Electric Vehicle Charging Allocation Considering Electricity Price Fluctuation

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Abstract. Charging decisions on electric vehicles is an important aspect to consider for ensuring the continuity of the electric vehicle demand satisfaction. An electric vehicle system could not operate well without sufficient resources for charging each vehicle's battery after its use. In this study, we propose an allocation problem of electric vehicles to battery recharging stations. We discuss a real-time electric vehicle charging problem, in which the decision to allocate the vehicles to the charging stations must be made fast. Such a situation occurs when we need to charge the vehicles within the operational time of the electric vehicle system. We consider the required charging time and the number of recharging slots available at each station to ensure the recharging demand satisfaction. To allocate the vehicles efficiently, we consider the charging price at each station and minimize the total costs for the recharging. We formulate the problem mathematically. Important cases to be considered in the problem are listed.

Keywords: Electric Vehicle Recharging, Price Fluctuation, Allocation Problem.

1 Introduction

The usage of electric vehicles (EVs) for various purposes (e.g., car sharing, public transportation, etc.) has become clearly important nowadays [1, 2]. EV sales have been reported to increase every year, as shown in Fig. 1 [3]. Many studies have discussed various optimization problems in the EV system, including the EV station location problem [4, 5], EV routing problem [6, 7], EV recharging problem [1, 8], etc. In this study, we address the EV recharging allocation problem, in which the EVs to be recharged are allocated to one of many recharging stations, as illustrated in Fig. 2 [9].

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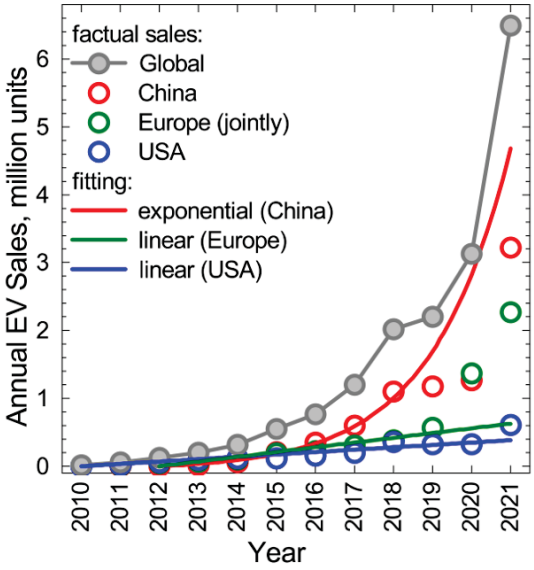

Fig. 1. Increased global EV sales.

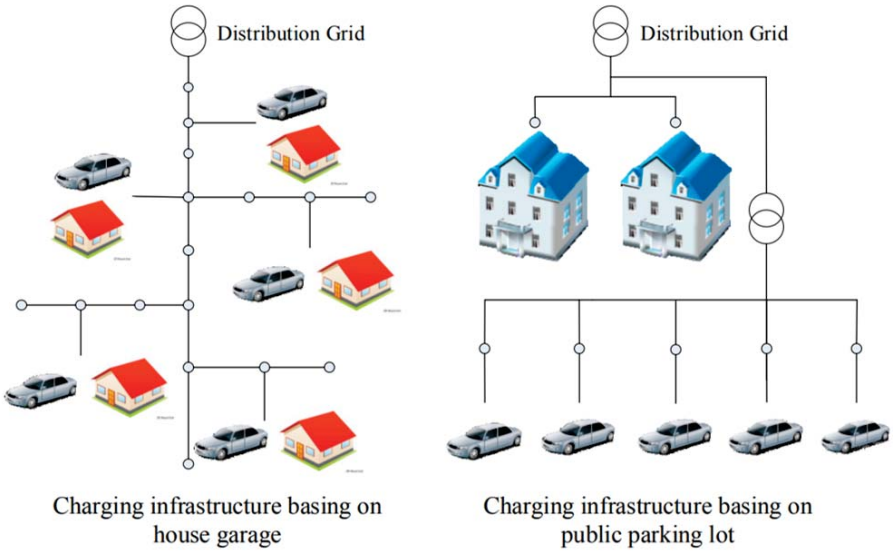

Fig. 2. Alternative of EV recharging stations.

