Abstract: In this paper, we describe a methodology used to design a new Devanāgarī typeface for newspaper use. The main aim of this exercise was to find a balance between aesthetic and functional requirements of newspaper text typefaces. It was designed intentionally for Hindi, Marathi and basic Sanskrit. This typeface has been made functional keeping in mind today’s requirement of economic printing and online usage of newspaper. Our design mainly focuses on issues such as advantages and disadvantages of using modulated verses mono-linear typefaces for text in newspapers, structure of Devanāgarī script, functional requirements of newspaper body-text typefaces, aesthetic parameters of developed Devanāgarī type design, work process for developed design, comparative analysis of developed design in terms of the economy of printing, legibility and readability of characters, users’ aesthetic preference in letter designs, impersonal behavior of characters and effective functionality for online usage i.e. e-papers.

Key words: comparative study of newspaper fonts, Devanāgarī typefaces, type design legibility, economy.

1. Introduction
A newspaper is a scheduled publication containing news of current events, informative articles, diverse features and advertising. It communicates authentic, unbiased and transparent information. Type used for newspaper sets the tone and mood for its communication with the readers and so this ‘voice’ of newspaper needs to be carefully considered and crafted. Type plays a memorable role in newspaper design.

In Devanāgarī, fonts are differentiated in Modulated stroke fonts and Mono-linear fonts. Currently, Devanāgarī newspapers are set in fonts like ITR Mitra, CDAC Surekh, Shree Lipi 701 for text and display sizes. Text fonts such as Surekh are derived from the Modulated stroke approach of calligraphic writing.
Our observation shows that Modulated fonts (Figure 1) are preferred by most of
newspapers set in Devanāgarī. There are hardly any newspapers which use Monolinear
fonts (Figure 2) for type setting.

Hence it becomes important to understand why Modulated stroke fonts which have their
roots in early manuscripts; are preferred by people while reading a newspaper. Are they
more legible than Mono-linear fonts? Are they easier and/or faster to read? Do they give a
feeling of being traditional? This had been a pertinent question for years. There is a
similarity between Modulated fonts in Devanāgarī and Serif fonts in Latin and Monolinear
fonts from Devanāgarī with San serif fonts. This led us to study both the advantages and
disadvantages of using ‘Serifs’ and ‘San serif’ for newspaper use through earlier researches.
in Latin, and hence decide on whether Modulated stroke font or Mono-linear font should be
designed for Devanāgarī newspaper.

2. Serif vs. San serif
Earlier research in Latin presents certain arguments in favour of Serif typefaces, and gives
reason as to why probably people prefer Serifs over San serifs:

1. Serifs are used to guide the horizontal “flow” of the eyes; the lack of serifs is said to
   contribute to a vertical stress in sans serifs, which is supposed to compete with the
2. Serifs are used to increase spacing between letters and words to aid legibility.
   [Rubinstein, R. (1988); Sassoon, R. (1993)]
3. Serifs are used to increase contrast (and irregularity) between different letters to
   improve identification. [Reynolds, L. (1979)]
4. Serifs are used to bind characters into cohesive ‘word wholes’. [Poulton, E.C. (1965)]
5. Readers prefer the traditionalism of body text set in serif typefaces, so they must be
   more legible. [Lund, O. (1999)]

There are also some arguments in favour of Sans serif typefaces, these include:

1. Sans serifs are robust in nature and better at small sizes. Sans serif fonts are better
   suited to survive reproduction and smearing because of their simple forms. [Morris, R.
   A., Aquilante, K., et al. (2001)]
2. Sans serif is better on the web hence it can be better adopted for the online PDF’s of
   newspapers (e-paper). [Poulton, E.C. (1972); Reynolds, L. (1979); Bernard, M., Mills,
   M., Peterson, M., Storrer, K. (2001)]

These important arguments lead us to choose Modulated stroke approach for a font for
Devanāgarī newspaper. We also observed that reader’s preference and likeness in terms of
reading choice always differ. Readers like Mono-linear fonts as they look simple in terms of
forms and are readable. But when it comes to reading a Devanāgarī newspaper body text;
readers prefer Modulated stroke fonts.

