INTENSITY ENHANCEMENT IN GRAY LEVEL IMAGES USING HSV COLOR CODING TECHNIQUE

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Abstract The capability will increase the efficiency by decreasing the time required to visualize the image clearly and reduce the probability of errors due to fatigue. The work in this thesis is motivated from the practical point of view by several shortcomings of traditional methods. The first problem is the inability of all known traditional methods to properly segment the objects from the background without the interference from object shadows and highlights. Moreover there is inadequate research on the combination of hue- and intensity-based similarity measures to improve color. The ineffective use of color can degrade an application reference and lesson user application. The HSV color space is quite similar to the way in which humans perceive color. The other models define color in relation to the primary colors. RGB is not efficient since it uses equal bandwidth for each color component. However, human eye is more sensitive to the luminance component than the color component. Thus, many image coding standards use HSV color scheme.

Key Words: HSV, Pixels, RGB, CIE, Gray Scale Image

1.INTRODUCTION

This introduction is a practical guide to the challenges, and the hardware and algorithms used to meet them. Image processing modifies pictures to improve them (enhancement, restoration), extract the information (analysis, recognition), and change their structure (composition, image editing). Images can be processed by optical, photographic, and electronic means, but image processing using digital computers is the most common method because digital methods are fast, flexible, and precise. An image can be synthesized from a micrograph of various cell organelles by assigning alight intensity value to each cell organelle. The sensor signal is "digitized"-- converted to an array of numerical values, each value representing the light intensity of a small area of the cell. The digitized values are called picture elements, or "pixels," and are stored in computer memory as a digital image. A typical size for a digital image is an array of 512 by 512 pixels, where each pixel has value in the range of 0 to 255. The digital image is processed by a computer to achieve the desired result. Image enhancement improves the quality (clarity) of images for human viewing. Removing blurring and noise, increasing contrast, and revealing details are examples of enhancement operations. Reducing the noise and blurring and increasing the contrast range could enhance the image. The original image might have areas of very high and very low intensity, which mask details. An adaptive enhancement algorithm reveals these details. Adaptive algorithms adjust their operation based on the image information (pixels) being processed. In this case the mean intensity, contrast, and sharpness (amount of blur removal) could be adjusted based on the pixel intensity statistics in various areas of the image. Images are produced by a variety of physical devices, including still and video cameras, x-ray devices, electron microscopes, radar, and ultrasound, and used for a variety of purposes, including entertainment, medical, business (e.g. documents), industrial, military, civil (e.g. traffic),security, and scientific. The goal in each case is for an observer, human or machine, to extract useful information about the scene being imaged. Often the raw image is not directly suitable for this purpose, and must be processed in some way. Such processing is called *image enhancement*; processing by an observer to extract information is called *image analysis*. Enhancement and analysis are distinguished by their output, images vs. scene information, and by the challenges faced and methods employed. Image enhancement has been done by chemical, optical, and the electronic means, while analysis has been done mostly by humans and electronically. Digital image processing is a subset of the electronic domain wherein the image is converted to an array of small integers, called *pixels*, representing a physical quantity such as scene radiance, stored in a digital memory, and processed by computer or other Digital hardware. Digital image processing, either as enhancement for human observers or performing autonomous analysis, offers advantages in cost, speed, and flexibility, and with the rapidly falling price and rising performance of personal computers it has become the dominant method in use

1.1Concept Of Image

Perhaps the first guiding principal is that humans are better at judgment and machines are better at measurement. Along these lines image enhancement, which generally requires lots of numeric computation but little judgments, is well-suited for digital processing. On top of this many digital image processing applications are constrained by severe cost targets. Thus we often face the engineer's dreaded triple curse, the need to design something good, fast, and cheap all at once.

1.1.1 Types of Digital Images

There are two important types of digital images—color and black and white. Color images are made up of colored pixels while black and white images are made of pixels in different shades of gray.

(a) Black and White Images

A black and white image is made up of pixels each of which holds a single number corresponding to the gray level of the image at a particular location. These gray levels span the full range from black to white in a series of very fine steps, normally 256 different grays. Since the eye can barely distinguish about 200 different gray levels, this is enough to give the illusion of a steeples tonal scale .Assuming 256 gray levels, each black and white pixel can be stored in a single byte (8 bits) of memory.

