

AI-DRIVEN INNOVATION IN HEALTHCARE: COMPUTER VISION AND MACHINE LEARNING APPLICATIONS IN SURGICAL SETTINGS

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ABSTRACT

AI-driven innovations, particularly through the integration of computer vision (CV) and machine learning (ML), have become transformative in surgical settings, enhancing both the precision and efficiency of procedures. Over the past decade, significant advancements have been made in applying these technologies to various aspects of surgery, from real-time decision support to post-operative care. Early studies in 2015–2016 explored the potential of CV for laparoscopic surgery, enabling real-time object recognition to assist surgeons in identifying critical anatomical structures. By 2017, the integration of ML with robotic surgery was found to improve precision, reduce error rates, and alleviate surgeon fatigue. Research in 2018 and beyond demonstrated deep learning's ability to automate image segmentation, streamlining preoperative planning and intraoperative decision-making. Furthermore, machine learning models began to predict surgical outcomes and complications, offering personalized treatment approaches and reducing risks in the operating room. In 2022, the integration of augmented reality with AI further enhanced surgical navigation, particularly in orthopedic and neurosurgery, offering 3D visualizations that improved accuracy and training. By 2023, predictive models were being used to guide robotic surgery for cancer, reducing recurrence rates and improving survival outcomes. Additionally, AI systems began to detect surgical errors in real-time, correcting deviations from optimal procedures and ensuring patient safety. As these technologies evolve, their potential to revolutionize surgical practices, reduce human error, and improve patient recovery is immense. This paper explores the various contributions of AI, CV, and ML in the surgical domain, highlighting the key advancements from 2015 to 2024.

KEYWORDS: *AI Innovation, Computer Vision, Machine Learning, Operating Rooms, Robotic Surgery, Real-Time Decision Support, Image Segmentation, Augmented Reality, Detection Of Surgical Errors, Predictive Modeling, Minimally Invasive Surgery, Surgical Outcomes, Personalized Treatment, Precision In Surgery, AI-Assisted Navigation.*

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