

HERMES

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SBIG CCD Camera: Linux driver setup

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1 Introduction

This document describes how to install and setup the linux driver for the SBIG ST-1603ME CCD camera. These informations may also prove useful for other SBIG cameras.

For its cameras, the SBIG company mainly distributes drivers suited for Microsoft Windows. For Linux users, a few drivers have been written but are not “officially supported”. For Linux 2.4 kernels, SBIG distributes two kernel modules, one for parallel port cameras, and the other for USB cameras. The main problem is that they have to maintain the kernel modules while the Linux kernel is evolving quite fast. For Linux 2.6 kernels, they chose a different approach. Instead of a kernel module, they wrote a driver in userspace, which interacts with the USB port through the `libusb` interface. We decided to go that way for HERMES, as the kernel module approach is being abandoned by SBIG.

The Linux 2.6 driver is made of a firmware loaded at start-up into the CCD camera, and a userspace library based on `libusb`. We describe here how to install it, how to load manually the firmware, and how to automatically load the firmware when the camera is plugged in.

2 Installation

2.1 Needed software

The SBIG driver for Linux 2.6 communicates with the USB port through the `libusb` userspace library. Therefore, you will need:

- A recent Linux kernel (tested with 2.6.14 and 2.6.15)
- `libusb` (tested with 0.1.12)
- `libusb++` (tested with 0.1.12) Needed as the SBIG driver is partly written in C++.
- `fxload` (tested with 0.0.20020411) Needed to load the firmware.
- `udev` (tested with 0.081) Needed for the “hotplug” configuration.

2.2 Installing the driver

1. **Get the driver software.** Download from the SBIG website the Linux Development Kit [1]. You do not need to compile the software. You just need to pick the dynamic libraries (`*.so`) and the firmware files (`*.hex`, `*.bin`).
2. **Install the firmware files.** Copy the following files

```
sbigfcam.hex sbiglcam.hex sbigucam.hex stfga.bin
```

in `/usr/share/usb/`. If that directory does not exist create it. The directory location is mandatory as it is hardcoded in one of the firmware files.

```
mkdir -p /usr/share/usb  
cp sbigfcam.hex sbiglcam.hex sbigucam.hex stfga.bin /usr/share/usb
```

3. **Install the interface library.** Copy the `libsbigudrv.so` and `libsbigcam.so` dynamic libraries into a directory where they will be found by the dynamic loader. We suggest `/usr/local/lib/`:

```
cp libsbigcam.so libsbigudrv.so /usr/local/lib
```

You may need afterwards to define or modify the `LD_LIBRARY_PATH` environment variable. This library should be loaded by any program wanting to access to the SBIG camera.

3 Manual setup step by step

We describe here how to setup the SBIG CCD camera step by step. See the next section for an “hotplug” configuration that will automatically do what is described here.

1. **Connect the camera** to the power (power cable, connector labelled “POWER”) and to the PC USB port (“USB”).
2. **Determine the USB connection ID.** Check it with the `lsusb` command:

```
llg@leie ~> lsusb
Bus 003 Device 003: ID 413c:2003 Dell Computer Corp.
Bus 003 Device 002: ID 413c:3200 Dell Computer Corp.
Bus 003 Device 001: ID 0000:0000
Bus 005 Device 071: ID 0d97:0003 Santa Barbara Instrument Group
Bus 005 Device 001: ID 0000:0000
Bus 004 Device 001: ID 0000:0000
Bus 001 Device 001: ID 0000:0000
Bus 002 Device 001: ID 0000:0000
```

The line with “Santa Barbara Instrument Group” corresponds to the SBIG camera without any firmware loaded. You need to remember the USB bus ID indicated by “Bus XXX” (hereafter noted `BUSID`) and the USB device ID on that USB bus, given by “Device XXX” (hereafter noted `DEVID`).

3. **Load the firmware into the CCD camera.** To do so, you will use the `fxload` tool, like this:

```
fxload -I /usr/share/usb/sbigfcam.hex -t fx2 \  
-D /proc/bus/usb/BUSID/DEVID
```

by replacing `BUSID` and `DEVID` by their respective values provided by the `lsusb` output. For instance (see above),

```
fxload -I /usr/share/usb/sbigfcam.hex -t fx2 -D /proc/bus/usb/005/071
```

When doing so, you should see the SBIG red LED (previously off) blinking a few seconds, and then stay on. If you check the `lsusb` command output, you should now see something like this:

```
Bus 003 Device 003: ID 413c:2003 Dell Computer Corp.
Bus 003 Device 002: ID 413c:3200 Dell Computer Corp.
Bus 003 Device 001: ID 0000:0000
Bus 005 Device 072: ID 0d97:0101 Santa Barbara Instrument Group
```

```
SBIG Astronomy Camera (with firmware)
Bus 005 Device 001: ID 0000:0000
Bus 004 Device 001: ID 0000:0000
Bus 001 Device 001: ID 0000:0000
Bus 002 Device 001: ID 0000:0000
```

Note the “with firmware” which tells us that the firmware is now loaded, and also that the device ID is now different, as well as the USB product identification (0d97:0101 instead of 0d97:0003 without firmware).