This led us to following conclusions:

1. Devanāgarī newspaper should follow modulated text type approach:
   Modulated text type face reflects the discipline, convention, tradition, something that to
   be taken seriously. The root of this approach lies in our early manuscripts which are
calligraphed with the help of various tools like cut nib pen, brushes, stylus etc. Some
manuscripts didn’t have word spacing associated with them. Instead, various types of
punctuation and cantillation marks were used to show pauses and tones in reading. The sentences were closed with ‘Danda’ mark. The use of thick and thin strokes in letters enriches the beauty of complex Devanāgarī character forms. It is an old practice and should be cherished in terms of type development.

Figure 3 Example of Sanskrit Manuscript (Source: ‘Arvachya Prachin Vibhag’ library, Thane)

2. A text face is not supposed to be noticed:
We read the article and the typeface disappears into the background. It’s not supposed to draw our attention. A headline typeface on the other hand is meant to grab attention and keep it. Headline typeface can be loud and expressive. But body text is where letters comes in cluster hence irregularity in letters is necessary to improve identification. Here, characters play a silent role.

3. Impression behind type or the subconscious impression it leaves with the reader:
All typefaces give the reader a certain feeling or impression. Most readers won’t consciously notice that the font is conveying anything more than the words on the page. The robust and neutral typeface can also make a subconscious aesthetic impression. The text in well designed typeface transmits complex intellectual and emotional messages in a very concise and precise way.

3. Functional requirements for newspaper body-text
- Font should be absolutely legible and readable- “Legibility is a rate by which a type character can be identified” while “Readability is the ease of reading printed page or message. It refers to arrangement of type. Readability involves design of total visual entity, the complex interrelations among type, symbols, photos and illustrations”.
  [Berryman, 1984, p.28]
• Economy of the typeface in newspaper should be considered- Due to rapid growth in technology and easy acquaintance with digital media; readers are exposed to various sources to get the single information or news. Newspaper reading on internet or on digital media like tablets or phones is much cost and time saving. This has affected the economy of print media. The cost of a newspaper, number of pages, content, designing, amount of advertising through newspaper, etc. are the factors which affect the economy of newspaper. Hence it becomes important to test the efficiency of text type to accommodate maximum content in lesser space.

• Significant difference in reading pace of the reader- Consideration of reading pace in type testing really matters in today’s fast life, where people really get any time for newspaper reading or they hardly take some effort to go through a complete news.

• Font should play the silent role and should not draw reader’s attention to the design- It should give importance to the content rather than its form itself. Hence neutrality of the font is very necessary.

• Online usage of the font for e-paper should also be taken into consideration while designing it- Due to rapid growth in digital and electronic media, an increasing amount of text is being read directly from CRTs, LCDs and TVs. Corporate people, businessmen, travelers always prefer to read news on their mobile screen, tablets or laptops rather than investing an extra time with printed newspaper. Hence this rapidly growing era of digitalization demands a newspaper typeface to be functional for its digital usage also.

4. Structure of Devanāgarī script in Modulated fonts
Calligraphic study of manuscripts helped us to understand the structural characteristics of letters, flesh construction around the structure, axis for letters, contrast within the character, loops, nodes, grey value or weight of characters, turns etc.
Study of basic handwriting and formal calligraphy led us to learn differences in structural widths of different letters like र (Ra), क (Ka), छ (Cha), ढ (Lla) etc. In ‘Conceptual Model of Devanāgarī Typefaces’ by Dr. Girish Dalvi, structure of letters are differentiated into Root Letters and Derived letters, where it shows, ten letters अ, इ, ए, ख, त, भ, द, ध, थ, ष can almost capture all the properties of remaining Devanāgarī letters. This character form grouping has helped us in our font design process to develop characters sharing similar structural properties in right manner.
The height and guidelines of Devanāgarī fonts are not completely defined by above and below base matrā proportions. Several key letters, glyphs, conjuncts, diacritical, vocalization and cantillation marks are required to set the vertical proportions. The nomenclature used in the below image is defined by (Gokhale 1983).
5. Aesthetic parameters of our Devanāgarī type design

