

**LIGHT EFFICIENT PHOTOGRAPHY FUSION BASED ON
GRADIENT EXPOSURE**

KIRUTHIGA.S

11PCR09

**A Project Report submitted to Avinashilingam Institute for Home Science and
Higher Education for Women, Coimbatore in partial fulfillment of the
requirements for the Master's Degree in Computer Science**

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**SIGNATURE OF THE
HEAD OF THE DEPARTMENT**

**SIGNATURE OF THE
SUPERVISOR**

**SIGNATURE OF THE
EXTERNAL EXAMINER**

ACKNOWLEDGEMENT



ACKNOWLEDGEMENT

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SYNOPSIS



SYNOPSIS

The aim of the project titled “**LIGHT-EFFICIENT PHOTOGRAPHY FUSION BASED ON GRADIENT EXPOSURE**” is to create pleasing images and try to reproduce as much detail and color as possible. The total exposure times reduce motion blur, can also be thought of as complementary to recent synthetic shutter approaches whose goal is to reduce such blur. Instead of controlling aperture and focus, these techniques divide a given exposure interval into several shorter ones, with the same total exposure fusion.

The proposed scheme is novel for capturing a scene by using a standard dynamic range device (SDR) and synthesizing an image suitable for SDR displays. In particular, SDR capture device is used to trace scene details (i.e., contrasts and gradient directions) in a series of SDR images with different coverage levels. With the captured photo series, the image luminance levels is calculated, which maximize the observable contrasts, and then the scene gradients embedded in these images. The fusion algorithm techniques of diffusion and contrast are implemented. This is done in a multi-resolution of brightness variation in the sequence. The proposed scheme does not require any human interaction or parameter tuning for different scenes.

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INTRODUCTION



1. INTRODUCTION

This section describes about the overview of the project description for which the project is developed and used.

1.1 OVERVIEW OF THE PROJECT

Two of the most important choices when taking a photo are the photo's exposure level and its depth of field. Ideally, these choices will result in a photo whose subject is free of noise or pixel saturation and appears to be in focus. These choices, however, come with a severe time constraint: in order to take a photo that has both a specific exposure level and a specific depth of field, the camera's sensor for a length of time that is dictated by the lens optics should be exposed. Moreover, the wider the depth of field, longer the sensors have to wait to reach the chosen exposure level. In practice, this makes it impossible to efficiently take sharp and well-exposed photos of a poorly-illuminated subject that spans a wide range of distances from the camera. To get a good exposure level, something should be compromised, either using a narrow depth of field (and incur defocus blur) or take a long exposure (and incur motion blur).

The article seeks to overcome the time constraint imposed by lens optics, by capturing a sequence of photos rather than just one. If the aperture, exposure time, and focus setting of each photo is selected appropriately, a given depth of field is spanned with a given exposure level in less total time than it takes to expose a single photo (Fig), without increased imaging noise.

This novel observation is based on a simple fact: even though wide apertures have a narrow depth of field (DOF), they are much more efficient than narrow apertures in gathering light from within their depth of field.

Hence, even though it is not possible to span a wide DOF with a single wide-aperture photo, it is possible to span it with several of them, and do so very efficiently.

Using this observation as a starting point, development of a general theory of light-efficient photography should be done that addresses four questions: (1) under what conditions is capturing photo sequences with “synthetic” DOFs more efficient than single-shot photography? (2) Characterize the set of sequences that are globally optimal for a given DOF and exposure level, i.e., whose total exposure time is the shortest possible. (3) Compute such sequences automatically for a specific camera, depth of field, and exposure level. (4) Finally, convert the captured sequence into a single photo with the specified depth of field and exposure level.

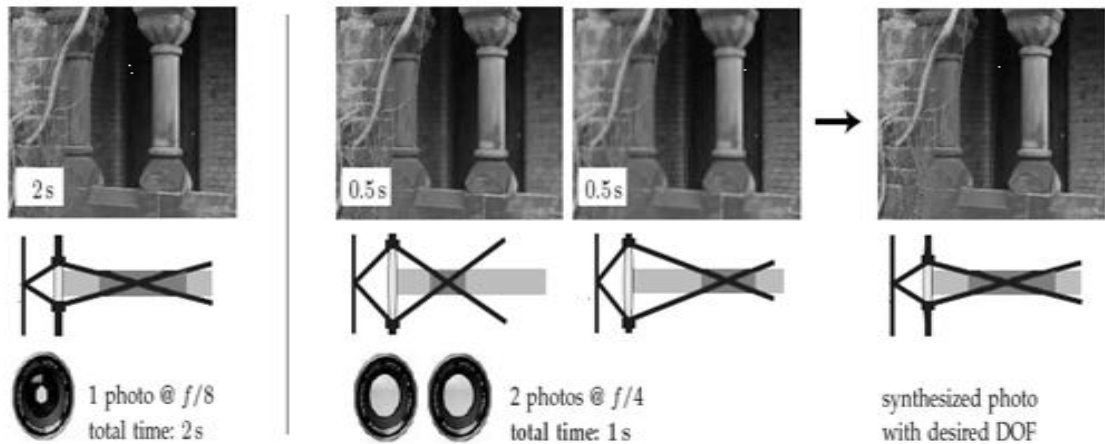


Fig: Left: Traditional single-shot photography

The scene luminance, which is perceived by us without involving any device between the scene and our eyes, can greatly vary between and from region to region. However, the dynamic range of a normal digital camera/monitor, termed as the standard dynamic range (SDR) device, is only about. As a consequence, high dynamic range (HDR) devices need professionals to fully capture and display scenes. However, these devices are expensive and are thus not accessible to most people. Compared with HDR devices, SDR devices are cheaper, and thus, it is important and attractive to capture and display HDR scenes by using SDR devices.

When HDR capture devices are not available, existing systems typically first apply algorithms to synthesize an HDR image via a set of SDR images, which record scene details, and then reproduce an SDR image via the synthesized HDR image, so that scene on an SDR device can be displayed. This two-stage approach usually requires complex manual interactions and damages some scene details in both stages. A comprehensive review of algorithms for HDR image synthesis and display is given in the succeeding section.

Little is known about how to gather light efficiently from a specified DOF. No previous methods have been considered the problem of optimizing exposure time for a desired DOF and exposure level. For example, even though there has been great interest in manipulating a camera's DOF through optical, or computational means, most approaches do so without regard to exposure time—they simply assume that the shutter remains open as long as necessary to reach the desired exposure level.

