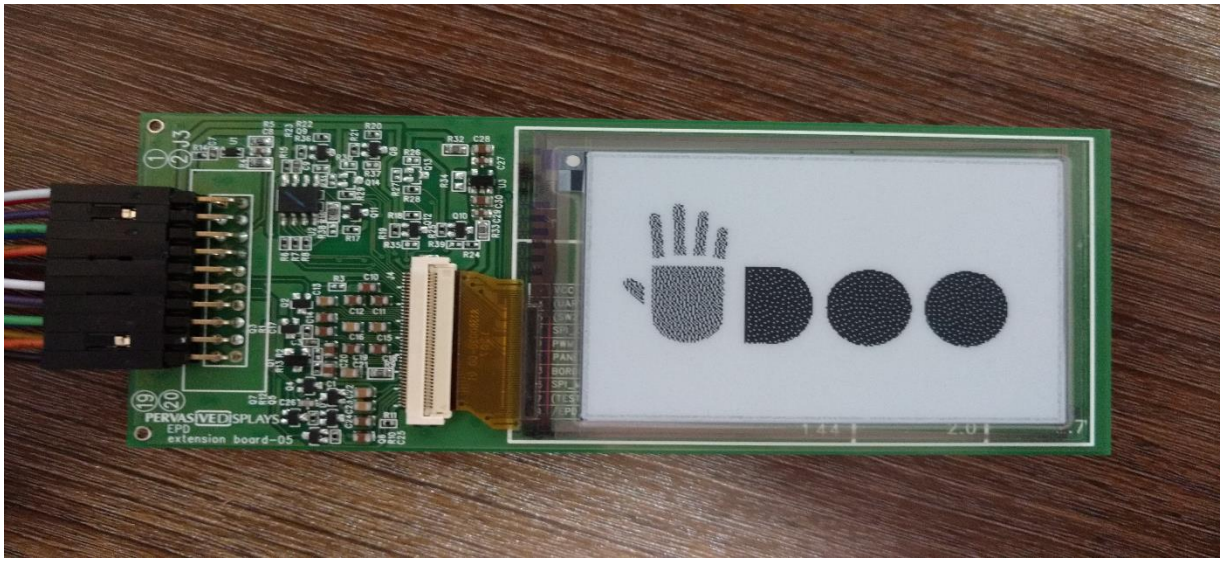
Repaper eInk Development Board for ARM+GNU/Linux
(Udoo-neo board on processor side).

Overview



Now you can add eInk displays to your favorite single-board Linux computers! This tutorial will show you how to wire and run the RePaper eInk displays with Udoo-neo board.

The RePaper development boards from Pervasive Displays come with a driver board that is powered from 3V and has level shifting on all the I/O pins so it can be used with 5V microcontrollers such as the Arduino. The PCB also has a lot of driver circuitry required to keep the display running smoothly such a temperature sensor, FLASH memory and ZIF socket. All signals are broken out to a 20 male socket header on the left. A 20 pin socket/socket cable is included to make wiring easier and there's also some extra-long header so you can plug these wires into a header or a breadboard.

The displays are available in 1.44", 2" and 2.7" diagonal sizes with resolutions of 128x96, 200x96 and 264x176 pixels. These are intended for use as small dynamic signage in grocery stores since a barcode displayed on it can be scanned by a laser barcode-reader. The display does not require any power to keep the image and will stay 'on' without any power connection for many days before slowly fading. Of course, its also daylight readable and is very high contrast. This makes it excellent for data-logging applications, outdoor displays, or any other ultra-low power usages

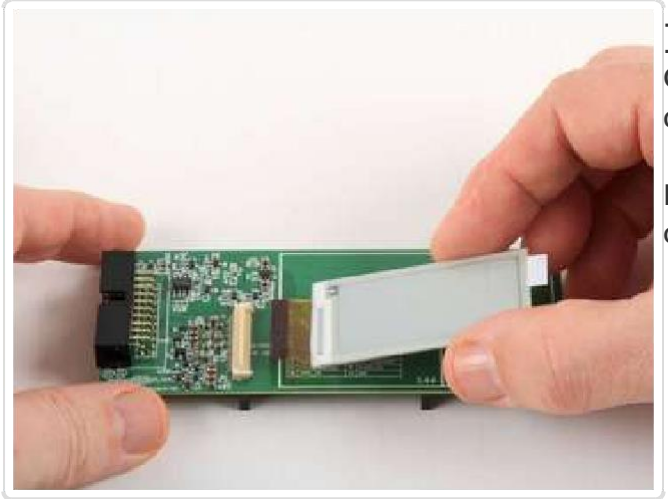
Assembly and Wiring

The eInk development board comes completely assembled. All you need to do is attach the eInk display and the breakout cable.

