

**CENTERIS / ProjMAN / HCist**

CENTERIS – Conference on ENTERprise Information Systems

ProjMAN – International Conference on Project MANagement

HCist – International Conference on Health and Social Care Information Systems and Technologies



# **CENTERIS / ProjMAN / HCist 2022**

Book of industry papers, poster papers and abstracts

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Book of industry papers, poster papers and abstracts of the  
**CENTERIS 2022 – Conference on ENTERprise Information Systems /**  
**ProjMAN 2022 – International Conference on Project MANagement /**  
**HCist 2022 – International Conference on Health and Social Care**  
**Information Systems and Technologies**

October 9–11, Lisboa, Portugal

**Editors:**

Maria Manuela Cruz-Cunha, Polytechnic Institute of Cávado and Ave, Portugal

Ricardo Martinho, Polytechnic Institute of Leiria, Portugal

Rui Rijo, Polytechnic Institute of Leiria, Portugal

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Emanuel Peres, University of Trás-os-Montes e Alto Douro, Portugal

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# Diabetic Retinopathy Grading using Blended Deep Learning

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## Abstract

Diabetic retinopathy is a complication of diabetes that is mainly caused by the damage of the blood vessels located in the retina. Retinal screening contributes to early detection and treatment of diabetic retinopathy. DR has five stages, namely healthy, mild, moderate, severe and proliferative diabetic retinopathy. Computer-aided diagnosis approaches are needed to allow an early detection and treatment. Several automated deep learning (DL) based approaches have been proven to be a powerful tool for DR grading. However, these approaches are usually based on one DL architecture only which could produce over-fitted results. Another identified problem is the use of imbalanced datasets. In this paper, we proposed a blended deep learning approach obtained by training several individual DL models, using a 5-fold cross-validation technique and combining their predictions in a final score. This blended model highlights each individual model where it performs best and discredits where it performs poorly, increasing the robustness of the results. The experiments were conducted on a balanced DDR dataset containing 33310 retina fundus images equally distributed for the DR grades. An explainability algorithm was also used to show the efficiency of the proposed approach in detecting DR signs.

*Keywords:* Diabetic retinopathy grading; blended deep learning; retina fundus images; retinopathy levels.

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