Project Capo Documentation

Wydanie 1.0

CAPO Team

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Spis treści

Following documentation provides information about preparing robot to use it in laboratory.

ROZDZIAŁ 1

Panda

Robot called *Panda* is available in *Robolab* laboratory. That robot has following components:

- *Polulu* engines controlled by *Roboclaw* drivers
- *Ninedof* motion sensor
- *Hokuyo* laser scanner (optional)
- additional things, like servo engines *Maestro* (optional)
- *Pandaboard* motherboard
- battery, wiring, cover and driving gear

Next chapters describe how to install operating system and prepare robot to work in laboratory.

Requirements

Working environment

Informacja: It is assumed that writing OS on card is done from Linux system. Modifying files on card can be done *only* from Linux system. Modification should be done after mounting system partition which file system is `ext4`.

Informacja: For installation process, virtual machine *Robolab* has been prepared.

Used technologies and tools

To understand and execute following instruction you need to be familiar with following things:

- using basic Linux commands, eg. `cd`, `ls`, `tar`, `gz`, etc.

- using console text editore, eg. `vim` or `nano`
- using package manager used in Ubuntu eg. `aptitude` or `apt-get`
- using console serial port application used in communication with *PandaBoard* eg. `minicom`
- using SSH remote console and generating SSH keys eg. *Putty* (windows) or `ssh` (Linux)

To follow the operating system installation process following things are required:

- SD card size 8 GB or bigger
- SD card reader
- if you are using virtual machine *Robolab* you need to have USD card reader
- serial port (there is ability to install system without using serial port)
- if you are using virtual machine *Robolab* required is USB serial port conventer
- board *PandaBoard* with power supply with DC voltage 5 V and current ca. 2.5 A
- WiFi network router
- display with HDMI input and keyboard on USB or serial port communication cable RS-232 DE-9 (optional)
- other required network cables

Ostrzeżenie: Please check *PandaBoard* board version. You should find this on label which can be found at the bottom of board. Following instruction describes installation process on boards *ES Rev B2* and *ES Rev B3*.

Prepare to run

Write OS image to SD card

- **Download** Ubuntu Server 12.04 amrhf+omap4 image for PandaBoard from website Ubuntu.

Zobacz także:

More information about Ubuntu support for board based on OMAP are available on website ARM/OMAP.

- **Check** *md5* sums with sums which are available on server.
- **Check** if SD card is in *write mode*.

Informacja: Write switch on card should be in **up** position, closed to contacts.

- **Insert** card in computer card reader.
- **Execute** one of following commands sets:

```
gunzip -c ubuntu-12.04-preinstalled-server-armhf+omap4.img.gz | sudo dd bs=1M of=/dev/
↪<device name>
sync
```

or:

```
sudo sh -c 'zcat ubuntu-12.04-preinstalled-server-armhf+omap4.img.gz > /dev/<device␣
↪name>'
sync
```

<device name> should be replaced with the block device name.

- **Pull** card from card reader.
- **Insert** card *PandaBoard* card reader.

Installation and system configuration

Operating system installation can be done in two ways:

Official method

First installation boot

- **Start** application used for serial port communication, eg. `miniterm` or `minicom`.

Informacja: *PandaBoard* provides communication over serial port. Port baud speed is 115200bps.

- **Connect** *PandaBoard* to PC with serial port.
- **Turn on** *PandaBoard*.

First system loading will cause that the system partition will be expanded to the size of memory card. That process **cannot be interrupted**. You **need to wait** till the moment when one of LEDs will blink.

For the first time configuration wizard will be started. Instructions will be displayed on the console.

```
(local)  sudo miniterm.py -b 115200 -p /dev/ttyUSB3
--- Miniterm on /dev/ttyUSB3: 115200,8,N,1 ---
--- Quit: Ctrl+]  |  Menu: Ctrl+T | Help: Ctrl+T followed by Ctrl+H ---

U-Boot SPL 2011.12 (Apr 02 2012 - 18:13:04)
Texas Instruments OMAP4460 ES1.1
OMAP SD/MMC: 0
reading u-boot.img
reading u-boot.bin
mkimage signature not found - ih_magic = ea000014
Assuming u-boot.bin ..
reading u-boot.bin


U-Boot 2011.12 (Apr 02 2012 - 18:13:04)

CPU  : OMAP4460 ES1.1
Board: OMAP4 Panda
I2C:   ready
DRAM:  1 GiB
WARNING: Caches not enabled
MMC:   OMAP SD/MMC: 0
Using default environment
```

```
In:    serial
Out:   serial
Err:   serial
Net:   No ethernet found.
checking for preEnv.txt
reading preEnv.txt

** Unable to read "preEnv.txt" from mmc 0:1 **
Hit any key to stop autoboot:  0
reading uEnv.txt

** Unable to read "uEnv.txt" from mmc 0:1 **
reading boot.scr

350 bytes read
Loaded script from boot.scr
Running bootscript from mmc0 ...
## Executing script at 82000000
reading uImage

4434784 bytes read
reading uInitrd

4314202 bytes read
## Booting kernel from Legacy Image at 80000000 ...
   Image Name:   Ubuntu Kernel
   Image Type:   ARM Linux Kernel Image (uncompressed)
   Data Size:    4434720 Bytes = 4.2 MiB
   Load Address: 80008000
   Entry Point:  80008000
   Verifying Checksum ... OK
## Loading init Ramdisk from Legacy Image at 81600000 ...
   Image Name:   Ubuntu Initrd
   Image Type:   ARM Linux RAMDisk Image (gzip compressed)
   Data Size:    4314138 Bytes = 4.1 MiB
   Load Address: 00000000
   Entry Point:  00000000
   Verifying Checksum ... OK
   Loading Kernel Image ... OK
OK

Starting kernel ...

Uncompressing Linux... done, booting the kernel.
Resizing root partition ...

Disk /dev/mmcblk0: 3790 cylinders, 128 heads, 32 sectors/track
Old situation:
Units = sectors of 512 bytes, counting from 0

   Device Boot    Start       End   #sectors  Id  System
/dev/mmcblk0p1   *        32    147455     147424   c  W95 FAT32 (LBA)
/dev/mmcblk0p2        147456   3104767    2957312  83  Linux
/dev/mmcblk0p3             0         -          0   0  Empty
/dev/mmcblk0p4             0         -          0   0  Empty
New situation:
Units = sectors of 512 bytes, counting from 0
```

```
   Device Boot      Start         End      #sectors  Id  System
/dev/mmcblk0p1   *          32      147455      147424   c  W95 FAT32 (LBA)
/dev/mmcblk0p2         147456    15523839    15376384  83  Linux
/dev/mmcblk0p3              0           -           0   0  Empty
/dev/mmcblk0p4              0           -           0   0  Empty
Successfully wrote the new partition table

Re-reading the partition table ...

If you created or changed a DOS partition, /dev/foo7, say, then use dd(1)
to zero the first 512 bytes:  dd if=/dev/zero of=/dev/foo7 bs=512 count=1
(See fdisk(8).)
Resizing root filesystem. Please wait, this will take a moment ...
Checking filesystem before resizing...
Resizing, please wait...
```

For the first time system partition will be expanded to the size of memory card.

```
Enabling serial console login
Setting up fstab
Setting up swap
Enabling oem-config
Writing flash-kernel configuration
Creating bootloader configuration
Rebooting into configuration session
[   94.273376] Restarting system.
```

