# Development of Sewing Path Design Software for Broidery

Chie-Chi Chao Chun-Yen Lin Shiuan Tai Chen
Department of Electrical Engineering, Chien-Kuo Technology University
Assistant Professor Graduate Student Associate Professor
e-mail：chao-23@ctu.edu.tw e-mail：box22922@yahoo.com.tw e-mail：chen6502@ctu.edu.tw

## Abstract

A software has been developed for the design of the sewing path for an automatic broidery machine. Based on the friendly graphic user interface and incorporated with the common features found in the commercial graphic software, the sewing path software will transform the graphical sewing path into a file with the absolute coordinate of each stitch point. Commercial graphic software does not provide the function to transform the coordinate. The design process done by commercial drawing software is required user to obtain the absolute coordinates manually. It is a tedious and error-prone process for the design of the sewing path. This paper will develop a software, based on Visual Basic, with the GUI inherent and real-time coordinate transformation for the sewing path design. The coordinate will be saved into a text file that will feed into the broidery machine. The sewing path can save as common graphic format for the other useful purpose. Implementing the proposal software in the sewing path design, It will resulting in time and money saving greatly for the design process.

**Keywords: Sewing path, Broidery, Link list, Visual Basic.**

## 1. Introduction

As the technology advanced in the textile industry, the design methods for broidery have been greatly changed. Traditionally, people sew the pattern one stitch by on stitch manually on their cloth. Nowadays, the new technology provides the automatic broidery machine transforms the textile product into small production, vast diversity, and high unit cost. This becomes a fashion among the young generation. Pattern of broidery can by designed digitally by the general commercial graphical software, such as PhotoShop, CorelDraw. However, the sewing path, resulted from the design of pattern of broidery, can not be transformed into the corresponding coordinate for each stitch point. The transformation is solely relying on user to pick up each stitch by hand and measured manually. This is a tedious task and error-prone process. This paper will propose and develop the sewing path software that will provide the coordinate transformation function for the user 's design sewing path into the absolute coordinate for each stitch point that coordinate will be utilized by the computer-control broidery machine. The sewing path software will base on Visual Basic that is powerful development tool for the design of window-base graphic interface and provide many useful API functions for the advanced applications.

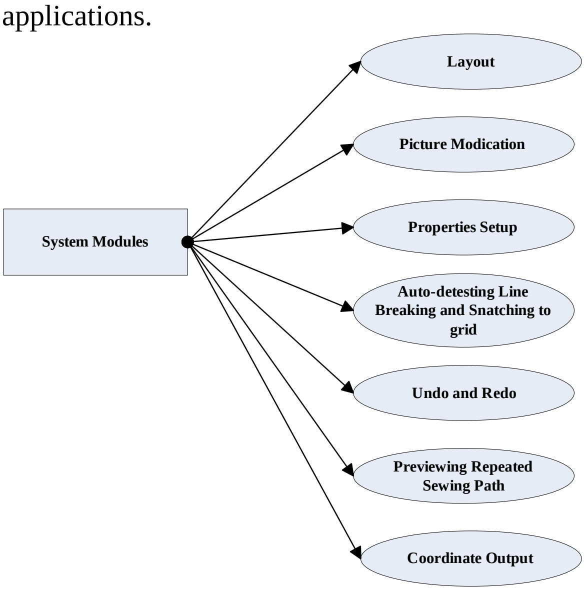


Figure 1: System Modules

## 2. Software Modules

For the purpose of easy use, the software has included many similar functions found in CorelDraw and PhotoShop. By the combination those functions, the software can be divided into seven modules as shown on Figure 1 and they are [1]: layout, modification of picture, properties setup, auto-detesting line breaking and snatching to the grid, redo and undo, previewing the repeated sewing path and coordinate output. The following is the details of each module:

