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TEACHING A ROBOT THE LEVELS OF WRITING: ARTIFICIAL INTELLIGENCE AS A SUPPORT TO THE LITERACY TEACHER

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ABSTRACT

The object of study of this research is the adaptation of computer vision tools by Artificial Intelligence to identify the writing levels of students in the Early Years of elementary school, based on Conceptual Dictations. The objective of the research is to produce an application that helps literacy teachers in identifying the students' writing levels, based on the images of the children's manuscripts, in order to propose personalized activities. The methodology adopted was Design Based Research (DBR), where each stage of prototype development includes suggestions from the users themselves in order to improve the performance of the prototype. Initial findings point to the limitations of computer vision tools and the need for improvements.

Keywords: Artificial Intelligence. Literacy. Teaching Support. Writing Levels.

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Revista ARACÊ
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INTRODUCTION

The literacy process is a primordial stage in the Early Years of elementary school, as it consolidates the appropriation of a child's reading and writing. However, this process is much more complex than one might think and goes beyond the domain of encoding and decoding words [Pérez 2007].

In most Brazilian public schools, the initial literacy process has often resulted in failure and a considerable gap. In general, they train students with difficulties in reading, writing, interpreting and producing small texts [Pontes; Diniz & Martins-Reis, 2013].

On June 12, 2023, through Decree No. 11,556 [Brazil 2023], the Federal Government instituted the National Literate Child Commitment. The program seeks to ensure literacy for all children in the country by the end of the 2nd year of elementary school. In addition, it seeks to recover the learning affected by the pandemic (SARS-CoV-2/COVID 19), of 100% of children enrolled in the 3rd, 4th and 5th grades. The investment will be more than R$ 2 billion over four years, in addition to a joint effort between the Union, States and the Federal District.

In view of the scenario described, that is, of recovering students' learning in the post-pandemic, seeing the literacy process in the Early Years of elementary school, through another perspective, became a challenge. In this sense, the authors focused on different strategies capable of improving the literacy process of children, including technology tools.

Therefore, the guiding question of this research work is: How could digitally automated tools, such as Artificial Intelligence for image recognition, help the literacy teacher in identifying[8] students' writing levels?

In order to answer the proposed question, we intend, as the objective of this work, to develop a methodology employing neural network algorithms in *deep learning* for recognition and identification of writing levels that, in line with the classification of writing levels already existing, is a support to the work of the literacy teacher in daily classroom activities.

[8] Writing levels refer to a classification for the so-called Conceptual Dictations, developed by Emília Ferreiro and Ana Teberosky (1999). Students are classified into Pre-syllabic, Syllabic without value, Syllabic with value, Syllabic Alphabetic, Alphabetic, and Orthographic.

Revista ARACÊ
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THE IMAGE RECOGNITION PROCESS

The process of image recognition is not, in itself, something very innovative. It is recorded that the first processes involving facial recognition, for example, are from the 1960s. However, the absence of robust databases, as well as more efficient machine processing, have prevented significant advances [Ambika & Suresh 2024].

With the advancement of *deep learning* techniques, as well as the use of convolutional neural networks, image recognition processes become more developed, allowing the detection of greater details in images, their transmission through convolution chains, and refining recognition processes [Géron 2019].

In order to carry out the proposal of recognition of the images of the Conceptual Dictations obtained by the group of researchers in a municipal school in a city in the state of Minas Gerais, a code was created, in the Python language, using Artificial Intelligence concepts, such as image recognition and processing, data analysis and statistical concepts for character recognition, letters, words or phrases handwritten by students who are attending the second to fifth year of elementary school at the aforementioned educational institution.

The data used for this research were collected from students and teachers who were doing the Conceptual Dictation activities in the school space. The data was converted into images and was later pre-processed so that it could be prepared for use in the code. Approximately 1000 images of words or phrases were used for this implementation.

The images were cleaned using image editing techniques to remove stains, scribbles, to separate them from each other because, in some cases, they came with the writings too close together, or other inclement weather that could hinder the pre-processing of the images.

The initial idea was to create and train a new neural network to learn to recognize handwriting images. However, as today there are already neural networks trained to do such a task, for example the famous *Convolutional Neural Network* , or CNN, which are powerful networks for image processing, we use existing computer vision and image processing techniques to carry out this research.

For this task, the following libraries were used:

Pillow (Python Imaging Library, Fork) is a Python library used for image processing. It helps us open, manipulate, and save images in different formats.

