DEEPX
DX-M1& DX-M1M
Quick User Manual
for Ubuntu Linux

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1. Introduction

The **DX-M1 (& DX-M1M)** is a middle-entry edge NPU designed for high-performance AI acceleration. This manual provides technical guidance for integrating the **DEEPX DX-M1 (& DX-M1M) Accelerator Card** with the **x86 (DEEPX AIBOX) System** via PCIe M.2. It covers hardware architecture, installation with thermal management, and the software setup required for AI inference, including sample applications and real-time monitoring via **dxtop**.

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2. System Overview

This chapter provides a technical overview of the **DEEPX DX-M1** accelerator and its integration environment.

2.1. Hardware Architecture: DX-M1 M.2

The system utilizes high-performance heterogeneous architecture specifically engineered to support demanding edge AI workloads.

DX-M1 M.2 Accelerator Card Specifications

The DX-M1 is a high-efficiency AI inference accelerator designed for seamless integration into edge computing environments through its optimized internal architecture.



Figure 1. DX-M1 M.2 Architecture

Table. DX-M1 M.2 Technical Specifications

Features	Details
AI Performance	25 TOPS (INT8)
Host Interface	PCIe Gen3 x4 (Supports Gen 1/2/3 & x1/x2/x4)
Memory	4GB LPDDR5 (5600 MT/s)
Power Consumption	5W (Typical)
Operating Temperature	0 ~ 70°C (Commercial) -25 ~ 85°C (Extended) -40 ~ 85°C (Industrial)
Thermal Solution	Heatsink (Option)
Form Factor	M.2 2280 (M Key), 22 x 80mm
OS Support	Windows 11/10 Debian-based Linux (Ubuntu 24.04/22.04/20.04 LTS), Docker Yocto Linux

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Features	Details
	Android
AI Frameworks	Ultralytics, PyTorch, TensorFlow, ONNX, Keras
System Support	x86 and ARM-based Architectures

2.2. Hardware Installation and I/O Setup

This section outlines the physical integration of the DEEPX DX-M1 accelerator. Follow these steps to ensure the host system and hardware components are properly configured for a stable edge AI environment.

Step-by-Step Connection Guide

Step 1. Host System Initial Setup

Complete the power configuration referring to the AIBOX Manual.

- **Getting started with your AIBOX** (https://developer.deepx.ai/download/?id=530)

Step 2. Connecting the DX-M1 M.2 Module

Once the host is prepared, install the **DX-M1 M.2 NPU module** via the **M.2 slot.**



Figure 2. DEEPX DX-M1 AI Accelerator for DEEPX AIBOX

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3. Getting Started

This chapter provides a concise guide to configuring the **DEEPX DX-M1** development environment. It covers the essential steps from verifying system requirements to executing your first AI inference benchmarks.

3.1. System Prerequisites

Before proceeding with the installation of the driver, ensure the host system is properly configured by following these environment preparation steps.

Environment Preparation

Step 1. Install Ubuntu Linux 22.04 LTS

- Download and install the OS.
- **Link:** https://ubuntu.com/tutorials/install-ubuntu-desktop#1-overview

Step 2. Connect to the Internet

- Verify that the AIBOX has an active **Internet connection**.
- A stable connection is required to access external repositories and download necessary dependencies during the setup process.

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3.2. Software Setup and Demo Execution

This section provides a brief guide to installing the necessary drivers and executing AI inference benchmarks using the DX-M1 accelerator.

3.2.1. Install DEEPX M1 Driver and Runtime

Follow these steps to configure the official repository and install the driver libraries. This process involves downloading Linux kernel modules and building the driver; completion time may vary based on network performance.

Step 1. Clone the source from GitHub

Execute the following commands to clone the source code from GitHub.

```
# Step 1. Clone the DX-Runtime
$ sudo apt-get update
$ sudo apt-get install git
$ git clone --recurse-submodules https://github.com/DEEPX-AI/dx-runtime.git
```

