

Slow Time Variant Image Visualization

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Abstract: When changes occur in complex images that involve minute details, it is usually a daunting task to track the changes that may have occurred between two time periods. We will be presenting a method for identifying these changes through digitizing; anchoring, reorienting and subtracting, successive images, and compiling an animated sequence of image difference that will include only the changes. This method will save time, and effort and will more importantly provide an accurate depiction of changes. This can also be applied to satellite images of cities, forests, and mountain ranges. Also, it can be applied to track down the material fatigue images that are hard to identify by the naked eye.

Key-Words: image visualization, data mining, data manipulation, data streams, rule mining, spatial temporal data mining.

1 Introduction

The flow of satellite images, for example, created a need for accurate and fast methods to read them and identify the changes that may occur [1]. This will be helpful to forecast natural changes and predict future behavior, like motion pathways [2]. One can easily say that mount St. Helena, which exploded on May 18, 1980, could have been monitored more accurately, if satellite images were able to process and track down the rising top more accurately. Processing video images is becoming an important tool in extracting details, more information or even monitoring moving objects [3]. Extracting spatial, temporal relationships of vehicles from traffic video sequences and recognizing a pattern by relying on a few discriminating features that were derived from spatiotemporal intensity of color variation [4]. In other cases [5], the power of human recognition is employed or taken advantage of in recognizing complex patterns or discover complex relationships in a tabular data taken from relational databases by converting each of them into what is called "table graph," and assembling them to form multiple design visual images. Minimizing the weight differences of color pixels, thus allowing adjacent tables with near values to look similar renders these images but color contrast will be created if there appear to be a change. This will provide, what is called hidden features. The technique is applied to

productions data to discover, for example idle machine time. In this paper we complement this work by doing the reverse. It is possible that the human inspection may miss minute changes on images. The idea is to select and extract images after subtracting complex background images attributed to environmental effect that does not contribute to the enrichment of the object, like weather effects. However, the assumption was based on following fixed routes, like streets, thus be able to subtract successive images to track down the changes. This technique is invaluable when dealing with highly camouflaged images that cannot be traced by the naked eye. In other words, digitizing two successive images of the same environment and applying the subtraction will reveal the minute changes that have had occurred.

One of the main challenges in this technique is the fact the images are usually taken from high altitude or distance, thus it get affected by environmental noise, and also when dealing with slow moving (sloth moving) objects, images are takes at extended time periods, thus allowing more noise or changes in the environment to occur. This will result in creating some technical difficulty in aligning the images, the same was as superimposing them on a lighted frame. In addition, when images are taken from a moving object, like satellites or airplanes, the image frames coordinates may change

orientation, especially when the camera is not locked on the object, thus providing kinematics' self-adjusting mechanism, therefore, it may require re-orienting them before digitizing. To overcome this difficulty, an anchoring technique is developed to identify, land mark coordinates, and saving it for alignment. Kikochi and Konishi [devised an indexing algorithm for image sequences [6]. In today's technology, the use of the GPS is useful in allowing the images to be taken again of the same position as before, thus avoiding the problem of fuzziness. However, another parameter needs to be added, to eliminate additional environmental effects, like light shadows, and the sun angle. This is better and more effective than applying algorithms, to "clean" or post process the images [3]. Therefore, a correction is needed to the GPS coordinates to eliminate these effects. This is sometimes important, especially when we are dealing with slow changing images, like forests.

2 Problem Formulation

Let assume that $P_1(i, j)$ is a pixel in the first image, where i, j are the coordinates of the pixel and R_1, G_1, B_1 are the colors of the pixel in the first image (Red, Green and Blue). Then $P_1(i, j) \equiv R_1, G_1, B_1$. (1)

Also let assume that $P_2(i, j)$ is a pixel in the second image where i, j are the same coordinates of a pixel in the first image, and R_2, G_2, B_2 are the colors of the pixel in the second image (Red, Green and Blue).

