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Survey: Mood Detection in Images

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Abstract

The image processing communities together with vision and computer scientists have, for a long time, have made an effort to solve image semantics inference or in simple words the "semantic gap". They made an effort to deduce the content of an image and relate high level semantics to it, in fraction or in whole. Lately, researchers have drained ideas from the aforesaid to address yet more tricky problems such as relating pictures with emotions that they arouse in humans, with low-level image composition. Since emotions also have high-level semantics, it is not a surprise that research in these areas is greatly tangled. Moreover, researchers in emotion detection also need to be aware of and take into account the subjectivity and the context in which the emotion is perceived. As a consequence ties between computational image analysis and psychology, study of beauty including photography, are also natural and essential. The vital challenges for researchers are the loose and highly subjective nature of semantics associated with emotions and the apparently inherent semantic gap between low-level computable visual features and high-level human-oriented semantics. In this paper we attempt to give the basic understanding of what is an image, what are its low level features and how emotions are associated with these low level features and in turn to high level semantics.

Keywords: Computational image analysis, Emotion, High level semantics, Image semantics, Low level features.

A. Introduction

An image (from Latin: imago) is an artefact that depicts or records visual perception, for example a two-dimensional picture, that has a similar appearance to some subject usually a physical object or a person, thus providing a depiction of it. According to Gonzalez and Woods " An image may be defined as a two-dimensional function, f (x, y), where x and y are spatial coordinates, and the amplitude of f at any pair of coordinates (x, y) is called the intensity or gray level of the image at that point.

When x, y, and the amplitude values of f are all finite, discrete quantities, we call the image a digital image."

An image as defined on, say a photographic film, is a continuous function of brightness values. Each point on the developed film can be associated with a gray level value representing how bright that particular point is To store images in a computer we have to sample and quantize (digitize) the image function. Sampling refers to considering the image only at a finite number of points. And quantization refers to the representation of the gray level value at the sampling point using finite number of bits. Features of an image can be classified into three categories according to the level of abstraction they represent: ambiguous and very difficult to be automated.

B. Literature Survey

Color Models:-

Color models can be differentiated as: Hardware -oriented models:- Examples include the RGB, CMY(K) and YIQ models and User oriented models:-HLS, HCV, HSV, HSB, MTM models belong to this class.

A brief description of most widely used colour models :-

CIE Chromaticity Diagram

A tool for colour definition conceived by Commission Internationale de l'Enclairage(CIE) that reveals that almost any spectral composition can be achieved by a suitably chosen mix of three monochromatic primaries(lights of single wavelength), namely red, green and blue.

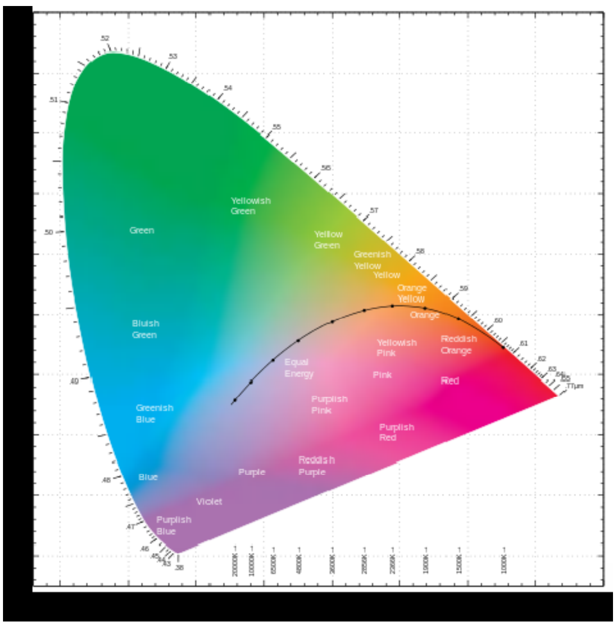

Figure 1. CIE chromaticity diagram

RGB:
The most commonly used hardware -oriented colour scheme for digital images. It preserves compatibility with the devices that originate or display images and is somewhat based on the physiology of the human retina. The RGB colour space is represented as unit cube.

