UNDERGRADUATE THESIS

A COMPARATIVE MULTI METHOD STUDY FOR CARDIAC ULTRASOUND IMAGE ENHANCEMENT USING RETINEX BASED

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FACULTY OF COMPUTER SCIENCE
INFORMATICS STUDY PROGRAM
SURABAYA
2026

APPROVAL SHEET

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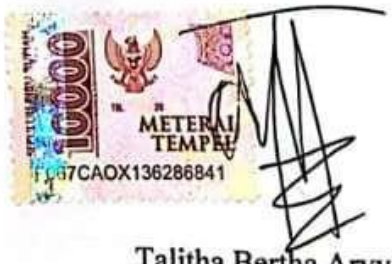

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ABSTRACT

Student Name / NPM	:	Talitha Bertha Arvyandita / 21081010253
Thesis Title	:	*A Multi-Method Comparative Study for Cardiac Ultrasound Image Enhancement Using Retinex-Based Methods*
Advisor	:	1. Dr. I Gede Susrama Mas Diyasa, S.T., M.T., IPU 2. Fetty Tri Anggraeny, S.Kom, M.Kom.

Cardiovascular disease is the leading cause of death worldwide, making accurate diagnosis essential. Cardiac ultrasound (echocardiography) is a commonly used imaging modality, yet its images often suffer from low visual quality due to speckle noise, poor contrast, and uneven illumination. This study conducts a multi-method comparative analysis for cardiac ultrasound image enhancement using Retinex-based methods, namely Single Scale Retinex (SSR), Multi Scale Retinex (MSR), and Multi Scale Retinex with Color Restoration (MSRCR), combined with Bilateral Filter and Median Filter preprocessing, together with Contrast Limited Adaptive Histogram Equalization (CLAHE) as a non-Retinex comparison method. The cardiac ultrasound dataset was obtained from the Unity Public Portal, focusing on the parasternal long axis (PLAX) view. Six enhancement combinations (K1–K6) together with CLAHE were evaluated quantitatively using PSNR, SSIM, Entropy, and CII metrics. The results show that Retinex-based methods excel in Entropy (average 7.07) and CII (average 1.22), which are most relevant to the enhancement objective, whereas CLAHE excels in PSNR (24.32 dB) and SSIM (0.5383). Based on the aggregate score of the four metrics, stability, and the percentage of images with CII greater than 1, the K1 combination (Bilateral Filter + SSR) was determined to be the most optimal, achieving the lowest aggregate score (2.50), the highest Entropy (7.3040), and a CII > 1 percentage of 95.95%. This combination enhances contrast smoothly and evenly without introducing artifacts that interfere with clinical interpretation, making it the most suitable for cardiac ultrasound image enhancement.

***Keywords**: cardiac ultrasound, echocardiography, image enhancement, Retinex, SSR, MSR, MSRCR, CLAHE.*

ACKNOWLEDGEMENTS

Praise be to Allah SWT for all His grace, guidance, and blessings upon the author, so that the undergraduate thesis entitled "**A Comparative Study of Multiple Methods for Cardiac Ultrasound Image Enhancement Using Retinex-Based Approaches**" could be completed successfully.

The preparation of this thesis is one of the requirements for obtaining a Bachelor's degree in the Informatics Study Program, Faculty of Computer Science, Universitas Pembangunan Nasional "Veteran" Jawa Timur. The author would like to express the deepest appreciation to everyone who provided support and contributions throughout this research process, who devoted their time, energy, and thoughts to guide and motivate the author in completing this thesis. The author recognizes that the completion of this thesis would not have been possible without the assistance, guidance, and encouragement whether moral, spiritual, or material from various parties. Therefore, the author would like to extend gratitude to:

1. Mrs. Prof. Dr. Ir. Novirina Hendrasarie, MT., as the Dean of the Faculty of Computer Science, Universitas Pembangunan Nasional "Veteran" Jawa Timur.
2. Mrs. Intan Yuniar Purbasari, S.Kom, M.Sc, as the Head of the Informatics Study Program, Faculty of Computer Science, Universitas Pembangunan Nasional "Veteran" Jawa Timur.
3. Mr. Dr. I Gede Susrama Mas Diyasa, S.T., M.T., IPU, as the First Supervisor, who guided the author throughout the course of this research.
4. Mrs. Fetty Tri Anggraeny, S.Kom, M.Kom, as the Second Supervisor, who guided the author throughout the course of this research.
5. Mr. Faisal Muttaqin, S.Kom, M.T, as the First Examiner, who examined the author and provided a fresh perspective on this research.
6. Mr. Andreas Nugroho Sihananto, S.Kom., M.Kom, as the Second Examiner, who examined the author and provided a fresh perspective on this research.
7. Mr. Hendra Maulana, S.Kom, M.Kom., as the Academic Advisor, who guided the author throughout their studies and this research.

8. The lecturers and staff of the Informatics Study Program, Faculty of Computer Science, Universitas Pembangunan Nasional "Veteran" Jawa Timur, for all their assistance in facilitating the author in preparing this research.
9. The author's father, mother, siblings, and relatives, who never tired of praying for and encouraging the author, as well as providing material support throughout the author's studies.
10. To Naura, Divarelia, Lativa, and Thalita, who have faithfully accompanied the author in the struggle to rise again.
11. The author would like to express gratitude to someone who once played a meaningful role in the author's life journey. The interaction and companionship shared provided valuable lessons in the process of personal growth. All the support and kindness given contributed positively to shaping the author's attitude and understanding. May every step taken going forward be blessed and go well.
12. Friends who provided support throughout the course of study and the preparation of this research.

The author recognizes that this thesis still contains many shortcomings. Therefore, constructive criticism and suggestions from all parties are greatly appreciated for the improvement of this thesis. Finally, despite the author's limitations, it is hoped that this report will be beneficial to all parties in general and to the author in particular.

Surabaya, 22 July 2026

The Author,

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