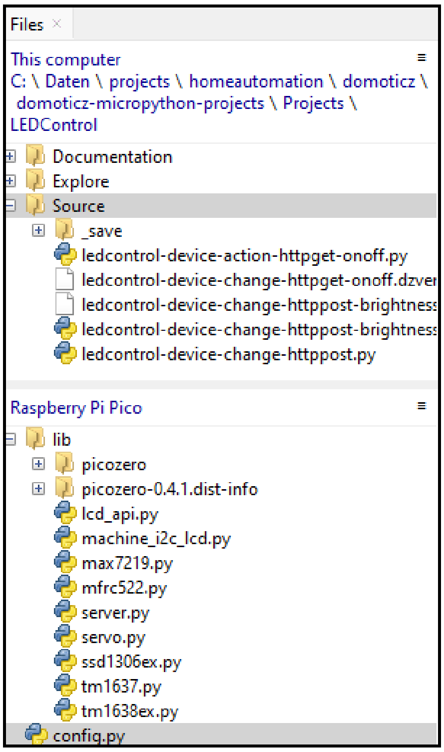
Folder structure on the development device and the Pico W.
Go to Thonny > View > Files.

The *config.py* is stored in the dedicated folder *Config* on the development device and then uploaded to the Pico W.
Upload a file to the Pico W by selecting the file, right click, select “Upload to /”.

If changes to the Pico W *config.py* file are made, ensure to download to the development device.

Download a file from the Pico W by selecting the file, right click, select “Download to…”.

Folder Structure Development Device and Pico W – Project LEDControl



Folder structure on the development device and the Pico W. Go to Thonny > View > Files.

This computer

The folder structure of the projects on the development device.
The projects are running from the development device.
The picture shows the files for the project LEDControl.

Raspberry Pi Pico

The folder structure with the *config.py* file and additional libraries.
Whilst building the projects, no *main.py* is used (this to avoid autostart).

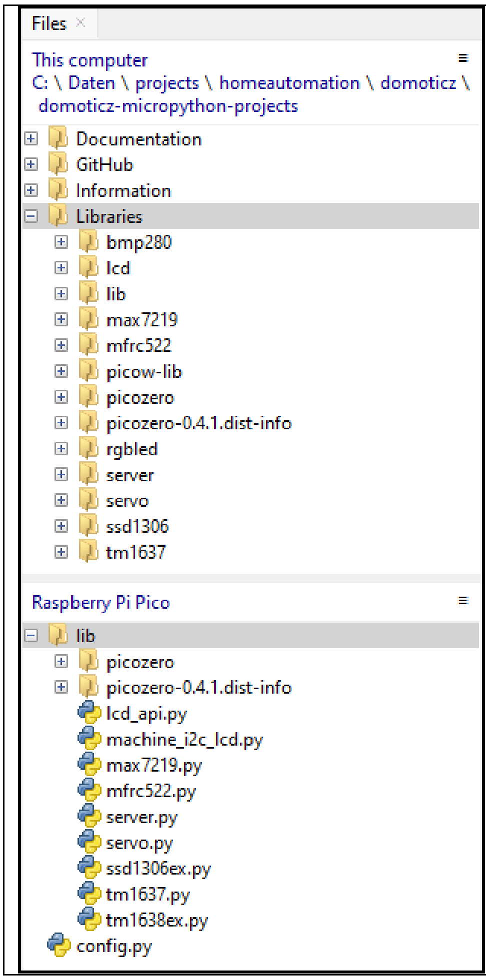
Source Code Configuration Script – config.py

```
"""
File:config.py
Date:202303124
Author: Robert W.B. Linn

:description
Constants for the MCU Web Server.
Specific constants for the Pico Breadboard Kit.

Import the configuration file: import config.py
Access configuration item: config.PIN_LED1
"""

# Import the const package
from micropython import const

# Network
WIFI_SSID       = const('SSID')
WIFI_PASSWORD   = const('password')

# Domoticz IP + Port
DOMOTICZ_IP  = const('domoticz-ip:port')

# Pico W onboard LED
PIN_LED_ONBOARD = const('LED')

# Pico Breadboard Kit LEDs connected to GPnn (Pin #nn)
PIN_LED1   = const(16)     #Pin 21
PIN_LED2   = const(17)     #Pin 22
PIN_LED3   = const(18)     #Pin 24
PIN_LED4   = const(19)     #Pin 25

# Pico Breadboard Kit Buttons connected to GPnn (Pin #nn)
PIN_BUTTON_K1= const(20)   #Pin 26

# Domoticz
# HTTP response JSON keys
KEY_STATE  = const('status')
KEY_TITLE  = const('title')
KEY_MESSAGE  = const('message')

# Messages used for HTTP response
STATE_ERR   = const('ERROR')
STATE_OK    = const('OK')
MESSAGE_EMPTY  = const('')
MESSAGE_UNKNOWN  = const('Unknown')
MESSAGE_CMD_UNKNOWN = const('Unknown command.')
MESSAGE_ON   = const('On')
MESSAGE_OFF   = const('Off')
```

[TODO] Optimize RAM usage for constants (see MicroPython for Microcontrollers).

External Libraries

Several external MicroPython libraries are used and stored on the development device and the Pico W.



On the development device the MicroPython libraries are stored in the folder *Libraries*.

The content of this folder is uploaded to the Pico W folder *lib*.

If changes made to the libraries on the Pico W, then download the updates library files to the development device folder Libraries.

The folder structure on the left shows the additional libraries for using the LCD 20x4 I2C, web server, controlling a servo motor, TM1637 7-segment display.
In addition, starting to use the picozero library (BETA).

It is mandatory to store the additional library files on the Pico W else the projects will fail to run.

Note
There are more libraries used then shown on the screenshots at the left. Also newer versions in place.

Picozero Library
The picozero library is used in some of the projects. It is easy to use for external components.

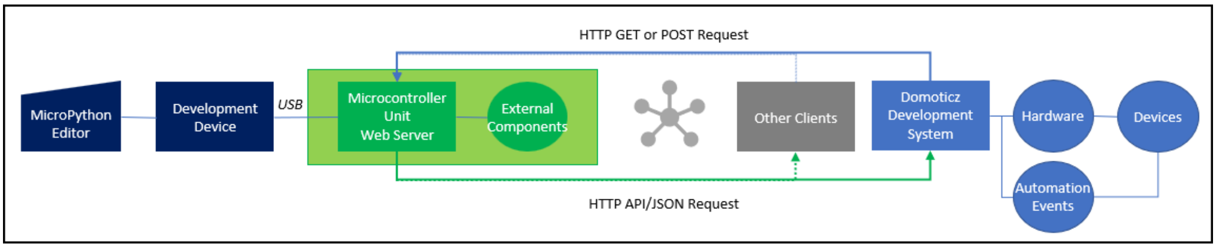
Credits
Thanks to the developers of the open-source libraries used in several projects.

Web Server

The projects use, in most cases, a web server (server.py) running on the MCU developed with MicroPython.

The communication between

- The MCU Web Server and Domoticz uses Domoticz HTTP API/JSON requests,
- Domoticz and the MCU Web Server uses HTTP GET or POST requests.



Class Server

The MCU Web Server makes use of an own developed MicroPython Class Server (server.py) to handle HTTP GET or POST requests.
This class is the core of the web server and makes it easier to create the projects.

- Create a server objected called network,
- Connect to the network,
- Get network client connection,
- Handle the GET or POST request,
- Send response back to the client.

The client in this book is by default Domoticz, but can be any other as well (curl, Node-RED, applications).

Example
Code Snippet to control LED1 of the Pico Breadboard Kit via HTTP command:

```
http://picow-ip/led1/on or off or state
```

```
def HandleRequest(cmd):
    if cmd == CMD_LED_ON:
        led1.on()
        response[config.KEY_MESSAGE] = config.MESSAGE_ON
        response[config.KEY_STATE] = config.STATE_OK
    elif cmd == CMD_LED_OFF:
        led1.off()
        response[config.KEY_MESSAGE] = config.MESSAGE_OFF
        response[config.KEY_STATE] = config.STATE_OK
    elif cmd == CMD_LED_STATE:
        if led1.value() == 1:
            response[config.KEY_MESSAGE] = config.MESSAGE_ON
        else:
            response[config.KEY_MESSAGE] = config.MESSAGE_OFF
```

```
        response[config.KEY_STATE] = config.STATE_OK
    else:
        response[config.KEY_STATE] = config.STATE_ERR
        response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN
    return response

network = Server(config.WIFI_SSID, config.WIFI_PASSWORD)
server = network.Connect()
while True:
    try:
        cl, request = network.GetClientConnection(server)
        response = {}
        cmd, status = network.ParseGETRequest(request)
        response[config.KEY_TITLE] = cmd
        if status == 1:
            response = HandleRequest(cmd)
        else:
            response[config.KEY_STATE] = config.STATE_ERR
            response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN
        network.SendResponse(cl, response, True)
    except OSError as e:
        cl.close()
        print('[ERROR] Network Connection closed')
```

Pseudo Code

The steps performed when starting the web server and listening for client requests.

1. Import config.py (stored on the MCU) to get the network parameter,
2. Connect to the Network & turn MCU onboard LED (as status indicator) on,
3. If the network connection fails, the MCU onboard LED is off. Check the Thonny log,
4. Listen to incoming client connections submitted HTTP GET or POST requests,
5. Accept the client connection,
6. Get the data from the HTTP request,
7. Parse the data from the GET or POST request,
8. Take any action accordingly,
9. Sent HTTP response, aligning with the Domoticz HTTP API/JSON response, to the client. Example:
   {"status": "OK", "title": "/led1/on", "message": "On"}
   status: OK or ERROR
   title: Command
   message: OK or error message

[TODO] Check out the new Raspberry Pi Debug Probe Device.

HTTP GET / POST Request Examples

Two HTTP request examples handled by the MCU Web Server.
The GET request URL contains the command to be executed by the MicroPython script.
The POST request URL contains post-data as JSON object parsed by the MicroPython script.

HTTP GET request to set LED1 state on (Project LEDControl)

The command is sent for example from the direct On action of a Domoticz Switch Type On/Off.

```
HTTP Command: http://picow-ip/led1/on
```

```
HTTP Response: {"status": "OK", "title": "/led1/on", "message": "On"}
```

HTTP POST request to set text on a LCD2004 I2C display (Project LCDLEDControl)

The last line of the received data contains the post-data (JSON object) sent by the Domoticz Automation Events dzVents openURL function.
The JSON object has several key:value pairs for selected Domoticz motherboard devices (Domoticz runs on a Raspberry Pi).
For each of the displayed items, the position col:row and text are defined. This is done by the Domoticz event, which enables flexibility in positioning items on the display. There is no need to change the MicroPython script for the MCU web server.

```
POST / HTTP/1.1
Host: picow-ip
User-Agent: Mozilla/5.0 (Windows NT 10.0; WOW64) AppleWebKit/603.36 (KHTML, like Gecko) Chrome/53.0.34736.0 Safari/603.38
Accept: */*
Accept-Encoding: deflate, gzip, br
content-type: application/json
Content-Length: 193

{"cpuusage":{"col":6,"row":3,"text":"C:0.54"},"internaltemperature":{"col":0,"row":3,"text":"T:40"},"memoryusage":{"col":14,"row":3,"text":"M:21"},"timestamp":{"col":15,"row":1,"text":"18:45"}}'
```

```
HTTP Response: {"status": "OK", "title": "Set LCD", "message": ""}
```

Domoticz Automation Event dzVents Snippet

```
local function getMotherboardData(domoticz)
  local data = {}
 data['timestamp'] = setText(1, 15, string.sub(domoticz.time.rawTime, 1, 5))
  data['internaltemperature'] = setSensor(3, 0, 'T:',
round(domoticz.devices(IDX_INTERNALTEMPERATURE).temperature, 0))
 data['cpuusage'] = setSensor(3, 6, 'C:',
round(domoticz.devices(IDX_CPUUSAGE).percentage, 2))
 data['memoryusage'] = setSensor(3, 14, 'M:',
round(domoticz.devices(IDX_MEMORYUSAGE).percentage, 0))
 return data
end

if (item.isTimer) then
  domoticz.openURL({
    url = URL_SERVER, method = 'POST', headers = { ['content-type'] =
'application/json' },
```

```
    postData = getMotherboardData(domoticz), callback = RES_HTTP })
end
```

MicroPython Script

This is a stripped down MicroPython script example of a MCU Web Server class Server.

```
"""
File:server.py
Date:20230425
Author: Robert W.B. Linn
"""

import network
import urequests
import socket
import time
from machine import Pin
import json

class Server:
    # Constants
    NAME = 'Server'
    VERSION = 'v20230425'

    CRLF = chr(13) + chr(10)
    SPACE = chr(32)

    # Domoticz
    # HTTP response JSON keys
    KEY_STATE= 'status'
    KEY_TITLE= 'title'
    KEY_MESSAGE = 'message'

    # Messages used for HTTP response
    STATE_OK     = 'OK'
    STATE_ERR    = 'ERROR'
    MESSAGE_EMPTY  = ''
    MESSAGE_UNKNOWN = 'Unknown'
    MESSAGE_CMD_UNKNOWN    = 'Unknown command.'
    MESSAGE_ON    = 'On'
    MESSAGE_OFF    = 'Off'

    def __init__(self, wifi_ssid, wifi_password, STATUS_PIN="LED", DEBUG=True):
        """
        Init the network with defaults.

        :param string wifi_ssid
            SSID of the network to connect

        :param string wifi_password
            Passord of the network to connect

        :param string | int STATUS_PIN
            Pin number of the LED indicating network status connected

        :param bool DEBUG
            Flag to set the log for debugging purposes
        """
        self.debug = DEBUG
        self.wifi_ssid = wifi_ssid
        self.wifi_password = wifi_password

        # Create the onboard LED object to indicate controller is up and network
connected
        self.ledstatus = Pin(STATUS_PIN, Pin.OUT)
        self.ledstatus.off()
```

```
    def log(self, msg):
        """
        Log to the console if debug flag is true.

        :param string msg
            Message to print
        """
        if self.debug:
            print(msg)

    def connect(self):
        """
        Connect to the network using the class SSID and password.
        If connected start listening for incoming connections.

        :param None

        :return object server
            Server object.

        :example
            # Create network object
            network = Server(config.WIFI_SSID, config.WIFI_PASSWORD)
            # Connect to the network and get the server object
            server = network.connect()
        """
        try:
            wlan = network.WLAN(network.STA_IF)
            wlan.active(True)
            wlan.connect(self.wifi_ssid, self.wifi_password)

            # Network connection
            self.log(f'Network waiting for connection...')
            max_wait = 10
            while max_wait > 0:
                if wlan.status() < 0 or wlan.status() >= 3:
                    break
                max_wait -= 1
                time.sleep(1)

            if wlan.status() != 3:
                self.ledstatus.off()
                raise RuntimeError('[ERROR] Network connection failed!')
            else:
                self.ledstatus.on()
                self.log(f'Network connected OK')
                status = wlan.ifconfig()
                self.log(f'Network IP ' + status[0] )

            # Network Get address
            addr = socket.getaddrinfo('0.0.0.0', 80)[0][-1]

            # Network Create the server socket
            server = socket.socket()

            # Option to reuse addr to avoid error EADDRINUSE
            server.setsockopt(socket.SOL_SOCKET, socket.SO_REUSEADDR, 1)

            # Bind the address befor starting to listen for icoming client
connections
            server.bind(addr)
            server.listen(1)
            self.log(f'Network listening on {addr}')
            # self.log(server)
            return server
        except OSError as e:
            self.ledstatus.off()
            cl.close()
```

```
            raise RuntimeError('[ERROR] Network connection closed')

    def connect2(self):
        """
        Connect to the network using the class SSID and password.

        :param None

        :example
            # Create network object
            network = Server(config.WIFI_SSID, config.WIFI_PASSWORD)
        """
        try:
            wlan = network.WLAN(network.STA_IF)
            wlan.active(True)
            wlan.connect(self.wifi_ssid, self.wifi_password)

            # Network connection
            self.log(f'Network waiting for connection...')
            max_wait = 10
            while max_wait > 0:
                if wlan.status() < 0 or wlan.status() >= 3:
                    break
                max_wait -= 1
                time.sleep(1)

            if wlan.status() != 3:
                self.ledstatus.off()
                raise RuntimeError('[ERROR] Network connection failed!')
            else:
                self.ledstatus.on()
                self.log(f'Network connected OK')
                status = wlan.ifconfig()
                self.log(f'Network IP ' + status[0] )

        except OSError as e:
            self.ledstatus.off()
            cl.close()
            raise RuntimeError('[ERROR] Network connection closed')

    def parse_get_request(self, request):
        """
        Parse the command from the HTTP GET Request.
        The first line of the request contains the command.
        The first line is split and the 2nd item holds the command + data.
        Example first line with the command:
        GET /led1/on HTTP/1.1
        The command is /led1/on.

        :param string request
            HTTP GET request

        :return string command
            Command, i.e. /led1/on

        :return int status
            0 = Error, 1 = OK

        :example
            # Parse the get data. In case of error, the status is 0.
            cmd, status = network.parse_get_request(request)
        """
        status = 0
        cmd = self.MESSAGE_CMD_UNKNOWN

        # Split the decoded request string into a list
        data = str(request.decode()).split(self.CRLF)

        # Check if there is data to get the first item
```

```
        if (len(data) > 0):
            # print(data[0])
            # Split the first item which is the command string into a list with 3
items
            cmds = data[0].split(self.SPACE)
            # Check length and get the 2nd item, i.e. /led1/on
            if len(cmds) == 3:
                cmd = cmds[1]
                status = 1
            else:
                print(f'[ERROR] HTTP GET number of command items invalid. Expect 3,
got {len(cmds)}.')
        else:
            print(f'[ERROR] HTTP GET request not valid.')
        self.log(f'HTTP Command={cmd}')

        # Return the command, i.e. /led1/on etc.
        return cmd, status

    def parse_post_request(self, request):
        """
        Parse the command from the HTTP POST Request.
        The last line of the HTTP request contains the command + data.
        The HTTP request is decoded and split as a string list.
        The last line is a JSON object with key:value pair(s).

        :param string request
            HTTP request

        :return string command
            Command as JSON key:value pair(s), i.e. {"led":1}

        :return int status
            0 = Error, 1 = OK

        :example
            # Parse the post data. In case of error, the status is 0.
            data, status = network.parse_get_request(request)
        """
        status = 0
        cmd = self.MESSAGE_CMD_UNKNOWN

        # Split the decoded request string into a list
        data = str(request.decode()).split(self.CRLF)

        # Check if there is data to get the last item
        # At least 8 items
        if (len(data) > 7):
            # JSON parse the last list item holding the command as JSON string
            # Convert the string to a JSON object
            try:
                cmd = json.loads(data[len(data) - 1])
                status = 1
            except ValueError:
                # In case the JSON data can not be parsed
                cmd = data[len(data) - 1]
                print('[ERROR] HTTP POST request not valid (ValueError).')
        else:
            print(f'[ERROR] HTTP POST request not valid (Not enought items, must be
8 or more).')
        self.log(f'HTTP Command={cmd}')

        # Return the command as JSON object, i.e. HTTP Command: {'state': 'on'}
        return cmd, status

    def get_client_connection(self, server):
        """
        Get the client connection.
```

```
        :param object server
            Server object which is listening

        :return object cl

        :return string data
            The requested data format depends on the request

        :example
            cl, request = network.get_client_connection(server)
        """
        # Get client connection
        cl, addr = server.accept()
        self.log(f'Network client connected from {addr[0]}')

        # Get the request data used to extract the command
        request = cl.recv(1024)
        # Return cl and the request data
        return cl, request

    def send_response(self, cl, response, close):
        """
        Send the response to the client, i.e. Domoticz, curl etc. as JSON object.

        :param object cl

        :param JSON response

        :param bool close
        """
        self.log(f'HTTP Response={json.dumps(response)}')

        # Important to have a blank line prior JSON response string
        # Note the use of json.dumps for the response
        cl.send('HTTP/1.1 200 OK'+self.CRLF+'content-type:
application/json'+self.CRLF+self.CRLF+json.dumps(response))

        # If flag close is set, ensure to close the connection
        if close == True:
            cl.close()
            self.log(f'Network connection closed')

    def send_get_request(self, url):
        """
        Network submit http get request to the domoticz server.

        :param string url
            URL of the HTTP request

        :return int status
            0 = Error, 1 = OK

        :return string content
            HTTP response content sent by Domoticz engine

        :example
            Update the Domoticz temp+hum device with IDX 15
            http://domoticz-
ip:port/json.htm?type=command&param=udevice&idx=15&nvalue=0&svalue=16;55;1
        """
        status = 0
        content = ''
        self.log(f'Send GET request url={url}')
        try:
            # URL encode space
            url = url.replace(' ', '%20')
            r = urequests.get(url)
            j = json.loads(r.content)
            content = j
```

```
            self.log(f'Send GET request status={j['status']}')
            r.close()
            status = 1
        except OSError as e:
            # print(f'[ERROR] Sending data {e}')
            raise Exception(f'[ERROR] Sending data {e}')
        except ValueError as e:
            # print(f'[ERROR] {e}, {r.content.decode()}')
            raise Exception(f'[ERROR] {e}, {r.content.decode()}')
        return status, content

    def send_post_request(self, url, postdata):
        """
        Network submit http post request to the domoticz server.

        :param string url
            URL of the HTTP request

        :param string postdata
            postdata as JSON object

        :return int status
            0 = Error, 1 = OK

        :example
            Trigger the Domoticz custom event named DHT22 with data JSON object
            http://domoticz-
ip:port/json.htm?type=command&param=customevent&event=DHT22&data={"h": 58, "t": 16,
"s": 0}
        """
        status = 0
        self.log(f'Send POST request url={url}, postdata={postdata}')
        try:
            r = urequests.post(url, data=json.dumps(postdata))
            j = json.loads(r.content)
            self.log(f'Send POST request status={j['status']}')
            r.close()
            status = 1
        except OSError as e:
            print(f'[ERROR] Sending data {e}')
            # raise Exception('Network Connection failed.')
        return status
```

Pico W Projects

LED Control

Description

This project switches, triggered by a Domoticz Switch Device, an LED connected to the Pico W (running as a web server).

Ideas for Use

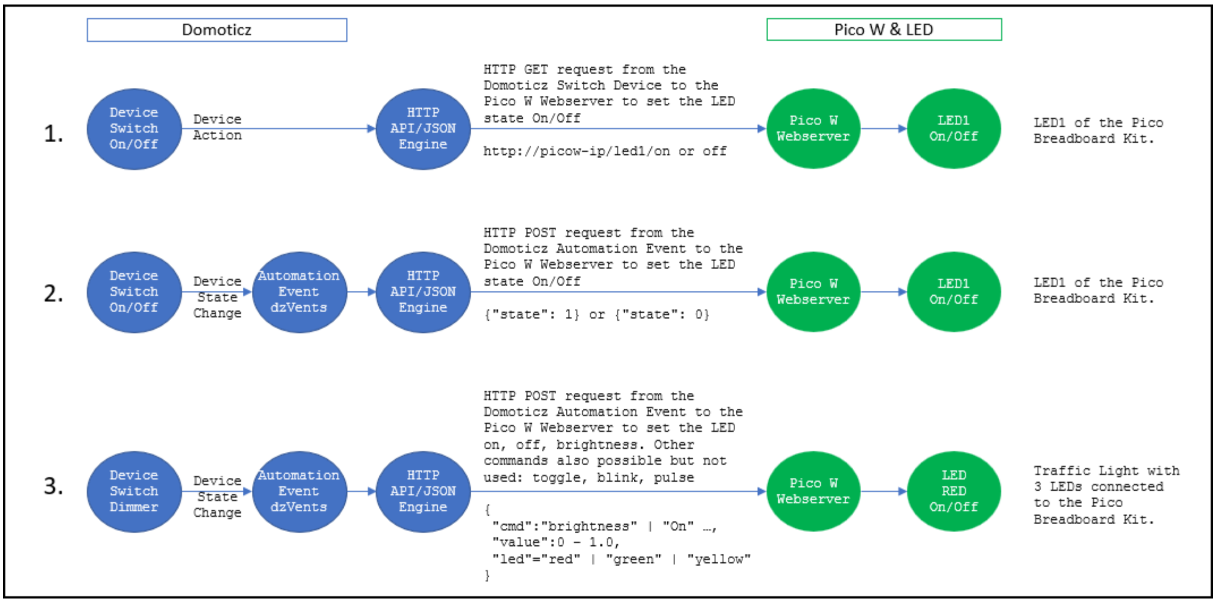
- Alarm indicators
- Status indicator

Solution

Various solutions are developed:

1. Domoticz Switch Action triggers HTTP GET request to the Pico W web server to set the state of the LED to on or off,
2. Domoticz Switch State Change is handled by an Domoticz Automation Event dzVents which triggers HTTP POST request to the Pico W web server to set the state of the LED to on or off,
3. Domoticz Switch, configured as Dimmer, State Change is handled by an Domoticz Automation Event dzVents which triggers HTTP POST request to the Pico W web server to set the brightness of the LED between 0-100%.
   This solution also accepts other commands: on, off, toggle, blink, pulse.

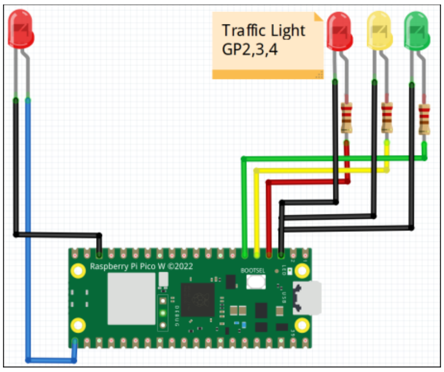
Block Diagram



Wiring

LED1	**Pico W**
+ (Anode)	GP16 (Pin #21)
GND (Cathode)	GND (Pin #38)
Traffic Light	
LED RED	GP2 (Pin #4) , GND (Pin #3)
LED YELLOW	GP3 (Pin #5) , GND (Pin #3)
LED GREEN	GP4 (Pin #6) , GND (Pin #3)

Circuit Diagram



Domoticz Setup

Devices

Create a virtual sensor, hardware dummy, named LED1 Control from sensor type Switch/Light.

After creating the device, the Domoticz devices list shows the entry:

```
Idx=16, Hardware=VirtualSensors, ID=00014060, Unit=1, Name=LED1 Control,
Type=Light/Switch, SubType=Switch, Data=On
```

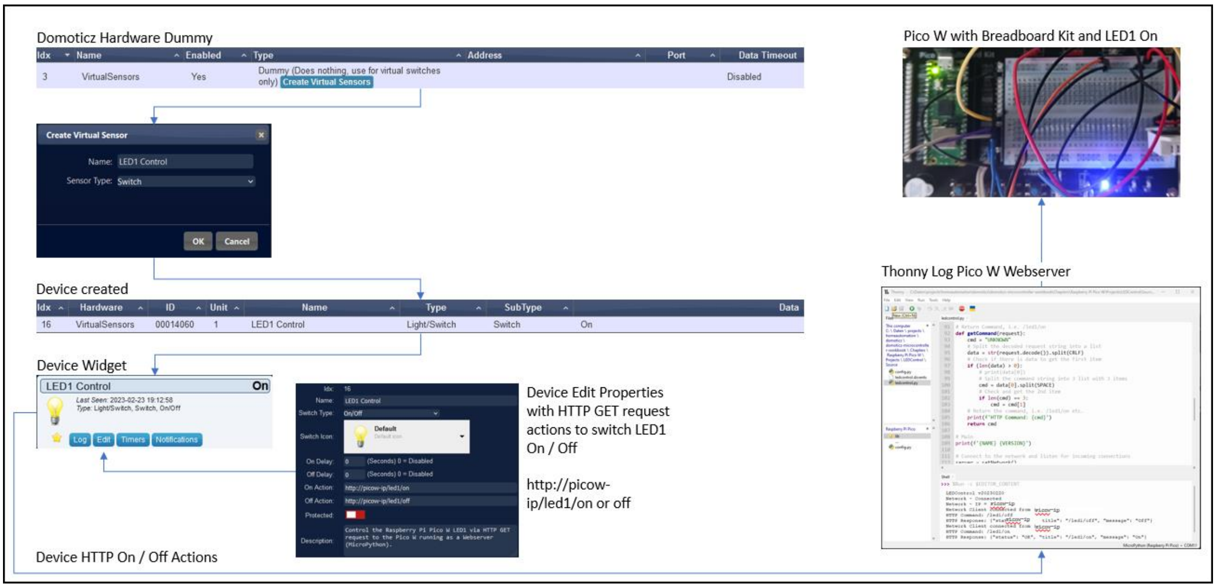
Domoticz Switch Device Action

Solution

Set LED1 state On/Off via a Domoticz switch device On/Off Action containing the URL for the HTTP GET request with the command /led1/on or off to the Pico W (running as a web server).

The picture shows the flow of actions from creating a switch device (virtual sensors hardware), edit the switch device On / Off actions (http://picow-ip/led1/on or off) and examples switching LED1 off and on via the device widget logged by Thonny running the Pico W web server.

Block Diagram



<u>Domoticz Log</u>

```
2023-02-24 10:55:04.790 VirtualSensors: Light/Switch (LED1 Control)
2023-02-24 10:55:04.784 Status: User: admin initiated a switch command (16/LED1
Control/On)
2023-02-24 10:55:07.408 VirtualSensors: Light/Switch (LED1 Control)
2023-02-24 10:55:07.402 Status: User: admin initiated a switch command (16/LED1
Control/Off)
```

Example Log Error – wrong Pico W web server URL for On Action.

```
2023-02-24 10:56:20.321 Error: Error opening url: http://picow-ip/led1/on
```

MicroPython Script

```
"""
File:ledcontrol-device-action-httpget-onoff.py
Date:20230409
Author: Robert W.B. Linn

PicoW RESTful web server listening to control an LED via Domoticz Switch.
Commands are set via HTTP GET request with HTTP response JSON object.

:commands
LED ON:
HTTP Request:http://picow-ip/led1/on
HTTP response:{"status": "OK", "title": "/led1/on", "message": "On"}

LED OFF:
HTTP Request:http://picow-ip/led1/off
HTTP response:{"status": "OK", "title": "/led1/off", "message": "Off"}

LED STATE:
HTTP Request:http://picow-ip/led1/state
HTTP response:{"status": "OK", "title": "/led1/state", "message": "On"}

In case of an error:
HTTP response:{"status": "ERROR", "title": "/led1/x", "message": "Unknown
command."}

Example using curl to turn LED1 on:
curl -v http://picow-ip/led1/on

:log
ledcontrol-device-action-httpget-onoff v20230409
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Network client connected from client-ip
HTTP Command=/led1/on
HTTP Response={"title": "/led1/on", "message": "On", "status": "OK"}
Network connection closed
Network client connected from client-ip
HTTP Command=/led1/off
HTTP Response={"title": "/led1/off", "message": "Off", "status": "OK"}
Network connection closed
Network client connected from client-ip
HTTP Command=/led1/state
HTTP Response={"title": "/led1/state", "message": "Off", "status": "OK"}
Network connection closed
"""

# Libraries
import network
import socket
import time
from machine import Pin
import json
# Import server class from server.py
from server import Server
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config

# Constants
NAME = 'ledcontrol-device-action-httpget-onoff'
VERSION = 'v20230409'

# URL params to switch LED1 on or off or request state
# http://pico-ip/command
CMD_LED_ON  = '/led1/on'
CMD_LED_OFF  = '/led1/off'
```

```
CMD_LED_STATE= '/led1/state'

# Create the LED1 object using config.py settings
led1 = Pin(config.PIN_LED1, Pin.OUT)
# Turn the LED off
led1.value(0)

"""
Handle the request containing the command.
The LED is turned on/off or the state is requested.
The response JSON object is updated.

:param string cmd
    Command to set the LED1 state on/off or get the state.

:return JSON object response
"""
def handle_request(cmd):
    # Turn the LED on
    if cmd == CMD_LED_ON:
        led1.on()
        response[config.KEY_MESSAGE] = config.MESSAGE_ON
        response[config.KEY_STATE] = config.STATE_OK
    # Turn the LED off
    elif cmd == CMD_LED_OFF:
        led1.off()
        response[config.KEY_MESSAGE] = config.MESSAGE_OFF
        response[config.KEY_STATE] = config.STATE_OK
    # Get the LED state
    elif cmd == CMD_LED_STATE:
        if led1.value() == 1:
            response[config.KEY_MESSAGE] = config.MESSAGE_ON
        else:
            response[config.KEY_MESSAGE] = config.MESSAGE_OFF
        response[config.KEY_STATE] = config.STATE_OK
    else:
        response[config.KEY_STATE] = config.STATE_ERR
        response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN
    return response

# Main
print(f'{NAME} {VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD)
# Connect to the network and get the server object
server = network.connect()

while True:
    try:
        # Get client connection and the request data
        cl, request = network.get_client_connection(server)

        # Create the HTTP response JSON object
        response = {}

        # Parse the get data. In case of error, the status is 0.
        cmd, status = network.parse_get_request(request)

        # Assign the command to the response KEY_TITLE
        response[config.KEY_TITLE] = cmd

        # If the status is 1, handle the command
        if status == 1:
            response = handle_request(cmd)
        else:
            response[config.KEY_STATE] = config.STATE_ERR
            response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN
```

```
        # Send response to the client and close the connection
        network.send_response(cl, response, True)

    except OSError as e:
        network.ledstatus.off()
        cl.close()
        print('[ERROR] Network Connection closed')
```

Domoticz Switch State Change

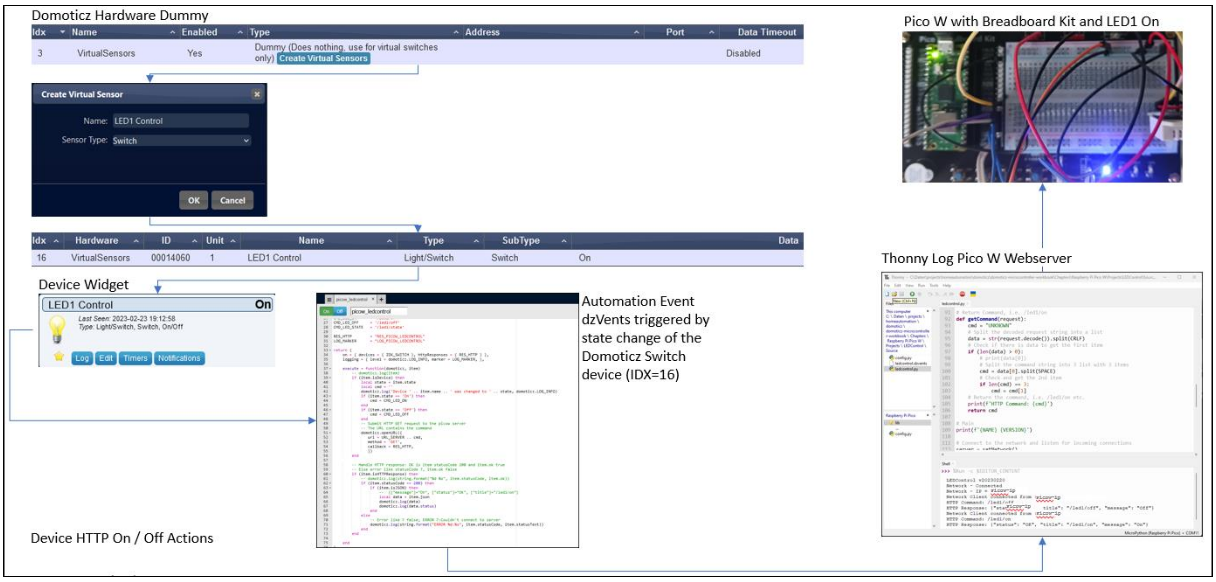
Solution

Set LED1 state On/Off via an Domoticz Automation Event dzVents listening to the Domoticz Switch device state change. The event

1. submits the URL for the HTTP GET request via the function openURL to the Pico W running as a web server,
2. handles the Pico W web server response.

The Domoticz configuration is as described for the previous solution, except that there are no Switch device On/Off actions defined but an Automation Event dzVents is used.

Block Diagram



MicroPython Script

```
The same script is used as for the previous project:
ledcontrol-device-action-httpget-onoff.py
```

Automation Script

```
-- ledcontrol-device-change-httpget-onoff.dzvents
-- Domoticz IDX of the switch triggering Pico W LED on/off
local IDX_SWITCH  = 16

local URL_SERVER      = "picow-ip"
local CMD_LED_ON      = '/led1/on'
local CMD_LED_OFF     = '/led1/off'
local CMD_LED_STATE   = '/led1/state'

local EXPERIMENT    = "LEDCONTROL-DEVICE-CHANGE"
local RES_HTTP        = "RES_" .. EXPERIMENT
local LOG_MARKER      = "LOG_" .. EXPERIMENT

return {
 on = { devices = { IDX_SWITCH }, httpResponses = { RES_HTTP } },
 logging = { level = domoticz.LOG_INFO, marker = LOG_MARKER, },
 execute = function(domoticz, item)
   if (item.isDevice) then
       local state = item.state
       local cmd = ''
       domoticz.log('Device ' .. item.name .. ' was changed to ' .. state,
domoticz.LOG_INFO)
       if (item.state == 'On') then
         cmd = CMD_LED_ON
       end
       if (item.state == 'Off') then
         cmd = CMD_LED_OFF
       end
       -- Submit HTTP GET request to the picow server
       -- The URL contains the command
       domoticz.openURL({
         url = URL_SERVER .. cmd,
         method = 'GET',
         callback = RES_HTTP,
         })
    end
    -- Handle HTTP response: OK is item statusCode 200 and item.ok true
    -- Else error like statusCode 7, item.ok false
    if (item.isHTTPResponse) then
      -- domoticz.log(string.format("%d %s", item.statusCode, item.ok))
      if (item.statusCode == 200) then
        if (item.isJSON) then
          --  {["message"]="On", ["status"]="OK", ["title"]="/led1/on"}
          local data = item.json
          domoticz.log(data)
          domoticz.log(data.status)
        end
      else
        -- Error like 7 false; ERROR 7:Couldn't connect to server
        domoticz.log(string.format("ERROR %d:%s", item.statusCode,
item.statusText))
      end
    end
 end
}
```

Domoticz Log

```
2023-02-24 11:04:05.512 VirtualSensors: Light/Switch (LED1 Control)
2023-02-24 11:04:05.506 Status: User: admin initiated a switch command (16/LED1 Control/On)
2023-02-24 11:04:05.606 Status: dzVents: Info: Handling events for: "LED1 Control", value: "On"
2023-02-24 11:04:05.606 Status: dzVents: Info: LEDCONTROL-DEVICE-CHANGE: ------ Start internal script: picow_ledcontrol: Device: "LED1 Control (VirtualSensors)", Index: 16
2023-02-24 11:04:05.606 Status: dzVents: Info: LEDCONTROL-DEVICE-CHANGE: Device LED1 Control was changed to On
2023-02-24 11:04:05.606 Status: dzVents: Info: LEDCONTROL-DEVICE-CHANGE: ------ Finished picow_ledcontrol
2023-02-24 11:04:05.606 Status: EventSystem: Script event triggered: /home/pi/domoticz/dzVents/runtime/dzVents.lua
2023-02-24 11:04:05.693 Status: dzVents: Info: Handling httpResponse-events for: "RES_ LEDCONTROL-DEVICE-CHANGE "
2023-02-24 11:04:05.693 Status: dzVents: Info: LEDCONTROL-DEVICE-CHANGE: ------ Start internal script: picow_ledcontrol: HTTPResponse: "RES_PICOW_LEDCONTROL"
2023-02-24 11:04:05.694 Status: dzVents: Info: LEDCONTROL-DEVICE-CHANGE: {["message"]="On", ["title"]="/led1/on", ["status"]="OK"}
2023-02-24 11:04:05.694 Status: dzVents: Info: LEDCONTROL-DEVICE-CHANGE: OK
2023-02-24 11:04:05.694 Status: dzVents: Info: LEDCONTROL-DEVICE-CHANGE: ------ Finished picow_ledcontrol
```

Example Log Error
Wrong Pico W web server URL for On Action.

```
2023-02-24 11:05:18.130 VirtualSensors: Light/Switch (LED1 Control)
2023-02-24 11:05:18.124 Status: User: admin initiated a switch command (16/LED1 Control/Off)
2023-02-24 11:05:18.214 Status: dzVents: Info: Handling events for: "LED1 Control", value: "Off"
2023-02-24 11:05:18.215 Status: dzVents: Info: LEDCONTROL-DEVICE-CHANGE: ------ Start internal script: picow_ledcontrol: Device: "LED1 Control (VirtualSensors)", Index: 16
2023-02-24 11:05:18.215 Status: dzVents: Info: LEDCONTROL-DEVICE-CHANGE: Device LED1 Control was changed to Off
2023-02-24 11:05:18.215 Status: dzVents: Info: LEDCONTROL-DEVICE-CHANGE: ------ Finished picow_ledcontrol
2023-02-24 11:05:18.215 Status: EventSystem: Script event triggered: /home/pi/domoticz/dzVents/runtime/dzVents.lua
2023-02-24 11:05:21.440 Status: dzVents: Info: Handling httpResponse-events for: "RES_ LEDCONTROL-DEVICE-CHANGE "
2023-02-24 11:05:21.440 Status: dzVents: Info: LEDCONTROL-DEVICE-CHANGE: ------ Start internal script: picow_ledcontrol: HTTPResponse: "RES_PICOW_LEDCONTROL"
2023-02-24 11:05:21.440 Status: dzVents: Info: LEDCONTROL-DEVICE-CHANGE: ERROR 7:Couldn't connect to server
2023-02-24 11:05:21.440 Status: dzVents: Info: LEDCONTROL-DEVICE-CHANGE: ------ Finished picow_ledcontrol
2023-02-24 11:05:21.361 Error: Error opening url: http://picow-ip/led1/off
2023-02-24 11:05:21.440 Error: dzVents: Error: (3.1.8) LEDCONTROL-DEVICE-CHANGE: HTTP/1.1 response: 7 ==>> Couldn't connect to server
```

Domoticz Dimmer State Change

Solution

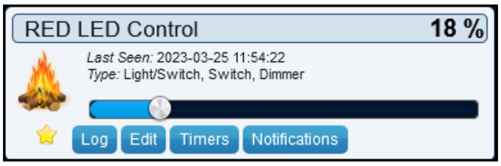
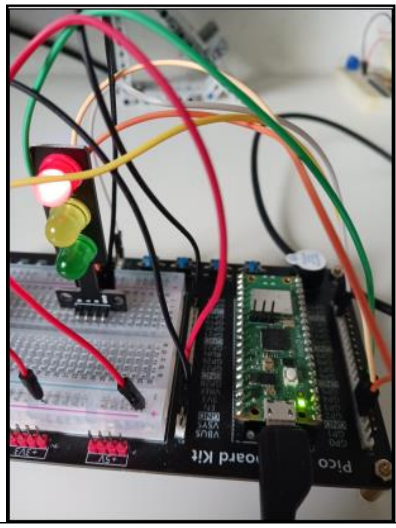
Set the brightness of an RED LED (from a Traffic Light) via a Domoticz dimmer.
A Domoticz Automation Event dzVents listens to the state change of the Domoticz dimmer.
If the state is changed, the dimmer level 0-100 is converted to a brightness value 0-1.0.
The event submits a HTTP POST request to the Pico W web server, which sets the brightness of the RED LED.
The post data submitted by the Domoticz automation event dzVents.:

```
{["cmd"]="brightness", ["value"]=0 – 1.0, ["led"]="red"}
```

The Pico W web server sends response back:

```
{
"status": "OK", "title": {"led": "red", "value": 0.18, "cmd": "brightness"},
"message": "brightness"
}
```

This solution makes use of the MicroPython picozero package to control the LED.

Domoticz Dimmer to set the RED LED Brightness 0-100% converted to 0-1.0.	Pico W with Traffic Light LEDs connected. RED LED brightness 0-1.0 controlled.
	

Automation Script

```
-- ledcontrol-device-change-httppost-brightness.dzvents
-- Remote control, via Domoticz switch dimmer, the state of a RED LED connected the
Pico W.
-- Action triggered by the switch running function openURL with POST request:
-- http://picow-ip with postdata: {["cmd"]="brightness", ["value"]=0.39,
["led"]="red"}
-- 20230325 rwbl

-- Domoticz IDX of the dimmer triggering Pico W LED
local IDX_SWITCH  = 1

local URL_SERVER    = 'http://picow-ip'
local EXPERIMENT    = 'LEDBRIGHTNESS'
local RES_HTTP      = 'RES_' .. EXPERIMENT
local LOG_MARKER    = 'LOG_' .. EXPERIMENT

return {
 on = { devices = { IDX_SWITCH }, httpResponses = { RES_HTTP } },
    logging = { level = domoticz.LOG_INFO, marker = LOG_MARKER,    },

 execute = function(domoticz, item)
   if (item.isDevice) then
       -- Create the postdata table
            local postdata = {}
            postdata['led'] = 'red'
            postdata['cmd'] = 'brightness'
            local brightness = item.level
            if brightness > 0 then brightness = brightness / 100 end
            if item.state == 'Off' then brightness = 0 end
            postdata['value'] = brightness
       domoticz.log('Device ' .. item.name .. ' brightness changed.')
       domoticz.log(postdata)
            -- Submit HTTP POST request to the picow server
            domoticz.openURL({
               url = URL_SERVER, method = 'POST',
               postData = postdata, callback = RES_HTTP })
        end

        -- Handle HTTP response: OK is item statusCode 200 and item.ok true
        -- Else error like statusCode 7, item.ok false
        if (item.isHTTPResponse) then
            -- domoticz.log(string.format("%d %s", item.statusCode, item.ok))
            if (item.statusCode == 200) then
                if (item.isJSON) then
                    --  {["message"]="On", ["status"]="OK", ["title"]="/led1/on"}
                    local data = item.json
                    domoticz.log(data)
                    -- domoticz.log(data.status)
                end
            else
                -- Error like 7 false; ERROR 7:Couldn't connect to server
                domoticz.log(string.format("ERROR %d:%s", item.statusCode,
item.statusText))
            end
        end

 end
}
```

MicroPython Script

```
"""
ledcontrol-device-change-httppost-brightness.py
20230409 rwbl

Pico W RESTful web server listening to set the state of an LED via Domoticz Dimmer
Switch.
The states are on, off, toggle, blink, pulse, brightness.

Commands set via HTTP GET request with HTTP response JSON object.
This script handles setting the led using the library picozero.
The picozero LED class functions can be set via the POST request.
Reference: https://picozero.readthedocs.io/en/latest/recipes.html#leds

:commands
LED ON:
curl -v -H "Content-Type: application/json" -d
"{\"led\":\"red\",\"cmd\":\"on\",\"value\":0}" http://picow-ip {"status": "OK",
"title": {"led": "red", "value": 0, "cmd": "on"}, "message": "on"}

LED OFF:
curl -v -H "Content-Type: application/json" -d
"{\"led\":\"red\",\"cmd\":\"off\",\"value\":0}" http:// picow-ip {"status": "OK",
"title": {"led": "red", "value": 0, "cmd": "off"}, "message": "off"}

:note
When using curl ensure to escape the " to \" in the JSON object.

:log
ledcontrol-device-change-httppost-brightness v20230409
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Network client connected from client-ip
HTTP Command={'led': 'yellow', 'value': 0, 'cmd': 'on'}
HTTP Response={"status": "OK", "title": {"led": "yellow", "value": 0, "cmd": "on"},
"message": "on"}
Network connection closed
Network client connected from client-ip
HTTP Command={'led': 'yellow', 'value': 0.1, 'cmd': 'brightness'}
HTTP Response={"status": "OK", "title": {"led": "yellow", "value": 0.1, "cmd":
"brightness"}, "message": "brightness"}
Network connection closed
Network client connected from client-ip
HTTP Command={'led': 'yellow', 'value': 0, 'cmd': 'off'}
HTTP Response={"status": "OK", "title": {"led": "yellow", "value": 0, "cmd":
"off"}, "message": "off"}
Network connection closed
"""

# Libraries
from machine import Pin
import json
# Picozero - note: beta version
import picozero
from picozero import LED
# Import network class
from server import Server
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config

# Constants
NAME = 'ledcontrol-device-change-httppost-brightness'
VERSION = 'v20230409'

# Create the 3 LED objects GP2,3,4
led_red = LED(2)
```

```
led_red.off()
led_yellow = LED(3)
led_yellow.off()
led_green = LED(4)
led_green.off()

"""
Control an LED.

:param object led
    LED object created via led = LED(GPIO pin number)

:param string cmd
    LED command, like on, off, toggle, blink, pulse, brightness

:param int|float|string value
    Value for the command, like for brightness a float between 0-1
"""
def set_led(led,cmd,value):
    # Set the command
    if cmd == 'on':
        led.on()
    elif cmd == 'off':
        led.off()
    elif cmd == 'toggle':
        led.toggle()
    elif cmd == 'blink':
        led.blink()
    elif cmd == 'pulse':
        led.pulse()
    elif cmd == 'brightness':
        if 0 <= value <= 1:
            led.brightness = value
        else:
            print(f'[ERROR] Command {cmd} value {value} out of range 0-1.')
    else:
        prinf('[ERROR] Command {cmd} unknown.')

"""
Handle the request containing the command as JSON object.
The LED is turned on or off depending on JSON key state {"state":0 or 1}
The response JSON object is updated.
Reference: https://picozero.readthedocs.io/en/latest/recipes.html#leds

:param string data
    JSON object with key:value pair to set the LED
    led:red|green|yellow, cmd:on|off|blink<pulse|brightness, value:NNN

:return JSON object response
"""
def handle_request(data):
    # Get the JSON key:
    led = data['led'].lower()
    cmd = data['cmd']
    value = data['value']

    if led == 'red':
        set_led(led_red,cmd,value)
    elif led == 'green':
        set_led(led_green,cmd,value)
    elif led == 'yellow':
        set_led(led_yellow,cmd,value)
    else:
        prinf('[ERROR] LED {led} unknown.')

    # Response is OK
    response[config.KEY_STATE] = config.STATE_OK
    response[config.KEY_MESSAGE] = cmd
    return response
```

```
# Main
print(f'{NAME} {VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD)
# Connect to the network and get the server object
server = network.connect()

while True:
    try:
        # Get client connection and the request data
        cl, request = network.get_client_connection(server)

        # Create the HTTP response JSON object
        response = {}

        # Parse the post data. In case of error, the status is 0.
        data, status = network.parse_post_request(request)

        # Assign the postdata to the response KEY_TITLE
        response[config.KEY_TITLE] = data

        # If status is 1, then the post response is properly parsed, lets change
the led state.
        if status == 1:
            response = handle_request(data)
        else:
            # Error with unknown command
            response[config.KEY_STATE] = config.STATE_ERR
            response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN

        # Send response to the client and close the connection
        network.send_response(cl, response, True)

    except OSError as e:
        network.ledstatus.off()
        cl.close()
        print('[ERROR] Network Connection closed')
```

Button Control

Description

This project turns a Domoticz Switch (IDX=16) On/Off by pressing the Pico Breadboard Kit Button K4.
If the Domoticz switch state is On, the Pico Breadboard Kit LED1 is On else Off.
The Domoticz switch device state is changed by using HTTP API/JSON GET or POST request to the Domoticz server.

Ideas for Use

- Control a switch On/Off,
- Remote control, like turning a thermostat setpoint On/Off or switch a blind up/down.

Solutions

The Pico W is built in a Pico Breadboard Kit. A RESTful web server runs on the Pico W.
If the web server network connection is successful, the Pico W onboard LED is On else Off indicating an error.

If the pushbutton K4 (of the Pico Breadboard Kit) is pressed, the Domoticz switch state with IDX NN is set to On or Off via HTTP API/JSON request to Domoticz.

Two solutions worked out:

HTTP API/JSON GET Request with Parameter switchlight

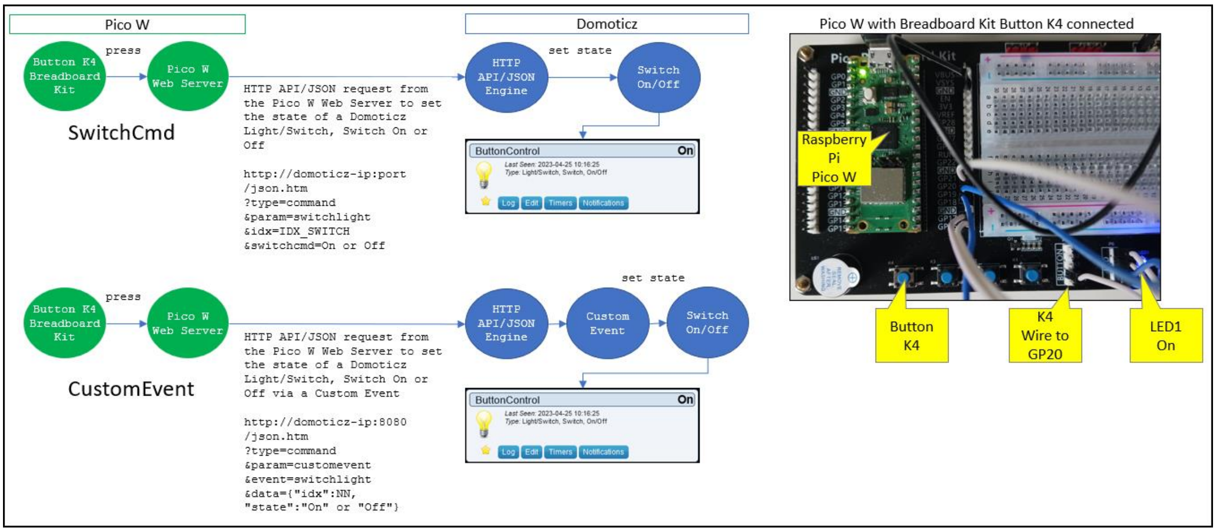
```
http://domoticz-ip:port/json.htm?type=command&param=switchlight&idx=NN&switchcmd=<On|Off|Toggle|Stop>
```

Note
The switch commands On and Off are used.

HTTP API/JSON GET Request with Parameter customevent

```
http://domoticz-ip:8080/json.htm?type=command&param=customevent&event=switchlight&data={"idx":NN,"state":"On" or "Off"}
```

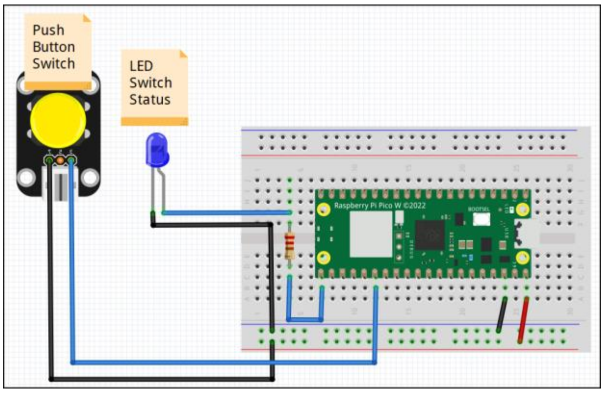
Block Diagram



Wiring

Pico Breadboard Kit	Pico W
Button K4	GP20 (Pin #26), GND (Pin #38)
LED RED	GP16 (Pin #21), GND (Pin #3)

Circuit Diagram



Domoticz Setup

Devices

Create a virtual sensor, using the hardware controller “dummy”, named “ButtonControl” from sensor type Switch/Light.

After creating the device, the Domoticz devices list shows the entry:

```
Idx=16, Hardware=VirtualSensors, ID=00014060, Unit=1, Name=ButtonControl,
Type=Light/Switch, SubType=Switch, Data=On
```

Domoticz Device Update

MicroPython Script

```
"""
File:   buttoncontrol.py
Date:   20230418
Author: Robert W.B. Linn

:description
Turn Domoticz Switch (IDX=16) On/Off by pressing Pico Breadboard Kit Button K4.
If the switch state is On, the Pico Breadboard Kit LED1 is On else Off.
The Domoticz switch device state is changed by using HTTP API/JSON GET request to
the Domoticz server.
http://domoticz-ip:port/json.htm?type=command&param=switchlight&idx=16&switchcmd=On
or Off

:notes
This script handles button press using the library picozero.
Configuration is stored in config.py - Ensure to upload to the picow.
The button K4 of the Pico Breadboard Kit is used.
Press the button short set the switch state On or Off.
When keeping the button down the switch state with change On/Off constantly.
Instead of using the global switch_status could use the state of LED1 to determine
if the light is on or off.

:log
ButtonControl v20230410
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Button K4 pressed - setstatus=On
Send GET request url=http://domoticz-
ip:port/json.htm?type=command&param=switchlight&idx=16&switchcmd=On
Send GET request status=OK

:wiring
Pico Breadboard Kit Button = Pico W
K4 = GP20 (Pin #26) # Pushbutton
LED1 = GP16 (Pin #21)      # LED switch state
The Pico W onboard LED is also used     to indicate the network connection state.
"""

from machine import Pin, Timer
from utime import sleep
# picozero - BETA version
from picozero import Button
# Network class to communicate with Domoticz or other clients
from server import Server
# Configuration (must be uploaded to the picow)
import config

# Constants
NAME = 'ButtonControl'
VERSION = 'v20230410'

# Breadboard Kit LED1 object using config.py settings
led1 = Pin(config.PIN_LED1, Pin.OUT)
led1.value(0)

# LED object indicating the state of the K4 button On/Off
ledbuttonstatus = Pin(config.PIN_LED1, Pin.OUT)
ledbuttonstatus.value(0)

# Button K4 pin
BUTTON_PINNR = 20
# Button K4 object
```

```
btn = Button(BUTTON_PINNR)
# Status of the switch On or Off
switch_status = "Off"

# Domoticz IDX of the switch device
IDX_SWITCH = 16

# URL Domoticz
# Note the idx of the domoticz device ( see GUI > Setup > Devices)
# http://domoticz-
ip:port/json.htm?type=command&param=switchlight&idx=99&switchcmd=<On|Off|Toggle|Sto
p>
# OK: {"status": "OK","title": "SwitchLight"}
# ERROR: {"message" : "Error sending switch command, check device/hardware
(idx=nnn) !","status" : "ERROR","title" : "SwitchLight"}
URL_DOM_SWITCH =
"http://"+config.DOMOTICZ_IP+"/json.htm?type=command&param=switchlight&idx=" +
str(IDX_SWITCH) + "&switchcmd="

"""
Handle Button Pressed.
The global switch_status is used but could also use the LED1 state.
"""
def set_domoticz_switch():
    global switch_status
    if switch_status == "Off":
        switch_status = "On"
        ledbuttonstatus.value(1)
    else:
        switch_status = "Off"
        ledbuttonstatus.value(0)
    print(f'Button K4 pressed - setstatus={switch_status}')
    # Submit HTTP API/JSON request to Domoticz to set switch status
    status = network.send_get_request(URL_DOM_SWITCH + switch_status)

"""
Main
"""
print(f'{NAME} {VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD)
# Connect to the network and get the server object
server = network.connect()

"""
Press the button short set the switch state On or Off.
When keeping the button down the switch state with change On/Off constantly.
"""
while True:
    # Check if the button is pressed
    if btn.is_pressed:
        # If the button is not released then set the switch state
        if btn.is_released == False:
            set_domoticz_switch()
```

Automation Script

```
--[[
File:   buttoncontrol.dzvents
Date:   20230418
Author: Robert W.B. Linn

Handle switch device (idx=16, name=Pico W LED1 Control) state change On or Off
triggered by the Pico W web server submitting HTTP API/JSON requests.
The HTTP request submitted from the Pico W to switch On/Off:
http://domoticz-ip:port/json.htm?type=command&param=switchlight&idx=16&switchcmd=On
or Off

Log Example
2023-04-10 13:13:21.310 VirtualSensors: Light/Switch (ButtonControl)
2023-04-10 13:13:21.304 Status: User: admin initiated a switch command
(16/ButtonControl/Off)
2023-04-10 13:13:21.415 Status: dzVents: Info: Handling events for:
"ButtonControl", value: "Off"
2023-04-10 13:13:21.415 Status: dzVents: Info: LOG_BUTTONCONTROL: ------ Start
internal script: buttoncontrol: Device: "ButtonControl (VirtualSensors)", Index: 16
2023-04-10 13:13:21.415 Status: dzVents: Info: LOG_BUTTONCONTROL: Device State
Change: device=ButtonControl, state=Off
2023-04-10 13:13:21.415 Status: dzVents: Info: LOG_BUTTONCONTROL: ------ Finished
buttoncontrol
]]--

-- Domoticz IDX of the switch which state is set by the Pico W web server
local IDX_SWITCH  = 16

local LOG_MARKER = "LOG_BUTTONCONTROL"

return {
 on = {
     devices = {IDX_SWITCH}
    },
 logging = {
     level = domoticz.LOG_INFO, marker = LOG_MARKER
    },
 execute = function(domoticz, device)
  domoticz.log(string.format('Device State Change: device=%s, state=%s',
device.name, device.state), domoticz.LOG_INFO)
 end
}
```

Domoticz Custom Event

MicroPython Script

```
"""
File:   buttoncontrol_customevent.py
Date:   20230418
Author: Robert W.B. Linn

:description
Turn Domoticz Switch (IDX=16) On/Off by pressing Pico Breadboard Kit Button K4.
If the switch state is On, the Pico Breadboard Kit LED1 is On else Off.
The Domoticz switch device state is changed by using HTTP API/JSON POST request to
the Domoticz server.
Example:
http://domoticz-
ip:8080/json.htm?type=command&param=customevent&event=switchlight&data={"idx":16,"s
tate":"On"}
http://domoticz-
ip:8080/json.htm?type=command&param=customevent&event=switchlight&data={"idx":16,"s
tate":"Off"}

:notes
This script handles button press using the library picozero.
Configuration is stored in config.py - Ensure to upload to the picow.
The button K4 of the Pico Breadboard Kit is used.
Press the button short set the switch state On or Off.
When keeping the button down the switch state with change On/Off constantly.

:log
ButtonControl Custom Event v20230410
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Button K4 pressed - setstatus=On
Send POST request url=http://domoticz-
ip:port/json.htm?type=command&param=customevent&event=switchlight&data=,
postdata={'idx': 16, 'state': 'On'}
Send POST request status=OK
Button K4 pressed - setstatus=Off
Send POST request url=http://domoticz-
ip:port/json.htm?type=command&param=customevent&event=switchlight&data=,
postdata={'idx': 16, 'state': 'Off'}
Send POST request status=OK

:wiring
Pico Breadboard Kit Button = Pico W
K4 = GP20 (Pin #26) # Pushbutton
LED1 = GP16 (Pin #21)      # LED switch state
The Pico W onboard LED is also used to indicate the network connection state.
"""

# Convert the Domoticz HTTP API/JSON response
import json
from machine import Pin, Timer
from utime import sleep
# picozero - BETA version - beginner-friendly library to help you use common
electronics components with the Raspberry Pi Pico. Thanks to Raspberry Pi
Foundation.
from picozero import Button
# Network class to communicate with Domoticz or other clients
from server import Server
# Configuration (must be uploaded to the picow)
import config

# Constants
NAME = 'ButtonControl Custom Event'
```

```
VERSION = 'v20230410'

# Create the led object indicating the state of the K4 button On/Off
ledbuttonstatus = Pin(config.PIN_LED1, Pin.OUT)
ledbuttonstatus.value(0)

# Button K4 pin
BUTTON_PINNR = 20
# Button K4 object
btn = Button(BUTTON_PINNR)
switch_status = "Off"

## Domoticz IDX of the Switch device
IDX_SWITCH = 16

# URL Domoticz
# Note the idx of the domoticz device ( see GUI > Setup > Devices)
# http://domoticz-
ip:port/json.htm?type=command&param=customevent&event=MyEvent&data=MyData
URL_DOM_SWITCH = "http://"+ config.DOMOTICZ_IP
+"/json.htm?type=command&param=customevent&event=switchlight&data="

# Handle Key Pressed
def set_domoticz_switch():
    global switch_status
    if switch_status == "Off":
        switch_status = "On"
        ledbuttonstatus.value(1)
    else:
        switch_status = "Off"
        ledbuttonstatus.value(0)
    print(f'Button K4 pressed - setstatus={switch_status}')
    # Post data
    postdata = {}
    postdata['idx'] = 16
    postdata['state'] = switch_status
    # Submit domoticz
    status = network.send_post_request(URL_DOM_SWITCH, postdata)

# Main
print(f'{NAME} {VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD)
# Connect to the network and get the server object
server = network.connect()

"""
Press the button short set the switch state On or Off.
When keeping the button down the switch state with change On/Off constantly.
"""
while True:
    # Check if the button is pressed
    if btn.is_pressed:
        # If the button is not released then set the switch state
        if btn.is_released == False:
            set_domoticz_switch()
```

Automation Script

```
--[[
File:   buttoncontrol_customevent.dzvents
Date:   20230418
Author: Robert W.B. Linn

Handle switch device (idx=16, name=Pico W LED1 Control) state change On or Off
triggered by the Pico W web server submitting HTTP API/JSON requests.
The HTTP request  submitted from the Pico W to switch On/Off:
http://domoticz-
ip:port/json.htm?type=command&param=customevent&event=switchlight&data={"idx":16,"s
tate":"On"} or {"idx":16,"state":"Off"}
]]--

-- Custom event name as used by the Pico W web server HTTP API/JSON POST request
local CUSTOM_EVENT_NAME = 'switchlight'

return {
 on = {
  customEvents = { CUSTOM_EVENT_NAME }
 },
 data = {},
 logging = {},
 execute = function(domoticz, triggeredItem)
  if (triggeredItem.isCustomEvent) then
      -- domoticz.log(triggeredItem.data)
            -- Check the custom event name in case there are more custom events
      if (triggeredItem.trigger == CUSTOM_EVENT_NAME) then
                -- Get the JSON object from the triggered item
        local data = triggeredItem.json
                -- Log to check idx and state to be set
        domoticz.log(string.format('idx=%d,state=%s', data.idx, data.state))
        -- Set the light state
        domoticz.devices(data.idx).setState(data.state)
      end
  end
 end
}
```

Button Control MQTT Auto Discovery

Description

This project auto creates a Domoticz Push On Button device which is controlled via Pico W Button.

Solution

This project is based up the project Button Control.

Instead communicating via HTTP, the Domoticz hardware controller MQTT Auto Discovery Client Gateway with LAN interface (MQTT Auto Discovery) is used.

The Pico W connects to the network and to the Domoticz Client Gateways for MQTT & MQTT Auto Discovery.
The config & state messages published by the Pico W are handled by the Domoticz hardware controller MQTT Auto Discovery Client Gateway with LAN interface.

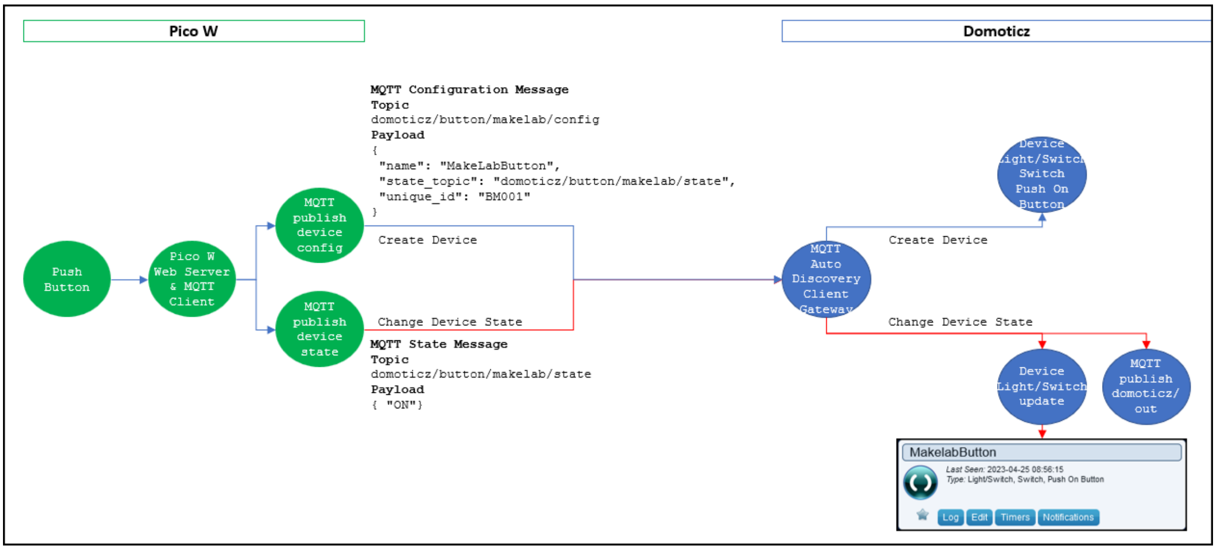
Step 1 – Publish MQTT Config message to create the Domoticz Push On Button device.
If these devices are already in place, Domoticz takes no action.

The Domoticz devices list with the device auto created assigned to the MQTT Auto Discovery hardware (named MQTTADGateway):

	Idx	Hardware	ID	Unit	Name	Type	SubType	
	41	MQTTADGateway	BM001	1	MakelabButton	Light/Switch	Switch	On

Step 2 – Publish MQTT State message after pressing the button.
The MQTT messages published are picked up by Domoticz and the device state is updated.
See block diagram.

Block Diagram



MQTT Auto Discovery Topics & Payload

CONFIGURATION	
Light/Switch Device	
Configuration Topic	domoticz/button/makelab/config

Configuration Payload	{
	"name": "MakeLabButton",
	"state_topic": "domoticz/button/makelab/state",
	"unique_id": "BM001"
	}

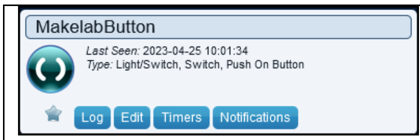
STATE	
Topic	domoticz/button/makelab/state

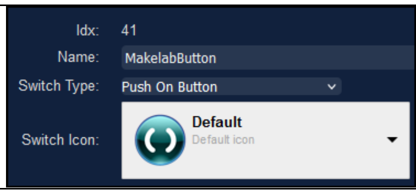
Payload	{
	"ON"
	}

Domoticz

Devices

The device widget created via MQTT Auto Discovery.
Note: the switch type is “Push On Button”.





Debug Log

Domoticz Debug Log showing the MQTT Auto Discovery gateway receiving the message with the payload.
The message is published using Domoticz topic “domoticz/out”.

```
2023-04-25 10:01:34.149 Debug: MQTTADGateway: topic: domoticz/button/makelab/state,
message: {"ON"}
2023-04-25 10:01:34.280 Debug: MQTTADGateway: topic: domoticz/out, message: {
2023-04-25 10:01:34.280 "Battery" : 255,
2023-04-25 10:01:34.280 "LastUpdate" : "2023-04-25 10:01:34",
2023-04-25 10:01:34.280 "RSSI" : 12,
2023-04-25 10:01:34.280 "description" : "",
2023-04-25 10:01:34.280 "dtype" : "Light/Switch",
2023-04-25 10:01:34.280 "hwid" : "6",
2023-04-25 10:01:34.280 "id" : "BM001",
2023-04-25 10:01:34.280 "idx" : 41,
2023-04-25 10:01:34.280 "name" : "MakelabButton",
2023-04-25 10:01:34.280 "nvalue" : 1,
2023-04-25 10:01:34.280 "stype" : "Switch",
2023-04-25 10:01:34.280 "svalue1" : "0",
2023-04-25 10:01:34.280 "switchType" : "Push On Button",
2023-04-25 10:01:34.280 "unit" : 1
2023-04-25 10:01:34.280 }
```

Automation Script

There is no automation script used, but … if want to capture device changes, this is a simple example.

```
--[[
File:   buttoncontrol_mqtt_ad.dzvents
Date:   20230425
Author: Robert W.B. Linn

:description
Listen to device changes which has been created using MQTT Auto Discovery.

:log
INFO: Log after Domoticz restart
2023-04-25 08:53:18.791 Debug: MQTTADGateway: topic:
domoticz/button/makelab/config, message: {"name": "MakelabButton", "state_topic":
"domoticz/button/makelab/state", "unique_id": "BM001"}
2023-04-25 08:53:18.892 Debug: MQTTADGateway: topic: domoticz/status, message:
online
```

```
INFO: Log after pressing button K4
2023-04-25 08:53:27.610 MQTTADGateway: Light/Switch/Switch (MakelabButton)
2023-04-25 08:53:27.710 Status: dzVents: Info: Handling events for:
"MakelabButton", value: "On"
2023-04-25 08:53:27.710 Status: dzVents: Info: BUTTONCONTROL_MQTT_AD: ------ Start
internal script: buttoncontrol_mqtt_ad: Device: "MakelabButton (MQTTADGateway)",
Index: 41
2023-04-25 08:53:27.710 Status: dzVents: Info: BUTTONCONTROL_MQTT_AD: Device
changed: name=MakelabButton, unique_id=BM001, state=On
2023-04-25 08:53:27.710 Status: dzVents: Info: BUTTONCONTROL_MQTT_AD: ------
Finished buttoncontrol_mqtt_ad
]]--

-- IDX of the device
local IDX_BUTTON = 41

return {
 on = { devices = { IDX_BUTTON } },
 logging = { level = domoticz.LOG_INFO, marker = 'BUTTONCONTROL_MQTT_AD', },
 execute = function(domoticz, device)
  domoticz.log(string.format('Device changed: name=%s, unique_id=%s, state=%s',
      device.name, device.deviceId, device.state))
 end
}
```

Web Server

Libraries

The MicroPython script uses the MicroPython library Lightweight MQTT client for MicroPython “umqtt.simple”.

Credits
Thanks for developing & sharing the MicroPython library micropython-umqqt.simple.

