ISSN 2007-9737

Thematic Section: Advances in Pattern Recognition

This thematic section of Computación y Sistemas (CYS) presents a curated selection of 12 research papers—out of eighteen total submissions—highlighting significant, current advancements in the field of Pattern Recognition (PR). This collection offers essential reading for the PR community.

The guest editors managed the entire review process, resulting in the final selection of these 12 papers. A high standard of quality was maintained through a rigorous peer-review process, in which each paper was evaluated by at least three members of the scientific committee. Acceptance was predicated on a comprehensive assessment of the work's originality, contribution to the field, theoretical soundness, and technical quality. We now provide a synopsis of the research included in this thematic section.

A. Jiménez-Frías et al. present an improved, automated system for counting vehicles and pedestrians from drone footage. The four-module pipeline consists of (1) a robust video stabilization module, (2) a deep learning-based object detection model, (3) an object tracking algorithm, and (4) a counting module. These modules allow a user to define any counting line within the video scene. In experiments on the YucaMex-MOCS dataset, the proposed counting system achieves higher average precision than a previous work of the authors that did not use the stabilization module, demonstrating the importance of adding it.

A. J. Aceves-Ramírez and L. Altamirano-Robles, building upon a previous implementation of an exponential decay method on a Jetson Nano, present an experimental comparison of multiple correction approaches based on polynomial regression (PR) as well as artificial neural network (ANN) models. All evaluated models demonstrated real-time processing capability. Notably, the ANN model achieved the highest performance, outpacing the slower model. The results of this study indicate that the methods improve measurement accuracy within the 3- to 7-meter range while maintaining high-speed processing performance, thereby enhancing data reliability for Unmanned Aerial Vehicle (UAV) applications.

Hiram Efraín Orocio-García et al. proposes a deep learning approach for segmenting the major temporal arcade (MTA) in retinal fundus images using a U-Net based architecture. In particular an attention module is added in the deep architecture for enabling neural networks to prioritize meaningful regions within an image. A comparative study is conducted and evaluated in terms of F1 score, sensitivity, specificity, and accuracy confirming that the proposed approach has a competitive behavior when comparing with other methods for segmenting arterial structures.

Víctor Romero-Bautista et al. address the problem of monocular visual odometry (VO) in unstructured agricultural environments by proposing a deep learning approach considering depth, spatial, and temporal features. The proposal consists of building a deep learning-based monocular VO method considering two image processing pathways: scene and depth. The deep learning method is tested over the agricultural Rosario dataset showing that the use of depth features improves significantly the performance, obtaining consistent and coherent estimated trajectories in training and testing sequences.

Adrián J. Ramírez-Díaz et al. report an experimental analysis by comparing density-based clustering methods considering medium-large datasets. This experimental study evaluates different scalability strategies which is not considered in other published works and this experimentation constitutes the main contribution of the paper. In addition, the effect on sample sizes and clustering quality as well as runtimes are analyzed. According to the detailed reported results, the study indicates that each scalability

strategy involves trade-offs between quality and runtime.

Guillermo De Ita Luna et al. present an algorithmic approach for recognizing patterns in extreme topologies dendrimer structures associated with the Merrifield-Simmons (M-S) index for molecular graphs in computational chemistry. This contribution shows how graph theory and recurrence relations can be used to design efficient counting algorithms, benefiting both the pattern recognition area and applications such as molecular design, drug delivery, and nanomaterials engineering. The proposed algorithm has a linear time complexity on the number of edges involved in the dendrimer compounds.

Jaramillo-Olivares et al. present a comparative analysis of dissimilarity-based graph embeddings for supervised classification. The paper investigates whether employing subsets of mined patterns, specifically closed and maximal patterns, improves performance compared to using the complete set of frequent patterns. Experiments conducted on benchmark graph collections demonstrate that these compact, non-redundant pattern subsets effectively reduce the embedding space while consistently yielding higher accuracy and F1-scores. Furthermore, the research highlights that embeddings built from approximate graph patterns significantly outperform those based on exact patterns, offering a robust approach for classifying complex graph-structured data.

G. A. Oropeza-Gomez et al. compare various computer vision algorithms for detecting Airy disk peaks on a low-performance computer. These algorithms are useful for real-time control of spatial optical systems based on Airy disk diffraction. According to their experiments, Fast Block Matching (FBM) and Connected Component Labeling (CCL) algorithms are good choices for low-resource systems, such as portable or embedded platforms. On the other hand, Simple Linear Iterative Clustering (SLIC) is a suitable alternative for applications where reliability and cluster size estimation are important. This study provides a framework for selecting a suitable computer vision algorithm for auto-aligning spatial filters.

A. L. Lezama Sánchez and M. Tovar Vidal present a comparative study of machine learning and deep learning models for the automatic detection of harassment and discrimination in text. Using the Everyday Sexism Project dataset, the authors evaluate four approaches: TF-IDF with logistic regression, BERT-based classification, a CNN with GloVe embeddings, and a GRU model with attention mechanisms and capsule networks. Performance is measured using accuracy, precision, recall, and F1-score. The results show that deep learning models outperform traditional methods, demonstrating a better capability to capture complex linguistic patterns in abusive content.

J. J. Gortarez-Pelayo et al. present an approach to improve the recognition of the Mexican Sign Language (LSM) alphabet by enhancing keypoint selection in hand models. Motivated by the importance of the manual alphabet in sign languages and the need for efficient real-time performance, the study focuses on selecting the most critical hand landmarks to simplify the hand model. This optimization reduces model complexity while maintaining high recognition performance, achieving an F1-score greater than 0.94. The results support the development of lightweight and efficient systems for real-time learning and deployment of the LSM alphabet.

A. Cruz-Bernal and M. E. Martínez-García propose an automated system for the early detection and classification of bark beetles to address the limitations of manual monitoring under the increasing impact of climate change. The approach combines Connected-Component Labeling for insect detection and counting with a modified ResNet50 residual neural network for classification, including a customized final layer. Experiments conducted on a dataset augmented with over 3,000 images achieve an accuracy above 90%. The system successfully distinguishes between Dendroctonus mexicanus and Dendroctonus frontalis, demonstrating its potential

to improve forest pest management and enable timely, proactive responses to infestations.

García-Galindo et al. This study proposes a computational approach for classifying suicide notes by analyzing sentence-level emotional dynamics. The authors employed two LSTM architectures to model the sequence and evolution of emotions within notes. Experiments using datasets of consummated suicide notes, suicidal ideation posts, and general domain texts revealed that integrating emotional vectors with document-level linguistic features significantly improves classification performance. Specifically, the attention-based model combined with BERT embeddings achieved the highest F-scores (exceeding 92% in some scenarios). The findings highlight that while consummated suicide notes often lack explicit suicidal markers, they exhibit distinct, highly concentrated emotional patterns that differentiate them from general text and ideation notes.

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