Combined AI and Data solutions for AUTOMATION

Challenge 4.3

Semi-automated EV battery disassembly for recycling

4 Combined AI and Data solutions for AUTOMATION

4.3 Semi-automated EV battery disassembly for recycling

Challenge and Context: EV batteries across manufacturers and cars vary significantly, with each battery type having its own cables, bus bars, modules, and different types of cells inside. This variability makes the automation of battery dismantling for recycling purposes challenging. Additionally, current EV batteries subject to recycling are mainly Li-ion based, posing hazard risks for recycling processes. Automating each process for each battery type is time-consuming and costly. Battery recycling companies face these challenges, which AID4SME can overcome for use-case owners both inside and outside the consortium. Inside the consortium, a partner aims to implement semi-automatic dismantling of batteries cells and modules. As the dismantling would be implemented on not-good batteries coming out of the production line, automation could be envisioned since battery cells and modules design would be known and controlled. This would enable the creation of an in-house circular input stream for the resources needed for battery production.

Use Case and Expected Solution: Currently, different battery recycling developments are ongoing, using collaborative robots. However, these activities mainly focus on automating the dismantling of one type of battery, with limited applicability to other types of batteries with different geometries and internal distributions. Another partner has a laboratory for battery dismantling with an industrial robot at TRL 4, specifically focusing on developing a flexible battery dismantling process. This partner has several technology blocks at TRL 4, using computer vision and AI technologies from other areas, supporting the development of dismantling operations on different batteries without specific robot programming for each.

The solution enables upscale the circular input stream for battery production and reduce hazard risks. This will result in more efficient battery recycling processes, better utilization of resources, and enhanced overall sustainability.

Specifications for Use Case: The consortium partner will guide and mentor SMEs to develop a robot cell for semi-automatic battery dismantling of various EV battery types, extending to overall mechatronic system demanufacturing approaches. In this solution, a human operator manually performs tasks the robot cannot, while the robot handles repetitive and dangerous operations such as opening the battery pack while charged or picking up heavy components. For operations that cannot be automated, the user can control the robot using teleoperation, moving the robot and indicating the position using a VR device. Solutions will be demonstrated for the partner’s use case at TRL 6. This will enable to implement an EV battery type-agnostic, semi-automated dismantling process, upscaling the circular input stream of resources needed for their battery production while maintaining low hazard and safety risks for operators.

The selected third party is expected to contribute with the following:

- **Battery Assessment**
  Evaluation of battery performance, capacity, and overall condition.
- **Safety Measures for Battery Handling**
  Protocols and best practices to ensure safe handling, storage, and transportation of batteries.
- **Battery Defect Detection**
  Identification of manufacturing or operational defects in batteries using diagnostic tools and inspection methods.
- **Battery Health Monitoring**
  Assessment of battery state-of-health (SoH) using sensors and diagnostic data (e.g., temperature, voltage, internal resistance).
- **Battery Charging and Discharging Methods**
  Procedures and technologies for safe and efficient charging and discharging of batteries.
- **Decision-Making for Second Life, Reuse, or Recycling**
  Criteria and processes for determining whether a battery should be reused, repurposed for second-life applications, or sent for recycling.

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Key Performance Indicators:

- Percentage of dismantling operations performed autonomously by the robot, reduction in manual intervention compared to traditional dismantling methods, value of battery dismantled in a week, percentage of weight battery recovery, accuracy of robotic operations, scalability potential (% of dismantling steps automated, % reduction in dismantling time per battery).
- increase in the number of reusable/recyclable materials recovered, reduction in waste and environmental impact from battery dismantling (% of materials recovered for reuse, % increase in recyclable material yield)
- demonstrate progress in labour conditions, improvement in ergonomic conditions for workers, adoption rate of teleoperation, gender diversity (% reduction in manual labor exposure to hazards).

To be noted, the list of KPIs provided in this section is not exhaustive but rather indicative. Additional KPIs will be studied and can be integrated to ensure quality outcomes.

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