



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

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**Abstract.** 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. The solution that can be given to reduce the use of personal vehicles is to provide public transportation facilities, such as buses. This bus is specifically for segments of society that have the same daily mobility. Before providing employee buses, it is necessary to plan bus routes. Route planning certainly requires accurate location point data. During the pandemic, Regional Apparatus Organization (OPD) employees in Madiun City were location-based. This study uses the data point locations of 3066 employees in Madiun City obtained from location presence history data. This location point is used as data for designing employee bus routes. Problems in determining employee bus routes can be solved with the Vehicle Routing Problem (VRP) using its variation, namely the Multi-Depot Vehicle Routing Problem (MDVRP). This study looks at the movement patterns of employees from the point of location of the home address, which is analyzed using QGIS. The stages of this research started with collecting point location data and visualization using a heatmap to determine high-intensity areas. Then, the route is formed by selecting the depot and calculating its capacity to determine the number of employees who can meet it. Then data processing is carried out using QGIS software by grouping each employee into the nearest depot. Finally, sort the route to get the closest mileage. The result is that there are two recommended routes assuming departure from the bus station, namely the east bus line (Gajah Mada Road - Yos Sudarso Road - Jawa Road - Dr. Sutomo Road - Mastrip Road) and the west bus (Letkol Suwarno Road - Panglima Besar Sudirman Road - Mastrip Road - Heroes Road - Jawa Road).

**Keywords:** Bus Route, Multi-Depot Vehicle Routing Problem, GIS.

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M. Hartono et al. (eds.), *Proceedings of the 4th International Conference on Informatics, Technology and Engineering 2023 (InCITE 2023)*, Atlantis Highlights in Engineering 21,  
[https://doi.org/10.2991/978-94-6463-288-0\\_46](https://doi.org/10.2991/978-94-6463-288-0_46)

## 1 Introduction

Madiun City is strategically positioned as the center of regional activities in the western part of East Java Province. This position makes Madiun City a center for government services, trade, services, industry, education, and health in the western part of East Java Province. The 2019-2024 City of Madiun RPJMD document explains GRDP growth. There are three sectors with the highest average growth during the 2013–2018 period. One is the transportation and warehousing sector, at 7.70% per year. Based on an analysis of the City of Madiun in the 2021 Figures published by BPS, the number of private vehicles is 123,077 units [1]. This figure continues to rise every year. Meanwhile, the population of the City of Madiun in 2021 is 196,917 people [1]. When compared between the number of residents and private vehicle units, the number is almost the same. The solution that can be given to reduce the use of personal vehicles is to provide public transportation facilities such as bus for 196,917 people. The aim is to reduce the use of private vehicles.

Public transportation brings many benefits to society when providing mobility and access opportunities for people [2]. Based on the Smart Living Roadmap in the Madiun City Smart City Master Plan, 2020-2024 has one program, namely the Collaboration Program for the Provision of Affordable and Environmentally Friendly Transportation. This is the basis for the implementation of this research that there is a need for a transportation concept to support Madiun City as a smart city, especially in terms of smart mobility indicators. However, the provision of public transportation for all levels of society will undoubtedly be challenging to implement given the different mobility of people, making it difficult to determine the most effective route. The mobility of one of the elements of society that have the same rhythm, namely government employees, who have definite working hours and days. There is research which explains that the congestion point in Madiun City is on Jalan Jawa because it connects 4 main roads, namely Jl. MT. Haryono – Jl. Salak – Jl. Major General De Panjaitan – Jl. Panoramic Raya [3]. This road will become one of the bus lanes that will be passed so that there will be less private vehicles.

Based on data obtained from the Employee Performance Targets (SKP) application managed by the Madiun City Government Communication and Information Service, the number of Madiun City government employees is 3,066 people. Determining the route, of course, requires accurate location point data. During the pandemic, the presence of Regional Apparatus Organization (OPD) employees in Madiun City was location-based. So that there is data on the location of each employee's house. This data can be used to determine bus routes for OPD employees in Madiun City to support Madiun City as a smart city, especially in terms of smart mobility indicators. However, the provision of public transportation for all levels of society will undoubtedly be challenging to implement given the different mobility of people, making it difficult to determine the most effective route. The mobility of one of the elements of society that has the same rhythm, namely government employees, who have definite working hours and days.

Route determination using the minimum mileage has been suggested by [4] in his research entitled "Truck Dispatching Problem". This research models how a homoge-

neous truck fleet can serve oil demand from several gas stations from a central hub. These problems are known as vehicle routing problems or Vehicle Routing Problems (VRP) [5]. Other studies have examined bus routes with the highest acceptable distance for students to travel from their homes to the bus lane. Since the research location is in a tropical zone and the subjects are pre-adolescent children, the distance has been reduced from 400 to 300 meters [6].