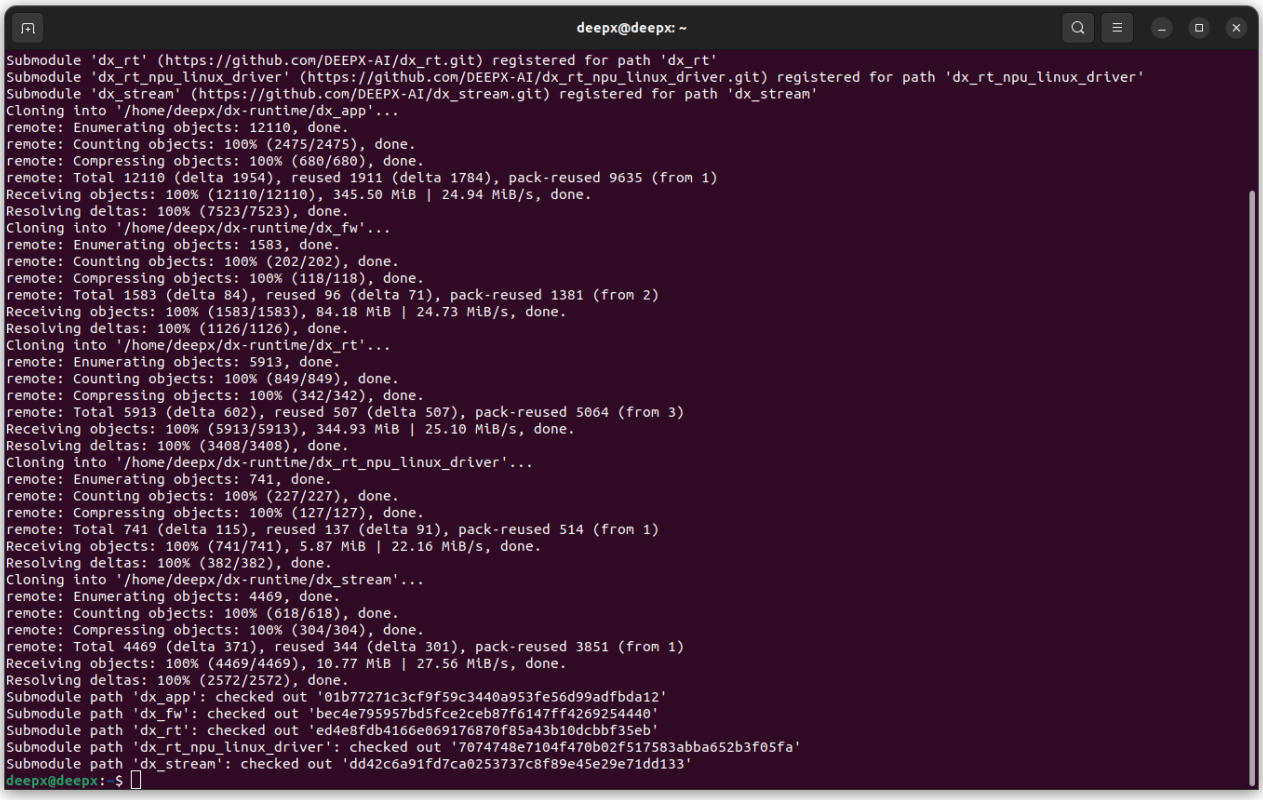

Figure 3. Clone the source

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Step 2. Installation of `dx-runtime`

Update the local package index and install the DEEPX runtime library.

```
# Step 2. Installation
$ cd dx-runtime


# Option 1: Install dx-runtime with sample applications (dx_app & dx_stream)
$ ./install.sh --all


# Option 2: Custom install (Driver, Runtime, and Firmware separately)
$ ./install.sh --target=dx_rt_npu_linux_driver && ./install.sh --target=dx_rt
&& ./install.sh --target=dx_fw
```

