Pseudo-colour image processing

Meghana Ravishankar

mr0060@uah.edu

Abstract- A false- colour image is an image that depicts an object in colours that differ from those a photograph (a true-colour image) would show. A pseudo-colour is derived from a greyscale image by mapping each intensity value to a colour according to a table or function. Pseudo colour is typically used when a single channel of data is available (e.g. temperature, elevation, soil composition, tissue type, and so on), in contrast to false colour which is commonly used to display three channels of data. In this project I have written a MATLAB code to convert images obtained from google to show example for both false and pseudo colour.

Keywords: false colour, pseudo colour, true colour

I. Background

Long ago, when radio astronomers first started generating images of sources, they wound up with essentially images that were just shades of grey - ranging from pure black to pure white. Each shade represented the intensity of the radio emission from a part of the object. Radio astronomers took their shades-of-grey images and converted them to colour ones by assigning red to the most intense radio emission and blue to the least intense emission recorded on the image. Intermediate colours (orange, yellow, and green) were assigned to the intermediate levels of radio intensity. Black was assigned to places in the image in which there appeared to be no radio emission [1]. Most of the radar and telescope images are greyscale image including images from mars rover and Hubble telescope.

The first type of colour is true or natural colour. This is the type of colour you get with your typical home camera and is what you would see if you were to observe the target first hand with your own two eyes. In a false colour image, the colours that are shown are not what you would see if you were to look at the object with your own two eyes. A perfect example of false colour is when one or more of the filters being used to take the picture are of wavelengths that are outside the visible portion of the electromagnetic spectrum. The most well-known example of this type of image are those that are taken by the Hubble Space Telescope.

Processing Hubble images from archived data takes skill, care, and technical know-how. Processors must be familiar with combining multiple images, reducing noise, applying colour, and adjusting brightness and contrast, among other critical steps. They must have a working knowledge of image processing software and a basic understanding of Hubble instruments and data in order to pick out useful datasets, and to appropriately scale intensities and assign colours to images. Finally, they must be able to consider the multiple challenges of creating a visually accurate image, an informative image, and a beautiful image. [2]

The final type of colour is known as pseudo colour. Pseudo colour begins with a single band of data or data from one single filter. This means that for a single pixel, there are 256 possible values. The next step is to take each of these values and map them to a specific colour thus creating a colour image.

II. Objectives

First objective was to implement a RGB image that will output an RGB image whose pixels for specified grey intensity has different colour (in this case red) and rest of the image is same as original. This objective is an example for false colour image processing. Second objective was to consider a grey scale image, process it with the written program so that a part of it appears yellow and the rest of the pixels are the same shades of grey as in the input image. This is an example for pseudo-colour image processing.

III. Work description

The basic technique for pseudo-colouring is performed by directly applying a single colour hue to replace a particular grayscale. Example, the colour range from $C_{0\text{-}255}$ can be used to code the grayscale range $I_{0\text{-}255}$. In another approach defining a function P[ ], which maps the original grayscale data I(x,y) to the primary colour values R(x,y), G(x, y), and B(x, y). This process can be represented as follows:

$$R(x, y) = P_R\,[I(x, y)]$$
$$G(x, y) = P_G\,[I(x, y)]$$
$$B(x, y) = P_B\,[I(x, y)]$$

Where, the transforms P_R [], P_G[] and P_B[] could be either linear or nonlinear functions, based on the desired output image. The complete colour-coding process can be described as follows:

$$I(x, y) \Rightarrow \begin{Bmatrix} P_R\,[\,] \\ P_G\,[\,] \\ P_B\,[\,] \end{Bmatrix} \Rightarrow \begin{Bmatrix} R(x, y) \\ G(x, y) \\ B(x, y) \end{Bmatrix} \Rightarrow C(x, y)$$

Where I(x,y) is the gray value of pixel, P_R [], P_G[] and P_B[] is the colour transform or mapping function to generate value for R,G, and B channel to yield colour image C(x,y).

Pseudo-colour image processing consists of assigning colours to gray values based on a specified criterion. The term―pseudo-colour emphasizes that the colours were assigned artificially opposing to the true (real) colours.

Grey images have same RGB values, thus to change colours we have to convert grey image to a RGB matrix.