Attach the Display

Open the Socket

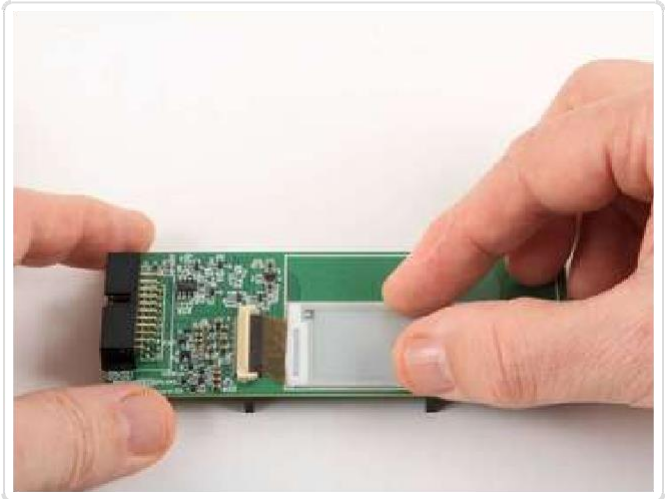
Lift the front edge of the flex connector socket and raise it to the vertical position as shown on the left.

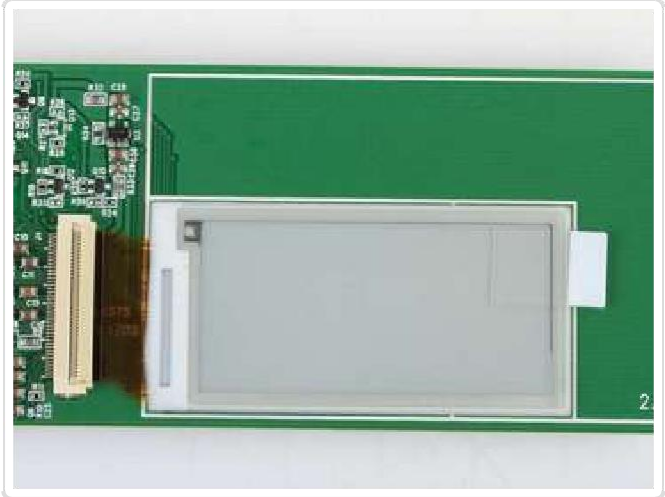


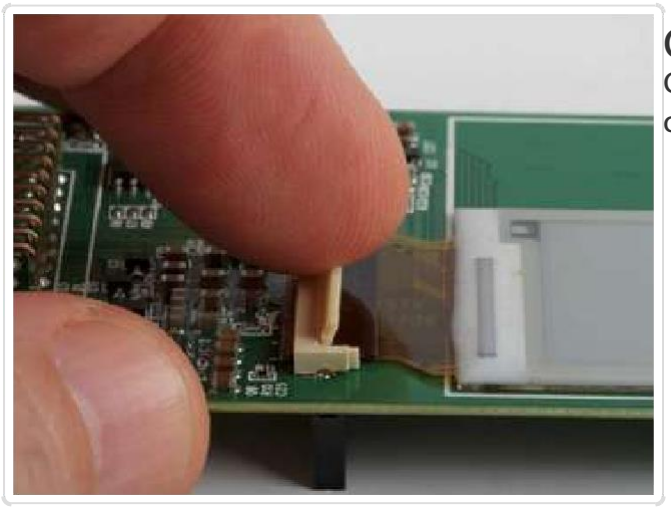
Insert the Flex Connector

Gently slide the flex connector (contact side down) into the socket.

Make sure that the display is aligned with the outline on the silkscreen.

