USE OF DIGITAL IMAGE DIFFERENCING IN STUDY OF MORPHOLOGICAL PROPERTIES OF CORONAL MASS EJECTIONS

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ABSTRACT

This paper describes the basic technological aspects of Digital Image Differencing technique in study of morphological properties with special reference to Coronal Mass Ejections. The former step deals with two images taken from SOHO satellite. The images are taken with a time interval. Then these two images are processed to get pure CME by using Digital Image Differencing. The enhancement procedures are applied to image data in order to effectively display. It involves techniques for increasing the visual distinction between features in a scene. The objective of the information extraction operations is to study Morphological properties of CMEs.

Keywords: SOHO, CME, Image Difference, Morphology

I INTRODUCTION

"Coronal mass ejections (CMEs) are large scale magneto plasma structure that erupts from the Sun and propagate through the interplanetary medium". Coronal mass ejections (CMEs) were first detected by the Orbiting Solar Observatory (OSO-7) on 14th Dec. 1971 [1]. CMEs are eruptions of plasma from the Sun it travels with speed ranges from 10 km/s to more than 3300 km/s and it carries a mass of 10^{15} gm of coronal material [2]. CMEs observed in white light are highly structured and are three-dimensional in nature. Many CMEs, especially the ones originating from filament regions show a three-part structure: a bright frontal structure, a dark void, and a bright core [3]. CMEs originate from active regions, filament regions or from complexes containing filaments and active regions. However, different ARs may have different capability of generating CMEs, and CMEs may not be necessary to take place in ARs [4]. N. Gopalswamy investigates the morphological properties of CMEs [5].

Pictures are the most common and convenient means of conveying or transmitting information. A picture is worth a thousand words [6]. Computer images have been "digitized", a process which converts the real world color picture to instead be numeric computer data consisting of rows and columns (2D Matrix, Figure 1) of millions of color samples measured from the original image [7]. Computer images are generated from tiny numeric color components known as Pixels. In computer graphics, pictures or graphics objects are presented as a collection of discrete picture element called pixels. The piexel also known as pel (shortest form of pixel element) is the smallest addressable screen element [8]. Its intensity and colour is controlled to compose the picture. Each pixel on the graphics does not represent mathematical point. Rather it represents a region which theoretically can contain an infinite number of points [9]. A digital color image pixel is just numbers representing a RGB data value (Red, Green, and Blue). Each pixel's color sample has three numerical RGB components (Red, Green, and Blue) to represent the color of that tiny pixel area. These three RGB components are three 8-bit numbers for each pixel. Three 8-bit bytes (one byte for each of RGB) are called 24 bit color. Each 8 bit RGB component can have 256 possible values, ranging from 0 to 255. For example, three values like (250, 165, 0), meaning (Red=250, Green=165, Blue=0) to denote one Orange pixel [7]. With these three color values Pixels also has one another value known as 'alpha' which specifies opacity of the pixel.
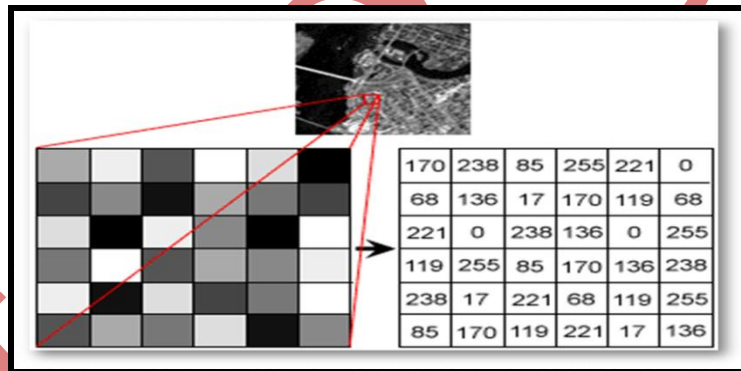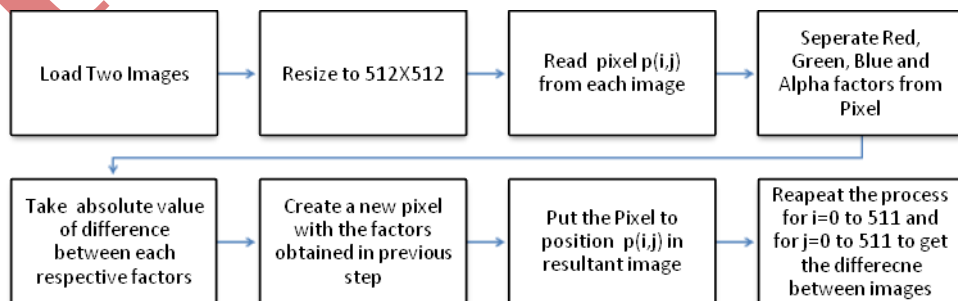

Figure1: Different colors of spot and code numbers [7].

