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DATA FUSION TECHNIQUE TO IMPROVE IMAGE QUALITY OF LOW-RESOLUTION OPTICAL DEVICES

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Abstract

Data fusion is a process that seeks to improve the ability to estimate the position, velocity and characteristics of entities by combining information from multiple sensors and sources. The study aims at evaluation of data fusion technique using frequency distribution analysis. Considering images as input data, data fusion is carried out by using commercial available software. It is shown that the quality of image after fusion is substantially improved. By image processing and analyzing the results, it is tried to affirm that synergy is obtained using data fusion technique.

Keywords: Data fusion, image processing, frequency distribution analysis

I. INTRODUCTION

In recent years, the discipline of multi-sensor data fusion has rapidly evolved. The research community is beginning to adopt common models and terminology, while system developers are beginning to reach consensus on engineering guidelines. In addition, various commercial tools have appeared in the market for many applications.

Data fusion deals with the synergistic combination of information made available by different measurement sensors, information sources, and decision makers, Thus, sensor fusion is concerned with distributed detection, sensor registration, data association, state estimation, target identification, decision fusion, user interface and database management. A group of many incomplete sets of data from many sensors may be fused and lead to useful and unambiguous declarations. This effect obtained from the fusion is called synergy [1-2].

Image fusion is defined as the process of combining multiple input images into a single composite image. The aim is to create from the collection of input images a single output image, which contains a better description of the scene than the one provided by any of the individual input images. The output image should therefore be more useful for human visual perception or for machine perception. The basic problem of image fusion is one of determining the best procedure for combining the multiple input images. The principal motivation for image fusion is to improve the quality of the information contained in the output image in a process known as synergy [3].

The paper presents a simple demonstration of image fusion using commercial available software. The quality of image is increased which is obviously perceptible as shown in figure 1.

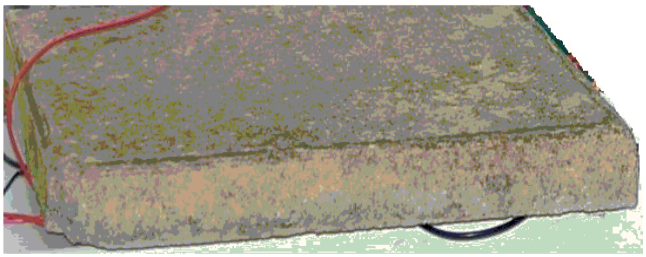

Figure 1.a First Image of slab using mobile camera

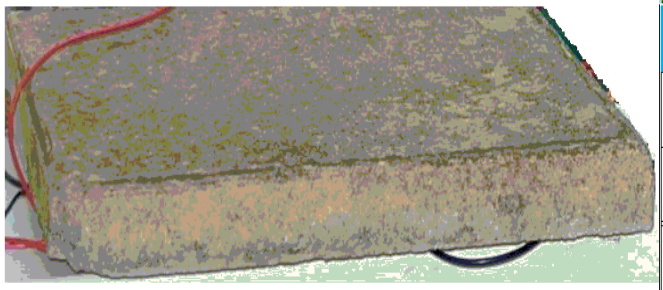

Figure 1.b Second Image of slab using mobile camera

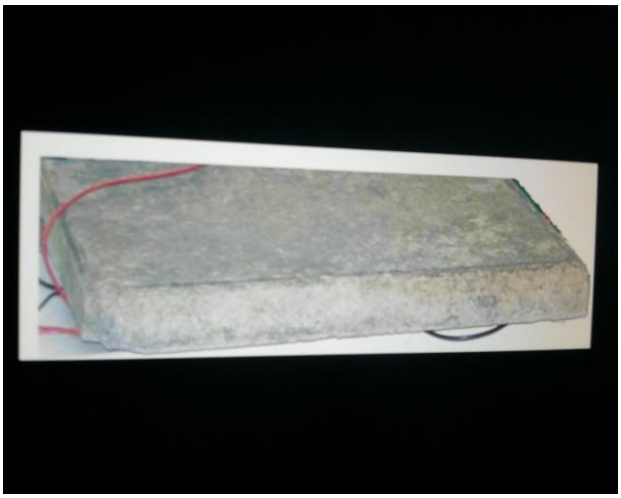

Figure 1.c Image after fusion

II. DATA FUSION

Traditionally, the input images are captured by the same camera at different times or are captured by different cameras at the same time. In this experiment, same camera is used sequentially to capture the images of a concrete slab. Low costing mobile camera of 2-Mega pixel resolution is used. Any mobile/digital camera records the time-and space-varying light intensity information reflected and emitted from the object.

DreamFusion [4], commercially available software is used for fusing two images of concrete slabs as shown in figure 2.

Figure 2 Screen shot of DreamFusion software

DreamFusion pro is a software system for image fusion. The software takes care of combining relevant information in two or more images. It reads in a set of images and combines them into a single highly informative image. The input and output formats for the images include a wide range of formats, including tif, jpg, gif, png, bmp, pgm etc. The software manages automatic image alignment, proper sampling and noise reduction in the process of fusion.

III. IMAGE PROCESSING

The image is processed using Matlab Image processing toolbox and Simulink [5]. RGB images are converted to matrices as an initial step for processing. The histogram block computes the frequency distribution of the elements in each input image by sorting the elements into a specified number of discrete bins. We can use the histogram block to calculate the histogram of the R, G, and/or B values in an image. It computes the frequency distribution of the elements in a vector input, of the elements in each channel of a frame-based matrix input. The Running histogram parameter selects between basic operations and running operation. The histogram block accepts real and complex fixed-point and floating-point inputs.

The block distributes the elements of the input into the number of discrete bins specified by the number of bins parameter, n.

y = hist (u, n) % Equivalent MATLAB code

The histogram value for a given bin represents the frequency of occurrence of the input values bracketed by that bin. The histogram of respective image is computed using Simulink as shown in figures 3 a, b, c.

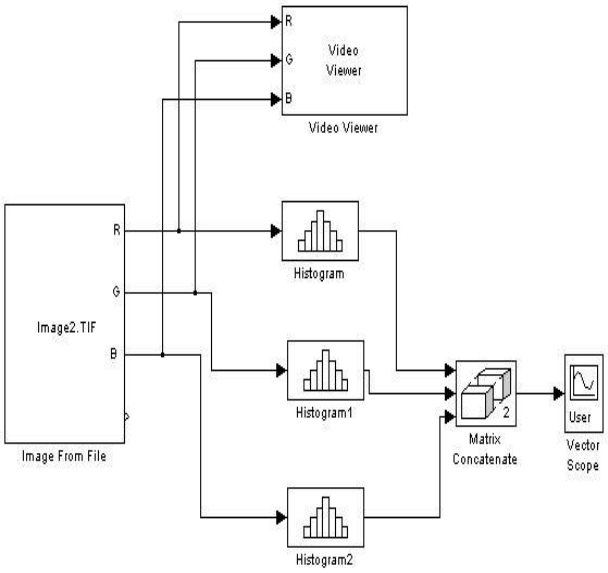

Figure 3.a Simulink Computation of Image1

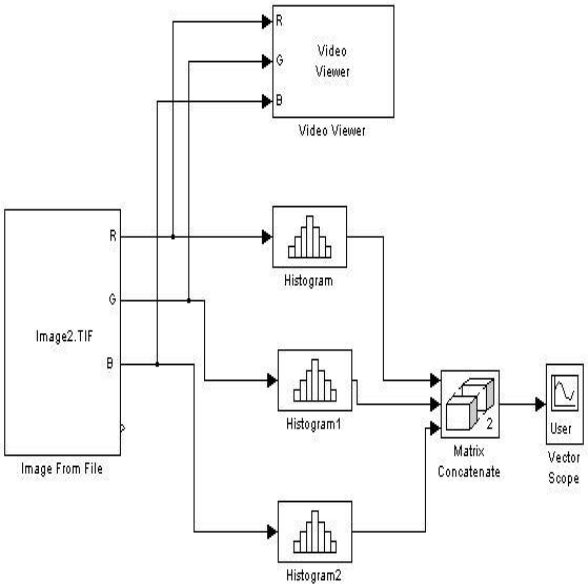

Figure 3.b Simulink Computation of Image2

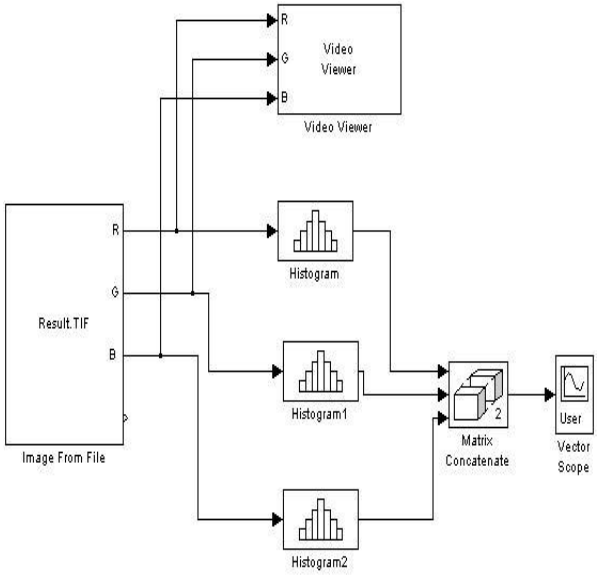

Figure 3.c Simulink Computation of Fused Image

IV. RESULTS AND DISCUSSION

As shown in figures 4a, b, c, the frequency distribution of image1 and image2 are almost identical which is also an indicating factor that the quality of both the images are approximately same. After the fusion of two images, the frequency distribution of resulting image is quite different, distinct over shoot spike is shown in the figures 4 c. The same histograms are smoothed and redrawn to log based graph in figures 5 a b c. The histogram bins are represented in X-axis while frequency in Y-axis.