The difference between our study and previous studies are listed in Table 1. While most studies discussed how to determine the EV charging price, our study deals with

the EV allocation to the charging stations to minimize the total charging costs. Even though [10] also discussed an EV allocation problem, our study differs from theirs because we consider the limited number of charging slots available at each station, while Aljafari et al. [10] allowed each EV to wait in queue at its allocated station.

Table 1. The novelty of our study.

Study	Decision variables	Objective
Ren et al. [11]	EV charging price	Minimizing charging load fluctuation and total charging costs
Liang et al. [12]	EV charging price	Minimizing charging costs of all users
Zhong et al. [13]	Whether to charge each electric taxi or not based on its level (state of charge)	Minimizing travel costs to the recharging station, the queuing cost, and the recharging cost
Deng et al. [14]	EV routing and charging schedule	EV energy consumption
Lin et al. [15]	EV charging price	Minimizing charging load fluctuation and maximizing profits for the company
Aljafari et al. [10]	EV allocation to charging stations (allowing queue at each station)	Minimizing total costs for EV recharging
Our study	EV allocation to charging stations (no queue, considering an exact number of empty charging slots at each station)	Minimizing total costs for EV recharging

Section 2 introduces a simplified EV allocation problem that does not consider the transportation time required for the EV from its initial location to the recharging station. Section 3 discusses the EV allocation problem considering the required EV transportation time. Section 4 shows the numerical experiment result. Section 5 discussed some important aspects of the defined problems and possible extensions of the problems to be considered by the next researchers. Section 6 concludes the study.

2 Electric Vehicle Allocation Problem without Transportation Time Consideration

In the first problem, we consider the problem of allocating EVs to recharging stations. We define time slots (e.g., 30 minutes) and consider that each EV requires a number of time slots to recharge its battery to reach a minimum battery level for its next use. At the moment of such real-time decision-making, each recharging station has a limited number of empty recharging slots. The mathematical model is presented as follows.

Sets

E : Set of electric vehicles to recharge ($e = 1, 2, \ldots, |E|$)
S : Set of recharging stations ($s = 1, 2, \ldots, |S|$)

Parameters

c_s : Recharging cost per time slot at station s
p_s : Number of available recharging slots at station s
r_e : Number of required time slots to recharge EV e and reach its minimum battery level

Decision variables

x_{es} : 1, if EV e is recharged at station s; otherwise, 0

$$\sum_{e}\sum_{s} x_{es}c_s r_e \tag{1}$$

$$\sum_{s} x_{es} = 1 \qquad \forall e \in E \tag{2}$$

$$\sum_{e} x_{es} \leq p_s \qquad \forall s \in S \tag{3}$$

$$x_{es} = \{0,1\} \qquad \forall e \in E, s \in S \tag{4}$$

Objective (1) minimizes the total charging costs considering the allocation of EVs to recharging stations. Constraints (2) ensure each EV e to be recharged at exactly one station. Constraints (3) limit the number of recharged EVs with the number of available slots at each station s. Constraints (4) are binary constraints.

This first problem can easily be solved by using the transportation (mathematical) model. The supply nodes are the slots available at the recharging stations, and the demand nodes are the EVs. Considering that the number of EVs to be recharged is less than the number of recharging slots, we introduce dummy nodes at the demand side of the transportation model. Matrix representing the transportation problem is shown in Fig. 3. A similar way to convert the allocation problem into the transportation model was considered by [1].

3 Electric Vehicle Allocation Problem with Transportation Time Consideration

In the second problem, we consider a more realistic problem. We consider the EV allocation problem to the recharging slots while considering the required transportation time for each EV from its initial location to its recharging station. To consider the required transportation time, we introduce the time slot index, and to deal with a more realistic setting, we consider the changes (fluctuation) in recharging prices at different

time slots. Time slots with a higher demand have a higher price [16, 17]. The mathematical model is presented as follows.

