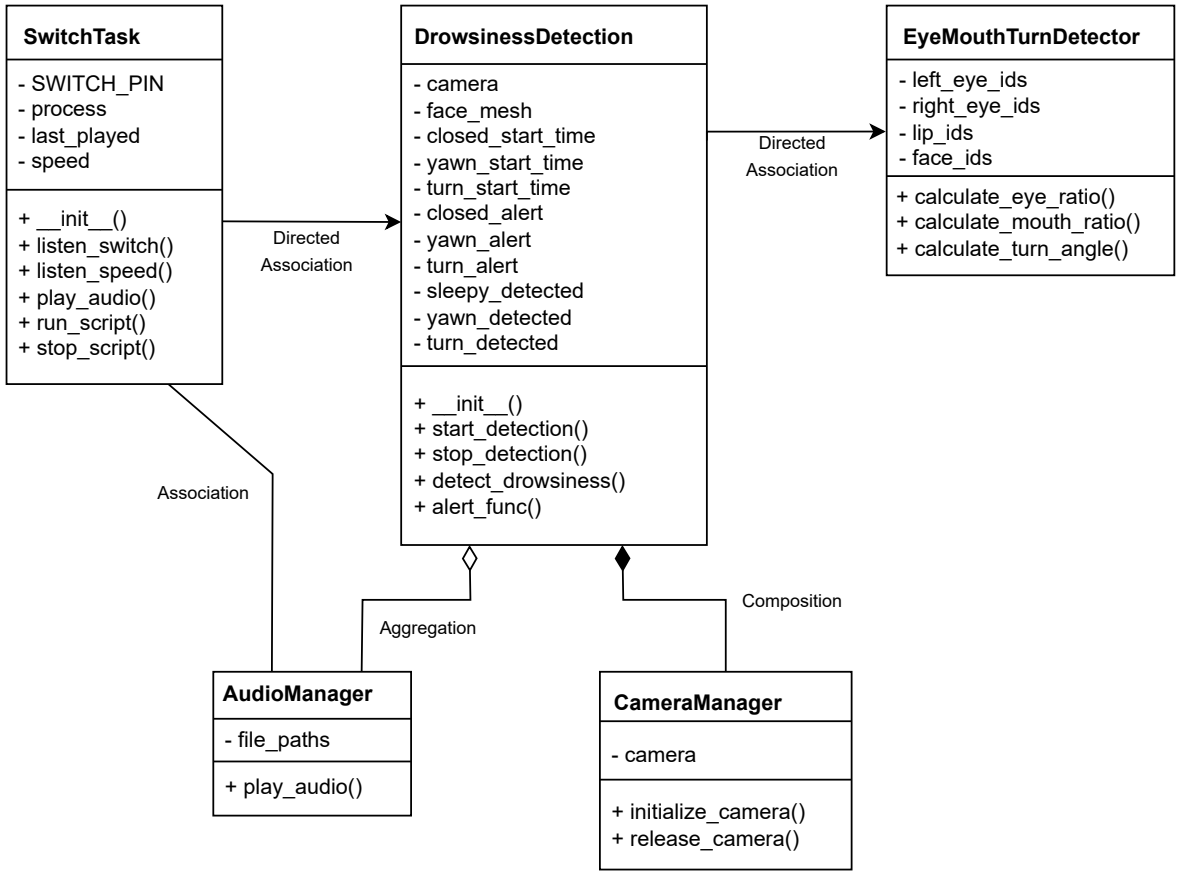
IFS Class Diagram



Class diagram connections:

- **SwitchTask to AudioManager**:
    - Connection: **Association**.
    - Purpose: SwitchTask uses AudioManager to play audio files.
- **SwitchTask to DrowsinessDetection**:
    - Connection: **Directed Association**.
    - Purpose: SwitchTask starts/stops the DrowsinessDetection process based on the car speed and switch state.
- **DrowsinessDetection to AudioManager**:
    - Connection: **Aggregation**.
    - Purpose: DrowsinessDetection uses AudioManager to play alerts and DrowsinessDetection does not function properly without the ability to generate alerts.
- **DrowsinessDetection to CameraManager**:
    - Connection: **Composition**.
    - Purpose: DrowsinessDetection fully owns and manages the CameraManager lifecycle.
- **DrowsinessDetection to EyeMouthTurnDetector**:
    - Connection: **Directed Association**.
    - Purpose: DrowsinessDetection uses EyeMouthTurnDetector to analyze facial feature ratios.

Class diagram explanation:

SwitchTask:

- **Purpose**: Monitor the switch state and the car speed, controls whether the drowsiness detection script is running and plays audio reminders if auto detection is off.
- **Attributes**:
  - SWITCH_PIN: GPIO pin connected to the switch (GPIO17, pin number is 11).
  - process: Tracks the subprocess running the detection script.
  - last_played: Timestamp for the last reminder.
  - speed: Variable to store the car speed.
- **Methods**:
  - listen_switch(): Continuously checks the switch state.
  - listen_speed(): Continuously checks the car speed.
  - play_audio(): Plays audio reminders.
  - run_script(): Runs the drowsiness detection script when needed.
  - stop_script(): Stops the drowsiness detection script when needed.

DrowsinessDetection:

- **Purpose**: Implements the logic for detecting drowsiness using the camera input, analyzing eye, mouth and turn ratios, and playing alerts.
- **Attributes**:
  - camera: Camera device used for capturing video frames.
  - face_mesh: MediaPipe FaceMesh model for detecting facial landmarks.
  - closed_start_time & yawn_start_time & turn_start_time: Track the timing for eye closure, yawning and turn events.
  - closed_alert & yawn_alert & turn_alert: Flags for detected alerts.
  - sleepy_detected & yawn_detected & turn_detected: Flags for detected states.
- **Methods**:
  - start_detection(): Starts the detection process.
  - stop_detection(): Stops the detection process.
  - detect_drowsiness(): Detect eye closure, yawning and looking away based on ratios and angle.
  - alert_func(): Trigger alerts for detected states.

EyeMouthTurnDetector:

- **Purpose**: Provides the calculations of ratios for eyes and mouth and turn angle using facial landmark data.
- **Attributes**:
  - `left_eye_ids` & right_eye_ids: Landmark IDs for detecting eyes.
  - lip_ids: Landmark IDs for detecting mouth.
  - face_ids: Four landmark IDs for detecting turns.
- **Methods**:
  - calculate_eye_ratio(): Computes the eye aspect ratio to detect closures.
  - calculate_mouth_ratio(): Computes the mouth aspect ratio to detect yawning.
  - calculate_turn_angle(): Computes the face turn angle to detect looking away.

AudioManager:

- **Purpose**: Handles playing audio files for notifications, reminders, and alerts.
- **Attributes**:
  - file_paths: Stores paths to audio files.
- **Methods**:
  - play_audio(): Plays a specified audio file.

CameraManager:

- **Purpose**: Manages camera initialization and cleanup operations for video capturing.
- **Attributes**:
  - camera: Represents the connected video capture device.
- **Methods**:
  - initialize_camera(): Sets up the camera.
  - release_camera(): Releases the camera when not in use.