3-D Image Reconstruction from 2-D Image Using Lab VIEW

N.V.SaiSwaroop, A.V.S.S.T.Siddharatha, A.SriNath, S.Vandana, G.Shanthi

Abstract- Traditionally, ophthalmologists and neurologists are depending on 2-D images for detection of retinopathy and fractures in the skull and their diagnosis. Analysis using 2-D images has certain limitations such as intensity and color of the same physical positions may vary considerably across consecutive images. Secondly, the shape of retinal fundus is almost planar, which makes the estimation of depth more difficult. Analysis of the skull is also complex by viewing it from single two dimensional view. So, objective of our paper is 2-D registration, depth extraction and 3-D reconstruction of an image.3-D reconstruction system is needed, which enables the ophthalmologists and neurologists to monitor the depth variations from the desktop itself.

In this paper, a 3-D depth extraction and reconstruction system is designed and developed to estimate the depth variations as well as identify the defects of the images. This paper has enumerated the use of Lab VIEW to implement a complex 3-D depth extraction and shape reconstruction system which is of lower cost and of acceptable performance.

Key Words: 2-D registration ,Depth Extraction, 3-D reconstruction, Lab VIEW.

I. INTRODUCTION

Medical Imaging techniques are used for diagnosing and treatment of many diseases as well as surgical operations. CT and MR imaging techniques are the mostly used ones. Reconstruction of 3-D volume and surface models of the tissues, by using 2-D image slices, provides many advantages to medical doctors. 3-D models have gained its importance and are used in medical applications. During the treatment period, tracing the temporal changes of the abnormalities is a very important task for deciding whether the treatment is positively effective or something going wrong. For detection of changes that appear in tissues, firstly the location and the geometric quantities of the abnormal regions are required. For example, the volume and the surface area of the tumor are to be known for temporal comparisons.

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Furthermore, it is also important to know the location of the abnormalities according to some reference points which were cited on the external surfaces of the body such as human face and internal abnormalities such as defects in retina. 3-D image diagnostic equipments such as CT scanners, MRI, 3D-4D ultrasound etc. have been used widely; they are used just at some high quality hospitals and medical centers.

These equipments have been alternatively assisted by information technology, which need strong computers with dedicated soft wares. At present, such high-tech equipments are unable to be manufactured with domestic technology, but feasible developing supporting accessories and soft wares can enhance their utilization effectively and reduce the dependence on foreign maintenance system with high cost. On the other hand, medical information system does not shape clearly; medical units in national health care system have not united yet in any standard process to operate image diagnostic equipments or to manage patient data. Therefore, a project making facilities for medical information system in general and for medical imaging in particular has been alternatively developed in order to master mentioned 3-D technology and to develop domestic products partially taken place of very expensive imported facilities and soft wares. This paper introduces some results of reconstructing 3-D images of skull and also depth extraction and its variation of retinal images, which are necessary tools for medical image processing.

3-D reconstruction and depth extraction are used for detection and differentiation of the retinal images and skull. Computer based diagnosis of the retinopathy is proven effective in research labs. But, unfortunately, many of these advances have subsequently failed during transition from the lab to the clinic. The best way to diagnose and treat retinopathy is by studying the depth variations of the retinal fundus by using 3-D reconstruction techniques. In the same way, fracture or any other defects in the skull can be identified by reconstructing the skull in 3 dimensional format using number of MRI slices of the skull.

By the application of 3-D reconstruction techniques, it is possible to

- Analyze retinal images
- Detect the defects in the retina
- Obtain the depth map of different images
- Analyze the skull images

II. PREVIOUS WORK

A novel information processing algorithm was developed to reconstruct a real scene with two static images taken of the scene with an un-calibrated camera. The algorithm displays the two images and the user matches corresponding points in both images[1]. A method for 2-D registration of retinal image sequences and 3-D shape analysis from the fluorescien images was presented in which Y-feature extraction method finds a set of Y-feature candidates using local image gradient information. To reconstruct the retinal fundus in 3-D, the extracted Y-features are used to estimate the epipolar geometry with a plane and parallax approach[2]. A novel method for 3-D shape recovery of faces that exploits the similarity of faces. This method obtains as input a single image and uses a mere single 3-D reference model of a different person's face[3]. An algorithm is designed to reconstruct 3D models of human body by using CT, MR slices and digital images and precisely finding locations of pathological formations such as tumors. For this purpose, software was developed, called as "Medical Image Processing and Analysis System (MIPAS)"[4]. The primary contribution of the algorithm is the development of a novel method for automatic facade reconstruction, which when applied to the coarse model automatically adds facade details such as recessed windows and doors. The proposed method is based on analyzing the appearance of the facade, and this is achieved using methods for image processing and pattern classification[5].

