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Conversion of 3D Medical Image Model into Augmented Reality World

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ABSTRACT: The learning framework has evolved during the years, particularly when joined with advanced technologies. This blend has set out new development to open doors and adds quality of learning through various view points. The augmented reality is the advanced field which helps to merge virtually constructed object with the real scene. This paper established a way to superimpose the virtually constructed object over the real scene. The collaboration of real and virtual object from various sources help medical practitioners to learn human anatomy which can show human organs in a detailed manner, assist doctors in treatment planning and helps to construct the surgical simulators.

KEYWORDS: Superimposition based Augmented Reality; 3D Reconstruction; Iterative Closest Point algorithm.

I. INTRODUCTION

Virtual and augmented reality occupies a crucial part in the field of clinical training. In view of the degree of drenching, the reality can be ordered under three, they are completely vivid, semi vivid and non vivid. The completely vivid procedure is additionally called by virtual reality, where the specialist doesn't know about this present reality situation. The specialist is totally associated with the artificially constructed world. In semi vivid the expert is to some extent mindful about this present reality. It is referred by the name of augmented reality. So the specialist knows about both the genuine and virtual world. There is another subcategory in semi vivid named blended reality. The difference between the blended reality and augmented reality is, in the blended reality the virtual articles are profoundly coordinated with this present reality objects. The non vivid virtual reality is additionally known by WoW (Windows on World) where the professional is totally mindful about this present reality situation; the virtual object is worked just through the work area screens. The augmented reality was sub classified into two; they are see through augmented reality and pass through augmented reality. See through augmented reality utilized glasses, which permit members to feel the virtual component blended in with this present reality object. In pass through augmented reality a virtual component is superimposed over this present reality object, which is seen by tablet, laptop or desktop cameras.

II. RELATED WORK

In AR surgical simulation, anatomical 3D model incorporates rich and in depth information that are developed from Computed Tomography (CT) or Magnetic Resonance Imaging (MRI). During the surgery, the constructed 3D models are registered to the real surgical scene and mixed with the reality by one of the means of 3D image overlay [1-5], optic see-through display [6-9], video see-through display [10-12] and projector-based mapping [13, 14], to provide surgeons augmented view.

Registration [15] is the core of AR, which aligns the virtual scene with the reality. Souzaki et al. [16] presented an Augmented Reality navigation system for surgery of oncology using a fiducial marker-based registration algorithm with an external tracking device.

Su et al. [12] proposed a navigation system to perform surgery in an augmented reality environment which uses a 3D cloud registration technique with manual initialization to overlay the virtual content in real. Puerto- Souza et al. [17]

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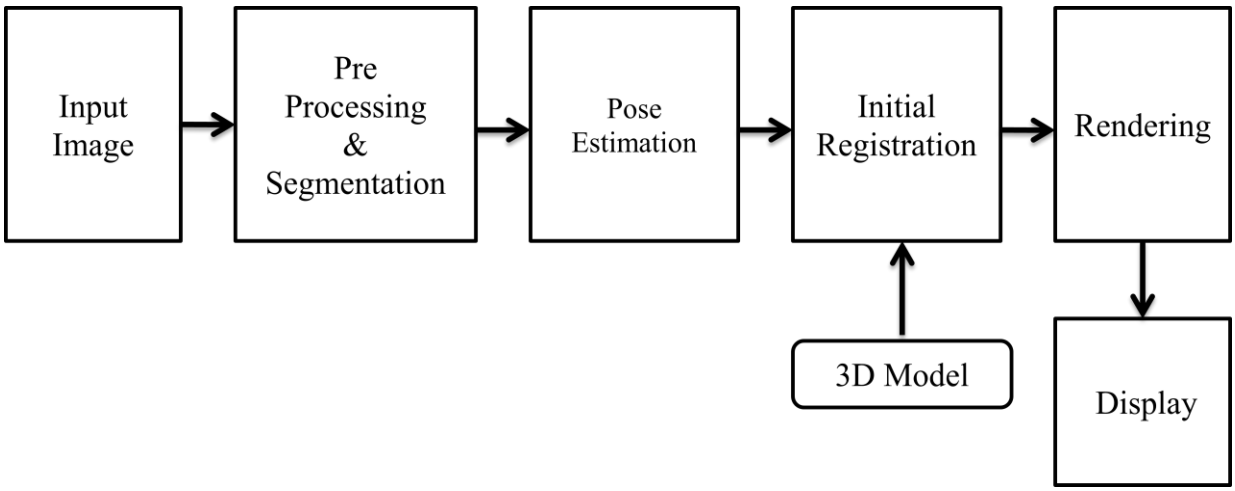
presented an image based tracking system for AR display. Initial registration is expected to align the 3D anatomical model with the live video stream, and fine registration is performed to successive video frames to perform the correct overlay. One method for accomplishing marker-less picture registration for stomach surgery in a stereoscopic laparoscope manner in order to recreate 3D surface of the organ which is additionally enrolled to its preoperative CT model utilizing an rigid or affine shape matching plan.