After studying the construction of Devanāgarī letters it further led us to fix on certain type design parameters which would help us imbibe the above qualities and parameters for Devanāgarī font design, which include, structural guidelines, letter nomenclature and formal variations which were consolidated from (Gokhale, 1983) (Saynkar, 1996) and (Dalvi, 2010). Based on our earlier study of forms and guidelines we fixed the design parameters as follows:

1. Large kana-height (Base character height).
2. Large inner counters.
3. Setting the letter, word and line spacing by measuring widths of news-paper column and frequency of number of words in one line of column so as to achieve a right balance between base character height, length of the line and distance between two lines.
4. Moderate modulation in stem widths of the letter (considering the on screen use of the font contrast within characters is kept lesser).
5. Slightly condensed structure of characters to allow more text efficiency.
6. Converting maximum frequently used conjuncts into Akhanda conjunct ligatures, so that the right balance of counter spaces can be achieved in conjuncts also.
7. Consideration of Hindi, Marathi and basic Sanskrit language while developing a glyph set.
8. Provision of design alternatives for peculiar forms.
6. Font design process

We started our development with study of handwriting structure. This was a stepping stone in the development. It helped us to analyze stroke variations in characters, their starting and end points, joineries, balance in inner and outer counter space, achieving right amount of grey value though character, word and line spacing, etc.

We took the inspiration from Sanskrit manuscripts, calligraphic artworks, etc. and tried to emulate such sample in Devanāgarī calligraphy by adding weight in structure of initial paragraph with the help of cub nib tool. It gave us the right judgment of proportions of stroke width to character height, optical balance in positive and negative space, etc.

During design process, the aim was to design a structure which has a modulated stroke but experimenting with a newer formal feature which is unlike existing Modular stroke fonts. The design which we arrived at was a hybrid between Modulated strokes and Monolinear strokes; which looked Modulated but had lesser stroke contrast, had slightly inclined axis with a condensed horizontal width. In order to achieve this, we required to have higher base height to stroke width ratio. This was done to make it more functional for print as
As a part of a process, we studied the influence of calligraphy on font development of modulated fonts like Natraj, Surekh and monolinear fonts like Yogesh and Firang. Also their inter comparison to understand dependency of structures within character with character widths, character heights, stroke widths to character height proportion, difference in stroke widths within a character, character axis, balance of inner and outer character space, etc. helped us substantiate our font structure.

Figure. 10 Structural comparison with Modular and Monolinear existing fonts in Devanāgarī
‘Vertical proportions’ (figure 11) for our font are set considering base character height, Vertical conjuncts, above base and below base matra and cantillation marks. The x-height and below base height is almost set same in proportion considering the vertical conjuncts with below base matra.

Figure.11 Vertical proportion of our font (Artha)

7. Comparison of font features
The below comparisons are some of the important features which define the characteristics of a font. The terminologies for font features are defined by (Dalvi, 2010).

