typEm — a generative typeface that represents the emotion of the text

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Figure 1: Different 'a' glyphs to represent different emotions.

ABSTRACT

The introduction of programmatic concepts brought to typography new experiments, concepts, and the possibility to create generative typefaces, capable of adapting to different contexts. This work aims to explore these new creative possibilities in the field of type design. Through the implementation of a generative system, we created a typeface that adapts its shape to the sentiments expressed in a text. In this project, we used the emotional values retrieved from each sentence of a given text to deform the typographic glyphs to represent those emotional values. Additionally, and to enable the user to interact with the system, we implemented an application which receives a text as input and, as output, exports the input text composed with our generative typeface.

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CCS CONCEPTS

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1 Introduction

The introduction and exploration of new technologies in the design process have improved and accelerated the process of design as well as expanded the creative possibilities. Most of today's typefaces are created through computational methods, which ease the development and fine-tuning of every glyph. Additionally, they allow the development of new strategies to compose the typographic elements in a canvas, such as the random selection of glyphs to generate dynamic designs. These complex compositions can augment the relationship between reader/viewer and content, by involving him/her in a visual experience that can facilitate the understanding of the message underneath the design. Accordingly, the creation of typefaces which relate themselves with the text may entice this involvement between reader, typeface, and text.

In "Thames and Hudson Manual of Typography", McLean states that typography can help express an emotion or state of mind in harmony with the meaning of the written word [16]. In the current days, several techniques can be used to represent emotions through typography: (i) the use of uppercase, expressing more aggressive or enthusiastic reactions; (ii) the use of "smiles", a pictorial representation of facial expressions through the composition of a set of glyphs; and (iii) the use of typefaces with different characteristics or styles, highlighting important sentences in the text. With this project, we intend to expand these techniques by creating a generative typeface which adapts each glyph to represent the emotions expressed throughout a given text. Our generative typeface is based on the idea that typography can represent the word and at the same time, its meaning — meaning, text, and typographic shape are one [8]. We opted to portray the emotion expressed in the text into the glyphs' shape (Fig. 1), to ease the understanding of the emotional value of the text. We intend to explore the visual expressiveness of the glyph and, for this reason, legibility can be impaired. Nonetheless, a minimum degree of legibility will be taken into account.

Our generative typeface deforms automatically the shape of its glyphs to the contents of the text, representing its emotional values (e.g., sadness, disgust, anger) and augmenting the expressive strength of the words. Additionally, to enable the user to interact with such typeface, we developed an interactive application that: (i) composes a given text automatically with the generative typeface; (ii) exports the composed text in the PDF format; and (iii) exports the generated typeface in the TTF format for use in external applications.

The remainder of this paper is organised as follows: Section 2 summarises the related work of generative typography, Section 3 presents the development of the typeface, Section 4 presents the reflections over our generative typeface, and Section 5 presents the conclusions and directions for future work.

2 Related Work

Generative Typography can be described as code-driven typeface that is generated automatically and, for example, can adapt the glyphs' shape to the context in which they are inserted [4]. These algorithms consist mainly of a set of rules and parameters previously defined by the designer/programmer to represent his/her visual concept. We distinguish generative typography from dynamic typography by the ability of a generative typeface to shape itself autonomously according to random or data inputs. Dynamic typography can be described by the computational generation of glyphs, which can be modified by changing manually the parameters. The modification of such parameters can occur through the interaction with a computational program [6], physical buttons [17], or through vector graphics editors [13].

In generative typography, a typeface is automatically generated with the aid of a set of rules. These rules define the final shape of the glyph. To add unpredictability and dynamism to each glyph, random systems can be applied to distort its final shape. For example, random systems can be used to define the modules with which the different glyphs are generated [7] or the contour points of each glyph [14][15]. Generative typefaces can also be created through other typefaces glyphs [20][22], or even by deforming the drawing of each glyph as time passes [3]. There are other examples of generative typefaces which can adapt their shapes according to data. In this context, the data serves as input to the system which will generate the typeface. This data defines how the glyphs will be drawn and can be retrieved from the capture of facial expressions [9], from musical files [21][10], or from the time spent by the user to type a certain text [18]. The use of the content of the text itself to manipulate the glyphs can also be seen in the project "Colloquy" of Joel Baker [1]. This typeface is developed by a system which evaluates the written text and varies the glyphs accordingly.

As a summary, it is possible to perceive that, to generate a dynamic or generative typeface, one can rely on four methods: (i) the direct manipulation of the glyphs' characteristics (e.g., Cap height, ligature, and serif); (ii) the usage of random systems to create unpredictable glyphs; (iii) the definition of a set of rules; and (iv) the use of input data to define how the typeface is generated. These methods can be used independently or in combination. In this project, we combine the application of random systems and input data with the aim of creating a typeface which is defined by the text's content, where each glyph is a representation of the word and its emotional context.

3 typEm

To generate a typeface that shapes itself according to the emotion of a text, we implemented a system in Java, using the open-source graphical library Processing, which receives a text as input, extracts the emotions expressed in it and defines the shapes of each glyph depending on that information. With this, the typeface is a representation of the word and a visual interpretation of the text emotional values. We aim to explore the shape of the glyphs as a means to enhance the representation and interpretation of an emotion. As an exaggerated exploration of the glyphs' shape may lead to limited legibility, we explore them carefully so the texts composed with the generative typeface can be read. All glyphs are implemented through a set of rules, hereafter explained.