MicroPython Script

```
"""
File:   buttoncontrol_mqtt_ad.py
Date:   20230425
Author: Robert W.B. Linn

:description
Test MQTT auto discovery with Domoticz and the Pico W running as web server.
Domoticz Hardware: MQTT Auto Discovery Client Gateway with LAN Interface,
Name=MQTTADGateway
Domoticz Device created via MQTT auto discovery by publishing config topic (see
domoticz log below).
The autodiscover component is button and the Domoticz device is type=Light/Switch.
Note that this script does not use the library server.py but has simple code to
connect to the network.

:external libraries
umqtt.simple

MQTT Remove Retained message for creating the button:
mosquitto_sub -h localhost --remove-retained -t 'domoticz/button/makelab/config' -W
1
Restart Domoticz:
sudo service domoticz.sh restart

:thonny log
buttoncontrol_mqtt_ad v20230425
Network connecting...
Network connected: picow-ip
MQTT Broker connecting...
MQTT Broker connected: domoticz-ip
MQTT State published: topic=domoticz/button/makelab/config, payload={"name":
"MakeLabButton", "state_topic": "domoticz/button/makelab/state", "unique_id":
"BM001"}
MQTT published: topic=domoticz/button/makelab/state, payload={"ON"}

:wiring
Button = Pico W
Button K4 = GP20 (Pin #26)
GND (-) = GND (Pin #28)
"""

# Imports
import network
import time
from machine import Pin
# picozero - BETA version (Installed via Thonny manage packages)
from picozero import Button
# mqtt simple (Installed via Thonny manage packages)
from umqtt.simple import MQTTClient
# Configuration (must be uploaded to the pico w)
import config

# Constants
```

```
VERSION = const('buttoncontrol_mqtt_ad v20230425')

"""
BUTTON
"""
# Button K4 pin
BUTTON_PINNR = 20
# Button object
btn = Button(BUTTON_PINNR)

# MQTT publish with encoded topic & payload (buffered objects required).
# The topic is the state_topic as defined in the configuration.
# The payload is the string ON (uppercase).
def button_pressed():
    client.publish(STATE_TOPIC, STATE_PAYLOAD)
    print(f'MQTT published: topic={STATE_TOPIC.decode()},
payload={STATE_PAYLOAD.decode()}')

# Set the function to run if the button is pressed
btn.when_pressed = button_pressed

"""
MQTT
"""
MQTT_BROKER  = const('domoticz-ip')
MQTT_CLIENT_ID = const('picow_button_k4')

# Topic & payload to create the device. The configuration component is button.
BUTTON_TOPIC_CONFIG = const(b'domoticz/button/makelab/config')
BUTTON_PAYLOAD_CONFIG     = const(b'{"name": "MakeLabButton", "state_topic":
"domoticz/button/makelab/state", "unique_id": "BM001"}')

# Topic used to publish the state of the button
# Payload is JSON format (uppercase): {"ON"}
STATE_TOPIC  = const(b'domoticz/button/makelab/state')
STATE_PAYLOAD   = const(b'{"ON"}')

# Connect to the MQTT broker with client id and server address
def mqtt_connect(client_id, mqtt_server):
    client = MQTTClient(client_id, mqtt_server, keepalive=3600)
    client.connect()
    print(f'MQTT Broker connecting...')
    return client

# Reconnect to the MQTT broker
def mqtt_reconnect():
    print('[ERROR] Failed to connect to the MQTT Broker. Reconnecting...')
    time.sleep(5)
    machine.reset()

# Info
print(f'{VERSION}')

# Connect to the network
try:
    print(f'Network connecting...')
    wlan = network.WLAN(network.STA_IF)
    wlan.active(True)
    wlan.connect(config.WIFI_SSID, config.WIFI_PASSWORD)
    time.sleep(5)
    if not wlan.isconnected():
        raise RuntimeError('[ERROR] Can not connect to the network.')
    print(f'Network connected: {wlan.ifconfig()[0]}')
except Exception as e:
    raise RuntimeError('[ERROR] Can not connect to the network.')

# Connect to MQTT
# Publish mqtt auto discovery topic & payload for the switch device (button)
try:
```

```
    # Connect to MQTT broker
    client = mqtt_connect(MQTT_CLIENT_ID, MQTT_BROKER)
    print(f'MQTT Broker connected: {MQTT_BROKER}')

    # Publish config topics to auto create the device in domoticz
    client.publish(BUTTON_TOPIC_CONFIG, BUTTON_PAYLOAD_CONFIG)
    print(f'MQTT State published: topic={BUTTON_TOPIC_CONFIG.decode()},
payload={BUTTON_PAYLOAD_CONFIG.decode()}')

except OSError as e:
    mqtt_reconnect()

# Main
while True:
    pass
```

DHT22 Temperature & Humidity

Description

This project reads in regular intervals the DHT22 sensor temperature & humidity, connected to the Pico W, and sent the data to a Domoticz Temperature + Humidity device.

Ideas for Use

- Mini weather station,
- Room temperature & humidity control.

Solutions

The Pico W has a DHT22 sensor connected and runs as a web server.
The web server reads in regular intervals the temperature & humidity.

Two solutions worked out:

Domoticz Device Update
The DHT22 sensor data is sent to Domoticz via HTTP API/JSON GET request with parameter:

- udevice – used for the command,
- svalue - contains the temperature, humidity, humidity status,
- idx – the Domoticz temperature humidity device to be updated.

```
http://domoticz-
ip:port/json.htm?type=command&param=udevice&idx=15&nvalue=0&svalue=16;64;0
```

Domoticz Custom Event
The DHT22 sensor data is sent to Domoticz via HTTP API/JSON POST request with parameter:

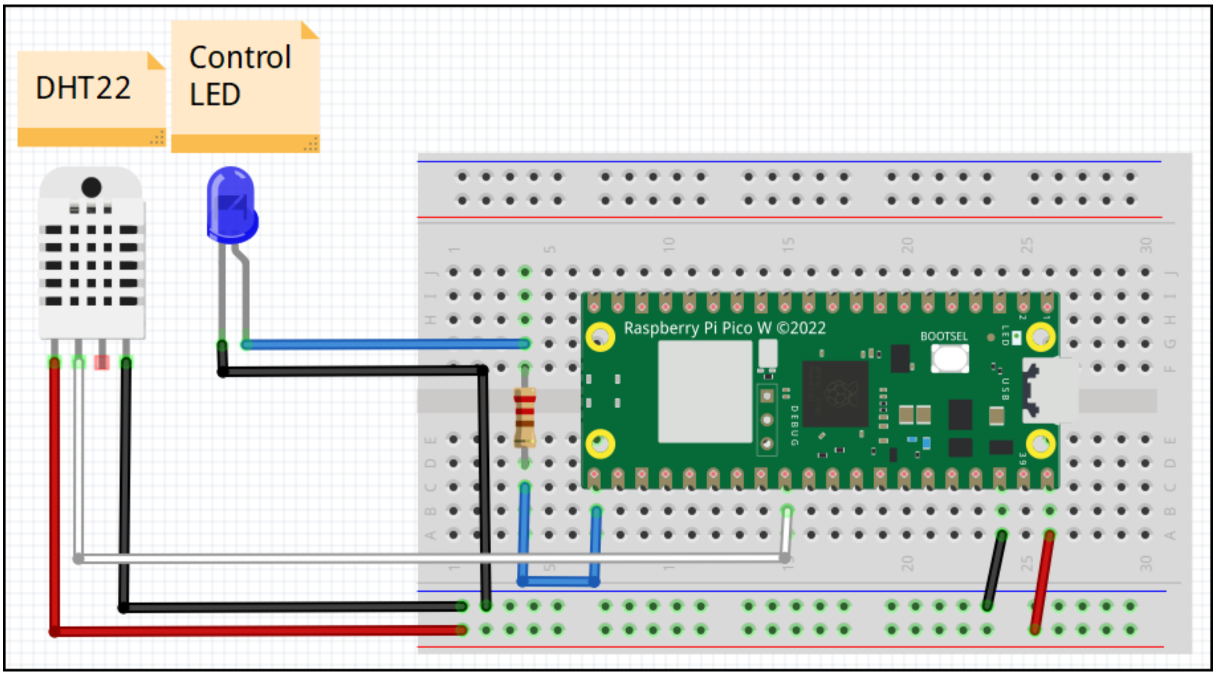
- customevent – used for the command,
- event - the custom event name,
- data - contains JSON object temperature (t), humidity (h), and humidity status (s).

```
http://domoticz-
ip:port/json.htm?type=command&param=customevent&event=DHT22&data={"h": 56, "t": 16,
"s": 0}
```

Wiring

DHT22	**Pico W**
VCC (+)	VBUS (Pin #40)
OUT	GP22 (Pin #29)
GND (-)	GND (Pin #38)
LED (blue)	**Pico W**
+ (Anode)	16 (Pin #21)
GND (Cathode)	GND (Pin #38)

Circuit Diagram

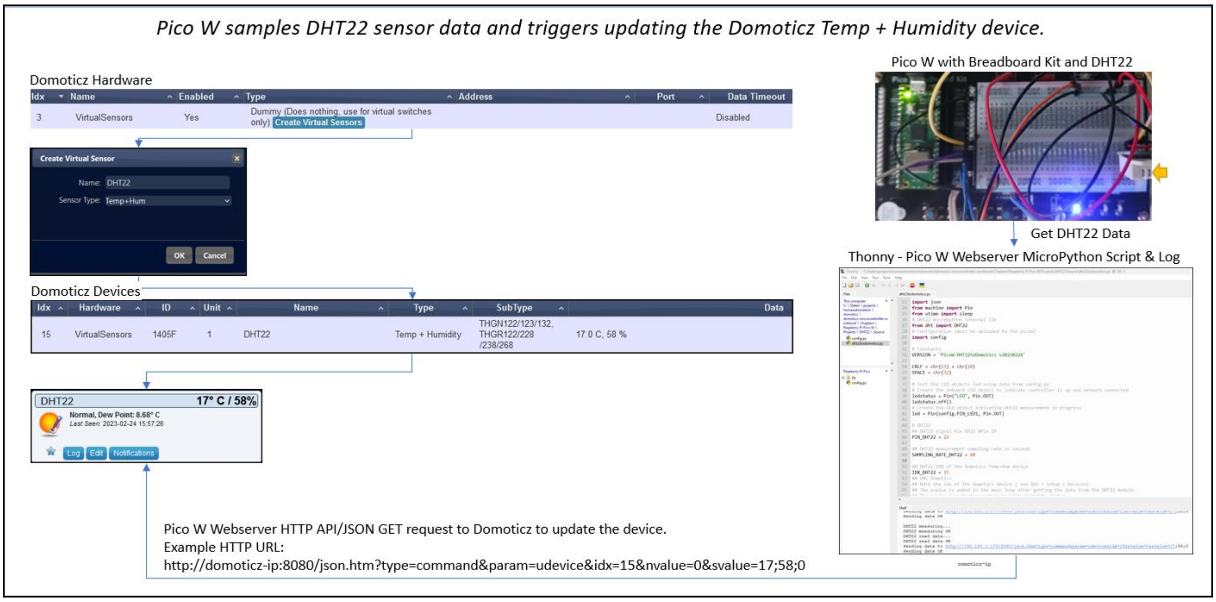


Domoticz Device Update

The picture shows the flow of actions:

1. Create the Domoticz Temp+Hum device from the hardware “Dummy” (Create Virtual Sensors) ,
2. Run the Pico W web server and request every 60 seconds the DHT22 data,
3. After receiving data, the Pico W web server submits the data to Domoticz via HTTP API/JSON GET request with the command “udevice” for the device “idx” and the data as “svalue”,
4. Domoticz handles the incoming HTTP request and updates the device.

Block Diagram



MicroPython Script

```
"""
File:   dht22.py
Date:   20230318
Author: Robert W.B. Linn

Read in regular intervals the DHT22 temperature and humidity and update the svalue
(i.e., 16;55;1) of a Domoticz device named DHT22.
The Domoticz device is updated using HTTP API/JSON request to the Domoticz server.

:notes
Pico Breadboard Kit is used to wire up the DHT22.
Pico Breadboard Kit LED1 is used as status LED when requesting DHT22 data and
updating domoticz.
Configuration stored in config.py, ensure to upload to the picow.
DHT22 measures every 60 seconds.

:log
DHT22 v20230311
Sampling Rate: 60s.
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
DHT22 t=19, h=43, hs=0, svalue=19;43;0
Send GET request url=http://domoticz-
ip:port/json.htm?type=command&param=udevice&idx=15&nvalue=0&svalue=19;43;0
Send GET request status=OK

:wiring
DHT22 = Pico W
VCC (+) = VBUS (Pin #40)
OUT = GP22 (Pin #29)
GND (-) = GND (Pin #28)
"""

# Imports
from machine import Pin
from utime import sleep
# DHT22 micropython internal lib
from dht import DHT22
# Call server from server.py (must be uploaded to the picow)
from server import Server
# Configuration (must be uploaded to the picow)
import config

# Constants
VERSION = 'DHT22 v20230311'

# Create the led object indicating dht22 measurement in progress
led1 = Pin(config.PIN_LED1, Pin.OUT)
led1.value(0)

# DHT22 Signal Pin GP22 #Pin 29
PIN_DHT22 = 22
# DHT22 measurement sampling rate in seconds
SAMPLING_RATE_DHT22 = 60
# DHT22 IDX of the Domoticz Temp+Hum device
IDX_DHT22 = 15
# URL Domoticz
# Note the idx of the domoticz device ( see GUI > Setup > Devices)
# The svalue is added in the main loop after getting the data from the DHT22
module.
# The svalue format: temperature,humidity,humidity status
URL_DOM_DHT22 = "http://"+ config.DOMOTICZ_IP
+"/json.htm?type=command&param=udevice&idx=" + str(IDX_DHT22) + "&nvalue=0&svalue="

# Create the dht22 sensor object
```

```
dht22_sensor = DHT22(Pin(Pin_DHT22, Pin.IN, Pin.PULL_UP))

"""
Set the humidity status level used for Domoticz HUM_STAT value.

:param int hum
    0: NORMAL, 1: COMFORTABLE, 2: DRY, 3: WET

:return int level
    Humidity level 0 - 3
"""
def set_humidity_status(hum, temp):
    level = 9
    # 2 = Dry
    if hum <= 30:
        level = 2
    # 3 = Wet
    elif hum >= 70:
        level = 3
    # 1 = Comfortable
    elif hum >= 35 and hum <= 65 and temp >=22 and temp <= 26:
        level = 1
    # 0 = Normal
    else:
        level = 0
    return level

"""
DHT22 measurement with roundes values for temperature and humidity.
During measurement, LED1 of the Pico Breadboard is on.

:return string svalue
    svalue with temperature (°C), humidity (0-100%) and humidity_status (0-3)

:example
    16;55;1
"""
def get_dht22_data():
    led1.value(1)
    sleep(1)
    # print(f'DHT22 measuring...')
    dht22_sensor.measure()
    # print(f'DHT22 measuring OK')

    # print(f'DHT22 read data...')
    # Assign the data (rounded)
    temperature     = round(dht22_sensor.temperature())
    humidity        = round(dht22_sensor.humidity())
    humidity_status = set_humidity_status(humidity, temperature)

    # Set the svalue, i.e. svalue=TEMP;HUM;HUM_STAT
    svalue = str(temperature) + ';' + str(humidity) + ';' + str(humidity_status)
    led1.value(0)
    print(f'DHT22 t={temperature}, h={humidity}, hs={humidity_status},
svalue={svalue}')
    return svalue

# Info
print(f'{VERSION}')
print(f'Sampling Rate: {SAMPLING_RATE_DHT22}s.')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect()

# Main
# Measure DHT22 every NN seconds (see constant SAMPLING_DELAY)
```

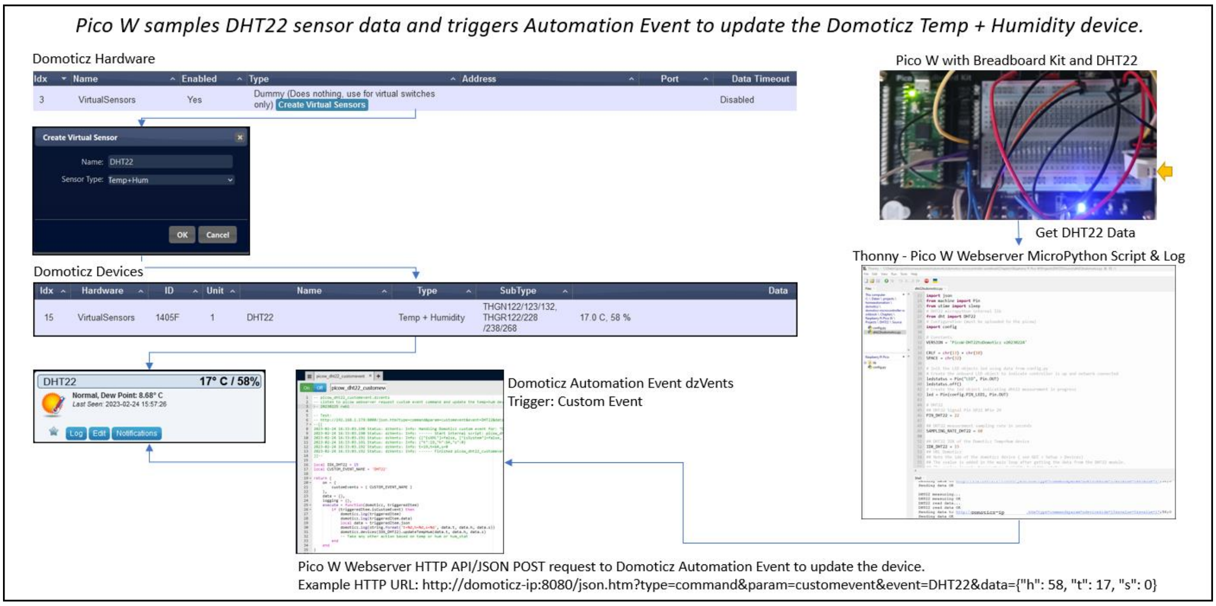
```
while True:

    # Measure DHT22 temperature & humidity & humidity status
    # Submit Domoticz HTTP API/JSON GET request to update the device
    network.send_get_request(URL_DOM_DHT22 + get_dht22_data())

    # Delay till next sample
    sleep(SAMPLING_RATE_DHT22)
```

Domoticz Custom Event

The picture shows the flow of actions:

1. Create the Domoticz Temp+Hum device from the hardware “Dummy” (Create Virtual Sensors) ,
2. Run the Pico W web server and request every 60 seconds the DHT22 data,
3. After receiving data, the Pico W web server submits the data to Domoticz via HTTP API/JSON POST request with the command “customevent” and data as “JSON object”,
4. Domoticz handles the incoming HTTP request and updates the device.

Block Diagram



MicroPython Script

```
"""
File:   dht22_customevent.py
Date:   20230318
Author: Robert W.B. Linn

Read in regular intervals the DHT22 temperature and humidity and update the
Domoticz device named DHT22.
The Domoticz device is updated using HTTP API/JSON POST request Custom Event to the
Domoticz server.
The data is a JSON object: {"t":temperature NN,"h":humidity 0-100,"s":humidity
status 0-3}

:example
http://domoticz-
ip:8080/json.htm?type=command&param=customevent&event=DHT22&data={"t":19,"h":64,"s"
:0}

:notes
Pico Breadboard Kit is used to wire up the DHT22.
Pico Breadboard Kit LED1 is used as status LED when requesting DHT22 data and
updating domoticz.
Configuration stored in config.py, ensure to upload to the picow.
DHT22 measures every 60 seconds.
```

```
:log
DHT22_CustomEvent v20230311
Sampling Rate: 60s.
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
DHT22 t=19, h=43, hs=0, data={'h': 43, 't': 19, 's': 0}
Send POST request url=http://domoticz-
ip:port/json.htm?type=command&param=customevent&event=DHT22&data=, postdata={'h':
43, 't': 19, 's': 0}
Send POST request status=OK

:wiring
DHT22 = Pico W
VCC (+) = VBUS (Pin #40)
OUT = GP22 (Pin #29)
GND (-) = GND (Pin #28)
"""

# Imports
from machine import Pin
from utime import sleep
# Convert the Domoticz HTTP API/JSON response
import json
# DHT22 micropython internal lib
from dht import DHT22
# Call server from server.py (must be uploaded to the picow)
from server import Server
# Configuration (must be uploaded to the picow)
import config

# Constants
VERSION = 'DHT22_CustomEvent v20230311'

# Create the led object indicating dht22 measurement in progress
led1 = Pin(config.PIN_LED1, Pin.OUT)
led1.value(0)

# DHT22 Signal Pin GP22 #Pin 29
PIN_DHT22 = 22
# DHT22 measurement sampling rate in seconds
SAMPLING_RATE_DHT22 = 60
# DHT22 IDX of the Domoticz Temp+Hum device
IDX_DHT22 = 15
# URL Domoticz
# Note the idx of the domoticz device ( see GUI > Setup > Devices)
# The data is a JSON object, i.e. {"t":19,"h":64,"s":0}
URL_DOM_DHT22 = "http://domoticz-
ip:port/json.htm?type=command&param=customevent&event=DHT22&data="

# Create the dht22 sensor object
dht22_sensor = DHT22(Pin(Pin_DHT22, Pin.IN, Pin.PULL_UP))

"""
Set the humidity status level used for Domoticz HUM_STAT value.

:param int hum
    0: NORMAL, 1: COMFORTABLE, 2: DRY, 3: WET

:return int level
    Humidity level 0 - 3
"""
def set_humidity_status(hum, temp):
    level = 9
    # 2 = Dry
    if hum <= 30:
        level = 2
    # 3 = Wet
```

```
    elif hum >= 70:
        level = 3
    # 1 = Comfortable
    elif hum >= 35 and hum <= 65 and temp >=22 and temp <= 26:
        level = 1
    # 0 = Normal
    else:
        level = 0
    return level

"""
DHT22 measurement with roundes values for temperature and humidity.
During measurement, LED1 of the Pico Breadboard is on.

:return string data
    JSON object with key:value pairs t=temperature (°C), h=humidity (0-100%),
s=humidity_status (0-3)

:example
    {'h': 48, 't': 18, 's': 0}
"""
def get_dht22_data():
    led1.value(1)
    sleep(1)
    # print(f'DHT22 measuring...')
    dht22_sensor.measure()
    # print(f'DHT22 measuring OK')

    # print(f'DHT22 read data...')
    # Assign the data (rounded)
    temperature     = round(dht22_sensor.temperature())
    humidity        = round(dht22_sensor.humidity())
    humidity_status = set_humidity_status(humidity, temperature)

    # Set the data JSON object: {"t":NN,"h":NN,"s":N}
    data = {}
    data['t'] = temperature
    data['h'] = humidity
    data['s'] = humidity_status
    led1.value(0)
    print(f'DHT22 t={temperature}, h={humidity}, hs={humidity_status},
data={data}')
    return data

# Info
print(f'{VERSION}')
print(f'Sampling Rate: {SAMPLING_RATE_DHT22}s.')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect()

# Main
# Measure DHT22 every NN seconds (see constant SAMPLING_DELAY)
while True:

    # Measure DHT22 temperature & humidity & humidity status
    # Submit Domoticz HTTP API/JSON POST request to update the device
    network.send_post_request(URL_DOM_DHT22, get_dht22_data())

    # Delay till next sample
    sleep(SAMPLING_RATE_DHT22)
```

Automation Script

```
--[[
File:   dht22_customevent.dzvents
Date:   20230225
Author: Robert W.B. Linn

Listen to Pico W web server request custom event command and update the temp+hum
device temp,hum,hum_stat.

Test
http://domoticz-
ip:port/json.htm?type=command&param=customevent&event=DHT22&data={"t":19,"h":64,"s"
:0}
Log
2023-02-24 16:33:03.190 Status: dzVents: Info: Handling Domoticz custom event for:
"DHT22"
2023-02-24 16:33:03.190 Status: dzVents: Info: ------ Start internal script:
picow_dht22_customevent: Custom event: "DHT22"
2023-02-24 16:33:03.191 Status: dzVents: Info: {["isXML"]=false,
["isSystem"]=false, ["customEvent"]="DHT22", ["data"]="{"t":19,"h":64,"s":0}",
["isShellCommandResponse"]=false, ["type"]="customEvent", ["isHTTPResponse"]=false,
["json"]={["h"]=64, ["t"]=19, ["s"]=0}, ["isCustomEvent"]=true, ["message"]="",
["isGroup"]=false, ["isHardware"]=false, ["status"]="info", ["isDevice"]=false,
["trigger"]="DHT22", ["isSecurity"]=false, ["baseType"]="custom",
["dump"]=function, ["isTimer"]=false, ["isScene"]=false, ["isVariable"]=false,
["isJSON"]=true}
2023-02-24 16:33:03.191 Status: dzVents: Info: {"t":19,"h":64,"s":0}
2023-02-24 16:33:03.192 Status: dzVents: Info: t=19,h=64,s=0
2023-02-24 16:33:03.192 Status: dzVents: Info: ------ Finished
picow_dht22_customevent
]]--

local IDX_DHT22 = 15
-- Custom event name as used by the Pico W web server HTTP API/JSON POST request
local CUSTOM_EVENT_NAME = 'DHT22'

return {
 on = {
  customEvents = { CUSTOM_EVENT_NAME }
 },
 data = {},
 logging = {},
 execute = function(domoticz, triggeredItem)
  if (triggeredItem.isCustomEvent) then
   domoticz.log(triggeredItem)
         -- Check the custom event name in case there are more custom events
     if (triggeredItem.trigger == CUSTOM_EVENT_NAME) then
      domoticz.log(triggeredItem.data)
      local data = triggeredItem.json
      domoticz.log(string.format('t=%d,h=%d,s=%d', data.t, data.h, data.s))
      domoticz.devices(IDX_DHT22).updateTempHum(data.t, data.h, data.s)
      -- Take any other action based on temp or hum or hum_stat
     end
  end
 end
}
```

DHT22 Temperature & Humidity MQTT Auto Discovery

Description

This project auto creates two Domoticz devices for Temperature & Humidity and regular updates the devices state.

Solution

This project is based up the project DHT22 Temperature & Humidity and uses this Home Assistant Example (thanks for sharing).

Instead communicating via HTTP, the Domoticz hardware controller MQTT Auto Discovery Client Gateway with LAN interface (MQTT Auto Discovery) is used.

The Pico W connects to the network and to the Domoticz Client Gateways for MQTT & MQTT Auto Discovery.
The config & state messages published by the Pico W are handled by the Domoticz hardware controller MQTT Auto Discovery Client Gateway with LAN interface.

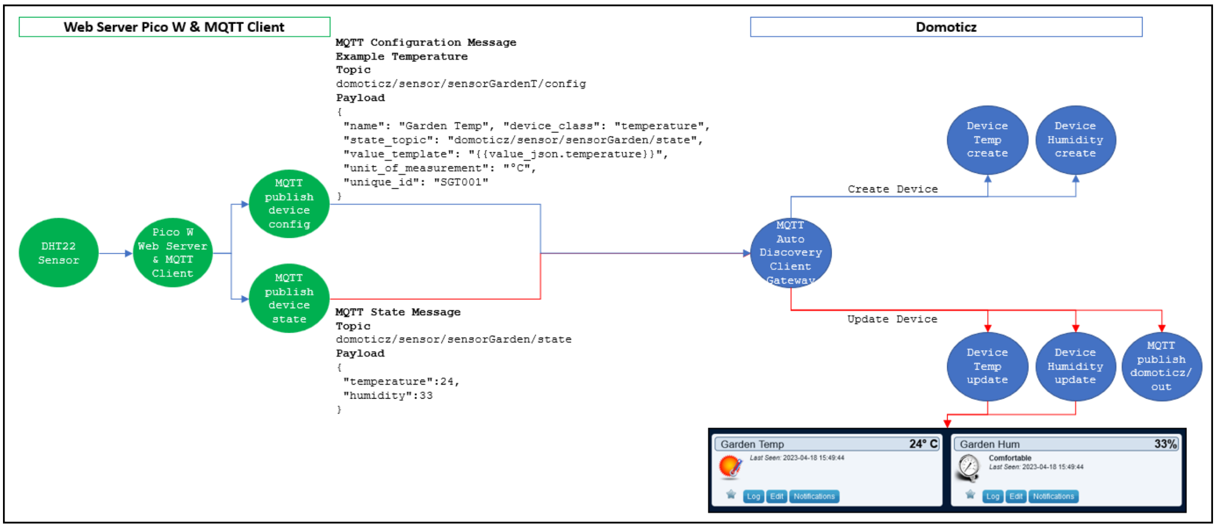
Step 1 – Publish MQTT Config messages to create the two Domoticz devices for Temperature & Humidity.
If these devices are already in place, Domoticz takes no action.

The Domoticz devices list with the two devices auto created for the MQTT Auto Discovery hardware (named MQTTADGateway):

	Idx	Hardware	ID	Unit	Name	Type	SubType	
	38	MQTTADGateway	SGT001	1	Garden Temp	Temp	THR128/138, THC138	19.0 C
	37	MQTTADGateway	SGH001	1	Garden Hum	Humidity	LaCrosse WS2300	Humidity 39 %

Step 2 – Publish MQTT State message after reading the DHT22 temperature and humidity.
The MQTT messages published are picked up by Domoticz and the value of the two devices are updated.
See block diagram showing the two device widgets Garden Temp & Garden Hum.

Block Diagram



MQTT Auto Discovery Topics & Payload

CONFIGURATION	
Temperature Device	
Configuration Topic	domoticz/sensor/sensorGardenT/config

Configuration Payload	{
	"name": "Garden Temp",
	"device_class": "temperature",
	"state_topic": "domoticz/sensor/sensorGarden/state",
	"value_template": "{{value_json.temperature}}",
	"unit_of_measurement": "°C",
	"unique_id": "SGT001"
	}

Humidity Device	
Configuration Topic	domoticz/sensor/sensorGardenH/config

Configuration Payload	{
	"name": "Garden Hum",
	"device_class": "humidity",
	"state_topic": "domoticz/sensor/sensorGarden/state",
	"value_template": "{{value_json.humidity}}",
	"unit_of_measurement": "%",
	"unique_id": "SGH001"
	}

STATE	
Topic	domoticz/sensor/sensorGarden/state

Payload
Temperature &
Humidity
	{
	"temperature":{T},
	"humidity":{H}
	}

Payload
Temperature
	{
	"temperature":{T},
	}

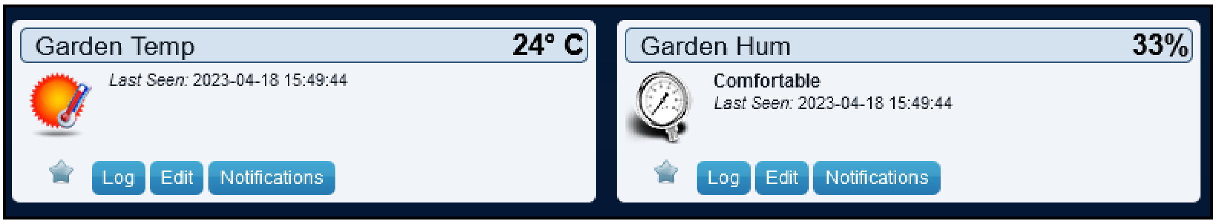
Payload
Humidity
	{
	"humidity":{H},
	}

	Note {T} and {H} are placeholders for the values.

Domoticz

Devices

The two devices widget created via MQTT Auto Discovery:



Debug Log

Domoticz Debug Log showing the MQTT Auto Discovery gateway receiving the message with the payload containing the temperature & humidity keys with values.
The message is split into two messages for the temperature & humidity for the Domoticz topic “domoticz/out”.

```
2023-04-18 15:51:15.090 Debug: MQTTADGateway: topic:
domoticz/sensor/sensorGarden/state, message: {"temperature":24, "humidity":33}
2023-04-18 15:51:15.220 Debug: MQTTADGateway: topic: domoticz/out, message: {
2023-04-18 15:51:15.220 "Battery" : 255,
2023-04-18 15:51:15.220 "LastUpdate" : "2023-04-18 15:51:15",
2023-04-18 15:51:15.220 "RSSI" : 12,
2023-04-18 15:51:15.220 "description" : "",
2023-04-18 15:51:15.220 "dtype" : "Humidity",
2023-04-18 15:51:15.220 "hwid" : "6",
2023-04-18 15:51:15.220 "id" : "SGH001",
2023-04-18 15:51:15.220 "idx" : 37,
2023-04-18 15:51:15.220 "name" : "Garden Hum",
2023-04-18 15:51:15.220 "nvalue" : 33,
2023-04-18 15:51:15.220 "stype" : "LaCrosse WS2300",
2023-04-18 15:51:15.220 "svalue1" : "1",
2023-04-18 15:51:15.220 "unit" : 1
2023-04-18 15:51:15.220 }
2023-04-18 15:51:15.220
2023-04-18 15:51:15.321 Debug: MQTTADGateway: topic: domoticz/out, message: {
2023-04-18 15:51:15.321 "Battery" : 255,
2023-04-18 15:51:15.321 "LastUpdate" : "2023-04-18 15:51:15",
2023-04-18 15:51:15.321 "RSSI" : 12,
2023-04-18 15:51:15.321 "description" : "",
2023-04-18 15:51:15.321 "dtype" : "Temp",
2023-04-18 15:51:15.321 "hwid" : "6",
2023-04-18 15:51:15.321 "id" : "SGT001",
2023-04-18 15:51:15.321 "idx" : 38,
2023-04-18 15:51:15.321 "name" : "Garden Temp",
2023-04-18 15:51:15.321 "nvalue" : 0,
2023-04-18 15:51:15.321 "stype" : "THR128/138, THC138",
2023-04-18 15:51:15.321 "svalue1" : "24.00",
2023-04-18 15:51:15.321 "unit" : 1
2023-04-18 15:51:15.321 }
```

```
2023-04-18 15:51:15.321
```

Automation Script

There is no automation script used, but … if want to capture device changes, this is a simple example.

```
--[[
File:   dht22_mqtt_ad.dzvents
Date:   20230424
Author: Robert W.B. Linn

:description
Listen to two device changes which has been created using MQTT Auto Discovery.

:log
2023-04-24 10:53:30.121 MQTTADGateway: Humidity/LaCrosse WS2300 (Garden Hum)
2023-04-24 10:53:30.136 MQTTADGateway: Temp/THR128/138, THC138 (Garden Temp)
2023-04-24 10:53:30.215 Status: dzVents: Info: Handling events for: "Garden Hum", 
value: "51"
2023-04-24 10:53:30.215 Status: dzVents: Info: DHT22_MQTT_AD: ------ Start internal 
script: dht22_mqtt_ad: Device: "Garden Hum (MQTTADGateway)", Index: 37
2023-04-24 10:53:30.215 Status: dzVents: Info: DHT22_MQTT_AD: Device changed: 
name=Garden Hum, unique_id=SGH001, state=51
2023-04-24 10:53:30.215 Status: dzVents: Info: DHT22_MQTT_AD: ------ Finished 
dht22_mqtt_ad
2023-04-24 10:53:30.268 Status: dzVents: Info: Handling events for: "Garden Temp", 
value: "18.00"
2023-04-24 10:53:30.268 Status: dzVents: Info: DHT22_MQTT_AD: ------ Start internal 
script: dht22_mqtt_ad: Device: "Garden Temp (MQTTADGateway)", Index: 38
2023-04-24 10:53:30.268 Status: dzVents: Info: DHT22_MQTT_AD: Device changed: 
name=Garden Temp, unique_id=SGT001, state=18.00
2023-04-24 10:53:30.268 Status: dzVents: Info: DHT22_MQTT_AD: ------ Finished 
dht22_mqtt_ad
2023-04-24 10:53:30.117 Debug: MQTTADGateway: topic: 
domoticz/sensor/sensorGarden/state, message: {"temperature":18, "humidity":51}
]]--

-- IDX of the devices Temperature & Humidity
local IDX_DHT22_T = 38
local IDX_DHT22_H = 37

return {
 on = { devices = { IDX_DHT22_T, IDX_DHT22_H } },
 logging = { level = domoticz.LOG_INFO, marker = 'DHT22_MQTT_AD', },
 execute = function(domoticz, device)
  domoticz.log(string.format('Device changed: name=%s, unique_id=%s, state=%s', 
      device.name, device.deviceId, device.state))
     -- Device changed: name=Garden Temp, unique_id=SGT001, state=21.00
 end
}
```

Web Server

Libraries

The MicroPython script uses the MicroPython library Lightweight MQTT client for MicroPython “umqtt.simple”.

Credits
Thanks for developing & sharing the MicroPython library micropython-umqqt.simple.

MicroPython Script

```
"""
File:   dht22_mqtt_ad.py
Date:   20230424
Author: Robert W.B. Linn

:description
Test MQTT auto discovery with Domoticz and the Pico W running as web server.
Domoticz Hardware: MQTT Auto Discovery Client Gateway with LAN Interface,
Name=MQTTADGateway
Domoticz Devices created via MQTT auto discovery by publishing config topic (see
domoticz log below).
The two devices are from type=Temp and type=Humidity.
Note that this script does not use the library server.py but has simple code to
connect to the network.

:external libraries
umqtt.simple

MQTT Remove Retained messages:
mosquitto_sub -h localhost --remove-retained -t '#' -W 1

:domoticz log
NOTE:
Initially the two devices for temperature & humidity are not in place.
These are created first time by the MQTT topics
"domoticz/sensor/sensorGardenT/config" and "domoticz/sensor/sensorGardenH/config".
The state, i.e. the two device value updates is set by the topic
"domoticz/sensor/sensorGarden/state".
See below log for payload examples for the topics.

2023-04-16 14:30:33.183 Debug: : MQTT PublishSchema 1 (1), Retain 0
2023-04-16 14:30:33.183 Debug: : MQTT PublishSchema 0 (0), Retain 0
2023-04-16 14:30:36.702 Debug: MQTTADGateway: topic: domoticz/status, message:
online
2023-04-16 14:30:52.422 Debug: MQTTADGateway: topic:
domoticz/sensor/sensorGardenT/config, message: {"name": "Garden Temp",
"device_class": "temperature", "state_topic": "domoticz/sensor/sensorGarden/state",
"value_template": "{{value_json.temperature}}", "unit_of_measurement": "°C",
"unique_id": "SGT001"}
2023-04-16 14:30:52.523 Debug: MQTTADGateway: topic:
domoticz/sensor/sensorGardenH/config, message: {"name": "Garden Hum",
"device_class": "humidity", "state_topic": "domoticz/sensor/sensorGarden/state",
"value_template": "{{value_json.humidity}}", "unit_of_measurement": "%",
"unique_id": "SGH001"}
2023-04-16 14:30:53.704 Debug: MQTTADGateway: topic:
domoticz/sensor/sensorGarden/state, message: {"temperature":21, "humidity":45}
2023-04-16 14:31:04.907 Debug: MQTTADGateway: topic:
domoticz/sensor/sensorGarden/state, message: {"temperature":21, "humidity":45}

:thonny log
dht22_mqtt_ad v20230420
Sampling Rate: 10s.
Network connecting...
```

```
Network connected: picow-ip
MQTT Broker connecting...
MQTT Broker connected: domoticz-ip
MQTT Auto Discovery published: topic=domoticz/sensor/sensorGardenT/config,
payload={"name": "Garden Temp", "device_class": "temperature", "state_topic":
"domoticz/sensor/sensorGarden/state", "value_template":
"{{value_json.temperature}}", "unit_of_measurement": "°C", "unique_id": "SGT001"}
MQTT Auto Discovery published: topic=domoticz/sensor/sensorGardenH/config,
payload={"name": "Garden Hum", "device_class": "humidity", "state_topic":
"domoticz/sensor/sensorGarden/state", "value_template": "{{value_json.humidity}}",
"unit_of_measurement": "%", "unique_id": "SGH001"}
MQTT published: topic=domoticz/sensor/sensorGarden/state,
payload={"temperature":21, "humidity":37}
MQTT published: topic=domoticz/sensor/sensorGarden/state,
payload={"temperature":21, "humidity":37}

:wiring
DHT22 = Pico W
VCC (+) = VBUS (Pin #40)
OUT = GP22 (Pin #29)
GND (-) = GND (Pin #28)
"""

# Imports
import network
import time
from machine import Pin
from utime import sleep, sleep_ms
# Installed via Thonny manage packages
from umqtt.simple import MQTTClient
# DHT22 micropython internal lib
from dht import DHT22
# Call server from server.py (must be uploaded to the picow)
from server import Server
# Configuration (must be uploaded to the pico w)
import config
import sys

# Constants
VERSION = const('dht22_mqtt_ad v20230420')

"""
DHT22
"""
# DHT22 Signal GP22 (Pin #29)
PIN_DHT22 = const(22)
# DHT22 measurement sampling rate in seconds
SAMPLING_RATE = const(60)

# Create the DHT22 sensor object
dht22_sensor = DHT22(Pin(PIN_DHT22, Pin.IN, Pin.PULL_UP))

# DHT22 measurement with roundes values for temperature and humidity.
# return int temperature, int humidity
def get_dht22_data():
    # print(f'DHT22 measuring...')
    dht22_sensor.measure()
    # print(f'DHT22 measuring OK')

    # print(f'DHT22 read data...')
    # Assign the data (rounded)
    temperature     = round(dht22_sensor.temperature())
    humidity        = round(dht22_sensor.humidity())

    # Create the payload for the STATE_TOPIC (see below)
    payload = STATE_PAYLOAD
    payload = payload.replace('{T}', str(temperature))
    payload = payload.replace('{H}', str(humidity))
```

```
    # print(f'DHT22 t={temperature}, h={humidity}')
    return payload.encode()

"""
MQTT
"""
MQTT_BROKER  = const('domoticz-ip')
MQTT_CLIENT_ID = const('picow_dht22')

# Topics & payload to create the devices. The configuration component is sensor.
TEMP_TOPIC_CONFIG= const(b'domoticz/sensor/sensorGardenT/config')
TEMP_PAYLOAD_CONFIG = const(b'{"name": "Garden Temp", "device_class": "temperature",
"state_topic": "domoticz/sensor/sensorGarden/state", "value_template":
"{{value_json.temperature}}", "unit_of_measurement": "°C", "unique_id": "SGT001"}')
HUM_TOPIC_CONFIG = const(b'domoticz/sensor/sensorGardenH/config')
HUM_PAYLOAD_CONFIG = const(b'{"name": "Garden Hum", "device_class": "humidity",
"state_topic": "domoticz/sensor/sensorGarden/state", "value_template":
"{{value_json.humidity}}", "unit_of_measurement": "%", "unique_id": "SGH001"}')

# Topic used to publish the state of the two sensors
# Payload is JSON format: {"temperature":21, "humidity":45}
STATE_TOPIC  = const(b'domoticz/sensor/sensorGarden/state')
STATE_PAYLOAD   = '{"temperature":{T}, "humidity":{H}}'

# Connect to the MQTT broker with client id and server address
def mqtt_connect(client_id, mqtt_server):
    client = MQTTClient(client_id, mqtt_server, keepalive=3600)
    client.connect()
    print(f'MQTT Broker connecting...')
    return client

# Reconnect to the MQTT broker
def mqtt_reconnect():
    print('[ERROR] Failed to connect to the MQTT Broker. Reconnecting...')
    time.sleep(5)
    machine.reset()

# Info
print(f'{VERSION}')
print(f'Sampling Rate: {SAMPLING_RATE}s.')

# Connect to the network
print(f'Network connecting...')
wlan = network.WLAN(network.STA_IF)
wlan.active(True)
wlan.connect(config.WIFI_SSID, config.WIFI_PASSWORD)
time.sleep(5)
if not wlan.isconnected():
    raise RuntimeError('[ERROR] Can not connect to the network.')
print(f'Network connected: {wlan.ifconfig()[0]}')

# Connect to MQTT
# Publish mqtt auto discovery topic & payload for the temperature & humidity device
try:
    # Connect to MQTT broker
    client = mqtt_connect(MQTT_CLIENT_ID, MQTT_BROKER)
    print(f'MQTT Broker connected: {MQTT_BROKER}')

    # Publish config topics to auto create the two devices in domoticz
    client.publish(TEMP_TOPIC_CONFIG, TEMP_PAYLOAD_CONFIG)
    print(f'MQTT Auto Discovery published: topic={TEMP_TOPIC_CONFIG.decode()},
payload={TEMP_PAYLOAD_CONFIG.decode()}')

    client.publish(HUM_TOPIC_CONFIG, HUM_PAYLOAD_CONFIG)
    print(f'MQTT Auto Discovery published: topic={HUM_TOPIC_CONFIG.decode()},
payload={HUM_PAYLOAD_CONFIG.decode()}')

except OSError as e:
    mqtt_reconnect()
```

```
# Main
while True:
    # Read the sensor data to get the payload {"temperature":19, "humidity":39}
    payload = get_dht22_data()

    # MQTT publish with encoded topic & payload (buffered objects required)
    client.publish(STATE_TOPIC, payload)
    print(f'MQTT published: topic={STATE_TOPIC.decode()},
payload={payload.decode()}')

    # Delay till next sample
    sleep(SAMPLING_RATE)
```

LCD 20x4 I2C LED Control

Description

This project switches, via Domoticz, LED1 of the Pico Breadboard Kit On/Off and display the LED state on an LCD 20x4 I2C display (LCD2004) connected to the Pico W.

This project shows how to set text on the LCD2004. It will be used by other projects.

Ideas for Use

- Domoticz Mini Information display,
- Domoticz Motherboard Monitor,
- Weather Station.

Screenshot LED1 On displayed on the LCD2004.

Solution

The Pico W has an LCD 20x4 I2C display connected and runs as a web server.
A Domoticz Switch state change triggers an Domoticz Automation Event dzVents.
This event listens to the switch device state changes and submits an HTTP POST request to the Pico W web server.

The POST data received by the Pico W is a JSON object:

```
{"state": "on" or "off"}
```

The LED1 is set according to the given state on or off.
The LCD2004 displays “LED1: On OK” on line 3 (row index 2, col index 0).

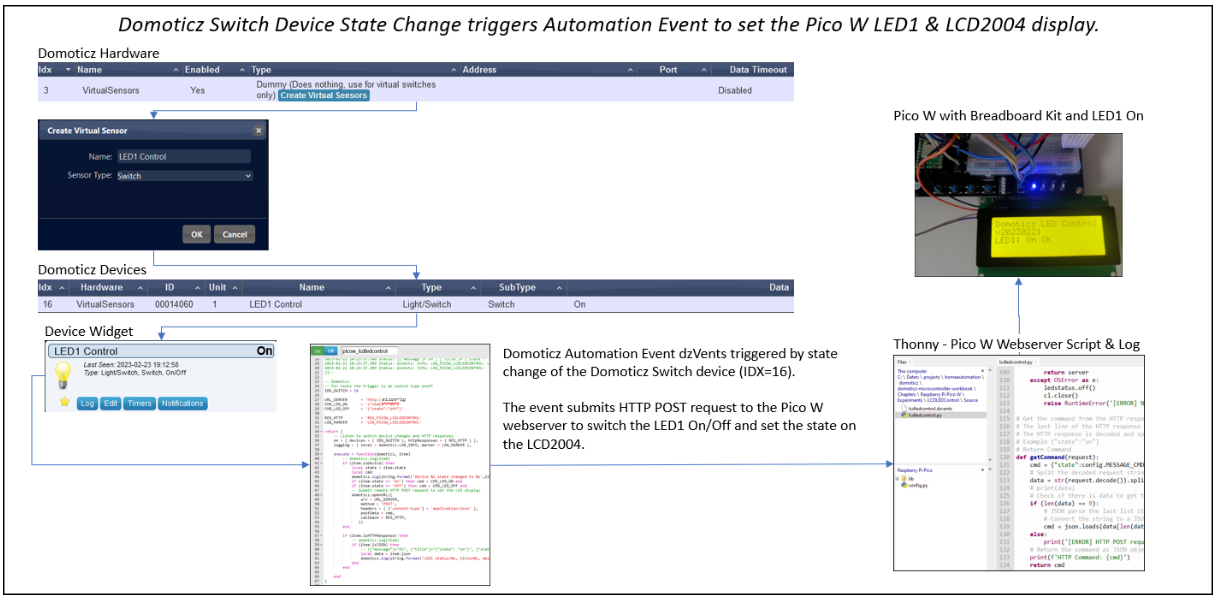
The Pico W web server sends an HTTP response back to Domoticz (as the client).

The HTTP response received by Domoticz, is a JSON object with key:value pairs parsed by the Domoticz event.

```
{["message"]="On", ["title"]="{"state": "on"}", ["status"]="OK"}
```

- message - LED1 state On or Off,
- title - Command received from the Domoticz Automation Event,
- status - OK, means the command has been executed successfully.

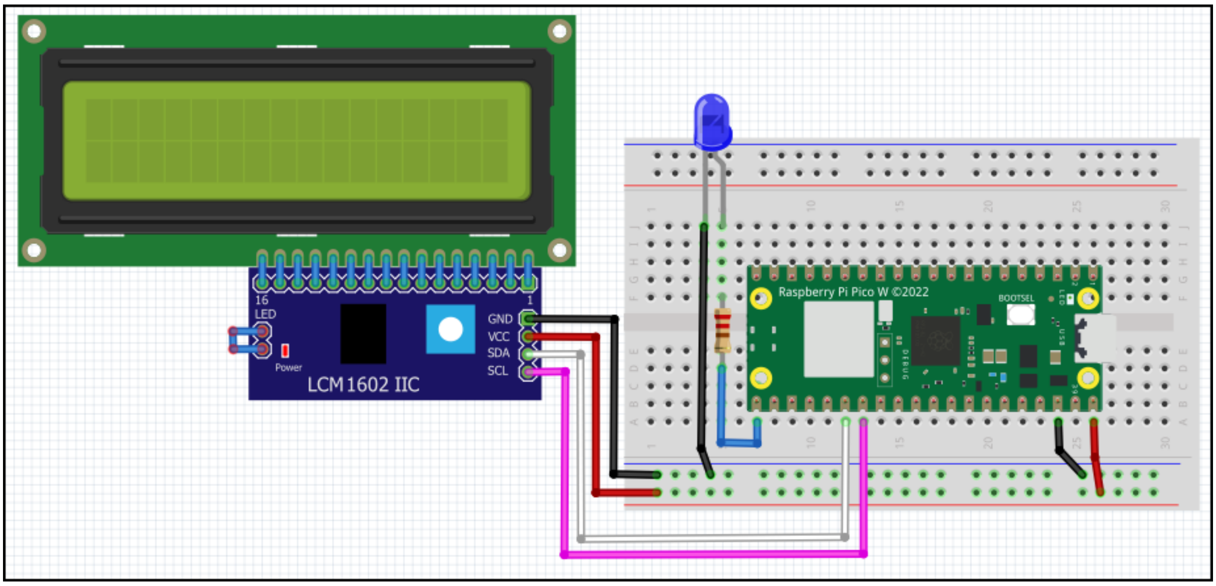
Block Diagram



Wiring

LCD 2004 I2C	**Pico W**
VCC	VBUS (5V)
SDA	GP20 (Pin #26)
SCL	GP21 (Pin #27)
GND	GND (Pin #38)
I2C Address	0x27
LED (blue)	**Pico W**
+ (Anode)	GP16 (Pin #21)
GND (Cathode)	GND (Pin #38)

Circuit Diagram



Note
The circuit shows an LCD 16x2 I2C instead the used LCD 20x4 I2C.
This solution can also be used for an LCD 16x2 I2C - need to change parameter in the Pico W web server script:

```
# LCD1602 Constants
LCD_I2C_ADDRESS = 0x27
LCD_ROWS = 2
LCD_COLS = 16
```

Note
The I2C address must be checked via the scan function. See MicroPython source code below.

Domoticz Setup

Devices

Create a virtual sensor, hardware dummy, named LED1 Control from sensor type Switch/Light.

After creating the device, the Domoticz devices list shows the entry:

```
Idx=16, Hardware=VirtualSensors, ID=00014060, Unit=1, Name=LED1 Control,
Type=Light/Switch, SubType=Switch, Data=On
```

Automation Script

The event listens to the Domoticz switch device state change On or Off.
Depending on the switch state, the HTTP POST JSON object is defined.
The HTTP POST request is sent to the Pico W web server.
The HTTP response from the Pico W web server is logged in the Domoticz log.

```
--[[
File:   lcdledcontrol.dzvents
Date:   20230221
Author: Robert W.B. Linn

Switch the Pico W LED1 (of the Breadboard Kit) and display on LCD2004.
The Pico W runs a RESTful web server.
The HTTP POST request to the Pico W web server is a JSON object: {"state":"on" or
"off"}.
The Pico W web server HTTP response is a JSON object with key:value pairs:
{["message"]="On", ["title"]="{"state": "on"}", ["status"]="OK"}

Domoticz Log
2023-02-21 10:23:36.299 Status: dzVents: Info: Handling events for: "Pico W-
Control", value: "On"
2023-02-21 10:23:36.300 Status: dzVents: Info: LOG_PICOW_LCDLEDCONTROL: ------
Start internal script: picow_lcdledcontrol: Device: "Pico W-Control
(VirtualSensors)", Index: 16
2023-02-21 10:23:36.300 Status: dzVents: Info: LOG_PICOW_LCDLEDCONTROL: Device Pico
W-Control state changed to On
2023-02-21 10:23:36.300 Status: dzVents: Info: LOG_PICOW_LCDLEDCONTROL: ------
Finished picow_lcdledcontrol
2023-02-21 10:23:36.300 Status: EventSystem: Script event triggered:
/home/pi/domoticz/dzVents/runtime/dzVents.lua
2023-02-21 10:23:37.308 Status: dzVents: Info: Handling httpResponse-events for:
"RES_PICOW_LCDLEDCONTROL"
2023-02-21 10:23:37.308 Status: dzVents: Info: LOG_PICOW_LCDLEDCONTROL: ------
Start internal script: picow_lcdledcontrol: HTTPResponse: "RES_PICOW_LCDLEDCONTROL"
2023-02-21 10:23:37.308 Status: {["message"]="On", ["title"]="{"state": "on"}",
["status"]="OK"}
2023-02-21 10:23:37.309 Status: dzVents: Info: LOG_PICOW_LCDLEDCONTROL: LED1
status=OK, title={"state": "on"}, message=On
2023-02-21 10:23:37.309 Status: dzVents: Info: LOG_PICOW_LCDLEDCONTROL: ------
Finished picow_lcdledcontrol
]]--

-- Domoticz
-- For tests the trigger is an switch type onoff
local IDX_SWITCH = 16

local URL_SERVER      = 'http://picow-ip'
local CMD_LED_ON      = '{"state":"on"}'
local CMD_LED_OFF     = '{"state":"off"}'
```

```
local RES_HTTP        = 'RES_PICOW_LCDLEDCONTROL'
local LOG_MARKER      = 'LOG_PICOW_LCDLEDCONTROL'

return {
    -- Listen to switch device changes and HTTP responses
 on = { devices = { IDX_SWITCH }, httpResponses = { RES_HTTP } },
 logging = { level = domoticz.LOG_INFO, marker = LOG_MARKER },

 execute = function(domoticz, item)
        -- domoticz.log(item)
   if (item.isDevice) then
            local state = item.state
            local cmd
       domoticz.log(string.format('Device %s state changed to %s',item.name,state),
domoticz.LOG_INFO)
            if (item.state == 'On') then cmd = CMD_LED_ON end
            if (item.state == 'Off') then cmd = CMD_LED_OFF end
            -- Submit remote HTTP POST request to set the LCD display
            domoticz.openURL({
                url = URL_SERVER,
                method = 'POST',
                headers = { ['content-type'] = 'application/json' },
                postData = cmd,
                callback = RES_HTTP,
               })
        end

        if (item.isHTTPResponse) then
            -- domoticz.log(item)
            if (item.isJSON) then
                -- {["message"]="On", ["title"]="{"state": "on"}", ["status"]="OK"}
                local data = item.json
                domoticz.log(string.format("LED1 status=%s, title=%s, message=%s",
data.status, data.title, data.message))
            end
        end

 end
}
```

Web Server

Libraries

The MicroPython script uses the two external libraries *lcd_api.py* and *machine_i2c_lcd.py* to control the LCD2004.
Enhanced is the library *lcd_api.py* with additional functions, like setting text at position col:row and more.
The two libraries are stored on the Pico W in folder lib (see sub chapter Additional Libraries).

Credits
Thanks for developing & sharing the libraries lcd_api and machine_i2c_lcd.

MicroPython Script

```
"""
File:lcdledcontrol.py
Date:20230318
Author: Robert W.B. Linn

Pico W RESTful web server listening for data from Domoticz event.
The incoming data is from a HTTP POST request with JSON object to switch LED1 on or
off.
LED1 is attached on the Pico Breadboard kit.

:log
Example turning LED1 on from Domoticz:
HTTP Command:{'state': 'on'}
HTTP Response:{"status": "OK", "title": {"state": "on"}, "message": "On"}

:wiring
LCD2004 = Pico W
VCC = VBUS (5V) (red)
SDA = GP20 (Pin #26) (white)
SCL = GP21 (Pin #27) (Pink)
GND = GND (black)
"""

# Libraries
from time import sleep
from machine import Pin
import json
# Call server from server.py (must be uploaded to the picow)
from server import Server
# LCD Display libs stored in Pico W folder lib
# lcd_api.py, machine_i2c_lcd.py
from machine import I2C, Pin
from machine_i2c_lcd import I2cLcd
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config

# Constants
NAME = 'Domoticz LED Control'
VERSION = 'v20230311'

CRLF = chr(13) + chr(10)
SPACE = chr(32)

# Create the LED1 (blue) object using config.py settings
led1 = Pin(config.PIN_LED1, Pin.OUT)
led1.off()

# LCD2004 Constants
LCD_I2C_ADDRESS = 0x27
```

```
LCD_PIN_SDA = 20
LCD_PIN_SCL = 21
LCD_ROWS = 4
LCD_COLS = 20

def set_lcd(address, pinsda, pinscl, rows, cols):
    """
    Create the LCD object by init the lcd with i2c.

    :param hex address
        Address of the LCD I2C. Default 0x27

    :param int pinsda
        SDA pin

    :param int pinscl
        SCL pin

    :param int rows
        Number of rows 20 or 16

    :param int cols
        Number of cols 4 or 2

    :return
        LCD object

    :example
    set_lcd(LCD_I2C_ADDRESS, LCD_PIN_SDA, LCD_PIN_SCL, LCD_ROWS, LCD_COLS)
    """
    try:
        # I2C object
        i2c = I2C(0, sda=Pin(Pinsda), scl=Pin(Pinscl), freq=100000)
        # Init LCD object using I2C with address & rows (4, index 0-3) & cols (20,
index 0-19)
        lcd = I2cLcd(i2c, address, rows, cols)
        print("LCD init. Address: " + str(i2c.scan()))
        return lcd
    except OSError as e:
        raise RuntimeError('[ERROR] LCD init.')

def set_lcd_welcome(row1, row2):
    """
    LCD Initial text on row 1 & 2
    """
    lcd.putstr(row1 + "\n" + row2)
    sleep(.3)

def handle_request(cmd, status):
    """
    Handle the LCD command defined as JSON object.

    :param JSON object
        JSON object with key:value pair {"state":"on" or "off"}

    :status
        If status is 1 set the display else unknown command

    :return JSON object response
    """
    # Assign the command to the response title
    response[config.KEY_TITLE] = cmd

    if status == 1:
        # Select the command and set the lcd text
        if cmd['state'] == 'on':
            led1.on()
            response[config.KEY_MESSAGE] = config.MESSAGE_ON
            response[config.KEY_STATE] = config.STATE_OK
```

```
        elif cmd['state'] == 'off':
            led1.off()
            response[config.KEY_MESSAGE] = config.MESSAGE_OFF
            response[config.KEY_STATE] = config.STATE_OK
        else:
            response[config.KEY_STATE] = config.STATE_ERR
            response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN
    else:
            response[config.KEY_STATE] = config.STATE_ERR
            response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN

    # LCD display set
    # Clear row 2 (the row range for LCD2004 is 0 to 3)
    lcd.clrrow(2)
    sleep(.3)

    # Write the keys message and state as string at col 0, row 2
    lcd.putstrat(0, 2, 'LED1: ' + response[config.KEY_MESSAGE] + ' ' +
response[config.KEY_STATE])
    sleep(.3)

    return response

# Main
# Listen for incoming connections from the Domoticz Automation Event dzVents
print(f'{NAME} {VERSION}')

# Create the LCD object
lcd = set_lcd(LCD_I2C_ADDRESS, LCD_PIN_SDA, LCD_PIN_SCL, LCD_ROWS, LCD_COLS)

# Set the LCD display welcome text
set_lcd_welcome(NAME, VERSION)

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect()

"""
Main Loop
"""
while True:
    try:
        # Get client connection and the request data
        cl, request = network.get_client_connection(server)

        # Get the cmd as JSON object from the POST request
        # {"state":"on" or "off"}
        cmd, status = network.parse_post_request(request)

        # Create the HTTP response JSON object
        response = {}

        # Handle the command to update the LCD text.
        # Set the response
        response = handle_request(cmd, status)

        # Send the response to Domoticz and close the connection (wait for new)
        network.send_response(cl, response, True)

    except OSError as e:
        ledstatus.off()
        cl.close()
        print('[ERROR] Network Connection closed')
```

LCD 20x4 I2C Motherboard Info

Description

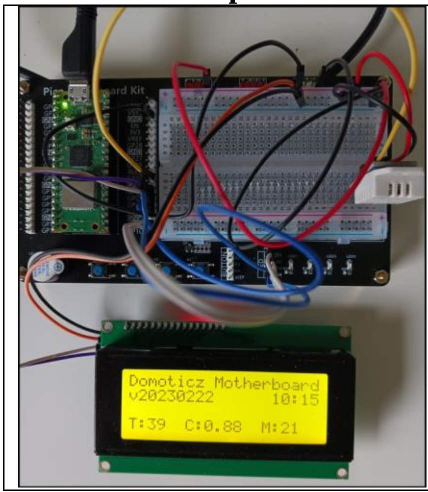
This project displays and updates in regular intervals selective Domoticz data from the hardware motherboard sensors on an LCD 20x4 I2C display (LCD2004) connected to the Pico W.

Solution

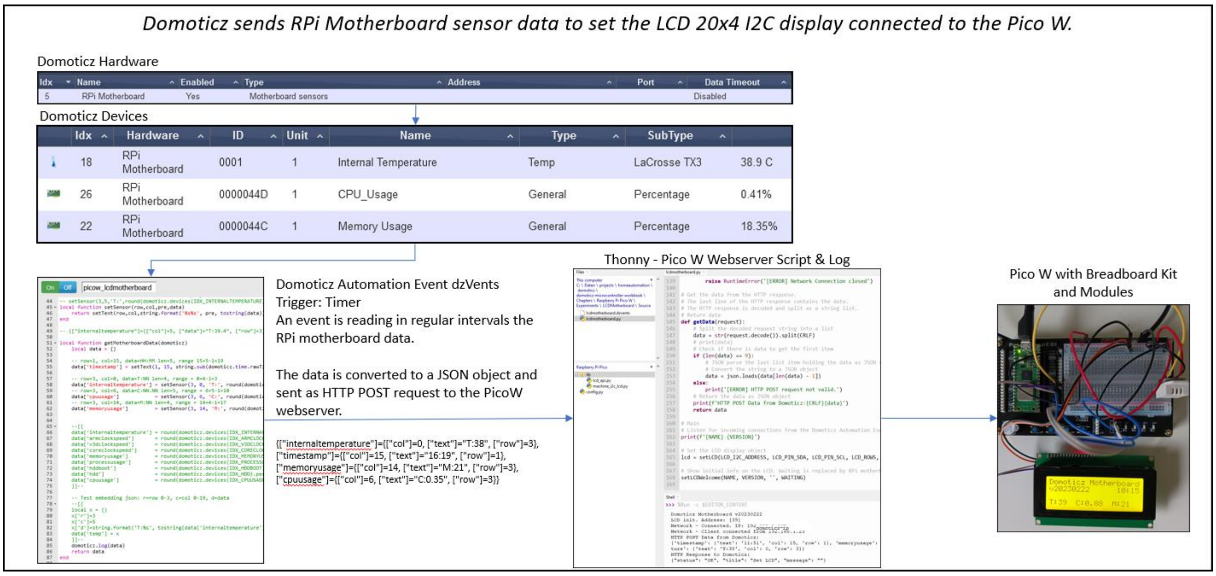
The LCD2004 setup is as previous described in the project [LCD 20x4 I2C LED Control [Domoticz to Pico W]].

Domoticz uses an Automation Event dzVents, triggered by a switch or timer, to send the selective Domoticz hardware motherboard sensors data via HTTP POST request to the Pico W web server. The data is a JSON array with items per LCD line.

LCD Text Example

		The motherboard sensors T=internaltemperature C=cpuusage M=memoryusage

Block Diagram



Wiring

See project LCD 20x4 I2C LED Control [Domoticz to Pico W].

Circuit Diagram

See project LCD 20x4 I2C LED Control [Domoticz to Pico W].

Domoticz Setup

Devices

The hardware Motherboard sensors is added, and the devices Internal Temperature, CPU Usage and Memory Usage are added.
The other devices from the hardware Motherboard sensors are not used for this project.

After creating the device(s), the Domoticz devices list shows the entries:

```
IDX=26, Hardware=RPi Motherboard, ID=0000044D, Unit=1, Name=CPU Usage,
Type=General, SubType=Percentage, Data=0.43%
IDX=22, Hardware=RPi Motherboard, ID=0000044C, Unit=1, Name=Memory Usage,
Type=General, SubType=Percentage, Data=22.93%
IDX=18, Hardware=RPi Motherboard, ID=0001, Unit=1, Name=Internal Temperature,
Type=Temp, SubType=LaCrosse TX3, Data=38.4 C
```

Automation Script

```
--[[
File:   lcdmotherboard.dzvents
Date:   20230221
Author  Robert W.B. Linn

Switch the Pico W LED1 (of the Breadboard Kit) and display on LCD2004.
The Pico W runs a RESTful web server.
The HTTP POST request to the Pico W web server is a JSON object: {"state":"on" or
"off"}.
The Pico W web server HTTP response is a JSON object with key:value pairs:
{["message"]="On", ["title"]="{"state": "on"}", ["status"]="OK"}

Log
2023-03-06 10:45:00.310 Status: dzVents: Info: LOG_PICOW_LCDMOTHERBOARD: ------
Start internal script: picow_lcdmotherboard:, trigger: "every minute"
2023-03-06 10:45:00.334 Status: dzVents: Info: LOG_PICOW_LCDMOTHERBOARD:
{["memoryusage"]={["row"]=3, ["text"]="M:20", ["col"]=14}, ["cpuusage"]={["row"]=3,
["text"]="C:0.37", ["col"]=6}, ["timestamp"]={["row"]=1, ["text"]="10:45",
["col"]=15}, ["internaltemperature"]={["row"]=3, ["text"]="T:44", ["col"]=0}}
2023-03-06 10:45:00.335 Status: dzVents: Info: LOG_PICOW_LCDMOTHERBOARD: ------
Finished picow_lcdmotherboard
2023-03-06 10:45:00.335 Status: EventSystem: Script event triggered:
/home/pi/domoticz/dzVents/runtime/dzVents.lua
]]--

-- Domoticz
-- For tests the trigger is an switch type onoff
local IDX_SWITCH = 16
--- IDX of the motherboard sensors (devices)
local IDX_INTERNALTEMPERATURE = 18      -- temperature
local IDX_ARMCLOCKSPEED = 19            -- sensorValue
local IDX_V3DCLOCKSPEED = 20            -- sensorValue
local IDX_CORECLOCKSPEED = 21           -- sensorValue
local IDX_MEMORYUSAGE = 22              -- percentage
local IDX_PROCESSUSAGE = 23                    -- sensorValue
local IDX_HDDBOOT = 24                         -- percentage
local IDX_HDD = 25                -- percentage
local IDX_CPUUSAGE = 26                        -- percentage

-- Round a number with digital places
local function round(num, numDecimalPlaces)
  return tonumber(string.format("%." .. (numDecimalPlaces or 0) .. "f", num))
end

-- Create table with keys col, row and text to be displayed on the LCD.
-- For a LCd2004 row 0-3, col 0-19, text length max 20 characters
-- setText(3,0,'Hello World')
local function setText(row,col,text)
    local x = {}
    x['row']=row
    x['col']=col
    x['text']=text
 return x
end

-- Create table with sensor data for LCD display
-- setSensor(3,5,'T:',round(domoticz.devices(IDX_INTERNALTEMPERATURE).temperature,
2))
local function setSensor(row,col,pre,data)
    return setText(row,col,string.format('%s%s', pre, tostring(data)))
end

-- {["internaltemperature"]={["col"]=5, ["data"]="T:39.4", ["row"]=3},
["cpuusage"]=0.68, ["coreclockspeed"]=500, ["v3dclockspeed"]=250,
["processusage"]=45.06, ["armclockspeed"]=600, ["hdd"]=38.19, ["memoryusage"]=20.9,
["hddboot"]=19.68}
```

```
local function getMotherboardData(domoticz)
    local data = {}

    -- row=1, col=15, data=HH:MM len=5, range 15+5-1=19
 data['timestamp'] = setText(1, 15, string.sub(domoticz.time.rawTime, 1, 5))

    -- row=3, col=0, data=T:NN len=4, range = 0+4-1=3
    data['internaltemperature'] = setSensor(3, 0, 'T:',
round(domoticz.devices(IDX_INTERNALTEMPERATURE).temperature, 0))
    -- row=3, col=6, data=C:NN.NN len=5, range = 6+5-1=10
 data['cpuusage']            = setSensor(3, 6, 'C:',
round(domoticz.devices(IDX_CPUUSAGE).percentage, 2))
    -- row=3, col=14, data=M:NN len=4, range = 14+4-1=17
 data['memoryusage']         = setSensor(3, 14, 'M:',
round(domoticz.devices(IDX_MEMORYUSAGE).percentage, 0))


    --[[
    data['internaltemperature'] =
round(domoticz.devices(IDX_INTERNALTEMPERATURE).temperature, 2)
 data['armclockspeed']       =
round(domoticz.devices(IDX_ARMCLOCKSPEED).sensorValue, 0)
 data['v3dclockspeed']       =
round(domoticz.devices(IDX_V3DCLOCKSPEED).sensorValue, 0)
 data['coreclockspeed']      =
round(domoticz.devices(IDX_CORECLOCKSPEED).sensorValue, 0)
 data['memoryusage']         = round(domoticz.devices(IDX_MEMORYUSAGE).percentage,
2)
 data['processusage']        =
round(domoticz.devices(IDX_PROCESSUSAGE).sensorValue, 2)
 data['hddboot']             = round(domoticz.devices(IDX_HDDBOOT).percentage, 2)
 data['hdd']                 = round(domoticz.devices(IDX_HDD).percentage, 2)
 data['cpuusage']            = round(domoticz.devices(IDX_CPUUSAGE).percentage, 2)
    ]]--

 -- Test embedding json: r=row 0-3, c=col 0-19, d=data
    --[[
    local x = {}
    x['r']=3
    x['c']=5
    x['d']=string.format('T:%s', tostring(data['internaltemperature']))
 data['temp'] = x
    ]]--
 domoticz.log(data)
 return data
end

-- URL of the Pico W web server
local URL_SERVER      = 'http://picow-ip'

local PROJECT         = 'PICOW_LCDMOTHERBOARD'
local RES_HTTP        = 'RES_' .. PROJECT
local LOG_MARKER      = 'LOG_' .. PROJECT

local TIMER_RULE = 'every minute'

return {
    -- Listen to switch device changes and HTTP responses
 on = { devices = { IDX_SWITCH }, timer = { TIMER_RULE }, httpResponses = {
RES_HTTP } },
 logging = { level = domoticz.LOG_INFO, marker = LOG_MARKER },

 execute = function(domoticz, item)
        -- domoticz.log(item)
        if (item.isTimer) then
            domoticz.openURL({
                url = URL_SERVER,
                method = 'POST',
```

```
                headers = { ['content-type'] = 'application/json' },
                postData = getMotherboardData(domoticz),
                callback = RES_HTTP,
               })
        end

   if (item.isDevice) then
       domoticz.log(string.format('Device %s state changed to %s', item.name,
item.state), domoticz.LOG_INFO)
            if (item.state == 'On') then
                -- Submit remote HTTP POST request to set the LCD display
                domoticz.openURL({
                    url = URL_SERVER,
                    method = 'POST',
                    headers = { ['content-type'] = 'application/json' },
                    postData = getMotherboardData(domoticz),
                    callback = RES_HTTP,
                   })
            end
        end

        -- Handle HTTP response: OK is item statusCode 200 and item.ok true
        -- Else error like statusCode 7, item.ok false
        if (item.isHTTPResponse) then
            -- domoticz.log(string.format("%d %s", item.statusCode, item.ok))
            if (item.statusCode == 200) then
                if (item.isJSON) then
                    -- {["message"]="On", ["title"]="{"state": "on"}",
["status"]="OK"}
                    local data = item.json
                    domoticz.log(data)
                    -- domoticz.log(string.format("LED1 status=%s, title=%s,
message=%s", data.status, data.title, data.message))
                end
            else
                -- Error like 7 false; ERROR 7:Couldn't connect to server
                domoticz.log(string.format("ERROR %d:%s", item.statusCode,
item.statusText))
            end
        end
 end
}
```

Web Server

Libraries

See project LCD 20x4 I2C LED Control [Domoticz to Pico W].

