Motif on Indus Valley Civilization (IVC) seals

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Problem Statement :-

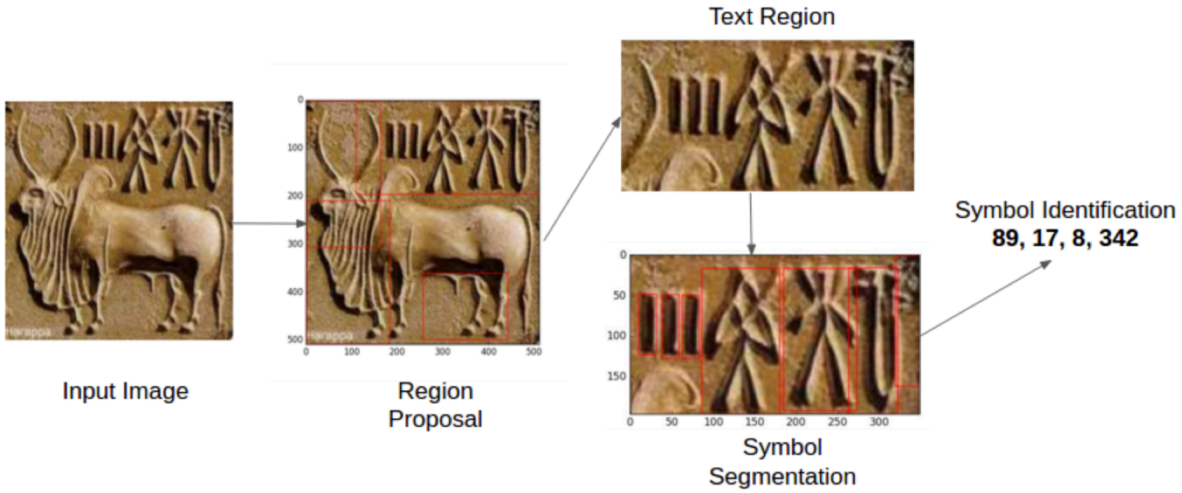
Detect a motif on Indus Valley Civilization (IVC) seals using CNN. [Reference: our past work.]

IV seal image -> 0/1 (Motif present/not).

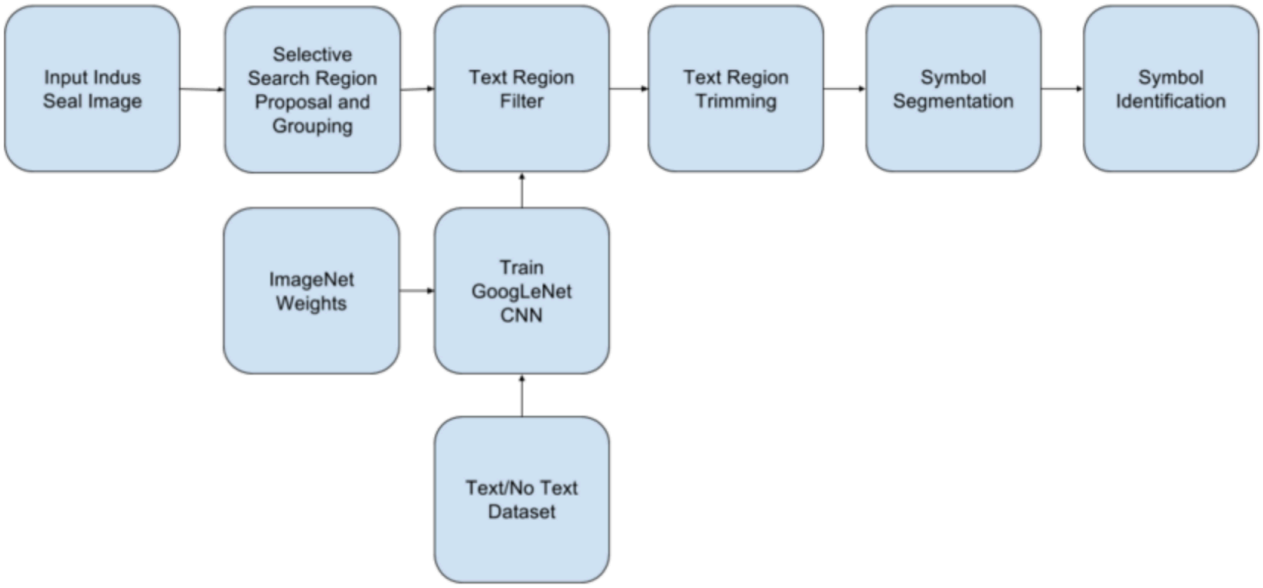
Using image processing and machine learning techniques, it is possible, given photographs of Indus seals from archaeological sites, to automatically discover text patches/regions, segment individual symbols/characters from those regions, and identify each symbol/character as being from the Indus Script.

Input and Expected Output class :-

Applying image processing and machine learning techniques, it is possible, given photographs of Indus seals from archaeological sites, to automatically discover text patches/regions, segment individual symbols/characters from those regions, and identify each symbol/character as being from the Indus Script.



Architectural design :-



Enhancement of Data and Pre-processing :-

Data Augmentation: To accomplish the same thing, an image data augmentation tool was created. The initial code was influenced by the online picture data augmenter "Keras," which contained rotation, scaling, translation, horizontal and vertical flip, as well as shear, swirl, blur, contrast, and brightness (TO DO)

Pre-processing: Sample-wise mean-zero and standard normalization and feature-wise mean-zero and standard normalization are two additional frequently used image pre-processing techniques.

