
libembroidery 0.1

The Embroidermodder Team

Abstract

Libembroidery is a library for manipulating, converting and creating embroidery files between all major embroidery machine formats and some graphics formats to aid the creation of designs.

Most of the supported formats are in an experimental state as the library is under active development.

The library has 3 intended user interfaces: the GUI in EmbroiderModder2, the CLI in **embroider** (see `embroider-main.c`) and Arduino embedded systems (`libembroidery.ino`). The most actively maintained user interface is the CLI **embroider**.

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Features

Formats

Toyota (.100)

- Stitch Only Format.
- Uses an external color file.
- ☒ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

The stitch encoding is in 4 byte chunks.

Toyota (.10o)

- Stitch Only Format.
- Uses an external color file.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

The stitch encoding is in 3 byte chunks.

Bernina (.art)

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

We don't know much about this format. TODO: Find a source.

Bitmap Cache (.bmc)

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

We don't know much about this format. TODO: Find a source.

Bits and Volts (.bro)

- Stitch Only Format.
- Uses an external color file.
- ☒ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

The header is 256 bytes. There's a series of unknown variables in the header.

The stitch list uses a variable length encoding which is 2 bytes for any stitch

Melco (.cnd)

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

We don't know much about this format. TODO: Find a source.

Embroidery Thread Color Format (.col)

- Stitch Only Format.
- ☒ Basic Read Support
- ☒ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

Singer (.csd)

- Stitch Only Format.
- ☒ Basic Read Support
- ☒ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

Comma Separated Values (.csv)

- Stitch Only Format.
- ☒ Basic Read Support
- ☒ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

(.dat)

- Stitch Only Format.
- ☒ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

(.dem)

- Stitch Only Format.
- ☐ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

(.dsb)

- Stitch Only Format.
- ☒ Basic Read Support
- ☐ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

Tajima (.dst)

- Stitch Only Format.
- ☒ Basic Read Support
- ☒ Basic Write Support
- ☐ Well Tested Read
- ☐ Well Tested Write

.DST (Tajima) embroidery file read/write routines Format comments are thanks to tspilman@dalcoathletic.com who's notes appeared at <http://www.wotsit.org> under Tajima Format.

Header

The header seems to contain information about the design. Seems to be ASCII text delimited by 0x0D (carriage returns). This must be in the file for most new software or hardware to consider it a good file! This is much more important than I originally believed. The header is 125 bytes in length and padded out by 0x20 to 512 bytes total. All entries in the header seem to be 2 ASCII characters followed by a colon, then it's value trailed by a carriage return.

<code>char LA[16+1];</code>	First is the 'LA' entry, which is the design name with no path or extension information. The blank is 16 characters in total, but the name must not be longer than 8 characters and padded out with spaces (0x20).
<code>char ST[7+1];</code>	Next is the stitch count ST, this is a 7 digit number padded by leading zeros. This is the total stitch count including color changes, jumps, nups, and special records.
<code>char CO[3+1];</code>	Next, is CO or colors, a 3 digit number padded by leading zeros. This is the number of color change records in the file.
<code>char POSX[5+1];</code>	Next is +X or the positive X extent in centimeters, a 5 digit non-decimal number padded by leading zeros.
<code>char NEGX[5+1];</code>	Following is the -X or the negative X extent in millimeters, a 5 digit non-decimal number padded by leading zeros.
<code>char POSY[5+1];</code>	Again, the +Y extents.
<code>char NEGY[5+1];</code>	Again, the -Y extents.
<code>char AX[6+1];</code> <code>char AY[6+1];</code>	AX and AY should express the relative coordinates of the last point from the start point in 0.1 mm. If the start and last points are the same, the coordinates are (0,0).
<code>char MX[6+1];</code> <code>char MY[6+1];</code>	MX and MY should express coordinates of the last point of the previous file for a multi-volume design. A multi-volume design means a design consisted of two or more files. This was used for huge designs that can not be stored in a single paper tape roll. It is not used so much (almost never) nowadays.
<code>char PD[9+1];</code>	PD is also storing some information for multi-volume design.

Uses 3 byte per stitch encoding with the format as follows:

Bit	7	6	5	4	3	2	1	0
Byte 0	y+1	y-1	y+9	y-9	x-9	x+9	x-1	x+1
Byte 1	y+3	y-3	y+27	y-27	x-27	x+27	x-3	x+3
Byte 2	jump	color change	y+81	y-81	x-81	x+81	set	set

T01 and Tap appear to use Tajima Ternary.

Where the stitch type is determined as:

- Normal Stitch ‘00000011 0x03‘
- Jump Stitch ‘10000011 0x83‘
- Stop/Change Color ‘11000011 0xC3‘
- End Design ‘11110011 0xF3‘

Inclusive or’ed with the last byte.

Note that:

1. The max stitch length is the largest sum of ‘1+3+9+27+81=121‘ where the unit length is 0.1mm so 12.1mm.
2. The co-ordinate system is right handed.

Sources on the Tajima dst format: [3], Edutech format description[2], KDE Liberty Description[4], ACHATINA[1].

Threads

Supported Manufacturers

Sources

Development

A *right-handed co-ordinate system* is one where up is positive and right is positive. Left-handed is up is positive, left is positive. Screens often use down is positive, right is positive, including the OpenGL standard so when switching between graphics formats and stitch formats we need to use a vertical flip (`embPattern_flip`).