Revista ARACÊ
ISSN: 2358-2472

In addition, the *ORC Tesseract was used*. *Tesseract* is an *open-source* ORC (Optical Character Recognition) tool that extracts written or printed text from images. It was originally developed by *Hewlett-Packard,* and its development was later taken over by *Google*. Today it is known as *Google Tesseract OCR*.

Tesseract is not a neural network necessarily so-called, but rather an optical tool for character recognition. However, *Tesseract* uses *machine learning* techniques, including neural networks, for image recognition and processing.

OpenCV (Open Source Computer Vision Library) is also not a neural network per se, but rather a wide library of programming features, mainly used in computer vision situations that require a real-time approach. OpenCV provides tools for image and video processing, which can be used in conjunction with neural networks to perform various tasks, such as object recognition, facial recognition, and image segmentation.

OpenCV can be used for pre-processing images before using them in neural networks. And that was the use of this library in our implementation. OpenCV also works in conjunction with deep learning neural networks such as TensorFlow, Keras, and PyTorch.

Numpy is a famous library in Python used for mathematical calculations.

Matplotlib is a library, also known in Python, used to plot 2D and 3D graphs and in our case, it was used in conjunction with the OpenCV library to plot the images.

The implementation of the code to test our analysis was done online through Google Colab, in which we had all the implementations and experiments executed.

METHODOLOGICAL PATH

The present study is characterized as a case study, since the material studied refers to the Conceptual Sayings obtained in a municipal school in a city in Minas Gerais, and can be later generalized from new data inserted in the database used for the *deep learning algorithms* [Yin

In order to improve the results obtained with the prototypes, with each new adjustment, the *Design Based Research (DBR) was chosen as a research methodology*, whose objective is to generate several prototypes, which are improved as they are put to the test by the users of the product under construction. Each stage of prototype validation includes suggestions and adaptations generated in direct contact with potential users of the tool [Matta & Boaventura 2014].

Revista ARACÊ
ISSN: 2358-2472

The research is characterized as quantitative because, so far, the interest is to obtain an application that identifies the images through computer vision. Analysis is based on the accuracy of the results, as a percentage [Creswell & Creswell 2021].

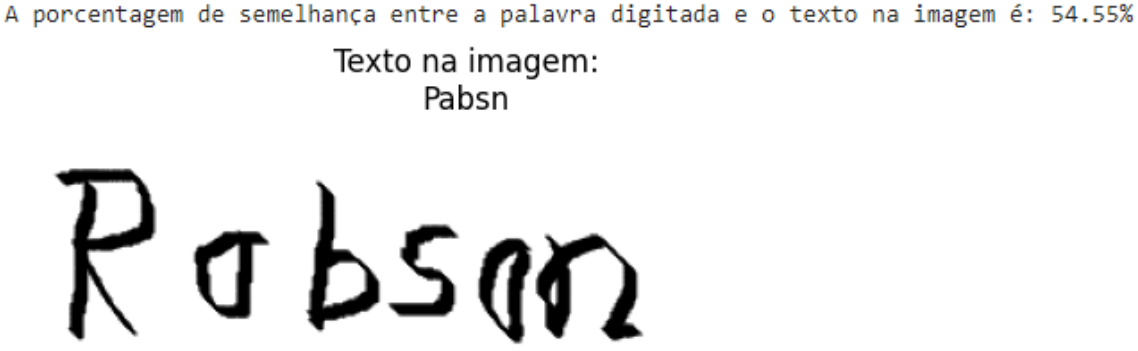
PRELIMINARY RESULTS

The code created to analyze the task was developed in stages, according to the need to obtain coherent results, taking as a guide the percentage of accuracy in each test performed.

FIRST APPROACH

In this first approach, the code was fed a random image and then the word in which it was expected to be recognized in the image was typed. With this, this test aimed to recognize and present the result, in percentage of accuracy, of how much the algorithm was able to recognize this image. No image processing techniques were used. The results are presented in Figures 1 and 2.

Figure 1: Similarity test between a typed word and the image, without the use of image processing techniques.



