1 July 16th, 2022

Installation guide for the web-server-light_v50

New in this version are:

- Added an HttpRequest parser for GET requests Almost all manual searches on incoming requests are removed. Incoming request are now adapted and evaluated by Forth!
- An HTML dictionary is now used for html tags and svg parts.
- TcpTime is changed to Forth-style messages for ESP32/ESP8266
- To start the servers use: start-servers and NOT Start-http-server
- Renamed: <#tdC to <#tdC> <#tdL to <#tdL> <#tdR to <#tdR>
  <<option>> to <option> .<<option>> to <<option-cap>>
- Added a schedule with a web-gui for a Daily_schedule

The aims for the web-server-light_v50 are:

- To be able to run a smart home by using a wireless UDP or TCP connection.
- Exchange data.
- Keep all data local.

This guide was written to get a Raspberry Zero W running headless on a local network.
Warning: I could only test the guide on my own network.
So, you might have to find solutions yourself in case of problems.

The guide expects from you some skills. If you don't know much about Forth see:
http://home.iae.nl/users/mhx/sf.html
If you don't know much about IP addresses see:
https://www.youtube.com/watch?v=9FzKxMiZWgg and also the manual of your router.
If you have never used Linux in a bash shell see:
https://www.youtube.com/watch?v=oxuRxtrO2Ag
If you don't know much about HTML see:
https://www.youtube.com/watch?v=v4oN4DuR7YU and the extensive:
https://www.w3schools.com/html/default.asp

In this manual black **bold underlined** text means: there must be an option you can see in the menu, desktop or screen.
$ text means type in a bash shell the **text** after the dollar sign and press <Enter>.
Lines that contain IP-addresses should be changed to your local situation.

The master-slave part only works on a local network under Gforth on a Raspberry Pi with the Linux and in a BASH-shell. See https://youtu.be/xlzHTPlj8bo for a demonstration.
The Web server light can be used under Windows with Win32Forth version 6.15 or with Gforth using version 0.7.9_20220713 on a Linux PC or Raspberry Pi.

Minor changes in various updates of Gforth or Linux might lead to problems.
It was last tested on Gforth version: **Gforth 0.7.9_20220713** and the Bullseye (Kernel: Linux 5.15.32+)

Your WiFi network should be stable. Speed is less important.
For me the following setting in my router did the trick:
Transmission mode: **11bg mixed** (Try to use as less protocols as possible)
Channel width: **20Mhz**
Channel: **1**
Protection: **WPA2-PSK**
Encryption: **AES**
Beacon interval: **100**
RTS threshold: **576**
DTIM interval: **1**
Connect as many as possible devices to **5G** and set it's RTS threshold to **576**.

If your network connection disappears or hangs, then try the following:
Switch your router off, wait 10 seconds and switch it on again.

Before you start read the entire guide so you know what to expect.
Start on your PC the CMD prompt and enter: **ipconfig /all** <ENTER>
Determine an IP-addres for your Pi. Use one that ends with a **zero** for the first Pi for an easy master-slave configuration.

Next follows how a Raspberry Zero W can be changed to run on a network without a keyboard, mouse or monitor (headless)
The parts between [[and]] are optional.
As far as I could test they increase the stability of the Raspberry Pi which is needed when you run a Pi 24/7. Try Google to find out if these parts or other parts that are unclear.

In order to install or clone a Raspberry Zero W in an easy way the following extra hardware is used:
A Transcend USB 3.0 SDHC/SDXC / microSDHC/SDXC Card Reader, TS-RDF5K
to put files on a SDcard.
A mini HDMI to HDMI adapter to connect the Pi to a monitor.
A microUSB OTG cable.
A SDcard. The SDcards I used till now had a lifespan of about 1 year.
Now I am trying: A SanDisk SDSQXAF-032G-GN6AA. They issue a 30-year warranty in Germany for this model.
A 5Vdc 1A power unit. (I use an old 5V power supply of a previous smartphone)
A PC with connected to the internet.
A NAS with a shared directory (Only needed when there are multiple Pi's used.)
I use a Linux PC that is connected to my router.

