Application of Internet of Things (IoT) Technology and Machine Learning Methods for Promotion of Lithium Battery Recycling in HK Community

應用物聯網技術和機器學習方法在香港推廣鋰電池回收

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Strategic Theme(s):

Green and Sustainable Energy

Smart Interactive Kiosk for Lithium Battery Recycling Promotion

Smart Robot

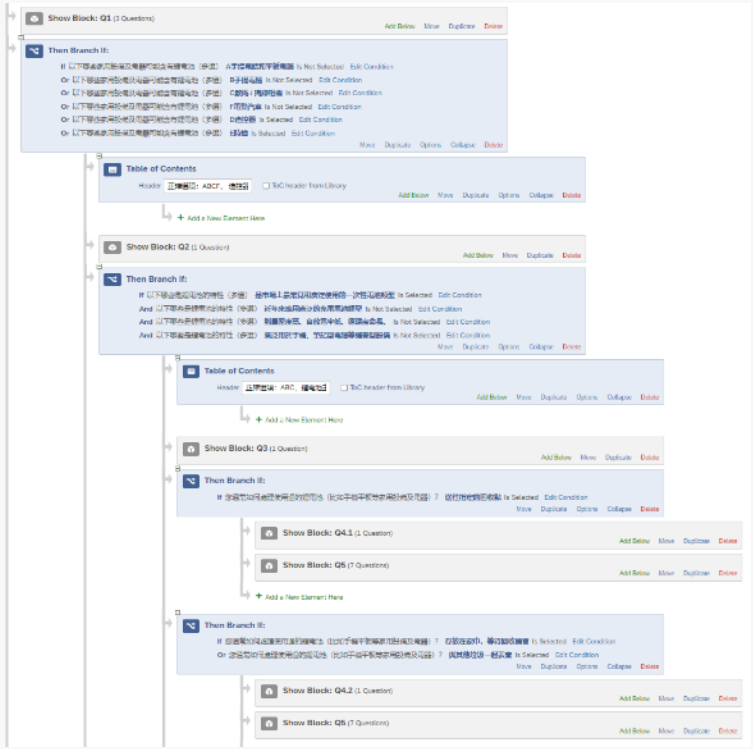
The project has developed a smart interactive kiosk called smart robot for Lithium Battery Recycling Promotion, which aims to increase public awareness and participation in the recycling of used lithium batteries through a mobile promotional platform.

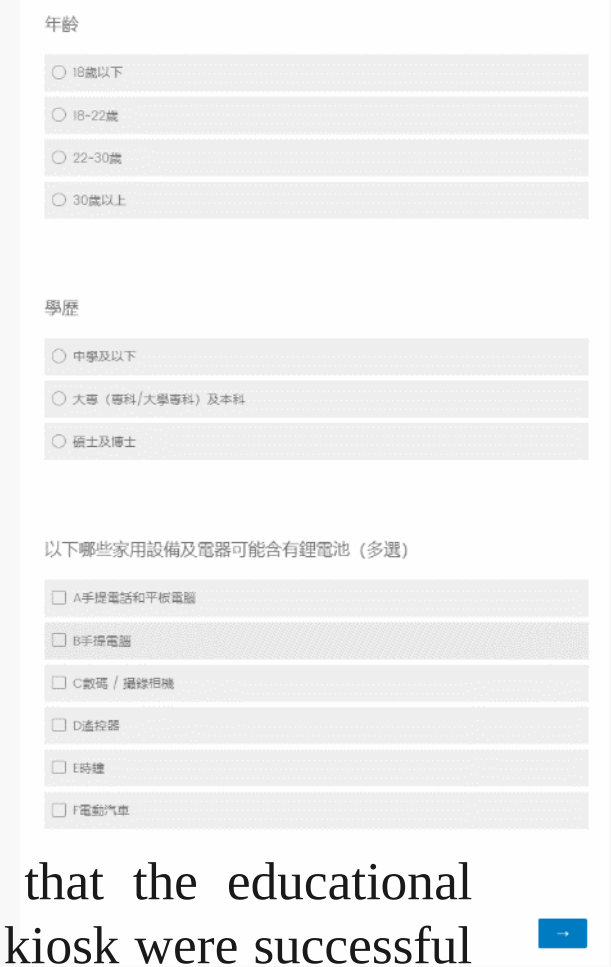
The robot is capable of flexible movement and features a built-in screen for playing promotional videos and a QR code survey. This allows the public to participate in battery recycling campaigns anytime, anywhere. The robot is not only user-friendly and convenient, but also highly efficient and energy-saving, making it a powerful tool for promoting environmental awareness.

