**January 29, 2023**

**Dear Editor in Chief:**

Journal of Imaging

I am pleased to resubmit for publication the revised version of our manuscript entitled: “*Vectorial Image Representation for Image Classification*”. The manuscript was identified as *jimaging-2826885*. I am very thankful to the Editor and reviewers for their thorough review. We have revised our research article in the light of their useful suggestions and comments, and hope our revision has improved the manuscript to a level of their satisfaction. In the manuscript, the changes were marked using blue and the red text was eliminated from the article.

**Review´s comments:**

**Review 1**

Dear Review, we appreciate your comments and questions to improve the quality of our work. These are answered below.

1. This paper primarily focuses on explaining the proposed method. Therefore, it is written in an explanatory style, listing various facts. However, readers may be more interested in how the proposed method can be used and what possibilities it holds. Therefore, it would be more persuasive to provide more detailed information on these aspects. For instance, although there is a brief mention of the potential applications in medical image processing or the localization of missing persons, it would be beneficial to elaborate on why it could be useful in medical image processing and what technical advantages it may have over other algorithms.

Answer:

A medical diagnosis system based on texture classification can help in the medical prescription of patients, improving their quality of life. Effective diagnosis can be achieved by developing efficient classification systems where texture extraction together with the classifier play a relevant role. Taking the aforementioned into consideration, this work proposes a new texture extraction technique and a classifier for multiple classes, whose experimental results demonstrate its efficiency in the recognition of digital images. For this reason, we propose medical image recognition as future work. It is worth mentioning that the classification of medical images is not considered in this work due to the complexity of its analysis and description, and the focus of the description of the proposed method may be lost.

However, taking into consideration his comment, point 9 and references were placed in section 4 (discussion) [26-29].

Point 9:

**“9. Because medical images contain local textural features which can be extracted through local analysis [3,4,26,27], and knowing that the technique reported in this work also extracts texture features based on local analysis local, then the VIR-TS transform and the classifier described in section 2.3 can be applied in medical image recognition. The benefit would be the development of medical diagnostic systems with high efficiency, easy to implement because the definition of the texture unit is based on a linear transformation and not on the encoding of a pattern [21,28], where the overflow of physical memory of the computer is possible [29].”**

[26] González-Castro, V.; Cernadas, E.; Huelga, E.; Fernández-Delgado, M.; Porto, J.; Antunez, J.R.; Souto-Bayarri, M. CT Radiomics in Colorectal Cancer: Detection of KRAS Mutation Using Texture Analysis and Machine Learning. Appl. Sci. 2020, 10, 6214.

[27] Park, Y.R.; Kim, Y.J.; Ju, W.; Nam, K.; Kim, S.; Kim, K.G. Comparison of machine and deep learning for the classification of cervical cancer based on cervicography images. Sci. Rep. 2021, 11, 16143.

[28] Kurmyshev, E.V. Is the Coordinated Clusters Representation an analog of the Local Binary Pattern? Comput. Sist. 2010, 14, 54–62

[29] Kurmyshev, E.V. and Guillen Bonilla J. T., Complexity reduced coding of binary pattern units in image classification Optics and Lasers in Engineering 2011, 49, pp. 718-722

1. The same applies to image classification. What distinguishes this new representation from other image classification methods? Providing readers with some insights into this matter would enhance the clarity of the discussion

Respuesta:

Dear reviewer, your question is very interesting..

As mentioned in the introduction of our work, there are various forms of texture extraction: Based on signal processing, statistics and mathematical models. Each technique offers advantages in certain types of applications.

So, if we make a comparison between statistical techniques and the Vector Image Representation on the Texture Space (VIR-TS) technique, in both a local analysis is made about the texture characteristics on the image. However, their definitions of texture units are very different. In statistical techniques, the texture unit is defined based on the coding of random discrete patterns and the texture features are represented by a discrete histogram. While, in the VIR-TS technique, its texture unit is defined based on a linear transformation and its texture characteristics are expressed through a random vector in the texture space.

