

# Chapter 18

## Technological Advancements in E-Waste Management and Resource Recovery

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### **ABSTRACT**

*As the world digitizes rapidly, there has been an exponential surge in the generation of electronic waste (e-waste), and it poses a grave threat to our planet due to its hazardous components, improper disposal methods, and the sheer volume being generated. Adding to the problem, e-waste recycling is highly complex and tedious, making it difficult to keep up with the pace of generation as well as leading to wastage of various precious metals. The solution involves using advanced technology to develop and optimise a multi-step resource recovery system. This chapter emphasizes the importance of engineers in tackling e-waste and how cutting edge technology can have a significant positive impact on society without necessarily requiring on-site involvement. The research aims to explore innovative strategies and technologies which will play a vital role in revolutionizing e-waste management, with AI-driven diagnostics, repair guidance, component identification, and value assessment being the future of efficient, effective, and sustainable e-waste recycling.*

### **INTRODUCTION**

As the world digitizes rapidly, there has been an exponential surge in the generation of electronic waste (E-Waste), and it poses a grave threat to our planet due to its hazardous components, improper disposal

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methods, and the sheer volume being generated. Adding to the problem, e-waste recycling is highly complex and tedious, making it difficult to keep up with the pace of generation as well as leading to wastage of various precious metals.

The solution involves using advanced technology to develop and optimise a multi-step resource recovery system. This chapter emphasizes the importance of engineers in tackling e-waste and how cutting edge technology can have a significant positive impact on society without necessarily requiring on-site involvement. Two AI-based software utilising computer vision and deep learning algorithms are involved in the recovery process:

1. Identification of the different components present in a printed circuit board along with their physical health status to calculate recyclability.
2. Accurate assessment of the value of a printed circuit board by analysis of its composition and precious metals present.

The research aims to explore innovative strategies for making genuine factory parts more affordable and accessible, thus encouraging smartphone repair and prolonging their useful lifespan. Artificial intelligence will play a vital role in revolutionizing e-waste management, with AI-driven diagnostics, repair guidance, component identification, and value assessment, being the future of efficient, effective, and sustainable e-waste recycling.

## **The Problem at Hand**

The rise in popularity of electronic devices brings with it an escalating global concern: the surge of electronic waste (e-waste), especially pronounced in nations like India. The burden posed by e-waste is significant due to its harmful components, inadequate disposal strategies and overwhelming quantities being produced. Statistics further attest to the severity of this predicament. For instance, during 2019 alone, India stood as Earth's third highest producer of e-waste at roughly 3.2 million metric tons—with a mere tenth successfully recycled or properly disposed of. Regrettably, most end up strewn across landfills or processed through unofficial and perilous deconstruction methods (World Economic Forum, 2017).

The perils related to improper handling are highlighted via real-world occurrences; informal recycling endeavors within locations such as Ghana and Guiyu from China expose laborers to lethal elements without adequate protection—resulting in polluting soil & and water resources detrimentally affecting local ecological systems and communities alike (Chinese Academy of Sciences, 2018). Exactly so occurs also within Seelampur-Delhi, a region synonymous with unregulated e-waste recycling has impacted residents' health adversely with increased concentrations of heavy metals found throughout air, soil and even water bodies.

Concerns mount when coupled with lackluster awareness about correctly disposing of E-waste considered signs show large sectors oblivious regarding potential risks associated with the importance of maintaining responsible recycling habits. Therefore hordes continue to pile unwanted electronics onto landfill sites which invariably leads to loops dangerous pollution resource exhaustion.

Addressing this complex situation requires adopting all-encompassing sustainable action plans which include initiating educational outreach programs, spearheading policy change procedures, promoting infrastructure growth besides encouraging mindful consumer production behaviors. Roll-out responsibilities would mean setting up operative collection points and reengineering existing technologies used

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