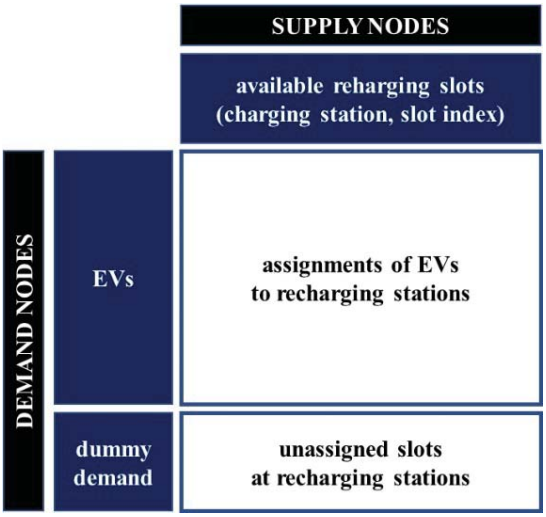

Fig. 3. Alternative of EV recharging stations.

Sets

E : Set of electric vehicles to recharge ($e = 1, 2, \ldots, |E|$)
S : Set of recharging stations ($s = 1, 2, \ldots, |S|$)
T : Set of time slots (each time slot could refer to 30 minutes, 1 hour, etc.) ($t = 1, 2, \ldots, |T|$)

Parameters

c_{st} : Recharging cost per time slot at station s during time slot t
d_{su} : Required EV transportation time from station s to station u
o_e : Station where EV e is initially located
p_s : Number of available recharging slots at station s
r_e : Number of required time slots to recharge EV e and reach its minimum battery level

Decision variables

w_e : The first time slot during when EV e is recharged at a station
x_{est} : 1, if EV e is recharged at station s during time slot t; otherwise, 0
y_{es} : 1, if EV e is recharged at station s; otherwise, 0
z_e : The last time slot during when EV e is recharged at a station

$$\sum_{e}\sum_{s}\sum_{t} x_{est} c_{st} \tag{5}$$

$$x_{est} \leq y_{es} \qquad \forall e \in E,\ s \in S,\ t \in T \tag{6}$$

$$\sum_{s} y_{es} = 1 \qquad \forall e \in E \tag{7}$$

$$\sum_{e} x_{est} \leq p_s \qquad \forall s \in S, t \in T \tag{8}$$

$$x_{est} = 0 \qquad \forall e \in E, s \in S, t \in \{1,2,\ldots,d_{o_e s}\} \tag{9}$$

$$x_{est} = 0 \qquad \forall e \in E, s \in S, t \in \{|T| - d_{o_e s} - r_e, |T| - d_{o_e s} - r_e + 1,\ldots,T\} \tag{10}$$

$$w_e \leq |T|(1 - x_{est}) + t x_{est} \qquad \forall e \in E, s \in S, t \in T \tag{11}$$

$$z_e \geq t x_{est} \qquad \forall e \in E, s \in S, t \in T \tag{12}$$

$$z_e - w_e + 1 = r_e \qquad \forall e \in E \tag{13}$$

$$\sum_{s}\sum_{t} x_{est} = r_e \qquad \forall e \in E \tag{14}$$

$$x_{est} = \{0,1\} \qquad \forall e \in E, s \in S, t \in T \tag{15}$$

Objective (5) minimizes the total charging costs considering the allocation of EVs to recharging stations. Constraints (6)−(7) ensure that each EV e must be recharged at exactly one station. Constraints (8) limit the number of recharged EVs with the number of available slots at each station s during each time slot t. Constraints (9) ensure that each EV e cannot be recharged before it has been transported to the target station. Constraints (10) limit the EV recharging decision at recharging station u if the EVs cannot arrive at station u and complete the recharging before the planning horizon ends. Constraints (11) and (12) calculate the first and last time slots when the EV e is recharged. Constraints (13) and (14) ensure each EV e is recharged as long as it is required. Constraints (15) are binary constraints.

4 Numerical Experiment

A numerical experiment was used to verify the mathematical model in Section 3 that represents the more realistic situation. The solutions were obtained using GUROBI 10.0.2. The experiment was conducted on an Intel(R) Xeon(R) CPU at 2.20GHz on the Google Colab platform. The input data are shown in Tables 2-6. The optimal solution was obtained in less than 1 second and is shown in Fig. 4. It shows the recharging schedule at each station s on each time slot t. As an example, electric vehicles 1 and 4 are recharged at station 1 during time slots 3-4, while electric vehicle 5 is recharged at station during time slots 3-5. The number of electric vehicles recharged at each time slot at station 1 does not violate the station's number of available recharging slots (3).

