Version Control and Management System

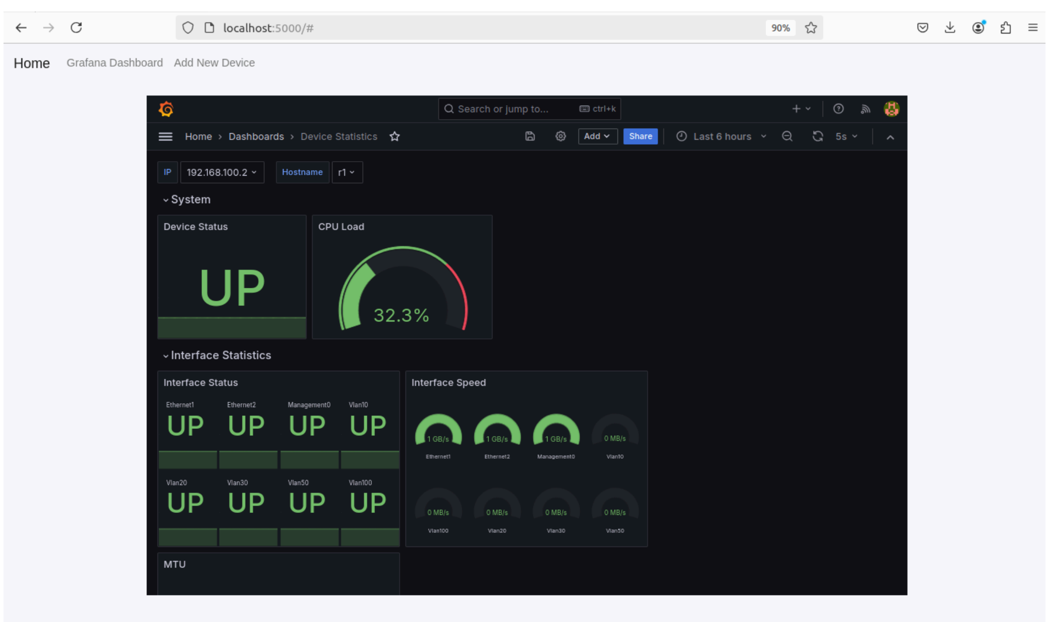
I am utilizing my personal GitHub repository to manage and store all configuration files and automation scripts. You can access the repository here: GitHub Repository.

Automation Framework

Grafana Setup

I used **Grafana** to visualize network metrics collected from various network devices. By integrating Grafana with the backend, I can monitor key metrics like **interface statuses**, **CPU utilization**, **packets transmitted**, and more, all in real-time.

- The **Grafana** dashboard is embedded in the web interface. I've customized the navigation bar to include a "Grafana Dashboard" tab, which, when clicked, loads the Grafana dashboard in an iframe.
- The dashboard pulls data from **Prometheus** and **InfluxDB**, which collects metrics from devices using **SNMP** and **gNMI** protocols.



Screenshot 1: Grafana embedded in the website

Metrics Tracked

- **MTU** values for all interfaces
- **Interface status** (*Up/Down*)
- **Packets in/out** per interface
- **Packet discards** per interface
- **CPU utilization** across devices
- **System uptime**