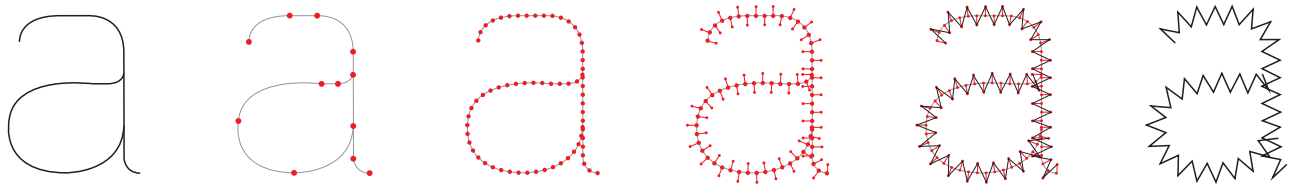

Figure 2. Example of the different phases of the glyph construction: (i) skeleton; (ii) base points; (iii) additional equidistant points; (iv) creation of new point which define the new glyph; (v) their connection; and (vi) final glyph.

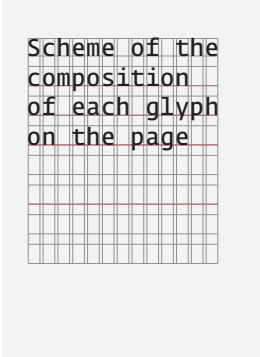

Figure 3. Page composition with a mono-spaced typeface.

To obtain the emotions present in the text, we used an external Java library called *Synesketch* [12]. The classification of the emotions of *Synesketch* is based on Paul Ekman's research. From his studies, Ekman defined 6 emotions which could be expressed and detected by facial expressions. These 6 emotions can also be extracted from the text: happiness, sadness, anger, fear, disgust, and surprise. To do so, *Synesketch* uses a method based on the detection of keywords within the text and the application of heuristic rules from dictionaries based on *WordNet*, emotions, and common abbreviations [12]. For every analysed text, *Synesketch* returns the weight values for the 6 emotions, the valence (positive or negative), and a general weight value. These weights represent the intensity of an emotion and vary between 0, not intense, and 1, very intense.

In this project, we approached the representation of emotions in two distinct phases. In the first, we used the positive and negative valences and corresponding weights. In the second, we used the weights of the 6 emotions to characterise and shape the glyphs. Both phases have a similar workflow: (i) we divide the text by sentence; (ii) we detect the emotions and valences present in the sentence with the *Synesketch* library; (iii) we morph the typographic glyphs used in each word, to represent the corresponding valence or emotion (Fig. 2); (iv) we compose the text with the resulting glyphs; and (v) we generate a typeface which represents the general emotion described in the text. We opted to analyse each sentence in the text independently because the same text can express several emotions. With this, as the emotions change throughout the text, the typeface adapts and also changes to represent the new emotion value.

To enable the user to interact and generate the typeface, we implemented an interactive application in Processing [19]. This application enables the user to upload a text, visualise, manipulate and export the text composed with the generated glyphs, and export a final typeface, which represents the general emotion of the text, and can be used in any application.

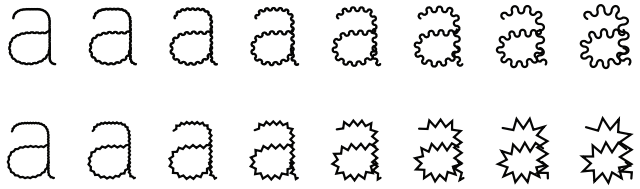

Figure 4. Different 'a' glyphs of the first approach to represent positive (top) and negative valences (bottom), from low (left) to high weight values (right).

3.1 Typographic Skeleton

To generate the typeface, and to make all glyphs coherent, we generated each glyph by deforming a common typographic skeleton. We based this typographic skeleton on *FedraMono*, designed by Peter Bil'ak, which is mono-spaced and whose similar glyphs (e.g., I, 1, 0, and O) can be easily distinguished. This typeface is characterised by its detachment from any emotion and its mechanical and dehumanised forms. As it is a mono-spaced typeface, all glyphs have the same width and occupy the same space. This characteristic ease the composition of the text in a page, once it enables the division of the page into a regular grid in which each cell can contain a different glyph (Fig. 3).

The skeleton was created in a vector editor, so it was possible to export the skeleton glyphs to an SVG file which allows the access to the geometric information of each point through a programmatic approach. In the Processing environment [19], for each glyph, we read the corresponding SVG file and, from the set of points which define the glyph, we extrapolate a higher number of equidistant points. With these new points, we aim to manipulate the skeleton with higher definition and create more expressive glyphs. In Figure 2, we exemplify the different steps of the glyphs generation.

3.2 Positive and Negative Valences

To comprehend how the typographic skeleton could be deformed to represent the emotions present in a text, we opted to use first the valence (positive or negative) and the general weight of the text. The valence takes two possible values, 1 for positive and 0 for negative. The general weight represents the intensity of a certain emotion or valence, ranging from 0, not very intense, to 1, very intense.

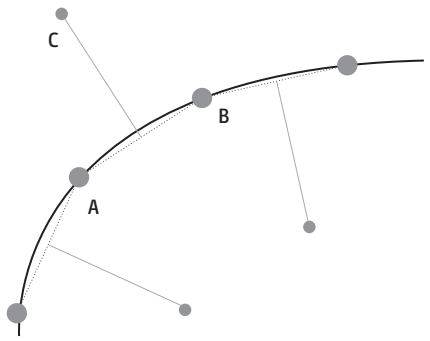

Figure 5. Definition of the perpendicular points along the glyph's line.

