AN IMPROVED HDR IMAGE PROCESSING USING FAST GLOBAL TONE MAPPING

Sajeena A[1], Sunitha Beevi K[2]

[1] *Assistant Professor, Department of Electronics and Communication Engg. TKM College of Engg. Kollam, Kerala, India ,* ***sajina.nizam@gmail.com***

[2] *Assistant Professor, Department of Electrical and Electronics Engg., . TKM College of Engg. Kollam, Kerala, India,* ***.sunitha_haris@yahoo.com***

Abstract

People always try to reconstruct images that look like original scene. But it is not succeeded up to the expected level because the display devices cannot accommodate the actual range of illumination. The original scene is having high dynamic range (HDR) and the display devices are having low dynamic range (LDR) of values. Tone mapping can be used to display HDR image in an LDR device. In this paper we are trying to develop a better tone mapping method. A number of images with different exposure are fused to form an HDR image.. Here we used average method for this which is the simplest one. Then by using tone mapping the HDR image is converted into LDR. We tried Tone Reproduction Curve (TRC) based global tone mapping. TRC method results faster operation The global tone mapping operator algorithm is simple and does not introduce ghosting. The image will also free from blur and halo like artifacts. We took log average of the images to keep the pixel values within limit.

Index Terms: *Image fusion, High dynamic range images, , Tone mapping. Low dynamic range image, global operator.*

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1. INTRODUCTION

Digital cameras may give clear picture of the scene they are capturing. With the increasing megapixel values of the image capturing device (camera) the output become more clearer. But they nevern succeeded in displaying the exact dynamic range of illumination of the actual scene. This may not be the fault of the camera alone but the common displaying devises like CRT, LCD, LED displays, printers etc cannot accommodate the wide dynamic range of the scene. The real world scenes will have a dynamic range of about ten orders of magnitude. This will vary according to the climatic conditions and exposure time. Human eye can preserve around five to nine orders of magnitude. The display devices are having only two orders of dynamic range. Even though most of the devices are following the technology of human eye, they have not met the requirement.

We can say that real world scenes are having High Dynamic Range (HDR) of luminance values and the reproducing devices are having Low Dynamic Range (LDR). High Dynamic Range imaging allows capturing of the object with a wide dynamic range. This may be done with the help of a radiance map. Radiance map can be prepared in the following way: Take a number of images with different shutter speeds. Images obtained will have different brightness levels. Darker portions will be more dark for shorter exposure and longer exposures will make the brighter areas more bright. Both the cases will make image with less details

Radiance map is produced by fusing the multiple exposure images [2] using suitable method. Here we used the average method with a control factor f. This factor will control the output image brightness level. Methods for better colour reproduction is also provided.

The resulted HDR image is subjected to tone mapping. Tone mapping is the process of converting HDR images for making it suitable for display on an LDR display device. Two broad categories of tone mapping technology are available They are tone reproduction curve (TRC) based and tone reproduction operator (TRO) based, Pixel distributions are considered in TRC based technique and TRO based technique considered spatial manipulation of local neighbouring pixel values,.

Spatial tone mapping can be done in two ways, either globally or locally. Global operators compresses the image with an identical curve on all pixels and local operators will do it with different curves. They are done with different scales.

In this project we tried [1] global tone mapping. We took logarithmic intensity values of pixels to make it between 0 and 1.

2. METHODOLOGY

Multiple exposure images can be combined to form an HDR image with large dynamic range pixel values [2]. With the increase in the number of images the dynamic range of

the HDR can also be increased. Then a tone mapping operator is applied to make the image displayed on an LDR device.

A number of images of the scene (RAW images) is taken with a digital camera by adjusting the shutter speed. Cameras are available that can take multiexposure images with a single click. Images From each image the red green and blue pixel values are taken separately averaged are combined with a weighting factor. The average value determines the overall brightness of the image. Using this algorithm it is possible to process about 21 images. Then a global tone mapping algorithm is applied to compress the 32 bits of the HDR images to 8 bit LDR image.

The algorithm is implemented with Java NetBeans.

The block diagram is shown in figure 1

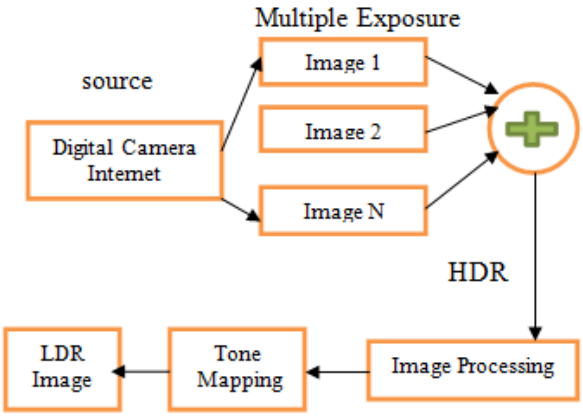


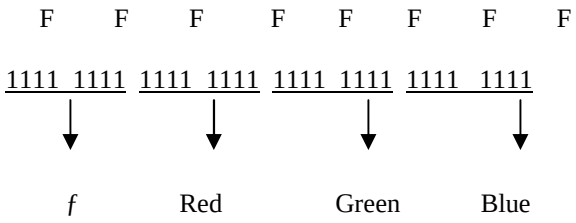
Figure 1 : Block diagram of HDR image processing system

2.1 Combining multiple images:

Images can be ditectly taken using a digital camera or can be downloaded fro the internet as jpeg images. They should be taken with different shutter speeds. Let N be the number of images of the scene taken.