Revista ARACÊ
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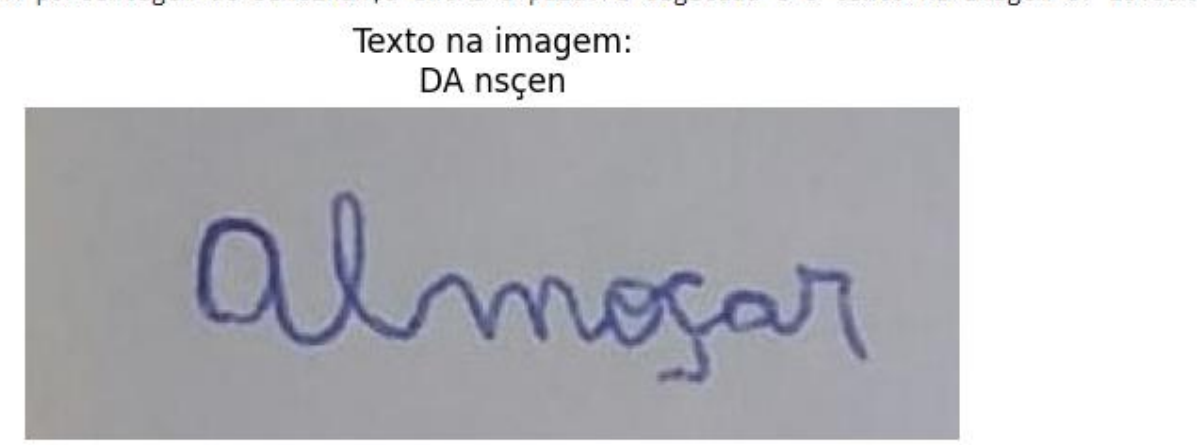
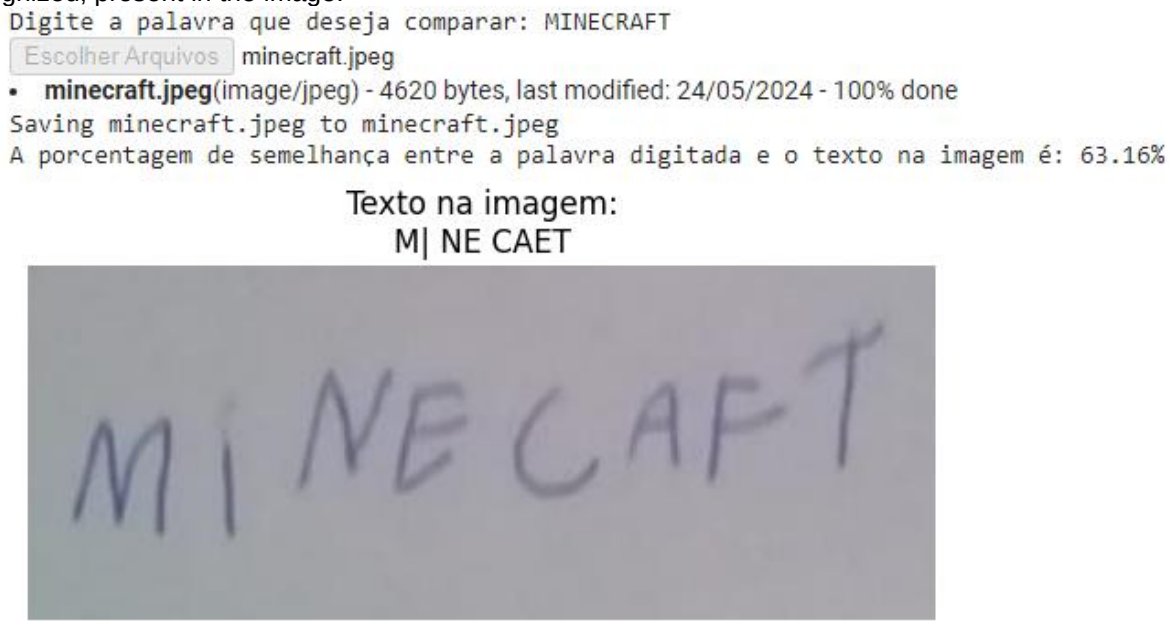
Figure 2: Similarity test between a typed word and the image, without the use of image processing techniques.



