Design and realization of the drawing software for snow/ice stratigraphic profile

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Abstract   Snow/ice stratigraphic profile is one of the traditional and important research fields in glaciology. The profile drawn by hand, however, is a tough job. Using the Object Oriented Programming (OOP) Visual Basic (VB), we developed a Drawing Software for Snow/Ice Stratigraphic Profile (DSSISP). This paper introduces the functions, designing process and realizing methods of the drawing software. It presents the key techniques and aspects that should be payed attention to during the software development. Moreover, it also proposes the ideas for complete development of this drawing system. Legend database is a key aspect in the software designing. The major functions of the software include the stratigraphic profile drawing, edition and data management, which can help researchers draw the stratigraphic profile (including the scale, stratigraphic figure, text note and legend) quickly in a computer. In addition, the database technique is used to manage drawing data, which makes the figure drawing convenient and efficient. The drawing data is also convenient to be preserved, exchanged, processed and used.

Key words   snow/ice stratigraphy, drawing software, legend, database.

1   Introduction

Snow/ice stratigraphic profile is one of the traditional and important research fields in glaciology (Qin 1995; Xie 1988). The snow-pit profiles are observed directly in the field, and the stratigraphic profiles of ice cores are delineated and compiled in detail at 1: 1 scale through naked eyes in low-temperature laboratory. The major stratigraphic characteristics observed including crystal grain size, structure of depth hoar, light transmission, melt phenomena, wind crust etc. (Shoji and Langway 1989), are necessary to be delineated in diagram, which is the diagram of snow/ice stratigraphic profile.

The profile drawn by hand is a tough job and not convenient to save, exchange and use. Moreover, the diagram is also not so delicate. With the development of computer technologies, the computer-aided design has become practical. It is necessary to develop a software, that is the Drawing Software for Snow/Ice Stratigraphic Profile (DSSISP) to help researchers draw stratigraphic profiles. Using the Object Oriented Programming (OOP) Visual Basic (VB), we have developed a drawing software. This paper introduces the

ideas and ways of design and realizing as well as the functions of the Drawing Software.

2   Software designing

A drawing of snow/ice stratigraphic profile includes stratigraphic profile, label text, legend, ruler etc. The design and development of such a software need to meet the request of the drawing contents as mentioned above. The software is developed on Visual Basic and Windows 98SE.

2.1   Functions of the software

DSSISP consists of four functional modules: Drawing module, data management module, file operation and help module (Fig. 1).
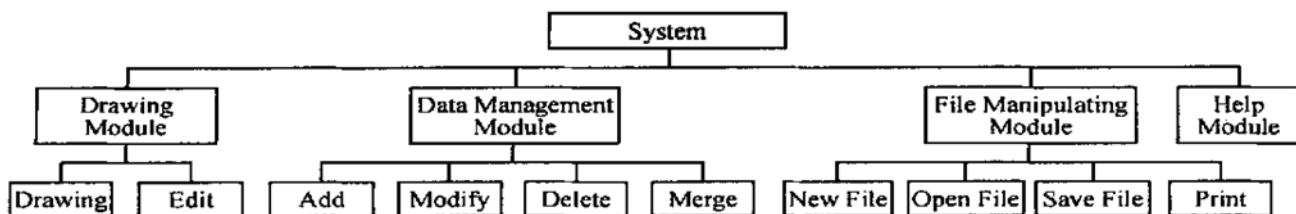

Fig. 1.   Map showing the system frame.

2.2   Design of drawing function

2.2.1   Legend design
Design and drawing legend bank is an important step in the development of DSSISP. A variety of snow/ice types divided previously were synthesized, while fine and thin ice crusts were further divided in more detail due to its monotone of stratigraphic profile in Antarctic inland ice sheet (Wen et al. 2001). Then, a set of relatively complete legend bank was designed and drawn (Fig. 2).

2.2.2   Function design
There are three instances while drawing a snow/ice profile: new diagram drawing, diagram copying and diagram merging.

For drawing a new diagram, it has to start from the very beginning. But if the new diagram has some parts similar to an old diagram, it is possible to get a new diagram quickly by copying and modifying from the old diagram. For a bigger diagram, it is difficult to complete once, thus different parts can be drawn first and then merged together.

