Analytical Survey of Colour to Greyscale Conversion Methods Based on Primary Image Processing Techniques

Isunuri Bala Venkateswarlu
Computer Science and Engineering
India

Abstract— Image Processing established itself as one of the most contemporary research areas because of its wide variety of application requirements. Complexity in Colour image processing motivated the researchers to use Colour to Greyscale conversion as the preliminary step for any Image processing applications. All the new proposals on Colour to Greyscale conversion are more expensive and hence we considered fundamental methods for this analytical survey. Majority of the researchers use a common fundamental method of averaging RGB channels which is not preferable for all applications. This paper shows that results of the Image Processing application are influenced by selection of Colour to Greyscale conversion method. We mainly focused to compare these conversion methods based on primary Image Processing techniques: Edge detection and Segmentation along with Colour perception. Main objective of this paper is to produce fruitful results that will help in selection of application specific Colour to Greyscale conversion method to experience good results with low computational speed.

Keywords— Colour to Greyscale conversion method, Image Processing techniques, Colour Perception, Edge detection, Segmentation, Analytical survey

I. IMAGE PROCESSING TECHNIQUES AT GLANCE

Digital Image processing[1] will be the heart of many real time applications in the world of multimedia. In general, Image Processing[1] refers to set of operations or techniques that can be performed on two dimensional picture by the computer algorithms to produce various types of outputs based on the requirements of the user. With in the span of few years, Image Processing is flooded with number of processing techniques. Most of these techniques produce image as output by embedding some effects or changes on the given image and few of them produces some features or information as output. Most promising categories includes Image representation, Image Compression, Image Enhancement, Image Analysis and Image Understanding.

A. Image Representation

Representation is the primitive step in digitization of captured image from cameras. Roots of digital image representation is started around 1870’s with digitization of black and white image. Later 1960’s became a mile stone by the colour image representation with three co-ordinate system known as Colour model like RGB. Even though RGB is the fundamental for representation of pixels, many of the real time application requirements provoked for other representations like CMY, YUV and HSV etc. Che-YenWen[3] presented the details of mostly used Colour models along with equations used for representation and transformation. RGB[2,3] is an additive model which uses Red, Green and Blue colours to represent each pixel and is preferable in display units. Similarly CMY[2,3] is subtractive colour model which uses Cyan, Magenta and Yellow colours to represent each pixel and is prescribed in printing devices. Summary of primary colour models are listed in Table 1 along with components used for representation and usage of colour model.

Table 1: Information of Color Models

<table>
<thead>
<tr>
<th>Color Model</th>
<th>Color Components</th>
<th>Primary usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>RGB</td>
<td>Red, Green, Blue</td>
<td>Used for display devices because it describes what kind of light need to be emitted to produce given color</td>
</tr>
<tr>
<td>CMY / CMYK</td>
<td>Cyan, Magenta, Yellow</td>
<td>Used in printing process because it describes what kind of inks need to apply so the light reflected from substrate and through inks produces given color</td>
</tr>
<tr>
<td>CIE XYZ/RGB</td>
<td>X, Y, Z</td>
<td>Used for display devices with gamma correction which is based on the measurements of human color perception</td>
</tr>
<tr>
<td>CIE LAB/LUV</td>
<td>L, U, V</td>
<td>Used for surface colors and it is more perceptually linear than other color models</td>
</tr>
<tr>
<td>HSV /HSL</td>
<td>Hue, Saturation, Value/Lightness</td>
<td>Used by artists because it is often more natural to think about color in terms of hue and saturation, it is transformation of RGB color model</td>
</tr>
<tr>
<td>YUV</td>
<td>Luminance(Y),</td>
<td>Used as analog video representation for PAL television broadcasting</td>
</tr>
</tbody>
</table>
B. Image compression

Technical advancements in the field of multimedia caused to use larger resolution images which costs more in terms of memory. In case of networked multimedia applications like broadcast TV, remote sensing via satellites, military communication via aircraft, radar and teleconferencing large amount of image data need to be transferred over network which increases bandwidth. This bottleneck of bandwidth can be reduce by minimizing the number of bits required to represent an image. These applications increases the need of compression techniques for the image and video data. There are several image compression techniques which are broadly classified as Lossless and Lossy techniques. Details of these techniques are out of the scope to this paper and hence not considered for the discussion.