Second configuration boot

Configuration wizard will be started:

```
U-Boot SPL 2011.12 (Apr 02 2012 - 18:13:04)
Texas Instruments OMAP4460 ES1.1
OMAP SD/MMC: 0
reading u-boot.img
reading u-boot.bin
mkimage signature not found - ih_magic = ea000014
Assuming u-boot.bin ..
reading u-boot.bin


U-Boot 2011.12 (Apr 02 2012 - 18:13:04)

CPU  : OMAP4460 ES1.1
Board: OMAP4 Panda
I2C:   ready
DRAM:  1 GiB
WARNING: Caches not enabled
MMC:   OMAP SD/MMC: 0
Using default environment

In:    serial
Out:   serial
Err:   serial
Net:   No ethernet found.
```

```
checking for preEnv.txt
reading preEnv.txt

** Unable to read "preEnv.txt" from mmc 0:1 **
Hit any key to stop autoboot:  0
reading uEnv.txt

** Unable to read "uEnv.txt" from mmc 0:1 **
reading boot.scr

373 bytes read
Loaded script from boot.scr
Running bootscript from mmc0 ...
## Executing script at 82000000
reading uImage

4434784 bytes read
reading uInitrd

4314202 bytes read
## Booting kernel from Legacy Image at 80000000 ...
   Image Name:   Ubuntu Kernel
   Image Type:   ARM Linux Kernel Image (uncompressed)
   Data Size:    4434720 Bytes = 4.2 MiB
   Load Address: 80008000
   Entry Point:  80008000
   Verifying Checksum ... OK
## Loading init Ramdisk from Legacy Image at 81600000 ...
   Image Name:   Ubuntu Initrd
   Image Type:   ARM Linux RAMDisk Image (gzip compressed)
   Data Size:    4314138 Bytes = 4.1 MiB
   Load Address: 00000000
   Entry Point:  00000000
   Verifying Checksum ... OK
   Loading Kernel Image ... OK
OK

Starting kernel ...

Uncompressing Linux... done, booting the kernel.
fsck from util-linux 2.20.1
/dev/mmcblk0p2: clean, 29269/961536 files, 1651666/7688192 blocks
 * Starting system logging daemon                                    [ OK ]
 * Starting load fallback graphics devices                           [ OK ]
 * Stopping load fallback graphics devices                           [ OK ]
...
```

After loading system wizard screen will be displayed.

First step is selecting language:

```
System Configuration
  ----------------- Select a language -----------------
  | Choose the language to be used for the installation process. The        |
  | selected language will also be the default language for the installed   |
  | system.                                                                 |
  |                                                                         |
  | Language:                                                               |
```

```
  |                                                                    |
  |               Bulgarian - ↑                                        |
  |               Catalan - Català                                     |
  |               Chinese (Simplified) - ()                            |
  |               Chinese (Traditional) - ()                           |
  |               Croatian - Hrvatski                                  |
  |               Czech - Čeština                                      |
  |               Danish - Dansk                                       |
  |               Dutch - Nederlands                                   |
  |               English - English ↓                                  |
  |                                                                    |
  |                                                                    |
  |                   <Ok>                    <Cancel>                 |
  |                                                                    |
  ----------------------------------------------------
```

Next step is selecting country:

```
System Configuration
  ---------------- Select your location -----------------
  | The selected location will be used to set your time zone and also for   |
  | example to help select the system locale. Normally this should be the   |
  | country where you live.                                                 |
  |                                                                         |
  | This is a shortlist of locations based on the language you selected.    |
  | Choose "other" if your location is not listed.                          |
  |                                                                         |
  | Country, territory or area:                                             |
  |                                                                         |
  |                          Nigeria              ↑                        |
  |                          Philippines                                   |
  |                          Singapore                                     |
  |                          South Africa                                  |
  |                          United Kingdom                                |
  |                          United States        ↓                        |
  |                                                                         |
  |                                                                         |
  |                   <Ok>                    <Cancel>                      |
  |                                                                         |
  ----------------------------------------------------
```

By selecting other next screen will display list of continents:

```
System Configuration
  ---------------- Select your location -----------------
  | The selected location will be used to set your time zone and also for   |
  | example to help select the system locale. Normally this should be the   |
  | country where you live.                                                 |
  |                                                                         |
  | Select the continent or region to which your location belongs.          |
  |                                                                         |
  | Continent or region:                                                    |
  |                                                                         |
  |                            Asia               ↑                       |
  |                            Atlantic Ocean                             |
  |                            Caribbean                                  |
  |                            Central America                            |
  |                            Europe                                     |
```

```
  |                            Indian Ocean                                  |
  |                            North America      ↓                           |
  |                                                                           |
  |                                                                           |
  |                    <Ok>                        <Cancel>                   |
  |                                                                           |
  -----------------------------------------------
```

After selecting continent next step will be again selecting country:

```
System Configuration
  ----------------- Select your location -----------------
  | The selected location will be used to set your time zone and also for    |
  | example to help select the system locale. Normally this should be the    |
  | country where you live.                                                  |
  |                                                                          |
  | Listed are locations for: Europe. Use the <Go Back> option to select a   |
  | different continent or region if your location is not listed.            |
  |                                                                          |
  | Country, territory or area:                                              |
  |                                                                          |
  |                      Poland                            ↑                 |
  |                      Portugal                                            |
  |                      Romania                                             |
  |                      Russian Federation                                  |
  |                      San Marino                                          |
  |                      Serbia                            ↓                 |
  |                                                                          |
  |                                                                          |
  |                    <Ok>                        <Cancel>                  |
  |                                                                          |
  -----------------------------------------------
```

Next step is selecting locales settings:

```
System Configuration
  ----------------- Configure locales ------------------
  | There is no locale defined for the combination of language and country   |
  | you have selected. You can now select your preference from the locales   |
  | available for the selected language. The locale that will be used is     |
  | listed in the second column.                                             |
  |                                                                          |
  | Country to base default locale settings on:                              |
  |                                                                          |
  |                        Ireland - en_IE.UTF-8           ↑                 |
  |                        New Zealand - en_NZ.UTF-8                         |
  |                        Nigeria - en_NG                                   |
  |                        Philippines - en_PH.UTF-8                         |
  |                        Singapore - en_SG.UTF-8                           |
  |                        South Africa - en_ZA.UTF-8                        |
  |                        United Kingdom - en_GB.UTF-8                      |
  |                        United States - en_US.UTF-8     ↓                 |
  |                                                                          |
  |                                                                          |
  |                    <Ok>                        <Cancel>                  |
  |                                                                          |
  -----------------------------------------------
```

Next step is selecting time zone used in selected location:

```
System Configuration
  ------------------ Where are you? -------------------
  |                                                                        |
  | Based on your country, your time zone is Europe/Warsaw.                |
  |                                                                        |
  | If this is not correct, you may select from a full list of time zones  |
  | instead.                                                               |
  |                                                                        |
  | Is this time zone correct?                                             |
  |                                                                        |
  |                    <Yes>                       <No>                    |
  |                                                                        |
  ------------------------------------------------
```