Initial Steps in Dataset Creation :-

In order to obtain Indus Seal Images from the Google image search engine, a Python script was utilized to access the Google.

There was a cap of 100 photos per search keyword.

The following keywords were used in the search: "indus seals," "harappan seals," "harappan pashupati seal," "harappan unicorn seal," "indus inscriptions," "harappan seals wikipedia," "indus seal stones," "seal impressions indus valley civilization," "indus valley tiger seals," "indus valley seals yoga," and "indus valley seals for kids."

This dataset is referred to as the "crawled dataset" because out of the 1000 photos downloaded, noisy images were manually removed, yielding 350 useable images.

Sample snapshot of the dataset class :-

Identification by Symbol :-

To categorize each symbol into one of the 417 Indus symbol classes identified by the Mahadevan Corpus after improving the symbol segmentation module of the aforementioned Indus OCR pipeline (M77)

We need to create a more robust dataset for training such a CNN classifier by adding noise to the currently available base dataset and collecting more seal images labeled with pertinent text sequences.

In a previous experiment known as the Jar sign experiment, we aimed to create a classifier that could recognize the JAR sign, the Indus symbol that is most frequently observed, in photographs of the Indus Seal.

Segmentation of Symbols (1)

We need to segment out the characters and symbols after we get the text sections, however the selective search technique was ineffective for that. To extract the individual symbols from the text sections, the following steps were employed in a bespoke algorithm:

The image is in grayscale.

To obtain a discrete binary image, Otsu used black and white thresholding (easy to segment)

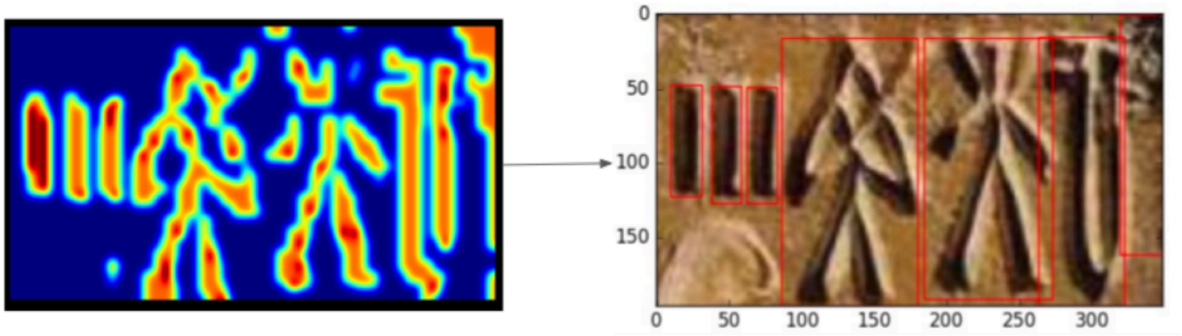
Continued use of Gaussian Blur to eliminate noise

Segmentation of Symbols (1)

Using SciPy's find object() method, you may get the image's related subregions.

Application of the previously stated region grouping mechanisms with minor adjustments

Include these areas on top of the original image.



Result after step 3

Final result

Methodology :-

- Formulating the dataset
- Region proposal
  - Selective Search
  - Fine tuning and Region grouping
- Text region filtering (using Convolutional Neural Networks)
  - Text - no text classifier
  - Filtering and Trimming region proposals
- Symbol segmentation

The Results:

- Evaluating the pipeline

Assessment of the Pipeline :-

evaluation of the pipeline (1)-

25 different seal photos were collected from Google and run through the Indus OCR pipeline in order to assess the efficacy of the text localization and segmentation pipeline outlined above.

Results:

Text localization: Successful text region extraction was achieved in 23 of 25 photos.

The projected text sections, however, missed one symbol in five of the 23 photos, 92% accurate (Approximate)

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evaluation of the pipeline (2)-

14 of the 23 of those photos had symbols that could be correctly retrieved.

Five of the nine unsuccessful images were blurry and of low quality.

The remaining 4 of the 9 photos were unsuccessful as a result of physical damage to the seals.

Experimenting using jar signs to train the classifier :-

The Jar Symbol Binary Classifier was created to find the Jar symbol in the image of the Indus seal.

A CNN architecture called IndusNet that was modeled off "pannous/caffe-OCR" was created for this purpose. Here is a picture of the skeleton.
DATA\[32x32x3\]
(256-fold downscaling) 20 Outputs, 5x5 Kernel, Stride 1 Convolution -> Convolution[1st Stride, 50 Outputs, 5x5 Kernel] To avoid over-fitting, go from Dropout to Fully Connected [500 Outputs]. Fully Connected -> ReLU (Non Linearity) -> [2 Outputs] Two Classes Classifier, SoftMax

The "Jar sign dataset" was split into two halves using a stratified split of 70:30 to create the dataset.
After 1000 iterations, the model's accuracy was 93.4%.

(Reference: https://github.com/tpsatish95/OCR-on-Indus-Seals/blob/master/slides/slides.md

Reference: https://arxiv.org/abs/1702.00523

Reference: https://www.researchgate.net/publication/313248299_Deep_Learning_the_Indus_Script

Reference: https://deepai.org/publication/deep-learning-the-indus-script)