Poetry Based 3D Printed Sculpture

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The paper discusses materialization of verses into abstract printed artwork. It is an experimental project involving artists and people from IT, where poetry is reinterpreted through the relationship between man and machine. At one end, the artist inputs one verse using his voice and collects a physical form of it at the other end. Between the input and output, the machine analyses the information and creates material evidence of the voice (a 3D printed layer). The final step is made by the artist who assembles all layers into a sculpture.

Digital culture. Machine learning. 3D printing.

1. INTRODUCTION

The paper presents an on-going project of a mixed team, composed by artists from the Art and Design University from Cluj-Napoca, Romania, who initiated this project, and IT specialists from Zenitech Ltd. who brought their valuable programming skills into this practical research that aims to translate performed poetry into abstract 3D sculpture, via 3D printing.

In line with recent research into artificial intelligence for art (Lisek 2018), the present project involves the use of artificial intelligence techniques for exploring emotional triggers from poetry to translate them into another art form, which is mediated by the artist's interpretation.

2. A BIT OF HISTORY

The aim of this section is to provide a better understanding of computer based artistic practice as well as creative exchange across borders during cold-war politics in Romania.

The '60s and '70s have constituted a period of intense research into the impact of digital technology upon art, on both sides of the Iron Curtain. International exhibitions, such as the seminal 1968 Cybernetic Serendipity in London, or the Stuttgart Impulse Computerart, in 1969, which was presented by Herbert W. Franke in 1974 at the

Goethe Institute in Bucharest, had an important impact on Romanian researchers and artists, too.

The same year, 1974, the painter Florin Maxa (1943-2018), who would become later full professor at the Art and Design University from Cluj-Napoca, presented a computer graphics work at the collective exhibition Art and Energy in Bucharest. Other artists who had interests in digital technology were Adina Caloenescu, Sherban Epuré (who managed to escape from Romania and moved to New York in 1980), Savel Cheptea, Cristian Bruteanu, Ileana Bratu, and Francis Goebész (Epuré 1970, 2006). They were accompanied by theoreticians like Viktor Ernest Mašek, who published the first Romanian text applying Max Bense's aesthetic theories to semiotics of visual art (Mašek 1972), and mathematicians like Solomon Marcus who edited a volume containing substantial texts in the field of the computer-art relationship (Marcus 1982). But this frail practice of computer art faded during Romania's strong isolation period of the '80s.

Figure 1 shows a selection of works that have survived Florin Maxa's drastic action from 1981 in which he burnt many of his early works as a sign of personal freedom and protest against communist censorship in Romania. Those were times when Romania experienced a total paranoid communist isolation from other countries, a time when importing a PC was seen as a hostile action, undermining the national industry.

Wing, 1980. Linen over metallic stretcher (double-sided), 165 x 27 x 0.7 cm.

Metamorphoses, 1973. Computer graphics plotted on paper, 29 x 41 cm each.

Metamorphoses, 1973. Computer graphics plotted on paper, 41 x 29 cm.

Hexagon with turquoise lines, 1980. Acrylic on canvas on custom stretcher, 72 x 67 cm.

Figure 1: Works by Florin Maxa, from the Kazuko Miyamoto <> Florin Maxa: A dialogue. Installation view, New York, 2015.

Founded in 1926, the University of Arts and Design Cluj-Napoca Romania (UAD) survived a period of 50 years of “socialist realism” and was able to return to international standards in art education after the Revolution from 1989. Art has gained its identity in the city with art centres and galleries like Plan B Gallery, The Paint Brush Factory, The Center of Interest and The Cluj Cultural Center, which are in the spotlight of contemporary art world since alumni artists such as Adrian Ghenie, Ciprian Mureșan, Șerban Savu or Victor Man became internationally acclaimed. Over the past 10 years, the multicultural city of Cluj-Napoca has become a Silicon Valley of Eastern Europe. IT and education became the main highways, fostering a climate of collaboration between universities and multinational companies.