Next step is selecting time zone of hardware clock:

```
System Configuration
 ------------------- Where are you? -------------------
 |                                                                      |
 | System clocks are generally set to Coordinated Universal Time (UTC). The  |
 | operating system uses your time zone to convert system time into local    |
 | time. This is recommended unless you also use another operating system    |
 | that expects the clock to be set to local time.                           |
 |                                                                      |
 | Is the system clock set to UTC?                                      |
 |                                                                      |
 |                    <Yes>                       <No>                  |
 |                                                                      |
 ------------------------------------------------
```

Next step is setting full name of user:

```
System Configuration
 ------------------- Who are you? --------------------
 | A user account will be created for you to use instead of the root         |
 | account for non-administrative activities.                                |
 |                                                                           |
 | Please enter the real name of this user. This information will be used    |
 | for instance as default origin for emails sent by this user as well as    |
 | any program which displays or uses the user's real name. Your full name   |
 | is a reasonable choice.                                                   |
 |                                                                           |
 | Full name for the new user:                                               |
 |                                                                           |
 | ___________________________________________________________________________ |
 |                                                                           |
 |                    <Ok>                        <Cancel>                   |
 |                                                                           |
 -------------------------------------------------
```

Next step is setting name of user:

```
System Configuration
 ------------------- Who are you? --------------------
 | Select a username for the new account. Your first name is a reasonable    |
 | choice. The username should start with a lower-case letter, which can be  |
 | followed by any combination of numbers and more lower-case letters.       |
```

```
 |                                                                              |
 | Username for your account:                                                   |
 |                                                                              |
 | robolab_____________________________________________________________________ |
 |                                                                              |
 |                    <Ok>                          <Cancel>                    |
 |                                                                              |
 ------------------------------------------------
```

Next step is setting password for user:

```
System Configuration
      ----------------- Who are you? -----------------
      | A good password will contain a mixture of letters, numbers and   |
      | punctuation and should be changed at regular intervals.          |
      |                                                                  |
      | Choose a password for the new user:                              |
      |                                                                  |
      | ________________________________________________________________ |
      |                                                                  |
      |                  <Ok>                      <Cancel>              |
      |                                                                  |
      ------------------------------------------
```

Next step is repeating password.

Next step is setting default network interface:

```
System Configuration
 ----------------- Network configuration -----------------
 | Your system has multiple network interfaces. Choose the one to use as     |
 | the primary network interface during the installation. If possible, the   |
 | first connected network interface found has been selected.                |
 |                                                                           |
 | Primary network interface:                                                |
 |                                                                           |
 |                    eth0: Ethernet                                         |
 |                    wlan0: Wireless ethernet (802.11x)                     |
 |                                                                           |
 |                                                                           |
 |                    <Ok>                        <Cancel>                   |
 |                                                                           |
 -------------------------------------------------
```

`eth0` should be selected. After this, network testing will be done. There is no need to finish test with success:

```
System Configuration
 ----------------- Network configuration -----------------
 |                                                                           |
 | Network autoconfiguration failed                                          |
 |                                                                           |
 | Your network is probably not using the DHCP protocol. Alternatively, the  |
 | DHCP server may be slow or some network hardware is not working           |
 | properly.                                                                 |
 |                                                                           |
 |                                  <Ok>                                     |
 |                                                                           |
 -------------------------------------------------
```

If this test was not finished with success, address need to be set manually:

```
System Configuration
 ----------------- Network configuration -----------------
 | From here you can choose to retry DHCP network autoconfiguration (which   |
 | may succeed if your DHCP server takes a long time to respond) or to        |
 | configure the network manually. Some DHCP servers require a DHCP           |
 | hostname to be sent by the client, so you can also choose to retry DHCP    |
 | network autoconfiguration with a hostname that you provide.                |
 |                                                                            |
 | Network configuration method:                                              |
 |                                                                            |
 |           Retry network autoconfiguration                                  |
 |           Retry network autoconfiguration with a DHCP hostname             |
 |           Configure network manually                                       |
 |                                                                            |
 |           Do not configure the network at this time                        |
 |                                                                            |
 |                                                                            |
 |                   <Ok>                         <Cancel>                    |
 |                                                                            |
 ----------------------------------------------
```

```
System Configuration
  ---------------- Network configuration -----------------
  | The IP address is unique to your computer and is either:                 |
  |                                                                          |
  | * Four numbers separated by periods; or                                  |
  |                                                                          |
  | * Blocks of hexadecimal characters separated by colons (IPv6).           |
  |                                                                          |
  | You can also optionally specify a CIDR netmask.                          |
  |                                                                          |
  | If you don't know what to use here, consult your network administrator.  |
  |                                                                          |
  | IP address:                                                              |
  |                                                                          |
  | 192.168.1.50_____________________________________________________________ |
  |                                                                          |
  |                   <Ok>                       <Cancel>                    |
  |                                                                          |
  ----------------------------------------------
```

```
System Configuration
   --------------- Network configuration ---------------
   | The netmask is used to determine which machines are local to your      |
   | network.  Consult your network administrator if you do not know the    |
   | value.  The netmask should be entered as four numbers separated by     |
   | periods.                                                               |
   |                                                                        |
   | Netmask:                                                               |
   |                                                                        |
   | 255.255.255.0____________________________________________________      |
   |                                                                        |
   |                   <Ok>                       <Cancel>                  |
   |                                                                        |
   ----------------------------------------------
```

```
System Configuration
  ---------------- Network configuration -----------------
  | The gateway is an IP address (four numbers separated by periods) that    |
  | indicates the gateway router, also known as the default router.  All     |
  | traffic that goes outside your LAN (for instance, to the Internet) is    |
  | sent through this router.  In rare circumstances, you may have no        |
  | router; in that case, you can leave this blank.  If you don't know the   |
  | proper answer to this question, consult your network administrator.      |
  |                                                                          |
  | Gateway:                                                                 |
  |                                                                          |
  | 192.168.1.1_____________________________________________________________ |
  |                                                                          |
  |                   <Ok>                         <Cancel>                  |
  |                                                                          |
   ----------------------------------------------
```

```
System Configuration
 ---------------- Network configuration -----------------
 | The name servers are used to look up host names on the network. Please    |
 | enter the IP addresses (not host names) of up to 3 name servers,          |
 | separated by spaces. Do not use commas. The first name server in the      |
 | list will be the first to be queried. If you don't want to use any name   |
 | server, just leave this field blank.                                      |
 |                                                                           |
 | Name server addresses:                                                    |
 |                                                                           |
 | 192.168.1.1_____________________________________________________________ |
 |                                                                           |
 |                   <Ok>                          <Cancel>                  |
 |                                                                           |
 ----------------------------------------------
```

Ostrzeżenie: Above configuration causes assigning address `192.168.2.50` in network `192.168.2.0/24` to the wired interface which is located on board. Additionally, default gateway is set with IP address `192.168.2.1` and DNS with IP `8.8.8.8`.