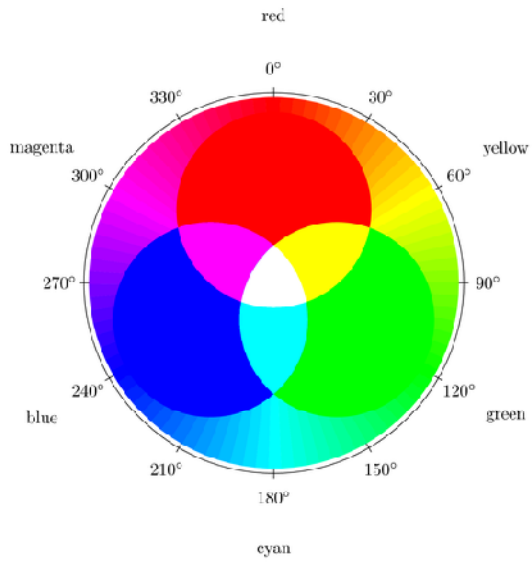

Figure 2. RGB model

CMY(K):
The CMY color space is used for color printing. It is based on the three subtractive primary colors, Cyan, Magenta, and Yellow.

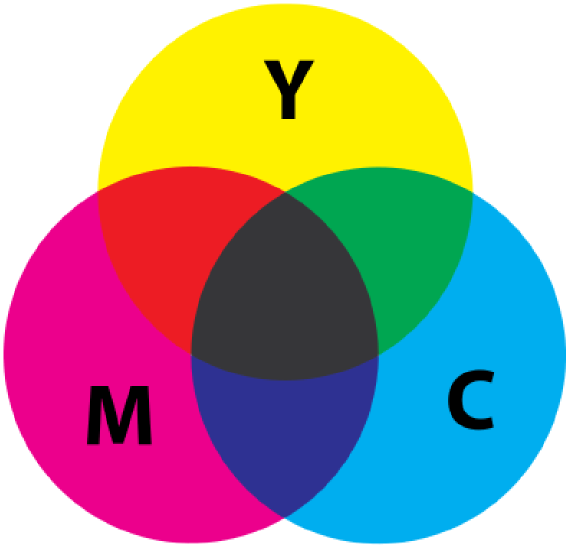

Figure 3. CMY(K) model

HSV:

The HSV (Hue-Saturation-Value) colour model is part of family of non-uniform colour spaces, containing other similar models such as HIS (or HIS), HCV, HSB, and HLS. It is of cone vertex. usually represented as double cone

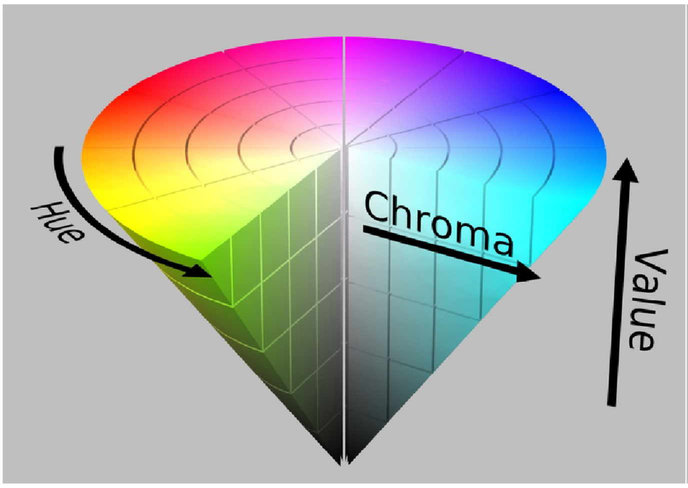

Figure 4. HSV model

Color Features:-

Color is one of the most important features of images. Colour features are defined subject to a particular colour space or model. A number of color spaces have been used in literature such as, RGB, LUV, HSV.

