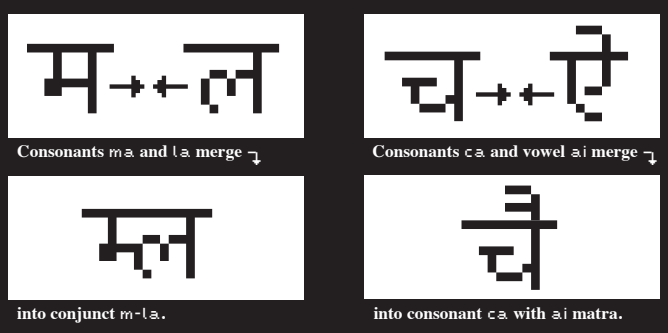
This is a graduation project report by Kinnat Sóley Lydon from the department of visual communication at the Iceland Academy of the Arts in 2016.

1
A short introduction to the Devanagari script

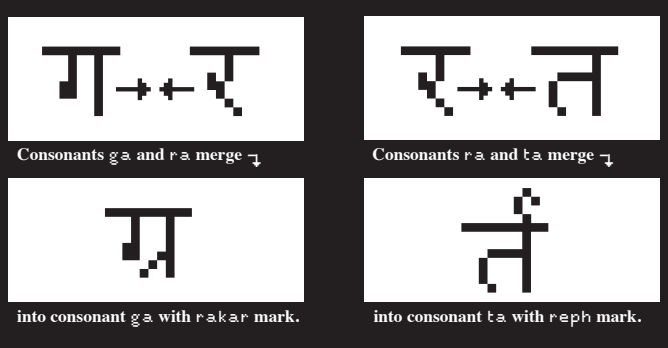
→ Devanagari is one of the most used scripts in the world, used to write over 120 languages. These languages include Hindi, the most prominent language in India, Marathi and Nepali, as well as being used for Sanskrit manuscripts.[1] Despite being widespread and used by millions, the script's typographical needs have been insufficiently met in past and present typeface design.[2] Devanagari is a complex script containing a large character set produced by unique typographical behaviors. I began researching the Devanagari script in my Bachelor thesis Designing Devanagari Type. In the thesis I explored the process of designing typefaces for the script, as well as the many technological restrictions the script has faced in printing technology, which have a direct effect on how it is designed today. As a continuation of this research, I decided to design a Devanagari typeface as my graduation project.

→ One of the biggest complications faced when printing the script is its extremely large character set.[3] This character set is caused by a unique typographical behavior, which happens when two or more consonants are written consecutively. The consonants merge together creating a new ligated consonant or conjunct. The number of these conjuncts is vast due to the many possibilities of merging – all consonants can merge with each other, and conjuncts can contain up to four consonants. Recent Devanagari typefaces usually contain between 1000–2000 glyphs, the largest portion of them being conjuncts. These conjuncts are most commonly horizontal, but can also stack vertically or be completely unique to the consonants involved.[4] Another unique behavior of the script are the vowel marks or matras. They occur when a vowel is written next to a consonant. The vowel transforms into a mark, attaching to the affected consonant.



← Image 1: A diagram showing the behavior of conjuncts and matras.

→ There are various other marks in the script, for instance the consonant ra attaches to affected characters with either a rakar mark or a reph, placed in sub- and superscript positions.[5] Printing a script with such a large and complex character set was a challenge, and from the days of hot metal type the script and its legibility has been affected by incorrect rendering.



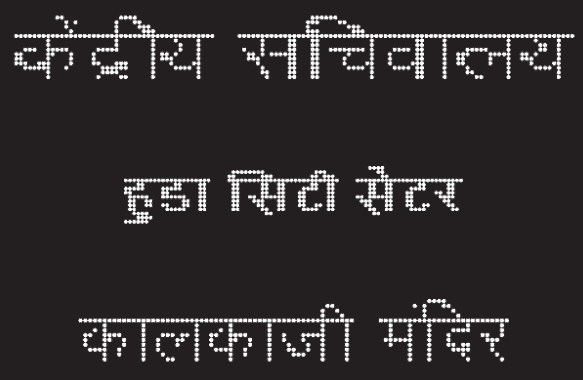
← Image 2: A diagram showing the behavior of the consonant ra.

→ The legacy of printing restrictions carried into the digital age as the first standard digital font formats of the 1990s, TrueType and PostScript, could only store up to 256 characters. The breakthrough came in the early twenty-first century with the development of OpenType font files, where all character set constraints were removed, allowing a maximum number of 65,536 glyphs in a single font. OpenType specifications were also developed for contextual alternatives and other typographic behaviors crucial to Devanagari, allowing for these features to be easily coded into the typeface.[6]

2
The idea and process

→ I came across an article on the difficulties in rendering Devanagari characters in the early days of computers, as screen resolution was low and the character shapes more complex than Latin ones. This made me think of the pixel fonts of the early digital age. I researched non-Latin pixel typefaces and found Arapix – an Arabic pixel font with plenty of OpenType features to fully support the scripts complex typographical behaviors.[7] I wanted to design a Devanagari pixel typeface that would support all of the scripts marks, ligatures and behaviors. Since computers now have excellent resolution there is no longer a need for low-resolution computer typefaces such as pixel fonts. However, dot matrix typefaces are still used for many applications, such as in thermal printers and LED displays.

