Tangible Type + CODE

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Language is a way of human communication. Visual language is a system of communication using visual elements. It is a visual representation of the written language. *Tangible TYPE + CODE* is a collaboration with two distinctive projects, the *TYPE + CODE* series, by Yeohyun Ahn, and *Tangible Type*, by Taekyeom Lee. The *TYPE + CODE* series explores the expressive aesthetic of computational typography. *Tangible Type* extends typography to perceptible typography with physical touch, which is one of the human senses, by using digital fabrication. It suggests another linguistic experience beyond spoken, written, and visual languages. The design process accomplishes artistic expression, construction technique, and materiality. It results in expressive, dimensional, textural, and touchable types. *Tangible Type + CODE* enhances the direct experiences of typography from written and visual communication to tangible communication by computation and digital fabrication. It is applicable as a learning tool for children to acquire a written language through a form play that is engaging, playable, and touchable.

Typography. Generative art. Digital fabrication. Touch. 3D printing. Expression. Visual language. Tangible Language.

1. INTRODUCTION

Tangible Type + CODE explores physically tangible typography by using computation and digital fabrication. It is a collaboration with two distinctive projects: *TYPE + CODE* and *Tangible Type*. These typographic research projects range across code-driven typography to tangible typography in collaboration with digital fabrication.

2. BACKGROUND

Letters are materialised signs of a spoken language. Although language was developed much earlier than written language, writing did not emerge until clay tablets were used for record keeping around 3100 BC (Meggs & Purvis 2016) While pictorial signs were also used in the earlier forms of writing, earlier forms of letters were made out of various abstract geometric signs, including dots, lines, squares, and wedges. While pictorial signs were also parts of the writing system, as the writing system developed, it became more abstract and less pictorial.

Letterforms are constructed with abstract geometric shapes, although each character may not be simple graphic forms. Edward Johnston wrote:

Essential or structural forms are the simplest forms which preserve the characteristic structure, distinctiveness, and proportions of each individual letter. The essential forms may be briefly defined as the necessary parts (Johnston 1994).

The modernist movement from Bauhaus, a well-known German art and design school operational between 1919 and 1931, promoted geometric construction and established what would be the essence of the letterform (Unger 2018).

3. COMPUTATION IN TYPE DESIGN

Initially, computation was embedded into the type design process as a rule-based type design system in 1954 by Adrian Frutiger's font 'Universe'. Frutiger's approach to the design of Universe was radically different from other fonts. He focused on creating a system of inter-related weights. MetaFont was a first parameterised typeface in the world created by Donald Knuth in 1977. MetaFont took a substantially new approach to create new outlines by hand. It is represented by a series of variables inspired by handwriting and implemented computationally (Madsen 2016). In the Early 2000s,

pioneering works of computational type design began at MIT's Media Lab. Prof John Maeda's graduate student, Peter Cho, at MIT's Media Lab, investigated and showcased expressive, dimensional and interactive letterforms, type design and typography by using computation through his thesis, Computational Models for Expressive Dimensional Typography.

3.1 *TYPE + CODE*

The *TYPE + CODE* series explores legible, readable and expressive type design by using computation. It was initiated by Yeohyun Ahn, as her MFA thesis, *TYPE + CODE*, at Maryland Institute College of Art. *TYPE + CODE* shows the aesthetic of code-driven typography by using Processing. Processing is a programming language for artists and designers initiated by Ben Fry and Casey Reas. *TYPE + CODE* experiments with traditional and culturally oriented calligraphy to reinterpret modern and expressive type design with the computer codes (Figure 1). It uses letterforms to explore innovative typographic forms by using mathematical expressions, computer algorithms such as Binary Tree and L-system as well as Geomerative library developed by Richard Maxer.

Figure 1: *TYPE + CODE, seed font: Arial, type design by Yeohyun Ahn and Layout Design by John Page Corrigan.*

3.2 *TYPE + CODE II*

TYPE + CODE II extends the letterforms, to words, phrases, and sentences. It conveys diversified visual messages inspired by nature, addressing environmental issues such as green design (Figure 2), and healing through arts, exploring philosophical and religious interpretations of life, death, and love.
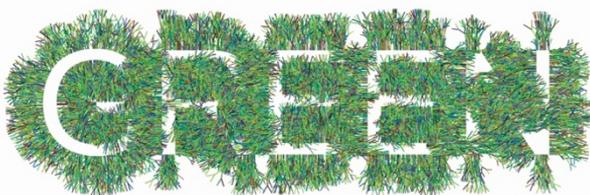