MicroPython Script

```
"""
File:lcdmotherboard.py
Date:20230318
Author: Robert W.B. Linn

On an LCD2004 connected to the Pico W, display text and selective RPi motherboard
sensor data received from Domoticz.
The Pico W runs a RESTful web server handling incoming data from a Domoticz
Automation event dzVents.
The incoming data is received from a HTTP POST request with JSON object to set the
text.
The JSON object contains for each of the displayed text, the col, row and text.
{'sensor': {'text': 'TEXT', 'col': NN, 'row': N}, ...}
This enables to set the LCD display layout from the Domoticz event.

:log
Domoticz Motherboard v20230311
LCD init. Address: [39]
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Network client connected from client-ip
HTTP Command={'timestamp': {'text': '16:00', 'col': 15, 'row': 1}, 'memoryusage':
{'text': 'M:20', 'col': 14, 'row': 3}, 'cpuusage': {'text': 'C:0.3', 'col': 6,
'row': 3}, 'internaltemperature': {'text': 'T:41', 'col': 0, 'row': 3}}
HTTP Response={"status": "OK", "title": {"timestamp": {"text": "16:00", "col": 15,
"row": 1}, "memoryusage": {"text": "M:20", "col": 14, "row": 3}, "cpuusage":
{"text": "C:0.3", "col": 6, "row": 3}, "internaltemperature": {"text": "T:41",
"col": 0, "row": 3}}, "message": ""}
Network connection closed

:wiring
LCD2004 = Pico W
VCC = VBUS (5V) (red)
SDA = GP20 (Pin #26) (white)
SCL = GP21 (Pin #27) (Pink)
GND = GND (black)
"""

# Libraries
import time
from time import sleep
from machine import Pin
import json
# Call server from server.py (must be uploaded to the picow)
from server import Server
# LCD Display libs stored in Pico W folder lib
# lcd_api.py, machine_i2c_lcd.py
from machine import I2C, Pin
from machine_i2c_lcd import I2cLcd
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config

# Constants
## Name (row 0), Version (row 1), Waiting (row 3) are displayed on the LCD
NAME = 'Domoticz Motherboard'
VERSION = 'v20230311'
WAITING = 'Waiting for data...'
```

```
## Title used for the HTTP JSON response to Domoticz key title
TITLE = 'Set LCD'

# Create the LED1 (blue) object using config.py settings
led1 = Pin(config.PIN_LED1, Pin.OUT)
led1.off()

# LCD2004 Constants
LCD_I2C_ADDRESS = 0x27
LCD_PIN_SDA = 20
LCD_PIN_SCL = 21
LCD_ROWS = 4
LCD_COLS = 20

"""
Create the LCD object by init the lcd with i2c.

:param hex address
    Address of the LCD I2C. Default 0x27

:param int pinsda
    SDA pin

:param int pinscl
    SCL pin

:param int rows
    Number of rows 20 or 16

:param int cols
    Number of cols 4 or 2

:return
    LCD object

:example
init_lcd(LCD_I2C_ADDRESS, LCD_PIN_SDA, LCD_PIN_SCL, LCD_ROWS, LCD_COLS)
"""
def init_lcd(address, pinsda, pinscl, rows, cols):
    try:
        # I2C object
        i2c = I2C(0, sda=Pin(Pinsda), scl=Pin(Pinscl), freq=100000)
        # Init LCD object using I2C with address & rows (4, index 0-3) & cols (20,
index 0-19)
        lcd = I2cLcd(i2c, address, rows, cols)
        print("LCD init. Address: " + str(i2c.scan()))
        return lcd
    except OSError as e:
        raise RuntimeError('[ERROR] LCD init.')

"""
LCD Initial text on row 1 & 2
"""
def set_lcd_welcome(row1, row2, row3, row4):
    lcd.putstr(row1 + "\n" + row2 + "\n" + row3 + "\n" + row4)
    sleep(.3)

"""
Set the sensor text at col, row

:param string Sensor
    String defining the RPi motherboard sensor, i.e. internaltemperature

:example
set_lcd_sensor_text('internaltemperature')
"""
def set_lcd_sensor_text(data, sensor):
    # Get the sensor data
    col = data[sensor]['col']
```

```
    row = data[sensor]['row']
    text = data[sensor]['text']
    # Clear the sensor data text at col, row
    lcd.clrtext(col, row, len(text))
    sleep(.1)
    # Write the sensor text at col, row
    lcd.putstrat(col, row, text)
    sleep(.1)

"""
Handle the LCD command defined as JSON object.
The command defines for every sensor data the text and the LCD start position
col/row.
{'timestamp': {'text': '15:53', 'col': 15, 'row': 1}, 'memoryusage': {'text':
'M:20', 'col': 14, 'row': 3}, 'cpuusage': {'text': 'C:0.39', 'col': 6, 'row': 3},
'internaltemperature': {'text': 'T:39', 'col': 0, 'row': 3}}

:param JSON object
    JSON object with key:value pair {"state":"on" or "off"}

:status
    If status is 1 set the display else unknown command

:return JSON object response
"""
def handle_request(cmd, status):
    # Assign the command to the response title
    response[config.KEY_TITLE] = cmd

    # If the status is 1 (OK) then set the lcd display with the sensor data.
    if status == 1:
        # Clear rows first (the row range for LCD2004 is 0 to 3)
        # Clear row 2 = NOT USED
        lcd.clrrow(2)
        sleep(.1)

        # Row 3 is used to display the RPi motherboard sensor data
        lcd.clrrow(3)
        sleep(.1)

        # Set the sensor data (subset only) on row 3
        set_lcd_sensor_text(cmd, 'timestamp')
        set_lcd_sensor_text(cmd, 'internaltemperature')
        set_lcd_sensor_text(cmd, 'cpuusage')
        set_lcd_sensor_text(cmd, 'memoryusage')

        # Set the response
        response[config.KEY_STATE] = config.STATE_OK
        response[config.KEY_MESSAGE] = config.MESSAGE_EMPTY
    else:
        response[config.KEY_STATE] = config.STATE_ERR
        response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN

    # Return the response which is send to Domoticz
    return response

# Main
# Listen for incoming connections from the Domoticz Automation Event dzVents
print(f'{NAME} {VERSION}')

# Create the LCD display object
lcd = init_lcd(LCD_I2C_ADDRESS, LCD_PIN_SDA, LCD_PIN_SCL, LCD_ROWS, LCD_COLS)

# Show initial info on the LCD. Waiting is replaced by RPi motherboard sensor data
set_lcd_welcome(NAME, VERSION, '', WAITING)

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)
```

```
# Connect to the network and get the server object
server = network.connect()

"""
Main Loop
"""
while True:
    try:
        # Get client connection and the request data
        cl, request = network.get_client_connection(server)

        # Get the cmd to set the LCD text as JSON object from the POST request
        cmd, status = network.parse_post_request(request)

        # Create the HTTP response JSON object
        response = {}

        # Handle the command to update the LCD text.
        # Set the response
        response = handle_request(cmd, status)

        # Send the response to Domoticz and close the connection (wait for new)
        network.send_response(cl, response, True)

    except OSError as e:
        ledstatus.off()
        cl.close()
        print('[ERROR] Network - Connection closed')
```

LCD 20x4 I2C Text Input

Description

This project enables to enter text in a Domoticz text device with input field and display the text on an LCD 20x4 I2C display.

Ideas for Use

- Message or Information display with text set by user,
- Instead, LCD use a larger display or 7-segment display.

Solution

This project is

- based upon the project LCD 20x4 I2C LED Control,
- inspired by this solution shared in the Domoticz Forum (thanks).

A Domoticz text device is enhanced by an input field with a button (Set).
If the button is pressed, Domoticz sends an HTTP POST request to the Pico W web server.
The POST request data (JSON format) contains the text to be displayed.
The display lines are separated by comma:

```
"text": "Line1,Line2,Line3,Line4"
```

The Pico W webserver parses the post data, performs checks, and display the text as lines on the LCD display.

Notes

- The LCD 20x4 has 20 columns and 4 rows,
- Although the Domoticz database has VARCHAR(200) for the field svalue specified, SQLite3 will not enforce that length specified

A Domoticz Automation event sets the text device input field and sends the HTTP POST request.

Block Diagram

Domoticz Setup

Device

Create a virtual sensor, hardware dummy, named “LCD Text Input” from sensor type Text.

After creating the device, the Domoticz devices list shows the entry:

```
Idx=36, Hardware=VirtualSensors, ID=00082036, Unit=1, Name=LCD Text Input,
Type=General, SubType=Text
```

Automation Script

```
--[[
File: lcdtextinput.dzvents
Date: 20230425
Author: Robert W.B. Linn
Based on this solution:
https://www.domoticz.com/forum/viewtopic.php?p=293175#p293175 (Thanks)

Create a Domoticz GUI input widget for text. The widget uses a text device.
The text is sent to the Pico W web server and sets the text of up-to 4 lines (LCD
rows 0-3).

As the event is running on the Domoticz system, there is no need to add an IP
address to the HTML form POST action.
See below variable widgetinputhtml.
]]--

local URL_SERVER      = 'http://picow-ip'

-- IDX of the switch which enables to init the textinput device
local IDX_SWITCH = 16

-- IDX of the text device which is functioning as an input device
local IDX_TEXT_DEVICE = 36
local INPUT_LABEL = "Text:"
-- Optional store the text in a user var (NOT USED)
local IDX_UV = 1
```

```
local PROJECT       = 'LCDWIDGETINPUT'
local RES_HTTP      = 'RES_' .. PROJECT
local LOG_MARKER    = 'LOG_' .. PROJECT

-- Create the HTML code for the text device containing input field.
-- This is a form submitting a POST request on the localhost.
-- The input field has type text. The label is commented out. The input field has
default with 200px.
-- The POST data contains all parameter as defined in the text device Domoticz HTTP
API/JSON documentation.
local widgetinputhtml = [[<!-- Widget Input for Text -->
 <iframe name="dummyframe" id="dummyframe" style="display: none">
 </iframe>
 <form method="POST" action="/json.htm" target="dummyframe">
  <input type="hidden" id="" name="type" value="command">
  <input type="hidden" id="" name="param" value="udevice">
  <input type="hidden" id="" name="idx" value="{IDX}"
  <input type="hidden" id="" name="nvalue" value="0">
  <!-- <label for="fname">{LABEL}</label><br> -->
  <input type="text" id="fname" name="svalue" value="{VALUE}" style="width: 200px;">
    <input type="image" class="btnsmall" alt="Set">
</form>]]

-- Set the content of the text device.
-- The content is HTML code (see previous var widgetinputhtml) with the value.
-- Ensure to remove the newline characters.
local function setTextDevice(domoticz, value)
    local text = widgetinputhtml
    text = string.gsub(text, "{IDX}", IDX_TEXT_DEVICE)
    text = string.gsub(text, "{LABEL}", string.format("%s", INPUT_LABEL))
    text = string.gsub(text, "{VALUE}", string.format("%s", value))
    text = string.gsub(text, "\n", "")
    domoticz.log(text)
    -- Silent update of the text device to avoid triggering device change.
    domoticz.devices(IDX_TEXT_DEVICE).updateText(text).silent()
end

local function updateLCD(domoticz, text)
    local postdata = {}
    postdata['text'] = text
    domoticz.openURL({
        url = URL_SERVER, method = 'POST',
        headers = { ['content-type'] = 'application/json' },
        postData = postdata, callback = RES_HTTP,
       })
end

return {
 on = {
  devices = { IDX_SWITCH, IDX_TEXT_DEVICE },
  httpResponses = { RES_HTTP }
 },
 logging = {
  level = domoticz.LOG_DEBUG, marker = LOG_MARKER,
 },
 -- Handle device changes
 execute = function(domoticz, item)
        -- Handle switch which inits the text of the text device with html
        if item.isDevice then
            device = item
            if device.idx == IDX_SWITCH then
                setTextDevice(domoticz, '')
            end

            -- Handle change text device triggered by set button of the HTML form.
            -- The text device content is the inputted value without HTML code.
            if device.idx == IDX_TEXT_DEVICE then
```

```
                -- Get the state of the input device which is the text put in
(without HTML code)
                -- Device TextInputDevice changed, state=Line1,Line2,Line3,Line4
             domoticz.log(string.format('Device change: name=%s, state=%s',
device.name, device.state))

                -- Update text device with new value embedded in the html code
                setTextDevice(domoticz, device.state)

                -- Update LCD display via HTTP POST request to Pico W web server
                updateLCD(domoticz, device.state)
            end
        end

        if (item.isHTTPResponse) then
            -- domoticz.log(item)
            if (item.isJSON) then
                local data = item.json
                domoticz.log(string.format("status=%s, title=%s, message=%s",
data.status, data.title, data.message))
            end
        end
 end
}
```

Web Server

Libraries

See project LCD 20x4 I2C LED Control.

MicroPython Script

```
"""
File:lcdtextinput.py
Date:20230425
Author: Robert W.B. Linn
"""

# Libraries
from time import sleep
from machine import Pin
import json
# Call server from server.py (must be uploaded to the picow)
from server import Server
# LCD Display libs stored in PicoW folder lib
# lcd_api.py, machine_i2c_lcd.py
from machine import I2C, Pin
from machine_i2c_lcd import I2cLcd
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config

# Constants
NAME = 'LCD Text Input'
VERSION = 'v20230425'

CRLF = chr(13) + chr(10)
SPACE = chr(32)

# LCD2004 Constants
LCD_I2C_ADDRESS = 0x27
LCD_PIN_SDA = 20
LCD_PIN_SCL = 21
LCD_ROWS = 4
LCD_COLS = 20
```

```
def set_lcd(address, pinsda, pinscl, rows, cols):
    """
    Create the LCD object by init the lcd with i2c.

    :param hex address
        Address of the LCD I2C. Default 0x27

    :param int pinsda
        SDA pin

    :param int pinscl
        SCL pin

    :param int rows
        Number of rows 20 or 16

    :param int cols
        Number of cols 4 or 2

    :return
        LCD object

    :example
    set_lcd(LCD_I2C_ADDRESS, LCD_PIN_SDA, LCD_PIN_SCL, LCD_ROWS, LCD_COLS)
    """
    try:
        # I2C object
        i2c = I2C(0, sda=Pin(pinsda), scl=Pin(pinscl), freq=100000)
        # Init LCD object using I2C with address & rows (4, index 0-3) & cols (20,
index 0-19)
        lcd = I2cLcd(i2c, address, rows, cols)
        print("LCD init. Address: " + str(i2c.scan()))
        return lcd
    except OSError as e:
        raise RuntimeError('[ERROR] LCD init.')

def set_lcd_welcome(row1, row2):
    """
    LCD Initial text on row 1 & 2
    """
    lcd.putstr(row1 + "\n" + row2)
    sleep(.3)

def handle_request(cmd, status):
    """
    Handle the LCD command defined as JSON object.

    :param JSON object
        JSON object with key:value pair {"text":"widget_input"}

    :status
        If status is 1 set the display else unknown command

    :return JSON object response
    """
    # print(lcd.num_lines, lcd.num_columns)

    # Assign the command to the response title
    response[config.KEY_TITLE] = cmd
    # Reset the message
    response[config.KEY_MESSAGE] = ''
    # Rest response
    response[config.KEY_STATE] = config.STATE_OK

    # If the status is 1 set the LCD text else error
    if status == 1:
        # Clear the LCD first
        lcd.clear()
```

```
        # Write the text input from the widget starting at col 0, row 0
        # Get the text
        text = cmd['text']
        # Split the text by , into up-to 4 lines 0-3
        lines = text.split(",")
        linenr = 0
        # Loop over the lines and write the line at col 0, row rownr
        # Check if the number of lines and number of columns are in range
        for line in lines:
            if 0 <= linenr <= lcd.num_lines - 1:
                if len(line) > lcd.num_columns:
                    response[config.KEY_MESSAGE] = f'[WARNING] Line {linenr}
exceeds max length {str(lcd.num_columns)} ({str(len(line))}).'
                    response[config.KEY_STATE] = config.STATE_WARNING
                    print(response[config.KEY_MESSAGE])
                    line = line[0:lcd.num_columns]
                lcd.putstrat(0, linenr, line)
                linenr = linenr + 1
            else:
                response[config.KEY_MESSAGE] = f'[WARNING] Line {linenr} ("{line}")
out of range 0-{lcd.num_lines - 1}.'
                response[config.KEY_STATE] = config.STATE_WARNING
                print(response[config.KEY_MESSAGE])
        # sleep(.3)
    else:
        response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN
        response[config.KEY_STATE] = config.STATE_ERR

    return response

# Main
# Listen for incoming connections from the Domoticz Automation Event dzVents
print(f'{NAME} {VERSION}')

# Create the LCD object
lcd = set_lcd(LCD_I2C_ADDRESS, LCD_PIN_SDA, LCD_PIN_SCL, LCD_ROWS, LCD_COLS)

# Set the LCD display welcome text
set_lcd_welcome(NAME, VERSION)

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect()

"""
Main Loop
"""
while True:
    try:
        # Get client connection and the request data
        cl, request = network.get_client_connection(server)

        # Get the cmd as JSON object from the POST request
        # {"state":"on" or "off"}
        cmd, status = network.parse_post_request(request)

        # Create the HTTP response JSON object
        response = {}

        # Handle the command to update the LCD text.
        # Set the response
        response = handle_request(cmd, status)

        # Send the response to Domoticz and close the connection (wait for new)
        network.send_response(cl, response, True)
```

```
    except OSError as e:
        ledstatus.off()
        cl.close()
        print('[ERROR] Network Connection closed')
```

Enhancements

Few enhancement ideas.

Use a user variable or persistent data (dzVents) to store the text (only) input.

Use text input device to send an emergency message. This handled by the Automation script.

Use number input to set a 7-segment LED display.

LCD 240x135 1.14 Inch

Description

This project explores how to connect and use a 1.14-inch LCD display module with Raspberry Pi Pico W.

Solution

Developed is a Domoticz Mini Controller (picodomc) which enables to select a Domoticz device from a group of Domoticz devices, show the current value and set a new value.
As an example: controlled can be two Domoticz devices from type Setpoint & Light.

Source: minicontroller.py

<table>
<tr>
<td>

Sorry for the bad picture quality.</td>
<td>The LCD screen with menu Thermos (=Thermostats) and the device named “Essen” (=Dining Room) selected. The current setpoint is 20.0°C.
The setpoint is changed in 1 degree's steps using User Key A (top right) and set in Domoticz with User Key B (bottom right).</td>
</tr>
</table>

The Waveshare Pico-LCD-1.14 is used. This is a 1.14inch LCD Display Module for Raspberry Pi Pico, 65K Colors, 240×135, SPI, joystick and two user keys (more information).

The Pico W runs as a RESTful server to communicate with the Domoticz system via HTTP API/JSON GET (PULL) requests.

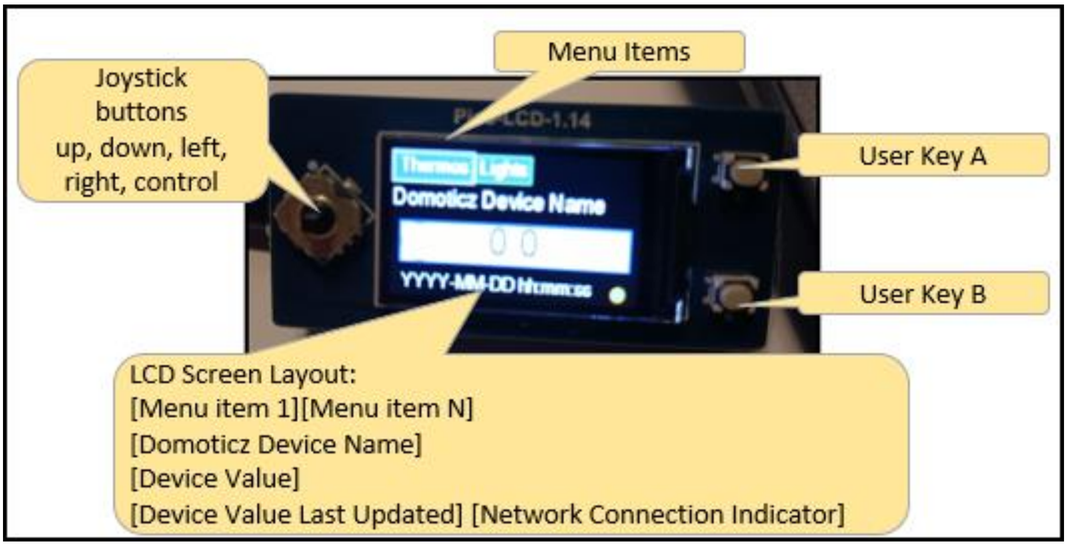
MicroPython GUI library
The solution make use of the MicroPython GUI library micro-gui.
This library supports options for data input, which are used for this project because the LCD has a joystick and user keys.

Notes

- Only selective micro-gui widgets are used for the demos.
- A custom widget “userkey” is developed based on the micro-gui widget pushbutton.. The *custom widget()s are experimental* as require a deeper dive into the concept (esp. async screen refresh).
- More complex solutions with a mix of widgets are subject for future projects.

CREDITS
To the developer(s) of the lightweight, portable, MicroPython GUI library **micropython-micro-gui** for displays having drivers subclassed from framebuf. Written in Python it runs under a standard MicroPython firmware build.

Let’s start with the LCD screen layout



The LCD screen layout from top to bottom:

GUI Items	GUI Widget
[Menu item 1] [Menu item N]	Menu
[Domoticz Device Name]	Label
[Device Value]	Adjuster
[Device Value Last Updated] [Network Connection Indicator]	Label, LED
[Joystick middle left]	Button,
Left, Right = select control (menu items, input),	Pushbutton
Up, Down = In/Decrease value	
[User Key A top right]: select device	UserKey
[User Key B bottom right]: set new device value	(Custom Widget)

The menu items are used to select the Domoticz devices. The menu items are based on group definitions using external Python scripts for the Domoticz devices. Each group has its own definition and external Python script.

For this demo, there are two groups and therefor two menu items Thermos and Lights. Snippet from MicroPython script *minicontroller.py* defining the groups:

```
groups = [
    # Thermostats
    {'text':'Thermos',
     'id':0,
     'devices':thermostats.devices,
     'step':1,
     'valueattribute':'SetPoint', 'valuemin':5, 'valuemax':21,
     'setcmd':'param=setsetpoint&idx={IDX}&setpoint={VALUE}'},
    # Lights controlled by setting the level
    {'text':'Lights',
     'id':1,
     'devices':lights.devices,
     'step':10,
     'valueattribute':'LevelInt', 'valuemin':0, 'valuemax':100,
     'setcmd':'param=switchlight&idx={IDX}&switchcmd=Set%20Level&level={VALUE}'}
        # param=switchlight&idx=99&switchcmd=<On|Off|Toggle|Stop>
```

```
]
```

The key text is used to set the label widget device name.

The group devices are defined with the key devices using a devices list defined in an external script.
Example:
Thermostats using setpoint devices defined in the external script *devices_utility_setpoint.py*.
The list is imported:

```
# Import the Domoticz devices as a list with JSON object
# Setpoint devices = thermostats
import devices.devices_utility_setpoint as thermostats
```

and contains entries like

```
devices=[{"n": "Thermostat MakeLab","i": 32}, ...]
```

n=Name, i=Domoticz Idx.

For the second group lights:

```
# Light/Switch
import devices.devices_light as lights
```

with content snippet:

```
devices=[{"n": "Wohnen","i": 335},{"n": "Wohnen Links","i": 319}, …]
```

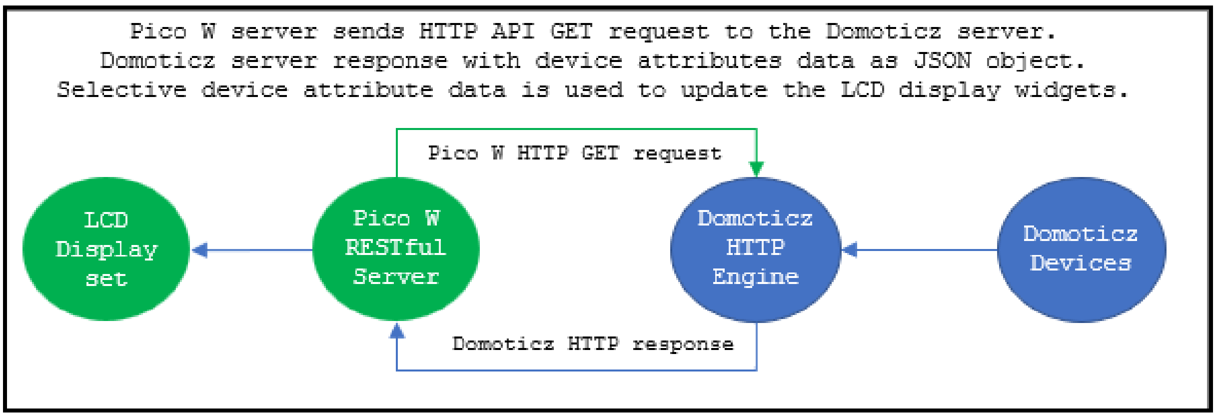
The device data is PULLED via Domoticz HTTP API GET request and received as JSON object.

```
/json.htm?type=command&param=getdevices&rid=IDX
```

From the Domoticz HTTP response, the device attribute as defined in the group, i.e. *SetPoint* for the thermostats or *LevelInt* for the lights is used:

```
{ … 'SetPoint': 20.0 … }
```

Block Diagram



Wiring

The arbitrary pins for the Pico to connect to the board – These are fixed by the supplier.

Pin	**Nr**	**Description**
LCD_DC	8	LCD Command/Data. Writing command when DC = 0, writing data when DC=1.
LCD_CS	9	LCD Chip Select. The chip can be enabled when the voltage of CS is low.
LCD_SCK	10	SPLI CLK. SPI communication clock.
LCD_MOSI	11	SPI MOSI. transmitted data, that is, RGB data.
LCD_BL	13	LCD backlight.
LCD_RST	12	LCD reset. Usually set to 1 and is pulled low when the module is powered on.
Joystick Up	2	
Joystick Down	18	
Joystick Left	16	
Joystick Right	20	
Joystick Control	3	
User Key A	15	User key A (Top right)
User Key B	17	User key B (Bottom right)

Circuit Diagram

Not created.

Domoticz Setup

Devices

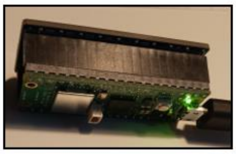
The devices are defined in the external MicroPython scripts for the groups used.

Automation Script

There are no automation scripts (written in dzVents) used.

Pico W Setup

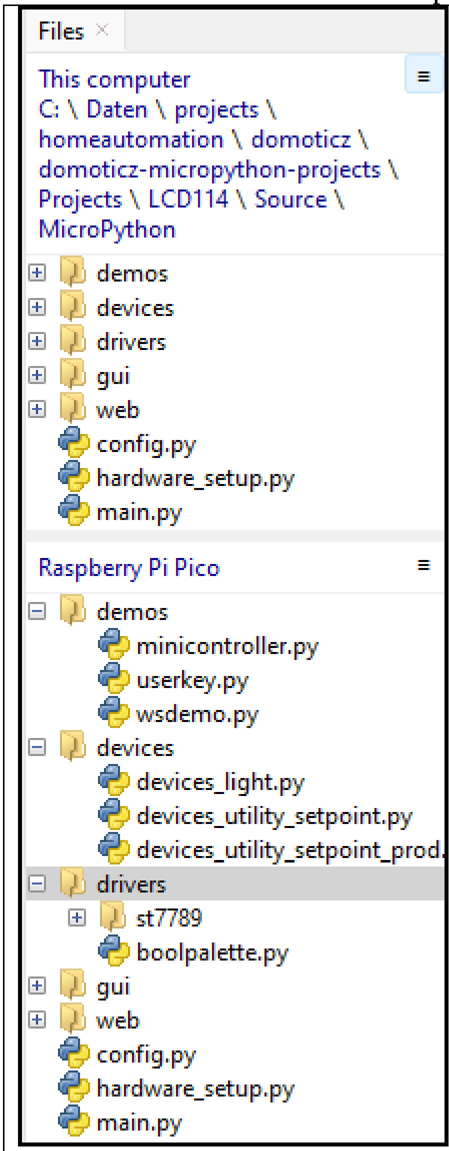
Board

 LCD Front Side Demo: minicontroller	 LCD Back Side with Pico WH Built in	The LCD is a Pico HAT. No addition wiring required.

MicroPython

Install
The archive **lcd114.zip** contains the library and the demos.
Extract the archive to a folder of choice and copy the content to the Pico.

The folder structure of the development device and the Raspberry Pi Pico W used:



The screenshot (from Thonny) shows the folder structure of the development device (top) and the Raspberry Pi Pico W (bottom).

The scripts are developed and tested on the Raspberry Pi Pico and copied to the development device.

Raspberry Pi Pico Folder & Files

demos
The minicontroller and widget userkey developed by the author. The wsdemo.py is not used.

drivers
micro-gui display drivers.

gui
micro-gui core etc.

web
RESTful server.

config.py
Set the secrets and IP addresses.

hardware_setup.py
Hardware setup for the Waveshare Pico-LCD-1.14 with the ST7789 display driver .

main.py
Auto start script at boot.
Comment out the script to be run at start.

Update micropython-micro-gui
If there is an update of the micro-gui library, copy the content of the folders driver and gui to the Pico W. The subfolder gui/demos can be deleted if not used for exploring/testing.

Enhancements

The Mini Controller is just a first example, but many other come to mind either as display-only or display + input with the joystick and user keys.

Display Only
Domoticz System State (widget label and LED with traffic light colors),
Alarm Message (widget label with big font),
Weather Info (widget grid),
Power Status (widget meter widget)

Display + Input
Remote Control (widget menu with submenus or various menus with on/off state)

LCD 480x320 3.5 Inch No Touch

Description

This project explores how to connect and use an LCD 3.5-inch display with 480x320 resolution with the Raspberry Pi Pico W. Developed are various demos displaying selective Domoticz device(s) data or state of LCD micro-gui widgets.

Solution

The Waveshare display Pico-ResTouch-LCD-3.5 is used with the Pico W inserted in the LCD board. This is a 3.5inch Touch Display Module for the Raspberry Pi Pico, 65K Colors, 480 x 320 Pixels, Resistive Touch Controller XPT2046, ILI9488 Driver, Using SPI Bus.

The Pico W runs as a RESTful server to communicate with the Domoticz system via HTTP API/JSON GET (PULL) or POST (PUSH) requests.
For the POST requests, the server listens to incoming client connections, to control the LCD display content. This means that any client which can submit POST requests, can control the LCD display content. So not only Domoticz as used for this project, but also other like Node-RED, Web browser, apps.

MicroPython GUI library
The demos make use of the MicroPython GUI library micro-gui. This library supports options for data input which are not used for this project. In addition, this library has **no touch support**, therefor the **demos are display-only**.

Notes

- Only selective micro-gui widgets are used for the demos.
- More complex solutions with a mix of widgets are subject for future projects.
- Both data input and touch support are subject for future projects.
- Various custom widgets developed based on the micro-gui widgets & demos.
  The *custom widgets are experimental* as require a deeper dive into the concept (esp. async screen refresh).

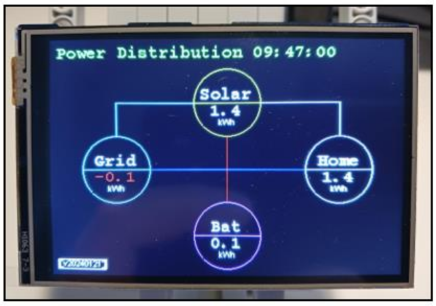
Demos
Each demo is described next briefly.
Look-up for details in the sources. These are well documented.

Project source: lcd480x320.zip

Demo Selection

Domoticz Single Device
Pico pulls data from Domoticz
Micro-GUI Widgets:
Label, Button
Project: temphumbaro

Domoticz Multiple Devices
Pico pulls data from Domoticz
Micro-GUI Widgets:
Grid, Label, Button
Projects: thermostats



Domoticz Multiple Devices
Domoticz pushes data to Pico
Micro-GUI Widgets:
Label, Button, Custom Labeled Circle
Project: powerdistribution

CREDITS

To the developer(s) of the lightweight, portable, MicroPython GUI library **micropython-micro-gui** for displays having drivers subclassed from framebuf. Written in Python it runs under a standard MicroPython firmware build.

Demo Temp+Hum+Baro

Domoticz demo for a device type Temp+Humidity+Baro.
Source: temphumbaro.py

The device data is PULLED every 60 seconds by the Pico W server via Domoticz HTTP API GET request (single request for the device):

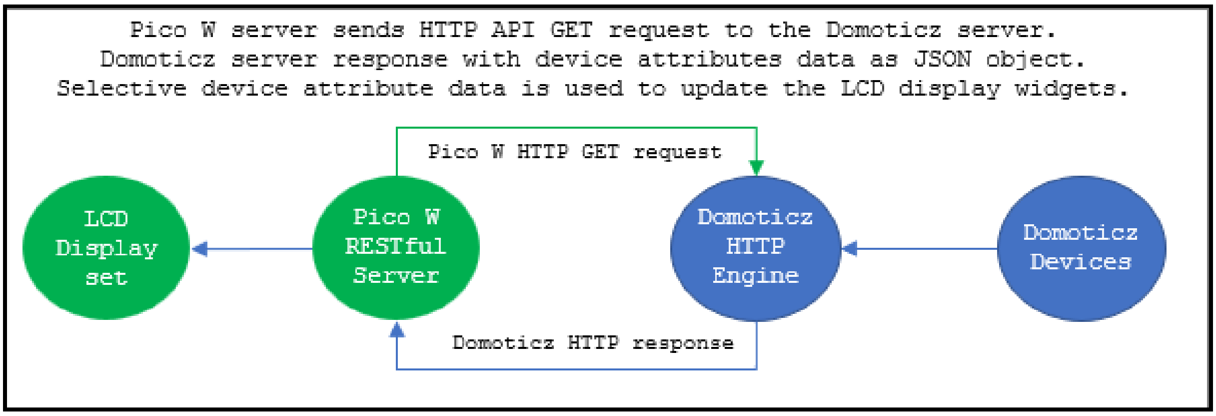
```
/json.htm?type=command&param=getdevices&rid=IDX
```

From the Domoticz HTTP response, the device attributes Temperature, Humidity and Barometer are displayed in label widgets.

```
{
…
'Temp': 13.4,
'Humidity’: 50.0
'Barometer': 1001.0,
…
}
```

In addition, the attributes Name & idx are used for the label widget device.

The LCD screen with label caption + horizontal line followed by a Label with Domoticz device name & idx. Next is a label with device last updated. The device data Temperature, Humidity & Barometer are display with label caption and label value. The bottom shows a button (not active) with version info.



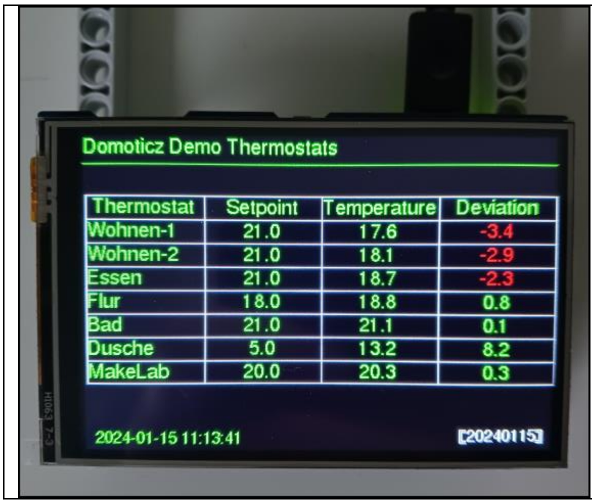
Demo Thermostats

Domoticz demo for a grid widget with up-to 7 room thermostat setpoint & temperature devices.
Source: thermostats.py

Grid dimensions: 8 rows x 4 columns
Columns: name, setpoint, temperature, deviation (= temperature - setpoint, text color red if < 0).
Row 1: column headers.
Rows 2-8: thermostat data per room.

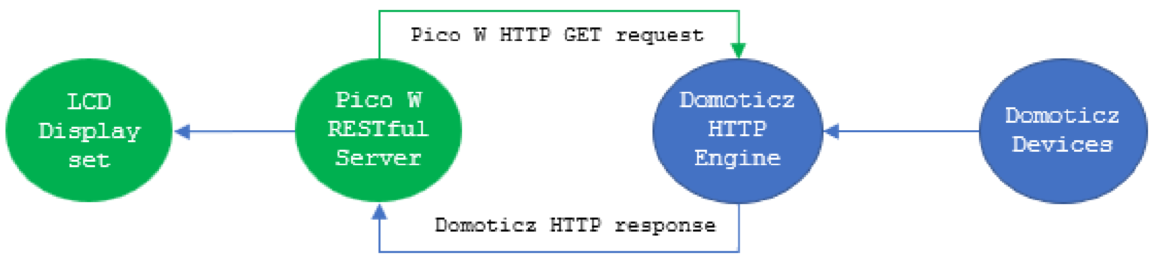
The device data is PULLED every 120 seconds by the Pico W server via Domoticz HTTP API GET requests (one request per device).
Per thermostat there are 2 HTTP requests for the setpoint & temperature device.
The thermostat device properties are defined in a list:

```
devices = [
    # row 0: title for the 4 columns
    {'row':1, 'idxsp':338, 'idxpv':361},
    {'row':2, 'idxsp':339, 'idxpv':362},
    …
    {'row':7, 'idxsp':336, 'idxpv':360},
]
```



The LCD screen with label caption + horizontal line followed by a grid with 8 rows and 4 columns.
The bottom shows a label with last update and a button (not active) with version info.

Pico W server sends HTTP API GET request to the Domoticz server.
Domoticz server response with device attributes data as JSON object.
Selective device attribute data is used to update the LCD display widgets.



Demo LCD LED Control

Domoticz demo to set the state of an LCD LED widget.
Source: lcdledcontrol.py, pico_lcdledcontrol.dzvents.

There are 3 LED widgets LED A,B,C with state color GREEN, YELLOW, RED.
The state of the selected LED is set via Domoticz device from type Light/Switch, Switch, Push On Button.
If the switch state changes, a dzVents script sends an HTTP POST request (PUSH) to the Pico W. The request is parsed and the state, i.e. color, for the selected LED is set.

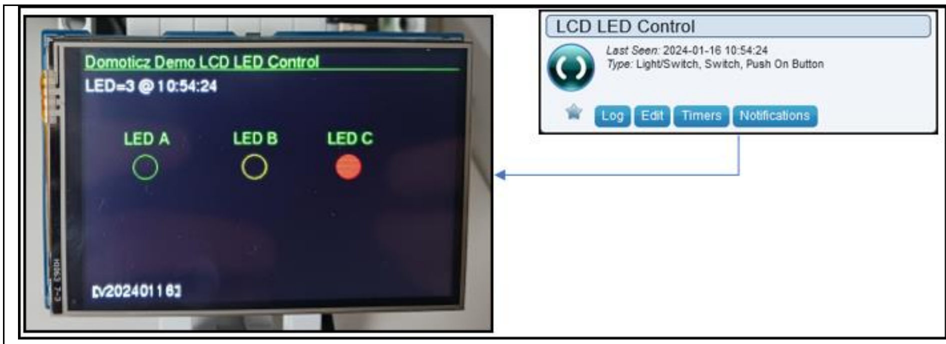
Domoticz POST request submitted via dzVents script:

```
{
  "id": 3, "lastupdate": "LED=3 @ 10:54:24", "state": 1
}
```

The color of LED C is set to RED.

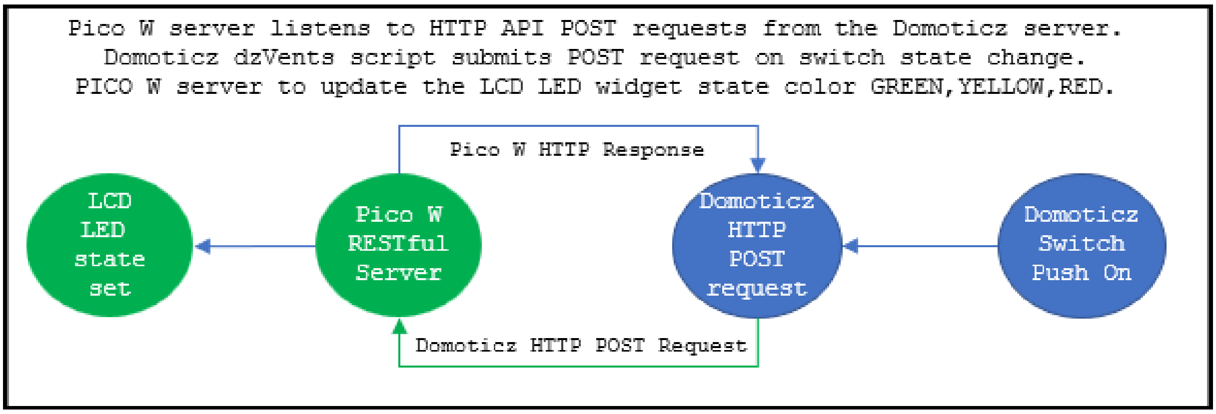
Pico W server response to the Domoticz server:

```
{
  "status": "OK",
  "title": {"id": 3, "lastupdate": "LED=3 @ 10:54:24", "state": 1},
  "message": 1
}
```



Click on the Domoticz push on buttons, sets randomly the color GREEN, YELLOW or RED of one of the LEDs.

The LCD screen with label caption + horizontal line followed by a Label last LED change. Each LED has a caption and widget LED. The bottom shows a button (not active) with version info.



Demo Energy Overview

Domoticz energy & weather data displayed in 4 TileBox custom widgets.
Source: energyoverview.py, pico_energyoverview.dzvents.

The data is received as JSON object from the Domoticz server via Domoticz HTTP POST request from automation script dzVents. Domoticz PUSHES the data to the Pico W server. The server listens for incoming connections, parses the data, and updates the 4 TileBoxes.

The TileBox custom widget consists out of a caption (Label widget) and text with up-to 3 lines (Textbox widget).
It is the first custom widget developed by the author using the micro-gui widget framework.

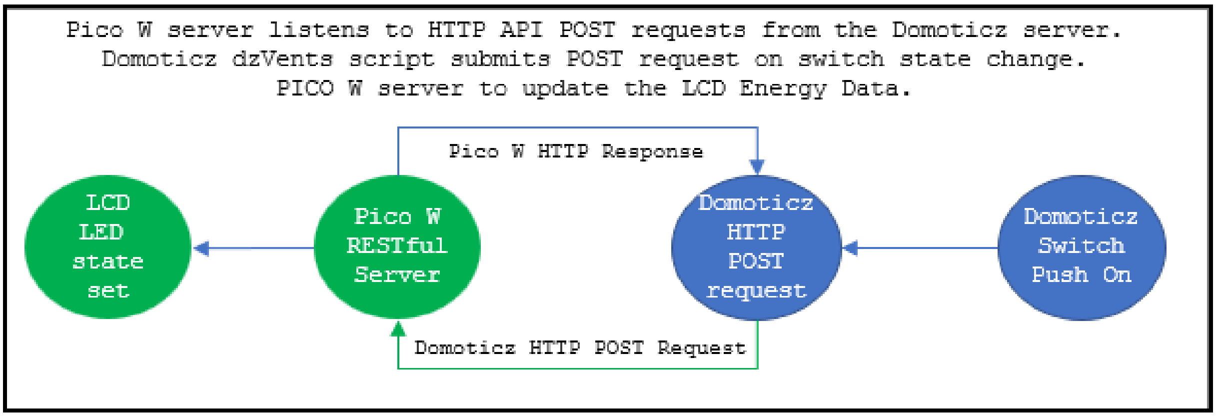
Domoticz POST request submitted via dzVents script device switch or timer trigger:


```
{
  "caption":"Energy Overview","lastupdate":"09:57:02",
  "tiles":[
    {"caption":"Gas kWh","id":0,"text":["YTD:2110","ADU:117",""]},
    {"caption":"Power kWh","id":1,"text":["YTD:103","ADU:6.29",""]},
    {"caption":"Water m3","id":2,"text":["YTD:9","ADU:1.30",""]},
    {"caption":"Weather","id":3,"text":["21 C","58 %RH","970 hPa"]}
  ]
}
```


Pico W server response to the Domoticz server:


```
{
  "status": "OK", "title": "energyoverview", "message": 1
}
```


The LCD screen with label caption + last update followed by 4 TileBoxes with Gas, Power, Water Year-To-Date (YTD) and Year-Average (ADU). The weather TileBox shows the temperature + humidity + barometer.



Demo Power Distribution

Domoticz power distribution data displayed in 4 Labelled Circle custom widgets.
Source: powerdistribution.py, pico_powerdistribution.dzvents.

The Pico W runs as a RESTful server.
The data is received as JSON object from the Domoticz server via Domoticz HTTP POST request from an automation script dzVents.
Domoticz PUSHES the data to the Pico W server.
The server listens for incoming connections, parses the data and updates the LCD display:
Label Caption with title + last update
Labelled Circles Solar, Grid, Home, and Bat with value. For the Grid, the value color is set to red if negative else green.

The Labelled Circle custom widget

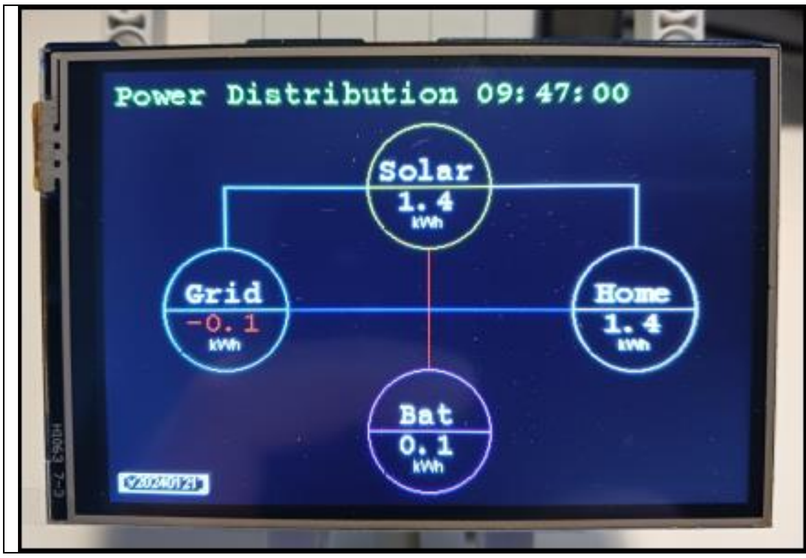
- consists out of a circle (framebuf) caption (Label widget), value (Label widget) and Unit (Label widget).
- are connected using h-/v-lines.

Domoticz POST request submitted via dzVents script either using a device switch or timer trigger:

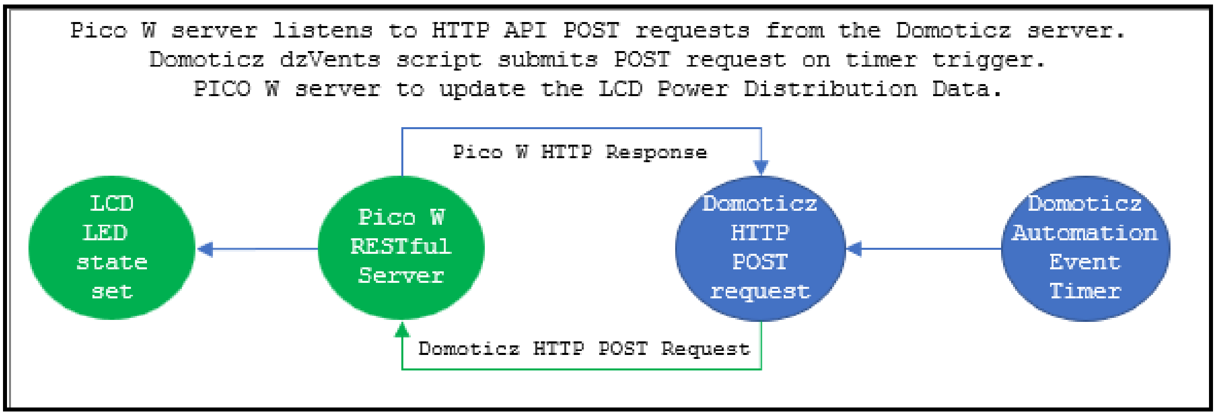
```
{
 "battery":0.1,"batteryfgcolor":15,
 "caption":"Power Distribution","lastupdate":"10:01:00",
 "grid":-0.3,"gridfgcolor":2,
 "home":1.8,"homefgcolor":15,
 "solar":1.6,"solarfgcolor":15}
}
```

Pico W server response to the Domoticz server:

```
{
  "status":"OK",
  "title":"powerdistribution",
  "message":1
}
```



The LCD screen with label caption + last update followed the 4 custom widgets LabelledCircle containing a label Caption, label Value and label Unit.


Pico W server listens to HTTP API POST requests from the Domoticz server.
Domoticz dzVents script submits POST request on timer trigger.
PICO W server to update the LCD Power Distribution Data.
Pico W HTTP Response
LCD LED state set
Pico W RESTful Server
Domoticz HTTP POST request
Domoticz Automation Event Timer
Domoticz HTTP POST Request

Block Diagram

See previous demo descriptions.

Wiring

The arbitrary pins for the Pico to connect to the board – These are fixed by the supplier.

Pin	Nr	Description
LCD_DC	8	LCD Command/Data. Writing command when DC = 0, writing data when DC=1.
LCD_CS	9	LCD Chip Select. The chip can be enabled when the voltage of CS is low.
LCD_SCK	10	SPLI CLK. SPI communication clock.
LCD_MOSI	11	SPI MOSI. transmitted data, that is, RGB data.
LCD_MISO	12	SPI MISO.
LCD_BL	13	LCD backlight.
LCD_RST	15	LCD reset. Usually set to 1 and is pulled low when the module is powered on.
TP_CS	16	Touch controller chip select.
TP_IRQ	17	Touch controller interrupt

Note
The micro-gui library supports options for data input which are not used for this project.

Circuit Diagram

Not created.

Domoticz Setup

Devices

The use of devices is demo dependent. See demo descriptions.

Automation Script

The use of automation scripts (written in dzVents) is demo dependent. See demo descriptions.

Pico W Setup

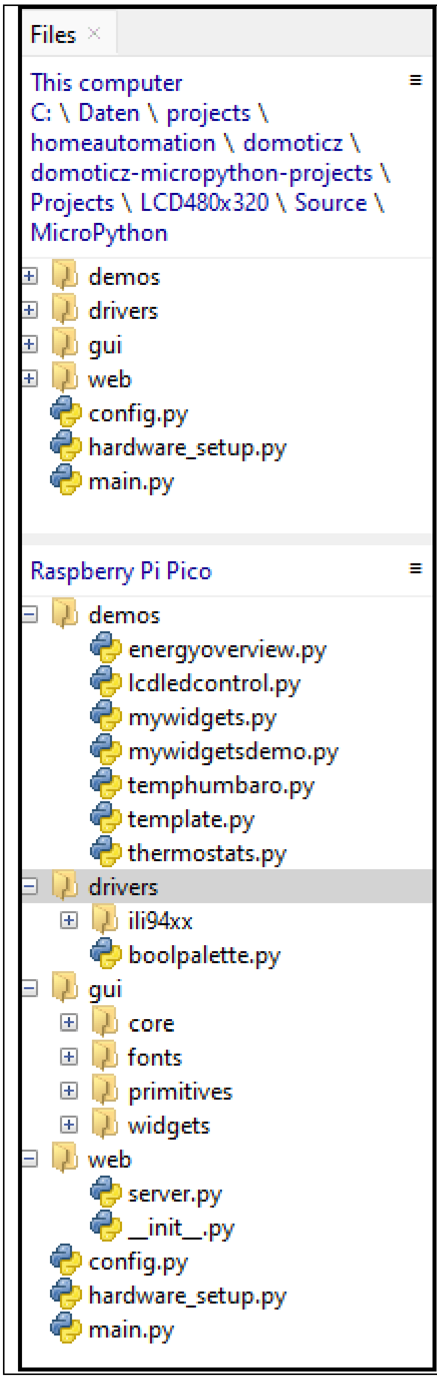
Board

	LCD Back Side with the Pico WH built in. No addition wiring required as this project is display-only.

MicroPython

Install
The archive **lcd480x320.zip** contains the library and the demos.
Extract the archive to a folder of choice and copy the content to the Pico.

The folder structure of the development device and the Raspberry Pi Pico W used:



The screenshot (from Thonny) shows the folder structure of the development device (top) and the Raspberry Pi Pico W (bottom).

The scripts are developed and tested on the Raspberry Pi Pico and copied to the development device.

Raspberry Pi Pico Folder & Files

demos
The various demos developed by the author. There might be more but not listed at the time of writing.

drivers
micro-gui display drivers.

gui
micro-gui core etc.

web
RESTful server.

config.py
Set the secrets and IP addresses.

hardware_setup.py
Hardware setup for the Waveshare Pico-ResTouch-LCD-3.5 with the ILI9488 display driver (based upon the ILI9486 driver).

main.py
Auto start script at boot.
Comment out the script to be run at start.

Update micropython-micro-gui
If there is an update of the micro-gui library, copy the content of the folders driver and gui to the Pico W. The subfolder gui/demos can be deleted if not used for exploring/testing.

Development Notes

Running a Script
Ensure to Stop/Restart the Thonny backend (CTRL+F2) prior running the script (F5).

Message: memory allocation failed

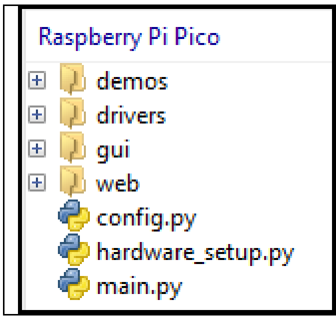
If this message occurs, then Stop/Restart Thonny backend twice.

```
MemoryError: memory allocation failed, allocating NNNN bytes.
```

Message: No Module named 'hardware_setup'

If this message occurs, then set the Pico W root folder as focus instead a sub-folder.

```
ImportError: no module named 'hardware_setup'
```



If a sub-folder is focussed, then click on “Raspberry Pi Pico” to set the root folder as focus.

Domoticz Automation Events

The demos submitting post requests from Domoticz automation events to the Pico W RESTful server, use Lua tables as post data.
The Lua table is converted to JSON and the request-header application/json is set.
The Pico W RESTful server uses the JSON data direct.

<table>
<tr><th>dzVents Lua Table</th><th>Pico W RESTful server JSON data</th></tr>
<tr><td><pre>
local postdata={}

postdata['caption']='Power Distribution'
postdata['lastupdate']=domoticz.time.rawTime
postdata['solar']=solar
postdata['solarfgcolor']=COLOR_WHITE
postdata['home']=home
postdata['homefgcolor']=COLOR_WHITE
postdata['grid']=grid
if grid < 0 then
 postdata['gridfgcolor']=COLOR_RED
else
 postdata['gridfgcolor']=COLOR_GREEN
end
postdata['battery'] = battery
postdata['batteryfgcolor']=COLOR_WHITE
</pre></td><td><pre>
{
'caption': 'Power Distribution',
'lastupdate': '10:40:00',
'home': 2.2, 'homefgcolor': 15,
'solar': 2.8, 'solarfgcolor': 15,
'grid': 0.4, 'gridfgcolor': 1,
'battery': 0.2, 'batteryfgcolor':
15
}
</pre></td></tr>
</table>

Enhancements

Data Input Push Button Support
Options on data input for push buttons:
1. Insert the Raspberry Pi Pico W in an external breadboard and connect the required pins including power & ground to the LCD board
2. Solder the push button pins & ground direct on the Raspberry Pi Pico W.

Touch Support
Touch support for the widgets.
Because of the high memory requirements (framebuf) and limited availability this is probably subject for a next generation of the Raspberry Pi Pico W.

Complex Solutions
The micro-gui library has a variety of widgets but also custom widgets can be developed. This enables to create more complex solutions which are projects on their own.

Thinking of:
- Multiple views controlled by a Domoticz Selector Switch.
  Each view could use 4 TileBoxes with different captions and content.
- Energy distribution with connected info widgets. The info widget could be a custom widget with a circle and label inside.
- Dashboard with blinking LEDs in case of issues.
- …

Custom Widgets
The TileBox is the first custom widget developed. It was quite fun creating and seeing the result. More custom widgets could be:
- Checkbox with label,
- Info circle with icon & label,
- Power meter,
- …

TM1637 4-digit 7-segment LED Display

Description

This project displays and updates in regular intervals selective Domoticz sensor data on a 4-digit 7-segment LED display connected to a Pico W.

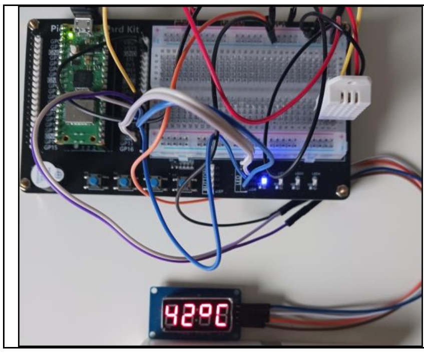
Solution

The Pico W web server listens to incoming HTTP POST requests.
The POST data is a JSON object with key:value pair(s) to set the TM1637 display:

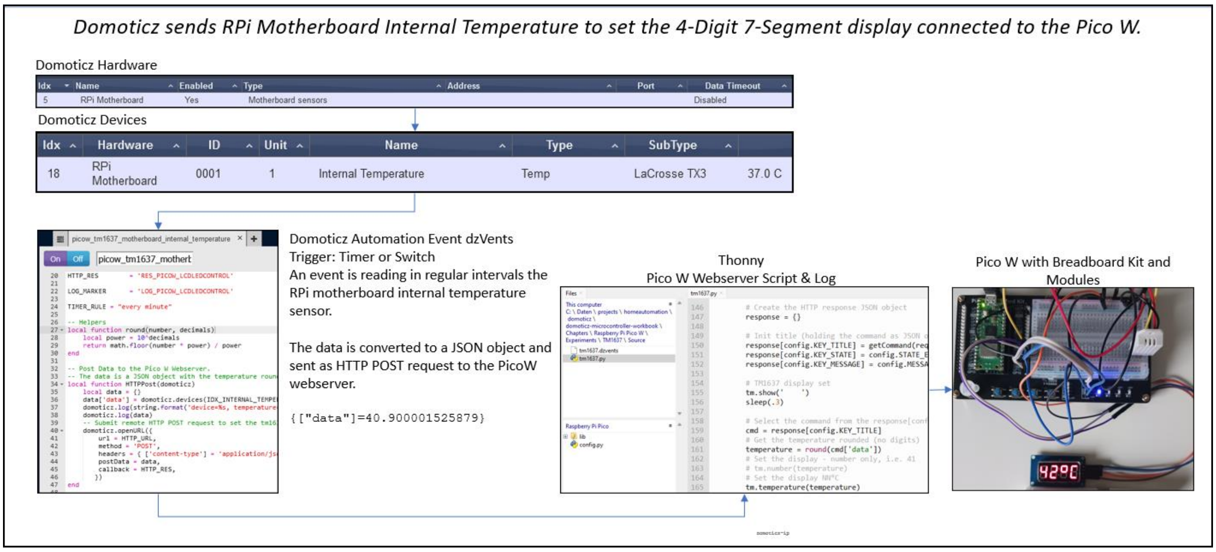
```
{"data":NNNN}
```

Domoticz uses an Automation Event dzVents, triggered by a switch or timer, to send data to the Pico W web server.

To get started using the TM1637, the display shows the Raspberry Pi Motherboard Internal Temperature.



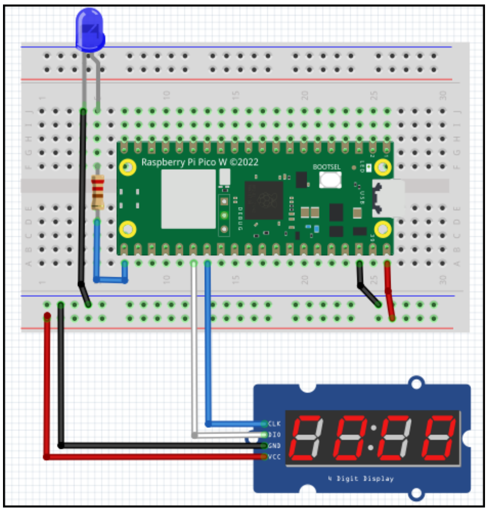
Block Diagram



Wiring

TM1637 I2C	**Pico W**
VCC	VBUS (5V) (Pin #40)
SDA	GP20 (Pin #26)
SCL	GP21 (Pin #27)
GND	GND (Pin #38)
LED (blue)	**Pico W**
+ (Anode)	GP16 (Pin #21)
GND (Cathode)	GND (Pin #38)

Circuit Diagram



Domoticz Setup

Devices

The hardware "Motherboard sensors" is added and selective devices, like the Internal Temperature are added.
The other devices from the hardware Motherboard sensors are not used for this project.

After creating the device, the Domoticz devices list shows the entries:

```
…
IDX=18, Hardware=RPi Motherboard, ID=0001, Unit=1, Name=Internal Temperature,
Type=Temp, SubType=LaCrosse TX3, Data=38.4 C
…
```

Note
Only the Internal Temperature device is shown here

Automation Script

```
--[[
File:   tm1637_motherboard_internal_temperature.dzvents
Date:   20230304
Author: Robert W.B. Linn

Display the motherboard interna temperature on a TM1637 connected to the Pico W.
The Pico W runs a RESTful web server.
The HTTP POST request to the Pico W web server is a JSON object: {"data":NN}.
The NN is the temperature with 0 digit (integer).
The Pico W web server HTTP response is a JSON object with key:value pairs:
{["message"]="On", ["title"]="{"data": "NN.N"}", ["status"]="OK"}
]]--

-- Domoticz
local IDX_INTERNAL_TEMPERATURE = 18
local IDX_SWITCH = 16

local HTTP_URL        = 'http://picow-ip'
-- HTTP_POST_DATA  = '{"data":"on"}'
local HTTP_RES        = 'RES_PICOW_LCDLEDCONTROL'
local LOG_MARKER      = 'LOG_PICOW_LCDLEDCONTROL'
local TIMER_RULE = "every minute"

-- Helpers
local function round(number, decimals)
    local power = 10^decimals
    return math.floor(number * power) / power
end

-- Post Data to the Pico W web server.
-- The data is a JSON object with the temperature rounded: {"data":NN}
local function HTTPPost(domoticz)
    local data = {}
    data['data'] = domoticz.devices(IDX_INTERNAL_TEMPERATURE).temperature
    domoticz.log(string.format('device=%s, temperature=%.1f',
                 domoticz.devices(IDX_INTERNAL_TEMPERATURE).name,
                 domoticz.devices(IDX_INTERNAL_TEMPERATURE).temperature),
domoticz.LOG_INFO)
    -- Submit remote HTTP POST request to set the tm1637
    domoticz.openURL({
        url = HTTP_URL, method = 'POST',
        headers = { ['content-type'] = 'application/json' },
        postData = data, callback = HTTP_RES,
       })
end

return {
 on = {
     devices = { IDX_SWITCH, IDX_INTERNAL_TEMPERATURE },
     timer = { TIMER_RULE },
     httpResponses = { HTTP_RES }
    },
 logging = { level = domoticz.LOG_INFO, marker = LOG_MARKER },
 execute = function(domoticz, item)
  if (item.isTimer) then
    HTTPPost(domoticz)
   end
  if (item.isDevice) then
    HTTPPost(domoticz)
   end
   if (item.isHTTPResponse) then
     if (item.isJSON) then
       local data = item.json

domoticz.log(string.format("status=%s,title=%s,message=%s",data.status,data.title,
data.message))
```

```
     end
   end
 end
}
```

Web Server

Libraries

The MicroPython script uses the external MicroPython TM1637 library to control the TM1637.
The library is stored on the Pico W in folder lib (see sub chapter Additional Libraries).

Credit
Thanks for developing & sharing the MicroPython TM1637 library.

MicroPython Script

```
"""
File:tm1637.py
Date:20230318
Author: Robert W.B. Linn

:description
Pico W RESTful web server listening for data from Domoticz event.
The incoming data is from a HTTP POST request with JSON object.
The JSON object has key:value pais: {"data":NNNN}
LED1 is attached on the Pico Breadboard kit.

:log
Domoticz TM1637 v20230304
TM1637 init.
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Network client connected from client-ip
HTTP Command={'data': 40.90001}
HTTP Response={"title": {"data": 40.90001}, "message": "41°C", "status": "OK"}
Network connection closed

:wiring
TM1637 = Pico W
VCC = VBUS (5V) (red)
DIO = GP20 (Pin #26) (white)
CLK = GP21 (Pin #27) (Pink)
GND = GND (black)
"""

# Libraries
import time
from time import sleep
from machine import Pin
# Call server from server.py (must be uploaded to the picow)
from server import Server
# TM1637 lib stored in Pico W folder lib
import tm1637
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config

# Constants
NAME = 'Domoticz TM1637'
VERSION = 'v20230304'

# Create the LED1 (blue) object using config.py settings
led1 = Pin(config.PIN_LED1, Pin.OUT)
led1.off()

# TM1637 Constants
TM1637_I2C_ADDRESS = 0x27
```

```
TM1637_PIN_DIO = 20
TM1637_PIN_CLK = 21

# Create the TM1637 object by init the TM1637 with i2c.
# Example: init_tm1637(TM1637_I2C_ADDRESS, TM1637_PIN_DIO, TM1637_PIN_CLK)
# Return - TM1637 object
def init_tm1637(address, pindio, pinclk):
    try:
        # Init TM1637 object
        tm = tm1637.TM1637(clk=Pin(pinclk), dio=Pin(pindio))
        print("TM1637 init.")
        return tm
    except OSError as e:
        raise RuntimeError('[ERROR] TM1637 init.')

# TM1637 set display from the JSON object.
# cmd - Command from the key response[config.KEY_TITLE]
# Example: cmd['data']=41.3001
# Return - Temperature rounded
def set_tm1637(cmd, status):
    # Assign the command to the response title
    response[config.KEY_TITLE] = cmd

    # If the status is 1 (OK) then set the tm1637 with data.
    if status == 1:
        # Clear the display
        tm.show('    ')
        sleep(.3)

        # Get the temperature rounded (no digits) from the JSON key 'data'
        temperature = round(cmd['data'])

        # Set the display NN°C
        tm.temperature(temperature)

        # Not Used = Just to show
        # Set the display - number only, i.e. 41
        # tm.number(temperature)

        # Set the response
        # Convert the KEY_TITLE from JSON object to a string
        response[config.KEY_MESSAGE] = str(temperature) + "°C"
        response[config.KEY_STATE] = config.STATE_OK
    else:
        response[config.KEY_STATE] = config.STATE_ERR
        response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN

    return response

# Main
# Listen for incoming connections from the Domoticz Automation Event dzVents
print(f'{NAME} {VERSION}')

# Set the TM1637 display
tm = init_tm1637(TM1637_I2C_ADDRESS, TM1637_PIN_DIO, TM1637_PIN_CLK)
tm.show('1958')
#tm.show('    ')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect()

"""
Main Loop
"""
while True:
    try:
```

```
        # Get client connection and the request data
        cl, request = network.get_client_connection(server)

        # Get the cmd to set the LCD text as JSON object from the POST request
        cmd, status = network.parse_post_request(request)

        # Create the HTTP response JSON object
        response = {}

        # Set the display with data from the command
        response = set_tm1637(cmd, status)

        # Send the response to Domoticz and close the connection (wait for new)
        network.send_response(cl, response, True)

    except OSError as e:
        ledstatus.off()
        cl.close()
        print('[ERROR] Network Connection closed')
```

Servo Motor

Description

This project enables to control, via Domoticz, a servo motor connected to the Pico W.

Ideas for Use

- Use as a switch.

Solution

The Pico W is built in a Pico Breadboard Kit.
The servo, type Tower Pro Micro Servo 9g SG90, is connected to the Pico W.

A RESTful web server runs on the Pico W.
If the web server network connection is successful, the Pico W onboard LED is ON else OFF indicating an error.
The web server listens to incoming client connections, which are HTTP POST requests.
The POST data is a JSON object with the key:value pair to set the angle (position) of the servo:

```
{"angle":NNN}
```

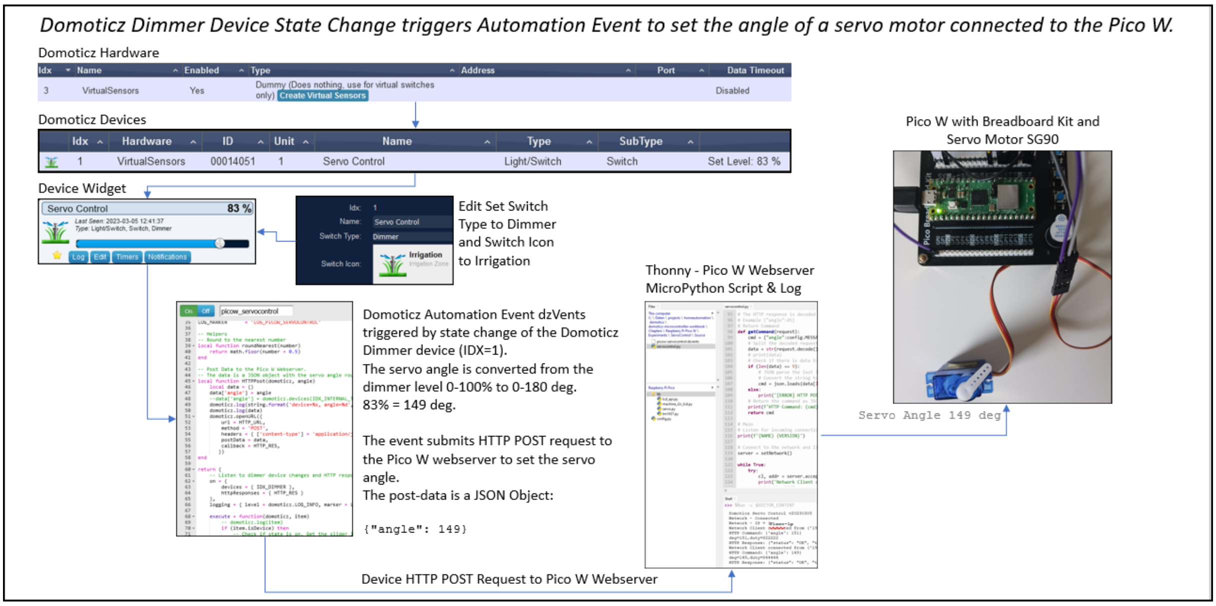
The angle is between 0-180 degrees.

A Domoticz switch device type dimmer sets the position of the servo motor (0-100% is converted to 0-180 degrees).
If the level value changes, a Domoticz Automation Event dzVents submits the HTTP POST request to the Pico W web server.
The web server sets the servo angle.
If the dimmer is set to off, the angle is set to 0. If set to on, the last level is set as shown by the dimmer slider.

Flow

1. Create the Domoticz Switch device from the hardware “Dummy” (Create Virtual Sensors) ,
2. Edit the Switch device widget and set the type to Dimmer.
   The Switch icon is also changed (as a test),
3. Run the Pico W web server (Thonny),
4. In Domoticz change the dimmer level of the switch device,
5. The automation event is triggered and converts the dimmer level 0-100% to a servo motor angle 0-180 deg. The angle is used as post-data for the HTTP POST request to the Pico W web server,
6. After receiving data, the Pico W web server set the servo motor angle and submits an HTTP POST request back to Domoticz with the status. The LED1 is on whilst setting the servo motor angle.

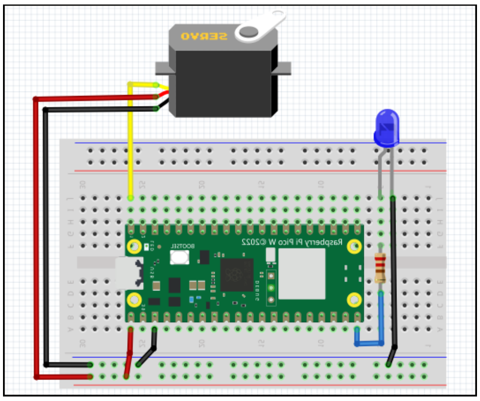
Block Diagram



Wiring

Servo Motor **Tower Pro Micro Servo 9g SG90**	**Pico W**
VCC	VBUS (5V)
Signal	GP0 (Pin #1)
GND	GND (Pin #38)
LED (blue)	**Pico W**
+ (Anode)	GP16 (Pin #21)
GND (Cathode)	GND (Pin #38)

Circuit Diagram



Domoticz Setup

Device

From the Domoticz hardware Dummy, a switch device is added, and its type changed to dimmer.