The final step in light-efficient photography involves merging the captured photos to create a new one (Fig). The work is related to the well-known technique of focus bracketing for extended depth-of-field imaging. This technique creates a new photo whose DOF is the union of DOFs in a sequence, and has found wide use in microscopy, macro photography and photo manipulation. Current work on the subject concentrates on the problems of image merging and 3D reconstruction with minimal artifacts. Indeed, an existing implementation is used for merging step. However, the problem of how to best acquire such sequences remains open. In particular, the idea of controlling aperture and focus to optimize total exposure time has not been explored.

The difference between the luminance of a point and the average luminance of its surrounding points is visible for humans and term the difference as the visible contrast. In the proposed approach, visible contrast and gradient of the whole scene is used to describe scene details. Given an SDR capture device, the scene luminance is recorded under a specific exposure level as the image luminance, which is determined by the response function of the film or the charge-coupled device.

1.2 PROBLEM DESCRIPTION

The problem of imaging a scene with a given depth of field at a given exposure level in the shortest amount of time possible. By showing (1) collecting a sequence of photos and (2) controlling the aperture, focus and exposure time of each photo individually, the given depth of field is spanned in less total time than it takes to expose a single narrower-aperture photo. Using this as a starting point, we obtain two key results.

Given a set of available aperture diameters, construct a capture sequence such that: (1) its synthetic DOF is equal to $[\alpha, \beta]$, (2) all its photos have exposure level L^* ; (3) the total exposure time (or capture time) is smaller than τ^{one} ; and (4) this time is a global minimum over all finite capture sequences.

Intuitively, whenever such a capture sequence exists, it can be thought of as being optimally more efficient than single-shot photography in gathering light.

SYSTEM SPECIFICATION



2. SYSTEM SPECIFICATION

System configuration is means by which it defines in terms meaningful to the operating system any or all of the peripheral devices attached to the computer for the input(entering) or output (storing or displaying)of data.

2.1 HARDWARE SPECIFICATION

Processors will continue to get faster, smaller and cheaper, where as memory will continue to get faster, larger and cheaper.

Processor : Intel® Pentium®

RAM : 512 MB

Monitor : Lenovo

Keyboard : Lenovo

Pointing device : Optical Mouse

2.2 SOFTWARE SPECIFICATION

Software configuration includes the software features that are needed for the implementation of the project.

Tool : MATLAB

Version : 7.11.0.584

Operating System : Microsoft Windows XP

2.3 ABOUT THE SOFTWARE

Introduction to mat lab

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation.

Typical uses include Math and computation Algorithm development Data acquisition Modeling, simulation, and prototyping Data analysis, exploration, and visualization Scientific and engineering graphics Application development, including graphical user interface building MATLAB is an interactive system whose basic data element is an array that does not require dimensioning. This helps to solve many technical computing problems, especially those with matrix and vector formulations, in a fraction of the time it would take to write a program in a scalar non interactive language such as C or FORTRAN.

The name MATLAB stands for matrix laboratory. MATLAB was originally written to provide easy access to matrix software developed by the LINPACK and EISPACK projects In university environments, it is the standard instructional tool for introductory and advanced courses in mathematics, engineering, and science.

Toolboxes are comprehensive collections of MATLAB functions that extend the MATLAB environment to solve particular classes of problems. Areas in which toolboxes are available include signal processing, control systems, neural networks, fuzzy logic, wavelets, simulation, and many others.

MATLAB has extensive facilities for displaying vectors and matrices as graphs, as well as annotating and printing these graphs. It includes high-level functions for two-dimensional and three-dimensional data visualization, image processing, animation, and presentation graphics. It also includes low-level functions that allow to fully customize the appearance of graphics as well as to build complete graphical user interfaces on MATLAB applications.

The MATLAB API is a library that allows to write C and Fortran programs that interact with MATLAB. It includes facilities for calling routines from MATLAB (dynamic linking), calling MATLAB as a computational engine, and for reading and writing MAT-files.

Key Features

- ❖ High-level language for technical computing.
- ❖ Development environment for managing code, files, and data.
- ❖ Interactive tools for iterative exploration, design, and problem solving.
- ❖ Mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, and numerical integration.
- ❖ 2-D and 3-D graphics functions for visualizing data.
- ❖ Tools for building custom graphical user interfaces.
- ❖ Functions for integrating MATLAB based algorithms with external applications and languages, such as C, C++, Fortran, Java™, COM, and Microsoft® Excel.

Syntax

The MATLAB application is built around the MATLAB language. The simplest way to execute MATLAB code is to type it in the Command Window, which is one of the elements of the MATLAB Desktop. When code is entered in the Command Window, MATLAB can be used as an interactive mathematical shell. Sequences of commands can be saved in a text file, typically using the MATLAB Editor, as a script or encapsulated into a function, extending the commands available

Structures

MATLAB supports structure data types. Since all variables in MATLAB are arrays, a more adequate name is "structure array", where each element of the array has the same field names. In addition, MATLAB supports dynamic field names (field look-ups by name, field manipulations etc). Unfortunately, MATLAB JIT does not support MATLAB structures, therefore just a simple bundling of various variables into a structure will come at a cost MATLAB can call functions and subroutines written in the C programming language or Fortran. A wrapper function is created allowing MATLAB data types to be passed and returned. The dynamically loadable object files created by compiling such functions are termed "MEX-files" (for MATLAB executable).

Interfacing with other languages

Libraries written in Java, ActiveX or .NET can be directly called from MATLAB and many MATLAB libraries (for example XML or SQL support) are implemented as wrappers around Java or ActiveX libraries. Calling MATLAB from Java is more complicated, but can be done with MATLAB extension, which is sold separately by

MathWorks, or using an undocumented mechanism called JMI (Java-to-Mat lab Interface), which should not be confused with the unrelated Java Metadata Interface that is also called JMI.

As alternatives to the MuPAD based Symbolic Math Toolbox available from Math Works, MATLAB can be connected to Maple or Mathematica.

MATLAB has a direct node with modeFRONTIER, a multidisciplinary and multi-objective optimization and design environment, written to allow coupling to almost any computer aided engineering (CAE) tool. Once obtained a certain result using Mat lab, data can be transferred and stored in a modeFRONTIER.

