Machine Learning:

Convolutional Neural Network for hand sign recognition

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Introduction

The sign language is a powerful tool as it can be interpreted in a universal way, there a lot of applications from helping disabled people to command in the battlefield.

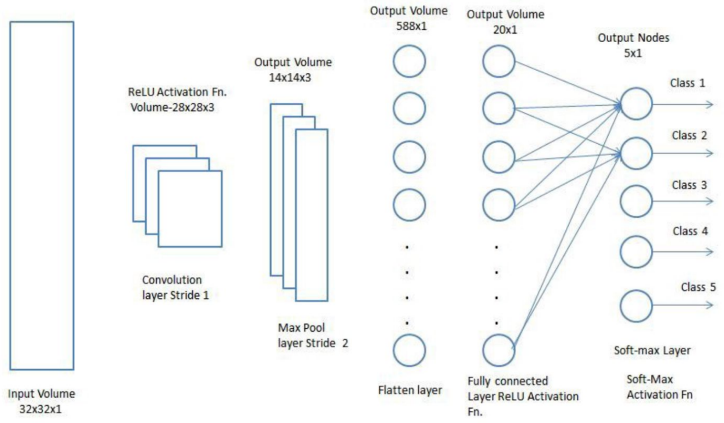
Development

Using a generic neuronal network is not the best of the option when we are leading with images and patterns inside them, an alternative for this will be a convolutional neural network.

The key concept behind Convolutional Neural Networks (CNNs) is the application of filters and which operate over raw pixel intensities.

Convolution layers are stacked on top of each other deeper in the network architecture prior to applying a destructive pooling operation

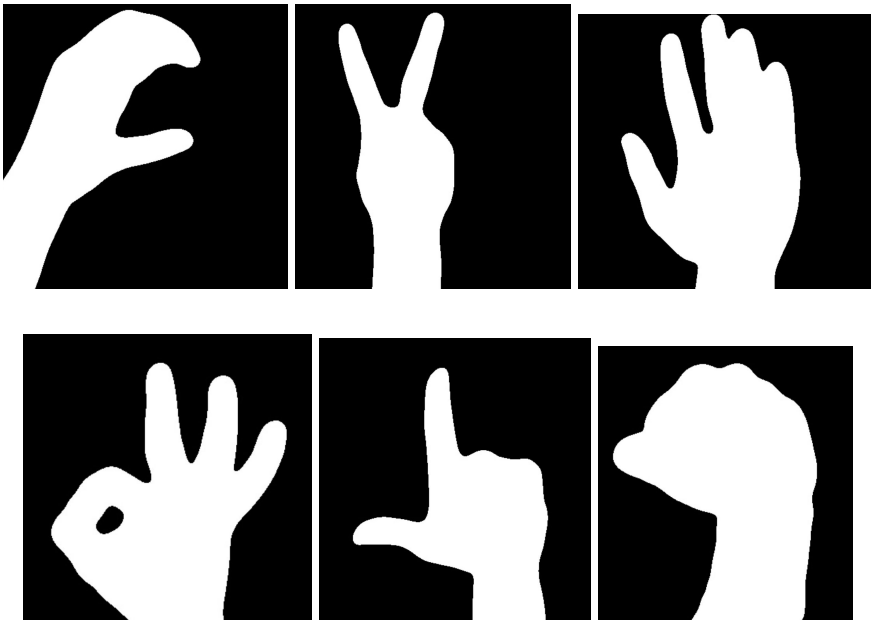
Model Structure



- Input:
  - The input layer is based on the size of the images (width, height)
- Layers
  - Fully connected layers are used for this implementation, in keras they are known as Dense layers.
  - Rectified Linear Unit (ReLU), activation function in this network architecture.

    - Batch Normalization is used to normalize the activations of a given input volume before passing it to the next layer in the network.
    - Pooling layers have a primary function of progressively reducing the size of the input as it goes deeper through the network, the are located between each of the convolutional layers
    - Dropout Optimization is also implemented inside the network, the process consist of disconnecting random variable in order to simplify the model and evade the probability of an overfitted model (In this case 25%)
- Output:
    - The softmax layer returns the class probabilities for each label.

