



UNDERGRADUATE THESIS

**OPTIMIZATION OF SOYBEAN QUALITY
CLASSIFICATION USING EFFICIENTNET-B0 WITH
MIXUP AND BAYESIAN HYPERPARAMETER
OPTIMIZATION**

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FACULTY OF COMPUTER SCIENCE
INFORMATICS STUDY PROGRAM
SURABAYA
2026**

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OPTIMIZATION

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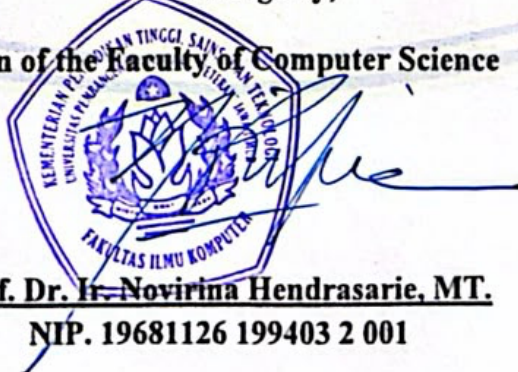
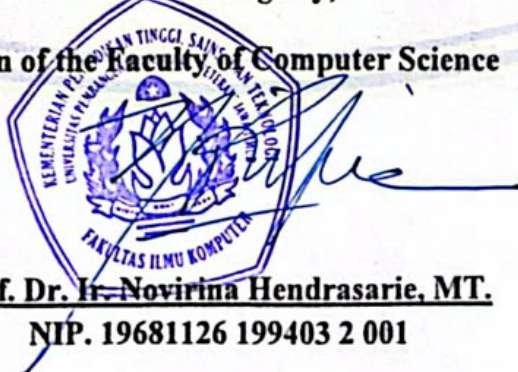
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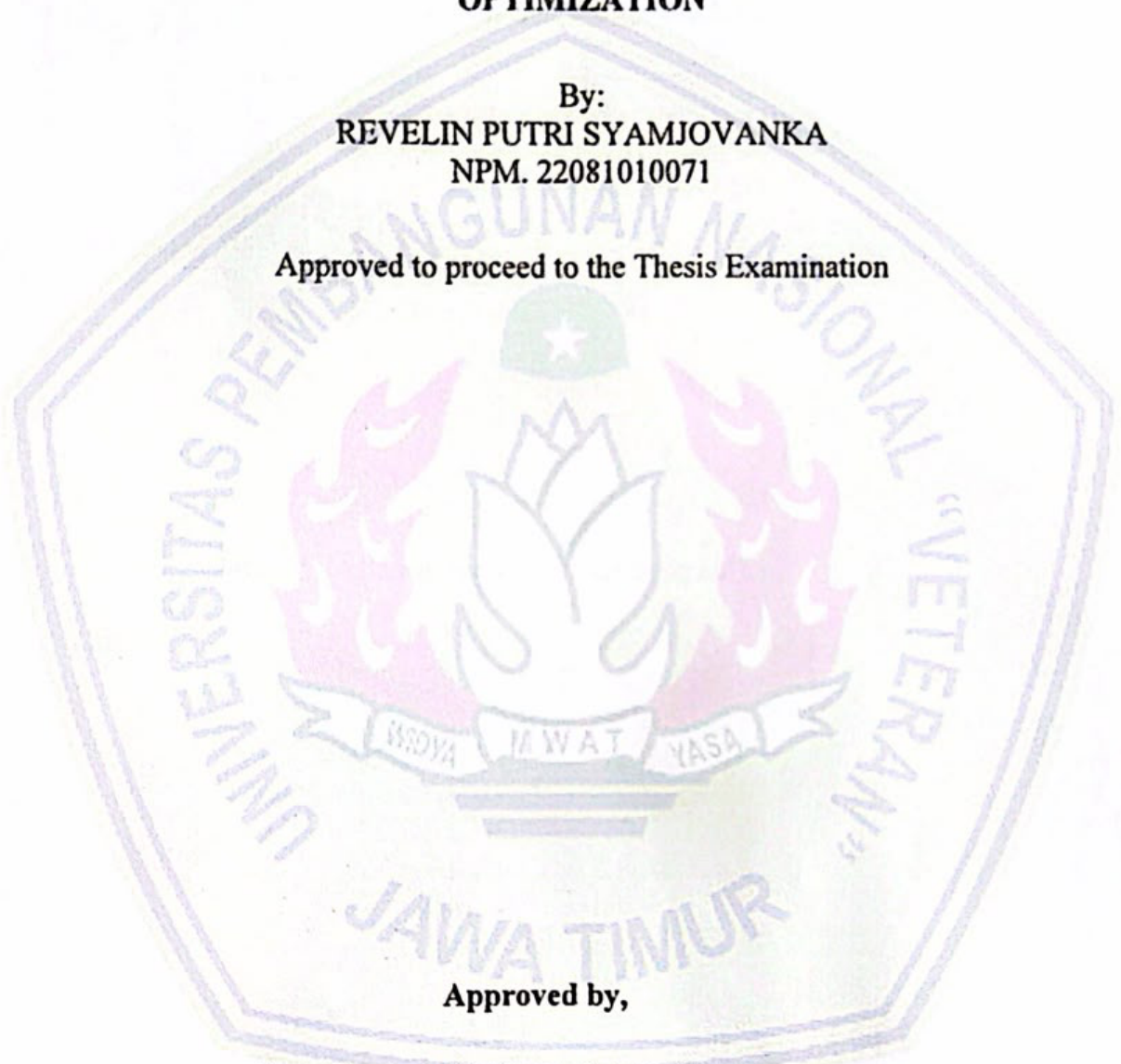
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ABSTRACT