Figure 2: *GREEN, seed font: Arial, by Yeohyun Ahn.*

3.3 *TYPE + CODE III*

The third version, *TYPE+CODE III*, shows the possibilities of an extension of the aesthetic of code driven typography from cyberspace to physical space by using digital fabrication (Figure 3).
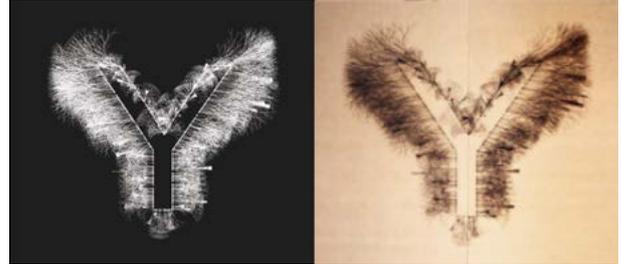

Figure 3: *Left: Y (TYPE + CODE II), seed font: Arial. Right: Y (TYPE + CODE III) with laser cutting on MDF by Yeohyun Ahn.*
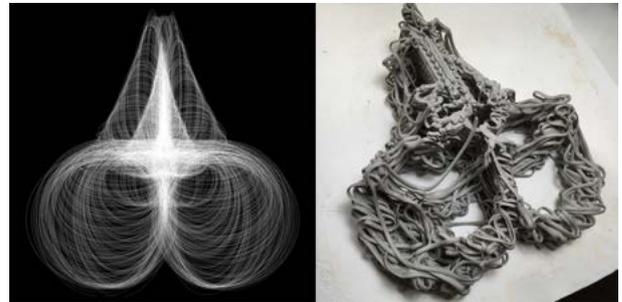

Figure 4: *Left: Erotica A, seed font, Arial, by Yeohyun Ahn. Right: 3D printing with ceramic material, Porcelain, by Taekyoem Lee.*

3.4 *TYPE + CODE V*

TYPE+CODE V experiments with date driven typography. It utilises diverse data including word collection for Valentine's Day related with love on Internet (Figure 5).

Figure 5: *Love Version 2.0, seed font, Arial, by Yeohyun Ahn.*

3.5 *TYPE + CODE VI*

TYPE+CODE VI is a computational type design system to explore computationally expressive letter forms. It shows how a custom illustration can be embedded into a selected typeface to explore legible and expressive typeface designs in a generative system (Figure 6).
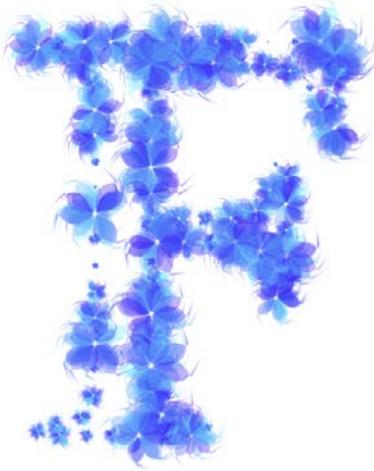

Figure 6: F, seed font: Times, by Yeohyun Ahn.

4. THREE-DIMENSIONAL PRINTING IN TYPE DESIGN

Designers can use a variety of printing techniques to produce visual materials and to solve visual problems. Since the invention of printing technologies, type designers have spent hundreds of years developing impeccably proportioned, beautiful typefaces to use on flat and static space and print technologies to support the perfection of printed materials. Digital fabrication can change the notion of printed text and how we experience materialised type since the tangible type does not lie on the static surface or live on-screen as a mirrored image. Three-dimensional printing, in particular, has become more refined, common, and accessible. These new technologies have introduced new tools for pushing the boundaries of typography both in terms of concept and medium.

4.1 Creating Do-It-Yourself 3D printers

The first phase of the research project was building 3D printers to work with various conventional and unconventional materials in three-dimensional printing. The RepRap project is one of the most famous open-source projects on building 3D printers and provides resources for designers, artists, and makers to build affordable machines. The most exciting feature of these Do-It-Yourself 3D printers is that the maker can build affordable machines and customise them for individual creative practices. Self-build 3D printers could adopt different printing heads to print unconventional materials like clay. Most 3D printer filaments for fused deposition modelling (FDM) are with some software modification.

4.2 *Tangible Type*

Tangible TYPE translates the digital type into the tangible typographic form using 3D printing to enable the new typographic experience. Abbott Miller said, "Designers accustomed to dealing with the flat pictorial paradigms of print are now dealing with the architectural, ergonomic, and cinematic paradigms of environmental, immersive media" (Miller 1997). Type design is considered as the process of designing letters on flat and static surfaces. However, with the development of digital technologies, it naturally expands into physical and spatial realms. Materialised type provides engaging, tactile experiences with physical substance, which could be more intuitive, expressive, and memorable. For this project, various conventional and unconventional materials in 3D printing were used to explore both the challenges and potentials for type design offering tangible experiences.