II PROCESS

In our context of study we need to extract an image from two images, and which could be the difference between these two images. To extract the image we could use these values of pixels. To get the difference between two images we can use the following simple algorithm (Algorithm complexity O (n^2)) and flowchart.

1. Start
2. If next pixel is not present go to step 7 else Read next pixel from each images, say a,b
3. Extract each color value and opacity value from each pixel as r1,g1,b1,a1 and r2,g2,b2,a2 for (Red, Green, Blue & Alpha) Respectively
4. Subtract each color value and Opacity value rs=|r1-r2|, gs=|g1-g2|, bs=|b1-b2| and as=|a1-a2|
5. Generate new pixel from the calculated values Pixel C (as, rs, gs, bs) and store in a matrix
6. Go to step 2
7. Generate an image from the new matrix C
8. Stop
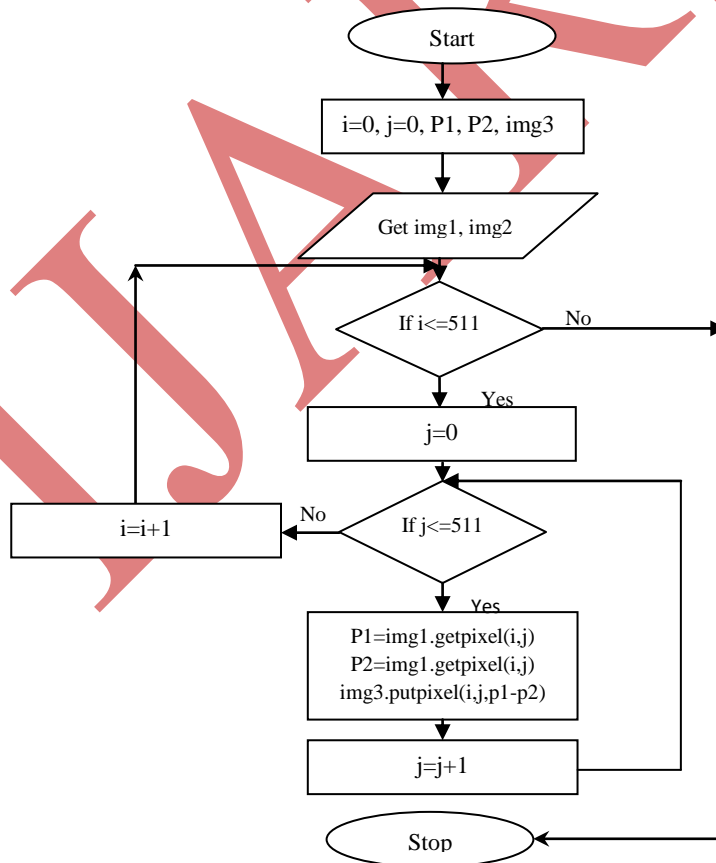
By following the above algorithm we can get a new image showing difference between two images in color form (Figure 2).
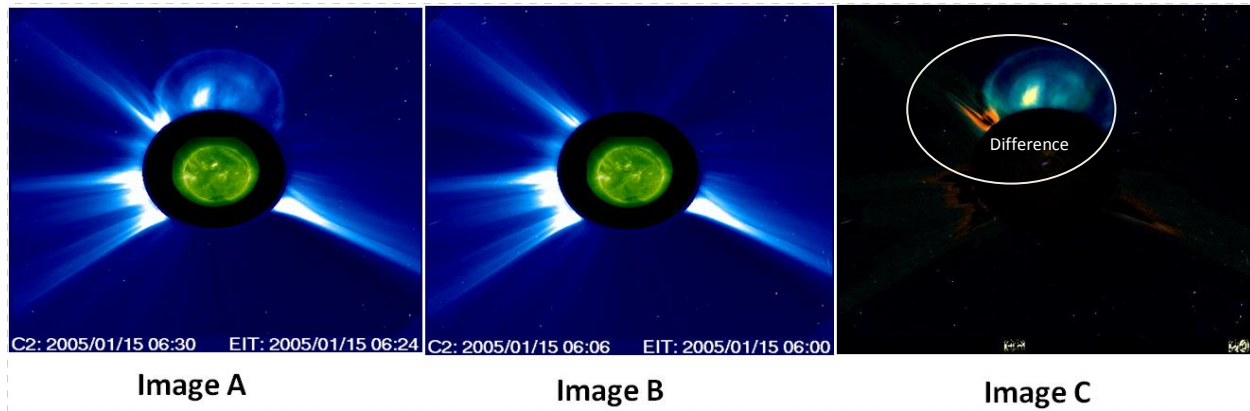

