Development of a Classifier Based on Neural Networks and K-Neighbors for Pediatric Pneumonia Diagnosis through X-Ray Images

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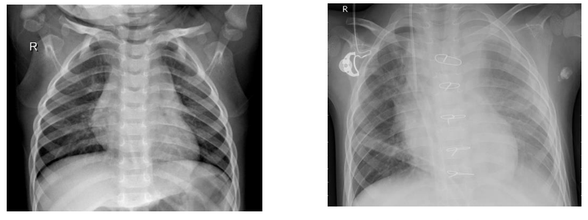
Introduction

Pneumonia is an acute infection of the lung parenchyma which can cause anything from inflation to accumulation of fluid in the lungs, its etiology may be due to infection from viruses, bacteria or fungi.



A) B)

Figure 1. A) Image without pneumonia. B) Image with pneumonia

Affects non-patients hospitalized and hospitalized, is characterized by a series of clinical manifestations such as the appearance of fever and/or respiratory symptoms (cough, expectoration) among others, along with the presence of alterations in the chest x-ray, accounts for more than 155 years worldwide

Neuronal networks

In this section, the concepts that constitute the theory of artificial neural networks and the K-means algorithm are presented. The basic elements of an artificial neuron are

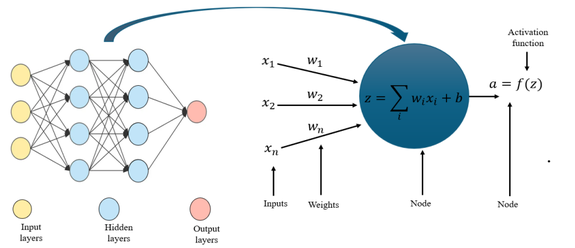


Figure 2. Components of the neural network for the K means algorithm.Source: Own authorship

KNN (k-nearest neighbors)

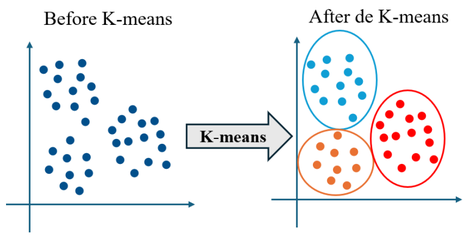


Figure 3. Example of application of K means to a data bank. Source: Own authorship

Methodology

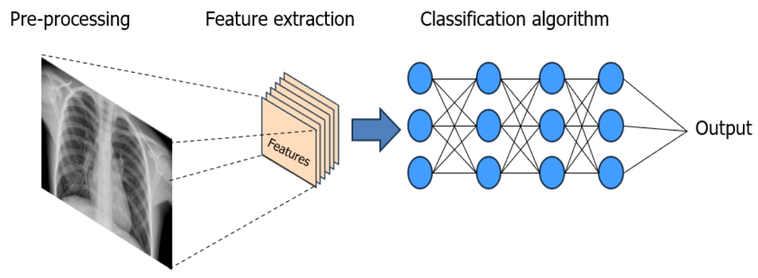


Figure 4. Applied methodology for network training. Source: Own authorship

Results

The confusion matrix can be visualized in Figure 5, the confusion matrix with 4 neurons and 7 inputs (features), the result obtained is 96.9% efficiency in the entire matrix and has its highest performance in the validation data.

Figure 5. Confusion matrices obtained. Source: Own authorship

Table 1.- Classification results for different values of K.

Iterations	K= 1	K=2	K=3	k=4	K=5
1	0.8	0.6	0.95	0.8	0.9
2	0.65	0.8	0.8	0.5	0.7
3	0.75	0.3	0.95	0.95	0.8
4	0.65	0.45	0.85	0.65	0.65
5	0.7	0.7	0.9	0.3	0.4
6	0.95	0.9	0.95	0.85	0.95
7	0.95	0.55	1	0.7	0.85
8	0.9	0.65	1	0.85	0.85
9	0.4	0.8	0.85	0.9	0.2
10	0.35	0.5	0.75	0.75	0.55
11	0.85	0.2	0.9	0.85	0.85
12	0.55	1	0.7	0.8	0.6
13	0.9	0.5	0.95	0.5	0.95
14	0.65	0.35	0.7	0.6	1
15	0.1	0.75	0.85	0.95	0.9
16	0.55	0.5	1	0.4	0.65
17	0.9	0.9	1	0.3	1
18	0.55	0.95	0.9	0.3	0.3
19	0.7	0.25	1	0.95	0.95
20	0.75	0.5	0.8	0.95	0.95
Average	0.68	0.6075	0.89	0.68	0.7475

Conclusion

The findings indicate that for this type of image classification task, convolutional neural networks (CNNs) are highly recommended, achieving approximately 97% efficiency, compared to the k-nearest neighbors algorithm, which does not exceed 90% efficiency with ***K=3***. For future work, it is suggested to incorporate Local Binary Patterns (LBP), a powerful operator for describing local image features, which offers advantages such as grayscale and rotational invariance.

This study provides a practical tool to support specialists in accurately classifying results from X-ray images, thereby improving diagnostic efficiency.

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References

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