C. Image Enhancement

Image enhancement is to process an image so that result is more suitable than original image for specific application. Photo editing is the most important economical task in this digital world which involves process of adjusting digital images so that the results are more suitable for display or further image analysis. It refers to sharpening of image features such as increasing quality, brightness and contrast to make more attractive image production. Raman Maini[4] classified enhancement methods into Spatial Domain and Frequency Domain and focused mainly on various transformations based, histogram based methods. Similarly, Matlab programming aspects of image processing can be found from Chris Solomon[5]. Here generalized set of Image Enhancement techniques are discussed.

- **Noise Reduction**: Image noise is random variation of brightness or colour information in image that is included due to environment and camera sensors. Gaussian noise and Salt-and-Pepper noise are most occurring noise in the images. It is impossible to eliminate noise completely, but noise can be suppressed using filters like Linear smoothing, Median.

- **Changing Sharpness or Brightness of image**: Lightness or Darkness of image pixel can be referred as Brightness of image where as Sharpness is defined as edge contrast. If brightness increases, lighting effect in the image increases. Similarly, if Sharpness increases smoothness of edges increases.

- **Histogram equalization**: It is a method of adjusting contrast of image which usually increases global contrast that allows for areas of lower local contrast to gain higher contrast. This can be accomplished by effectively spreading out most frequent intensity values.

- **De-blurring**: Image blur is difficult to avoid in many situations and can often ruin a photograph. Image blur causes decrease of quality in the image and left with unclear images. Smoothing filters are generally used for de-blurring images.

D. Image Analysis

Image analysis[6, 7] is the extraction of meaningful information from images by means of digital image processing techniques. Image processing research requires more sophisticated techniques in order to measure the characteristics of the Region of Interest or Objects on the given image. This induced for novel techniques to extract measurements of the objects for the analysis of image. Useful methods for image analysis and their evaluation can be obtained from Punam Thakare[6].

- **Edge Detection(ED)**: It is the process of identifying points in digital image at which image brightness changes sharply or more formally has discontinuities. The points at which image brightness changes sharply are typically known as Edges. Typical edge might for instance be border between block of two regions. Canny edge detector is one of the mostly used edge detection methods.

- **Segmentation or Pixel Classification(SEG)**: It is the process of partitioning digital image into multiple segments. More precisely, image segmentation is the process of assigning label to every pixel in an image such that pixels with same label share certain visual characteristics. Thresholding, Clustering, Region-growing methods are some of the segmentation techniques.

E. Image Understanding

Image understanding[7] is the process of actually interpreting those regions or objects to figure out what is actually happening in the image. Advanced Computer Vision applications motivated the researchers to inculcate several operations that are mainly focusing the concept of understanding images by extracting high level features of the objects. Image analysis techniques can be considered as primitive tools for various image understanding operations. Most common techniques of them are given below.

- **Optical Character Recognition(OCR)**: It is the process of converting images of written or printed text into computer readable text. It is widely used as form of data entry from some sort of original paper data source like passport documents, invoices, bank statements etc.
**Feature Extraction or Pattern Recognition (PR):** It involves simplifying amount of resources required to describe large set of data accurately. When performing analysis of complex data one of major problems stem from number of variables involved. Best results are achieved when an expert constructs a set of application dependent features. Thresholding, Template matching techniques are used for feature extraction.

**Object Recognition (OR):** It is the task of finding and identifying objects in image. Objects can even be recognized when they are partially obstructed from view. Approaches used for object recognition are Edge matching, Greyscale matching, Gradient matching.

**Object Motion Tracking (OMT):** Motion capture is the process of recording movement of objects or people. It refers to recording actions of human actors and using that information to animate digital character models in 2D or 3D. Radio Frequency (RF) positioning system are generally used to capture motion of objects.

