KLASIFIKASI KUALITAS BUAH PADA *FRUITVISION DATASET* MENGGUNAKAN CNN RESNET50-KELM

SKRIPSI

Disusun Oleh

NAYLA FITRIYATUS SAIDAH

09020222038

PROGRAM STUDI MATEMATIKA

FAKULTAS SAINS DAN TEKNOLOGI

UNIVERSITAS ISLAM NEGERI SUNAN AMPEL

SURABAYA

2026

PERNYATAAN KEASLIAN

Saya yang bertanda tangan di bawah ini,

Nama	:	Nayla Fitriyatus Saidah
NIM	:	09020222038
Program Studi	:	Matematika
Angkatan	:	2022

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Demikian pernyataan keaslian ini saya buat dengan sebenar-benarnya.

Surabaya, 29 Desember 2025

Yang menyatakan,



Nayla Fitriyatus Saidah

NIM. 09020222038

LEMBAR PERSETUJUAN PEMBIMBING

Proposal skripsi oleh

Nama	:	Nayla Fitriyatus Saidah
NIM	:	09020222038
Judul skripsi	:	Klasifikasi Kualitas Buah Pada *FruitVision Dataset* Menggunakan CNN ResNet50-KELM

telah diperiksa dan disetujui untuk diujikan.

Pembimbing I	Pembimbing II
Dr. Dian Candra Rini Novitasari, M. Kom	Dr. Ahmad Hanif Asyhar, M. Si
NIP. 198511242014032001	NIP. 198601232014031001

Mengetahui,
Ketua Program Studi Matematika
UIN Sunan Ampel Surabaya

Dr. Yuniar Farida, M.T
NIP. 197905272014032002

PENGESAHAN TIM PENGUJI SKRIPSI

Skripsi oleh:

Nama : Nayla Fitriyatus Saidah
NIM : 09020222038
Judul : Klasifikasi Kualitas Buah Pada *FruitVision Dataset* Menggunakan CNN ResNet50-KELM

Telah dipertahankan di depan Tim Penguji pada tanggal 6 Januari 2026.

Mengesahkan,
Tim Penguji

Penguji I

Aris Fanani, M.Kom
NIP. 198701272014031002

Penguji II

Wika Dianita Utami, M.Sc
NIP. 199206102018012003

Penguji III

Dr. Dian Candra Rini Novitasari, M. Kom
NIP. 198511242014032001

Penguji IV

Dr. Ahmad Hanif Asyhar, M. Si
NIP. 198601232014031001

Mengetahui,
Dekan Fakultas Sains dan Teknologi
UIN Sunan Ampel Surabaya

Dr. A. Saepul Hamdani, M.Pd
NIP. 196507312000031002

KEMENTERIAN AGAMA
UNIVERSITAS ISLAM NEGERI SUNAN AMPEL SURABAYA
PERPUSTAKAAN
Jl. Jend. A. Yani 117 Surabaya 60237 Telp. 031-8431972 Fax.031-8413300
E-Mail: perpus@uinsby.ac.id

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NIM : 09020222038
Fakultas/Jurusan : Sains dan Teknologi / Matematika
E-mail address : 09020222038@student.uinsby.ac.id

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ABSTRAK

Klasifikasi Kualitas Buah Pada *FruitVision Dataset* Menggunakan CNN ResNet50-KELM