(b) Color Images

A color image is made up of pixels each of which holds three numbers corresponding to the red, green, and blue levels of the image at a particular location. Red, green, and blue (sometimes referred to as RGB) are the primary colors for mixing light-these so-called additive primary colors are different from the subtractive primary colors used for mixing paints (cyan, magenta, and yellow). Any color can be created by mixing the correct amounts of red, green, and blue light. Assuming 256 levels for each primary, each color pixel can be stored in three bytes (24 bits) of memory. This corresponds to roughly 16.7 million different possible colors. Note that for images of the same size, a black and white version will use three times less memory than a color version.

(c) Binary or Bi-level Images

Binary images use only a single bit to represent each pixel. Since a bit can only exist in two states—on or off, every pixel in a binary image must be one of two colors, usually black or white. This inability to represent intermediate shades of gray is what limits their usefulness in dealing with photographic images.

(d) Indexed Color Images

Some color images are created using a limited palette of colors, typically 256 different colors. These images are referred to as indexed color images because the data for each pixel consists of a palette index indicating which of the colors in the palette applies to that pixel. There are several problems with using indexed color to represent photographic images. First, if the image contains more different colors than are in the palette, techniques such as dithering must be applied to represent the missing colors and this degrades the image. Second, combining two indexed color images that use different palettes or even retouching part of a single indexed color image creates problems because of the limited number of available colors.

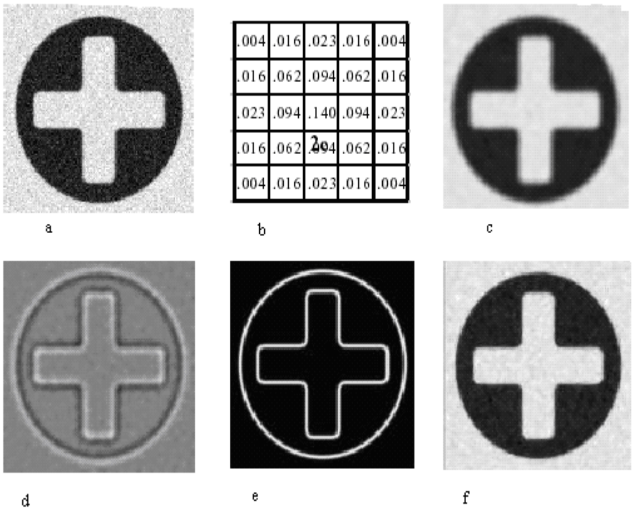
2. HARDWARE

Lights: All image processing applications start with some form of illumination, typically light but more generally some form of energy. In some cases ambient light must be used, but more typically the illumination can be designed for the application. In such cases the battle is often won or lost right here—no amount of clever software can recover information that simply isn't there due to poor illumination. Generally one can choose illumination intensity, direction, spectrum (color), and continuous or strobe. Intensity is easiest to choose and least important; any decent image processing algorithm should be immune to significant variations in contrast, although applications that Demand photometric accuracy will require control and calibration of intensity.

Direction is harder to choose and more important, as any professional photographer knows.

3. LINEAR FILTERS

Linear filters amplify or attenuate selected spatial frequencies, can achieve such effects as smoothing and sharpening. and usually form the basis of re-sampling and boundary detection algorithms. Linear filters can be defined by a convolution operation, where output pixels are obtained by multiplying each neighborhood pixel by a corresponding element of a like shaped set of values called a *kernel*, and then summing those products.. Figure1. a, for example, shows a rather noisy image of a cross within a circle. Convolution with the smoothing (low pass) kernel of figure 1.3.6.2b produces figure 1.3.6.c. In this example the neighborhood is 25 pixels arranged in a 5x5 square. Note how high frequency noise has been attenuated, but at a cost of some loss of edge sharpness. Note also that the kernel elements sum to 1.0 for unity gain. The smoothing kernel of figure 2b is a 2D Gaussian approximation. The 2D Gaussian is among the most important functions used for linear filtering. Its frequency response is also a Gaussian, which results in a well-defined pass band and no ringing. Kernels that approximate the difference of two Gaussians of different size make excellent band-pass and high-pass filters. Figure 3.1dillustrates the effect of a band-pass filter based on a difference of Gaussian approximation using a 10x10 kernel. Both the high frequency noise and the low frequency uniform regions have been attenuated, leaving only the mid-frequency components of the edges.



.004	.016	.023	.016	.004
.016	.062	.094	.062	.016
.023	.094	.140	.094	.023
.016	.062	.094	.062	.016
.004	.016	.023	.016	.004

Figure-1: An image enhanced to reduce noise or emphasize boundaries.

