УДК 004.896

LEVERAGING AI FOR OPTIMIZED WASTE MANAGEMENT AT ELECTRONICS INDUSTRY

Kolpikova V.O. (ITMO)
Supervisor – associate professor of the Faculty of Ecotechnologies, Sergienko O.I. (ITMO University)

Introduction. Electronic waste volumes are rising exponentially, posing environmental hazards and sustainability challenges [1]. Manual e-waste handling cannot cope with the diversity of materials and toxins involved. While linear "cradle-to-grave" production models still dominate, circular economy ideals are gaining traction. Intelligent systems leveraging AI and IoT can elevate e-waste tracking, segregation and process improvements to enable closed-loop flows [2].

Main Body. Emerging techniques like computer vision, convolutional neural networks and sensor analytics are primed to transform e-waste management. Sensor networks powered by machine learning algorithms can automatically characterize waste streams in real-time across factory floors and supply chains [3]. Models like TensorFlow Lite [4] allow lightweight yet accurate on-device inference without connectivity constraints. Cloud-based systems aggregate sensor outputs like images, weight and fill levels to reveal waste accumulation patterns. Advanced forecasting and simulation modules test operational changes prior to implementation.

Overall, the integrated solution establishes a digital thread connecting equipment data, anomaly trends and waste flows to preemptively highlight recurring sources of e-waste. It combines real-time visibility, analytics-based intelligence and automated handling to significantly minimize hazardous scrap volumes through informed segregation and data-backed adaptation. The system heralds a shift from mere disposal compliance to circular flows where components re-enter production lines instead of landfills.

Conclusions. In summary, AI and IoT-powered techniques offer sophisticated e-waste management capabilities beyond manual approaches. The proposed system exemplifies technologies like computer vision, machine learning and digital twin simulations that can provide granular tracking, predictive modelling and scenario testing. For electronics manufacturers, this enables optimized segregation, tailored process improvements and establishing circular material flows. The solution can scale across industry sectors to drive the sustainability transformation.

Literature review

1. Forti V. et al. The global e-waste monitor 2020 // United Nations University (UNU), International Telecommunication Union (ITU) & International Solid Waste Association (ISWA), Bonn/Geneva/Rotterdam. 2020. Vol. 120.
2. Dorsemaine B. et al. Internet of things: a definition & taxonomy // 2015 9th International Conference on Next Generation Mobile Applications, Services and Technologies. IEEE, 2015. P. 72–77.
3. Yang M., Thung G. Classification of trash for recyclability status // CS229 project report. Stanford university, 2016. Vol. 2016, № 1. P. 3.
4. Voskergian D., Ishaq I. Smart E-Waste Management System Utilizing IoT and DL Approaches // International Conference of Innovation and New Trends in Information Technology. Springer, 2022. P. 88–103.