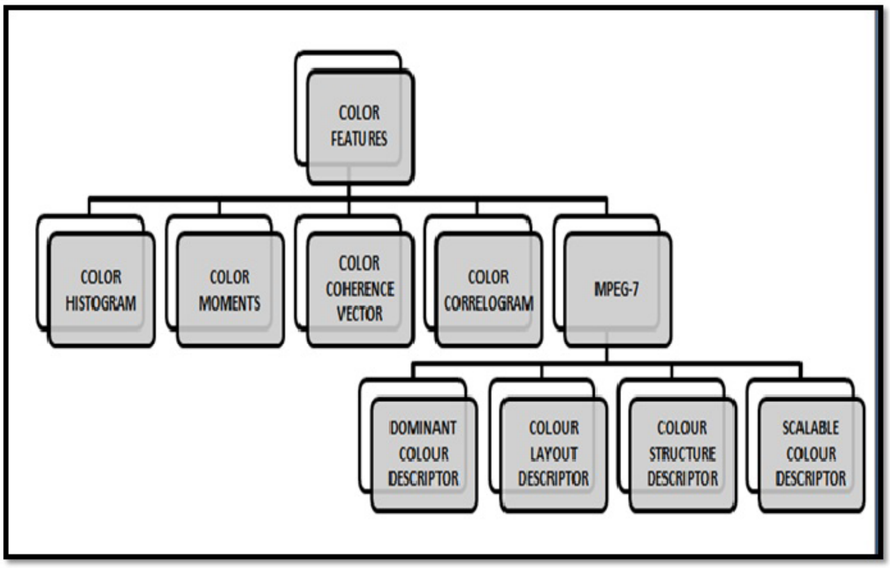

Figure 5. Different color features

Table 1. Pros and Cons of the color features

COLOR METHODS	PROS	CONS
Histogram	Simple to compute, Intuitive	High dimension, no spatial information, susceptible to noise
CM	Compact, robust	Not enough to describe all colours, no spatial information
CCV	Spatial information	High dimension, high computation cost
Correlogram	Spatial information	Very high computation cost, sensitive to noise, rotation and scale
DCD	Compact, robust, Perceptual meaning	Need post-processing for spatial information
CSD	Spatial information	No spatial info, less accurate if compact
SCD	Compact on need, Scalability	Relation to instincts

Texture Features:-

Texture is another important image feature. While colour is usually a pixel property, texture group of pixels. Due to its strong discriminative capability, texture feature is widely used in image retrieval and semantic learning techniques. Texture has been well studied in image processing and computer vision area. A number of techniques have been proposed to extract texture features. Based on the domain from which the texture feature is extracted, they can be broadly classified as:

Spatial Texture Feature Extraction Method:-

Spatial texture methods are easy to understand and many of them even have semantics. They do not require regular region shape and can be applied to irregular regions straight forwardly. However, these features are usually sensitive to noise and distortions

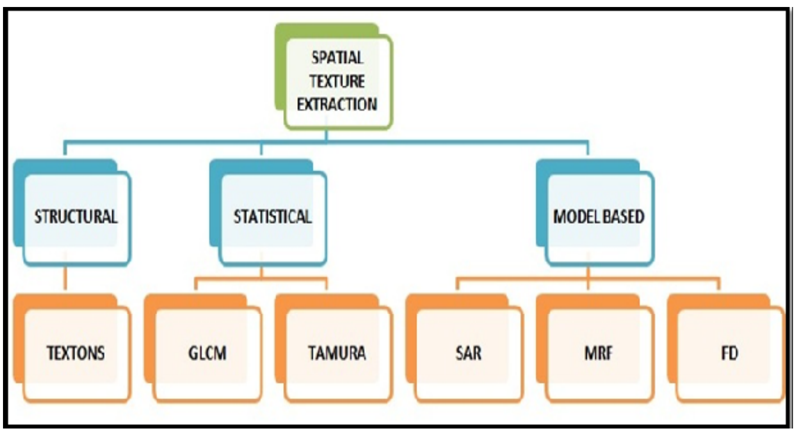

Figure 6. Different spatial texture extraction methods

Table 2. Pros and Cons of spatial texture features

TEXTURE METHODS	PROS	CONS
Texton	Intuitive	Sensitive to noise, rotation and scale, difficult to define textons
GLCM based method	Intuitive, compact, Robust	High computation cost, not enough to describe all textures
Tamura	Perceptually meaningful	Too few features
SAR	Compact, robust, Rotation invariant	High computation cost, difficult to define pattern size
FD	Compact, perceptually meaningful	High computation cost, sensitive to scale

Spectral Texture Feature Extraction Techniques:-

In spectral texture feature extraction techniques, an image is transformed into frequency domain and then feature is calculated from the transformed image.