III. OBJECTIVE OF THE PAPER

Previously retinal image analysis and skull reconstruction has focused on 2-D registration. Since the retinal fundus has depth variation, 2-D registration cannot account for these depth variations and residual errors must be expected and skull reconstruction requires MRI images of the skull.

In this paper, an approach to obtain 3-D reconstruction and depth mapping from different 2-D images such as retinal images, MRI images and human faces etc… is done. A simple essential matrix based on self-calibration approach is employed. Image registration, segmentation and pixel mapping is done for 3-D depth extraction of retinal images and human faces. For reconstruction of skull, obtaining a 3-D array from the MRI slices and iso-surface extraction is done to obtain the complete 3-D reconstructed skull.

This reconstruction helps in identifying the defects in the skull and also in diabetic retinopathy. Depth extraction of human faces helps in further improvisation of the faces for complete reconstruction in the future.

IV. IMPLEMENTATION

The 3-D reconstruction system was developed with Lab VIEW, which has different stages. The input to the system is an unknown retinal fundus image or MRI slices or human faces images, while output is the 3-D reconstruction result, identifying the depth variations.

2-D image of retinal fundus or series of MRI images or face images are taken for reconstructing the 3-D shape of the skull or 3-D depth map of retinal fundus. This proposed method can provide a useful tool for ophthalmologists in the identification of defects in the skull or eye and is helpful in diagnosis of retinopathy or analysis of fractures or defects in the skull.

The above tasks are achieved using Lab VIEW software. The software analyses the image, identifies the control points, estimates a depth mask and finally generates a 3-D image from a new view.

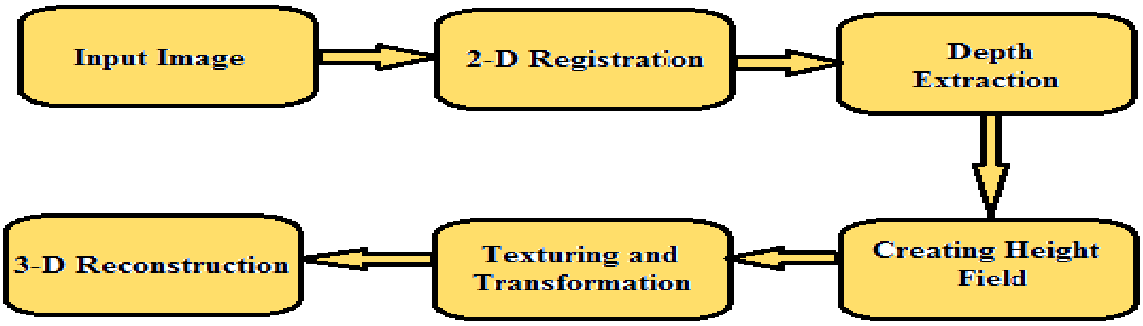


Fig 1: System Block Diagram of 3 D Image Reconstruction

A. 2-D Image Registration

Each image that has to be reconstructed in 3 dimensional format should be registered initially. Image registration is the process of establishing point-by-point correspondence between two points of an image. This process is needed in various computer vision applications such as stereo depth perception, motion analysis, change detection, object localization, object recognition and image fusion.

Image registration is a crucial step in all image analysis tasks in which the final information is gained from the combination of various data sources like in image fusion, change detection, and multichannel image restoration. Typically, registration is required in monitoring 2-D image.

Registration methods consist of the following four steps:

1. Feature Detection:

Salient and distinctive objects (closed-boundary regions, edges, contours, line intersections, corners etc…) are manually or automatically detected. For further processing, these features can be represented by their point representatives (centre of gravity, line endings, distinctive points etc…) which are called control points (CP's).

2. Feature Matching:

In this step, the correspondence between the features detected in the source image (2-D Image) and those detected in the image (3-D Image) is established. One or more feature descriptors and similarity measures are used for that purpose.

3. Transform Model Estimation:

The type and parameters of the mapping functions, aligning the source image with the targeted image, are estimated. The parameters of the mapping functions are computed by means of the established feature correspondence.

4. Image Re-sampling and Transformation:

The source 2-D image is transformed by means of the mapping functions. Image values in non-integer co-ordinates are computed by the appropriate interpolation technique.

B. Depth Extraction of an Image:

Depth extraction is a crucial step in all image analysis tasks in which the final information is gained from the combination of various sources like in image creation, change detection and multi-channel image restoration.