Physiological Factors Color is determined by an interaction among three photo pigments; the perceived color is a mixture of the relative responses of the red, green, and blue photo pigments, in much the same way as a television camera creates color [4]. Given a dramatic imbalance among the percentages of cells containing red (approximately 64%), green (approximately 32%), and blue (approximately 2%) photo pigments, it is clear that the perception of color is both highly specialized and physiologically biased (data from March, 1988).

Color results from the interaction of light with the nervous system. There are several components that affect color perception, including the eye lens, the retina, and a color processing unit along the optic nerve. These areas are discussed in the following sections.

(a) Lens

The function of the lens is to focus the incoming light on the retina, which contains the photoreceptors. Different wavelengths of light have different focal lengths. Therefore, for pure hues, the lens must change its shape so that the light is focused correctly. For a given lens curvature, longer wavelengths have a longer focal length, i.e., red is the longest focal length and blue is the shortest. To have an image focused on the retina, the lens curvature must change with wavelength with red light requiring the greatest curvature and blue light the least curvature. This means that if pure blue and pure red hues are intermixed, the lens is constantly changing shape and the eye becomes tired.

A related effect is called chromo here pure colors located at the same distance from the eye appear to be at different distances, e.g. reds appear closer and blues more distant. Sometimes pure blues focus in front of the retina and so appear unfocused. At night, a deep blue sign may appear fuzzy while other colors appear sharp. The lens also absorbs light about twice as much in the blue region as in the red region. As people age the lens yellows, which means it absorbs more in the shorter wavelengths. Therefore, the result is that people are more sensitive to longer nets, wavelengths (yellows and oranges) than they are to shorter wavelengths (cyan to blue) and these increases with age. The fluid between the lens and the retina also absorb light and this effect increases as people age, so the older people get the less sensitive they are to light in general (the apparent brightness level decreases) and especially the sensitivity to blue decreases.

(b) Retina

The retina contains the photoreceptors that absorb photons and transmit chemical signals to the brain. There are two types: rods, which are night-vision receptors and have no color dependency, and cones, which have color sensitivity and require a higher level of light intensity than rods.

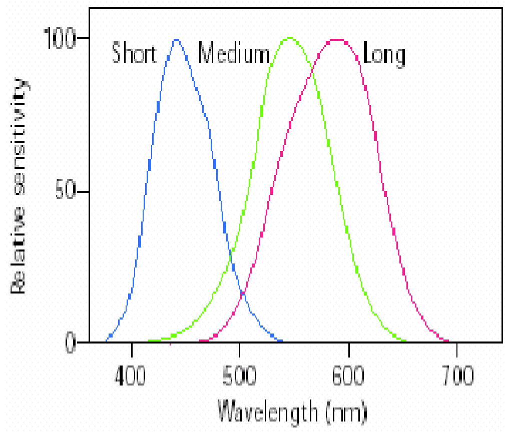


Figure-2: Spectral sensitivities of the three classes of photoreceptors in the retina

As shown in Figure2. there are three types of photo-pigments in the cones; "blue" with a maximum sensitivity at 430 nm, "green" with a maximum sensitivity at 530 nm, and "red" at 560 nm. (This wavelength actually corresponds to yellow). Light at a single wavelength will partially activate all three types of cones, e.g. at a wavelength of 470 nm, blue is strongest plus some red and green components. The percentage of cones is not equal but is as follows: blue (4%), green (32%), and red (64%). In addition, the cones are differentially distributed in the retina. The center of the retina has a dense concentration of cones but no rods while the periphery has many rods but few cones. The color distribution is also asymmetrical. The center of the retinas primarily green cones, surrounded by red-yellow cones, with the blue cones being mainly on the periphery. The center of the retina has no blue cones. Objects are seen by edge detection, where an edge can be created by a difference in color or brightness or both. Edges formed by color differences alone, with no brightness differences, appear fuzzy and unfocused, so changes in brightness should be added to get sharp edges.

Photoreceptors adjust their sensitivity to the overall light level, e.g. going into or out of a dark room require some adjustment time. There is also a required minimum intensity level for the photoreceptors to respond. This minimum varies with wavelength with the highest sensitivity in the center of the spectrum. Therefore, blues and reds must have a higher intensity than greens or yellows in order to be perceived.