After creating the device, the Domoticz devices list shows the entry:

```
IDX=1, Hardware=VirtualSensors, ID=00014051, Unit=1, Name=Servo Control,
Type=Light/Switch, SubType=Switch, Date=Set Level: 28 %
```

Automation Script

```
--[[
File:   servocontrol.dzvents
Date:   20230305
Author: Robert W.B. Linn

Display the motherboard_internal_temperature on a TM1637 connected to the Pico W.
The Pico W runs a RESTful web server.
The HTTP POST request to the Pico W web server is a JSON object: {"angle":NNN}.
The NN is the angle of the servo to set. The angle is converted from the dimmer
range 0-100% to 0-180 deg.
The Pico W web server HTTP response is a JSON object with key:value pairs:
{"status": "OK", "title": "{\"angle\": 133}", "message": "133"}
]]--

-- Domoticz
local IDX_SWITCH = 16
local IDX_DIMMER = 1

local HTTP_URL        = 'http://picow-ip'
-- HTTP_POST_DATA  = '{"angle":90}'
local HTTP_RES        = 'RES_PICOW_SERVOCONTROL'
local LOG_MARKER      = 'LOG_PICOW_SERVOCONTROL'

-- Round to the nearest number
local function roundNearest(number)
    return math.floor(number + 0.5)
end

-- Post Data to the Pico W web server.
-- The data is a JSON object with the servo angle rounded: {"angle":NNN}
local function HTTPPost(domoticz, angle)
    local data = {}
    data['angle'] = angle
    --data['angle'] = domoticz.devices(IDX_INTERNAL_TEMPERATURE).temperature
    domoticz.log(string.format('device=%s,
angle=%d',domoticz.devices(IDX_SWITCH).name, angle), domoticz.LOG_INFO)
    domoticz.log(data)
    domoticz.openURL({
        url = HTTP_URL,
        method = 'POST',
        headers = { ['content-type'] = 'application/json' },
        postData = data,
        callback = HTTP_RES,
       })
end

return {
    -- Listen to dimmer device changes and HTTP responses
  on = {
      devices = { IDX_DIMMER },
      httpResponses = { HTTP_RES }
```

```
    },
  logging = { level = domoticz.LOG_INFO, marker = LOG_MARKER },

  execute = function(domoticz, item)
        -- domoticz.log(item)
   if (item.isDevice) then
             -- Check if state is on. Get the slider level to set the angle.
             if (item.state == 'On') then
            -- Get the level 0 - 100 %
            level = tonumber(item.levelVal)
            -- Convert the level to angle 0 - 180 deg
            angle = roundNearest((180 / 100) * level)
             end
             -- Check if the state is Off (the off button pressed)
             if (item.state == 'Off') then angle = 0 end

             -- Log
       domoticz.log(string.format("device=%s, state=%s, levelVal=%d, angle=%d",
item.name, item.state, item.levelVal, angle))

       -- Set the servo angle
             HTTPPost(domoticz, angle)
        end

        if (item.isHTTPResponse) then
             -- domoticz.log(item)
             if (item.isJSON) then
                 -- {"status": "OK", "title": "{\"angle\": 133}", "message": "133"}
                 local data = item.json
                 domoticz.log(string.format("status=%s, title=%s, message=%s",
data.status, data.title, data.message))
             end
        end

  end
}
```

Domoticz Log

```
2023-03-05 14:10:59.616 VirtualSensors: Light/Switch (Servo Control)
2023-03-05 14:10:59.610 Status: User: admin initiated a switch command (1/Servo
Control/Set Level)
2023-03-05 14:10:59.705 Status: dzVents: Info: Handling events for: "Servo
Control", value: "On"
2023-03-05 14:10:59.705 Status: dzVents: Info: LOG_PICOW_SERVOCONTROL: ------ Start
internal script: picow_servocontrol: Device: "Servo Control (VirtualSensors)",
Index: 1
2023-03-05 14:10:59.705 Status: dzVents: Info: LOG_PICOW_SERVOCONTROL: device=Servo
Control, state=On, levelVal=45, angle=81
2023-03-05 14:10:59.706 Status: dzVents: Info: LOG_PICOW_SERVOCONTROL: device=Pico
W LED1 Control, angle=81
2023-03-05 14:10:59.706 Status: dzVents: Info: LOG_PICOW_SERVOCONTROL:
{["angle"]=81}
2023-03-05 14:10:59.706 Status: dzVents: Info: LOG_PICOW_SERVOCONTROL: ------
Finished picow_servocontrol
2023-03-05 14:10:59.707 Status: EventSystem: Script event triggered:
/home/pi/domoticz/dzVents/runtime/dzVents.lua
2023-03-05 14:11:00.079 Status: dzVents: Info: Handling httpResponse-events for:
"RES_PICOW_SERVOCONTROL"
2023-03-05 14:11:00.079 Status: dzVents: Info: LOG_PICOW_SERVOCONTROL: ------ Start
internal script: picow_servocontrol: HTTPResponse: "RES_PICOW_SERVOCONTROL"
2023-03-05 14:11:00.079 Status: dzVents: Info: LOG_PICOW_SERVOCONTROL: status=OK,
title={"angle": 81}, message=81
2023-03-05 14:11:00.079 Status: dzVents: Info: LOG_PICOW_SERVOCONTROL: ------
Finished picow_servocontrol
```

Web Server

Libraries

The MicroPython script uses the library *servo.py* to set the angle of the servo motor.
The library is stored on the Pico W in folder lib (see sub chapter Additional Libraries).

```
"""
File:servo.py
Date:20230305
Author: Robert W.B. Linn

Class to control a servo motor.
Tested with a Tower Pro Micro Servo 9 g SG90.
Min and max duty default values are obtained via try out.
Min angle is 0, max angle is 180.
Servo signal pin is default Pico Pin GP0 (Pin #1).
"""

# Imports
import machine
from machine import Pin, PWM

# Servo Class
class Servo:
    """
    Init the servo with defaults.

    :parameter long MIN_DUTY

    :parameter long MAX_DUTY

    :parameter int pin

    :parameter int frequency
    """
    def __init__(self, MIN_DUTY=500000, MAX_DUTY=2500000, pin=0, frequency=50):
        self.pwm = machine.PWM(machine.Pin(Pin))
        self.pwm.freq(frequency)
        self.MIN_DUTY = MIN_DUTY
        self.MAX_DUTY = MAX_DUTY

    """
    Set the servo angle between 0 - 180 degrees.

    :parameter int angle
        Set the angle of the servo between 0 - 180 degrees.

    :return flat duty_ns
    """
    def setAngle(self, angle):
        if angle < 0:
            angle = 0
        elif angle > 180:
            angle = 180
        duty_ns = int(self.MAX_DUTY - angle * (self.MAX_DUTY-self.MIN_DUTY)/180)
        # print(duty_ns)
        self.pwm.duty_ns(duty_ns)
        return duty_ns
```

MicroPython Script

```
"""
File:servocontrol.py
Date:20230318
Author: Robert W.B. Linn

Pico W RESTful web server listening for data from Domoticz event.
The incoming data is from a HTTP POST request with JSON object to set the position
(angle) of a servo motor 0-180 degrees.

:log
Domoticz Servo Control v20230311
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Network client connected from client-ip
HTTP Command={'angle': 180}
Servo position deg=180,duty=500000
HTTP Response={"status": "OK", "title": {"angle": 180}, "message": "180"}
Network connection closed

:wiring
Servo = Pico W
VCC = VBUS (5V) (red)
Signal = GP0 (Pin #1) (yellow)
GND = GND (black)
"""

# Libraries
import time
from time import sleep
from machine import Pin
import json
# Call server from server.py (must be uploaded to the picow)
from server import Server
# Servo lib stored in Pico W folder lib
from servo import Servo
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config

# Constants
NAME = 'Domoticz Servo Control'
VERSION = 'v20230311'

# Create the LED1 (blue) object using config.py settings
led1 = Pin(2, Pin.OUT)
led1.off()

# Create the servo object with the default (GP0 (Pin #1)
servo = Servo()

# Set the servo pos and log
def set_servo_position(pos):
    duty = servo.set_angle(pos)
    print("Servo position deg=" + str(pos) + ",duty=" + str(duty))

"""
Handle the resquest to set the servo pos between 0-180 degrees.
"""
def handle_request(cmd, status):
    # Assign the command to the response title
    response[config.KEY_TITLE] = cmd

    # If the status is 1 (OK) then set the lcd display with the sensor data.
    if status == 1:
        led1.on()
```

```
        # Get the angle of the servo to set
        angle = cmd['angle']

        # Set the servo pos
        set_servo_position(angle)

        # Set the response
        response[config.KEY_STATE] = config.STATE_OK
        response[config.KEY_MESSAGE] = str(angle)

        led1.off()
    else:
        response[config.KEY_STATE] = config.STATE_ERR
        response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN

    # Return the response which is send to Domoticz
    return response

# Main
print(f'{NAME} {VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect()

"""
Main Loop
"""
while True:
    try:
        # Get client connection and the request data
        cl, request = network.get_client_connection(server)

        # Get the cmd to set the LCD text as JSON object from the POST request
        cmd, status = network.parse_post_request(request)

        # Create the HTTP response JSON object
        response = {}

        # Handle the command to set the servo pos
        # Set the response
        response = handle_request(cmd, status)

        # Send the response to Domoticz and close the connection (wait for new)
        network.send_response(cl, response, True)

    except OSError as e:
        ledstatus.off()
        cl.close()
        print('[ERROR] Network Connection closed')
```

Thonny Log

```
Domoticz Servo Control v20230305
Network - Connected
Network - IP = picow-ip
Network Client connected from ('client-ip', 52702)
HTTP Command: {'angle': 151}
deg=151,duty=822222
HTTP Response: {"status": "OK", "title": "{\"angle\": 151}", "message": "151"}
Network Client connected from ('client-ip', 46286)
HTTP Command: {'angle': 149}
deg=149,duty=844444
HTTP Response: {"status": "OK", "title": "{\"angle\": 149}", "message": "149"}
```

Enhancement Ideas

Some ideas whilst exploring setting the servo motor. These depend of course on solution.

- Domoticz selector switch with angle positions, like 0, 45, 90, 135 and 180.
- Show the angle on a 4-digit 7-segment display TM1637.
- Use a linear servo to control a throttle or switch.

RFID Reader

Description

This project reads the UID of an RFID card and sends the data to Domoticz text device.

Ideas for Use

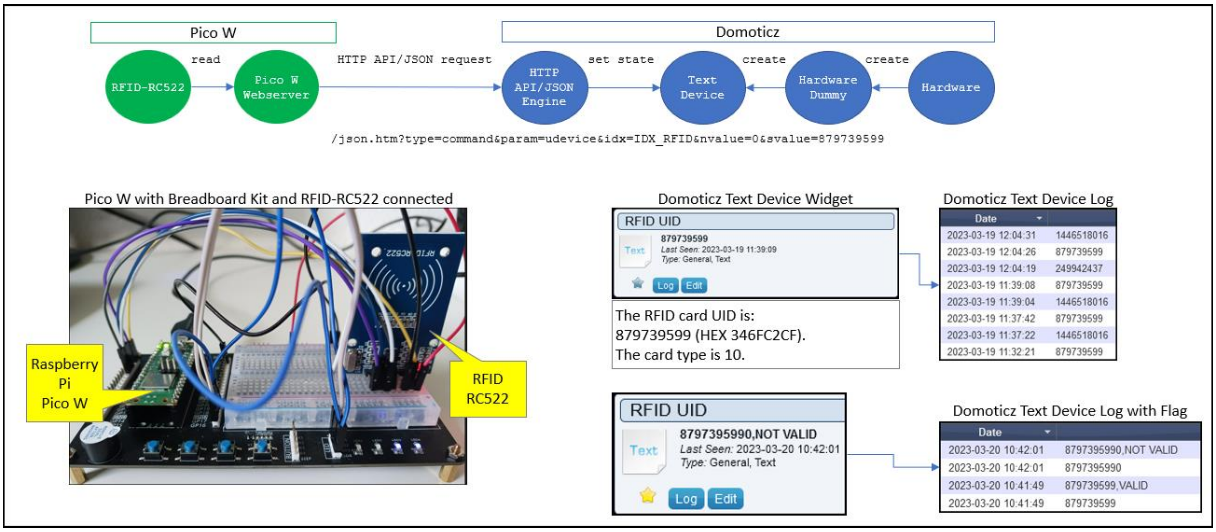
- Access control,
- Open garage door.

Solution

The Pico W web server listens to card readings of the RFID-RC522 sensor connected.
An Domoticz text device is updated with the card UID as decimal value using HTTP API/JSON request to the Domoticz server.
The log of the Domoticz text device lists all the cards read.
The time between the card readings must be greater threshold (default 2 seconds) to avoid multiple readings and updates of the Domoticz text device.

For a later version, its planned to send the RFID card data, beside the RFID card UID. This could be done via custom event.

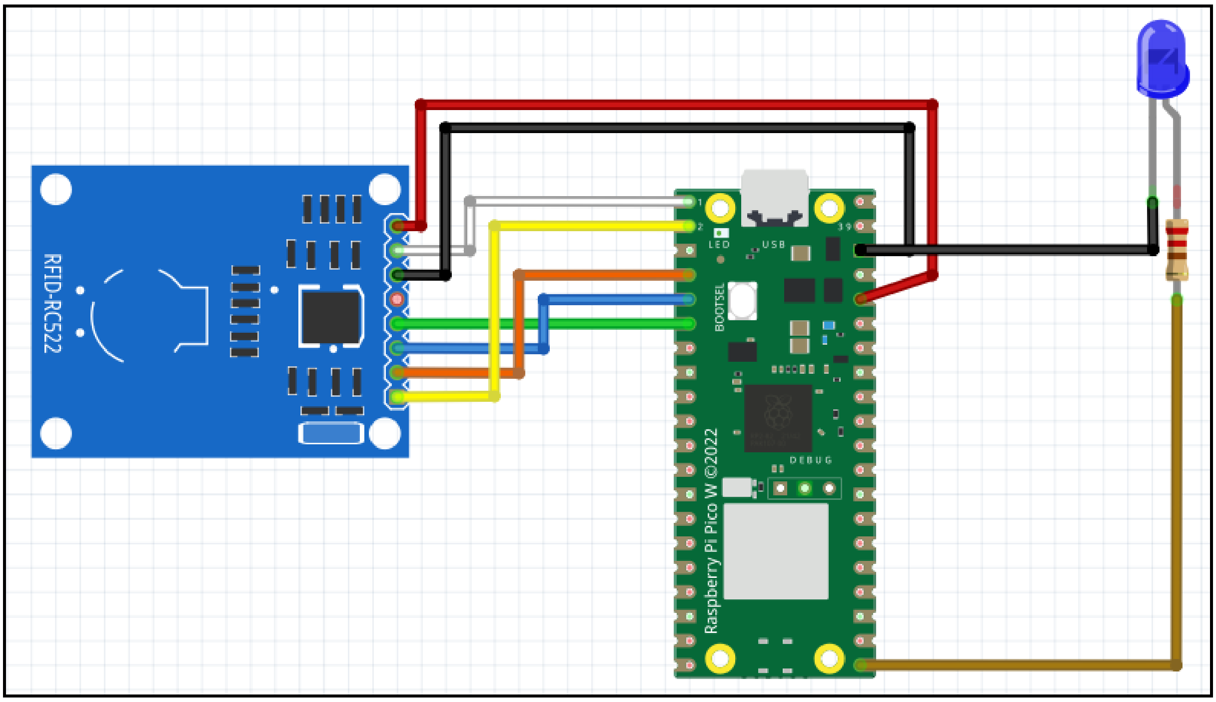
Block Diagram



Wiring

RFID-RC522	Pico W
VCC	3V3 (Pin #36)
RST	GP0 (Pin #1)
GND	GND (Pin #38)
IRQ	Not connected
MISO	GP4 (Pin #6)
MOSI	GP3 (Pin #5)
SCK	GP2 (Pin #4)
SDA	GP1 (Pin #2)
LED (blue)	**Pico W**
+ (Anode)	GP16 (Pin #21)
GND (Cathode)	GND (Pin #38)

Circuit Diagram



Domoticz Setup

Device

A text device is used to store the card UID as a decimal value i.e., 879739599.
From the Domoticz hardware Dummy, add a text device:
Create a virtual sensor with Name: RFID UID, Sensor Type: Text

After creating the device, the Domoticz devices list shows the entry:

```
Idx=27, Hardware=VirtualSensors, ID=00082027, Unit=1, Name=RFID UID, Type=General,
SubType=Text, Data=Hello World
```

Device Update

The device is updated via HTTP API/JSON request for a Text sensor. This is handled by the Pico W web server.

```
http://domoticz-
ip:port/json.htm?type=command&param=udevice&idx=IDX&nvalue=0&svalue=TEXT
```

Web Server

Libraries

The MicroPython script uses the external library PiPicoRFID to read the card.
The library is stored on the Pico W in folder lib (see sub chapter Additional Libraries).

Credit
Thanks for developing & sharing the PiPicoRFID library.

MicroPython Script

```
"""
File:rfid.py
Date:20230319
Author: Robert W.B. Linn

:description
Read the UID of an RFID card and send to Domoticz text device.
The Domoticz text device is updated using HTTP API/JSON request to the Domoticz
server.
The log of the Domoticz text device lists all the cards read.
The time between the card readings must be greater threshold to avoid multiple
readings and updates of the Domoticz text device.
The threshold in seconds is defined as constant MIN_DELTA_TIME = 2.

:notes
Pico Breadboard Kit is used to wire up the RFID.
Pico Breadboard Kit LED1 is used as status LED when requesting RFID data and
updating domoticz.
Configuration stored in config.py, ensure to upload to the picow.
For a later version, its planned to send the RFID card data, beside the RFID card
UID. This could be done via custom event.

:credits
The MFRC522 library PiPicoRFID from Saket Upadhyay (https://github.com/Saket-
Upadhyay/PiPicoRFID).
```

```
The base code is from https://github.com/wendlers/micropython-mfrc522.

:log
RFID v20230319
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Init RFID Module=rp2
CARD DETECTED: tag_type=10, uid_hex=346FC2CF, uid_dec=879739599
Send GET request url=http://domoticz-
ip:8080/json.htm?type=command&param=udevice&idx=27&nvalue=0&svalue=879739599
Send GET request status=OK
CARD DETECTED: tag_type=10, uid_hex=56381D00, uid_dec=1446518016
Send GET request url=http://domoticz-
ip:8080/json.htm?type=command&param=udevice&idx=27&nvalue=0&svalue=1446518016
Send GET request status=OK

:wiring
RFID-RC522 Module = Pico W
VCC = 3.3V
RST = GP0
GND = GND
IRQ = Not connected
MISO = GP4
MOSI = GP3
SCK = GP2
SDA = GP1
"""

"""
Imports
"""
from machine import Pin
from utime import sleep
import time
# RFID
import mfrc522
from os import uname
# Call server from server.py (must be uploaded to the picow)
from server import Server
# Configuration (must be uploaded to the picow)
import config

# Constants
VERSION = 'RFID v20230319'

# Create the led object indicating RFID read in progress
led1 = Pin(config.PIN_LED1, Pin.OUT)
led1.value(0)

"""
Domoticz
"""
# IDX text device
IDX_RFID = 27
# URL to update the text device
# Note the idx of the domoticz device ( see GUI > Setup > Devices)
# The svalue is added in the main loop after getting the data from the RFID.
URL_DOM = "http://"+ config.DOMOTICZ_IP
+"/json.htm?type=command&param=udevice&idx=" + str(IDX_RFID) + "&nvalue=0&svalue="

"""
RFID
"""
# Flag to read the data
# Not used as only the card uid is used
READ_DATA = False

"""
```

```
RFID Timer
"""
first_time_reading = True
# Delta time between readings in seconds
MIN_DELTA_TIME = 2
# Start time in seconds
start_time = time.time()
# Read_time
read_time = start_time
# Previous UID NOT USED
uid_previous = -1

"""
RFID object init

:return object mfrc522
"""
def init_rfid():
    print(f'Init RFID Module={str(uname()[0])}')
    return mfrc522.MFRC522(sck=2, miso=4, mosi=3, cs=1, rst=0)
    # print(f'Place card before reader. READ ARRD: 0x08')

"""
Read the RFID data (optional)

:param object rdr
    Card reader object

:return string hexstr
    Card data as hex string

:example
read_data(rdr)
RAW DATA: ['0x0', '0x0', '0x0', '0x0', '0x0', '0x0', '0x0', '0x0', '0x0', '0x0',
'0x0', '0x0', '0x0', '0x0', '0x0', '0x0']
['0x0', '0x0', '0x0', '0x0', '0x0', '0x0', '0x0', '0x0', '0x0', '0x0', '0x0',
'0x0', '0x0', '0x0', '0x0', '0x0']
"""
def read_data(rdr):
    hexstr = []
    # Get the card data (optional)
    if rdr.select_tag(raw_uid) == rdr.OK:

        key = [0xFF, 0xFF, 0xFF, 0xFF, 0xFF, 0xFF]
        auth = rdr.auth(rdr.AUTHENT1A, 8, key, raw_uid)
        if rdr.auth(rdr.AUTHENT1A, 8, key, raw_uid) == rdr.OK:
            data = rdr.read(8)
            # print(data) [0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0]
            if data is not None:
                for i in data:
                    hexstr.append(hex(i))
            print("RAW DATA: " + str(hexstr))
            rdr.stop_crypto1()
        else:
            print("AUTH ERR")
    else:
        print("Failed to select tag")

    return hexstr

"""
Main
"""
print(f'{VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
```

```
server = network.connect()

# Init the RFID module
rdr = init_rfid()

while True:

    # Wait for RFID card to read.
    # If RFID card found, send the card UID as decimal to Domoticz text device
    # Read the rfid card data
    (stat, tag_type) = rdr.request(rdr.REQIDL)
    # print(stat)

    # If the reader status is OK, then get the card type and uid
    if stat == rdr.OK:
        # LED1 indicator on
        led1.value(1)

        # Get the reading status and uid as raw data
        (stat, raw_uid) = rdr.anticoll()

        # If the status is OK, lets send the UID to Domoticz
        if stat == rdr.OK:
            # Get the tag type, i.e. 10
            tagtype = f'{tag_type:0X}'

            # Get the card uid as hex (each byte 2 hex size in uppercase) and dec,
i.e. 56381D00 = 1446518016
            # The dec value is send to domoticz
            uid_hex =
f'{raw_uid[0]:0>2X}{raw_uid[1]:0>2X}{raw_uid[2]:0>2X}{raw_uid[3]:0>2X}'
            uid_dec = int(uid_hex, 16)
            print(f'CARD DETECTED: tag_type={tagtype}, uid_hex={uid_hex},
uid_dec={uid_dec}')

            # Read_time and check the delta time in seconds between the readings
            # This to avoid multiple text device updates within (milli)seconds
            read_time = time.time()
            delta_time = read_time - start_time
            # print(f'{start_time}, {read_time}, {delta_time}')

            # Update domoticz if the delta time exceeded or if first time reading
            if delta_time > MIN_DELTA_TIME or first_time_reading:
                first_time_reading = False
                uid_previous = uid_dec
                start_time = read_time

                # Submit Domoticz HTTP API/JSON GET request to update the device
                # The uid card id decimal value is submitted to the Domoticz text
device
                network.send_get_request(URL_DOM + str(uid_dec))

                # Read data is not used and to be developed further like handling
auth error
                if READ_DATA:
                    data = read_data(rdr)
                    # network.send_get_request(URL_DOM + data)

        # LED1 indicator off
        led1.value(0)
```

Thonny Log

```
RFID v20230319
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Init RFID Module=rp2
```

```
CARD DETECTED: tag_type=10, uid_hex=346FC2CF, uid_dec=879739599
Send GET request url=http://domoticz-
ip:port:port/json.htm?type=command&param=udevice&idx=27&nvalue=0&svalue=879739599
Send GET request status=OK
```

Enhancement Ideas

Some ideas whilst exploring the card reader.

Device Change

Use an Automation Event dzVents to handle changes of the text device, i.e., the card or token UID received from the Pico W.
The card or token UID can be checked to trigger any action (see next enhancement idea).
The action could be to set a switch or send a notification.

Automation Script

```
--[[
File:   rfid_device_change.dzvents
Date:   20230320
Author: Robert W.B. Linn

:description
Handle the rfid text device state change triggered by the Pico W web server
submitting HTTP API/JSOM requests.

2023-03-19 11:37:33.558 Status: dzVents: Info: LOG_PICOW_RFID: ------ Start
internal script: picow_rfid: Device: "RFID UID (VirtualSensors)", Index: 27
2023-03-19 11:37:33.558 Status: dzVents: Info: LOG_PICOW_RFID: Device RFID UID:
statechange=1446518016
2023-03-19 11:37:33.558 Status: dzVents: Info: LOG_PICOW_RFID: Card UID 1446518016
is WRONG.
2023-03-19 11:37:33.558 Status: dzVents: Info: LOG_PICOW_RFID: ------ Finished
picow_rfid
2023-03-19 11:37:42.775 Status: dzVents: Info: Handling events for: "RFID UID",
value: "879739599"
2023-03-19 11:37:42.775 Status: dzVents: Info: LOG_PICOW_RFID: ------ Start
internal script: picow_rfid: Device: "RFID UID (VirtualSensors)", Index: 27
2023-03-19 11:37:42.775 Status: dzVents: Info: LOG_PICOW_RFID: Device RFID UID:
statechange=879739599
2023-03-19 11:37:42.775 Status: dzVents: Info: LOG_PICOW_RFID: Card UID 879739599
is OK.
2023-03-19 11:37:42.775 Status: dzVents: Info: LOG_PICOW_RFID: ------ Finished
picow_rfid
]]--

-- Domoticz IDX of the text device state is set by the Pico W web server
IDX_DEVICE  = 27

UID_CARD_A = '879739599'

LOG_MARKER = "LOG_PICOW_RFID"

return {
 on = { devices = { IDX_DEVICE } },
 logging = { level = domoticz.LOG_INFO, marker = LOG_MARKER },
 execute = function(domoticz, device)
  domoticz.log(string.format('Device %s: statechange=%s', device.name,
device.state), domoticz.LOG_INFO)
  local uid = device.state
  if uid == UID_CARD_A then
      domoticz.log(string.format('Card UID %d is OK.', uid))
       else
      domoticz.log(string.format('Card UID %d is WRONG.', uid))
  end
 end
}
```

Check & Additional Log

If the text of the device has not changed, no new log entry is added for the device.
This means if the same card or token UID is read, but not logged.
To ensure a new log entry is added every time a card is read, a flag VALID or NOT VALID could be added to the device text.

This solution provides therefor an additional log entry and a check of the UID is valid or not.

Date	Data
2023-03-20 10:42:01	8797395990,NOT VALID
2023-03-20 10:42:01	8797395990
2023-03-20 10:41:49	879739599,VALID
2023-03-20 10:41:49	879739599

Automation Script

```
--[[
File:   rfid_uid_check.dzvents
Date:   20230320
Author: Robert W.B. Linn

:description
Handle the rfid text device state change triggered by the Pico W web server
submitting HTTP API/JSOM requests.

:log
2023-03-20 10:41:49.155 Status: dzVents: Info: Handling events for: "RFID UID",
value: "879739599"
2023-03-20 10:41:49.155 Status: dzVents: Info: LOG_PICOW_RFID: ------ Start
internal script: picow_rfid: Device: "RFID UID (VirtualSensors)", Index: 27
2023-03-20 10:41:49.155 Status: dzVents: Info: LOG_PICOW_RFID: Device RFID UID:
statechange=879739599
2023-03-20 10:41:49.155 Status: dzVents: Info: LOG_PICOW_RFID: Card UID 879739599
is VALID.
2023-03-20 10:41:49.156 Status: dzVents: Info: LOG_PICOW_RFID: ------ Finished
picow_rfid
2023-03-20 10:41:49.156 Status: EventSystem: Script event triggered:
/home/pi/domoticz/dzVents/runtime/dzVents.lua
2023-03-20 10:41:49.204 Status: [web:8080] Incoming connection from: ::1
2023-03-20 10:41:49.246 Status: dzVents: Info: Handling events for: "RFID UID",
value: "879739599,VALID"
2023-03-20 10:41:49.246 Status: dzVents: Info: LOG_PICOW_RFID: ------ Start
internal script: picow_rfid: Device: "RFID UID (VirtualSensors)", Index: 27
2023-03-20 10:41:49.246 Status: dzVents: Info: LOG_PICOW_RFID: Device RFID UID:
statechange=879739599,VALID
2023-03-20 10:41:49.246 Status: dzVents: Info: LOG_PICOW_RFID: ------ Finished
picow_rfid
2023-03-20 10:42:01.345 Status: dzVents: Info: Handling events for: "RFID UID",
value: "8797395990"
2023-03-20 10:42:01.345 Status: dzVents: Info: LOG_PICOW_RFID: ------ Start
internal script: picow_rfid: Device: "RFID UID (VirtualSensors)", Index: 27
2023-03-20 10:42:01.345 Status: dzVents: Info: LOG_PICOW_RFID: Device RFID UID:
statechange=8797395990
2023-03-20 10:42:01.345 Status: dzVents: Info: LOG_PICOW_RFID: Card UID 8797395990
is NOT VALID.
2023-03-20 10:42:01.345 Status: dzVents: Info: LOG_PICOW_RFID: ------ Finished
picow_rfid
2023-03-20 10:42:01.346 Status: EventSystem: Script event triggered:
/home/pi/domoticz/dzVents/runtime/dzVents.lua
2023-03-20 10:42:01.430 Status: dzVents: Info: Handling events for: "RFID UID",
value: "8797395990,NOT VALID"
2023-03-20 10:42:01.431 Status: dzVents: Info: LOG_PICOW_RFID: ------ Start
internal script: picow_rfid: Device: "RFID UID (VirtualSensors)", Index: 27
2023-03-20 10:42:01.431 Status: dzVents: Info: LOG_PICOW_RFID: Device RFID UID:
statechange=8797395990,NOT VALID
2023-03-20 10:42:01.431 Status: dzVents: Info: LOG_PICOW_RFID: ------ Finished
picow_rfid
]]--

-- Domoticz IDX of the text device state is set by the Pico W web server
local IDX_DEVICE  = 27
-- Card UID to verify
local UID_CARD_A = '879739599'
local FLAG_VALID = 'VALID'
local FLAG_NOT_VALID = 'NOT VALID'
-- Log marker
local LOG_MARKER = "LOG_PICOW_RFID"

-- Add a flag VALID or NOT VALID to the device state.
-- If the uid of the device is not changed, no new log entry is set.
-- Note the use of openurl with http api/json get request.
```

```
-- This updates the text of the device immediate, whereas dzvents updateText needs
more time.
local function UpdateDevice(domoticz, device, state)
    -- Define the new svalue with uid,state
    local svalue = string.format('%s,%s', device.text, state)
    -- Define the url for the http api/json get request
    local url =
string.format('http://localhost:8080/json.htm?type=command&param=udevice&idx=%d&nva
lue=0&svalue=%s', device.idx, svalue)
    -- Replace space by %20 in the url
    url = string.gsub(url, ' ', '%%20')
    -- Submit the http get request
    domoticz.openURL(url)
    -- Optional return the new device svalue
    return svalue
end

-- Handle two device state changes:
-- First state change triggered by the Pico W web server with the card UID only.
-- Second state change by this event after adding the flag to the UID to add as
device log entry uid,flag.
-- If the card UID only is used, no new device log entry is added.
-- By using a flag Domoticz notices a text change and adds a log entry.
return {
 on = {
     devices = { IDX_DEVICE }
 },
 logging = {
     level = domoticz.LOG_INFO, marker = LOG_MARKER
    },
 execute = function(domoticz, device)
  domoticz.log(string.format('Device %s: statechange=%s', device.name,
device.state), domoticz.LOG_INFO)
  -- Check if the device state contains the flag uid,flag
  if string.find(device.state, ",") == nil then
      -- Get the UID
      uid = device.state
          -- Check the uid for any action
      if uid == UID_CARD_A then
          domoticz.log(string.format('Card UID %d is %s.', uid, FLAG_VALID))
          UpdateDevice(domoticz, device, FLAG_VALID)
          -- Trigger any action ...
           else
          domoticz.log(string.format('Card UID %s is %s.', uid, FLAG_NOT_VALID))
          UpdateDevice(domoticz, device, FLAG_NOT_VALID)
      end
       end
 end
}
```

TM1638 LED&KEY

Description

This project explores how to use the 8-digit TM1638 seven segment 8 LEDs and 8 Push buttons component (TM1638 LED&KEY) with Domoticz.

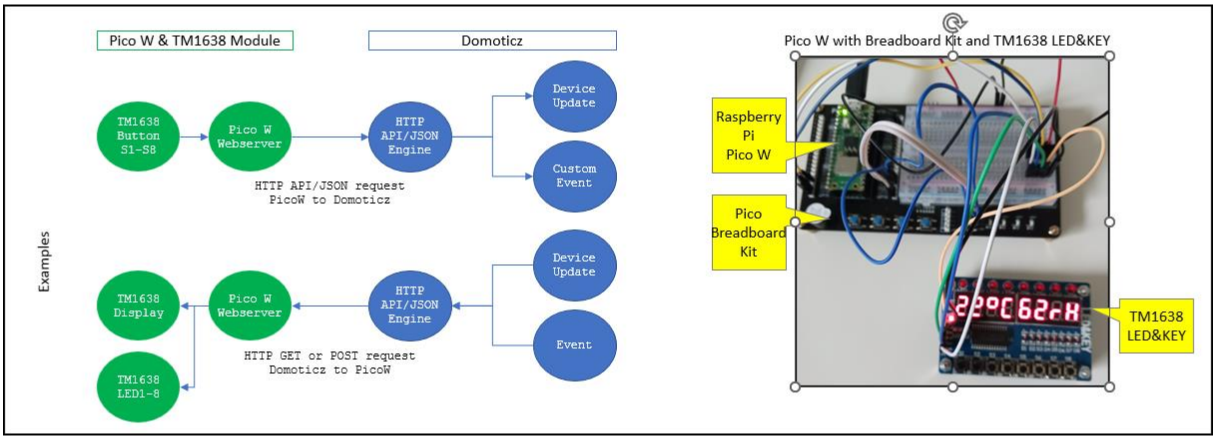
Ideas for Use
This component offers a variety of applications with Domoticz. Just a few to mention are
- Devices monitor using up-to 8 LEDs as indicators,
- Push buttons to set the setpoint of up-to 8 thermostats or turn light on/off,
- Segment display to display thermostat setpoint changes or temperatures or server sensor data,
- and many more...

Solution

A two-way communication can be used, either the Pico W web server

- listens to HTTP GET or POST requests triggered by Domoticz
  (Domoticz to Pico W)
  or
- sends HTTP API/JSON requests to Domoticz to update a device or trigger an Automation Event, like a dzVents Custom Event
  (Pico W to Domoticz)

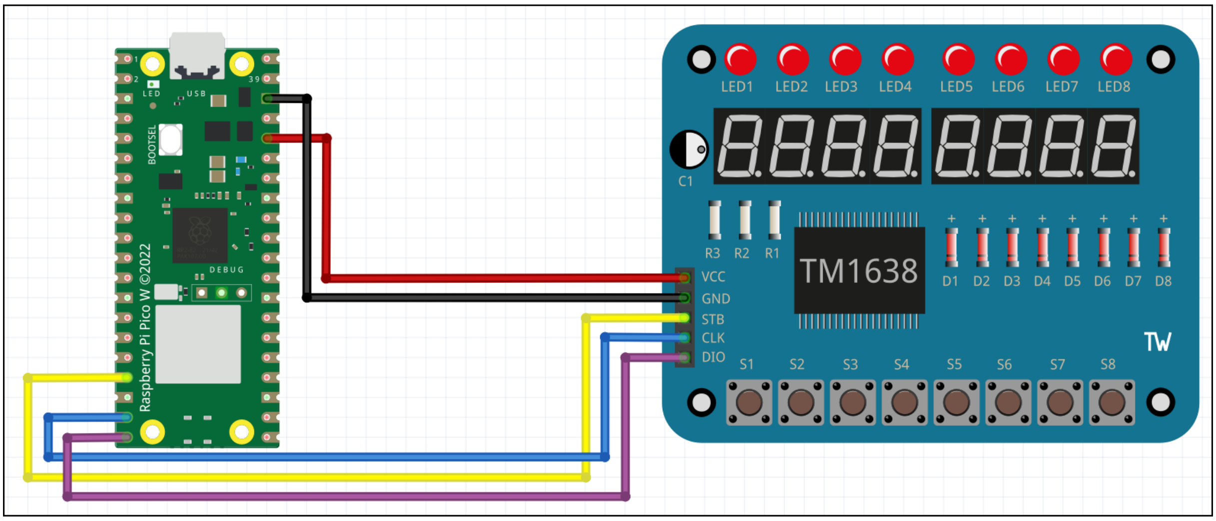
Block Diagram



Wiring

TM1638 LED&KEY Module	Pico W
VCC	3V3 (Pin #36)
GND	GND (Pin #38)
STB	GP13 (Pin #17)
CLK	GP14 (Pin #19)
DIO	GP15 (Pin #20)

Circuit Diagram



Domoticz Setup

The Domoticz device(s) or Domoticz Automation Event(s) used, depend on the solution developed.

Several basic projects have been developed which can be a base for solutions using the TM1638 LED&KEY component.

Web Server

Libraries

The MicroPython script(s) uses a modified version (by the author of this book) of the external MicroPython TM1638 LED display driver for 8x 7-segment decimal LED components with 8x individual LEDs and 8x push buttons.
The library is stored on the Pico W in folder lib (see sub chapter Additional Libraries).

Credit
Thanks for developing & sharing the TM1638 LED driver.

MicroPython Script

There are several projects developed, each having their own script.
All scripts are using the class Server from server.py (in folder lib on the Pico W) and the configuration script config.py

Projects

Next some simple projects to explore how to use the TM1638 LED&KEY component.

LED1-8 set by Domoticz Switch On/Off

Pico W RESTful web server listening to control LED1-8 of the TM1638LEDKEY component via Domoticz Switch.
Commands set via HTTP GET request with HTTP response JSON object.
The command can be in any case as converted to lowercase.
Communication: Domoticz to Pico W.

MicroPython Script

```
"""
File:tm1638-ledcontrol-get.py
Date:20230321
Author: Robert W.B. Linn

:description
Pico W RESTful web server listening to control LED1-8 of the TM1638LEDKEY module
via Domoticz Switch.
Commands set via HTTP GET request with HTTP response JSON object.
The command can be in any case as converted to lowercase.

:commands
N = LED number 1 to 8 as displayed on the module.

LED ON
HTTP Request:http://picow-ip/led/N/on
HTTP response:{"status": "OK", "title": "/led/N/on", "message": "On"}

LED OFF
HTTP Request:http://picow-ip/led/1/off
HTTP response:{"status": "OK", "title": "/led/N/off", "message": "Off"}

LED STATE
HTTP Request:http://picow-ip/led/1/state
HTTP response:{"status": "OK", "title": "/led/N/state", "message": "On"}

In case of an error:
HTTP response:{"status": "ERROR", "title": "/led/N/x", "message": "Unknown
command."}

Example using curl to turn LED1 on:
curl -v http://picow-ip/led/1/on

:log
TM1638-LEDControl-GET v20230321
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Network client connected from client-ip
HTTP Command=/led/8/on
HTTP Response={"title": "/led/8/on", "message": "on", "status": "OK"}
Network connection closed
Network client connected from client-ip
```

```
HTTP Command=/led/8/state
HTTP Response={"title": "/led/8/state", "message": "On", "status": "OK"}
Network connection closed
"""

# Libraries
import network
import socket
import time
from machine import Pin
# Server class from server.py
from server import Server
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config
# TM1638: credits to https://github.com/mcauser/micropython-tm1638
import tm1638ex

# Constants
NAME = 'TM1638-LEDControl-GET'
VERSION = 'v20230321'

# URL params to switch LED1-8 on or off or request state
CMD_LED_ON  = 'on'
CMD_LED_OFF  = 'off'
CMD_LED_STATE= 'state'

# Create the LED1 object (as indicator) using config.py settings
led1 = Pin(config.PIN_LED1, Pin.OUT)
led1.value(0)

# Create the tm1638 object with STB = GP13, CLK = GP14, DIO = GP15
tm = tm1638ex.TM1638(stb=Pin(tm1638ex.PIN_STB), clk=Pin(tm1638ex.PIN_CLK),
dio=Pin(tm1638ex.PIN_DIO))
# Turn all LEDs off
tm.leds(tm.STATE_OFF)

"""
Handle the request containing the command.
The LED is turned on/off or the state is requested.
The response JSON object is updated.

:param string cmd
    Command to set the LED1-8 state on/off or get the state.
    The command can be in any case as converted to lowercase.
    Examples: /led/8/on, /led/8/off, /led/8/state

:return JSON object response
    JSON key:value pairs: {"title": <command>, "message": <state>, "status": OK or
ERROR}
    Example: {"title": "/led/8/on", "message": "on", "status": "OK"}
"""
def handle_request(cmd):
    # Convert the command to lowercase
    cmd = cmd.lower()

    # Split the command to get the led number and state
    # /led/N/on split into 4 items: '', led, 1-8, on|off|state
    cmd_params = cmd.split('/')

    # Check if the command length is 4
    if len(cmd_params) != 4:
        response[config.KEY_MESSAGE] = f'LED command unknown ({led_cmd}).'
        response[config.KEY_STATE] = config.STATE_ERR
        # raise ValueError(f'LED command unknown ({led_cmd}).')
        return response

    # Get & check the led pos in range 0-7.
    # Note the message is for the led range 1-8 as on the module LED1-LED8
    led_pos = int(cmd_params[2]) - 1
```

```
    if not tm.LED_POS_MIN <= led_pos <= tm.LED_POS_MAX:
        response[config.KEY_MESSAGE] = f'LED position {led_pos + 1} out of range
{tm.LED_POS_MIN + 1}-{tm.LED_POS_MAX + 1}.'
        response[config.KEY_STATE] = config.STATE_ERR
        # raise ValueError(f'LED Position out of range ({led_pos}).')
        return response

    # Get & check the command on,off,state
    led_cmd = cmd_params[3]
    if not led_cmd in [CMD_LED_ON, CMD_LED_OFF, CMD_LED_STATE]:
        response[config.KEY_MESSAGE] = f'LED command unknown ({led_cmd}).'
        response[config.KEY_STATE] = config.STATE_ERR
        # raise ValueError(f'LED command unknown ({led_cmd}).')
        return response

    # Set the led on or off or get the state
    if led_cmd == CMD_LED_ON:
        tm.led(led_pos, 1)
        response[config.KEY_MESSAGE] = config.MESSAGE_ON
    if led_cmd == CMD_LED_OFF:
        tm.led(led_pos, 0)
        response[config.KEY_MESSAGE] = config.MESSAGE_OFF
    if led_cmd == CMD_LED_STATE:
        if tm.led_value(led_pos) == 1:
            response[config.KEY_MESSAGE] = config.MESSAGE_ON
        else:
            response[config.KEY_MESSAGE] = config.MESSAGE_OFF
    response[config.KEY_STATE] = config.STATE_OK
    return response

"""
Main
"""
print(f'{NAME} {VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD)
# Connect to the network and get the server object
server = network.connect()

while True:
    try:
        # Get client connection and the request data
        cl, request = network.get_client_connection(server)

        # Create the HTTP response JSON object
        response = {}

        # Parse the get data. In case of error, the status is 0.
        cmd, status = network.parse_get_request(request)

        # Assign the command to the response KEY_TITLE
        response[config.KEY_TITLE] = cmd

        # If the status is 1, handle the command
        if status == 1:
            response = handle_request(cmd)
        else:
            response[config.KEY_STATE] = config.STATE_ERR
            response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN

        # Send response to the client and close the connection
        network.send_response(cl, response, True)

    except OSError as e:
        network.ledstatus.off()
        cl.close()
        print('[ERROR] Network Connection closed')
```

Key S1-8 press sets Domoticz Alert Device

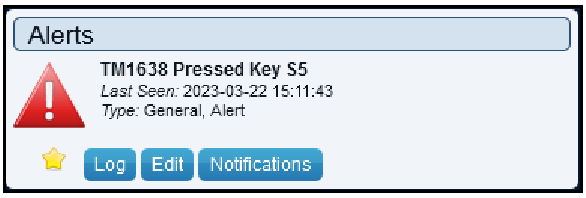
Pico W RESTful web server listening if one of the push buttons S1-S8 of the TM1638LEDKEY component is pressed.
For S1 to S5, an HTTP API/JSON request is sent to Domoticz to set the Level and Text for an Alert Device.
Example: pressing S1 is sets alert level 0 with text "TM1638 Pressed Key S1".
This is a basic example for handling push button press and submit HTTP API/JSON request to Domoticz.
Communication: Pico W to Domoticz.

MicroPython Script

```
"""
File:tm1638-keys.py
Date:20230321
Author: Robert W.B. Linn

:description
Pico W RESTful web server listening if one of the push buttons S1-S8 of the
TM1638LEDKEY module is pressed.
For S1 to S5, an HTTP API/JSON request is send to Domoticz to set an the Level and
Text for an Alert Device.
Example: pressing S1 is sets alert level 0 with text "TM1638 Pressed Key S1".
This is a basic example for handling push button press and submit HTTP API/JSON
request to Domoticz.

The log shows pressing keys S1 to S5 with HTTP API/JSON request updating level and
text for the Alert device with idx 7.
:log
tm1638-keyscontrol v20230321
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Send GET request url=http://domoticz-
ip:port/json.htm?type=command&param=udevice&idx=7&nvalue=0&svalue=TM1638 Pressed
Key S1
Send GET request status=OK
Send GET request url=http://domoticz-
ip:port/json.htm?type=command&param=udevice&idx=7&nvalue=1&svalue=TM1638 Pressed
Key S2
Send GET request status=OK
Send GET request url=http://domoticz-
ip:port/json.htm?type=command&param=udevice&idx=7&nvalue=2&svalue=TM1638 Pressed
Key S3
Send GET request status=OK
Send GET request url=http://domoticz-
ip:port/json.htm?type=command&param=udevice&idx=7&nvalue=3&svalue=TM1638 Pressed
Key S4
Send GET request status=OK
Send GET request url=http://domoticz-
ip:port/json.htm?type=command&param=udevice&idx=7&nvalue=4&svalue=TM1638 Pressed
Key S5
Send GET request status=OK
"""

# Libraries
import network
import socket
import time
from machine import Pin
# Server class from server.py
from server import Server
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config
```

```
# TM1638: credits to https://github.com/mcauser/micropython-tm1638
import tm1638ex

# Constants
NAME = 'tm1638-keyscontrol'
VERSION = 'v20230321'

"""
/json.htm?type=command&param=udevice&idx=IDX&nvalue=LEVEL&svalue=TEXT
IDX = id of your device (This number can be found in the devices tab in the column
"IDX")
Level = (0=gray, 1=green, 2=yellow, 3=orange, 4=red)
TEXT = Text you want to display
"""
URL_DOM_ALERT_DEVICE = 'http://' + config.DOMOTICZ_IP +
'/json.htm?type=command&param=udevice&idx={IDX}&nvalue={LEVEL}&svalue={TEXT}'
IDX_ALERT_DEVICE = 7

# Create the LED1 object (as indicator) using config.py settings
led1 = Pin(config.PIN_LED1, Pin.OUT)
led1.value(0)

# Create the tm1638 object with STB = GP13, CLK = GP14, DIO = GP15
tm = tm1638ex.TM1638(stb=Pin(tm1638ex.PIN_STB), clk=Pin(tm1638ex.PIN_CLK),
dio=Pin(tm1638ex.PIN_DIO))
# Turn all LEDs off
tm.leds(tm.STATE_OFF)

"""
Handle Request
"""
def handle_request(cmd):
    print(f'NOT USED')

"""
Main
"""
print(f'{NAME} {VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD)
# Connect to the network and get the server object
server = network.connect()

while True:
    # Listen to key pressed
    pressed = tm.keys()

    # Loop over the 8 keys S1-S8
    for i in range(8):
        # Check which key is pressed
        if ((pressed >> i) & 1):
            # Set the LED display with the key number
            tm.number(i+1)
            # tm.show(f'      S{i+1}')

            # Send request to Domoticz for the keys 1-5 (index 0-4)
            if 0 <= i <= 4:
                url = URL_DOM_ALERT_DEVICE.replace('{IDX}', str(IDX_ALERT_DEVICE))
                url = url.replace('{LEVEL}', str(i))
                url = url.replace('{TEXT}', f'TM1638 Pressed Key S{i + 1}')
                network.send_get_request(url)
    time.sleep(.01)
```

Domoticz Widget Alert Device


Alerts
TM1638 Pressed Key S5
Last Seen: 2023-03-22 15:11:43
Type: General, Alert
Log
Edit
Notifications

Key S1 press gets Domoticz Temp+Hum Device Data and set display

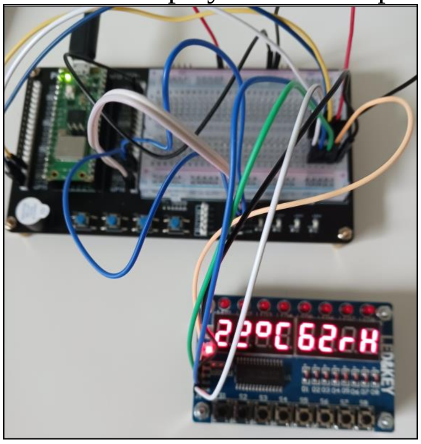
Pico W RESTful web server listening if key S1 of the TM1638LEDKEY component is pressed.
If pressed, an HTTP API/JSON request is sent to Domoticz to get the status of a Temp+Hum device.
The Domoticz server sends a JSON object as response back.
The JSON object is parsed to get the temp and hum values.
These are set on the 8-segment display i.e., 20°C54rH
Communication: Pico W to Domoticz and Domoticz to Pico W.

MicroPython Script

```
"""
File:tm1638-keys1-temphum.py
Date:20230321
Author: Robert W.B. Linn

:description
Pico W RESTful web server listening if key S1 of the TM1638LEDKEY module is
pressed.
If pressed, an HTTP API/JSON request is send to Domoticz to get the status of a
Temp+Hum device.
The Domoticz server sends a JSON object as response back.
The JSON object is parsed to get the temp and hum values.
These are set on the 8-segment display i.e., 20°C54rH

:log
tm1638-keys1-temphum v20230321
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Send GET request url=http://domoticz-ip:port/json.htm?type=devices&rid=15
Send GET request status=OK
Handle request status=1,json={'Sunset': '18:35', 'NautTwilightS ...
Handle request temp=20,hum=54
"""

# Libraries
import network
import socket
import time
from machine import Pin
import json
# Server class from server.py
from server import Server
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config
# TM1638: credits to https://github.com/mcauser/micropython-tm1638
import tm1638ex

# Constants
NAME = 'tm1638-keys1-temphum'
VERSION = 'v20230321'

# Define the url for the HTTP API/JSON GET request
URL_DOM = 'http://' + config.DOMOTICZ_IP + '/json.htm?type=devices&rid={IDX}'
# IDX of the Domoticz temp+hum device
IDX_DEVICE = 15

# Create the LED1 object (as indicator) using config.py settings
led1 = Pin(config.PIN_LED1, Pin.OUT)
led1.value(0)

# Create the tm1638 object with STB = GP13, CLK = GP14, DIO = GP15
```

```
tm = tm1638ex.TM1638(stb=Pin(tm1638ex.PIN_STB), clk=Pin(tm1638ex.PIN_CLK),
dio=Pin(tm1638ex.PIN_DIO))
# Turn all LEDs off
tm.leds(tm.STATE_OFF)

"""
Handle Request.
The status for the Domoticz temp+hum device is requested from the Domoticz server.
The Domoticz server sends a JSON response back.
The JSON object is parsed to get the temp and hum values.
These are set on the display i.e., 20°C,54rH
During the request handling, LED1 of the Pico W Breadboard is on, but also LED1 of
the TM1638 module.
"""
def handle_request(cmd):
    led1.value(1)
    tm.led(tm.LED1, tm.STATE_ON)
    status, content = network.send_get_request(url)
    print(f'Handle request status={status},json={content}')
    if status == 1:
        try:
            # Get key result first array entry
            result = content['result'][0]
            # print(result)
            # Get the properties Temp and Humidity
            temp = int(result['Temp'])
            hum = int(result['Humidity'])
            print(f'Handle request temp={temp},hum={hum}')
            # Set the temp + hum on the display
            tm.temperature(temp,0)
            tm.humidity(hum,4)
        except ValueError as e:
            # print(f'[ERROR] {e}, {r.content.decode()}')
            raise Exception(f'[ERROR] {e}, {r.content.decode()}')
    else:
        tm.show('ERR')
    led1.value(0)
    tm.led(tm.LED1, tm.STATE_OFF)

"""
Main
"""
print(f'{NAME} {VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD)
# Connect to the network and get the server object
server = network.connect()

while True:
    # Listen to key pressed
    pressed = tm.keys()

    # Loop over the 8 keys S1-S8
    for i in range(8):
        # Check which key is pressed
        if ((pressed >> i) & 1):
            key_nr = i+1
            if key_nr == 1:
                url = URL_DOM.replace('{IDX}', str(IDX_DEVICE))
                handle_request(url)
    time.sleep(.01)
```

TM1638 Display shows Temp 22°C + Humidity 62 RH



OLED 0,96" I2C Display

Description

This project displays and updates in regular intervals selective Domoticz data from the hardware motherboard sensors on an 0,96" I2C OLED display (OLED) connected to the Pico W.

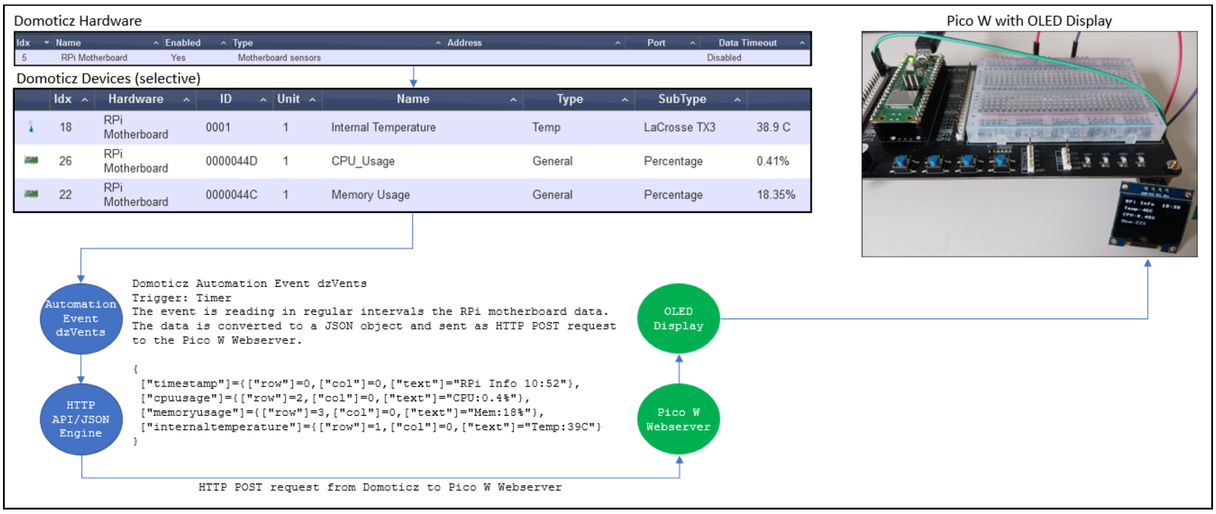
Solution

Domoticz uses an Automation Event dzVents, triggered by a switch or timer, to send the selective Domoticz hardware motherboard sensors data (internal temperature, CPU usage, memory usage) via HTTP POST request to the Pico W web server.
The data is a JSON array with items text, row, col per OLED line.

Example:

```
{
  'timestamp': {'text': '15:53', 'col': 15, 'row': 1},
  'memoryusage': {'text': 'M:20', 'col': 14, 'row': 3},
  'cpuusage': {'text': 'C:0.39', 'col': 6, 'row': 3},
  'internaltemperature': {'text': 'T:39', 'col': 0, 'row': 3}
}
```

Block Diagram

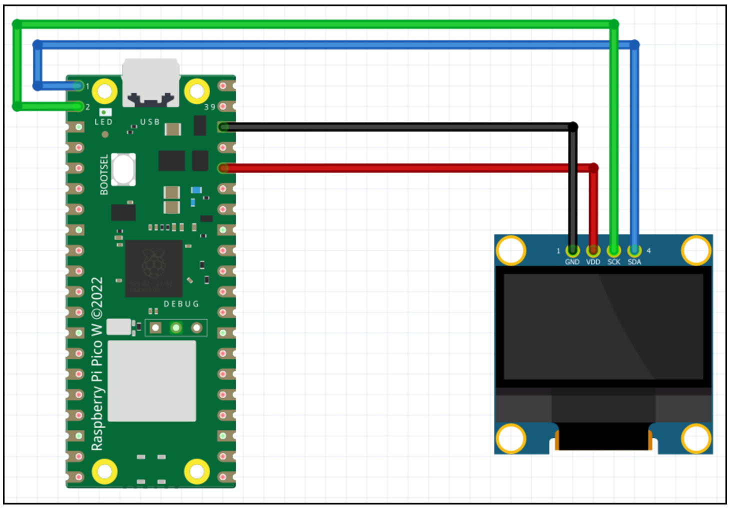


This project can be used as a base for solutions using this OLED display.

Wiring

OLED	Pico W
GND	GND (Pin #38)
VCC	3V3 (Pin #36)
SDA	GP0 (Pin #1)
SCL	GP1 (Pin #2)
I2C Address	0x3C

Circuit Diagram



Domoticz Setup

Devices

The hardware Motherboard sensors is added, and the devices Internal Temperature, CPU Usage and Memory Usage are added.
The other devices from the hardware Motherboard sensors are not used for this project.

After creating the device(s), the Domoticz devices list shows the entries:

```
IDX=26, Hardware=RPi Motherboard, ID=0000044D, Unit=1, Name=CPU Usage,
Type=General, SubType=Percentage, Data=0.43%
IDX=22, Hardware=RPi Motherboard, ID=0000044C, Unit=1, Name=Memory Usage,
Type=General, SubType=Percentage, Data=22.93%
IDX=18, Hardware=RPi Motherboard, ID=0001, Unit=1, Name=Internal Temperature,
Type=Temp, SubType=LaCrosse TX3, Data=38.4 C
```

Automation Script

```
--[[
File:   oled_motherboard.dzvents
Date:   20230323
Author: Robert W.B. Linn

:description
Display selective motherboard information on an OLED display connected to the Pico
W.

:log
2023-03-23 10:04:00.563 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD: ------
Start internal script: picow_oled_motherboard:, trigger: "every minute"
2023-03-23 10:04:00.586 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD:
{["internaltemperature"]={["col"]=0, ["row"]=1, ["text"]="Temp:44C"},
["cpuusage"]={["col"]=0, ["row"]=2, ["text"]="CPU:0.39%"},
["memoryusage"]={["col"]=0, ["row"]=3, ["text"]="Mem:22%"},
["timestamp"]={["col"]=0, ["row"]=0, ["text"]="RPi Info 10:04"}}
2023-03-23 10:04:00.587 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD: ------
Finished picow_oled_motherboard
2023-03-23 10:04:00.587 Status: EventSystem: Script event triggered:
/home/pi/domoticz/dzVents/runtime/dzVents.lua
2023-03-23 10:04:01.084 Status: dzVents: Info: Handling httpResponse-events for:
"RES_PICOW_OLED_MOTHERBOARD"
2023-03-23 10:04:01.084 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD: ------
Start internal script: picow_oled_motherboard: HTTPResponse:
"RES_PICOW_OLED_MOTHERBOARD"
2023-03-23 10:04:01.084 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD:
{["title"]={["cpuusage"]={["col"]=0, ["row"]=2, ["text"]="CPU:0.39%"},
["timestamp"]={["col"]=0, ["row"]=0, ["text"]="RPi Info 10:04"},
["internaltemperature"]={["col"]=0, ["row"]=1, ["text"]="Temp:44C"},
["memoryusage"]={["col"]=0, ["row"]=3, ["text"]="Mem:22%"}}, ["status"]="OK",
["message"]=""}
2023-03-23 10:04:01.084 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD: ------
Finished picow_oled_motherboard
]]--

-- Domoticz
-- For tests the trigger is an switch type onoff
local IDX_SWITCH = 16
--- IDX of the motherboard sensors (devices)
local IDX_INTERNALTEMPERATURE = 18      -- temperature
local IDX_ARMCLOCKSPEED = 19            -- sensorValue
local IDX_V3DCLOCKSPEED = 20            -- sensorValue
local IDX_CORECLOCKSPEED = 21           -- sensorValue
local IDX_MEMORYUSAGE = 22              -- percentage
local IDX_PROCESSUSAGE = 23                    -- sensorValue
local IDX_HDDBOOT = 24                         -- percentage
local IDX_HDD = 25                -- percentage
local IDX_CPUUSAGE = 26                        -- percentage

-- Round a number with digital places
local function round(num, numDecimalPlaces)
  return tonumber(string.format("%." .. (numDecimalPlaces or 0) .. "f", num))
end

-- Create table with keys col, row and text to be displayed on the OLED.
-- For an OLED row 0-3, col 0-15, text length max 16 characters
-- setText(3,0,'Hello World')
local function setText(row,col,text)
    local x = {}
    x['row']=row
    x['col']=col
    x['text']=text
 return x
end
```

```
-- Create table with sensor data for OLEDdisplay
-- setSensor(0,0,'T:',round(domoticz.devices(IDX_INTERNALTEMPERATURE).temperature,
2),'*C')
local function setSensor(row,col,pre,data,unit)
    return setText(row,col,string.format('%s%s%s', pre, tostring(data), unit))
end

-- {["internaltemperature"]={["col"]=5, ["data"]="T:39.4", ["row"]=3},
["cpuusage"]=0.68, ["coreclockspeed"]=500, ["v3dclockspeed"]=250,
["processusage"]=45.06, ["armclockspeed"]=600, ["hdd"]=38.19, ["memoryusage"]=20.9,
["hddboot"]=19.68}

local function getMotherboardData(domoticz)
    local data = {}

    -- row=0, col=0, data=HH:MM len=5, range 0+5=5
 data['timestamp'] = setText(0, 0, string.format('%s%s', 'RPi Info  ',
string.sub(domoticz.time.rawTime, 1, 5)))

    -- row=1, col=0, data=T:NN len=4, range = 0+4=4
    data['internaltemperature'] = setSensor(1, 0, 'Temp:',
round(domoticz.devices(IDX_INTERNALTEMPERATURE).temperature, 0), 'C')
    -- row=2, col=0, data=C:NN.NN len=5, range = 0+5=5
 data['cpuusage']            = setSensor(2, 0, 'CPU:',
round(domoticz.devices(IDX_CPUUSAGE).percentage, 2), '%')
    -- row=3, col=0, data=M:NN len=4, range = 0+4=4
 data['memoryusage']         = setSensor(3, 0, 'Mem:',
round(domoticz.devices(IDX_MEMORYUSAGE).percentage, 0), '%')


    --[[
    data['internaltemperature'] =
round(domoticz.devices(IDX_INTERNALTEMPERATURE).temperature, 2)
 data['armclockspeed']       =
round(domoticz.devices(IDX_ARMCLOCKSPEED).sensorValue, 0)
 data['v3dclockspeed']       =
round(domoticz.devices(IDX_V3DCLOCKSPEED).sensorValue, 0)
 data['coreclockspeed']      =
round(domoticz.devices(IDX_CORECLOCKSPEED).sensorValue, 0)
 data['memoryusage']         = round(domoticz.devices(IDX_MEMORYUSAGE).percentage,
2)
 data['processusage']        =
round(domoticz.devices(IDX_PROCESSUSAGE).sensorValue, 2)
 data['hddboot']             = round(domoticz.devices(IDX_HDDBOOT).percentage, 2)
 data['hdd']                 = round(domoticz.devices(IDX_HDD).percentage, 2)
 data['cpuusage']            = round(domoticz.devices(IDX_CPUUSAGE).percentage, 2)
    ]]--

 -- Test embedding json: r=row 0-3, c=col 0-19, d=data
    --[[
    local x = {}
    x['r']=3
    x['c']=5
    x['d']=string.format('T:%s', tostring(data['internaltemperature']))
 data['temp'] = x
    ]]--
 domoticz.log(data)
 return data
end

-- URL of the Pico W web server
local URL_SERVER      = 'http://picow-ip'

local PROJECT         = 'PICOW_OLED_MOTHERBOARD'
local RES_HTTP        = 'RES_' .. PROJECT
local LOG_MARKER      = 'LOG_' .. PROJECT

local TIMER_RULE = 'every minute'
```

```
return {
    -- Listen to switch device changes and HTTP responses
  on = { devices = { IDX_SWITCH }, timer = { TIMER_RULE }, httpResponses = {
RES_HTTP } },
  logging = { level = domoticz.LOG_INFO, marker = LOG_MARKER },

  execute = function(domoticz, item)
        -- domoticz.log(item)
        if (item.isTimer) then
            domoticz.openURL({
                url = URL_SERVER,
                method = 'POST',
                headers = { ['content-type'] = 'application/json' },
                postData = getMotherboardData(domoticz),
                callback = RES_HTTP,
               })
        end

   if (item.isDevice) then
       domoticz.log(string.format('Device %s state changed to %s', item.name,
item.state), domoticz.LOG_INFO)
            if (item.state == 'On') or (item.state == 'Off') then
                -- Submit remote HTTP POST request to set the OLED display
                domoticz.openURL({
                    url = URL_SERVER,
                    method = 'POST',
                    headers = { ['content-type'] = 'application/json' },
                    postData = getMotherboardData(domoticz),
                    callback = RES_HTTP,
                   })
            end
        end

        -- Handle HTTP response: OK is item statusCode 200 and item.ok true
        -- Else error like statusCode 7, item.ok false
        if (item.isHTTPResponse) then
            -- domoticz.log(string.format("%d %s", item.statusCode, item.ok))
            if (item.statusCode == 200) then
                if (item.isJSON) then
                    -- {["message"]="On", ["title"]="{"state": "on"}",
["status"]="OK"}
                    local data = item.json
                    domoticz.log(data)
                    -- domoticz.log(string.format("LED1 status=%s, title=%s,
message=%s", data.status, data.title, data.message))
                end
            else
                -- Error like 7 false; ERROR 7:Couldn't connect to server
                domoticz.log(string.format("ERROR %d:%s", item.statusCode,
item.statusText))
            end
        end
  end
}
```

Domoticz Log

```
2023-03-23 10:04:00.563 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD: ------
Start internal script: picow_oled_motherboard:, trigger: "every minute"
2023-03-23 10:04:00.586 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD:
{["internaltemperature"]={["col"]=0, ["row"]=1, ["text"]="Temp:44C"},
["cpuusage"]={["col"]=0, ["row"]=2, ["text"]="CPU:0.39%"},
["memoryusage"]={["col"]=0, ["row"]=3, ["text"]="Mem:22%"},
["timestamp"]={["col"]=0, ["row"]=0, ["text"]="RPi Info 10:04"}}
2023-03-23 10:04:00.587 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD: ------
Finished picow_oled_motherboard
2023-03-23 10:04:00.587 Status: EventSystem: Script event triggered:
/home/pi/domoticz/dzVents/runtime/dzVents.lua
2023-03-23 10:04:01.084 Status: dzVents: Info: Handling httpResponse-events for:
"RES_PICOW_OLED_MOTHERBOARD"
2023-03-23 10:04:01.084 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD: ------
Start internal script: picow_oled_motherboard: HTTPResponse:
"RES_PICOW_OLED_MOTHERBOARD"
2023-03-23 10:04:01.084 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD:
{["title"]={["cpuusage"]={["col"]=0, ["row"]=2, ["text"]="CPU:0.39%"},
["timestamp"]={["col"]=0, ["row"]=0, ["text"]="RPi Info 10:04"},
["internaltemperature"]={["col"]=0, ["row"]=1, ["text"]="Temp:44C"},
["memoryusage"]={["col"]=0, ["row"]=3, ["text"]="Mem:22%"}}, ["status"]="OK",
["message"]=""}
2023-03-23 10:04:01.084 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD: ------
Finished picow_oled_motherboard
```

Web Server

Libraries

The MicroPython script uses a modified version of the external OLED library MicroPython SSD1306 OLED driver, I2C and SPI interfaces.
The library is stored on the Pico W in folder lib (see sub chapter Additional Libraries).

Parameter

- A character has size 8px width x 16px height.
- Max char per row is 16, max rows is 4.
- The starting index for the columns and rows is 0.

Credits
Thanks for developing & sharing the OLED library.

MicroPython Script

```
"""
File:oled_motherboard.py
Date:20230323
Author: Robert W.B. Linn

:description
On 0,96inch I2C OLED display connected to the Pico W, display text and selective
RPi motherboard sensor data received from Domoticz.
The Pico W runs a RESTful web server handling incoming data from a Domoticz
Automation event dzVents.
The incoming data is received from a HTTP POST request with JSON object to set the
text.
The JSON object contains for each of the displayed text, col and row.
{'sensor': {'text': 'TEXT', 'col': NN, 'row': N}, ...}
This enables to set the OLED display layout from the Domoticz event.

:log
Domoticz Motherboard v20230323
Init OLED address=60, sda=GP0, scl=GP1
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Network client connected from client-ip
HTTP Command={'timestamp': {'text': 'RPi Info  10:52', 'col': 0, 'row': 0},
'memoryusage': {'text': 'Mem:22%', 'col': 0, 'row': 3}, 'cpuusage': {'text':
'CPU:0.3%', 'col': 0, 'row': 2}, 'internaltemperature': {'text': 'Temp:44C', 'col':
0, 'row': 1}}
HTTP Response={"status": "OK", "title": {"timestamp": {"text": "RPi Info  10:52",
"col": 0, "row": 0}, "memoryusage": {"text": "Mem:22%", "col": 0, "row": 3},
"cpuusage": {"text": "CPU:0.3%", "col": 0, "row": 2}, "internaltemperature":
{"text": "Temp:44C", "col": 0, "row": 1}}, "message": ""}
Network connection closed

:wiring
OLED = Pico W
GND = GND
VCC = 3V3
SCL = GP1 (Pin #2)
SDA = GP0 (Pin #1)
"""

# Libraries
import time
from time import sleep
```

```
from machine import Pin, I2C
import json
# Call server from server.py (must be uploaded to the picow)
from server import Server
# OLED display lib stored in Pico W folder lib
import ssd1306ex
from ssd1306ex import SSD1306_I2C
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config

# Constants
## Name (row 0), Version (row 1), Waiting (row 3) are displayed on the OLED
NAME = 'Domoticz Motherboard'
VERSION = 'v20230323'
WAITING = 'Waiting for data...'
## Title used for the HTTP JSON response to Domoticz key title
TITLE  = 'Set OLED'

def init_oled(Pin_sda=ssd1306ex.PIN_SDA, pin_scl=ssd1306ex.PIN_SCL,
width=ssd1306ex.DISPLAY_WIDTH, height=ssd1306ex.DISPLAY_HEIGHT):
    """
    Create the OLED object. The I2C 0 is used.

    :param int pin_sda

    :param int pin_scl

    :param int width
        Width of the display, default = 128

    :param int height
        Height of the display, default = 64

    :return
        OLED object

    :example
        init_oled()
    """
    try:
        # Init I2C
        i2c = I2C(0, sda=Pin(Pin_sda), scl=Pin(Pin_scl), freq=400000)

        # OLED display with 128px width and 64px height and i2C
        oled = SSD1306_I2C(width, height, i2c)
        print(f'Init OLED address={oled.addr}, sda=GP{pin_sda}, scl=GP{pin_scl}')

        # Return the OLED object
        return oled
    except OSError as e:
        raise RuntimeError('[ERROR] Init OLED: {e}.')

def set_oled_welcome(row1, row2, row3, row4):
    """
    Initial text at col 0 on row 1 to 4.
    """
    oled.text_col_row(row1, 0, 0)
    oled.text_col_row(row2, 0, 1)
    oled.text_col_row(row3, 0, 2)
    oled.text_col_row(row4, 0, 3)
    oled.show()

def set_oled_sensor_text(data, sensor):
    """
    Set the sensor text at col, row
    : param JSON data
        JSON object with keys for col, row and text.

    :param string Sensor
```

```
        String defining the RPi motherboard sensor, i.e. internaltemperature.

    :example
        set_oled_sensor_text('internaltemperature')
    """
    # Get the sensor data
    col = data[sensor]['col']
    row = data[sensor]['row']
    text = data[sensor]['text']
    oled.text_col_row(text, col, row)

def handle_request(cmd, status):
    """
    Handle the OLED command defined as JSON object.
    The command defines for every sensor data the text and the OLED start position
col/row.
    {'timestamp': {'text': 'RPi Info  10:52', 'col': 0, 'row': 0}, 'memoryusage':
{'text': 'Mem:22%', 'col': 0, 'row': 3}, 'cpuusage': {'text': 'CPU:0.3%', 'col': 0,
'row': 2}, 'internaltemperature': {'text': 'Temp:44C', 'col': 0, 'row': 1}}

    :param JSON object
        JSON object with key:value pair {"state":"on" or "off"}

    :status
        If status is 1 set the display else unknown command

    :return JSON object response
    """
    # Assign the command to the response title
    response[config.KEY_TITLE] = cmd

    # If the status is 1 (OK) then set the OLED display with the sensor data.
    if status == 1:
        # Clear the display first
        oled.clear()
        sleep(.1)

        # Set the sensor data (subset only)
        set_oled_sensor_text(cmd, 'timestamp')
        set_oled_sensor_text(cmd, 'internaltemperature')
        set_oled_sensor_text(cmd, 'cpuusage')
        set_oled_sensor_text(cmd, 'memoryusage')
        # Show the text
        oled.show()

        # Set the response
        response[config.KEY_STATE] = config.STATE_OK
        response[config.KEY_MESSAGE] = config.MESSAGE_EMPTY
    else:
        response[config.KEY_STATE] = config.STATE_ERR
        response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN

    # Return the response which is send to Domoticz
    return response

print(f'{NAME} {VERSION}')

# Create the OLED display object
oled = init_oled(ssd1306ex.PIN_SDA, ssd1306ex.PIN_SCL, ssd1306ex.DISPLAY_WIDTH,
ssd1306ex.DISPLAY_HEIGHT)

# Show initial info on the OLED. Waiting is replaced by RPi motherboard sensor data
set_oled_welcome(NAME, VERSION, '', WAITING)

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect()
```

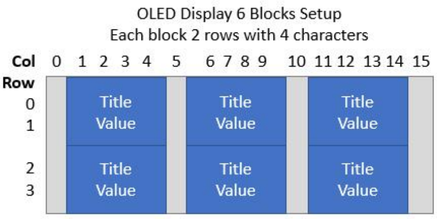
```
"""
Main Loop
"""
while True:
    try:
        # Get client connection and the request data
        cl, request = network.get_client_connection(server)

        # Get the cmd to set the OLED text as JSON object from the POST request
        cmd, status = network.parse_post_request(request)

        # Create the HTTP response JSON object
        response = {}

        # Handle the command to update the OLED text.
        # Set the response
        response = handle_request(cmd, status)

        # Send the response to Domoticz and close the connection (wait for new)
        network.send_response(cl, response, True)

    except OSError as e:
        ledstatus.off()
        cl.close()
        print('[ERROR] Network - Connection closed')
```

Enhancement Ideas

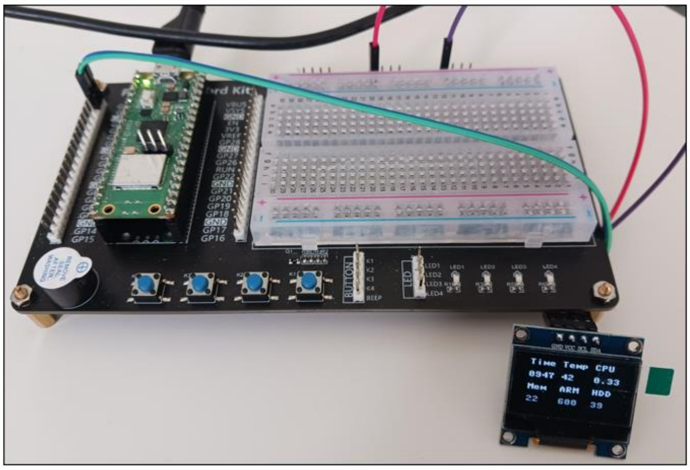
Display Blocks

Display data in 6 blocks Time, Temp, CPU, Mem, ARM, HDD with title & value for the timestamp (block 1) + Raspberry Pi selective Motherboard sensors data (blocks 2-6).

The display is segmented in 6 blocks, 3 top and 3 bottom.
Each block has two rows to show a title and value with max text length of 4 characters.




```
Block Data generated by Domoticz Automation Event.
Example JSON array with 6 blocks:
[
 {'block': 1, 'title': 'Time', 'value': '0947'},
 {'block': 2, 'title': 'Temp', 'value': 42},
 {'block': 3, 'title': 'CPU', 'value': 0.33},
 {'block': 4, 'title': 'Mem', 'value': 22},
 {'block': 5, 'title': 'ARM', 'value': 600},
 {'block': 6, 'title': 'HDD', 'value': 39}
]
```



Pico W with OLED Display showing 6 blocks with RPi Motherboard sensor data

The data, a JSON array, is prepared by Domoticz Automation Event dzVents and submitted via HTTP POST request to the Pico W web server. The Pico W web server sends a response back.