Neural Network Toolbar

Neural networks are composed of simple elements operating in parallel. These elements are inspired by biological nervous systems. As in nature, the network function is determined largely by the connections between elements. Neural network can train to perform a particular function by adjusting the values of the connections (weights) between elements. Commonly neural networks are adjusted, or trained, so that a particular input leads to a specific target output. The network is adjusted, based on a comparison of the output and the target, until the network output matches the target. Typically many such input/target pairs are needed to train a network.

Neural networks have been trained to perform complex functions in various fields, including pattern recognition, identification, classification, speech, vision, and control systems.

Today neural networks can be trained to solve problems that are difficult for conventional computers or human beings. Throughout the toolbox emphasis is placed on neural network paradigms that build up to or are themselves used in engineering, financial, and other practical applications.

Key Features

- ❖ Neural network design, training, and simulation.
- ❖ Pattern recognition, clustering, and data-fitting tools.
- ❖ Supervised networks including feed forward, radial basis, LVQ, time delay, nonlinear autoregressive (NARX), and layer-recurrent.
- ❖ Unsupervised networks including self-organizing maps and competitive layers.
- ❖ Preprocessing and post processing for improving the efficiency of network training and assessing network performance.
- ❖ Modular network representation for managing and visualizing networks of arbitrary size.
- ❖ Routines for improving generalization to prevent over fitting.
- ❖ Simulink® blocks for building and evaluating neural networks, and advanced blocks for control systems applications.

SYSTEM ANALYSIS



3. SYSTEM ANALYSIS

The system study is comparative study of existing system and proposed system in order to analyse the development. It helps to understand the functions of the existing system. So it exposes the requirements and expansion of the existing system.

3.1 EXISTING SYSTEM

- The possibilities of obtaining increased dynamic range and depth of field, as well as fused images of objects under varying illumination. However, these earlier approaches had difficulty capturing fine detail. They also did not provide any interactive control over the results.
- The Extended depth-of-field image technique tended to produce noisy results due to the lack of spatial regularization.
- The texture synthesis community representing the quality of pixel combinations as a Markov Random Field and formulating the problem as a minimum-cost graph-cut allows the possibility of quickly finding good seams.
- Standard image-editing tools such as Adobe Photoshop can be used for photomontage; however, they require mostly manual selection of boundaries, which is time consuming and burdensome. While interactive segmentation algorithms like “intelligent scissors” do exist, they are not suitable for combining multiple images simultaneously.

Drawbacks

- ✓ In existing system, fusion process does not produce the single clear image.
- ✓ It does not provide any interactive control.

3.2 PROPOSED SYSTEM

The proposed scheme is novel for capturing a scene by using a standard dynamic range device and synthesizing an image suitable for SDR displays. In particular, an SDR capture device is used to trace scene details (i.e., contrasts and gradient directions) in a series of SDR images with different coverage levels. With the captured photo series, the image luminance levels is calculated, which maximize the observable contrasts, and then the scene gradients embedded in these images. The fusion algorithm techniques of diffusion and contrast are implemented. This is done in a multi-resolution of brightness variation in the sequence. The proposed scheme does not require any human interaction or parameter tuning for different scenes.

Advantages

- ✓ The Fusion is that it processes multiple bracketed images into a single image. The "look" of the image is a really good exposure of the original image.
- ✓ It minimizes total exposure time and constraint.
- ✓ It does not require parameter tuning for different scenes.

SYSTEM DESIGN



4. SYSTEM DESIGN

System design is the process of planning a new system to complement or altogether replace the old system. The purpose of the design phase is the first step in moving from the problem domain to the solution domain. The design of the system is the critical aspect that affects the quality of the software. System design is also called top-level design. The design phase translates the logical aspects of the system into physical aspects of the system.

4.1 INPUT DESIGN

As the project is concentrated fully matching the template over the input image so the input parameters which is consider for the process are Gray scale image.

Gray scale image

A grayscale (or gray level) image is simply one in which the only colors are shades of gray. The reason for differentiating such images from any other sort of color image is that less information needs to be provided for each pixel. In fact a 'gray' color is one in which the red, green and blue components all have equal intensity in RGB space, and so it is only necessary to specify a single intensity value for each pixel, as opposed to the three intensities needed to specify each pixel in a full color image.

Often, the grayscale intensity is stored as an 8-bit integer giving 256 possible different shades of gray from black to white. If the levels are evenly spaced then the difference between successive gray levels is significantly better than the gray level resolving power of the human eye.

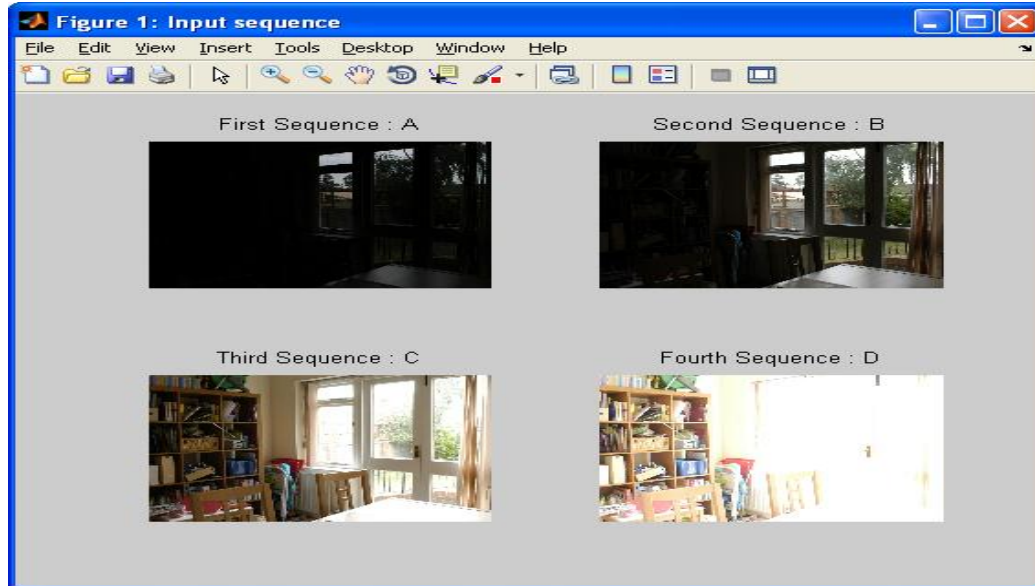


Fig 1: Input Image

4.2 OUTPUT DESIGN

Output design generally refers to the results and information that are generated by the system.