(c) Brain

From the retina, the optic nerve (actually a collection of nerves) connects to the brain but before it reaches the brain, there is a color-processing unit, called the lateral geniculation body. This recombines the RGB color information into three new channels as

Follows:

R-G gives red or green color perception
R+G gives the perception of brightness and yields yellow (Y)
Y-B gives yellow or blue color perception

Thus, blue plays no part in brightness so that colors differing only in amount of blue don't produce sharp edges. Also, note that since blue and yellow and red & green are Linked together it is impossible to experience combinations such as reddish green or bluish yellow.

(d) Color blindness

About nine percent of the population has some kind of color perception problem. The most common is red-green deficiency, which can arise from a deficiency of either the red or the green photo-pigments. These people have difficulty distinguishing any color that is dependent upon the red: green ratio.

4. GENERAL GUIDELINES BASED ON PHYSIOLOGY

These are some of the guidelines drawn from Munch [5] principles based on physiology. Avoid the simultaneous display of highly saturated, spectrally extreme colors. This causes the lens to rapidly change shape and thus tires the eyes. Desiderate the colors or else use colors that are close together in the spectrum.

Pure blue should be avoided for text, thin lines, and small shapes. Since there are no blue cones in the center of the retina, these are difficult to see. But blue makes an excellent background color, e.g. for a computer display it tends to blur the raster lines.
Avoid adjacent colors that differ only in the amount of blue. Since blue does not Contribute to brightness, this creates fuzzy edges.

Older operators need higher brightness levels to distinguish colors.

Colors change in appearance as the ambient light level changes.

The magnitude of a detectable change in color varies across the spectrum.

It is difficult to focus upon edges created by color alone.

Avoid red and green in the periphery of large displays. Opponent colors go well together.

For color-deficient observers, avoid single color distinctions. Color selection guidelines based on human color vision

Avoid adjacent areas of strong blue and strong red in a display to prevent unwanted depth effects (colors appearing to lie in different planes).

Never use the blue channel alone for fine detail such as text or graphics. Do not use, for example, blue text on a black background or yellow text on a white background.

Areas of strong color and high contrast can produce after images when the viewer looks away from the screen, resulting in visual stress from prolonged Viewing.

Do not use hue alone to encode information in applications where serious consequences might ensue if a color-deficient user were to make an incorrect Selection.

5. PSYCHOLOGICAL FACTORS

As well understood as the physiology of color is, this factor provides little explanation for our opinions of color and color combinations. At the very least, opinions of color are learned and highly associative. For example, as children, we often had a "favorite color" and we liked everything: clothes, toys, books that matched our preference. Over time, we learned a variety of color schemes and in most cases, our tastes become more refined. But even as adults, we are influenced by fashion, and may still associate our more sophisticated sense of color with increasingly more sophisticated emotions, desires, or impressions. For example, even a cursory examination of changes in interior design from the 1950s to the present reveals a dramatic evolution of what was considered warm or even comfortable colour.

6. ALGORITHM BACKGROUND

6.1 Color Space

A color model is an abstract mathematical model describing the way colors can be represented as tulles of numbers, typically as three or four values or color components. When this model is associated with a precise description of how the components are to be interpreted (viewing conditions, etc.), the resulting set of The most saturated colors are located at the outer rim of the region, with brighter colors farther removed from the origin. The human tristimulus space has the property that additive mixing of colors corresponds to the adding of vectors in this space. This makes it easy to, for example, describe the possible colors (gamut) that can be constructed from the red, green, and blue primaries in a computer display.colors is called color space. This section describes ways in which human color vision can be modeled.

6.1 Tristimulus color space

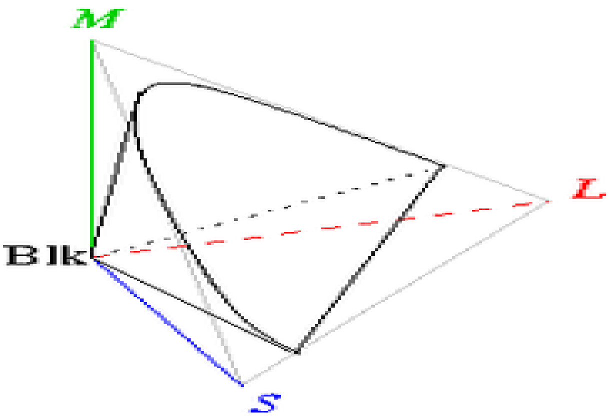


Fig-3: 3 D representation of the human color space.

