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Master Thesis (30 ECTS)

Color Palettes: Pattern Recognition and Classification of Images

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Introduction

Color plays a fundamental role in visual multimedia such as images or videos. One commonly used strategy to convey the color content of an image is by means of a so-called color palette. In collaboration with the ERC FilmColors project we developed VIAN, a video annotation tool which extracts, among other low-level feature vectors, color palettes to describe the visual content. These palettes are later used to visualize the color distribution of single movies as well as ensembles thereof. Implementations of color palettes are as diverse as their use-cases, in the context of VIAN [3], a color palette is the product of a SEEDS superpixels [1, 2] segmentation followed by a bottom-up clustering. This results in a hierarchically structured color palette (Fig. 1), where every parent node is assigned the average color of its children, allowing the user to define the merge depth of interest with a comprehensive result. However, film scholars often need to find temporal segments or single frames by a given color palette within a large corpus of film material. This includes queries to find all palettes containing certain colors by name, as well as query them by a user-defined color palette. Furthermore, it is often not only the actual colors present which are of interest, but also the color contrasts [4,5] formed by the presence of two or more colors.

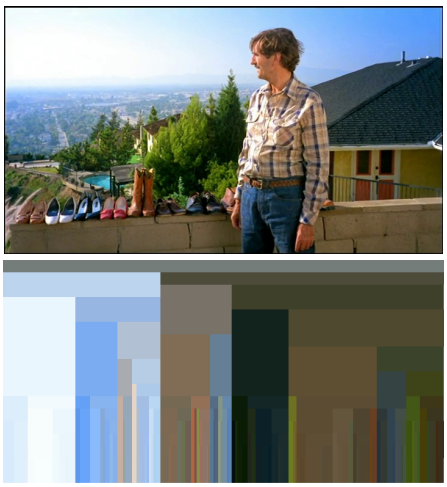

Figure 1: An example of an image and a hierarchical color palette.

Description

The primary goal of this thesis is to allow the user to query a database of color palettes, as extracted by VIAN, based on color names, user defined color palettes, as well as by color contrasts. The development and implementation will be in close contact with film scholars actively working in the realm of film color.

The project consists of the following main parts:

1. Given a hierarchically structured color palette, classify the contained colors such that a palette is searchable using categorical names.
2. Implement a method to compute the distance between hierarchically structured color palettes.

3. Classify the patterns within the color palettes in different types of color contrasts defined by the ERC FilmColors project
4. Implement a web-based user interface that allows the user to select or create a palette and generate a list of similar color palettes.

The resulting software should allow the user to define a palette or color contrast visually as well as text-based, and retrieve a list of color palettes, ranked by their distance to the query provided. Apart from the implementation, the color categories should be backed with the sound color theoretical background established in the ERC FilmColors project. The implementation should be in line with established scientific color analysis, as well as with the work already done in VIAN and the VIAN WebApp.

Requirements

The implementation will be in Python. Knowledge of linear algebra and Python is a must, familiarity with its libraries, such as OpenCV, Scikit-learn and NumPy is beneficial.

Work Load

40% Theory (1. Literature Review, 2. Data Collection, 3. Concepts and Model Design, 4. Methodology)

50% Implementation (5. Prototype, 6. Optimization, 7. Assessment)

10% Test (8. Survey evaluation, 9. Discussion, 10. Results)

Remarks

In addition to the above described software, the student also has to write a report/thesis (according the the IFI rules) and defend it. This defense includes a live demonstration or video of the results. The code, a demo video as well as the report are part of the deliverables of the thesis. This thesis will be supervised by Prof. Dr. Renato Pajarola.

All source code written as a part of this thesis should be released under suitable open-source licenses. The typical rules of academic work must be followed.

References

1. L. Mouselimis. Image segmentation based on Superpixels and Clustering, 2019.
2. M. Van den Bergh, X. Boix, G. Roig, B. de Capitani, and L. Van Gool, “SEEDS: Superpixels Extracted via Energy-Driven Sampling,” in *ECCV*, pages 13–26, 2012.
3. G. Halter, R. Ballester-Ripoll, B. Flueckiger, and R. Pajarola, “VIAN: A Visual Annotation Tool for Film Analysis,” *Computer Graphics Forum*, 38(3):119–129, 2019. doi: 10.1111/cgf.13676.
4. D. Cohen-Or, O. Sorkine, R. Gal, T. Leyvand, and Y.-Q. Xu, “Color Harmonization,” *ACM Transactions on Graphics*, 25(3):624–630, 2006. doi: 10.1145/1141911.1141933.
5. J. Itten, “Kunst der Farbe”. Studienausgabe. Ravensburg: Ravensburger Buchverlag, 1970.