The first process is to load the Input sequence images and calculate the dimensions of each image. It has to calculate the gradient direction for identifying the color pixels variation values by calculating the mean and Co-variance. Each image only records a small portion of the dynamic range and partial scene details (scene details refer to the visible contrasts and the scene gradients), but this series of captured images collectively contains all scene details.

The Luminance extraction image dimensions (width, height and number of channels) are to calculate the image luminance (color variance) that maximizes the visible contrasts over different captured images.

SYSTEM DEVELOPMENT



5. SYSTEM DEVELOPMENT

The system development project is used in project management and it describes the stages involved in a project.

5.1 MODULE DESCRIPTION

The project of four modules namely

- Image synthesis
- Scene Gradient Extraction
- Luminance Extraction
- Fusion

5.1.1 IMAGE SYNTHESIS

To synthesize novel photos with different camera settings, DOF (Depth of Field) is generalized compositing and take advantage of the different levels of defocus throughout the capture sequence. Intuitively, rather than selecting pixels at in-focus depths from the input sequence, the recovered depth map is used to select pixels with appropriate levels of defocus according to the desired synthetic camera setting.

For synthetic images that takes advantage of the ability of the human visual system to decompose a scene into intrinsic “layers”, such as reflectance and illumination. Because vision is sensitive mainly to the reflectance layers, they reduce contrast only in the illumination layer. This technique is unfortunately applicable only when the characteristics of the 3D scene are known. The work can be seen as an extension to photographs.

5.1.2 SCENE GRADIENT EXTRACTION

A camera can record details of a scene in a series of images at different coverage levels. Each image only records a small portion of the dynamic range and partial scene details (scene details refer to the visible contrasts and the scene gradients), but this series of captured images collectively contains all scene details. Each exposure level responds to a particular luminance level at the same point in a captured image. By using all the captured images, at each point, the image luminance (to represent the visible contrast) and the scene gradient are calculated.

The gradient-based approach typically performs edge detection to locate potential text regions. The proposed the stroke width transform, based on the observation that character strokes in the same text line often have almost constant thickness. A similar idea was used to identify “pixel couples”, pairs of pixels that had similar gradient magnitudes and opposite directions. Although these methods are fast, it produces many false positives for images with complex backgrounds.

The mutual objects/regions undergo an object/region activity measure to select the suitable fusion rule. And finally, to insure the transferability of all the important visual information present in the source images, including the un-extracted objects, the background information is fused in a pixel-based fashion using gradient activity measures.

5.1.3 LUMINANCE EXTRACTION

The image dimensions (width, height and number of channels) to calculate the image luminance (color variance) that maximizes the visible contrasts over different captured images. The corresponding points of x co-ordinate and y co-ordinate surrounding points, which form local window in a scene, the visible contrast of the window between the point and its surrounding points is observed.

The different fusion levels lead to different visible contrasts. The visible contrast is weakened at a low luminance level because of the insufficient exposure and is enhanced with the growing of the luminance. However, it is again weakened at a high luminance level because of the overexposure (out of focus). To observe stronger visible contrast for each pixel points, the exposure level is adjusted to incident-light quantity adaptively, and the visibility of the contrast is consequently enhanced.

5.1.4 FUSION

To compute a weighted (Distance of each pixel similarity) average along each pixel to fuse the N (Number of images) images, using weights computed from our quality measures. To obtain a consistent result, normalize the values of the N weight maps such that they sum to one at each pixel.

A Laplacian filter to the grayscale version of each image, and take the absolute value of the filter response. This yields a simple color indicator (Red, Green and Blue) for contrast. It tends to assign a high weight to important elements such as edges and texture (color surface). A similar measure was used for multi-focus fusion for extended depth-of-field (DOF).

Multi resolution of scale separately, sharp transitions in the weight map can only affect sharp transitions appear in the original images (e.g. edges). Conversely, flat regions in the original images will always have negligible coefficient magnitude, and are thus not affected by possibly sharp variations in the weight function, even though the absolute intensities among the inputs could be different there.

SYSTEM TESTING



6 .SYSTEM TESTING

Software testing is a critical element of software quality assurance that represents the ultimate review of specifications, design and coding. The user tests the developed system and changes are made according to their needs. The testing phase involves the testing of developed system using various kinds of data. It involves user training, system testing and successful running of the developed system.

The changes are made according to their needs. The testing phase involves the testing of the developed system using various kinds of data. While testing, errors are noted and corrections are made. System testing is the stage of implementation, which is aimed at ensuring that the system works accurately and efficiently before live operation commences. The candidate system is subject to variety of tests such as stress recovery, and security and usability tests.

Test Plan

After the integration of this proposed system, the verification and validation of the system has been carried out. When the user gives the appropriate input, the system simulates properly and gives reasonable output.

When the input from the user is found to be inappropriate, it display an error message to indicate the user to give appropriate input.

Verification

Verification has been done by getting inappropriate input. If the user gives inappropriate image, a message box will be displayed with “no match found”.

Validations

Validation also has been done through inappropriate user input. For example, giving in appropriate image. This will give the user an alarm message to give correct input.

Testing Methods

Testing plays vital role in the success of the system. It is an iterative process of both validating functionality and attempting to break the software. It makes a logical assumption that if all the parts of the system are correct. The goal will be successfully achieved once program has been developed, testing begins.

The objective of system testing is to find the problems and fix them to improve quality. While testing tends to be considered a part of the development, it is really its own discipline and should be tracked as its own project. The testing steps are as follows

1. Unit testing
2. Integration testing
3. Validation testing
4. Output testing
5. User Acceptance Testing

6.1 UNIT TESTING

Unit testing focuses verification efforts on the smallest unit of software design, of the module. This is also known as “Module Testing” the modules are tested separately, this testing is carried out during the programming stage itself. In this step each module is found to be working correctly to meet the expected output.

6.2 INTEGRATION TESTING

Integration testing focuses on the design and construction of the software architecture. Data can be lost across an interface, one module can have adverse effect on another sub functions and show on. Thus integration testing is a systematic technique for constructing test to uncover errors associated with the interface. In this project, all the modules are combined and then the entire program is tested as a whole.

