LAPORAN SKRIPSI

IMPLEMENTATION OF LIGHTWEIGHT ATTENTION BASED CNN WITH CLAHE PRE-PROCESSING FOR ROBUST FACIAL EXPRESSION RECOGNITION UNDER LOW-LIGHT AND PARTIAL OCCLUSION CONDITIONS



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Diajukan dalam Rangka Memenuhi

Salah Satu Syarat Memperoleh

Gelar Sarjana Komputer

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ABSTRACT

Facial Expression Recognition (FER) systems often fail in real world environments due to poor lighting and covered facial features. To solve this, we propose a highly efficient pipeline that combines Contrast Limited Adaptive Histogram Equalization (CLAHE) to recover details in dark images, and a Convolutional Block Attention Module (CBAM) inside a custom lightweight CNN to maintain focus when parts of the face are hidden. We evaluated this model using the CK+ dataset under controlled stress tests. During severe partial occlusion (like wearing a mask), the proposed model successfully maintained an 83.76% accuracy, suffering only a 10.15% drop rate, whereas a standard CNN crashed to 48.22%. In extreme low-light conditions (30% illumination), CLAHE pre-processing salvaged the model's recognition ability, achieving 40.10% accuracy compared to the baseline's 17.77%. Furthermore, Grad-CAM visualizations confirmed that our attention mechanism actively shifts computational focus from blocked areas to visible facial muscles. While this aggressive training caused a minor 4.5% drop in peak accuracy under perfect conditions (from 98.48% to 93.91%), the resulting structural resilience is a necessary and highly valuable trade-off. Finally, the entire architecture is extremely efficient, requiring only 686,049 parameters (8.1 MB) with an inference speed of 75.99 ms per image. This proves that integrating adaptive pre-processing and spatial attention creates a robust FER system that is fully optimized for real-time edge devices.

Keywords: facial expression recognition, low light, partial occlusion, CLAHE, CBAM, lightweight CNN, robustness