

# Research on Interactive Traditional Craft Diagram Model and Simulation System: Take Nanjing Rong Hua Craft as an Example

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**Abstract** Modern industrial civilization and material progress of life push traditional crafts and cultural heritage into an awkward, difficult situation. To solve this problem, we make use of digital art, combined with three-dimensional rendering engine, database and virtual reality technology in Unity platform, constructing an interactive diagram model and simulation training system for traditional craft heritage. First, by initiating material, tools, process and diagram in the system, we build a craft knowledge database and three-dimensional models for later simulation. Then, in order to enhance the immersive feeling in three-dimensional scene, we provide interactive process simulation to the trainers, in which we load the process as a real-time three-dimensional scene, by using techniques such as linking and real-time rendering effect. The practice result proves that this model and simulation system can effectively promote the training and cultural heritage of traditional craft techniques.

## Introduction

Chinese traditional crafts are the foundation of traditional culture, which have special significance meanings in the course of human history. Production and development of each craft, and even discontinuation are closely related with the social development. Unfortunately, with rapidly developing of industry and electronic technology these days, the ever-changing industrial civilization and material life expanding pushes traditional craft skills and cultural heritage into an awkward, difficult predicament. Influenced by its own characteristics and public acceptance, the practitioner's number of traditional crafts has reducing gradually. The consequence is that many processes are in danger of extinction, and it is urgent for us to protect these folk crafts.

Recently, with promoting in Chinese intangible culture heritage digitalization, digital technology has been applied in a large number of these preservation projects[1,2], including demonstrate the process of the crafts, architectures and restoration of cultural relics, represent an archaeological site, and so on. The advantages of these technologies, visualized and easy-to-use, are obvious. In this paper, we proposed an interactive simulation training model of traditional crafts by diagram, which using of digital art creation and training, and it can be a good solution to the problem mentioned before.

These days, most simulation systems are created on physical equipment, and by making use of intelligent human-computer interaction, they present real entities, or process in virtual environment. The simulation system has been widely used in various fields. Such as: electronic power class software Multisim[3], automatic control software design tools ControlBuild[4], manufacturing simulation software Prosolvia[5], etc. But these systems are mainly work for technical environment simulation, yet, by now, we have no any simulation software for traditional crafts procedure [6].

The purpose of the simulation system we proposed is designed to provide a new method of training traditional crafts, which can transplant training process from real training studio to the digital platform, so that for the users, the traditional crafts training can also be done on the mobile terminal.

By combined with fragmented learning and simulation training, virtualization and realization, we can achieve better flexibility and efficiency in learning traditional crafts. Interactive simulation training system designed provides functions including the cultural background of process, steps, process simulation and manufactures displaying, etc., which can be a substitute the physical training effect, even beyond. Content database of the system involved, namely, tools, materials and process decomposition data, have been extracted from chosen examples to satisfy the basic process

requirements of traditional crafts as much as possible. The user can verify traditional processes or training interactively, and the simulation training parameters can be recorded by the system.

### Chinese traditional craft interactive diagram model design

Chinese traditional craft interactive diagram model established on the base of Chinese traditional craft knowledge database. It aims to provide the beginners an easy-to-learn and user-friendly e-learning App(say, simulation system). Chinese traditional craft knowledge database has four parts, materials, tools and skills in the process of crafts making, and the patterns of typical crafts.

By analyzing crafts learning questionnaires, we established a typical user model, female, 25-years-old, craft amateur, learning craft by herself on weekday, attending craft activities at weekend. She is short of instruction from the master, communication with companions, exhibition to demonstrate the crafts. To solve this problem, we have designed a craft e-learning simulation App on both mobile platform and PC.

According to the contents of Chinese traditional craft diagram, we provide the craft animations which show the key processes of making, following by recognizing tools, materials and craft works, as shown in Fig.1. By the end of first stage, preparation for craft learning has finished. Then, the craft process will be decomposed. The methods and quantities of the decomposition are based on the craft characters. In general, each of decomposition tasks provides possibilities and premises for accomplishing an entry-level craft. We organize learning materials according to three aspects, "the master example videos", "companions learning videos" and "personal learning videos". Each decomposition task corresponds to a craft activity. In the activity, participators have opportunities to exhibit their craft works, share personal learning and making experiences, then upload relative contents on the App platform. At the last stage, it also contains the master example videos, companions learning videos and personal learning videos. Craft amateurs show their final works on the final craft activity, i.e., simulations. In addition, the system can generate records according to the individual learning data, by which the user can know him or her learning process and outcomes.