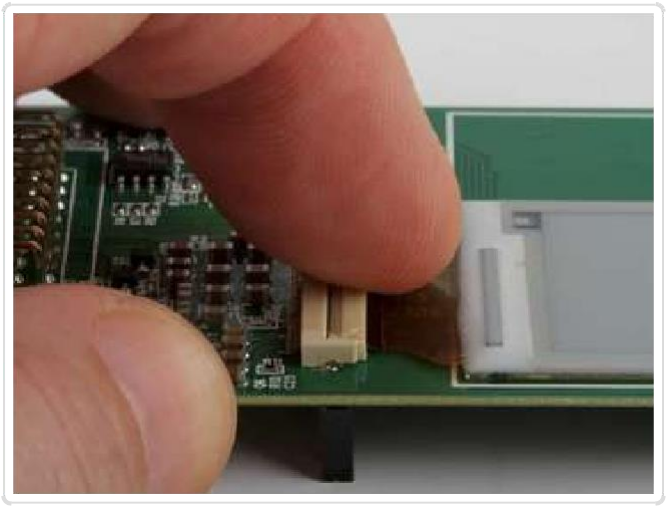


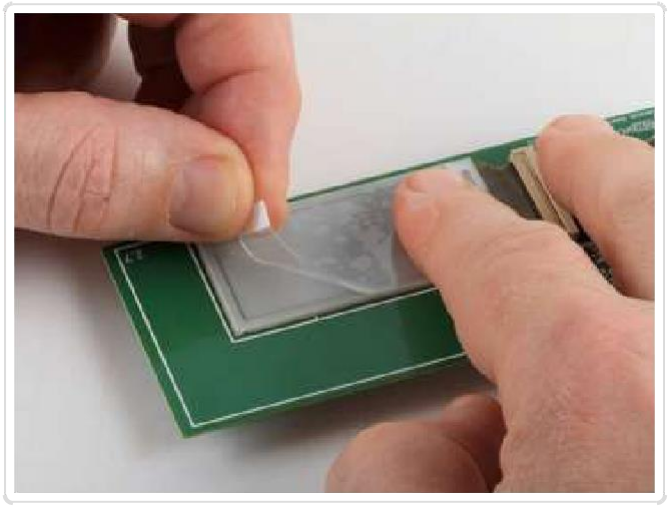


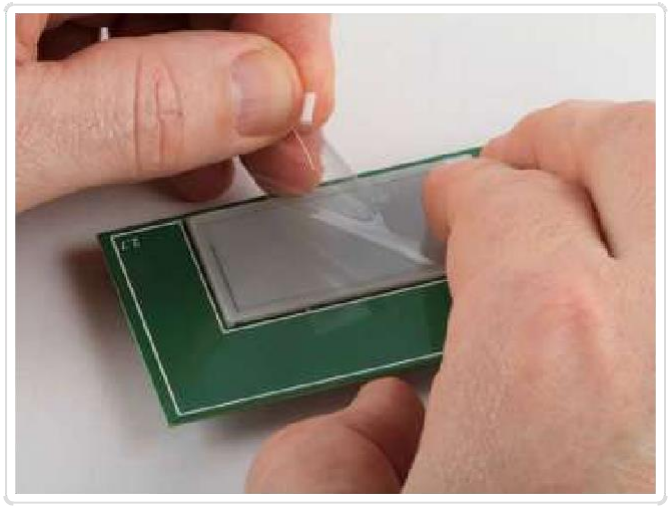


Close the Socket

Gently push the socket closed to lock the flex connector in place.







Remove the protective film

Lift the white tab and gently peel back the protective film from the display.

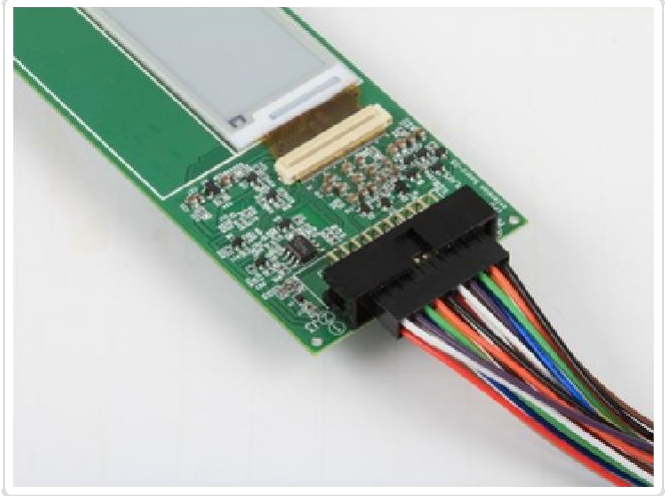
Attach the breakout cable-

Locate Pin 1

Pin 1 is marked with a white dot on the connector. There will be a red wire connected to that pin.

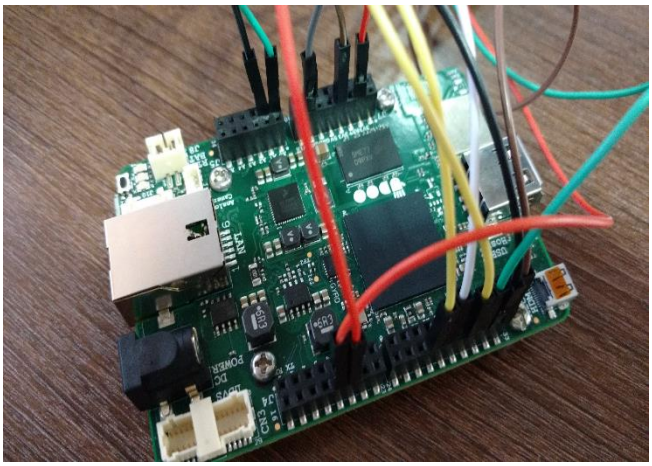
Insert the cable

- Flip the cable over so that the white dot is facing down.
- Center the connector in the socket with Pin 1 on the side marked with a circled "1" on the board.



EPD PIN Assignment-

Pin No.	Description	Pin No.	Description
1	VCC 10-3.3V	11	PANEL_ON
2	LED1	12	DISCHARGE
3	UART_RX	13	BORDER_CONTROL
4	UART_TX	14	SPI_MISO
5	SW2	15	SPI_MOSI
6	TEMPERATURE	16	RST/SBWTDIO
7	SPI_CLK	17	TEST/SBWTCK
8	BUSY	18	FLASH_CS
9	PWM	19	/EPD_CS
10	/RESET	20	GND