Figure 6. Different 'a' glyphs to represent happiness, from low (top left) to high weight values (bottom right).

In this phase, we explored two different approaches to distinguish positive and negative valences. In the first approach, we used the line to differentiate the valences, and in the second approach, we used filled shapes. In the former, to represent the positive valences, we draw an undulating line, in an attempt to make reference to the sound waves drawn when projecting our voice in a harmonic and smooth manner, transmitting the sense of calm (Fig. 4, top). For the negative valences, and in contrast to the positive representation, we draw spiky lines, creating a more aggressive and mechanic representation, and relating such shapes to the sound waves representing noisy and strident sounds, as when we shout (Fig. 4, bottom). To represent both valences, we apply a similar method, in which, along the skeleton lines, we define perpendicular points that will define the height of the spikes and waves (Fig. 5). For the positive valence, these new points will define the intermediate point of a Bézier curve [2] and for the negative valence, this point defines the tip of the spike. To represent the differences in weight, we vary the lines explained above by accentuating or reducing each pattern. If the weight value is closer to 0, we augment the number of waves/spikes and reduce their height, if it is closer to 1, we diminish the number of waves/spikes and augment their height, as shown in Fig. 4 (from left to right).

To improve the distinction between valances, we defined new representations for each valence and created a second visual approach. These shapes were based on the previous concepts, and the waves were replaced by circles, and the spikes by rectangles (Fig. 6). In this approach, instead of creating new points to define the waves/spikes, we place the circles or rectangles directly on the glyphs lines. Additionally, instead of drawing those shapes evenly spaced, we implemented a random system. This system defines,

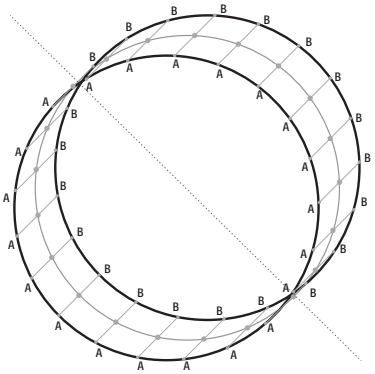

Figure 7. Difference in the calligraphic trace along a circular line (in grey). Each segment AB is defined by a predefined angle and width. The connection of all B points and all A points create the calligraphic trace.

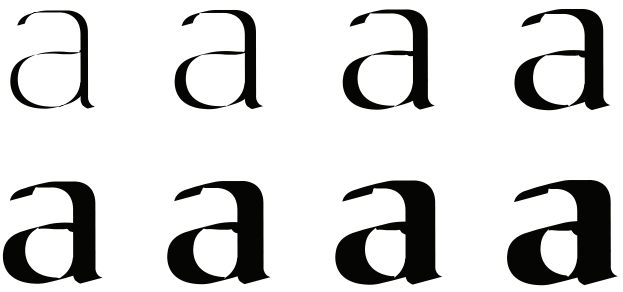

Figure 8. Different 'a' glyphs to represent happiness, from low (top left) to high values (bottom right).

within a restricted set of possibilities, the position of each shape along the line and its size according to the weight values. The higher the weight, fewer and larger shapes are drawn along the line, and the smaller the weight, more and smaller shapes are drawn. In addition, our random system gives higher size variation to the shapes along the line as the weight gets closer to 1. Our intent with this is that the higher the intensity of the valence, the more deformed and chaotic the glyph will be. By applying random values, we intend to generate unique glyphs, that in spite of being generated with the same rules can vary along the text. With this second approach, we could improve the distinction between valences and accentuate the diversity of glyphs with the application of a restricted randomness.

3.3 The 6 Emotional Types

For the second phase of the project, we aimed to distinguish visually the 6 available emotions: happiness, fear, rage, sadness, disgust, and surprise. The concepts behind the shapes of the glyphs are based on the descriptions made by Darwin in "The expression of the emotions in man and animals" [5] about the reactions of the human being to the respective emotion — the way he/she express the emotion, through voice, gestures, or the reactions triggered by certain emotions. In this subsection, we describe the concept behind each representation and its implementation.

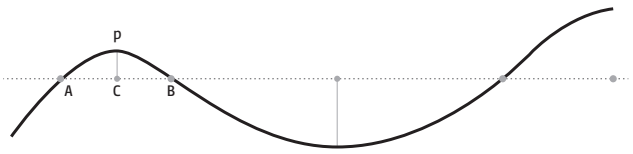

Figure 9. Irregular wavy line (black) along the skeleton (grey)

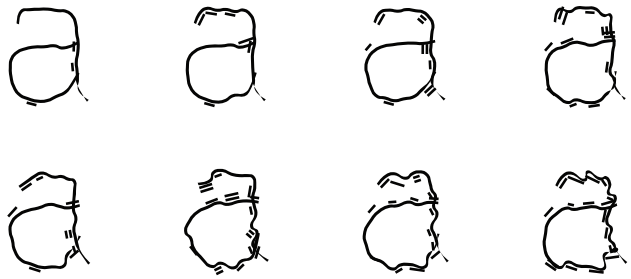

Figure 10. Different 'a' glyphs to represent fear, from low (top left) to high weight values (bottom right).