A control parameter f is taken to control the image brightness. Here we took averaging method to make the HDR image. It will help in building the HDR image with average brightness of the overall images,

Including the f coordinate value ,we need 32 bits to represent an HDR image. That is 8 bits to represent blue, 8 bits to represent green, 8 bits to represent red and another 8 bits to represent f value. We let the first 8 bits to represent blue pixel value ,9 to 16 bits to represent green, 17 to 24 bits to represent red and 25 to 32 bits to represent f.



Let βbe the bitrate.

Then the average value is calculated using the following equation

$$Ravr = \frac{\sum_1^N (Ri \times 2^{bitrate})}{N}$$

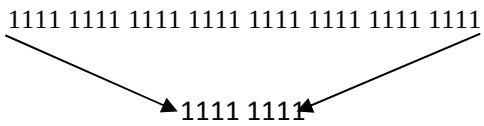
$$Gavr = \frac{\sum_1^N (Gi \times 2^{bitrate})}{N}$$

$$Bavr = \frac{\sum_1^N (Bi \times 2^{bitrate})}{N}$$

Using these average values we constructed the HDR image.In order to display this image in an LDR device we used tone mapping.

2.2 Tonemapping:

Tone mapping is done to convert the 32 bit HDR image to 8 bit LDR image suitable for the display devices. It should be done without loss of information.



We used an index whose value is from 0 to less than 3.

Let x be the length and y be the width of the matrix. Therefore the number of pixels in the matrix Nn is x * y

Consider value ‘a’ equal to a key value multiplied by the brightness. It can be specified by the user.

Another constant μ is taken equal to 0.00001 for the log of a black pixel in order to reduce the contrast.

For these values the log average luminance is calculated as

$$Lavl = \frac{\sum_{1}^{Nn} log(\mu + Lw)}{N}$$

Where Lw is the luminance of white. Now the scaled luminance is calculated as

$$Scl = \frac{a \times Lw}{Lavl}$$

Now the maximum luminance is mapped to that of pure white.

Finally the tone mapping operator is applied.

The scaled luminance pixel value is calculated as

$$Scl\ [(1+\frac{Scl}{(Lw)^2}) \Big/ (1+Scl)]$$

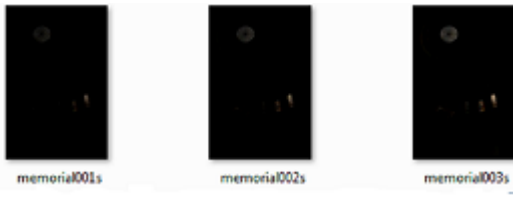
These pixel values in the matrix form makes the LDR image. The luminance value is always kept between zero and one.

Here we are compressing the bit rate of the HDR image to make it fit to an LDR display. That is the information contained in 32 bits should be represented by 8 bits. This will reduce the clarity of the picture.

In this project we can fuse multiexposure images from three to twenty one .More number of images will make the output more clearer.

3. RESULTS

The following multexposue images are processed.



These images after processing gave the following output

Another example. Here we took four different exposures

Images 1 to 4

The LDR image obtained is

In this paper we used Java Netbeans for doing the operation Tonemapping operators are applied on the images using the

above mentioned formula].We took {1},[2}, [3],[4], [5], [6] as the references. We also took [7]. [8], [9] for the HDR image and colour correction.

C. Abbreviations and Acronyms

HDR	High Dynamic Range Images
LDR	Low Dynamic Range Images
TRO	Tone Reproduction Operator
TRC	Tone Reproduction Curve
HDRI	HDR image
RAW	Raw HDR image

CONCLUSIONS

High dynamic images can be displayed with more details in a low dynamic range display by using our method. The resultant image contains average brightness on all parts with more colour information. The number of exposures can be from three to nineteen. Averaging pixel values with global tone mapping is a fast and simple method of HDR processing.

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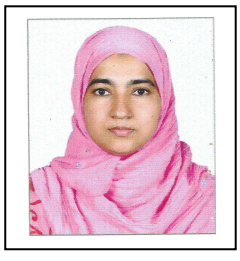
BIOGRAPHIES



Sajeena A, currently working as Assistant Professor in Electronics and Communication Engg department at TKM College of Engg. Kollam, Kerala, India

Sunitha Beevi K, working as Assistant Professor in Electrical and Electronics Engg. Department at TKM College of Engg. Kollam, Kerala, India