Taking into consideration your comment, in section 4 (discussion) the point was placed 10:

Point 10:

**“10. Comparing the statistical texture extraction techniques reported in reference [21] with the VIR-TS technique based on linear transformations, both texture extraction techniques are very different. In statistical techniques, the texture unit is calculated based on the encoding of discrete random patterns located on the digital image, its texture unit is considered a random event and the texture characteristics are represented through a discrete histogram. While, in our technique called VIR-TS, the texture unit is calculated based on a linear transformation, its texture unit is a radius vector and the texture features are represented in a texture space through a random vector.”**

**Review 2**

Dear reviewer, we appreciate your comment to improve the quality of our work. Your comments and questions are answered below.

1.- I suggest avoiding paragraphs containing a single sentence only (e.g., lines 104-6).

Answer:

The phrase contained in lines 104-106 were removed,

“Based on the results, the VIR-TS transforms holds a high efficiency and has the potential to be applied in computer vision systems focused on texture recognition and security access.”

2.- It would be useful to announce the structure of the manuscript in the introductory section

Answer:

Dear reviewer, taking into account your comment, in section 1 (introduction), paragraph 3 was introduced where the structure of the article is described,

“The work has the following structure. Materials and methods are presented in section 2. In section 2.1. The texture space is described based on three subsections: in 2.1.1 the definition of the texture unit is shown, in section 2.1.2. The definition of the texture unit is represented graphically and in section 2.1.3. describes the representation of a digital image in texture space. In section 2.2. The procedure to measure the similarity in texture space between a prototype vector and a test vector is explained. Section 2.3 describes a classifier for multiple classes in texture space and where the VIR-TS vector is used as a feature vector. In section 3 the experimental work is developed. In section 3.1, a digital image database is vector represented in texture space where each vector has its own direction and magnitude. Furthermore, using the vectors obtained in the transformation, the similarity between images is measured. In section 3.2, experimental results of image classification are reported where the high efficiency of the VIR-TS technique is demonstrated. A discussion of our work is described in section 4. Finally, in section 5 the most relevant conclusions are presented.”

3.- Albeit the manuscript reads well, it would still benefit from careful proofreading – I spotted several typos here and there, also in the figures (see e.g., Figure 6 – “clasification").

Answer:

Dear reviewer, the document was read and corrected by a native English speaker, including the Figures.

4.       Please provide a link to the repository containing the implementation of the method to ensure its full reproducibility. Also, please include a minimal example showing how to reproduce the experimental results reported in this work.

Answer:

Dear reviewer, the code, three databases and an explanatory file were placed in the repository.

The code was called “Image Classification” and three parameters must be set: I and J are used to define the 3x3 window size and Lambda is used to solve the homogeneous system of equations. With the code, each digital image in a database is transformed into its vector . Subsequently, using the resulting vectors, the similarity between images is measured and they are also classified. Both results are shown in a confusion matrix.

With the program and the databases uploaded to the repository, the results reported in our work can be reproduced, confirming the effectiveness of our proposal.

5. I encourage the authors to provide qualitative analysis as well.

Answer:

Taking into consideration your comment, in section 4 (Discussion), paragraph 2, the text was placed,

“The Vector Image Representation on the Texture Space (VIR-TS) transformation is very different from the statistical techniques reported in references [21]. In the VIR-TS transformation, the texture unit is a radius vector, the vector is calculated by solving a homogeneous system of equations and its graph can be visualized in the texture space. With the transformation, the digital image *S* is expressed in texture space by the random vector , which is made up of three components and whose addresses are . Because the image is vector-represented, image classification in texture space is done by measuring the similarity between the prototype vectors and the test vector. Their similarity is calculated through the projection between both vectors. Finally, the test image is assigned to the most similar class. Based on the experimental work, the VIR-TS transformation has high classification efficiency because its texture feature extraction efficiency is very high. Furthermore, its implementation is very easy because the digital image is represented through a three-component random vector. “

Thank you very much for your kind attention. We hope you find our manuscript suitable for publication and look forward to hearing from you soon.

Sincerely: