UNDERGRADUATE THESIS

DETECTION OF FOOT-AND-MOUTH DISEASE (FMD) IN CATTLE USING THE INCEPTIONV3-CBAM MODEL WITH HYPERPARAMETER OPTIMIZATION USING BAYESIAN OPTIMIZATION

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APPROVAL SHEET

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ABSTRACT

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ABSTRACT

Foot-and-Mouth Disease (FMD), known locally as Penyakit Mulut dan Kuku (PMK), poses a serious threat to cattle productivity in Indonesia, particularly in Tuban Regency, where active cases continued to rise throughout 2025. The disease causes sudden death in calves (pedet) due to acute myocarditis, especially in those under two months of age, characterized by the pathognomonic "tigroid heart" myocardial lesions, which are frequently fatal. This study develops an image-based early detection model for FMD using the InceptionV3 architecture, combined with the Convolutional Block Attention Module (CBAM), to enhance the focus on critical features such as lesions on cattle's gums, nose, and hooves. Hyperparameter optimization was performed using Bayesian Optimization, and model performance was evaluated through 5-fold Cross-Validation. The dataset consists of 3,000 field-collected images obtained in collaboration with the Department of Food Security, Agriculture, and Fisheries of Tuban Regency. These images were manually cropped, resized to 299×299 pixels, and normalized to the range [-1, 1]. The evaluation results show that the baseline model achieved a mean accuracy of 97.17% with a standard deviation of 0.0099, along with a precision of 97.15%, recall of 97.19%, and F1-score of 97.16%. After optimization, the model's performance improved to a mean accuracy of 97.50% with a lower standard deviation of 0.0063, precision of 97.48%, recall of 97.53%, and F1-score of 97.49%. The 0.33% increase in accuracy and reduced standard deviation indicate that the optimized model is not only more accurate but also more stable. The best model (from fold 5 in the optimized scenario) was implemented in an Android application using TensorFlow Lite, supporting offline detection via real-time camera access or gallery uploads with a simple and user-friendly interface for farmers. This research demonstrates that Bayesian Optimization significantly improves all evaluation metrics of the InceptionV3-CBAM model, enabling effective early detection of FMD to reduce disease spread and livestock mortality, particularly among calves. Future improvements may include dataset expansion and cloud system integration for continuous monitoring.

Keywords : Android Application, Bayesian Optimization, Foot-and-Mouth Disease (FMD), Image-based Detection, InceptionV3-CBAM

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The author recognizes that this thesis has areas for improvement and welcomes any constructive feedback or suggestions. Finally, with all the author's limitations, may this thesis be beneficial to all parties in general and to the author in particular.

Surabaya, May 13, 2026

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