IEEE YESIST12 IEngage Track Problem Statement

Sustainable E-Waste Tracking & Recovery Platform for India

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1. Abstract

India lacks a transparent, technology-driven, end-to-end digital ecosystem that ensures traceability, accountability, and incentivized participation across the e-waste value chain—from manufacturers to consumers to recyclers.

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2. Keywords

E-Waste, Sustainability, Re-Cycle, IoT, Cloud

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3. Introduction

India is the **third-largest producer of e-waste** globally, generating over **1.7 million metric tonnes annually**, with volumes growing rapidly due to smartphone penetration, affordable electronics, and digital transformation initiatives such as "Digital India" and "Make in India". The increasing turnover of smartphones, laptops, appliances and IoT devices has significantly shortened product lifecycles.

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4. Background and Motivation

Despite the introduction of the regulatory frameworks like E-Waste (Management) Rules 2016 and 2022, key challenges persist:

- Over 80% of e-waste is handled by the informal sector
- Limited traceability from production to end-of-life
- Poor collection efficiency in Tier-2 and Tier-3 cities
- Lack of consumer awareness and incentives
- Weak enforcement of Extended Producer Responsibility

(EPR) This results in:

- Environmental contamination
- Loss of valuable rare-earth metals
- Worker health risks
- Revenue leakage for formal recyclers

5. Problem Statement

Despite the introduction of the regulatory frameworks like E-Waste (Management) Rules 2016 and 2022, India still lacks a transparent, technology-driven, end-to-end digital ecosystem that ensures traceability, accountability, and incentivized participation across the e-waste value chain—from manufacturers to consumers to recyclers.

This results in

- Environmental contamination
- Loss of valuable rare-earth metals
- Worker health risks
- Revenue leakage for formal recyclers

Therefore**, there is a need to design** and develop a secure, scalable, and interoperable Circular E-Waste Tracking & Recovery Platform tailored to the Indian regulatory and socio-economic ecosystem that:

- Enables digital tracking of electronic products from manufacturing/import to disposal.
- Integrates formal and informal sector participants.
- Ensures compliance with India's EPR regulations.
- Incentivizes responsible disposal by consumers.
- Provides real-time analytics for regulators (CPCB/SPCB).

6. Scope of the Problem

- In scope:
    - E-Waste of India
- Out of scope:
    - Hazardous Waste
    - Biomedical Waste
    - Any other Waste category

7. Objectives

To Design and develop a sustainable, secure, scalable, and interoperable Circular E-Waste Tracking & Recovery Platform tailored to the Indian regulatory and socio-economic ecosystem that:

- Enables digital tracking of electronic products from manufacturing/import to disposal.
- Integrates formal and informal sector participants.
- Ensures compliance with India's EPR regulations.
- Incentivizes responsible disposal by consumers.
- Provides real-time analytics for regulators (CPCB/SPCB).

8. Constraints and Assumptions

Constraints:

- Regulatory Constraints
    - Must comply with India's E-Waste Management Rules 2016 & 2022
    - Alignment with CPCB / SPCB requirements
    - Data handling must comply with Digital Personal Data Protection (DPDP) Act 2023
- Infrastructure Constraints
    - Limited E-waste collection centers in Tier-2 / 3 cities
    - Lack of standardized product identification mechanisms across manufactures.
- Operational Constraints
    - Large volume of legacy devices already in circulation without digital records
    - Informal sector dominance in last-mile collection
    - Limited technical expertise among recyclers and dismantlers
    - Hazardous material handling

requirements Assumptions

- Smartphone penetration in India exceeds 70%
- Cloud Infrastructure is accessible and scalable
- Unique device identification is available for major product categories

9. Significance of the Problem

Addressing this problem contributes directly to:

- India's Net Zero 2070 commitment
- Sustainable Urban development
- Digital India Infrastructure Goals
- Digital transformation for societal benefit
- Sustainable engineering

10. Expected Outcomes (Optional)

Expected Outcomes

- Increase formal collection rate by ≥30%
- Improve EPR compliance transparency
- Reduce environmental leakage from informal recycling
- Enable circular economy data visibility
- Support India's Net Zero 2070 goals

Measurable KPIs

- % increase in traceable e-waste
- Reduction in informal processing share
- Consumer participation rate
- Material recovery efficiency
- Regulatory reporting accuracy

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