# Project Guidance: Video Analysis

This project focuses on video analysis using basic image process techniques. Students will explore concepts such as optical flow, feature detection, frame stabilization, etc. to analyze video inputs. The project aims to process videos to extract meaningful insights, such as predicting motion, detecting objects, stabilizing frames, and creating dynamic visual effects. The scope includes practical applications like navigation, video enhancement, and entertainment.

## Project Scope

**Navigation and Tracking**

1. **Human Motion Detection**: Track and visualize a person's movement in first-person videos (e.g., walking, running, or biking).
2. **Object Trajectory Prediction**: Use CCTV or sports videos to predict and draw object paths (e.g., basketball trajectory).
3. **Obstacle Detection**: Detect obstacles like doors, walls, or potholes for navigation using YOLO or DPT models.

**Video Enhancement**

1. **Video Stabilization**: Smooth shaky videos from action cameras or smartphones using affine transformation or optical flow.
2. **Video Denoising**: Remove noise from old or low-quality videos to enhance clarity.
3. **Video Smoothing**: Add cinematic effects by creating smooth transitions in fast-paced scenes.

**Creative Effects**

1. **Video Saliency Detection**: Highlight differences between frames to detect moving objects, making an engaging visualization of action scenes.
2. **Video FX**: Add fun motion-based effects, like glowing trails for fast-moving objects (e.g., light trails for cars).
3. **Motion Blur Simulation**: Use optical flow to generate realistic motion blur for animations or games.

**Gaming and Entertainment**

1. **Vanishing Point Prediction**: Find vanishing points in video frames to create a cool perspective effect or assist in virtual game mapping.
2. **Dynamic Scene Analysis**: Detect and label objects in gaming scenes (e.g., cars, tanks, or planes) with their predicted motion paths.
3. **Speed Estimation**: Analyze racing or sports videos to estimate the speed of moving objects.

**AI-Powered Tools**

1. **Depth Prediction**: Use DPT to calculate depth maps from videos for 3D reconstruction or VR applications.
2. **Camera Movement Prediction**: Predict camera shake or movement to improve recording quality.
3. **SLAM (Simultaneous Localization and Mapping)**: Simplify and implement basic SLAM concepts for mapping indoor spaces.

**Practical Applications**

1. **Action Object Detection**: Find objects like dropped phones, trash, or lost items in action or surveillance videos.
2. **Driving Assistance**: Predict object speeds in driving scenes for cars or pedestrians to enhance safety.
3. **Motion-Based Alerts**: Detect moving objects in CCTV feeds to alert for unusual activities.
4. **Manhole and Door Detection**: Create navigation tools that highlight hazards or pathways for visually impaired individuals.
5. **Crowd Movement Analysis**: Analyze the motion of people in a crowd for event or safety planning.

**3D and Advanced Visualization**

1. **3D Reconstruction**: Create a 3D model of a scene using depth and motion cues from videos.
2. **Highlight Key Areas**: Use motion analysis to highlight regions of interest, like fast-moving objects in sports.
3. **Time-Lapse Motion Mapping**: Combine multiple frames into a time-lapse map showing how objects move over time.

**Others**

1. **Pet Tracking**: Track the movement of pets in videos and create a heatmap of their activity.
2. **Dance Motion Analysis**: Visualize dance moves in terms of trajectories and saliency.
3. **Sports Replay Effects**: Create replay-like effects by focusing on the motion of a single player or object.
4. **Shadow Matching**: Detect objects and their shadows, creating shadow-art-like effects.

## Project Plan

**Week 1: Code development and Data collection:**- Process videos to extract frames and generate outputs such as RGB and grayscale images, optical flow maps, and feature detection maps (e.g., SIFT).  
- Familiarize yourself with video and image processing techniques.  
  
**Collect Dataset:**- Gather videos related to motion scenarios like walking, running, biking, or driving.  
- Record video links for online sources and ensure the dataset fits the project requirements.  
  
**Week 2: Develop and Test Your Idea:**- Apply your chosen method to the dataset (e.g., video stabilization, object trajectory prediction).  
- Use tools like YOLO, DPT, or optical flow to generate meaningful outputs.  
- Test the application with real-world scenarios to ensure usability and effectiveness.

## Expected Applications

**Goal:** Process the videos using your code and apply a specific idea of your choice. Here are a few examples of what you could do:

* Use YOLO + DPT to predict objects like manholes or doors, aiding pedestrians or drivers.
* Detect object speed in driving videos using object detection models.
* Track human motion, predict object trajectories, or detect obstacles for safer navigation.
* Stabilize shaky action videos for smoother playback or add cinematic effects.
* Remove noise from low-quality footage or create smooth transitions in fast-paced scenes.
* Highlight moving objects using saliency detection to make actions more prominent.
* Add glowing trails to fast-moving objects for dynamic visual effects.
* Simulate realistic motion blur for animations or enhance action-packed scenes.
* Apply video saliency detection to highlight differences between frames dynamically.
* Predict depth maps for 3D reconstruction or detect camera movements for stabilization.
* Apply SLAM for mapping environments and improving spatial awareness.
* Apply object detection to CCTV footage and visualize object trajectories for surveillance.
* Identify specific objects in action videos, like dropped phones or trash, using object tracking.
* Analyze crowd movement in event planning or estimate object speeds in sports.