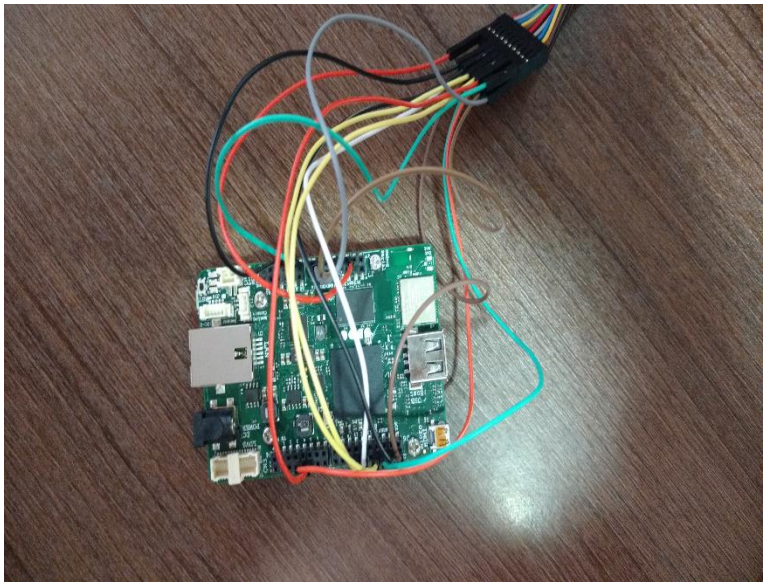


Connections:

Start by connecting Pin 1 of the breakout cable (red wire) to the header pin for 3.3v.

Continue making connections in the order listed below. There are duplicate wire colors, so don't mix them up!

Make connections to:

