**Objectives**

1. Restructure the threading output for Threshold CLAHE and refine the code for efficiency.
2. Simplify code by removing unused functions, restructuring adjustments, and updating the control panel connections.
3. Enhance the Split & Merge function for various energy types and improve user-controlled Stretch and Zoom functionalities.
4. Implement new Zoom functionality independent of OpenCV to provide smoother scaling and better user experience.
5. Address the logic issue for Threshold CLAHE and improve usability by displaying clear indicators for line detection.
6. Explore the Hough Circle Transform theory for potential tire detection and shape validation in vehicle images.

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**Activities**

1. **Code Refinement and Restructuring:**
    - Restructured threading output for Threshold CLAHE in both CPU and GPU modes.
    - Cleaned up CLAHE.h and CLAHE.cpp files by removing unused functions.
    - Moved overall and regional adjustments to separate files for better code organization.
    - Updated .pro file to resolve all log warnings and improved control panel connections for adjustments.h and adjustments.cpp.
2. **Enhancements to Split & Merge Function:**
    - Added options for choosing high-energy, low-energy, or combined parts during the split.
    - Enhanced merging by adding methods for minimum or weighted average, improving clarity on certain raw files.
3. **Stretch Function Update:**
    - Enabled user selection for horizontal or vertical stretch direction, independent of rotation state.
4. **Zoom Function Implementation:**
    - Built a custom Zoom function without relying on OpenCV, featuring:

        - setZoomLevel() for precise zoom setting.
        - zoomIn() and zoomOut() methods with a 1.2x factor adjustment.
        - resetZoom() to revert to the original size.
    - Incorporated smooth transformation with bilinear interpolation using Qt, maintaining aspect ratio.
    - Updated control panel to show relevant zoom options only when zoom mode is active.
    - Added a warning dialog for users attempting to apply other functions in zoom mode, preserving the original image data.
5. **Threshold CLAHE and Line Detection Update:**
    - Added a hasCLAHEBeenApplied flag to the constructor to allow accurate processing of Threshold CLAHE in CPU and GPU modes.
    - Enhanced updateImageDisplay() to display “isolated” or “in object” labels to improve line detection clarity for users, with red lines indicating isolated areas and blue lines indicating vehicle regions.
6. **Hough Circle Transform Exploration:**
    - Investigated the OpenCV Hough Circle Transform to assess its use in detecting round shapes, aiming to validate tire roundness in vehicle images.

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**Achievements**

1. Successfully restructured threading output for Threshold CLAHE and transferred adjustment functions to dedicated files for clearer code management.
2. Expanded the Split & Merge function to handle various energy types and introduced stretch direction choice for users.
3. Developed a high-quality custom Zoom function with aspect-ratio preservation and user-friendly controls.
4. Resolved the Threshold CLAHE processing flag issue, improving detection functionality and providing clear visual cues for line detection.
5. Laid groundwork for tire shape validation through exploration of Hough Circle Transform theory.

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**Problems and Solutions**

**Problem 1:** Redundant functions cluttered the CLAHE code and made bug tracking challenging.
**Solution 1:** Removed unused functions from CLAHE.h and CLAHE.cpp, improving code cleanliness and facilitating easier debugging.

**Problem 2:** Threshold CLAHE logic failed to proceed correctly, causing detection issues.
**Solution 2:** Introduced a hasCLAHEBeenApplied flag in the constructor, ensuring the logic flow operates as intended.

**Problem 3:** User confusion regarding red and blue line highlights for isolated or in-object regions.
**Solution 3:** Enhanced updateImageDisplay() to label each line's region as "isolated" or "in object," making the display more intuitive for users.

**Problem 4:** Conflict between Zoom mode and other processing functions could alter original pixel data.

**Solution 4:** Created a warning dialog to notify users when attempting incompatible functions in Zoom mode, preserving the original image and avoiding unintended changes.

**Problem 5:** Compatibility issues in detecting tire shape without reliable roundness validation.
**Solution 5:** Explored the Hough Circle Transform to understand its potential in round shape validation, forming a basis for future tire detection functionality.