Colours quantification of children's drawings

COMHUM18

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5 June 2018

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COMHUM 2018

Outline

- Introduction
- Method
- Conclusion and further works

I. Introduction

Introduction

The **Goal** is to develop a method to automatically and systematically quantify colours of children drawings.

The **Quantification** defines coulour information, colour signature of the drawing; which include measure to distinguish same colour information.

Build the link: **Drawer** $\leftrightarrow$ **Observer** for humanities.

In computer vision, there are well developed techniques to analyse natural images

- e.g. Convolution Neural Network or Specific objet colours detection (i.e. skin, vehicle)

What can we do with drawings to answer specific queries?

Not labeled dataset which contains :

- Unrealistic and various objects,
- Various styles (several authors)
    - $\rightarrow$ no training sample.

Figure 1: Children drawing

Dataset : children drawings (of gods)

Each drawing ($i = 1, \ldots, n,\ n = 1212$) belongs to the Children's drawings of gods dataset.

Country	Drawings
Japan	142
Russia	538
Switzerland	532

- Landscape size : 1280×901,
- Portrait : 676×960.

Numerical object, support of colours information

We have an object with a given colour information:

Three dimensional matrix of S pixels, where the pixel is the smallest measurable unit encoded in Red, Green and Blue (RGB)

$$\vec{s} = \{s^{\mathtt{R}}, s^{\mathtt{G}}, s^{\mathtt{B}}\}$$

where $s^{\mathtt{R},\mathtt{G},\mathtt{B}} \in [0, 255]$

The Human perception and Colour categorisation (Gap 1)

The most fundamental information given by an image is its colored pixels (intensities).

- The human perception of colours is an interpretation of a **continuous** signal of light, intensity received and processed,
- which is communicable by **categories** e.g. (WHITE), (BLACK), RED, GREEN, YELLOW, BLUE, BROWN, PURPLE, PINK, ORANGE, and GRAY.

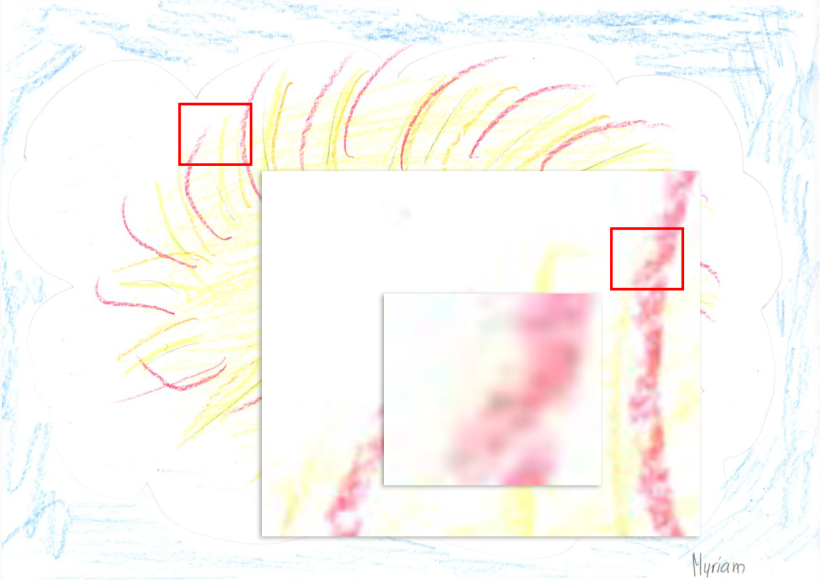
As a work in progress, we put on side the colored pixel spatial configuration (see further work).

The human category and the pixel colour (Gap 2)

Even if we commonly identify main categories of colours, an image contains various imperceptible colours.

- The human categorisation of colours is ideally universal at small scale (roughly),
- but the digital object, image or matrix, has exact colour for each pixel (almost continuous colours at a fine scale).

The human category and the pixel colour (Gap 2)



II. Method

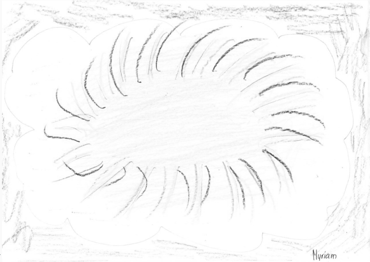
Human perception and Colour categorisation - part 1

We first define general measures to distinguish each *i* drawing to another by its colour signature (intensity).