VRP has many variants as research develops, as analyzed by [7] based on literature studies discussing VRP. Multi-depot vehicle routing problem (MDVRP) is the VRP variant appropriate for this research because it involves multiple depots [8]. The multi-depot vehicle routing problem (MDVRP) is a variant of the vehicle routing problem (VRP) in which vehicles depart and return to one of several depot locations [9]. In addition to designating vehicle routes, selecting the depot from which customers will be visited is necessary. MDVRP simultaneously establishes the closest vehicle route and defines the service area of each depot [10]. MDVRP is proven to solve vehicle routing problems by recommending the shortest route [11]. With MDVRP, logistics distribution management tasks such as shipment routing and scheduling can result in reduced delivery distances or times [12].

This research focuses on the Madiun City area, multi-depot vehicle routing models combined with GIS will facilitate decision support for problems with complex path restrictions and many vehicles, to obtain optimal delivery route planning with minimum travel distance [13]–[17]. The goal is to find employee bus routes that can find the shortest distance to shorten the time. Multi-depot vehicle routing problem (MDVRP) analysis is mostly done with Quantum GIS (QGIS) software [18], [19]. QGIS is a classic desktop geographic information system (GIS), a highly customizable, open-source geospatial environment that can create effective visualizations [20]. Therefore, this study uses QGIS software to analyze employee and office location data using MDVRP. Distance is utilized in the processing and analysis of the data for this study. Distance refers to the utmost acceptable distance between employees' homes and offices and the bus stop. MDVRP's primary objective is to determine the optimal route for each vehicle by minimizing the total distance or travel time traveled.

## 2 Research Methodology

This research focuses on the location of employees' houses based on the presence of Madiun City employees to design employee bus routes in the Madiun City Government. The research process is divided into five stages: identification of existing location data, location data visualization, location data processing, route assessment, and route selection (**Figure 1**).

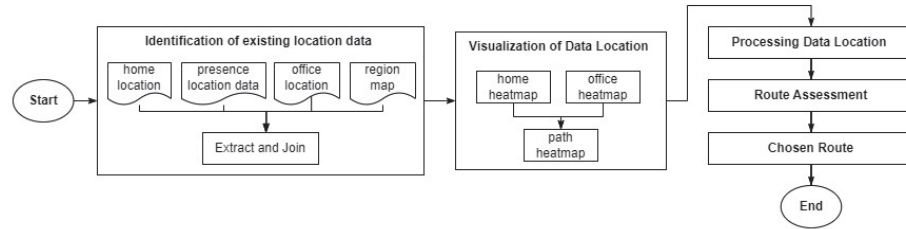


Fig. 1. Research Methodology

2.1 Identification of existing location data

The initial data was identified by collecting data on the number of employees and the location of the house obtained from the history of attendance locations in the City of Madiun. Data were collected at the Office of Communication and Informatics, which is responsible for the application of employee presence in all Regional Apparatus Organizations (OPD) of the Madiun City Government. Obviously, data collection is conducted legally, with permission and sanction from the appropriate Office. Employee home location data and selfie absence location data were used to identify location data.

Data collection was carried out from the beginning of 2022 to August 25, 2022. The data was collected from the employee records of Madiun City, which included 2653 ASN, 2140 Non-ASN, and 1462 Teachers. At this initial stage, it generates location data for employee homes and location data for selfie attendance that has been mapped into QGIS (Figure 2 and Figure 3)

- Data on employee's house location

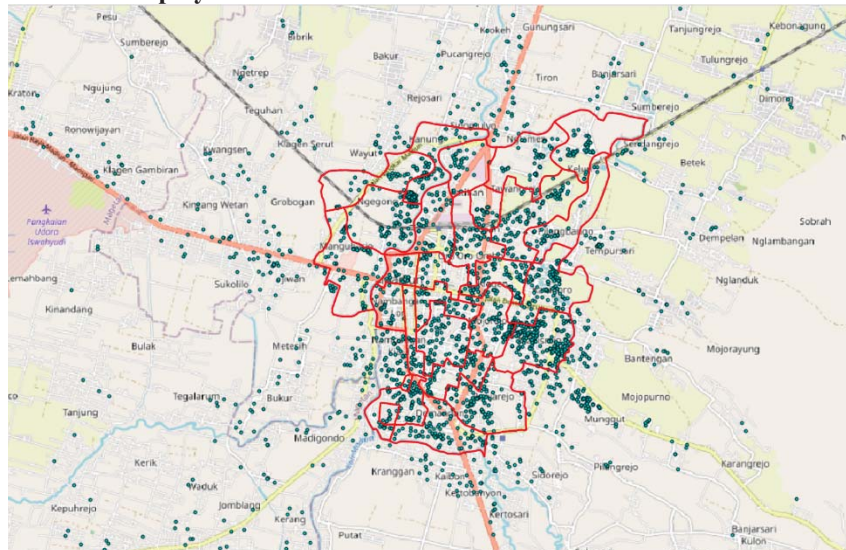
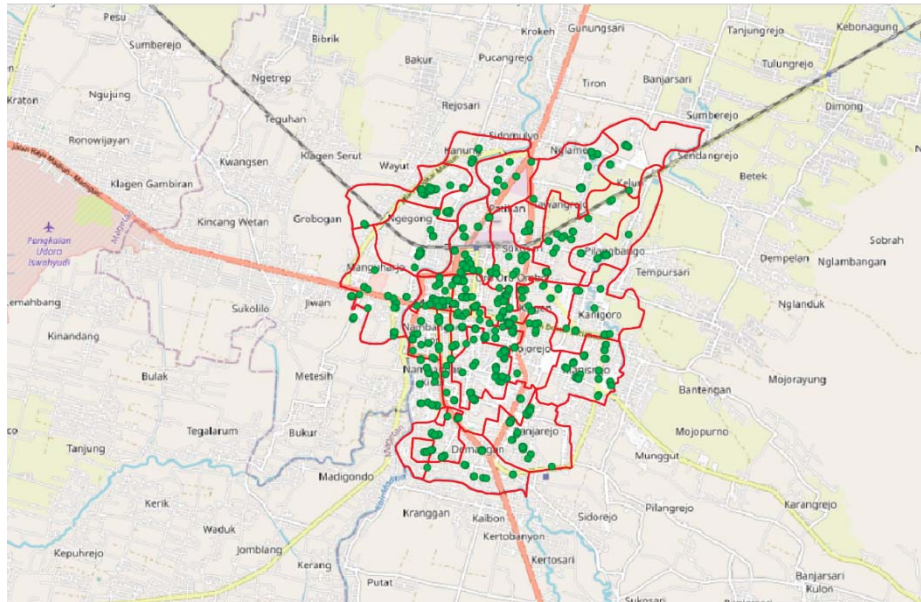


