Advancing Low-Light Face Detection with Image Enhancement Models

The paper focuses on the innovative approach to improving low-light face detection by integrating RetinaFace with advanced image enhancement models, such as MirNet, AGC, Retinex Net, and Retinex. Validated on LOL and Dark Face datasets, the study demonstrates significant advancements, particularly with Retinex, achieving a notable 0.43% mAP. Results underscore the efficacy of blending image enhancement techniques with face detection models for superior performance in challenging lighting conditions.

Motivation/Purpose/Aims/Hypothesis

Motivated by the accuracy challenges faced in low-light scenarios, the study aims to enhance RetinaFace, a prominent face detection model. The hypothesis posits that the integration of sophisticated image enhancement techniques can substantially boost the precision of face detection models in low-light conditions.

Contribution

This work contributes by proposing a novel approach to heighten face detection accuracy in low-light conditions. Leveraging cutting-edge image enhancement methods enhances RetinaFace's ability to detect faces in challenging lighting situations, providing empirical evidence for future advancements in this domain.

Methodology

The methodology involves a dual-phase experimentation process. Firstly, low-light image enhancement models are trained and evaluated using the LOL dataset, utilizing metrics such as PSNR and SSIM. Subsequently, a pre-trained RetinaFace model is employed for low-light face detection with testing conducted on the Dark Face dataset. The proposed method combines the most effective image enhancement model with RetinaFace, evaluated based on mAP.

Conclusion

This study investigates the fusion of low-light image enhancement techniques with face detection using the RetinaFace model. While MirNet excels in image enhancement, Retinex proves particularly effective for low-light face detection, yielding a substantial mAP improvement to 0.43%. The research underscores the enhanced performance achievable through tailored image preprocessing, offering valuable insights for optimizing face detection in challenging low-light conditions.

Limitations

Acknowledging limitations, the study emphasizes that, despite improvements in low-light face detection through image enhancement, the overall performance is still constrained by the challenges of extremely low-light conditions. The proposed method may encounter limitations in

scenarios with minimal illumination and may exhibit variability in diverse real-world environments.

First Limitation/Critique
The study's exclusive focus on improving low-light face detection may potentially limit its applicability across broader lighting conditions. A more comprehensive evaluation across diverse scenarios is crucial for a holistic understanding.

Second Limitation/Critique
Relying on specific datasets for training and evaluation, such as LOL and Dark Face, may restrict the model's generalizability to varied real-world scenarios. A more diverse dataset selection would enhance the model's robustness and credibility across different low-light conditions.

Synthesis
The synthesis amalgamates low-light image enhancement models, with MirNet standing out as the top performer, achieving superior results in PSNR and SSIM. In face detection, Retinex demonstrates the highest mAP score, highlighting its efficacy in enhancing RetinaFace's performance in low-light conditions.