Table 2. Values for *c* parameter.

	t											
	1	2	3	4	5	6	7	8	9	10	11	12
$s = 1$	20	50	13	31	81	62	54	97	13	47	65	19
$s = 2$	96	86	65	62	46	97	63	82	44	31	51	31
$s = 3$	8	26	64	56	71	42	10	10	9	30	10	19
$s = 4$	79	50	3	20	94	85	46	28	50	73	57	93

Table 3. Values for *d* parameter.

	u			
	1	2	3	4
$s = 1$	0	3	6	4
$s = 2$	3	0	5	7
$s = 3$	6	5	0	2
$s = 4$	4	7	2	0

Table 4. Values for *o* parameter.

t					
1	2	3	4	5	6
1	1	3	2	2	1

Table 5. Values for *p* parameter.

s			
1	2	3	4
3	4	3	2

Table 6. Values for *r* parameter.

e					
1	2	3	4	5	6
2	2	3	2	3	1

5 Discussions

The problems above are still simplified versions of what happens in reality. To ensure more realistic cases, we could consider the following additional aspects:

1. A relaxation of the time slot concept. It will allow more effective use of available charging times but require more computational time.

2. Availability of the relocation vehicles, e.g., trucks transporting the EVs [1] or vehicles driven by the relocation operators [18].
3. A longer planning horizon that considers the recharging operation of multiple EVs at every single slot. It optimizes the relocation system better considering more look-ahead periods.
4. A strong use of big data for understanding relationships between data and allowing a better prediction that could increase the efficiency of the EV relocation process [19, 20]. An example of how big data could be considered to optimize the EV system operation is shown in Fig. 5 [21].

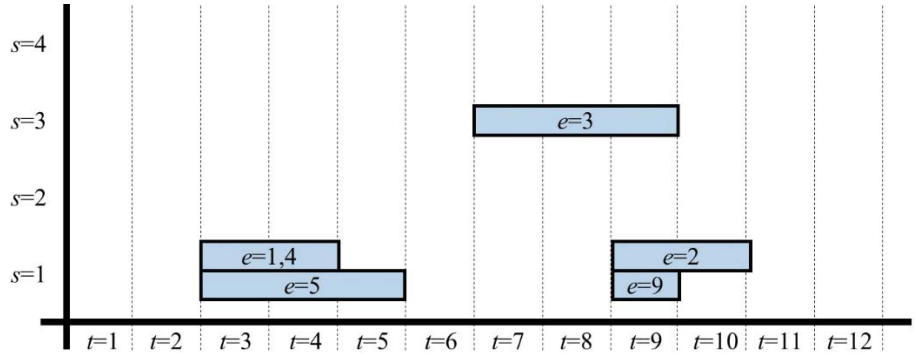

Fig. 4. The obtained optimal solution.

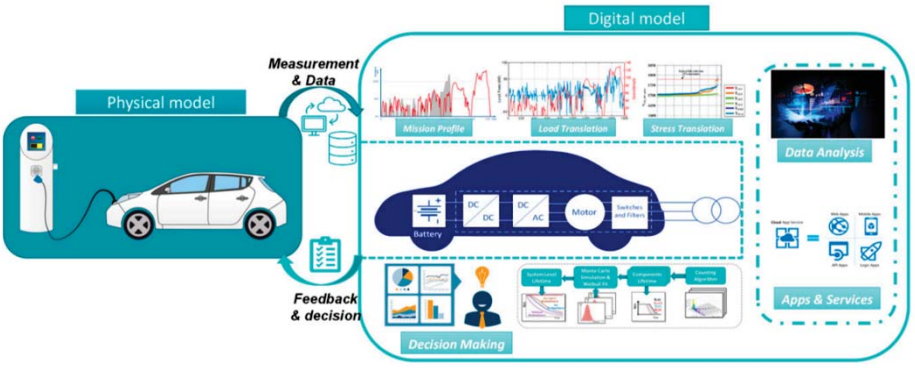

Fig. 5. Optimization framework for the EV system based on big data.

6 Conclusions

In our study, we introduced problems of allocating EVs to recharging stations. We proposed two models: (1) when the transportation times of EVs from their initial locations to the recharging stations are not considered, and (2) when the transportation

times are taken into account. We provide the mathematical formulation for both cases. At the end of our study, we list some important aspects to be additionally considered in the models to ensure considering more realistic scenarios. For further studies, it is also necessary to conduct more experiments with realistic data to observe the proposed models' behavior and assess the model's strengths and weaknesses.