As the colour is an intensity of light, the RGB encoding is converted to a linear-light signal $\in [0, 1]$:

$$s^{\mathtt{CRT}} = 0.2125 s^{\mathtt{R}} + 0.7154 s^{\mathtt{G}} + 0.0721 s^{\mathtt{B}}$$

$\longrightarrow$



Method (part 1): to linear-light signal

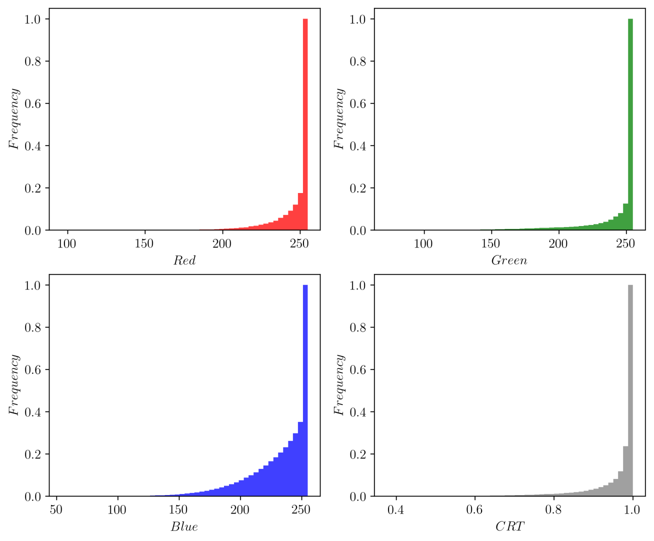


Figure 2: Colour cumulative histograms of Red, Green, Blue and the linear conversion, CRT, of them.

Method (part 1): Measures

We compute systematically three fundamental measures of colours :

As the colours choice of the drawer is unpredictable, the entropy yields its average information content:

$$H(S^{\texttt{CRT}}) = \frac{-\sum_s p(s^{\texttt{CRT}}) \log(p(s^{\texttt{CRT}}))}{log \delta^{\texttt{CRT}}} \quad .$$

- More the drawing is uniforme, higher is the entropy.

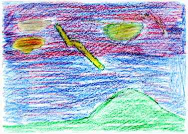
The variety $\delta^{\texttt{CRT}} \in [1, 1280 \times 901]$ or $[1, 676 \times 960]$ is the number of unique intensity, namely types or modalities.

- More the drawing is uniforme, lower is the variety.

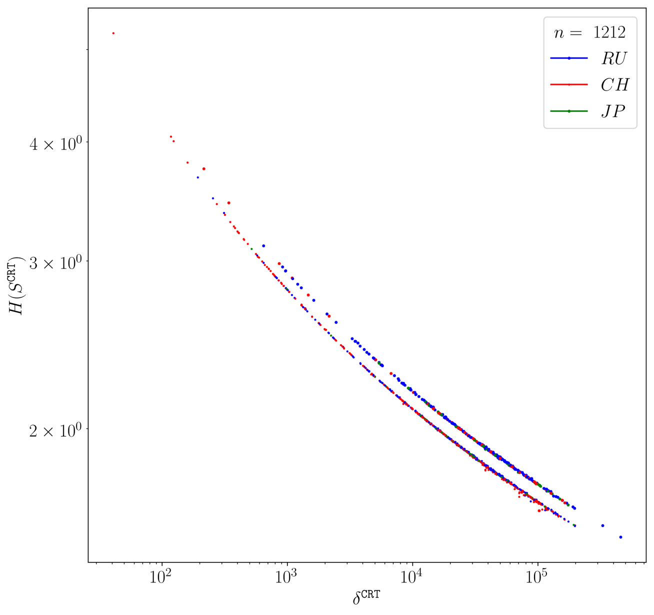
The mean linear-light intensity $\mu^{\texttt{CRT}} \in [0, 1]$, the mean colour, is computed.