SECOND APPROACH

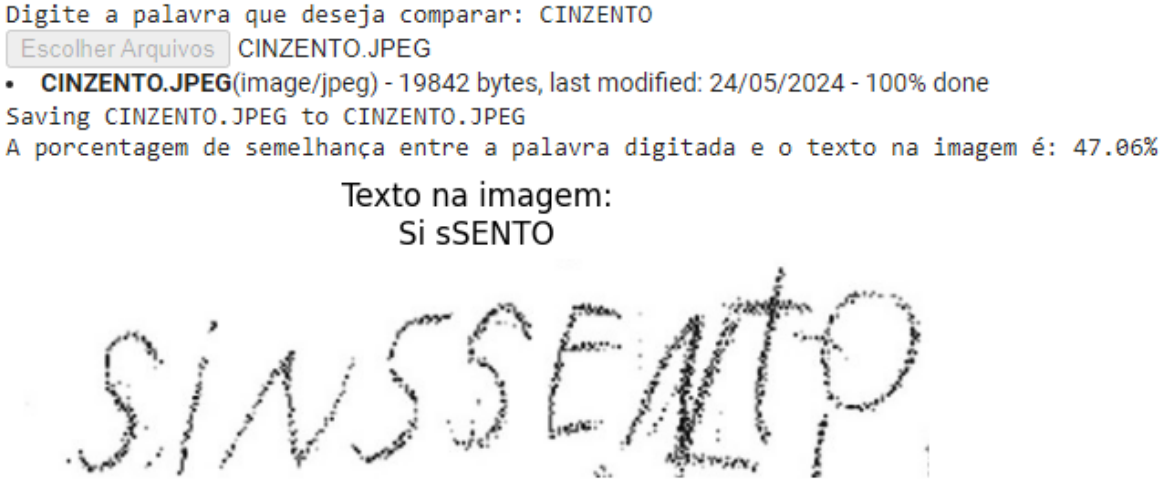
For the second approach, suggestions were considered and the code was fed with a random image and then the word that was expected to be recognized in the image was typed. This test aimed to recognize and present the result, in percentage accuracy, of how much the algorithm was able to recognize the proposed image. Image processing techniques were used. The results are presented in Figures 3 and 4.

Figure 3: Recognition of the word in the image, random, and then typing the word that was expected to be recognized, present in the image.



Revista ARACÊ
ISSN: 2358-2472

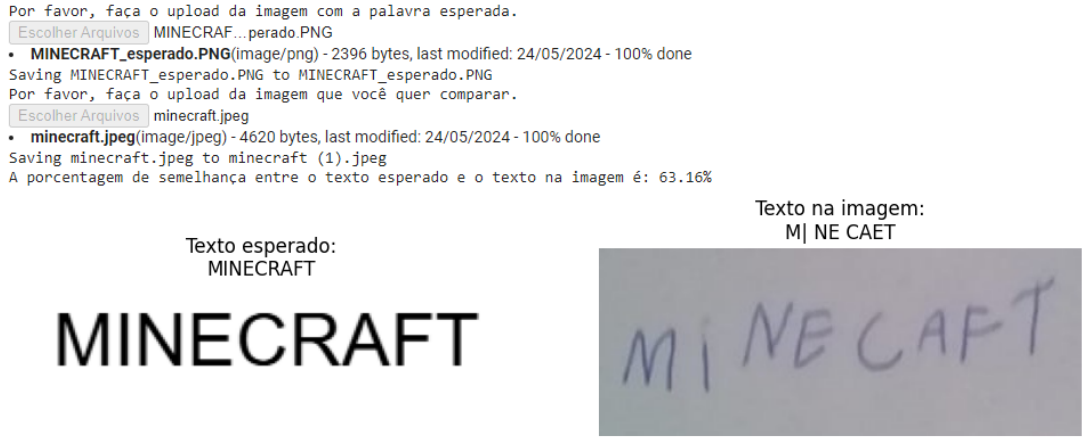
Figure 4: Recognition of the word in the image, random, by typing later the word that was expected to be recognized, present in the image.



THIRD APPROACH

Finally, for the third approach, new suggestions were accepted and the code was fed with two images: one being of the expected word and the other with that of the Conceptual Dictation of the image bank, which was intended to be recognized. This test aimed to recognize and present the result, in percentage accuracy, of how much the algorithm was able to recognize the similarity between the two images. Image processing techniques were used. The results are presented in Figures 5, 6 and 7.

Figure 5: Approach with the word that was expected to be recognized and with the image from the Conceptual Dictation.



Revista ARACÊ
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Figure 6: Approach with the word that was expected to be recognized and with the image from the Conceptual Dictation.