Hardware setup:
Connect a keyboard to the Pi through the microUSB OTG cable.
Connect the Pi to a monitor with the mini HDMI to HDMI adapter.
Connect the power unit to the Pi. The Pi is very sensitive to power fluctuations.
If you use a power bar then use the socket that is **closest** to the power line.

For Installation of the OS on the Pi go in the internet to: https://www.raspberrypi.org/software/
1. Hit the link **Download for Windows** on your PC.
2. Install and start the Raspberry Pi Imager.
3. Put the SDcard you'll use with your Raspberry Pi in the Transcend USB Device
4. Place the the Transcend USB Device in the PC
5. Select left at **OS**: Raspberry PI OS (32bit) (**Other**)
   and then **Raspberry PI OS Lite** (32bit) with **no desktop environment**
6. Select next at the **Storage device**:
   The **Transcend USB Device** (holding the SDcard)
7. Hit **write** And overwrite the SDcard.

When you are ready on the PC shut it down

Important: Enable in your **router** the **DHCP server**
Be sure to use always the same determined IP address in your network by adding the PI in your router in **the Reservation list** at the **DHCP server**

Put the SDcard in the pi and power on the PI.
An installation should start.
That takes a while. As long as you are able to move the mouse or see a LED blinking on the Pi there is progress.
At the end a wizzard will apear. Answer the questions.
This manual assumes you entered the logon name **pi**
Restart the Pi at the end.

After the restart the bash shell should apear. Enter:
$ sudo raspi-config
Use the **cursor** keys to select an item then **<tab>** to select choises like **Ok**, **Cancel** or **Finish** and **<enter>** to activate the option.
Choose: **System options | Wireless Lan**
Select your country, fill in the SSD and its password,
Finish | reboot

After the restart:
Check the ip address by enter:
$ **ifconfig** and see it under **wlan0:** at **inet**
Check the network with:
$ **ping -c3 8.8.8.8**
That should respond 3 times with something like:
64 bytes from 8.8.8.8: icmp_seq=1 ttl=59 time=13.1 ms
$ **pwd**
That should show: (restart when it does not)
$ /home/pi

$ **sudo raspi-config**
Enable SSH with: **Interface Options | SSH**
Enable SPI with: **Interface Options | SPI**
Enable I2C with: **Interface Options | 12C**
Choose: **Localisations Options | Timezone** Set it to the right zone.
Change the hostname at: **System options | hostname**
Finish | reboot

$ sudo shutdown 0 -h
Wait till the powerled is off.
Disconnect the monitor and the keyboard.
The Pi is now able to run headless.

Download on a PC that also is connected to your network
the newest (Update it to avoid errors!) **MSI ('Windows Installer')** of **PuTTy**
from: https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html and install it on your PC.

Put power on the Pi so it starts again and wait 60 seconds.
Then start PuTTY on the PC and enter at the top **the IP address** of the **Pi** and use Port **22** with connection type **SSH.**
Then click on **Open**.
If a screen with a PuttY Security Alert about a fingerprint appears then hit **Yes**.

After you logged on you get into the BASH-shell on your Pi.
Logon and enter **$ nano test.txt** type the word test and save it.
Familiar yourself a bit with this simple editor.
See https://www.youtube.com/watch?v=f_nAA_cbSW4 for a quick tutorial.
The Nano editor is a safe way to change files that end with **.sh**
If you use notepad or another editor that produce a DOS format then these files will not work anymore.

Update the PI:
$ sudo apt-get update
$ sudo apt-get upgrade -y

For ARP:
sudo apt-get install net-tools

To get access to your Pi with the Explorer on a PC:
$ sudo apt-get install samba -y
If a dialog window appears about the use of a DHCP-server then choose **[No]**
$ sudo apt-get install winbind -y

$ sudo nano /etc/samba/smb.conf
Changes in this file:
1) Find the line with
workgroup = **WORKGROUP**
Change WORKGROUP in your used workgroup of your **PC** if they are not the same.

2) Find the line with
read only
at **Share Definitions** under **[homes]**
Change it into:
read only = no

3) Add at the end of the file the line:
socket options = TCP_NODELAY IPTOS_LOWDELAY SO_RCVBUF=65536 SO_SNDBUF=65536 SO_KEEPALIVE
Then save the file.