Table 3. Pros and Cons of Spectral texture features

TEXTURE METHODS	PROS	CONS
FT/DCT	Fast computation	Sensitive to scale and Rotation
Wavelet	Fast computation, multi-resolution	Sensitive to rotation, limited orientations
Gabor	Multi-scale, multi-orientation, robust	Need rotation normalization, losing of spectral information due to incomplete cover of spectrum plane
Curve let	Multi-resolution, multi-orientation, robust	Need rotation, Normalization

Emotions:-

The word emotion includes a wide range of observable behaviours, expressed feelings, and changes in the body state. To clarify the concept of emotions, three definitions of various aspects of emotions can be distinguished:

- Emotion is a feeling that is private and subjective. Humans can report an extraordinary range of states, which they can feel or experience. Some reports are accompanied by obvious signs of enjoyment or distress, but often these reports have no overt indicators.
- Emotion is a state of psychological arousal an expression or display of distinctive somatic and autonomic responses. This emphasis suggests, that emotional states can be defined by particular constellations of bodily responses..

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Emotion Dimensions

Emotion dimensions - Models that use a dimensional approach to represent the emotion are found to overcome cultural difficulties. This because translations of the words that describe the emotion categories can have a different meaning in other languages. By using the dimensions of arousal and valence the measurement of the felt emotion can be very accurate. Many techniques converge on the conclusion that to a first approximation, emotion terms can be understood as referring to points within a circular space defined by those two dimensions [SCHLOSBERG, PLUTCHIK, ROSEMAN, RUSSEL].

Table 4. Summary of emotion theories

THEORISTS	BASIC EMOTIONS	BASIS FOR INCLUSION
Plutchik	Acceptance, anger, anticipation, disgust, joy, fear, sadness, surprise	Relation to adaptive biological processes
Arnold	Anger, aversion, courage, dejection, desire, despair, fear, hate, hope, love, sadness	Relation to action tendencies
Frijda	Desire, happiness, interest, surprise, wonder, sorrow	Forms of action readiness
Gray	Rage and terror, anxiety, joy	Hardwired
Izard	Anger, contempt, disgust, distress, fear, guilt, interest, joy, shame, surprise	Hardwired
James	Fear, grief, love, rage	Bodily involvement
McDougall	Anger, disgust, elation, fear, subjection, tender-emotion, wonder	Relation to instincts
Mowrer	Pain, pleasure	Unlearned emotional states
Oatley and Johnson-Laird	Anger, disgust, anxiety, happiness, sadness	Do not require propositional content
Panksepp	Expectancy, fear, rage, panic	Hardwired

Emotions Affecting The Reading Of An Image

Here we learn about the frequent color features used to detect mood.

Color As Emotions In Artwork:-

A knowledge of color theory helps us to express our feelings in an artwork. The language of color has even entered our vocabulary to help us describe our emotions. You can be red with rage or green with envy. We often speak of bright cheerful colors as well as sad or dull ones. A grey day may be depressing and result in a feeling of the blues..

Goethe's Theory:-

Goethe first divided colours into three categories: positive, negative and neutral. In general the positive ones have an agile, lively and striving effect on mind.

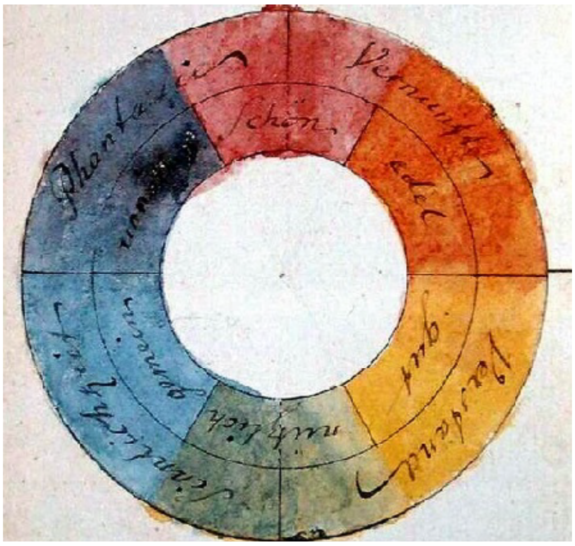

Figure 7. Goethe's color model

Table 5. Summary of Goethe's theory of color

COLOR	EMOTIONS
	POSITIVE COLORS
Yellow	Awaken, kindly seducing, warm and pleasant
Red-yellow	immortality, superstition, grief
Yellow-red	Violent and very energetic
	NEGATIVE COLORS
Blue	Urge and Calm, it may also be cold.
Red-Blue	nervous, anxious
Blue-Red	More anxious
	NEUTRAL COLORS
Red	Seriousness and dignity, delightfulness and pleasure.
Green	Peaceful, satisfaction

