Development of Design System for Family-Type Sprouting Vegetable Cultivation Equipment

Yi Guo [1, a], and Guiqin Zhang[2, b]

[1]Department of Horticulture, Beijing Vocational College of Agriculture, Beijing, China

[2]Beijing Green Valley Sprouts Limited Liability Company, Beijing, China

[a]guoyibvca@163.com; [b]zhanguiqin0405@sina.com

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Abstract: In order to meet the promotion office of sprouting vegetable cultivation equipment, and the needs that design different specifications of cultivation equipment according to sprouting vegetable cultivation scale of customers, Visual Basic language and secondary development technology of SolidWorks were used to develop design system for family-type sprouting vegetable cultivation equipment. By inputting the design parameters through the user interface of the system, the 3D modeling of the family-type sprouting vegetables cultivation equipment can be automatically completed, and the three-dimensional design result is presented to the user. The application example shows that the equipment is suitable for the cultivation of household sprouting vegetables, and has the characteristics of simple structure and convenient usage. The design system has a user-friendly interface and accurate design results. The system has wide application value in the field of household sprouting vegetables cultivation. At the same time, the design method of the system can provide experience for the development of other related design systems.

1. Introduction

With the continuous development of the economy, people are paying more and more attention to the quality of life and diet health, and they are more inclined to choose foods with high nutritional value. Many of the ingredients in plant-derived vegetables are not only biologically active, but are also involved in many important metabolic processes in the human body. Many vegetables cannot meet people's needs due to seasonal and regional restrictions. Sprouting vegetables are getting more and more attention and approve because their production is not restricted by seasons and regions, and have high nutritional value. Many studies have shown that germinated edible seeds can significantly improve their nutritional value and function [1, 2].

Solidworks is the world's mainstream 3D CAD software with powerful parametric modeling, assembly capabilities, high market share and wide application. The Solidworks API is well developed and compatible, and most of the functions of Solidworks software itself can be implemented by calling API commands, as well as interfaces that support OLE object operations. Solidworks can be developed in a development language that supports COM and OLE, such as VB, VBA, VC++, C# and other mainstream development languages [3, 4]. The secondary development of SolidWorks software, mainly through the use of its own a large number of API interfaces, using a high-level programming language platform, in the creation of a friendly user interface, access and operate SolidWorks by calling API objects in the program to achieve SolidWorks modeling and create the required, professional SolidWorks module for users [5].

Using the secondary development technology of SolidWorks software, Yi Guo et al realized the development of the design system of the tidal irrigation equipment for sprouting vegetables [6], and also designed the household matrix culture equipment [7]. Weiliang Li and others realized the parametric design of hydraulic cylinders [8]. Yu Deng et al developed the evolvent gear parameter modeling system [9]. Kang Shi et al. developed a window cleaner parts library [10]. Yulin Yang et al. realized the parametric modeling of the plunger pump retainer shoe [11]. Yu Jiang et al.

developed a universal part library for clamp joints [12].

At present, although there are many studies on secondary development, the development of the design system for the family-type sprouting vegetables cultivation equipment has not been reported. In order to meet the promotion office of sprouting vegetable cultivation equipment, and the needs that design different specifications of cultivation equipment according to sprouting vegetable cultivation scale of customers, Visual Basic language and secondary development technology of SolidWorks were used to develop design system for family-type sprouting vegetable cultivation equipment. By inputting the design parameters through the user interface of the system, the 3D modeling of the family-type sprouting vegetables cultivation equipment can be automatically completed, and the three-dimensional design result is presented to the user.