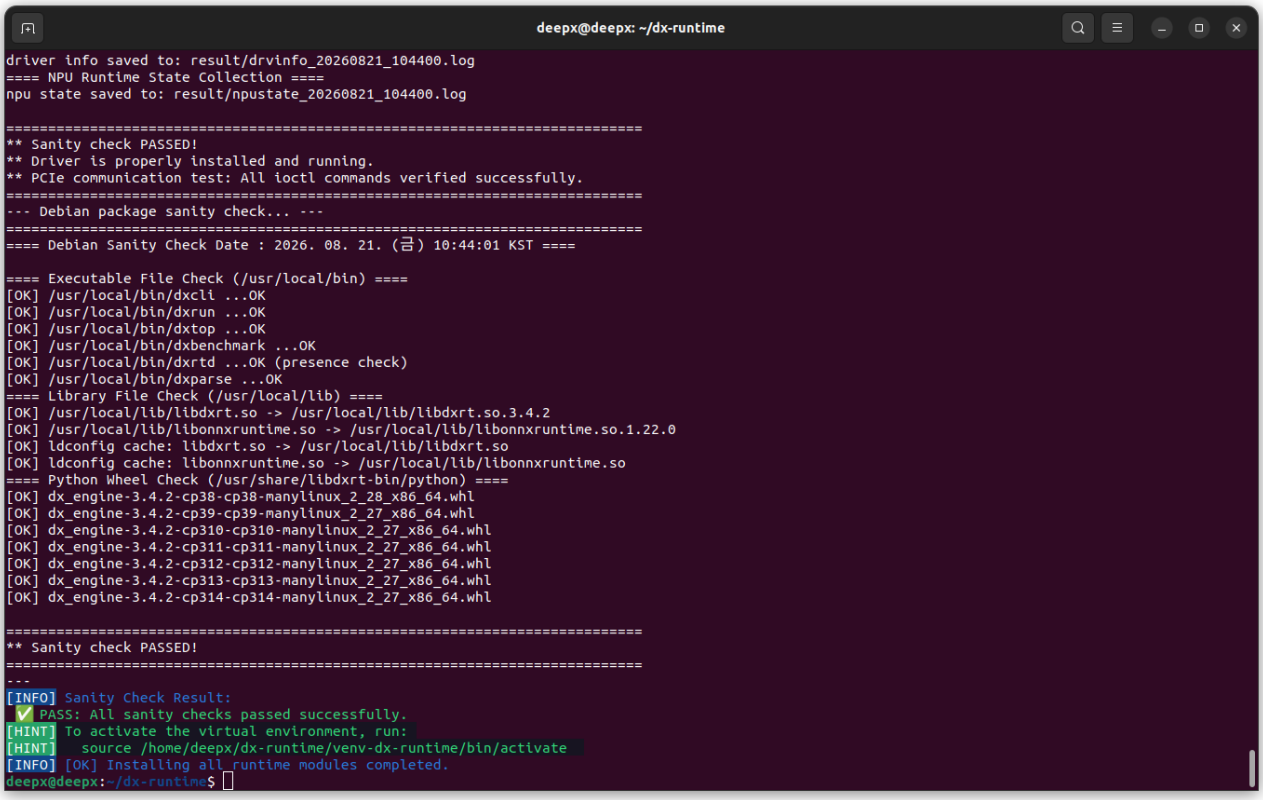

Figure 4. DEEPX Runtime Installation Progress

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Step 3. Hardware Status Verification

Confirm that the DX-M1 module is correctly interfaced and recognized by the system.

```
$ dxrt-cli -s
```