Fig. 2. Point Location of employee's house in Madiun City

The mapped location data is spread throughout the Madiun City area but has the most points in the city center. The green-colored points residential houses of the madiun city employee. The red line shows the boundaries of the Sub-districts in Madiun City. The attendance location mapping is carried out after all employees' homes are mapped.

- **Selfie presence location data**

Data on the presence of selfies were collected from 859 locations. The number differs from the number of employees because selfies are primarily taken at workplaces. The selfie presence location is indicated by a green dot (**Figure 3**). The location point for selfie presence is carried out at the Office in the Madiun City Region so that the variations in location points are spread only in the city center.



**Fig. 3.** Location Points of Employee Selfie Presence in Madiun City

## 2.2 Data Location Visualization

QGIS is used to generate heatmaps for use in data visualization. The purpose of data processing is to generate patterns. Visualizing the density of the analyzed location markers is used to process data. One is using the Kernel Density Estimation (KDE) method to generate a Heatmap. This technique generates a continuous map based on the data points distribution.

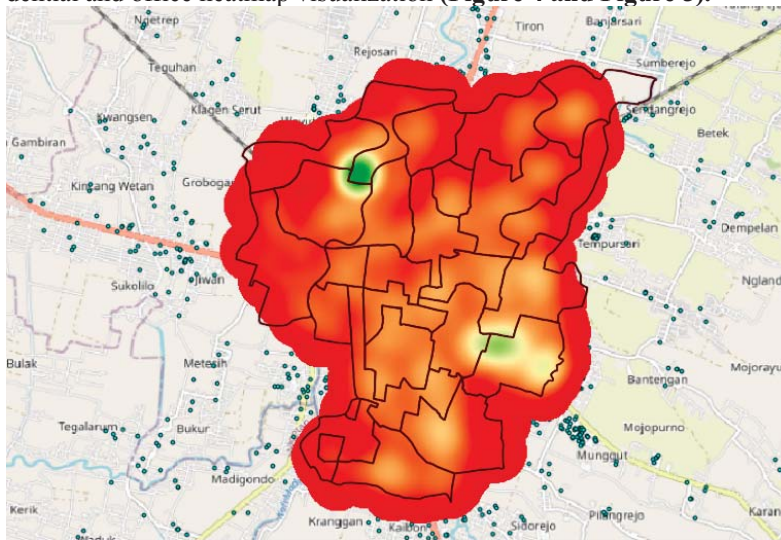
Heatmap is used to find out which locations have high intensity. Three intensities will be made, namely:

- House intensity: The greater the intensity value, it will show the density of the house's occupants at that point.

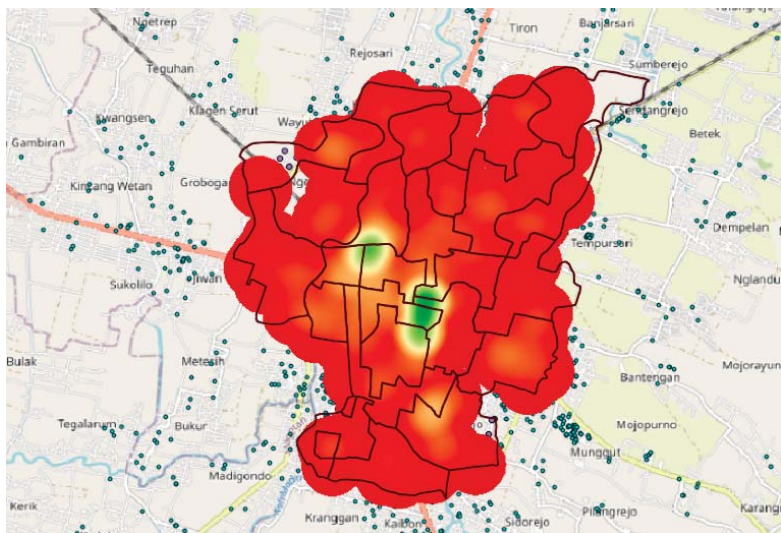


- Office intensity: The greater the intensity value, it will show the office density at that point.
- Path intensity: The greater the intensity value, the more frequently the path is traversed.