Generate a password for pi in samba:
$ sudo smbpasswd -a pi

$ sudo apt-get install git -y

Install the wiringpi for GPIO under the Bullseye.
$ **git clone https://github.com/WiringPi/WiringPi**
$ **cd WiringPi**
$ **./build**
$ **gpio -v**
# Run gpio -v and version 2.70 will appear.
# If it does not appear, it means that there is an installation error.

[[Making a RAM disk:
Careful here 1 mistake and you need to repeat the whole installation
$ sudo nano /etc/fstab
Then add the following 6 lines at the end:

```
tmpfs /tmp tmpfs defaults,noatime,nosuid,size=50m 0 0
tmpfs /var/tmp tmpfs defaults,noatime,nosuid,size=10m 0 0
tmpfs /var/log tmpfs defaults,noatime,nosuid,mode=0755,size=100m 0 0
tmpfs /var/log/samba tmpfs defaults,noatime,nosuid,mode=0755,size=10m 0 0
tmpfs /var/spool/mqueue tmpfs defaults,noatime,nosuid,mode=0700,gid=12,size=30m 0 0
tmpfs /var/run/samba tmpfs defaults,noatime,nosuid,mode=0755,size=20m 0 0
```

Save the file with added 6 lines above
$ sudo reboot
If you decided that the IP adress of your Pi is 192.168.0.110
Then check in the windows explorer if you can open your \\192.168.0.110\pi
(Use the pasword of samba)
Create a simple text file as a test.

Disable logging rsyslog
$ sudo systemctl disable rsyslog
See also after a reboot: **ls -l /var/log**

Get improved networking stability at the cost of some power consumption:
$ sudo nano /boot/config.txt
Add the following line at the end:
dtparam=eee=off
dtoverlay=disable-bt # Bluetooth hangs the serial interface
Save the file.

Disable swapping for a faster webserver.
$ sudo dphys-swapfile swapoff
$ sudo dphys-swapfile uninstall
$ sudo update-rc.d dphys-swapfile remove
$ sudo apt purge dphys-swapfile
$ After this operation, 69.6 kB disk space will be freed.
$ Do you want to continue? [Y/n] y

The Pi is going to use simple uni-cast DNS - multi-cast DNS support is not required.
$ sudo systemctl disable avahi-daemon
$ sudo systemctl stop avahi-daemon
]]

Download Gforth and the code with:
$ git clone https://github.com/Jos-Ven/A-smart-home-in-Forth
$ mv A-smart-home-in-Forth/*.* /home/pi

Install gforth-0.7.9_20220713 for the webserver light:
$ mkdir Downloads
$ sudo chmod 777 Downloads
$ cd Downloads
$ unzip ../gforth.zip
$ tar xvfJ gforth.tar.xz
To see where the unpacked version is, enter.
$ ls
If the new directory is gforth-0.7.9_20220713 then:
$ cd gforth-0.7.9_20220713
$ sudo apt-get install m4 libtool-bin libffi-dev -y

Ignore ALL errors of the following 4 commands
It will also take a long time and produce a lot of text.

$ sudo ./install-deps.sh # Ignore the fatal error when shown

$ sudo ./configure
$ sudo make
$ sudo make install
and wait for the line with: === INSTALL SUCCEEDED ===
$ hash -r

Reboot the Pi with: **$ sudo reboot**
Login to the Pi and enter **$ gforth**
As soon as you a line that looks like:
Gforth 0.7.9_20220713, Copyright (C) 1995-2018 Free Software Foundation, Inc.
Then you know the installation is indeed OK
Enter **Bye**

Grant all rights with: **$ sudo chmod 777 *.***
$ sudo gforth
Needs _demo1.f
A line like: ' Webserver started at: http://192.168.0.201:8080/home ' should appear.
Go to the indicated page in your browser to see if it works.

Note: If you interrupt the program with **<Control c>** you need to enter **+f** to get to the Forth dictionary !

My preferred way is to start Gforth in the back ground of Linux, then it will continue to run even if your logoff. To do this just start enter **$ ./gf.sh**

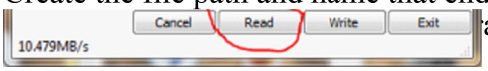
[[More optimizations:

To turn off the power management option. Add in:
$ sudo nano /etc/rc.local
at the end before the line **exit 0** the line:
/sbin/iw wlan0 set power_save off
And to run the application of Gforth in the background as soon as the Rpi boots insert:
bash /home/pi/auto.sh
]]
Now I recommend you to backup the entire PI by making an image of the SDcard.
After all a SDcard can de **crash** .....