6.3 VALIDATION TESTING

Validation testing is the requirement established as a part of software requirement analysis is validated against the software that has been constructed. This test provides the final assurance whether the software needs all functional, behavioral and performance requirements

Thus the proposed system under consideration has been tested by using validation testing and found to be working satisfactory.

6.4 OUTPUT TESTING

After performing the validation testing, the next step is the output testing of the proposed system, since no system could be useful if it does not produce required output in the specific format. The outputs generated or displayed by the system under consideration are

- Tester asking the users about the format required by them. Here, the output is considered into two ways: one is on the screen and the other is printed format.
- The output format on the screen is found to be correct as the format designed according to the user needs, for the hard copy also, the output comes as specified by the user.

Hence output testing does not result in correction in the system.

6.5 USER ACCEPTANCE TESTING

User acceptance testing of a system is the key factor for the success of any system. The system under consideration is tested for user acceptance by constantly keep in touch with the prospective system user at the time of developing and making changes wherever required.

Testing in your System

The modules in this project has been tested thoroughly and found to be accurate which can meet the needs on the user. The tested modules are finally combined together into a complete one. The user acceptance testing is found to be little difficult and in this project user satisfaction is obtained.

EXPERIMENTAL ANALYSIS



7. EXPERIMENTAL ANALYSIS

The examples were constructed from JPG-encoded photographs, with unknown gamma correction and camera response curve. Equally weighted quality measures in most examples are used.

A typical bracketed exposure shots like underexposed, normally exposed and overexposed. Every exposure contains relevant information that is not present in the other exposures. The low frequency brightness change, which is not present in the original image set. It is caused by a highly varying change in brightness among the different exposures. Constructing a higher Laplacian pyramid partially solves this problem. However, the pyramid height is also limited by the size of the down sampling/up sampling filter.

The technique blends images in a multi-exposure sequence, guided by simple quality measures like saturation and contrast. This is done in a multi resolution fashion to account for the brightness variation in the sequence. Quality is comparable to existing tone mapping operators. The approach is controlled by only a few intuitive parameters, which can be updated at near-interactive rates in our unoptimized implementation.

To investigate different pyramidal image decompositions, such as wavelets and steerable pyramids. More measures are included in particular one that would detect camera noise. An optimized GPU (graphical processing unit) implementation would enable the user to interactively control the fusion process, but could also be used to display a multi-exposure video stream in real-time. Finally, the technique to image fusion tasks is carried out in order to look into the applicability depth of field.

CONCLUSION



8. CONCLUSION

A new fusion scheme by taking into account local variation and gradient reversal suppression. The visible scene contrasts and the scene gradient can be captured by adaptively utilizing different exposures. A gradient model has been then proposed to carry out the scene reproduction (i.e., SDR (Standard Dynamic Range) image synthesis) by preserving both the visible contrasts and the gradient consistency. Apply new scheme to the scene capture and display by using SDR devices, and it is demonstrated that, the proposed scheme renders the visible contrasts and maintains the gradient consistency effectively.

The technique blends images in a multi-exposure sequence, guided by simple quality measures like saturation and contrast. This is done in a multi resolution fashion to account for the brightness variation in the sequence. Quality is comparable to existing tone mapping operators. The approach is controlled by only a few intuitive parameters, which can be updated at near-interactive rates in our unoptimized implementation.

FUTURE ENHANCEMENT



9. SCOPE FOR FUTURE ENHANCEMENT

The future work to improve the color consistency of the fused images, more suitable color space and color recover scheme should be investigated. Expansion and generalization of the image features is used to improve their versatility and potential for the use on ITER. Plans are made to continue our effort in the area of plasma safety by monitoring issues regarding plasma control, plasma shutdown, and plasma disruptions as they affect safety. Specifically, safe shutdown concepts, runaway electron generation and deposition, and liquid surface induced disruptions and their severity to support future reactor concept design studies are examined.

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BOOK REFERENCE

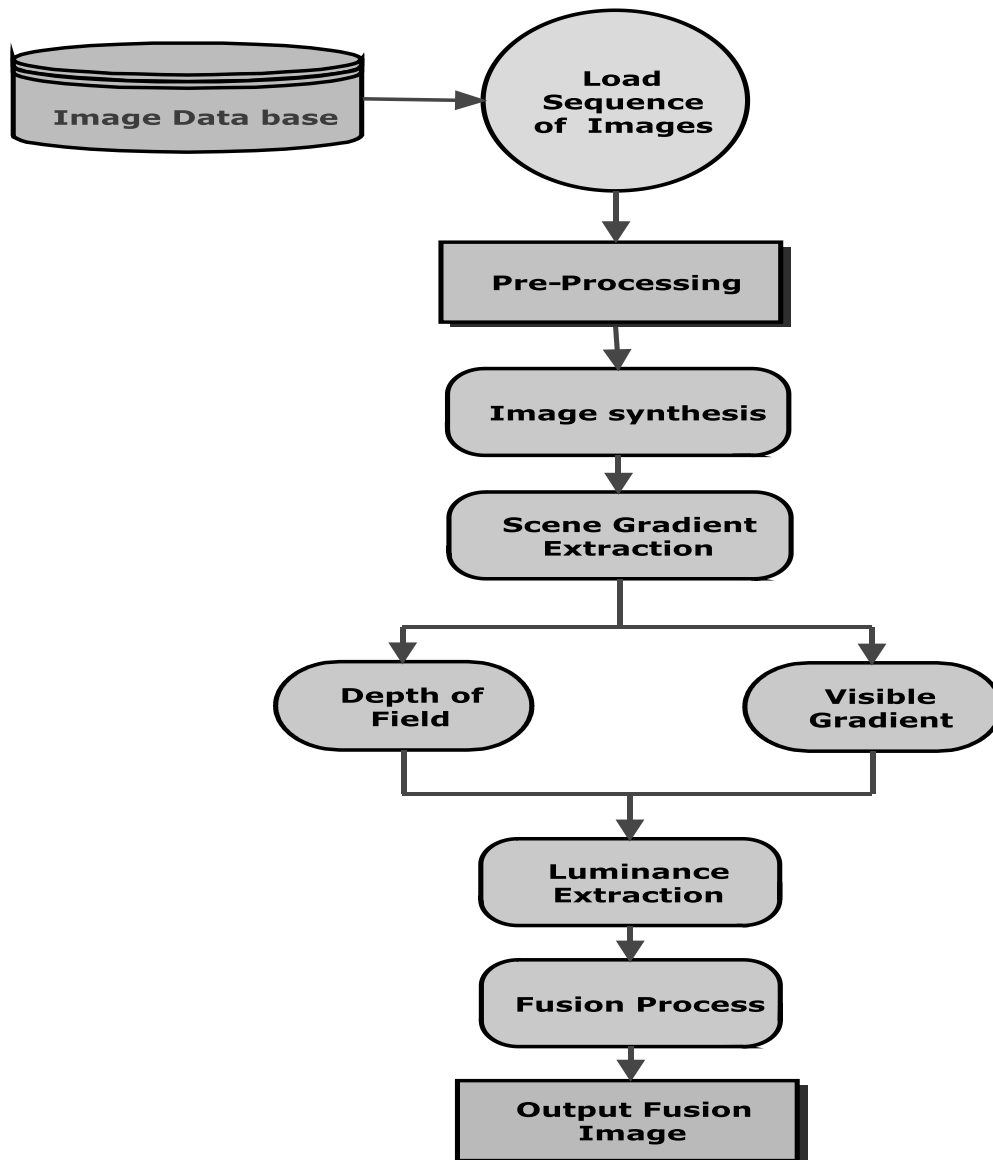
- ✓ Digital Image Processing-Jayaraman.S,Esakkirajan.S,Veerakumar.T
- ✓ Digital Image Processing-3/e(New Edition)-Rafael C.Gonzalez
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APPENDIX