Therefore, the optimal employee shuttle route will pass through a high-intensity home, then a high-intensity line, and finally a high-intensity office. A 500-meter-radius heatmap is generated to visualize the concentration of employee residences, office locations, and frequently traveled routes. The following is the result of a residential and office heatmap visualization (**Figure 4 and Figure 5**).



**Fig. 4.** Home location Heatmap



**Fig. 5.** Office Location Heatmap

The results of the visualization of the home and office heatmaps will serve as the foundation for the creation of pathway heatmaps. To achieve this, a home-office relationship must be established, followed by the reduction of the high-value area on the office heatmap so that data does not accumulate at the destination location but rather at locations in between.

### 2.3 Processing Data Location

At this stage, a line is made from the home point to the office. Draw Location Point Lines Using location point data, draw a line connecting the points. The home-office path data used is 429,921 records. Draw a line for one day and one month (**Figure 6 and Figure 7**), the goal is to be able to see the density of home-office paths to be visualized into a path heatmap.

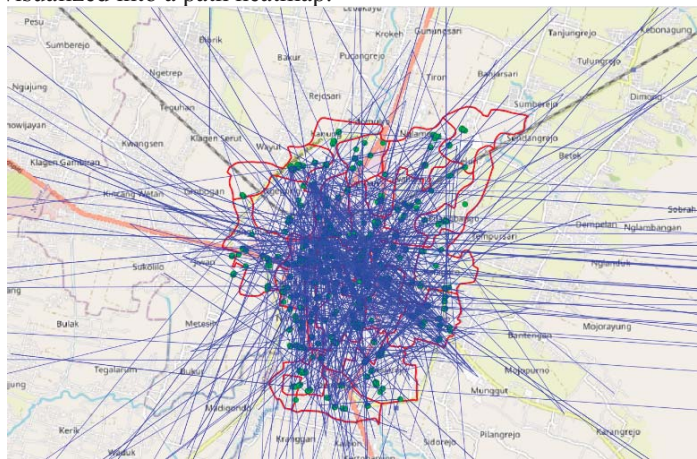


Fig. 6. Home-Office line in one day

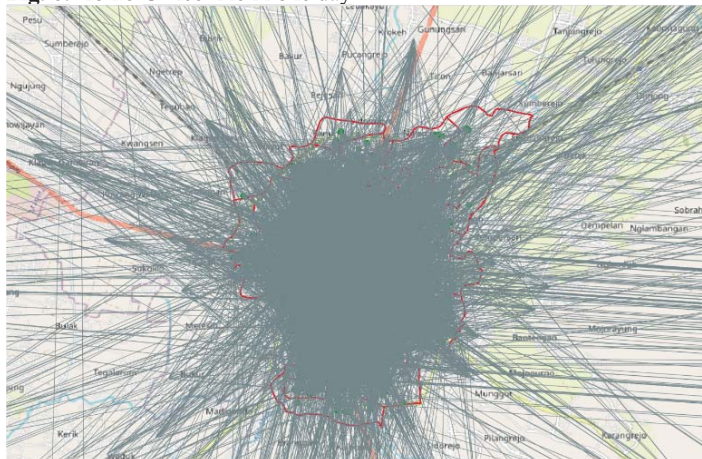
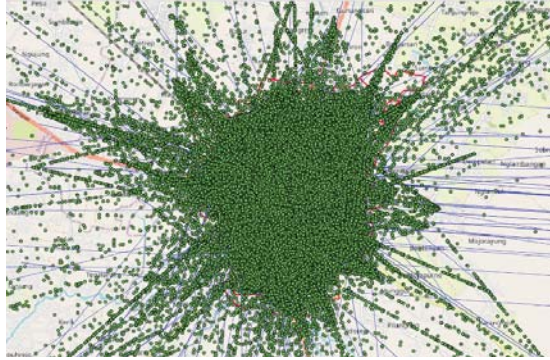