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Agung Prayitno, Veronica Indrawati, Pyae Pyae Phyo

This paper presents synchronization of vehicle platoon with limited-output information based on constant time heading spacing policy. Two control schemes, namely neighborhood controller neighborhood observer and neighborhood controller local observer designed based on constant time heading will be applied...

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The Interaction Effect of $CaCo_3$ Composition, Injection Temperature, and Injection Pressure on the Tensile Strength and Hardness of Recycled HDPE

Hendra Prasetyo, Yon Haryono, The Jaya Suteja

The mechanical properties of recycled High-Density Polyethylene (HDPE) are inferior compared to non-recycled HDPE. To overcome this problem, Calcium Carbonate (CaCO3) is added to improve the material's mechanical properties. The temperature and injection pressure changes can affect the material's mechanical...

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Comparing the Effects of Efficiency and Distortion in Audio Power Amplifiers with and without Tracking Power Supply Circuit Design

Yohanes Gunawan Yusuf, Veronica Indrawati

This research aims to compare the effects of efficiency and distortion in Audio Power Amplifiers with and without Tracking Power Supply (TPS) circuit design. The TPS circuit design is known for enhancing power efficiency while keeping low distortion in the amplifiers. This paper examined the performance...

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Risk Analysis to Mitigate Dominant Risk of Electrical Infrastructure Construction

Salim Afif, Moses Laksono Singgih

Over the past 5 years, the achievement of the Risk Maturity Model (RMM) level value at PT PLN (Persero) UID Bali has not yet reached the target with a gap of 0.47 from the target of 4.19 at the end of 2024. The company's lack of optimization in using the budget period 2018-2023 may be an indicator that...

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Reducing Procurement Waiting Time through Lean Six

Sigma

Bagoes Iman Prakoso, Moses Laksono Singgih

A Mass Transportation Manufacturer (MTM) is a pseudonym for the company's name as the subject in this study, faces significant challenges in its procurement process, particularly in acquiring components from foreign suppliers, which often results in prolonged delays. This delay in procurement has a direct...

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A Model for Evaluating the Impact of Priority Rules on Flow Time and Wait Time In A Job Shop Scheduling System: A Single Machine Case

Muhammad Usman Nisar, Andi Cakravastia Arisaputra Raja, Anas Ma'ruf, Abdul Hakim Halim

In the dynamic realm of job shop scheduling (JSS), where decisions regarding the order of job processing have a significant impact on the initial state and performance of the system, addressing the effects of priority changes becomes crucial. To address this challenge, the first part of the study proposes...

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Modeling and Optimization of Location Selection of Fuel Terminal Considering Vessels and Pipeline Operations

F. Qudsi, R. T. Cahyono, N. F. Sa'idah

This study discusses mathematical modeling using the mixed-integer

linear programming (MILP) technique for selecting the optimal fuel terminal location which considers not only aspects of ship and pipeline transportation, but also marine technical aspects. In addition, coverage days are also included...

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Lean Six Sigma and TRIZ to Reduce Non-Value-Added Activities of the Transformer Production Process

Adritho Zaifar, Moses Laksono Singgih

Electronic Transformer Producer (ETP, a nickname) is electronic transformer manufacturing and distribution in Indonesia. The company has encountered challenges in meeting the escalating demands for both quantity and quality from its clientele. Concurrently, the company strives to curtail superfluous...

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Driving Growth in Village Industries: Exploring Effective Financing Facilities for Micro and Small Enterprises

Gunawan

The challenge of financing for micro and small manufacturing enterprises is a global issue but needs local solutions, as the industry characteristics and financing facilities are different among countries and even within countries. In the post-pandemic period, recovering micro and small industries in...

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Remarshaling in A Bin-to-Person-based Smart Automated Warehouse

Ivan Kristianto Singgih, Mai-Ha Phan, Indri Hapsari

In a bin-to-person warehouse, robots lift and then transport racks that contain items from the replenishment area to the storage area and from the storage area to the pickup area. In such an automated warehouse, it is necessary to ensure smooth item flows. One of the important decisions is on which racks...

