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Making Art with 3D Laser Cutting. Audio-enriched Tactile Poetry

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A 3D laser cutter was used to produce lines of poetry from acrylic sheets that can be configured in real world 3D space to make tactile poetry more accessible to a blind or visually-impaired reader. The process of positioning laser cut lines of poetry in 3D space for greater accessibility led to the unanticipated outcome that real-world 3D shapes could now be viewed or sensed as mixed medium art that was accepted in juried tactile art exhibitions. Tactile art exhibits are becoming more common and are part of the venue for many creative art centers, museums and art galleries across the United States and in other countries. The aim of this paper is to describe the process of making real world audio-responsive tactile poetry and show how the lines of poetry can now be configured in 3D space so as to be viewed as mixed medium tactile art.

When lines of poetry exist in 3D space, as in a 3D haiku poetic cube¹ (Tweedie and Kolitsky, 2002), the use of a screen reader does not easily permit reading of all the ways that the lines of a 3D poem may be configured in 3D space. More supportive templates and use of iPads as audio sources (Kolitsky, 2016) have been shown to provide a reader who is blind or visually impaired the same opportunities as a sighted reader to experience reading poetry in 3-dimensional space. The interface when using an iPad as an audio source must be 2D, such as seen in a raised line graphic so that a blind reader can know where to touch the raised line graphic in order to trigger an audio button on the iPad. The 2D template was an important advance in creating an interface to allow a 3D haiku poem to be read in the same way as that by a sighted person. A blind reader, however, is required to make a 2D to 3D leap in an attempt to imagine what a 3D haiku poem actually looks like in the real or digital 3D world. It is more valuable and rewarding for a blind reader of 3D poetry if they have an actual real-world model of the 3D poem, so that they can touch and feel the structure and location of each line in a 3D poem. This type of tactile poetry made to exist in the real world provides a bridge for the blind reader to cross

from just hearing the poetry to building in their minds a structural image of the poetic shape in which meaning, interpretation and the sense of touch coalesce to form a tactile work of art. It is the aim of this report to show how 3D tactile poetry can be recreated as a 3D tactile work of art using laser cutting technology.

Examples of 3D Laser Cut "Talking" Tactile Art

A number of exhibits in museums and creative art centers in the United States and else where in the world have announced calls for tactile artwork designed around the theme of "please touch the art," such as at Newseum Tactile Art (NFB, 2018), Somatosensory exhibit (Carnegie Library, 2018), "Please Touch the Art" (Smithsonian, 2018) and "Touch and See" (NEA Arts Magazine, 2015). The examples of "talking" tactile poetry included in this report were all made by the author and have been accepted by jurors for display at several locations around the USA for inclusion in their tactile art exhibits.

Ferris Haiku

Figure 1 shows a real-world laser cut version of a "Ferris Haiku", patterned after an animation written using Flash software in 2001². The laser cut version of the "Ferris Haiku" in the shape of a real-world Ferris wheel was designed and made to allow an audio response when the buttons were touched. The "Ferris Haiku" can be rotated by hand, and the buttons on the side can be touched to play the audio for a particular haiku poem. The "Ferris Haiku" mixed medium art piece was accepted in the juried "Please Touch the Art" exhibit for display at the Mosesian Center for the Arts in Waterford, MA, which ran from June through to August 30, 2019. A second version of the "Ferris Haiku" was also accepted by the jury process for the "Touch the Art Exhibit" at the McKeon Center for Creativity in Tulsa, OK, from June 7 to July 30, 2019, while a version was also accepted at the 18th Annual

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¹ Kolitsky, M.A. (2006). <http://www.nextgenemedia.com/3DHaiku/3dhaikuCube.html>

² Kolitsky, M.A. (2001). <http://www.nextgenemedia.com/FerrisHaiku1.html>

Gala Juried Fine Arts Exhibition at the Arts Center in Elkins, WV, which ran from June 10 through to July 21, 2019. Most recently, on October 18, 2019, the “Ferris Haiku” piece received a “Best in Show” first place selection at the ART Libris – 22nd Annual Art Show at the Pequot Library in Southport, CT.

