Prisirah

Jens Thiele*

November 6, 2023

Building digital photo frames for family and friends using open-source hardware[1] and free software in X=? minutes.[2]

Figure 1: different A20-OLinuXino-MICRO prototypes: 2 using A13-LCD7-TS and one using A13-LCD10TS

*karme@karme.de

Contents

1 Introduction

As I recently became a father I was more or less forced by many to share photos of our lovely son. At the same time it became evident that our internet traffic is monitored and captured[3] and even worse that you can't trust your hardware[4]. First of all this is a political and social problem, but it likely will need some time to get that fixed. That was the reason to build digital picture frames for family and friends using open-source hardware[1] and free software that allow to share photos via internet while at least trying to protect our privacy.

WARNING: this is still work in progress and should be considered pre-alpha!

About this document

Versions

The latest version is always at `http://karme.de/prisirah/`. A printable version is at `http://karme.de/prisirah/prisirah.pdf`. The document source is at `http://karme.de/prisirah/prisirah.org` or you can get it via Git (s.a. A.1):

```
$ git clone https://www.karme.de/git/prisirah-image-builder
```

Conventions

Terminal / shell interaction:

```
$ echo hello
hello
```

In this case you are expected to type "echo hello" in a terminal/shell. The character string "$ " only indicates your command prompt that likely will look different on your system, you don't type it. The output will be "hello" as indicated by the second line. The output isn't always included for brevity.

If a line ends with a "\", you are expected to type the next line, too:

```
$ echo hello \
world
hello world
```

If you are expected to replace some text first it is indicated like this:

```
$ echo «TOREPLACE»
hello
```

To make the output match the input you have to replace "«TOREPLACE»" with "hello".

WARNING: Never ever type in some text from some web-site without thinking, especially if you are using http instead of https. Make sure you understand what you are doing first.

2 Open-source Hardware

As base Olimex's open-source hardware boards are used. You can choose between the A20-OLinuXino-MICRO and the A20-OLinuXino-LIME2. Both are single-board computers (SBCs) using the Allwinner A20 system on a chip (SoCs).[5]

The A20-OLinuXino-MICRO is bigger but has more ports and is easier to handle. In the A20-ENC plexyglass enclosure[6] the A20-OLinuXino-MICRO takes approximately 15cm x 9cm x 4cm of space. It accepts 6-16V power input. Especially the audio headphones output is missing on the A20-OLinuXino-LIME2. For the A20-OLinuXino-LIME2 there is a nice small box that only takes approximately 9cm x 6.5cm x 3cm of space and it needs 5V power input.[7] Both are nice devices – maybe grandpa might feel more comfortable with a completely closed box. (Update: there are now nice boxes for the A20-OLinuXino-MICRO, too and for the A20-OLinuXino-LIME2 there are nice metal boxes that integrate the display: LCD7-METAL-FRAME and LCD10-METAL-FRAME.)

Table 1: Using A20-OLinuXino-MICRO

Required part	approx. price (€)	comments
A20-OLinuXino-MICRO	65	
LCD-OLinuXino-7TS	65	You can also use the LCD-OLinuXino-10TS (~90€)
CABLE-IDC40-15cm	2	maybe you still have lots of old PATA cables?
SY0612E (12V, 0.5A) or Watterott HNP24-120 (12V, 2A)	8	plug: 5mm/2.1mm - maybe you have a good enough PSU - for the 10" display the SY0612E might not suffice
Samsung Pro MB-MGBGB Class 10	20	any fast microSDHC card >= 8G should do [11]
Subtotal	160	
Recommended part		
MOD-WIFI-R5370-ANT or MOD-WIFI-AR9271-ANT	10	USB Wireless adapter [12]
USB-SERIAL-CABLE-F	7	one of those should be enough
ALUMINIUM-HEATSINK-20x20x6MM	1	not sure if it's really needed
A20-ENC	6	to mount your board
4 nuts	1	to adjust the distance of the A20-ENC
stylus	2	for handwriting recognition
A20-VGA-CABLE	3	VGA adapter from 6-pin connector
Total	190	