2. Design System Development

2.1 Functional Analysis.

The family-type sprouting vegetable cultivation equipment design system is mainly used for the promotion office of the sprouting vegetable cultivation equipment, and designs different specifications of cultivation equipment to meet the different cultivation scales of customers' sprouting vegetables. Through the investigation of the promotion unit, it is determined that the main function of the design system is: it can be established 3D model of each part and assembly parts according to the main structural parameters (including: cultivation trough size, cultivation layer number, layer spacing, etc.) of the family-type sprouting vegetables cultivation equipment given by the user for ease of use, the design interface should be friendly, easy to operate, easy to use, and reliable in design results.
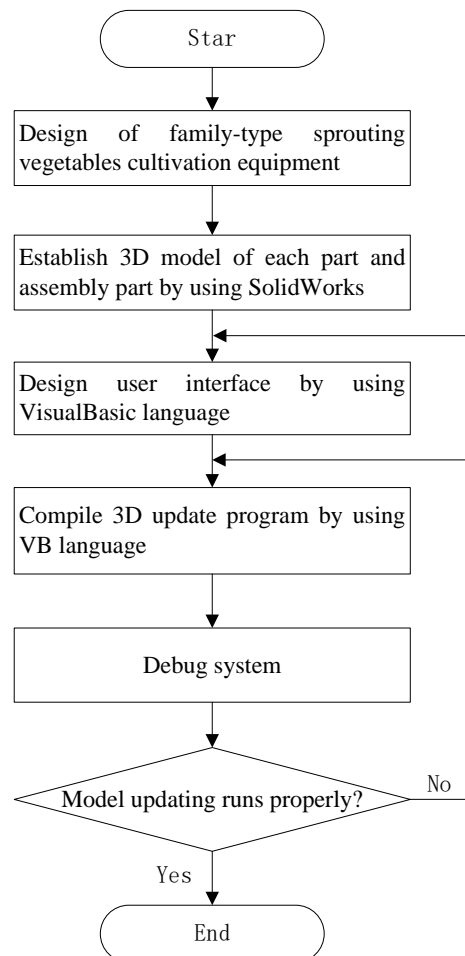
2.2 System Development Process.

Figure 1. System development process

Analyze the above functions of the systems and determine the development process of the system. First, according to the characteristics of household-cultivated sprouting vegetables, a sprouting vegetable cultivation equipment suitable for using in the home is designed. Then, establish the 3D model of each part and assembly parts of the family-type sprouting vegetables cultivation equipment according to the general structural parameters by using the SolidWorks software. After that, the program is programmed in Visual Basic language to create the user interface of the design system, and compile the 3D model update program for each part and assembly parts. Finally, the system runs and debugs, and according to the debugging results, the user interface and the 3D model update program are modified until meet the functional requirements. The specific development process is shown in Figure 1.

2.3 Design of Family Sprout Cultivation Equipment.

According to the characteristics of household-cultivated sprouting vegetables, the family-type sprouting vegetables cultivation equipment was designed.

2.4 Establish the 3D Model of the Equipment.

Establish the main structure (Figure 2), cultivation trough (Figure 3), water circulation system (Figure 4), fill light system, control system parts and assembly 3D model were completed by SolidWorks software according to the design of family-type sprouting vegetables cultivation equipment.

2.5 Creating a User Interface.

According to the requirements of the design system of the family-type sprouting vegetables cultivation equipment, analyze the 3D model of the parts and assembly parts, and determine that the user interface is mainly consisted of design parameter input dialog box, the update model button, and the exit system button. The parameter input dialog box is mainly used to receive data such as the length, width, height of the cultivation trough, number of cultivation layers, and layer spacing input by the user. The update model button is used to call SolidWorks' API functions to update the 3D model of each part and assembly parts that has been created, according to the parameters entered by the user. For ease of use, the design interface should be friendly, easy to operate, easy to use, and reliable in design results.
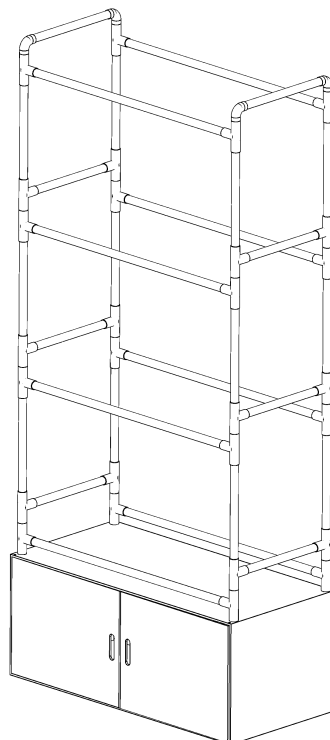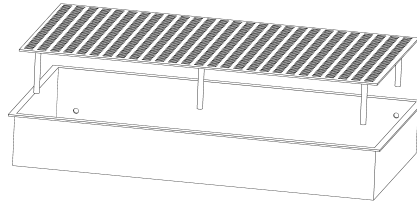