In Figure 1, note that the rectangular templates containing laser cut haiku poetry can be rotated like a Ferris wheel, allowing the templates beneath to become visible and ready to be read during the next rotation. There are buttons located on the side which can be pressed for an audio reading of the haiku poetry on each template and also for recording poetry by people visiting the art exhibit, making this piece “unfinished” as more poetry can be added throughout the exhibit period.

Figure 1. “Ferris Haiku” showing how templates can be rotated like a Ferris wheel



Source: author’s own work.

Merry-Go-Round Haiku

“Merry-Go-Round Haiku” was also selected to appear in the juried “Please Touch the Art” show at the Mosesian Center for the Arts in Waterford, MA, which ran from June 7 to July 30, 2019. The “Merry-Go-Round Haiku” is a 3D laser cut tactile art piece designed to hold four haiku poems. The “Merry-Go-Round Haiku” can also be rotated by hand in either the counter clockwise or clockwise direction and could be named a “Carousel Haiku” or “Round about Haiku” dependent upon the local custom where the tactile art resides. Each haiku template on the “Merry-Go-Round Haiku” contains audio-response buttons, so that by touching a button in the upper right portion of a 3D haiku template causes the audio for that haiku to be played. The buttons on the upper left and lower left of a haiku template, when pressed simultaneously with the button on the lower right, cause a double beep to occur to indicate the start of audio recording. When the audio recording is complete, pressing the upper left or lower left button causes a single beep, indicating that the audio has been saved. By pressing either the upper left button or lower left button the recorded audio can be played. The option to add poems to the “Merry-Go-Round Haiku” also makes the 3D laser cut tactile art piece an unfinished work of art, with poetic contributions by the visitors encouraged throughout the exhibition. The “Merry-Go-Round Haiku” templates are colored red, and each template has the entire haiku poem for that template laser cut on the template so a sighted or deaf visitor can read the haiku on that template. When the button on the upper right is pressed, the poem cut into the template is played with the artist’s voice so that a blind visitor can hear what a sighted visitor sees and hence completes the expectations for meeting Universal Design standards (Universal Design and Accessibility, 2018). A “Merry-Go-Round Haiku” is shown in Figure 2.

Figure 2. Merry-Go-Round Haiku showing a side view of a template with a haiku laser cut into it



Source: author’s work.

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Figure 2 also shows the locations of the buttons for both playing and recording the audio. The “Merry-Go-Round Haiku” can be rotated either in a counter-clockwise or clockwise direction.

Sagittarius A as Tanka

The next work, shown in Figure 3, has two tanka poems in a 3D real world form and demonstrates how the lines of multiple tanka poems (5-7-5-7-7 line syllables) arranged in an X format can share the same middle line and hence be used to create a mixed medium art piece that builds on the theme that information in lines of poetry, like any information stored in our Universe, is never destroyed, and that when it enters the edge of a black hole, as is thought to exist at the center of our galaxy, it becomes stretched at the event horizon to exist solely as 2D information in the form of a hologram. Hence the name of these art pieces, “Sagittarius A Tanka”, is tied to the black hole in the center of our Galaxy, known as “Sagittarius A” or “SagA*[®]”. These new “talking” tactile art pieces may then be thought of as a reflection of the information contained in them, which is never destroyed but can be imagined to be stored in a black hole event horizon awaiting our call to retrieve them for interpretation and analysis.

Figure 3: Sagittarius A shows two tanka poems sharing same middle line (RISKY ENCOUNTER) attached to a black platform (surface of black hole) using right angle brackets. Pressing the small buttons linked to

each bracket produces audio for that particular Tanka line. Pressing the buttons near the center edge at the same time as the button at the bottom near a tanka line produces a double beep indicating the audio recording option is operating. When the audio button at the bottom near the tanka line is pressed, a single beep is produced to indicate that the new audio is now saved and can be produced again by pressing the same red button. Dimensions: 12 inches wide, 10.5 inches deep and 16 inches high.

Bits to Memes

The Art League Rhode Island in Providence, RI, had a call for the exhibit “One Zero One” which focused on our digital world being dependent upon a binary system composed of the numbers zero and one, and which form the basis for all computer code. The image below shows the mixed medium acrylic “book” that was selected to be part of the show, which runs from September 16 through November 15, 2019. Figure 4 shows the three page acrylic book with one line of a haiku cut out on each page, and beneath each haiku line are the numbers, zeros and ones, that form the bits forming the bytes (8 bits for each byte forming a letter in a haiku) and together generate the memes that we now can exchange on the internet.

