THE FUTURE OF BATTERY RECYCLING (IT'S AUTOMATED DISASSEMBLY)

A review on the current and potential future of battery recycling

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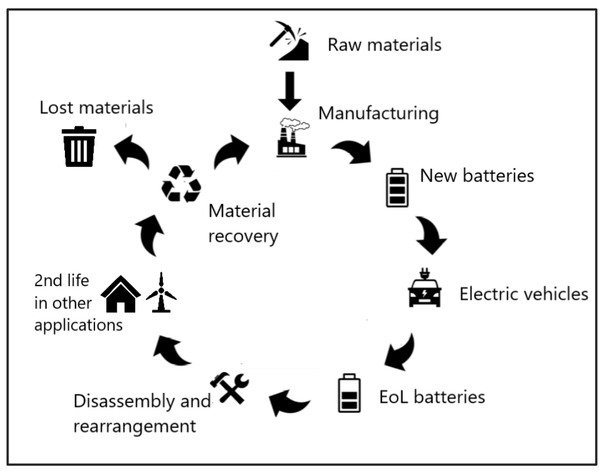
1. ABSTRACT

The electric vehicle (EV) revolution is quickly taking over the personal transport market. Initially popularized as a greener alternative to internal combustion engines, we are now facing the consequences of the production of countless EV battery modules. The discarding of these modules harms the environment, and the material recovery process is both energy intensive and wasteful.

This literature review aims to provide a comprehensive guide to the current state of battery recycling, the issues it faces, and how automation can help alleviate them. The difficulty of recycling end of life (EoL) batteries is a symptom of our shortsighted manufacturing. This can be addressed with partially automated, telerobotic workstations and cured with a more modular, standardized manufacture process.

2. MOTIVATION

- Material recovery of batteries is energetically inefficient, and environmentally demanding .
- The EV boom[1] will result in thousands of end-of-life batteries in coming years.
- The current system is not built to allow an optimal circular battery economy.

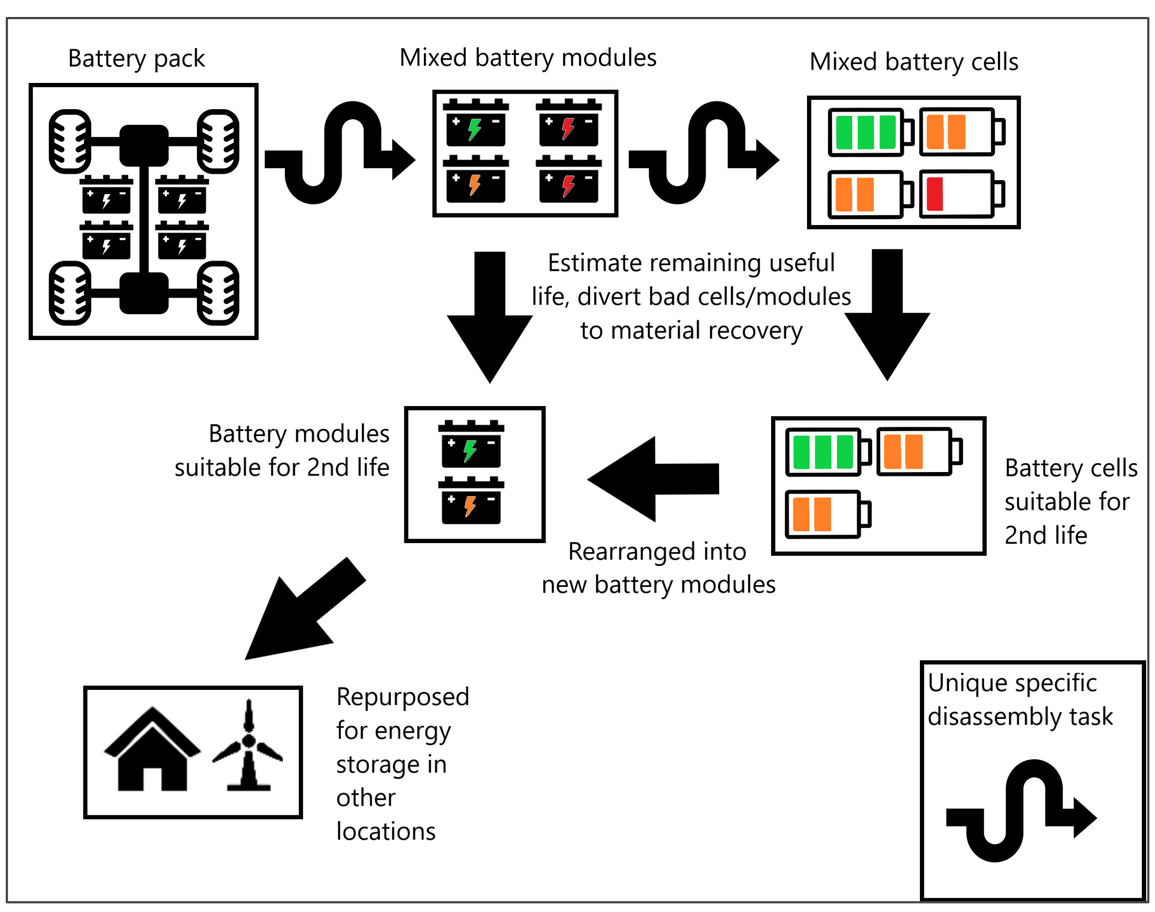


3. METHODS

- Web Of Science, Google, and Google Scholar were used to search for papers and other sources of information.
- Keywords: Battery, recycling, end of life (EoL), material recovery sorting, digital passport, AI, disassembly, automation, image recognition, telerobotics, VR, state of health, (SoH), remaining useful life (RuL), echelon utilization