Next step is setting system name and domain:

```
System Configuration
 ---------------- Network configuration -----------------
 | Please enter the hostname for this system.                                |
 |                                                                           |
 | The hostname is a single word that identifies your system to the          |
 | network. If you don't know what your hostname should be, consult your     |
 | network administrator. If you are setting up your own home network, you   |
 | can make something up here.                                               |
 |                                                                           |
 | Hostname:                                                                 |
 |                                                                           |
 | _______________________________________________________________________ |
 |                                                                           |
 |                   <Ok>                          <Cancel>                  |
 |                                                                           |
 ----------------------------------------------
```

```
System Configuration
 ----------------- Network configuration -----------------
 | The domain name is the part of your Internet address to the right of      |
 | your host name.  It is often something that ends in .com, .net, .edu, or  |
 | .org. If you are setting up a home network, you can make something up,    |
 | but make sure you use the same domain name on all your computers.         |
 |                                                                           |
 | Domain name:                                                              |
 |                                                                           |
 | _________________________________________________________________________ |
 |                                                                           |
 |                    <Ok>                          <Cancel>                 |
 |                                                                           |
 -------------------------------------------------
```

Next step is selecting basic system functions:

```
System Configuration
    --------------- Software selection ----------------
    | You can choose to install one or more of the following predefined   |
    | collections of software.                                            |
    |                                                                     |
    | Choose software to install:                                         |
    |                                                                     |
    |     [ ] Basic Ubuntu server                                         |
    |     [*] OpenSSH server                                              |
    |     [ ] DNS server                                                  |
    |     [ ] LAMP server                                                 |
    |     [ ] Mail server                                                 |
    |     [ ] PostgreSQL database                                         |
    |     [ ] Print server                                                |
    |     [ ] Samba file server                                           |
    |     [ ] Tomcat Java server                                          |
    |     [ ] Virtual Machine host                                        |
    |                                                                     |
    |                                                                     |
    |                   <Ok>                        <Cancel>              |
    |                                                                     |
    -----------------------------------------------
```

`OpenSSH server` need to be selected. After this, SSH server will be installed, additional parameters will be set and unused packages will be removed. After this, there will be login prompt displayed:

```
Ubuntu 12.04 LTS hostname ttyO2

hostname login: username
Password:
Welcome to Ubuntu 12.04 LTS (GNU/Linux 3.2.0-1412-omap4 armv7l)

 * Documentation:  https://help.ubuntu.com/

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.
```

```
username@hostname:~$
```

Updating software

Cleaning packages

Unused packages need to be removed. To do this following command can be used `sudo aptitude install`:

```
username@hostname:~$ sudo aptitude install
The following packages will be REMOVED:
  apt-clone{u} archdetect-deb{u} bc{u} bogl-bterm{u} btrfs-tools{u}
  dmraid{u} dpkg-repack{u} kpartx{u} kpartx-boot{u} libdebconfclient0{u}
  libdebian-installer4{u} libdmraid1.0.0.rc16{u} libicu48{u} os-prober{u}
  python-pyicu{u} rdate{u} realpath{u} reiserfsprogs{u}
0 packages upgraded, 0 newly installed, 18 to remove and 0 not upgraded.
Need to get 0 B of archives. After unpacking 24.6 MB will be freed.
Do you want to continue? [Y/n/?] y

(Reading database ... 24784 files and directories currently installed.)
Removing apt-clone ...
Removing archdetect-deb ...
Removing bc ...
Removing bogl-bterm ...
Removing btrfs-tools ...
Removing dmraid ...
update-initramfs: deferring update (trigger activated)
Removing dpkg-repack ...
Removing kpartx-boot ...
update-initramfs: deferring update (trigger activated)
Removing kpartx ...
Removing libdebconfclient0 ...
Removing libdebian-installer4 ...
Removing libdmraid1.0.0.rc16 ...
Removing python-pyicu ...
Removing libicu48 ...
Removing os-prober ...
Removing rdate ...
Removing realpath ...
Removing reiserfsprogs ...
Processing triggers for man-db ...
Processing triggers for install-info ...
Processing triggers for initramfs-tools ...
update-initramfs: Generating /boot/initrd.img-3.2.0-1412-omap4
Using u-boot partition: /dev/mmcblk0p1
Creating backups of boot files ... done.
Generating kernel u-boot image... done.
Generating Initramfs u-boot image... done.
Generating u-boot configuration from /boot/boot.script... done.
Processing triggers for libc-bin ...
ldconfig deferred processing now taking place
```

Wireless card installation

To use wireless card you need to install package `wpasupplicant`:

```
username@hostname:~$ sudo aptitude install wpasupplicant
The following NEW packages will be installed:
  libpcsclite1{a} wpasupplicant
0 packages upgraded, 2 newly installed, 0 to remove and 0 not upgraded.
Need to get 0 B/432 kB of archives. After unpacking 950 kB will be used.
Do you want to continue? [Y/n/?] y

Selecting previously unselected package libpcsclite1.
(Reading database ... 24571 files and directories currently installed.)
Unpacking libpcsclite1 (from .../libpcsclite1_1.7.4-2ubuntu2_armhf.deb) ...
Selecting previously unselected package wpasupplicant.
Unpacking wpasupplicant (from .../wpasupplicant_0.7.3-6ubuntu2_armhf.deb) ...
Processing triggers for man-db ...
Setting up libpcsclite1 (1.7.4-2ubuntu2) ...
Setting up wpasupplicant (0.7.3-6ubuntu2) ...
Processing triggers for libc-bin ...
ldconfig deferred processing now taking place
```

After this, please update file `/etc/network/interfaces`:

```
sudo nano /etc/network/interfaces

# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

# The loopback network interface
auto lo
iface lo inet loopback

auto eth0
iface eth0 inet static
    address 192.168.1.50
    netmask 255.255.255.0

auto wlan0
iface wlan0 inet dhcp
    pre-up  ifconfig wlan0 hw ether de:ad:be:ef:00:10
    wpa-ssid "SSID"
    wpa-psk "PSK"
```

After saving changes, execute commands `sudo ifconfig eth0 down` and `sudo ifup wlan0`. After this, please check network connectivity:

Informacja: To have correctly working wireless network it is required to have MAC address manually set.

Ostrzeżenie: Be aware that network addressing settings have been changed in last step due to fact that the same network cannot be used on both interfaces.

Informacja: Above configuration is used in wireless network *robolab* which is in laboratory. Current preshared key for wireless network is published in laboratory. IP addresses are connected with MAC addresses. In laboratory used MAC prefix is `de:ad:be:ef:00:**`. Last two characters decide which IP address will be assigned. Following scheme is used:

```
de:ad:be:ef:00:00 - 192.168.2.200
de:ad:be:ef:00:01 - 192.168.2.201
...
de:ad:be:ef:00:09 - 192.168.2.209
de:ad:be:ef:00:10 - 192.168.2.210
```

Updating system

Ostrzeżenie: It is available updating to *Ubuntu 14.04.1* LTS using command `do-release-upgrade`. Due to issues with modules for devices *Ninedof* and *Roboclaw* it is **not recommended**. Following steps could skipped and you can jump to step related to *updating packages*.

Informacja: Update process executed by command `do-release-upgrade` can take few minutes. Using *screen* prevents situation that command execution will be interrupted and allows detaching from console/session with keys `[Ctrl]+[a]` and `[d]`. Reconnecting can be done by executing command `screen -r`.

Ostrzeżenie: Please monitor updating process. During updating there will be several questions. When updating process will finish system need to be rebooted. Reboot need to be confirmed.

Zobacz także:

Packages which are used by *PandaBoard* are published in the repository http://ports.ubuntu.com/pool/main/l/linux-ti-omap4/.