→ LED displays in India are prominently used both in public transportation and their accompanying stations. Pooja Saxena, an Indian type designer, documented the typefaces used in these displays and critiqued their design. Many of the typefaces are seriously flawed—some have inconsistent contrast and strangely designed letter shapes, others are missing marks or ligatures. These flaws seriously affect readability.[9] The New Delhi Metro system alone carries an average of 2.4 million passengers a day, creating an extremely large readership of these flawed typefaces. Searching the Internet for Devanagari pixel fonts turned out to be difficult and the existing typefaces available are incomplete and inconsistent in design. I decided to design a Devanagari pixel font focusing on use in dot matrixes such as LED displays.



← Image 3: Examples of the flawed typefaces critiqued by Pooja Saxena: the top being a poor digital rendering, the others showing little thought on consistency in shape and contrast.

3
The design

→ Using the description of the process of designing Devanagari typefaces from my thesis as a guide, I looked at all kinds of type designs. These included both current and historical samples. Calligraphy guides and contemporary typefaces were used to gain a feel for the construction of the characters. This also helped with understanding which design features were stylistic and which elements constitute the scripts original structure. Classifications of the graphic structure of the script, such as the ones by Dr. A. V. Bhagwat in Typography of Devanagari,[10] determined which characters shared similar shapes, helping to keep proportional consistency in the typeface. I chose the name Khand, Hindi for unit or component, to refer to the pixel construction, as well as the conjuncts of the script being composed of components.

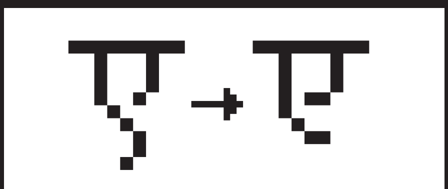
→ I started by deciding the size of the grid to work with, wanting to keep it as compact as possible. Devanagari vowels and consonants share a consistent x-height[11] but due to the script's typographical behaviors, the characters need a large amount of space above and below them. This is to allow for vertically stacked conjuncts and mark placement in sub- and superscript positions.

← Image 4: Example of a vertical conjunct with two different marks – a character reaching the typeface's maximum height of 20 pixels.

→ I began designing the characters with a 10 pixel x-height, quickly changing it to 8 pixels when I realized it had little to no effects on legibility. This x-height was smaller than what was used on the typeface samples found in public transportation, leaving more

1 Rupert Snell, *Read and write Hindi script*, London: Hodder Education, 2010, i. 2 Fiona Ross, "Non-Latin scripts: key issues in type design," in *Non-Latin scripts: From metal to digital type*, 125–153, London: St Bride Foundation, 2012, 125. 3 Fiona Ross, "From Metal Type to Multilingual Pixel Font," *29 Letters blog*, 8/6/16, http://blog.29lt.com/2013/09/21/29lt-arapix/. 8 "Category: Type in Transit," *Its a Nerd's Life!*, 8/6/16, http://poojasaxena.wordpress.com/category/type-in-transit/. 9 "Dehli Metro," *Wikipedia*, 8/5/16, http://en.wikipedia.org/wiki/Delhi_Metro. 10 Bapurao S. Naik, *Typography of Devanagari vol. I*, Bombay: Directorate of Languages, 1971, ix. 11 The term x-height is used in Latin type design to define the height of a lowercase character from the baseline to the mean line, typically the height of the letter x. I use this term here to refer to the height of the characters from the baseline to the headline, where the main components of the character lie. 4 Ross, "Non-Latin scripts: key issues in type design," 134. 5 Snell, *Read and write Hindi script*, 10. 6 "Developing OpenType Fonts for Devanagari Script," *Microsoft*, 28/10/15, http://www.microsoft.com/typography/OpenTypeDev/devanagari/intro.htm. 7 "29LT Arapix: Digital Letterforms – a Straightforward Transition for Indian Scripts?," in *Matrix* 9, 128–136, Andoversford: Whittington Press, 1989, 128

space for conjuncts and marks. I decided to start with a minimal character set and no Latin letters, around 603 glyphs. Then begun a process of getting feedback and refining the character construction. I received feedback from two Devanagari type designers; Gunnar Vilhjálmsson and Pooja Saxena, who wrote the critiques on the typefaces used in public transportation in India. They helped me simplify the shapes, as early designs contained many calligraphic elements, something not very fitting to a pixel font. I then received critiques from three native speakers, gaining helpful insight on how to increase the legibility of the typeface.