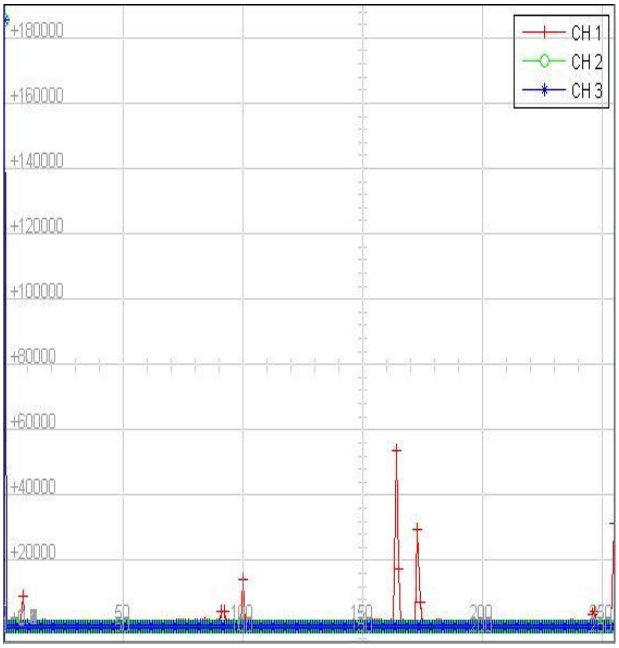

Figure 4.a Histogram output of image1

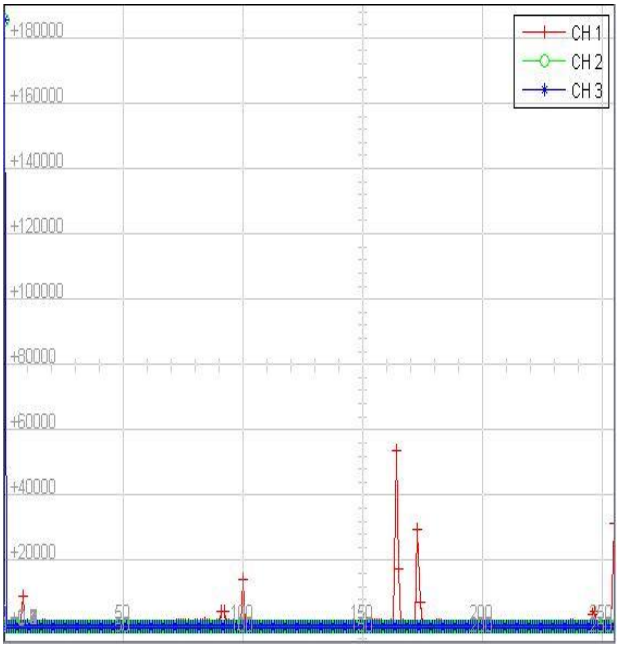

Figure 4.b Histogram output of image2

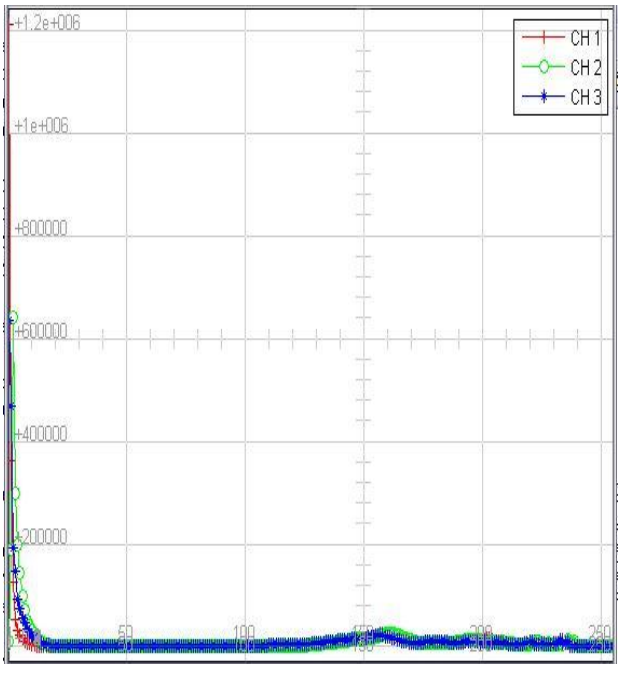

Figure 4.c Histogram output of fused image

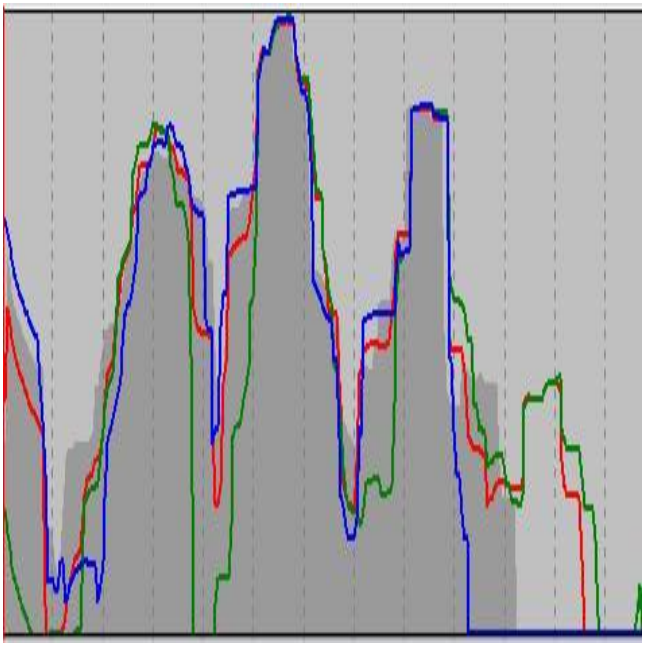

Figure 5.a Log-based histogram of image1

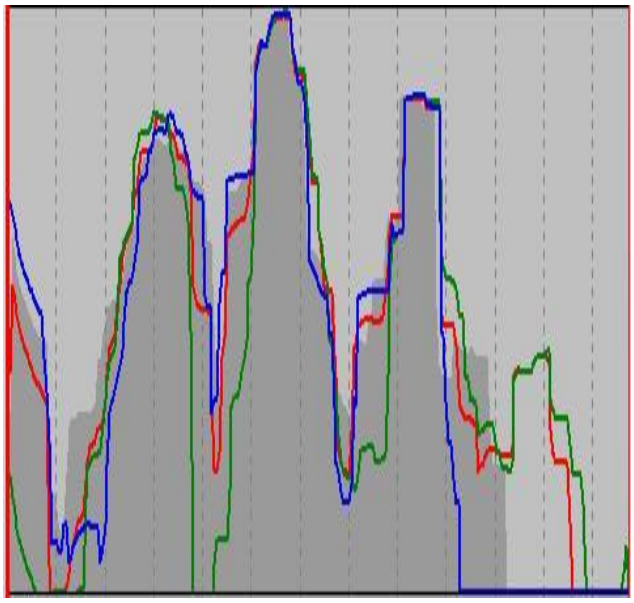

Figure 5.b Log-based histogram of image2

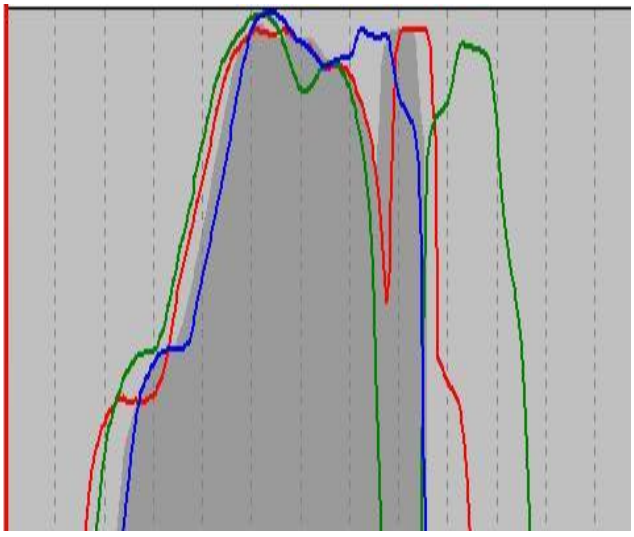

Figure 5.c Log-based histogram of fused image

V. CONCLUSION

Data fusion is a rapidly maturing technology with an extensive legacy. The data in this experiment is considered as image data, captured from image sensors. A simple demonstration was carried out to explore the virtue of data fusion to improve the quality of image. Thus by processing and analyzing the images, it is shown that information content in the fused image is more than individual image. The experiment also tries to explore use of low cost, moderate resolution optical device to render better quality images using data fusion technique. The future work is to perform singular value decomposition (SVD) analysis to observe the effect of data fusion.

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