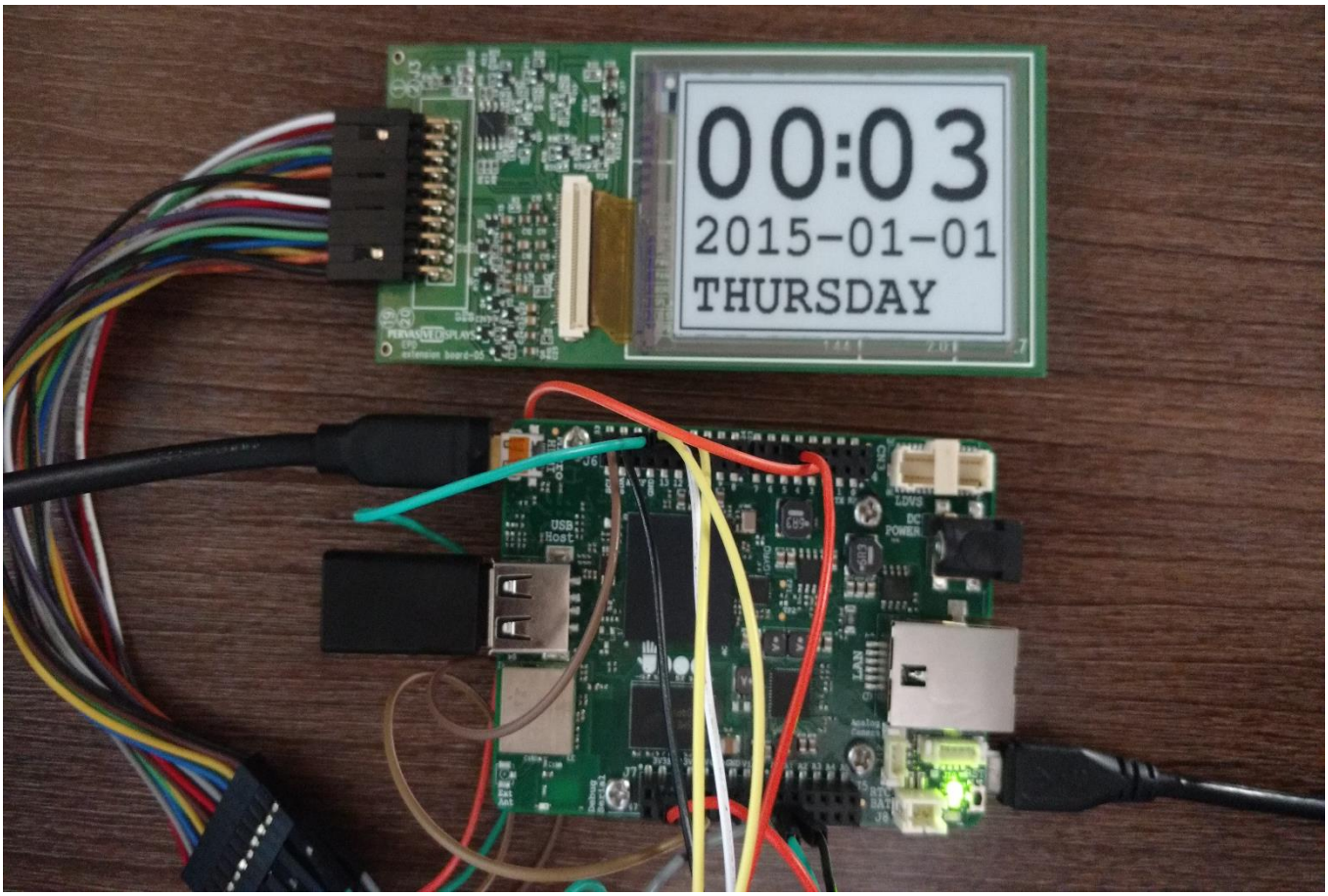


- (Red #1) ----------→ VCC 3V3
- (Green #6) -> not used (ext ADC required)
- (Yellow #7) ----------→ ECSPI_2_SCLK
- (Orange #8) ----------→ GPIO_16
- (Brown #9) ----------→ GPIO_20
- (Black #10) ----------→ GPIO_21
- (Red #11) ----------→ GPIO_15
- (White #12) ----------→ GPIO_19
- (Grey #13) ----------→ GPIO_18
- (Purple #14) ----------→ ECSPI2_MISO
- (Blue #15) ----------→ ECSPI2_MOSI
- (Orange #18) ----------→ VCC 3V3
- (Brown #19) ----------→ ECSPI_2_SS0
- (Black #20) ----------→ GND

Udoo pin-out –

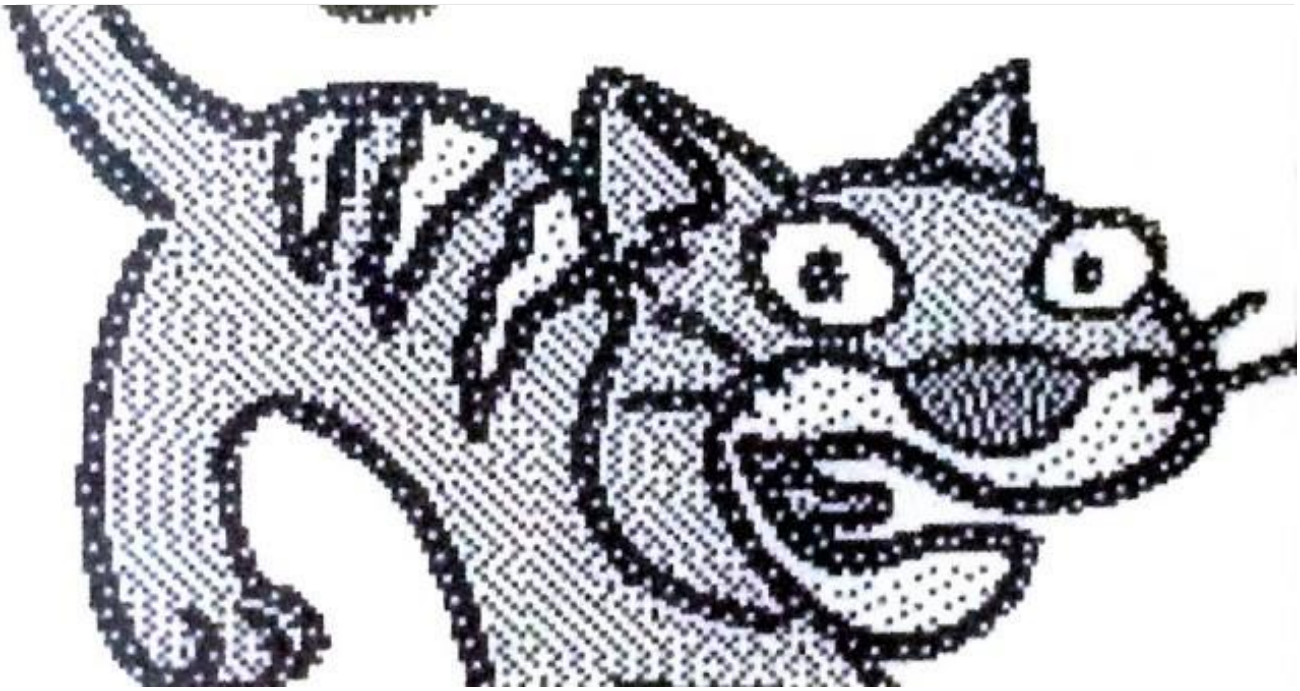
For udoo neo pin-out reference go through below link

https://drive.google.com/file/d/0B6wp51VBztpQa0VpVS0tUW16bFE/view



Now you are done wiring and ready to test the display!

Driver and Examples



Compiling

These test programs should compile with no additional libraries, but the EPD driver needs the fuse development library installed. And a few examples make us of the Python Imaging Library (PIL)

Udoo-neo

```
sudo apt-get install libfuse-dev python-imaging

Use the epd.rar folder library provided with this document.

cd gratis/PlatformWithOS

make ud PANEL_VERSION='V231_G2'
(PANEL_VERSION='V231_G2'  this depend on your panel size)

make ud-install PANEL_VERSION='V231_G2' (to install)

make ud-clean PANEL_VERSION='V231_G2'  (to remove)
```

