FUSION OF INFRARED AND VISIBLE IMAGES USING TARGET-ORIENTED IMAGE ENHANCEMENT STRATEGIES

ABSTRACT

Infrared and visible image fusion aims to generate a composite image that integrates thermal radiation information from infrared images with detailed texture information from visible images. However, existing methods often struggle with poor detail visibility and low target contrast, especially in low-light conditions. This paper proposes a novel fusion framework that integrates image enhancement and target extraction to address these challenges. The method involves three key stages: (1) an enhancement stage using an improved guided filter with deep features for decomposition, followed by adaptive brightness correction and detail adjustment; (2) a target extraction stage employing morphological operations and background subtraction to accurately isolate infrared targets; and (3) a fusion stage where the extracted target is injected into the enhanced visible image using a compression ratio to prevent overexposure. Experimental results on TNO and LLVIP datasets demonstrate that the proposed method outperforms state-of-the-art techniques in both subjective visual quality and objective evaluation metrics, such as average gradient, information entropy, and spatial frequency.

EXISTING SYSTEM

The existing infrared and visible image fusion system typically follows a pipeline involving decomposition, feature extraction, and fusion. Common approaches include:

1. **Multi-scale decomposition** using filters like guided filters or wavelet transforms to separate base and detail layers.
2. **Feature-based fusion** where saliency maps or sparse coefficients are combined using rules like weighted averaging or max selection.
3. **Deep learning models** that extract and merge features using pre-trained networks or GANs.

Disadvantages of the Existing System:

1. **Inadequate Detail Preservation**: Under low-light conditions, visible images lack contrast, leading to blurred details in the fused output.
2. **Poor Target Contrast**: Infrared targets are often not prominently highlighted, reducing the utility of fused images for applications like surveillance.

3. **Overexposure and Artifacts**: Direct fusion of infrared and visible images can result in overexposed regions or artifacts, degrading visual quality.

PROPOSED SYSTEM

The proposed system introduces a three-stage framework for infrared and visible image fusion:

Enhancement Stage:

- Decomposes the visible image using an improved guided filter with deep features from ResNet-50.
- Applies adaptive brightness correction to the low-frequency layer and detail adjustment to the high-frequency layer.

Target Extraction Stage:

- Reconstructs the infrared background using morphological operations.
- Extracts targets via background subtraction and optimizes them using nonlinear transformation to suppress redundant background information.

Fusion Stage:

- Injects the extracted infrared target into the enhanced visible image using a compression ratio to prevent overexposure.

Advantages of the Proposed System:

1. Enhanced Detail Visibility: Adaptive enhancement strategies improve both global and local contrast, revealing hidden details in visible images.
2. Accurate Target Extraction: Background subtraction and optimization ensure precise isolation of infrared targets, enhancing their prominence in the fused image.
3. Suppression of Overexposure: The compression ratio controls the infusion of infrared targets, preventing overexposure and preserving natural appearance.

SYSTEM REQUIREMENTS

- **H/W System Configuration:-**
- Processor - Pentium –IV
- RAM - 4 GB (min)
- Hard Disk - 20 GB
- Key Board - Standard Windows Keyboard
- Mouse - Two or Three Button Mouse
- Monitor - SVGA

SOFTWARE REQUIREMENTS:

- **Operating system** **:** Windows 7 Ultimate.
- **Coding Language** **:** Python.
- **Front-End** **:** Python.
- **Back-End** **:** Django-ORM
- **Designing** **:** Html, css, javascript.
- **Data Base** **:** MySQL (WAMP Server).