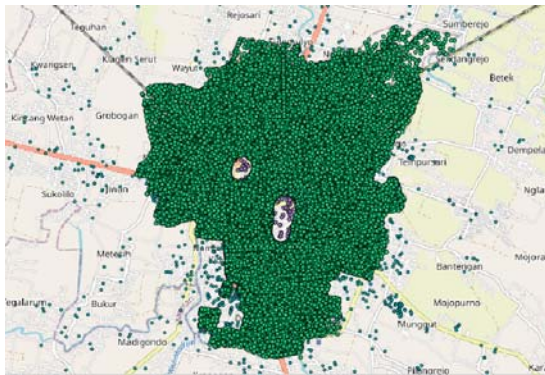
Fig. 7. Home-Office line in one month



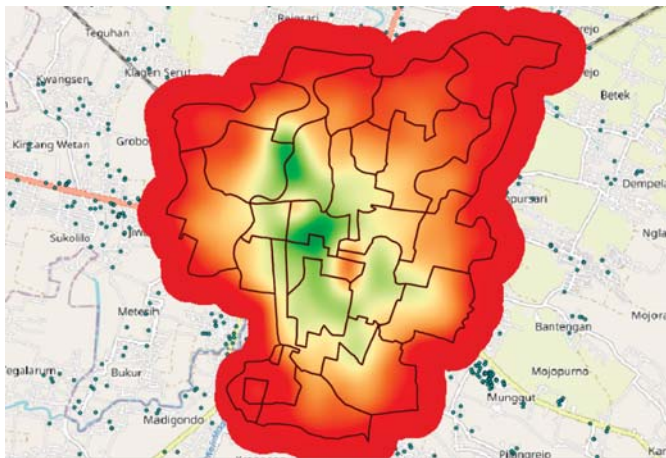
Based on these results, intermediate points are generated for each line (**Figure 8**) so that they can be used for path heatmaps. Then subtract the high-value locations on the office heatmap (**Figure 9**). So it will generate a path heatmap (**Figure 10**).



**Fig. 8.** Generate Point from Line



**Fig. 9.** The result of reducing the line with the office heatmap



**Fig.10.** Path Heatmaps



Based on the results of the path heatmap, the next step is to convert the Heatmap to Vector and identify the paths with the highest heatmap values. Heatmap analysis was carried out to see the population density or the location of the Madiun City employee's home address. The red color indicates areas with low values to be used as bus lanes. While the green color indicates areas with high scores as bus route recommendations.

#### **2.4 Route assessment**

QGIS is utilized to conduct network analysis for route formation. This analysis is conducted by accumulating relational data arranged in the form of a matrix as opposed to conducting surveys pertaining to the social characteristics of a sample of the larger population [21]. Network analysis can be used to model infrastructure and networks such as water distribution, electricity networks, roads, and telephones. After the route has been determined, it will be sorted to determine the optimal route.

Using the MDVRP settlement method, the formation of vehicle routes is conducted independently for each depot. This phase analyzes, using QGIS software, the movement patterns of employees from the location of their residential addresses. First, ascertain the depot's capacity and location. Second, determine how many employees are necessary to satisfy the depot's capacity. This will determine how many employees with the minimum distance to the depot can be classified and how many employees with the greatest distance to the depot can be classified.

#### **2.5 Chosen Route**

Route sequencing is a step in executing the order of employee pick-up routes computed with QGIS so that employees in the queue or next visit are at the most convenient location. The nearest point from one employee to the next will continue to be determined so that all employees who have not been selected remain in the sorting queue up to a predetermined capacity limit. MDVRP recommends the most efficient solution or quickest route at this sorting stage. This phase will generate optimal route suggestions for every employee.

### **3 Result and Discussion**

Based on attendance results, the initial data analysis stage has been completed to ascertain the location of the employee's residence and place of business. The MDVRP routing stages have been completed, which included determining the optimal route for each vehicle deposited at the depots. The primary objective is to minimize total travel distance or travel time while adhering to all restrictions. This routing stage helps determine the optimal route for a vehicle in MDVRP by considering existing constraints and criteria. The location of high-intensity residences and workplaces has been selected by employing heatmap visualization. Then the relationship between the home-office has also been connected with a line for data in a day and a month. The results

will be converted to points and then subtracted by the location with the highest value on the office heatmap. The path heatmap will then be created.

The path heatmap is then converted to a vector to show the roads with high heatmap values. Areas with high values are shown in green on the heatmap analysis (Figure 10). The area will be the recommended bus route. As a result, buses will pass through Jawa Road and Mastrip Road (Figure 11) for areas with high office intensity. Then, the location of the high-intensity house passes Gajah Mada Road and Letkol Suwarno Road (Figure 12).