After update done by tool `do-release-upgrade` system does not support wireless network. You need **add** *omap* repository to repositories. After this, **update** packages list need to be done and following packages need to be installed:

```
aptitude install -y software-properties-common
add-apt-repository ppa:tiomap-dev/release
aptitude update
touch /boot/initrd.img-3.13.0-37-generic
aptitude install linux-headers-omap linux-image-omap linux-omap
```

Ostrzeżenie: Kernel installation requires files in directory `/boot/`. When some files are missing, please create them using command `touch`.

- **Execute** `reboot`.

Updating packages

Recommended is to **turn off** installing recommended packages in *aptitude*:

- Start `aptitude`
- Use keys `[Ctrl]+[t]`
- Go to menu `Options` → `Preferences`

- Disable option `Install recommended packages automatically`
- Close *aptitude* using keys `[Ctrl]+[q]`
- **Perform** update i **install** additional packages:

```
aptitude update
touch /boot/initrd.img-3.2.0-1455-omap4
aptitude full-upgrade
aptitude install -y
aptitude install -y wpasupplicant wireless-crda wireless-regdb
aptitude install -y htop psmisc mc unzip bash-completion cpufrequtils ntp
aptitude install -y byobu tmux
```

Ostrzeżenie: Kernel installation requires files in directory `/boot/`. When some files are missing, please create them using command `touch`.

- **Add** to file `/etc/rc.local` line `iw reg set PL`.
- **Shutdown** system using command `sudo poweroff`.

Updating bootloader

To have card combatible with board in version **B3**, you need download latest bootloader version *u-boot* and manually compile it as per following instruction. To execute following commands additional software need to be installed:

- make
- g++
- gcc
- u-boot-tools
- g++-arm-linux-gnueabihf
- gcc-arm-linux-gnueabihf
- binutils-arm-linux-gnueabihf

Command to execute: `apt-get install make g++ gcc u-boot-tools g++-arm-linux-gnueabihf gcc-arm-linux-gnueabihf binutils-arm-linux-gnueabihf`.

For some distributions version need to be changed. For Debian, current `testing` version has listed packages.

```
$ wget ftp://ftp.denx.de/pub/u-boot/u-boot-latest.tar.bz2
  [..]
$ tar xf u-boot-latest.tar.bz2
$ cd u-boot-*
$ make ARCH=arm CROSS_COMPILE=arm-linux-gnueabihf- omap4_panda_config
  HOSTCC  scripts/basic/fixdep
  HOSTCC  scripts/kconfig/conf.o
  SHIPPED scripts/kconfig/zconf.tab.c
  SHIPPED scripts/kconfig/zconf.lex.c
  SHIPPED scripts/kconfig/zconf.hash.c
  HOSTCC  scripts/kconfig/zconf.tab.o
  HOSTLD  scripts/kconfig/conf
#
# configuration written to .config
```

```
#
$ make ARCH=arm CROSS_COMPILE=arm-linux-gnueabihf-
  [..]
$ cat <<EOF > boot.script
fatload mmc 0:1 0x80000000 uImage
setenv bootargs rw vram=32M fixrtc mem=1G@0x80000000 root=/dev/mmcblk0p2␣
↪console=ttyO2,115200n8 rootwait
bootm 0x80000000
EOF
$ mkimage -A arm -T script -C none -n "Boot Image" -d boot.script boot.scr
  Image Name:   Boot Image
  Created:      Fri Nov 20 17:48:09 2015
  Image Type:   ARM Linux Script (uncompressed)
  Data Size:    164 Bytes = 0.16 kB = 0.00 MB
  Load Address: 00000000
  Entry Point:  00000000
  Contents:
    Image 0: 156 Bytes = 0.15 kB = 0.00 MB
$ mkimage -A arm -T script -C none -n "Boot Image" -d boot.script boot.scr
```

As a result of these commands, following files will be generated and should be copied on first partition of memory card:

- `boot.scr`
- `boot.script`
- `MLO`
- `u-boot.bin`
- `u-boot.img`

After copying that files, card can be used on both *PandaBoard* types **B2** and **B3**.

Post-konfiguracja

- **Dodaj** do `/etc/modules` wpis:

```
...
i2c-dev
```

- **Zmień** `/etc/init.d/cpufrequtils`:

```
...
GOVERNOR="performance"
...
```

- **Be aware** about script `/etc/init.d/ondemand`. It need to be disabled from runlevel by command `update-rc.d -f ondemand remove`.

Legacy method

First installation boot

First system loading will cause that the system partition will be expanded to the size of memory card. That process **cannot be interrupted**. You **need to wait** till the moment when one of LEDs will blink.

Informacja: If you have display with HDMI input and keyboard or serial port in your PC, you are able to follow instructions which will be displayed on console (official method). If you do not have it, it is able to finish system installation as per this instruction.

- **Turn on** *PandaBoard*.
- **Wait** till the moment when on of LEDs will blink.
- **Turn off** *PandaBoard*.
- **Pull out** memory card from *PandaBoard* card reader.
- **Put** memory card in computer card reader.

Prepare system to configuration

- **Mount** system partition (second partition).
- **Change** file which has network settings, which is located on system partition - path `/etc/network/interfaces`.

```
# interfaces(5) file used by ifup(8) and ifdown(8)
auto lo
iface lo inet loopback

auto eth0
iface eth0 inet static
    address 192.168.2.50
    netmask 255.255.255.0
    gateway 192.168.2.1
    dns-nameservers 8.8.8.8
```

Informacja: Applied configuration causes assigning address `192.168.2.50` in network `192.168.2.0/24` to the wired interface which is located on board. Additionally, default gateway is set with IP address `192.168.2.1` and DNS with IP `8.8.8.8`.

Ostrzeżenie: **Attentione!** That addressing schema is used in network in laboratory. In your network might be different. Please check it.

Ostrzeżenie: Network `192.168.2.0/24` **eventually** is used on wireless interface. Configuration will be changed in next steps of this instruction, in step related to *updating network settings*.

- **Change** file which is located on system partition - path `/etc/rc.local`.

```
#!/bin/sh -e
#
# rc.local
#
# This script is executed at the end of each multiuser runlevel.
# Make sure that the script will "exit 0" on success or any other
# value on error.
```

```
#
# In order to enable or disable this script just change the execution
# bits.
#
# By default this script does nothing.

apt-get install -y openssh-server

exit 0
```

Informacja: That configuration causes installation of remote access server SSH when the system is booting. Remember that after first login you need to remove line starting with `apt-get...` from file `/etc/rc.local`.

- **Change** file responsible for passwords, by removing characters `x` or `*` from fields responsible for password, which are in files `/etc/passwd` and `/etc/shadow`.

```
#-/etc/passwd
root::0:0:root:/root:/bin/bash

#-/etc/shadow
root::15454:0:99999:7:::
```

Informacja: That changes will remove password for `root` account. After first login please remember about setting password for administrator.

- **Add** your own public SSH key to file `/root/.ssh/authorized_keys`

```
ssh-rsa AAA... user@hostname
```

Informacja: Your public SSH key is located in file `~/.ssh/id_rsa.pub`. If you do not have this file it means that you do not have SSH key. To generate the private and public key, please execute command `ssh-keygen`. That works on Linux only.

- **Unmount** system partition.
- **Pull out** card from reader.
- **Connect** board with network device, eg. switch, using network cable..
- **Put** card in reader in *PandaBoard*.
- **Turn on** *PandaBoard*.