1. Layout: the design interface for the grid setup will have two options: 7mm and 9mm. By the grid setup process, the sewing path for each stitch can be created and manipulated by the process of insertion, deletion, and relocation.
2. Picture modification: Before the designing process of the sewing path, a picture is needed to be loaded into the grid area to serve as a base picture for the following designing process. A size of the loaded-picture can be adjusted by the mouse dragging process.
3. Properties setup: The software includes the following setups: the grid size and format of line for grid, the size of loaded picture, and the size and format of text and line. The setup will depend on the desire of the user.
4. Auto-detesting line breaking and snatching to the grid: Software imposes some constraints on the line and point. Line segment is not longer than the preset range for a given moving step allowed by the broidery machine. The preset range is represented by a bounding box. The presence of the violation will be indicated by bringing up a warning message. As for each stitch point, it has to snatch to the nearby grid point.
5. Undo and redo: During the design process, user can undo or redo their action done on the software to modify or redesign their sewing path. The algorithm of undo and redo will describe later.
6. Previewing the repeated sewing path: Once the completion of the design of the sewing path, software allows users to preview the repeated sewing path for providing the users to have a global view of their design. Figure 2 is an example of the repeated sewing path.
7. Coordinate output: All the points that form the each line on the grid will be transformed to their corresponding two-dimensional absolute coordinates. Those coordinates will be fed into the broidery machine. Figure 3 is an example of the output coordinate file.

