# Documentation for Flask-Based YouTube Video Processing Application

## Overview

This application provides a web interface to download YouTube videos, extract frames at regular intervals, compare images to detect unique frames, and generate a PDF of selected frames. It is built using Flask and utilizes various libraries for video processing, image analysis, and PDF generation.

## Technologies and Libraries Used

- Flask: A lightweight web framework for handling HTTP requests and rendering templates.

- yt-dlp: A powerful YouTube video downloader.

- moviepy: A Python library for video processing, used for extracting frames.

- OpenCV (cv2): Used for image processing and similarity comparison.

- scikit-image (skimage.metrics): Provides the structural similarity index (SSIM) for image comparison.

- NumPy: Used for numerical operations on images.

- ReportLab: Used to generate PDF files.

- os, re, time, logging: Built-in Python libraries for file handling, logging, and time manipulation.

## Application Workflow

1. The user inputs a YouTube video URL.

2. The application downloads the video using yt-dlp.

3. Frames are extracted at one-second intervals using moviepy.

4. Images are compared using SSIM to detect uniqueness.

5. A PDF is generated containing the unique frames.

6. The user can download the generated PDF.

## Detailed Functionality

### Sanitizing Filenames

Removes invalid characters from filenames to prevent OS errors.

### Downloading the Video

Uses yt-dlp to download the YouTube video as an MP4 file.

### Extracting Frames

Uses moviepy to extract frames at every interval seconds.

### Checking if an Image is Black and White

Converts the image to grayscale and checks its standard deviation.

### Comparing Images Using SSIM

Uses SSIM to compare two images and detect similarity.

### Creating a PDF of Unique Frames

Filters unique frames using SSIM and generates a PDF with ReportLab.

### Handling Web Requests (Flask Routes)

Processes user input, downloads videos, extracts frames, and serves PDFs.