Second configuration boot

- **Login** to the system using SSH `ssh root@192.168.2.50`.
- **Set** password for `root` using command `passwd root`.
- **Remove** line `apt-get install -y openssh-server` from file `/etc/rc.local`.
- **Set** system name in file:

`/etc/hostname`

```
panda.robonet
```

/etc/hosts

```
127.0.0.1 localhost
127.0.1.1 panda panda.robonet
```

Ostrzeżenie: **Interrupt** board wizard configuration which is running on the console (available when serial port is used).

- **Execute** command `fuser -k /var/cache/debconf/config.dat` sevaral times.
- **Remove** package `oem-config` (using `aptitude` - `aptitude purge oem-config`) and directory `/var/lib/oem-config`.
- **Restart** system using command `reboot`.

Updating software

Updating system

- **Install** *screen* using `aptitude install screen`.
- **Start** *screen* using `screen`.

Ostrzeżenie: It is available updating to *Ubuntu 14.04.1* LTS using command `do-release-upgrade`. Due to issues with modules for devices *Ninedof* and *Roboclaw* it is **not recommended**. Following steps could skipped and you can jump to step related to *updating packages*.

Informacja: Update process executed by command `do-release-upgrade` can take few minutes. Using *screen* prevents situation that command execution will be interrupted and allows detaching from console/session with keys `[Ctrl]+[a]` and `[d]`. Reconnecting can be done by executing command `screen -r`.

Ostrzeżenie: Please monitor updating process. During updating there will be several questions. When updating process will finish system need to be rebooted. Reboot need to be confirmed.

Zobacz także:

Packages which are used by *PandaBoard* are published in the repository http://ports.ubuntu.com/pool/main/l/linux-ti-omap4/.

After finished update by tool `do-release-upgrade` system does not support wireless network. You need **add** *omap* repository to repositories. After this, **update** packages list need to be done and following packages need to be installed:

```
aptitude install -y software-properties-common
add-apt-repository ppa:tiomap-dev/release
aptitude update
touch /boot/initrd.img-3.13.0-37-generic
aptitude install linux-headers-omap linux-image-omap linux-omap
```

Ostrzeżenie: Kernel installation requires files in directory `/boot/`. When some files are missing, please create them using command `touch`.

- **Execute** `reboot`.

Updating packages

Recommended is to **turn off** installing recommended packages in *aptitude*:

- Start `aptitude`
- Use keys `[Ctrl]+[t]`
- Go to menu `Options` → `Preferences`
- Disable option `Install recommended packages automatically`
- Close *aptitude* using keys `[Ctrl]+[q]`
- **Perform** update i **install** additional packages:

```
aptitude update
touch /boot/initrd.img-3.2.0-1455-omap4
aptitude full-upgrade
aptitude install -y
aptitude install -y wpasupplicant wireless-crda wireless-regdb
aptitude install -y htop psmisc mc unzip bash-completion cpufrequtils ntp
aptitude install -y byobu tmux
```

Ostrzeżenie: Kernel installation requires files in directory `/boot/`. When some files are missing, please create them using command `touch`.

- **Add** to file `/etc/rc.local` line `iw reg set PL`.
- **Change** network settings: to file `/etc/network/interfaces` add settings related to wireless network:

```
# interfaces(5) file used by ifup(8) and ifdown(8)
auto lo
iface lo inet loopback

auto eth0
iface eth0 inet static
    address 192.168.1.50
    netmask 255.255.255.0

auto wlan0
iface wlan0 inet dhcp
    pre-up  ifconfig wlan0 hw ether de:ad:be:ef:00:10
    wpa-ssid "SSID"
    wpa-psk  "PSK"
```

Informacja: To have correctly working wireless network MAC address need to be setup manually.

Ostrzeżenie: Be aware that network addressing settings have been changed in last step due to fact that the same network cannot be used on both interfaces.

Informacja: Above configuration is used in wireless network *robolab* which is in laboratory. Current preshared key for wireless network is published in laboratory. IP addresses are connected with MAC addresses. In laboratory used MAC prefix is `de:ad:be:ef:00:**`. Last two characters decide which IP address will be assigned. Following scheme is used:

```
de:ad:be:ef:00:00 - 192.168.2.200
de:ad:be:ef:00:01 - 192.168.2.201
...
de:ad:be:ef:00:09 - 192.168.2.209
de:ad:be:ef:00:10 - 192.168.2.210
```

- **Reboot** system.
- **Connect** to the system using IP address assigned by router. You can check it via administrative portal.

Updating bootloader

To have card combatible with board in version **B3**, you need download latest bootloader version *u-boot* and manually compile it as per following instruction. To execute following commands additional software need to be installed:

- make
- g++
- gcc
- u-boot-tools
- g++-arm-linux-gnueabihf
- gcc-arm-linux-gnueabihf
- binutils-arm-linux-gnueabihf

Command to execute: `apt-get install make g++ gcc u-boot-tools g++-arm-linux-gnueabihf gcc-arm-linux-gnueabihf binutils-arm-linux-gnueabihf`.

For some distributions version need to be changed. For Debian, current `testing` version has listed packages.

```
$ wget ftp://ftp.denx.de/pub/u-boot/u-boot-latest.tar.bz2
  [..]
$ tar xf u-boot-latest.tar.bz2
$ cd u-boot-*
$ make ARCH=arm CROSS_COMPILE=arm-linux-gnueabihf- omap4_panda_config
  HOSTCC  scripts/basic/fixdep
  HOSTCC  scripts/kconfig/conf.o
  SHIPPED scripts/kconfig/zconf.tab.c
  SHIPPED scripts/kconfig/zconf.lex.c
  SHIPPED scripts/kconfig/zconf.hash.c
  HOSTCC  scripts/kconfig/zconf.tab.o
  HOSTLD  scripts/kconfig/conf
#
# configuration written to .config
#
```

```
$ make ARCH=arm CROSS_COMPILE=arm-linux-gnueabihf-
  [..]
$ cat <<EOF > boot.script
fatload mmc 0:1 0x80000000 uImage
setenv bootargs rw vram=32M fixrtc mem=1G@0x80000000 root=/dev/mmcblk0p2␣
↪console=ttyO2,115200n8 rootwait
bootm 0x80000000
EOF
$ mkimage -A arm -T script -C none -n "Boot Image" -d boot.script boot.scr
  Image Name:   Boot Image
  Created:      Fri Nov 20 17:48:09 2015
  Image Type:   ARM Linux Script (uncompressed)
  Data Size:    164 Bytes = 0.16 kB = 0.00 MB
  Load Address: 00000000
  Entry Point:  00000000
  Contents:
    Image 0: 156 Bytes = 0.15 kB = 0.00 MB
$ mkimage -A arm -T script -C none -n "Boot Image" -d boot.script boot.scr
```

As a result of these commands, following files will be generated and should be copied on first partition of memory card:

- `boot.scr`
- `boot.script`
- `MLO`
- `u-boot.bin`
- `u-boot.img`

After copying that files, card can be used on both *PandaBoard* types **B2** and **B3**.

Post-configuration

- **Add** to `/etc/modules` line:

```
...
i2c-dev
```

- **Update** `/etc/init.d/cpufrequtils`:

```
...
GOVERNOR="performance"
...
```

- **Be aware** about script `/etc/init.d/ondemand`. It need to be disabled from runlevel by command `update-rc.d -f ondemand remove`.