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Soybean quality is a crucial factor influencing the overall quality of agricultural products. Traditionally, quality assessment has been performed manually, making the results inefficient and highly dependent on subjective judgment. To address this limitation, an artificial intelligence (AI)-based system is required to automate and improve the classification of soybean quality. This study employs the EfficientNet-B0 deep learning architecture to categorize soybeans into five distinct quality classes: whole, spotted, immature, broken, and damaged-skin beans. To enhance model performance the MixUp data augmentation method was applied with bayesian optimization was utilized to hyperparameter tuning. The model was evaluated under three distinct scenarios first, using EfficientNet-B0 as the baseline; second, incorporating MixUp data augmentation and third, combining MixUp with Bayesian Optimization. The secondary dataset used for model development was sourced from Kaggle, comprising a total of 5,513 images. Model performance was evaluated using accuracy, precision, recall, and F1-score metrics.

The results demonstrated that the baseline model achieved an accuracy of 91.67%, whereas the model with MixUp alone showed a slightly lower accuracy of 89.31%. However, incorporating Bayesian Optimization significantly improved the performance of the MixUp configuration, yielding an accuracy of 90.94%, a precision of 90.98%, recall of 90.97%, and F1-score of 90.92%. These findings indicate that hyperparameter tuning effectively optimizes the MixUp technique during training. Finally, the optimized model from the third scenario was deployed into a web-based system using FastAPI. To evaluate the system's real-world functionality, web testing was conducted using 15 primary images collected directly. The system successfully automates the entire sorting pipeline, from image ingestion to displaying the predicted class alongside its confidence score. Consequently, the developed system offers a more efficient, rapid, and objective approach to assessing soybean seed quality.

Keywords: Image classification, Soybean quality, EfficientNet-B0, MixUp, Bayesian Optimization, FastAPI

ACKNOWLEDGEMENTS

Praise be to Allah SWT for everything the blessings, guidance with gifts given to the author, enabling the completion of this thesis with the specified title. “Optimization Of Soybean Quality Classification Using EfficientNet-B0 With Mixup And Bayesian Hyperparameter Optimization” can be completed properly. Out of the entire sequence of pages in this thesis, the dedication section holds the most profound meaning for the author. Within these lines lies the expression of gratitude and appreciation that words often fail to represent.

Bismillahirrahmanirrahim. With the utmost respect and humility, the author dedicates this humble work to:

1. Mrs. Prof. Dr. Ir. Novirina Hendrasarie, M.T. as the Dean of the Faculty of Computer Science, National Development University "Veteran" East Java.
2. Mrs. Dr. Intan Yuniar Purbasari, S.Kom., M.Sc. as the Coordinator of Informatics Study Program, Faculty of Computer Science, National Development University "Veteran" East Java.
3. Mr. Dr. Faisal Muttaqin, S.Kom., M.T. as Supervisor 1, who has been a guide throughout the author's academic journey during the preparation of this thesis. Thank you for the time, patience, insights, and every guidance provided with full attention, enabling the author to overcome various challenges in the research process until this thesis could be completed.
4. Mrs. Eva Yulia Puspaningrum, S.Kom., M.Kom. as Supervisor 2, who has provided valuable inputs, perspectives, and encouragement that helped the author refine this research. Thank you for the thoroughness, support, and guidance given during the thesis preparation process, allowing the author to complete this work in the best possible way.
5. My dearest Mother and Father, the author's parents. The author expresses deepest gratitude for the endless love home has always been the first place to teach the author the meaning of resilience, and you both are the reasons why these steps never truly stopped. Thank you for the unceasing prayers, even when the author almost lost faith. When the world felt too loud and exhausting, Mother's embrace was always the most peaceful place to return, while Father's steadfastness served as a reminder that giving up is never an option. This thesis is not merely an

academic achievement, but a footprint of the love, sacrifice, and hope that you have placed in every step of the author.

6. My dearest brother, Revaldo Putra Atariq, the author expresses sincere gratitude for every form of support and care provided all this time. Not all help comes with many words, and not every presence needs to be loudly announced. Thank you for being someone who silently stays, even when the author does not always ask for help. In a journey that often felt exhausting, your presence was like a pillar that kept everything from collapsing all at once. The author might not always say it, but every small token of attention holds a meaning far greater than it appears. May all your kindness and sincerity always receive the best rewards and blessings in every step of your life.
7. The author's three beloved cats, thank you for faithfully accompanying the author from length of the thesis writing process. Your simple presence, sitting near the desk and staying up until late at night, provided peace and comfort whenever the author felt exhausted. Even without words, that togetherness held great meaning and helped the author persevere to successfully complete this thesis.
8. My friends, perhaps in the future, what will be missed the most is not this journey itself, but the people who were present in every difficult process of drafting this thesis. Thank you for being a beautiful part of it.
9. And to myself, Revelin Putri Syamjovanka, thank you for surviving this far. Thank you for staying strong, even when the world felt so heavy, and for still being able to stand tall despite wanting to give up countless times. Not all wounds are visible, not all exhaustion is spoken, yet you still chose to endure. Embrace yourself as tightly as possible and love yourself more than anything, because in the end, you are the one who truly understands how long and heavy this journey has been. For every part of yourself that was once fragile yet chose to hold on, thank you.

The author acknowledges that there may be errors or areas for improvement in this thesis. Therefore, readers are encouraged to offer constructive feedback and ideas to enhance the quality of the work. Finally, despite any limitations, it is hoped that this report proves beneficial to all parties involved, and particularly to the author.

Surabaya, June 23th 2026

Author

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