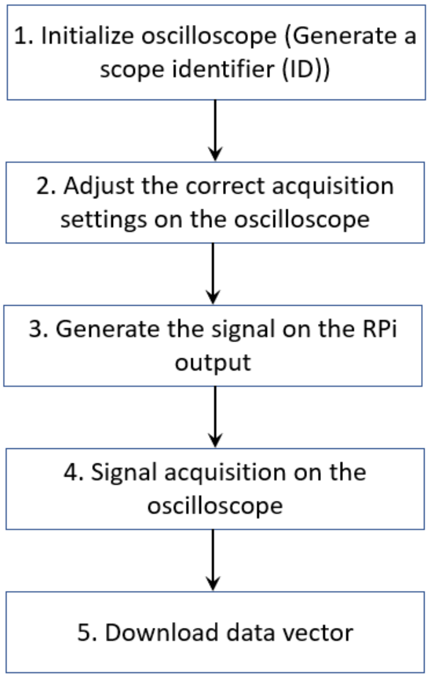
Troubleshooting of Timeout errors using RPi controlled oscilloscope acquisition

Info: In the course IC231 we use a predefined library to control and acquire signals called "ScopeRead". Commands in the following text require the loading of this library as:

```
import ScopeRead as scope
```

The general program flow: For generating a signal with the RPi and the subsequent acquisition using the oscilloscope the following sequence has to be ensured:


1. Initialize oscilloscope (Generate a scope identifier (ID))

2. Adjust the correct acquisition settings on the oscilloscope

3. Generate the signal on the RPi output

4. Signal acquisition on the oscilloscope

5. Download data vector

Step	Command examples
1.	`scope_id = scope.initialize()`

2.	`scope.voltagescale_ch1(ID, time/division)`
	`scope.timescale_set(ID, time/division)`
	`scope.voltagescaleset_ch1(ID, volts/division)`
	`scope.triggerset_ch1(ID, triggerlevel)`
	`scope_id.single()`

3.	`GPIO.output(GPIO pin, level)`
	`time.sleep(0.1)`
	`GPIO.output(GPIO,level)`

4.	→ Happens when a trigger level crossing is detected
5.	`data = scope.acquire_ch1(ID)`

If this logical sequence **is not strictly followed**, there will be **an acquisition error**. For example we cannot send a signal (3.) before we have prepared the oscilloscope for an acquisition (2.). In such a case it is a logical consequence that the acquisition will fail.

Important: When the command `scope.acquire_ch1(ID)` is executed, the raspberry tries to download a data vector which **has already been acquired** by the oscilloscope. If there is no data available, then, after a certain waiting time, a timeout error occurs, because there is no data to download.

Furthermore, the adjustment of the oscilloscope after step 2, and the acquisition of the signal at step 4 take some time. This settling time is longer than the plain execution of the python code. Consequently, if there are no pauses implemented after step 2 and after step 4, then there is a very high chance of timeout error because there is no signal available.

<u>In step 2 there are three main adjustments to make:</u>

1. Define the horizontal time axis (Time/division)
2. Define the vertical voltage amplitude axis (Voltas/division)
3. Define the trigger channel and trigger amplitude

- ➔ If these three adjustments are not make accordingly to suit the expected signal then most probably the signal acquisition will fail.
- ➔ Timescale and timerange settings are mutually exclusive, because **both adjust the horizontal axis**. Whatever code is executed latest is active.

Probable false settings leading to timeout error:

1. **Timerange much larger than signal (e.g. trigger pulse):** The oscilloscope acquires with **62500 samples** per channel. This means that the time resolution **Δt = timerange / 62500.** If **Δt > Pulsewidth of trigger**, then there is a high chance that the pulse is not detected because it is to fasts to be detected. Please note:
   a. The command `scope.timerange` is used to set the full acquisition window
   b. The command scope. `timescale` is used to set time/division (Oscilloscope has 10 divisions)

2. **Triggersetting wrong:** If the trigger is set with a **level larger than the actual signal** or it is set on **the wrong channel** then the oscilloscope will not detect a signal.
   a. Please note: Only one channel at a time can be used as trigger channel. The code:

   ```
   scope.triggerset_ch1(ID, triggerlevel)
   scope.triggerset_ch1(ID, triggerlevel)
   ```
   will select channel 2 as trigger because the second line overwrites the first line.

   b. The probe which connects the oscilloscope to the pin has an attenuator. It may have a false setting. (Check URL Source on moodle.)

3. **Not enough resting times for adjustments:** See under **Important** above
4. Multiple sequential acquisition with updated settings can be conducted within one script sequence. It is sufficient to initialize the **scope one time**. However, it is of utmost importance to strictly follow the setting sequence as shown above and ensure enough settling time. Otherwise, there surely will be a timeout error.