

RANCANG BANGUN SISTEM PEMILAHAN TELUR PUYUH SECARA OTOMATIS BERBASIS SEGMENTASI CITRA KECACATAN TELUR DENGAN *COLOR THRESHOLDING* PADA RUANG WARNA HSV

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INTISARI

Subsektor peternakan puyuh tradisional berpotensi besar sebagai penghasil bahan pangan bergizi tinggi, namun pengelolaannya masih didominasi oleh proses manual terutama pemanenan dan pemilahan telur, yang memakan banyak waktu, tenaga, serta rawan terhadap kesalahan manusia. Keterbasan teknologi di bidang ini mempengaruhi kualitas dan efisiensi produksi telur puyuh. Telur puyuh rentan mengalami kerusakan yang dipengaruhi berbagai faktor baik secara fisik, kimia, maupun biologis.

Oleh karena itu, penelitian ini mengusulkan pengembangan lebih lanjut terkait sistem otomasi berbasis segmentasi citra dengan analisis ruang warna HSV untuk mendeteksi cacat pada telur puyuh secara *real-time*, sebagai solusi meningkatkan efisiensi dan kualitas dalam proses pemanenan serta pemilahan telur puyuh. Penelitian ini menerapkan teknologi pemanenan telur pada konveyor dan sistem pemilahan menggunakan pencahayaan sinar UV dengan kamera untuk menentukan kualitas berdasarkan citra telur puyuh. Komponen mekanis dan elektronis diintegrasikan menggunakan *microcontroller* ESP32 yang juga menghubungkan sistem ke PC *image processing* secara nirkabel. Program pengolahan citra dikembangkan sedemikian rupa dengan teknik *color thresholding* untuk pendeteksian kerusakan pada permukaan luar cangkang telur puyuh.

Hasil perancangan dan pengujian alat menunjukkan bahwa sistem terintegrasi pemilahan telur puyuh berbasis segmentasi citra area cacat telur dengan metode *color thresholding* di ruang warna HSV telah berhasil diwujudkan dan dapat bekerja memilah telur berdasar kualitas. Sistem ini mampu memilah telur ke dalam kategori kualitas baik dan kualitas buruk dengan rerata nilai akurasi sebesar 94%, *precision* sebesar 96%, dan *recall* sebesar 93%, berdasarkan *performance metrics* yang telah dikalkulasi melalui tiga iterasi pengujian sistem pada 100 butir sampel telur puyuh.

Kata kunci: telur puyuh, pemilahan, otomasi, *color thresholding*, segmentasi citra

DESIGN OF AUTOMATIC QUAIL EGG SORTING SYSTEM BASED ON EGG DEFECT IMAGE SEGMENTATION USING COLOR THRESHOLDING IN HSV COLOR SPACE

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ABSTRACT

The traditional quail farming subsector has great potential as a producer of highly nutritious food, but its management is still dominated by manual processes, especially harvesting and sorting eggs, which takes a lot of time, energy, and is prone to human error. The lack of technology in this area affects the quality and efficiency of quail egg production. Quail eggs are susceptible to damage, which is influenced by various physical, chemical and biological factors.

Therefore, this research proposes further development of an automation system based on image segmentation with HSV color space analysis to detect defects in quail eggs in real-time, as a solution to improve efficiency and quality in the process of harvesting and sorting quail eggs. This research applies egg harvesting technology on a conveyor and sorting system using UV lighting with a camera to determine quality based on quail egg images. The mechanical and electronic components are integrated using an ESP32 microcontroller that also connects the system to an image processing PC wirelessly. An image processing program was developed using color thresholding technique for damage detection in outer surface of quail egg shell.

The results of the design and testing of the prototype indicate that the integrated system for sorting quail eggs based on image segmentation of egg defect areas with the color thresholding method in HSV color space has been successfully realized and feasible to sort eggs based on quality. The system is able to sort eggs into good quality and poor quality categories with an average accuracy value of 94%, precision of 96%, and recall of 93%, based on performance metrics that have been calculated throughout three iterations of system testing on 100 quail egg samples.

Keywords: quail eggs, sorting, automation, color thresholding, image segmentation