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Simultaneous Reduction of False Positives and Negatives in Strawberry Quality Control via YOLO Computer Vision

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Abstract

Manual strawberry quality inspection is physically demanding and presents a critical dilemma: aggressive removal leads to false positives (discarding healthy fruit), while lenient inspection risks false negatives (shipping defective fruit). Achieving optimal balance is difficult through human inspection alone. Due to fatigue, subjectivity, and inconsistency, human inspectors cannot simultaneously minimize both false positives and false negatives. This limitation results in either unnecessary waste or compromised product quality. This research aimed to develop an intelligent quality inspection assistance system capable of simultaneously reducing both false positive and false negative errors in strawberry sorting. We built an AI-assisted vision system using YOLO (You Only Look Once) computer vision, deployed on a Raspberry Pi 5 platform with integrated AI acceleration. This setup balances accuracy, speed, and affordability. The initial model successfully reduced both error types but suffered from overfitting due to annotation limitations. In the second version, we redesigned the annotation strategy, which significantly improved detection accuracy and model robustness. The solution remains low-cost (~$300 USD), energy-efficient, and easily scalable — ideal for smart farming applications in both developed and emerging markets.

Keywords
Visual Fatigue, Human Error in Inspection, AI-assisted quality control, YOLO Computer Vision, Raspberry Pi 5

Biographies
Mariam Almutairi is an honor student in Industrial Engineering at AUM with a strong interest in Artificial Intelligence and its real-world applications in quality control, automation, and healthcare. She has contributed to AI-driven projects, including a computer vision system for sorting defective strawberries and a retinal disease classification model. Mariam completed a certification program in AI and entrepreneurship from UC Berkeley with honors in May 2025, where she developed her skills through hands-on, interdisciplinary work. She brings a pragmatic mindset and a drive to apply intelligent systems to solve real problems.

Sundos Alazemi is an honor student in Industrial Engineering at the American University of the Middle East (AUM), with a strong interest in automation, artificial intelligence, and sustainable solutions. She completed the UC Berkeley – AMENA Program in Applied Artificial Intelligence and Entrepreneurship with honors in May 2025, further strengthening her expertise in tech-driven innovation. For her graduation project, we developed a real-time strawberry sorting system using YOLO-based computer vision and Raspberry Pi, designed to improve quality control and reduce manual labor in agriculture. Her work reflects a deep commitment to leveraging AI for real-world impact and advancing smart farming technologies.

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Fatima Saleh is an honor student in Industrial Engineering at the American University of the Middle East (AUM) in Kuwait. She has a strong interest in computer vision and automation within the field of industrial engineering. Fatima completed an AI and Entrepreneurship course in collaboration with University of California, Berkeley, where she explored the intersection of AI technology and real-world business innovation. Her academic focus blends engineering problem-solving with innovative technologies, aiming to develop smarter and more sustainable systems in modern industry.

Latifa Aljeaan is an honor student in Industrial Engineering at the American University of the Middle East. Throughout her academic journey, she has gained knowledge in problem-solving, quality control, production management, and more. Her work has focused on developing cost-effective systems, with a strong interest in combining technology with practical solutions to reduce human error and ergonomic hazards. Her senior project centered on intelligent quality control using computer vision. Latifa is representing her university at the IEOM competition, where she aims to showcase her skills in innovation, teamwork, and problem-solving. She is passionate about continuous learning, self-development, and making a meaningful impact through engineering.

Manal Almutairi is a high-achieving Industrial Engineering student at American University of the Middle East (AUM) , with a strong drive to innovate and improve systems that impact everyday life. Her academic journey has been shaped by her curiosity for emerging technologies and her desire to solve real-world problems. She has developed a keen interest in computer vision and its role in enhancing quality control and reducing ergonomic risks in industrial environments. Her senior project reflects the vision, as it focuses on intelligent inspection systems powered by AI. Through competition like IEOM, she aims to challenge herself, grow as a leader, and contribute to a smarter, safer future through engineering.

Takeaki Toma is an Assistant Professor in Industrial Engineering at the American University of the Middle East, Kuwait. He earned a Bachelor of Science in Information Engineering from the University of the Ryukyus, Japan, a Master of Science in Industrial and Management Engineering from Montana State University, and a Doctor of Philosophy in Industrial Engineering from Oregon State University. He has experience in industry and academia in the United States, Japan, and Kuwait. His research interests include Cognitive Engineering, Safety Engineering, Quality Control, Statistical Data Analysis, and Machine Learning. He is a member of IEOM and IISE.

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