





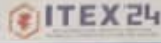
## DYNAMIC MACHINE LEARNING SYSTEM FOR BEV CHARGING DEMAND PREDICTION



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ITEX 24

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**Product Background**



- EV Battery Electric Vehicle (BEV) relies on the lithium battery for propulsion. Charging periods charging from the electric grid due to its high lithium capacity.
- The variable and uncertain charging patterns of BEVs create substantial difficulty 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 a computer science discipline that uses statistical methods to build models that can learn from data to make predictions or decisions. In this study, the proposed system uses machine learning to predict the charging demand for BEVs within the transportation system.

**USE CASE FOR PREDICTING BEV CHARGING DEMAND FROM CHARGING STATION**

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**Usefulness/Applicability**

- Resolves data management, accessibility, and security for charging station data, providing charging station owners with valuable insights and data for predictive maintenance.
- Enables smart charging stations for better load balancing and energy efficiency.
- Reduces the need for manual data collection and analysis.

**Novelty/Inventiveness**

- Introduces a dynamic machine learning system for predicting BEV charging demand.
- Integrates real-time data and historical data for improved accuracy.
- Provides a user-friendly interface for charging station operators.

**Marketability & Commercialization**

- Targets urban centers with high population density and a high concentration of charging stations.
- Market potential: High demand for smart charging solutions.
- Revenue model: Subscription-based service.

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**Status of Innovation**

**API Services**

- Machine Learning
- Statistical Analysis
- Data Management
- Visualization
- Reporting
- Integration
- System

**Achievement/Reward**

ITEX 24 GOLD AWARD

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**Publications**

1. Rosli Mazarinah, Shaheizal Salem, Niti Rosli Andriyaz, Noor Kholeah Ahm Raz, "Dynamic Machine Learning System for BEV Charging Demand Prediction from Charging Station", *International Journal of Advanced Research in Computer Science and Information Technology*, Vol. 11, No. 10, pp. 1015-1022, 2021.


2. Rosli Mazarinah, Shaheizal Salem, Niti Rosli Andriyaz, Noor Kholeah Ahm Raz, "Dynamic Machine Learning System for BEV Charging Demand Prediction from Charging Station", *International Journal of Advanced Research in Computer Science and Information Technology*, Vol. 11, No. 10, pp. 1015-1022, 2021.

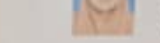
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**Environmental Impact/SDGs**

7: Affordable and Clean Energy  
 11: Sustainable Cities and Communities  
 13: Climate Action

RE  
CL





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**Product Background**

**Novelty/Originality/Inventiveness**

- Suitable for cleaning, monitoring and detecting pollution, water levels and data to monitor water quality and water temperature.
- Equipped with industrial-grade underwater sensor modules for efficient data logging (depth range 270m).

**Benefits/Usefulness/Applicability**

- Enhanced cleaning efficiency
- Improved navigation
- Comprehensive coverage and 24/7 cleaning
- Comprehensive data collection (temperature, pressure and depth)
- Proactive maintenance
- Reduces the need for manual inspection
- Applicable to various underwater environments (docking ports, oil rigs, etc.)
- Contributes to government cleanup efforts, promoting cleaner and sustainable ecosystems

**Status of Innovation**

- TTC, Level B
- Prototype

**SDG Impact**

6: Clean Water and Sanitation  
 14: Life Below Water

**Publication**

1. Rosli Mazarinah, Shaheizal Salem, Niti Rosli Andriyaz, Noor Kholeah Ahm Raz, "Dynamic Machine Learning System for BEV Charging Demand Prediction from Charging Station", *International Journal of Advanced Research in Computer Science and Information Technology*, Vol. 11, No. 10, pp. 1015-1022, 2021.

2. Rosli Mazarinah, Shaheizal Salem, Niti Rosli Andriyaz, Noor Kholeah Ahm Raz, "Dynamic Machine Learning System for BEV Charging Demand Prediction from Charging Station", *International Journal of Advanced Research in Computer Science and Information Technology*, Vol. 11, No. 10, pp. 1015-1022, 2021.

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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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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.



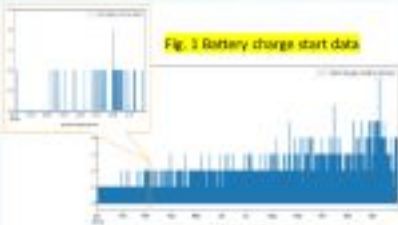


Fig. 1 Battery charge start data

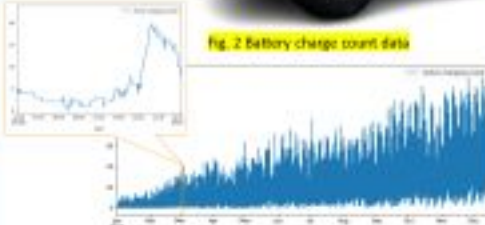


Fig. 2 Battery charge count data

### 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

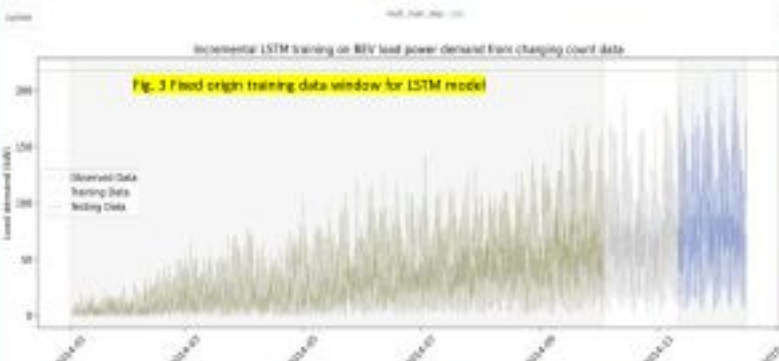


Fig. 3 Fixed origin training data window for LSTM model




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. ICGM, 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


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 International Matching Grant: UIC241502/RDU242702

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### Environmental Impact/ SDGs

### Collaboration



Chinohint Services

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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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