In paper [18] author recommended a semi automatic marker less augmented reality approach in order to provide on patient visualization of medical data. Which incorporates Kinect device to capture the real depth scene, it was developed by Microsoft Kinect. The variant of iterative closest point algorithm is implemented to provide this visualization.

III. PROPOSED ALGORITHM

The proposed technique converts the 3D medical model into superimposed based Augmented Reality world. The steps incorporating in this procedure is described in Figure 1. It has the following phases, pre processing and segmentation, pose estimation, initial registration, rendering and display.



A. *Input Image:*

Input image used in this section are downloaded from kinect head pose estimation web repository [19], which have twenty four different persons head poses along with its depth image information such as roll, yaw and pitch along with its camera calibration matrix.

B. *Pre processing and Segmentation:*

The region of interest is extracted from the image. In segmentation phase human head is segmented to perform the registration.

C. *Pose Estimation:* pose of the depth image is extracted from the database.

D. *Initial Registration:* The 3D model is constructed from brain MR images that have been downloaded from brain web repository[20]. The steps incorporated in 3D model construction are preprocessing, segmentation and 3D Reconstruction. The preprocessing is performed to remove the artifacts present in the brian MR Image, Distance Regularized Level Set Evaluation is used to segment the pre processed images. then marching cube algorithm is used to construct the 3D model. Then the constructed 3D model is registered with the depth data downloaded from Kinect web repository. Only initial registration can be performed here, because the images used to construct the 3D model is different from depth images, that is these are two different persons data. So only initial registration can be

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performed, no fine registration can be accomplished. The Iterative Closest Point algorithm is used to perform the registration procedure. The working principle of ICP is The points are obtained from depth and constructed 3D model. It performs the translation and rotation operation to move model over the depth data and performs alignment based on matching points. Then performs registration operation.

E. *Rendering and Output:* finally rendering is performed and super imposed based Augmented Reality output will be displayed over the screen

IV. SIMULATION RESULTS

The proposed conversion technique is implemented with MATLAB. The depth images used in this research work is shown in Figure 2. The constructed 3D medical model developed from Magnetic Resonance Images is shown in Figure 3. The constructed 3D model is rotated appropriately with the depth images roll, yaw and pitch information and it is shown in Figure 4. The final super imposed based augmented reality is shown in image Figure 5.

Fig 2: Kinect head pose estimation depth image frames

Fig 3: Constructed 3D head model

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Fig 4: The constructed 3D model is rotated appropriately with the depth images roll, yaw and pitch information

Fig 5: The final super imposed based augmented reality results

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V. CONCLUSION AND FUTURE WORK

The Augmented Reality takes an important role in learning human anatomy and surgical training. Presently medical students learn human anatomy using textbooks, 2D atlases, 3D mannequin and by dissecting cadaver. The textbooks, atlases and mannequin do not provide the actual portrayal of human anatomy. Cadaver dissection takes the dominant place in anatomy education, but lack of cadaver availability and cost becomes an obstacle. This Augmented Reality application helps to learn human anatomy system along with its cross sectional views and integral details in an expertise manner, and it helps in providing surgical training such as laparoscopic and endoscopic surgeries.

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