Table 2: Using A20-OLinuXino-LIME2

Required part	approx. price (€)	comments
A20-OLinuXino-LIME2	54	
LCD-OLinuXino-7TS	65	You can also use the LCD-OLinuXino-10TS (~90€)
SY0605E (5V, 1.2A) or Watterott HNP18-050 (5V, 3A)	9	Attention: 5V! For the 10" display the SY0605E is not strong enough
CABLE-40-40-10CM	4	Better order at least 2 as they break easily
Samsung Pro MB-MGBGB Class 10	20	any fast microSDHC card >= 8G should do
Subtotal	152	
Recommended part		
MOD-WIFI-R5370-ANT or MOD-WIFI-AR9271-ANT	10	USB Wireless adapter [12]
USB-SERIAL-CABLE-F	7	one of those should be enough
ALUMINIUM-HEATSINK-20x20x6MM	1	not sure it is really needed
stylus	2	for handwriting recognition
A10-OLinuXino-LIME-BOX	6	you can file off a keyway? for the lcd cable
Total	178	

Table 3: addtional parts nice to have for both versions

Name	approx. price (€)	comments
Bluetooth	15	I use the DeLOCK USB2.0 61889 - Bluetooth V4.0 dual mode network adapter - [13]
picture frame	3	you likely will have to saw because of the aspect ratio
USB-ISO	35	if you want to attach other/high voltage stuff to the board, one of those should be enough
easel	5	if you use the LCD-OLinuXino-10TS or A13-LCD10TS, DIY superstore [14] (or pretty: MABEF M/16 or M/21 ~20-25€)
USB 2.0 self-powerd hub	10	
USB keyboard	6	
USB mouse	3	
Wii Remote		together with a bluetooth dongle makes a nice remote control[15]
HDMI cable		
DVI to HDMI adapter		

As display you can choose between the 7" LCD-OLinuXino-7TS and the 10" LCD-OLinuXino-10TS.[8] Unfortunately I got displays and touch screen components differing in quality[9][10].

In total one frame costs around 200-250€ (s.a. tables 1, 2, 3) . If you are really low on budget but have some time to spend, you could also try to use one of those tablets sold at ~100€ (s.a. `https://linux-sunxi.org/Buying_guide`) or maybe you could re-use parts (display, casing?) of those digital photo frames sold for around ~40€?[16] On the other hand it's really better to support open-source hardware manufacturers and you can use the boards for other fun stuff, too.

2.1 Electric energy consumption

As the devices are always on electric energy consumption should be low. A friend measured the electric energy consumption of the A20-OLinuXino-MICRO with a A13-LCD7-TS and different USB devices connected including the power supply unit (PSU) (s.a. Figure 2). In short you can expect around 3.5W if the display is on and around 1.5W if it is off.[17] I think this is acceptable.

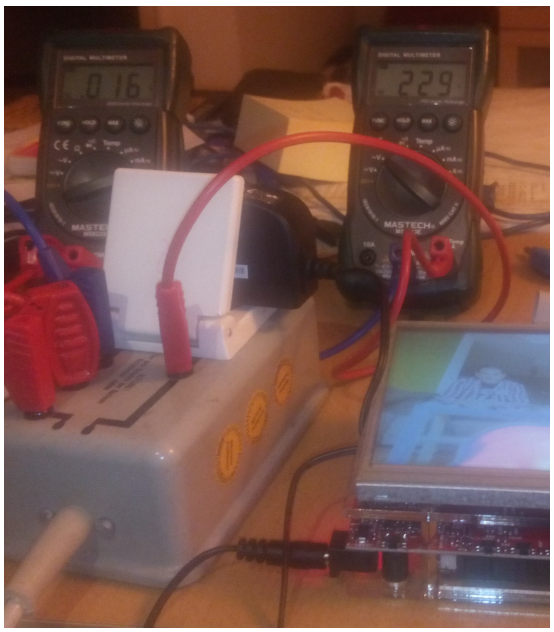

Figure 2: measuring electric energy consumption

3 Free software

As operating system Debian GNU/Linux for the *armhf* architecture is used.

3.1 Linux kernel

Debian's 3.16 armmp kernel version in jessie is now good enough[18]. Only a custom device tree file is still needed to make the touchscreen work.

3.2 U-Boot

To boot the Linux kernel the boot loader "Das U-Boot" is used. Debian's U-Boot version in jessie isn't good enough. At the moment I am using a modified version from debian/testing. For now for each possible hardware setup a different U-Boot binary is provided in the u-boot-sunxi Debian binary package in the Prisirah repository[19]. The corresponding source is in the u-boot Debian source package.