Website for Lithium Battery Recycling Popularization

The project has developed a website called Website for Lithium Battery Recycling Popularization, which features two promotional videos aimed at raising public awareness and encouraging participation in lithium battery recycling. Additionally, the website offers a QR code survey for users to complete.

Survey for Lithium Battery Recycling





The survey data analysis showed that the educational videos displayed at the information kiosk were successful in increasing public knowledge and significantly promoting recycling participation.

Lithium Battery Recycling Knowledge Popularization Video

Lithium Battery Recycling.mp4

EV Battery Recycling Knowledge Popularization Video

EV Battery Recycling.mp4

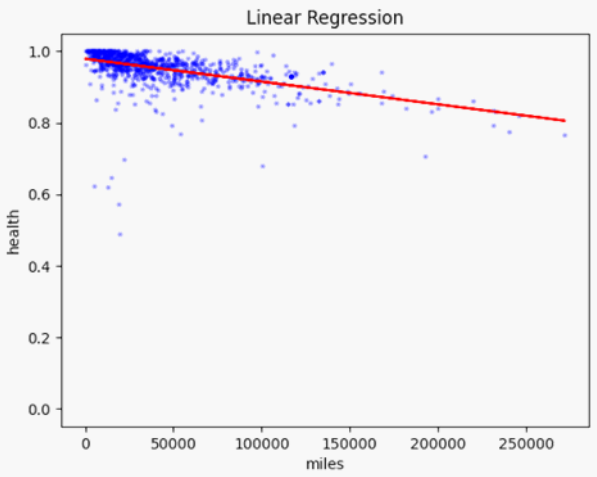
EV Battery Recycling Knowledge - Degradation Curve

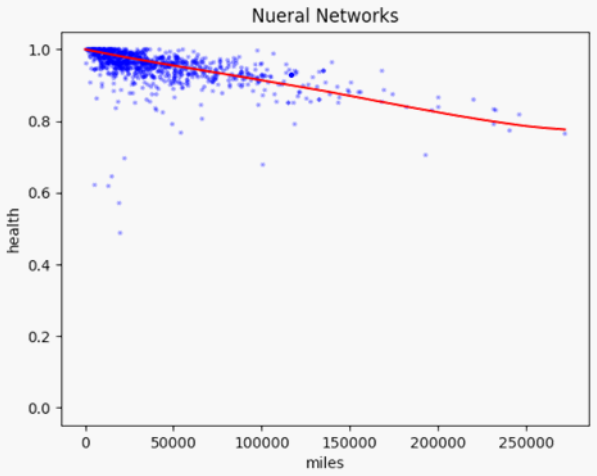
From the collected EV battery samples in the project, we used various methods to analyze and obtain the decreasing trend of the EV battery health with driving distance.

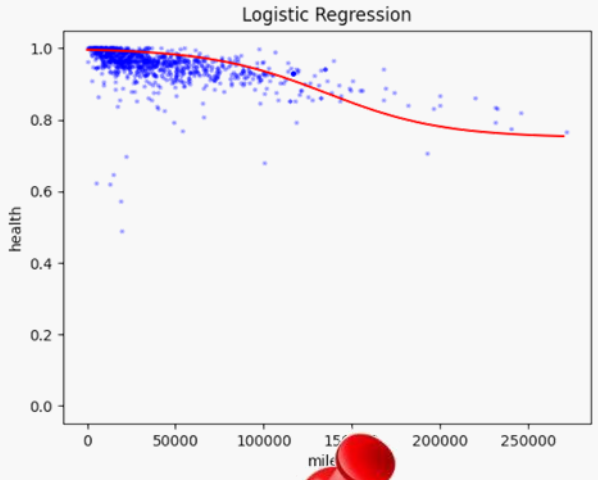
In order to improve the rationality of the degradation curve, constraint conditions were added to the model $\widehat{\boldsymbol{F}}$ during AI-based learning.

$$\widehat{\boldsymbol{F}}(0) = 1$$

$$\frac{\partial \widehat{\boldsymbol{F}}}{\partial miles} \leq 0$$







Based on the curve, it can be inferred that at approximately 220,000 miles of driving, the battery health will decrease to around 80%, indicating the need for replacement.