Then $P_2(i, j) \equiv R_2, G_2, B_2$. (2)

Now to apply the image subtraction technique we may use the following equation:

$$\begin{aligned} S(i, j) &\equiv P_1(i, j) - P_2(i, j) \\ &\equiv R_1 - R_2, G_1 - G_2, B_1 - B_2 \\ &\equiv S_1, S_2, S_3 \end{aligned} \quad (3)$$

where S_1 is the difference between the i, j pixel of the first image and the i, j pixel of the second image. Since the RGB format of any pixel would not be more than 255 for each color, then we have to eliminate the negative numbers, as follows:

if S_1 or S_2 or $S_3 < 0$ then

$$S_1 = |S_1|, S_2 = |S_2|, S_3 = |S_3|$$

If the subtraction is between two identical images then the resulting color will be black, as the differences will always be zero. The following diagram shows the subtraction technique:

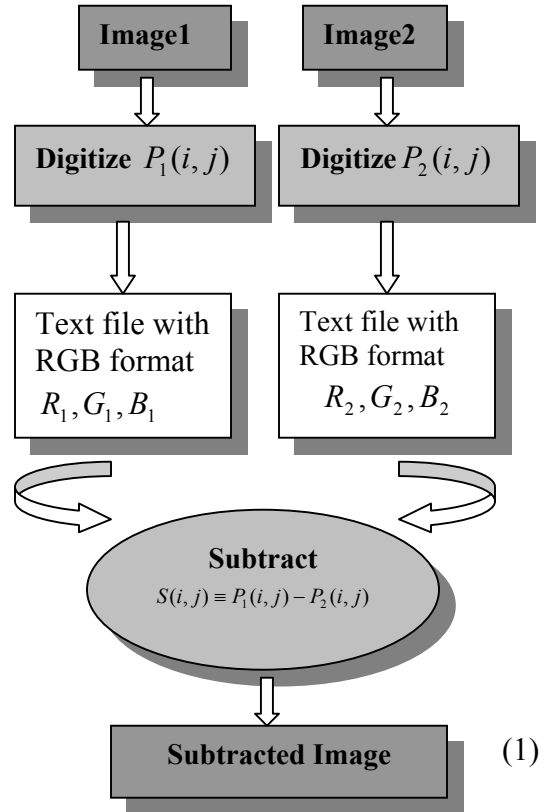


Fig. 1 The subtraction technique

3 Problem Solution

The objective of data mining is to extract valuable information from data, to discover the "nuggets of gold." [7]

The object of the proposed method of image subtraction is to find some information that could not be discovered by eyeballing the image. In order to manipulate the images in data form we have processed the images to data. The technique used is to transfer every pixel into its RGB format. The difference between the images will produce black color only if there are no changes in the position of the image.

We have taken a sample case of the bacteria growth of Coli bacteria [8]. The following sample represents the growth of bacteria in the normal image viewing:



Fig. 2 first shot of Coli Bacteria growth

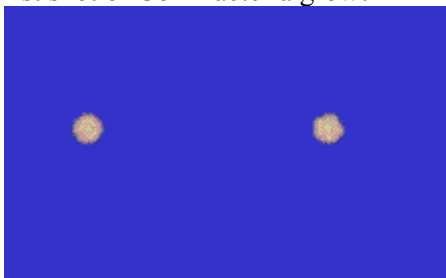


Fig. 3 second shot of Coli Bacteria growth

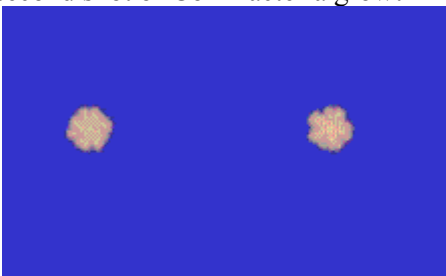


Fig. 4 third shot of Coli Bacteria growth

It is clearly shown from the above images that the center of movements of the bacteria is not indicated.

In applying the image subtraction we may find some information more clearly than the previous ones. The following figure is the result of the image subtraction of the above first two cases:

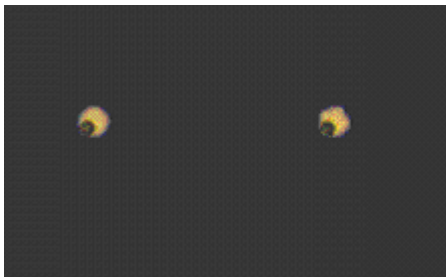


Fig. 5 image subtraction of Fig.2 and Fig.3

The lack circular regions indicate that there was no growth.