3. WHY POETRY?

To answer this question, we have to invoke the words of a famous Romanian poet, known as “the poet of unwords”, Nichita Stănescu (1933-1983), that accurately define the significance of the work of art:

Transposing into a notion something that is not notional in character is very difficult. Poetry does not have a notional character, although it uses the notion as a brick in the construction. Its final significance is an emotional, a metaphoric and a visionary one. Confusing the material with the significance of the material is a very easy and very damaging approach.

– quote from a TV interview from 1982, The creator and his work, TVR archive, original in Romanian.

The use of information in modern day systems brought to our attention the issue of semantics. Most often the meaning of a message is integral to performance of the consequent task (Szpankowski 2015). Theories of semantics point out that linguistic expressions denote specific entities, which are not necessarily real entities (Zhong & Li 2017, Wang 2017), but can also be abstract ones which are better perceived with “the eye of the mind”. It is a characteristic of poetry, expressing emotions, no matter what language is used, that inspired us to use poetry in our project.

The idea of using poetry is rooted also into the usage-based theory of language acquisition

(Tomasello 2003, 2008), which can be summarised by the following two aphorisms:

- Meaning is use
- Structure emerges from use

According to this theory, the language acquisition of children is a process based on two sets of cognitive skills, evolved for other general functions of the human species, namely intention-reading and pattern finding.

The pattern-finding skills can be easily associated with the use of neural networks in our research. The intention-reading skill can be associated with the emotional significance of poetry, similar to the kind of language we use when addressing to little children.

4. ARTISTIC STATEMENT

Usually visual artists consider that an image does not need words as it speaks for itself. But recently, in the artistic landscape of Cluj-Napoca, the idea of a visual linguistics become in focus (Fabini 2017). It is the idea of a path in the opposite direction, the one in which words express images. And this is not about working techniques or methods such as metaphors and comparisons or narratives and scenarios, it is about the semantic, morphologic and syntactic capacity of words to function as a shape or figure against a background.

Figure 2: 3D Printed Sculpture – Sculptural element, one verse (left) 8 x 7 x 0.1 cm. Proposed final result from multiple elements assembled by the artist (right) 15 x 14 x 16 cm.

5. TECHNICAL IMPLEMENTATION

At the technical level, the project works like a pipeline. It uses parts of an audio recording (duration imposed by limitations of technology), applies several operations on it and generates a drawing. The drawing is composed by chaining together basic symbols that correlate one-to-one to vowels and consonants or words and phonemes, and applying than various geometrical transformations based on several features of the

audio clip: the detected emotion, rhythm, pitch and loudness.

5.1 Geometrical symbols

The software uses as input a verse from a poem in text and audio recording form. In order to start drawing, the software correlates vowels and consonants, to a set of predefined geometrical symbols. Next, the software extracts the list of unique vowels and consonants from the text and generates a list of basic symbols.

The geometrical symbols are represented by Bezier curves in SVG format. When chained together, they form a closed shape (Bezier spline), which can then be displayed on a screen, printed on paper or using a 3D printer.

5.2 Emotion detection

The main feature of the software is the detection of emotions in an utterance. Because the input recording is supposed to be a fragment of poetry, the goal was to detect emotions regardless of the lexical meaning of the text. The software relies on the acoustic features of the audio clip (Ayadi, Kamel & Karray 2011).

Figure 3: Waveform for an audio recording.

Figure 4: The spectrogram of the audio recording.

Based on existing research, in feature extraction for emotion recognition (Demircan & Kahramanl 2014; Gancev, Fakotakis & Kokinakis 2005), the most appropriate feature to use is Mel-frequency cepstrum coefficients. The Mel scale is a good fit, because it approximates the human auditory systems' perception of sound (Stevens, Volkman & Newman 1937).

Figure 5: Mel-frequency cepstrum coefficients.

At present the software aims to detect a set of 6 basic emotions. This becomes a classification problem, and the solution trains a convolutional neural network (CNN) to process the extracted MFCCs. CNN is using the Berlin Emotional Speech Database (Burkhardt et al. 2005) and additional audio recorded for this research, targeting a 60% accuracy on test data.