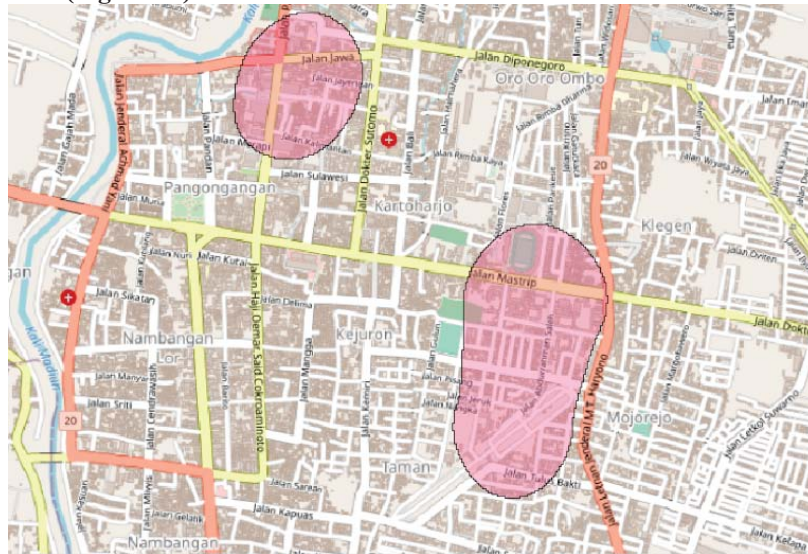
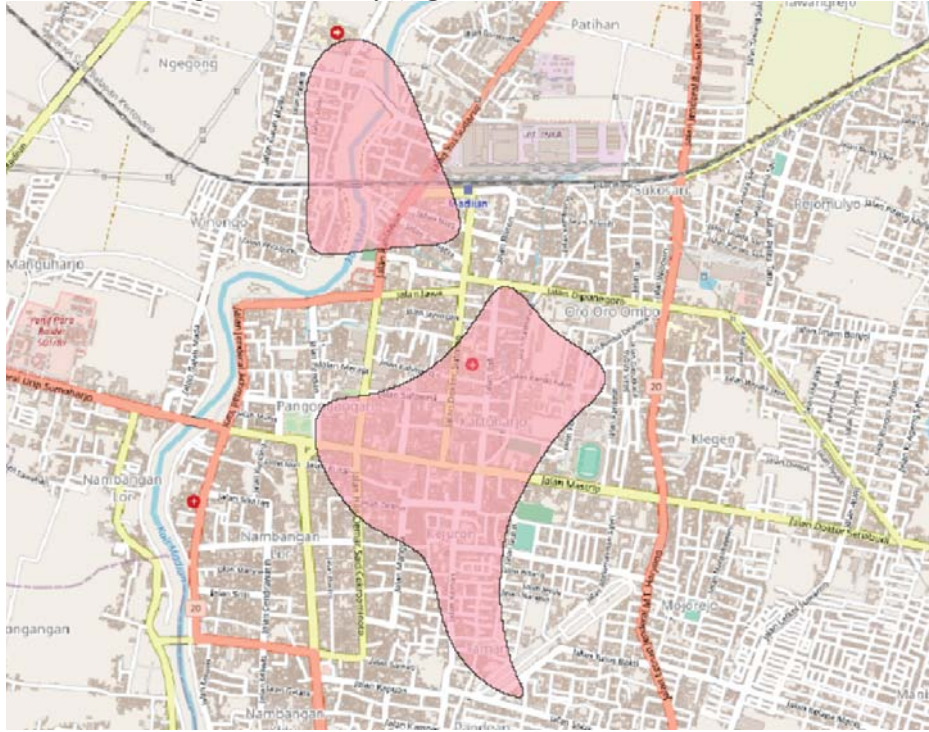


Fig. 11. Area with High-intensity Office



Fig. 12. Area with High-intensity house

Because the two regions are far apart and the destination location is between them, it is necessary to make two bus routes: the eastern bus for passing Letkol Suwarno Road and the western bus for passing Gajah Mada Road. These two bus lines will go to 2 roads with high office intensity (**Figure 13**).



**Fig. 13.** Density Strip Intensity

The intensity of the congested lanes can be seen at the top, passing Yos Sudarso and Pahlawan roads. The lower portion then traverses Mastrip Road and Panglima Sulaiman Road. According to the results of the analysis, the West Bus Line and the East Bus Line are proposed as the two optimal bus lanes for Madiun City employee buses.

Assuming the bus departs from the bus station, for West Bus departure to the office in the morning, it will go through the route, namely Bus station -> Gajah Mada Road (house of high-intensity employees) -> Yos Sudarso Road (busy line of employee travel) -> Jawa Road (high-intensity office) -> Dr. Sutomo Road (busy line of employee travel) -> Mastrip Road (high-intensity office) (**Figure 14**).