Happiness. We associated the trace left by a calligraphy pen to the happiness emotion. Contrary to regular pens, which leave an uniform trace, a calligraphy pen leaves a line segment which changes its width according to the drawing angle. We used the calligraphy trace due to its organic shape and smooth but dynamic transitions between stroke widths.

To implement the stroke of each glyph, an angle and width values were predefined. These parameters enabled us to draw a calligraphic trace as depicted in Fig. 7. The width value is then manipulated to change according to the weight value. The higher the weight, the bigger the width and, consequently, the higher the contrast between lines with different angles. The smaller the weight, the smaller the contrast between lines, and more balanced the final glyph (Fig. 8).

Fear. To represent fear, we tried to interpret the shaking muscles of the human body when in a fear situation [5]. For each glyph, the lines will get an irregular wavy shape, as an attempt to resemble the involuntary and inordinate shake of the human body. This visual representation of fear can also be seen in comic books. To create this irregular waves, first a set of random points are selected along the skeleton (Fig. 9, AB) then we calculate the middle point between those segments (Fig. 9, point C) and create a perpendicular with a random height, which defines the height of the Bézier curve (Fig. 9, point p). These wavy lines are then intensified by parallel lines drawn above or below them.

To generate glyphs with different weights, it was defined that the higher the value, the more spaced and larger the waves, and the greater the occurrence of parallel lines. These parallel lines are also created with a certain degree of randomness (Fig.10).

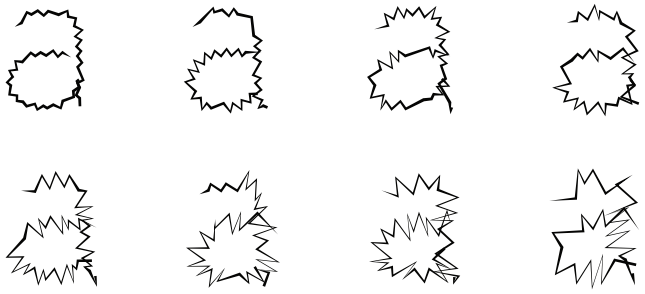

Figure 11. Different 'a' glyphs to represent rage, from low (top left) to high weight values (bottom right).

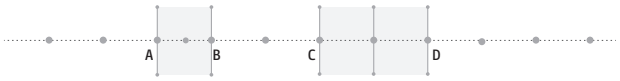

Figure 12. To create the sad glyphs, random pairs of points are selected along the skeleton. Those points define the length of the rectangular shapes.

Rage. As stated by Darwin [5], the human being tends to react in an irrational manner, screaming and taking more aggressive reactions when in a rage emotional state. These actions are the basis for our interpretation of rage in the glyphs. By creating spiky zigzagging lines, we intend to create a pattern similar to the intense scratching in a paper.

To create these scratches, a set of points are randomly selected from the glyph, as it was made with the fear glyphs and is depicted in Figure 9. Then, perpendicular points with a random height are defined and a zigzagging line connects those final points. We defined different heights to the zigzagging lines to resemble the random and inconsistent scratch in a paper. To vary the glyphs according to the weight value, we manipulate the maximum height of each perpendicular point and the space between points. The lower the weight value, smaller and more frequent zigzagging lines will appear. The higher the weight value, bigger, less frequent but more inconstant zigzagging lines will appear (Fig. 11).

Sadness. Sadness is often associated with feelings of loss. This feeling of incompleteness is the basis for the fear glyphs. This concept was transferred to the shape of the glyphs by the generation of an incomplete glyph, in which the lines along the glyph are interrupted during the drawing process. To do so, along the skeleton random pair of points are selected. Those points define the areas in which a rectangular shape will be drawn as depicted in Figure 12. The emptiness created by these spaced rectangles represents the feeling of incompleteness.

To distinguish the different weights, we apply a different number of breaks in the lines drawing. The higher the weight value, the more incomplete the glyph, and the lower the weight value, the more complete the glyph (Fig.13).

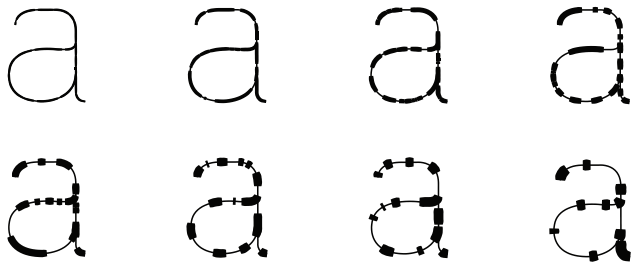

Figure 13. Different 'a' glyphs to represent sadness, from low (top left) to high weight values (bottom right).

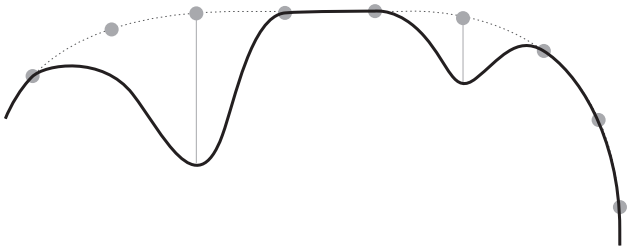

Figure 14. Scheme representing the construction of the melting glyph.

Disgust. Disgust is characterised by a strong feeling of repulse towards filthy objects, not edible, infectious. Darwin [5] refers also to disgust as a feeling which is manifested primarily in the palate. To create the disgust glyphs, we associated the shape of the glyphs to something which is melting, creating a reference to something which is not edible anymore. To this extent, each line of the glyph will be drawn with a set of curves pointing down, creating a melting effect, as seen in Fig. 14. Additionally, a random system is used to create a more organic representation, by applying it to the height of each curve and to the number of curves along the line.

