# DESIGNING A WASTE SORTING SYSTEM USING THE RECURRENT NEURAL NETWORK METHOD FOR SOUND RECOGNITION INTEGRATED WITH THE INTERNET OF THINGS

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**ABSTRACT**

The complex waste management challenges in Indonesia demand effective, sustainable, and technology-driven solutions that enable direct waste sorting at its source. This study proposes the design of an automated waste sorting system employing sound recognition based on the Recurrent Neural Network (RNN) algorithm, integrated with the Internet of Things (IoT). The system utilizes the acoustic characteristics of various waste materials—such as plastic, organic, and metal—which exhibit distinct sound reflection patterns when dropped, represented in the form of mel-spectrograms. A Raspberry Pi 4 serves as the primary processing unit, supported by a microphone for sound input. The RNN model processes audio signals and classifies them into three categories: organic, inorganic, and noise. Classification results control a servo motor, directing waste to the organic compartment (130°), inorganic compartment (30°), or holding position when noise is detected. The system incorporates a single HCSR04 ultrasonic sensor as a classification validator to confirm the presence of a physical object, along with two additional HCSR04 sensors for real-time waste volume monitoring. Sound data were collected from various household waste types and used to train the model over 100 epochs, achieving validation accuracy between 90–95% with stable convergence and no overfitting. Actual experimental testing resulted in classification accuracy rates of 85.71% and 62.86% for inorganic and organic waste, respectively. The system's operational reliability is enhanced by both manual button-based interruptions and remote control via MQTT, both of which consistently achieved 100% success, affirming the system's robustness as a backup mechanism.

***Keywords**: Recurrent Neural Network, Sound Recognition, Internet of Things*.