

Chapter 12

A Deep Learning–Based Framework for Accurate Facial Ethnicity Classification and Efficient Query Retrieval

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ABSTRACT

Facial images carry important demographic information such as ethnicity and gender. Ethnicity is an essential part of human identity and serves as a useful identifier for numerous applications ranging from biometric recognition, targeted advertising to social media profiling. Recent years have seen a huge spike in the use of convolutional neural networks (CNNs) for various visual, face recognition problems. The ability of the CNN to take advantage of the hierarchical pattern in data makes it a suitable model for facial ethnicity classification. As facial datasets lack ethnicity information it becomes extremely difficult to classify images. In this chapter a deep learning framework is proposed that classifies the individual into their respective ethnicities which are Asian, African, Latino, and White. The performances of various deep learning techniques are documented and compared for accuracy of classification. Also, a simple efficient face retrieval model is built which retrieves similar faces. The aim of this model is to reduce the search time by 1/3 of the original retrieval model.

INTRODUCTION

“Faces” have always been an intriguing area of research. Scientists have been digging into human abilities to grasp a lot of information by just looking into someone’s face (Kennedy & Eberhart, 1995). According to psychology whenever a human encounters a stranger the first thing he does is evaluate the other person based on his facial features. The brain intercepts rich data just from a glance at the other person’s face and classifies their gender, ethnicity, in some cases even their economic background. Facial Recognition is another highly complex activity. The brain performs it with almost 100% accuracy. All these are done in just a matter of few seconds. And this has consequential effects on the perceiver and the perceived.

In the field of Artificial Intelligence, technologists are taking interest in this field now more than ever. The upsurge of facial recognition apps is the proof. And truly, facial recognition technology now occupies a strategic position in the defence sector. It has eliminated the mundane job and the time consuming task of manually searching through files. With the CCTVs installed everywhere, literally scanning every person in every video frame, it has become a challenging task for illegal immigrants or terrorists to operate. But what if the targeted person has disguised himself, or his picture isn’t in the database, or it isn’t a recent one. These are the circumstances where the current facial recognition technology might fail.

To address the above impediments, a mechanism is devised where similar pictures of the targeted person are retrieved from the database instead of replicas. Hence the objectives of the chapter are

- To solve the ethnicity classification problem
- Identify a novel approach that results in enhancing global convergence in the initial stages
- Compare this approach with multiple optimization techniques. Test the hypothesis that meta-heuristic optimization techniques are better than gradient descent optimization techniques
- To retrieve faces based on the texture and colour features of the face from the database of its classified ethnicity

It isn’t a secret anymore that the coming ages will be dominated by robots, cyborgs, humanoids, super Computers etc. Every innovation or a novel approach in AI today is ultimately going to help us program them. Advances in computer vision, computer graphics and machine learning based on racial face analysis has started to become popular. It is safe to say that learned features are better for Ethnicity Classification (Muthiah-Nakarajan & Noel, 2016). Hence it is a necessity for us to explore various global optimization techniques that can help a fully connected neural network classify a face into either Asian or Caucasian or Latino or African.

BACKGROUND:

Anthropometric statistics show the racial and ethnic morphometric differences in the craniofacial complex. 25 identified measurements on the face were used to examine three racial groups Caucasian, African-American, and Chinese. The three groups exhibited significant differences. For example, the Chinese group had the widest faces. Also, the soft nose is wider in the Chinese group and it had the highest upper lip in relation to mouth width.

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