3.3 Secure Shell (SSH) and Tor

To transfer the pictures from frame to frame Secure Shell (SSH)[20] and Tor hidden services[21] are used.

For the initial pairing of the frames you have to enter the host part of the hidden service address, called friend code in the GUI for simplicity.

3.4 Graphical user interface (GUI)

The special purpose touch-screen GUI is written in gauche scheme and uses SVG. For text input the handwriting recognition software CellWriter is used.

3.5 Putting it all together and building the SD card image

A bash script is used to build a SD card image based on Debian jessie using `debootstrap`.

4 Building your own

4.1 Getting the hardware

As I live in Germany I ordered the Olimex parts via a German distributor. I chose `http://www.watterott.com/` and can only recommend them.[22]

There is a list of distributors at: `https://www.olimex.com/Distributors/`.

4.2 Hardware setup

4.2.1 Using A20-OLinuXino-MICRO

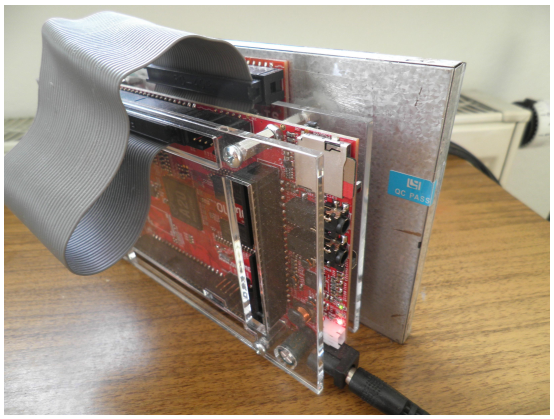

Figure 3: A20-OLinuXino-MICRO in a A20-ENC with nuts glued to the back of a A13-LCD7-TS

Fairly simple. Just connect the CABLE-IDC40-15cm to the A20-OLinuXino-MICRO and the LCD display. If you have the A20-ENC plexyglass enclosure, make sure to get 4 additional nuts because the ones inlcuded are too short. Also be careful not to break the thin part of the plexyglass near the LCD connector. If you have the A20-ENC and the A13-LCD7-TS[23] you can glue[24] the nuts on the back of the display to get a nice raw device (see also Figure 3). For details read the official manual[25].

4.2.2 Using A20-OLinuXino-LIME2

A little bit more tricky. **Make sure you plug in 5V only!** [26] Be **very careful** with the LCD cable (likely you will break one). Try to get it right on the first try, so you don't have to remove it again (see also Figure 4). If you have the nice A10-OLinuXino-LIME-BOX you may have to play with the board direction, at some point everthing should just fit. To get the cable out of the box you have to file off a notch.