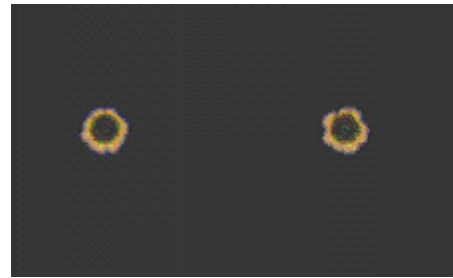


Fig. 6 image subtraction of Fig.3 and Fig.4

The above figure is the subtraction of the second and third images. Notice that the growth is uniform around the center. By more careful examination, it is clear that the growth occurred in Fig. 5 shows a growth only toward the northeast region; however, Fig. 6 shows a uniform growth around the center. This information could not have been detected by inspecting the original images, Figs.2-4.

We can find out the changes in the images taken from the satellite of a forest area that are usually difficult to recognize by the naked eye.

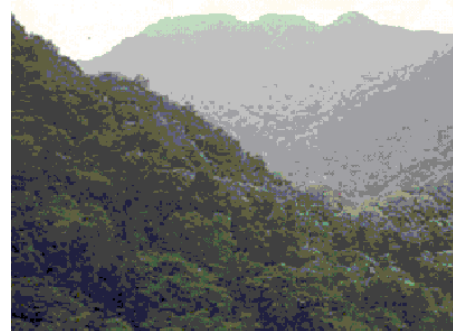


Fig. 7 Forest image

Fig. 8 The same image after making a synthetic change.

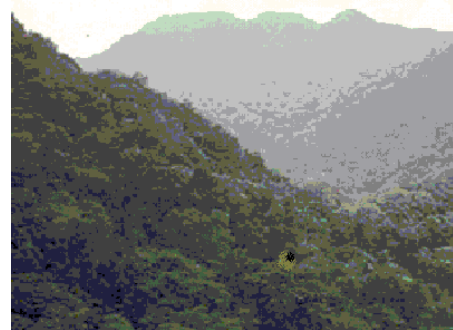


Fig. 8 Image after a change

After subtracting the first image from the second, we can easily recognize the change.

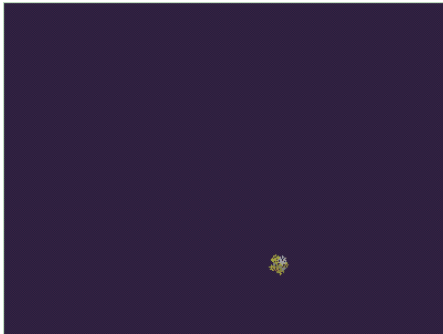


Fig. 9 the differences between images

The whole process would go through three stages. The first is when the two images are digitized. The second is when the resulting data files are processed to find the difference, and the last stage when the resulting digital data file is reversed to examine the resulting image. A program is written with VB.NET to implement the above procedure. The subtracting stage screen is shown below:



Fig.10 Image subtraction using VB.NET

3 Conclusion

In situation where the human eye fails to determine changes in images, especially when these changes are subtle. You may find this in heavily detailed images, like forests, of metropolitan areas; the subtraction technique will be a good method to adopt. The ability of the computer to process large amount of data is used here to mathematically compute the changes in images after digitizing them. This research is directed toward the situations where changes on the images are slow and hard to detect, either due to intricacy or the extreme detail or slow pace of changes.

The pixel color code subtraction offers a unique way to identify structural changes in images. However, unique problems may occur. It is likely

that a color code may be a result of large number of combinations of color codes. For example the probability that two adjacent pixels carry the same color, while they were a result of two distinct combinations, namely a result of subtraction or addition processes, like blue, is close to nil.¹ When the change in color attributes of the two images is not too significant, the resulting difference footprints become faint. To overcome this, a suitable multiplier to intensify the image of the difference is used.

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¹ Such probability is close to 9.2×10^{-13}