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Comparison of Classification Machine Learning Models for Production Flow Analysis in a Semiconductor Fab

Ivan Kristianto Singgih, Stefanus Soegiharto, Arida Ferti Syafiandini

A semiconductor fab has complex wafer lot movements between machines and workstations. To ensure a smooth flow of the wafer lots, the system must be observed appropriately. Observation of such a complicated system is possible using machine learning. In this study, various machine learning techniques...

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Circular Economy at LNG Bontang Company: Transforming Aluminum Jacketing Waste Into Sacrificial Anode Products

Defi Willy Simanjuntak, Moses Laksono Singgih

In the industrial activities of the company, one of the crucial considerations and management aspects is waste. At PT. Badak NGL, an existing environmental issue pertains to aluminum jacketing waste. This waste emanates from the factory's operational activities, thereby presenting an opportunity for...

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Restructuring Job Design Using Job Analysis to Balance Workload and Enhance Productivity

Revy Maghriza, Moses Laksono Singgih

One logistics company in Indonesia has experienced a drastic increase of 60% in the demand for imported goods from 2018 to 2022. This upward trend is expected to continue. The admin staff, leader, and supervisor of the Export-Import Department feel the direct impact and are experiencing a higher workload...

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Design of Mid Drive Electric Cargo Bike for Urban Area

Sunardi Tjandra, Susila Candra, Albertus Agung Jody Saputra, Yehezkiel D. Faraisc Putra

Some couriers use bicycles for work. However, it is not efficient because relies on their stamina, which can affect the delivery duration and capacity. E-bike can be a solution to this problem. However, its price is unaffordable for most couriers. It is necessary to modify the couriers' bicycles into...

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The House of Risk with Multi-Actor Approach Aligned with ISO 31000:2018 for Effective Risk Management in Business with Risky Environment

Evy Herowati, Rosita Meitha Surjani, I Made Panca Bayu Tarsa Ragacca

Effective risk management requires a thorough comprehension of risks and the involvement of multiple actors in the process. In conjunction with the internationally recognized ISO 31000 standard, the House of Risk (HOR) framework provides a robust approach to risk management. This article examines the...

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Centralized AGV Control Systems based on OutsealESP32 PLC and ESP-NOW Protocol

Fransiscus Xaverius Florenza, Hendi Wicaksono Agung

In this paper, a centralized wireless AGV control system is presented using the OE32-PLC board. The OutsealESP32 PLC (O32-PLC) is a combination of the Outseal PLC Mega and the ESP32. Wire-less communication is carried out using the ESP-NOW protocol. The system is divided into three sections according...

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Improving Loading and Unloading Performance at Patimban Port Car Terminal with a Lean Strategy

Yanuar Ardiansyah, Moses Laksono Singgih

Patimban Port located in Subang, West Java, has gained recognition as a National Strategic Project. Its operations, which commenced in December 2020, area primarily designed to optimize the Car Terminal's functionality. This terminal facilitates the loading and unloading of Completely Built Up (CBU)...

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The Influence of Noise Factors on Concentration Based on EEG Signal

Rahmaniyah Dwi Astuti, Rahma Sabilah Nurbi, Bambang Suhardi, Pringgo Widyo Laksono, Irwan Iftadi

The noise intensity with different levels can affect human cognitive abilities, performance, and brain activity. Human cognitive performance, especially concentration, is needed when doing work activities. However, there are still few studies related to the effect of continuous noise in the textile industry...

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Indonesia e-Bike Consumer Preference Trough Market Potential Research: A Choice-Based Conjoint Analysis

Andi Ameera Sayaka Cakravastia, Anas Ma'ruf

E-bike is gaining popularity and accelerating the bike industry to speed up

new product development. This study aims to identify e-bike preferences desired by consumers through market research. The choice-based conjoint method analyzes consumer preferences, forecasts potential e-bike market share, and...

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Electric Vehicle Charging Allocation Considering Electricity Price Fluctuation

Ivan Kristianto Singgih, Christian Yavin Ibrahim, Stefanus Soegiharto, Olyvia Novawanda

Charging decisions on electric vehicles is an important aspect to consider for ensuring the continuity of the electric vehicle demand satisfaction. An electric vehicle system could not operate well without sufficient resources for charging each vehicle's battery after its use. In this study, we...