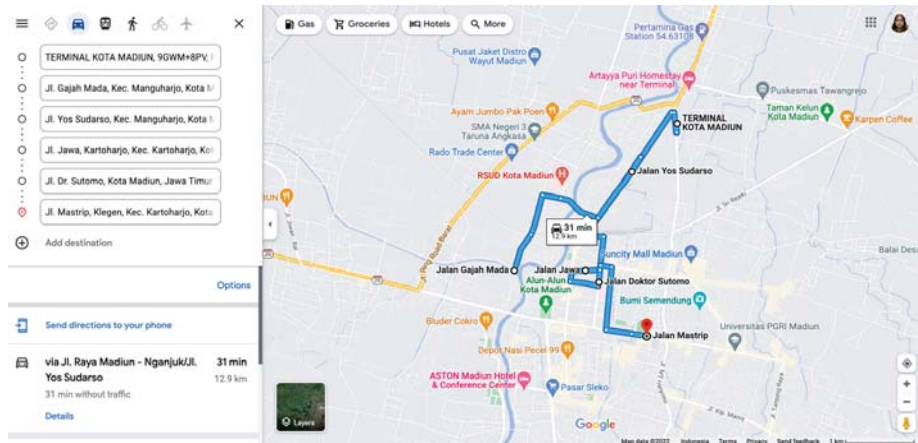


Fig. 14. East Bus Route Recommended Line

Then, the West Bus route to the office will take the following route: Bus station -> Letkol Suwarno Road (high-intensity employee's house) -> Panglima Besar Sudirman Road (the congested route for employee travel) -> Masprip Road (high-intensity of-fice) -> Pahlawan Road (the congested route for employee travel) -> Jawa Road (high-intensity office) (Figure 15).

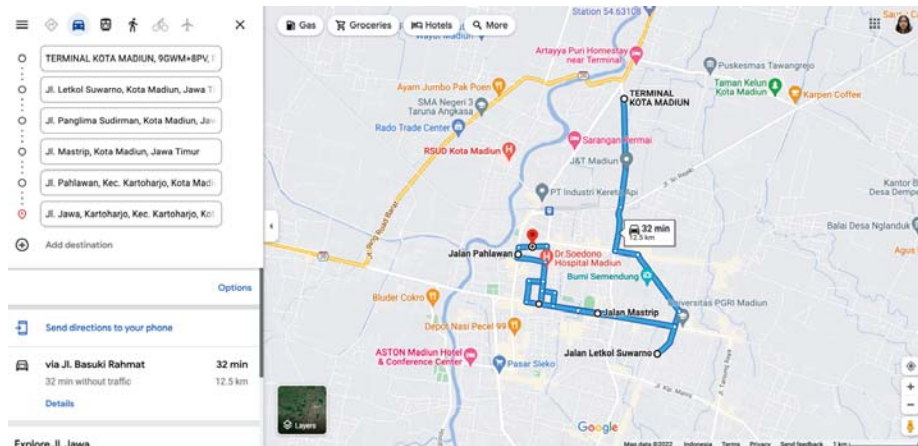


Fig. 15. West Bus Route Recommended Line

Another study conducted a traffic jam analysis, the level of congestion in Madiun city often occurs at the Java intersection that connects Jl. MT. Haryono – Jl. Salak – Jl. Major General De Panjaitan – Jl. Panoramic Raya [3]. The results of the analysis of bus routes pass through major roads in Madiun City, one of which is the Java road



and will reduce congestion because the presence of buses can reduce the use of private vehicles.

## 4 Conclusion

Utilizing employee presence data in the City of Madiun that has not been optimally used thus far, this study aids in providing a solution for recommending employee transportation routes. This research employed the Multi-depot vehicle routing problem (MDVRP), which was analyzed using QGIS software. The analysis uses a heatmap to visualize the level of intensity, home, and office data. Afterward, a path heatmap is constructed using 429,921 home-office data points. The data is depicted as lines for a 1-day and 1-month line. Then points are generated based on the existing line and subtracted from the office heatmap's high-intensity locations. It will then create a path heatmap, which will be converted to a vector so that the routes with the highest heatmap can be identified. The bus will proceed through Jawa Road and Mastrip Road for high-density office areas and Gajah Mada and Lt. Col. Suwarno Road for high-density residential areas. This study concludes with two recommendations for bus routes leaving the bus station each morning: the east bus line (Gajah Mada Road - Yos Sudarso Road - Jawa Road - Dr. Sutomo Road - Mastrip Road) and the west bus line (Letkol Suwarno Road - Panglima Besar Sudirman Road - Mastrip Road - Pahlawan Road - Jawa Road).

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Proceedings of the 4th  
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ISSN 2731-7927

ISSN 2589-4943 (electronic)

Atlantis Highlights in Engineering

ISBN 978-94-6463-287-3

ISBN 978-94-6463-288-0 (eBook)

<https://doi.org/10.2991/978-94-6463-288-0>

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#### **Proceedings Article**

### Warehouse Safety in Order Picking

Donna Kharisma, Markus Hartono

Safety in warehouse becomes one of the important factors in manual order picking process. Workplace accidents can be caused by a variety of things, including the use of incorrect tools, a lack of work processes, inadequate equipment and safety equipment, and pickers' negligence. Picker safety must...

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### Designing Smart Contracts on Insurance Claims to Support the Supply Chain Performance

Josephine Permata Sari, Joniarto Parung

Blockchain as a distributed ledger technology that can guarantee transparency and speed in real time is increasingly being used to increase supply chain performance directly or indirectly. Blockchain in the form of smart contracts in the insurance business will speed up insurance claims and increase...

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### Measuring E-Service Quality & Webqual 4.0 in ICMS Through Kano Method & Importance-Performance Analysis For Development Strategies

Billy Hartanto, Moses Laksono Singgih

This research focuses on the Palm Oil Company (POC), operating in Indonesia's palm oil industry, and its implementation of the Integrated Calibration Management System (ICMS) application. The study aims to analyze the quality of the ICMS application and propose alternative solutions based on the quality...