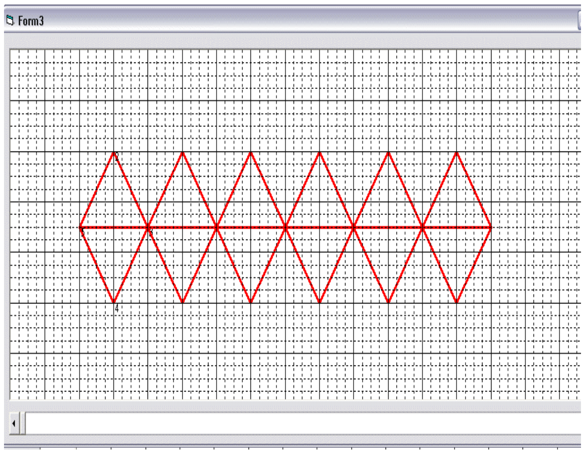


Figure 2: Example of Repeated Swing Path

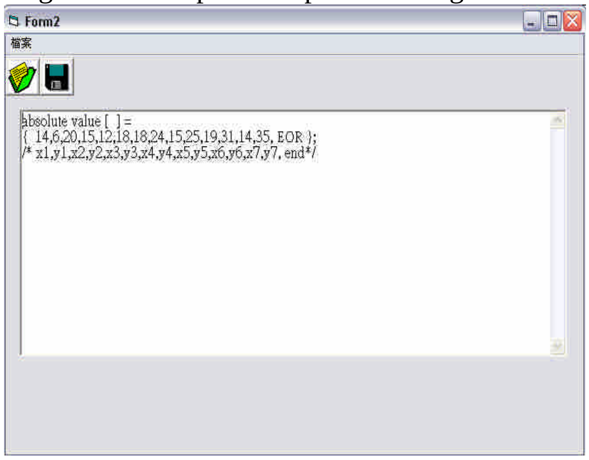


Figure 3: Example of Coordinate File

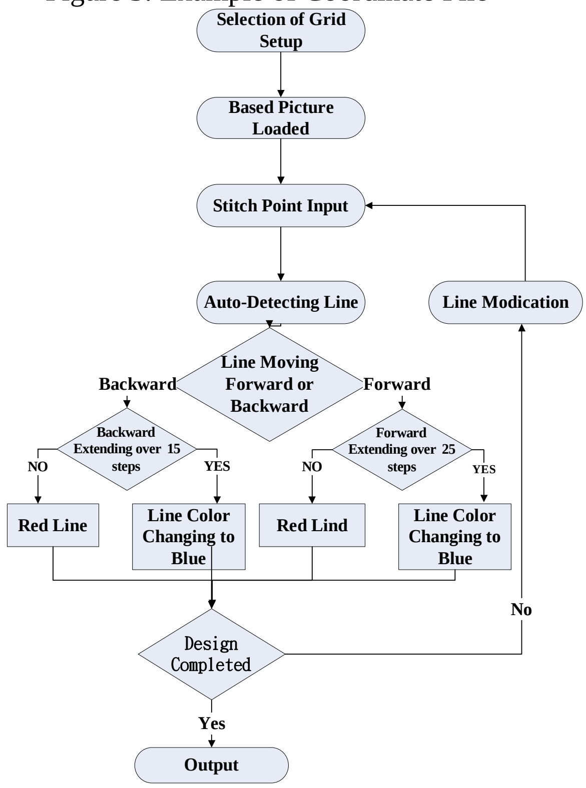


Figure 4: Flow Chart of Development Process

# 3. Software Development Process

The process for the developing the sewing path software can be divided into seven steps. The flow chart of the developing process is shown on Figure 4. The detail of each step is presented next.

Step 1: Selection of grid size. To begin the designing process on the software, users have to choose the proper grid size. Software provides two grid sizes, 7mm and 9mm measuring in *x*-axis. For the grid size with 7mm, there are four sub-grids for each mini-meter. For he size of 7mm, there will have 28 sub-grids in total. As for 9mm grid size, five sub-grids are embedded for each mini-meter. There are 45 sub-grids in total for 9mm grid size. Each sub-grid will represent the each stepping size of the broidery machine.

Step 2: Picture loading. Working picture prepared by the user is loaded by the software and to be the base picture for the sewing path design. The working picture can be jpg and bmp format. Software utilizes the VB component ImageBox [2] for loading process. ImageBox component provides the easy and fast way to adjust the size of the loading picture.

Step 3: Input the stitch points: Based on the based picture, user uses the mouse to construct each line segment by simply click the button on the mouse at the grid point. The software will automatically construct each line by the user's picking points. The function Line is implementing for the line construction process. Each stitch is labeled by a sequential index.

Step 4: Line detecting: Due to the characteristic of the broidery machine, each line segment has to be inside a preset bounding box. The bounding box represents the maximum distance that each line is allowed to extend. Software provides two grid settings, 7mm and 9mm. For 7mm setup, the maximum distance for the forward extension is 28 sub-grids and 15 sub-grids for backward extension. And for 9mm grid setup, the bounding box will be 25 sub-grids for forward extension and 15 sub-grids for backward extension. If the line segment is drawn over the bounding box, the line will be broken into two sub-segments; one line segment inside the bounding box will color as blue line and the red color will be on the portion of line segment outside the bounding box. A warning message box will pop up to indicate the situation.

Step 5: Sewing path completion: Once the design of the sewing path is completed, the sewing path can be output to a coordinate file or saved as a picture format. If the design process is not finish, the current working part of the sewing path can be saved for the continuation in the future.

Step 6: Modification of line segment: For the uncompleted design process of the sewing path, user can restart his work and execute the operations of insertion, deletion, and relocation on the desired stitch point. The insertion of a point is the process to insert a desired stitch point on a line segment that will result in breaking the original line segment into two independent line segments. The deletion of point is the process to remove an unwanted stitch point. All the lines are stored in a link list data structure. Relocation of point will be done by using function MouseMove function [2] that will pick up a new location of moving point and save it back to the link list. The design process will repeat back to Step 3 till the design is completed.

Step 7: Output coordinate and picture: The completion of the sewing path will be transformed to the absolute coordinate and saved into a text file. The sewing path can save as a common picture format, such as bmp, jpg, for the user desire.

# 4. Special Design Technology

A link list is implementing for storing of information of each line segment [3]. The link list is used for the ease of operations of addition, insertion, and deletion. Stacks are utilized for the actions of undo and redo. Figure 5 is the data structure for each line segment. Figure 6 is shown the stack function for the redo and undo actions. Figure 7 is shown as an example of user inputting the stitch point and snatching to the nearby grid points. Some special design technology implemented in the software will discuss next.