HTTP Request received from Domoticz parsed by the Pico W web server

```
[
{'block': 1, 'title': 'Time', 'value': '1405'},
{'block': 2, 'title': 'Temp', 'value': 42},
{'block': 3, 'title': 'CPU', 'value': 0.45},
{'block': 4, 'title': 'Mem', 'value': 22},
{'block': 5, 'title': 'ARM', 'value': 600},
{'block': 6, 'title': 'HDD', 'value': 39}
]
```

HTTP Response from the Pico W web server to Domoticz (see Domoticz Log)

```
{
"status": "OK",
"title": [{"block": 1, "title": "Time", "value": "1405"}, {"block": 2, "title":
"Temp", "value": 42}, {"block": 3, "title": "CPU", "value": 0.45}, {"block": 4,
"title": "Mem", "value": 22}, {"block": 5, "title": "ARM", "value": 600}, {"block":
6, "title": "HDD", "value": 39}],
"message": ""
}
```

Automation Script

```
--[[
File:   oled_blocks.dzvents
Date:   20230323
Author: Robert W.B. Linn

:description
Set raspberry pi selective motherboard data on an 0,96" I2C OLED display connected
to a Raspberry Pi Pico W ruinning as web server.
The data is submitted to the Pico W as HTTP POST request.
The OLED display has 6 block to display title:value for a motherboard sensor.

Domoticz Log
2023-03-23 14:29:36.115 VirtualSensors: Light/Switch (Pico W LED1 Control)
2023-03-23 14:29:36.109 Status: User: admin initiated a switch command (16/Pico W
LED1 Control/On)
2023-03-23 14:29:36.210 Status: dzVents: Info: Handling events for: "Pico W LED1
Control", value: "On"
2023-03-23 14:29:36.210 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD: ------
Start internal script: picow_oled_blocks: Device: "Pico W LED1 Control
(VirtualSensors)", Index: 16
2023-03-23 14:29:36.210 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD: Device
Pico W LED1 Control state changed to On
2023-03-23 14:29:36.216 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD:
{{["value"]="1429", ["block"]=1, ["title"]="Time"}, {["value"]=43, ["block"]=2,
["title"]="Temp"}, {["value"]=0.7, ["block"]=3, ["title"]="CPU"}, {["value"]=22,
["block"]=4, ["title"]="Mem"}, {["value"]=600, ["block"]=5, ["title"]="ARM"},
{["value"]=39, ["block"]=6, ["title"]="HDD"}}
2023-03-23 14:29:36.216 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD: ------
Finished picow_oled_blocks
2023-03-23 14:29:36.217 Status: EventSystem: Script event triggered:
/home/pi/domoticz/dzVents/runtime/dzVents.lua
2023-03-23 14:29:36.754 Status: dzVents: Info: Handling httpResponse-events for:
"RES_PICOW_OLED_MOTHERBOARD"
2023-03-23 14:29:36.754 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD: ------
Start internal script: picow_oled_blocks: HTTPResponse:
"RES_PICOW_OLED_MOTHERBOARD"
2023-03-23 14:29:36.755 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD:
{["status"]="OK", ["message"]="", ["title"]={{["value"]="1429", ["block"]=1,
["title"]="Time"}, {["value"]=43, ["block"]=2, ["title"]="Temp"}, {["value"]=0.7,
["block"]=3, ["title"]="CPU"}, {["value"]=22, ["block"]=4, ["title"]="Mem"},
{["value"]=600, ["block"]=5, ["title"]="ARM"}, {["value"]=39, ["block"]=6,
["title"]="HDD"}}}
2023-03-23 14:29:36.755 Status: dzVents: Info: LOG_PICOW_OLED_MOTHERBOARD: ------
Finished picow_oled_blocks
]]--

-- URL of the Pico W web server
local URL_PICOW     = 'picow-ip'
local PROJECT       = 'PICOW_OLED_MOTHERBOARD'
local RES_HTTP      = 'RES_' .. PROJECT
local LOG_MARKER    = 'LOG_' .. PROJECT
local TIMER_RULE    = 'every minute'

-- Domoticz
-- For tests the trigger is an switch type onoff
local IDX_SWITCH = 16
--- IDX of the motherboard sensors (devices)
local IDX_INTERNALTEMPERATURE = 18      -- temperature
local IDX_ARMCLOCKSPEED = 19            -- sensorValue
local IDX_V3DCLOCKSPEED = 20            -- sensorValue
local IDX_CORECLOCKSPEED = 21           -- sensorValue
local IDX_MEMORYUSAGE = 22       -- percentage
local IDX_PROCESSUSAGE = 23             -- sensorValue
local IDX_HDDBOOT = 24                                -- percentage
local IDX_HDD = 25                             -- percentage
local IDX_CPUUSAGE = 26                        -- percentage
```

```
-- Round a number with digital places
local function round(num, numDecimalPlaces)
  return tonumber(string.format("%." .. (numDecimalPlaces or 0) .. "f", num))
end

-- Create table with keys block, title, value to be displayed on the OLED.
-- Block numbers are 1 to 6, title and value length max 4 characters
-- setBlock(1,'Title', 123)
local function setBlock(block, title, value)
    local x = {}
    x['block']=block
    x['title']=title
    x['value']=value
 return x
end

-- Create a json array with sensor data to display on the oled in block 1-6
--- {["title"]={{["block"]=1, ["title"]="Time", ["value"]="1353"}, {["block"]=2,
["title"]="Temp", ["value"]=42}, {["block"]=3, ["title"]="CPU", ["value"]=0.48},
{["block"]=4, ["title"]="Mem", ["value"]=22}, {["block"]=5, ["title"]="ARM",
["value"]=600}, {["block"]=6, ["title"]="HDD", ["value"]=39}}, ["status"]="OK",
["message"]=""}
local function setMotherboardData(domoticz)
    local data = {}
    t = string.sub(domoticz.time.rawTime, 1, 5)
    t = string.gsub(t, ':','')
 data[1] = setBlock(1, 'Time', t)
    data[2] = setBlock(2, 'Temp',
round(domoticz.devices(IDX_INTERNALTEMPERATURE).temperature, 0))
 data[3] = setBlock(3, 'CPU', round(domoticz.devices(IDX_CPUUSAGE).percentage, 2))
 data[4] = setBlock(4, 'Mem', round(domoticz.devices(IDX_MEMORYUSAGE).percentage,
0))
 data[5] = setBlock(5, 'ARM',
round(domoticz.devices(IDX_ARMCLOCKSPEED).sensorValue, 0))
 data[6] = setBlock(6, 'HDD', round(domoticz.devices(IDX_HDD).percentage, 0))

    --[[
    data['internaltemperature'] =
round(domoticz.devices(IDX_INTERNALTEMPERATURE).temperature, 2)
 data['armclockspeed']       =
round(domoticz.devices(IDX_ARMCLOCKSPEED).sensorValue, 0)
 data['v3dclockspeed']       =
round(domoticz.devices(IDX_V3DCLOCKSPEED).sensorValue, 0)
 data['coreclockspeed']      =
round(domoticz.devices(IDX_CORECLOCKSPEED).sensorValue, 0)
 data['memoryusage']         = round(domoticz.devices(IDX_MEMORYUSAGE).percentage,
2)
 data['processusage']        =
round(domoticz.devices(IDX_PROCESSUSAGE).sensorValue, 2)
 data['hddboot']             = round(domoticz.devices(IDX_HDDBOOT).percentage, 2)
 data['hdd']                 = round(domoticz.devices(IDX_HDD).percentage, 2)
 data['cpuusage']            = round(domoticz.devices(IDX_CPUUSAGE).percentage, 2)
    ]]--
 domoticz.log(data)
 return data
end

local function submitRequest(domoticz)
    domoticz.openURL({
        url = URL_PICOW, method = 'POST',
        headers = { ['content-type'] = 'application/json' },
        postData = setMotherboardData(domoticz), callback = RES_HTTP,
       })
end

return {
 on = { devices = { IDX_SWITCH }, timer = { TIMER_RULE }, httpResponses = {
RES_HTTP } },
```

```
  logging = { level = domoticz.LOG_INFO, marker = LOG_MARKER },
  execute = function(domoticz, item)
    if (item.isTimer) then submitRequest(domoticz) end
   if (item.isDevice) then
       domoticz.log(string.format('Device %s state changed to %s', item.name, 
item.state))
       if (item.state == 'On') or (item.state == 'Off') then 
submitRequest(domoticz) end
    end
    -- Handle HTTP response: OK is item statusCode 200 and item.ok true
    -- Else error like statusCode 7, item.ok false
    if (item.isHTTPResponse) then
      -- domoticz.log(string.format("%d %s", item.statusCode, item.ok))
      if (item.statusCode == 200) then
        if (item.isJSON) then
          -- {["message"]="On", ["title"]="{"state": "on"}", ["status"]="OK"}
          local data = item.json
          domoticz.log(data)
        end
      else
        -- Error like 7 false; ERROR 7:Couldn't connect to server
        domoticz.log(string.format("ERROR %d:%s", item.statusCode, item.statusText))
      end
    end
  end
}
```

MicroPython Script

```
"""
File:oled_motherboard_block.py
Date:20230324
Author: Robert W.B. Linn

:description
On 0,96inch I2C OLED display connected to the Pico W, display text and selective
RPi motherboard sensor data received from Domoticz.
The Pico W runs a RESTful web server handling incoming data from a Domoticz
Automation event dzVents.
The incoming data is received from a HTTP POST request with JSON object to set the
text.
The JSON object contains for each of the displayed sensor data the block number,
title and value.
[{'block': 1, 'title': 'Time', 'value': '1403'}, {'block': 2, 'title': 'Temp',
'value': 42}, {'block': 3, 'title': 'CPU', 'value': 0.37}, {'block': 4, 'title':
'Mem', 'value': 22}, {'block': 5, 'title': 'ARM', 'value': 600}, {'block': 6,
'title': 'HDD', 'value': 39}]
This enables to set the OLED display layout from the Domoticz event.

:log
Domoticz Motherboard v20230323
Init OLED address=60, sda=GP0, scl=GP1
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Network client connected from client-ip
HTTP Command=[{'block': 1, 'title': 'Time', 'value': '1405'}, {'block': 2, 'title':
'Temp', 'value': 42}, {'block': 3, 'title': 'CPU', 'value': 0.45}, {'block': 4,
'title': 'Mem', 'value': 22}, {'block': 5, 'title': 'ARM', 'value': 600}, {'block':
6, 'title': 'HDD', 'value': 39}]
HTTP Response={"status": "OK", "title": [{"block": 1, "title": "Time", "value":
"1405"}, {"block": 2, "title": "Temp", "value": 42}, {"block": 3, "title": "CPU",
"value": 0.45}, {"block": 4, "title": "Mem", "value": 22}, {"block": 5, "title":
"ARM", "value": 600}, {"block": 6, "title": "HDD", "value": 39}], "message": ""}
Network connection closed

:wiring
OLED = Pico W
GND = GND
VCC = 3V3
SCL = GP1 (Pin #2)
SDA = GP0 (Pin #1)
"""

# Libraries
import time
from time import sleep
from machine import Pin, I2C
import json
# Call server from server.py (must be uploaded to the picow)
from server import Server
# OLED display lib stored in Pico W folder lib
import ssd1306ex
from ssd1306ex import SSD1306_I2C
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config

# Constants
## Name (row 0), Version (row 1), Waiting (row 3) are displayed on the OLED
NAME = 'Domoticz Motherboard'
VERSION = 'v20230324'
WAITING = 'Waiting for data...'
## Title used for the HTTP JSON response to Domoticz key title
TITLE  = 'Set OLED'
```

```
def init_oled(Pin_sda=ssd1306ex.PIN_SDA, pin_scl=ssd1306ex.PIN_SCL,
width=ssd1306ex.DISPLAY_WIDTH, height=ssd1306ex.DISPLAY_HEIGHT):
    """
    Create the OLED object. The I2C 0 is used.

    :param int pin_sda

    :param int pin_scl

    :param int width
        Width of the display, default = 128

    :param int height
        Height of the display, default = 64

    :return
        OLED object

    :example
        init_oled()
    """
    try:
        # Init I2C
        i2c = I2C(0, sda=Pin(Pin_sda), scl=Pin(Pin_scl), freq=400000)

        # OLED display with 128px width and 64px height and i2C
        oled = SSD1306_I2C(width, height, i2c)
        print(f'Init OLED address={oled.addr}, sda=GP{pin_sda}, scl=GP{pin_scl}')

        # Return the OLED object
        return oled
    except OSError as e:
        raise RuntimeError('[ERROR] Init OLED: {e}.')

def handle_request(cmd, status):
    """
    Handle the OLED command defined as JSON object.
    The command defines for every sensor data the text and the OLED start position
col/row.
    {'timestamp': {'text': 'RPi Info  10:52', 'col': 0, 'row': 0}, 'memoryusage':
{'text': 'Mem:22%', 'col': 0, 'row': 3}, 'cpuusage': {'text': 'CPU:0.3%', 'col': 0,
'row': 2}, 'internaltemperature': {'text': 'Temp:44C', 'col': 0, 'row': 1}}

    :param JSON object
        JSON object with key:value pair {"state":"on" or "off"}

    :status
        If status is 1 set the display else unknown command

    :return JSON object response
    """
    # Assign the command to the response title
    response[config.KEY_TITLE] = cmd

    # If the status is 1 (OK) then set the OLED display with the sensor data.
    if status == 1:
        # Clear the display first
        oled.clear()
        sleep(.1)

        # Set the sensor data in the text blocks 1-6
        for item in cmd:
            oled.text_block(item['block'],item['title'],item['value'])

        # Show the text blocks
        oled.show()

        # Set the response
        response[config.KEY_STATE] = config.STATE_OK
```

```
        response[config.KEY_MESSAGE] = config.MESSAGE_EMPTY
    else:
        response[config.KEY_STATE] = config.STATE_ERR
        response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN

    # Return the response which is send to Domoticz
    return response

print(f'{NAME} {VERSION}')

# Create the OLED display object
oled = init_oled(ssd1306ex.PIN_SDA, ssd1306ex.PIN_SCL, ssd1306ex.DISPLAY_WIDTH,
ssd1306ex.DISPLAY_HEIGHT)

# Show initial info on the OLED. Waiting is replaced by RPi motherboard sensor data
oled.text_rows(NAME, VERSION, '', WAITING)

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect()

"""
Main Loop
"""
while True:
    try:
        # Get client connection and the request data
        cl, request = network.get_client_connection(server)

        # Get the cmd to set the OLED text as JSON object from the POST request
        cmd, status = network.parse_post_request(request)

        # Create the HTTP response JSON object
        response = {}

        # Handle the command to update the OLED text.
        # Set the response
        response = handle_request(cmd, status)

        # Send the response to Domoticz and close the connection (wait for new)
        network.send_response(cl, response, True)

    except OSError as e:
        ledstatus.off()
        cl.close()
        print('[ERROR] Network - Connection closed')
```

PIR Motion Sensor

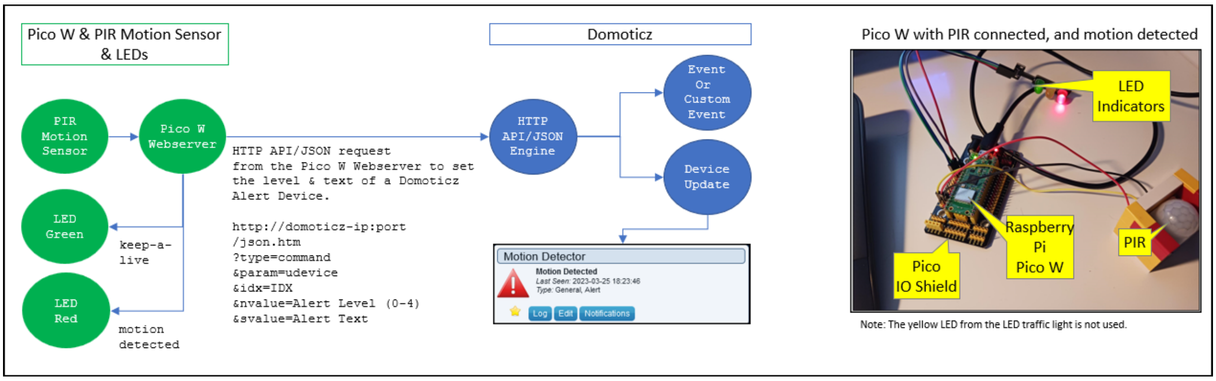
Description

This project detects motion and sends a message to a Domoticz Alert sensor.

Solution

The Pico W has a Passive Infrared (PIR) sensor connected and listens to an interrupt assigned to the PIR sensor signal pin. The Pico W runs as a web server.
If a motion is detected, an HTTP API/JSON request is sent to Domoticz to set for an Alert Device the Level to 4 and the Text "Motion Detected".
Also, a RED LED is blinking for a second.
In addition, a GREEN LED is blinking every 5 seconds to indicate the motion detector is working.

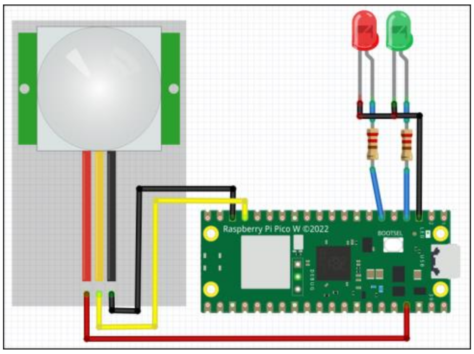
Block Diagram



Wiring

PIR	**Pico W**
VCC	3V3 (Pin #36)
Signal	GP13 (Pin #1)
GND	GND (Pin #38)
LED RED	
+	GP2 (Pin #4)
LED GREEN	
+	GP4 (Pin #6)

Circuit Diagram



Domoticz Setup

Devices

From the hardware "Dummy", create an Alert device:
Name: Motion Detector, Sensor Type: Alert

After creating the device, the Domoticz devices list shows the entry:

```
IDX=7, Hardware=VirtualSensors, ID=82007, Unit=1, Name=Motion Detector,
Type=General, SubType=Alert, Data=Motion Detected
```

Automation Script

No automation event used, but if additional action(s) required in case motion is detected, then for example an Event with trigger “Device Change” could be used.

```
--[[
File: pir_motion_sensor.dzvents
Date: 20230326
Author: Robert W.B. Linn

:description
Listen to PIR motion device changes
]]--

-- Alert device
IDX_ALERT = 7

return {
    -- Listen to device changes.
 on = { devices = { IDX_ALERT } },
 logging = { level = domoticz.LOG_INFO, marker = 'PIR', },
 execute = function(domoticz, device)
  domoticz.log(string.format('Device %s - Motion detected.', device.name))
 end
}
```

Web Server

Libraries

No dedicated PIR library used.

MicroPython Script

```
"""
File:pir-motion-detection.py
Date:20230325
Author: Robert W.B. Linn

:description
Pico W RESTful web server listening if a motion is detected.
If a motion is detected, an HTTP API/JSON request is send to Domoticz to set an the
Level and Text for an Alert Device.
Also a RED LED is blinking for a sec. In addition a GREEN LED is on every 5 seconds
to indicate the motion detector is working.
Example: Motion detected sets alert level 4 with text "Motion detected".

:log
pir-motion-detection v20230326
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Motion detected!
Send GET request url=http://domoticz-
ip:port/json.htm?type=command&param=udevice&idx=7&nvalue=4&svalue=Motion Detected
Send GET request status=OK
"""

# Libraries
import network
import socket
import time
from machine import Pin
# Server class from server.py
from server import Server
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config

# Constants
NAME = 'pir-motion-detection'
VERSION = 'v20230326'

# Domoticz alert sensor
URL_DOM_ALERT_DEVICE = 'http://' + config.DOMOTICZ_IP +
'/json.htm?type=command&param=udevice&idx={IDX}&nvalue={LEVEL}&svalue={TEXT}'
IDX_ALERT_DEVICE = 7
ALERT_LEVEL = 4
ALERT_TEXT = 'Motion Detected'

# Motion detection duration (red led blinking): 1s = 10 cycles a 100ms
MOTION_DETECTION_DURATION = 10

# Create LED objects
# LED RED GPIO2 indicated motion detected (blinking)
led_red = machine.Pin(2, machine.Pin.OUT)
led_red.value(0)
# LED GREEN GPIO4 indicates motion detection process running
led_green = machine.Pin(4, machine.Pin.OUT)
led_green.value(0)

# Set GPIO13 PIR_Interrupt as input
sensor_pir=Pin(13, Pin.IN, Pin.PULL_UP)
```

```
# Handle motion detection triggered by the interrupt
def pir_handler(Pin):
    print("Motion detected!")
    url = URL_DOM_ALERT_DEVICE
    url = url.replace('{IDX}', str(IDX_ALERT_DEVICE))
    url = url.replace('{LEVEL}', str(ALERT_LEVEL))
    url = url.replace('{TEXT}', str(ALERT_TEXT))

    network.send_get_request(url)

    # Let red led blink for a sec
    for i in range(MOTION_DETECTION_DURATION):
        led_red.toggle()
        time.sleep_ms(100)
    led_red.value(0)

# Attach external interrupt to GPIO13 and rising edge as an external event source
sensor_pir.irq(trigger=machine.Pin.IRQ_RISING, handler=pir_handler)

"""
Handle Request
"""
def handle_request(cmd):
    print(f'NOT USED')

"""
Main
"""
print(f'{NAME} {VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD)
# Connect to the network and get the server object
server = network.connect()

while True:
    led_green.toggle()
    time.sleep(5)
```

BMP280 Temperature + Barometer

Description

This project reads in regular intervals, from a Bosch BMP280 environmental sensor, the temperature (°C) & barometric pressure (hPa) and sends the data to a Domoticz Temp+Baro device.

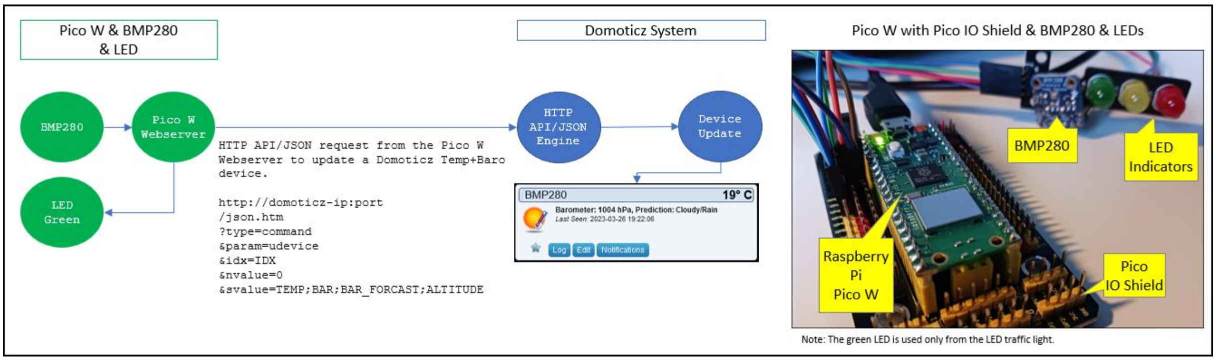
Ideas for Use

- Mini weather station,
- Room temperature control.

Solution

The Pico W has a BMP280 pressure & temperature sensor and LED connected and runs as a web server.
The web server reads in regular intervals the temperature & barometric pressure and sends the data via Domoticz HTTP API/JSON request to a Domoticz Temp+Baro device.

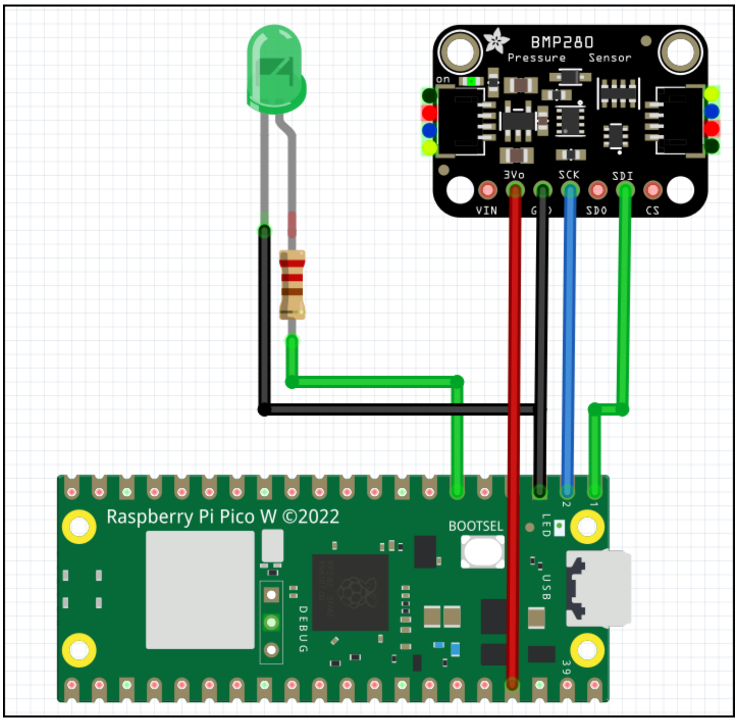
Block Diagram



Wiring

BMP280	**Pico W**
VCC	3V3 (Pin #36)
GND	GND (Pin #28)
SDI	GP0 (Pin #1)
SCK	GP1 (Pin #2)
LED (green)	**Pico W**
+ (Anode)	GP4 (Pin #6)
GND (Cathode)	GND (Pin #38)

Circuit Diagram



Domoticz Setup

Devices

From the hardware "Dummy", create a Temp+Baro device:
Name: BMP280, Sensor Type: Temp+Baro

After creating the device, the Domoticz devices list shows the entry:

```
IDX=29, Hardware=VirtualSensors, ID=1406D, Unit=1, Name=BMP280, Type=Temp + Baro,
SubType=BMP085 I2C, Data=32.0 C, 1004.0 hPa
```

Automation Script

No automation event used, but if additional action(s) required in case device has changed, then for example an Event with trigger “Device Change” be used.

```
--[[
File:   bmp280.dzvents
Date:   20230418
Author: Robert W.B. Linn

:description
Listen to bmp280 device changes. No action defined.
]]--

-- BMP280 device IDX
IDX_BMP280 = 29

return {
  -- Listen to device changes.
 on = { devices = { IDX_BMP280 } },
 logging = { level = domoticz.LOG_INFO, marker = 'BMP280', },
 execute = function(domoticz, device)
     -- domoticz.log(device)
   domoticz.log(string.format('Device %s has changed. New state %s', device.name,
device.state))
 end
}
```

Web Server

Libraries

The MicroPython script uses external the MicroPython BMP280 library.
The library is stored on the Pico W in folder lib (see sub chapter Additional Libraries).

Credits
Thanks for developing & sharing the micropython-bmp280 library.

MicroPython Script

```
"""
File:   bmp280.py
Date:   20230327
Author: Robert W.B. Linn

:description
Read in regular intervals the BMP280 temperature and barometric pressure and update
a Domoticz Temp+Baro device.
The Domoticz devices are updated using HTTP API/JSON POST request Custom Event to
the Domoticz server.

:log
BMP280 v20230326
Sampling Rate: 60s.
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
BMP280 t=24,p=101340.5,hpa=1013,bar=1.013404,mmhg=760.1157,svalue=24;1013;0;0
Send GET request url=http://domoticz-
ip:port/json.htm?type=command&param=udevice&idx=29&nvalue=0&svalue=24;1013;0;0
Send GET request status=OK
"""

# Imports
from machine import Pin,I2C
from utime import sleep
# BMP280
from bmp280 import *
# Call server from server.py (must be uploaded to the picow)
from server import Server
# Configuration (must be uploaded to the picow)
import config

# Constants
VERSION = 'BMP280 v20230326'

# Create the led object (GP4, Pin #6) indicating bmp280 measurement in progress
led_green = Pin(4, Pin.OUT)
led_green.value(0)

# BMP280 SCK & SDA Pins and address
BMP_PIN_SDI = 0
BMP_PIN_SCK = 1
BMP_ADDR = 0x77
# BMP280 measurement sampling rate in seconds
SAMPLING_RATE = 60
# BMP280 IDX of the Domoticz Temp+Baro device
IDX_TEMP_BARO = 29
# URL Domoticz
# Note the idx of the domoticz device ( see GUI > Setup > Devices)
# The svalue is added in the main loop after getting the data from the BMP280.
# The svalue format: TEMP;BAR;BAR_FOR;ALTITUDE
```

```
URL_DOM = "http://"+ config.DOMOTICZ_IP
+"/json.htm?type=command&param=udevice&idx={IDX}&nvalue=0&svalue={SVALUE}"

# Create the bmp280 sensor object
# Init the bus with GP0 (SDA) and GP1 (CLK)
bus = I2C(0, scl=Pin(BMP_PIN_SCK), sda=Pin(BMP_PIN_SDI), freq=200000)
# Create the bmp280 object with address 0x77. The default address 0x76 gives error
OSError: [Errno 5] EIO
bmp = BMP280(bus, addr=BMP_ADDR)
# The use case is indoor
bmp.use_case(BMP280_CASE_INDOOR)

"""
Set the barometer forecast depending pressure.

:param int pressure

:return int forecast
    0=Stable,1=Sunny,2=Cloudy,3=Unstable,4=Thunderstorm,5=Unknown,6=Cloudy/Rain
"""
def barometer_forecast(pressure):
    if pressure < 966:
        return 4 # THUNDERSTORM
    elif pressure < 993:
        return 2 # CLOUDY
    elif pressure < 1007:
        return 6 # PARTLYCLOUDY
    elif pressure < 1013:
        return 3 # UNSTABLE
    elif pressure < 1033:
        return 0 # STABLE
    else:
        return 5 # Unknown

"""
BMP280 measurement with rounded values for temperature and pressure.
During measurement, the green led is on.

:return string svalue
    svalue with TEMP;BAR;BAR_FOR;ALTITUDE

:example svalue
    19;1004;6;0
"""
def get_bmp280_data():
    led_green.value(1)
    sleep(1)
    # print(f'BMP280 measuring...')
    temperature = round(bmp.temperature)
    pressure    = bmp.pressure
    p_pa   = pressure
    p_hpa  = round(pressure/100)
    p_bar  = pressure/100000
    p_mmHg  = pressure/133.3224
    forecast = barometer_forecast(p_hpa)

    # Set the svalue, i.e. svalue=TEMP;BAR;BAR_FOR;ALTITUDE
    svalue = str(temperature) + ';' + str(p_hpa) + ';' + str(forecast) + ';' +
str(0)
    print(f"BMP280
t={temperature},p={p_pa},hpa={p_hpa},bar={p_bar},mmhg={p_mmHg},svalue={svalue}")

    # Return the svalue
    led_green.value(0)
    return svalue

# Info
print(f'{VERSION}')
print(f'Sampling Rate: {SAMPLING_RATE}s.')
```

```
# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect()

# Domoticz url
url = URL_DOM
url = url.replace('{IDX}', str(IDX_TEMP_BARO))

# Main
while True:
    # Measure & submit BMP280 data to Domoticz
    network.send_get_request(url = url.replace('{SVALUE}', get_bmp280_data()))
    # Delay till next sample
    sleep(SAMPLING_RATE)
```

Potentiometer Dimmer

Description

This project enables to set the level 0-100% of a Domoticz Dimmer switch via potentiometer connected to the Pico W running as a web server.

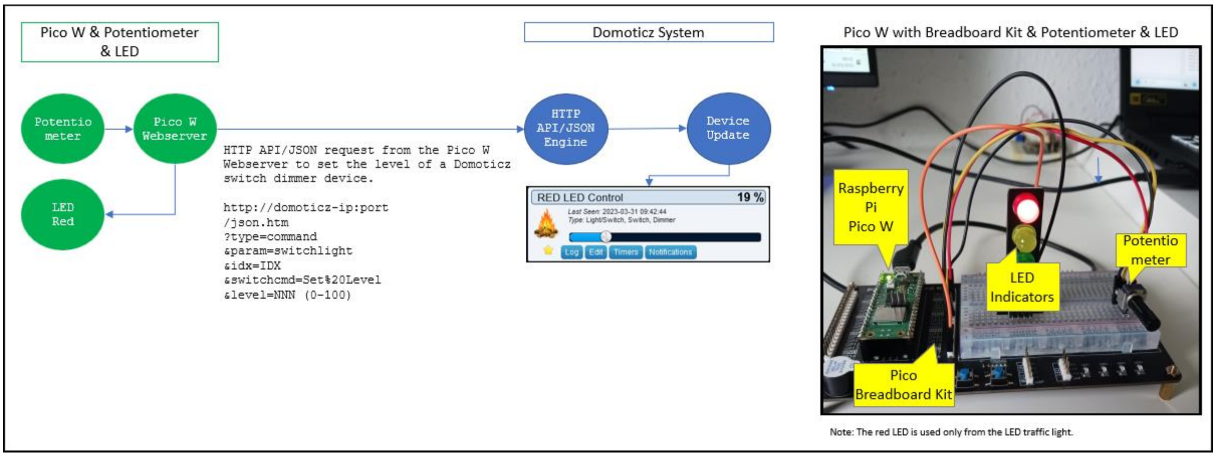
Ideas for Use

- Control lights

Solution

The Pico W has a potentiometer and LED connected and runs as a web server.
The web server listens to potentiometer signal changes and sends the converted potentiometer signal via Domoticz HTTP API/JSON request to a Domoticz dimmer device (Type Light/Switch, Subtype Switch) to set the level between 0-100%.

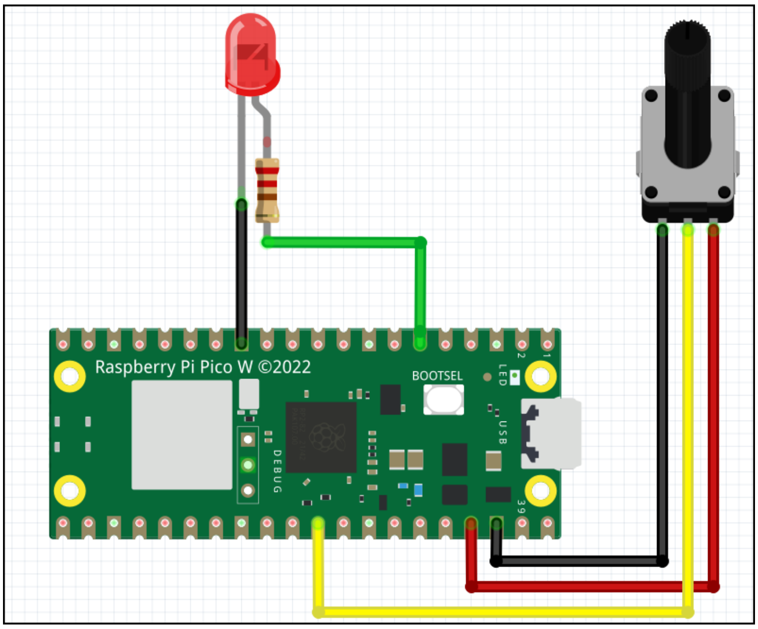
Block Diagram



Wiring

Potentiometer	Pico W
VCC	3V3 (Pin #36)
GND	GND (Pin #28)
Signal	GP26 (Pin #31, ADC0)
LED (red)	**Pico W**
+ (Anode)	GP16 (Pin #6)
GND (Cathode)	GND (Pin #21)

Circuit Diagram



Domoticz Setup

Devices

Create a virtual sensor, hardware dummy, named Dimmer from sensor type Switch/Light.

After creating the device, the Domoticz devices list shows the entry:

```
Idx=1, Hardware=VirtualSensors, ID=00014051, Unit=1, Name=Dimmer,
Type=Light/Switch, SubType=Switch, Data=Off
```

The switch type Dimmer is set in the Switch device properties (edit the widget).

Automation Event

No automation event used, but if additional action(s) required in case device has changed, then for example an Event with trigger “Device Change” be used.

Web Server

Libraries

No additional libraries used, beside the server and the config script.

MicroPython Script

```
"""
File:potmeterdimmer.py
Date:20230330
Author: Robert W.B. Linn

:description
To dim a Domoticz dimmer switch.
The Domoticz device is updated using HTTP API/JSON request to the Domoticz server.

:notes
Pico Breadboard Kit is used to wire up the potmeter.
Configuration stored in config.py, ensure to upload to the picow.

:log
PotMeterDimmer v20230330
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
value=11026, level=17, prev_level=-1, abs=18
Send GET request url=http://domoticz-
ip:port/json.htm?type=command&param=switchlight&idx=1&switchcmd=Set%20Level&level=1
7
Send GET request status=OK
value=224, level=0, prev_level=17, abs=17
Send GET request url=http://domoticz-
ip:port/json.htm?type=command&param=switchlight&idx=1&switchcmd=Set%20Level&level=0
Send GET request status=OK

:wiring
PotMeter = Pico W
VCC (+) = VBUS (Pin #40)
OUT = GP26 (Pin #31, ADC0)
GND (-) = GND (Pin #28)

LED = Pico W
+ (Anode) = GP16 (Pin #21)
"""

# Imports
from machine import Pin, ADC, PWM
from utime import sleep
# Call server from server.py (must be uploaded to the picow)
from server import Server
# Configuration (must be uploaded to the picow)
import config

# Constants
VERSION = 'PotMeterDimmer v20230330'

# Dimmer min max range using offsets
DIMMER_MAX = const(65500)  # 65535
DIMMER_MIN = const(250)          # 0

# Helper to map the PWM range to 0-100%
def mapRange(value, inMin, inMax, outMin, outMax):
    return outMin + (((value - inMin) / (inMax - inMin)) * (outMax - outMin))

# Create ADC0 object GP26
```

```
adc0 = ADC(0)

# Create PWM LED GP16 to control the dimmer level 0-100%
pwmled = PWM(Pin(16, Pin.OUT))
pwmled.freq(1000)

# IDX of the Domoticz Dimmer Switch device
IDX_DIMMER = 1
# URL Domoticz
# Note the idx of the domoticz device ( see GUI > Setup > Devices)
# /json.htm?type=command&param=switchlight&idx=99&switchcmd=Set%20Level&level=6
URL_DOM =
'http://'+config.DOMOTICZ_IP+'/json.htm?type=command&param=switchlight&idx='+str(ID
X_DIMMER)+'&switchcmd=Set%20Level&level='

# Por meter noise level 2%
NOISE_LEVEL = 2
# Keep the previous level
prev_level = -1

"""
Get the dimmer level between 0-100.

:return int level
    level between 0-100

:example
    18
"""
def set_dimmer_level():
    global prev_level

    # Read ADC0
    # Noise reduction: Not used but either LSB divide (adc0.read_u16() >> 2) or
remove (adc0.read_u16() & 0b1111111111111100)
    value = adc0.read_u16()

    # Map the potmeter range to 0-100
    level = round(mapRange(value, DIMMER_MIN, DIMMER_MAX, 0, 100))

    # Check if the abs value between the current and prev reading is greater noise
level
    if abs(prev_level - level) > NOISE_LEVEL:
        print(f'value={value}, level={level}, prev_level={prev_level},
abs={abs(level - prev_level)}')

        # Set PWM-Duty-Cycle = brightness of the control LED
        pwmled.duty_u16(value)

        # Keep the prev level
        prev_level = level

        # Submit Domoticz HTTP API/JSON GET request to update the device
        network.send_get_request(URL_DOM + str(level))
        sleep(0.5)

# Info
print(f'{VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect()

# Main
while True:
    # Listen to potmeter changes & set domoticz dimmer to 0-100%
    set_dimmer_level()
```

DS18B20 Temperature (Push)

Description

This project reads in regular intervals the temperature (°C), from DS18B20 1-wire digital thermometer sensors and sends (push) the data to Domoticz Temperature device(s).

Ideas for Use

- Mini weather station,
- Room temperature control.

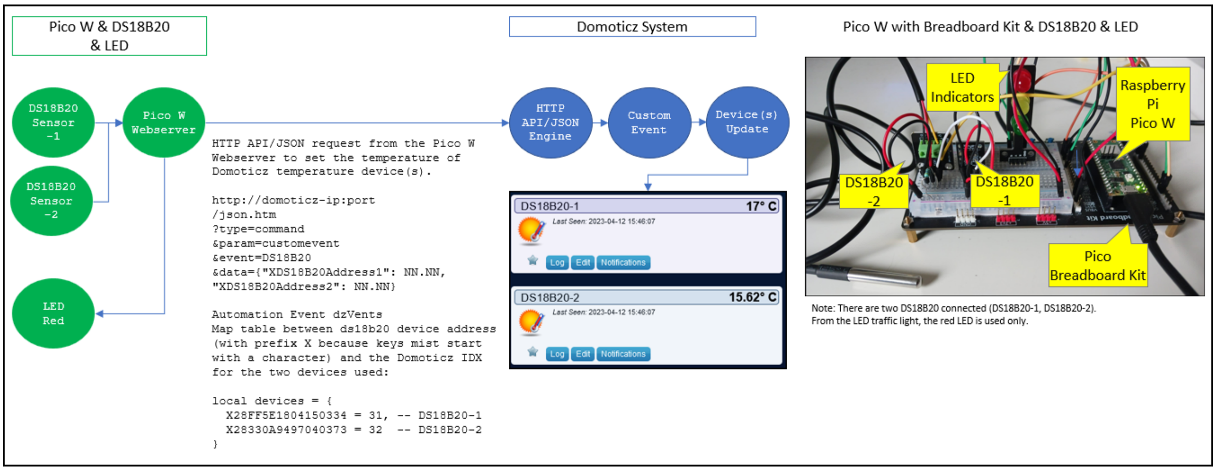
Solution

The Pico W has two DS18B20 sensors and an LED connected and runs as a web server. The web server reads in regular intervals the temperature and sends the data via Domoticz HTTP API/JSON request to Domoticz Temperature device(s).

The two DS18B20 sensors are:

- Keyes DS18B20 sensor (address 28FF5E1804150334)
- Oumefar Digital Temperature DS18B20 sensor (address 28330A9497040373)

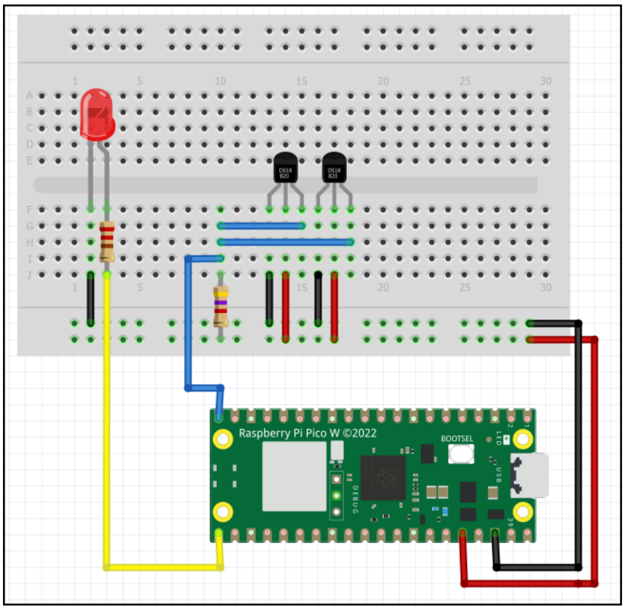
Block Diagram



Wiring

DS18B20 (2x)	**Pico W**
VCC	3V3 (Pin #36)
GND	GND (Pin #28)
Data	GP15 (Pin #20)
The wiring applies to the two DS18B20 sensors.	
LED (green)	**Pico W**
+ (Anode)	GP4 (Pin #6)
GND (Cathode)	GND (Pin #38)

Circuit Diagram



Domoticz Setup

Devices

From the hardware “Dummy”, create a Temperature device:
Name: DS18B20-1, Sensor Type: Temperature
Do the same if more DS18B20 devices, i.e.
Name: DS18B20-2, Sensor Type: Temperature

After creating the device(s), the Domoticz devices list shows the entries:

```
IDX=31, Hardware=VirtualSensors, ID=1406F, Unit=1, Name=DS18B20-1, Type=Temp,
SubType=LaCrosse TX3, Data=0.0 C
IDX=32, Hardware=VirtualSensors, ID=14070, Unit=1, Name=DS18B20-2, Type=Temp,
SubType=LaCrosse TX3, Data=0.0 C
```

Automation Script

A custom event handles updating the Domoticz temperature devices.
The event receives data as JSON array with key:value pairs:

```
device address : temperature

Example
{'X28FF5E1804150334': 16.5, 'X28330A9497040373': 15.25}
```

The DS18B20 device address has a prefix X to get handled by the custom event devices table.

```
--[[
File:   ds18b20_customevent.dzvents
Date:   20230412
Author: Robert W.B. Linn

:description
Listen to picow webserver request custom event command and update the temp devices
assigned to the ds18b20 device(s).

:log
023-04-12 15:42:03.651 Status: dzVents: Info: Handling Domoticz custom event for:
"DS18B20"
2023-04-12 15:42:03.652 Status: dzVents: Info: ------ Start internal script:
ds18b20_customevent: Custom event: "DS18B20"
2023-04-12 15:42:03.653 Status: dzVents: Info: d=X28FF5E1804150334, t=16.75
2023-04-12 15:42:03.678 Status: dzVents: Info: d=X28330A9497040373, t=15.50
2023-04-12 15:42:03.679 Status: dzVents: Info: ------ Finished ds18b20_customevent
2023-04-12 15:42:03.680 Status: EventSystem: Script event triggered:
/home/pi/domoticz/dzVents/runtime/dzVents.lua
]]--

-- Custom event name as used by the PicoW webserver HTTP API/JSON POST request
local CUSTOM_EVENT_NAME = 'DS18B20'

-- Define map table between ds18b20 device address (with prefix X because keys must
start with a character) and the domoticz idx
local devices = {
    X28FF5E1804150334 = 31, -- DS18B20-1
    X28330A9497040373 = 32  -- DS18B20-2
}

-- Update the devices by looping over the Lua table containing address &
temperature
local function updateDevices(domoticz, data)
    for k,v in pairs(data) do
        -- d=X28FF5E1804150334, t=16.75
        -- d=X28330A9497040373, t=15.50
        domoticz.log(string.format('d=%s, t=%0.2f', k, v))
        -- Select the device and update
        domoticz.devices(devices[k]).updateTemperature(v)
    end
end

return {
 on = { customEvents = { CUSTOM_EVENT_NAME } },
 execute = function(domoticz, triggeredItem)
  if (triggeredItem.isCustomEvent) then
       -- Check the custom event name in case there are more custom events
       if (triggeredItem.trigger == CUSTOM_EVENT_NAME) then
        -- domoticz.log(triggeredItem.data)
        local data = triggeredItem.json
        updateDevices(domoticz, data)
       end
  end
```

```
  end
}
```

Web Server

Libraries

The MicroPython script uses the MicroPython internal libraries OneWire and DS18X20.

MicroPython Script

```
"""
File:ds18b20_customevent.py
Date:20230412
Author: Robert W.B. Linn

:description
Read in regular intervals the temperature of two DS18B20 devices and update the
temperature of the Domoticz devices named DS18B20-1, DS18B20-2.
Each DS18B20 has an unique 8-byte address, like 28 FF 5E 18 04 15 03 34.
The two DS18B20 sensors are:
* Keyes DS18B20 sensor (address 28FF5E1804150334)
* Oumefar Digital Temperature DS18B20 sensor (address 28330A9497040373)

The Domoticz devices are updated from a Domoticz Custom Event (dzVents) triggered
by a HTTP API/JSON CustomEvent request to the Domoticz server.
Example:
http://domoticz-
ip:port/json.htm?type=command&param=customevent&event=DS18B20&data={'X28FF5E1804150
334': 16.5, 'X28330A9497040373': 15.25}

:notes
Pico Breadboard Kit is used to wire up the DS18B20.
Configuration stored in config.py, ensure to upload to the picow.
DS18B20 measures every 60 seconds.

:log
DS18B20 v20230412
Sampling Rate: 60s.
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
One-Wire Devices found: 2
Device: 28FF5E1804150334
Device: 28330A9497040373
-----
Send POST request url=http://domoticz-
ip:port/json.htm?type=command&param=customevent&event=DS18B20&data=,
postdata={'X28FF5E1804150334': 16.5, 'X28330A9497040373': 15.25}
Send POST request status=OK

:wiring
DS18B20 = Raspberry Pi Pico W
VDD = 3V3 (Pin #36)
GND = GND (Pin #38)
Data = GP15 (Pin #20)
The wiring applies to N sensors.
"""

# Imports
from machine import Pin
from utime import sleep, sleep_ms
# The onewire and ds18x20 are micropython internal libs.
from onewire import OneWire
from ds18x20 import DS18X20
import json
# Call server from server.py (must be uploaded to the picow)
from server import Server
# Configuration (must be uploaded to the picow)
```

```
import config

# Constants
VERSION = 'DS18B20 v20230412'

# Create the led object indicating sensor measurement in progress
led_indicator = Pin(config.PIN_LED1, Pin.OUT)
led_indicator.value(0)

# DS18B20 Signal Pin GP15 #Pin 20
PIN_DS18B20 = 15
# DS18B20 measurement sampling rate in seconds
SAMPLING_RATE = 60
# URL Domoticz
URL_DOM = "http://"+ config.DOMOTICZ_IP
+"/json.htm?type=command&param=customevent&event=DS18B20&data="

# Init OneWire with the pin to which one or more DS18B20 sensors are connected
one_wire_bus = Pin(Pin_DS18B20)
# Init the DS18X20 class with constructor function
ds_sensor = DS18X20(OneWire(one_wire_bus))

"""
Read the temperature of the DS18B20 sensor(s).

:return json array
    JSON array with key:value pairs {"device address":temperature, ...}
    NOTE: The device address has prefix X to get handled by the Domoticz dzVents
custom event.
    {'X28FF5E1804150334': 16.5, 'X28330A9497040373': 15.1875}
"""
def read_ds_sensor():
    # Read & convert temperature
    ds_sensor.convert_temp()
    # Wait: min. 750 ms
    sleep_ms(750)
    # Loop over the devices to get the temperature
    result = {}
    for device in devices:
        device_address = 'X' + bytes(device).hex().upper()
        # print(f'Sensor: {device_address}')
        temperature = ds_sensor.read_temp(device)
        # print(f'Temperatur: {temperature}°C')
        # Add the device address and temperature to the json array
        result[device_address] = temperature
    # Return the json array with the data
    return result

# Info
print(f'{VERSION}')
print(f'Sampling Rate: {SAMPLING_RATE}s.')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect()

# Scan for One-Wire devices
# Get list of ROM addresses for all attached slaves. Each ROM address is an 8-byte
long byte array.
devices = ds_sensor.scan()
print(f'One-Wire Devices found: {len(devices)}')
for device in devices:
    print(f'Device: {bytes(device).hex().upper()}')
print(f'-----')

# Main
# Measure every NN seconds (see constant SAMPLING_DELAY)
```

```
while True:
    led_indicator.value(1)
    # Read the sensor(s)
    data = read_ds_sensor()
    # print(f'{data}')
    # Submit Domoticz HTTP API/JSON POST request to update the devices via
customevent
    network.send_post_request(URL_DOM, data)
    led_indicator.value(0)
    # Delay till next sample
    sleep(SAMPLING_RATE)
```

DS18B20 Temperature (Pull)

Description

This project listens to HTTP client requests to read the temperature (°C), from DS18B20 1-wire digital thermometer sensors and sends an HTTP response with data to the client (Domoticz, Node-RED or other).

Solution

The Pico W has two DS18B20 sensors and an LED connected and runs as a web server.

The two DS18B20 sensors are (same as previous project with Push solution):

- Keyes DS18B20 sensor (address 28FF5E1804150334)
- Oumefar Digital Temperature DS18B20 sensor (address 28330A9497040373)

The web server listens to HTTP POST requests (JSON object) to read the sensor temperature (°C).
The JSON request object has key:value pair:

- request:1 | 0 where 1 is requesting for data.

```
{'request': 1} or {'request': 0}
```

The web server sends an HTTP response back to the client containing the data (JSON object).
The JSON object structure is Domoticz like with the keys

- status: OK or ERROR
- title: the HTTP POST request
- message: the sensor data as array with fields id, temperature and address for each sensor.

```
{
 "status": "OK",
 "title": "{'request': 1}",
 "message":
   [
    {"id": 1, "temperature": 17.0, "address": "28FF5E1804150334"},
    {"id": 2, "temperature": 13.875, "address": "28330A9497040373"}
   ]
}
```

Wiring

The wiring is described in project DS18B20 Temperature (Push).

Circuit Diagram

The circuit diagram is described in project DS18B20 Temperature (Push).

Web Server

Libraries

The MicroPython script uses the MicroPython internal libraries OneWire and DS18X20.

MicroPython Script

```
"""
File:ds18b20_client_pull.py
Date:20230413
Author: Robert W.B. Linn

:description
The Pico W runs as a web server and listens to post request from clients (PULL).
If the post request is {"request":1} then the temperatures of the connected sensors
are read.
The data is returned to the client as JSON object in Domoticz format:
{"status": "OK", "title": "{'request': 1}", "message": [{"id": 1, "temperature":
22.0, "address": "28FF5E1804150334"}, {"id": 2, "temperature": 17.4375, "address":
"28330A9497040373"}]}
The key message contains the JSON array with the DS18B20 address and temperature.

Each DS18B20 has a unique 8-byte address, like 28 FF 5E 18 04 15 03 34.
The two DS18B20 sensors are:
* Keyes DS18B20 (address 28FF5E1804150334)
* Oumefar Digital Temperature sensor DS18B20 (address 28330A9497040373)

:example
Using curl with HTTP response JSON object.
HTTP Request
curl -v -H "Content-Type: application/json" -d "{\"request\":1}" http://picow-ip
HTTP Response
{"status": "OK", "title": "{'request': 1}", "message": [{"id": 1, "temperature":
22.0, "address": "28FF5E1804150334"}, {"id": 2, "temperature": 17.4375, "address":
"28330A9497040373"}]}

:notes
Pico Breadboard Kit is used to wire up the DS18B20.
Configuration stored in config.py, ensure to upload to the picow.
DS18B20 measures every 60 seconds.

:log
DS18B20 v20230413
Sampling Rate: 60s.
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
One-Wire Devices found: 2
Device: 28FF5E1804150334
Device: 28330A9497040373
-----
Network client connected from client-ip
HTTP Command={'request': 1}
HTTP Response={"status": "OK", "title": "{'request': 1}", "message": [{"id": 1,
"temperature": 17.0, "address": "28FF5E1804150334"}, {"id": 2, "temperature":
13.875, "address": "28330A9497040373"}]}
Network connection closed
HTTP Command={'request': 0}
HTTP Response={"status": "ERROR", "title": {"request": 0}, "message": ""}
Network connection closed
Network client connected from client-ip

:wiring
DS18B20 = Raspberry Pi Pico W
VDD = 3V3 (Pin #36)
```

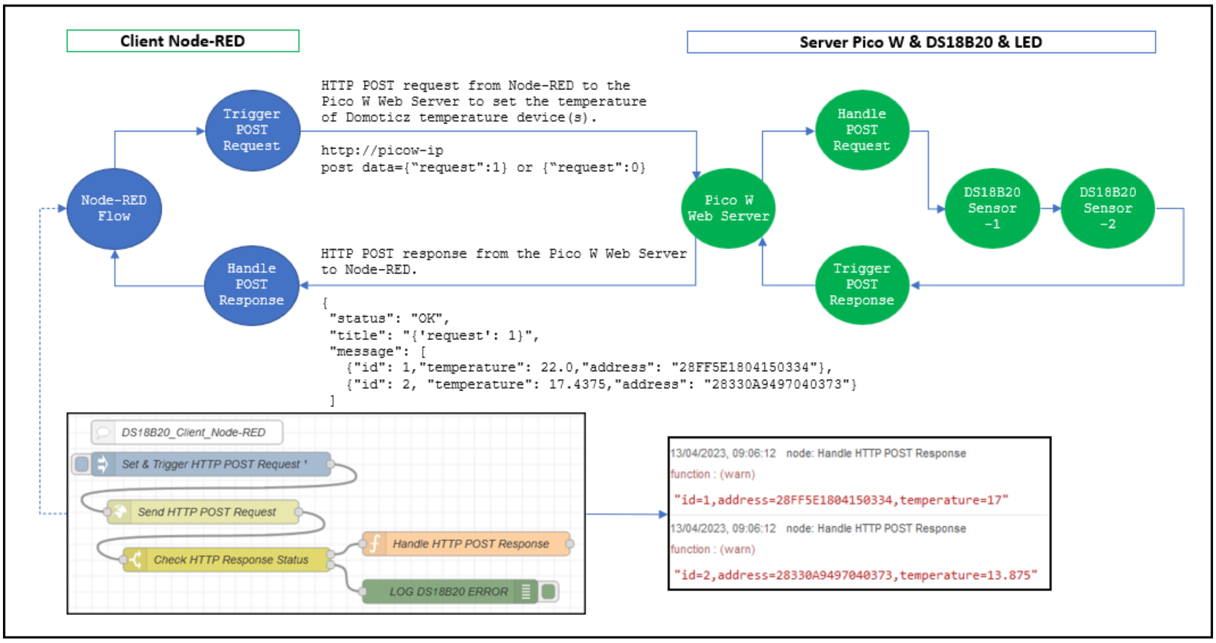
```
GND = GND (Pin #38)
Data = GP15 (Pin #20)
The wiring applies to N sensors.
"""

# Imports
from machine import Pin
from utime import sleep, sleep_ms
# The onewire and ds18x20 are micropython internal libs.
from onewire import OneWire
from ds18x20 import DS18X20
import json
# Call server from server.py (must be uploaded to the picow)
from server import Server
# Configuration (must be uploaded to the picow)
import config

# Constants
VERSION = 'DS18B20 v20230412'

# Create the led object indicating sensor measurement in progress
led_indicator = Pin(config.PIN_LED1, Pin.OUT)
led_indicator.value(0)

# DS18B20 Signal Pin GP15 #Pin 20
PIN_DS18B20 = 15

# Init OneWire with the pin to which one or more DS18B20 sensors are connected
one_wire_bus = Pin(Pin_DS18B20)
# Init the DS18X20 class with constructor function
ds_sensor = DS18X20(OneWire(one_wire_bus))

"""
Read the temperature of the DS18B20 sensor(s).

:return json array
    JSON array with key:value pairs:
    [{"id": 1, "temperature": 17.0, "address": "28FF5E1804150334"},
     {"id": 2, "temperature": 13.875,    "address": "28330A9497040373"}]
"""
def read_ds_sensor():
    # Read & convert temperature
    ds_sensor.convert_temp()
    # Wait: min. 750 ms
    sleep_ms(750)
    # Loop over the devices to get the temperature
    result = []
    id = 0
    for device in devices:
        device_address = bytes(device).hex().upper()
        # print(f'Sensor: {device_address}')
        temperature = ds_sensor.read_temp(device)
        # print(f'Temperatur: {temperature}°C')
        # Add the device address and temperature to the json array
        device = {}
        id = id + 1
        device["id"] = id
        device["address"] = device_address
        device["temperature"] = temperature
        result.append(device);
    # Return the json array with the data
    return result

"""
Handle the request containing the command as JSON object.

The DS18B20 sensor data is read if the command is {"request":1}.
The response JSON object is updated.
```

```
:param string data
    JSON object with key:value pair containing the command

:return JSON object response
"""
def handle_request(data):
    # Get the JSON key request {"request":0 or 1}
    request = data["request"]
    if request == 1:
        # Response is OK
        response[config.KEY_STATE] = config.STATE_OK
        response[config.KEY_MESSAGE] = read_ds_sensor()
    else:
        response[config.KEY_STATE] = config.STATE_ERR
        response[config.KEY_MESSAGE] = ""
    return response

# Info
print(f'{VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect()

# Scan for One-Wire devices
# Get list of ROM addresses for all of the attached slaves. Each ROM address is an
8-byte long bytearray.
devices = ds_sensor.scan()
print(f'One-Wire Devices found: {len(devices)}')
for device in devices:
    print(f'Device: {bytes(device).hex().upper()}')
print(f'-----')

# Main
while True:
    try:
        # Get client connection and the request data
        cl, request = network.get_client_connection(server)

        # Create the HTTP response JSON object
        response = {}

        # Parse the post data. In case of error, the status is 0.
        data, status = network.parse_post_request(request)

        # Assign the postdata to the response KEY_TITLE: {'request': 1} or 0
        response[config.KEY_TITLE] = str(data)

        # If status is 1, then the post response is properly parsed, lets get the
sensor data.
        if status == 1:
            response = handle_request(data)
            # HTTP Response={"status": "OK", "title": {"request": 1}, "message":
{"28FF5E1804150334": 19.75, "28330A9497040373": 15.5625}}
        else:
            # Error with unknown command
            response[config.KEY_STATE] = config.STATE_ERR
            response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN

        # Send response to the client and close the connection
        network.send_response(cl, response, True)

    except OSError as e:
        network.ledstatus.off()
        cl.close()
        print('[ERROR] Network Connection closed')
```

Node-RED Client

This solution uses Node-RED as client.
Node-RED is running on the Domoticz Test System.

Block Diagram



Node-RED Flow

The flow starts with the Inject node “Set & Trigger HTTP POST Request”, to the msg.payload = {“request”:1} and the msg.url = “picow-ip”.

The node injects after 0.1 second, the HTTP Request node “Send HTTP POST Request” to submit the HTTP POST request to the Pico W Web Server.

The HTTP response JSON object, key status is checked by the Switch node “Check HTTP Response” on OK or ERROR.

If the msg.payload.status is OK, then the Function node “Handle HTTP POST Response” lists the DS18B20 sensor data derived from the JSON array in the key msg.payload.message.

```
// Get the device data from the key message of the payload
data = msg.payload.message;
// node.warn(data);

// Loop over the data
data.forEach(getDevices);

function getDevices(item, index) {
    // node.warn(JSON.stringify(item), index)
    // get the device data
    let device = JSON.parse(JSON.stringify(item));
    node.warn("id=" + device.id + ",address=" + device.address + ",temperature=" +
device.temperature);
}
```

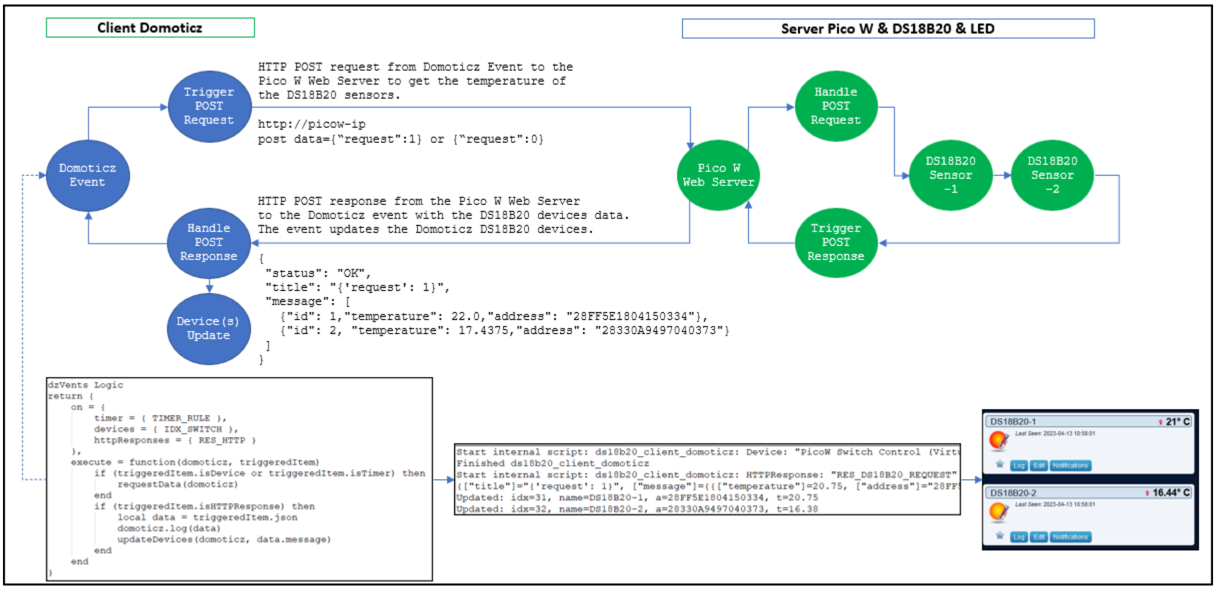
Node-RED Flow Source


```
[{"id":"5e7fdee23c9d653f","type":"tab","label":"DMPP","disabled":false,"info":"domo
ticz-micropython-
projects","env":[]},{"id":"23a82a4e9c805de6","type":"inject","z":"5e7fdee23c9d653f"
,"name":"Set & Trigger HTTP POST
Request","props":[{"p":"payload"},{"p":"url","v":"http://picow-
ip","vt":"str"}],"repeat":"","crontab":"","once":true,"onceDelay":0.1,"topic":"","p
ayload":"{\"request\":1}","payloadType":"json","x":190,"y":80,"wires":[["b88c7ce9a1
832e9a"]]},{"id":"b88c7ce9a1832e9a","type":"http
request","z":"5e7fdee23c9d653f","name":"Send HTTP POST
Request","method":"POST","ret":"obj","paytoqs":"ignore","url":"","tls":"","persist"
:false,"proxy":"","insecureHTTPParser":false,"authType":"","senderr":false,"headers
":[],"x":180,"y":140,"wires":[["17d1f4aaf93e79c5"]]},{"id":"7b7b06756ee15219","type
":"debug","z":"5e7fdee23c9d653f","name":"LOG DS18B20
ERROR","active":true,"tosidebar":true,"console":false,"tostatus":false,"complete":"
payload","targetType":"msg","statusVal":"","statusType":"auto","x":490,"y":240,"wir
es":[]},{"id":"854cb3f9d6670309","type":"comment","z":"5e7fdee23c9d653f","name":"DS
18B20_Client_Node-RED","info":"DS18B20 Get Temperature\n\nSent a HTTP POST request
to the Pico W web server.\nThe post data contains a JSON object:\n{\"request\":1}
or {\"request\":0}\nSet 1 to ask for data.\n\nThe HTTP response is a JSON
object.\nThe key message holds the data from the sensors.\nThe data is a JSON
array.\n{\n    \"status\":\"OK\",\n    \"title\":\"{'request': 1}\",\n
\"message\":\n        [\n
{\"id\":1,\"temperature\":22,\"address\":\"28FF5E1804150334\"},\n
{\"id\":2,\"temperature\":17.4375,\"address\":\"28330A9497040373\"}\n
]\n}\n","x":160,"y":40,"wires":[]},{"id":"ef2c522da453a408","type":"function","z":"
5e7fdee23c9d653f","name":"Handle HTTP POST Response","func":"// Get the device data
from the key message of the payload\ndata = msg.payload.message;\n//
node.warn(data);\n\n// Loop over the data\ndata.forEach(getDevices);\n\nfunction
getDevices(item, index) {\n    // node.warn(JSON.stringify(item), index)\n    //
get the device data\n    let device = JSON.parse(JSON.stringify(item));\n
node.warn(\"id=\" + device.id + \",address=\" + device.address + \",temperature=\"
+
device.temperature);\n}\n","outputs":1,"noerr":0,"initialize":"","finalize":"","lib
s":[],"x":510,"y":180,"wires":[[]]},{"id":"17d1f4aaf93e79c5","type":"switch","z":"5
e7fdee23c9d653f","name":"Check HTTP Response
Status","property":"payload.status","propertyType":"msg","rules":[{"t":"eq","v":"OK
","vt":"str"},{"t":"eq","v":"ERROR","vt":"str"}],"checkall":"true","repair":false,"
outputs":2,"x":210,"y":200,"wires":[["ef2c522da453a408"],["7b7b06756ee15219"]]}]
```

Domoticz Client

This solution uses Domoticz as client.
An Automation Event dzVents triggers every minute or via a switch, an HTTP POST request to the Pico W Web Server.
The web server reads the temperature of the DS18B20 sensors and sends HTTP response back to the Automation Event. The response is a JSON object which is parsed to update the Domoticz Temperature devices.

Block Diagram



Automation Script

```
--[[
File:   ds18b20_client_domoticz.dzvents
Date:   20230413
Author: Robert W.B. Linn

:description
Requests in regular intervals DS18B20 sensor data from a Pico W Web Server.
The HTTP response JSON object is parsed and the Domoticz temperature devices
assigned to the ds18b20 device(s) are updated.
{["message"]={{["temperature"]=19.5, ["address"]="28FF5E1804150334", ["id"]=1},
{["temperature"]=15.4375, ["address"]="28330A9497040373", ["id"]=2}},
["status"]="OK", ["title"]="{'request': 1}"}

:log
2023-04-13 10:54:29.351 VirtualSensors: Light/Switch (PicoW Switch Control)
2023-04-13 10:54:29.345 Status: User: admin initiated a switch command (16/PicoW
Switch Control/On)
2023-04-13 10:54:29.452 Status: dzVents: Info: Handling events for: "PicoW Switch
Control", value: "On"
2023-04-13 10:54:29.452 Status: dzVents: Info: LOG_DS18B20_REQUEST: ------ Start
internal script: ds18b20_client_domoticz: Device: "PicoW Switch Control
(VirtualSensors)", Index: 16
2023-04-13 10:54:29.453 Status: dzVents: Info: LOG_DS18B20_REQUEST: ------ Finished
ds18b20_client_domoticz
2023-04-13 10:54:29.453 Status: EventSystem: Script event triggered:
/home/pi/domoticz/dzVents/runtime/dzVents.lua
2023-04-13 10:54:30.428 Status: dzVents: Info: Handling httpResponse-events for:
"RES_DS18B20_REQUEST"
2023-04-13 10:54:30.428 Status: dzVents: Info: LOG_DS18B20_REQUEST: ------ Start
internal script: ds18b20_client_domoticz: HTTPResponse: "RES_DS18B20_REQUEST"
2023-04-13 10:54:30.428 Status: dzVents: Info: LOG_DS18B20_REQUEST:
{["title"]="{'request': 1}", ["message"]={{["temperature"]=20.75,
["address"]="28FF5E1804150334", ["id"]=1}, {["temperature"]=16.375,
["address"]="28330A9497040373", ["id"]=2}}, ["status"]="OK"}
2023-04-13 10:54:30.440 Status: dzVents: Info: LOG_DS18B20_REQUEST: Updated:
idx=31, name=DS18B20-1, a=28FF5E1804150334, t=20.75
2023-04-13 10:54:30.441 Status: dzVents: Info: LOG_DS18B20_REQUEST: Updated:
idx=32, name=DS18B20-2, a=28330A9497040373, t=16.38
2023-04-13 10:54:30.441 Status: dzVents: Info: LOG_DS18B20_REQUEST: ------ Finished
ds18b20_client_domoticz
2023-04-13 10:54:30.441 Status: EventSystem: Script event triggered:
/home/pi/domoticz/dzVents/runtime/dzVents.lua
]]--

-- Domoticz IDX of the switch triggering the request
local IDX_SWITCH  = 16

local URL_SERVER    = 'http://picow-ip'
local PROJECT       = 'DS18B20_REQUEST'
local RES_HTTP      = 'RES_' .. PROJECT
local LOG_MARKER    = 'LOG_' .. PROJECT

-- Define map table between ds18b20 device address (with prefix X because keys must
start with a character) and the domoticz idx
local devices = {
    X28FF5E1804150334 = 31, -- DS18B20-1
    X28330A9497040373 = 32  -- DS18B20-2
}

-- Send HTTP POST request to get the sensor data from the Pico W Web Server
local function requestData(domoticz)
    local postdata = {}
    postdata["request"] = 1
    domoticz.openURL({
       url = URL_SERVER, method = 'POST',
```

```
       postData = postdata, callback = RES_HTTP,
       })
end

-- Update the devices by looping over the Lua array data and the Lua device table
containing address & temperature.
-- The data is taken from the key message from the HTTP JSON response.
-- {{["address"]="28FF5E1804150334", ["id"]=1, ["temperature"]=19.25},
{["address"]="28330A9497040373", ["id"]=2, ["temperature"]=15.5}}
local function updateDevices(domoticz, data)
    for i, device in ipairs(data) do
        -- Select the device and update
        local deviceaddress = 'X' .. device.address
        local deviceidx = devices[deviceaddress]
        domoticz.devices(deviceidx).updateTemperature(device.temperature)
        domoticz.log(string.format('Updated: idx=%s, name=%s, a=%s, t=%0.2f',
domoticz.devices(deviceidx).idx, domoticz.devices(deviceidx).name, device.address,
device.temperature))
    end
end

--Timer Rule (for tests use every minute)
local TIMER_RULE = 'every minute'

return {
 on = {
     timer = { TIMER_RULE },
     devices = { IDX_SWITCH },
     httpResponses = { RES_HTTP }
    },
    logging = {
        level = domoticz.LOG_INFO,
        marker = LOG_MARKER,
    },
 execute = function(domoticz, triggeredItem)
     -- Trigger the HTTP POST request to the Pico W Web Server
        if (triggeredItem.isDevice or triggeredItem.isTimer) then
requestData(domoticz) end

        -- Handle HTTP response: OK is item statusCode 200 and item.ok true
        -- Else error like statusCode 7, item.ok false
        if (triggeredItem.isHTTPResponse) then
            -- domoticz.log(string.format("%d %s", item.statusCode, item.ok))
            if (triggeredItem.statusCode == 200) then
                if (triggeredItem.isJSON) then
                    local data = triggeredItem.json
                    domoticz.log(data)
                    updateDevices(domoticz, data.message)
                end
            else
                -- Error like 7 false; ERROR 7:Couldn't connect to server
                domoticz.log(string.format("ERROR %d:%s", item.statusCode,
item.statusText))
            end
        end
 end
}
```

Stepper Motor Selector Switch Angle Move

Description

This project moves a stepper motor by step via a Domoticz Selector Switch device.