Kualitas buah yang beredar di pasaran tidak selalu seragam, karena adanya buah segar, buah busuk, serta buah yang dicampur bahan berbahaya seperti formalin, yang sulit dibedakan secara visual dan berpotensi menimbulkan risiko kesehatan bagi konsumen. Penelitian ini bertujuan mengembangkan sistem klasifikasi kualitas buah berbasis citra digital yang mampu mengidentifikasi buah segar, busuk, dan tercampur formalin secara otomatis, serta mengevaluasi kinerjanya berdasarkan akurasi, presisi, *recall*, *F1-score*, dan efisiensi waktu komputasi. Metode yang digunakan, yaitu menggabungkan *Convolutional Neural Network* ResNet50 untuk proses ekstraksi fitur dan *Kernel Extreme Learning Machine* (KELM) untuk proses klasifikasi pengklasifikasi. Dataset penelitian mencakup lima jenis buah, yaitu apel, pisang, mangga, jeruk, dan anggur. Setiap citra diekstraksi menggunakan ResNet50 melalui lapisan *Global Average Pooling* sehingga menghasilkan vektor fitur berdimensi 2048, yang selanjutnya diklasifikasikan menggunakan KELM dengan kernel *linear*, *polynomial*, dan *Radial Basis Function* (RBF). Evaluasi model dilakukan menggunakan skema *K-Fold Cross Validation* dengan rentang $K = 5$ hingga $K = 10$. Hasil pengujian menunjukkan bahwa performa terbaik diperoleh pada skema *K-Fold Cross Validation* dengan $K = 9$ menggunakan metode ResNet50–KELM dengan kernel *Radial Basis Function* (RBF), parameter $\sigma = 15$, dan koefisien regularisasi $C = 100$. Pada konfigurasi tersebut, model menghasilkan akurasi rata-rata sebesar 99,3% dengan waktu komputasi yang relatif efisien, yaitu sekitar 25 detik dan pada penerapan metode ResNet50 hingga tahap klasifikasi tanpa KELM pada skema $K = 9$ menghasilkan akurasi rata-rata sebesar 95,2% dengan waktu komputasi sekitar 5.546 detik. Berdasarkan hasil tersebut, dapat disimpulkan bahwa model gabungan ResNet50–KELM efektif dalam mendeteksi kualitas buah secara akurat dan efisien, serta berpotensi diterapkan sebagai sistem pendukung dalam pengawasan keamanan pangan.

Kata kunci: *Computer Vision*, *Convolutional Neural Network*, KELM, Klasifikasi Kualitas Buah, ResNet50.

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ABSTRACT

Fruit Quality Classification on the *FruitVision Dataset* Using CNN ResNet50–KELM

The quality of fruit on the market is not always consistent, as there are fresh fruits, rotten fruits, and fruits mixed with harmful substances such as formaldehyde. These differences are often difficult to distinguish visually, which can increase health risks for consumers. This study aims to develop a digital image-based fruit quality classification system capable of identifying three classes, namely fresh, rotten, and formalin mixed, and to evaluate its performance using metrics of accuracy, precision, recall, F1-score, and computation time. The proposed method combines a Convolutional Neural Network (CNN) ResNet50 as a feature extractor and Kernel Extreme Learning Machine (KELM) as a classifier. The dataset consists of five types of fruits apples, bananas, mangoes, oranges, and grapes. Each image is processed using ResNet50 through the Global Average Pooling layer to produce a 2048-dimensional feature vector, which is then classified using KELM with linear, polynomial, and Radial Basis Function (RBF) kernels. Model evaluation was conducted using a *K-Fold Cross-Validation* scheme with values of K ranging from 5 to 10. The experimental results indicate that the best performance is achieved using the *K-Fold Cross Validation* scheme with $K = 9$ by applying the ResNet50–KELM method with a *Radial Basis Function* (RBF) kernel, a parameter value of $\sigma = 15$, and a regularization coefficient of $C = 100$. Under this configuration, the model attains an average accuracy of 99.3% with a relatively efficient computational time of approximately 25 seconds. In addition, the application of the ResNet50 method up to the classification stage without KELM under the same $K = 9$ scheme yields an average accuracy of 95.2% with a computational time of about 5.546 seconds. Based on these results, it can be concluded that the combined ResNet50–KELM model is effective in accurately and efficiently detecting fruit quality and has the potential to be implemented as a decision support system for food safety monitoring.

Keywords: Computer Vision, Convolutional Neural Network, KELM, Fruit Quality Classification, ResNet50.

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