2.2.3   Diagram edit
During drawing, it is possible to make some mistakes or not to be satisfied the diagram that has been drawn. At that moment, you may edit the diagram by the ways as fellows: undoing previous operation, moving or modifying parts of the diagram, erasing parts that are not needed, deleting, painting some irregular drawings that are not included in legends with a pen. Drawing a stratigraphic profile would become more efficient and

simple by using these functions synthetically.

Fresh snow		Old snow
Drifting snow		Fine firn
Fine firn with a little medium firn		Fine firn with medium firn
Fine and medium firn in half-and-half		Medium firn with a little fine firn
Medium firn with fine firn		Medium firn
Medium firn with a little coarse		Medium firn with coarse firn
Medium and coarse firn in half-and-half		Coarse firn with medium firn
Coarse firn with a little medium firn		Coarse firn
Wet firn		Infiltration ice
Radiation crust		Radiation crust (medium)
Radiation crust (strong)		Wind crust (weak)
Wind crust (medium)		Wind crust (strong)
Multilayered crust		Multilayered radiation crust
Multilayered wind crust		
Regelation ice piece		Infiltration ice piece
Superimposed ice		Dynamically
Glacier ice		
Depth hoar		Dirty layer
Annual mark		Scale
Point		Line
Text		Ice gland
Ice lens		

Fig. 2.   Legend.

2.3   Data management

All regular figures and legends will be saved into database while drawing, which makes it easy to realize many functions: diagram copying, modifying and merging, batch editing as well as creating a new diagram quickly.

2.4   File management and help

The functions of file management include creating new diagrams, opening old diagrams, editing, saving and printing diagrams. Help can offer information about the software and usage tips.

3   Interfaces of the software

3.1   Design of system interface

The software uses a single document interface only with function menus, floating

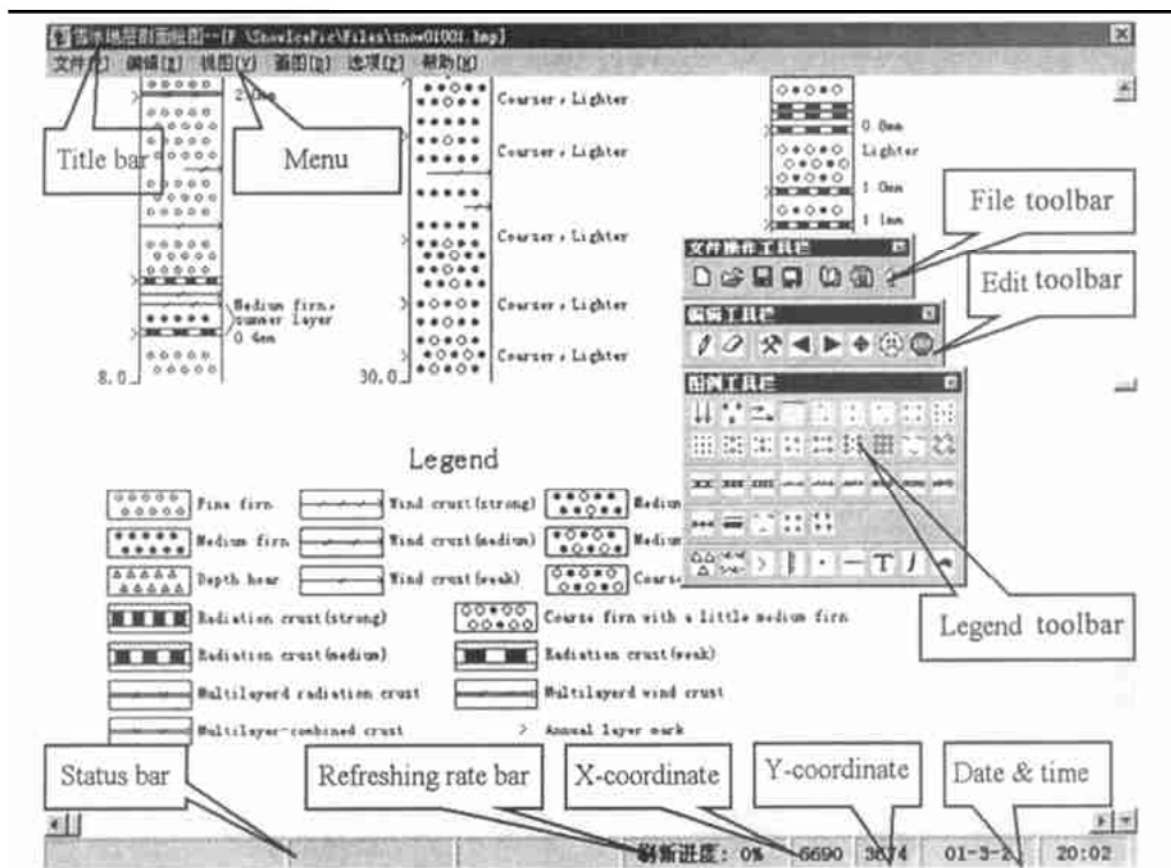toolbars and a status bar to make the drawing area as big as possible (Fig. 3) .