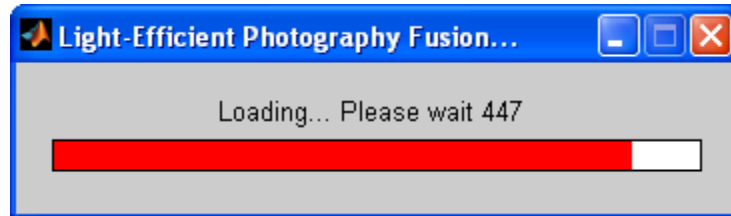


APPENDIX

SYSTEM FLOW DIAGRAM



SCREEN SHOTS



Loading Wait Bar

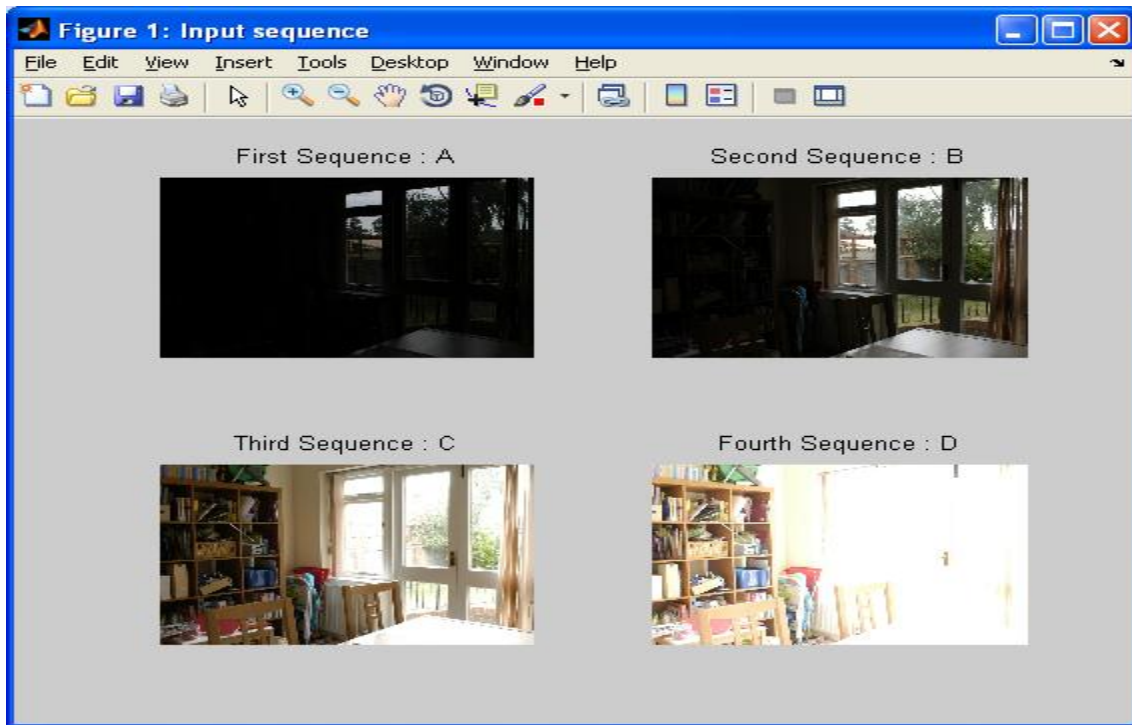


Fig 1: Input Sequence Image