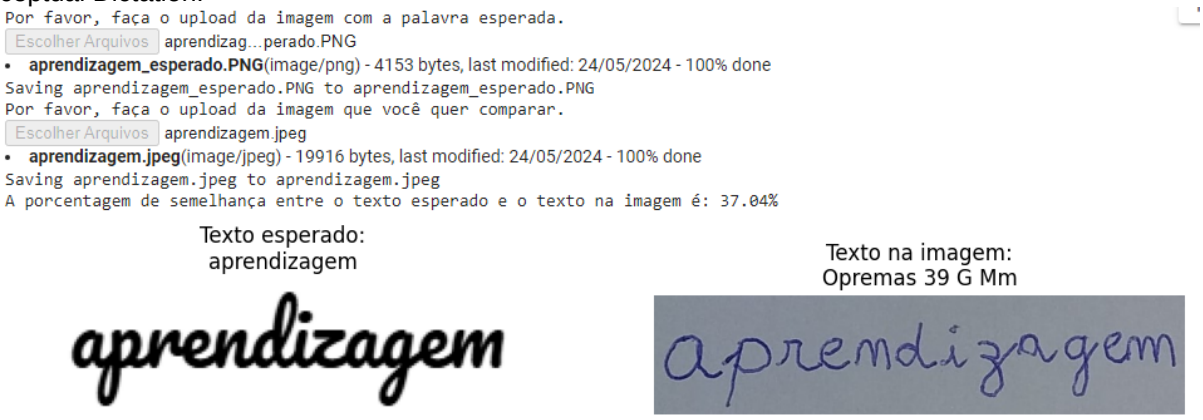
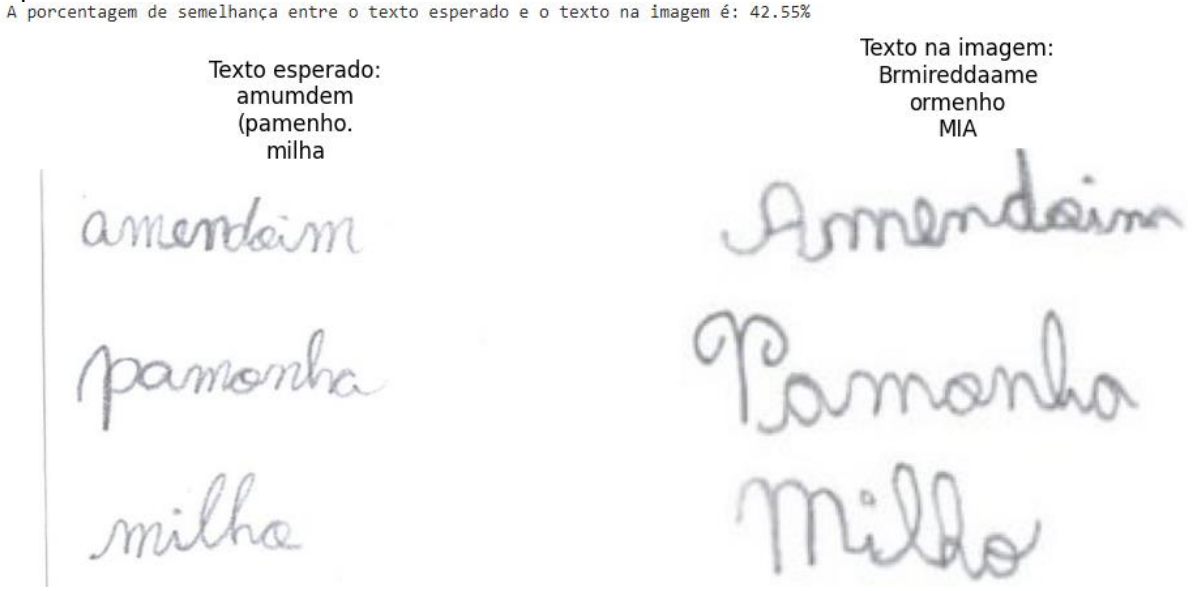


Figure 7: Approach with the word that was expected to be recognized and with the image from the Conceptual Dictation.



DISCUSSIONS AND FUTURE PERSPECTIVES

The present work proposed to implement, through techniques involving Artificial Intelligence, in the form of *machine learning* (*deep learning*) the recognition of images in the field of computer vision, with the objective of classifying the Conceptual Dictations of students in the Early Years of elementary school in their different levels of writing. The proposal is innovative, since there are no Artificial Intelligence tools that can identify the level of writing in students in the literacy process in Brazil.

Since the work is in progress, the results presented so far are restricted to the testing of different approaches aimed at the recognition of images of the Conceptual Dictations, in order to evaluate the accuracy of the proposals. Satisfactory accuracy has not yet been verified. Several factors contribute to the absence of better results: wide

Revista ARACÊ
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variability of the students' spelling, few images that make up the image bank for training image processing tools, and testing of other approaches, such as comparison between spellings of students' Conceptual Dictations at the orthographic level with students at the alphabetic syllabic level, for example, which will be evaluated in the continuity of this research.

The next steps refer to, from the detection of the image, classify them at the appropriate level of writing to later be implemented in an application for use in schools.

Revista ARACÊ
ISSN: 2358-2472

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