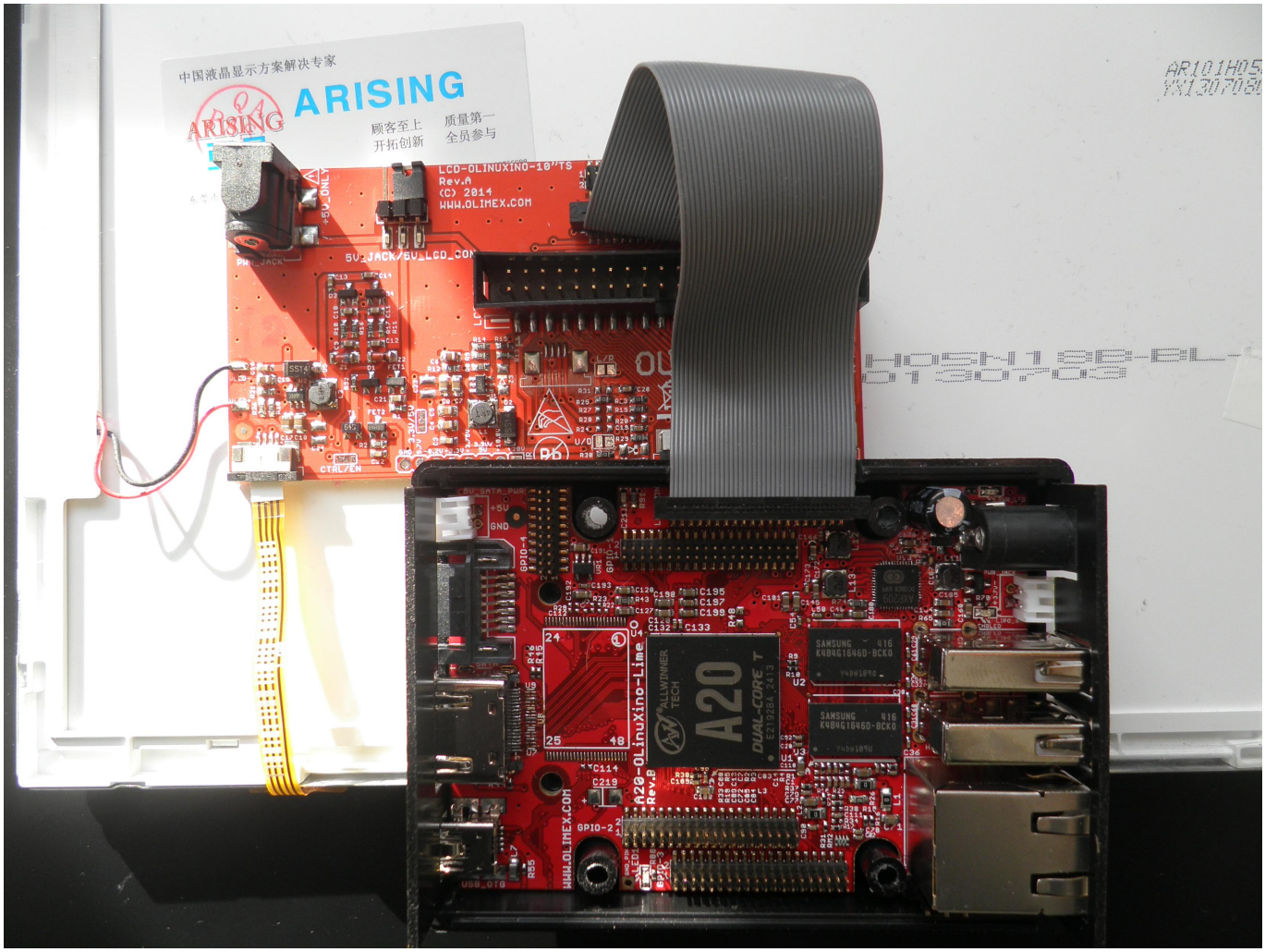

Figure 4: A20-OLinuXino-LIME2 with CABLE-40-40-10CM connected to LCD-OLinuXino-10TS sitting in the A10-OLinuXino-LIME-BOX with a filed off notch for the cable

For details read the official manual[25].

4.3 Software setup

4.3.1 Using pre-built prisirah image and U-Boot

For your convenience there is a pre-built compressed Prisirah disk image (including U-Boots) you can write to your SD card. The image can also be used for a self-hosted build (it can build itself). The following assumes you use some Linux system.

1. Get my public GPG key

   To get my GNU Privacy Guard (GnuPG or GPG) public key do:

```
$ gpg --keyserver keys.gnupg.net --recv-key E682ADC8
$ LANG=C gpg --fingerprint E682ADC8
pub   4096R/E682ADC8 2013-01-05
      Key fingerprint = 0E2F E7D0 941E 53D1 B748  14B7 CFCD E252 E682 ADC8
uid                  Jens Thiele <karme@karme.de>
sub   4096R/27C72A37 2013-01-05
```

2. Download and verify Prisirah image

```
$ wget 'http://karme.de/prisirah/image/prisirah-latest.img.bz2' \
       'http://karme.de/prisirah/image/prisirah-latest.img.bz2.sig'

$ gpg --verify prisirah-latest.img.bz2.sig prisirah-latest.img.bz2
```

3. Copy Prisirah image to SD card[27]

   To copy the image to your SD card you must know the corresponding device name of your card reader. If you don't know it, maybe the simplest method is to compare the output of the mount command before and after insertion of the empty[28] SD card[29] looking for "on /media".