### II. BROAD VIEW OF IMAGE PROCESSING APPLICATIONS

Many requirements of our daily life propels Image processing to render with wide verity of applications. These applications spread over various fields to work in real time environments. Broad classification of the fields are discussed along with most possible applications that are categorized based on relevance of applications. Most dominating areas and their applications are listed below.

#### A. Traffic Control Applications

With globalization and traffic growth all over the world, the problem of congestion on highways and in cities is becoming more and more acute. This is one of the critical network where there is a large scope of accidents and fatalities. Nearly 3,400 people die on the world’s roads every day and Tens of millions of people are injured or disabled every year. This shows the importance of effective Intelligent Traffic control system. Many cities and districts have developed traffic control systems to monitor the movement and flow of vehicles around the road network. Configuration and functions of advanced Traffic Signal Control System installed in Thailand is explained by Sakakibara[8]. A concise review of vehicle detection and tracking techniques like background subtraction, feature based, motion based and frame differencing methods are discussed by Ahme Hadli[9]. Primary applications of traffic control systems are discussed below and recent proposals can be referred from [13-16].

- **Intelligent Traffic Signaling (ITS):** Heavy traffic jams consumes spending of more amount of time by the driver in the journey. This requires an Intelligent Traffic Signaling system for helping the drivers by giving suggestions of traffic less route to avoid congestion over the roads. Close Circuit TV cameras are connected at each heavy cross roads and are connected to central traffic monitoring station through network. These cameras always captures the movement of vehicles and sends live video signals to the central station, allowing for traffic management decisions to be made in real-time. This system is also helpful in suggesting alternative route for the drivers when there is some accident or unfamiliar situation on the roads.

- **Automatic Number Plate Recognition (ANPR):** Whenever misfortunes or unusual things occurs in the traffic, it is very big challenge for the traffic control officer to trace the vehicle. Tracking of unusual vehicles will be very easy when the vehicle number is identified and is able to share with nearby traffic controlling authorities. This is possible with Automatic Number Plate Recognition system which is a mass surveillance method that uses Optical Character Recognition on images to read vehicle registration number. This can be used to store images captured by cameras as well as the text from license plate, with some configurable to store a photograph of the driver.

- **Moving Object/Vehicle Tracking (MOT):** Recent innovations have contributed to the adoption of ANPR for perimeter security and access control applications at government facilities. Networks of IP based surveillance cameras that perform double duty alongside Facial recognition, Object tracking and recording systems for the purpose of monitoring suspicious or anomalous behavior of terrorism acts. Similarly Global Positioning System (GPS) based navigation is also another solution to track the moving objects.

#### B. Space Applications

Severe disasters over the world are only due to lack of information about the environment changes in the surrounding layers of Earth. Launching of satellites resolved this problem with the capability of capturing images of earth and other planets at various longitude and altitudes. Quantitative analysis of satellite and aircraft derived remotely sensed data is published by Rechards[10]. Even though Tele communication and GPS services are the major tasks of satellites, Weather forecasting applications impulsive to include high resolution image capturing and processing systems. Major classification of space applications are discussed below.

- **Satellite Image Processing (SIP):** Satellite imagery includes photographs of the earth taken through an artificial satellite revolving around the earth. The process of correcting these satellite images for haze, cloud and sensor induced defects within satellite image and overlaying the 2D satellite image on 3D surface of the earth is called Satellite Image Processing. Processed satellite images have different scientific and need based applications in the field of agriculture, geology, forestry, biodiversity conservation, regional planning, education, intelligence and warfare.

- **Earth Remote Sensing (ERS):** Remote sensing refers to the activities of recording or sensing objects or events at far away or remote places in which sensors are not in direct contact with objects or events being observed. The electromagnetic radiation is normally used as an information carrier in remote sensing. The output of a remote...
sensing system is usually an image representing the scene being observed. A further step of image analysis and interpretation is required in order to extract useful information from the image. In satellite remote sensing of the earth, the sensors are looking through a layer of atmosphere separating the sensors from the Earth’s surface being observed.

C. Industrial Applications

Even though problem of rapid production in industries is solved by Industrial robots, quality of product became one of the hurdle for the rapid production. But Image processing came with solution for this with intelligent failure product finding system which can detect failure product automatically and separate them from the process of shipping.