← **Image 5: The character e developing from a calligraphic style to a simplified version.**

→ As the typeface was intended for use on dot matrix displays, I started researching them very early on in the process. During this research I came across some technological restrictions that also had an effect on the design of the typeface. Dot matrixes almost always come in eight by eight pixel components. Using multiples of eight, I first attempted to shrink the grid down to sixteen pixels. This however had dire effects on the readability of vertical conjuncts and marks so I decided to expand the grid to 20 pixels, fitting to a 24 pixel dot matrix. I re-drew the characters into a LED sign font editor and worked with a programmer to program them into the display. The sign displays metro stations in English and Hindi, as well as some of the typographical behaviors explained in the type specimen.

← **Image 6: The LED display at the exhibition, displaying the metro station Janakpuri West.**

4 The presentation

→ When designing the type specimen, I needed to find a way to display the character set and the scripts behaviors in an approachable way, as the vast majority of people viewing it would not be readers of the script, and most likely hearing about it for the first time. Although non-Latin type design is on the rise, it is still a very niche subject – there are no courses that approach the topic in the Iceland Academy of the Arts. I felt it was important to raise awareness of the subject at the exhibition. To connect with more people, I designed a Latin counterpart to the Devanagari and displayed the typeface in the names of metro stations in both English and Hindi. To tie further into the train station atmosphere, I offset printed the specimen on newsprint. For non-natives, the characters appear as shapes or symbols so I decided to blow them up and use a large character as a graphic on one side of the specimen. I researched newspaper headers in India and surrounding countries, which inspired the pixelated bitmap drop shadow. The other side of the specimen presented the character set along with short descriptions of the main typographical behaviors. The design of the specimen is intended to appeal both to viewers unfamiliar with the script and those who were looking for further information. The specimen was printed in 500 copies, distributed for free at the exhibition.

→ The exhibition design ties into the theme of the specimen and LED display. I painted a large graphic on the wall displaying a conjunct character with a vowel mark, along with metro station names running along the bottom and right hand side. The specimen was hung on three bars, mimicking a simplified version of metro station newspaper stands. The rest of the specimens were laid in a stack on a small raised platform.

5 Conclusion

→ When I chose to design a pixel font I thought it might simplify the process of designing a typeface with such a vast character set in such a short amount of time. This turned out to be completely untrue, as the restrictions set when designing into a small grid pressed me to find solutions to fitting tall characters into a small space. However, I always had a clear vision that the readability of the typeface was the most important aspect and made all my design decisions with that in mind. This proved frustrating at times; often there were only a handful of characters restricting me from being able to make the grid more compact. After the research conducted in my thesis I had a great respect for the script, as despite the fact that I cannot read the characters, it is a writing system for millions of people. Making design decisions purely for aesthetic purposes with disregard to the legibility and construction of the characters, a mistake often made by non-native type designers, was unacceptable.

← **Image 7: The exhibition design.**

→ The typeface design was a research on fitting the complex characters and behaviors of the Devanagari script into a compact grid. During this research I discovered many things that could explain the flaws of the current dox matrix display typefaces in use in India. Apart from the design of the typefaces themselves, technical aspects involved in programming the actual displays are also restricting. In the display I used for the exhibition, it was impossible to program all the characters and behaviors into the sign due to lack of memory space. Although inputting pre-determined words and characters into the display is not a problem, programming a sign allowing for free inputting would be a tremendous feat. This creates the problem of the user of the display requiring programming skills or access to a person with this skill set to operate and change the text on their sign. For signs with set displays such as metro station names this is fine, however problems arise when the user would need to input custom messages, for instance for announcements on delays or security. The need for better Devanagari dot matrix display typefaces is therefore twofold: on one hand there is a need for better designs, and on the other there is a need for a better program to control the displays themselves. I feel I have addressed the former in my design, creating compact but legible characters with great detail to the consistency of the forms.

→ As a conclusion, this project is not so much of a final project as the beginning of one. I intend to develop the typeface further by continuing to receive critiques on my design by type designers and native readers of the script, including legibility tests conducted on the LED display. I would like to publish the typeface on the Internet, as there is no available Devanagari pixel font available for purchase as of now. Furthermore I would like to develop the typeface with help from a programmer and look for possibilities of implementation on dot matrix displays in India and Nepal.

Image 1 A diagram showing the behavior of *matras* and *conjuncts* by the author, 2016. Image 2 A diagram showing the bahvior of the consonant *ra* by the author, 2016. Image 3 Examples of the flawed typefaces critiqued by Pooja Saxena on her blog, *Type in Transit*, 2016, https://poojasaxena.wordpress.com/category/type-in-transit/. Image 4 Example of a vertical conjunct with two different marks by the author, 2016. Image 5 The development of the letter *e* by the author, 2016. Image 6 Photograph of the LED display by Laura Valentino, 2016. Image 7 Photograph of the exhibition design by Laura Valentino, 2016.