The first objective was to assign a false colour to a true coloured image; this was done using following algorithm in MATLAB

Algorithm

- Convert true colour image to grey scale using rgb2gray function.
- Create a binary mask, for my project I assigned any grey pixel value with more that 180 as 255(white) rest as black.
- Reconstruction of image using the mask

The second objective was to assign pseudo colour to a greyscale image; this was done using MATLAB too using the following algorithm; Algorithm

- Convert m×n grey image to m×n×3 image by using ‘cat’ function in MATLAB
- Change value of red and green channel to form colour yellow for grey pixels with intensity less than 20.

Recombine the image to show changes made in original image.

IV. Results

Result of objective 1, pixels with value greater than 180 has turned red are shown from figure 1. Where 1st image is the original RGB image, 2nd is the converted grey image, 3rd is the binary mask obtained and 4th image is the final output image.

Result of objective 2, the river has been shown in yellow from figure 2. Where 1^{st} and 2^{nd} image are original grey image and converted grey image respectively, 3^{rd} is final image.

V. Conclusions

The principal use of pseudo-colours is for human visualization and interpretation of gray scale details on an image or their sequence. The main objective of pseudo-colouring is to obtain a color representation of the data that can be easily recognized by a human with normal sight. A variety of mapping schemes can be used to achieve this task, and extensive interactive trial shave to be performed to determine an optimum mapping for displaying a given set of data. In this paper only one level of grey intensity was changed to show results. This method can be used to change the whole grey image to colour by assigning them different colours.

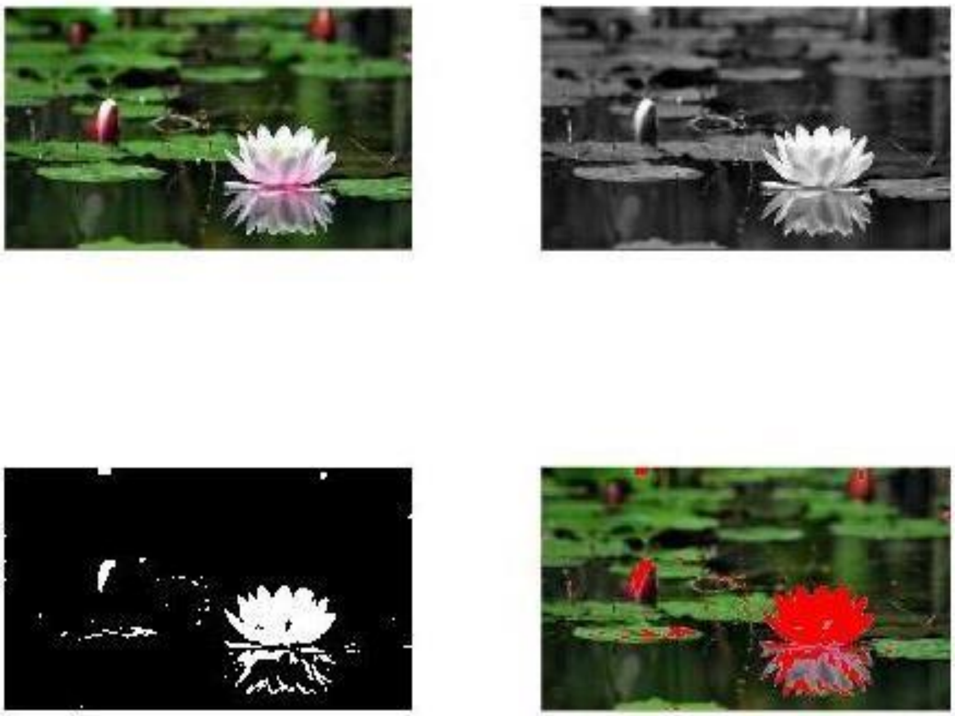

Fig.1

Fig.2

VI. References

[1]https://starchild.gsfc.nasa.gov/docs/StarChild/questions/question20.html

[2]http://hubblesite.org/get_involved/hubble_image_processors/

[3]http://www.imageprocessingplace.com/DIP3E/dip3e

_student_projects.htm#06-02

[4] digital image processing 3rd edition, Rafael C. Gonzalez and Richard E. Woods

[5] https://www.mathworks.com