- **Automatic Surface Inspection System (ASIS):** In metal industries it is essential to detect the flaws on the surfaces. For instance, it is essential to detect any kind of aberration on the rolled metal surface in the hot or cold rolling mills in a steel plant. Image processing techniques such as texture identification, edge detection, fractal analysis etc are used for the detection.

- **Faulty Component Identification System (FCIS):** This application identifies the faulty components in electronic or electromechanical systems. Higher amount of thermal energy is generated by these faulty components. The Infra-Red images are produced from the distribution of thermal energies in the assembly. The faulty components can be identified by analyzing the Infra-Red images.

D. Defense Surveillance Applications

Aerial surveillance methods are used to continuously keep an eye on the land and oceans. This application is also used to locate the types and formation of naval vessels of the ocean surface. The different parameters such as length, breadth, area, perimeter, compactness are set up to classify of objects. It is important to recognize the distribution of these objects in different directions to explain all possible formations of the vessels.

- **Space and Missile Tracking System (SMTS):** The Space and Missile Tracking System also known as Brilliant Eyes, is currently in the demonstration and validation phase. The key role of Brilliant Eyes is to support Theater Missile Defense by providing the capability for world-wide tracking of ballistic missiles in flight from launch to re-entry. During peacetime, it monitors ballistic missile tests worldwide by collecting threat development, deployment, signature and trajectory data. This allows defenses to maintain and optimize their effectiveness as new threats appear.

E. Medical Applications

Medical imaging is the technique and process used to create images of the human body or parts for clinical purposes or medical science. Molecular imaging is a relatively new discipline that allows the biological processes taking place in the body to be viewed at a cellular and molecular level. Molecular imaging procedures are used to diagnose and manage the treatment of brain and bone disorders, cancer, gastrointestinal disorders, heart and kidney diseases, lung and thyroid disorders. Medical applications starts with capturing of images of body or part of body with different types of imaging tools summarized in Table 2.

<table>
<thead>
<tr>
<th>Imaging Tool</th>
<th>Imaging Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrasound Imaging</td>
<td>Sound waves produced by reflected by organs and other interior body parts</td>
</tr>
<tr>
<td>Magnetic Resonance Imaging (MRI)</td>
<td>Uses magnetic fields and radiofrequency to visualize body’s internal structures</td>
</tr>
<tr>
<td>Radiography (Plain X-rays)</td>
<td>Earliest radiological imaging and today digital X-ray techniques are replacing film</td>
</tr>
<tr>
<td>Computed Tomography (CT)</td>
<td>High resolution images of the body can be produced with conventional radiography</td>
</tr>
<tr>
<td>Mammography</td>
<td>Special type of X-ray imaging used to create detailed images of breast</td>
</tr>
<tr>
<td>Angiography</td>
<td>Special type of X-ray technique for viewing blood vessels and organs especially heart</td>
</tr>
<tr>
<td>Fluoroscopy</td>
<td>Produces continuous live X-ray image of patient’s internal structures on a monitor</td>
</tr>
</tbody>
</table>

All these imaging tools are used to captures images of infecting part of the body and those images are used for medical diagnosis. Most of these Biomedical imaging applications mainly focus on dangerous diseases discussed below.

- **Cancer Imaging (CI):** Cancer may be difficult to detect but for some types of cancer, the earlier it is detected the better are the chances of treating it effectively. Imaging techniques have become an important element of early detection for many cancers. Cancer Imaging is not simply used for detection, but also important for determining how advanced the cancer stage and the precise locations of cancer to aid in directing surgery and other cancer treatments or to check if a cancer has returned.

- **Neuro Imaging (NI):** Various types of brain disease are growing day to day and causes very sudden deaths. Neuro imaging became the tool for taking image of brain and is useful for the diagnosis. It includes the use of various techniques to either directly or indirectly image the structure, function/pharmacology of the brain. It is a relatively
new discipline within medicine and neuroscience/psychology. It is helpful for Physicians who specialize in the performance and interpretation of neuro imaging.

