# OPTIMALISASI PENERANGAN JALAN UMUM DAN DESAIN ULANG PENERANGAN JALAN UMUM BERBASIS DIALUX DAN LOGIKA FUZZY

**SKRIPSI**

Diajukan untuk memenuhi syarat untuk memperoleh gelar Sarjana Teknik Elektro

Program Studi S1 Teknik Elektro

Oleh :

**Haryo Iri Satrio Wicaksono**

**E.5051.1603417**

**PROGRAM STUDI TEKNIK ELEKTRO**

**DEPARTEMEN PENDIDIKAN TEKNIK ELEKTRO**

**FAKULTAS PENDIDIKAN TEKNOLOGI DAN KEJURUAN**

**UNIVERSITAS PENDIDIKAN INDONESIA**

**2020**

**Haryo Iri Satrio Wicaksono, 2020**
***OPTIMALISASI PENERANGAN JALAN UMUM DAN DESAIN ULANG PENERANGAN JALAN UMUM BERBASIS DIALUX DAN LOGIKA FUZZY***
Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

# OPTIMALISASI PENERANGAN JALAN UMUM DAN DESAIN ULANG PENERANGAN JALAN UMUM BERBASIS DIALUX DAN LOGIKA FUZZY

Oleh

Haryo Iri Satrio Wicaksono

Sebuah skripsi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Teknik pada Program Studi S1 Teknik Elektro

© Haryo Iri Satrio Wicaksono

Universitas Pendidikan Indonesia

Juni 2020

Hak Cipta dilindungi Undang-Undang.

Skripsi ini tidak boleh diperbanyak seluruhya atau sebagian,

dengan dicetak ulang, di*photocopy*, atau cara lainnya tanpa izin dari penulis.

**Haryo Iri Satrio Wicaksono, 2020**
***OPTIMALISASI PENERANGAN JALAN UMUM DAN DESAIN ULANG PENERANGAN JALAN UMUM BERBASIS DIALUX DAN LOGIKA FUZZY***
Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu

**LEMBAR PENGESAHAN**

**PENGAJUAN SIDANG SARJANA**

**Haryo Iri Satrio Wicaksono**

**E.5051.1603417**

**OPTIMALISASI PENERANGAN JALAN UMUM DAN DESAIN ULANG PENERANGAN JALAN UMUM BERBASIS DIALUX DAN LOGIKA FUZZY**

**DISETUJUI & DISAHKAN OLEH:**

| PEMBIMBING I | PEMBIMBING II |
|---|---|
| **Prof. Dr. Ade Gafar Abdullah, M.Si.** | **Dr. Ir. H. Dadang Lukman Hakim M.T.** |
| **NIP. 19721113 199903 1 001** | **NIP. 19610604 198603 1 001** |

**MENGETAHUI**

**KETUA DEPARTEMEN PENDIDIKAN TEKNIK ELEKTRO**

**Dr. H. Yadi Mulyadi, M.T.**
**NIP. 19630727199302 1 001**

# ABSTRAK

Pencahayaan jalan merupakan salah satu infrastruktur yang sangat penting di perkotaan, salah satu fungsi utamanya adalah demi memberikan kenyamanan bagi pengguna jalan juga sebagai pencegah kejahatan di malam hari. Namun selain memiliki berbagai fungsi, sistem penerangan jalan umum harus sesuai dengan standar dan juga memperhatikan aspek efisiensi energi. Penelitian ini membahas optimasi menggunakan kecerdasan buatan dengan metode logika fuzzy mamdani untuk mendapakan tingkat kemerataan yang sesuai standar, dengan variabel masukan seperti lebar jalan, tinggi tiang, daya lampu dan pemasangan jarak antar tiang. Kemudian hasil dari logika fuzzy mamdani dijadikan sebagai dasar masukan perancangan ulang menggunakan DIALux dan beberapa masukan tambahan sesuai kriteria standar yang ada di dalam perangkat lunak DIALux. Hasil dari penelitian ini menunjukan baik tingkat kemerataan ataupun aspek lainya sudah memenuhi standar dan juga memiliki penghematan energi hingga 58,6% dari kondisi eksisting, penelitian ini diharapkan bisa menjadi rekomendasi dalam perancangan penerangan jalan.