Depth extraction involves in the following steps:

1. Acquiring an Image:

Initially, a temporary location is created for the image using IMAQ create. IMAQ load image dialog specifies a path to the images acquired from the computer. Once the image is acquired, the type of format of the image is identified or read using IMAQ read file and then used for further processing.

2. Image Plane Extraction:

In this step, from the obtained image a single color plane is extracted. Using 3-D options, a cluster of elements can be controlled in this step. Elements such as alpha(light intensity), image size, direction of the image etc…

3. Depth map generation:

Depth map is obtained using the 3-D view option in the vision module. This helps in obtaining the depth map of an image. We obtained the depth of a retinal image. From the depth map, we identified the defects in the retina. Diabetic retinopathy can be identified and diagnosed.

C. Improved Image height field of an Image

For obtaining a better 3-D reconstructed image based on height field from an image taken in a single view, the following steps are required:

1.Acquiring the image:

Image is acquired using the image from the image dialog box or path to jpeg file. The obtained image is then read; this creates the data necessary to display the file in a picture control.

2.Pixel to array conversion:

Unflattened pixel mapping helps to convert a cluster of image data into a 2-D array. Creates an array of double data type that has same dimensions as that of original image. Then, initialization of array is done. This helps to create a n-dimensional array which every element is initialized.

3.Creating height field:

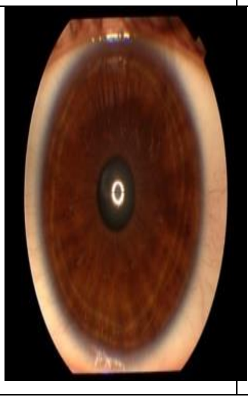
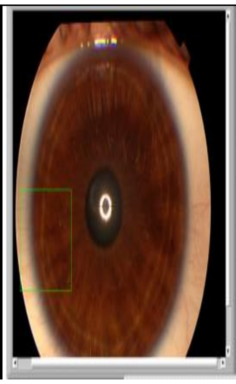
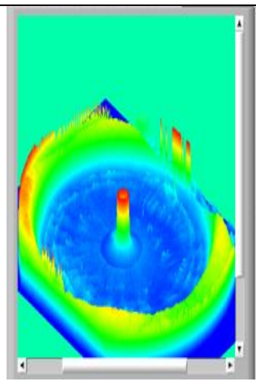
The obtained 2-D array is then used for creating height field. The array of values represent the height of the surface. Each entry in the data array specifies a point up to which the height of the image is obtained.

D. 3-D Image Reconstruction

The image acquired is then given to a read image dialog box which converts the data of the image into a 3-D array. In the 3-D array, x co-ordinates and y co-ordinates are pixel spacing's in x and y directions and z is the slice thickness. Using these co-ordinates, the iso-surface and iso-normal of MRI images are obtained. 2-D viewer control is used to obtain the 2-D slices of the MRI images. The iso-surface and iso-normal of the images are given to the 3-D picture control for obtaining the 3-D reconstructed image in different views.

V .EXPERIMENTAL RESULTS

In the Depth Extraction of an image the 2 –D Retina, Human Face and Skull are provided in the image paths in the block diagram view and the 3-D Depth Extraction and Improved Height Field of the respective images are obtained in the front panel of Lab VIEW.

	Input Image	**2-D Registered Image**	**3-D Depth Extracted Image**	**Improved Height Field**
Retinal Image Reconstruction				