   First type:

```
$ mount|grep 'on /media'
```

   This hopefully will produce no output. Now insert the SD card and try again:

```
$ mount|grep 'on /media'
/dev/sdb1 on /media/...
```

   In this example the device name would be "sdb" (1 is the partition number). You likely will get different output and therefore a different device name.[30] Don't forget to unmount the partition(s). If there are multiple partitions repeat for each partition[31]:

```
$ umount /dev/«DEVICENAME»1
```

   If you are **really sure** you found the correct device and unmounted all corresponding partitions and you don't need the data on the SD card you can now simply do[32]:

```
$ bzcat < prisirah-latest.img.bz2 > /dev/«DEVICENAME» ; sync
```

   to decompress and write the image to your SD card. This will take 5-10 minutes and produce no output in your terinal.

   If you have `pv` installed[33] you could also do something like

```
$ time { bzcat < prisirah-latest.img.bz2 |pv > «DEVICENAME» ; sync ; }
   6GB 0:07:11 [14,2MB/s] [          <=>          ]

real    7m45.423s
user    2m17.049s
sys     0m40.911s
```

   instead, to see some progress.

4. Make the SD card bootable

   To make the SD card bootable you have to mount the just written SD card (you can also remove and insert the card again[29]). You then have to find the correct U-Boot version for your setup.

Setup	U-Boot file name
A20-OLinuXino-MICRO + LCD-OLinuXino-7TS (or A13-LCD7-TS)	u-boot-A20-OLinuXino_MICRO-lcd7.bin
A20-OLinuXino-MICRO + LCD-OLinuXino-10TS (or A13-LCD10-TS)	u-boot-A20-OLinuXino_MICRO-lcd10.bin
A20-OLinuXino-MICRO + HDMI/DVI/VGA	u-boot-A20-OLinuXino_MICRO.bin
A20-OLinuXino-LIME2 + LCD-OLinuXino-7TS	u-boot-A20-OLinuXino-Lime2-lcd7.bin
A20-OLinuXino-LIME2 + LCD-OLinuXino-10TS	u-boot-A20-OLinuXino-Lime2-lcd10.bin
A20-OLinuXino-LIME2 + HDMI/DVI	u-boot-A20-OLinuXino-Lime2.bin

To install U-Boot you then do[34]:

```
$ dd if=/media/boot/u-boot-A20-OLinuXino«SETUPSPECIFIC».bin \
     of=/dev/«DEVICENAME» bs=1024 seek=8
```

5. Unmount SD card

```
$ umount /media/boot
```

4.3.2 Using `prisirah-image-builder` to build your own image

for now take a look at the output of[35]:

```
$ git clone https://www.karme.de/git/prisirah-image-builder \
 && cd prisirah-image-builder && ./prisirah-image-builder --help
```

4.3.3 First boot

Insert your microSDHC card and power on.[36] Keep your stylus ready to calibrate the touchscreen (s.a. Figure 5). The first boot at the moment is **very** slow so please be really patient.[37]

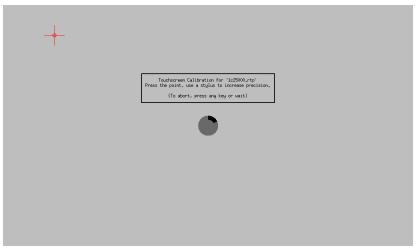

Figure 5: touchscreen calibration using xinput_calibrator

After waiting some time your initial password for the user "prisirah" will be displayed. Maybe setup your wireless network (s.a. Figure 6).[38]

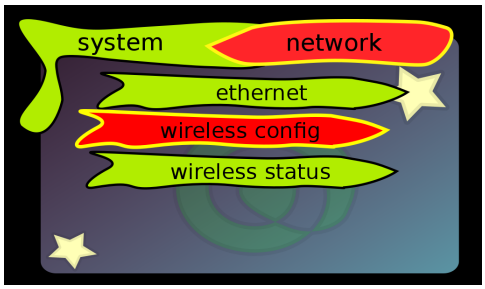

Figure 6: network configuration

4.3.4 Remote access

If the network is up, you can use the initial password to login via SSH and change your password[39]:

```
$ ssh -t prisirah@prisirah.local passwd
```

It is recommended to setup key-based authentication. If you don't have a SSH key pair yet, create one using something like[20]:

```
$ ssh-keygen -t rsa -b 4096
```

or

```
$ ssh-keygen -t ed25519
```

To copy your public SSH key to the Prisirah do:

```
$ ssh-copy-id prisirah@prisirah.local
```

If you verified key-based login works, best disable SSH password login alltogether:

```
$ ssh -t prisirah@prisirah.local sudo \
   sh -c    \
    "'sed -i \
         \"s/^#PasswordAuthentication yes/PasswordAuthentication no/\" \
          /etc/ssh/sshd_config \
      && service ssh reload && echo ok'"
```

Verify you can't login with password.