To represent the variation in weight we vary the deformation on the glyph. The higher the weight, the higher the number of deformations (i.e., the number of curves pointing down and corresponding height). If the weight is smaller, the number of curves and respective height diminish. It is important to note that the vertical lines are not deformed, as their deformations would be imperceptible (Fig. 15).

Surprise. Surprise is an emotional state that results from an unexpected event. It can be representative of positive or negative emotions. As a reference for the drawing of the glyph, we apply the concept of expansion, visible in the facial expressions when the eyebrows go up and the jaw down, as well as in the appearance of the expression wrinkles. With this in mind, the glyphs are characterised by a set of contour lines around the typographic skeleton. For each line in the glyph, we trace contour

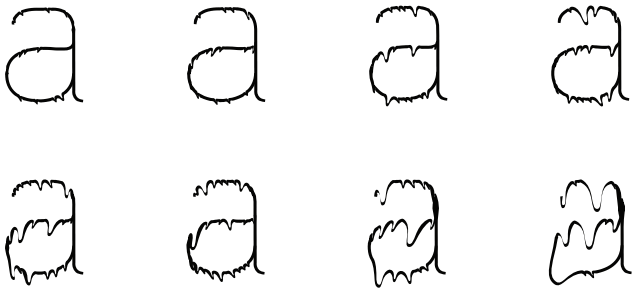

Figure 15. Different 'a' glyphs to represent disgust, from low (top left) to high weight values (bottom right).

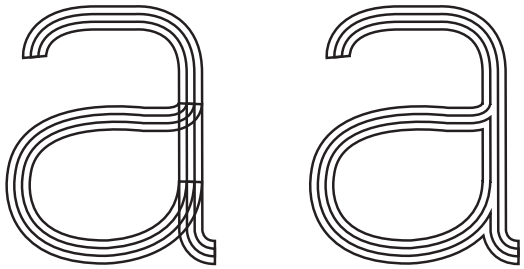

Figure 16. The two phases of the surprise glyphs constructions. First, we draw the contour lines around each line of the glyph (left). Then those lines are merged, so they do not cross (right).

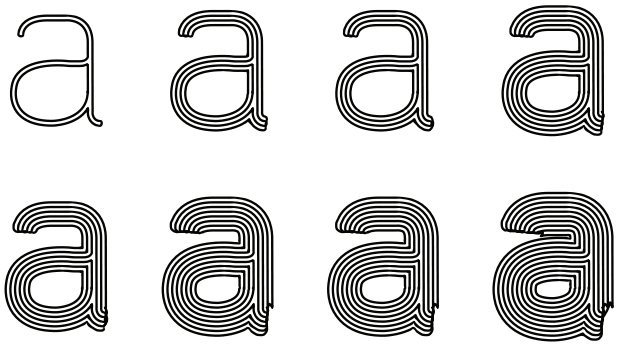

Figure 17. Different 'a' glyphs to represent surprise, from low (top left) to high weight values (bottom right).

lines around with the same space between them. These lines are then merged as depicted in Fig.16.

For the different weights, we defined that the higher the value, the more contours will be drawn around the skeleton, giving a

higher emphasis to the character. The smaller the weight, fewer contour lines will be drawn (Fig. 17).

3.4 Interface

To enable the interaction with the system, we developed an application in Processing [19]. The main goal is to guide the user in the creation of a text composed with the generative typeface. As input, the application receives a text, and as output, the

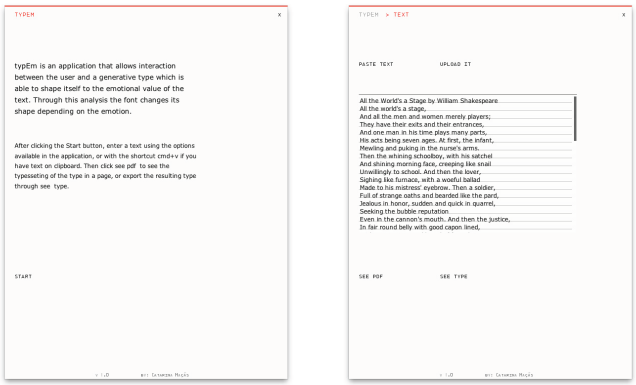

Figure 18. Screenshots of the application. The introduction page (left) and the input page (right).

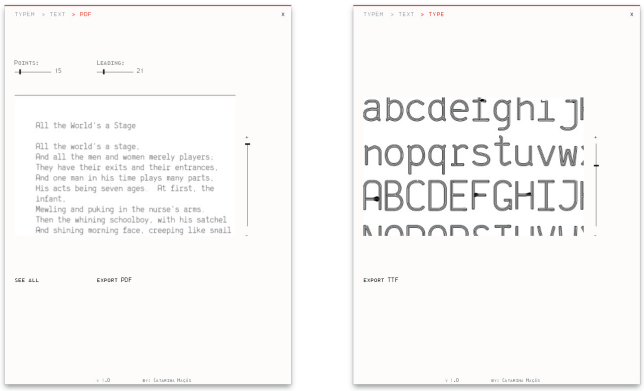

Figure 19. Screenshots of the application. The text composition page (left) and the typeface page (right).

application can export (i) a PDF file in which the inserted text is composed with the resulting glyphs and (ii) a typeface in the True Type Format (TTF), representing the overall emotion of the input text. A video exemplifying the interaction with the application can be seen in: https://vimeo.com/74389105.