Figure 2: The image (A) represents the CMEs with streamer image (B) represents the streamer only, image (C) represents the difference image gives only CMEs [10].

To make the difference more color we can apply more filtering steps to the image such as converting the image to grayscale image by taking average of each Red, Green, Blue and Opacity value. Conversion to grayscale is another common conversion. Grayscale values are determined by calculating the luminosity of a color, which is a weighted average of the R, G and B color components. The average is weighted according to the sensitivity of the human eye to each color component. The weights used here are as given by the NTSC (North America Television Standards Committee) and are widely accepted [11]. To convert the produced image shows the difference between two images in colour to convert the coloured images to gray scale we used the 'colormatrix' class of .NET framework's graphic library [11, 12].
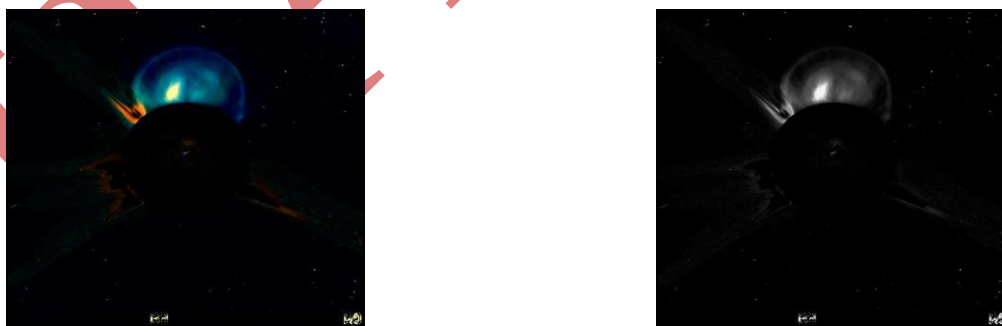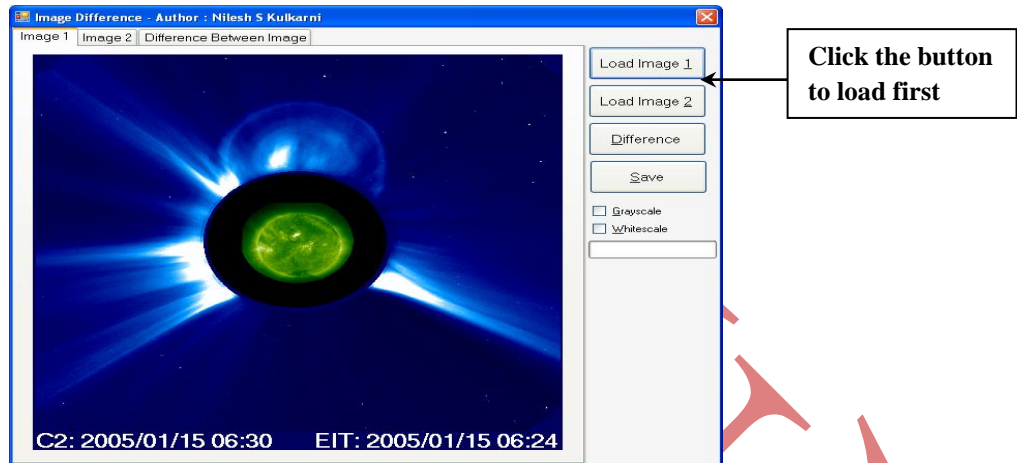

Figure 2:   The difference images in color and gray form after converting.

III PROGRAM USER MANUAL

1. Click on the 'Load Image 1' button which will display an Open File Dialog, browse the image to load; only .JPG and .PNG format is supported. An 'open file dialog' class of .net framework provides a special window to select and open files known as open file dialog [13].