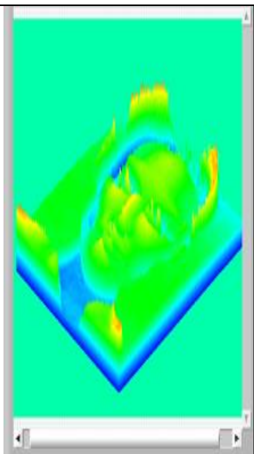
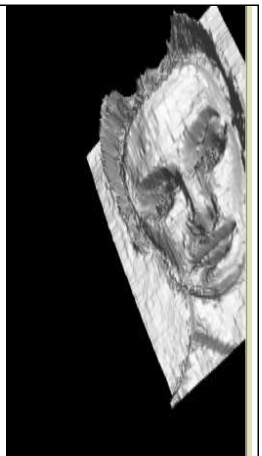
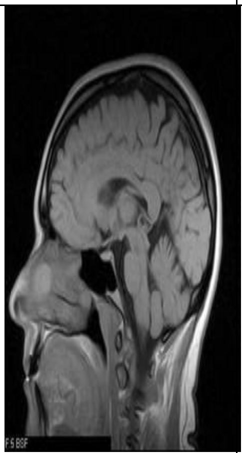
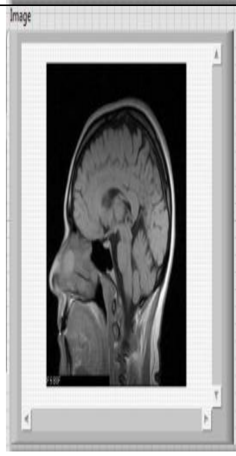
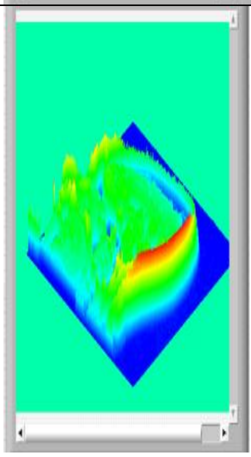
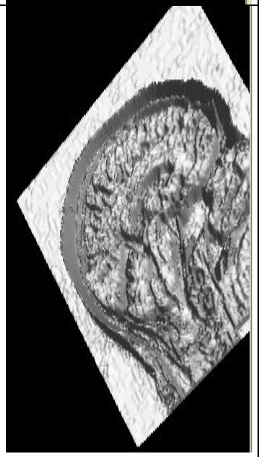
Human face Reconstruction				
Skull Reconstruction				

Fig 2: 2-D Registered Image, 3-D Depth Extracted Image and Improved Height Field Images of Retina, Face and Skull

