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ANIMATION OF CRYOSURGICAL PROCESS OF BIOLOGICAL TISSUES DURING TUMOR TREATMENT

Wei RAO, Z. Q. SUN, L. GUI, J. LIU[(a)]
Technical Institute of Physics and Chemistry, Chinese Academy of Sciences, P. O. Box 2711, Beijing 100080, P. R. China
[(a)] Tel: +86-10-82543765, E-mail: jliu@cl.cryo.ac.cn

ABSTRACT

Cryosurgery is being regarded as a very important minimally invasive surgical technique for treating tumors efficiently. However, strong lack of knowledge and acquaintance with cryotherapy significantly prevent people from choosing cryosurgery as medical option. In this study, by way of the graphic tools Flash 8 software, animation in the cryosurgical process of biological tissues subjected to freezing and thawing was made. The software thus developed can possibly be used in research institutes, medical clients, training division of medical equipment enterprise which will help promote the spread of advanced cryosurgery technology in future medicine.

1. INTRODUCTION

Owing to advantages such as quick, clean, relative painless, good hemostasis and reduced scarring, cryosurgery is regarded as a powerful way of destroying large tumors with strong anti-drug effects. However, it plays a much less prominent role in modern tumor clinics, compared with that of radiotherapy or chemotherapy serving as the current standard therapy methods. Although patients may always suffer serious pain or even injury during the treatment, radiotherapy or chemotherapy still keeps as the first choice for a cancer clinician. A key reason can be attributed to that most physicians received their training only on such traditional tumor therapies. That makes them feel more familiar with the medical strategy and get used to equipment thus involved. As a contrast, strong lack of knowledge and acquaintance with cryotherapy significantly prevent people from choosing cryosurgery. In fact, with high efficiency of acceptable treatment, the targeted tumor cryotherapy is rather helpful in improving both clinicians and patients' confidence in conquering tumor. Therefore, spreading the knowledge of the cryosurgery would significantly push forward its popularity and wide application.

To help users understand and get familiar with the cryosurgery, animation may be an effective way. With the appearance of powerful computers and better graphics capabilities, animations are increasingly used for interactive remote education. Here aiming to provide a relatively complete picture on the cryosurgical technique, a computer video film was made to animate the freezing and thawing process of a typical cryosurgery treatment protocol. Taking into account the most basic features of a cryosurgery, the film is treated as being consisted of several parts such as working principle of typical cryotherapy equipment, treatment planning for tumor therapy, procedure for operation regulations, image monitoring and evaluating process after operation. The animation is based on the accumulation of experimental data in our group, including book, pictures, video and data analysis (Liu, 2007; Deng and Liu, 2004; Liu et al., 2004; Yu et al., 2004; Yu et al., 2005). This system is expected to be useful in future education purpose, user manual and

product exhibition, which will positively help spread cryomedical knowledge expeditiously, and then promote cryotherapy in future tumor clinics.

2. PRODUCTION ENVIRONMENT

2.1. Hardware

CPU: Pentium IV
Memory: 1G
Hard disk space: 80 GB
CD-ROM drivers
Sound card.

2.2 Software

Operating system: Windows XP
Graphics software: Adobe Photoshop CS2, SolidWorks, 3D-Max
Voice software: Cool Edit
Animation software: Flash Professional 8, director MX.
The main tool for making the animation is Flash, which can produce high quality, scalable vector graphics and can be delivered in a small file size. Abundant organized photos and videos are inserted into Flash 8 to broadcast with a rate of 12 key frame per second.

