Arabic Hand Gesture Recognition

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Introduction

The project mainly belongs to deep learning(subdomain of machine learning) involving neural networks to develop a predictive model trained on the collected dataset. The domain of this project is related to sign language used by the deaf and the mute people. The system will use the visual hand dataset based on an Arabic Sign Language and interpret this visual data in textual information. While running the system, each meaningful text is translated using its corresponding hand gesture as an input. So, before giving an insight of the dataset and the deep learning methods used, it is useful to talk about the problem statement described in the succeeding section.

Problem statement

Sign language is very important for the deaf and the mute people to communicate both with the normal people and with themselves. We as normal people tend to ignore the importance of sign language which is the mere source of communication for the deaf and the mute communities. These people are facing major downfalls in their lives because of these disabilities or impairments leading to their unemployment, severe depression, and several other symptoms. One of the services they are using for communication or for us to talk to them are the sign language interpreters. But, hiring these interpreters is very costly and therefore, a cheap solution is required for resolving this big problem of these massive unfortunate people. A thorough analysis and survey to find a way to make these disabled communicable with themselves and the normal people have led to the breakthrough of the Sign Language Recognition System. The system targets to recognize the sign language and translate it into text for some meaningful communication.

Objective

Our aim is to develop a sign language recognition system capable enough to translate the most commonly expressed hand gestures used by deaf or a dumb person into textual data. To make these disabled people communicable is our prime objective.

Dataset description

The provided dataset consists of 54049 images of American sign language alphabets performed by more than 40 people for 32 standard Arabic signs and alphabets. The number of images per class differs from one class to another. Each distinct hand gesture

indicates some meaningful information. Estimatedly, there are around 1500 images per class and each class represents a different meaning by its hand gesture or sign. Pictorially, the sample image of each class along with its label is represented in the figure below.

For some storage schemes, 32 folders are created and each folder consists of around 1500 images incorporating differently aged people's hand gestures in different environments. The directories containing these folders are treated as training and validation datasets for the model which will be explained later in this section.

Now, before talking about the model used, it is mandatory to undergo data preprocessing to make the dataset more consistent and compatible to the model as an input. So, how the data preprocessing is done is elaborated in the next section.

Data preprocessing

The data preprocessing involves the transformation applied to the data before feeding it to the model for training/testing. So, what changes are performed on the dataset is described below.

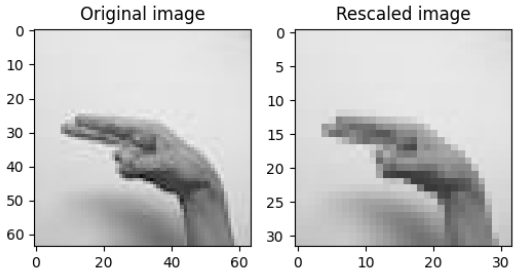
Removing data imbalancement

As already mentioned, the number of images per class differs from each other. This imbalancement among the classes may degrade the training performance of the model. Thus, to avoid this imbalancement, there must be an equal number of images among all

classes. This imbalancement is removed by looping over each class folder to get the list of filenames of all the images per class. During each iteration, 1000 images are picked randomly from the current class folder and the rest are removed. Resultantly, a total 32000 images are filtered by summing up 1000 images of all the classes.

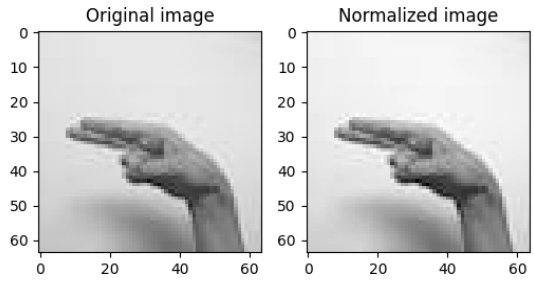
Data rescaling

The images contained in each class have the dimensions of (64x64). In order to keep the computations while training less complex and fast, the images can be rescaled into (32x32) following the same ratio of dimensionality. Rescaling is explained pictorially by the following figure.



Data normalization

This step performs the normalization process on each image of the dataset. Usually, the pixel values in the image range from 0 to 255. But, these values must be rescaled before providing these images to the model as an input. So, the normalization will rescale these pixel values in the range of (0, 1). This rescaling will keep the model easy to learn and train in a fast way. So, this process is explained by the figure below.



Considering the above figure, there is some contrast difference between the two images. Normalized image is a bit more clear and bright than the original image. So, normalized images are more adaptable and easy to learn for the model to train.

Data splitting

The data used to build the model comes from multiple types of datasets. There are three different purposeful datasets for any computer vision project to analyze, make some comparisons and improve the performance of the model. In particular, these three different types of datasets are used in different stages of the creation of any machine learning model. These three distinct datasets are stated below:

Training dataset

The training set is a dataset on which the model is trained for learning weights or features. Initially, the model is fitted on the training dataset and in our case specifically, 80 percent of the whole dataset is used for the training dataset which is approximately 25600 images.

Validation dataset

The model is fitted on the validation dataset for the unbiased evaluation of itself during training. It validates the performance of the model based on how well the model is learning its weights before it is used for the real-time testing on the testing dataset. In our scenario of sign language recognition, 20 percent of the dataset is used which is equivalent to 6400 images.

Test dataset

After the completion of training and validation phenomena, the test dataset is used for testing the model and to measure the goodness of how well the model is trained. For this, 960 samples are used for the test dataset since there are 30 test images for each sign alphabet. This self-generated test set is created in order to measure the model's ability to generalize. More importantly, this test set is not collected from the 32000 images.