Embedded Systems – II

Project Report

Object Detection using OpenCV on Jetson Nano

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1. Description of the Task Being Performed:

This project focuses on implementing an object detection system using the Jetson Nano and OpenCV. The main objective was to detect and identify objects in real-time using computer vision techniques. This involved:

1. Setting up the Jetson Nano development board in headless mode.
2. Establishing a Wi-Fi connection to enable communication and data transfer.
3. Installing the necessary libraries and dependencies required for running OpenCV-based object detection algorithms.
4. Developing and executing a Python-based code to process video input and detect objects.

The successful implementation of this project demonstrates the ability of the Jetson Nano to handle real-time object detection tasks effectively.

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2. Instructions to Install the Dependencies:

To set up the Jetson Nano in headless mode and install the required dependencies, follow these steps:

Step 1: Initial Setup of the Jetson Nano in Headless Mode

1. Insert a microSD card with the pre-flashed Jetson Nano Developer Kit image.
2. Connect the Jetson Nano to a power supply and a local network via an Ethernet cable or Wi-Fi dongle.
3. Locate the Jetson Nano's IP address using your router's admin interface.
4. Use an SSH client (e.g., ssh in a terminal or PuTTY) to connect to the Jetson Nano:

   ssh username@<IP_ADDRESS>

Replace <IP_ADDRESS> with the Jetson Nano's IP address and username with the default user name (e.g., nvidia).

5. Complete the initial setup process via the terminal prompts.

Step 2: Connect to Wi-fi

1. Use the nmcli command to scan and connect to a Wi-Fi network:

   nmcli dev wifi connect "<SSID>" password "<PASSWORD>"

Replace <SSID> with your Wi-Fi network name and <PASSWORD> with the network password.

Step 3: Update the System

Run the following commands to update the system:

sudo apt-get update

sudo apt-get upgrade

Step 4: Install OpenCV and Other Dependencies

1. Install Python and pip if not already installed:

   sudo apt-get install python3-pip

2. Install OpenCV:

   pip3 install opencv-python

   pip3 install opencv-python-headless

3. Install additional required libraries:

   pip3 install numpy

   pip3 install cv2

Step 5: Verify Installation

Run the following Python script to verify the OpenCV installation:

```
import cv2
print(cv2.__version__)
```

Ensure the output displays the OpenCV version.

3.How to Run the Code and Record Results:

Step 1: Clone or Transfer the Project Code

1. Transfer the project code files to the Jetson Nano using SCP or a similar method over Wi-Fi:

   scp -r /path/to/project username@<IP_ADDRESS>:/home/username/

2. SSH into the Jetson Nano and navigate to the project directory:

   cd /home/username/project

Step 2: Run the Object Detection Script

1. Ensure a compatible external camera is connected to the Jetson Nano. We have used Gstreamer to connect camera with jetson nano.
2. Run the object detection script using the following command:

   python3 object_detection.py

Step 3: Observe the Results

1. The script will process the video input from the external camera and detect objects, displaying output directly in the terminal or saving frames with detections if coded.

Step 4: Record Results

1. Use the following methods to document the results:
    - **Saved Frames:** Modify the code to save detected objects and confidence scores to image files.
    - **Log Files:** Save detected objects and confidence scores to a log file.
2. To save frames with detected objects, update the code to use the following snippet:

    ```
    cv2.imwrite(f"output/frame_{frame_count}.jpg", frame)
    ```