Fig. 3.   System interface.

3.1.1   Menu

Menu is the most fundamental part of the software (Fig. 4) . Every menu item has a corresponding ALT key combination, which is convenient for users to operate DSSISP, who do not like to use the mouse. The functions most in use also has shortcut keys, for example, saving files can be realized through four ways: clicking ' File' and then clicking ' Save' in the menu bar; pressing down ALT and pressing ' F' and ' S' ; pressing CTRL + S; or clicking the icon like a disk on the floating toolbar.

3.1.2   Floating toolbars

Floating toolbars include File toolbar, Edit toolbar and Legend toolbar (Fig. 3) . They cover most of the software functions. These toolbars can be closed and redisplayed by clicking Views and corresponding submenus. Floating toolbars can be moved anywhere in the work area.

3.1.3   Status bar

Status bar is used to display information about working status, such as current time, mouse position and so on. Some space of status bar has been reserved for the future use when the software functions are expanded. The mouse position displayed in the status bar is convenient for users to know the property of drawing position in time.

Fig. 4. Menu.

3.2 Data management interface

All legends and regular figure data will be saved in database while drawing a diagram. Editing the data in the database can create a new diagram quickly.

Data management interface is shown in Fig. 5. The interface is made up of four parts: Drawing data, Data edit, Select legend and Operation command.

Fig. 5. Editing data interface.
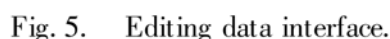
3.2.1   Drawing data window

It is used to display and edit the drawing data in the current database. Edited data will become available after Refreshing function is used to create a new drawing.

3.2.2   Edit data panel

Data in this area are linked to the corresponding fields in the Drawing data window. Data input can be added to the database by Operation commands.

3.2.3   Select legend

A proper legend can be selected. Combined with the input data in the Edit data panel, a drawing record can be created and added to the database.

3.2.4   Operation command

These commands can realize the database operations including functions such as adding, deleting, and updating records.

4   Software realization and key technologies

4.1   Drawing diagram

Operations of drawing diagram include three types: Drawing regular and irregular figures via the legend, Drawing by hand.

4.1.1   Drawing regular figures

Legends shown in Fig. 2 are regular figures except ice-gland and ice-lens. Before drawing regular figures, proper parameters shown in Fig. 6 should be set up. These parameters are: figure's top left corner, width, height, color, line width, point size, font size and space between two figure elements and so on.

Some parameters that are not needed can not be inputted, for example, while drawing 'Medium firn with a little coarse firn', some parameters such as 'font size', 'showing text', and 'point-line width' are not required. The software automatically makes these parameters gray and disables data input in order to make the drawing convenient and efficient.

