



DYNAMIC MACHINE LEARNING SYSTEM FOR BEV CHARGING DEMAND PREDICTION





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Product Background

- EV Battery Electric Vehicle (BEV) relies on its lithium battery for propulsion. Reducing power demand from the battery will lead to its longer lifetime operation.
- The variable and uncertain charging demand of BEVs creates substantial difficulties for the power grid by causing surge in peak power usage. Fluctuations in frequency and voltage levels, and an overall increase in average utilization that needs to be carefully managed.



Methods

- Machine learning is employed to predict BEV charging demand and power demand to optimize charging and power usage.
- The model is trained using data collected from real-time monitoring of BEV charging stations.
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Usefulness/ Applicability

- Provides data-driven insights and analysis for charging stations, power grids, and vehicle manufacturers to optimize their operations.
- Helps in predicting and managing BEV charging demand, reducing power usage, and improving overall system efficiency.

Novelty/ Inventiveness

- Developed a dynamic machine learning system for BEV charging demand prediction.
- Implemented a real-time monitoring and prediction system for BEV charging stations.

Marketability & Commercialization

- Targeted for use in charging stations, power grids, and vehicle manufacturers.
- Potential for integration with existing BEV infrastructure and charging networks.

Status of Innovation

ITEX 24 Gold Award

RECLAMATION OF UNDERWATER WASTE



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Product Background

- Underwater waste is a significant environmental issue that poses a threat to marine ecosystems and human health.
- The current methods of underwater waste collection are inefficient and costly.





Methods

- Developed an intelligent underwater waste collection system using machine learning.
- Implemented a real-time monitoring and prediction system for underwater waste.

Usefulness/ Applicability

- Enhanced cleaning efficiency.
- Improved navigation.
- Comprehensive coverage and cleaning.
- Cost-effective data collection (temperature, pressure, and depth).
- Proactive maintenance.
- Reduces the need for manual labor.
- Applicable to various underwater environments (coastal areas, ports, etc.).
- Contributes to environmental conservation efforts, promoting cleaner and healthier ecosystems.

Novelty/ Inventiveness

- Developed an intelligent underwater waste collection system using machine learning.
- Implemented a real-time monitoring and prediction system for underwater waste.

Marketability & Commercialization

- Targeted for use in coastal areas, ports, and other underwater environments.
- Potential for integration with existing underwater infrastructure.

Status of Innovation

- ITEX Level B
- Prototype

SDG Impact

- 14: Life Below Water
- 13: Climate Action

Publication

Impact and Commercialization of Research (Undergraduate Research Month, University of Malaya)

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[Research](#)

Associate Professor Dr. Roslinazairimah produces electricity forecasting software for electric cars

15 July 2024

PEKAN, 27 May 2024 – It is common knowledge that the use of electric cars in Malaysia is gaining attention, especially Malaysian automotive enthusiasts and consumers.

However, the increasing use of electric cars will also affect the generation and distribution of electricity in Malaysia because the battery capacity of electric cars is large and needs to be connected to the electricity supply system to be charged.

The lecturer of the Centre for Mathematical Sciences (PSM) Universiti Malaysia Pahang Al-Sultan Abdullah (UMPSA), Associate Professor Dr. Roslinazairimah Zakaria produced software to predict the electricity requirements with high accuracy using statistical modelling hybridised with machine learning models.

This research was conducted with the lecturer of PSM UMPSA, Dr. Siti Roslindar Yaziz, lecturer of Universiti Teknologi Mara (UiTM), Dr. Noor Fadhilah Ahmad Radi and UMPSA postgraduate student, Syahrizal Salleh.

According to her, the increase in the use of electric cars in Malaysia will lead to an increase in the need for electricity that needs to be generated by electricity producing industries such as Tenaga Nasional Berhad (TNB).


“An accurate electricity demand forecasting model is absolutely necessary to avoid demand exceeding the capacity of the electricity generated.

“The lack of electricity can cause power outages, affect other industries and further stunt the country’s economic growth.

“The need for electricity from private chargers is dynamic because it depends on consumer activities such as during festive seasons, weekdays and weekends,” she said.

She added that the location of electricity needs will also change depending on the movement of electric vehicles such as swarm models.


“The infrastructure of the electricity supply system in strategic locations needs to be improved to ensure adequate electricity supply,” she said.




DYNAMIC MACHINE LEARNING SYSTEM FOR BEV CHARGING DEMAND PREDICTION

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AL-SULTAN ABDULLAH



25th INTERNATIONAL INVENTION, INNOVATION, TECHNOLOGY EXHIBITION & CONFERENCE, MALAYSIA

Product Background

- A Battery Electric Vehicle (BEV) relies on its onboard battery for propulsion, requiring periodic charging from the electric grid due to its large battery capacity.
- The variable and uncertain charging patterns of BEVs create substantial difficulties for the power grid by causing surges in peak power usage, fluctuations in frequency and voltage levels, and an overall increase in energy demand that needs to be carefully managed.



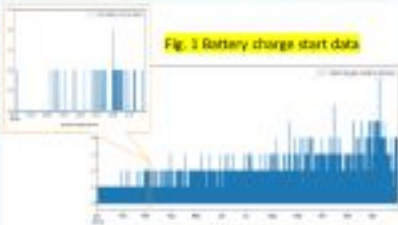


Fig. 1 Battery charge start data

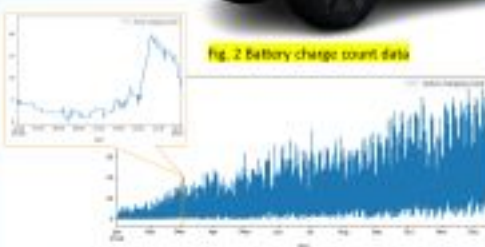


Fig. 2 Battery charge count data

Methods

- Feature engineering to transform multivariate discrete start-stop BEV charging data to univariate continuous time series BEV
- The use of fixed origin training data window for Long Short-Term Memory model suitable for ML/Dps workflow for production use.

