AI-Assisted Sorting for The Circular Economy

Neatco Engineering Services Inc.

When it comes to recycling solid waste, especially e-waste, sorting is a crucial element of the process. It is essential to first separate different commodities or objects based on their characteristics and composition in order to recycle them properly. In light of new Extended Producer Responsibility (EPR) regulations, the classification, tracking, and sorting based on branding or OEM manufacturer has lately become important as well.

A good example of the importance of sorting is battery recycling. Rechargeable batteries contain rare-earth metals such as Lithium, Nickle, and Cadmium, whereas non-rechargeable Alkaline batteries have different chemical compositions containing mostly Zinc and Manganese. Household batteries are produced by different manufacturers in different sizes and shapes. When they are collected and brought to recycling warehouses, they are mixed. The first tedious recycling task is to sort them based on their chemical composition as explained above.

Currently, manual sorting lines consisting of a conveyor belt and human pickers are very common for this task. The human pickers must go through a training program to learn the tens of hundreds of different types of batteries showing up on the sorting line. They must be manually picked and placed into different bins based on the categories they belong to before being recycled. As such, the experience of those human sorters plays a major role in the quality and purity of sorted batteries. However, as labor retention is a growing issue in recycling, recyclers must either struggle with labor shortages and bear the financial burden of training new employees or they must consider employing automated technology such as optical sorters. Due to the complexity, cost, and efficiency of employing such optical sorters have legitimate concerns and questionable ROI.

Like battery sorting, there are other tasks that require human experience for identification such as classifying Printed Circuit Boards (PCBs). The classification is determined by the value of precious metals present on the PCB. For example, high- or low-grade board grading can be based on the amount of gold present, the value of surface-mounted components such as certain types of chipsets, or based on the serial number of the boards and the OEM manufacturer. The human sorter must have a great deal of experience and knowledge to determine the value of these boards and to sort them properly.

Recent advancements in AI hardware and software have made it possible to train deep learning networks using labeled images of objects with certain features. These networks can then act like experienced human sorters to categorize the objects based on their desired classifications. The output of these networks is typically utilized by robots or other physical actuators to sort the objects into different bins. However, as mentioned before the cost of implementation of these mechanical manipulators may be prohibitive for some recyclers. An alternative would be an AI-Assisted approach which augments the human sorting skills by using a trained neural network to aid an unskilled worker.

This novel approach uses a trained network that mimics a well-experienced human picker and can assist an unskilled one to perform the physical sortation by color-coding the objects based on their categories. The worker simply needs to sort based on the projected colors, rather than understanding themselves with the more nuanced characteristics for sorting. The advantages of this intermediate solution are a drastic reduction in training required to perform complex sorting tasks, maintaining sorting experience

in the company, improving the soring experience by retraining the network on further nuanced data, achieving a throughput of high quality and purity of sorted materials, and considerable cost and time reduction in implementation compared to robotics or optical sorters.

About Neatco's AI-vision Controller, IntelSight:

Some Applications in WEEE Recycling:

- IT assets data collection, analytics, tracking, and reporting
- IT assets inspection, value estimation, and OEM detection
- Identifying devices with embedded battery
- PCB grading based on the number of precious metals
- Detecting valuable and sellable chipsets and components on PCBs
- Connectivity to websites and databases for tracking IT assets and value estimation for buyers
- Providing an online tool for the customer to evaluate their electronic devices and boards
- Battery classifications and sorting based on their chemicals
- Hazards detection prior to shredding
- Detecting metal concentration in shredded materials
- Identifying contamination in Zorba aluminum and ferrous lines
- Classifying plastics based on their polymers using IR cameras

Process Monitoring and Control:

- Control different types of robots for sorting (IntelSort)
- Robotic dismantling of IT assets
- Control projectors for color coding on moving objects (Neatco's proprietary AI-Assisted Sorting technology)
- Control diverters and air-jets of sorting equipment
- Output monitoring of existing commodity recovery equipment and parameter tuning for improving their performance

Main Features: Rugged industrial design, scalable and compatible with common machine vision standards, variety of industrial I/Os, user-friendly, easy to install, train, maintain, and operate (no need for special AI skills), NA field support, and affordable.

Neatco is your reliable and trustable AI technology provider with over a decade of working experience in WEEE recycling. To learn more about Neatco's **IntelSight,** a proprietary **AI-Assisted Sorting** solution, and receive a live demo, please contact us at info@neatcoeng.com or visit us at https://neatcoeng.com

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