4.1.2   Drawing irregular figures

Ice gland and ice-lens are irregular figures with varieties of sizes and shapes. It is impossible to draw them simply through regular points and lines. It is also not convenient to draw them by hand. The function of drawing irregular figures can be realized using PictureBox control and PaintPicture method (Appleman 1998; Regelski et al. 1998):

PaintPicture method: [object.] PaintPicture pic, destX, destY[, destWidth[, destHeight[, srcX[, srcY[, srcWidth[, srcHeight[, Op]]]]]]]。

A bigger irregular figure is designed first, and then a proper figure can be got using PaintPicture method's zoom. This technique is applied successfully in the software.
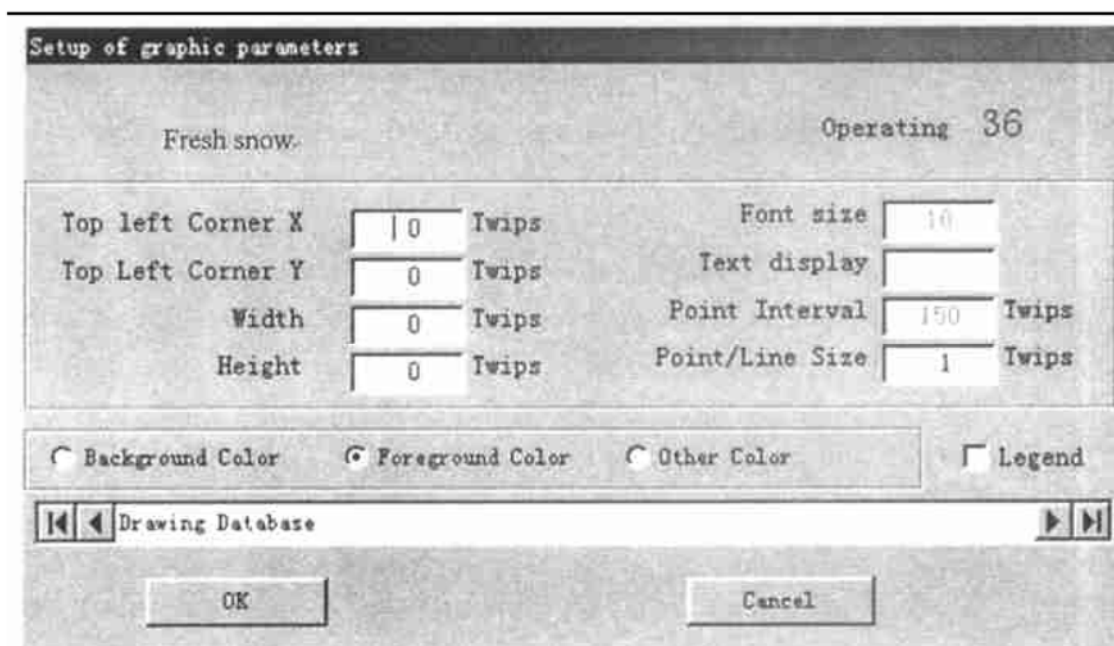
Fig. 6.   Setup of graphic parameters.

4.1.3   Drawing by hand

After having drawn figures using the legend, it is sometimes necessary to modify the diagram manually if you are not satisfied with some places of the diagram. You can, of course, paint with mouse directly.

4.2   Data management

As mentioned above, Data management is a very important function for the drawing software. Data controls (DBGrid and text edit) in VB are linked with the database, thus it is convenient to manage the data and draw efficiently. While modifying the data in the database, the data controls can show the newest records in the database. Similarly, if modifying the records in the controls, the corresponding records in the database are changed (Mckinney 1998).

5   Concluding remarks

The software can draw a snow/ice stratigraphic diagram including the ruler, snow/ice stratigraphic profile, legend and label text, and has functions such as undoing, moving, modifying and so on. The major functions for drawing a snow/ice profile have been realized. But some functions should still be improved or expanded. For example, the software can only be used to draw black and white diagrams now, the next version should draw color figures (the interfaces have been finished). The diagram is composed of simple points and lines that are not very delicate, the next version will be improved at these matters. Zooming in and zooming out will be added to the next version. The vector graph has been defined, and it is easy to implement zooming function. The next version is also expected to be able to draw density-depth and chemistry-depth profiles.

The opening-up of the software is no doubt the direction for further development in terms of its practice and maintenance. The opening up of legend bank is of the most need. If this function is completed, the users could add legends themselves without software developers' help. The software, Therefore, could also be used to draw other diagrams such as geological profile.

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