The application is divided into four simple pages. In the first, there is a small description about the project and the application itself (Fig. 18, left). Then the user is requested to insert the text, by uploading a text file or by inserting the text through the keyboard commands `ctrl+v` or `cmd+v` (Fig. 18, right). Afterwards, the user can proceed and visualise the text composed with the generative typeface or export the generated typeface.

When visualising the text composition (Fig. 19, left), the user can modify the leading and the font size of the typeface. Additionally, the user can zoom and pan in the page to view the details of each glyph. By clicking on the export button, the user will download the composed text in the PDF format.

If the user chooses to see the resulting typeface, the user will see an alphabet composed by the generative typeface and will be

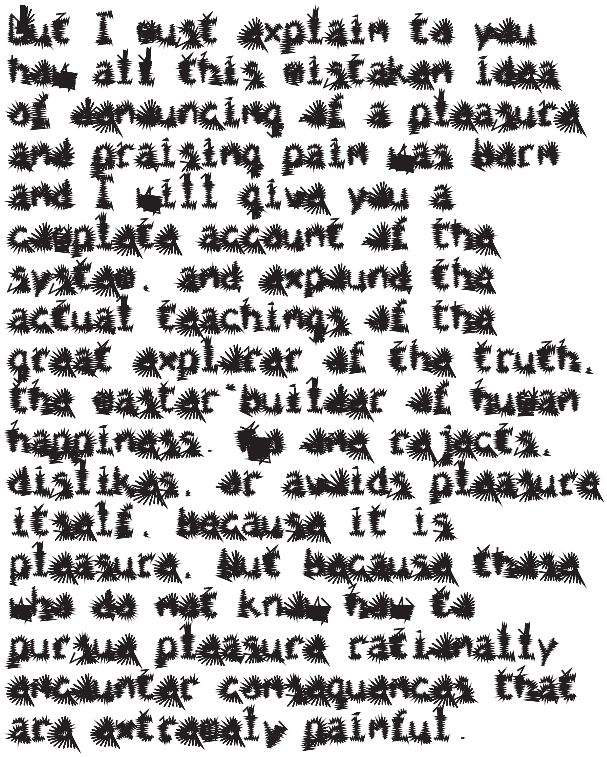

Figure 20. Legibility boundaries of the typeface.

able to export it (Fig. 19, right). Note that the resulting typeface of the input text, will be generated by the analysis of the entire text and will represent the general emotion of the text. To generate the TTF file, we used a Processing library, *Fontastic*, created by Andreas Koller [11].

4 Results and Reflections

This article presents a set of visual approaches to represent the emotional values of a given text through typographic elements — glyphs. These visual representations are not an exercise of conventional typography, which usually focus on the legibility and coherence of a typeface, but instead an artistic exploration of the visual possibilities to represent the written words and its meaning, generating an emotional portrait of the text itself. We base our work in an external library to extract the emotion values, *Synesketch*, and use those values as input in a generative system which generate autonomously the typographic glyphs (Fig. 20). This system is based on a set of coded procedures, and stylistic concepts, to obtain the final visual output. These concepts can be seen as rules and constraints that inform the system on how to draw each glyph. Note that such rules can be further explored to create other representations.

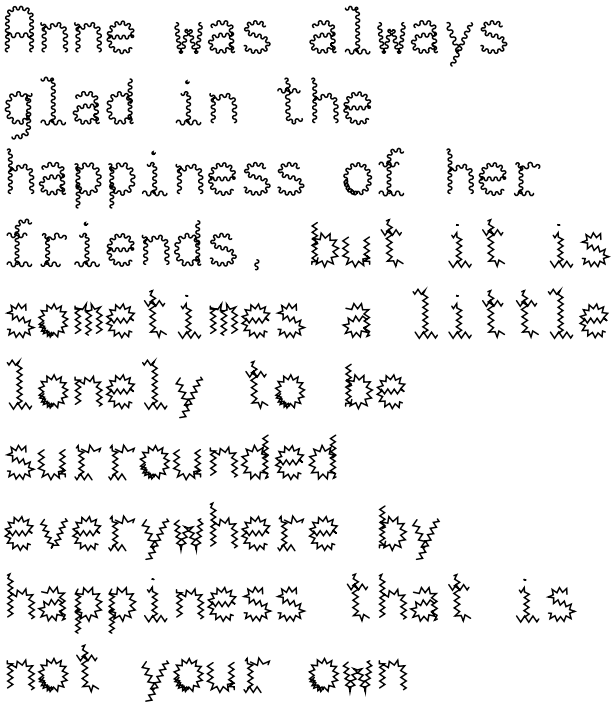

Figure 21. Output of the text with the positive/negative valences of the first approach (excerpt from "Anne of the Island", L. M. Montgom).

