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CLENS: Garbage Awareness App using Gamification and IoT

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Abstract: Solid waste management remains a persistent challenge in rapidly urbanizing cities, such as Iligan City, Philippines, where increasing waste volumes strain existing facilities. This study conceptualizes CLENs, a holistic waste management awareness system that integrates gamification, artificial intelligence (AI), and Internet of Things (IoT) technologies. The proposed system employs AI-driven computer vision for garbage classification and volume estimation, IoT sensors for real-time data collection on waste and water quality, and a gamified mobile platform to incentivize community participation in proper waste segregation. By equipping waste collection vehicles with IoT devices and cameras, CLENs enables accurate data gathering, predictive analytics for optimized collection routes, and heat maps of waste generation. Furthermore, an IoT-based water monitoring subsystem measures critical environmental parameters, enhancing sustainability efforts. The study contributes to solid waste management research by presenting an integrated technological framework that supports local government units (LGUs), waste processors, and communities in fostering environmental responsibility. Expected outcomes include improved waste segregation compliance, optimized collection scheduling, enhanced recycling rates, and actionable insights for sustainable urban governance.

Key Words: solid waste management; gamification; Internet of Things (IoT); computer vision; environmental monitoring

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