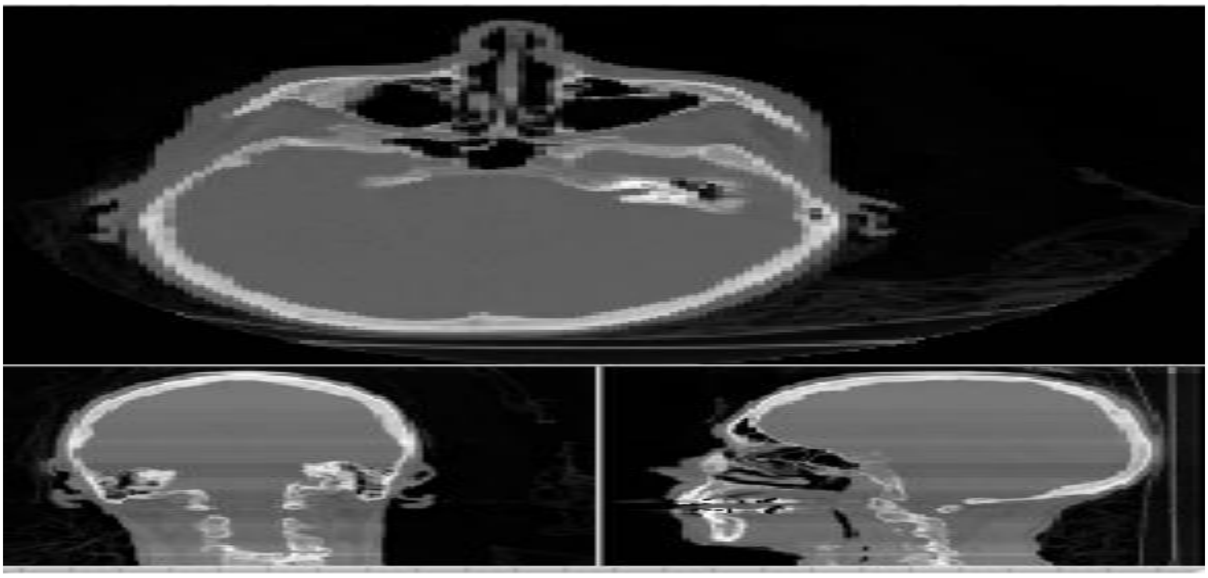


Fig 3: 2-D Image of Skull in Different Views

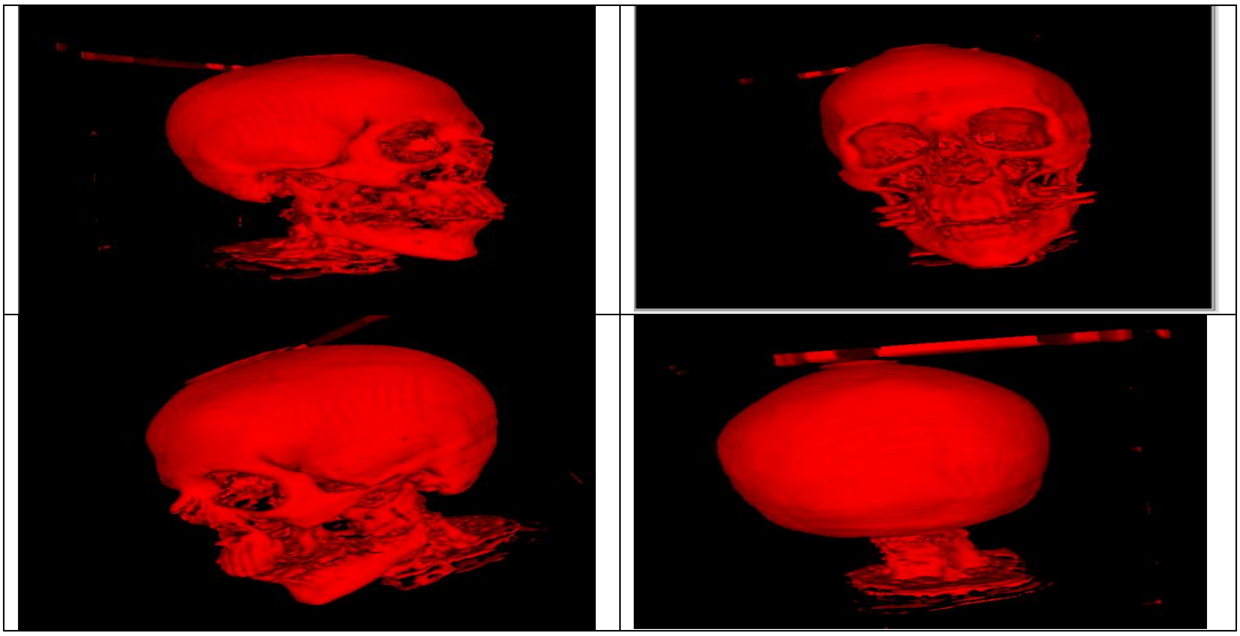


Fig 4: 3-D Reconstructed skull in different views

VI. APPLICATIONS

The 3-D Reconstruction of Images has vast application areas which include **Medical Applications** like Reconstruction of 3D skull for fracture identification, Forensic labs during crime inspection, Retinal fundus defects identification, Extraction of geometric features of biological objects, Surgery ,Anatomy ,Tomography, Angiography and **Imaging Applications like** Face Recognition, 3D Digital Elevation Model Generation, Developing 3D movies to experience the virtual situation as if it is real, Morphological reconstruction of images, Visual effects in gaming, Holography , Stereo photography, Data acquisition.

VII. ADVANTAGES AND LIMITATIONS

The Advantages of this technique is it can process Real time bio-medical applications and the system is Cost effective. This method can handle static images of varying lighting conditions and the image will be High quality reconstructed image. The system is User friendly and it has Good hardware compatibility and improved measurement precision.

The main limitations are the images that are used should be of constant light intensity and the Retinal images should be of almost similar contrast. Reconstruction of MRI images are of database consisting of large number of images and Depth extraction of faces is identified well only in the front view rather than side views.

VIII. CONCLUSION AND FUTURE ENHANCEMENT

A set of methods and tools for image registration and 3D reconstruction are presented. Different image registration and 3D depth extraction algorithms are implemented and their detection quality and features are compared. The reconstruction method using multiple MRI images gives the most promising results in terms of obtaining the complete 3D image of the skull and helps in analyzing the computational complexity to be used in a real-time video sequencing system.

The proposed feature extraction and feature point matching algorithm successfully enhances the 3D reconstruction of the images obtained from different frames. Our tests in sample applications shows the retinal defects which uses depth extraction algorithm and gives promising results in 3D skull reconstruction which analyses any defects in the skull and more complicated methods are necessary for reconstruction of face and other images. Depth extraction algorithm gives a 3D view of the images which is helpful in different bio-medical and industrial applications.

The method presented for 3D image reconstruction shows promising results and can be used as part of real-time systems. However, no reconstruction algorithm is perfect, so is our method since it needs improvements in constructing every image and also should be implemented for video sequences. An image segmentation and feature extraction algorithm can be implemented for this purpose. Currently, data collection from MRI and CT scans is a laborious and time-consuming process of amassing a series of point-to-point measurements. The automated capture of 3D data from CT scans is an imminent proposition, but will not be cost effective for facial reconstruction in the near future. Methods for ageing a reconstruction or for making comparisons with digitized missing person's databases are also far off. The real-time surveillance system presented can be utilized as a base for more advanced research. 3D imaging enhances the target recognition capability due to the improved imaging quality obtained from the reconstruction from different views.

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