EPD fuse

This allows the display to be represented as a virtual directory of files, which are:

```
File        Read/Write  Description
--------    ----------  -------------------------------
version     Read  Only  The driver version number
panel       Read Only   String describing the panel and giving
                        its pixel width and height
current     Read  Only  Binary image that matches the currently
                        displayed image (big endian)
display     Read Write Image being assembled for next display
                        (big endian)
temperature Read Write  Set this to the current temperature in Celsius
command     Write Only  Execute display operation
BE          Directory   Big endian version of current and display
LE          Directory   Little endian version of current and display

Command  Byte   Description
--------  -----  -------------------------------
'C'       0x43  Clear the EPD, set `current` to all zeros, `display`
                is not affected
'U'       0x5A  Erase `current` from EPD, output `display` to EPD,
                copy display to `current`
```

Notes:

- The default bit ordering for the display is big endian i.e. the top left pixel is the value 0x80 in the first byte.
- The `BE` directory is the same as the root `current` and `display`.
- The `LE` directory `current` and `display` reference the top left pixel as 0x01in the first byte.
- The `current_inverse` and `display_inverse` represent black as zero (0) and white as one (1) while those item without the suffix represent the display's natural coding (0=>white, 1=>black)
- The particular combination of `BE/display_inverse` is used in the Python EPD demo since it fits better with the Imaging library used.

Set Panel Size in FUSE Configuration

```
cat /etc/default/epd-fuse
```

Expected Output:

```
# Default settings for epd-fuse file is sourced by /bin/sh  from
# /etc/init.d/epd-fuse

# Options to pass to epd_fuse
#EPD_MOUNTPOINT=/dev/epd
#EPD_SIZE=2.0
#EPD_OPTS=
```

Note: All the configurations are commented out and represent the default settings. If your panel is NOT the 2.0", then you mustchange this configuration.

How to edit the configuration file:

```
sudo nano /etc/default/epd-fuse
```

Uncomment the **EPD_SIZE** and change the value to your panel size (either **2.7** or **1.44**). Save and exit.

Start the Driver

```
sudo service epd-fuse start
cat /dev/epd/panel
```

Expected Output for a 2.7" panel:

```
EPD 2.7  264x176
```

Python Demo Program
Drawing Demo

Draw some lines, graphics and text:

```
python demo/DrawDemo.py
```

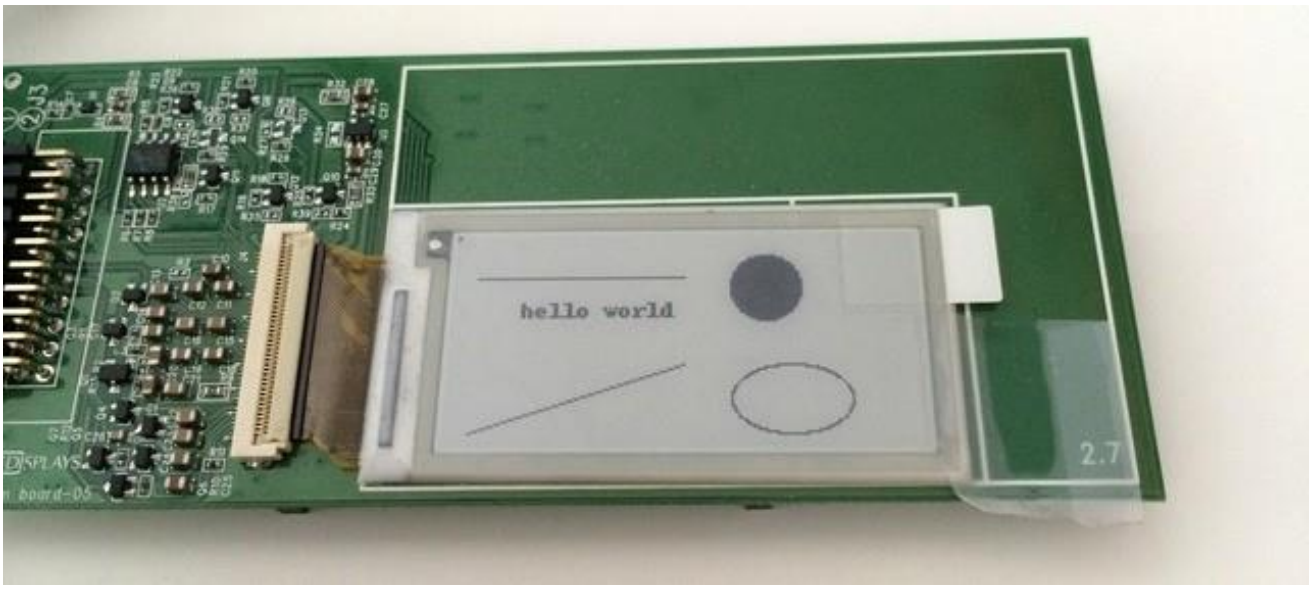


Image demo

- Accepts a lists of image files on the command line.
- Converts them to grey scale to ensure formats like PNG, JPEG and GIF will work.
- Inverts the image since the E-Ink panel is reverse (i.e. black on white).
- Converts image to single bit (PIL "1" mode).
- Display the middle of the image (using crop function).
- Delay.
- Display the re-sized image.
- Delay before fetching next file.

```
python demo/ImageDemo.py /usr/share/scratch/Media/Costumes/Animals/cat*
python demo/ImageDemo.py  /usr/share/scratch/Media/Costumes/Animals/d*.png
```

Note: if scratch is installed on the system, the following commands will show some cartoon animals. The images when re-sized will be distorted if the aspect ration of the original image is not the same as the display.

