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CLASSIFICATION OF SATELLITE IMAGES FOR DEFORESTATION REGIONS IN NORTHEASTERN PARÁ USING DEEP LEARNING TECHNIQUE

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Abstract: It is estimated that the Legal Amazon covers about 60% of the Brazilian territory and is home to 21 million inhabitants, 12% of the total population, of which 70% live in cities and towns, where high rates of deforestation are found in the northeast of the state. from Pará. This study presents a classification algorithm for degraded images using an image database provided by the State Secretariat for the Environment and Sustainability (SEMAS) to justify the objective of favorable conditions in the provision of environmental services in deforested areas using the computational implementation of learning machine in order to promote technological advancement through remote sensing.

INTRODUCTION

The region of agricultural expansion in the Amazon has been affected in recent years by socioeconomic and anthropic factors focused on agriculture and the typologies of environmental areas and large scale of specific vegetation. Much of these regions are degraded due to soil-related deforestation, affecting the environment and expanding pasture. With the advance of deforestation, some monitoring technologies for degraded areas were developed in order to show researchers and farmers in real time, the decline in agricultural productivity in the regions of northeastern Pará [CANAVIEIRA, L.O, 2018]. The study area selected for the study was the municipality of Thailand, identified as protected and classified as a Conservation Unit by the Space Research Institute (INPE), with the objective of diagnosing environmental regularities and irregularities of a rural property. [Alcântara Laudares, 2014]

This work presents an algorithm based on the subarea of computational intelligence, related to machine learning, classified as Convolutional Neural Network. The technique used acts in the classification of images of degraded areas, presenting the classification of Landsat ⅞ satellite images to aid in the automatic detection of deforested areas in order to strengthen actions to prevent illegal deforestation, favoring the agrarians in which they use agriculture as a way of supporting the family.

The study is divided into 5 sections. Section 2 presents the rationale for the study, section 3 is composed of the methodology, section 4 are results and section 5 highlights final considerations and future perspectives.

JUSTIFICATION

According to Brazilian legislation, when identifying the region of a PA, it is necessary to understand the environmental and socioeconomic plan that runs through that region. Therefore, the federative entities in partnership with the Ministry of the Environment, make possible exclusive decrees for the Rural Environmental Registry System, integrating the environmental information of the rural areas and possessions, composing a database for control, monitoring, environmental and economic planning at the combating deforested regions in line with Brazilian environmental legislation [CAMPANILI, Maura, 2010], in which it competes to prevent the increase in deforestation and demands in which it measures actions to prevent illegal deforestation.

Thus, in order to identify the degradation of deforested and non-deforested areas, the application of the technique consists of obtaining data originating from mapping via Landsat ⅞ satellite, analyzing wavelengths capable of being divided into several layers to better manipulate the acquired information. by the number of pixels forming a compiled image [GONZALEZ, Rafael C., 2000]. In

order to facilitate the process of classifying patterns of degraded and non-degraded areas, robust systems use machine learning and computer vision techniques to identify these areas in easily identifiable classes, presenting a proposal for the preservation of the crop and agricultural production [CORNELI, Vanessa Medeiros, 2014].

METHODOLOGY

In this work, the first step was the discrimination of the typology of the convolutional neural network model for the selection of data extracted from the images. The second stage consisted of pre-processing with image segmentation techniques [Simões, A. D. S, 2000] and for resizing the images according to their spectrum-based bands. In figure 1, the architecture of the neural network based on deep learning is identified, showing the repetition of convolutional and clustering layers after recording the post-processed images. The layers originate from the fusion of convolutions and were grouped, where higher level features are extracted. Finally, we have the dense layer (Fully Connected) in which the classification is performed based on the extracted features. Finally, the result of the classification represented in the output layer, in the case of the study, proving the deforestation or not of the area. Another technique known as *Data Augmentation*, was applied to increase the database for the execution of the model and generation of new images based on the pattern estimated by satellite images in order to better visualize the degraded areas of the municipality.

RESULTS AND DISCUSSION

As a sub-area of computer vision, CNN has been used recently due to its efficiency with input data with multidimensional characteristics, for example, images. This tool is used to classify and/or group the output data, in this case, the study proposes to group the data extracted from the images in the database to assign them to the algorithm developed by the computational model, after registering the classification. On the other hand, the structure of this type of computational manipulation is related to the structure of the visual cortex of the human system, in which its main objective is to receive and interpret images when received by the human retina. The classification of images for deforested areas refers to a modeling based on hypotheses constituted by rules and data available for the control of information from a database obtained with high-precision algorithms such as the Visual Geometry Group (VGG), in which they identified some

