Project Report: Video Highlight Generator

1. Introduction

The **Video Highlight Generator** is an AI-powered application designed to streamline the video editing process by automatically creating highlight reels. It combines advanced scene detection, audio analysis, and action recognition techniques to identify the most engaging moments in videos. This project is built with user-friendly tools and is designed to save time for content creators, businesses, and consumers.

2. Objectives

- **Automate Video Editing**: Eliminate the manual effort of identifying key moments in videos.
- **Increase Engagement**: Deliver concise, engaging highlight reels for social media and other platforms.
- **Ease of Use**: Provide an intuitive interface for users with no technical expertise.

3. Features

3.1 Core Features

- **Scene Detection**: Identifies sharp visual changes to segment videos into scenes.
- **Audio Analysis**: Detects exciting audio moments based on volume spikes and tonal variations.
- **Action Recognition**: Identifies motion and visually interesting activities.
- **Highlight Creation**: Merges, ranks, and compiles the best segments into a highlight reel.
- **User Customization**: Enables control over sensitivity, duration, and transitions.

3.2 Advanced Features

- **Multi-modal Detection**: Combines scene, audio, and action analysis for comprehensive highlight generation.
- **Parallel Processing**: Speeds up analysis with multi-threaded execution.
- **Resolution Scaling**: Offers output in various resolutions (Original, 1080p, 720p, 480p).

4. Workflow

1. **Video Intake**:

   - Users upload videos via a web interface.
   - Metadata (duration, resolution, FPS) is extracted and displayed.

2. **Analysis Phase**:

   - **Scene Detection**: Analyzes frame differences to identify scene transitions.
   - **Audio Analysis**: Processes audio for exciting moments using librosa.
   - **Action Recognition**: Detects motion and brightness variations using OpenCV.

3. **Highlight Selection**:

   - Segments are ranked based on "interestingness."
   - Overlapping segments are merged, and the final set is selected.

4. **Output Generation**:

   - Selected segments are extracted, transitions are applied, and clips are compiled into a highlight video.

5. Technologies Used

5.1 Libraries and Tools

- **Streamlit**: For the user-friendly web interface.
- **OpenCV**: For scene detection and image processing.
- **librosa**: For advanced audio analysis.
- **FFmpeg**: For video and audio editing.
- **NumPy & SciPy**: For numerical and signal processing.

5.2 Programming Language

- **Python**: Primary language due to its rich ecosystem of video and audio processing libraries.

6. Challenges & Solutions

6.1 Challenges

1. **Slow Processing**: Initial implementation processed videos sequentially.
   - **Solution**: Implemented parallel processing and resolution scaling to speed up analysis.
2. **Missed Highlights**: Difficulty in detecting subtle audio or action cues.
   - **Solution**: Improved sensitivity and added fallback mechanisms to force detection.
3. **User Experience**: Complex configurations led to confusion.
   - **Solution**: Simplified settings with tooltips and default recommendations.

7. Real-World Applications

7.1 Content Creation

- Social media creators can generate reels, TikToks, or YouTube Shorts.
- Livestream highlights can be automatically extracted.

7.2 Business Use Cases

- Marketing teams can create product demo highlights.
- Sports analysts can compile key plays from game footage.

7.3 Consumer Applications

- Personal highlight reels from vacation or family videos.
- Security footage review by extracting action-packed moments.

8. Future Improvements

1. **Advanced ML Models**:
   - Integrate pre-trained action recognition models for higher accuracy.
2. **Cloud Integration**:
   - Enable processing of larger videos through cloud-based solutions.
3. **Batch Processing**:
   - Allow users to upload and process multiple videos simultaneously.
4. **Custom Intro/Outro**:
   - Provide options to add personalized branding to highlight videos.

9. Conclusion

The **Video Highlight Generator** is a powerful tool that simplifies video editing and empowers users to create professional-quality highlights effortlessly. With further enhancements, it has the potential to become a widely adopted solution for content creators, businesses, and consumers alike.