2.3 Animation flowchart

The entire animation production process is shown as follows:

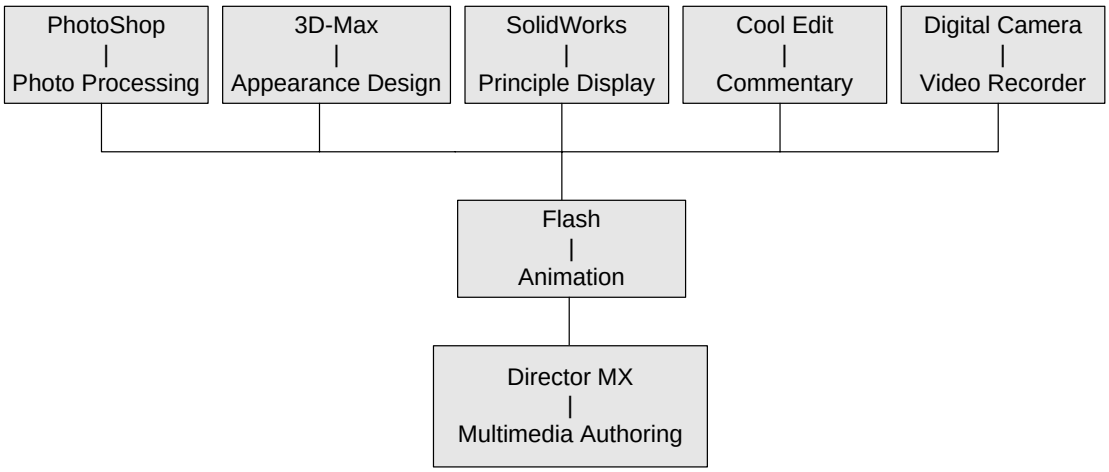

Figure 1. The proposed scheme for animation

3. DESIGN PROCESS

3.1 Target to be achieved

To achieve the goal of universal education, the animation should meet the following criterions:
(1) Easy to understand and convenient to spread. Rely on a number of lively content and form to remove the barriers between the public and cryosurgery.

(2) Scalability and applicability. It should be easy for the software to be upgraded. Meanwhile, in order to meet the needs of customers with various options, the software should be able to be operated in an ordinary personal computer.
(3) 3D demo. 3D animation is adopted to demonstrate principle, the operator interface and conceptual experiments of freezing-heating probe vividly, in line with the actual results.
(4) Video display. Startup of the equipment, the process of operation and surgery are displayed through real video display to illustrate the use of freezing-heating probe.
(5) Friendly human-computer interface and excellent operability. The animation has real-time operating functions, such as control of play, view of any size and arbitrary sectional drawing on the screens.

3.2 System architecture

The architecture of the system is displayed in Fig. 2. It consists of four active sub-menus and corresponding sub-sub menus.