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Overview of Ergonomics and Safety Aspects of Human-Cobot Interaction in the Manufacturing Industry

Muhammad Ragil Suryoputro, Tieling Zhang, Senevi Kiridena

The technological advancements accompanied by Industry 4.0 have created more opportunities for collaborative interactions between humans and machines. In work environments where humans work alongside collaborative robots (i.e., cobots), there is a critical need to address ergonomics and occupational...

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Affective-based Human Factors Design: Design Thinking & Sustainability Approach

Markus Hartono

This paper proposes a refined framework of affect/Kansei-based applied to product/service experience considering design thinking and sustainability approaches. Design thinking facilitates more comprehensive step-by-step methodology starting with more human basic needs, followed by the global issues which...

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Performance Evaluation of Roof Tile Solar PV under Tropical Climate of Surabaya, Indonesia

Elieser Tarigan, Fitri Dwi Kartikasari, Fenny Irawati, Rafina Destiarti Ainul, Pradiksa Pratyahara Kirana

This paper discusses the applications of roof tiles type of PV modules. Published researches on this topic were reviewed. In addition, performance evaluation of a roof tile type of PV modules was conducted under the tropical climate of Surabaya, Indonesia. The objectives of present study are to review...

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Pillared Interlayered Clays (PILCs): Harnessing Their

Potential as Adsorbents and Catalysts - A Mini Review

Restu Kartiko Widi

The Pillared Interlayered Clays (PILCs) have attracted significant attention in recent years due to their versatile applications as adsorbents and catalysts in various environmental and industrial processes. This mini review presents a comprehensive overview of the recent researches conducted on PILCs...

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Implementation of K-Means and K-Nearest Neighbor Methods for Laptop Recommendation Websites

Vincentius Riandaru Prasetyo, Mohammad Farid Naufal, Budiarjo

Along with technology development, laptops are becoming increasingly popular and are handy tools in everyday life. However, with so many brands and laptops available, people often find it difficult and need help choosing the laptop that best suits their needs and desires. A website-based system has been...

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Implementation of Recency, Frequency, and Monetary Patterns in Adaptive Blockchain-Based Transactions

Daniel Soesanto, Igi Ardiyanto, Teguh Bharata Adji

The development of cryptocurrency cannot be separated from the development of blockchain technology. However, problems arise related to the scalability of the blockchain itself. The long duration of the consensus

process means that the scalability of the blockchain cannot increase. Various methods have...

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Electronic Election for Small Medium Non-Profit Organizations in Indonesian Cities

Felix Handani

Elections in Indonesia often include direct voting, enabling every community member to immediately contribute to the election process and support their chosen leader. The digital divide, the security of data and systems, verification and transparency, and the legal and social-cultural acceptance of online...

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Online Claim and Guarantee Mechanism for Electronics Peripheral in Urban Country

Liliana, Felix Handani, Daniel Soesanto, Maya Hilda Lestari Louk

According to consumer protection law, business actors must provide good services, including post-transaction services. Most of the current warranty claim process is still done conventionally, where consumers must come to the store to bring their documents and goods and ask the officer for the repair...

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Perceived Usability Evaluation of IRiS: an Integrated Recommendation Collection System

Jimmy, Kristian Tanuwijaya

This study evaluates the perceived usability of IRiS, which was developed to collect recommendations from senators related to the election of principals in the University of Surabaya (UBAYA). The primary question of this study was “Will IRiS be usable for all senators to use as intended?”. The answer...

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Incorporating Interactive Elements into Children’s Storybook to Improve Children’s Motivation to Learn Bible: Case Study on the Parable of the Sower

Ng Melissa Angga, Tyrza Adelia, Jiechella Davidson

Christian children frequently show low enthusiasm in learning the Bible due to difficulties in understanding the language and unappealing content for their taste. Moreover, their motivation towards Bible studies getting even lower by the exposure to more captivating multimedia products available in this...

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Development of Artificial Immune System in Multi-Objective Vehicle Routing Problem with Time Windows

Iris Martin, Eric Wibisono

Setting logistics routes and product distribution in everyday problems, such as delivery of fresh products, requires an algorithm that can produce decisions in a short time. This type of problem belongs to a methodology popularly known as the vehicle routing problem (VRP). VRP is NP-Hard, and its complexity...

