

INFORMATION OF THE DOCTORAL THESIS

Thesis title: " *Research on 3D object surface simulation and application in pediatric training*"

Major: Computer engineering

Code: 9.48.01.06

PhD. Candidate: Nguyen Duc Hoang

Scientific supervisors:

1. **Assoc. Prof. Do Nang Toan, PhD**

2. **PhD. Vu Huu Tien**

Institution: Posts and Telecommunications Institute of Technology

NEW FINDINGS OF THE THESIS

The specific goal of the thesis is to propose several techniques to handle problems such as representing color and shape under the influence of external forces in the problem of representing the surface of 3D human objects in virtual space. The results of the thesis are directly applied to the representation of the skin of pediatric patients in a 3D virtual environment, which handles the representation of color and deformation of the skin due to influence of external forces. During implementation, the Candidate researches general techniques for 3D objects to handle object collisions and proposes a new technique that can be applied in many cases.

Based on the research on the above issues, the thesis has made three main contributions:

(i) Proposing a new method to improve the technique of determining collisions between two 3D objects in a virtual environment based on the use of two bounding box systems. This contribution could be considered as material, as it can be applied to solve many problems.

(ii) Improving the technique of representing the skin color of a 3D object that is a virtual pediatric patient due to external forces by applying the capillary refill time parameter and machine learning techniques. This is a medical problem only, parameters are set to meet the problem of pediatric emergency.

(iii) Improving the technique of representing skin deformation of a 3D object that is a virtual pediatric patient due to external forces simulating medical procedures such as pressing and touching. The technique allows for a large local increase in the mesh system in the area affected by external forces, increasing the detail but not increasing the storage capacity of the object. The subject's mesh system returns to its original state when the external force disappears. This is a medical problem only, parameters are set to meet the problem of pediatric emergency.

APPLICATIONS, PRACTICAL APPLICABILITY AND MATTER NEED FURTHER STUDIES

Based on the research of the thesis, the product belongs to the National project: "Research and development of a pediatric pre-clinical practice support system based on virtual reality technology." KC-4.0/19-25 has added features that allow for a more accurate representation of virtual pediatric disease simulations in practice environments for real-life training. In evaluating the effectiveness of the proposed technique, in addition to using quantitative measurement methods, an expert survey was also used with experts who are doctors at the Children's Hospital. The system has been practically deployed at Vietnam National Children's Hospital and four other pediatric hospitals in different provinces.

Some expected research that can be implemented after this thesis:

- (i) Building a model that represents interaction with the human skin surface with more input life parameters.
- (ii) Building a model to represent virtual patients and medical feedback based on machine learning.
- (iii) Finding techniques to automatically simulate human skin when encountering invasive medical procedures that break the surface layer.
- (iv) Research in influence of real-life human skin with uneven physical, chemical, and biological properties on performance in virtual space.

**Confirmation of representative of
Scientific supervisors**

PhD. Candidate

Assoc. Prof. Do Nang Toan, PhD

Nguyen Duc Hoang