- **Heart Disease Identification (HDI)**: Heart disease are very crucial to identify for the diagnosis. To improve the diagnosis of heart diseases, image analysis techniques are employed to radiographic images. The important diagnostic features such as size of the heart and its shape are required to know in order to classify the heart diseases.

F. Security Applications

Password protection became the most widely used technique for all types of system related applications even though there are several other techniques. This will be very much appropriate for the digital system and it is not useful to identify the unique significance of the persons in view of organizations or country. Unique identification of person with Nationality of country and Employability of some organization requires more sophisticated biometrics based applications which are having ability to process biometric characteristics like Finger print, Iris and Face.

- **Fingerprint Recognition (FPR)**: Fingerprint recognition identifies people by using the impressions made by the minute ridge formations or patterns found on the fingertips. Over the years fingerprint recognition has become one of the most widely used biometric technology with a number of civil and criminal automated fingerprint identification systems in use across the world.

- **Iris Recognition (IR)**: Iris recognition is an automated method of biometric identification that uses mathematical pattern-recognition techniques on video images of the irides of an individual's eyes, whose complex random patterns are unique and can be seen from some distance. We can use the Iris as an identity document or a password offering as it offers a very high degree of identity assurance.

- **Face Recognition (FR)**: A facial recognition system is a computer application for automatically identifying or verifying a person from a digital image or a video frame from a video source. One of the ways to do this is by comparing selected facial features like relative position, size and shape of the eyes, nose, cheekbones and jaw from the image and a facial database.

III. REVIEW OF IMAGE PROCESSING APPLICATIONS AND TECHNIQUES

This section is a literature survey of recent proposals in Image Processing applications along with month and year of publication. History of Image Processing applications gives large volume of proposals. But, objective of this paper is to consider only recent proposals and development raising from each application category.

- **ITS**: A new model of network based on Cell Transmission Model (CTM) was proposed by Ai Xiaolin[13] to address current urban traffic congestion in Jul 2014. Mittal P[14] presented image mosaicking technique for controlling of traffic signals which is evaluated using Matlab in May 2014.


- **MVT**: SIFT based mean shift algorithm was proposed by Liang Wei[16] which can be used for continuous vehicle tracking in complex situations in Jun 2014.

- **SIP**: High level architectural specification of MedioGRID for real time satellite image processing system was presented by Muresan O[17] in Jun 2006

- **ERS**: A study on TropiScat campaign in French Guiana to support Biomass project with Synthetic Aperture Radar (SAR) was illustrated by Hamadi A[18] in Sep 2014.


- **FCIS**: An illumination model on steel surface was developed by Yuan jiong[20] with consideration of conditions of circumstance, radiation and reflection in Aug 2010.

- **SMTS**: Barton D K[21] discussed an instrumentation radar development along with advantages and disadvantages of radar as compared to other instruments in May 2009.

- **CI**: Resende[22] proposed a model process of tumor segmentation as multi criteria decision making considering information embedded in both Position Emission Tomography and Computed Tomography in May 2014.

- **NI**: HPC infrastructure for the management and the processing of neuro-anatomical images was presented by Bria A[23] to optimize and integrate specific applications in Jul 2014.


- **IR**: A nonlinear approach to simultaneously account for both local consistency of iris bit and also the overall quality of the weight map was proposed by Chun Wei[26] in Jul 2014.

- **FR**: Zhen Hua[27] presented a random cascaded-regression copse (R-CR-C) for robust facial landmark detection in Aug 2014.

Now consider the summary of all applications along with suggestive image processing techniques which are listed in Table 3. Observe the last column of this table which indicates month and year of latest publications in the respective application. It also highlights the application in each area by considering recent publications indicated with an asterisk(*).
Table 3: Summary of Image Processing Applications Versus Techniques