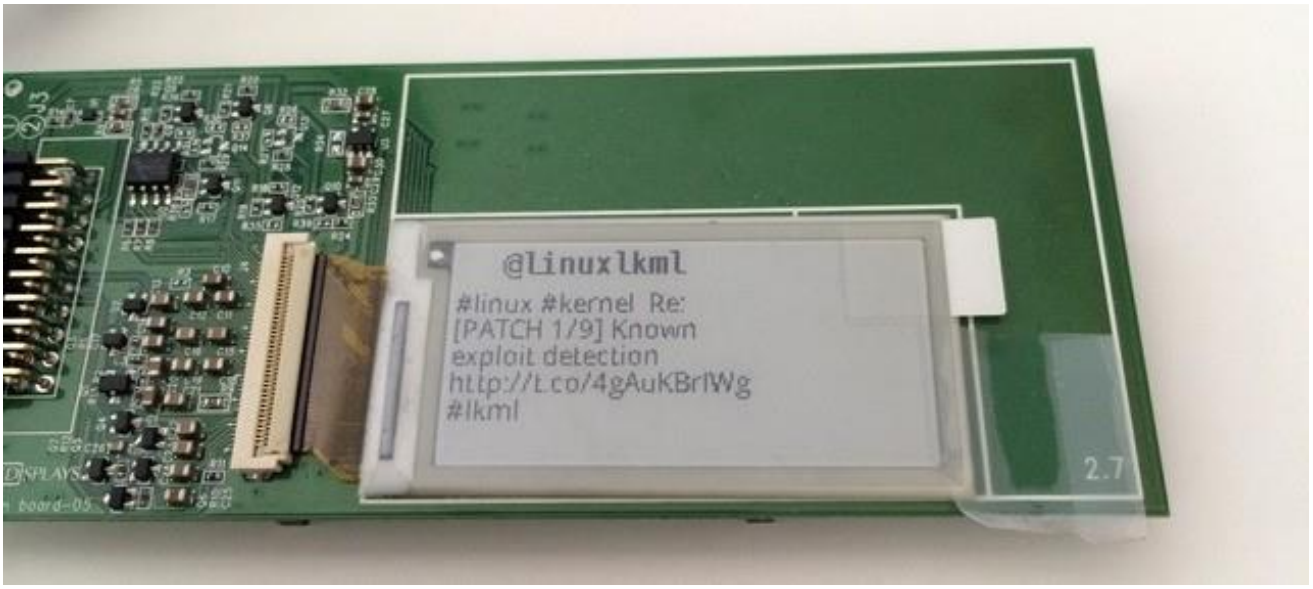
Twitter Demo

Setup easy_install and use it to get pip, then use pip to get tweepy. Copy the sample configuration an edit to include your authentication information. Rather than using the basic authentication it is better to set up a Twitter App and generate a token for this. The token generation is quick at
https://dev.twitter.com/ (http://adafru.it/d2C).

After creating the App, just click the button to create an access token.

Use **Ctrl-C** to stop this program.

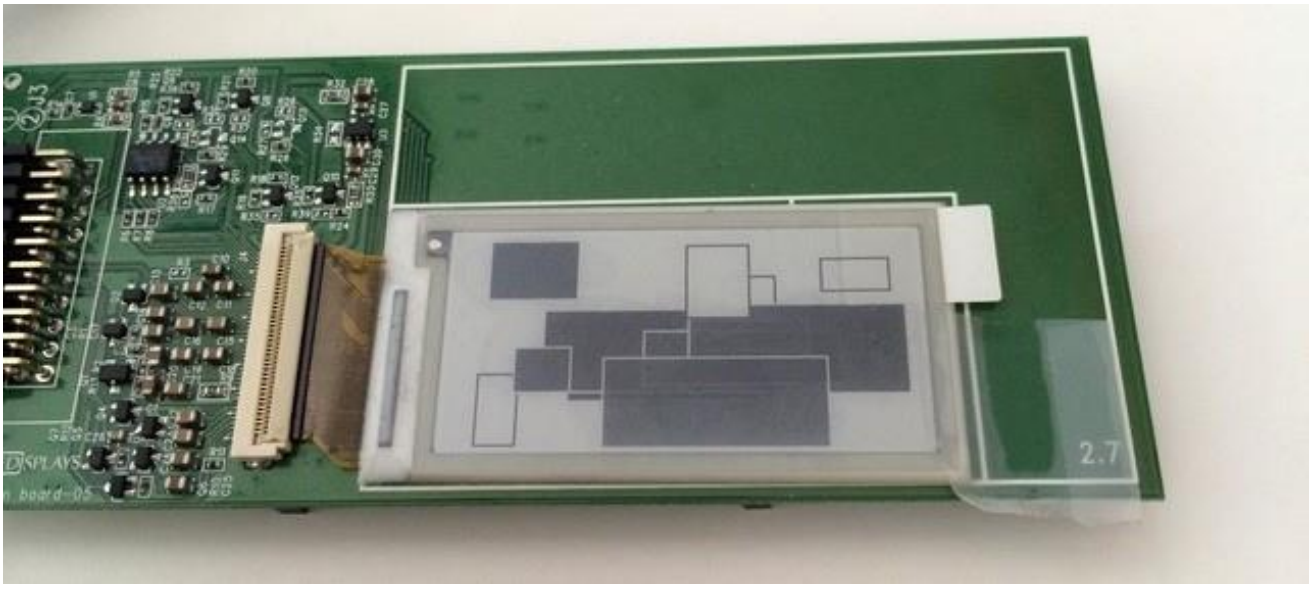
```
sudo pip install tweepy

# setup the config
cp demo/tweepy_auth.py-SAMPLE demo/tweepy_auth.py

# *** edit the config
nano demo/tweepy_auth.py

# run the demo (this watches for linux)
python demo/TwitterDemo.py linux
```