Additional information

More information you can find on:

- Wiki/ARM/OMAP
- Wiki/ARM/Server/Install

- Gentoo/PandaBoard

ROZDZIAŁ 2

Amber

Amber installation begins from amber-erlang-mediator. It is a mediator, which is used in comunication between drivers and clients.

In a normal scenario, there are following components:

- there is only one mediator
- there are different multiple drivers, which are communicating with different devices, there is no duplicated drivers
- there are multiple clients connected to mediator, which they use available devices

Installation and running

Installation can be done on any Linux system.

Informacja: Provided features are *only* available on robots which are in laboratory.

Prepare environment

Additional software installation

Informacja: For *Ubuntu 12.04.5 LTS* need to add additional repository used to install supported by *Amber* Erlang verion. Following line need to be added to `/etc/apt/sources.list`:

```
deb http://packages.erlang-solutions.com/debian wheezy contrib
```

After adding this entry `aptitude update` need to be executed. If there will be some issues with downloading packages list key need to be added with following command:

```
apt-key adv --recv-keys --keyserver keyserver.ubuntu.com D208507CA14F4FCA
```

To work with *Amber* platform additional software need to be installed. Additional software can be installed with following commands:

```
aptitude install -y git make
aptitude install -y esl-erlang
aptitude install -y g++ libcxxtools-dev liblog4cxx10-dev libboost-dev libboost-
↪program-options-dev libboost-thread-dev libboost-system-dev
aptitude install -y protobuf-compiler libprotoc-dev
aptitude install -y python python-dev python-setuptools python-pip python-virtualenv
```

Configuration file modifications

- **Add** entry to file `/etc/modules`:

```
...
i2c-dev
```

- **Change** content of file `/etc/rc.local`:

```
#!/bin/sh -e
#
# rc.local
#
# This script is executed at the end of each multiuser runlevel.
# Make sure that the script will "exit 0" on success or any other
# value on error.
#
# In order to enable or disable this script just change the execution
# bits.
#
# By default this script does nothing.

cpufreq-set -g performance

# Enable GPIO_136 and use it as output
echo 0x03 > /sys/kernel/debug/omap_mux/mcspi1_simo
echo 0x03 > /sys/kernel/debug/omap_mux/mcspi1_cs0
echo 0x03 > /sys/kernel/debug/omap_mux/mcspi1_cs2

# Export GPIO_136 to userspace
echo 136 > /sys/class/gpio/export
echo 137 > /sys/class/gpio/export
echo 139 > /sys/class/gpio/export

# Change pin direction to out
echo out > /sys/class/gpio/gpio136/direction
echo out > /sys/class/gpio/gpio137/direction
echo out > /sys/class/gpio/gpio139/direction

# Put it high
echo 1 > /sys/class/gpio/gpio136/value
echo 1 > /sys/class/gpio/gpio137/value
echo 1 > /sys/class/gpio/gpio139/value
```

```
# Permissions
chgrp dialout /sys/class/gpio/gpio136/*
chmod g+w /sys/class/gpio/gpio136/*

chgrp dialout /sys/class/gpio/gpio137/*
chmod g+w /sys/class/gpio/gpio137/*

chgrp dialout /sys/class/gpio/gpio139/*
chmod g+w /sys/class/gpio/gpio139/*

modprobe i2c-dev
chown root:dialout /dev/i2c*
chmod 660 /dev/i2c*

#su - panda -c "/home/panda/amber/amber-erlang-mediator/start_amber.sh"

exit 0
```

User creation

- **Create** user `panda`.
- **Add** user `panda` to group `dialout` and `sudo` with commands `adduser panda dialout; adduser panda sudo`.

Informacja: File responsible for groups `/etc/group`:

- **Login** with user `panda`: `su - panda`.
- **Add** your public SSH key to file `/home/panda/.ssh/authorized_keys`

```
ssh-rsa AAA... user@hostname
```

Installation

Installation need to be done as `panda` user in home directory of this user: `/home/panda`. Need to download and install *Amber* with extras with following script:

```
mkdir -p ${HOME}/amber
pushd ${HOME}/amber
    git clone https://github.com/project-capo/amber-cpp-drivers.git
    pushd ${HOME}/amber/amber-cpp-drivers
        make all
    popd
    git clone https://github.com/project-capo/amber-python-drivers.git
    pushd ${HOME}/amber/amber-python-drivers
        ${HOME}/amber/amber-python-drivers/bin/install.sh
    popd
    git clone https://github.com/project-capo/amber-erlang-mediator.git
    pushd ${HOME}/amber/amber-erlang-mediator
        make all
    popd
popd
```

Update of *Amber* platform with extras can be done with following script executed as `panda`:

```
pushd ${HOME}/amber/amber-cpp-drivers
    make clean
    git pull
    make all
popd
pushd ${HOME}/amber/amber-python-drivers
    ${HOME}/amber/amber-python-drivers/bin/uninstall.sh
    git pull
    ${HOME}/amber/amber-python-drivers/bin/install.sh
popd
pushd ${HOME}/amber/amber-erlang-mediator
    make clean
    make allclean
    git pull
    make all
popd
```

Post-configuration

- **Uncomment** following line in file `/etc/rc.local`:

```
...

su - panda -c "/home/panda/amber/amber-erlang-mediator/start_amber.sh"

exit 0
```

- **Copy** example configuration file:

```
cp ${HOME}/amber/amber-erlang-mediator/apps/amber/priv/settings.config.example ${HOME}
↪/amber/amber-erlang-mediator/apps/amber/priv/settings.config
```

Run

- **Run** `${HOME}/amber/amber-erlang-mediator/start_amber.sh`

To finish command `killall heart` need to executed. Application logs are in directory `${HOME}/amber/amber-erlang-mediator/log*`.

Informacja: It is possible to run platform in developer mode. It is standard mode with ability to view logs live and interrupt working with `[Ctrl]+[c]`. Command to use: `${HOME}/amber/amber-erlang-mediator/start_devel_amber.sh`.

Settings

Mediator

To run mediator you need to configure drivers which will be started together with mediator. Example configuration should be adapted to new conditions and should be saved as file with name `apps/amber/priv/settings`.

`config`.

Informacja: Currently fully supported are drivers for devices *Roboclaw*, *Ninedof*, *Hokuyo* and *Location*. These drivers can be uncommented in configuration filer `apps/amber/priv/settings.config`.

Drivers

Drivers and their configuration are managed by developers. Configuration is provided with drivers.

Klienci

Clients and their configuration are managed by developers. Configuration is provided with clients.

Device types

Currently supported devices:

- **Ninedof** - read values from **motion sensor**: accelerometer, gyroscope, compass
- **Roboclaw** - managing **engines** and reading current speed of each engine
- **DriveSupport** - managing **engines** with support from laser scanner and motion sensor (depends on **Hokuyo** and **Ninedof**)
- **DriveToPoint** - moving robot from point to point as per provided list of points, additional information about environment is used like location and view of visible area (depends on **Roboclaw** or **DriveSupport** and **Location**)
- **Hokuyo** - used to read values about distance between robot and obstacles located around robot
- **Location** - provides information about approximate location of robot in closed area (depends on **Hokuyo** and **Roboclaw**)
- **Maestro** - managing controller for servo motors (eg. used in arm)
- **PidFollowTrajectory** - moving robot by following line (depends on **Roboclaw** or **DriveSupport** and **Location**)

Ninedof

Main functions provided by this driver are following:

- *one-time read* data from accelerometer, gyroscope, compass
- *all-time read* data from sensors

It is possible to decide which data will be read from sensors. It is possible to set this for one-time and all-time operations.