Figure 7: MESS to NEAT, seed font: Universe, by Taekyoem Lee.

MESS to NEAT incorporates the meaning of the text and the letterform. The print quality of the bottom parts is disorganised and gradually gets better toward the top. The texture was made by manually controlling the extrusion, not from the software. The transition of the print quality shows the transition of the letterforms, as well as the meaning of the words. The time-lapse video of the printing process shows that the letters are moving through time and space (Figure 7).

The letterform was built from numbers of cones as building blocks. It is similar to the modular construction, but the size of the cone varies depending on the parameter. It was designed using CAD software called Rhino and its plugin called Grasshopper, a computational design tool. The computation tool distributes numbers of cones based on the character and generates the three-dimensional form (Figure 8).
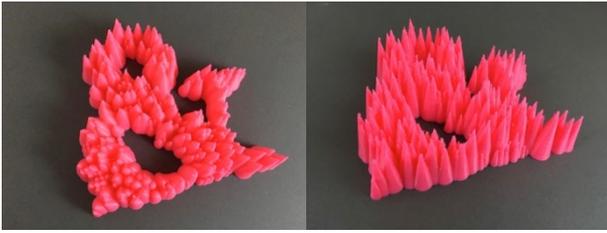
Figure 8: *Spiky &, font: Bodoni, by Taekyoem Lee.*

The next design is inspired from the cylinder seal, an ancient historical artefact leaves impression in wet clay. The 3D printed type embosser is digitally designed using Computer-Aided Design and fabricated using 3D printing. It provided not only visual experiences but also engaging physical experiences. Not like today's digital printing, the process involves rich tangible experience, which is more intuitive, fun, and memorable (Figure 9).
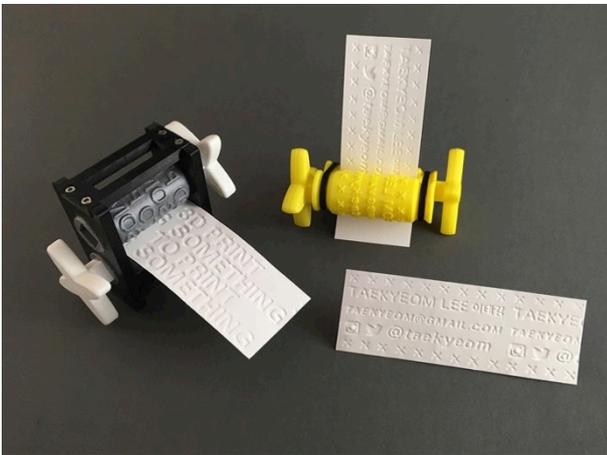

Figure 9: *3D type embosser, font used: DIN, Avenir & Nanum Gothic, by Taekyoem Lee.*

The rings were 3D printed with flexible material called thermoplastic polyurethane (TPU), which is safe to wear and provide interesting tactile experience (Figure 10).

Figure 10: *Wearable type ring, font used DIN, Avenir & Nanum Gothic, by Taekyoem Lee.*

5. *TANGIBLE TYPE + CODE*

Tangible Type + CODE suggests another linguistic experience beyond spoken, written, and visual languages, as it extends typography to the physical realm with touch by using computational design and digital fabrication. 3D printed tangible type not only amplified visual but physical interactions. The tangible type provides engaging tactile experiences, which would be more intuitive, expressive, and memorable.

5.1 Human sense and touch

Humans have five basic senses, and sensing organs send information to the brain to help us to perceive the surroundings and the world. The sense of touch is thought to be the first sense to develop, and we have the largest sensing organ for touch, which occurs across the whole body (Fulkerson 2015). Vision and touch are closely linked together, even though touch is fundamentally non-visual perception. When we look at things, we can imagine how they feel if we touch them. When we finally touch something, we feel more connected and enhance our memory with the object. As Ellen Lupton comments:

> Sensory experience hits us from all directions. Traditionally, designers focused on creating static artifacts—the monument, the vessel, the elegant monogram, or the essential logotype. Today, designers think about how people interact over time with a product or place (Lupton & Lipps 2018).

Touch can enhance and reinforce the user's experience of the text, and the idea has been accomplished with traditional printing methods. We aim to bring it to the next stage with new digital technologies such as computation and 3D printing.