Figure 2. Main structure
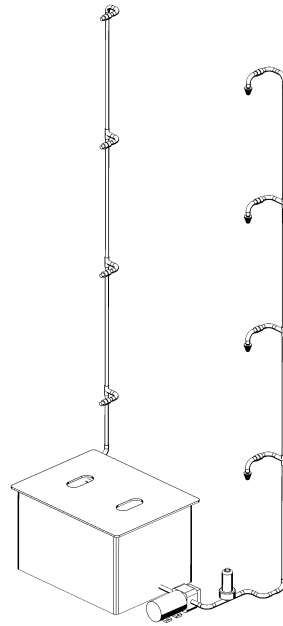
Figure 3. Cultivation trough

Figure 4. Water circulation system

The user interface is created by using the VisualBasic language to create a form file, adding frames, labels, text boxes, buttons, etc., and editing the properties of each control, and finally creating a user interface. The user interface design results are shown in Figure 5.

Figure 5. User interface

2.6 Compiling 3D Model Update Program.

The 3D model update program updates the structural dimensions of the family-type sprouting vegetables cultivation equipment parts and assembly parts based on design parameters input by the

user. That is to use the Visual Basic language programming program, complete the update of the three-dimensional model size of each part by the API function of the SolidWorks software called by the program according to the length l, width w, height h, number of cultivation layers s, layer spacing j, etc. input by the user. Then, using the full correlation of the SolidWorks file, after the part model update is completed, the size of part is directly transferred to the assembly file to complete the update of the assembly 3D model.

3. Application Examples

The application method of the system for designing a family-type sprouting vegetable cultivation equipment is as follows:

(1) Start the design system;

(2) Input the length of the cultivation trough 60mm, the width 30mm, the height 15mm, the number of cultivation layers 4, the layer spacing 35mm in the corresponding position of the user interface;

(3) Click the "Update 3D Model" button, the system will automatically update the 3D model of each part and assembly part according to the input parameters, and save the file. The design result is shown in Figure 6;
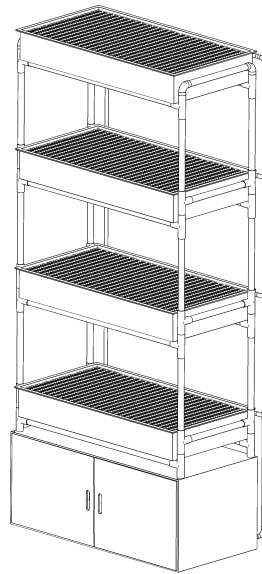

Figure 6. Design results of family-type sprouting vegetable cultivation equipment

(4) Click the "Exit System" button to exit the design system.

4. Conclusion

In order to meet the promotion office of sprouting vegetable cultivation equipment, and the needs that design different specifications of cultivation equipment according to sprouting vegetable cultivation scale of customers, Visual Basic language and secondary development technology of SolidWorks were used to develop design system for family-type sprouting vegetable cultivation equipment. The application example of the system shows that it can provide a simple user interface, and the user can complete the design of the family-type sprouting vegetable cultivation equipment without programming and designing capabilities, and the system can automatically generate a 3D model of each part and assembly parts. The system has wide application value in the field of household sprouting vegetables cultivation. At the same time, the design method of the system can provide experience for the development of other related design systems.

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