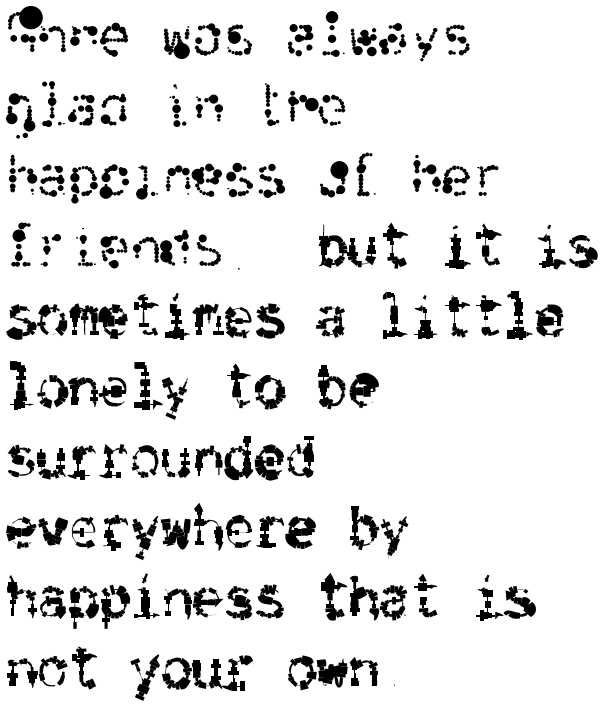

Figure 22. Output of the text with the positive/negative valences of the second approach (excerpt from "Anne of the Island", L. M. Montgom).

We approached the representation of emotions first by distinguishing only positive and negative valences, and second, by defining the visual representation of 6 emotion values extracted from the text. From the first approach, we could perceive that there was a rough transition between sentences of different valences (Fig. 21). Additionally, the visual distinction between glyphs of different valences was reduced, as they were visually very similar, specially in small sizes and with small weights. From this point, we used circular and rectangular shapes along the glyph lines to represent positive and negative valences, respectively. Additionally, we applied a random system to define the size and space between shapes according to the weight values. With this second approach, the deformation of the glyphs when the weight was higher led to some limitations in terms of legibility (Fig. 22). Notwithstanding, these two initial approaches proved to be useful (i) to define that the weights should influence the shapes, augmenting the glyphs deformation the closer the weight is to 1, and (ii) to establish that the glyphs should be distinguishable between different emotions. In the second phase of the project, we used the 6 emotion values retrieved from the *Synesketch* library (Fig. 23). In this phase, we defined a different shape to each emotion accordingly to its impact on the human being. The representations may be subjective and, for this reason, may not represent broadly the emotions of the text. However, this is a first step in the representation of emotions through the glyphs themselves.

The outcome of this research work is a typographic composition, which aims to incite the reader by its dynamism and to give visual cues on the emotional content of the text itself, enabling the direct expression of emotions. Additionally, this work highlights the possibilities of a generative system to create different glyphs along the text, but similar and coherent among them. This research resulted in controlled but unsupervised series of glyphs that match the emotional characteristics of the text. Such exploration can be applied in typographic compositions for posters, illustrations and interactive installations.

5 Conclusion

We have presented and described the conceptual thinking for the creation of a generative typeface, which deforms its glyphs to represent the emotions written in a text. We developed all glyphs deformations as well as an interactive application with which the user can interact with the generated typeface, insert a text and export the same text composed with the different glyphs according to the emotion expressed in each sentence.

Our main contributions include: (i) a generative typeface capable of automatically adapt to the emotion present in a text; (ii) the exploration of different representations for the different emotions; (iii) an interactive application from which the user can export the text or a typeface.