Itten's Color Theory:-

Color Contrasts There are seven different kinds of contrasts:1) Contrast of Hue 2) Light-Dark Contrast 3) Cold-Warm Contrast 4) Complementary Contrast 5) Simultaneous Contrast 6) Contrast of Saturation 7) Contrast of Extension

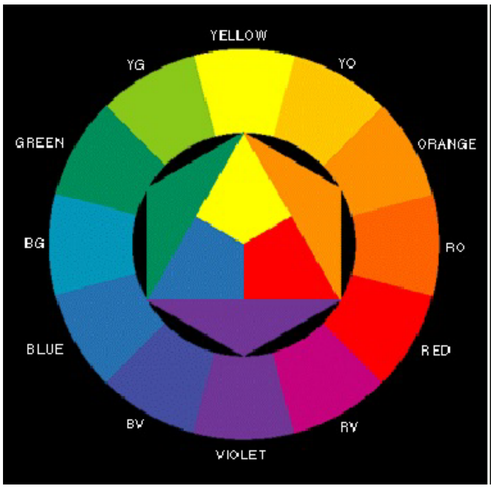

Figure 8. Itten's color model

Table 6. Summary of Colors and their relation with emotions

COLOR	**EMOTIONS**
Yellow	hope, understanding, knowledgeable, envy, betrayal, falseness, unreason
Red	immortality, superstition, grief
Blue	Stability, Strength, Power, Balance, Reliability
Green	impression of fruitfulness, contentment, and hope, flourishment
Orange	Maximum radiant activity, proud external ostentation
Violet	Unconscious, mysterious, royalty, terror, oppressive,

Texture As Emotion In Artwork

Texture refers to the roughness or smoothness of a surface in a work of art. Rough textures have more contrast than smooth textures. As a result, surfaces with rough texture are seen as more dynamic, emotionally active, and as having more depth.

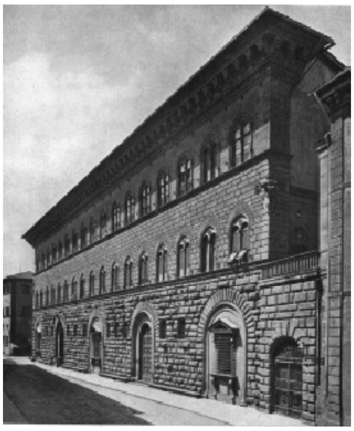

Figure 9. Medici Palace, Florence, Italy

The Medici Palace in Florence, Italy is a fine example. The first floor exterior of the building is rough. The second story uses medium-rough textures, and the third story is smooth. In this example, the rough textures closer to the ground suggest strength, and the smoother texture above invoke a sense of lightness.

Shape as a Emotion

Shapes are two-dimensional they can be free-form or geometric. Shapes can be defined by their color or by the combination of lines that make up their edges. Simple shapes can be combined to form complex shapes. Complex shapes can be abstracted to make simple shapes. The different characteristics of a shape convey different moods and meanings Changing the characteristics of a shape alter how we perceive that shape and make us feel differently about a design. Shapes are a powerful way to communicate.