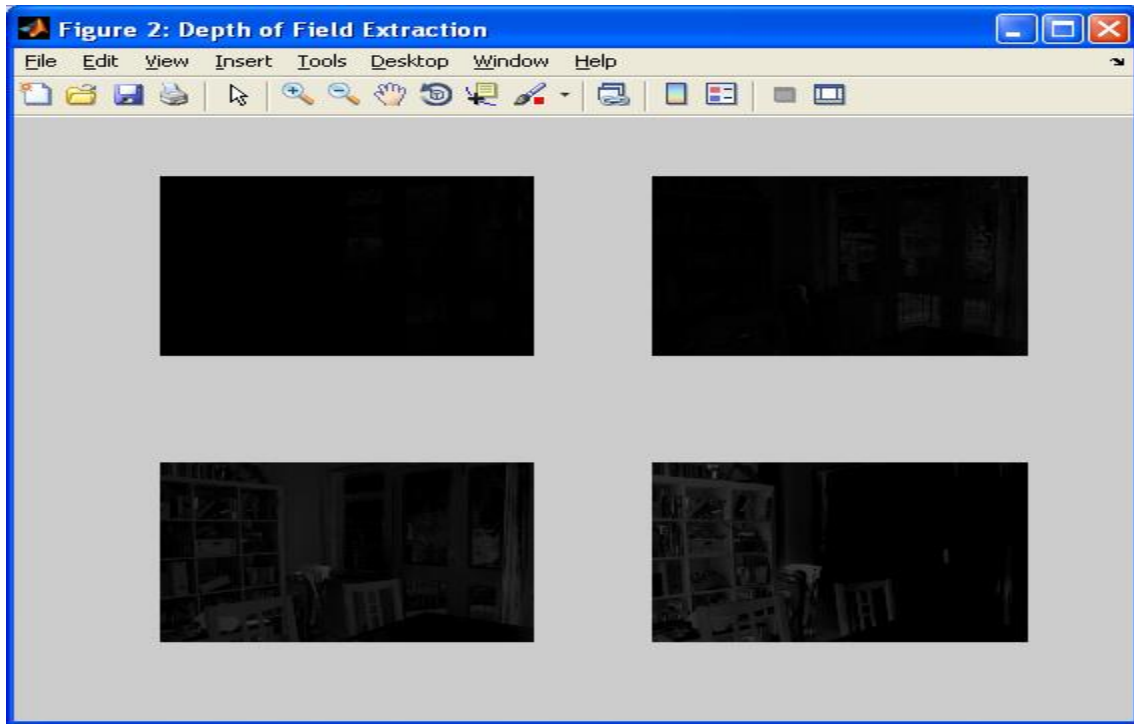


Fig 2: Depth of Field Extraction

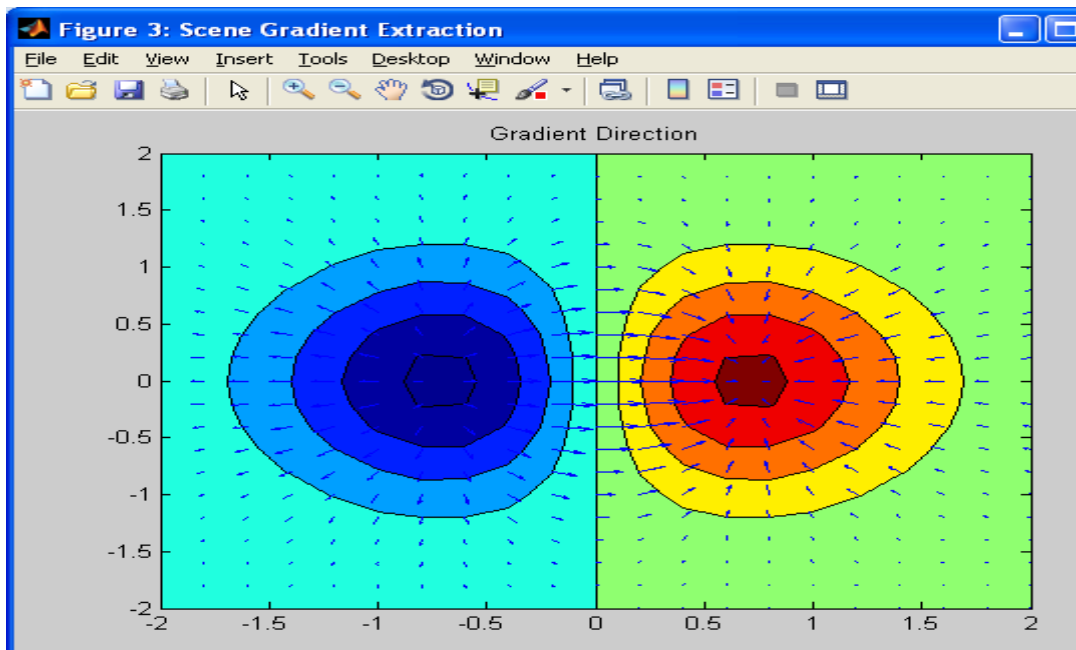


Fig 3: Scene Gradient Extraction

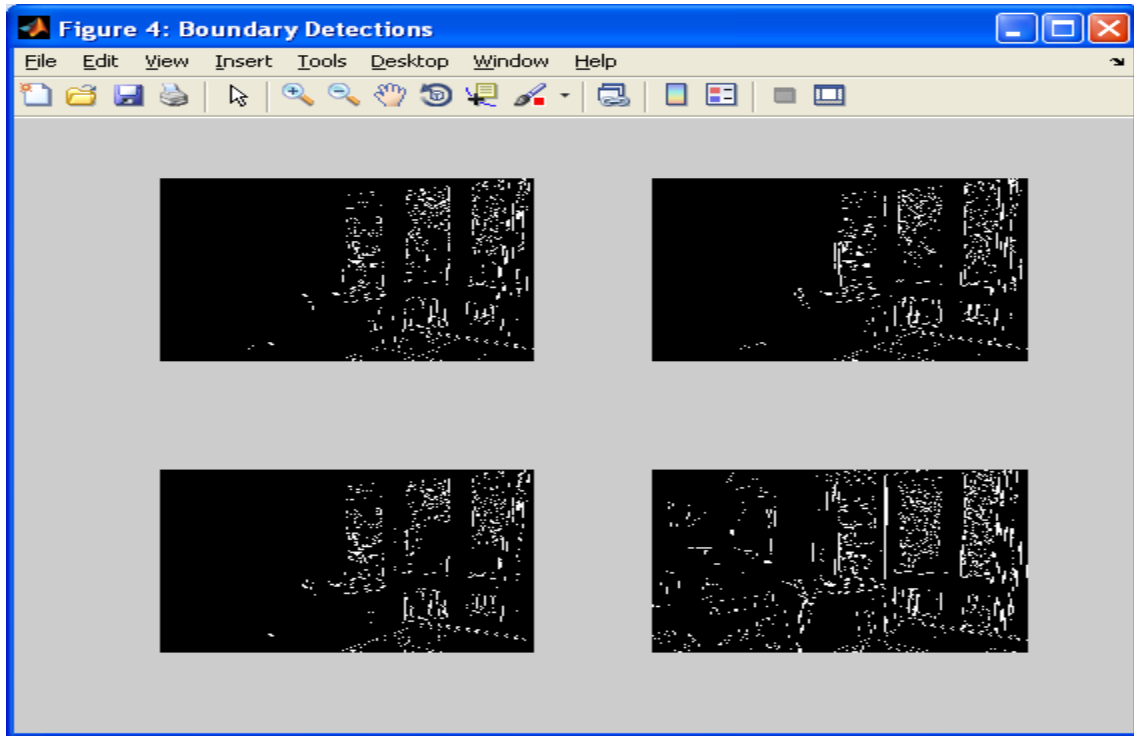