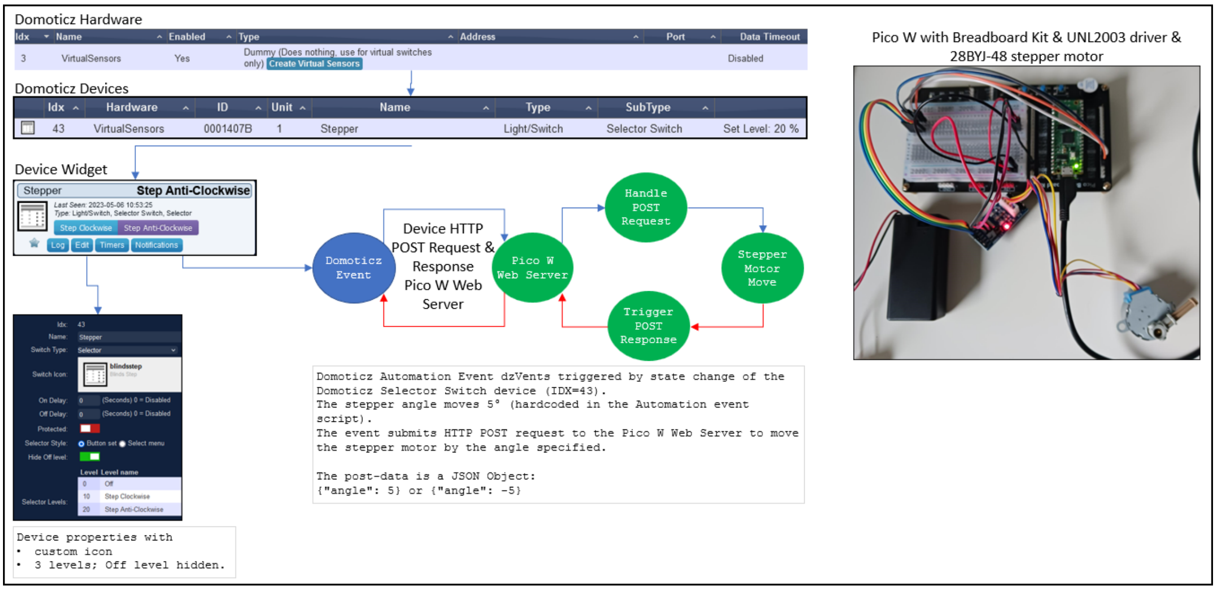
Solution

The Pico W has a 28BYJ-48 Stepper Motor with ULN2003 motor driver connected and runs as a web server.
The web server waits for a HTTP POST requests from a client connection. The POST data contains the command for moving the stepper motor.
The commands supported are

- “angle” - move the stepper motor by a given angle clockwise or anti-clockwise,
- “steps” - move the stepper motor by number of steps clockwise or anti-clockwise,
- “rotate” - rotate the stepper motor by number of rotations clockwise or ant1-clockwise,

The block diagram shows the solution to move the stepper motor by an angle 5° clockwise or anti-clockwise by a Domoticz Selector Switch.

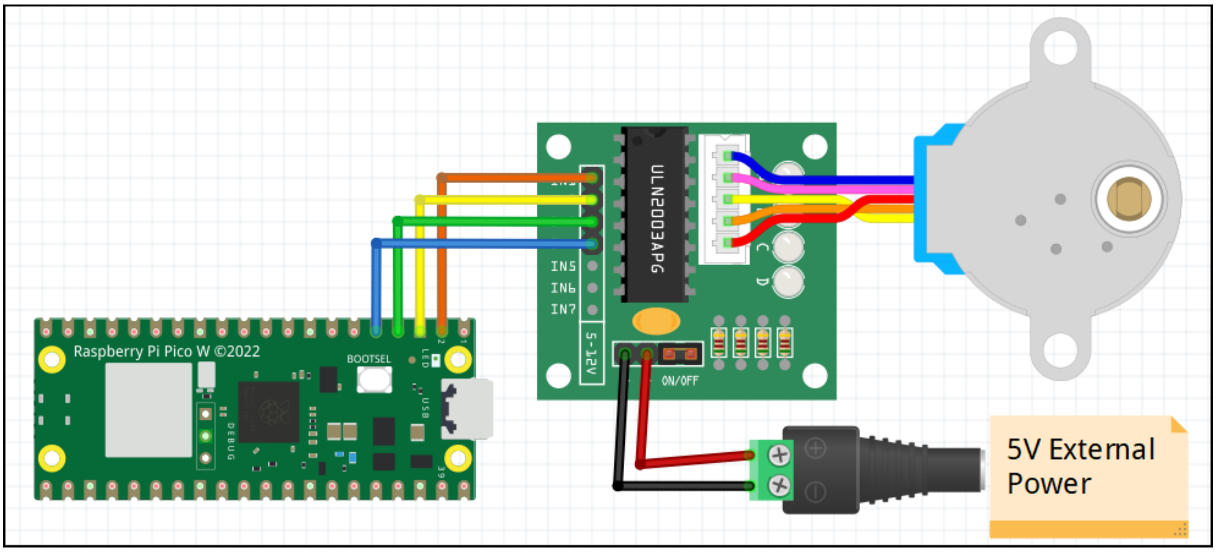
Block Diagram



Wiring

Stepper Motor Driver ULN2003	Pico W
IN1	GP2 (Pin #4)
IN2	GP3 (Pin #5)
IN3	GP4 (Pin #6)
IN4	GP5 (Pin #7)
VCC = External 5V	
GND = External 5V	

Circuit Diagram



Domoticz Setup

Devices

From the hardware “Dummy”, create a Selector Switch device:
Name: Stepper, Sensor Type: Selector Switch

After creating the device, the Domoticz devices list shows the entry:

```
IDX=43, Hardware=VirtualSensors, ID=0001407B, Unit=1, Name=Stepper,
Type=Light/Switch, SubType=Selector Switch, Data=Off
```

Automation Script

The automation script is triggered by the state change of the selector switch.

```
--[[
File:   steppermotor.dzvents
Date:   20230506
Author: Robert W.B. Linn

:description
Turn the stepper motor stepwise in the direction clockwise or anticlockwise by
using a Domoticz Selector Switch. The selector switch has 3 levels 0, 10, 20.
The level 0, Off, is not used. Level 10 is Step Clockwise, and level 20 is Step
Anti-Clockwise. This means the selector switch shows two buttons Step Clockwise and
Step Anti-Clockwise. Each step moves the stepper motor in the direction by an angle
of 5°. The angle is hardcoded but could be set flexible via a User Variable.
]]--

-- Domoticz device Selector Switch
local IDX_STEPPER_SELECTOR = 43
-- Pico W web server IP address
local HTTP_URL       = 'http://picow-ip'
-- Callback and logging
local PROJECT        = 'STEPPER'
local HTTP_RES       = 'RES_' .. PROJECT
local LOG_MARKER     = 'LOG_' .. PROJECT
-- Stepper
local ANGLE_MOVE = 5

-- Post Data to the Pico W Webserver.
-- The data is a JSON object with the servo angle to move: {"angle":NNN}
local function HTTPPost(domoticz, angle)
    local data = {}
    data['angle'] = angle
    domoticz.log(data)
    domoticz.openURL({
        url = HTTP_URL, method = 'POST',
        headers = { ['content-type'] = 'application/json' },
        postData = data, callback = HTTP_RES,
       })
end

return {
 on = { devices = { IDX_STEPPER_SELECTOR }, httpResponses = { HTTP_RES } },
 logging = { level = domoticz.LOG_INFO, marker = LOG_MARKER },
 execute = function(domoticz, item)
   if (item.isDevice) then
    if item.idx == IDX_STEPPER_SELECTOR then
      domoticz.log(string.format("device=%s, state=%s, level=%d",
        item.name, item.state, item.level))
       local angle
       if item.level == 10 then angle = ANGLE_MOVE end
```

```
        if item.level == 20 then angle = ANGLE_MOVE * -1 end
        HTTPPost(domoticz, angle)
      end
    end
    if (item.isHTTPResponse) then
      if (item.isJSON) then
       -- {"status": "OK", "title": "{\"angle\": 5}", "message": "5"}
       local data = item.json
       domoticz.log(string.format("status=%s, title=%s, message=%s",
         data.status, data.title, data.message))
      end
    end
  end
}
```

Web Server

Libraries

The MicroPython script uses the MicroPython library *stepper* stored in Pico W folder lib.

Credits
The stepper library is based on the ULN2003 library (c) IDWizard 2017, # MIT License.
Thanks for developing & sharing.

```
"""
File: stepper.py
Date: 20230506
Author: Robert W.B. Linn

:description
Library for the stepper motor 8BYJ-48 5V DC with ULN2003 motor driver.
Tested on a Raspberry Pi Pico W.

:credits
This library is based upon the Micropython code to drive stepper motors via ULN2003
with the BBC micro:bit.
https://github.com/IDWizard/uln2003 (c) IDWizard 2017, # MIT License. Thanks for
developing & sharing.

:usage
stepper = Stepper('HALF_STEP',2 , 3, 4, 5, delay=1)

stepper.step(60, 1)
time.sleep(1)
stepper.step(-60)
time.sleep(1)

stepper.angle(90, 1)
time.sleep(1)
stepper.angle(-90)
time.sleep(1)

stepper.rotate(1)
time.sleep(1)
stepper.rotate(-1)
time.sleep(1)
"""

# Imports
from machine import Pin
import time

#
class Stepper:
    # The number of steps for a full rotation. Between 508-509 steps for one
revolution.
    # Reference: http://www.jangeox.be/2013/10/stepper-motor-28byj-48_25.html
    FULL_ROTATION = int(4075.7728395061727 / 8)

    # Modes
    HALF_STEP_MODE = 'HALF_STEP'
    FULL_STEP_MODE = 'FULL_STEP'

    # Mode bit sequences for the 4 motor pins
    HALF_STEP = [
        [0, 0, 0, 1],
        [0, 0, 1, 1],
        [0, 0, 1, 0],
        [0, 1, 1, 0],
```

```
        [0, 1, 0, 0],
        [1, 1, 0, 0],
        [1, 0, 0, 0],
        [1, 0, 0, 1],
    ]

    FULL_STEP = [
        [1, 0, 1, 0],
        [0, 1, 1, 0],
        [0, 1, 0, 1],
        [1, 0, 0, 1]
    ]

    def __init__(self, mode=HALF_STEP_MODE, IN1=2, IN2=3, IN3=4, IN4=5, delay=1):
        """
        Init the class with default Pico pins GP2 - GP5.

        :param stepmode string
            Set the stepmode to HALF_STEP_MODE or FULL_STEP_MODE

        :param IN1 - IN4 int
            Set the 4 stepper motor pin numbers.
            The defaults are the Raspberry Pico pins GP2 (Pin #4) - GP5 (Pin #7).

        :param delay int
            Set the step move delay in ms.

        """
        if mode == self.FULL_STEP_MODE:
         self.mode = self.FULL_STEP
        else:
         self.mode = self.HALF_STEP

        self.pin1 = Pin(IN1, Pin.OUT)
        self.pin2 = Pin(IN2, Pin.OUT)
        self.pin3 = Pin(IN3, Pin.OUT)
        self.pin4 = Pin(IN4, Pin.OUT)
        # Recommend 10+ for FULL_STEP, 1 is OK for HALF_STEP
        self.delay = delay

        # Initialize all pins to 0
        self.reset()

    def step(self, count, direction=1):
        """
        Move the stepper by steps.

        :param count int
            Set the number of steps to move.
            If count == -1 then direction is anti-clockwise.

        :param direction int
            Set the stepper motor move direction.
            Directions: clockwise (cw) = 1, anti-clockwise (acw) = -1
        """
        if count < 0:
            direction = -1
            count = abs(count)
        for x in range(count):
            for bit in self.mode[::direction]:
                self.pin1(bit[0])
                self.pin2(bit[1])
                self.pin3(bit[2])
                self.pin4(bit[3])
                time.sleep_ms(self.delay)
        self.reset()

    def angle(self, r, direction=1):
        """
```

```
        Move the stepper by angle.

        :param angle int
            Set the angle to move the stepper motor.
            If r < 0 then direction is anti-clockwise.

        :param direction int
            Set the stepper motor move direction.
            Directions: clockwise (cw) = 1, anti-clockwise (acw) = -1
        """
        if r < 0:
            direction = -1
            r = abs(r)
     self.step(int(self.FULL_ROTATION * r / 360), direction)

    def rotate(self, count, direction=1):
        """
        Rotate the stepper by 360°.

        :param count int
            Set the number of rotations to move.
            If count == -1 then direction is anti-clockwise.

        :param direction int
            Set the stepper motor move direction.
            Directions: clockwise (cw) = 1, anti-clockwise (acw) = -1
        """
        if count < 0:
            direction = -1
            count = abs(count)
        for n in range(count):
            self.angle(360, direction)

    def reset(self):
        """
        Reset to the stepper motor pins to 0.
        There is no holding, the pins are geared, not movable.
        """
        self.pin1(0)
        self.pin2(0)
        self.pin3(0)
        self.pin4(0)
```

MicroPython Script

```
"""
File:steppermotor.py
Date:20230506
Author: Robert W.B. Linn

:description
PicoW RESTful webserver to move a stepper motor (28BYJ-48 Stepper Motor with
ULN2003 motor driver).
The incoming data is from a HTTP POST request with JSON object (key:value pair)
containing the command to control the stepper motor:
angle: NNN
steps: NNN
rotate: NNN

:examples
Command submitted using curl with HTTP response.

curl -v -H "Content-Type:application/json" -d "{\"angle\":90}" http://picow-ip
{"title": "{'angle': 90}", "message": "90", "status": "OK"}

curl -v -H "Content-Type:application/json" -d "{\"angle\":-90}" http://picow-ip
{"title": "{'angle': -90}", "message": "-90", "status": "OK"}

curl -v -H "Content-Type:application/json" -d "{\"steps\":-200}" http://picow-ip
{"status": "OK", "title": "{'steps': -200}", "message": "-200"}

curl -v -H "Content-Type:application/json" -d "{\"rotate\":2}" http://picow-ip
{"status": "OK", "title": "{'rotate': 2}", "message": "2"}

curl -v -H "Content-Type:application/json" -d "{\"rotate\":-2}" http://picow-ip
{"status": "OK", "title": "{'rotate': -2}", "message": "-2"}

Error example:
curl -v -H "Content-Type:application/json" -d "{\"step\":100}" http://picow-ip
{"status": "ERROR", "title": "{'step': 100}", "message": "Unknown command."}

:log
Stepper Motor v20230505
Network waiting for connection...
Network connected OK
Network IP picow-ip
Network listening on ('0.0.0.0', 80)
Network client connected from client-ip
HTTP Command={'steps': -200}
HTTP Response={"status": "OK", "title": "{'steps': -200}", "message": "-200"}
Network connection closed
Network client connected from client-ip
HTTP Command={'step': 100}
HTTP Response={"status": "ERROR", "title": "{'step': 100}", "message": "Unknown
command."}
Network connection closed
Network client connected from client-ip
HTTP Command={'steps': -200}
HTTP Response={"status": "OK", "title": "{'steps': -200}", "message": "-200"}
Network connection closed
Network client connected from client-ip
HTTP Command={'rotate': 2}
HTTP Response={"status": "OK", "title": "{'rotate': 2}", "message": "2"}
Network connection closed
Network client connected from client-ip
HTTP Command={'rotate': -2}
HTTP Response={"status": "OK", "title": "{'rotate': -2}", "message": "-2"}
Network connection closed

:wiring
Stepper Motor = Pico W
```

```
IN1 = GP2
IN2 = GP3
IN3 = GP4
IN4 = GP5
VCC = External 5V
GND = GND common with external GND
"""

# Libraries
# Steppermotor lib created by the author
from machine import Pin
from time import sleep
import json
# Call server from server.py (must be uploaded to the picow)
from server import Server
# Stepper stored in PicoW folder lib
# Credits: This library is based on: https://github.com/IDWizard/uln2003 (c)
IDWizard 2017, # MIT License.
from stepper import Stepper
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config

# Constants
NAME = 'Stepper Motor'
VERSION = 'v20230506'

# Create a stepper motor object with defaults
stepper = Stepper()

"""
Handle the request to move the stepper.
"""
def handle_request(cmd, status):
    # Assign the command to the response title
    response[config.KEY_TITLE] = str(cmd)
    # Set the response initially to ok
    response[config.KEY_STATE] = config.STATE_OK

    # If the status is 1 (OK) then action
    if status == 1:

        # Get the command by checking the json key
        if cmd.get('angle') != None:
            # Get the angle of the stepper to move
            angle = cmd['angle']
            # Move the stepper by angle
            stepper.angle(angle)
            response[config.KEY_MESSAGE] = str(angle)

        elif cmd.get('steps') != None:
            # Get the number of steps for the stepper to move
            steps = cmd['steps']
            # Move the stepper by steps
            stepper.step(steps)
            response[config.KEY_MESSAGE] = str(steps)

        elif cmd.get('rotate') != None:
            # Get the number of steps for the stepper to move
            ntimes = cmd['rotate']
            # Move the stepper by rotation
            stepper.rotate(ntimes)
            response[config.KEY_MESSAGE] = str(ntimes)

        else:
            response[config.KEY_STATE] = config.STATE_ERR
            response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN

    else:
        response[config.KEY_STATE] = config.STATE_ERR
```

```
        response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN

    # Return the response which is send to Domoticz
    return response

# Main
print(f'{NAME} {VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect()

"""
Main Loop
"""
while True:
    try:
        # Get client connection and the request data
        cl, request = network.get_client_connection(server)

        # Get the cmd to set the LCD text as JSON object from the POST request
        cmd, status = network.parse_post_request(request)

        # Create the HTTP response JSON object
        response = {}

        # Handle the command to set the servo pos
        # Set the response
        response = handle_request(cmd, status)

        # Send the response to Domoticz and close the connection (wait for new)
        network.send_response(cl, response, True)

    except OSError as e:
        ledstatus.off()
        cl.close()
        print('[ERROR] Network Connection closed')
```

Enhancement Ideas

LED Indicators
If the stepper motor is moving, turn a RED LED on else turn a GREEN LED on indicating stand-by.
See steppermotorled.py.

Multiple Steppers
Control more then one stepper.

Stepper Motor Blind Simulation

Description

This project simulates a blind by moving the stepper up and down by a given angle.

Solution

The solution is based up-on the previous described project Stepper Motor.

Instead using a Domoticz Selector Switch to move the stepper motor by an angle (hardcoded 5°), a Domoticz Blind device, with states Open & Closed is used.

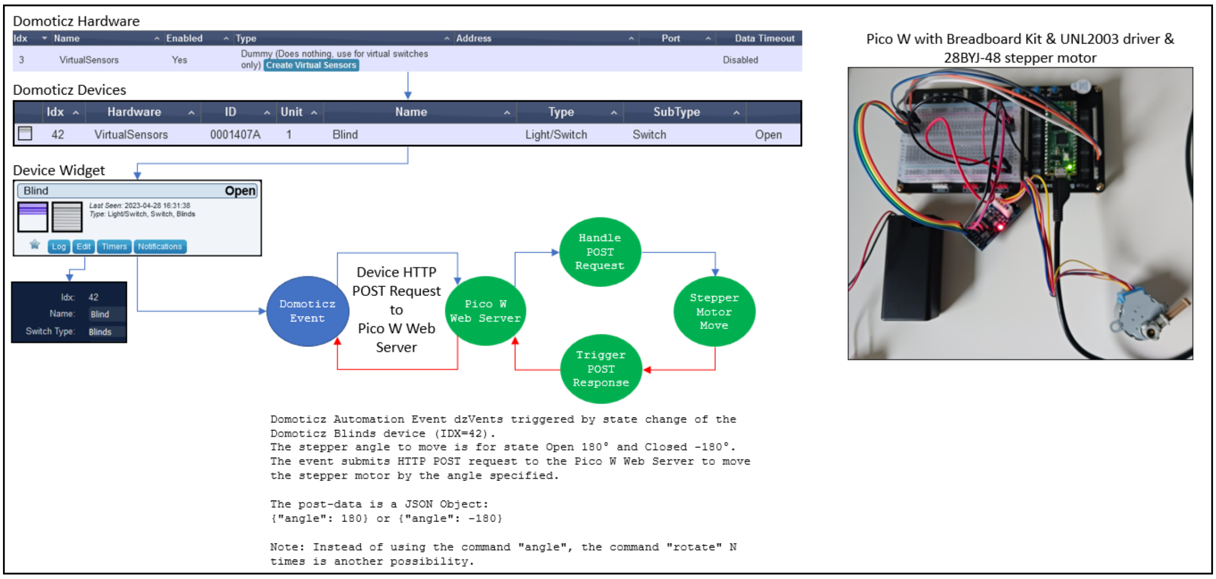
The stepper motor is moved by setting the angle. For the blind simulation:

- Blind Open = Angle 180°
- Blind Closed = Angle -180°

Notes
The previous described Domoticz Selector Switch can be used to set the stepper motor starting position (calibrate).

Alternatives
Instead changing the angle (command "angle":NNN) of the stepper motor, the stepper motor could rotate N times (command "rotate": N).

Block Diagram



Domoticz Setup

Devices

From the hardware “Dummy”, create a Blind device:
Name: Blind, Sensor Type: Switch
After creating the device, the Domoticz devices list shows the entry:

```
IDX=43, Hardware=VirtualSensors, ID=0001407A, Unit=1, Name=Blind,
Type=Light/Switch, SubType=Switch, Data=Off
```

To set the switch type, select the device widget and change the switch type to blind.
See Block Diagram.

Automation Script

```
--[[
File:   stepperblind.dzvents
Date:   20230506
Author: Robert W.B. Linn

:description
Simulating a blind state Open or Closed by moving a stepper motor by angle 180
(Open) or -180 (Closed).
]]--

-- Domoticz device from type light/switch, light, blinds
local IDX_BLIND = 42
-- Pico W web server IP address
local HTTP_URL       = 'http://picow-ip'
-- Callback and logging
local PROJECT       = 'STEPPERBLIND'
local HTTP_RES      = 'RES_' .. PROJECT
local LOG_MARKER    = 'LOG_' .. PROJECT
-- Stepper
local ANGLE_OPEN = 180
local ANGLE_CLOSED = ANGLE_OPEN * -1
local STATE_OPEN = 'Open'
local STATE_CLOSED = 'Closed'

-- Post Data to the Pico W Webserver.
-- The data is a JSON object with the servo angle rounded: {"angle":NNN}
local function HTTPPost(domoticz, angle)
    local data = {}
    data['angle'] = angle
    domoticz.log(string.format('device=%s, angle=%d',
     domoticz.devices(IDX_SWITCH).name, angle), domoticz.LOG_INFO)
    domoticz.openURL({
        url = HTTP_URL, method = 'POST',
        headers = { ['content-type'] = 'application/json' },
        postData = data, callback = HTTP_RES,
       })
end

-- Set the blind angle
local function setblind(domoticz, state)
    local angle = ANGLE_OPEN
    if state == STATE_CLOSED then angle = ANGLE_CLOSED end
    HTTPPost(domoticz, angle)
end

return {
 on = { devices = { IDX_BLIND }, httpResponses = { HTTP_RES } },
 data = { stateprev = {initial = STATE_OPEN}, },
```

```
 logging = { level = domoticz.LOG_INFO, marker = LOG_MARKER },
 execute = function(domoticz, item)
  if (item.isDevice) then
   domoticz.log(string.format("device=%s, state=%s, stateprev=%s",
    item.name, item.state, domoticz.data.stateprev))
    -- Check if the state has changed i.e., Open to Closed or Closed to Open
   if item.state ~= domoticz.data.stateprev then
    -- Set the blind state
    setblind(domoticz, item.state)
    -- Capture the new state
    domoticz.data.stateprev = item.state
   end
   end
  if (item.isHTTPResponse) then
   if (item.isJSON) then
    -- {"status": "OK", "title": "{\"angle\": 180}", "message": "180"}
    local data = item.json
    domoticz.log(string.format("status=%s, title=%s, message=%s",
     data.status, data.title, data.message))
   end
  end
 end
}
```

Web Server

Libraries

See project Stepper Motor > Web Server. The same solution is used.

MicroPython Script

See project Stepper Motor > Web Server. The same solution is used.

Stepper Motor Timer Run Stop

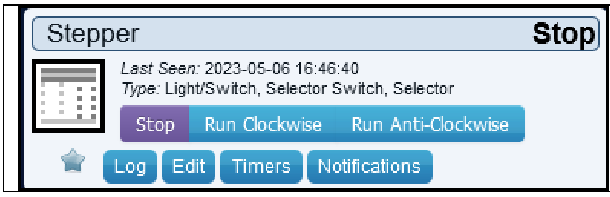
Description

This project enables to run or stop a stepper motor.

Solution

The solution is based up-on the previous described project Stepper Motor.

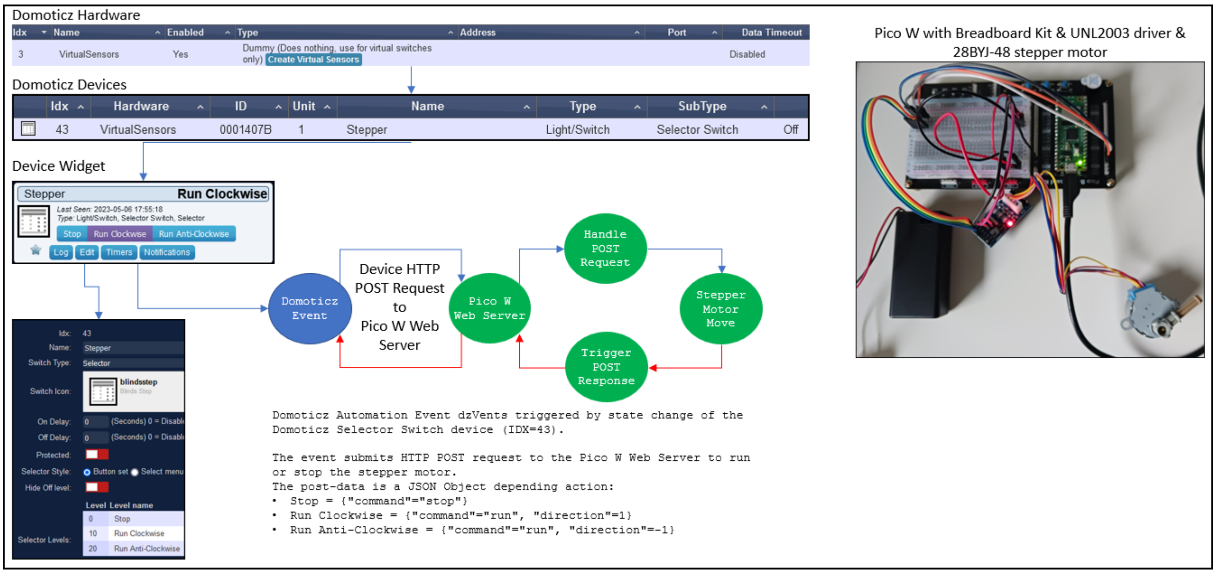
A Domoticz Selector Switch is used to move the stepper motor depending selected level:

	Levels 0 = Stop 10 = Run Clockwise 20 = Run Anti-Clockwise

By clicking on the selected selector switch button, an automation event is triggered. The event creates a JSON object used as post-data for an HTTP POST request to the Pico W, which is running as a web server.
The Pico W web server parses the post-data and executes the command. If the command is run then the stepper motor starts running in the direction given, until a stop command is received.
The stepper motor runs by using a timer with callback function.

Note
Prior using the timer class, explored other libraries like asyncio or thread ... but found (for now) too complex to use.
MicroPython’s Timer class defines a baseline operation of executing a callback with a given period (or once after some delay),

Block Diagram



Domoticz Setup

Devices

From the hardware "Dummy", create a Selector Switch device:
Name: Stepper, Sensor Type: Selector Switch
After creating the device, the Domoticz devices list shows the entry:

```
IDX=43, Hardware=VirtualSensors, ID=0001407A, Unit=1, Name=Stepper,
Type=Light/Switch, SubType=Selector Switch, Data=Off
```

Automation Script

```
--[[
File:   steppermotor_timer.dzvents
Date:   20230506
Author: Robert W.B. Linn

:description
Turn the stepper motor stepwise in the direction clockwise or anticlockwise by
using a Domoticz Selector Switch.
The selector switch has 3 levels 0, 10, 20.
The level 0, Off stops the stepper motor. Level 10 is Run Clockwise, and level 20
is Run Anti-Clockwise.
This means the selector switch shows two buttons Run Clockwise and Run Anti-
Clockwise.
]]--

-- Domoticz device Selector Switch
local IDX_STEPPER_SELECTOR = 43

-- Pico W web server IP address
local HTTP_URL        = 'http://picow-ip'
-- Callback and logging
local PROJECT         = 'STEPPERTIMER'
local HTTP_RES        = 'RES_' .. PROJECT
local LOG_MARKER      = 'LOG_' .. PROJECT

-- Post Data to the Pico W Webserver.
```

```
-- The data is a JSON object with the command run or stop.
local function HTTPPost(domoticz, data)
    domoticz.log(data)
    domoticz.openURL({
        url = HTTP_URL, method = 'POST',
        headers = { ['content-type'] = 'application/json' },
        postData = data, callback = HTTP_RES,
       })
end

return {
 on = { devices = { IDX_STEPPER_SELECTOR }, httpResponses = { HTTP_RES } },
 logging = { level = domoticz.LOG_INFO, marker = LOG_MARKER },
 execute = function(domoticz, item)
 if (item.isDevice) then
  if item.idx == IDX_STEPPER_SELECTOR then
    domoticz.log(string.format("device=%s, state=%s, level=%d",
     item.name, item.state, item.level))
    local data = {}
    if item.level == 0 then
     data['command'] = 'stop'
    end
    if item.level == 10 then
     data['command'] = 'run'
     data['direction'] = 1
    end
    if item.level == 20 then
     data['command'] = 'run'
     data['direction'] = -1
    end
    HTTPPost(domoticz, data)
   end
  end

  if (item.isHTTPResponse) then
    if (item.isJSON) then
     local data = item.json
     domoticz.log(string.format("status=%s, title=%s, message=%s",
       data.status, data.title, data.message))
    end
  end
 end
}
```

Web Server

Libraries

See project Stepper Motor > Web Server. The same solution is used.

MicroPython Script

```
"""
File:steppermotor_timer.py
Date:20230506
Author: Robert W.B. Linn

:description
PicoW RESTful webserver to move a stepper motor (28BYJ-48 Stepper Motor with
ULN2003 motor driver).
The incoming data is from a HTTP POST request with JSON object (key:value pair)
containing the command:
{"command":"run", "direction":1 or -1}. Clockwise is 1 and anti-clockwise is -1.
{"command":"stop"}
```

```
The motor is running using a timer with periodic=10ms and callback which sets one
step. The stepper motor object uses 1ms for a step.

Additionally, a RED LED indicates if the stepper motor is running

:note
Prior using the timer class, explored other libraries like asyncio or thread ...
but found (for now) too complex to use.
MicroPython’s Timer class defines a baseline operation of executing a callback with
a given period (or once after some delay),

:examples
Command submitted using curl with HTTP response.
curl -v -H "Content-Type:application/json" -d "{\"command\":\"run\",
\"direction\":1}" http://picow-ip
{"status": "OK", "title": "{'command': 'run', 'direction': 1}", "message": "run"}

curl -v -H "Content-Type:application/json" -d "{\"command\":\"run\",
\"direction\":-1}" http:// picow-ip {"status": "OK", "title": "{'command': 'run',
'direction': -1}", "message": "run"}

curl -v -H "Content-Type:application/json" -d "{\"command\":\"stop\"}" http://
picow-ip
{"status": "OK", "title": "{'command': 'stop'}", "message": "stop"}

:wiring
Stepper Motor = Pico W
IN1 = GP2
IN2 = GP3
IN3 = GP4
IN4 = GP5
VCC = External 5V
GND = GND common with external GND

LED RED = Pico W
+ = GP21 (Pin #27)
GND = GND
"""

# Libraries
from machine import Pin
from machine import Timer
from time import sleep
import json
# Call server from server.py (must be uploaded to the picow)
from server import Server
# Stepper stored in PicoW folder lib
# Credits: This library is based on: https://github.com/IDWizard/uln2003 (c)
IDWizard 2017, # MIT License.
from stepper import Stepper
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config

# Constants
NAME = 'Stepper Motor Timer'
VERSION = 'v20230506'

# Create the LED
led1 = Pin(21, Pin.OUT)
led1.off()

# Create a stepper motor object with defaults
stepper = Stepper()
sleep(0.1)

# Create the timer object used by the function handle_request
timer_stepper = Timer()
```

```
"""
Run the stepper motor by moving a single step in direction clockwise (cw) or anti-
clockwise (acw).
Function is used by the timer_stepper object as callback.
Argument t is mandatory.
"""
def run_stepper_motor_cw(t):
    stepper.step(1)

def run_stepper_motor_acw(t):
    stepper.step(-1)

"""
Handle the request to move the stepper.
"""
def handle_request(cmd, status):
    # Assign the command to the response title
    response[config.KEY_TITLE] = str(cmd)
    # Set the response initially to ok
    response[config.KEY_STATE] = config.STATE_OK

    # If the status is 1 (OK) then action
    if status == 1:

        if cmd.get('command') != None:
            command = cmd['command']
            # print(f'Stepper Motor Command: {command}')
            if command == 'run':
                # Set the direction clockwise or anti-clockwise
                direction = 1
                if cmd.get('direction') != None:
                    direction = cmd['direction']
                # periodic with 10ms period
                if direction == 1:
                    timer_stepper.init(mode=Timer.PERIODIC, period=10,
callback=run_stepper_motor_cw)
                elif direction == -1:
                    timer_stepper.init(mode=Timer.PERIODIC, period=10,
callback=run_stepper_motor_acw)
                else:
                    print(f'[ERROR] Wrong direction')
                led1.on()
                response[config.KEY_MESSAGE] = 'run'
            elif command == 'stop':
                timer_stepper.deinit()
                led1.off()
                response[config.KEY_MESSAGE] = 'stop'
            else:
                response[config.KEY_STATE] = config.STATE_ERR
                response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN

        else:
            response[config.KEY_STATE] = config.STATE_ERR
            response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN
    else:
        response[config.KEY_STATE] = config.STATE_ERR
        response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN

    # Return the response which is send to Domoticz
    return response

# Main
print(f'{NAME} {VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect()
```

```
"""
Main Loop
"""
while True:
    try:
        # Get client connection and the request data
        cl, request = network.get_client_connection(server)

        # Get the cmd
        cmd, status = network.parse_post_request(request)

        # Create the HTTP response JSON object
        response = {}

        # Handle the command to set the servo pos
        # Set the response
        response = handle_request(cmd, status)

        # Send the response to Domoticz and close the connection (wait for new)
        network.send_response(cl, response, True)

    except OSError as e:
        ledstatus.off()
        cl.close()
        print('[ERROR] Network Connection closed')
```

Distance Sensor

Description

This project reads in regular intervals, from an Ultrasonic Distance sensor HC-SR04, the distance and sends the distance to a Domoticz Distance device.

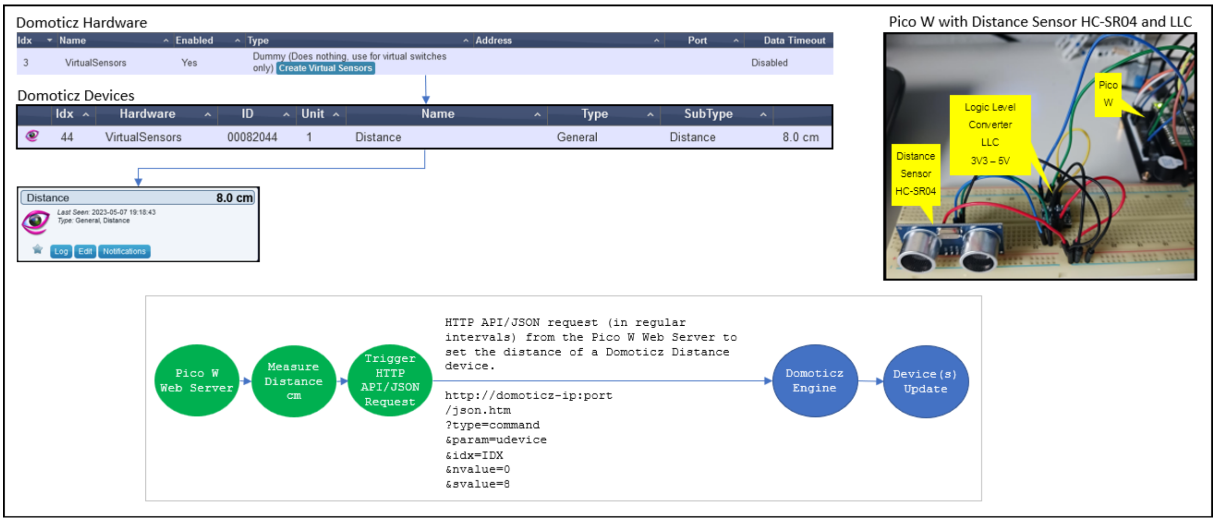
Ideas for Use

- Measure tank level,
- Monitor access control.

Solution

The Pico W has an Ultrasonic Distance sensor HC-SR04 connected and runs as a web server. The web server measures in regular intervals the distance and sends the distance via Domoticz HTTP API/JSON request to a Domoticz Distance device.

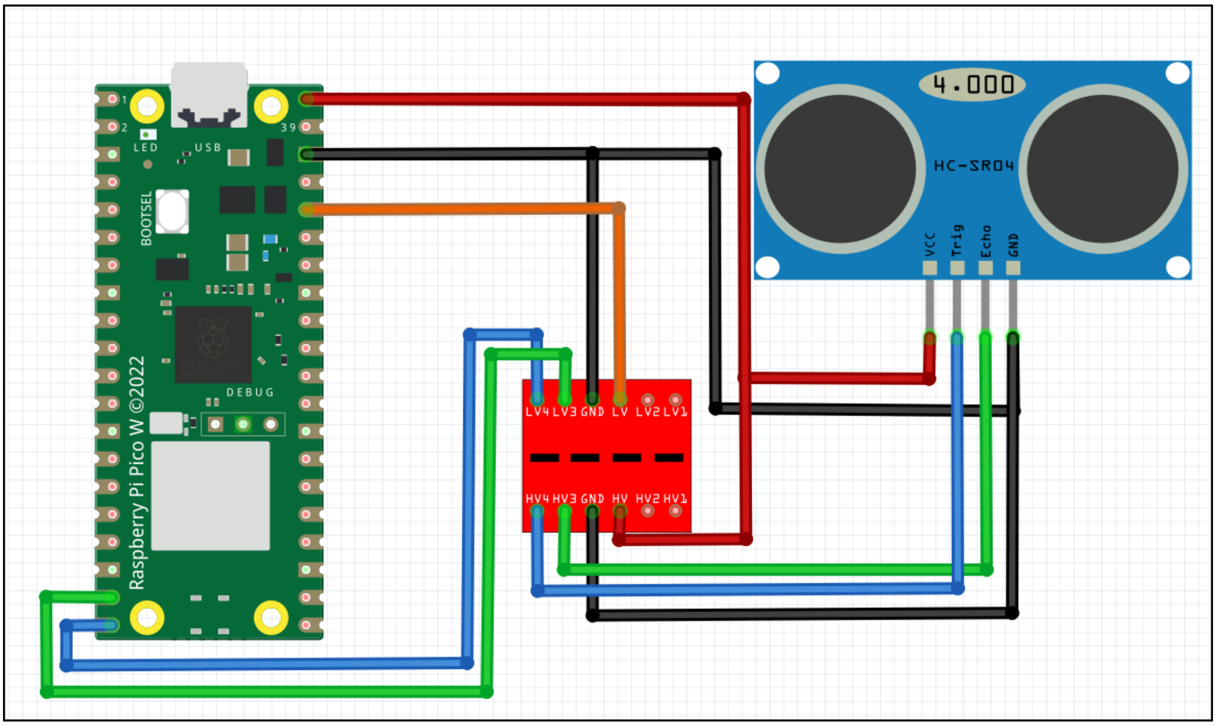
Block Diagram



Wiring

LLC = Pico W	**LLC = HC-SR04**
LV1 = N/A	LV1 = N/A
LV2 = N/A	LV2 = N/A
LV = 3V3 (OUT)	LV = N/A
GND = GND (Pin #38)	GND = N/A
LV3 = GP14 (Pin #19)	LV3 = N/A
LV4 = GP15 (Pin #20)	LV4 = N/A
HV1 = N/A	HV1 = N/A
HV2 = N/A	HV2 = N/A
HV = VBUS (Pin #40)	HV = VCC
GND = GND (Pin #38)	GND = GND
HV3 = N/A	HV3 = Echo
HV4 = N/A	HV4 = Trig
Notes LLC = Logic Level Converter 5V to 3V3. The LLC is used because the HC-SR04 operates at 5V which is higher then the Pico W GPIO pin voltage tolerance of 3V3. N/A = Pin is not used	

Circuit Diagram



Domoticz Setup

Devices

From the hardware “Dummy”, create a Distance device:
Name: Distance, Sensor Type: Distance
After creating the device, the Domoticz devices list shows the entry:

```
Idx=44, Hardware:VirtualSensors, ID=00082044, Unit=1, Name=Distance,
Type=General, SubType=Distance, Data=123.4 cm
```

Automation Script

No automation event used, but if additional action(s) required in case device has changed, then for example an Event with trigger “Device Change” could be used.

```
--[[
File:   distancesensor.dzvents
Date:   20230512
Author: Robert W.B. Linn

:description
Listen to distance device changes.
If the distance is below a threshold then log as domoticz error.
]]--

-- Device IDX
local IDX_DISTANCE = 44

-- Define the distance threshold.
-- For flexibility could use a user variable.
local THRESHOLD = 20    -- cm

return {
  -- Listen to device changes of the distance device.
 on = { devices = { IDX_DISTANCE } },
 logging = { level = domoticz.LOG_INFO, marker = 'DISTANCESENSOR', },
 execute = function(domoticz, device)
     -- domoticz.log(device)

     -- Log the device change.
   domoticz.log(string.format(
       'Device %s has changed. New state %s',
       device.name, device.state))

   -- Check if distance below threshold using the device property distance.
   local distance = device.distance
        -- Log a warning with error level to make immediate visible.
   if distance < THRESHOLD then
       -- 2023-05-12 10:53:38.046 Error: dzVents: Error: (3.1.8) IDX_DISTANCE:
[WARNING] Distance 16.2 below threshold 20!
       domoticz.log(string.format(
           '[WARNING] Distance %.1f below threshold %d!',
           distance, THRESHOLD), domoticz.LOG_ERROR)
        end
 end
}
```

Web Server

Libraries

The MicroPython script uses external the MicroPython HC-SR04 library.
The library is stored on the Pico W in folder lib (see sub chapter Additional Libraries).

Credits
Thanks for developing & sharing the MicroPython HCSR04 driver.

MicroPython Script

```
"""
File:   distancesensor.py
Date:   20230512
Author: Robert W.B. Linn

:description
Read in regular intervals the distance using a HC-SR04 sensor and update the svalue
(i.e., 20.132) of a Domoticz Distance device.
The Domoticz device from type general, distance, is updated using HTTP API/JSON
request to the Domoticz server.
/json.htm?type=command&param=udevice&idx=IDX&nvalue=0&svalue=DISTANCE
IDX = device id, DISTANCE = distance in cm or inches with decimals.

:external libraries
hcsr04 (https://github.com/rsc1975/micropython-hcsr04)
"""

# Imports
from machine import Pin
from utime import sleep
# HCSR04 from hcsr04.py (must be uploaded to the pico)
from hcsr04 import HCSR04
# Server from server.py (must be uploaded to the pico)
from server import Server
# Configuration (must be uploaded to the picow)
import config

# Constants
VERSION = 'Distance Sensor v20230512'

"""
DOMOTICZ
"""
# Distance Sensor IDX of the Domoticz Temp+Hum device
IDX_DISTANCE = 44
# URL Domoticz
# The svalue is added in the main loop after getting the data from the distance
sensor.
# The svalue format: distance
URL_DOM = "http://"+ config.DOMOTICZ_IP
+"/json.htm?type=command&param=udevice&idx=" + str(IDX_DISTANCE) +
"&nvalue=0&svalue="

"""
DISTANCESENSOR HC-SR04
"""
# Sensor Pins
PIN_ECHO = 14
PIN_TRIG = 15
distance_sensor = HCSR04(trigger_pin=PIN_TRIG, echo_pin=PIN_ECHO)

"""
SAMPLING
```

```
"""
# Distance measurement sampling rate in seconds
SAMPLING_RATE = 10

# Info
print(f'{VERSION}')
print(f'Sampling Rate: {SAMPLING_RATE}s.')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect2()

# Main
while True:

    # Measure the distance in cm
    try:
        distance = distance_sensor.distance_cm()
    except OSError as e:
        print(f'[ERROR] Can not get the distance {e}')

    # Submit Domoticz HTTP API/JSON GET request to update the device
    network.send_get_request(URL_DOM + str(distance))

    # Delay till next sample
    sleep(SAMPLING_RATE)
```

Distance Sensor MQTT Auto Discovery

Description

This project auto creates a Domoticz Distance device and regular updates the device state.

Solution

This project is based up the project Distance Sensor.

Instead communicating via HTTP, the Domoticz hardware controller MQTT Auto Discovery Client Gateway with LAN interface (MQTT Auto Discovery) is used.

The Pico W connects to the network and to the Domoticz Client Gateways for MQTT & MQTT Auto Discovery.
The config & state messages published by the Pico W are handled by the Domoticz hardware controller MQTT Auto Discovery Client Gateway with LAN interface.

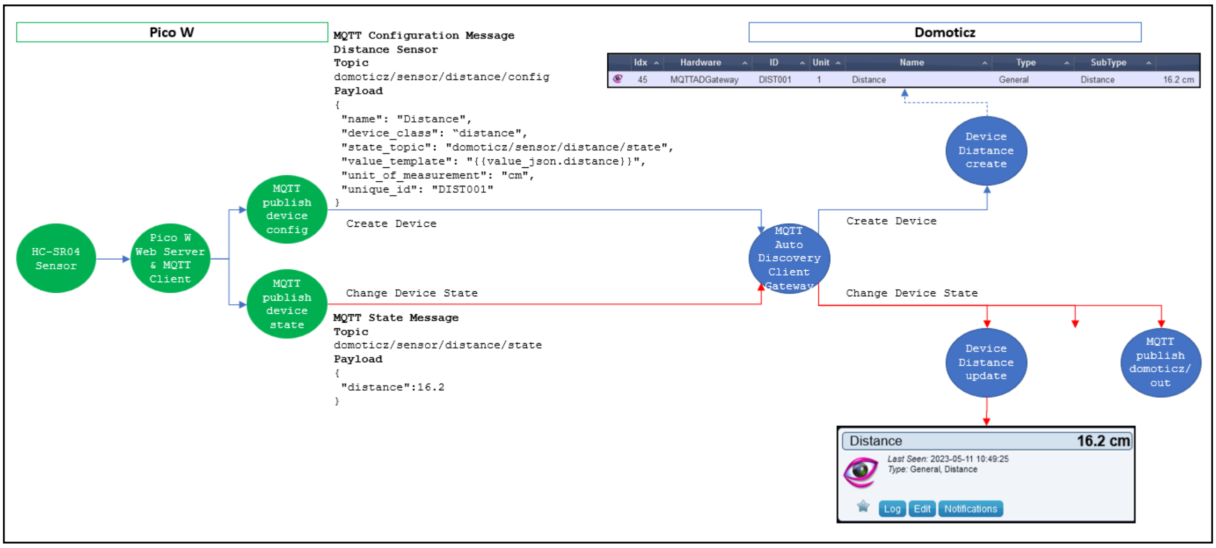
Step 1 – Publish MQTT Config message to create the Domoticz Distance device.
If these devices are already in place, Domoticz takes no action.

The Domoticz devices list with the Distance device auto created for the MQTT Auto Discovery hardware (named MQTTADGateway):

	Idx	Hardware	ID	Unit	Name	Type	SubType	
	45	MQTTADGateway	DIST001	1	Distance	General	Distance	12.7 cm

Step 2 – Publish MQTT State message after reading the distance.
The MQTT message published is picked up by Domoticz and the value of the Distance devices is updated.
See block diagram.

Block Diagram



MQTT Auto Discovery Topics & Payload

CONFIGURATION	
Distance Device	
Configuration Topic	domoticz/sensor/distance/config

Configuration Payload	{
	"name": "Distance",
	"device_class": "distance",
	"state_topic": "domoticz/sensor/distance/state",
	"value_template": "{{value_json.distance}}",
	"unit_of_measurement": "cm",
	"unique_id": "DIST001"
	}

STATE	
Topic	domoticz/sensor/distance/state

Payload
Distance
	{
	"distance":{D}
	}

	Notes • The key distance is defined in the configuration payload value_template property distance. • {D} is a placeholder for the distance value.

Domoticz

Devices

After creating the device via MQTT Auto Discovery, the Domoticz devices list shows the entry:

```
Idx=45, Hardware:VirtualSensors, ID=DIST001, Unit=1, Name=Distance,
Type=General, SubType=Distance, Data=123.4 cm
```

Debug Log

Domoticz Debug Log showing the MQTT Auto Discovery gateway receiving the message with the payload containing the distance key with values.

```
2023-05-12 11:07:12.189 Debug: MQTTADGateway: topic:
domoticz/sensor/distance/state, message: {"distance":16.23711}

2023-05-12 11:07:12.308 Debug: MQTTADGateway: topic: domoticz/out, message: {
2023-05-12 11:07:12.308 "Battery" : 255,
2023-05-12 11:07:12.308 "LastUpdate" : "2023-05-12 11:07:12",
2023-05-12 11:07:12.308 "RSSI" : 12,
2023-05-12 11:07:12.308 "description" : "",
2023-05-12 11:07:12.308 "dtype" : "General",
2023-05-12 11:07:12.308 "hwid" : "6",
2023-05-12 11:07:12.308 "id" : "DIST001",
2023-05-12 11:07:12.308 "idx" : 45,
2023-05-12 11:07:12.308 "name" : "Distance",
2023-05-12 11:07:12.308 "nvalue" : 0,
2023-05-12 11:07:12.308 "stype" : "Distance",
2023-05-12 11:07:12.308 "svalue1" : "16.2",
2023-05-12 11:07:12.308 "unit" : 1
2023-05-12 11:07:12.308 }
```

Automation Script

There is no automation script used.
See project Distance Sensor for an example.

Web Server

Libraries

In addition to the MicroPython HCSR04 library (see project Distance Sensor), the MicroPython script uses the MicroPython library Lightweight MQTT client for MicroPython "umqtt.simple".

Credits
Thanks for developing & sharing the MicroPython library micropython-umqqt.simple.

MicroPython Script

```
"""
File:   distancesensor_mqtt_ad.py
Date:   20230511
Author: Robert W.B. Linn

:description
Test MQTT auto discovery with Domoticz and the Pico W running as web server.
Domoticz Hardware: MQTT Auto Discovery Client Gateway with LAN Interface,
Name=MQTTADGateway
Domoticz Devices created via MQTT auto discovery by publishing config topic (see
domoticz log below).
The device is from type General, Distance.

:external libraries
umqtt.simple (https://github.com/micropython/micropython-
lib/tree/master/micropython/umqtt.simple)
hcsr04 (https://github.com/rsc1975/micropython-hcsr04)

MQTT Remove Retained messages:
Distance Device:
mosquitto_sub -h localhost --remove-retained -t 'domoticz/sensor/distance/config' -
W 1
"""

# Imports
import network
import time
from machine import Pin
from utime import sleep, sleep_ms
# Installed via Thonny manage packages
from umqtt.simple import MQTTClient
# HCSR04 from hcsr04.py (must be uploaded to the pico)
from hcsr04 import HCSR04
# Call server from server.py (must be uploaded to the picow)
from server import Server
# Configuration (must be uploaded to the pico w)
import config
import sys

# Constants
VERSION = const('distance_mqtt_ad v20230512')

"""
DISTANCESENSOR HC-SR04
"""
# Sensor Pins
PIN_ECHO = 14
PIN_TRIG = 15
distance_sensor = HCSR04(trigger_pin=15, echo_pin=14)

"""
```

```
SAMPLING
"""
# Distance measurement sampling rate in seconds
SAMPLING_RATE = 10

"""
MQTT
"""
MQTT_BROKER  = config.DOMOTICZ_MQTT_IP
MQTT_CLIENT_ID = const('picow_distance_sensor')

# Topic & payload to create the device. The configuration component is sensor.
DISTANCE_TOPIC_CONFIG     = const(b'domoticz/sensor/distance/config')
DISTANCE_PAYLOAD_CONFIG   = const(b'{"name": "Distance", "device_class":
"distance", "state_topic": "domoticz/sensor/distance/state", "value_template":
"{{value_json.distance}}", "unit_of_measurement": "cm", "unique_id": "DIST001"}')

# Topic used to publish the state of the sensor
# Payload is JSON format: {"distance":NN}
STATE_TOPIC  = const(b'domoticz/sensor/distance/state')
STATE_PAYLOAD   = '{"distance":{D}}'

def mqtt_connect(client_id, mqtt_server):
    """Connect to the MQTT broker with client id and server address"""
    client = MQTTClient(client_id, mqtt_server, keepalive=3600)
    client.connect()
    print(f'MQTT Broker connecting...')
    return client

def mqtt_reconnect():
    """Reconnect to the MQTT broker"""
    print('[ERROR] Failed to connect to the MQTT Broker. Reconnecting...')
    time.sleep(5)
    machine.reset()

def mqtt_init():
    """Connect to MQTT & Publish mqtt auto discovery topic & payload for the
domoticz device"""
    try:
        # Connect to MQTT broker
        client = mqtt_connect(MQTT_CLIENT_ID, MQTT_BROKER)
        print(f'MQTT Broker connected: {MQTT_BROKER}')

        # Publish config topic to auto create the distance device in domoticz
        client.publish(DISTANCE_TOPIC_CONFIG, DISTANCE_PAYLOAD_CONFIG)
        print(f'MQTT Auto Discovery published:
topic={DISTANCE_TOPIC_CONFIG.decode()},
payload={DISTANCE_PAYLOAD_CONFIG.decode()}')
        return client

    except OSError as e:
        mqtt_reconnect()

# Info
print(f'{VERSION}')
print(f'Sampling Rate: {SAMPLING_RATE}s.')

# Create network object using the ssid & password from config.py
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect()

# Connect to MQTT
mqtt_client = mqtt_init()

# Main
while True:
```

```
    try:
        # Measure distance, set payload message (encoded for mqtt client publish)
        payload = STATE_PAYLOAD.replace('{D}',
                  str(distance_sensor.distance_cm())).encode()

        # MQTT publish with encoded topic & payload (buffered objects required)
        mqtt_client.publish(STATE_TOPIC, payload)
        print(f'MQTT published: topic={STATE_TOPIC.decode()},
         payload={payload.decode()}')

    except OSError as e:
        print(f'[ERROR] Can not get the distance {e}')

    # Delay till next sample
    sleep(SAMPLING_RATE)
```

IKEA VINDRIKTNING Air Quality Sensor

Description

This project listens to data received from an IKEA VINDRIKTNING [1] Air Quality sensor and sends the Air Quality Particulate Matter 2.5µm Concentration (µg/m3, PM2.5) to a Domoticz Custom Sensor.

Ideas for Use

- Measure room air quality.

Solution

The Pico W runs as a web server with IKEA VINDRIKTNING Air Quality sensor connected.

From the sensor internal MCU test pad, the pin REST is connected to the Pico W UART Serial Bus 0 (UART0), pin GND to Pico W GND and pin 5V to Pico W VBUS or 5V.
This means, the sensor data is received by the Pico W via UART Serial Communication.
The sensor sends every ~20 seconds, 5-6 serial messages over UART0.

The message buffer received from the sensor must have a length of 20 bytes.
The first 3 bytes (the header) must be 0x16 0x11 0x0B.
The bytes 5 & 6 are used to calculate the PM2.5 concentration.
An offset (absolute difference between current and previous value) is used to update the sensor data in Domoticz instead of updating with a value that has not changed.

The data send to Domoticz can be via HTTP API/JSON (REST) or using the MQTT Auto Discovery Client Gateway.

The sensor has an RGB LED strip to indicate the Air Quality level:

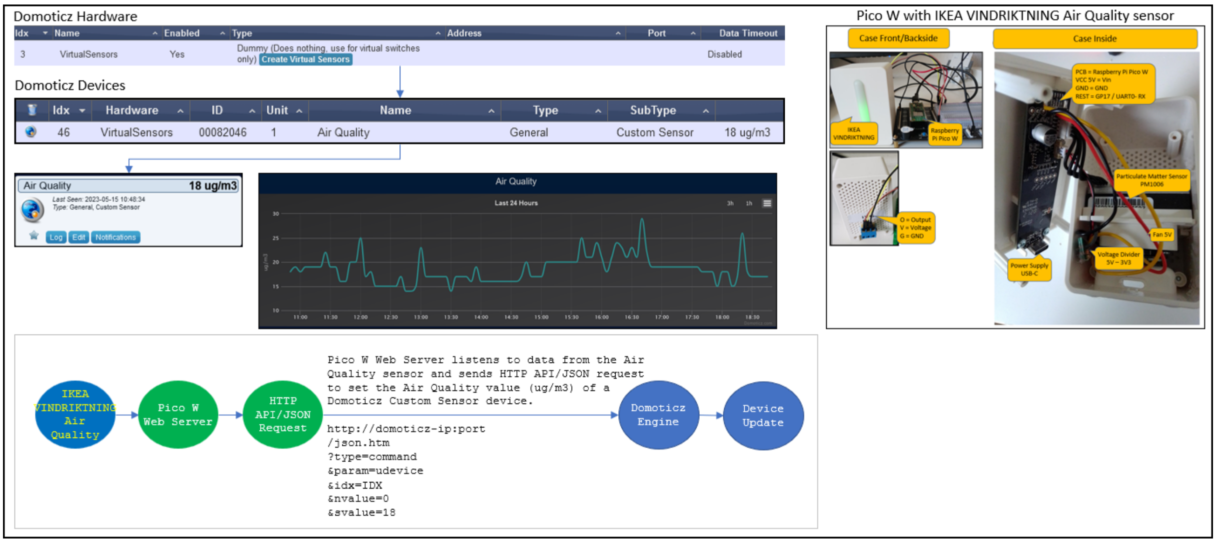
- Level 1 = 0-35 ug/m3 (good/green)
- Level 2 = 36-85 ug/m3 (moderate/yellow)
- Level 3 = 86 ug/m3 and up (bad/red)

Notes

- The sensor modification, at the MCU test pad, does not impact its operation.
- Making modifications to IKEA VINDRIKTNING Air Quality sensor are for your own risk.

[1] *IKEA*® is a *trademark* of Inter-*IKEA* Systems B.V.

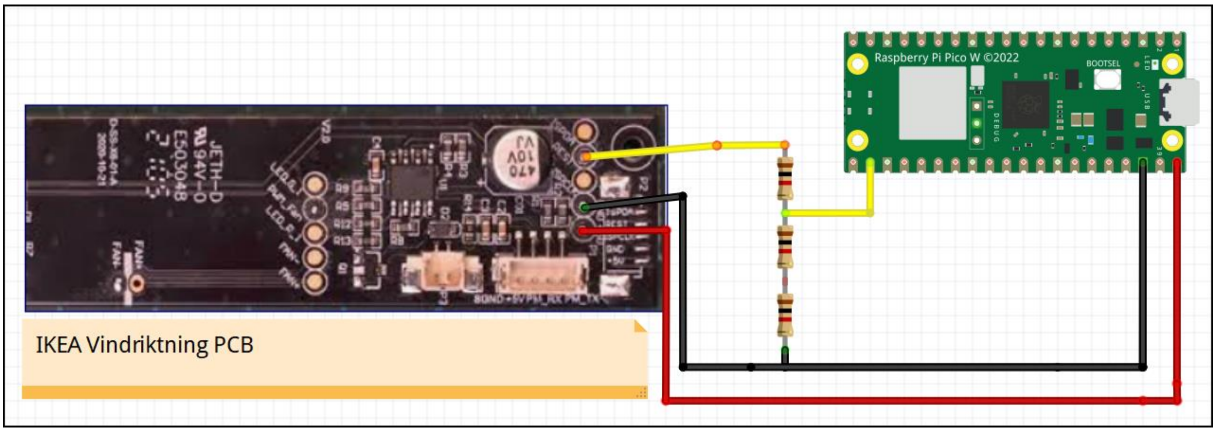
Block Diagram



Wiring

IKEA VINDRIKTNING Air Quality sensor	Pico W
VCC	VUSB (Pin #40)
GND	GND (Pin #38)
Test Pad REST (TX Pin)	GP17 (Pin #22) with voltage divider 5V to 3V3.

Circuit Diagram



Note
Between the sensor TX pin and the Pico W RX pin, a voltage divider 5V to 3V3 is required.

Domoticz Setup

Devices

From the hardware "Dummy", create a Custom Sensor device:
Name: Air Quality, Sensor Type: Custom Sensor
After creating the device, the Domoticz devices list shows the entry:

```
Idx=46, Hardware:VirtualSensors, ID=00082046, Unit=1, Name=Air Quality,
Type=General, SubType=Custom Sensor, Data=0 ug/m
```

Automation Script

No automation event used. See section Enhancements for some examples.

Web Server

Libraries

The MicroPython script uses the IKEA VINDRIKTNING library (ikeavindriktning.py) developed by the author.
The library is stored on the Pico W in folder lib (see sub chapter Additional Libraries).

```
"""
File:ikeavindriktning.py
Date:20230515
Author: Robert W.B. Linn
Description
Library for the IKEA Vindriktning Air Quality sensor. Tested on a Raspberry Pi Pico
W.
"""
__version__ = '0.5.0'
__author__ = 'Robert W.B. Linn'
__license__ = 'GNU GENERAL PUBLIC LICENSE Version 3, https://www.gnu.org/licenses/'

# Imports
from machine import Pin,UART
import time

class IKEAVINDRIKTNING:
    # Define the air quality level thresholds min & max
    AIR_QUALITY_LEVEL_GREEN_MIN  = 0
    AIR_QUALITY_LEVEL_GREEN_MAX  = 35
    AIR_QUALITY_LEVEL_YELLOW_MIN = AIR_QUALITY_LEVEL_GREEN_MAX
    AIR_QUALITY_LEVEL_YELLOW_MAX = 85
    AIR_QUALITY_LEVEL_RED_MIN    = AIR_QUALITY_LEVEL_YELLOW_MAX
    AIR_QUALITY_LEVEL_RED_MAX    = 1000

    def __init__(self, uartport=0, rxpin=17, offset=5):
        """
        Init the class with default UART port and RX pin.
        :param int uartport
            Set the UART peripherals 0 (for UART0) or 1 (for UART1).
        :param int rxpin
            Set the receiver (RX pin). Default GP 17 (Pin #22).
        :param int offset
            Set the value offset used to transmit the data.
        """

        # Properties for the current & previous air quality & level
        self.air_quality_current = -1
        self.air_quality_previous = self.air_quality_current
```

```
        self.air_quality_level_current = -1
        self.air_quality_level_previous = self.air_quality_level_current
        self.air_quality_offset = offset

        # Create the uart instance with uart0, tx=None, rx=gp17
        self.uart = UART(uartport, baudrate=9600, tx=None, rx=Pin(rxpin))

        # Initialize uart instance with 8 bits data, no parity bit, 2 stop bits.
        self.uart.init(bits=8, parity=None, stop=2)

    def is_valid_message_length(self, data):
        """Check if the message has 20 bytes"""
        if len(data) == 20:
            # print(f'Received message with correct length: {len(data)}.')
            return True
        else:
            print(f'[ERROR] Received message with invalid length: {len(data)}')

    def is_valid_message_header(self, data):
        """'Check the message header. The first 3 bytes must be 16 11 0B."""
        if (data[0] == 0x16) and (data[1] == 0x11) and (data[2] == 0x0B):
            # print(f'Received message with correct header.')
            return True
        else:
            print(f'[ERROR] Received message with invalid header.')
            return False

    def checksum(self, data):
        """Create a checksum."""
        return b'%02X' % (sum(data) & 0xFF)

    def is_valid_checksum(self, data):
        """Check if the data checksum is 0."""
        checksum = int(self.checksum(data))
        if (checksum == 0):
            # print(f'Received message with correct checksum: {checksum}.')
            return True
        else:
            print(f'[ERROR] Received message with invalid checksum. Expected: 0.
Actual: {checksum}')
            return False

    def air_quality(self, data):
        """Calculate the air quality pm2.5 value from the bytes data 5 & 6"""
        air_quality = data[5] * 256 + data[6]
        # print(f'air_quality={air_quality}')
        return air_quality

    def air_quality_level(self, data):
        """
        Get the air quality level depending on air_quality PM2.5 value.
        The sensor has 3 levels and LED indicators:
        Green LOW: 0-35=Good, Amber MEDIUM: 36-85=OK, Red (HIGH): 86-1000=NOT GOOD.
        Returns - air_quality level 1=LOW (GREEN), 2=MEDIUM (YELLOW), 3=HIGH (RED)
        """
        # Set initial air quality level
        air_quality_level = -1

        # Get the air quality
        value = self.air_quality(data)

        # Calculate the air quality level
        # Level 1 = LOW = GREEN
        if value <= self.AIR_QUALITY_LEVEL_GREEN_MAX:
            air_quality_level = 1
        # Level 2 = MEDIUM = YELLOW
        elif value > self.AIR_QUALITY_LEVEL_YELLOW_MIN and value <=
self.AIR_QUALITY_LEVEL_YELLOW_MAX:
            air_quality_level = 2
```

```
        # Level 3 = HIGH = RED
        elif value > self.AIR_QUALITY_LEVEL_RED_MIN:
            air_quality_level = 3
        # print(f'air_quality_level={level}, value={value}')
        return air_quality_level

    def air_quality_data(self, data):
        """Get sensor air_quality pm2.5 value 0-100 ug/m3 and the
           level 1-3 (GREEN, YELLOW, RED)."""
        # Check the message data
        if self.is_valid_message_length(data) and
           self.is_valid_message_header(data) and
           self.is_valid_checksum(data):

            # Get the current air quality pm2.5 (0 - 100) and the level 1-3
            self.air_quality_current           = self.air_quality(data)
            self.air_quality_level_current     = self.air_quality_level(data)

            # Check if value has changed > offset (to avoid sending same values)
            if abs(self.air_quality_current - self.air_quality_previous) >
self.air_quality_offset:
                self.air_quality_previous = self.air_quality_current
                self.air_quality_level_previous = self.air_quality_level_current

                # Return dit with two entries
                return self.air_quality_current, self.air_quality_level_current
```

MicroPython Script

```
"""
File:ikeavindriktning.py
Date:20230515
Author: Robert W.B. Linn
"""
# Imports
from machine import Pin,UART
from utime import sleep
# Class IKEAVINDRIKTNING library ikeavindriktning.py (must be uploaded to picow)
from ikeavindriktning import IKEAVINDRIKTNING
# Class server from the library server.py (must be uploaded to picow)
from server import Server
# Configuration (must be uploaded to the picow)
import config

# Constants
VERSION = 'IKEA VINDRIKTNING v20230515'

"""
PICO W
"""
PIN_UART0_RX = 17   # IKEA VINDRIKTNING UART0 RX Pin GP17 #Pin 22

"""
IKEA VINDRIKTNING SENSOR
"""
UART_BUS = 0        # UART bus 0
VALUE_OFFSET = 2    # Update Domoticz air quality device is abs value between old
and new value > offset
# Create an IKEA VINDRIKTNING object
# UART Serial Bus Number 0 or 1, RX pin (default GP17), offset new/old value
iv = IKEAVINDRIKTNING(UART_BUS, PIN_UART0_RX, VALUE_OFFSET)

"""
DOMOTICZ
"""
# IDX of the Domoticz Custom Sensor device for the Air Quality
DOM_IDX = 46
# Domoticz API/JSON URL
```

```
# The svalue (containing the air quality) is added in the main loop after getting
the data from the sensor.
DOM_URL = "http://"+ config.DOMOTICZ_IP
+"/json.htm?type=command&param=udevice&idx=" + str(DOM_IDX) + "&nvalue=0&svalue="

# Info
print(f'{VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect2()

# Loop forever
while True:
    # Check if there is data send from the sensor via serial line
    if iv.uart.any():

        # Get the air quality & air quality level as dict
        data = iv.air_quality_data(iv.uart.read())

        # Check if the dict contains data - only if above offset
        if data != None:
            # Log the air quality & level from the data dict
            print(f'Air Quality pm2.5={data[0]} ug/m3, level={data[1]}')

            # Submit Domoticz HTTP API/JSON GET request to update the device
            network.send_get_request(DOM_URL + str(data[0]))

        # Wait a second
        sleep(1)
```

Enhancements

The next described enhancements are ideas and not all fully worked out.

Domoticz Alert Device Air Quality Level

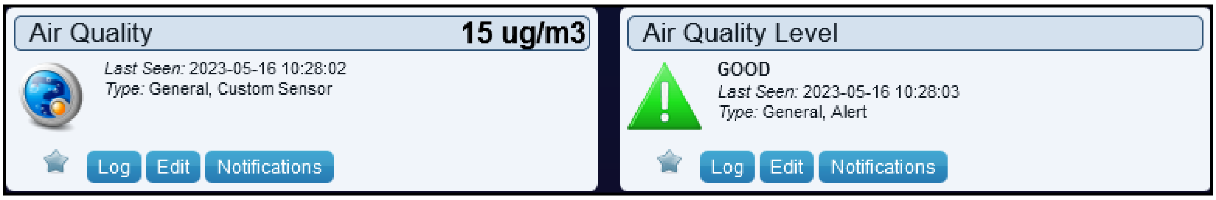
Define a Domoticz Alert device to show the Air Quality Level derived from the Air Quality value.
The Alert device text and value could be set via the next outlined solutions.

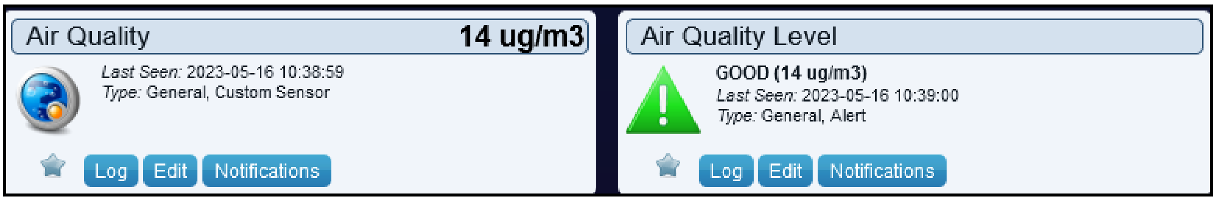
Create Alert Device
Create from the hardware controller dummy, the device named Air Quality Level and sensor type Alert. After device creation, the Domoticz devices list shows the new device:

```
IDX=48, Hardware=VirtualSensors, ID=82048, Unit=1, Name=Air Quality Level,
Type=General, SubType=Alert, Data=No Alert!
```

REST API Request MicroPython script

The MicroPython script below updates the Air Quality and the Air Quality Level devices via HTTP API/JSON requests to the Domoticz server.
The text of the Air Quality Alert Sensor could also show the Air Quality value in ug/m3 as displayed in the 2nd screen shot of the Air Quality widgets from the Domoticz GUI.





MicroPython Script

```
"""
File:ikeavindriktning-alert-sensor.py
Date:20230516
Author: Robert W.B. Linn
This example is an enhancement of ikeavindriktning.py.
"""

# Imports
from machine import Pin,UART
from utime import sleep
# Class IKEAVINDRIKTNING from lib ikeavindriktning.py - stored in Pico W folder lib
from ikeavindriktning import IKEAVINDRIKTNING
# Class Server from lib server.py - stored in Pico W folder lib

from server import Server
# Configuration (must be uploaded to the picow)
import config
```

```
# Constants
VERSION = 'IKEA VINDRIKTNING ALERT SENSOR v20230516'

"""
PICO W
"""
PIN_UART0_RX = 17   # IKEA VINDRIKTNING UART0 RX Pin GP17 #Pin 22

"""
IKEA VINDRIKTNING SENSOR
"""
UART_BUS = 0        # UART bus 0
VALUE_OFFSET = 2    # Update Domoticz air quality device is abs value between old
and new value > offset
# Create an IKEA VINDRIKTNING object
# UART Serial Bus Number 0 or 1, RX pin (default GP17), offset new/old value
iv = IKEAVINDRIKTNING(UART_BUS, PIN_UART0_RX, VALUE_OFFSET)

"""
DOMOTICZ
"""
# Air Quality
# IDX of the Domoticz Custom Sensor for the Air Quality
DOM_IDX_AIR_QUALITY = 46
# Domoticz API/JSON URL
# The svalue (containing the air quality) is added in the main loop after getting
the data from the sensor.
DOM_URL_AIR_QUALITY = "http://"+ config.DOMOTICZ_IP
+"/json.htm?type=command&param=udevice&idx=" + str(DOM_IDX_AIR_QUALITY) +
"&nvalue=0&svalue="

# Air Quality Level
# IDX of the Domoticz Alert Sensor for the Air Quality Level
DOM_IDX_AIR_QUALITY_LEVEL = 48
# Domoticz API/JSON URL
# Level = (1=green, 2=yellow, 3=orange), TEXT = GOOD, MODERATE, BAD.
DOM_URL_AIR_QUALITY_LEVEL = "http://"+ config.DOMOTICZ_IP
+"/json.htm?type=command&param=udevice&idx=" + str(DOM_IDX_AIR_QUALITY_LEVEL) +
"&nvalue={LEVEL}&svalue={TEXT}"
# Define the 3 air quality levels with text used for the alert sensor text.
# Note the text could be enhanced with the air quality value, i.e. GOOD (19 ug/m3)
air_quality_levels = { 1: "GOOD", 2: "MODERATE", 3: "BAD"}

# Info
print(f'{VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect2()

# Loop forever
while True:

    # Check if there is data send from the sensor via serial line
    if iv.uart.any():

        # Get the air quality & air quality level as dict
        data = iv.air_quality_data(iv.uart.read())

        # Check if the dict contains data - only if above offset
        if data != None:
            # Log the air quality & level from the data dict
            print(f'Air Quality pm2.5={data[0]} ug/m3, level={data[1]}')

            # Submit Domoticz HTTP API/JSON GET requests to update the devices
```

```
            # Air Quality Custom Sensor
            url = DOM_URL_AIR_QUALITY + str(data[0])
            network.send_get_request(url)

            # Wait a moment before sending another request
            sleep(1)

            # Air Quality Level Alert Sensor
            url = DOM_URL_AIR_QUALITY_LEVEL
            url = url.replace('{LEVEL}', str(data[1]))
            # Option text with level text only i.e., GOOD
            # url = url.replace('{TEXT}', air_quality_levels[data[1]])
            # Option to enhance text with air quality value i.e., GOOD (19 ug/m3)
            url = url.replace('{TEXT}',
                  f'{air_quality_levels[data[1]]}%20({str(data[0])}%20ug/m3)')
            network.send_get_request(url)

        # Wait a second
        sleep(1)
```

Automation Script Trigger Air Quality Device Change

The dzVents automation script updates the Air Quality Alert sensor using the same calculation as in the IKEA VINDRIKTNING library (ikeavindriktning.py).
The automation script enables to define additional actions depending on Air Quality level.