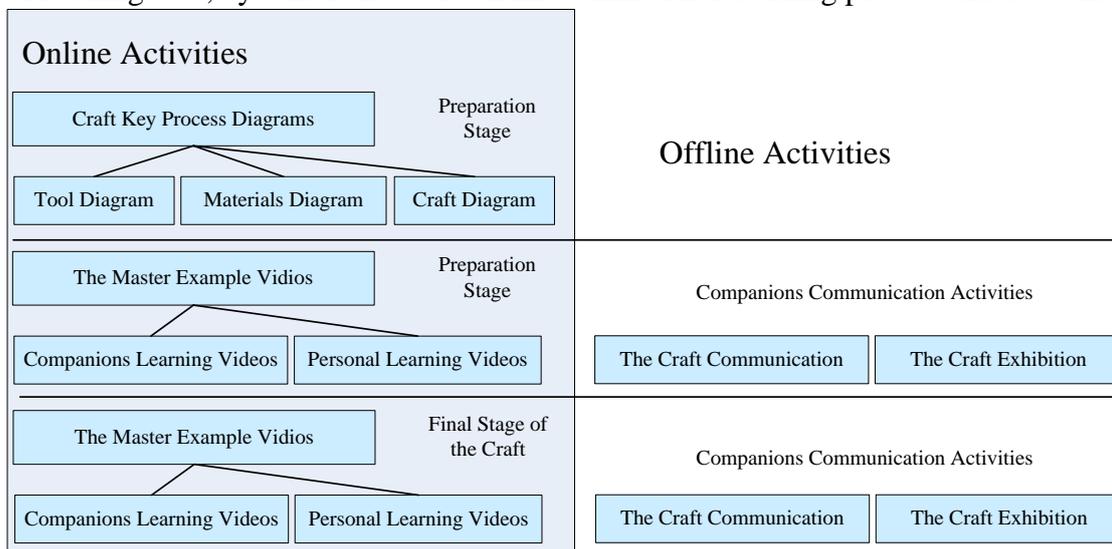


Fig. 1 Chinese Traditional Craft Interactive Diagram Model

We apply the diagram model in a local craft in Nanjing, Nanjing Rong Hua. At first, the craft was decomposed into four parts, according to materials, skills, tools and the patterns of typical crafts. The basic flower type, pattern flower is the first learning task. The App demonstrate its making process from this craft three typical parts, "Gou Tiao", "Da Jian", "Chuan Hua". Then, According to the process, arrange three tasks for users, "three kinds of Gou Tiao", "three kinds of Da Jian", "Chuan Hua skills of pattern flowers". Each of tasks has "the master example videos", "companions learning videos" and "personal learning videos". During the craft activities after the learners finished their task on the App, they can communicate with other learners face by face, all of these direct at three skills they learned by App.

## Interactive Simulation System Architecture

Most simulation system needs support from OpenGL technology and three-dimensional rendering engine [7,8]. We proposed a traditional craft training model by using simulation system created in Unity4.0 integrated development environment, which package OpenGL technology and three-dimensional rendering engine as APIs for software development. The system provides flexible rendering and interaction mechanisms, and makes use of SQLite database to achieve efficient data storage, meets the requirements of real-time rendering and consistency. As shown in Fig.2, the architecture of the system is modularized, including interactive simulation module, 3D model management module, animation management modules and special effects module, etc. Interactive simulation module is mainly responsible for user interaction based on the process parameters. Three-dimensional model management module is mainly responsible for the management three-dimensional models and real-time loading. Animation management module is mainly responsible for the simulation animation adding, deleting, and setting up the simulation constraint for animation sequence. Special effects module is mainly responsible for using lighting effects, sky box, and particles system to render the scene.

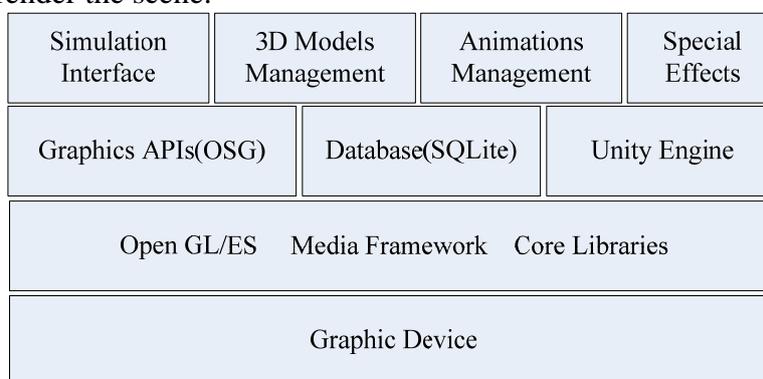


Fig.2 Structure of Inactive Simulation Training System

Basic components of the system are below:

1. Materials knowledge database: For starters, general physical properties of materials, process features, tools, manufactures appearance and other information of traditional crafts have been inputted into materials knowledge database in the form of graphics, images and text to facilitate Inquire.

2. Craft process: The key processes of craft have been recorded in video and picture by digital cameras and other recording equipment.