**Kata kunci:** Lampu jalan, logika fuzzy mamdani, DIALux, efisiensi energi.

## *ABSTRACT*

*Road lighting is one of the most important infrastructures in an urban area, one of its main functions is to provide comfort for road users as well as crime prevention at night. But besides having various functions, public street lighting systems must comply with standards and also pay attention to aspects of energy efficiency. This study discusses optimizations using artificial intelligence with civil fuzzy logic methods to obtain a level of evenness that is in accordance with the standard, with input variables such as road width, pole height, lamp power and mounting distance between poles. Then the results of the Mamdani fuzzy logic are used as the basis for re-design input using DIALux and some additional input according to the standard criteria contained in the DIALux software. The results of this study indicate that both the level of evenness and other aspects have met the standard and also has an energy savings of up to 58.6% of the existing conditions, this research is expected to be a recommendation in the design of the road installation.*



***Keywords:*** *Street lights, mamdani fuzzy logic, DIALux, energy efficiency*

# DAFTAR ISI

ABSTRAK ..... 3
*ABSTRACT* ..... **Error! Bookmark not defined.**
KATA PENGANTAR ..... **Error! Bookmark not defined.**
UCAPAN TERIMA KASIH ..... **Error! Bookmark not defined.**v
DAFTAR ISI ..... 5i
DAFTAR TABEL ..... 6
DAFTAR GAMBAR ..... **Error! Bookmark not defined.**x
DAFTAR LAMPIRAN ..... **Error! Bookmark not defined.**
BAB I PENDAHULUAN ..... **Error! Bookmark not defined.**
1.1 Latar Belakang ..... **Error! Bookmark not defined.**
1.2 Rumusan Masalah ..... **Error! Bookmark not defined.**
1.3 Tujuan Penelitian ..... 2
1.4 Manfaat Penelitian ..... 2
1.5 Sistematika Penulisan ..... **Error! Bookmark not defined.**
BAB II KAJIAN PUSTAKA ..... 4
2.1 Penerangan Jalan Umum ..... 4
2.2 Standarisasi Pencahayaan ..... 4
2.2.1 Standar Nasional Indonesia (SNI) 7391:2008 ..... 5
2.3 Jenis Penempatan Penerangan Jalan Umum ..... 7
2.4 Jenis Lampu Penerangan Jalan Umum ..... 9
*2.4.1 Low Pressure Sodium* ..... 9
*2.4.2 High Pressure Sodium* ..... 9
*2.4.3 Metal Halide* ..... **Error! Bookmark not defined.**
2.4.4 Lampu Uap Merkuri ..... **Error! Bookmark not defined.**
*2.4.5 Light Emitting Diode* ..... **Error! Bookmark not defined.**
2.5 Energi Listrik ..... **Error! Bookmark not defined.**
2.6 Perangkat Lunak *DIALux* ..... **Error! Bookmark not defined.**
2.7 Perangkat Lunak Matlab ..... **Error! Bookmark not defined.**
2.8 *Fuzzy Logic* ..... **Error! Bookmark not defined.**
*2.8.1 Fuzzy Logic Mamdani* ..... **Error! Bookmark not defined.**

BAB III METODE PENELITIAN ..... 18
3.1 Metode Penelitian ..... 18
3.2 Desain Penerangan Jalan Umum Menggunakan *DIALux* ..... 19
3.3 Sumber Data Penelitian ..... 21
3.4 Data Teknis Area Studi ..... **Error! Bookmark not defined.**
3.5 Perangkat Penunjang Penelitian ..... 22
BAB IV TEMUAN DAN PEMBAHASAN ..... 23
4.1 Karakteristik Penerangan Jalan Umum Area Studi.. **Error! Bookmark not defined.**
4.2 Optimalisasi Menggunakan *Fuzzy Inferensi System Mamdani* ..... 27
4.2.1 Kerangka Pemodelan Sistem ..... 27
4.2.2 Masukan ..... 28
4.2.3 Aturan (*Rule Base)* ..... 31
4.2.4 Keluaran ..... 31
4.*2.5 Rule Viewer* ..... 32
4.3 Perancangan Ulang Desain PJU menggunakan DIALux ..... 33
4.3.1 Menentukan Jenis Lampu ..... 34
4.3.2 Menentukan Variabel Simulasi ..... 34
4.4 Perbandingan Penggunaan Energi Listrik ..... 38
4.4.1 Penggunaan Energi Listrik Terpasang ..... 38
4.4.2 Penggunaan Energi Listrik Hasil Optimalisasi ..... 39
BAB V SIMPULAN, IMPLIKASI DAN REKOMENDASI ..... 41
5.1 Simpulan ..... 41
5.2 Implikasi ..... 42
5.3 Rekomendasi ..... 42
DAFTAR PUSTAKA ..... **Error! Bookmark not defined.**3
LAMPIRAN ..... **Error! Bookmark not defined.**