Figure 4 contrasts the text that we can read with the binary code that a computer can read. The actual lines of the haiku “Bits to Memes” are: on page 1 “as bits change to bytes”, on page 2 “base 2 shines revealing

Figure 3. Sagittarius A X1 (Twotanka in an X shape arrangement share the middle line)



Source: author's work.

Figure 4. Bits to Memes (compares binary code with text)



Source: author's work.

memes” and page 3 “best and worst of us”. A small button on the lower left of each page can be pressed to play the audio for the haiku line on that page.

Cube of Poetry

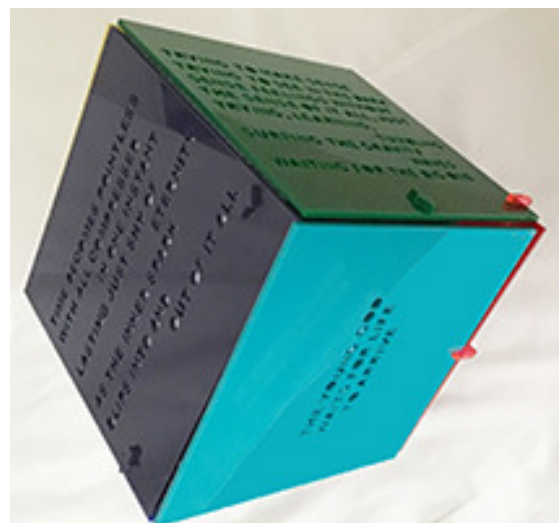
The Pequot Library in Southport, CT, sponsored a call for art at Art Libris, for the library’s 22nd Annual Art Show. This show celebrates the intersection of word and image. The author submitted several pieces, but shown below is one that exemplifies the artist’s view of making tactile poetry accessible as art. A cube composed of different colors of acrylic was designed, with each side of the cube’s six sides containing a portion of the poem “Timeless Patience”, written by the author. Figure 5a shows a top view angled to get a sense of the cube arrangement. What is not shown is that the cube sits upon a black cylinder pedestal assembled from acrylic cut into a cylindrical shape using a laser cutter. This piece is also made so that it can be picked up and rotated by hand for viewing the sides of the cube not easily seen from a single viewpoint.

Note that Figure 5a is described as “closed” because the cube can be opened to reveal the poetic lines translated into Braille for touch reading by blind patrons, as shown in Figure 5b. Raised arrows on each of the cube faces give the direction for reading the poem, which starts on the title face or page 1, then moves to faces 2 and 3 to be read in that order, with the cube faces rotated by hand to show the text. On face 3, there is the opportunity to choose to read either face 4 or face 5 next, and then the last portion of the poem on face 6. This means that there are two poems intermingled into one poetic cube, dependent upon whether the reader chooses the poetic lines on face 4 or face 5 before the final lines on face 6.

The cube of poetry is held together by magnets to allow face 1 of the cube to be separated from face 6, so that the cube can be opened to lay flat, revealing on the inner surface of each cube face the same lines that appear on the exterior surface except now they are in Braille. The Braille is produced using swell or microcapsule touch paper on a Tactile Graphics machine obtained from American Thermoform (American Thermoform, 2019).

The acrylic “pages” are held together by a hinge formed from flexible black tape so that two pages can be easily opened and then shut again multiple times. The magnets are held in place by glue, and the connection between the red and blue faces (faces 1 and

Figure 5a. Cube of Poetry (closed)



Source: author's work.

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Figure 5b. Cube of Poetry (showing Braille inside when open)



Source: author's work.

6 on the closed cube) are also held together by Velcro pads that can easily be pulled apart to open the cube and then close it again.

3D Laser Cutting (Hardware and Software Used)

A Glowforge Basic 3D laser cutter (Glowforge, 2019) was purchased mid-2018 which uses an on-board computer and a powerful laser to cut through 3–6 mm thick acrylic plastic sheets of different colors. The acrylic plastic sheets were purchased primarily from Glowforge as part of their Proofgrade collection. The Proofgrade acrylic sheets measure 12 inches x 20 inches and are available in 1/8 inch and 1/4 inch thick versions and priced from \$12.00 to \$18.00 per sheet. The Proofgrade acrylic is designed for optimal use with CO2 laser technology and lab tested for accurate printing. The Glowforge laser can both engrave and cut through the acrylic sheet, but for this study only the laser cutting was employed, with line drawings used as a guide for the laser to follow for cutting through the acrylic. Once a Glowforge laser cutter is purchased, a catalog of designs is available for printing, but in this study, the text for a poetry line is first converted into a scalable vector graphics (svg) file that can be used for laser cutting.