0x20 is the space symbol, so when padding either 0 or space is preferred and in the case of space use the literal ‘ ’. Use the macros:

```
#define PAD_SPACE(n) \
    embFile_pad(currentFile, ' ', n)
#define PAD_ZERO(n) \
    embFile_pad(currentFile, 0, n)
```

to save writing functions that may not inline.

* Puzzle: how can

Design Philosophy and Coding Standards

- No GUI code will be present here.
- The library will be written in pedantic ANSI C/C90, aiming for no compiler warnings under GCC for compatibility with the most possible platforms.

- The command line program ‘embroider’ targets 32-bit and 64 bit systems that comply to POSIX or current Windows/macOS standards. Practically, this means we only call C99 standard library functions.

To Do

1. Basic features.
 1. Incorporate `#if 0`ed parts of `emb-stitch-fill.c`.
 2. Interpret how to write formats that have a read mode from the source code and vice versa.
 3. Identify sources that break down the binary formats we currently don’t understand.
 4. Better documentation of the structure of the headers for the formats we do understand.
2. Code quality and user friendliness.
 1. Document all structs, macros and functions (will contribute directly on the web version).
 2. Make a texinfo/PDF user manual for embroider.
 3. Incorporate experimental code, improve support for language bindings.
 4. Make stitch x, y into an `EmbVector`.
3. embroider CLI
 1. Make `-circle` flag to add a circle to the current pattern.
 2. Make `-rect` flag to add a rectangle to the current pattern.
 3. Make `-fill` flag to set the current satin fill algorithm for the current geometry. (for example “`-fill crosses -circle 11,13,10`” fills a circle with center 11mm, 13mm with radius 10mm with crosses).
 4. Make `-ellipse` flag to add to ellipse to the current pattern.
 5. Make `-bezier` flag to add a bezier curve to the current pattern.
4. Improve embedded compatibility.
 1. Remove reliance on slower, memory expensive parts of the C Standard Library that are in the main library, for example, not using `printf`, `sprintf`, `fprintf` etc. (Use `embFile_puts`.)
 2. Share heavy memory usage between functions, for example use `embBuffer` for buffering headers rather than having a separate `char header[]` variables.
 3. Reduce calls to `malloc` when we know the total usage as dynamic memory may not be present and we may need to get rid of `malloc` entirely.
 4. Consider using an alternative C standard library for the remaining functions like `uclibc`.

Finding fixes

To find jobs marked within the source code rather than the list above, use:

```
grep "TODO" *.c *.h
```

Testing

Build `embroider` then run:

```
./embroider -test &> report.txt
```

If any of the tests return a fail in the summary (see `tail report.txt`) then it would help the project to send us an issue attaching the file to your message along with a description of the system you ran the program on.

On Arduino

The library is designed to support embedded environments.

Compatible Boards

We recommend using an Arduino Mega 2560 or another board with equal or greater specs. That being said, we have had success using an Arduino Uno R3 but this will likely require further optimization and other improvements to ensure continued compatibility with the Uno. See below for more information.

Arduino Considerations

There are two main concerns here: Flash Storage & SRAM.

libembroidery continually outgrows the 32KB of Flash storage on the Arduino Uno and every time this occurs, a decision has to be made as to what capabilities should be included or omitted. While reading files is the main focus on arduino, writing files may also play a bigger role in the future. Long term, it would be most practical to handle the inclusion or omission of any feature via a single configuration header file that the user can modify to suit their needs.

SRAM is in extremely limited supply and it will deplete quickly so any dynamic allocation should occur early during the setup phase of the sketch and sparingly or not at all later in the sketch. To help minimize SRAM consumption on Arduino and ensure libembroidery can be used in any way the sketch creator desires, it is required that any sketch using libembroidery must implement event handlers. See the ino-event source and header files for more information.

There is also an excellent article by Bill Earl on the Adafruit Learning System which covers these topics in more depth: <http://learn.adafruit.com/memories-of-an-arduino?view=all>

Special Notes

Due to historical reasons and to remain compatible with the Arduino 1.0 IDE, this folder must be called “utility”. Refer to the arduino build process for more info: <https://arduino.github.io/arduino-cli/0.19/sketch-build-process/>

libembroidery relies on the Arduino SD library for reading files. See the ino-file source and header files for more information.

Experimental Projects

Anything contained within the experimental/ folder is unstable and unsupported. Items in here may eventually be moved elsewhere or may not. If you have an interesting concept or prototype that you would like us to add, contact us and we may add it here.

Dependencies

To build additional language bindings for libembroidery from source you will need at least:

Ubuntu repository packages:

```
sudo apt-get install swig python-dev
```

Mac

```
brew install swig
```

An example for building for use in C#

```
swig -csharp -o ./csharp/binding/swig_wrap.c -I../ swig.i
```

References

- [1] Technical Info, Feb 2005. [Online; accessed 28. Sep. 2021].
- [2] Embroidery format DST - EduTech Wiki, Dec 2020. [Online; accessed 28. Sep. 2021].
- [3] FineEmb Studio » DST, Sep 2021. [Online; accessed 28. Sep. 2021].
- [4] Projects/Liberty/File Formats/Tajima Ternary - KDE Community Wiki, Jan 2021. [Online; accessed 28. Sep. 2021].

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