

A Comprehensive Review of Modern Technologies in Waste Collection: Driving Smarter and Greener Solutions for a Future-Ready Approach

RAKK Ranasinghe^{1#}, RPS Kathriarachchi², and GAD Ganepola³

^{1,2,3}Department of Information Technology, Faculty of Computing, General Sir John Kotelawala Defence University

[#]39-bit-0039@kdu.ac.lk

Abstract

Urbanization and Population Explosion are rapidly increasing challenges, for waste collection methods that struggle with inefficiency and environmental impact due to their reliance on fixed schedules and limited data utilization. This study tries to overcome these limitations and offers a comprehensive review of emerging technologies such as Internet of Things (IoT) based smart bins, Artificial Intelligence (AI) supported route optimization, Geographic Information System (GIS) applications in promoting waste collection effectiveness through green approach. Through these next generation technologies, cities can shift from outdated systems toward smarter, more efficient solutions that react dynamically based on real-time data. A systematic review of recent literature, from the last five years, on scholarly sources and academic databases was the research methodology. The concept was derived from case studies, which emphasized how modern technologies align and collaborate effectively mainly in lowering operational costs, optimizing resource usage, and improving sustainability. The key takeaway from this review is that the combined use of these modern technologies, the waste collection problem, is appropriately addressed through real-time monitoring, routing optimization and user engagement. A review points out the benefit of introducing such innovations into adaptive and eco-friendly waste collection systems in line with the objectives of smart cities. Although a few steps have been made forward in this regard, much more needs to be done on practical implementation, scalability, and representative precincts, therefore, requiring ample research opportunities in the future. This study offers a strategic roadmap for municipalities to adopt modern solutions, driving smarter and greener waste collection practices.

Keywords: *Waste collection, Modern technologies, Real-time monitoring, Route optimization, Environmental sustainability*