4.1 Addition, insertion and deletion of point:

Step 1: Addition of point: A link list is declared with the data structure of the coordinate of starting points X1, Y1, absolute coordinate X2, Y2, index number, and next node field pointing to next node.

Step 2: Insertion of point: Two points constitutes a line segment. The insertion process is done by inserting a point on a desired line segment. The newly inserted-point will become a new node and utilized the next node field in each node to construct each line connection.

Step 3: Deletion of point: The line segment is connected and the sequential index is labeled onto each stitch point. If the deletion is performed on a specific point, the next node field of the last node will be pointing to the next node to preserve the continuity of sequential index of path.

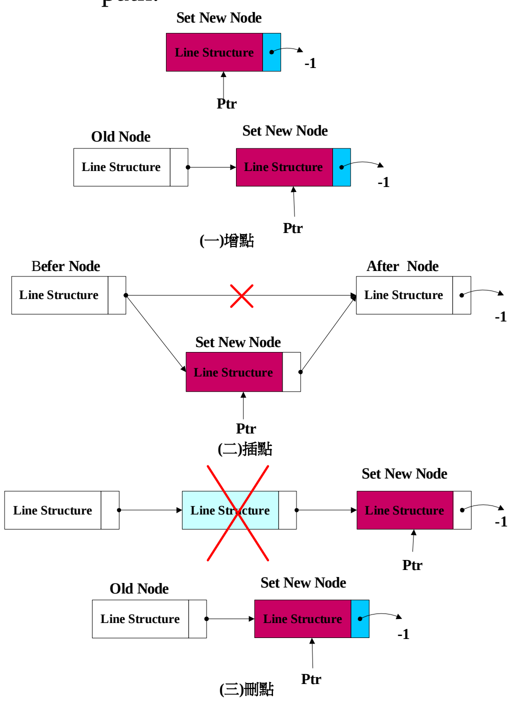


Figure 5: Link List

4.2 Undo and redo actions: Three stacks are created for the undo and redo processes [4]. Work stack is stored the information of the present action. Undo stack is stored the information of the last action. Redo stack is stored the information about the next step.

The execution of each stack is shown on figure 6 [5]

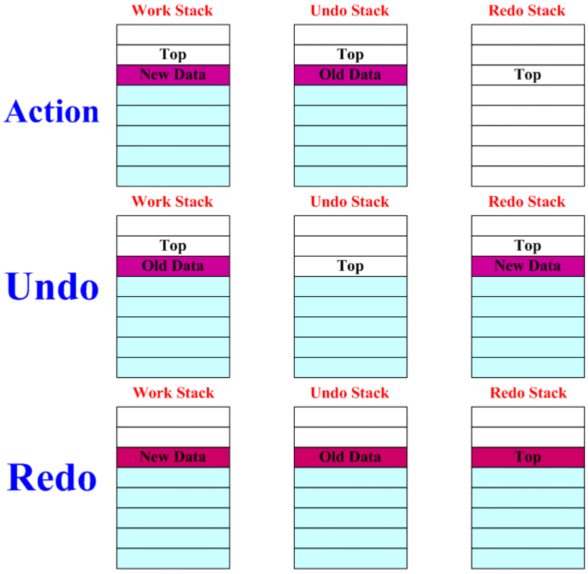


Figure 6: Stacks Operation

1. Action: the newly incoming information will add into the Work stack and move the old information to Undo stack that will preserve for the undo process.
2. Undo: the user execute the undo action, the information stored in Work stack will be retrieved and saved to Redo stack that will preserve for the undo process. And then, the information stored in Undo stack will put into the Work stack for the presence of information of last action for undo.
3. Redo: When the user execute the redo, the information stored in Work stack will be retrieved and saved to Undo stack that will preserve for the undo action in the future. And then, the information in Redo stack will put into Work stack for the completion of the redo action.