2. Click the 'Load Image 2' button to load the second image. Images are resized to 512X512 automatically.
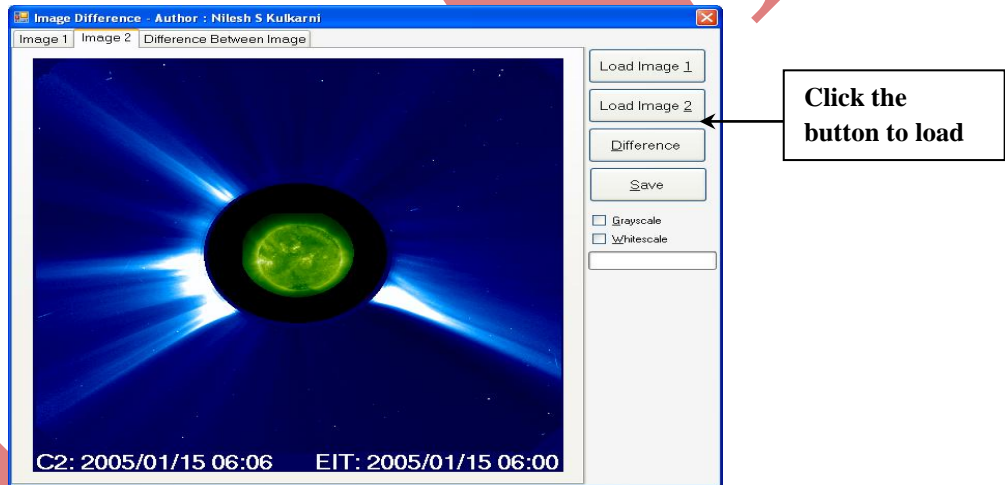
3. Click the Difference button to load the difference image. Images are resized to 512X512 automatically.
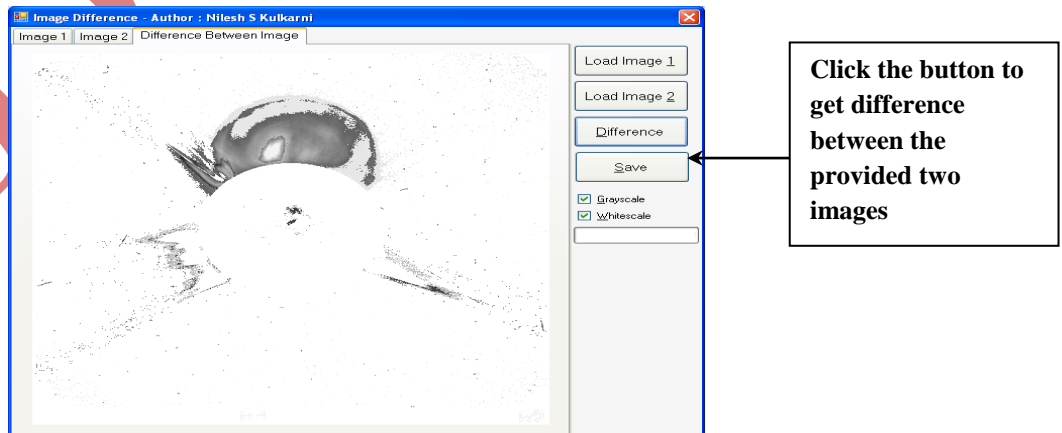
We have used many activex controls in our software module. An activex control is a piece of software which can be embedded in any software [14].To show the picture 'picture box' is used which is an activex control and is used to display an existing image or to draw image using graphic library of VB.NET [15]. The PictureBox control exposes the SizeMode property, which determines how the image will be sized and aligned on the control. Its default setting is Normal, and in this mode the control displays the image at its normal magnification. If the image is larger than the control, part of the image will be invisible. The Size Mode property can also be set to StretchImage and AutoSize. The StretchImage setting resizes the image so that it fills the control. If the control's aspect ratio isn't the same as the aspect ratio of the image, the image will be distorted in the process. If you want to use the StretchImage setting, you must also resize one of the dimensions of the control, so that the image will be properly resized [16]. We have set the SizeMode property to StrechImage and set the PictureBox Height to 512 Pixels and Width to 512 Pixels.

IV CONCLUSION

The image processing software those are available in the market doesn't fit to our requirement of image differencing in the morphological study of coronal mass ejections. The software module specified above provides the more precise morphological difference between two images that are taken successively which is beneficial to identify the ejections.

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