## DAFTAR PUSTAKA


Al Irsyad, M. I., & Nepal, R. (2016). A survey based approach to estimating the benefits of energy efficiency improvements in street lighting systems in Indonesia. *Renewable and Sustainable Energy Reviews*, *58*, 1569–1577. https://doi.org/10.1016/j.rser.2015.12.294

Beccali, M., Bonomolo, M., Lo Brano, V., Ciulla, G., Di Dio, V., Massaro, F., & Favuzza, S. (2019). Energy saving and user satisfaction for a new advanced public lighting system. *Energy Conversion and Management*, *195*, 943–957. https://doi.org/10.1016/j.enconman.2019.05.070

Boomsma, C., & Steg, L. (2014). The effect of information and values on acceptability of reduced street lighting. *Journal of Environmental Psychology*, *39*, 22–31. https://doi.org/10.1016/j.jenvp.2013.11.004

Carli, R., Dotoli, M., & Cianci, E. (2017). An optimization tool for energy efficiency of street lighting systems in smart cities. *IFAC-PapersOnLine*, *50*(1), 14460–14464. https://doi.org/10.1016/j.ifacol.2017.08.2292

Chiang, C. H., Liang, T. J., Lee, J. Y., & Li, J. S. (2015). Study and implementation of a two-stage electronic ballast for metal halide lamp. *2015 IEEE 2nd International Future Energy Electronics Conference, IFEEC 2015*. https://doi.org/10.1109/IFEEC.2015.7361622

Ciobanu, I., & Pentiuc, R. D. (2016). Analysis on the possibility of using retrofit solutions for increasing the energy efficiency of public lighting systems. *2016 International Conference on Applied and Theoretical Electricity, ICATE 2016 - Proceedings*, 0–4. https://doi.org/10.1109/ICATE.2016.7754632

Có, M. A., Resende, C. Z., Simonetti, D. S. L., Vieira, J. L. F., & Almeida, P. C. A. (2002). Microcontrolled electronic gear for low wattage Metal Halide (MH) and High-Pressure Sodium (HPS) lamps. *Conference Record - IAS Annual Meeting (IEEE Industry Applications Society)*, *3*, 1863–1868.

https://doi.org/10.1109/IAS.2002.1043787

Cole, M., & Driscoll, T. (2014). The lighting revolution: If we were experts before, we're novices now. *IEEE Transactions on Industry Applications*, *50*(2), 1509–1520. https://doi.org/10.1109/TIA.2013.2288210

Gafar Abdullah, A., Pambudi, R. L., Purnama, W., Bayu, A., Nandiyanto, D., Triawan, F., & Aziz, M. (2019). REDESIGNING STREET-LIGHTING SYSTEM USING LED AND HPS LUMINAIRES FOR BETTER ENERGY-SAVING APPLICATION. In *Journal of Engineering Science and Technology* (Vol. 14, Issue 4).

Gao, S., Wang, Y., Liu, X., & Xu, D. (2016). *Pressure Sodium Lamp*. 253–257.

Gómez-Lorente, D., Rabaza, O., Espín, A., & Peña-García, A. (2013). Optimization of efficiency and energy saving in public lighting with multi-objective evolutionary algorithms. *Renewable Energy and Power Quality Journal*, *1*(11), 62–65. https://doi.org/10.24084/repqj11.215

Jack, A., & Vrenken, L. (1980). Fluorescent lamps and low pressure sodium lamps. *Physical Science, Measurement and …*, *127*(3), 149–157.

Jinila, Y. B. (2016). Solar powered intelligent street lighting system based 1 on fuzzy logic controller. *International Review of Electrical Engineering*, *10*, 399–403.

Khalil, H. B., Abas, N., & Rauf, S. (2017). Intelligent street light system in context of smart grid. *8th International Conference on Computing, Communications and Networking Technologies, ICCCNT 2017*. https://doi.org/10.1109/ICCCNT.2017.8204158

Kim, D., & Park, S. (2017). Improving community street lighting using CPTED: A case study of three communities in Korea. *Sustainable Cities and Society*, *28*, 233–241. https://doi.org/10.1016/j.scs.2016.09.016

Lester, H. A. (1999). *Research Report Single-Molecule Fluorescence Observed*

*with Mercury Lamp Illumination*. *December*.