4.3 Snatching to the nearby grid point: Figure 7 is shown the construction of the stitch points. Software utilizes the PictureBox component for the environment of grid setup. The location of input stitch point is determined by the location of the mouse pointer. The location of mouse pointer is transformed into its corresponding absolute integer coordinate. Figure 8 is the algorithm for the snatching process that is based on 7mm grid setup. The unit for each sub-grid is 200 and function *ftt(A, 0)* is implemented to round off the coordinate. *A* is input variable and *0* is the decimal point. The following is the detail of Figure 8.

Step 1: Input coordinate: Coordinate is

been picked by the location of mouse pointer and denoted as X, and Y.

Step 2: Transformation into absolute coordinate: The input coordinate X, Y are divided by 200 to be the floating point of absolute coordinate and denoted as A, B.

Step 3: Rounding off the number: The floating point is rounding off to be an integer and denoted as C, D that are the absolute integer coordinates.

Step 4: Store the coordinate: The values of C and D are multiplied by 200 to transform to local coordinate. The local coordinates are stored into X1 and Y2 field of node in link list. The values of C and D are stored as X2 and Y2 fields of node of link list.

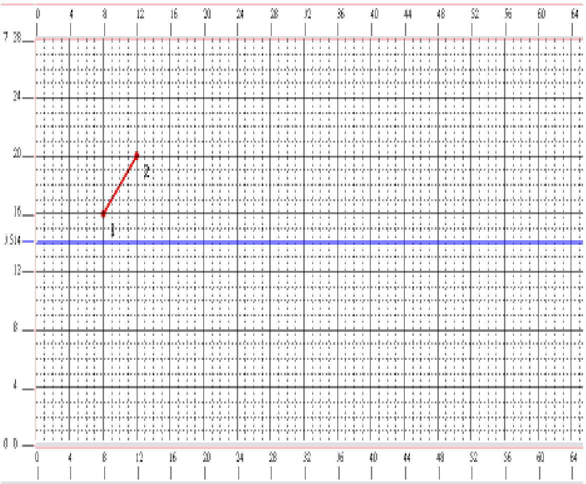

Figure 7: Construction of the Stitch Points

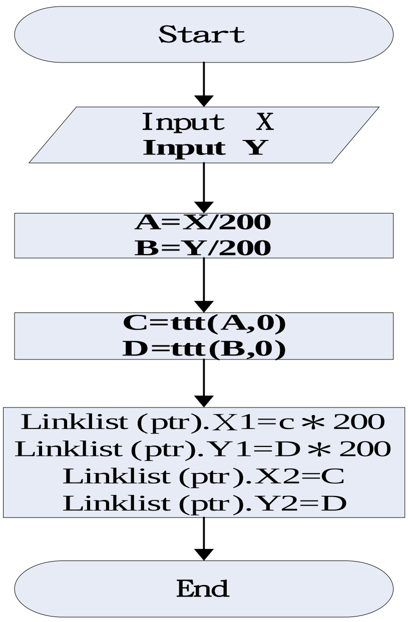


Figure 8: Algorithm for the Snatching Process

## 5. Testing and Results

Two grid setups, 7mm and 9mm, will be utilized for the testing process. The results will compare to the sewing path designed by the drawing software CorelDraw 9.

The sewing path designed by the CorelDraw 9 will need the designer to put the sequential index manually on each input stitch point. Furthermore, the absolute coordinate of each stitch point is measured and recorded by user. It will need a lot of patient and time for the user to finish one case of the sewing path design process. No need to mention about the errors and inconsistent occurred in the design process. Figure 9 is an example of the sewing path designed by CorelDraw 9.

Figure 10 is the one of example of the sewing path designed by the proposed software. Based on the 7mm grid setup, a base picture is loading into the grid setup region. User uses the mouse pointer to selection the input stitch pint that will snatch to a nearby grid. Software will label a sequential index on each input stitch point automatically. Once the design process of the sewing path is completed, the absolute coordinate file, will be generated by the software and will feed those coordinates into the broidery machine. Another example, based on 9mm, is shown on Figure 11 that shows no based picture. In this case, users can design any sewing path by their desires and save it into the absolute coordinate file.