<table>
<thead>
<tr>
<th>Area</th>
<th>Application</th>
<th>Techniques used</th>
<th>Month and year of Latest publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traffic Control</td>
<td>Intelligent Traffic Signaling (ITS)</td>
<td>√</td>
<td>Jul 2014*</td>
</tr>
<tr>
<td></td>
<td>Automatic Number Plate Recognition (ANPR)</td>
<td>√</td>
<td>Apr 2009</td>
</tr>
<tr>
<td></td>
<td>Moving Vehicle Tracking (MVT)</td>
<td>√</td>
<td>Jun 2014</td>
</tr>
<tr>
<td>Space</td>
<td>Satellite Image Processing (SIP)</td>
<td>√</td>
<td>Jul 2006</td>
</tr>
<tr>
<td></td>
<td>Earth Remote Sensing(ERS)</td>
<td>√</td>
<td>Sep 2014*</td>
</tr>
<tr>
<td>Industrial</td>
<td>Automatic Surface Inspection System (ASIS)</td>
<td>√</td>
<td>Jan 2008</td>
</tr>
<tr>
<td></td>
<td>Faulty Component Identification System (FCIS)</td>
<td>√</td>
<td>Aug 2010*</td>
</tr>
<tr>
<td>Defense</td>
<td>Space and Missile Tracking System (SMTS)</td>
<td>√</td>
<td>May 2009*</td>
</tr>
<tr>
<td>Medical</td>
<td>Cancer Imaging (CI)</td>
<td>√</td>
<td>May 2014</td>
</tr>
<tr>
<td></td>
<td>Neuro Imaging (NI)</td>
<td>√</td>
<td>Jul 2014*</td>
</tr>
<tr>
<td></td>
<td>Heart Disease Identification (HDI)</td>
<td>√</td>
<td>Nov 2013</td>
</tr>
<tr>
<td>Security</td>
<td>Finger Print Recognition (FPR)</td>
<td>√</td>
<td>Jun 2012</td>
</tr>
<tr>
<td></td>
<td>Iris Recognition(IR)</td>
<td>√</td>
<td>Jul 2014</td>
</tr>
<tr>
<td></td>
<td>Face Recognition(FR)</td>
<td>√</td>
<td>Aug 2014*</td>
</tr>
</tbody>
</table>

This table considered only Image Analysis and Understanding techniques, because most of the research articles addressing these techniques only. A tick mark(√) is indicated against all applicable techniques for each application based on their nature of application and proposals of research. Finally this section concludes two important points in view of the Analytical survey.

- **Point 1**: With the observation of Table 3, it is clear that out of six techniques considered only three techniques including Edge Detection, Segmentation and Pattern Recognition are most useful. Pattern Recognition can be ignored for the analysis, since it is an extension of other techniques.
- **Point 2**: Last column of Table 3, strongly supports that research is on going for ITS from Traffic Control, ERS from Space, NI from Medical and FR from Security. Industrial and Defense applications can be ignored for the analysis because no recent publications found to address these areas.

IV. ANALYTICAL SURVEY OF COLOR TO GREYSCALE CONVERSION METHODS

Greyscale image is an image in which the value of each pixel is a single sample that carries only intensity information. Simply removing color information from the image is called Colour to Greyscale(C2G) conversion. Even though color information of image is lost, characteristics of image is preserved in grey image. Even though RGB color model is used to display color images on the monitors, it is not useful for Image processing. This is because of two reasons, one is RGB is a three value system and greyscale representation is single value system. Image Processing operations are easy for single value images than three value system. Another reason is number of bits required to represent RGB i.e. 24 bits is more than Greyscale which is 8 bits only. Complexity of processing Greyscale image is reduced, which improves computational speed of Image processing algorithms. These conclusions forced the researchers to use Greyscale images for Image processing instead of Colour images.