Moghadam, M. H., & Mozayani, N. (2011). A street lighting control system based on holonic structures and traffic system. *ICCRD2011 - 2011 3rd International Conference on Computer Research and Development*, *1*, 92–96. https://doi.org/10.1109/ICCRD.2011.5763980

Mohandas, P., Dhanaraj, J. S. A., & Gao, X. Z. (2019). Artificial Neural Network based Smart and Energy Efficient Street Lighting System: A Case Study for Residential area in Hosur. *Sustainable Cities and Society*, *48*(August 2018). https://doi.org/10.1016/j.scs.2019.101499

Mrabet, B. M., & Chammam, A. M. (2017). *A Study of the Impact of a High Pressure Sodium (HPS) Lamps on Power Quality*. 56–61.

Nam, T. P., & Van Doai, N. (2019). Application of intelligent lighting control for street lighting system. *Proceedings of 2019 International Conference on System Science and Engineering, ICSSE 2019*, 53–56. https://doi.org/10.1109/ICSSE.2019.8823357

Nasional, S., Ics, I., & Nasional, B. S. (2008). *Standar Nasional Indonesia 7391 Tahun 2008*.

Pambudi, R. L., Abdullah, A. G., & Purnama, W. (2008). *Desain Penerangan Jalan Umum Pada Tipe Jalan Kolektor Sekunder*.

Pinto, M. F., Mendonca, T. R. F., Coelho, F., & Braga, H. A. C. (2015). Economic analysis of a controllable device with smart grid features applied to LED street lighting system. *IEEE International Symposium on Industrial Electronics*, *2015-Septe*, 1184–1189. https://doi.org/10.1109/ISIE.2015.7281640

Rabaza, O., Gómez-Lorente, D., Pérez-Ocón, F., & Peña-García, A. (2016). A simple and accurate model for the design of public lighting with energy efficiency functions based on regression analysis. *Energy*, *107*, 831–842.

https://doi.org/10.1016/j.energy.2016.04.078

Rafiq, A., Sameen, A., Shafaq, M., Parveen, H., & Haque, A. (2016). A reliable and low cost control circuit of electronic ballast for Metal Halide HID lamps. *12th IEEE International Conference Electronics, Energy, Environment, Communication, Computer, Control: (E3-C3), INDICON 2015*, 1–6. https://doi.org/10.1109/INDICON.2015.7443508

Riad, K., Christophe, S., Benoît, R., Emmanuel, P., Arnaud, M., & Jean-Michel, G. (n.d.). *A Power flow Control Strategy for High Energy Efficient Smart LED Lighting System Powered by PV and MPPT Controlled DC Grid*.

Rodrigues, C. R. B. S., Almeida, P. S., Soares, G. M., Jorge, J. M., Pinto, D. P., & Braga, H. A. C. (n.d.). *An Experimental Comparison Between Different Technologies Arising for Public Lighting: LED Luminaires Replacing High Pressure Sodium Lamps*.

Sędziwy, A. (2016). Sustainable street lighting design supported by hypergraph-based computational model. *Sustainability (Switzerland)*, *8*(1), 1–13. https://doi.org/10.3390/su8010013

Shahzad, K., Čuček, L., Sagir, M., Ali, N., Rashid, M. I., Nazir, R., Nizami, A. S., Al-Turaif, H. A., & Ismail, I. M. I. (2018). An ecological feasibility study for developing sustainable street lighting system. *Journal of Cleaner Production*, *175*, 683–695. https://doi.org/10.1016/j.jclepro.2017.12.057

Silva, A. F. C. V. (2016). *An educational approach to a Lighting Design Simulation using DIALux evo Software*.

*UU-RI No 38 Tahun 2004*. (2004). *1*, 1–40.

Yoomak, S., Jettanasen, C., Ngaopitakkul, A., Bunjongjit, S., & Leelajindakrairerk, M. (2017). Comparative Study of lighting quality and power quality FOR LED and HPS Luminaires IN A Roadway Lighting system. *Energy & Buildings*. https://doi.org/10.1016/j.enbuild.2017.11.060

**Haryo Iri Satrio Wicaksono, 2020**
***OPTIMALISASI PENERANGAN JALAN UMUM DAN DESAIN ULANG PENERANGAN JALAN UMUM BERBASIS DIALUX DAN LOGIKA FUZZY***
Universitas Pendidikan Indonesia | repository.upi.edu | perpustakaan.upi.edu