ADVANTAGES OF COMPUTER VISION SYSTEMS IN AGRICULTURAL PRODUCT SORTING

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Abstract. Visual recognition and sorting of fruits have emerged as revolutionary technologies in the agricultural sector. By leveraging advancements in computer vision and machine learning, these systems offer significant benefits in terms of efficiency, accuracy, cost reduction, and sustainability.

Keywords: Sorting, artificial intelligence, machine learning, algorithm, efficiency, consistency, accuracy.

Абстрактный. Визуальное распознавание и сортировка фруктов стали революционными технологиями в сельскохозяйственном секторе. Используя достижения в области компьютерного зрения и машинного обучения, эти системы обеспечивают значительные преимущества с точки зрения эффективности, точности, снижения затрат и устойчивости.

Ключевые слова: сортировка, искусственный интеллект, машинное обучение, алгоритм, эффективность, согласованность, точность.

Introduction. The agricultural sector is increasingly adopting automated technologies to enhance productivity and quality. Fruit visual recognition and sorting systems powered by Artificial Intelligence (AI) and Machine Learning (ML) are at the forefront of this transformation. These systems use cameras and algorithms to identify and classify fruits based on various attributes such as size, color, shape, and defects. This article discusses the main advantages of these technologies and their impact on the industry.

Increased Efficiency and Speed. Automated visual recognition systems significantly speed up the sorting process. Unlike manual sorting, these systems can process large volumes of fruits quickly and efficiently. For instance, systems utilizing deep learning algorithms can process images at high speed, matching the pace of harvest rates. This efficiency is crucial during harvest season, reducing bottlenecks and ensuring timely market supply (Liakos et al., 2018).

ISSN 3030-3907



Picture 1. Fruit sorting by hand and by machine

Consistency and Accuracy. One of the key advantages of visual recognition systems is their ability to provide consistent and accurate sorting. Human sorters may deliver inconsistent quality due to fatigue and variability in decision-making. In contrast, automated systems apply uniform criteria for sorting, ensuring that each fruit is assessed against the same standards. Advanced algorithms can detect subtle differences and defects that might be missed by human eyes, thereby enhancing sorting accuracy (Jiang et al., 2020).



Picture 2. Visual recognition and sorting of Mava

Reduction in Labor Costs. The implementation of automated sorting systems can lead to significant savings in labor costs. As these systems reduce the need for manual sorting, farms can lower their operational expenses. This is

ISSN 3030-3907

particularly beneficial in regions with high labor costs or labor shortages. Reduced dependence on manual labor allows human resources to be reallocated to more skilled tasks, thereby increasing overall productivity (Deepak et al., 2019).

Improvement in Fruit Quality. Automated visual sorting systems make the quality control process more precise by identifying and separating fruits based on quality parameters. High-quality fruits are designated for premium markets, while those with defects are directed to processing industries. This precise sorting delivers high-quality products to consumers, enhancing customer satisfaction and market reputation (Unay & Gosselin, 2021).

Data Collection and Analysis. Visual recognition systems generate valuable data on fruit quality and sorting patterns. This data can be analyzed to gain insights into crop performance, disease prevalence, and yield predictions. Farmers can use this information to make informed decisions regarding crop management, harvest timing, and marketing strategies. Over time, monitoring and analyzing data can improve agricultural practices and predict future trends (Kamilaris & Prenafeta-Boldú, 2018).

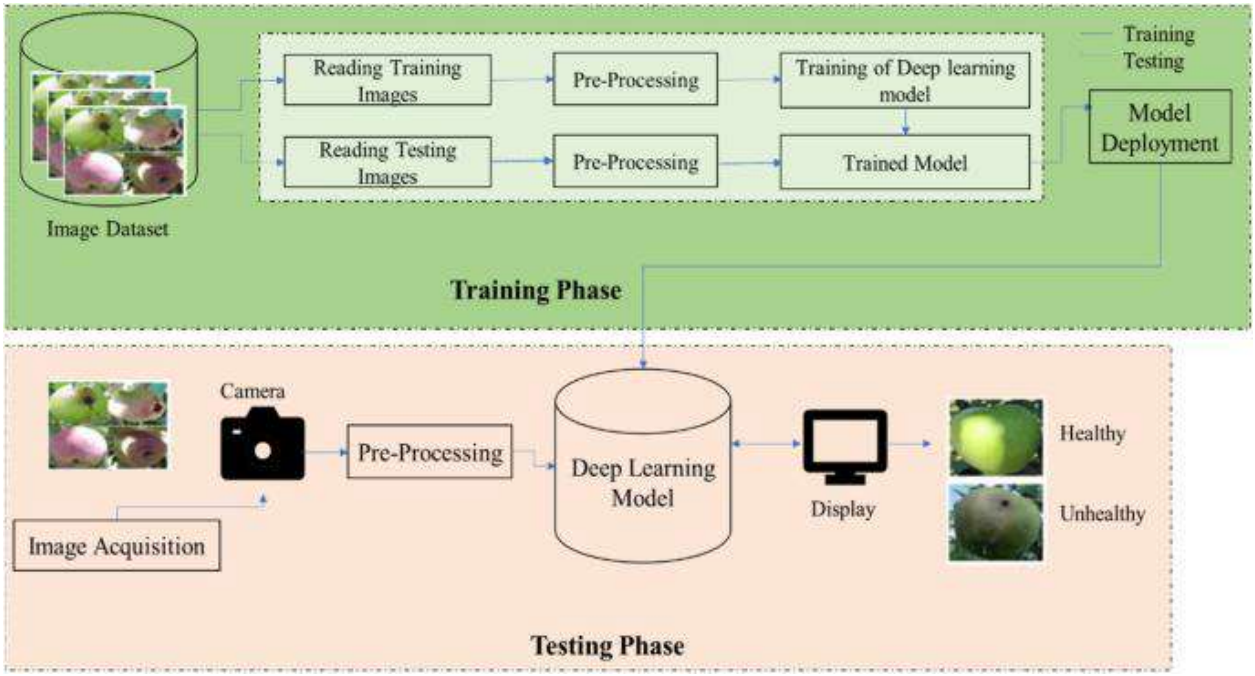


Figure 3.

Data collection and analysis

Scalability. Automated sorting systems are highly scalable and adaptable to different types of fruits and production volumes. Whether for small family farms or

ISSN 3030-3907

large commercial operations, these systems can be tailored to meet specific needs. Scalability allows businesses to expand or modify their sorting systems without additional investment as they grow (Gao et al., 2021).

Increased Market Value. By ensuring consistent and high-quality sorting, automated systems enhance the market value of the products. High-quality fruits command better prices and increase consumer confidence. This improved market position can boost revenues for farmers and suppliers, allowing them to recoup their initial investments in automated sorting technology (Barnea et al., 2020).

Environmental Benefits. Efficient sorting and quality control help reduce food waste by ensuring that all harvested fruits are used appropriately. Fruits that do not meet market standards can be directed for processing or other purposes, reducing waste. This contributes to more sustainable agricultural practices and aligns with global efforts to reduce food waste and improve resource utilization (Brosnan & Sun, 2004).

Conclusion. The application of visual recognition and sorting systems in agriculture offers numerous benefits, including increased efficiency, accuracy, cost savings, improved quality, and sustainability. These technologies are transforming the way fruits are sorted and marketed, providing significant advantages for farmers, consumers, and the environment. As advancements in artificial intelligence and machine learning continue, the capabilities and applications of these systems are expected to expand, further revolutionizing the agricultural sector.

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ISSN 3030-3907