Downloading and Loading Kria-Prophesee-Event-VitisAI Application Firmware in KV260 Board

Getting Started Guide

Overview of Kria-App

This Kria-App consists of setup steps for running the event camera based Machine learning inference in Kria KV260 Board. Here we are taking event camera from Prophesee and also performing recorded event file based ML inference.

This kria-app has Kria-Ubuntu and Kria-Petalinux both OS support.

Prerequisites

Following are the prerequisites of this Kria-App:

- KV260 board and power supply
- Ethernet cable
- USB cable (for serial connection to host machine)
- HDMI monitor and cable
- Prophesee CCAM5 (optional if using event file based ML)
- Mouse and Keyboard
- SD card (32 GB)

Setup Kria Ubuntu SD card for KV260:

Get the Kria Ubuntu 22.04 from - Link
Create SD card using balenaethcer tool and prepare the KV260 for SD card boot. Along with this getting started guide you can also perform test on SmartCam application for verification of your hardware and setup.

Getting the Kria Ubuntu Firmwares

Get the Kria Ubuntu firmware and necessary installation scripts from following repository :
https://github.com/LogicTronixInc/Kria-Prophesee-Event-VitisAI

After cloning the repository, run following scripts to update Ubuntu Kernel followed by Prophesee driver installation.

Update Kria Ubuntu kernel:

Run scripts to update the Ubuntu kernel:
Kria-Prophesee-Event-VitisAI/Kria-Ubuntu/scripts/install_updated_linux_kernel.sh

Setup Prophesee camera drivers :

Run following script to install Prophesee camera drivers:
Kria-Prophesee-Event-VitisAI/Kria-Ubuntu/scripts/install_psee_drivers.sh

Get the application:

```
Git clone
```

Docker-Based Application Preparation

Pull the docker image:

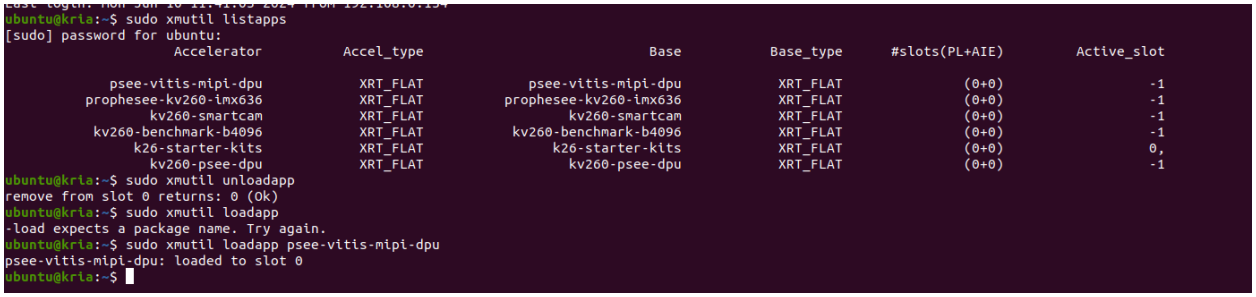
```
docker pull logictronixinc/prophesee-ml-kria:v0.1
```

View the available images using docker command:

```
docker images
```

Load the hardware overlay using xmutil :

```
Sudo xmutil unloadapp
Sudo xmutil loadapp <hardware overlay>
```



After loading the hardware overlay one can view Prophesee sensor media graph running `media-ctl -p` command:

```
ubuntu@kria:~$ media-ctl -p
Media controller API version 5.15.136

Media device information
------------------------
driver          psee-video
model           Prophesee Video Pipeline
serial
bus info
hw revision     0x0
driver version  5.15.136

Device topology
- entity 1: ps_host_if output 0 (1 pad, 1 link)
            type Node subtype V4L flags 0
            device node name /dev/video0
        pad0: SINK
                <- "a0050000.event_stream_smart_tra":1 [ENABLED]

- entity 5: a0010000.mipi_csi2_rx_subsystem (2 pads, 2 links, 0 routes)
            type V4L2 subdev subtype Unknown flags 0
            device node name /dev/v4l-subdev0
        pad0: SINK
                [stream:0 fmt:SRGGB8_1X8/1920x1080 field:none colorspace:srgb]
                <- "imx636 6-003c":0 [ENABLED]
        pad1: SOURCE
                [stream:0 fmt:SRGGB8_1X8/1920x1080 field:none colorspace:srgb]
                -> "a0040000.axis_tkeep_handler":0 [ENABLED]

- entity 8: a0050000.event_stream_smart_tra (2 pads, 2 links, 0 routes)
            type V4L2 subdev subtype Unknown flags 0
            device node name /dev/v4l-subdev1
        pad0: SINK
                [stream:0 fmt:unknown/0x0]
                <- "a0040000.axis_tkeep_handler":1 [ENABLED]
        pad1: SOURCE
                [stream:0 fmt:unknown/0x0]
                -> "ps_host_if output 0":0 [ENABLED]

- entity 11: a0040000.axis_tkeep_handler (2 pads, 2 links, 0 routes)
             type V4L2 subdev subtype Unknown flags 0
             device node name /dev/v4l-subdev2
        pad0: SINK
                [stream:0 fmt:unknown/0x0]
                <- "a0010000.mipi_csi2_rx_subsystem":1 [ENABLED]
        pad1: SOURCE
                [stream:0 fmt:unknown/0x0]
                -> "a0050000.event_stream_smart_tra":0 [ENABLED]

- entity 14: imx636 6-003c (1 pad, 1 link, 0 routes)
             type V4L2 subdev subtype Sensor flags 0
```

Next update the media format to `PSEE_EVT21` running `load.sh` script.

