A Comprehensive Review of Contactless Sanitization Systems Using Robotics, IoT, and Artificial Intelligence

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Abstract: *The global landscape of public health and institutional hygiene has undergone a profound paradigm shift, transitioning toward automated and contactless technologies to ensure safety and operational resilience. This review synthesizes current research on the integration of autonomous mobile robots (AMRs), the Internet of Things (IoT), and Artificial Intelligence (AI) across the healthcare, hospitality, and transportation sectors. Central to this analysis is a comparative evaluation of disinfection modalities, specifically manual wiping versus touchless fumigation; findings indicate that while manual methods currently excel in fungal eradication and reaching "micro shadows," automated vaporized hydrogen peroxide (VHP) systems offer superior scalability for high-risk environments. The paper further explores AI-driven smart gateways, which utilize hybrid CNN models to achieve up to 97% accuracy in face mask detection and 99% in face shield verification with sub-second processing latency. In the hospitality sector, predictive analytics and IoT sensors are shown to reduce resource wastage by 30% while significantly enhancing guest satisfaction. However, the adoption of these systems is hindered by technical challenges, including material degradation from UV-C/VHP exposure, high initial investment costs, and an expanded cybersecurity attack surface involving sensor jamming and data poisoning. Finally, this review addresses critical ethical and legal concerns, emphasizing the need for robust frameworks to manage data privacy (GDPR/HIPAA) and legal liability for autonomous agents. By examining resilient design and emerging trends like 5G-based Tactile Internet and Digital Twins, this paper provides a roadmap for transitioning from crisis-driven responses to sustainable, fully autonomous public health infrastructure.*

Keywords: Contactless sanitization, autonomous mobile robots, robotic disinfection, Internet of Things (IoT), artificial intelligence, smart healthcare systems, UV-C disinfection, robotic sanitization, contactless disinfection, smart hospitals, IoT-based monitoring