The camera is now ready to be used by any software able to control it.

We will see in the next section how to do this setup automatically at boot time and each time the CCD camera is plugged in.

4 Automatic setup: “hotplug” configuration with udev

We describe here a configuration based on udev, the successor of the hotplug system [2]. With that setup, the firmware will be automatically loaded when you plug in the USB cable of the CCD camera. Whatever the USB port id is, the SBIG camera device will be accessible through the `/dev/sbig` symbolic link.

To do so, you need to install and setup the udev system. It is the standard system to manage “hotplug” events for recent linux kernels (after version 2.6.12).

To let the udev system recognise the SBIG camera and load the firmware, you should write a few additional udev *rules*. The rules are stored in individual files in `/etc/udev`. Here is the `sbig.rules` file to add for the SBIG camera:

```
# ----- /etc/udev/sbig.rules -----
#
# SBIG ST-1603ME CCD camera
# udev rules file
# Laurent Le Guillou <laurentl@ster.kuleuven.be>
#
# Device without firmware
BUS=="usb", SYSFS{idVendor}=="0d97", SYSFS{idProduct}=="0003", \
MODE="664", GROUP="camera", SYMLINK="sbig-no-firmware", \
RUN+="/sbin/fxload -I /usr/share/usb/sbigfcam.hex -t fx2 \
-D /dev/sbig-no-firmware"
#
# Device with firmware loaded
# (the same device then has a different idProduct)
BUS=="usb", SYSFS{idVendor}=="0d97", SYSFS{idProduct}=="0101", \
MODE="664", GROUP="camera", SYMLINK="sbig"
# -----
```

Then, you should add a symbolic link to that file in `/etc/udev/rules.d/` (as super-user):

```
cd /etc/udev/rules.d/  
ln -s ../sbig.rules 000_sbig.rules
```

The symbolic link name (with '000' prefix) is set to insure that these new rules will be read first, before the default rules. To load these new rules you need to restart the udev daemon:

```
/etc/init.d/udev restart
```

The first rule recognizes the SBIG ST1603ME camera (by its USB `idVendor:idProduct=0d97:0003`) without firmware. It is activated by a udev event when the camera is plugged. The rule creates a symbolic link `/dev/sbig-no-firmware` linked to its USB low level device node, and then, runs the `fxload` command to load the firmware into the camera. At that point, the CCD camera USB id changes to `0d97:0101`, thus generating a new udev event. This last event activates the second rule, which just creates a `/dev/sbig` link to the corresponding device node.

With this setup, the firmware will be automatically loaded each time you plug in the USB camera after a power off. If the camera is unplugged and plugged again without turning off its power, the firmware will remain in the camera memory, and only the second udev rule will be activated.

The two rules give the group ownership on the device nodes to the camera user group, and change the access mode to 664, in order to give full access to the CCD camera to any Unix user who belongs to the camera group. This is an elegant way to manage the access rights, instead of running the camera related software as super-user.

Note that with udev, the device nodes in `/dev/` only exist while the corresponding device is plugged; therefore, `/dev/sbig` immediately disappears when the camera is disconnected¹.

5 Open issues

This document has been written for the Debian GNU/Linux systems. The adaptation to another recent Linux distribution should be quite straightforward. If the SuSE distribution is kept as the default Linux platform for HERMES control, this document should be adapted to SuSE. I do not advocate the use of the SuSE distribution, and encourage the switch to the Debian one which is much more flexible and much easier to maintain.

The udev hotplug management system is only available on recent Linux distributions, with kernel version 2.6.12 or later. The SuSE9.2 Linux boxes at the Mercator telescope would need an upgrade to be able to use the automatic setup described here.

References

- [1] SBIG Linux Development Kit, <ftp://ftp.sbig.com/pub/devsw/LinuxDevKit.tar.gz>
- [2] Introduction to the udev hotplug management system, <http://www.debian-administration.org/articles/126>

¹`/dev/sbig-no-firmware` appears when the camera is plugged and immediately disappears once the firmware is loaded, as the USB `idProduct` of the camera changes with the firmware.