Table 7. Summary of Shapes and their relation with emotions

SHAPES	EMOTIONS
Circular Shape	Tenderness, Love, Friendship, Care, Support, Protection, affection, Compassion
Squares	Stability, Strength, Power, Balance, Reliability
Rectangles	Stability, Strength, Power, Balance, Reliability
Pyramids	Stability, Strength, Power, Balance, Reliability
Vertical Lines	Strength, Masculinity, Power, Aggression, Courage, Brutality , Dominate, Menacing
Horizontal Lines	Tranquility, Feminine, Calm, Rest, Weak, Peaceful, Composed, Silent, Still, Non menacing
Soft Curves	Rhythm, Movement, Happiness, Pleasure, Generosity, Femininity
Sharp angled lines	Energy, Lively, Young, Explosive, Violent, Anger, Rapidity, Dynamic, Movement

Mapping To High Level Semantics:-

The function of mood detection is to bridge semantic gap between low-level feature and high-level emotional semantics. Generally, two kinds of methods as indicated in Fig.are used to build the mapping. One is machine learning method such as regression, neural networks (NN), fuzzy theory (FT), interactive genetic algorithm (IGA), support vector machine (SVM), etc, which needs training to calculate the mapping functions. This can be done:

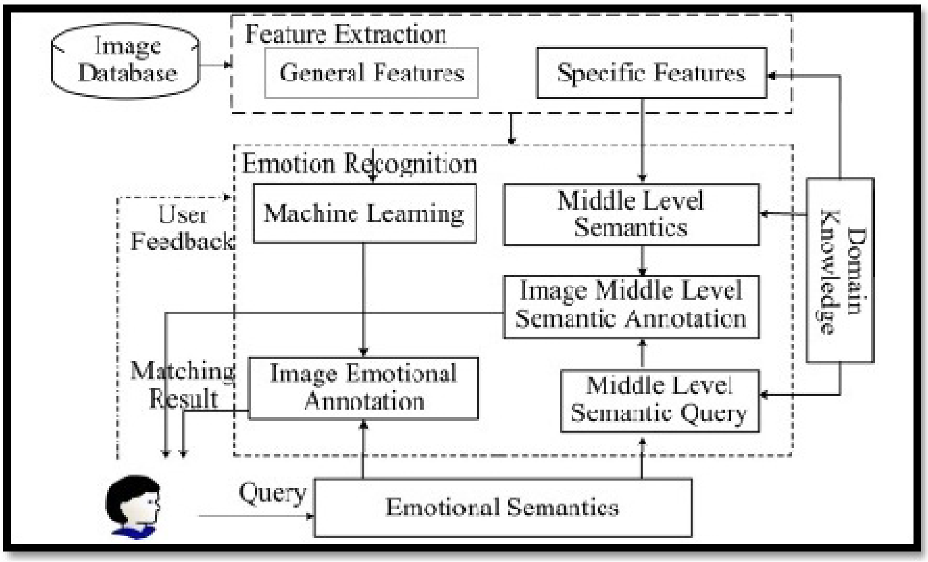

Figure 10. General scheme of emotion detection

- by using regression equations for recognizing emotional features. But this model can be insufficient because linear relationships are too simple to accomplish the mapping.
- by developing fuzzy rules and a neural network based evaluation system for converting physical features into emotional features.
- using support vector machine to derive common emotions from image
- by using machine learning, the recognition task is simply hand up to machine, and emotional semantics can be deduced from image features directly.

The other method of emotion recognition is building hierarchy model or rules with middle level semantics based on the domain knowledge without training. The knowledge is available from the colour research theory, aesthetics, art theory, design experts and psychological experiments. Wang proposed a hierarchical model from low level features to middle level semantics and then to high-level emotional semantics, by using accumulated knowledge and experience to accomplish image emotional semantic query.. In the future, new methods of machine learning, knowledge representation and psychological model, such as WordNet, ontology [7], Gestalt grouping principles [7], could be helpful in image emotion recognition.

C. Conclusion

In this paper, we have addressed the role of emotions in life. We have also highlighted the fact that emotions are an important part of the human-computer interaction. We also studied different features available to automatically detect emotions of image. By combining all these data the affective system must be able to determine the emotion of the image. This subject is hot and attractive but relatively new. Not real applications are already commercialize, currently there are only prototypes of affective application. This is a topic that has a future and will be increasingly present in our technologies life because emotions play an important role in our life. Finally the challenge today is to improve technologies to collect data from different features. Existing systems must be improve to really identify emotions despite factors that can skew results.

A perfect mood classification is not yet possible and will presumably never be possible due to the subjective impact of mood to individuals. Finally, investigation of user specifiable mood categories could lead to valuable applications by taking care of individual mood perception of the users.

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