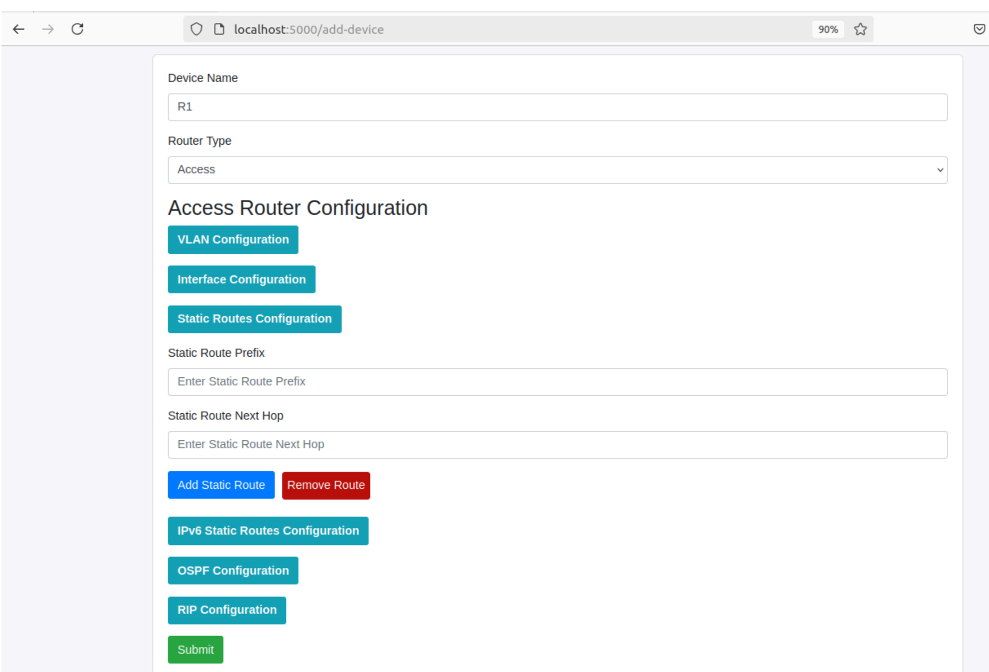
Backend and Frontend Integration

The **backend** is built using Flask, while the **frontend** uses HTML, CSS, and JavaScript. The goal was to provide a user-friendly interface to manage network devices, add new configurations, and visualize the system.

Frontend Overview

The **Add New Device** form allows users to add network devices of different types: **Access**, **Core**, and **Edge** routers.

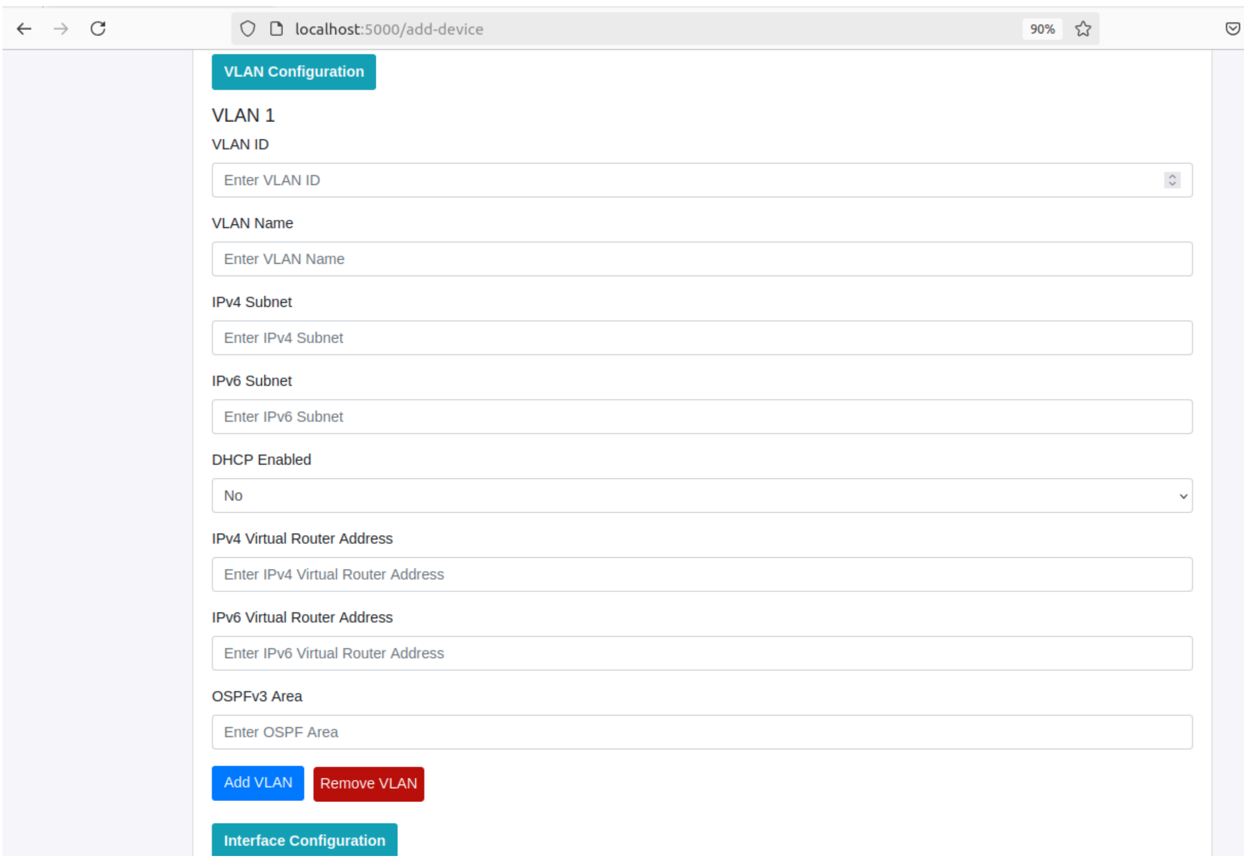
Each router type has a dedicated form, with **dynamic form sections** (*e.g., VLANs, interfaces, static routes*) that appear or hide based on user input.



Screenshot 2: Collapsible sections of the form

Dynamic Form Interaction

JavaScript is used to toggle between the forms for different router types. Based on the selected router type, different configurations (*VLANs, interfaces, routing protocols*) are made available.



Screenshot 3: Dynamic Forms

Backend Overview

Upon submission, the form data is sent to the backend, which is handled by a **Flask** route (*/add-device*). Here, the form data is processed and stored as **YAML** configuration files.

The files are saved in a specific directory (*/home/student/git/csci5840/lab4/*), with a naming convention *{device_name}_{type of router}.yaml*.

For example:

- If the user adds a Core router named R3, the generated file will be: R3_core.yaml.

- If the user adds an Access router named R1, the generated file will be: R1_access.yaml.
- The files follow the YAML format and can easily be used for configuration generation.

```
student@csci5840-vm1-snir8112:~/git/csci5840/lab4$ ls | grep yaml
r1_access.yaml
r3_core.yaml
student@csci5840-vm1-snir8112:~/git/csci5840/lab4$ pwd
/home/student/git/csci5840/lab4
student@csci5840-vm1-snir8112:~/git/csci5840/lab4$
```

Screenshot 4: Submitted form stored as a YAML file

Configuration Generation using Python

To streamline the generation of router configurations, I developed a Python script that uses **Jinja2** templates and **YAML** files to automate the process. This eliminates the need for manual configuration writing, improving efficiency and reducing errors.

YAML and Jinja2 Integration

The script reads **YAML files** provided, which define the configurations for devices such as **r3_core.yaml**. The appropriate **Jinja2 template** (*e.g., access.j2, core.j2, edge2.j2*) is selected based on the router type.

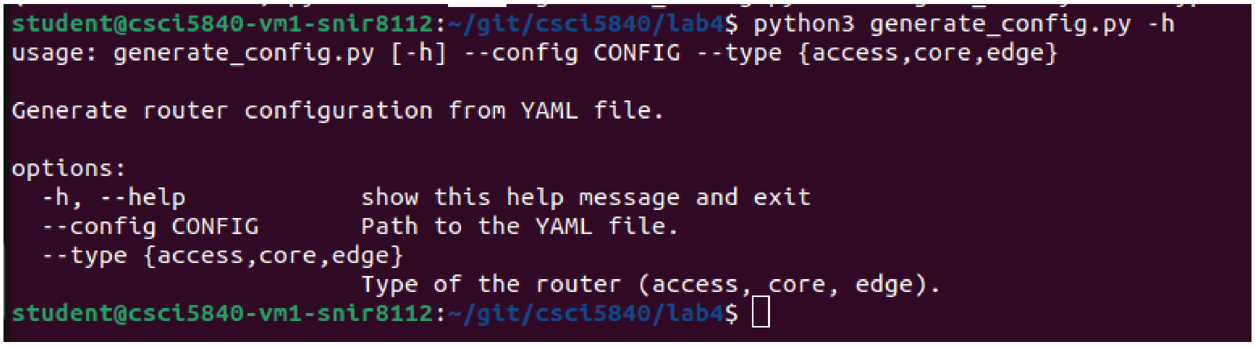
Command-Line Argument Parsing

The script accepts two command-line arguments:

1. **--config**: The YAML configuration file (*e.g., r1_access.yaml*).
2. **--type**: The type of router (Access, Core, Edge).

```
python generate_config.py --config r1_access.yaml --type access
```

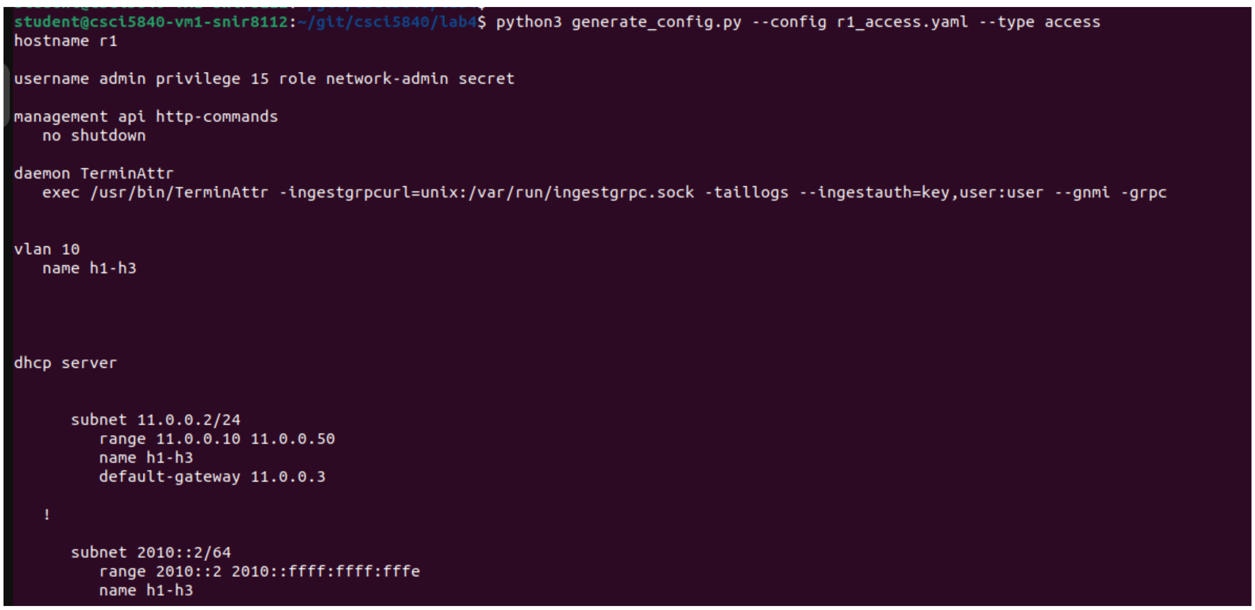
Based on the **type** argument, the script selects the correct Jinja2 template and renders the configuration.



Screenshot 5: Terminal Command Execution

Output

The output is a **fully rendered configuration** file based on the YAML data and the selected template.



Screenshot 6: Generated Router Configuration Output

Saving configs

To ensure regular and automated backups of network configurations, I implemented a systemd service (backup-configs.service) that runs a Python script to collect and store the running configurations of routers. The service automatically connects to each router, retrieves the configuration, and saves it in */home/student/git/csci5840/cfgs* directory.

Service Setup

The systemd service is defined to run continuously

```
student@csci5840-vm1-snir8112:~/git/csci5840/lab4$ systemctl status
backup-configs.service

backup-configs.service - Backup Network Configs Service
     Loaded: loaded (/etc/systemd/system/backup-configs.service; enabled;
vendor preset: enabled)
     Active: active (running) since Mon 2024-09-30 19:55:19 MDT; 59min ago
   Main PID: 12084 (python3)
      Tasks: 161 (limit: 4915)
     Memory: 39.5M
        CPU: 3min 19.600s
     CGroup: /system.slice/backup-configs.service
             └─12084 /usr/bin/python3
/home/student/git/csci5840/scripts/backup_configs.py
```

Screenshot 7: Service status

```
student@csci5840-vm1-snir8112:~/git/csci5840/cfgs$ ls
r1.cfg  r2.cfg  r3.cfg  r4.cfg  r5.cfg  s1.cfg  s2.cfg  s3.cfg  s4.cfg
```

Screenshot 8: Config files for each router