MicroPython Script

The MicroPython script, ikeavindriktning.py, is the same as for the first solution.

Automation Script

```
--[[
File:   ikeavindriktning-alert-sensor.dzvents
Date:   20230516
Author: Robert W.B. Linn

:description
Listen to air quality device changes to set the level & text of the air quality
alert sensor.
]]--

-- Device IDXs
local IDX_AIR_QUALITY = 46          -- Custom sensor
local IDX_AIR_QUALITY_LEVEL = 48    -- Alert sensor

-- Define the air quality levels.
local air_quality_levels = {"GOOD", "MODERATE", "BAD", "UNKNOWN"}

-- Update the alert sensor device
-- Green GOOD: 0-35, Amber MODERATE: 36-85, Orange BAD: > 86.
local function update_air_quality_level(domoticz, value)
    value = tonumber(value)
    local level = 4
    if value >= 0 and value <= 35 then
        level = 1
    elseif value > 35 and value <= 85 then
        level = 2
    elseif value > 85 then
        level = 3
    end
    -- local text = air_quality_levels[level]
    local text = string.format('%s (%d ug/m3)', air_quality_levels[level], value)
  domoticz.log(string.format(
        'update_air_quality_level: value=%d, level=%d, text=%s',
        value, level, text))
```

```
    -- Update the alert sensor
    domoticz.devices(IDX_AIR_QUALITY_LEVEL).updateAlertSensor(level, text)
end

return {
    -- Listen to device changes of the air quality device.
 on = { devices = { IDX_AIR_QUALITY } },
 logging = { level = domoticz.LOG_INFO, marker = 'IKEAVINDRIKTNING', },
 execute = function(domoticz, device)
        update_air_quality_level(domoticz, device.state)
 end
}
```

Automation Script Trigger Custom Event

MicroPython script sending a HTTP API/JSON POST request to a dzVents custom event with data in JSON format, like

```
{
"value":NN, "level":N
}
```

The custom event to update both devices Air Quality and Air Quality Level.
The dzVents automation script enables to define additional actions depending on air quality level.

MicroPython Script

```
"""
File:ikeavindriktning-custom-event.py
Date:20230515
Author: Robert W.B. Linn
This example is an enhancement of ikeavindriktning.py.
"""

# Imports
from machine import Pin,UART
from utime import sleep
# Class IKEAVINDRIKTNING from the lib ikeavindriktning.py - stored in Pico W folder
lib
from ikeavindriktning import IKEAVINDRIKTNING
# Class Server from the library server.py - stored in Pico W folder lib
from server import Server
# Configuration (must be uploaded to the picow)
import config

# Constants
VERSION = 'IKEA VINDRIKTNING CUSTOM EVENT v20230516'

"""
PICO W
"""
PIN_UART0_RX = 17   # IKEA VINDRIKTNING UART0 RX Pin GP17 #Pin 22

"""
IKEA VINDRIKTNING SENSOR
"""
UART_BUS = 0         # UART bus 0
VALUE_OFFSET = 0     # Update Domoticz air quality device is abs value between old
and new value > offset
# Create an IKEA VINDRIKTNING object
# UART Serial Bus Number 0 or 1, RX pin (default GP17), offset new/old value
iv = IKEAVINDRIKTNING(UART_BUS, PIN_UART0_RX, VALUE_OFFSET)
```

```
"""
DOMOTICZ
"""
# Domoticz API/JSON URL for the custom event handled by POST request.
# The postdata is added after having the data received: {"value":NN,"level":N}
DOM_URL = "http://"+ config.DOMOTICZ_IP
+"/json.htm?type=command&param=customevent&event=airquality&data="

# Info
print(f'{VERSION}')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect2()

# Loop forever
while True:

    # Check if there is data send from the sensor via serial line
    if iv.uart.any():

        # Get the air quality & air quality level as dict
        data = iv.air_quality_data(iv.uart.read())

        # Check if the dict contains data - only if above offset
        if data != None:
            # Log the air quality & level from the data dict
            print(f'Air Quality pm2.5={data[0]} ug/m3, level={data[1]}')

            # Submit Domoticz HTTP API/JSON GET request to update the device
            # Post data
            postdata = {}
            postdata['value'] = data[0]
            postdata['level'] = data[1]
            # Submit domoticz
            status = network.send_post_request(DOM_URL, postdata)

        # Wait a second
        sleep(1)
```

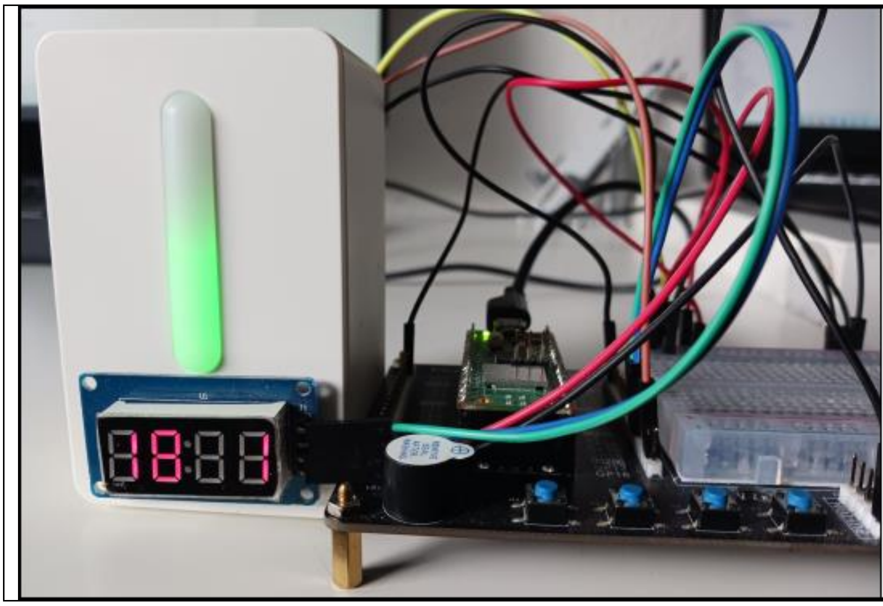
Automation Script

```
--[[
File:   ikeavindriktning-custom-event.dzvents
Date:   20230516
Author: Robert W.B. Linn

:description
Listen to custom event to set the air quality devices custom sensor value and level
& text of the air quality alert sensor.
]]--

-- Custom event name as used by the PicoW webserver HTTP API/JSON POST request
local CUSTOM_EVENT_NAME = 'airquality'

-- Device IDXs
local IDX_AIR_QUALITY = 46          -- Custom sensor
local IDX_AIR_QUALITY_LEVEL = 48    -- Alert sensor

-- Define the air quality levels.
local air_quality_levels = {"GOOD", "MODERATE", "BAD", "UNKNOWN"}

-- Get the air quality alert sensor level & text
-- Green GOOD: 0-35, Amber MODERATE: 36-85, Orange BAD: > 86.
local function air_quality_level_text(domoticz, value)
```

```
    value = tonumber(value)
    local level = 4
    if value >= 0 and value <= 35 then
        level = 1
    elseif value > 35 and value <= 85 then
        level = 2
    elseif value > 85 then
        level = 3
    end
    -- local text = air_quality_levels[level]
    local text = string.format('%s (%d ug/m3)', air_quality_levels[level], value)
    domoticz.log(string.format(
        'update_air_quality_level: value=%d, level=%d, text=%s',
        value, level, text))
    data = {}
    data['level'] = level
    data['text'] = text
    return data
end

return {
 on = { customEvents = { CUSTOM_EVENT_NAME } },
 logging = { level = domoticz.LOG_INFO, marker = 'IKEAVINDRIKTNING', },
 execute = function(domoticz, triggeredItem)
  if (triggeredItem.isCustomEvent) then
      -- domoticz.log(triggeredItem.data)
       -- Check the custom event name in case there are more custom events
      if (triggeredItem.trigger == CUSTOM_EVENT_NAME) then
        -- Get the JSON object from the triggered item
        local event_data = triggeredItem.json
        -- Log to check air quality value and level to be set
        domoticz.log(string.format('value=%d, level=%d',
         event_data.value, event_data.level))
        -- Update the custom sensor
        domoticz.devices(IDX_AIR_QUALITY).updateCustomSensor(event_data.value)
         -- Update the alert sensor
        local alert_data = air_quality_level_text(domoticz, event_data.value)
        domoticz.devices(IDX_AIR_QUALITY_LEVEL).updateAlertSensor(
         alert_data['level'], alert_data['text'])
      end
  end
 end
}
```

7-Segment Display TM1637

Display on a TM1637 7-Segment Display, the air quality value, 0-99 rounded and the level 1 or 2 or 3.
See TM1637 4-digit 7-segment LED Display.



Prototype Sensor + TM1637 showing Air Quality 18 ug/m3 and Air Quality Level 1 (GOOD).

MicroPython Script

```
"""
File:ikeavindriktning-tm1637.py
Date:20230516
Author: Robert W.B. Linn

:description
Receive data via UART Serial Communication from the IKEA VINDRIKTNING Air Quality
sensor based on particles. PM2.5 = Particulate Matter 2.5µm Concentration (µg/m3).
The air quality value 0-100+ and the air quality level 1 (good), 2 (moderate), 3
(bad) are calculated.
The value is sent via HTTP API/JSON to a Domoticz Custom Sensor.
The value and level are displayed on a 7-segment-LED display.

This example is an enhancement of ikeavindriktning.py.

:wiring
IKEA VINDRIKTNING = Pico W
VCC = 5V (Pin #40, VBUS)
GND = GND (Pin #38)
Data = GP17 (Pin #22, UART0 RX) + Voltage divider 5V to 3V3

TM1637 I2C = Pico W
VCC = VBUS (5V) (Pin #40)
SDA = GP20 (Pin #26)
SCL = GP21 (Pin #27)
GND = GND  (Pin #38)
"""

# Imports
from machine import Pin,UART
from utime import sleep
# Class IKEAVINDRIKTNING from lib ikeavindriktning.py - stored in Pico W folder lib
from ikeavindriktning import IKEAVINDRIKTNING
# TM1637 lib - stored in Pico W folder lib
import tm1637
# Class Server from the library server.py  - stored in Pico W folder lib
```

```
from server import Server
# Configuration (must be uploaded to the picow)
import config

# Constants
VERSION = 'IKEA VINDRIKTNING TM1637 v20230516'

"""
PICO W
"""
PIN_UART0_RX = 17   # IKEA VINDRIKTNING UART0 RX Pin GP17 #Pin 22

"""
IKEA VINDRIKTNING SENSOR
"""
UART_BUS = 0        # UART bus 0
VALUE_OFFSET = 2    # Update Domoticz air quality device is abs value between old
and new value > offset
# Create an IKEA VINDRIKTNING object
# UART Serial Bus Number 0 or 1, RX pin (default GP17), offset new/old value
iv = IKEAVINDRIKTNING(UART_BUS, PIN_UART0_RX, VALUE_OFFSET)

"""
TM1637
"""
TM1637_I2C_ADDRESS = 0x27  # Default I2C address
TM1637_PIN_DIO = 20
TM1637_PIN_CLK = 21

def tm1637_init(address, pindio, pinclk):
    """Create the TM1637 object by init the TM1637 with i2c.
        Example: tm1637_init(TM1637_I2C_ADDRESS, TM1637_PIN_DIO, TM1637_PIN_CLK)
        Return - TM1637 object
    """
    try:
        tm = tm1637.TM1637(clk=Pin(pinclk), dio=Pin(pindio))
        # print("TM1637 init.")
        return tm
    except OSError as e:
        raise RuntimeError('[ERROR] TM1637 init.')

def tm1637_set_display(value, level):
    """Display air quality value and level."""

    # Clear the display first
    tm.show('    ')
    sleep(.3)

    # Round the value
    value = round(value, 0)
    # Check if the value is < 100
    if value > 99:
        value = 99
    # Set the space between value and level
    space = ' '
    if value < 10:
        space = '  '
    # Set the text
    text = f'{value}{space}{level}'
    # Show the text
    tm.show(text)

"""
DOMOTICZ
"""
# IDX of the Domoticz Custom Sensor for the Air Quality
DOM_IDX = 46
# Domoticz API/JSON URL
```

```
# The svalue (containing the air quality) is added in the main loop after getting
the data from the sensor.
DOM_URL = "http://"+ config.DOMOTICZ_IP
+"/json.htm?type=command&param=udevice&idx=" + str(DOM_IDX) + "&nvalue=0&svalue="

# Info
print(f'{VERSION}')

# TM1637 display init
tm = tm1637_init(TM1637_I2C_ADDRESS, TM1637_PIN_DIO, TM1637_PIN_CLK)
tm.show(' Ok ')

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD, DEBUG=True)

# Connect to the network and get the server object
server = network.connect2()

# Loop forever
while True:

    # Check if there is data send from the sensor via serial line
    if iv.uart.any():

        # Get the air quality & air quality level as dict
        data = iv.air_quality_data(iv.uart.read())

        # Check if the dict contains data - only if above offset
        if data != None:
            # Log the air quality & level from the data dict
            print(f'Air Quality pm2.5={data[0]} ug/m3, level={data[1]}')

            # Display air quality value 0-99 and level 1-3 on the TM1637 display.
            tm1637_set_display(data[0], data[1])

            # Submit Domoticz HTTP API/JSON GET request to update the device
            network.send_get_request(DOM_URL + str(data[0]))

        # Wait a second
        sleep(1)
```

Traffic Light

Instead using the sensor RGB LEDs, use a Traffic Light LED.
Not started.

MQTT Auto Discovery

Use the Domoticz MQTT Auto Discovery Client Gateway (MQTT-AD) to send data from the Pico W to Domoticz.

Started testing for a Custom Sensor using the mosquitto_pub client from the CLI on the Domoticz Test System

Configuration Message

```
mosquitto_pub -r -h localhost -p 1883
-t "domoticz/sensor/airquality/config"
-m '{
"name": "Air Quality",
"device_class": "airquality",
"state_topic": "domoticz/sensor/airquality/state",
"value_template": "{{value_json.airquality}}",
"unit_of_measurement": "ug/m3",
"unique_id": "AQ001"
}'
```

MQTT-AD State Message

```
mosquitto_pub -h 127.0.0.1 -p 1883
-t "domoticz/sensor/airquality/state"
-m '{"airquality":16}'
```

Domoticz Device

The device is created after sending the MQTT-AD Config and State messages.

```
IDX=47, hardware=MQTTADGateway,ID=AQ001,Unit=1,Name=Air Quality, Type=General,
SubType=Custom Sensor, Data=16 ug/m3
```

[TODO] Create and update a Domoticz Alert Sensor.
Not supported at time of writing (20230515)

Bluetooth Low Energy Sensor MQTT Auto Discovery

Description

This project explores how to use the Raspberry Pi Pico W Microcontroller Bluetooth Low Energy (BLE) feature.

The purpose is to

- create a Bluetooth Low Energy (BLE) environment sensor using the Raspberry Pi Pico W.
- advertise in regular intervals, the environment data temperature, humidity & pressure, and sensor battery level.
- simulate, as a proof-of-concept, data advertised instead using connected sensors sending real data.
- create and update a Domoticz Temp+Humidity+Baro (including the battery level) device using the MQTT Auto Discovery feature.
- explore how to integrate the OpenMQTTGateway into Domoticz.
- Explore how to use the MQTT Explorer.

CREDITS
To the authors of the OpenMQTTGateway and the MQTT Explorer – great tools.

Solution

A MicroPython script, running on the Raspberry Pi Pico W (called PICOES for this project), generates the environment data temperature, humidity & air pressure + battery level every 2 seconds (indicated by the PICOES onboard GREEN LED).

The data is converted to bytes which are used as the BLE payload being advertised.

An OpenMQTTGateway (OMG), running on a ESP32-WROOM-32 microcontroller, reads the advertised data every 66 seconds (default) and converts the data to a MQTT message.

The data is published, in HEX format, using the PICOES device name.
Why? This is an OMG workaround because the OMG recognizes only the by the PICOES advertised fields MAC address, Name and RSSI.

A Node-RED flow acts as the bridge between the OMG and Domoticz MQTT Auto Discovery Gateway (MQTTAD).
Node-RED runs on the same Raspberry Pi system as Domoticz.

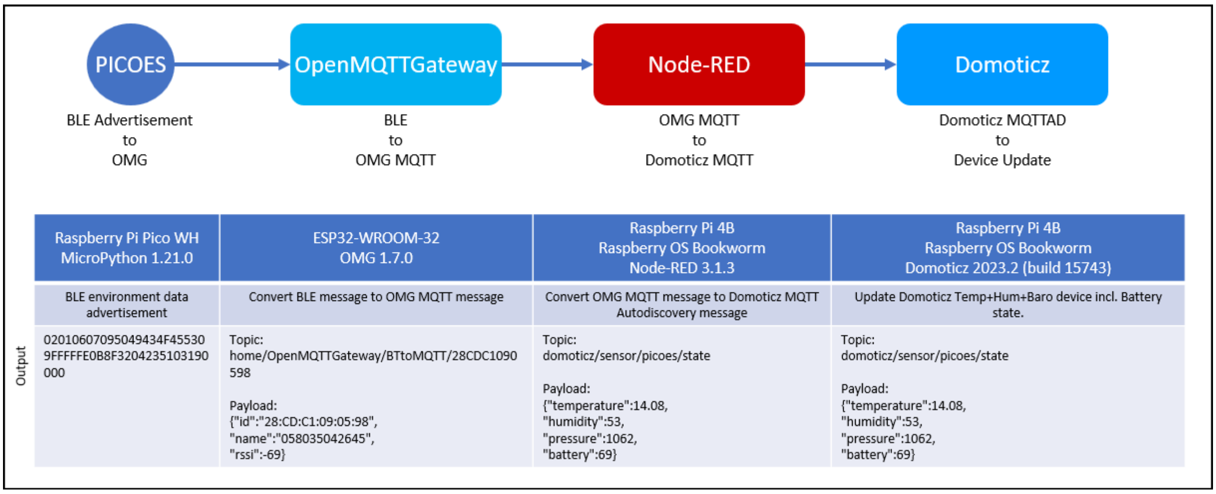
The OMG MQTT message is converted to a Domoticz MQTT-AD message.

The Domoticz MQTT Auto Discovery Gateway reads the Node-RED MQTT message published and updates the Domoticz Temp+Humidity+Baro device.

This solution is an example on how to advertise data and read in passive mode from the Pico W Microcontroller using Bluetooth Low Energy.
It could be the base for other solutions to advertise data and handle in Domoticz (or other).

Sources found in the archive: bleenvironmentsensor.zip.

Block Diagram



Flow
1. PICOES advertises data, every 2 seconds, via Bluetooth Low Energy (BLE).
2. OMG reads the PICOES advertised data every 66 seconds (default).
3. OMG converts the data and publishes to MQTT.
4. Node-RED flow listens to OMG MQTT messages for the PICOES topic and converts the OMG message to a Domoticz MQTT Auto Discovery message.
5. Domoticz MQTT Auto Discovery Client Gateway to subscribe to the messages.
6. Domoticz to update the auto-created devices, in this case a Temp+Humidity+Baro device.

Notes
The tool MQTT Explorer is used to analyse the MQTT messages from the various systems.

Components

* 1x Raspberry Pi Pico W, Firmware RPI_PICO_W-20231227-v1.22.0
* 1x ESP32-WROOM-32, Firmware 1.7.0 (esp32dev-ble)
* Domoticz 2023.2 (build 15781 BETA)
* Node-RED v3.1.3

Wiring

Raspberry Pi Pico W	**ESP32-WROOM-32**
No additional wiring as environment data is simulated.	No additional wiring.
Onboard GREEN LED used to indicate BLE advertising every 2 seconds.	Onboard RED LED used to indicate power status.
	Onboard Blue LED used to indicate network status.

Circuit Diagram

No additional wiring. See block diagram.
The 5V power for the Raspberry Pi Pico W and the ESP32-WROOM-32 are provided by the Raspberry Pi running Domoticz Test System and Node-RED.

Domoticz Setup

MQTT

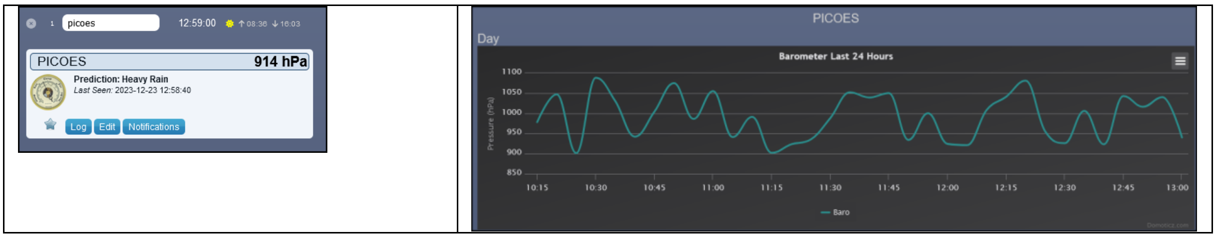
See chapter [MQTT Auto Discovery](#).

Devices

The devices are created automatically when receiving data.

For this solution, a single Temp+Humidity+Baro (Weather Station) device is created assigned to the hardware OMGGW with id 0001, unit 1 and name PICOES.

Idx	Hardware	ID	Unit	Name	Type	SubType	Data
38	OMGGW	0001	1	PICOES	Temp + Humidity + Baro	Weather Station	26.3 C, 56 %, 909.0 hPa



Automation Script

No automation event used.

MQTT Auto Discovery Configuration

Domoticz Device

The Domoticz Temp+Humidity+Baro device is created using the mosquitto_pub client with the retained flag set. The commands are executed from a Domoticz Test System terminal (CLI).

There are 4 commands required to create the single device Temp+Humidity+Baro with battery level state. For each command:

- set the same name PICOES
- set the same state topic “domoticz/sensor/picoes/state”
- set the same value for the configuration key device.identifiers
- set a unique id for each device

Notes
Looked up the Domoticz source on how to create a single device holding multiple environment data, like the Temp+Humidity+Baro sensor.

Bash Script

A bash script is used to create the devices.

```
#!/bin/bash

# File: setautoad.sh
# Date: 20231215
# Author: Robert W.B. Linn
# Description:
# For the PICOES project, create the Domoticz device type Temp+Humidity+Baro,
subtype Weather Station using MQTT Auto Discovery (MQTTAD).
# The message is published with the retain flag.
# Make Executable:
# sudo chmod +x setautoad.sh
# Run:
# ./setautoad.sh

# Init
# Pause function waiting for enter key.
function pause(){
   read -p "$*"
}

echo 'Creating Domoticz Temp+Humidity+Baro (Weather Station) device'

# Option: delete all retained messages
echo 'Clearing retained messages ...'
mosquitto_sub -h localhost --remove-retained -t '#' -W 1

# Create the Domoticz devices with the goal to create a single Temp+Humidity+Baro
device.
echo 'Creating Domoticz devices ...'

mosquitto_pub -r -h 127.0.0.1 -p 1883 -t
"domoticz/sensor/picoes/temperature/config" -m '{"name": "PICOES","device_class":
"temperature","state_topic": "domoticz/sensor/picoes/state","value_template":
"{{value_json.temperature}}","unit_of_measurement": "c","unique_id":
"PICOEST","device": {"identifiers": "1"}}'

mosquitto_pub -r -h 127.0.0.1 -p 1883 -t "domoticz/sensor/picoes/humidity/config" -
m '{"name": "PICOES","device_class": "humidity","state_topic":
"domoticz/sensor/picoes/state","value_template":
"{{value_json.humidity}}","unit_of_measurement": "%","unique_id":
"PICOESH","device": {"identifiers": "1"}}'

mosquitto_pub -r -h 127.0.0.1 -p 1883 -t "domoticz/sensor/picoes/pressure/config" -
m '{"name": "PICOES","device_class": "pressure","state_topic":
"domoticz/sensor/picoes/state","value_template":
"{{value_json.pressure}}","unit_of_measurement": "hpa","unique_id":
"PICOESP","device": {"identifiers": "1"}}'

mosquitto_pub -r -h 127.0.0.1 -p 1883 -t "domoticz/sensor/picoes/battery/config" -m
'{"name": "PICOES","device_class": "battery","state_topic":
"domoticz/sensor/picoes/state","value_template":
"{{value_json.battery}}","unit_of_measurement": "%","unique_id":
"PICOESB","device": {"identifiers": "1"}}'

echo 'Devices created. Check the Domoticz log and the devices list'
pause 'Done, press [Enter] to continue...'
exit
```

BLE Advertised Data Format

The BLE advertised data has a length of 31 bytes containing four fields.

Field	**Field Length Bytes**	**Field Length 1 Byte**	**Field Type 1 Byte**	**Field Data Byte(s)**
Flags	3	02	01	06 = 02+04 (see source code) Data length: 1 byte
Name	14	0D	09	NNNNNNNNNNNNNNNNNNNNNNNN containing the custom data 6-byte HEX string with length 6 * 2 = 12 bytes. Each byte holds the HEX value for the HEX character. Data length: 12 bytes
Custom Data	10	09	FF	Manufacturer Key FEFF (2 bytes) + 4 Data Fields (6 bytes) (see below custom data structure) Data length: 8 bytes
Appearance	4	03	19	0000 (see source code) Data length: 2 bytes
	31			

Example Advertised Payload (length 31 bytes):
0201060D0930413843333230333834333009FFFEFF0A8C3203843003190000

Field	**Data = Field Length Byte + Field Type + Data**
Flags	02 01 06
Name	0D 09 304138433332303338343330
Custom Data	09 FF FEFF 0A8C 32 0384 30
Appearance	03 19 0000

Custom Data Structure

Data	**Type (length)**	**Python Struct**	**Example Data**
t=temperature °C (in 1000)	short 2 bytes	struct.pack(">h", t)	HEX=0A8C DEC=2700=27 %C
h=humidity %RH (0-100%)	unsigned char 1 byte	struct.pack(">B", h)	HEX=32 DEC=50=50 %RH
p=air pressure (hPa)	short 2 bytes	struct.pack(">h", p)	HEX=0384 DEC=900=900 hPa
b=battery level (0-100%)	unsigned char 1 byte	struct.pack(">B", b)	HEX=30 DEC=48=48 %
		h=short (2 bytes) B=unsigned char (1 byte)	

BLE Device Environment Sensor

The Raspberry Pi Pico W acts as the environment sensor advertising via BLE environment data every 2 seconds.

Libraries

The MicroPython script uses a helper for generating BLE advertising payloads.
This helper is forked from this (> examples > bluetooth > ble_advertising.py) MicroPython example - THANKS for sharing:
The helper is stored on the Pico W, in same folder as the bleenvsensor.py script.

Configuration data is stored in the config.py script also stored in the same folder as the bleenvsensor.py script.
The BLE advertising interval is set to 2 seconds, which is higher than the OMG reading message interval of 66 seconds.

```
# File: config.py
# Date: 20231227
# Author: Robert W.B. Linn
# Description:
# Constants for the Raspberry Pi Pico W Environment Sensor (PICOES).
# Import the configuration file: import config.py
# Access configuration item: config.NAME

# Import the const package
from micropython import const

# Version Info - comment out if mem limited
VERSION = const('BLE Environment Sensor v20231227')

# States
STATE_OFF = 0
STATE_ON = 1

# Name of the BLE sensor
# For using the OMG, the name changes to sensor data HEX string (see below OMG)
NAME = const('PICOES')

# Advertised manufacturer id
MANUFACTURER_ID = const(0xFFFE)

# Gap advertising interval in us
# 1 second = 1000000, but use 0.5 seconds
GAP_ADVERTISE_INTERVAL = 500000

# BLE Advertising Interval in seconds
ADVERTISING_INTERVAL = const(2)

# Pico W onboard LED
PIN_LED_ONBOARD = const('LED')

# OpenMQTTGateway (OMG) to publish data HEX string as sensor name
# WORKAROUND
OMG = True
```

MicroPython Script

```
# File: bleenvsensor.py
# Date: 20231224
# Author: Robert W.B. Linn
# Description:
# Advertised via BLE simulated data temperature, humidity, pressure, battery level.

from machine import Pin
import sys
import bluetooth
import random
import struct
import time
from time import sleep
from ble_advertising_customdata import advertising_payload as advertisepayload
import config

# Create the LED as advertising status indicator
led_status = Pin(config.PIN_LED_ONBOARD, Pin.OUT)
led_status.value(config.STATE_OFF)

def sensor_task():
    """Set the random environment data and advertise.

    Instead, simulated data, add real sensor data here.
    """
    t = 2450
    h = 55
    p = 1000
    b = 85
    while True:
        led_status.value(config.STATE_ON)

        # Create the environment random data
        t = int(random.uniform(1000, 3000))
        h = int(random.uniform(50, 60))
        p = int(random.uniform(900, 1100))
        b = int(random.uniform(20, 90))
        print(f't={t},hex={"{:04X}".format(t)}')
        print(f'h={h},hex={"{:02X}".format(h)}')
        print(f'p={p},hex={"{:04X}".format(p)}')
        print(f'b={b},hex={"{:02X}".format(b)}')

        # Create the custom data as 9 bytes
        # h=short (2 bytes), B=unsigned char (1 byte)
        # Data has 6 bytes = 2 + 1 + 2 +1
        data = struct.pack(">h", t) + struct.pack(">B", h) + struct.pack(">h", p) +
struct.pack(">B", b)

        # Set the name of the device
        name = config.NAME

        # Use the OpenMQTTExplorer with workaround
        # The sensor name contains the data in HEX format
        if config.OMG:
            name = data.hex().upper()
            print(name, len(name))

        # Create the full payload as bytes to be advertised
        payload = advertisepayload(
            # services=[bluetooth.UUID("6E400001-B5A3-F393-E0A9-E50E24DCCA9E")],
            name=name,
            manufacturer_id=config.MANUFACTURER_ID,
            custom_data=data)
        print(payload.hex().upper(), len(payload))

        # Advertise payload interval (ms) and payload as buffer protocol (bytes)
```

```
        ble.gap_advertise(config.GAP_ADVERTISE_INTERVAL, adv_data=payload)

        led_status.value(config.STATE_OFF)

        # Short delay prior next advertisement
        sleep(config.ADVERTISING_INTERVAL)

# Print version info
print(f'{config.VERSION}')

# Create ble object
ble = bluetooth.BLE()

# Activate BLE
# Before using any other method of this class, the radio to be at active state.
try:
    ble.active(True)
    print(f'MAC Address: {ble.config('mac')[1].hex().upper()}, OMG Mode:
{config.OMG}')
except OSError as e:
    # Error like etimedout
    print(f'[ERROR] {str(e)}.')
    sys.exit(1)


# Start the sensor task which has an infinite loop
sensor_task()
```

OpenMQTTGateway

This solution makes use of the OpenMQTTGateway (OMG).
It is the first time that the OMG is used in this workbook.
It is a test, on how to integrate the PICOES into Domoticz using the OMG.

Setup

The OMG has been setup according to the provided guidelines (not repeated here) for OMG BLE support for a ESP32-WROOM-32.

- OMG Firmware 1.7.0 **esp32dev-ble** uploaded from the Web (Option 1)
- Configure WiFi Manager:
  - MQTT server: NNN.NNN.NNN.NNN:1883
    (this is the Domoticz Test system IP address running also MQTT mosquitto)
  - Gateway Name: OpenMQTTGateway
  - MQTT base topic: home/
  - OMG IP address: NNN.NNN.NNN.NNN
- OMG default settings used – check out with the OMG WebUI or MQTT Explorer.

Environment Data Workaround

The MQTT Explorer shows the PICOES sensor message with the keys:


```
{"id":"28:CD:C1:09:05:98","name":"PICOES","rssi":-31}
```


Because the PICOES is a custom sensor, it was clear that there is no other data received like the environment data.

Question: How to get the environment data into Domoticz?

WORKAROUND
The solution uses the data, which is a HEX string, as the name of the PICOES sensor.
The key "name" with default PICOES is replaced by the data in HEX format (see MicroPython code).
Example message seen in the MQTT explorer:

Topic

```
home/OpenMQTTGateway/BTtoMQTT/28CDC1090598
```

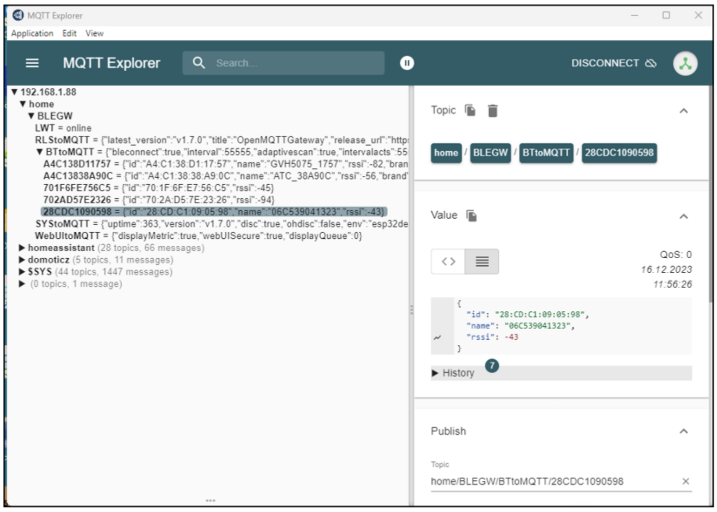
Payload


```
{"id":"28:CD:C1:09:05:98","name":"06C539041323","rssi":-43}
```

OpenMQTTGateway – Pico W Environment Sensor

The **PICOES** is recognized with its MAC address, but no manufacturer data.

WORKAROUND
Use the key name to publish the environment data in HEX format.
Example message: {
"id":"28:CD:C1:09:05:98",
"name":"06C539041323",
"rssi":-43 }
The name with HEX string contains the data:
06C539041323 = 06C5 39 0413 23
Temperature
HEX 06C5 = DEC 1733 = 17.33 °C
Humidity
HEX 39 = DEC 57 = 57 %RH
Pressure
HEX 0413 = DEC 1043 = 1043 hPa
Battery Level
HEX 23 = DEC 35 = 35 %



Note: Screenshot of the MQTT Explorer with the BLE devices messages.

The next step is to convert the OMG MQTT message to Domoticz MQTT Auto Discovery Client Gateway using Node-RED flow.

OMG MQTT Message

Topic

```
home/OpenMQTTGateway/BTtoMQTT/28CDC1090598
```

Payload

```
{
  "id":"28:CD:C1:09:05:98",
  "name":"06C539041323",
  "rssi":-35
}
```

Converted by the Node-RED flow "Update" and published to Domoticz (see next Node-RED).

Domoticz MQTT-AD Message

Topic

```
domoticz/sensor/picoes/state
```

Payload

```
{
  "temperature":17.33,
  "humidity":57,
  "pressure":1043,
  "battery":35
}
```

Just to reiterate:
The Domoticz MQTT-AD topic is the "state_topic" defined in the MQTT-AD configuration messages for temperature, humidity, pressure, and battery level.

Example temperature:

Topic

```
domoticz/sensor/picoes/temperature/config
```

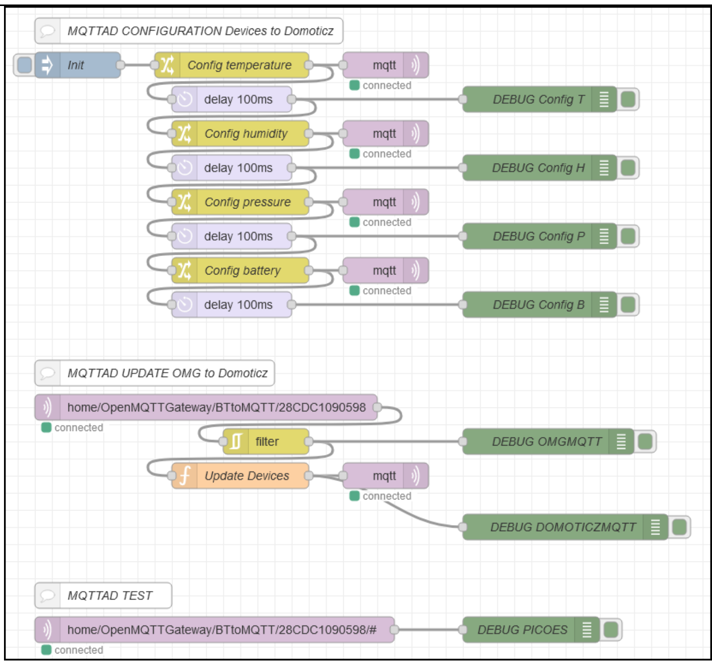
Payload


```
{
 "name": "PICOES",
 "device_class": "temperature",
 "state_topic": "domoticz/sensor/picoes/state",
 "value_template": "{{value_json.temperature}}",
 "unit_of_measurement": "c",
 "unique_id": "PICOEST",
 "device": {"identifiers": "1"}
}
```

Node-RED

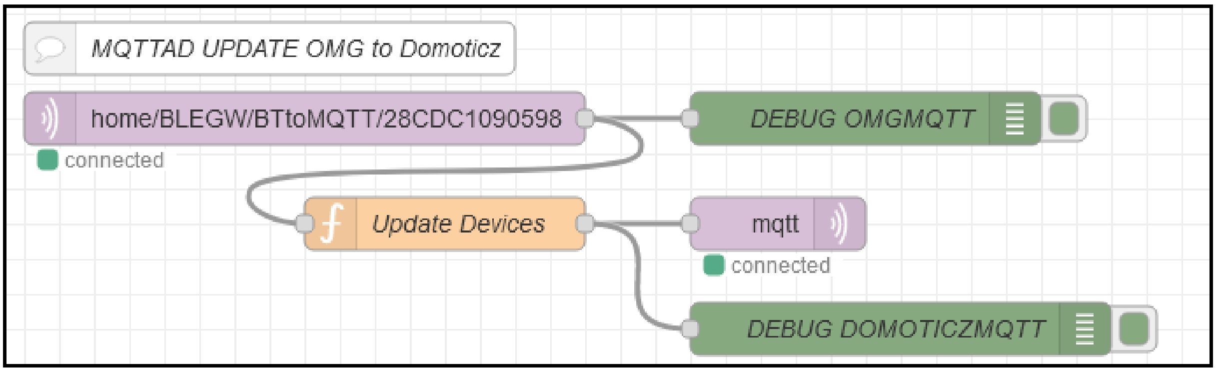
Node-RED is used to convert the OMG MQTT message to a Domoticz MQTT message.

Flows

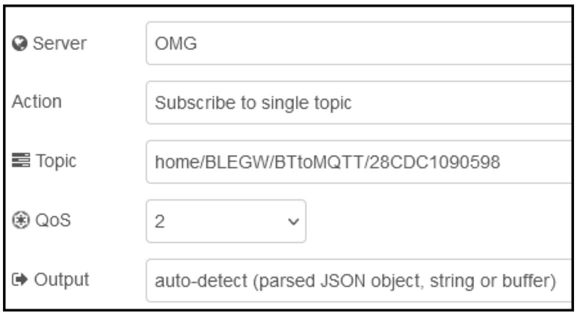
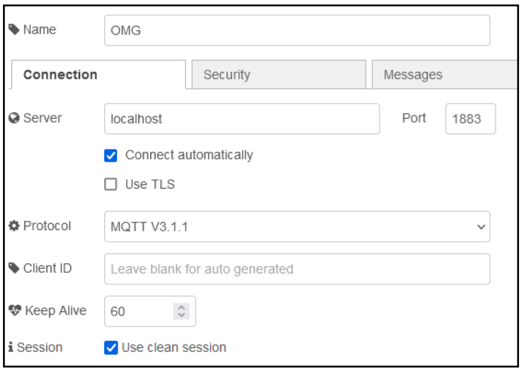
Flow Configuration to define the MQTT-AD topic & payload to create the Domoticz Temp+Humidity+Baro device. This flow is only created as a test. The previous described Bash script is used to create the MQTT-AD configuration messages. **Flow Update** to listen to the PICOES OMG topic, convert the payload to a Domoticz MQTT-AD message and publish to Domoticz. **Flow Test** to listen to all messages from the PICOES OMG.	

Flow Update

The Node-RED flow listens to OMG MQTT messages from the PICOES, converts the payload to a Domoticz MQTT-AD message and published to Domoticz MQTT-AD.



Node MQTT in

<table>
<tr>
<td>
</td>
<td>
</td>
</tr>
<tr>
<td>Listen to OMG MQTT messages from topic PICOES: home/BLEGW…</td>
<td>MQTT server runs on localhost = Domoticz test system.</td>
</tr>
</table>

Function Node

<table>
<tr>
<td><pre><code>// Assign the payload key name to data
let data = msg.payload.name;

// Get temperature from bytes 1,2 (len 4)
let thex = data.substring(0, 4);
// Get humidity from byte 3 (len 2)
let hhex = data.substring(4, 6);
// Get pressure from bytes 4,5 (len 4)
let phex = data.substring(6, 10);
// Get battery from byte 6 (len 2)
let bhex = data.substring(10, 12);

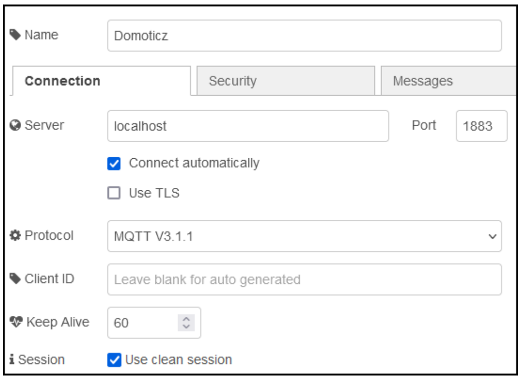
// Topic prefix as defined in the configuration flow
let topicPrefix = "domoticz/sensor/picoes/"

// Create update message
let msgx = {}
msgx.topic = topicPrefix + 'state';
msgx.payload = {
    'temperature': parseInt(thex, 16) / 100.0 ,
    'humidity': parseInt(hhex, 16),
    'pressure': parseInt(phex, 16),
    'battery': parseInt(bhex, 16)
};
return msgx;</code></pre></td>
<td>Get the environment data from the payload.name and create the Domoticz MQTT Auto Discovery state topic with payload.

Topic
domoticz/sensor/picoes/state,

Payload
{
"temperature":29.83,
"humidity":50,
"pressure":1006,
"battery":77
}</td>
</tr>
</table>

Node MQTT out

	
	Domoticz MQTT server running same host as the Domoticz test system.

Enhancements

Real Sensors
As mentioned, the environment data is simulated.

Lookup at other projects, like BMP280, DHT22 on how to connect sensors and get real data which can be published to Domoticz via BLE.

Actuators
It is also possible to connect actuators, like button(s) or a distance sensor to the PICOES and let Domoticz act accordingly.
The environment data to be replaced by the actuator data and the OMG scanning interval set to higher rate (for example 50 milliseconds with adaptivescan false).
See next chapter Bluetooth Low Energy Actuator MQTT Auto Discovery.

Bluetooth Low Energy Actuator MQTT Auto Discovery

Description

- To create a Bluetooth Low Energy (BLE) actuator using the Raspberry Pi Pico W Microcontroller.
- To advertise the actuator changed state.
- To auto create and update the state of Domoticz device(s) using the MQTT Auto Discovery feature.

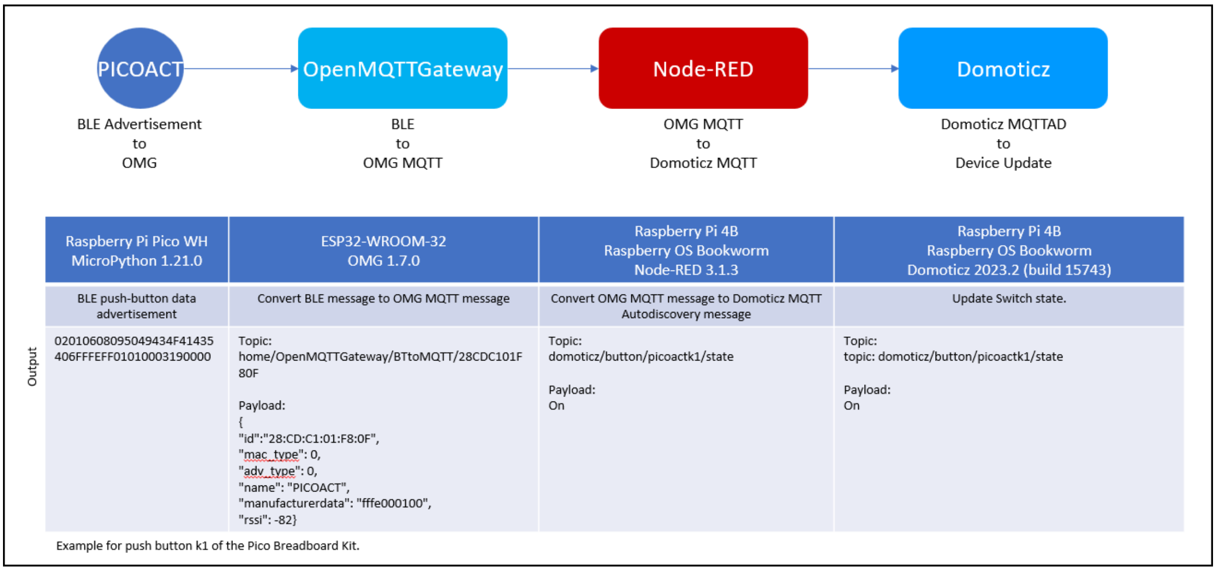
Note
This example is based upon the project PICOES - Bluetooth Low Energy Sensor MQTT Auto Discovery.

Solution

The Raspberry Pi Pico W (named PICOACT) is built in a Raspberry Pi Pico Breadboard Kit.
This kit has 4 pushbuttons, named K1-K4 and 4 LEDs named LED1-LED4.
The two pushbuttons K1 and K2 act as actuators.
If pressed, the state of an assigned Domoticz device from type Light/Switch, Switch, Push On Button is set to on.
A Micropython script, running on the PICOACT, generates data if a pushbutton is pressed.
The data is converted to bytes which are used as the BLE payload being advertised.
An OpenMQTTGateway (OMG), running on a ESP32-WROOM-32 microcontroller, reads the advertised data and converts the data to a MQTT message.
The MQTT messages is published, with payload containing the key manufacturerdata with the data.
A Node-RED flow acts as the bridge between the OMG and Domoticz MQTT Auto Discovery Gateway (MQTTAD).
The OMG MQTT message is converted to a Domoticz MQTT-AD message.
The Domoticz MQTT Auto Discovery Gateway reads the Node-RED MQTT message published and updates the Domoticz switch device.

Sources found in the archive: bleactuator.zip.

Block Diagram



Flow
1. PICOACT advertises data if a pushbutton (example push button k1 of the Pico Breadboard Kit) is pressed via Bluetooth Low Energy (BLE).
2. OMG reads the PICOACT advertised data every 100 milliseconds.
3. OMG converts the BLE message and publishes to MQTT.
4. Node-RED flow listens to OMG MQTT message for the PICOACT topic and converts the OMG message to a Domoticz MQTT Auto Discovery message.
5. Domoticz MQTT Auto Discovery Client Gateway to subscribe to the messages.
6. Domoticz to update the auto-created devices, in this case a push on button device.

Notes
The tool MQTT Explorer is used to analyse the MQTT messages from the various systems.

Components

* 1x Raspberry Pi Pico W, Firmware RPI_PICO_W-20231227-v1.22.0
* 1x Raspberry Pi Pico Breadboard Kit
* 1x ESP32-WROOM-32, Firmware 1.7.0 (esp32dev-ble)
* Domoticz 2023.2 (build 15781 BETA)
* Node-RED v3.1.3

Wiring

Pico Breadboard Kit	Pico W
Button K1	GP18 (Pin #24)(wire yellow)
Button K2	GP19 (Pin #25)(wire green)
Beep	GND (Workaround to avoid ad hoc beeping - not clear why this happens)
Onboard LED BLUE + (Anode)	GP25 (Onboard)

Circuit Diagram

No additional wiring. See block diagram.
The 5V power for the Raspberry Pi Pico W and the ESP32-WROOM-32 are provided by the Raspberry Pi running Domoticz Test System and Node-RED.

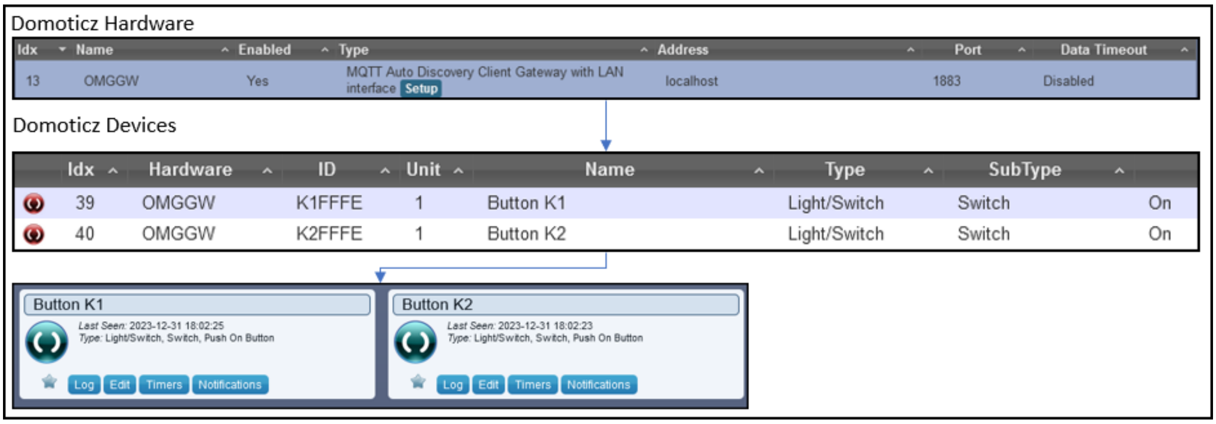
Domoticz Setup

MQTT

See chapter [MQTT Auto Discovery](#).

Devices

For this solution, two devices from type Light/Switch, Switch, Push On Button are created assigned to the hardware OMGGW.



The Domoticz devices list after submitting the MQTT Config messages.
The initial state of a pushbutton is Off.

Automation Script

Example of a dzVents script, which listens to device pushbutton changes.

```
--[[
File: picoact_pushbuttons.dzvents
Date: 20231231
Author: Robert W.B. Linn
Description:
Test handling the PICOACT pushbutton K1 or K2 press.
]]--

-- Domoticz Idx
-- Switch K1 from type push on button
local IDX_SWITCH_K1 = 39
local IDX_SWITCH_K2 = 40
local PUSH_BUTTONS = { IDX_SWITCH_K1, IDX_SWITCH_K2 }

return {
 on = {
      devices = PUSH_BUTTONS
    },
 execute = function(domoticz, item)
      -- domoticz.log(item)
         domoticz.log(string.format("Device %s state changed to %s", item.name,
item.state))
   -- Do something
 end
}
```

Domoticz Log

```
2023-12-31 10:53:44.168 OMGGW: Light/Switch/Switch (Button K1)
2023-12-31 10:53:44.252 Status: dzVents: Info: Handling events for: "Button K1",
value: "On"
2023-12-31 10:53:44.253 Status: dzVents: Info: ------ Start internal script:
picoact_pushbuttons: Device: "Button K1 (OMGGW)", Index: 39
2023-12-31 10:53:44.253 Status: dzVents: Info: Device Button K1 state changed to On
2023-12-31 10:53:44.253 Status: dzVents: Info: ------ Finished picoact_pushbuttons
2023-12-31 10:53:44.161 Debug: OMGGW: topic: domoticz/button/picoactk1/state,
message: On
2023-12-31 10:53:49.886 OMGGW: Light/Switch/Switch (Button K2)
2023-12-31 10:53:49.972 Status: dzVents: Info: Handling events for: "Button K2",
value: "On"
2023-12-31 10:53:49.972 Status: dzVents: Info: ------ Start internal script:
picoact_pushbuttons: Device: "Button K2 (OMGGW)", Index: 40
2023-12-31 10:53:49.972 Status: dzVents: Info: Device Button K2 state changed to On
2023-12-31 10:53:49.972 Status: dzVents: Info: ------ Finished picoact_pushbuttons
2023-12-31 10:53:49.880 Debug: OMGGW: topic: domoticz/button/picoactk2/state,
message: On
```

MQTT Auto Discovery

MQTT-AD is used to create & update the Domoticz devices.
The component is a button - default push on button in Domoticz.
This means that each state sent is a trigger setting the device state to On, i.e. push button pressed (see MQTT Update Message).

MQTT Config Message

MQTT configuration message to create the Domoticz pushbutton devices.
The MQTT command is executed from a terminal (CLI) on the Domoticz test system.
The retained flag is set.
Each button has a unique ID containing the Pico Breadboard pushbutton name and the manufacturer id (set in the MicroPython script).

```
mosquitto_pub -r -h 127.0.0.1 -p 1883 -t "domoticz/button/picoactk1/config" -m
'{"name": "Button K1", "state_topic": "domoticz/button/picoactk1/state",
"unique_id": "K1FFFE"}}'

mosquitto_pub -r -h 127.0.0.1 -p 1883 -t "domoticz/button/picoactk2/config" -m
'{"name": "Button K2", "state_topic": "domoticz/button/picoactk2/state",
"unique_id": "K2FFFE"}}'
```

Bash Script

```
#!/bin/bash

# File: setautoad.sh
# Date: 20231231
# Author: Robert W.B. Linn
# Description:
# For the PICOACT project, create the Domoticz device type Switch, subtype Switch
using MQTT Auto Discovery (MQTTAD).
# The message is published with the retain flag.
# Read more about MQTT-AD on Homeassistant.
# Make Executable:
# sudo chmod +x setautoad.sh
# Run from the Domoticz system:
# ./setautoad.sh

# Init
# Pause function waiting for enter key.
function pause(){
   read -p "$*"
}

echo 'Creating Domoticz Switch devices'

# Option: clear the button config retained messages
echo 'Clearing retained messages ...'
mosquitto_sub -h localhost --remove-retained -t 'domoticz/button/picoactk1/config'
-W 1
mosquitto_sub -h localhost --remove-retained -t 'domoticz/button/picoactk2/config'
-W 1

# Create the Domoticz devices with the goal to create Domoticz push button device.
# Each device is from type Switch, SubType Switch with unique ID KnManufacturerID,
i.e. K1FFFE, K2FFFE.
echo 'Creating Domoticz devices ...'

mosquitto_pub -r -h 127.0.0.1 -p 1883 \
```

```
-t "domoticz/button/picoactk1/config" \
-m '{"name": "Button K1", "state_topic": "domoticz/button/picoactk1/state",
"unique_id": "K1FFFE"}}'
# 2023-12-29 13:18:47.407 Status: OMGGW: discovered: PICOACT/PICOACT (unique_id:
K1FFFE)
# 2023-12-29 13:18:47.406 Debug: OMGGW: topic: domoticz/button/picoact/config,
message: {"name": "Button K1", "state_topic": "domoticz/button/picoactk1/state",
"unique_id": "K1FFFE"}

mosquitto_pub -r -h 127.0.0.1 -p 1883 \
-t "domoticz/button/picoactk2/config" \
-m '{"name": "Button K2", "state_topic": "domoticz/button/picoactk2/state",
"unique_id": "K2FFFE"}}'
# 2023-12-29 13:19:47.407 Status: OMGGW: discovered: PICOACT/PICOACT (unique_id:
K2FFFE)
# 2023-12-29 13:18:47.406 Debug: OMGGW: topic: domoticz/button/picoact/config,
message: {"name": "Button K2", "state_topic": "domoticz/button/picoactk2/state",
"unique_id": "K2FFFE"}

# ADD MORE like K3, K4

echo 'Devices created. Check the Domoticz log and the devices list'

pause 'Done, press [Enter] to continue...'
exit
```

Domoticz Log

The Domoticz log lists the devices discovered after submitting the MQTT config message.

```
2023-12-30 11:20:03.499 Status: OMGGW: discovered: Button K1/Button K1 (unique_id:
K1FFFE)
2023-12-30 11:20:03.499 Debug: OMGGW: topic: domoticz/button/picoactk1/config,
message: {"name": "Button K1", "state_topic": "domoticz/button/picoactk1/state",
"unique_id": "K1FFFE"}}
2023-12-30 11:20:15.844 Status: OMGGW: discovered: Button K2/Button K2 (unique_id:
K2FFFE)
2023-12-30 11:20:15.843 Debug: OMGGW: topic: domoticz/button/picoactk1/config,
message: {"name": "Button K2", "state_topic": "domoticz/button/picoactk2/state",
"unique_id": "K2FFFE"}}
```

MQTT Remove Config Topics

With these MQTT messages, the retained config topics are removed.

```
mosquitto_sub -h localhost --remove-retained -t 'domoticz/button/picoactk1/config'
-W 1
mosquitto_sub -h localhost --remove-retained -t 'domoticz/button/picoactk2/config'
-W 1
```

Domoticz Devices List

The Domoticz devices list after submitting the MQTT Config messages.
The initial state of the pushbutton is Off.

```
IDX=39, hardware=OMGGW, ID=K1FFFE, Unit=1, Name=Button K1, Type=Light/Switch,
SubType=Switch, Data=Off
IDX=40, hardware=OMGGW, ID=K2FFFE, Unit=1, Name=Button K2, Type=Light/Switch,
SubType=Switch, Data=Off
```

MQTT Update Message

Push the button on can be achieved by setting the state to whatever value.
Each state value is handled by Domoticz as a trigger to push the button.
DO NOT USE THE RETAINED FLAG -r.

```
mosquitto_pub -h 127.0.0.1 -p 1883 -t "domoticz/button/picoactk1/state" -m ON
OR
mosquitto_pub -h 127.0.0.1 -p 1883 -t "domoticz/button/picoactk1/state" -m
'{"state":1}'
```

Domoticz Log

```
2023-12-30 11:53:11.281 OMGGW: Light/Switch/Switch (Button K1)
2023-12-31 10:00:36.123 Debug: OMGGW: topic: domoticz/button/picoactk1/state,
message: ON
OR
2023-12-30 11:53:11.274 Debug: OMGGW: topic: domoticz/button/picoactk1/state,
message: {"state":1}
```

BLE Device Actuator

The Raspberry Pi Pico W acts as an actuator advertising the changed state of a pushbutton.

Libraries

The MicroPython script uses a helper for generating BLE advertising payloads.
This helper is forked from this (> examples > bluetooth > ble_advertising.py) MicroPython example - THANKS for sharing:
The helper is stored on the Pico W, in same folder as the bleenvsensor.py script.

Configuration data is stored in the config.py script also stored in the same folder as the bleenvsensor.py script.
The BLE advertising interval is set to 2 seconds, which is higher than the OMG reading message interval of 66 seconds.

```
# File: config.py
# Date: 20231227
# Author: Robert W.B. Linn
# Description:
# Constants for the Raspberry Pi Pico W Environment Sensor (PICOES).
# Import the configuration file: import config.py
# Access configuration item: config.NAME

# Import the const package
from micropython import const

# Version Info - comment out if mem limited
VERSION = const('BLE Environment Sensor v20231227')

# States
STATE_OFF = 0
STATE_ON = 1

# Name of the BLE sensor
# For using the OMG, the name changes to sensor data HEX string (see below OMG)
NAME = const('PICOES')

# Advertised manufacturer id
MANUFACTURER_ID = const(0xFFFE)

# Gap advertising interval in us
# 1 second = 1000000, but use 0.5 seconds
GAP_ADVERTISE_INTERVAL = 500000

# BLE Advertising Interval in seconds
ADVERTISING_INTERVAL = const(2)

# Pico W onboard LED
PIN_LED_ONBOARD = const('LED')

# OpenMQTTGateway (OMG) to publish data HEX string as sensor name
# WORKAROUND
OMG = True
```

MicroPython Script

```
# File: bleactuator.py
# Date: 20231229
# Author: Robert W.B. Linn
# Description:
# Advertised via BLE the state of 2 buttons (actuators).
# The Pico Breadboard Kit buttons K1-K2 are used.

from machine import Pin
import sys
import bluetooth
import random
import struct
import time
from time import sleep
from ble_advertising_customdata import advertising_payload as advertisepayload
import config

# Create the LED as advertising status indicator
led_status = Pin(config.PIN_LED_ONBOARD, Pin.OUT)
led_status.value(config.STATE_OFF)

# Create the Buttons K1 (Yellow), K2 (Green)
BUTTON_K1_PINNR = 18
button_k1 = Pin(BUTTON_K1_PINNR, Pin.IN, Pin.PULL_UP)
BUTTON_K2_PINNR = 19
button_k2 = Pin(BUTTON_K2_PINNR, Pin.IN, Pin.PULL_UP)

# Button globals handling the button interrupt and button debounce time
interrupt_flag = 0
debounce_time = 0

# Global button_data
button_data = None

def callback_button(pin):
    """Callback for the button pressed"""

    global button_data
    global button_k1, button_k2
    global interrupt_flag, debounce_time

    led_status.value(config.STATE_ON)

    # Init the button states
    state_k1 = 0
    state_k2 = 0

    # Check debounce
    if (time.ticks_ms()-debounce_time) > 500:
        # Interrupt flag set
        interrupt_flag = 1
        # Get the ticks for handling debounce
        debounce_time = time.ticks_ms()

        print(f'[DEBUG] callback_button: pin={pin}')
        if pin is button_k1:
            state_k1 = 1
        elif pin is button_k2:
            state_k2 = 1
        # and so on

        # Set the button data
        button_data = struct.pack(">B", state_k1) + struct.pack(">B", state_k2)
        print(f'[DEBUG] callback_button: data={button_data.hex()}')

    led_status.value(config.STATE_OFF)
```

```
# Assign interrupt to the buttons
button_k1.irq(trigger=Pin.IRQ_FALLING, handler=callback_button)
button_k2.irq(trigger=Pin.IRQ_FALLING, handler=callback_button)

# BLE Advertise id
advertise_id = 1

def actuator_task(advertise_id):
    """Set the button state and advertise"""

    # Get the button data set by the button callback
    global button_data

    # Create the custom data as 2 bytes
    # h=short (2 bytes), B=unsigned char (1 byte)
    # Data has 1 byte = 1
    data = struct.pack(">B", advertise_id) + button_data
    # struct.pack(">B", state)

    # Set the name of the device
    name = config.NAME

    # Use the OpenMQTTExplorer with workaround
    # The sensor name contains the data in HEX format
    if config.OMG:
        name = data.hex().upper()

    # Create the full payload as bytes to be advertised
    payload = advertisepayload(
        # services=[bluetooth.UUID("6E400001-B5A3-F393-E0A9-E50E24DCCA9E")],
        name = name,
        manufacturer_id = config.MANUFACTURER_ID,
        custom_data = data)
    print("[DEBUG]", payload.hex().upper(), len(payload))

    # Advertise the payload with interval (microseconds) and payload as buffer
protocol (bytes)
    ble.gap_advertise(config.GAP_ADVERTISE_INTERVAL, adv_data=payload)

# Print version info
print(f'{config.VERSION}')

# Create ble object
ble = bluetooth.BLE()

# Activate BLE = Before using any other method of this class, the radio to be at
active state.
try:
    ble.active(True)
    # Increase the MTU if data length > 31
    # ble.config(gap_name='test',mtu=100)
    print(f'MAC Address: {ble.config('mac')[1].hex().upper()}, OMG Mode:
{config.OMG}')
except OSError as e:
    print(f'[ERROR] {str(e)}.')
    sys.exit(1)

# if __name__ == "__main__":
while True:

    # Handle interrupt detected
    # Trigger: button pressed
    if interrupt_flag is 1:
        print("[DEBUG] Button Interrupt Detected")
        interrupt_flag = 0
        advertise_id = 0 if advertise_id == 1 else 1
        actuator_task(advertise_id)
```

OpenMQTTGateway

The OpenMQTTGateway (OMG) is used to listen to BLE advertised messages if the state of a PICOACT pushbutton changes.
Then convert the BLE message to a OMG MQTT message and publish the OMG MQTT message to the Domoticz MQTT broker.
The OMG WebUI is used to manage the settings.

Setup

The OMG settings are set using the OMG WebUI accessed via web browser OMG IP address.

WebUI Console Commands
Full command submitted using the OMG WebUI Console:

```
commands/MQTTtoBT/config {"adaptivescan":false, "interval":100, "white-
list":["28:CD:C1:01:F8:0F"], "bleconnect":false, "save": true}
```

OMG Console Log
Log entries after changing some settings:

```
N: [ MQTT->OMG ]: {"adaptivescan":false,"interval":100,"white-
list":["28:CD:C1:01:F8:0F"],"bleconnect":false,"save":true}
N: Config bleconnect changed: false
N: Config adaptivescan changed: false
N: Config interval changed: false
N: Config intervalacts changed: false
N: Config scanduration changed: false
N: BT config save:
{"bleconnect":false,"interval":100,"adaptivescan":false,"intervalacts":100,"interva
lcnct":3600000,"scanduration":1000,"onlysensors":false,"randommacs":false,"hasspres
ence":false,"prestopic":"presence/","presuseuuid":false,"minrssi":-
100,"extDecoderEnable":false,"extDecoderTopic":"undecoded","filterConnectable":fals
e,"pubadvdata":true,"pubuuid4topic":false,"ignoreWBlist":false,"presenceawaytimer":
120000,"movingtimer":60000,"forcepscn":false,"enabled":true}, result: 459
N: Send on /BTtoMQTT msg
{"bleconnect":false,"interval":100,"adaptivescan":false,"intervalacts":100,"interva
lcnct":3600000,"scanduration":1000,"onlysensors":false,"randommacs":false,"hasspres
ence":false,"prestopic":"presence/","presuseuuid":false,"minrssi":-
100,"extDecoderEnable":false,"extDecoderTopic":"undecoded","filterConnectable":fals
e,"pubadvdata":true,"pubuuid4topic":false,"ignoreWBlist":false,"presenceawaytimer":
120000,"movingtimer":60000,"forcepscn":false,"tskstck":2644,"crstck":3064,"enabled"
:true,"scnct":14}
N: Send on /BTtoMQTT/28CDC101F80F msg
{"id":"28:CD:C1:01:F8:0F","mac_type":0,"adv_type":0,"name":"PICOACT","manufacturerd
ata":"fffe000001","rssi":-67}
```

The last log entry contains the data send to the PICOACT.

Commands

Task	Command
Adaptive scan disabled:	commands/MQTTtoBT/config {"adaptivescan":false}
Change interval (ms):	commands/MQTTtoBT/config {"interval":100}
Set white list to PICOACT:	commands/MQTTtoBT/config {"white-list":["28:CD:C1:01:F8:0F"]}
Disable ble connect	commands/MQTTtoBT/config {"bleconnect":false}

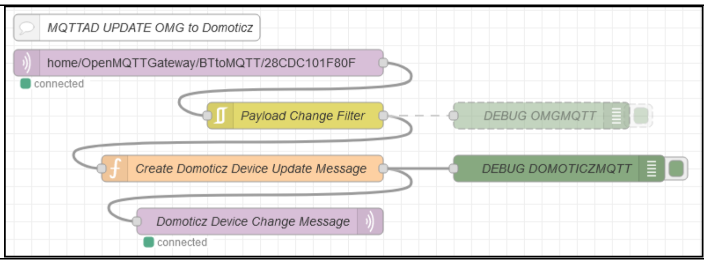
OMG Console Log PICOACT pushbutton press
Log entry after pushing the PICOACT K2 button.
The key manufacturerdata contains the data fffe000001, which is manufacturer-id:fffe, change-flag:00, k1 state:00, k2 state: 01.

```
N: Send on /BTtoMQTT/28CDC101F80F msg
{"id":"28:CD:C1:01:F8:0F","mac_type":0,"adv_type":0,"name":"PICOACT","manufacturerd
ata":"fffe000001","rssi":-67}
```

Node-RED

Node-RED is used to convert the OMG MQTT message to a Domoticz MQTT message.
To get the data published to Domoticz using MQTT Auto Discovery, an MQTT update flow is used.

Flows

<table>
<tr><td>Flow Configuration is not defined as a Bash script is used to create the devices using MQTT-AD.</td><td></td></tr>
<tr><td>Flow Update to listen to the PICOACT OMG topic, convert the payload to a Domoticz MQTT-AD message and publish to Domoticz.</td><td>


</td></tr>
</table>

MQTT Server
Two MQTT servers are defined: OMG and Domoticz.
The OMG MQTT server subscribes to the topic published by the OMG.

```
home/OpenMQTTGateway/BTtoMQTT/28CDC101F80F
```

The Domoticz MQTT server publishes the converted OMG message, but also the device autodiscovery message - only once or if device config has changed.

Flow Update

Publish device data and Domoticz to update the devices.

```
Node MQTT in > Node rbe > Node Function > Node MQTT out
```

```
Node MQTT in
```

Listen to topic

```
home/OpenMQTTGateway/BTtoMQTT/28CDC101F80F
```

with MQTT server localhost as running on the same system as Domoticz.

Node rbe
Filter to handle only messages which payload has changed.
Each PICOACT BLE message contains a change indicator, value 00 or 01, as the first byte.
This ensures that only MQTT messages are handled if the state of a pushbutton has changed.

Setting: Block unless value changes (ignore initial value).

Node Function
Update the temperature by MQTT publishing to Domoticz.

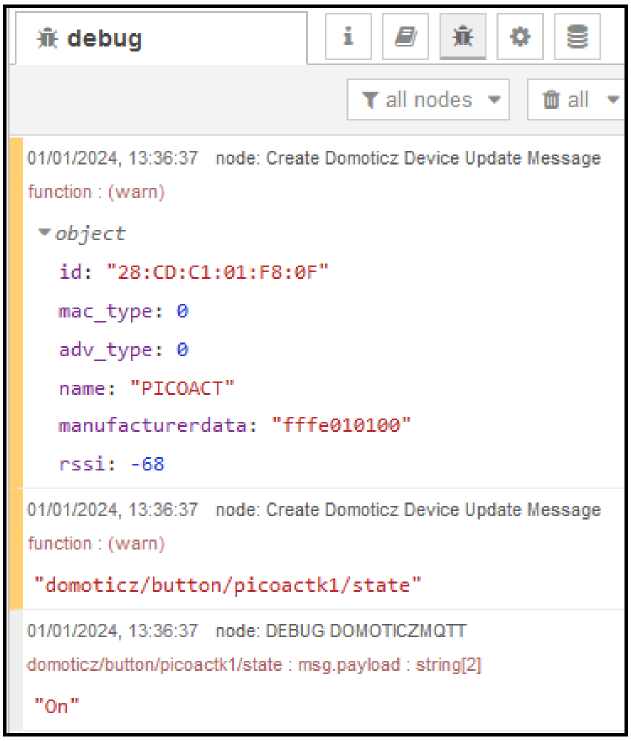
```
// Create Domoticz MQTT-AD message.

// Get the sensor data from the payload key name and convert the HEX string to
device values.
node.warn(msg.payload);

// Example message:
{"id":"28:CD:C1:01:F8:0F","mac_type":0,"adv_type":0,"name":"PICOACT","manufacturerd
ata":"fffe000100","rssi":-76}
// The key manufacturer data with HEX string contains the data:
"manufacturerdata":"fffe000100"
// feff (2 bytes) = manufacturer id (little endian)
// 00 (1 byte) = changed id
// 01 (1 byte) = state button k1 = 00 off, 01 pushed
// 00 (1 byte) = state button k2 = 00 off, 01 pushed

// Assign the payload key name to data
let data = msg.payload.manufacturerdata;
// feff000100
// node.warn(data);

// Get state button k1 from byte 4 (len 2)
// startpos: (4-1) * 2 = 6, endpos: startpos + 2 = 8
let k1hex = data.substring(6, 8);
// Get state button k2 from byte 5 (len 2)
// startpos: (5-1) * 2 = 8, endpos: startpos + 2 = 10
let k2hex = data.substring(8, 10);

let button = "";
// Check which button is pressed, i.e. hex value is 01
if (k1hex == "01") { button = "k1"; }
if (k2hex == "01") { button = "k2"; }
// node.warn(k1hex + ";" + k2hex);

// Create update message for the selected push button
if (button.length > 0) {
    let msgx = {}
    msgx.topic = "domoticz/button/picoact" + button + "/state";
    msgx.payload = 'On';
    // msgx.payload = { 'state': 1 };

    node.warn(msgx.topic);
    return msgx;
}
```

MQTT out

Publish to Domoticz MQTT-AD with server localhost.

Node-RED Debug Log

The Node-RED debug lists the output of the nodes Debug and messages from the function node.warn used in the function node.