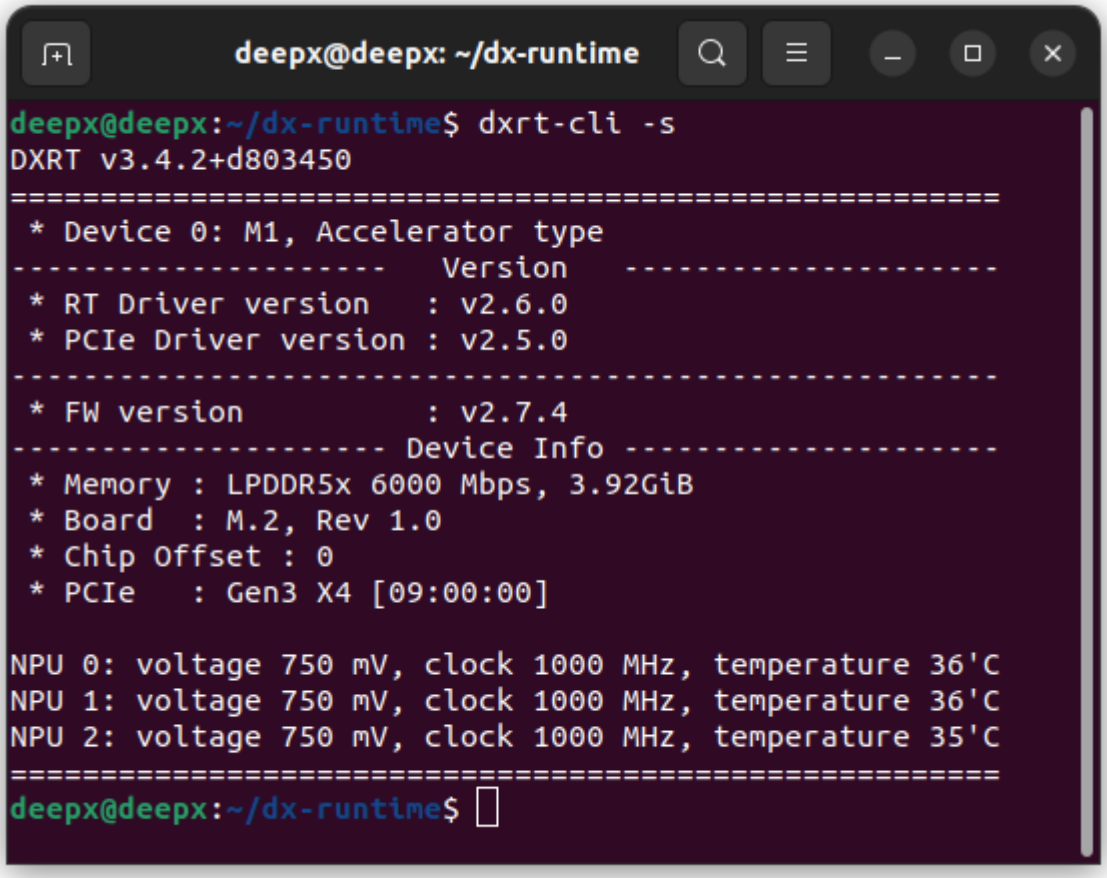

Figure 5. Hardware Verification using `dxrt-cli -s` Command

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3.2.2. [Optional] Firmware Update

To ensure full compatibility between the **DEEPX Runtime** library and the hardware, the device firmware **must** meet the minimum version requirements.

Prerequisites for Update

Perform a firmware update if any of the following conditions occur.

- **Version Mismatch:** The current firmware version is lower than the minimum requirement.
- **Execution Error:** A `[dxrt-exception] Invalid operation` error occurs during model execution.

Firmware Download

The latest firmware binaries and guides are available at the official DEEPX GitHub repository.

- **URL:** https://github.com/DEEPX-AI/dx_fw

Quick Update Procedure

After downloading the firmware, execute the following commands.

```
# 1. Stop service
$ systemctl stop dxrt.service


# 2. Update firmware
$ dxrt-cli -u <path_to_fw_bin>


# 3. Restart service
$ systemctl start dxrt.service
```

CAUTION: Do not power off the device during the update to prevent permanent hardware damage.

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3.2.3. Execution of Sample Applications

1. AI Inference Demo (dx_app)

The dx_app demonstrates real-time AI inference capabilities. The execution script automatically handles the acquisition of sample video assets and pre-compiled models.

```
# Change the directory to dx_app under dx-runtime
$ cd dx_app
$ ./install.sh --all
$ ./run_demo.sh
```