Table 4: information of colour to greyscale conversion methods

<table>
<thead>
<tr>
<th>S. No.</th>
<th>C2G Method</th>
<th>Code</th>
<th>Grey Value(GV) from RGB</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minimum of RGB</td>
<td>MIN</td>
<td>( GV = \min(R, G, B) )</td>
<td>Decreases intensity of pixels</td>
</tr>
<tr>
<td>2</td>
<td>Maximum of RGB</td>
<td>MAX</td>
<td>( GV = \max(R, G, B) )</td>
<td>Increases intensity of pixels</td>
</tr>
<tr>
<td>3</td>
<td>Average of RGB</td>
<td>AVG1</td>
<td>( GV = \frac{R + G + B}{3} )</td>
<td>Histogram equalization</td>
</tr>
<tr>
<td>4</td>
<td>Lightness/Desaturation</td>
<td>AVG2</td>
<td>( GV = \frac{\max(R,G,B) + \min(R,G,B)}{2} )</td>
<td>Average of most and least prominent colors</td>
</tr>
<tr>
<td>5</td>
<td>Luminosity</td>
<td>AVG3</td>
<td>( GV = 0.21<em>R + 0.71</em>G + 0.07*B )</td>
<td>Weighted average of human perception</td>
</tr>
<tr>
<td>6</td>
<td>GIMP grey scale</td>
<td>AVG4</td>
<td>( GV = 0.3<em>R + 0.59</em>G + 0.11*B )</td>
<td>Another weighted average of RGB</td>
</tr>
<tr>
<td>7</td>
<td>Only R</td>
<td>R</td>
<td>( GV = R )</td>
<td>Red shaded regions are intensified</td>
</tr>
<tr>
<td>8</td>
<td>Only G</td>
<td>G</td>
<td>( GV = G )</td>
<td>Green shaded regions are intensified</td>
</tr>
<tr>
<td>9</td>
<td>Only B</td>
<td>B</td>
<td>( GV = B )</td>
<td>Blue shaded regions are intensified</td>
</tr>
</tbody>
</table>

History of Colour to Greyscale(C2G) conversion lists several methods and All of them are simple arithmetic computations with following three steps.

© 2014, IJARCSSE All Rights Reserved
Step 1: Reading R, G, B values of each pixel  
Step 2: 8 bit Grey value Calculation  
Step 3: Result the pixel as 8 Bit grey value

Step 1 and 3 are common in all these conversion algorithms. Step 2 is calculation step which can be implemented in different ways depending on method. Essential computation step of each methods along with possible results after conversion are listed in Table 4. Objective of this paper is to showcase analytical exploration of these conversion methods which is completely based on two important points discussed in previous section. This analytical survey is conducted with comparison of visual results of Edge Detection and Segmentation techniques. This survey is extend to Color perception in addition these two techniques. Details of each perspective are illustrated below along with results.

A. Analytical survey in view of Color perception

First and primary aspect of image comes from the representation of pixel is Color. Simple common sense theory is sufficient to analyze expect results of the various Colour to Greyscale(C2G) conversion methods. We considered the behavior of eight fundamental colors including Black, White, Red, Green, Blue, Cyan, Magenta and Yellow and the results are tabulated in Table 5. This table shows the greyscale value for the selected colours along with colour name labels. It also focuses that exact colours are labeled directly and approximate colours are indicated with asterisk(*). Different colour name labels are assumed based on the Greyscale Value(GV) as follows: Black(GV=0), White(GV=255), Black*(GV=1 to 85), Grey(GV=86 to 170), White*(GV=171 to 255). It is useful to choose appropriate C2G conversion methods based on the most dominating colour in the image and application from the above table.

This table is helpful for the researchers while designing custom C2G algorithm to improve the results by considering dominating colour of the input image. If the object in the input image is apple whose dominating colour is RED then MAX and R are useful to produces object region with WHITE colour. So, researcher need to write algorithm to detect WHITE colour for finding region of apple. In the same way researcher can choose appropriate C2G method based on dominating colour of region of interest to experience the legible difference in their results. From Table 5, If the dominating input colour is either BLACK or WHITE produces same colour respectively. If the dominating input colour is primary colour then preferable methods are as follows: MAX and R for RED, MAX and G for GREEN, MAX and B for BLUE. In the same way, If the dominating input colour is secondary colour then preferable methods are as follows: MAX, G and B for CYAN, MAX, R and B for MAGENTA, MAX, R and B for YELLOW.

