Chapter 8
Modern Technological Innovation in Digital Wase Management

V. Vijayalakshmi
Department of DSBS, SRM Institute of Science and Technology, Kattankulathur, India

R. Radha
Department of DSBS, SRM Institute of Science and Technology, Kattankulathur, India

S. Sharanya
Department of DSBS, SRM Institute of Science and Technology, Kattankulathur, India

ABSTRACT

As the rapid pace of technological advancement continues to propel society into the digital age, the surge in electronic waste (e-waste) poses significant challenges to environmental sustainability. This research explores modern technological innovations in digital waste management that contribute to the reduction, recycling, and responsible disposal of electronic devices. Special attention is given to advancements in recycling methods, the application of artificial intelligence (AI), machine learning (ML), deep learning (DL), robotics, and IoT in automated e-waste processing. The research investigates the utilization of exploring how materials can facilitate easier recycling and reduce the environmental impact of electronic devices. The research also explores the role of extended producer responsibility (EPR) in adapting to sustainable practices in product design, disposal, and recycling. This research contributes by offering an understanding of the tools, strategies, and policies that can contribute to a more sustainable volume of e-waste in our increasingly digitized world.

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INTRODUCTION

E-waste poses a significant danger to human beings, animals, and even the environment due to its composition. Typically, e-waste contains materials such as metals, plastics, Cathode Ray Tubes (CRTs), circuit boards and printed cables. The precious metals such as platinum, gold, silver, and copper can be reclaimed through scientific processing of E-waste. However, the occurrence of hazardous substances including but not limited toarsenic, lead, copper, chrome, cadmium, barium, cobalt, brominated flame retardants, mercury, polychlorinated biphenyls (PCBs), nickel, selenium, lithium, and liquid crystal renders electronic waste (e-waste) highly perilous, particularly when subjected to crude dismantling methods and rudimentary processing techniques (Hindrise, 2023).

When electronic devices like Air Conditioners, Printers, Washing Machines, IPods, Medical apparatus, Televisions, Copiers, Servers, Cellular Phones, Transceivers, Fax Machines, Refrigerators, Battery Cells, Calculators, Compact Discs (CDs), Scanners, Monitors, Mainframes, and Computers become unfit for use, they contribute to the category of e-waste. Even in minute quantities, the occurrence of extremely toxic substances and heavyweight metals like lead, mercury, cadmium, and beryllium pose an important threat to the environment. Figure 1 clearly depicts the electronic waste materials.

Figure 1. E-waste materials

E-waste, or electronic waste, emerges when electronic or electrical devices become obsolete or surpass their expiration dates. The swift pace of technological progress and the constant introduction of new electronic devices contribute to the frequent replacement of older models, resulting in a substantial surge in e-waste generation in India. The inclination of individuals to embrace newer models and trending technologies, coupled with the natural decline in product lifespan, exacerbates the challenge of managing E-waste in the nation. The effective methods of E-waste in country like India hinges on the active participation of consumers. Various initiatives, like Extended Producer Responsibility (EPR), Design for environment, and the technology platform promoting the 3Rs (Reduce, Reuse, Recycle), aim to create a circular economy by encouraging customers to responsibly discard of E-Waste, enhance rates