Making scalable vector graphics (svg) files for laser cutting

A MacBook Pro was used for making the svg files for laser cutting, but a PC would work as well. For the “Ferris Haiku” and “Merry-Go-Round Haiku” projects in this study, solid text was first typed onto a rectangle graphic drawn in Photoshop (Photoshop, 2019) and circles were also drawn where holes were needed for the machine screws to hold each rectangular acrylic

in place, and the file was then saved as a jpeg file before being converted later to an svg file for the laser cutting. For the “Sagittarius A” models in this study, the warp option in Photoshop was also used to widen the text graphic on the left side near the base of the platform used for attachment of the text following laser cutting. The solid text for the “Sagittarius A” models in this study was also changed into outlined text (Photoshop CAFÉ, 2019) to produce solid text in the acrylic sheet when laser cut. A one-inch rectangular graphic with a hole cut in it was also added for attaching the laser cut text to a metal right angle joint for connection to the platform forming the base of the “Sagittarius A” models. A 3 mm wide rectangular graphic was also added underneath the text to have a platform for the text to adhere to when laser cut.

Super Vectorizer 2 Mac (SuperVectorizer, 2019) was used to convert the jpeg files into svg files. Super Vectorizer 2 Mac converts jpeg files into svg files by setting the working window options to “Line” and “Skeletalization” with a “Threshold” value of around 60, “Smooth Line” option set to 200 and “Reduce Noise” option set to 15. These settings can be adjusted so that the jpeg file after loaded into Super Vectorizer has no peripheral line breaks, as the laser cuts along black lines, and if a text letter does not have a complete line forming it then the laser will not cut completely around the letter component and that letter will not be easily removable from the acrylic sheet.

Making tactile art “talk”

The inclusion of audio generating tools, such as seen in audio-responsive greetings or birthday cards from bigDawgs (bigDawgs, 2019), provides a way to match touching a line with the audio for that particular line of poetry. Push button modules were used for

audio delivery of poetry lines and also push button options were available for recording fresh audio so that tactile art show attendees could record their own poetry and have it available for others to hear. The compact thin size of the audio recording and generating devices from bigDawgs permitted their placement inside the space underneath the platform to which the acrylic poetry lines are attached. The activating buttons for generating or recording the audio can then be placed on the surface of the platform near the site where the individual lines of poetry are attached.

From Accessibility to Art

The path followed to explore making laser cut lines of 3D poetry accessible to the blind or visually impaired reader has, surprisingly, led to the recognition that tactile poetry in 3D space can also be used to produce mixed medium tactile art pieces. This observation is similar to work that others have done in visual poetry (Michael and Sara Biggs Chaney, 2018) and leads one to predict that visual poetry can also be made into tactile poetry in 3D space using the methods described in this report. All of these studies affirm the importance of including Universal Design principles (Universal Design and Accessibility, 2018) into the planning process from the beginning when making accessible elements for learning via touch generated audio components. There is also an interesting and satisfying process of discovery in finding that the viable accessible solution is also one that includes an artistic component.

Abstract

Poetry written for display in 3D digital space presents challenges for blind or visually impaired readers. One approach to making 3D poetry more accessible is to design real-world 3D models of the poetry lines so they can be touched and made audio responsive. The unpredicted effect of making talking tactile poetry models is that they now can be viewed as works of mixed medium art. Some of them have even been accepted into juried tactile art shows, which are becoming more common in national and international art centers, museums, and art galleries. This report explains how 3D laser cutting technology is used to make audio-responsive 3D poetry mixed medium art pieces highlighted by a "Best in Show" award at a national art show in October 2019 for a piece titled "Ferris Haiku". It is of interest to note that making 3D poetry accessible can also lead to a tactile mixed medium art piece.

Keywords: 3D laser cut, poetry as art, acrylic sheets, accessibility

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