Roboclaw

Main function which can be done with engines are following:

- *set speed* for each engine

- *read current speed* from engines encoders

Used unit for speed is `mm/s`.

DriveSupport

That driver provides identical operations as *Roboclaw* driver. Used client is the same as for *Roboclaw*.

DriveToPoint

That driver allow to do following operations:

- set list of points which should be reached
- read list of points which were reached
- read last reached point
- read list of points which should be reached
- read point which should be reached as next

Hokuyo

Main functions which are provided by this device are following:

- *one-time read* data from scanner
- *all-time read* data from scanner

Scan is a set of data combined in tuples which are having angle and distance.

Scanner has a range of activity in which the distance is correctly measured. In our case it is between 50 `mm` and 5 `m`. When the distance is higher than 5 `m` it is marked as `zero`. When the distance is lower than 50 `mm` or close to `zero` it means that is *almost* zero and it should be treated as too close.

Location

Main function of this driver is provinding information about location. That driver depends on *Hokuyo* and *Roboclaw* drivers.

Drivers

Supported drivers

- amber-cpp-drivers is a project which contains drivers written in *C/C++*. Supported drivers are following:
  - **Ninedof** - reading information from sensor located on robot which provides information about motion from sensors accelerometer, gyroscope and compass
  - **Roboclaw** - controlling engines
  - **Stargazer** - provides ability to localize robot using camera and markers
  - **Location** - software computed location based on information from *Roboclaw* and *Hokuyo*

  - **Maestro** - servo-motors used in arm

- amber-python-drivers is a project which contains drivers written in *python*. Supported drivers are following:
  - **Hokuyo** - reading information from scanner about environment
  - **DriveSupport** - used to control engines, additional data are used like scans and motion data
  - **DriveToPoint** - allow to drive the route by list of points
  - **Roboclaw** - used to control engines without any additional support

Mediator configuration

Each driver has device type and number assigned. That values are set in Amber configuration. Configuration sould be saved in file `apps/amber/priv/settings.config`.

Example configuration:

```
{supervised_driver,
  {driver,
    {driver_name}
  },
  {driver_type_number, driver_nummber},
  [
    {cdriver, "path/to/driver"},
    {config_file, "path/to/driver/configuration"},
    {log_config_file, "path/to/log/configuration"}
  ]
}.
```

Paths to configuration are not required. Required is path to executable file used to start the driver.

Driver features

Driver is:

- an application which is running on robot
- an app. which is communicating with device connect to robot
- an app. which is communicating with mediator using pipes

Driver is responsible for:

- setting device parameters
- supporting simultaneous and parallel access to device
- monitoring clients presence and activity
- sending messages to clients which are registered as subscribers for specific type of messages
- receiving messages, servicing that messages and replying if it is needed

How it work

Ostrzeżenie: Following guidelines are as a consequence of common part in messages sent between clients and drivers. Using DriverMsg is not required. Message format can be manully definded, but so far drivers and clients does not support it.

Driver should support following features:

- handling received messages:
  - **DATA** - contains data which should be processed by driver
  - **PING** - echo request sent by mediator to check if driver is still alive, current not used, as a result driver should reply from **PONG**
  - **SUBSCRIBE** i **UNSUBSCRIBE** - used for client registration
  - **CLIENT_DIED** - used to inform driver about closed client, as a result client should be removed from subscribers list similar to **UNSUBSCRIBE**

Additionally it is recommended that driver should sent **DRIVER_DIED** to mediator when it is closing correctly.

Also driver should support:

- initialize device
- set device parameters
- buffer data from device
- synchronous access to device

Example

Example of driver can be DummyDriver. Drivers use common parts.

Clients

Supported clients

- amber-java-clients - it is a project which contains clients written in *Java*. Following devices are supported:
  - **Ninedof**
  - **Roboclaw**
  - **Hokuyo**
  - **Location**
  - **Maestro**
  - **DriveToPoint**
- amber-python-clients - it is a project which contains clients written in *python*. Following devices are supported:
  - **Ninedof**
  - **Roboclaw**

  - **Hokuyo**
  - **Location**
  - **DriveToPoint**

Client features

Client:

- is library used in client application
- provides ability to communicate with devices located on robot
- communicates with mediator over network

Client is responsible for:

- setting connection with mediator over UDP
- sending messages to mediator with correct type and number of device
- handling messages which are coming from mediator

Example

Example of driver can be DummyClient. Drivers use common parts.

Communication

Participants

In communication participate:

- one mediator
- one or more client(s)
- one or more driver(s)

Mediator features:

- is responsible for routing messages between clients and drivers
- does not modify message which is known only for driver and client
- processes message headers:
  - updates information about clients
  - updates information about type and number of device

Protocol

Driver communicates with mediator using pipes - standard input and output. It is required that driver will wait for data on standard input and will send data using standard output. Client communicates with mediator using UDP. Mediator is listening on port `26233`.

Format of message used in communication with mediator:

- 2 bytes which contain information about header length
- header data
- 2 bytes which contain information about message length
- message data

Length value should be sent in `big-endian` format (used in network). Be aware if used data are `signed` or `unsigned`. Due to fact that *Java* `signed` should be used.

Header and message data are binary data. Be aware how driver is communicating with mediator, what are the settings for pipes. For example in *python* interpreter should be started with option `-u` which allow using standard input and output in binary mode.

For serialization *Google Protobuf* is used. It is required that header will be combatible with used by mediator. Messages are not touched by mediator. It is recommended to use *protobuf* for message and to have message in format combatible with used in Amber project. Current header and message format is published in file project-capo/amber-common/drivermsg.proto.

Messages

Messages sent between clients and drivers contain:

- header `DriverHdr`
  - `deviceType` - device type
  - `deviceID` - device number
  - `clientIDs` - clients numbers
- message `DriverMsg`
  - `type` - message type
  - `synNum` - request number, set by client
  - `ackNum` - reply number, set by driver
  - `listenerNum` - listener number
  - additional fields (`extensions`)

Current device types `DeviceType`:

- 0 - unknown, not used
- 1 - **NineDof** (motion sensor)
- 2 - **Roboclaw** (engines)
- 3 - **Stargazer** (robot location based on markers)
- 4 - **Hokuyo** (laser scanner)
- 5 - **Dummy** (testing)
- 6 - **Location** (computed robot location)
- 7 - **Maestro** (servo-motors)
- 8 - **DriveToPoint** (following list of points)
- 9 - **CollisionAvoidance** (not used)
- 10 - **PidFollowTrajectory** (following line)

Current driver type messages `DriverMsg`:

- **DATA** - data sent between clients and drivers
- **PING** - echo request sent by mediator, currently not used
- **PONG** - echo reply sent by driver or client, currently not used
- **CLIENT_DIED** - information sent by client when client was correctly closed
- **DRIVER_DIED** - information sent by driver when driver was correctly closed
- **SUBSCRIBE** - subcribe messages sent by client
- **UNSUBSCRIBE** - closing subscribtion