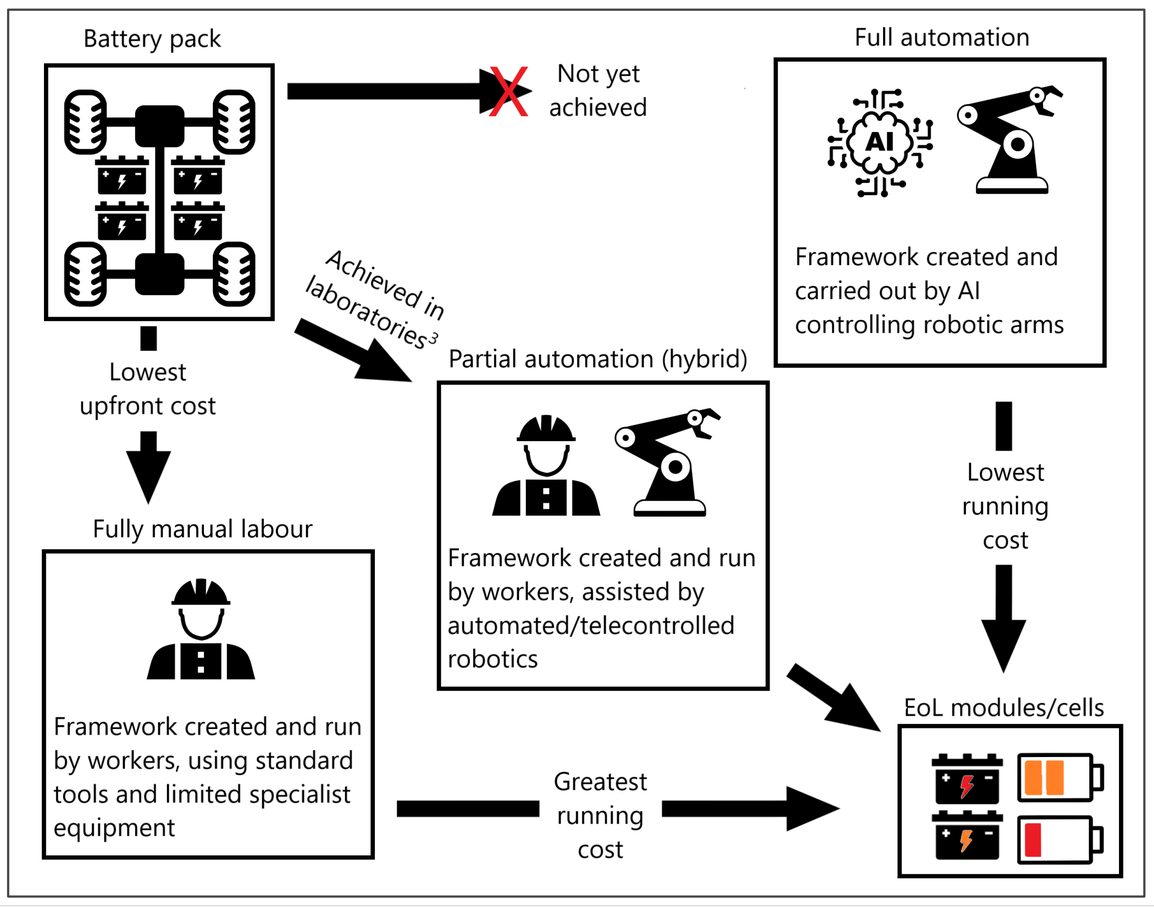
4. WHY SHOULD WE AUTOMATE DISASSEMBLY?

- To use 2nd, 3rd, 4th etc lives of EV batteries (A.K.A. the echelon lifespan) the battery packs must first be disassembled.
- Disassembly of EV batteries is a laborious and hazardous task. Automation of disassembly will reduce both the labour cost and risk to human life of the process.



5. CONCLUSIONS

- Sorting of batteries with the use of AI is likely viable but serves little purpose due to the abundant variety, akin to sorting snowflakes.
- The number of parameters in EV batteries makes training AI for framework formation impractical.
- Estimation of RuL can be accelerated via analysis of EIS spectra by AI[2].
- Requirement for sorting and estimating SoH could be eliminated by digital passports in future.



6. IMPACT / NEXT STEPS

Many of the issues illustrated above stem from the lack of a universal blueprint for an EV battery. By assembling with disassembly in mind, a greater degree of modularization can be achieved, making disassembly and repair easier.

- Focus research on telerobotics and hybrid workstations

The large variety of EV battery designs and chemistries makes training AI with *full* automation in mind is impractical with current EV battery waste.

- Further research on AI assisted RuL estimation

RuL estimation using AI analyzed EIS spectra is both quick and accurate, but has room for improvement.

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INTERN BIO

Ben is studying chemistry with computer science at the University of Birmingham. Interested in the energy sector – more specifically the production and storage of green energy, Ben is aspiring to use his chemistry/computer science background to assist in the world of chemical simulations to discover/study new and potentially interesting battery materials.
After working hours, Ben spends most his time playing badminton or League of Legends.

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