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### Lean Manufacturing to Reduce Production Time for Pressure Vessel Production

Bintang Timur Lazuardi, Moses Laksono Singgih

In a fiercely competitive business landscape, every company must optimize its resources and minimize wastage in the production process. At the Pressure Vessel Company (PVC), a study revealed various areas of waste, including non-compliant raw materials, delayed engineering documents, extended production...

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#### **Proceedings Article**



## The Application of the Box-Jenkins (BJ) Method for Process Identification of the Batch Milk Cooling System

Rudy Agustriyanto, P. Setyoprato, E. Srihari Mochni

The Box-Jenkins (BJ) method is a well-known system identification method that has been applied in several fields. Engineers use the Box-Jenkins method for quality control and process optimization in manufacturing. It can identify patterns and trends in production data, leading to improvements in product...

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## Performance and Kinetic Study of Xylan Hydrolysis by Free and Immobilized *Trichoderma Xylanase*

Lieke Riadi, Yuana Elly Agustin, Lu Ki Ong, Ferrent Auryn Hadiwijaya, Amelia Winoto, Edrea Adelia Gunawan, Jessica Tambatjong, Tjie Kok

Enzyme immobilization is essential for enhancing the stability and reusability of enzymes in various industrial processes. To improve its feasibility, efficient yet simple immobilization techniques were required to be explored with respect to enhance overall catalytic efficiency and/or operational performance....

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## Influence of Inulin and Isomalto-oligosaccharides as Thickener on the Stability of Vitamin C Containing $W_1/O/W_2$ Double Emulsion

Lanny Sapei, Emma Savitri, Hillary Emmanuella Darsono, Yenni Anggraeni

Encapsulation with a W1/O/W2 double emulsion (DE) system is a method that could protect vitamin C or other active ingredients from external influences thus increasing their stability and bioavailability. The DEs were prepared using hydrogenated coconut oil (HCNO) and middle chain triglycerides (MCT)...

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### Effect of the Amount of $KIO_3$ , Water, and Stirring Time on Salt Quality in the Iodization Process

Herry Santoso, Febianus F. Setyadi, Maria Lestanur, Kevin C. Wanta, Angel Nadut, Judy R. Witono

Currently, IDD (Iodine Deficiency Disorder) is a problem that still requires attention from the Indonesian government. IDD problems can be overcome by adding iodized salt to daily food. However, the quality of consumption salt produced by small industries in Indonesia is still relatively low in terms...

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### Carboxylated Multi-walled Carbon Nanotubes/Calcium Alginate Composite for Methylene Blue Removal

Puguh Setyoprato, Restu Kartiko Widi, Rudy Agustriyanto, Endang Srihari

In this research work, the adsorption of methylene blue (MB) on carboxylated poly-walled nanotubes carbon (PWNC)/calcium alginate composite was studied. The composite was synthesized by the impregnation method. The study was aimed to observe the impact of

carbon nanotube dosage on the ability of the...

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#### **Proceedings Article**

### Delignification and Characterization of Fiber from Durian Peel Waste

Emma Savitri, Prayogo Widyastoto Waluyo, Leonardus Edward Layantara, Nathasya Fabiola Rusly

The limited availability of natural fiber sources makes durian peel waste an alternative source of natural fiber. The characteristic of durian peel waste, which is mechanically strength, has the potential to be developed. During the durian season, the amount of durian consumption by the community increases...

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#### **Proceedings Article**

### Lean and Green Value Stream Mapping: Case Study of an East Java Furniture Factory

Reyhan Iskandar, Moses Laksono Singgih

Research on lean principles in developing countries remains limited, highlighting the need for exploring alternative methods that have a positive environmental impact. One such approach is the utilization of the Value Stream Mapping (VSM) method to develop a system for waste reduction in production processes....

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### Proceedings Article

## The Adoption of the Response Surface Methodology within the DMAIC Process to Achieve Optimal Solutions in Reducing Product Defect

Yenny Sari, Amelia Santoso, Nadia Angelina Putri Pangestu

The high number of defective products can cause the company to receive many complaints. This research aimed to apply the quality improvement approach i.e., the DMAIC methodology (Define-Measure-Analysis-Improve-Control), to reduce product defect. The object of discussion was the black-color cloth hangers...

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## Behavior of Vehicle Platoon with Limited Output Information Based on Constant Time Heading

Agung Prayitno, Veronica Indrawati, Pyae Pyae Phyoo

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<sub>3</sub> 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 (CaCO<sub>3</sub>) 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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#### **Proceedings Article**

### 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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## Proceedings Article

### 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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### Proceedings Article

## 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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### Proceedings Article

## 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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### Proceedings Article

## 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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#### **Proceedings Article**

### 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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### Proceedings Article

## 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, Budiarto

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 Widiastri, 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 Parkinson's disease (PD) is to utilize the voice change known as Parkinsonian dysarthria. Voice features 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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