One can picture this space as a region in three-dimensional Euclidean space if one identifies the x, y, and z axes with the stimuli for the long-wavelength (L), medium-wavelength (M), and short-wavelength (S) receptors. The origin, (S,M,L) = (0,0,0), corresponds to black. White has no definite position in this diagram; rather it is defined according to the color temperature or white balance as desired or as available from ambient lighting. The human color space is a horse-shoe-shaped cone such as shown here extending from the origin to, in principle, infinity.

6.2 The CIE Color Model

Though some colors can be created by a single, pure wavelength, most colors are the result of a mixture of wavelengths. A French organization, the Commission International de L'Eclairage (CIE), worked in the first half of the 20th century developing a method for systematically measuring color in relation to the wavelengths they contain. This system became known as the CIE color model (or system). The model was originally developed based on the tristimulus theory of color perception. The theory is based on the fact that our eyes contain three different types of color receptors called cones. These three receptors respond differently to different wavelengths of visible light. This differential response of the three cones is measured in three variables X, Y, and Z in the CIE color model.

Notice in Figure 3b that the perimeter edge marks the wavelengths of visible light. Along this edge will be the 'pure' spectral light colors. Other colors are developed by mixing varying amounts of different wavelengths. Notice the purples at the bottom do not have a wavelength associated with them. non-spectral colors

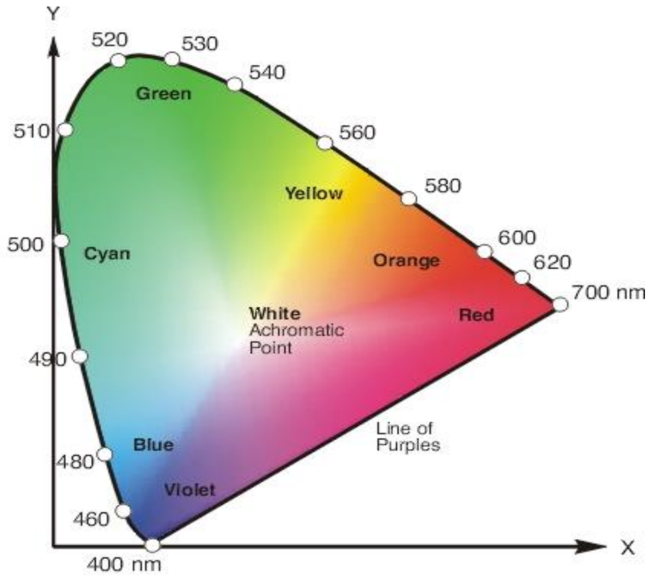


Fig-4: CIE color model.

7. RESULT AND DISUSSION

7.1 Implementation of Color Coding Methods

The output response of the three color coding techniques are plotted (using MATLAB) and are represented as Rainbow Transform, Phase and Frequency Transform and HSV Transform. Also the results are compared for the different input values and outputs of three diffe methods.4a Example 1- Gray Scale Image ColorCoding Frequency Transform are also plotted for different Input of this image for Rainbow method Phase and Frequency Transform and HSV method are plotted along with their Big view