Method (part 1): Measure illustrations

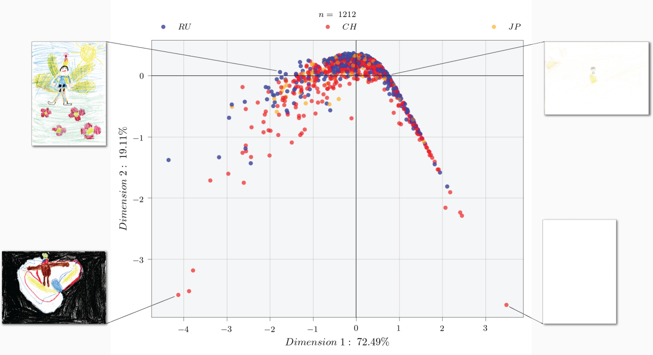
Figure 2: Illustration of variety measures.

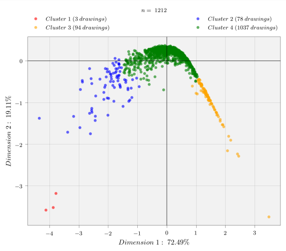
Index			
$\mu^{\mathtt{CRT}}$	0.696	0.876	0.999
$\delta^{\mathtt{CRT}}$	457068	37982	41
$H(S^{\mathtt{CRT}})$	1.538	1.903	5.200

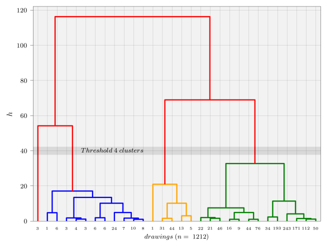
Method (part 1): Entropy an variety



Method (part 1): MDS and HAC (preliminary results)





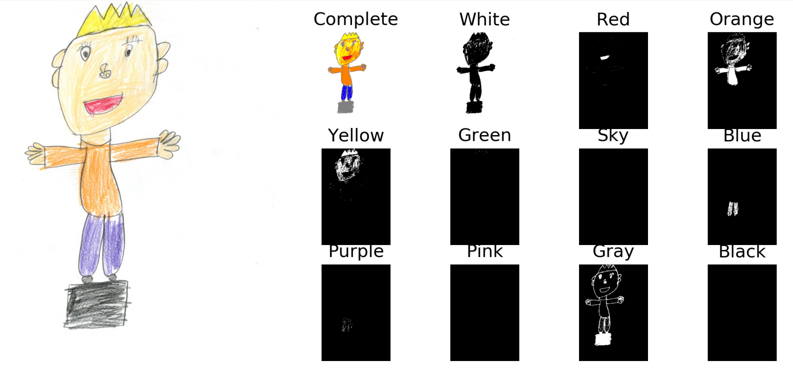


Human categories and the pixel colour - part 2

- Squared Euclidean dissimilarity between each pixel s and a reference set of 117 colours.
- Each pixel belongs to the less dissimilar colour.

117 colours grouped in 11 colours.

Method (part 2): Colours quantification (preliminary results)



Method (part 2): humanities questions (preliminary results)

Which colours appear? (white removed)

Figure 3: Means of the proportion of a colour according to the coloured pixels.

Country	1st colour	2nd colour	3rd colour	4th colour	5th colour	6th colour	7th colour	8th colour	9th colour
All	**achromatic**	**yellow**	**blue**	**orange**	**red**	**green**	**cyan**	**purple**	**pink**
	41.8	**19.2**	**14.1**	**8.9**	**7.9**	**4.1**	**3.1**	**0.5**	**0.4**
Japan	achromatic	yellow	orange	blue	red	green	cyan	pink	purple
	42.6	21.0	13.7	9.4	6.0	4.3	2.8	0.2	0.1
Switzerland	achromatic	yellow	blue	red	orange	green	cyan	pink	purple
	47.5	16.3	14.3	8.9	8.2	2.7	1.3	0.5	0.2
Russia	achromatic	yellow	blue	orange	red	green	cyan	purple	pink
	36.0	21.5	15.0	8.3	7.4	5.5	5.1	0.9	0.3

Summary

First gap

- Problem: Human perception to colour categorisation.
- Solution proposed: Transformation of pixel information into intensity.

Second gap

- Problem: Human categories of colours to exact colour of pixels.
- Solution proposed: Categorisation of the 16'777'216 (RGB) colours available into 11 specific groups.

Case study of children's drawings, but applicable on other drawings or paintings.

Further works

- Problem under investigation : when filling an area on the page, the colour application is not regular (human invisible noise).
- Solution under development : filtering to obtain uniform patches of colours.

Questions

Questions?

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A+!