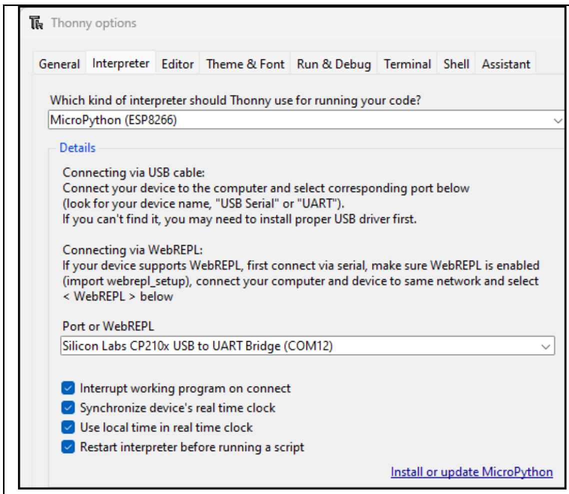
ESP8266 Projects

Introduction

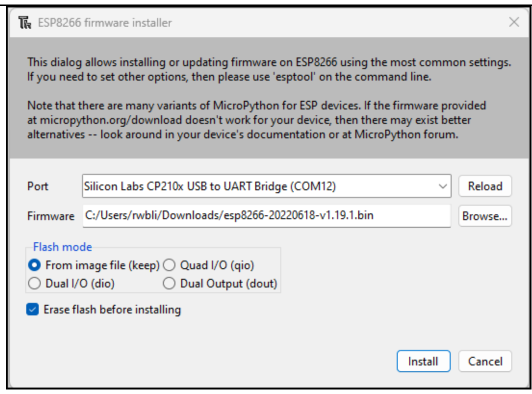
This chapter explores how to use the ESP8266 microcontroller with MicroPython.
As mentioned in the Introduction, the core of the projects uses the Raspberry Pi Pico W microcontroller, but out of curiosity made few simple ESP8266 projects.

Setup

The hardware is an ESP8266 NodeMCU (Model ESP8266MOD, Vendor AI-THINKER).
The NodeMCU is connected to USB COM12 of the development device.
Thonny is used to flash and program the NodeMCU.
The firmware is download from here.
To flash, open Thonny, go to bottom right, select MicroPython (ESP8266) COM12.
Then select menu Tools > Options > Interpreter



Select Install or Update MicroPython.
See picture right.



Press Install.
Notes
During flash the onboard blue LED is blinking.
If the option "Erase flash before installing" is disabled, the MicroPython files are not deleted.
After flash the Thonny log shows (REPL):
MicroPython v1.19.1 on 2022-06-18; ESP module with ESP8266

LED Blink

Description

This project let an LED blink every 2 seconds.

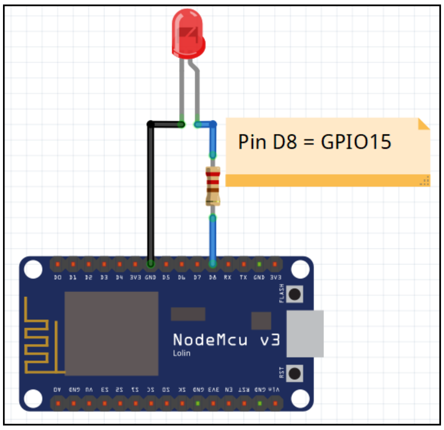
Solution

The ESP8266, NodeMCU, has an LED connected.

Wiring

LED (red)	NodeMCU
+ (Anode) with resistor 220k	GPIO15 (Pin #D8)
GND (Cathode)	GND

Circuit Diagram



MicroPython Script

```
"""
File:esp8266-ledblink.py
Date:20230413
Author: Robert W.B. Linn

:description
Let LED connected to an ESP8266 pin #D8 (GPIO15) blink every 2 seconds.

:log
esp8266-ledblink v20230413
LED state On
LED state Off
LED state On
"""

# Imports
from machine import Pin
from time import sleep

VERSION = 'esp8266-ledblink v20230413'

# Define the LED pin D8=GPIO15
```

```
PIN_LED_D8 = 15
# Create the LED object and set state off
led = Pin(PIN_LED_D8, Pin.OUT)
led.value(0)

# Set blink delay
DELAY = 2# seconds

def IIF(state):
    """Convert the state 1 | 0 to On | Off string.
    """
    if state == 1:
        return 'On'
    else:
        return 'Off'

print(VERSION)
# Loop forever
while True:
    led.value(not led.value())
    state = led.value()

    # Print the led state On or Off
    print('LED state', IIF(led.value()))

    # This is not working on the ESP8266
    # print(f'LED state {led.value()}')

    # Wait few seconds
    sleep(DELAY)
```

LED Remote Control

Description

This project sets the state of an LED (connected to the NodeMCU) On/Off via a Domoticz Switch submitting an HTTP GET request.

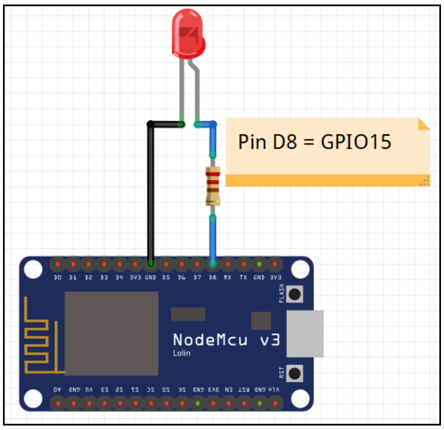
Solution

The NodeMCU runs as a web server and listens to HTTP GET requests to turn the LED On or Off.
This is the same project as described for the Pico W project Domoticz Switch Device Action.

Wiring

LED (red)	**NodeMCU**
+ (Anode) with resistor 220k	GPIO15 (Pin #D8)
GND (Cathode)	GND

Circuit Diagram



Web Server

Libraries

The MicroPython script uses the MicroPython library "espserver.py" developed by the author. This library is based upon the Pico W Web Server solution.

```
"""
File:espserver.py
Date:20230423
Author: Robert W.B. Linn

:description
Class to manage the ESP8266 RESTful webserver.
Commands set via HTTP GET or POST requests with HTTP response JSON object.
"""

# Libraries
import network
import urequests
import socket
import time
from machine import Pin
import json

"""
Class Server
"""
class Server:
    # Constants
    NAME = 'ESPServer'
    VERSION = 'v20230414'

    CRLF = chr(13) + chr(10)
    SPACE = chr(32)

    # Domoticz
    # HTTP response JSON keys
    KEY_STATE= 'status'
    KEY_TITLE= 'title'
    KEY_MESSAGE = 'message'

    # Messages used for HTTP response
    STATE_OK    = 'OK'
    STATE_ERR   = 'ERROR'
    MESSAGE_EMPTY  = ''
    MESSAGE_UNKNOWN = 'Unknown'
    MESSAGE_CMD_UNKNOWN    = 'Unknown command.'
    MESSAGE_ON   = 'On'
    MESSAGE_OFF    = 'Off'

    def __init__(self, wifi_ssid, wifi_password, STATUS_PIN=16, DEBUG=True):
        """
        Init the network with defaults.

        :param string wifi_ssid
            SSID of the network to connect

        :param string wifi_password
            Passord of the network to connect

        :param string | int STATUS_PIN
            Pin number of the LED indicating network status connected
            For an NodeMCU this is GPIO16 (pin #D0)

        :param bool DEBUG
```

```
            Flag to set the log for debugging purposes
        """
        self.debug = DEBUG
        self.wifi_ssid = wifi_ssid
        self.wifi_password = wifi_password

        # Create the onboard LED object to indicate controller is up and network
connected
        self.ledstatus = Pin(STATUS_PIN, Pin.OUT)
        self.ledstatus.off()

    def log(self, msg):
        """
        Log to the console if debug flag is true.

        :param string msg
            Message to print
        """
        if self.debug:
            print(msg)

    def connect(self):
        """
        Connect to the network using the class SSID and password.

        :param None

        :return object server
            Server object.

        :example
            # Create network object
            network = Server(config.WIFI_SSID, config.WIFI_PASSWORD)
            # Connect to the network and get the server object
            server = network.connect()
        """
        try:
            wlan = network.WLAN(network.STA_IF)
            if wlan.isconnected():
                wlan.active(False)
            wlan.active(True)
            wlan.connect(self.wifi_ssid, self.wifi_password)
            # Network connection
            max_wait = 10
            self.log('Network waiting for connection...')
            while wlan.isconnected() == False:
                if wlan.status() < 0 or wlan.status() >= 3:
                    break
                max_wait -= 1
                pass
                max_wait -= 1

            if wlan.isconnected() == False:
                self.ledstatus.off()
                raise RuntimeError('[ERROR] Network connection failed!')
            else:
                self.ledstatus.on()
                self.log('Network connected OK')
                status = wlan.ifconfig()
                self.log('Network IP ' + status[0] )

            # Network Get address
            addr = socket.getaddrinfo('0.0.0.0', 80)[0][-1]

            # Network Create the server socket
            server = socket.socket()

            # Option to reuse addr to avoid error EADDRINUSE
            server.setsockopt(socket.SOL_SOCKET, socket.SO_REUSEADDR, 1)
```

```
            # Bind the address befor starting to listen for icoming client
connections
            server.bind(addr)
            server.listen(1)
            self.log('Network listening on ' + str(addr))
            # self.log(server)
            return server
        except OSError as e:
            self.ledstatus.off()
            cl.close()
            raise RuntimeError('[ERROR] Network connection closed')

    def parse_get_request(self, request):
        """
        Parse the command from the HTTP GET Request.
        The first line of the request contains the command.
        The first line is split and the 2nd item holds the command + data.
        Example first line with the command:
        GET /led1/on HTTP/1.1
        The command is /led1/on.

        :param string request
            HTTP GET request

        :return string command
            Command, i.e. /led1/on

        :return int status
            0 = Error, 1 = OK

        :example
            # Parse the get data. In case of error, the status is 0.
            cmd, status = network.parse_get_request(request)
        """
        status = 0
        cmd = self.MESSAGE_CMD_UNKNOWN

        # Split the decoded request string into a list
        data = str(request.decode()).split(self.CRLF)

        # Check if there is data to get the first item
        if (len(data) > 0):
            # print(data[0])
            # Split the first item which is the command string into a list with 3
items
            cmds = data[0].split(self.SPACE)
            # Check length and get the 2nd item, i.e. /led1/on
            if len(cmds) == 3:
                cmd = cmds[1]
                status = 1
            else:
                print('[ERROR] HTTP GET number of command items invalid. Expect 3,
got ' + len(cmds))
        else:
            print('[ERROR] HTTP GET request not valid.')
        self.log('HTTP Command=' + cmd)

        # Return the command, i.e. /led1/on etc.
        return cmd, status

    def parse_post_request(self, request):
        """
        Parse the command from the HTTP POST Request.
        The last line of the HTTP request contains the command + data.
        The HTTP request is decoded and split as a string list.
        The last line is a JSON object with key:value pair(s).

        :param string request
```

```
            HTTP request

        :return string command
            Command as JSON key:value pair(s), i.e. {"led":1}

        :return int status
            0 = Error, 1 = OK

        :example
            # Parse the post data. In case of error, the status is 0.
            data, status = network.parse_get_request(request)
        """
        status = 0
        cmd = self.MESSAGE_CMD_UNKNOWN

        # Split the decoded request string into a list
        data = str(request.decode()).split(self.CRLF)

        # Check if there is data to get the last item
        # At least 8 items
        if (len(data) > 7):
            # JSON parse the last list item holding the command as JSON string
            # Convert the string to a JSON object
            try:
                cmd = json.loads(data[len(data) - 1])
                status = 1
            except ValueError:
                # In case the JSON data can not be parsed
                cmd = data[len(data) - 1]
                print('[ERROR] HTTP POST request not valid (ValueError).')
        else:
            print('[ERROR] HTTP POST request not valid (Not enought items, must be
8 or more).')
        self.log('HTTP Command=' + cmd)

        # Return the command as JSON object, i.e. HTTP Command: {'state': 'on'}
        return cmd, status

    def get_client_connection(self, server):
        """
        Get the client connection.

        :param object server
            Server object which is listening

        :return object cl

        :return string data
            The requested data format depends on the request

        :example
            cl, request = network.get_client_connection(server)
        """
        # Get client connection
        cl, addr = server.accept()
        self.log('Network client connected from ' + addr[0])

        # Get the request data used to extract the command
        request = cl.recv(1024)
        # Return cl and the request data
        return cl, request

    def send_response(self, cl, response, close):
        """
        Send the response to the client, i.e. Domoticz, curl etc. as JSON object.

        :param object cl

        :param JSON response
```

```
        :param bool close
        """
        self.log('HTTP Response=' + json.dumps(response))

        # Important to have a blank line prior JSON response string
        # Note the use of json.dumps for the response
        cl.send('HTTP/1.1 200 OK'+self.CRLF+'content-type:
application/json'+self.CRLF+self.CRLF+json.dumps(response))

        # If flag close is set, ensure to close the connection
        if close == True:
            cl.close()
            self.log('Network connection closed')

    def send_get_request(self, url):
        """
        Network submit http get request to the domoticz server.

        :param string url
            URL of the HTTP request

        :return int status
            0 = Error, 1 = OK

        :return string content
            HTTP response content sent by Domoticz engine

        :example
            Update the Domoticz temp+hum device with IDX 15
            http://domoticz-
ip:port/json.htm?type=command&param=udevice&idx=15&nvalue=0&svalue=16;55;1
        """
        status = 0
        content = ''
        self.log('Send GET request url=',url)
        try:
            # URL encode space
            url = url.replace(' ', '%20')
            r = urequests.get(url)
            j = json.loads(r.content)
            content = j
            self.log('Send GET request status=' + j['status'])
            r.close()
            status = 1
        except OSError as e:
            # print('[ERROR] Sending data', e)
            raise Exception('[ERROR] Sending data ' + e)
        except ValueError as e:
            # print('[ERROR]', e, r.content.decode()')
            raise Exception('[ERROR]', e, r.content.decode())
        return status, content

    def send_post_request(self, url, postdata):
        """
        Network submit http post request to the domoticz server.

        :param string url
            URL of the HTTP request

        :param string postdata
            postdata as JSON object

        :return int status
            0 = Error, 1 = OK

        :example
            Trigger the Domoticz custom event named DHT22 with data JSON object
```

```
            http://domoticz-
ip:port/json.htm?type=command&param=customevent&event=DHT22&data={"h": 58, "t": 16,
"s": 0}
        """
        status = 0
        self.log('Send POST request url='+url+',postdata='+postdata)
        try:
            r = urequests.post(url, data=json.dumps(postdata))
            j = json.loads(r.content)
            self.log('Send POST request status='+j['status'])
            r.close()
            status = 1
        except OSError as e:
            print('[ERROR] Sending data', e)
            # raise Exception('Network Connection failed.')
        return status
```

MicroPython Script

```
"""
File:esp8266-ledremotecontrol.py
Date:20230413
Author: Robert W.B. Linn

ESP8266 RESTful webserver listening to control an LED via Domoticz Switch.
Commands are set via HTTP GET request with HTTP response JSON object.

:commands
LED ON:
HTTP Request:http://esp8266-ip/led1/on
HTTP response:{"status": "OK", "title": "/led1/on", "message": "On"}

LED OFF:
HTTP Request:http://esp8266-ip/led1/off
HTTP response:{"status": "OK", "title": "/led1/off", "message": "Off"}

LED STATE:
HTTP Request:http://esp8266-ip/led1/state
HTTP response:{"status": "OK", "title": "/led1/state", "message": "On"}

In case of an error:
HTTP response:{"status": "ERROR", "title": "/led1/x", "message": "Unknown
command."}

Example using curl to turn LED1 on:
curl -v http://esp8266-ip/led1/on

:log
esp8266-ledremotecontrol v20230414
#7 ets_task(4020f560, 28, 3fff9430, 10)
Network waiting for connection...
Network connected OK
Network IP esp8266-ip
Network listening on ('0.0.0.0', 80)
Network client connected from client-ip
HTTP Command=/led1/on
HTTP Response={"title": "/led1/on", "message": "On", "status": "OK"}
Network connection closed
Network client connected from client-ip
HTTP Command=/led1/off
HTTP Response={"title": "/led1/off", "message": "Off", "status": "OK"}
Network connection closed
"""

# Libraries
import network
import socket
import time
from machine import Pin
import json
# Import server class from server.py
from espserver import Server
# Configuration read from config.py (must be uploaded to the picow prior testing)
import config

# Constants
NAME = 'esp8266-ledremotecontrol'
VERSION = 'v20230413'

# URL params to switch LED1 on or off or request state
# http://pico-ip/command
CMD_LED_ON  = '/led1/on'
CMD_LED_OFF  = '/led1/off'
CMD_LED_STATE= '/led1/state'
```

```
# Create the LED object using config.py settings
# Define the LED pin D8=GPIO15
PIN_LED_D8 = 15
# Create the LED object and set state off
led = Pin(PIN_LED_D8, Pin.OUT)
led.value(0)

"""
Handle the request containing the command.
The LED is turned on/off or the state is requested.
The response JSON object is updated.

:param string cmd
    Command to set the LED1 state on/off or get the state.

:return JSON object response
"""
def handle_request(cmd):
    # Turn the LED on
    if cmd == CMD_LED_ON:
        led.value(1)
        response[config.KEY_MESSAGE] = config.MESSAGE_ON
        response[config.KEY_STATE] = config.STATE_OK
    # Turn the LED off
    elif cmd == CMD_LED_OFF:
        led.value(0)
        response[config.KEY_MESSAGE] = config.MESSAGE_OFF
        response[config.KEY_STATE] = config.STATE_OK
    # Get the LED state
    elif cmd == CMD_LED_STATE:
        if led.value() == 1:
            response[config.KEY_MESSAGE] = config.MESSAGE_ON
        else:
            response[config.KEY_MESSAGE] = config.MESSAGE_OFF
        response[config.KEY_STATE] = config.STATE_OK
    else:
        response[config.KEY_STATE] = config.STATE_ERR
        response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN
    return response

# Main
print(NAME, VERSION)

# Create network object
network = Server(config.WIFI_SSID, config.WIFI_PASSWORD)
# Connect to the network and get the server object
server = network.connect()

while True:
    try:
        # Get client connection and the request data
        cl, request = network.get_client_connection(server)

        # Create the HTTP response JSON object
        response = {}

        # Parse the get data. In case of error, the status is 0.
        cmd, status = network.parse_get_request(request)

        # Assign the command to the response KEY_TITLE
        response[config.KEY_TITLE] = cmd

        # If the status is 1, handle the command
        if status == 1:
            response = handle_request(cmd)
        else:
            response[config.KEY_STATE] = config.STATE_ERR
            response[config.KEY_MESSAGE] = config.MESSAGE_CMD_UNKNOWN
```

```
        # Send response to the client and close the connection
        network.send_response(cl, response, True)

    except OSError as e:
        network.ledstatus.off()
        cl.close()
        print('[ERROR] Network Connection closed')
```

Domoticz Setup

Devices

Create a virtual sensor, hardware dummy, named LED1 Control from sensor type Switch/Light.

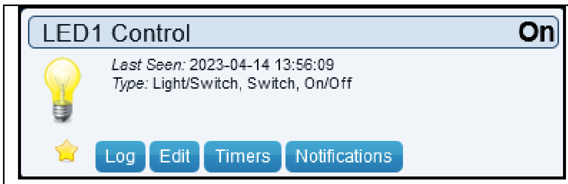
After creating the device, the Domoticz devices list shows the entry:

```
Idx=16, Hardware=VirtualSensors, ID=00014060, Unit=1, Name=LED1 Control,
Type=Light/Switch, SubType=Switch, Data=On
```

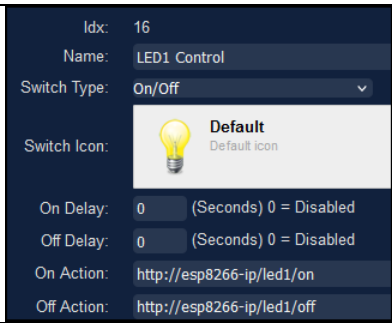
Device Actions

For the switch device with IDX=16, two device actions are defined:

```
On Action: http://esp8266-ip/led1/on
Off Action: http://esp8266-ip/led1/off
```



Edit to define the On / Off Action which is an HTTP request to the NodeMCU web server.



Automation Script

There is no automation script.
If required to take any other action rather switching the LED On/Off, create an dzVents script.

```
--[[
File:   esp8266_remotecontrol.dzvents
Date:20230224
Author: Robert W.B. Linn

:description
Listen to the state change of a switch device.
The state change is triggered by device actions http://esp8266-ip/led1/on or Off

:log
2023-04-14 14:02:38.682 VirtualSensors: Light/Switch (LED1 Control)
2023-04-14 14:02:38.676 Status: User: admin initiated a switch command (16/LED1
Control/Off)
2023-04-14 14:02:38.779 Status: dzVents: Info: Handling events for: "LED1 Control",
value: "Off"
2023-04-14 14:02:38.779 Status: dzVents: Info: template: ------ Start internal
script: esp8266_remotecontrol: Device: "LED1 Control (VirtualSensors)", Index: 16
2023-04-14 14:02:38.779 Status: dzVents: Info: template: Device LED1 Control state
changed to Off
2023-04-14 14:02:38.779 Status: dzVents: Info: template: ------ Finished
esp8266_remotecontrol
2023-04-14 14:02:41.070 VirtualSensors: Light/Switch (LED1 Control)
2023-04-14 14:02:41.067 Status: User: admin initiated a switch command (16/LED1
Control/On)
```

```
2023-04-14 14:02:41.117 Status: dzVents: Info: Handling events for: "LED1 Control",
value: "On"
2023-04-14 14:02:41.117 Status: dzVents: Info: template: ------ Start internal
script: esp8266_remotecontrol: Device: "LED1 Control (VirtualSensors)", Index: 16
2023-04-14 14:02:41.117 Status: dzVents: Info: template: Device LED1 Control state
changed to On
2023-04-14 14:02:41.117 Status: dzVents: Info: template: ------ Finished
esp8266_remotecontrol
]]--

IDX_SWITCH = 16

return {
 on = {
  devices = {
      IDX_SWITCH
  }
 },
 logging = {
  level = domoticz.LOG_INFO,
  marker = 'template',
 },
 execute = function(domoticz, device)
  domoticz.log(string.format('Device %s state changed to %s', device.name,
device.state), domoticz.LOG_INFO)
 end
}
```

ESP32 Projects

Introduction

This chapter explores how to use the ESP32 microcontroller with MicroPython.

As mentioned in the Introduction, the core of the projects uses the Raspberry Pi Pico W microcontroller, but out of curiosity made few simple ESP32 projects.

Setup

The hardware is an ESP32-WROOM-32 connected to for example USB COM4 of the development device.

The *esptool* is used to flash and program the NodeMCU.
The firmware is download from here.

ESP32CYD

Description

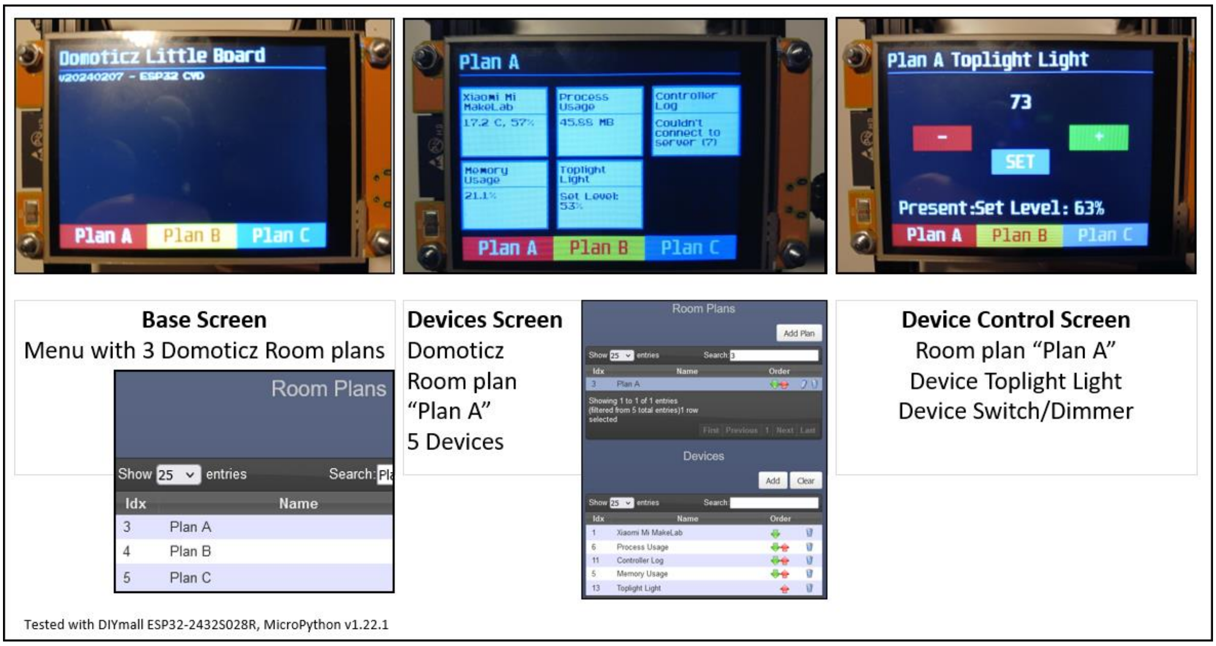
This project explores how to

- connect & use an ESP32 Cheap Yellow Display (CYD) and
- develop a solution to read & control Domoticz selective devices.

Solution

This project, named Domoticz Little Board (ESP32CYD), is a first attempt to create an ESP32 Cheap Yellow Display solution programmed with MicroPython.

Hardware Device
DIYmall ESP32 2.8" TFT Touch Screen Display ESP-32 WIFI BLE Dual Core Development Board ESP32-2432S028R.



From the MicroPython projects created so far, this one has been rather challenging, but fun to build, for various reasons, like memory constrains, framebuffer usage, screen setup & device control.

Brief Solution
There are three screens defined: base screen, devices screen, device control screen.

Every screen touch is handled by a widget, like a device or button and results in an action followed by rebuilt of a screen.

The base screen is shown after ESP32CYD boots and contains a caption at the top and selective Domoticz room plan names, as menus (button widgets), at the bottom.
In the ESP32CYD configuration (config.py), the room plans with its own colors are defined. The length of the room plan name displayed at the screen bottom, depends on the number of room plans defined and their name length.

Touching a room plan menu item, a new screen, called the devices screen, is built with the base screen plus up-to 6 devices configured in Domoticz for the room plan selected.
This is done by sending an HTTP API request to Domoticz to get the detailed devices defined for the given room plan idx … but because of memory constrains handling the Domoticz room plan detailed devices response size, a workaround with a Node-RED flow, as pre-parser has been developed and is in place

The devices are created as widgets with device name, value, and optional last update.
A device is controllable depending on the device type. So far 3 controllable devices are supported: switch, dimmer, setpoint.
If a controllable device is touched, the device control screen is shown.
This screen is made from (again) the base screen plus label widget showing the device value, two button widgets to de- or increase the value, a set button widget to update the value in Domoticz (via HTTP API request) and optional (set in config.py) the present value.
Touching a button results in de-/increasing a setpoint value with the step defined in the configuration. The device control screen is refreshed.

The solution has been developed to enable changes & enhancements, like additional controllable devices, make use of dedicated device control screens (for example a slider widget).
Examples: If a room plan changes (devices), this is immediate shown when touching the room plan menu item or add more room plans by amending the configuration.

During development experienced issues like network connection failed during boot process, Domoticz HTTP API requests not able to handle the response.
These have been mitigated but can not confirm full stability.
Important to use garbage collection to watch & free up memory. This was quite tedious - important is that the network connection is established prior loading drivers & widgets.
The use of images has been explored but dropped because of the memory constrains.
Also, careful use of fonts as high memory consumption. There are two fonts used with 9x11 (default, mainly for the device widget) & 23*12 (big, for the menus & device control screen) size.

Installation is done by flashing the ESP32 with stable firmware, copy the project files to the ESP32, change the secrets.py with network SSID & password, define the room plans to use. Thonny is used as the development tool.

Further developments will commence for a next release- as mentioned it has been challenging but fun to see the progress & result. Lot of TODOs.

CREDITS
To the developer(s) of the following libraries & modules:

- CYDR (info)
- MicroPython ILI9341 Display and XPT2046 Touch Screen Drivers (info),

Source

Source: esp32cyd.zip

Wiring

The wiring is given by the hardware manufacturer.

Pin IO	Type	Use	Note
0	Digital	Boot Button	
1	Digital	Connector P1	TX
2	Digital	Display	TFT_RS / TFT_DC
3	Digital	Connector P1	RX
4	Digital	RGB LED	RED, HIGH = off, LOW = on
5	Digital	SD Card	SS [VSPI]
6	Digital	Unpopulated Pad U4: pin 6	SCK / CLK
7	Digital	Unpopulated Pad U4: pin 2	SDO / SD0
8	Digital	Unpopulated Pad U4: pin 5	SDI / SD1
9	Digital	Unpopulated Pad U4: pin 7	SHD / SD2
10	Digital	Unpopulated Pad U4: pin 3	SWP / SD3
11	Digital	Unpopulated Pad U4: pin 1	SCS / CMD
12	Digital	Display	TFT_SDO / TFT_MISO [HSPI]
13	Digital	Display	TFT_SDI / TFT_MOSI [HSPI]
14	Digital	Display	TFT_SCK [HSPI]
15	Digital	Display	TFT_CS [HSPI]
16	Digital	RGB LED	GREEN, HIGH = off, LOW = on
17	Digital	RGB LED	BLUE, HIGH = off, LOW = on
18	Digital	SD Card	SCK [VSPI]
19	Digital	SD Card	MISO [VSPI]
20	N/A		
21	Digital	Display & Connector P3	TFT_BL (Backlight) / I2C SDA
22	Digital	Connector P3 & CN1 JST	I2C SCL
23	Digital	SD Card	MOSI [VSPI]
24	N/A		
25	Digital	Touch XPT2046	CLK [Software SPI]
26	Analog	Speaker	Speaker only, connected to Amp
27	Digital	Connector CN1 JST	Use as capacitive touch sensor pin
28	N/A		
29	N/A		
30	N/A		
31	N/A		
32	Digital	Touch XPT2046	MOSI [Software SPI]
33	Digital	Touch XPT2046	CS [Software SPI]
34	Analog	LDR Light Sensor	Input only
35	Digital	P3 Connector JST	Input only w/ no internal pull-ups
36	Digital	Touch XPT2046	IRQ, Input only
37	N/A		
38	N/A		
39	Digital	Touch XPT2046	MISO !!!Input ONLY!!! [Software SPI]

Circuit Diagram

Not created. Lookup ESP32 CYD Datasheet.

ESP32CYD Setup

The ESP32CYD (ESP32-2432S028) is setup using a notebook running Microsoft Windows [Version 10.0.22631.3085] and also tested on a notebook running Ubuntu 18.04 LTS.

Install ESPTool

Open terminal and run

```
pip install esptool
```

Log Snippet

```
Collecting esptool
Downloading esptool-4.7.0.tar.gz (285 kB)
…
Successfully built esptool
Installing collected packages: reedsolo, pyserial, intelhex, bitarray, six, PyYAML,
pycparser, bitstring, ecdsa, cffi, cryptography, esptool
Successfully installed PyYAML-6.0.1 bitarray-2.9.2 bitstring-4.1.4 cffi-1.16.0
cryptography-42.0.1 ecdsa-0.18.0 esptool-4.7.0 intelhex-2.3.0 pycparser-2.21
pyserial-3.5 reedsolo-1.7.0 six-1.16.0
```

Install setuptools

Open terminal and run

```
pip install setuptools
```

Log Snippet

```
Requirement already satisfied: setuptools in c:\prog\python\lib\site-packages
(68.0.0)
```

Check ESPTool

Open terminal and run

```
python -m esptool
```

Log Snippet

```
esptool.py v4.7.0
usage: esptool [-h]
esptool.py v4.7.0 - Espressif chips ROM Bootloader Utility
```

ESP32 Erase Flash

Connect the ESP32CYD to an USB port of the development device.

Open terminal and run

```
python -m esptool --chip esp32 erase_flash
```

Log Snippet

```
esptool.py v4.7.0
Found 1 serial ports
Serial port COM4
Connecting.....
Chip is ESP32-D0WD-V3 (revision v3.1)
Features: WiFi, BT, Dual Core, 240MHz, VRef calibration in efuse, Coding Scheme
None
Crystal is 40MHz
MAC: e4:65:b8:20:a8:a4
Uploading stub...
Running stub...
Stub running...
Erasing flash (this may take a while)...
Chip erase completed successfully in 1.9s
Hard resetting via RTS pin...
```

ESP32 Flash

Download firmware

```
https://micropython.org/download/ESP32_GENERIC/
```

The firmware ESP32_GENERIC-20240105-v1.22.1.bin is used to flash the ESP32.

Open terminal and run

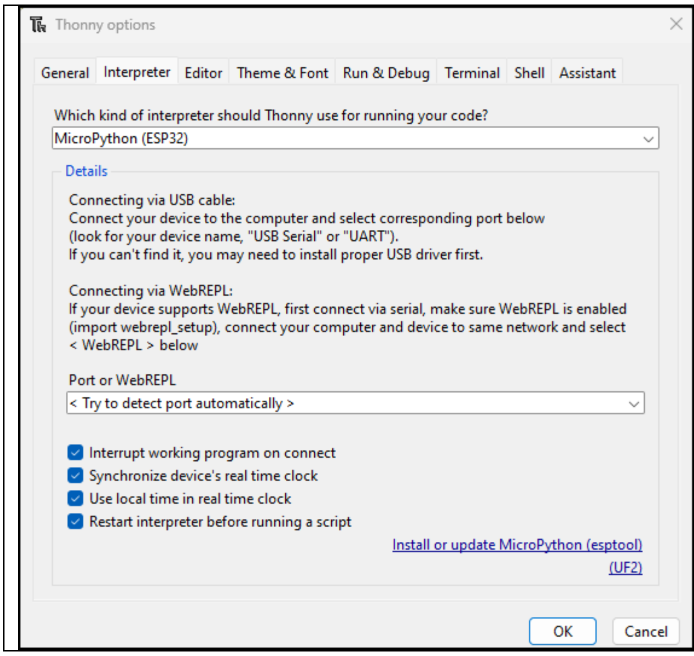
```
python -m esptool --chip esp32 --port COM4 write_flash -z 0x1000 ESP32_GENERIC-
20240105-v1.22.1.bin
```

Log Snippet

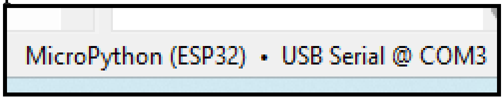
```
esptool.py v4.7.0
Serial port COM4
Connecting....
Chip is ESP32-D0WD-V3 (revision v3.1)
Features: WiFi, BT, Dual Core, 240MHz, VRef calibration in efuse, Coding Scheme
None
Crystal is 40MHz
MAC: e4:65:b8:20:a8:a4
Uploading stub...
Running stub...
Stub running...
Configuring flash size...
Flash will be erased from 0x00001000 to 0x001a9fff...
Compressed 1737664 bytes to 1143562...
Wrote 1737664 bytes (1143562 compressed) at 0x00001000 in 100.4 seconds (effective
138.4 kbit/s)...
Hash of data verified.
Leaving...
Hard resetting via RTS pin...
```

Start Thonny

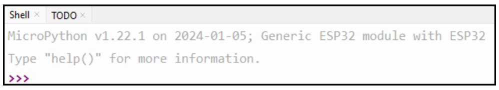
Select menu Run > Configure interpreter…
Set MicroPython (ESP32) and auto detect the port.



Thonny main screen info at bottom right with interpreter and USB serial port connected



Thonny Shell with MicroPython version info



Log Snippet after first ESP32CYD Thonny connection

```
ets Jul 29 2019 12:21:46

rst:0x1 (POWERON_RESET),boot:0x13 (SPI_FAST_FLASH_BOOT)
configsip: 0, SPIWP:0xee
clk_drv:0x00,q_drv:0x00,d_drv:0x00,cs0_drv:0x00,hd_drv:0x00,wp_drv:0x00
mode:DIO, clock div:2
load:0x3fff0030,len:4728
load:0x40078000,len:14888
load:0x40080400,len:3368
entry 0x400805cc
MicroPython v1.22.1 on 2024-01-05; Generic ESP32 module with ESP32
Type "help()" for more information.
MicroPython v1.22.1 on 2024-01-05; Generic ESP32 module with ESP32

Type "help()" for more information.

>>>
```

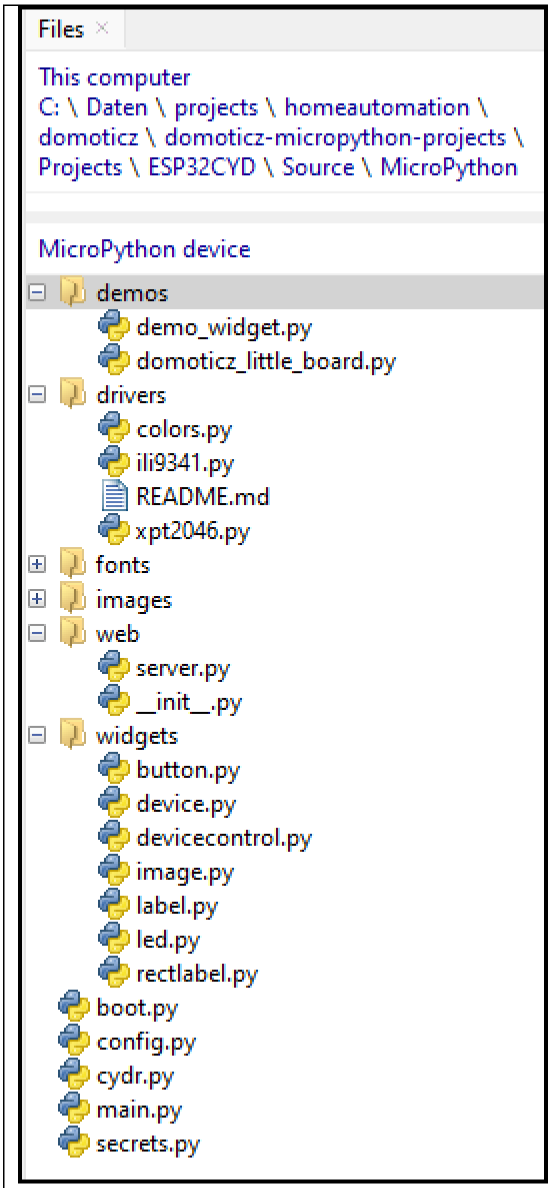
MicroPython

After successful flashing of the ESP32CYD and Thonny start, the folder structure has been built as outlined below.

Folder Structure

Installation
Extract the project archive *esp32cyd.zip* to a folder of choice on a development device and copy the content to the ESP32CYD.

The ESP32 folder structure outlined.



This is a Thonny 4.1.4 screenshot

The Thonny files tab shows the development device, **This computer**, project structure.
The default folder "… Source\MicroPython" is set to enable saving the files from the ESP32.
The **MicroPython device** is the ESP32 with interpreter MicroPython (ESP32) connected to USB Serial COM3.
Folder demos - The demo scripts with an example on how to create a widget and the main script which is started at boot (main.py).
Folder driver – Display driver (ILI9341) & touch controller (XPT2046)) plus color settings.

Folder fonts – Two fonts used ArcadePix9x11, (default), Unispace12x24 (big).
Folder images – Not used.
Folder web – Web server connecting to Domoticz, and handle HTTP API GET requests.
Folder widgets – Screen control elements which can be touchable, like button or device or display only like label, rectlabel, led.

boot – Not used.
config – Various configuration settings.
cydr – Library for display & touch control.
main – Auto start domoticz_little_board script
secrets – network settings SSID, password, IP.

Configuration

There are two configuration files in the root folder on the ESP32CYD.
Changes are required for network settings.
The constants are documented so read through on what can be set.

secrets.py

```
# Secret settings which are network SSID, password and the IP of the Domoticz
system.

# Example Import: import secrets.py
# Access configuration item: secrets.DOMOTICZ_IP
# To save memory use _ for vars used in the script only and const().

# Import the const package
from micropython import const

# Network - set SSID & Password
WIFI_SSID       = const('SSID')
WIFI_PASSWORD   = const('password')

# Domoticz
# Mode sets the server ip:port
# 0=test,1=production
_MODE = 0

# Domoticz IP + Port
if _MODE == 0:
    # Test system
    DOMOTICZ_IP = 'NNN.NNN.NNN.NNN:8080'
else:
    # Production system
    DOMOTICZ_IP = 'NNN.NNN.NNN.NNN:8080'
```

config.py

```
# Global configuration constants.

# Import configuration: import config.py
# Access configuration item: config.TOUCH_INDICATOR
# To save memory use _ for vars used in the script only and const().

# Import the const package
from micropython import const
from drivers.colors import *

# Display resolution. Landscape mode (270 degrees rotation) is used.
# Do NOT change.
DISPLAY_WIDTH = const(320)
DISPLAY_HEIGHT = const(240)
DISPLAY_ROTATION = const(270)

# Show the touch indicator (coloured circle)
TOUCH_INDICATOR = True
TOUCH_INDICATOR_COLOR = RED
```

```
# Define the menu items holding the room plan names & idx at bottom of a screen.
# The x,y pos is calculated from the display width and the number of menu items.
# Touching a menu item loads the associated roomplan devices.
# Menu item properties:
# id: Unique control id. Must be negative and start with -1000, followed by -1001
etc.
# text: Text which is set by the room plan name. Max text length depends on font
width and menu item width.
# idx: Associated room plan idx (mandatory). Look up Domoticz gui or run http api
room plan.
# fgcolor, bgcolor: text and background color (each menu item can have its own
color setting).
menu_items = [
    {'id':-1000, 'text':'Plan A', 'idx':3, 'fgcolor':WHITE, 'bgcolor':RED},
    {'id':-1001, 'text':'Plan B', 'idx':4, 'fgcolor':RED, 'bgcolor':YELLOW},
    {'id':-1002, 'text':'Plan C', 'idx':5, 'fgcolor':WHITE, 'bgcolor':BLUE}
    # add more
]

# Update the menu_items from Domoticz via HTTP API request.
# The updated menu items are not stored permanent.
UPDATE_MENUS = False

# Devices screen using the Node-RED pre-parser to set the room plan devices.
# The pre-parser is used to save memory handling the HTTP API response.
# Depending on the number of room plan devices, the Domoticz response is large.
# The pre-parser returns devices with selective attributes and is much smaller.
NODERED_PREPARSER = False

# Devices screen - Device widget colors.
DEVICE_FGCOLOR = BLACK # Text
DEVICE_BGCOLOR = WHITE # Background
DEVICE_BDCOLOR = BLUE  # Border

# Set the number, between 1 -6 of roomplan devices to be displayed on the devices
screen.
# Reduce if facing memory issues or use the Node-RED Pre-Parser.
MAX_PLAN_DEVICES = const(6)

# Flag to show the last update in the device widget (at bottom).
SHOW_LAST_UPDATE = const(False)

# Domoticz controlable devices
SWITCH_DEV = const('Switch')
ONOFF_DEV = const('On/Off')
DIMMER_DEV = const('Dimmer')
SETPOINT_DEV = const('SetPoint')
# ADD MORE like BLIND_DEV

# Define controlable devices for the devices screen enabling to set new value.
# See previous starting with the ONOFF devices.
CONTROLABLE_DEVICES = [ONOFF_DEV, DIMMER_DEV, SETPOINT_DEV]

# Domoticz HTTP API command param.
# Used in set_device_data triggered from the device control screen - must be
lowercase.
SWITCH_PARAM = const('switchlight')
SETPOINT_PARAM = const('setsetpoint')

# Domoticz device attribute (case sensitive) used to set new value.
# Default is 'Data', change here for any other like dimmer.
DIMMER_ATTR = const('LevelInt')   #No conversion to int required
SETPOINT_ATTR = const('SetPoint') #Convert from string to float
# ADD MORE

# In/Decrease step for a device.
DIMMER_STEP = const(5)
SETPOINT_STEP = const(0.5) #Check also the Domoticz device widget settings
```

```
# Device Control Screen
# Min/Max values for a device. Use int or float.
ONOFF_LIMITS = (0, 1)
DIMMER_LIMITS = (0, 100)
SETPOINT_LIMITS = (5.0, 21.0)

# Device Control Screen
# Set the prefix for the present value at the screen bottom left.
# Use None to hide the present value
PRESENT_VALUE_PREFIX = const('Present:')
# PRESENT_VALUE_PREFIX = None
```

Libraries

The MicroPython script uses the MicroPython library “server.py” developed by the author.
This library is based upon the Pico W Web Server solution.
Licence: GNU 3.0

MicroPython ILI9341 Display and XPT2046 Touch Screen Drivers (info).
Licence: MIT

Library to control the ESP32 CYD R (info).
Licence: MIT

Again, many thanks to the developers of the drivers and controllers.

Scripts

The scripts are well documented and therefore not further explained here.

Recommend starting with the script “domoticz_little_board.py” in the folder demos.

Use the _DEBUG global to see in detail what is happening during running of the script.
Recommend commenting out starting the script domoticz_little_board.py in the script main.py.

```
# Start - Abort with CTRL+C in Thonny
# import demos.domoticz_little_board
```

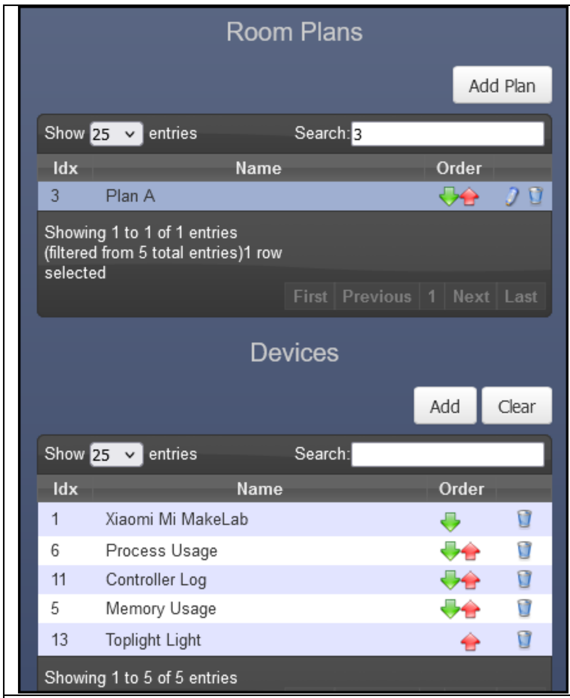
For the development of widget, there is examples *demo_widget_xxx.py* in the demos folder.

Domoticz Setup

Room Plans

As mentioned in the solution, room plans are used to build the menus and the devices screen.

Create Room Plan and add up-to 6 devices



Domoticz GUI > Setup > More Options > Plans > Roomplan

Add Plan, enter a name and ok.

Select the plan and add the devices.

Max 6 devices.

Hint
If memory issues, shown by error message can not load devices screen, reduce the number of devices or use the Node-RED Pre-Parser.

ESP32CYD Configuration (config.py)

Add New Room Plan
Add the room plan item Name and Idx to the configuration entry “menu_items”.
Set the color accordingly.

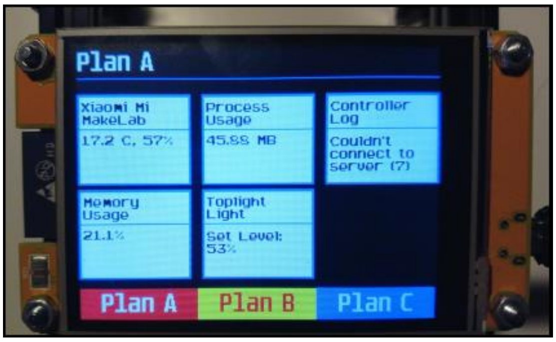
```
menu_items = [
    {'id':-1000, 'text':'Plan A', 'idx':3, 'fgcolor':WHITE, 'bgcolor':RED},
    {'id':-1001, 'text':'Plan B', 'idx':4, 'fgcolor':RED, 'bgcolor':YELLOW},
    {'id':-1002, 'text':'Plan C', 'idx':5, 'fgcolor':WHITE, 'bgcolor':BLUE}
    # add more with id -1003 etc.
]
```

Example using Thonny:
Stop the backend > load config.py > change the menu entry and run the ESP32CYD.

Room Plan Change
If for a room plan the list of devices changes, the ESP32CYD shows the changed device list in the devices screen when selecting the device menu.
No change in the ESP32CYD configuration.

If for a room plan, the name changes, the configuration entry “menu_item” text must be updated.
Example using Thonny:
Stop the backend > load config.py > change the menu entry and run the ESP32CYD.

Room Plan Menu Items
The width of a menu item is calculated from the display width and the number devices. The more devices, the smaller the menu item.
If the room plan text does not fit, then the text is truncated.
Hint
Keep the room plan text as short as possible.

	Devices Screen Room Plan A Room plan A devices shown in the Devices Screen after tapping on menu item “Plan A”. Tapping on a controllable device, like the “Toplight Light”, shows the Device Control Screen.
	Device Control Screen Room plan A Device Toplight Light Controls: -: Decrease level by step defined in the configuration DIMMER_LIMITS = (0, 100) +: Like previous but increase SET: Set the new level in Domoticz via HTTP API request. The Plan A devices screen is shown with the updated value(s).

Node-RED Setup

Node-RED is running on the same system as Domoticz.
Installed using following bash script from a terminal on the Domoticz system, which is a Raspberry Pi 4:

```
# Bash script to update Node-RED
# Make script executable: sudo chmod +x update-node-red.sh
# Run script: ./update-node-red.sh
# RwbL 20231206

echo ------------------
echo Node-RED Update
echo ------------------

bash <(curl -sL https://raw.githubusercontent.com/node-red/linux-
installers/master/deb/update-nodejs-and-nodered) --node20

echo Done
```

Node-RED Pre-Parser

Whilst developing & testing, the ESP32CYD gave an error message when updating the devices screen with detailed room plan device information.
Lookup garbage collection data to check memory and searched for options how to save memory. It did not help… which meant that the Domoticz HTTP response with detailed devices data is probably too large.

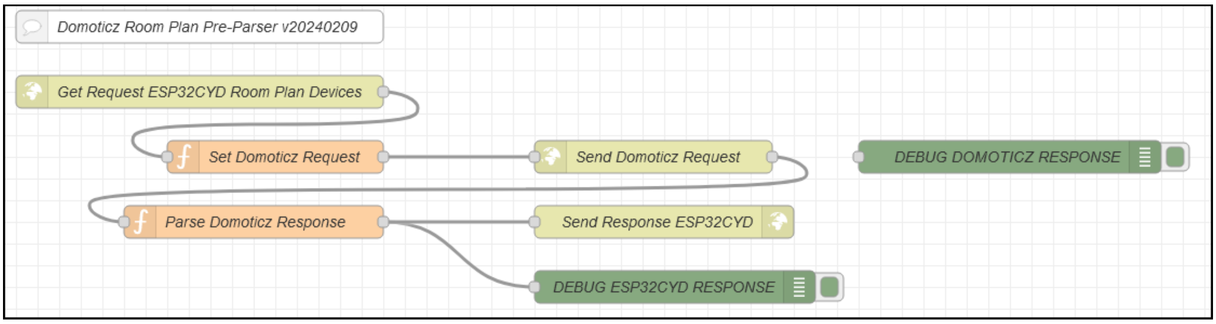
Created a helper in Node-RED, called the pre-parser, to extract selective device attributes for a room plan device. The data returned as HTTP response from Node-RED is much smaller than from Domoticz.
After implementing the Domoticz pre-parser, no issues with the ESP32CYD whilst building the room plan devices screen.

The HTTP command send from the ESP32CYD to Node-RED is like:

```
http://{ip}/command?param=getdevices&plan={idx}
```

Using (kind of) same structure as Domoticz.

Node-RED Flow



Node http in
Method: GET; URL: Command

Node Function Set Domoticz Request

```
// Set the domoticz url for the room plan http api request
// The IP localhost is used because Node-RED runs on the same system as domoticz
// Log the request from the ESP32CYD
// Example for room plan with idx = 4: domoticz-ip:1880/roomplans?plan=4
// {"param":"getdevices","plan":"4"}
node.warn(msg.req.query);
// Get the room plan idx from the HTTP request
let plan = msg.req.query.plan;
// Define the url with the room plan idx
let url = "http://localhost:8080/json.htm?type=command&param=getdevices&plan=" +
plan;
// Set the message url used for the HTTP request node
msg.url = url;
// Log the url property
node.warn(msg.url)
return msg;
```

Node http request

Method: GET

Node Function Parse Domoticz Response

```
// Parse the Domoticz HTTP API room plan request to get the devices.
// The response is a json array with selective attributes.
// This is done to save memory on the ESP32 when parsing the data.
// If an attribute is not found, the value is set to undefined.

// Get the devices array, status and title from the Domoticz HTTP API response
let devicesArray = msg.payload.result;
let statusFlag = msg.payload.status;
let statusTitle = msg.payload.title;

// Set the result array sent to the ESP32CYD
let resultArray = {
    "result": [],
    "status": statusFlag,
    "title": statusTitle
    };

// Loop over the devices
devicesArray.forEach(function(device) {

    // Select attributes and set with the exact keys as set by Domoticz!
    let devitem = {
        Name: device.Name,
        Data: device.Data,
        idx: device.idx,
        LastUpdate: device.LastUpdate,
        SubType: device.SubType,
        SwitchType: device.SwitchType,
        LevelInt: device.LevelInt,
        SetPoint: device.SetPoint
        // Add more if required
    };

    // Push the devitem to the result array
    resultArray["result"].push(devitem);
});

// msg.url = NOT REQUIRED because requester url is used to send the response
msg.payload = resultArray;
return msg;
```

Node http response
No settings, use default

Example HTTP Response to the ESP32CYD for a room plan with 6 devices


```
{"result":
[
{"Name":"Xiaomi Mi MakeLab","Data":"17.2 C, 57 %","idx":"1","LastUpdate":"2023-12-
08 11:30:07","SubType":"THGN122/123/132, THGR122/228/238/268"},
{"Name":"Process Usage","Data":"52.87 MB","idx":"6","LastUpdate":"2024-02-09
11:54:31","SubType":"Custom Sensor"},
{"Name":"Controller Log","Data":"Couldn't connect to server (7)
IP=192.168.1.110","idx":"11","LastUpdate":"2023-11-18 10:48:25","SubType":"Alert"},
{"Name":"Memory Usage","Data":"23.12%","idx":"5","LastUpdate":"2024-02-09
11:54:31","SubType":"Percentage"},
{"Name":"Toplight Light","Data":"Set Level: 40 %","idx":"13","LastUpdate":"2024-02-
09 10:26:57","SubType":"Switch","SwitchType":"Dimmer","LevelInt":40},
{"Name":"Button Test","Data":"Off","idx":"41","LastUpdate":"2024-02-09
10:48:20","SubType":"Switch","SwitchType":"On/Off","LevelInt":0}
],
"status":"OK",
"title":"Devices"}
```


Import Flow
The flow is imported into Node-RED, using the Import function – burger menu > import or ctrl-i. Then paste the content or select the file from the archive esp32cyd.zip folder Node-RED:

```
esp32cyd_room_plan_pre-parser.flow
```

Operate

Operating the ESP32CYD is rather easy.

1. Plug-in the ESP32CYD into power (5V).
2. Wait till network connection is made and the base screen is shown.
   The script main.py is executed with uncommented import of domoticz_little_help.py.
3. Tap on a room plan menu item at the bottom of the screen.
4. Wait till the room plan devices screen shows up.
5. View a device or tap on a controllable device, like a switch, dimmer or setpoint.
6. In the device control screen change the value using – or + button.
7. Update the value in Domoticz by tapping on SET.

Note
If not using the Node-RED pre-parser, set the configuration NODERED_PREPARSER = False.

Outlook

The script “domoticz_little_board.py” contains the TODO: items.
These are planned for a next version.
So more to come …

Appendix

MQTT Auto Discovery

Description

Whilst starting to write this book, the projects require to create manually Domoticz devices. For example, the DHT22 Temperature + Humidity project requires to create manually a Domoticz device from type Temp + Humidity using the Dummy hardware controller.

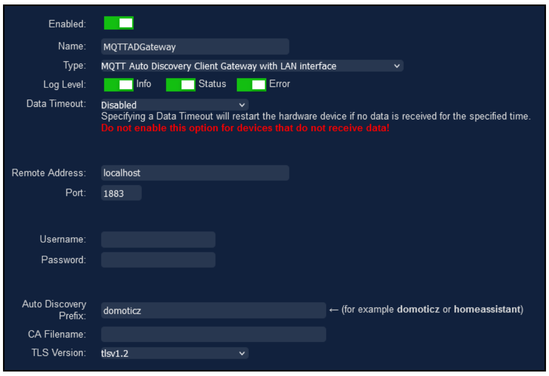
As from Domoticz version 2022.1 stable, the hardware controller MQTT Auto Discovery Client Gateway with LAN interface has been added.
This means that for a device, own state topics can be defined, handled by Domoticz.
No need to use the Domoticz topics "domoticz/in" or domoticz/out".
A device state can be set by its own MQTT topic with payload.

To mention is that the MQTT broker mosquitto and the clients mosquitto_pub and mosquitto_sub run on the Domoticz Test System (Raspberry Pi 4B). The Domoticz hardware controller MQTT Client with LAN interface is added and enabled.

Domoticz Setup

MQTT Auto Discovery Client Gateway with LAN interface
The first step is to add new hardware "MQTT Auto Discovery Client Gateway with LAN interface".

Hardware device settings

Screenshot	Settings
	Name: **MQTTADGateway** *Note* Used a short name for easier log reading. Remote Address: **localhost** *Note* The gateway runs on the same Domoticz system but can be accessed remote via MQTT. Port: **1883** *Note* This is the default MQTT port. Auto Discovery Prefix: **domoticz** *Note* Ensure to use the same prefix as for MQTT client gateway.

Domoticz MQTT Debug

For exploring how to use the MQTT Auto Discovery feature, it is helpful to log MQTT messages at debug level.

To enable (tested on Raspberry Pi) the mosquitto configuration file needs changes followed by a restart of Domoticz.

Modify the file "/etc/init.d/domoticz.sh" by a adding the two lines:

```
DAEMON_ARGS="$DAEMON_ARGS -loglevel normal,status,error,debug"
DAEMON_ARGS="$DAEMON_ARGS -debuglevel hardware"
```

Then restart Domoticz

```
sudo systemctl daemon-reload
sudo service domoticz restart
```

Domoticz Log

Below is a snippet of the Domoticz log after restarting Domoticz.

The gateways MQTT client (MQTTClientGateway) and Auto Discovery (MQTTADGateway) are connected to the localhost.

The MQTTADGateway discovers two devices.

```
2023-04-18 14:29:15.468 Status: MQTTClientGateway: Connecting to localhost:1883
2023-04-18 14:29:15.468 Status: MQTTADGateway: Connecting to localhost:1883
2023-04-18 14:29:15.669 Status: MQTTADGateway: connected to: localhost:1883
2023-04-18 14:29:15.669 Status: MQTTClientGateway: connected to: localhost:1883
2023-04-18 14:29:15.970 Status: MQTTADGateway: discovered: SGT001/Garden Temp
(unique_id: SGT001)
2023-04-18 14:29:15.970 Debug: MQTTADGateway: topic:
domoticz/sensor/sensorGardenT/config, message: {"name": "Garden Temp",
"device_class": "temperature", "state_topic": "domoticz/sensor/sensorGarden/state",
"value_template": "{{value_json.temperature}}", "unit_of_measurement": "°C",
"unique_id": "SGT001"}
2023-04-18 14:29:16.071 Status: MQTTADGateway: discovered: SGH001/Garden Hum
(unique_id: SGH001)
2023-04-18 14:29:16.070 Debug: MQTTADGateway: topic:
domoticz/sensor/sensorGardenH/config, message: {"name": "Garden Hum",
"device_class": "humidity", "state_topic": "domoticz/sensor/sensorGarden/state",
"value_template": "{{value_json.humidity}}", "unit_of_measurement": "%",
"unique_id": "SGH001"}
2023-04-18 14:29:16.171 Debug: MQTTADGateway: topic: domoticz/status, message:
online
```

MQTT Hints

MQTT Clients
Both clients “mosquitto_pub” and “mosquitto_sub”, are used for testing configuration, publish, and subscribe MQTT messages i.e., topics with payload.
The clients are running from a terminal on Domoticz Test System (Raspberry Pi).
Using the command line clients enables to understand the MQTT message topics and payloads.
These are used by the MicroPython scripts in the various projects.
So, for every project the command line clients are used prior developing the MicroPython code. This is essential.

Remote Access
To be able to access MQTT from remote clients, the mosquitto configuration require to “allow anonymous” and a listener on the default port.

Edit the Mosquitto configuration file (this is done on a Raspberry Pi)

```
sudo nano /etc/mosquitto/conf.d/mosquitto.conf
```

Add the lines

```
allow_anonymous true
listener 1883 0.0.0.0
```

Restart Mosquitto service

```
sudo service mosquitto restart
```

Check the mosquitto log message on errors

```
sudo cat /var/log/mosquitto/mosquitto.log
```

Test Remote Access
To test if able to access remotely, like publishing a message to update the temperature & humidity of the devices assigned to the object with id sensorGarden.

```
mosquitto_pub -h domoticz-ip -p 1883 -t "domoticz/sensor/sensorGarden/state" -m
'{"temperature":21.9,"humidity":71}'
```

Remove Retained Messages

```
mosquitto_sub -h localhost --remove-retained -t '#' -W 1
```

During testing a whole bunch of messages are published. Lots with errors. These are kept in the MQTT queue. It is therefore required to remove.
Here an example log output from the remove-retain command

```
{"name": "Garden Temp", "cmd_t" : "~/set", "stat_t" : "~/state", "uniq_id":"gt123"
}
{"name": "Garden Temp Sensor", "device_class": "temperature", "state_topic":
"domoticz/sensor/garden/tempsensor/state"}, "value_template": "{{
value_json.temperature|default(0)}}"
```

```
{"name": "plant_sensor_1", "state_topic": "domoticz/plants/1/state",
"value_template": "{{ value_json.temperature|default(0)}}"
{"name": "plant_sensor_1", "state_topic": "domoticz/plants/1/state"
{"name": "plantsensor1", "device_class": "temperature", "state_topic":
"domoticz/plants/1/state", "value_template": "{{ value_json.temperature|default(0)
}}"
{"name": "Garden Temp", "device_class": "temperature", "state_topic":
"domoticz/sensor/sensorGarden/state", "value_template": "{{
value_json.temperature}}", "unit_of_measurement": "°C" }
{"name": "Garden Hum", "device_class": "humidity", "state_topic":
"domoticz/sensor/sensorGarden/state", "value_template": "{{ value_json.humidity}}",
"unit_of_measurement": "%RH" }
```

IMPORTANT
Restart Domoticz after removing the retained messages and check the Domoticz log.

```
sudo service domoticz restart
```

MQTT Auto Discovery Hints

Some hints gathered during testing.

Sensor Multiple Measurement Values
The Autodiscover feature does not allow to create a Temp+Humidity device but require two devices Temperature and Humidity instead.
These are created by submitting two configuration topics using the same state topic.

IP-Address
The ip address used was localhost or 127.0.0.1 (because running from local terminal) but can also access remote, like domoticz-ip (see previous Hints > Remote Access).

Unit of Measure
Important to use the correct unit_of_measure.
Example if for a Humidity device the unit was set to %RH instead %, the device created was from type "General" instead "Humidity".
See Domoticz source code

```
void MQTTAutoDiscover::GuessSensorTypeValue(...
```

Device Unique ID
Ensure that each device has a unique id (key "unique_id") in the configuration message.
Hint
If familiar with Piping and Instrument Diagrams, an option is to use for the device an Instrumentation ID, like for the temperature TR001.

Clean All Retained Messages
To start with a clean sheet, all MQTT retained messages are removed, the related Domoticz devices deleted, and the Domoticz Test System is restarted.

Example with command and output:

```
mosquitto_sub -h localhost --remove-retained -t '#' -W 1

{"name": "Garden Temp", "device_class": "temperature", "state_topic":
"domoticz/sensor/sensorGarden/state", "value_template":
"{{value_json.temperature}}", "unit_of_measurement": "°C", "unique_id": "SGT001"}
{"name": "Garden Hum", "device_class": "humidity", "state_topic":
"domoticz/sensor/sensorGarden/state", "value_template": "{{value_json.humidity}}",
"unit_of_measurement": "%", "unique_id": "SGH001"}

sudo service domoticz.sh restart
```

Example Devices

Sensor Temperature & Humidity

Create Devices Temperature, Humidity

```
mosquitto_pub -r -h localhost -p 1883
-t "domoticz/sensor/sensorGardenH/config"
-m '{
"name": "Garden Hum",
"device_class": "humidity",
"state_topic": "domoticz/sensor/sensorGarden/state",
"value_template": "{{value_json.humidity}}",
"unit_of_measurement": "%",
"unique_id": "SGH001"
}'

mosquitto_pub -r -h localhost -p 1883
-t "domoticz/sensor/sensorGardenT/config"
-m '{
"name": "Garden Temp",
"device_class": "temperature",
"state_topic": "domoticz/sensor/sensorGarden/state",
"value_template": "{{value_json.temperature}}",
"unit_of_measurement": "°C",
"unique_id": "SGT001"
}'
```

Publish to Set Values

```
mosquitto_pub -h localhost -p 1883
-t "domoticz/sensor/sensorGarden/state"
-m '{"temperature":22.1,"humidity":64}'
```

Subscribe to Get Values

```
mosquitto_sub -h localhost -p 1883
-t "domoticz/sensor/sensorGarden/#"

{"temperature":22.1,"humidity":64}
```

Domoticz Devices List

```
IDX=33, Hardware=MQTTADGateway, ID=SGH001, Unit=1, Name=Garden Hum,
Type=Humidity, SubType=LaCrosse WS2300, Data=Humidity 64 %

IDX=34, Hardware=MQTTADGateway, ID=SGT001, Unit=1, Name=Garden Temp,
Type=Temp, SubType=THR128/138, THC138, Data=22.1 C
```

Remove Retained Message

```
mosquitto_sub -h localhost --remove-retained
-t 'domoticz/sensor/sensorGardenH/config' -W 1

mosquitto_sub -h localhost --remove-retained
-t 'domoticz/sensor/sensorGardenT/config' -W 1
```

Sensor Distance

Create Device Distance

`mosquitto_pub -r -h localhost -p 1883`
`-t "domoticz/sensor/distance/config"`
`-m '{`
`"name": "Distance",`
`"device_class": "distance",`
`"state_topic": "domoticz/sensor/distance/state",`
`"value_template": "{{value_json.distance}}",`
`"unit_of_measurement": "cm",`
`"unique_id": "DIST001"`
`}'`

Publish to Set Value

`mosquitto_pub -h localhost -p 1883`
`-t "domoticz/sensor/distance/state"`
`-m '{"distance":NN.NN}'`

Subscribe to Get Value

`mosquitto_sub -h localhost -p 1883`
`-t "domoticz/sensor/distance/#"`
 	
`{"distance":64}`

Domoticz Devices List
`Idx=45, Hardware:VirtualSensors, ID=DIST001, Unit=1, Name=Distance,` `Type=General, SubType=Distance, Data=123.4 cm`
Remove Retained Message
`mosquitto_sub -h localhost --remove-retained` `-t 'domoticz/sensor/distance/config' -W 1`

Push On Button

Create Device

`mosquitto_pub -r -h 127.0.0.1 -p 1883`
`-t "domoticz/button/makelab/config"`
`-m '{`
`"name": "MakeLabButton",`
`"state_topic": "domoticz/button/makelab/state",`
`"unique_id": "BM001"`
`}'`

Publish to Set Value

`mosquitto_pub -h 127.0.0.1 -p 1883`
`-t "domoticz/button/makelab/state"`
`-m {'ON'}`
`OR`
`-m ON`

Subscribe to Get Value

`mosquitto_sub -h localhost -p 1883`
`-t "domoticz/button/makelab/#"`
 	
`ON`

Domoticz Devices List
`IDX=39, Hardware=MQTTADGateway, ID=BM001, Unit=1, Name=MakeLabButton,` `Type=Light/Switch, SubType=Switch, Data=Off`
Remove Retained Message
`mosquitto_sub -h localhost --remove-retained` `-t 'domoticz/button/makelab/config' -W 1`

Custom Sensor

Create Device

`mosquitto_pub -r -h localhost -p 1883`
`-t "domoticz/sensor/airquality/config"`
`-m '{`
`"name": "Air Quality",`
`"device_class": "airquality",`
`"state_topic": "domoticz/sensor/airquality/state",`
`"value_template": "{{value_json.airquality}}",`
`"unit_of_measurement": "ug/m3",`
`"unique_id": "AQ001"`
`}'`

Publish to Set Value

`mosquitto_pub -h 127.0.0.1 -p 1883`
`-t "domoticz/sensor/airquality/state"`
`-m '{"airquality":16}'`

Subscribe to Get Value
`mosquitto_sub -h localhost -p 1883` `-t "domoticz/ sensor/airquality/#"`
Domoticz Devices List
`IDX=47, hardware=MQTTADGateway,ID=AQ001,Unit=1,Name=Air Quality, Type=General, SubType=Custom Sensor, Data=16 ug/m3`
Remove Retained Message
`mosquitto_sub -h localhost --remove-retained` `-t domoticz/sensor/airquality/config ' -W 1`

Hints

Useful Documentation

To get started with the Raspberry Pi Pico recommend studying:

- Getting started with the Pico
- Getting started with the Pico W
- MicroPython

Development Notes

Running a Script

Ensure to Stop/Restart the Thonny backend (CTRL+F2) prior running the script (F5).

Message: memory allocation failed

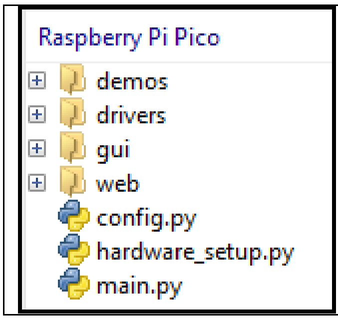
If this message occurs, then Stop/Restart Thonny backend twice.

```
MemoryError: memory allocation failed, allocating NNNN bytes.
```

Message: No Module named 'hardware_setup'

If this message occurs, then set the Raspberry Pi Pico W root folder as focus instead a sub-folder.

```
ImportError: no module named 'hardware_setup'
```

		If a sub-folder is focussed, like demos, then click on “Raspberry Pi Pico” to set the root folder as focus.

Memory Limitation

The Pico has limited memory available - 264kB of SRAM, and 2MB of on-board flash memory - which require careful usage & allocation.

Recommend reading this section of the MicroPython guide about memory.

Some observations during development of the projects:

- Avoid Domoticz HTTP API GET requests returning large response, like requesting the status of all devices,
- The same applies for sending POST requests to the Pico W acting as a RESTful server,
- For LCD displays, the class FrameBuffer - frame buffer manipulation – can take up high memory depending on the size of the screen. Consider using a GUI library, like micropython-micro-gui.

MicroPython Various

Item	**Hint**
Python	PEP 8 – Style Book for Python Code
REPL Command for Help on Modules >>> help('modules')	__main__ lwip uasyncio/lock ure _boot math uasyncio/stream urequests _boot_fat micropython ubinascii uselect _onewire mip/__init__ ucollections usocket _rp2 neopixel ucryptolib ussl _thread network uctypes ustruct _uasyncio ntptime uerrno usys _webrepl onewire uhashlib utime builtins rp2 uheapq uwebsocket cmath uarray uio uzlib dht uasyncio/__init__ ujson webrepl ds18x20 uasyncio/core umachine webrepl_setup framebuf uasyncio/event uos gc uasyncio/funcs urandom Plus, any modules on the filesystem

REPL Command for Help on rp2 module
>>> import rp2
>>> help('rp2')
	object rp2 is of type str
	find -- <function>, rfind -- <function>
	index -- <function>, rindex -- <function>
	join -- <function>, split -- <function>
	splitlines -- <function>, rsplit -- <function>
	startswith -- <function>, endswith -- <function>
	strip -- <function>, lstrip -- <function>
	rstrip -- <function>, format -- <function>
	replace -- <function>, count -- <function>
	partition -- <function>, rpartition -- <function>
	center -- <function>, lower -- <function>
	upper -- <function>, isspace -- <function>
	isalpha -- <function>, isdigit -- <function>
	isupper -- <function>, islower -- <function>
	encode -- <function>

Domoticz Automation Events

The demos submitting POST requests from Domoticz automation events to the Pico W RESTful server, use Lua tables as post data.
The Lua table is converted to JSON and the request-header application/json is set.
The Pico W RESTful server uses the JSON data direct.

<table>
<tr><th>dzVents Lua Table</th><th>Pico W RESTful server JSON data</th></tr>
<tr><td><pre>
local postdata={}

postdata['caption']='Power Distribution'
postdata['lastupdate']=domoticz.time.rawTime
postdata['solar']=solar
postdata['solarfgcolor']=COLOR_WHITE
postdata['home']=home
postdata['homefgcolor']=COLOR_WHITE
postdata['grid']=grid
if grid < 0 then
 postdata['gridfgcolor']=COLOR_RED
else
 postdata['gridfgcolor']=COLOR_GREEN
end
postdata['battery'] = battery
postdata['batteryfgcolor']=COLOR_WHITE
</pre></td><td><pre>
{
'caption': 'Power Distribution',
'lastupdate': '10:40:00',
'home': 2.2, 'homefgcolor': 15,
'solar': 2.8, 'solarfgcolor': 15,
'grid': 0.4, 'gridfgcolor': 1,
'battery': 0.2, 'batteryfgcolor':
15
}
</pre></td></tr>
</table>

Bluetooth

The Raspberry Pi Pico W or WH - not the Pico - supports Bluetooth Classic and Bluetooth Low Energy (BLE). No additional components required.
See the Raspberry Pi announcement.

Ensure to flash the latest stable MicroPython firmware for the Pico W.

As an example, from project Bluetooth Low Energy Actuator MQTT Auto Discovery:
After flashing, copy the content of the archive **bleactuator.zip** folder MicroPython to the Pico W. Then run main.py.

Abbreviations

Some of the abbreviations used. These apply esp. for the scripts.

BLE	Bluetooth Low Energy
CLI	Terminal Command Line Interface
domoticz-ip:port	Domoticz system IP address and port
~domoticz	Path to the Domoticz folder (Home Directory) on the RPi
dzVents	Domoticz Easy Events
GUI	Domoticz UI in Web Browser
Hm, HmIP	Homematic, HomematicIP
JSON	JavaScript Object Notation
LLC	Logic Level Converter
MCU	Microcontroller Unit (Raspberry Pi Pico/Pico W, ESP8266, ESP32)
MQTT	Message Queuing Telemetry Transport
NodeMCU	ESP8266 MCU
Pico W or PicoW	Raspberry Pi Pico W
picow-ip	Raspberry Pi Pico W web server IP address
RPi	Raspberry Pi
webserver	Web Server