<table>
<thead>
<tr>
<th>COLOR</th>
<th>C2G CONVERSION METHODS</th>
</tr>
</thead>
<tbody>
<tr>
<td>BLACK (0,0,0)</td>
<td>MIN</td>
</tr>
<tr>
<td>BLACK</td>
<td>GV=0</td>
</tr>
<tr>
<td>WHITE (255,255,255)</td>
<td>GV=255</td>
</tr>
<tr>
<td>RED (255,0,0)</td>
<td>GV=0</td>
</tr>
<tr>
<td>GREEN (0,255,0)</td>
<td>GV=0</td>
</tr>
<tr>
<td>BLUE (0,255,255)</td>
<td>GV=0</td>
</tr>
<tr>
<td>MAGENTA (255,0,255)</td>
<td>GV=0</td>
</tr>
<tr>
<td>YELLOW (255,255,0)</td>
<td>GV=0</td>
</tr>
</tbody>
</table>

B. Analytical survey in view of Edge detection

One of the most widely used image processing technique is Edge detection which is used to find the edges of the objects over the images. Quality of the edge can be considered by the connectivity and smoothness of the edge. Only three images original colour image of Cloud, Face and Balls as shown in Fig 1 are considered for the examination of edge detection behavior.

Fig. 1 Original colour images of (a) cloud (b) face (c) balls
We used very fundamental Edge detection method to produce analytical survey results by comparing successive pixel greyscale values and results are presented in Fig. 2-4 respectively. Most of the edges are similar in all the methods, but minute distinctions need to be identified to compare results of these methods. We focused only those portions of the images. In case of cloud image, edge connectivity of the lower portion is visible by MIN and R methods only and almost not visible in other methods can be seen in Fig. 2. In face image, Lower jaw of the face image is visible only in MAX and R methods can be seen in Fig. 3. Similarly, in Balls image edges of billiards board is more strong in MAX and G methods can be seen in Fig. 4.

Fig. 2 Edge detection results for cloud using (a) MAX (b) MIN (c) AVG1 (d) AVG2 (e) AVG3 (f) AVG4 (g) R (h) G (i) B

Fig. 3 Edge detection results for face using (a) MAX (b) MIN (c) AVG1 (d) AVG2 (e) AVG3 (f) AVG4 (g) R (h) G (i) B

Fig. 4 Edge detection results for Balls using (a) MAX (b) MIN (c) AVG1 (d) AVG2 (e) AVG3 (f) AVG4 (g) R (h) G (i) B
C. Analytical survey in view of Segmentation

Segmentation is the primary most essential image processing technique which is used to identify region of interest that involves measuring of object region. We considered only three images Brain, Numplate and Earth as shown in Fig. 5. Simple segmentation method is considered to produce analytical survey results are published in Fig. 6. Variations in case of segmentation with different methods can be observed from Fig. 6-8. In general, segmentation mainly focuses on area of interest which we have focused. More accurate region of damaged portion of brain will be obtained by AVG1, AVG2 and B methods which can be seen in Fig. 6. Even though remaining methods produces this region they are not considerable because they includes some other unwanted regions of the brain. In case of Numplate image, stars are almost disappeared in first four methods and clearly visible in remaining methods can be seen in Fig. 7. One more distinction we can find is blue region is completely vanished in B method. Similarly, border of the earth region and blue area of the earth is clearly visible in MAX and B method which can be seen in Fig. 8.

Fig. 5 Original colour images of (a) brain (b) numplate (c) earth

Fig. 4 Edge detection results for balls using (a) MAX (b) MIN (c) AVG1 (d) AVG2 (e) AVG3 (f) AVG4 (g) R (h) G (i) B
V. CONCLUSIONS

Use of Colour to Greyscale conversion methods in distinguishable applications is growing day to day due to complexity of colour image processing. Common method of C2G conversion with averaging is not suitable for all applications. On this perspective we experimented in different way by considering Edge detection, Segmentation and Colour perception point of views to produce useful results by analytical survey. For this, we considered nine C2G conversion methods for the analysis and generated reports in three essential views of image processing including Color Perception, Edge Detection and Segmentation. These reports will become the primary handouts for the researchers while choosing C2G conversion method and design of their algorithms. With this researchers are free to select most profitable C2G conversion methods suitable to their application domain.

REFERENCES


© 2014, IJARCSSE All Rights Reserved