Partial Demo

Display random overlapping rectangles using partial update. First argument is number of rectangle to generate before updating the EPD, second number is the number of frames to display before the program exits.

```
python demo/PartialDemo.py 3 20
```



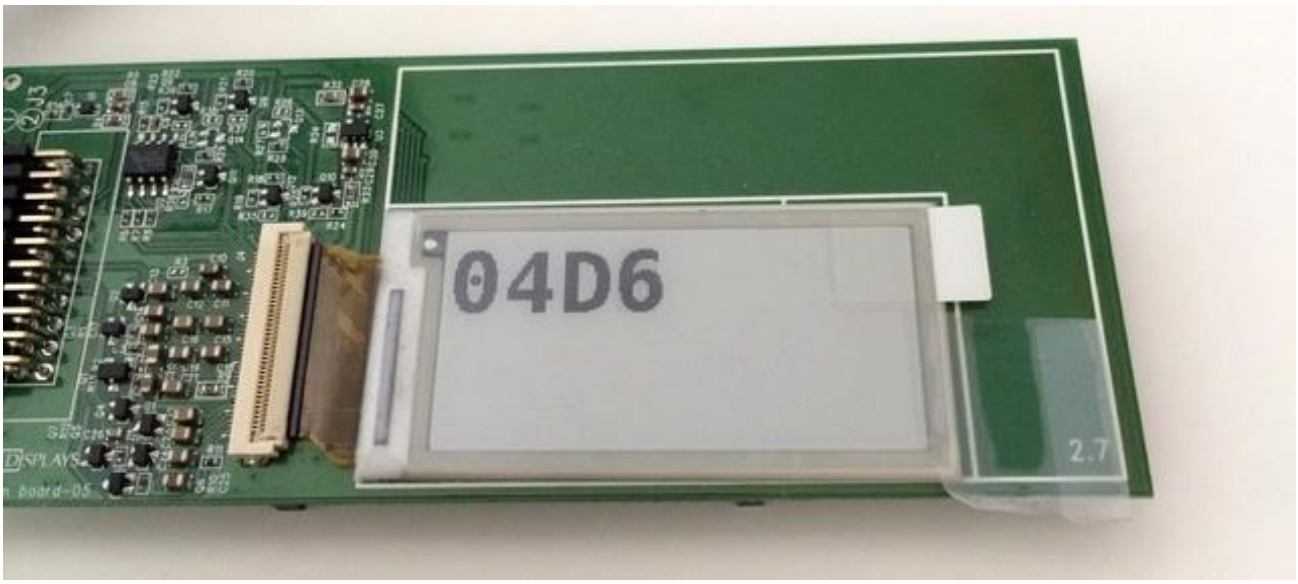
Counter Demo

Display a 4 digit hex counter uses partial update to only change the updated digits. This will look somewhat strange as the display inversion will make the counter appear to go through

a sequence like: 0000 0001 0000 0001 ...delay... 0001 0002 0001 0002

Use **Ctrl-C** to stop this program.

```
python demo/CounterDemo.py 3 20
```



FAQ

Everything compiled correctly, but I get no activity on the screen

The default driver compile is for a COG 1 (Computer On Glass, version 1). Your RePaper screen may be a COG 2.

You can check this my carefully lifting the display and looking on the back of it. Look for a barcode starting with "TEM" or "VEM".

If the seventh character of the barcode is 'B', then you have a COG 2. Follow these instructions for building the driver:

Udoo-neo

```
make ud-clean
make COG_VERSION=V2 ud
sudo make COG_VERSION=V2 ud-install
sudo reboot
```

After reboot make sure it is showing a "COG 2"

```
% cat /dev/epd/panel
EPD 2.7 264x176 COG 2
% echo C > /dev/epd/command
```

Note

For more information regarding board pinout, images, kernel compilation etc. please refer the below link:
http://www.udoo.org/udoo-neo/