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Has Website Design using Website Builder Fulfilled Usability Aspects? A Study Case of Three Website Builders

Argo Hadi Kusumo

The significance of e-commerce is particularly crucial for businesses. The enhancement of sales can be achieved through the contribution of e-commerce. In the current era of digitalization, it is unnecessary for SMEs to develop e-commerce platforms from scratch. Instead, they can opt for affordable website...

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Design of Employee Bus Routes for Madiun City Government Based on Home Locations and Presence Location History

Daniel Hary Prasetyo, Arizia Aulia Aziiza, Endang Sulistiyani

Madiun City is strategically positioned as the center of regional activities in the western part of East Java Province. Based on the data presented for the City of Madiun in Figures for 2022, the number of residents and private vehicle units is almost the same. Hence, road congestion is likely to occur....

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Arabic Letter Classification Using Convolutional Neural Networks for Learning to Write Quran

Mohammad Farid Naufal, Muhammad Zain Fawwaz Nuruddin Siswantoro, Andre

Learning to write the Arabic language, particularly the Arabic letters used in the Quran, is essential for individuals who aim to understand and recite the holy book accurately. In this research, we propose a classification method utilizing Convolutional Neural Networks (CNNs) with MobileNet architecture...

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Alveolar Bone Quality Classification from Dental Cone Beam Computed Tomography Images using YOLOv4-tiny

Monica Widiasri, Nanik Suciati, Chastine Fatichah, Eha Renwi Astuti, Ramadhan Hardani Putra, Agus Zainal Arifin

Bone quality is essential in dental implant planning for successful implant placement. Bone quality can be determined based on bone density observed from Beam Computed Tomography (CBCT) images which are commonly used in dental implant planning. The most accepted classification of alveolar bone quality...

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Exploring the Impact of Mobile-Based 3D Simulation on Student's Achievement and Satisfaction in Physics Education

Lisana Lisana, Edwin Pramana

The purpose of this study is to investigate the efficacy of utilizing a mobile-based 3D simulation to support students in the 11th grade in their learning of physics. The precise subject matter that was selected for this piece of research was the equilibrium of rigid bodies. There were 91 students from...

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An Encrypted QR Code Using Layered Numeral Calculation for Low Powered Devices

Rafina Destiarti Ainul, Susilo Wibowo, Irzal Zaini

Providing security system for every electronic data exchange through internet as the unsecured medium has become an essential regulation. Conventional Caesar Cipher had less computation complexity than other security method that really appropriate with low powered device requirement. However, it is susceptible...

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Spices Identification in Essential Oil Producers using Comparasion of KNN and Naïve Bayes Classifier

Fifin Ayu Mufarroha, Achmad Zain Nur, Mohammad Rizal Rahabillah,

Achmad Jauhari, Devie Rosa Anamisa, Mulaab

Indonesia is a spice-growing country, providing a variety of spices with numerous health advantages. Aside from being a producer, Indonesia is the world's largest supplier of spices. Spices have a wide range of usage, including food ingredients, herbal medicines, and essential oils. Essential oils are...

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Long Short-Term Memory Method Based on Normalization Data For Forecasting Analysis of Madura Ginger Selling Price

Devie Rosa Anamisa, Fifin Ayu Mufarroha, Achmad Jauhari, Muhammad Yusuf, Bain Khusnul Khotimah, Ahmad Farisul Haq

Forecasting is a method for estimating a future value using past data. The selling price of Madura ginger needs a forecasting analysis to predict future prices because, until now, the selling price has increased significantly. This analysis aims to increase trade business competition and maintain sales...

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Analyzing the Probability Density Distribution of Sustained Phoneme Voice Features in the PC-GITA Dataset for Parkinson's Disease Identification

Nemuel Daniel Pah, Veronica Indrawati, Dinesh K. Kumar, Mohammod A. Motin

One of the possibilities for developing computerized diagnostic tools for

Pa he voice change known as
Pa res extracted from sustained
phonemes have been statistically investigated as parameters for this purpose. However, the commonly...

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Drowsiness Eye Detection using Convolutional Neural Network

Heru Arwoko, Susana Limanto, Endah Asmawati

Eye fatigue while driving can cause drivers to be drowsy and less alert, which can potentially increase the risk of an accident. Existing data shows that the number of accidents in the world is increasing from year to year. One of the most common causes of accidents is fatigue and the leading cause of...

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