engineering proceedings

Abstract

Public Lighting Recognition System Based on Colored Reflection Index and Computational Machine Learning †

Francisco Fambrini [1,*], Diogo Gará Caetano [1,2], Rangel Arthur [3] and Yuzo Iano [3]

[1] Kasco—Research, Campinas 13083-872, Brazil
[2] School of Electrical Engineering, University of State of Campinas (UNICAMP), Campinas 13083-872, Brazil
[3] School of Electrical and Computer Engineering (FEEC), University of State of Campinas (UNICAMP), Campinas 13083-872, Brazil
* Correspondence: ffambrini@gmail.com
† Presented at the 9th International Symposium on Sensor Science, Warsaw, Poland, 20–22 June 2022.

Abstract: Identifying which type of lamp is installed on each public lighting pole and evaluating its luminous power is important because the new light-emitting diodes (LED)-type models are much more economical in terms of energy, and energy distribution companies need to know the consumption of public lighting energy. In Brazil, the following types of lamps exist in street lighting: incandescent, mercury vapor, sodium vapor, "mixed" lamps (composed of a mercury vapor arc tube in series with an incandescent tungsten filament), metal lamps and modern LED-type lamps. In this article, the authors describe the experimental results of the development of an automated system for recognizing lamps for public lighting based on the light pattern of each lamp, taking into account an innovative optic method, which uses the reproduction index of color (RIC) phenomenon and colored cards. Data collection in the field consisted of the task of driving a vehicle through public roads and obtaining several photos of the colored cards illuminated through the lamps of the poles and also through the use of a spectrophotometer, which is already traditionally employed for this application. Samples were obtained and used for training classifiers that use machine learning in order to identify the nature of the lamps. The tests were carried out on the city's public roads at night, so the resulting tables also show the noise from interfering light sources (examples: lights from windows in houses and buildings, lights in stores, etc.), thus creating a very realistic scenario. The performance of the classifiers was evaluated through parameters used in artificial intelligence.

Keywords: reproduction index of color; lamp identification; spectrophotometry; machine learning

Citation: Fambrini, F.; Caetano, D.G.; Arthur, R.; Iano, Y. Public Lighting Recognition System Based on Colored Reflection Index and Computational Machine Learning. *Eng. Proc.* **2022**, *21*, 56. https://doi.org/10.3390/engproc2022021056

Academic Editors: Piotr Lesiak, Tomasz Woliński and Leszek Jaroszewicz

Published: 13 September 2022

Author Contributions: F.F., D.G.C., R.A. and Y.I. contributed equally to these items: conceptualization; methodology; software; validation; formal analysis; investigation; resources; data curation; writing—original draft preparation; writing—review and editing; visualization; supervision, project administration; funding acquisition. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by CPFL Energia S.A., grant number ANEEL DE3014 and the APC was funded by ANEEL-Agencia Nacional de Energia Elétrica, Campinas, Brazil.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.