Content based image retrieval using fuzzy class membership for color images

Kale Mandar Govindrao
(14EC91P03)

Department of Electronics & Electrical Communication Engineering, Indian Institute of Technology Kharagpur, India

Abstract

The rapid growth of internet users across the globe and extensive use of digital multimedia devices have witnessed an exponential rise in imagery and visual information over the past decade. In recent times, the daily use of digitized images has become an inseparable part of human life in many fields such as entertainment, healthcare, education, e-commerce, etc. It has made information retrieval techniques very relevant in the current era. The content-based image retrieval (CBIR) systems exploit the visual information present in the images to find a suitable match similar to the human visual saliency mechanism.

This thesis proposes an efficient CBIR system to retrieve color images. Most of the CBIR systems are based on traditional distance-based retrieval. The thesis aims to improve retrieval accuracy by utilizing the fuzzy class membership-based retrieval framework. First, a few significant advancements are suggested to enhance the retrieval accuracy of the approach developed for textures. Next, the framework is generalized for natural color images and different classifiers. The set of standard color descriptors are utilized for the retrieval. In addition, the high-level description from pre-trained deep residual networks (ResNet) is explored for the improvements.

Although multiple descriptors are encouraging, they often have a high dimensionality that increases computational overhead. The feature selection methods could help reduce the size by finding the optimal set of features. However, it is difficult to decide which feature to try on before the retrieval. Hence, we propose the deep stack autoencoder sparse autoencoder (DSSAE) and convolutional autoencoder (CAE) to learn high-level descriptions directly from the images. DSSAE and CAE models achieve a high level of abstraction and competing retrieval performance.

Next, DSSAE model further explores the high-level description of ResNet18 and ResNet50 networks in place of image data. The experiment highlights its efficacy in learning low-dimensional latent presentation. The DSSAE model achieves a 50% reduction in the size of high-level description while maintaining the highly competing retrieval performance. In addition, the thesis highlights the impact of the database size on learning meaningful information using the DSSAE models. In summary, the thesis presents an effective retrieval method for natural color images.

Keywords: Content-based image retrieval, color images, feature extraction, classification, learning-based retrieval, fuzzy class membership, residual networks, sparse autoencoder, convolutional autoencoder