DETECTION OF CT MARKERS POSITION AND ORIENTATION FROM CT-SCAN IMAGE FOR NAVIGATION DENTAL IMPLANT SYSTEM

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ABSTRACT

The dental implants are important part of the rehabilitation of the human dentition. The implants are inserted into the bone of the jaws. The navigation dental implant system used computer and camera system for real-time navigation and tracking of the drilling guide of the dental implants. So the process requires the registration of the teeth position in the oral cavity with the CT-scan images (DICOM format) which contain CT markers. The aim of this research is the development of markers for positioning the dental template for transferring the CT information to the surgical field for real-time navigation. The methodology begins with the design the patterns of CT markers for CT guide. CT guide is made of acrylic which contains about 9-10 ceramics spheres (2.1 mm diameter). A U-shape registration is attached with the CT guide. The detection of CT markers from CT-scan images is the process of image filtering, binarization, edge detection and pattern recognition. The results show that the three-dimensional position and orientation information can be retrieved from CT-scan images for the navigation of the implant into the pre-planned implant location. In conclusion, we developed the CT markers and methodology for positioning and orientation of dental template for the real-time navigation and tracking system.

INTRODUCTION

Dental implantation is the process of the insertion of the implants into human jaws bone. The complicate procedure need to be carefully done. The navigation dental implant system used computer and camera system for real-time navigation and tracking of the drilling guide of the dental implants**.** The transferring information from the planning process to the tracking system needs to be accomplished for the real-time navigation. Researchers used the devices such as ultrasound [2], fluoroscopy and magnetic resonance [2] for the positioning information on medical devices in navigation applications [3]. But these equipments bought from aboard are very expensive. So this problem can be solved by the CT [5] markers development. The main concept of CT markers design is to transfer information from CT-scan images during them planning process to the real navigation tracking system [4].

METHODOLOGY

The development of CT markers can be separated into two parts. Part one is the design of the shape of CT markers, also part two is the development of algorithm of Image recognition for position and orientation [6] detection.

CT Markers Development
The design of pattern for CT Guide is done by the used of the CT scan image and the simulation of pattern of 9-10 small spheres that are shown in Figure 1. The next step is the design the CT guide that is made of acrylic which contains about 9-10 ceramics spheres [4] (2.1 mm diameter). A U-shape registration is attached with the CT guide (as shown in Figure 2.) After the CT scan process was done with the subject put the CT marker in the mouth, the CT scan data were analyzed with the developed algorithm for CT marker position and orientation detection.

Detection of CT Markers Position and Orientation
The detection of CT markers from CT-scan images is the process of image filtering [1], binarization, edge detection and finally pattern recognition [7]. The results of markers position and orientation detection are shown in Figure 4(a) and 4(b).
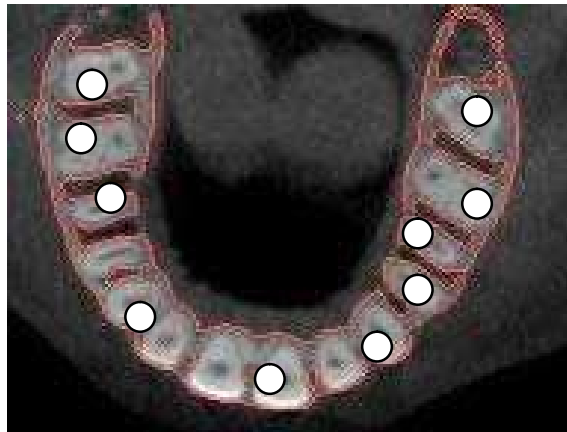
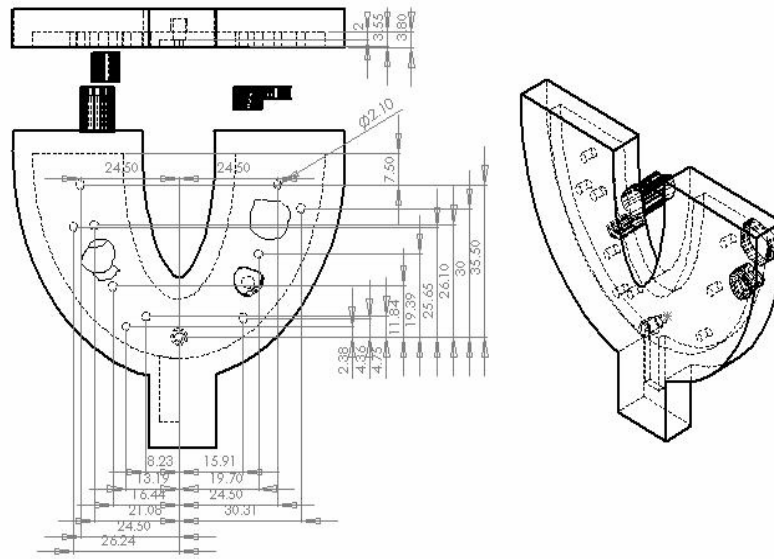Figure1. Simulation of markers pattern registered on human teeth in the CT-scan Image

Figure 2. The development of CT markers shape

RESULTS

(a)   (b)

Figure 3. (a) The developed CT markers pattern 1 (b) The developed CT markers pattern 2.
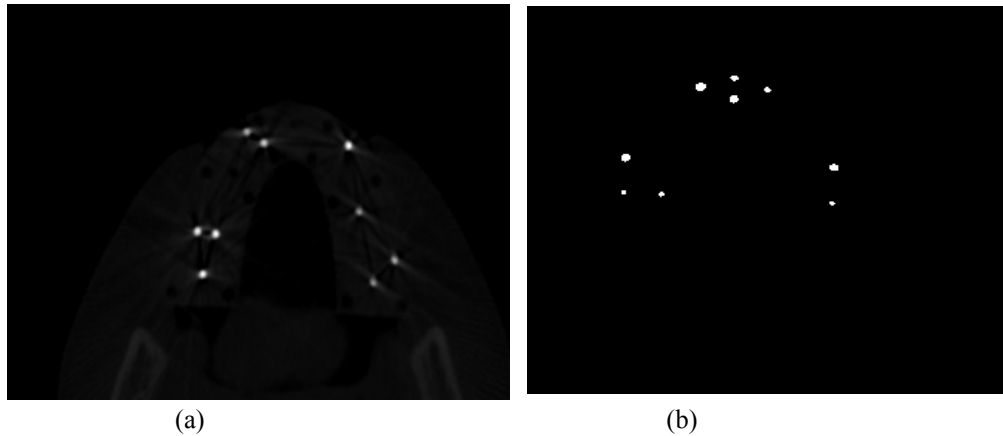
<div align="center">(a)   (b)</div>

Figure 4. (a) The detection of markers from CT marker 1. (b) The detection of markers from CT marker 2.

CONCLUSIONS

According to the results (Figure 3(a) and 3(b)) the designed CT markers with two different patterns are shown in Figure 3(a) and 3(b). After the scanning process was done, the CT images data (DICOM file) were exported as a CD-ROM. The procedure mentioned in methodology was implemented on CT images data for CT markers position and orientation detection (as shown in Figure 4(a) and 4(b)). We can get the position and orientation of the ceramic markers in CT images data, also the information from CT markers can be successfully transferred to the navigation tracking system. It implies that our development contributes the concept of transferring information from the dental planning process to the tracking system for the navigation dental implant system.

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