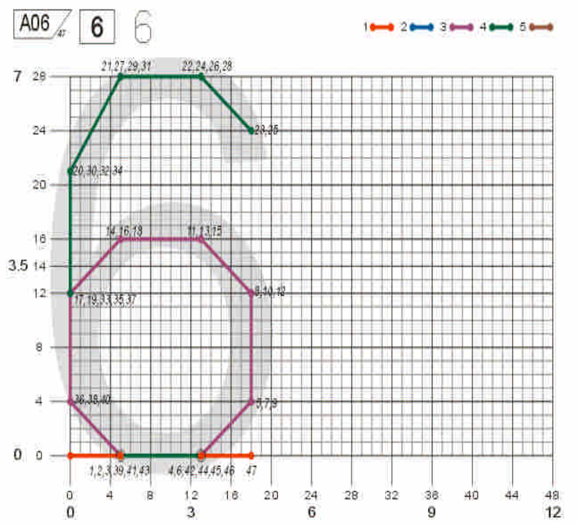

Figure 9: Example of the Sewing Path Designed by Commercial Drawing Software

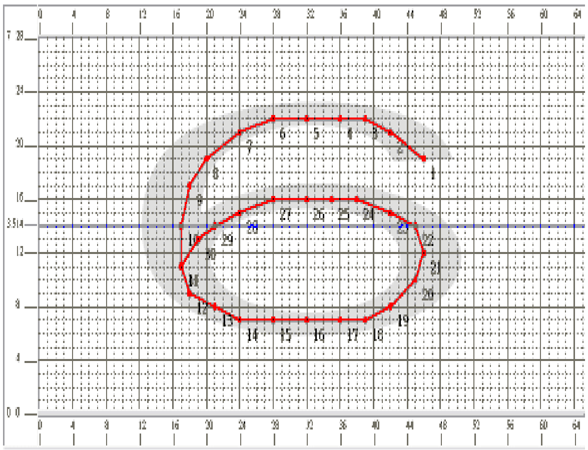

Figure 10: Example of the sewing Path Designed by the Proposed Software

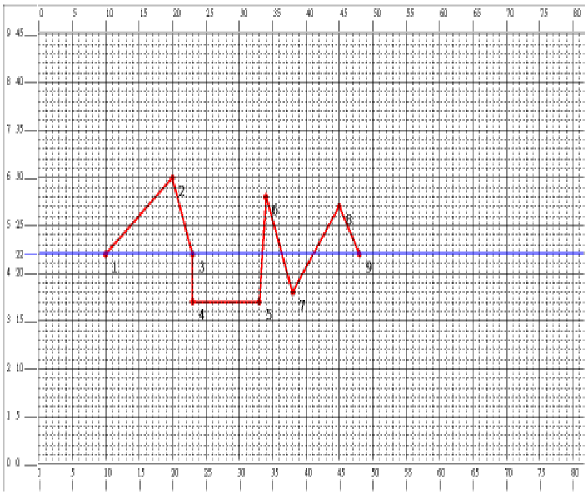

Figure 11: Sewing Path Design without Base Picture

## 6. Conclusion

The sewing path designed by the commercial drawing software creates lots of difficulties for the designer. Designer is required to trace the index sequentially for each stitch point. Furthermore, the absolute coordinates of each stitch point are needed to be measured manually. For a common case of the sewing path constituting a hundred stitch points, this manual designing process is a daunting task for the designer. The software proposed by this paper provides a solution for the sewing path design. A real-time absolute coordinate transformation and automatic labeling the sequential index for each stitch point provides a time-saving and money-saving solution for the design process of the sewing path.

### Reference

[1] 林建有(2004)「符合 SCORM 標準之概念圖軟體設計與實作」，國立台灣科技大學資訊管理系，碩士論文。

[2] 陳錦輝(2004)，Visual Basic 6 初學指引，金禾資訊

[3] 楊正宏(2004)，資料結構使用 Visual Basic，全華。

[4] 葉榮木(1999)，資料結構使用 Visual Basic，松崗。

[5] 陳澤雄(2002)，資料結構原理與應用，文魁資訊