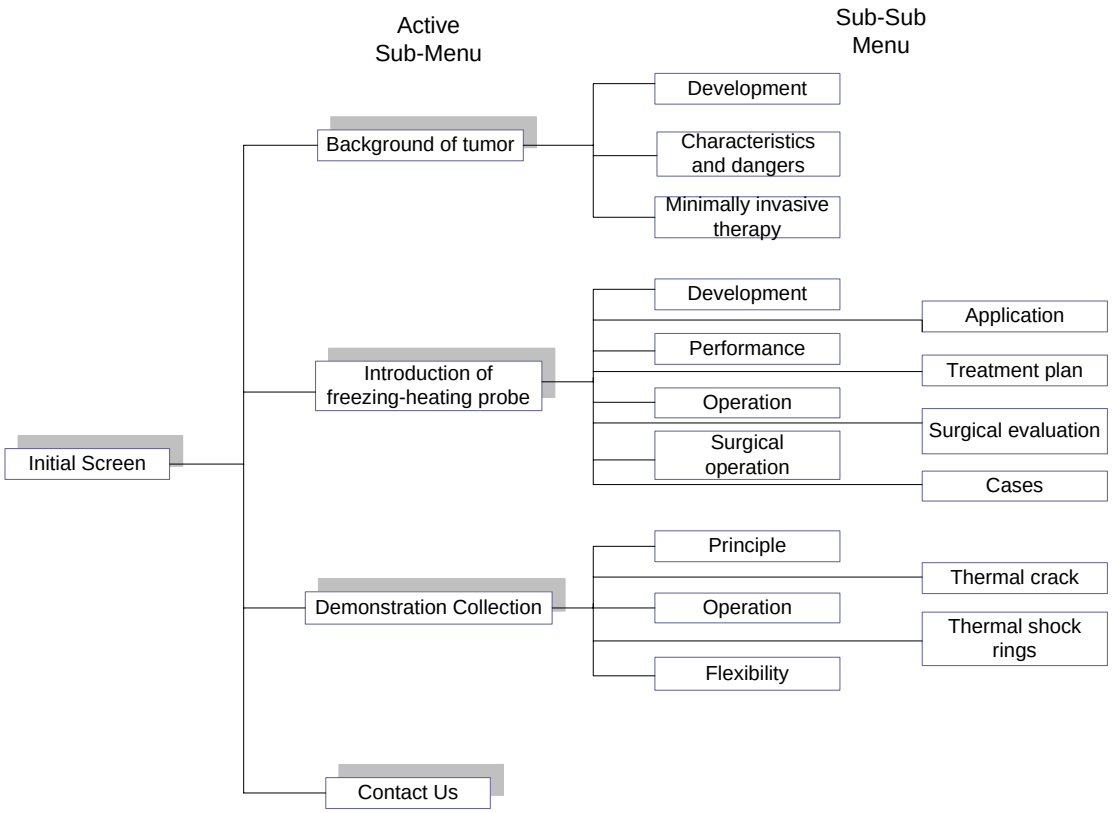

Figure 2. The architecture of the system

The background of tumor includes the introduction to the development of tumor in global, the characteristics and the danger of human tumor as well as roles of minimally invasive therapy in treating tumor. The information of tumor data and morphology in mouth cavity, skin, rectum, liver, stomach, lung, lactiferous gland, prostate and brain is displayed. Abundant practical photos from clinics and words are presented to describe the features and the fatality of human tumor. This part will help enhance people's understanding of tumor disease.
Introduction of freezing-heating probe is the focus of the animation, including invention and development history, performance, operation, surgery, application, treatment plan, surgical evaluation and cases report. To

describe the process of preparing the equipment, software and hardware control, monitoring surgery, the patient's data storage and other functions, continuous vivid pictures and videos are used. This section is of significant reference for clinical doctors.

Demonstration collection makes a list of some typical animation fragment, including principle of freezing-heating probe, operational steps of probe, generated ice ball with different shape, thermal crack in frozen samples subjected to re-warming, thermal shock rings induced in biomaterials subjected to strong freezing and heating. Visual and amazing display may serve to arouse the viewers' interest.

4. CASES

In initial screen (see Fig. 3), viewers can choose their interested content by clicking the mouse on the menu. By walking into each sub-menu, the sub-sub contents are embedded in a video Player (see Fig. 4), in which progress and the volume can be control freely and viewers can return to the main interface.

Figure 3. Main Interface

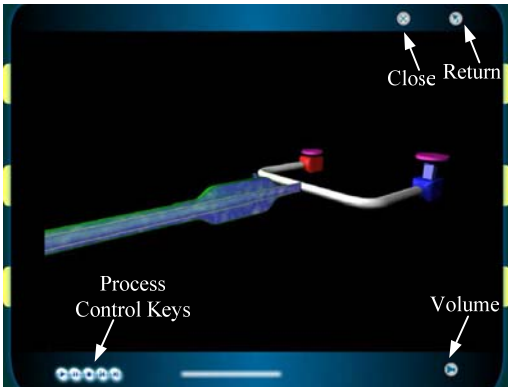

Figure 4. Sub Interface

5. CONCLUSIONS

In this paper, an animation of cryosurgical process of biological tissues is introduced. The design flow chart and the realization strategy are illustrated. By walking through the images and movies incorporated for each topic, viewers can easily choose either to study a specific step from one of the processes or to take a more immersive look at the process in its entirety. This 3D software is a user-friendly demonstration tool for the promotion of cryosurgical treatment.

Acknowledgment

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