4.3.5 Friend setup / initial pairing

To add a friend (s.a. Figure 7) you have to exchange friend codes and add each other in the "add friend" menu.

WARNING: at the moment you should only add real friends, as you grant remote access to your Prisirah.[40]

For each friend a user friend»FRIENDCODE« is created and "traditional Unix permissions" and access control lists (ACLs) apply.

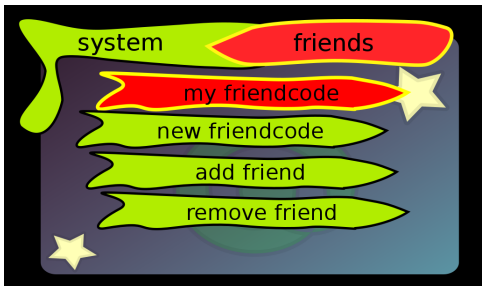

Figure 7: friend configuration

4.3.6 Getting photos onto your frame

To get photos onto your frame just plug in some USB mass storage device (USB flash drive, digital camera, ...) or if you did set up remote access (see 4.3.4) use SSH/SFTP maybe via some nice front-end. If you use GNOME, KDE, Xfce, MATE, Cinnamon or similar on your "normal computer(s)", the Prisirah should show up in the network folder.[39] If you want to access your Prisirah on the go from your laptop you might wish to install Tor and netcat-openbsd on your computer and adjust your SSH configuration. On a Debian(-based) distribution you would do something like:

```
$ apt-get install tor netcat-openbsd
```

then add something like:

```
Host *.onion
     IdentityFile ~/.ssh/id_rsa
     ProxyCommand nc.openbsd -X 5 -x 127.0.0.1:9050 %h %p
```

to your `~/.ssh/config`.

The A20-OLinuXino-MICRO also has a second SD card slot where you could insert a SD card with photos to import.[41]

4.3.7 Which photos are copied where?

All image files you put into `prisirah.local:/home/prisirah/share/all` will be shared with all friends. They will show up in `«FRIENDCODE».onion:/home/friend«YOURFRIENDCODE»/all`. If you want to share some photos only with a specific friend you copy them to `prisirah.local:/home/prisirah/share/«FRIENDCODE»` and they will show up in `«FRIENDCODE».onion:/home/friend«YOURFRIENDCODE»/«FRIENDCODE»`.

You can place relative symlinks in `/home/prisirah/share` to serve as aliases / pet names.

Figure 8: LCD-OLinuXino-10TS (A20-OLinuXino-LIME2 on the backside) on a Mabef M/21 easel (center of gravity isn't ideal)

5 Todos / bugs / future

Many...

In the long run this project maybe should be based upon Debian's FreedomBox project and/or the parts should be integrated into Debian.

6 Getting help

Unfortunately I didn't manage to setup a mailing list, yet. For now just contact me directly by e-mail.[42]

6.1 "FAQ" / known bugs

6.1.1 My prisirah stays at version 0.303-1 and doesn't update anymore

Yes, unfortunetely there is a bug in unattended-upgrades. You may have to run the update manually. First check if you are hit by the bug:

```
$ LC_ALL=C sudo unattended-upgrade -v
Initial blacklisted packages:
Initial whitelisted packages:
Starting unattended upgrades script
Allowed origins are: ['origin=Debian,n=jessie', 'origin=karme.de,n=jessie']
Cache has broken packages, exiting
Cache has broken packages, exiting
```

If the output contains "Cache has broken packages, exiting" you run:

```
$ sudo sh -c "apt-get update && apt-get -f dist-upgrade"
```