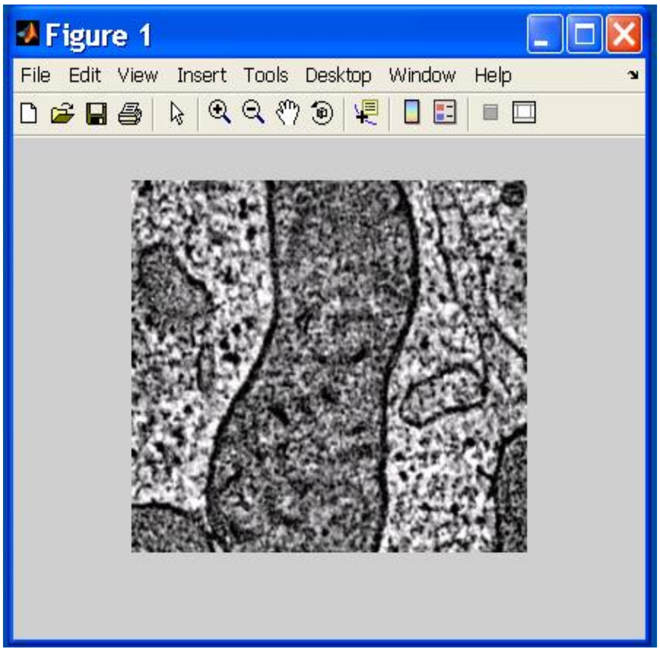


Figure- 4(a): Input Gray Scale Image of Cell

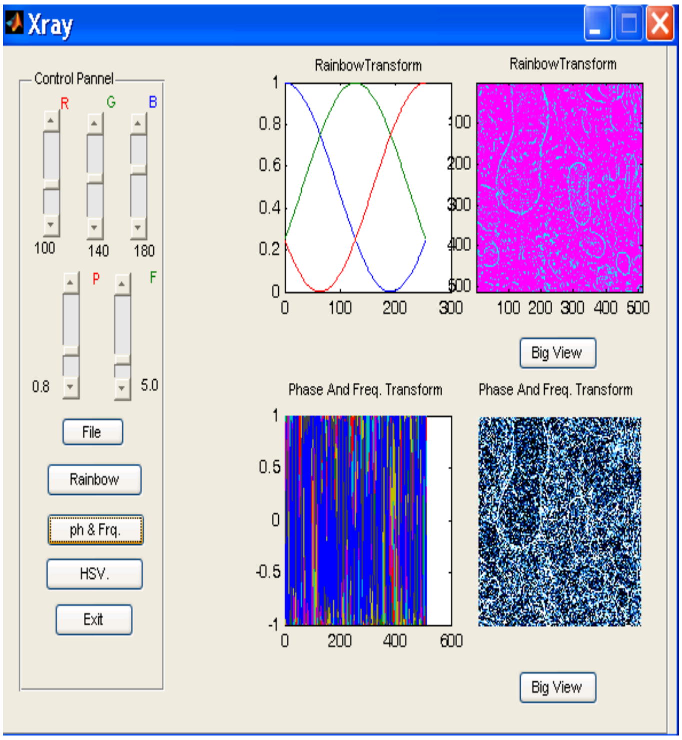


Figure -4(b): The Output Response of Ranibow Transform and Phase and Frequency Transform

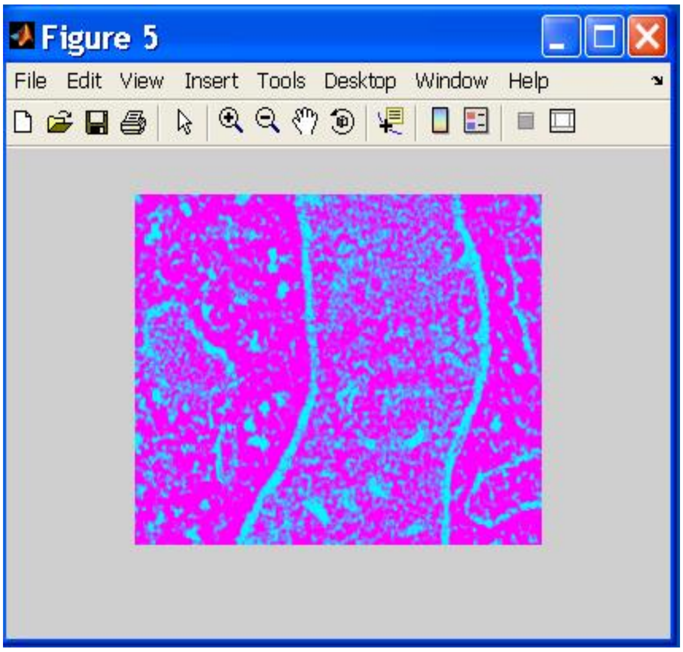


Figure -4(c): The Output Response of HSV Method for Gray Scale Cell image.

The Image color coding methods are implemented on gray scale image of Bag containing threat element having specifications of phase (p) = 1.78 and frequency (f) = 8.29 . The output response of this image for Rainbow method Phase and Frequency Transform and HSV method are ploted alongwith their Big view. The different output response of Phase and Frequency Transform are also plotted for different Input Phase and Frequency parameters.

8. CONCLUSION

Among the different coloring schemes the HSV scheme that was developed based on the color survey result was ranked highest . However, the other color maps were ranked very close to the HSV map. The cosine color map results were impressive. The difficulty with the HSV map is to set or pick the threshold. This can be solved by establishing an auto thresholding algorithm. The cosine color map produced very continuous and smooth results when compared to the other maps. In addition, color-coding already enhanced images may produce better results. Currently color-coding is applied directly to the intensity stretched image. This work shows that 90% of the edges are about the same in graylevel and in color images whereas using color coding technique 10% left over edges may be extracted from the color images.

To acquire statistically significant results, the images should be presented in a pseudo random fashion to avoid the influence of other images in detecting the threat. False positives should be evaluated by introducing images without any threat

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