Note: A restore only works when the new or blank SDcard has at least **the same size** as the SDcard that was used to backup the PI

Update the PI before the backup :
$ sudo apt-get update
$ sudo apt-get upgrade -y

Download, install the Win32DiskImager from https://sourceforge.net/projects/win32diskimager/ on a PC

1. **$ sudo shutdown 0 -h**
2. Disconnect the power cable when the systemled is off.
3. Put the SDcard in the Transcend USB Device and place it in the PC
4. Close all new explorers and do **NOT** format the suggested station.
5. Start the Win32DiskImager
6. Create the file path and name that end with **.img** of the image under **Image File**,
7. 

anscend USB Device (Contains the directory: overlays)
8. Click "Read"
9. Wait until ready.
10. Eject the Transcend USB Device in the explorer.

Now, if anything ever goes wrong with your Pi, you can restore your fully-set-up image using the reverse instructions:

1. **$ sudo shutdown 0 -h**
2. Disconnect the power cable when the systemled is off.
3. Insert the SDcard in the Card Reader and place it into your computer.
4. Head to the search of the start menu and type "disk management." Open the disk management program and find your SDcard in the list.
5. Right-click and delete all the partitions on your SDcard. **Be sure** to select the partitions of **SDcard** only!
6. When it's empty, make one new partition of maximal 32 GB
7. Right-click on the new partition it and format it as **FAT32**. **Be sure** to select the partition of **SDcard** only!
8. Open Win32DiskImager again and browse for your image file. Select your device from the **Device** dropdown just as you did before. **Be sure** to select the **SDcard**.
9. This time, click "Write" to write the image to the SDcard.
10. When it finishes, eject the SDcard and re-insert it into your Raspberry Pi. When you boot it up, it should be in the exact same state it was in when you first backuped the SDcard.

Once you've done this, setting up your Pi from scratch will be a whole lot simpler and faster!

In this pack: Files starting with an **underscore** load a complete application and contain additional information. All files that ends with **.f** or **.fs** can be compiled under Gforth.
Files ending with **.f** can also be compiled with Win32Forth and must be edited with an editor using a DOS format. Since **.fs** files may also be edited in DOS format I use the win32forthIDE to edit **.f** and **.fs** files.

gf.sh is used to start a Gforth application under Lunix in the background.
See gf.log for errors.
Modify **gf.sh** if you would like to use another application or example.
A TCP or UDP port can only be one time used.
To see all gforth processes enter: **$ ps aux | grep gforth**
Then you could also use: **$ sudo killall gforth-fast** to kill it.
Or you can try: **$ ./kf.sh** to kill Gforth processes.

More details:

The new HttpRequest parser make it a lot easier to see what is happening.
It is now possible to see the complete HttpRequest received from a browser and the line before it is evaluated by Forth.
EG: remove in _demo1.f the backslash in the following line
\ ' see-request is handle-request
at the end of the file. Then compile it again by using:
$ sudo gforth-itc
needs _demo1.f.
Start a browser go to home-page of the _demo1.fs and look what is happening in the console
When ready: Hit <control c>
+f \ To add Forth to the limited context.
Bye \ Leaving Forth

Errors should appear in the logging of the console (File gf.log).
Note the times in the logging to be sure that you are not looking at an old logging.
If you crash out of Gforth then the only way out is to use the console and find out what is going wrong. That can happen with an uncaught exception.

The *.f files can be compiled under Win32Forth and Gforth.
The *.fs files can only be compiled on Gforth.
It should be possible to use the Web server light over the internet (not recommended) if you know how to forward incoming requests to the web server.
That should be explained in the manual of your router.