6.1.2 I used a prisirah image version < 0.15 and the prisirah doesn't boot anymore

Yes, unfortunately there was a bug. To fix it you either can update to Prisirah image version >= 0.15 or if you have a working Debian(-based) system[43] you can try to fix the boot script as follows. Before you start insert your SD card into your card reader. Basically we want to insert the kernel version to use at some point of the boot script. Therefore we have to edit "boot.cmd" and reprocess it to a "boot.scr". One possible way to do that:

```
$ { test -d /media/boot \
 && sudo apt-get install u-boot-tools \
 && grep -q 'load mmc 0 0x43000000 dtb/${fdtfile}' /media/boot/boot.cmd \
 && sudo sed -i 's,load mmc 0 0x43000000 dtb/${fdtfile},'\
'load mmc 0 0x43000000 dtb/3.16.0-4-armmp-lpae/\${fdtfile},' \
        /media/boot/boot.cmd \
 && sudo mkimage -C none -A arm -T script -d /media/boot/boot.cmd \
    /media/boot/boot.scr \
 && sync && umount /media/boot \
 && echo 'ok, that worked' ; } || echo 'Sorry, mail me'
```

If it doesn't help, please mail me.

6.1.3 I have a A20-OLinuXino-MICRO with A13-LCD10TS and sometimes after a soft reset the display is corrupted

Please let me know! For now I don't have a solution other than power off and on again (please use the menu to power off!).

7 How to help

7.1 Development

todo

7.2 Sponsors

None, yet.

A Appendix

A.1 https and my CA certificate

You maybe don't want to trust me as certificate authority (CA), at least as long as I don't manage to setup name constraints limiting my CA certificate to my domain.[44] To temporarily trust my CA certificate for Git operations I recommend something like this:

First get my public GPG key (see 4.3.1). Then download and verify my CA certificate:

```
$ wget 'http://karme.de/cert/karme.de.pem' \
       'http://karme.de/cert/karme.de.pem.sig'
$ gpg --verify karme.de.pem.sig karme.de.pem
```

You can use the GIT_SSL_CAINFO environment variable to temporarily trust my CA certificate for Git operations:

```
$ GIT_SSL_CAINFO=karme.de.pem git clone https://www.karme.de/git/prisirah-image-builder
```

You then could configure that working directory to trust my CA certificate permanently:

```
$ cat << EOF >> prisirah-image-builder/.git/config
[http]
sslVerify = true
sslCAinfo = $PWD/karme.de.pem
EOF
```

Note: if you need multiple CA certificates in the same working directory, you can just concatenate them. For example if you want to use a remote https repository on github you would do something similar to:

```
$ cat /etc/ssl/certs/DigiCert_High_Assurance_EV_Root_CA.pem >> karme.de.pem
```

A.2 HDMI/DVI/VGA output

If you don't want to attach a LCD touch screen, you can also connect a monitor or TV via HDMI (or DVI using a HDMI to DVI adapter).

WARNING: There were reports about TVs without grounding damaging OLinuXino boards.[45]

The LCD U-Boots also use HDMI if a HDMI device is connected on boot. If HDMI video mode detection doesn't work as expected, you can try to set the mode on the U-Boot command line explicitly using something like this:

```
$ setenv video-mode sunxi:1280x720-24@60,monitor=hdmi,hpd=0,edid=0
$ saveenv
$ reset
```

If you want to do this using a USB keyboard, you need to plug in the keyboard via a USB 2.0 hub (thanks, Hans de Goede - s.a. Message-ID: <549FC68B.9000107@redhat.com>, `http://article.gmane.org/gmane.comp.hardware.netbook.arm.sunxi/14598`).

If you have a A20-OLinuXino-MICRO, you can also use the A20-VGA-CABLE to connect a monitor with a VGA connector. You then could use something like this

```
$ setenv video-mode sunxi:1280x1024-24@60,monitor=vga,hpd=0,edid=0
$ saveenv
$ reset
```

on the U-Boot command line to enable VGA output.[46]

Imprint / Impressum

Jens Thiele
Gartenstraße 33
72131 Ofterdingen
Germany
E-Mail: karme@karme.de
Tel.: +49-(0)7071-1380760

Figure 9: LCD-OLinuXino-10TS on a Mabef M/16 easel (A20-OLinuXino-LIME2 mounted on the backside using touch fasteners – my favorite at the moment)