5.3 Applying transformations

The transformations applied to the starting SVG shapes affect the positions of the Bezier curve control points, the number of control points, the colour and thickness of the curve. A “sad” voice recording will result in a more flattened shape, while a “happy” voice will determine the shape to have more pronounced curves. The loudness of the recording will determine the thickness of the curve, and the rhythm will determine the relative size of the basic symbols.

The final shape will be displayed in an HTML page, printed on paper or sent to a 3D printer. The artist will then have the opportunity to arrange the shapes together, to form a larger structure.

6. CONCLUSIONS

As mentioned before, this is a collaborative, ongoing project. Hopefully, it will evolve in time according to obtained results.

Already the collaboration between artists and programmers brought some valuable ideas for further research: involving poetry in different languages, belonging to different families of languages (Indo-European and Finno-Ugric); use of Kohonen self-organizing maps for pattern recognition... and the ideas could go on.

But probably the best outcome of the project is the climate of fostering new ideas that has been established within such a diverse team.

7. ACKNOWLEDGEMENTS

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8. REFERENCES

- Ayadi, M. E., Kamel, M. S. and Karray, F. (2011) Survey on speech emotion recognition: features, classification schemes, and databases, *Pattern Recognit.*, 44 (3), 572–587.
- Burkhardt, F., Paeschke, A., Rolfes, M., Sandlmeier, W. and Weiss, B. (2005) A database of German emotional speech. In: *9th European Conference on Speech Communication and Technology*. Lisbon, Portugal, 1517–1520.
- Demircan, S. and Kahramanl, H. (2014) Feature extraction from speech data for emotion recognition, *J. Adv. Comput. Netw.*, 2 (1) (2014), 28–30.
- Epuré, S. (1970) Cybernetic Attitude, Mathematical Thinking, *România Literară* No. 25, Bucharest, June 13 1970.
- Epuré, S. (2006) An Artist's Journey in Art and Science: From behind the Iron Courtin to Present-Day America. *Leonardo*, October 2006, vol. 39, #5, MIT Press, Boston. 402–409, 436.
- Fabini, D. (2017) *Dialog in Agora. Zeitgenossische Archäologie, künstlerische Forschung in situ*, Koln, Bukarest, EIKON Verlag,
- Ganchev, T., Fakotakis, N. and Kokkinakis, G. (2005) Comparative evaluation of various MFCC implementations on the speaker verification task, *10th International Conference on Speech and Computer*, Patras, Greece, 159–166.
- Lisek, R. B. (2018) AIA: Artificial intelligence for art. *Electronic Visualisation and the Arts (EVA 2018)*, London, UK, 9–12 July 2018, 26–31. BCS, London.
- Marcus, S. (ed.) (1982), *Semiotica matematică a artelor vizuale* [Mathematical Semiotics of Visual Arts], Bucharest, Editura Științifică și Enciclopedică.

Maşek, V. E. (1972) *Arta şi matematica. Introducere în estetica informaţională*, Bucureşti, Editura Politică

Stevens, S. S., Volkman J. and Newman, E. B. (1937) A Scale for the Measurement of the Psychological Magnitude Pitch, *The Journal of the Acoustical Society of America* 8, 185.

Szpankowski, W. (2015) Frontiers of Science of Information. *Proceedings of IS4IS Summit, The Information Society at the Crossroads*, Vienna, 2015, doi:10.3390/isis-summit-vienna-2015-i00

Tomasello, M. (2003) *Constructing a Language: The usage-based theory of language acquisition*, Cambridge, MA, Harvard University Press.

Tomasello, M. (2008) *Origins of Human Communication*, MIT Press, Cambridge, Massachusetts, London, England.

Wang, N.; Li, B. (2017) A Model of Deceitful Information Communication: Some Views on Theory and Practice of Semantic Information. *Proceedings of IS4SI Summit, Digitalization for a sustainable society*, Gothenburg, Sweden, 12–16 June 2017. doi.org/10.3390/IS4SI-2017-03998.

Zhong, Y. (2017) A Theory of Semantic Information, *Proceedings of IS4SI Summit, Digitalization for a sustainable society*, Gothenburg, Sweden, 12–16 June 2017. doi:10.3390/IS4SI-2017-04