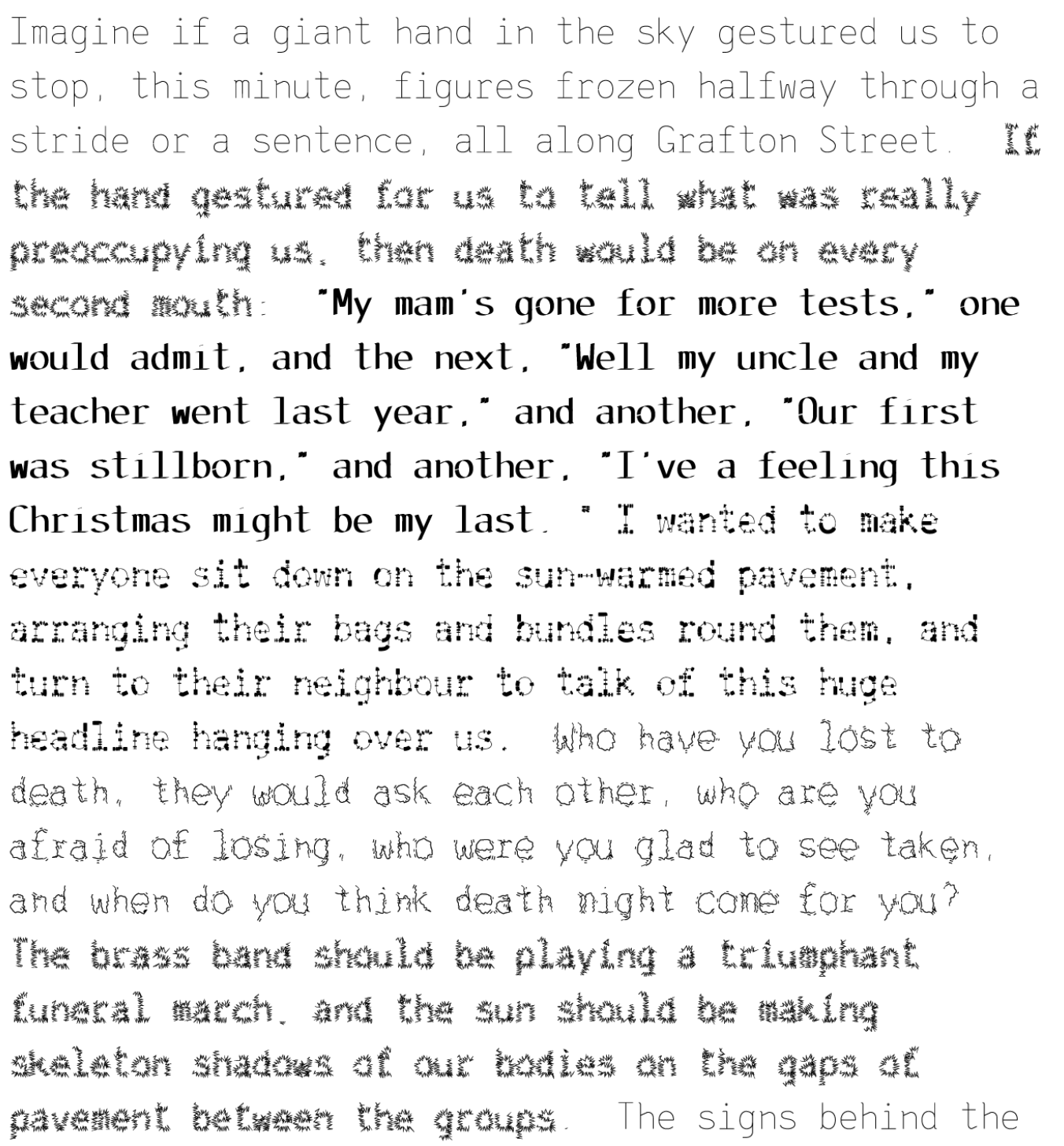

Figure 23. Output of the text with the 6 emotional types retrieved from the text (excerpt from "Hood", Emma Donoghue).

As future work, we intend to explore the different representations to small type sizes, so their glyphs can be distinguishable at reduced sizes. Additionally, the creation of a web application to enable other designers, artists and programmers to use and explore the system is also an improvement to be considered.

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REFERENCES

[1] Joel Baker. 2012. Colloquy Type. https://etapes.com/colloquy-type-un-caractere-generatif/ last accessed on 21/05/19.

[2] RH Bartels, JC Beatty, and BA Barsky. 1998. Bézier curves. *An Introduction to Splines for Use in Computer Graphics and Geometric Modelling* (1998), 211–245.

[3] Erik van Blokland and Just van Rossum. 1990. FF Beowolf. https://www.moma.org/collection/works/139326 last accessed on 18/05/19.

[4] Katherine Brooks. 2017. A Stunning Typography Experiment Inspired By 'The Great Gatsby'. http://www.huffingtonpost.com/2013/08/17/generative-gatsby_n_3767720.html last accessed on 18/05/19.

[5] Charles Darwin and Phillip Prodger. 1998. *The expression of the emotions in man and animals*. Oxford University Press, USA.

[6] Michael Fluckiger and Nicolas Kunz. 2009. LAIKA—a dynamic typeface. http://www.laikafont.ch/ last accessed on 19/05/19.

[7] Elias Hanzer. nd. Phase. https://www.eliashanzer.com/phase/ last accessed on18/05/19.

[8] Richard Hollis and A. M. Cassandre. 2002. The designer as programmer. http://www.eyemagazine.com/review/article/the-designer-as-programmer last accessed on 19/05/19.

[9] Mary Huang. 2011. Bold, Italic, Emphatic—Possibilities for Interactive Type. *IEEE Computer Graphics and Applications* 31, 3 (2011), 8–13.

[10] Denis Klein. nd. Blast. http://generative-typografie.de/generativetypografie/blast/ last accessed on 16/05/19.

[11] Andreas Koller. 2013. Fontastic. http://code.andreaskoller.com/libraries/fontastic/ last accessed on 20/05/19.

[12] Uros Krcadinac, Philippe Pasquier, Jelena Jovanovic, and Vladan Devedzic. 2013. Synesketch: An open source library for sentence-based emotion recognition. *IEEE Transactions on Affective Computing* 4, 3 (2013), 312–325.

[13] Jürg Lehni. 2001. Scriptographer. http://juerglehni.com/works/scriptographer last accessed on 20/05/19.

[14] FH Mainz. nd. Irratio. http://generative-typografie.de/generativetypografie/irratio/ last accessed on 19/05/19.

[15] FH Mainz. nd. Zwirn. http://generative-typografie.de/generativetypografie/zwirn/ last accessed on 19/05/19.

[16] Ruari McLean. 1980. *The Thames and Hudson manual of typography*. Thamesand Hudson.

[17] Rob Meek and Frank Müller. 2007. MEEK FM Typographic Synthesizer. http://robmeek.com/project/meek-fm/ last accessed on 21/05/19.

[18] Jonathan Puckey. 2005. Typographic Rhythm. https://jonathanpuckey.com/projects/typographic-rhythm/ last accessed on 19/05/19.

[19] Casey Reas and Ben Fry. 2007. *Processing: a programming handbook for visual designers and artists*. Vol. 6812. Mit Press.

[20] Michael Schmitz. 2004. genoTyp. https://interaktivegestaltung.net/genotyp/flashdetect_content.html last accessed on 19/05/19.

[21] Dina Silanteva. 2011. Typographic Music. http://www.ddina.com/index.php?/2011/typographic-music/2/ last accessed on 20/05/19.

[22] Bruce Willen and Nolen Strals. 2009. *Lettering & type: creating letters and designing typefaces.* Princeton Architectural Press. 25 pages.