3. Process simulation: We make use of three-dimensional dynamic simulation model, by linking and matching the interaction between controls to realize the different processes and materials, to simulate manufactures of certain process. With interactive process conducted by the trainer after matching, the system generates a three-dimensional visual simulation to display, which facilitates output of information. Meanwhile, the system records training process information for the users.

## System Function Design and Implement

After entering the interactive simulation training system, we provide functions (E.g., tool, material, process, flower pattern), in which, the material is a material knowledge database, tool is a knowledge base of tools needed in the process, process is a technique knowledge database and interactive simulation for training, and flower pattern is a typical manufacture for display. Users can choose the appropriate function to interact according to different needs. By accessing to "material" and choosing different materials, you can obtain material images and text introduced immediately, thus, it provides a simple and intuitive way to understand the basic physical properties, process characteristics of materials, along with the various purpose information, appropriate process on the materials, etc.

The function of "process" implement is based on the traditional standard hand process, illustrated by a series of continuous video recordings or animations, including tool selection, material

preparation, process method determining, making procedure etc., thus, a traditional crafts database has been formed. By presenting with three-dimensional illustrations and links, mixed with images and text, we can show the whole process of the manufacture to the system user, and provide guidance for the crafts beginners and heritage researchers. Not only can effectively and quickly assist users understand the basic process of the craft, but also to provide a support to the standardization and creative innovation of this traditional technique. On the basis of understanding of the process, the user can use the simulation training function to practice "Gou Tiao", "Da Jian" and "Chuan Hua". In digital craft simulating, the system calls matching automatically in background, according to methods and procedures user input. Because of different process methods combination in processing and the order of each skill are key factors to the final craft quality, the system provides interactive operation in simulation training to the user, which meet the actual rendering handmade effect at maximum extent, by selecting and setting steps under different conditions. As sequentially selected in the simulation interface, the system generates a three-dimensional show on each stage based on the user's steps and manufacturing conditions. Meanwhile, the system records the user training information into the system database, in order to display the comments and thereafter show the effect of the training. In this interactive training process, the user can select and set a series simulation method again according to the actual situation, also can record training information for showing the effect. On some ways, the simulation training can replace physical learning by hand, even in the process of method setting and the final craft display stage, or other aspects, the effect of this digital training is better than the practical training in real world.

## Results and Applications

By using interactive simulation system implemented on the mobile platform, which change the traditional craft training ways into combination of the graphical illustration and three-dimensional virtual simulation, we can improve convenience for the user significantly. By the simulation system, we solve the problem that it is very difficult to protect the traditional craft heritage. The method we proposed provides following benefits, mainly in traditional craft training applications.

1. During the practice of the process, the learners and researchers can carry out simulation directly on computer or mobile device, without needing some kind of raw materials, without needing process tool, and the process can be repeated, deepening the user for understanding and mastering the skills. At the same time, we solve the problem for user's tedious work to prepare training materials and tools, and limited learning time and space constraints, enhancing the efficiency of learning and resource utilization.

2. In the virtual simulation process of learning, the basic process techniques, methods and other information will be displayed vividly as an interactive graphical illustration to the user, simple and intuitive. This makes relative easy to heritage craft procedure both in the specialized knowledge of materials, processes, forms and the craft skills of artifacts selection, using, maintenance, etc., including the quality, size, configuration, and cultural connotations related to the craft.

3. During the manual process simulation, the user interacts with the system, and parameters for certain features of the process are adjusted intentionally if necessary. According to the actual process, the system records process information, renders real-time three-dimensional simulation, reflects the corresponding different artistic effects, and system user can evaluate the result intuitively.

4. The simulation system is modularized with flexible scalability. When some conditions are changed (E.g.: in type of craft, material, tool, etc.), we can adjust the parameters to update the database for adaption. Also we can modify existing process information to ensure the adaptability of the simulation system, enabling traditional techniques heritage, innovation and craft training constantly upgraded.

## Summary

Interactive simulation training system can meet the requirements of traditional crafts techniques heritage, and it can shorten the process design cycle and reduce costs. Compared to done in physical

ways, it has advantages of flexibility, interactivity, and sense of modern technology, since it is good interactive and graphic intuitive. In this paper, we take Nanjing Ronghua craft as an example, providing a digital interactive simulation system, which combined with collection of traditional craft production process features. It is established on the base of traditional craft knowledge, which needs guarantee by conventional process, so the method of this paper, that is, the training model requires traditional crafts masters to confirm for the creation, evaluation and verification in accordance with certain artistic evaluation criteria, in order to improve the accuracy of system simulation. Practice has proved that the simulation system is a new model and new development for learning traditional crafts, combined with modern science and education technology, and it can effectively play a positive role in promoting the traditional craft skills, cultural heritage.

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