Fig 4: Boundary Detection

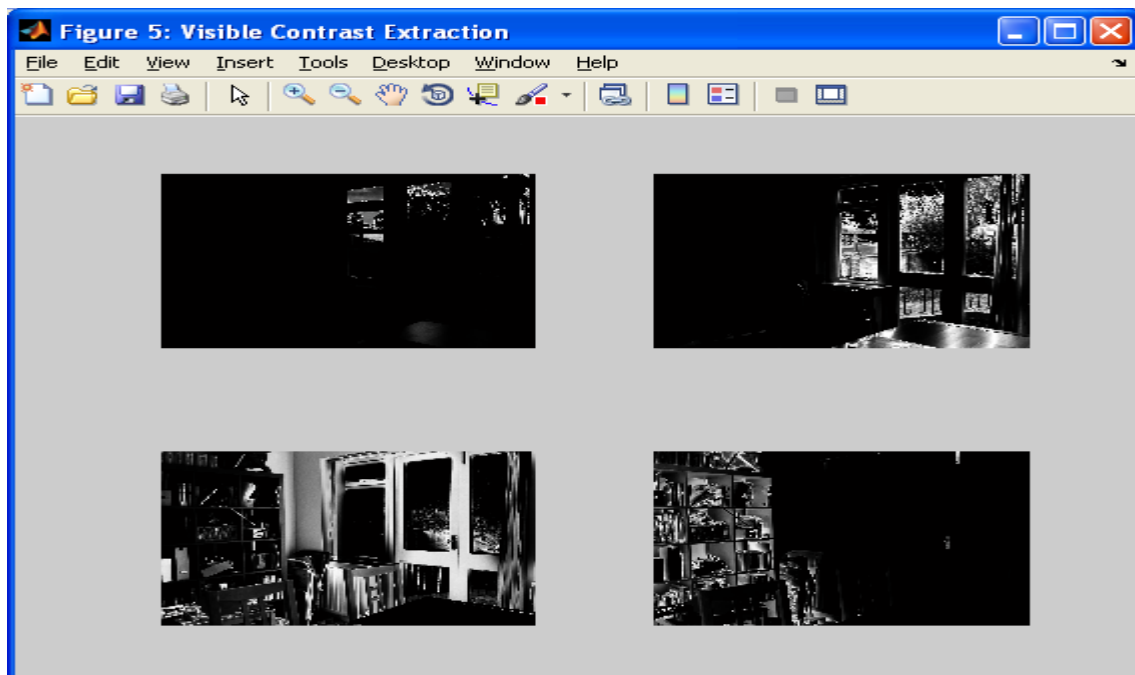


Fig 5: Visible Contrast Extraction

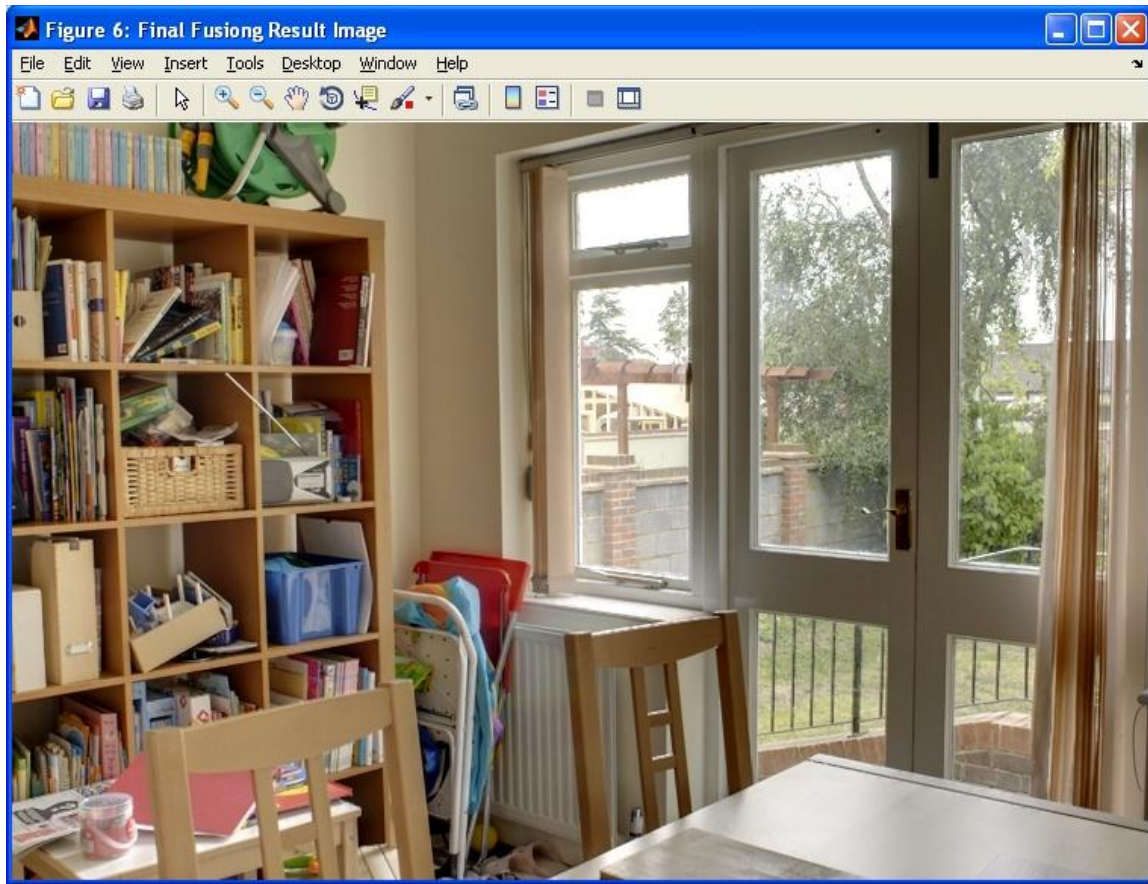


Fig 6: Final Fusion Image