And enable the camera sensor running following command:

```
echo on > /sys/class/video4linux/v4l-subdev3/device/power/control
```

Note: Here v4l2 subdev number may change depending upon loading of device driver, so update the above command with respect to imx636 node in media graph as obtained using media-ctl command.

```
ubuntu@kria:~$ cat load.sh
#!/bin/bash
: ${FORMAT:="PSEE_EVT21"}

# Force load of tkeep handler driver, so that we don't get the pass-through driver
# probed on tkeep handler
#modprobe psee-tkeep-handler

# Load the FPGA
#xmutil unloadapp
#xmutil loadapp prophesee-kv260-imx636

# Wait long enough for the drivers to be probed
sleep 1

# Set the pipeline to run in $FORMAT (eg PSEE_EVT3)
media-ctl -V "'imx636 6-003c':0[fmt:$FORMAT/1280x720]"
media-ctl -V "'a0010000.mipi_csi2_rx_subsystem':1[fmt:$FORMAT/1280x720]"
media-ctl -V "'a0040000.axis_tkeep_handler':1[fmt:$FORMAT/1280x720]"
media-ctl -V "'a0050000.event_stream_smart_tra':1[fmt:$FORMAT/1280x720]"
# The config of the pipeline can be seen with `media-ctl -p`

# Force the sensor to be ON, so that Metavision can do register accesses on it
# Write "auto" to let the sensor be powered down when not streaming
#echo on > /sys/class/video4linux/v4l-subdev3/device/power/control

# run with
# MV_LOG_LEVEL=TRACE V4L2_HEAP=reserved  V4L2_SENSOR_PATH=/dev/v4l-subdev3 metavision_viewer
ubuntu@kria:~$ sudo su
root@kria:/home/ubuntu# ./load.sh
root@kria:/home/ubuntu# echo on > /sys/class/video4linux/v4l-subdev3/device/power/control
root@kria:/home/ubuntu#
```

For GUI to get the output from application running in docker container, run following command:

```
xhost local:docker
```

Then run the docker run command:

```
docker run \
-e DISPLAY=unix$DISPLAY \
-h "xlnx-docker" \
--env="XDG_SESSION_TYPE" \
```

```
--net=host \
--privileged \
--volume="/home/ubuntu/.Xauthority:/root/dot.Xauthority:rw" \
-v /tmp:/tmp \
-v /dev:/dev \
-v /sys:/sys \
-v /etc/vart.conf:/etc/vart.conf \
-v /lib/firmware/xilinx:/lib/firmware/xilinx \
-v /run:/run \
-v /home/ubuntu:/ubuntu \
-it <psee-openeb-ml-vitis:latest> bash
```

```

Things to check before running application:

- DPU check
    - Run `show_dpu` command to get information about available DPU
    - Run `xdputil query` to get detail information


- Camera Check
    - `media-ctl -p` to get the v4l2 media graph and sensor device number
```

```
-----------------------
driver          psee-video
model           Prophesee Video Pipeline
serial
bus info
hw revision     0x0
driver version  5.15.136

Device topology
- entity 1: ps_host_if output 0 (1 pad, 1 link)
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        pad0: Sink
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- entity 5: a0010000.mipi_csi2_rx_subsystem (2 pads, 2 links)
            type V4L2 subdev subtype Unknown flags 0
            device node name /dev/v4l-subdev0
        pad0: Sink
                [fmt:unknown/1280x720 field:none colorspace:raw xfer:none]
                <- "imx636 6-003c":0 [ENABLED]
        pad1: Source
                [fmt:unknown/1280x720 field:none colorspace:raw xfer:none]
                -> "a0040000.axis_tkeep_handler":0 [ENABLED]

- entity 8: imx636 6-003c (1 pad, 1 link)
            type V4L2 subdev subtype Sensor flags 0
            device node name /dev/v4l-subdev1
        pad0: Source
                [fmt:unknown/1280x720 field:none colorspace:raw xfer:none]
                -> "a0010000.mipi_csi2_rx_subsystem":0 [ENABLED]

- entity 10: a0040000.axis_tkeep_handler (2 pads, 2 links)
             type V4L2 subdev subtype Unknown flags 0
             device node name /dev/v4l-subdev2
        pad0: Sink
                [fmt:unknown/1280x720 field:none colorspace:raw xfer:none]
                <- "a0010000.mipi_csi2_rx_subsystem":1 [ENABLED]
        pad1: Source
                [fmt:unknown/1280x720 field:none colorspace:raw xfer:none]
                -> "a0050000.event_stream_smart_tra":0 [ENABLED]

- entity 13: a0050000.event_stream_smart_tra (2 pads, 2 links)
             type V4L2 subdev subtype Unknown flags 0
             device node name /dev/v4l-subdev3
        pad0: Sink
                [fmt:unknown/1280x720 field:none colorspace:raw xfer:none]
                <- "a0040000.axis_tkeep_handler":1 [ENABLED]
        pad1: Source
                [fmt:unknown/1280x720 field:none colorspace:raw xfer:none]
                -> "ps_host_if output 0":0 [ENABLED]

root@xlnx-docker:/ubuntu#
```

In above media graph imx636 device node is /dev/v4l-subdev1, which is required to enable and running the application.

Run Event File based YoloV7

Run Event camera based YoloV7