KE outcomes and impact

This project aims to promote lithium-battery recycling in Hong Kong to contribute to the city's sustainability. Our team designed a smart interactive kiosk, conducted campus promotions, created posters and videos, and carried out surveys to raise public awareness and participation in lithium-battery recycling. Additionally, the project addressed the disposal needs of electric vehicle (EV) lithium-batteries. Our team utilised machine learning to analyse data from 625 Tesla vehicles, establishing a neural network model that describes the battery capacity decline with mileage. Combining this with Hong Kong's EV data, we projected the EV lithium-battery disposal demand in HK for the next 10 years, providing a decision-making basis for the government and enterprises to plan disposal or recycling facilities. In summary, this project tackles lithium-battery recycling from both the household appliance and EV perspectives. It is crucial for reducing battery disposal in landfills and recovering valuable metals. Through innovative approaches, such as smart kiosks and data-driven forecasting, the project aims to promote lithium-battery recycling and support Hong Kong's sustainable development.

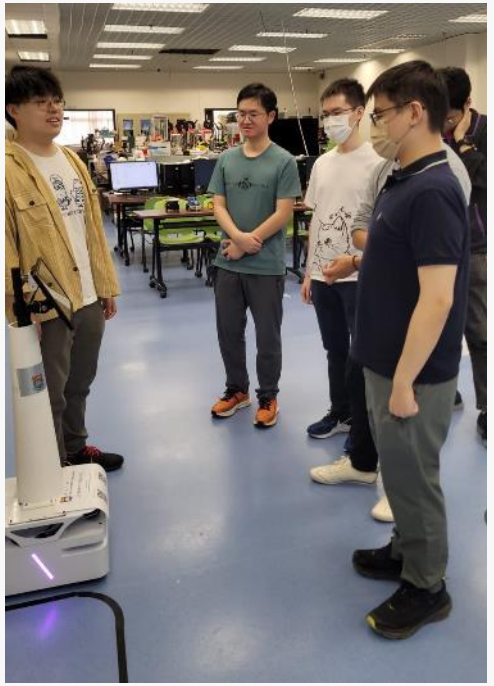
知識交流的成果和影響

本項目致力於促進香港鋰電池的回收。團隊通過設計智慧互動亭、開展校園宣傳、海報及視頻宣傳和問卷調查，提高了民眾對鋰電池回收的認知和參與意願。同時，針對EV鋰電池回收需求，團隊利用機器學習等方法，分析了625輛特斯拉的實際使用資料，建立了描述電池容量隨使用里程下降規律的神經網路模型。並結合香港電動車資料，預測了未來10年香港EV鋰電池的回收需求，為政府和企業規劃回收設施提供決策依據。總的來說，本項目從家用電器和EV兩個層面，致力於推動香港的鋰電池回收，對於減少電池進入垃圾填埋場、回收利用有價金屬具有重要意義。

Knowledge Promotion

We organized events to promote lithium battery recycling to secondary school students. The event included interactive activities and educational videos designed to increase awareness and encourage participation in battery recycling. The students were able to learn about the importance of recycling and how to properly dispose of their used batteries. The event was a success and helped to raise awareness among the younger generation about the importance of environmental sustainability.

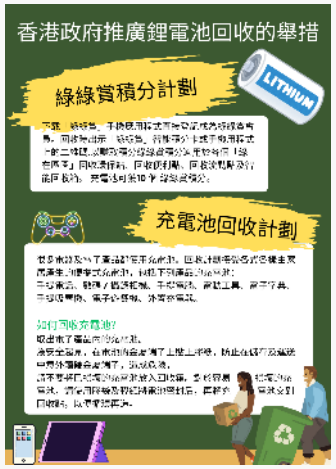
Knowledge Promotion for Secondary School Students

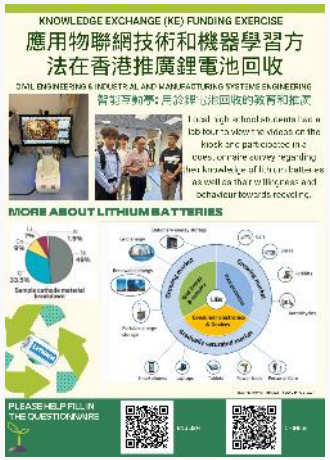


Knowledge Promotion Booth

We set up a booth within a university to promote lithium battery recycling. The project included the design of promotional posters, the placement of intelligent robots to promote battery recycling, and the distribution of gifts and souvenirs to encourage participants to watch educational videos, listen to lectures on battery recycling, and complete designed surveys. The event received positive feedback and was successful in raising awareness about the importance of proper battery disposal.

Knowledge Promotion Booth in HKU Campus





Original sized photos are requested for HKU's website/social media