LSTM Model for forecasting BEV load power demand from charging behavior

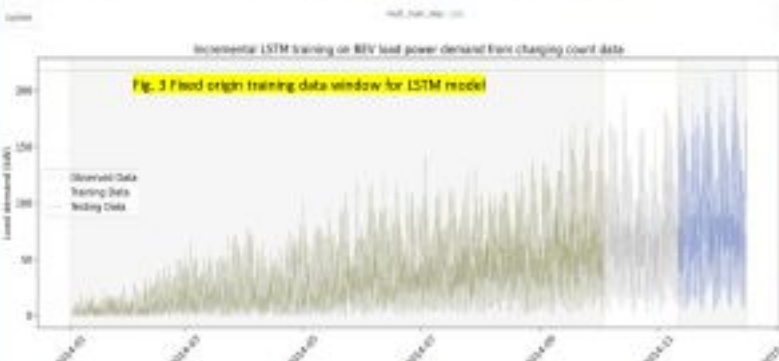


Fig. 3 Fixed origin training data window for LSTM model




Fig. 4 Loss function

Usefulness/ Applicability

- Accurate ultra-short-term forecasting is crucial for ensuring there is enough energy to meet peak demand, preventing financial losses and potential blackouts across the market.
- Statistical model developed able to predict the electricity demand from BEV at high accuracy.

Novelty/ Inventiveness

Ready-to-use system

- BEV data transformation procedure
- Forecasting electricity demand using hybrid Box-Jenkins-Machine Learning

Marketability & Commercialization

Electricity utility providers can develop comprehensive ecosystem to fulfil the electricity demand from BEV. TNB, PERCOUA, Sarawak Energy, etc.

Publication

- Salleh, S., Zakaria, R., Yaziz, S.R. 2024. Enhancing BEV Charging Prediction Using LSTM Networks on Feature-Engineered 1-Minute Resolution Start-Stop Charging Data. Jurnal Teknologi (Scopus, under review)
- Salleh, S., Zakaria, R., Yaziz, S.R. 2024. Battery Electric Vehicle Charging Load Forecasting Using LSTM on STL Trend, Seasonality and Residual Decomposition. Springer (Scopus, under review)
- Salleh, S., Zakaria, R., Mansor, M.M. 2024. LSTM Model Performance Comparison Between Estimation of BEV Charging Electricity Load Demanded and Its Reconstructed STL Time Series. IJEM, Springer (Scopus, under review)
- Salleh, S., Zakaria, R., Yaziz, S.R. 2023. Forecasting Electricity Demand from Battery Electric Vehicles using Box-Jenkins Modeling. IEEE (Scopus, under review)

API Services

- Installation and setup
- Technical support
- Maintenance
- Hardware support
- Application support
- Warranty

Status of Innovation

TRL – level 6

Achievement/Award





- GTREX 2023
- GTREX 2024

Acknowledgement


UMPSA Distinguished Research Grant: RDU233008
 International Matching Grant: UIC241502/RDU242702

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Environmental Impact/ SDGs

Collaboration



Chinohint Services

Malaysia is one of the countries that signed the Paris Agreement (Paris Climate Accords) in 2016 to limit the increase in global temperature to 1.5 °C since the era of industrialisation (starting in 1800).

In 2021, the 26th Conference of the United Nations Climate Change Conference (COP26) known as the Glasgow Climate Pact with the majority of members of the United Nations Framework Convention on Climate Change (UNFCCC) agreed to reduce the use of coal and fossil-based fuels for electricity generation and switch to green technologies to generate electricity such as solar and wind technologies.

She said that now we can be proud when Malaysia has shown a commitment by formulating policies to increase the use of electric cars to reduce carbon dioxide emissions.

“Electric cars rely on the energy stored in the battery to drive them.

“This software can reduce the gap between generation and the demand for electricity needed.

“In turn, it can reduce the risk of power outages and optimise operating costs,” she said.

The research, which began in 2021, was completed in early 2024 using data from a private electric car charger taken from research titled My Electric Avenue in 2017 in the United Kingdom.

According to her, the observed data should be changed to a time series format that can be modelled.

“After that, a statistical model hybridised with a machine learning model was built to predict electric energy consumption by electric cars that are being charged at private chargers for the next few minutes (ultra-short term load forecasting).

“This software can predict the amount of electricity needed with high accuracy at 98.8%.

“To extend the functionality of this software, private electric charging data from electric car manufacturers such as Perodua and Proton are needed to accurately predict electricity demand according to a dynamic location at a time and we have also held preliminary discussions with Perodua,” she said.

She said this is because the electric car private charging data obtained from Perodua or Proton can be analysed using this software to provide accurate information to electricity supply companies such as TNB to plan and develop appropriate and sustainable infrastructure.

“The estimated cost of the software is based on a working day wage of RM2,000 per day for a researcher for a period of five to ten days.

“Previously, I produced a machine learning model to predict chilli prices in Malaysia as well as economic indicators using econometric models,” she said.

The software won a silver medal in the Invention, Creative and Innovation Competition (CITREX) 2023 and CITREX 2024, while it received a gold medal in the 35th International Invention, Innovation & Technology Competition & Exhibition, Malaysia (ITEX) 2024 which took place on 16 to 17 May 2024 at the Kuala Lumpur Convention Centre (KLCC).

By: Nur Hartini Mohd Hatta, Centre for Corporate Communications

- 121 views

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