------- If you just use **ONE** Pi then there is no need to continue reading. -------

Cloning a **same** **Raspberry Pi model** can be used to install a secondary Pi.
You don't need to repeat the entire installation. Here is how it can be done:

Make a backup and restore it on a new SDcard
Place the restored SDcard in the new PI
Power up the new Pi without any other hardware connected to it.
You have already defined a WiFi connection on your first Pi.
Now the new Pi is going to connect to your router and behave totally as the first Pi.
Use **PuTTY** on your PC to logon to the new Pi (use the password of the first Pi)
To avoid 2 exact same Pi's on your network make the following modifications:
$ **sudo raspi-config**
Change the pasword at: **System options | Password**
Change the hostname at: **System options | hostname**
Finish | reboot

Setting up the NAS:
Copy all the extracted files **EXCEPT gf.sh** and **gforth.zip** from
rpi directory to the NAS.
Copy **gf.sh** directly to the slave(s).
The master will use **npush.sh** to copy files to the NAS.
The slaves will use **nget.sh** to copy files from the NAS.
These 2 scripts use the file: /home/pi/Documents/pw.sh
$ mkdir Documents
$ sudo chmod 777 Documents
$ cd Documents
Create **pw.sh** with nano containing the following 3 lines:
MOUNTING="//192.168.0.209/homes"
USR="pi"
PW="Password of pi on the machine of the NAS"
Most likely is that you have to change the used **IP address** and **password** between the quotes.
The IP address schould be the IP address of the machine of the NAS
save the file, then:
$ sudo chmod 777 pw.sh
$ cd ..

Make a small file named **test.f** in your **/home/pi** directory on the master
and enter **$ ./npush.sh**
Then see if test.f to has indeed been copied to the NAS.
On the slave enter **$ ./nget.sh**
$ ls test.f
to see that test.f has been copied to the /home/pi of the slave.
If one of these tests failed than you have to solve the problems before you continue.

Making the Pi a **slave**:
Change in the file **gf.sh** of the slave, so it is not a master when Gforth is started.
Put a '**#**' at the start of the line that contains **_DemoMaster.fs** so it will not start again.
Remove the '**#**' at the start of the line that contains **_down.fs.**
Save the file.
Start Gforth with **./gf.sh**

Disable NTP for slaves:
$ timedatectl | grep synchronized
System clock synchronized: **yes**
$ sudo timedatectl set-ntp False
$ sudo reboot
$ timedatectl | grep synchronized
System clock synchronized: **no**
The master will take care for the right time on the slaves.

An ip table is used for communications.
Specify the number of the used Pi's and other systems in the network on the **master**:
$ ./kf.sh to kill Gforth
In autogen_ip_table.fs there is a line with
10 constant FirstIpRange
Change the **10** into the number of Pi's you are going to use.
Delete the file **ip_table.bin** on the master
Start Gforth with **./gf.sh**

Start one or more slave and go to the home page of the master in your browser.
(Mine is at: http://192.168.0.201:8080/home) and choose:
Administration | **Update settings:** | the button **IP Table** at Update the ip table. |
back to **Administration** | then the button **UpdateAll** |
Then just wait a few seconds and hit **Scan** again. As soon as a new version number appears your slave is up again and ready to use.

The update and synchronize options are script driven.
When activated, Gforth writes a new nupdate.sh
Next Gforth uses **npush.sh** to copy nupdate.sh and the changed *.f files to the NAS.
*.f files that start with a **zero** are excluded. Then a message is send to the slaves.
They will use the following scripts:
1. Run nget.sh to copy all added/changed files from the NAS to their /home/pi directory.
2. Run nupdate.sh to execute more Linux scripts if they are there.
3. Run gf.sh to restart Gforth which will compile the web server and its application .

When you use the option **Update Gforth after download** you must copy a downloaded /gforth.tar.xz to your NAS first! It also assumes that there is an **/tmp** directory on your **RAM disk**.

Now you can also update an application without having to log on to a slave
and starting the Gforth-console manually.
In a network there should be only one Pi that is the master. All the other Pi's should be a slave.
Otherwise a secondary master will not receive data from the slaves.
The slaves can be updated through the link **Administration** on the Master.
If a version number is negative it means an update is in progress or there is an error. See **nget.log** or **nupdate.log** on the slave for errors.
upd_gforth.log is created when Gforth is updated.
Master.fs changes a system into a master.
See the sources _DemoMaster.fs and _down.fs.

That is all.