The data



Our data set consist of around 3000 images labeled with its corresponding form (C, Peace, Palm, OK, L, Fistt)

The images have been processed using OpenCV, in order to define the contours of the shape formed by the hand using Gaussian Blur, Background masking and Thresholding binarization, this process is also applied on the validation test

In order to do the proper improvement, the data set was splitted on a training set, and testing set, (80% + 20%) in a random way, sing also the scikit-learn toolkit,

In order, to improve the result, the data set was increased using keras' ImageDataGenerator, it also will help the to reduce the probability of a model to over and generalize in a better form.

Image augmentation allows us to construct "additional" training data from our existing training data by randomly rotating, shifting, shearing, zooming, and flipping.

Training

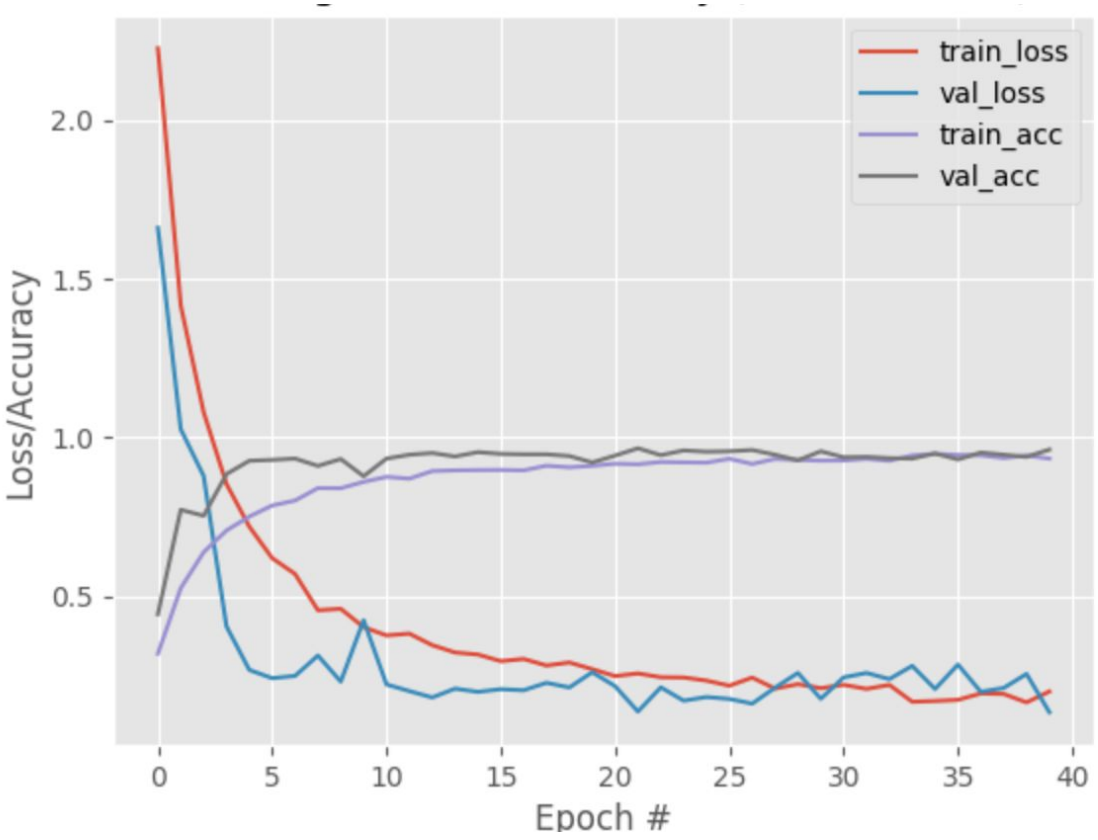
The training process is based on the hyperparameter, learning rate, empochs, batch size and loss generated.

As optimizing function is used Stochastic Gradient Descent (SGD), which compared to the common gradient descent it choosest the samples randomly.

Finally we call model.fit_generator (instead of model.fit), in order to add the data generated as parameter to the model

Finally, we'll evaluate our model, plot the loss/accuracy curves, and save the model.

as can be seen on the plot, the error starts to decrease from the first iterations



Observations and validations

Using OpenCV capabilities of video and photo recording, it was able to test the model using real pictures. The results seems to be very similar to the ones predicted by the model

For future and improvement for this implementations:

- Add more signs to the data set
- Reduce the area of interest for the frame recovered from the camera
- Improve the background and binarization thresholding

Referencias

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