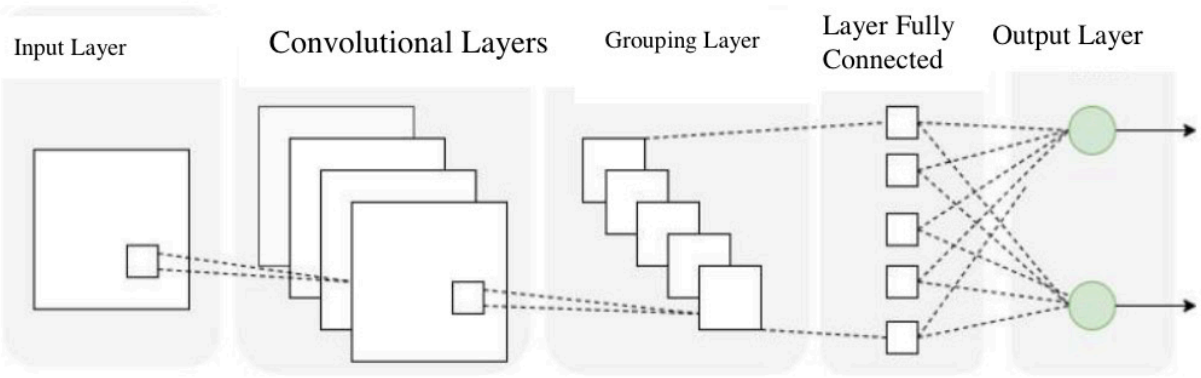

Figure 1 - Simplified representation of a Convolutional Neural Network (CNN).

deep neural network architectures, cited by networks VGG-16, VGG-19. The work used the open source neural network library known as Keras, cited in cases of image classification obtained the best results in the year 2014, investigating the effect of the depth of the convolutional network on its accuracy in the image recognition scenario on a large scale showing a significant improvement over prior art settings can be achieved by pushing the depth to 16-19 layers of weight [SIMONYAN; ZISSERMAN, 2014]. For better understanding, in table 1, the parameters were determined from image processing for data extraction, developed with two prediction classes for better visualization of the study model.

		CLASSIFICATION OF DEFORESTATION	
		Yes	Not
REAL	Not	75	25
	Yes	35	65

Table 1. Metrics for predicting the proposed model.

RESULTS AND DISCUSSION

This way, for a model in which the accuracy is greater than 70%, greater access to the number of Landsat images would be the future perspective for this work, as the conciseness of the neural network would estimate greater hits. However, during the model classification methodology, tests were developed and reported through established graphs on the importance of the deep learning technique for use in the region of Thailand, in order to predict productive areas for planting and development of new cultures, providing the increase in productivity in the municipality, since agricultural production in Pará is one of the main livelihoods in the state. Works for digital evaluation of forest stands in satellite images through accuracy indices also validate the problem of classification of images by convolutional neural network. [Bolfe, E. L., 2004].

With the evaluation of the confusion matrix, model parameters were estimated divided into sensitivity in 68.2%, specificity in 72.2%, accuracy in 70%, efficiency in 70.2%, positive predictive value, 75% and negative predictive value, 65% for real hits. These values were obtained after running the model eight times to evaluate satisfactory values. However, the values determined a low rate of classification of degraded and non-degraded areas in the region of Pará and this is justifiable based on the quantified data related to the database provided by the public agency SEMAS for the development of the research. Therefore, the model is acceptable and usable for incrementing from the addition of new images to increase information on the total area of the municipality.

FINAL CONSIDERATIONS AND FUTURE PERSPECTIVES

The work increased the convolutional neural network as a subarea of deep learning and prediction techniques for the classification of satellite images for the identification of deforested areas presented, based on remote sensing, to offer agricultural producers greater productivity in the northeastern regions of Pará. The development of technological access for implementation in these areas is essential for the advancement of the family economy, as agriculture reaches economic and social standards, acting regionally and nationally. In the future, new satellite images of the region proposed by the study are expected, with emphasis on spectral resolution indexes corresponding to the sensors determined by the study satellites. In the case of Landsat 7/8, many images identified large penetrations of water and mapping of coastal waters, making

it not possible to identify the deforested areas so clearly. of soil and agriculture and disturbances caused by the rain identified. The radiometric resolution characteristic of Landsat 7/8 will continue to be taken into account when choosing a dataset for the resolution of a satisfactory model adherent to the model prepared for the classification of degraded areas. It is estimated, in the future, the acquisition of a database of approximately 500 to 1,000 images for validating the model developed with the proposal of up to 80% to 95% in accuracy values. The final objective of this work is to provide services with techniques related to artificial intelligence for the advancement of production and with this, the approximation of society with the new technological advance called as *Deep Learning* for classifying deforestation in Pará.

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