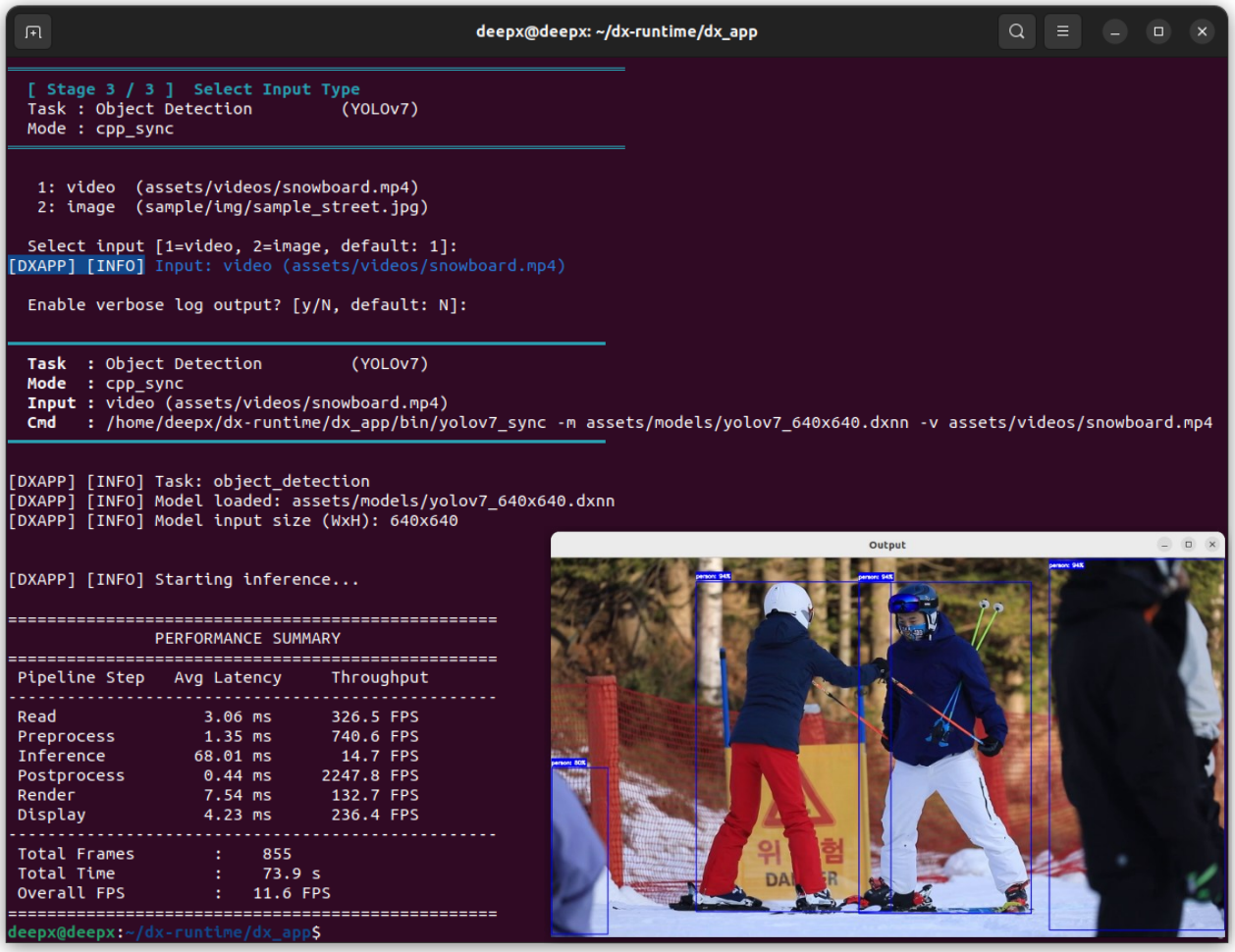

Figure 6. dx_app Demo Output: Terminal Performance Summary (top) and Real-time Object Detection Result (bottom).

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2. GStreamer Plugin Demo (dx_stream)

The `dx_stream` sample is optimized for high-performance video streaming pipelines utilizing the GStreamer framework.

```
# Change the directory to dx_stream under dx-runtime
$ cd dx_stream
$ ./install.sh
$ ./run_demo.sh
```

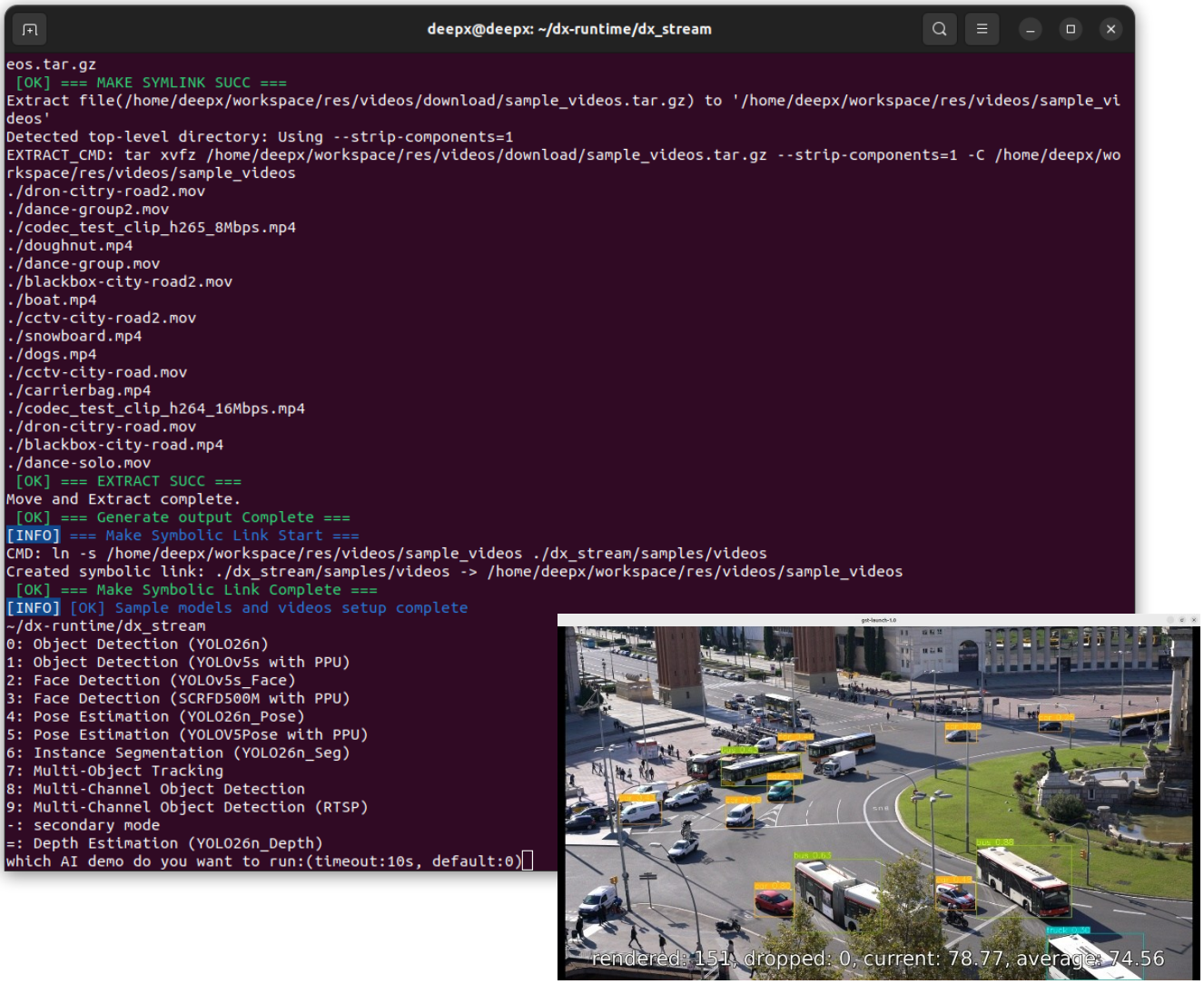

Figure 7. `dx_stream` GStreamer Pipeline: Plugin menu selection (top) and multi-object detection result (bottom).

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3.2.4. System Monitoring

NPU Utilization (dxtop)

The `dxtop` utility provides a real-time CLI (Command Line Interface) to monitor NPU utilization, temperature, and operational status.

```
$ dxtop
```

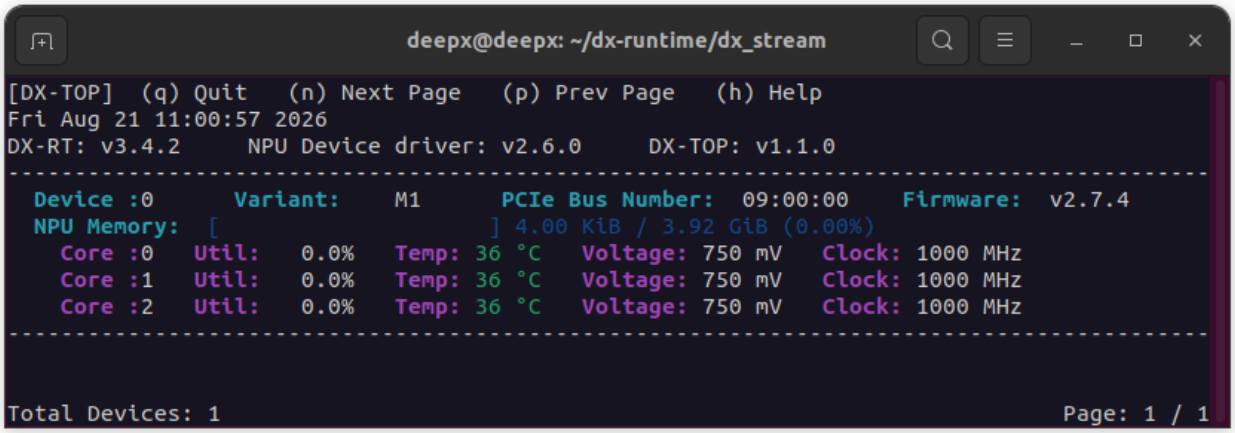

Figure 8. Real-time NPU Resource Monitoring via `dxtop`

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