5.2 Design process

Times New Roman was used as a base typeface, as it is one of the most influential typefaces in history. Also, it is a standard typeface on personal computers. The preliminary design was tested using Processing. The letterform is made out of circles, as it is one of the simple geometric shapes used in early forms of writing. The size, position, and density of the circles were drawn depending on the parameters. It enables rapid iteration of the design process like other approaches using computational design (Figure 11).
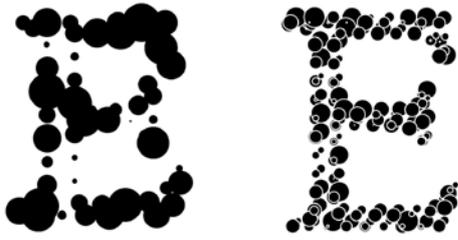
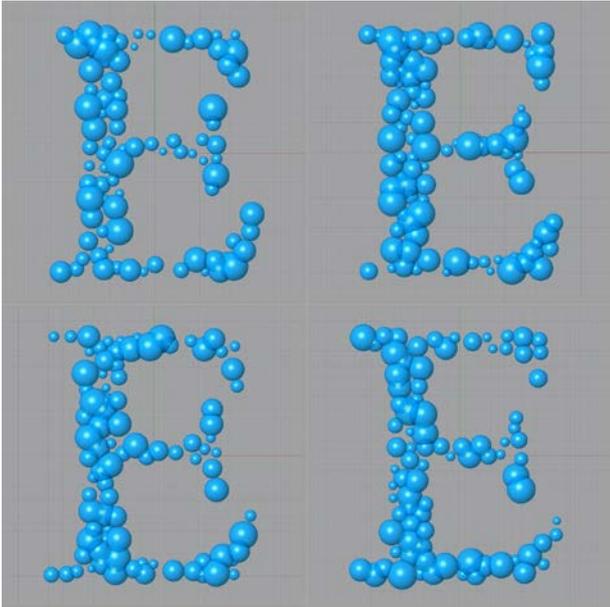**Figure 11:** *Letter E designed using Processing code.*

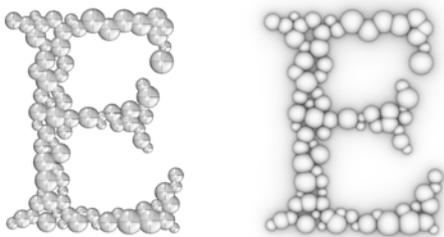**Figure 12:** *Letter E designed using Grasshopper in Rhino 3D.*

Figure 13: *Rendered images of Letter E in Rhino 3D.*

Based on the preliminary designs, the three-dimensional letterform was designed using Computer-Aided Design (CAD) software called Rhino and its plugin called Grasshopper. Grasshopper is one of the most popular and advanced computational modelling tools and commonly used in many areas, such as architecture, design, and other areas of arts. Parametric modelling enables rapid transformation and makes repetitive work easier (Figure 12). Spheres were used to construct the character instead of circles as the design should be a solid three-dimensional object (Figure 13).

The design and fabrication process is closely related, as it is crucial to make the ideas materialise with physical substances. It is a particularly important step for this project since we aim for not only visualising, but also materialising the written language. Based on the experience gained from *Tangible Type*, we decided to 3D print letters with polylactic acid (PLA) bioplastic. PLA is one of the most popular materials in 3D printing since it is easy to print, very affordable, and biodegradable (Figure 14). The material is also suitable for this project as it is light and safe to play for children. Various different colours are available in the market, but filament gives the colour gradient was chosen to attract the users (Figure 15).

Figure 14: *Letter E 3D printing with PLA.*

Figure 15: *3D printed letters.*

6. OUTCOMES

This work was featured in the exhibition, Typeforce, the 11th annual Chicago based exhibit celebrating wildly talented, emerging typographic artists and designers, in February 2020. The size of each character was approximately 180x180 mm. At this size, the letters comfortably fitted in hands and were more noticeable. This also maximised the 3D printing area and avoided possible choking hazards. The audience was allowed to touch them. The first physical response was usually touching the surface to feel the texture and lifting the letter. This was often followed by closely look at the letter form, examine how it feels, in hands.

7. CONCLUSION

This research suggests a new linguistic experience from written, visual to tangible language. It could be a learning tool for children to directly experience type as expressive, dimensional, textural, and touchable form. The computational type design enables us to create generative, expressive, type design systems that are transformative to tangible types using 3D printing. It makes the type available for the public to engage with, as it becomes touchable, playable, and discoverable for new linguistic learning experiences. This research is extendable to develop educational environments and programs for schools and children. It could supply engaged learning opportunities for children, who start learning languages by using one of the human senses, touch, to feel. This thereby enables a multi-sensory approach to learning types beyond verbal, written, and visual languages.

8. REFERENCES

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Figure 16: Children are interacting with Bubble Type at the exhibition, Typeforce, Chicago, IL, in 2020, photo by Taekyeom Lee.

Figure 17: An audience is touching Bubble Type at the exhibition, Typeforce, Chicago, IL, in 2020, photo by Taekyeom Lee.