- The ‘neck joinery’ can be identified in letters such as ट,ठ,द,ढ. It’s a junction where neck and character stroke meets. Joinery can be angular or horizontal. In Yogesh, all ट,ठ,द,ढ can be seen horizontal. In our font Artha, ट,ठ has angular joinery while द,ढ has horizontal one (figure 12). This structural influence is taken from handwriting. It is an authentic way to show such turns at joineries. Also angular joinery of ट,ठ helps to make these characters more legible.
The ‘counter’ is the negative space seen in the letters such as क, व, ब. The Marathi and Hindi nomenclature for counter is विक्र (first recommended by Gokhale, 2004). Counters could be of two types i.e. Close counters and Open counters. It is said that open counters increase the readability of the characters. But it could be just a matter of choice. The closed counter character can still be readable depending upon how it is designed. We have designed closed counter as it is an authentic way of writing a character (figure 13).
The ‘loop’ is the manner in which the stroke of the letter touches or overlaps over another stroke but not cross over; usually to create small counter space. In Hindi it is known at फांसा and in Marathi it is called फास or पाश. The size of loop can add a significant personality to the character. In Artha, we have kept letter ध open looped like Monolinear fonts such as Firang and Yogesh. It helps the character to balance the inner counter space with the character structure. Other closed loops are optically designed in such a way that it will show same size counters.
A ‘knot’ is the nature in which one stroke overlaps over another and transverses ahead in letters such as म, इ, द. In our font, the size of knots is kept lesser (figure 15). This design call was taken considering when font is used below 10pt, the knots should not shout and should create an even grey. Comparison between Modular stroke ITR Natraj, Monolinear Firang and Artha shows that moderately designed knots in Artha does not shout at lower point size.
As we can see in Figure 16, the ‘axis’ of each weight changes from less inclined to more inclined on left side, from Light to Black weight. It helps to balance the inner and outer counter space of each character with each weight without any expansion in linear structure of characters. Also to retain the beauty of the typeface at bold sizes, modulation between thick and thin stroke widths of the character increase with increase in each weight. Hence Black weight shows maximum modulation while Light weight show extremely moderate modulation in stroke widths. This show how just shift in axis and modulation in stroke widths can create harmonious weights without
disturbing structure of the character. This also prevents an expansion of font while working with bold weight.

8. Font features of Artha

- Important form feature of Artha is that, the joineries where circular strokes meet vertical strokes are comparatively thinner. The outer curves flow inside towards vertical terminals. In the below image, forms in dotted circles show details of these curves. In all weights, thin strokes comparatively remain same while thick strokes show significant width difference. Angular stress increases from Light to Black. The joineries where two strokes create less than 30° angle has ink traps. Letters like अ, ज्र has ink
traps. In this font, all vertical, horizontal and angular terminals of characters have smooth round curves. We have tried to retain as much of convention as possible while introducing these experimental elements. This unusual approach in newspaper type design let us think how far we can push typographic limits.

Figure.17 Letterform feature

- Form and size wise difference between Nuktā, Bīndu and Purnavīram helps in improving legibility. In our font Bīndu and Nuktā is diamond shaped while Purnavīram is in square shape.

Figure.18 Difference between Nuktā, Bīndu and Purnavīram
• We have designed Linguistic alternative numerals like Hindi and Marathi.

![Figure.19 Linguistic alternatives](image)

• Making provisions of design alternatives for characters like ‘Sha’, ‘La’ was essential.

![Figure.20 Design alternates](image)

9. OTF Development
Artha is developed into OTF font.
• In OTF type development, it came to our observation that frequently used conjuncts can be converted into akhanda forms. Conjuncts with half forms create uneven spacing in running body text. While using akhanda forms the amount of negative space can be balanced easily. Also whole akhanda form can be substituted in OTF encoding. Our font Artha compiles 380 frequently used conjunct ligatures.
Defining difference between character widths and setting the groups of them has helped us in positioning of pre-base and post-base Ikār Mātrā. For this, all the letters and Akhand conjuncts are measured for their character widths. Then grouped together into various sizes. This has helped us to standardize exact number of pre-base Ikār Mātrā. There are total 13 pre-base Ikār and 3 post base Ikār Mātrā in the glyph set.
Artha is developed considering functional requirement of typing Hindi, Marathi and Basic Sanskrit. The current Artha glyph set consist of around 700 glyphs which includes independent Vowels, Consonant full forms, Consonant half forms, Nuktā full forms, Nuktā half forms, Vowel alternatives, Consonant alternatives, Numbers, Rakār forms, independent matrā, Akhanda conjuncts (Sanyuktākshar) and Punctuation marks.

Figure 23: Artha glyph set
• Artha is generated into total eight weights from Light to Black. Light, Book, Regular and Medium weights are designed for body text. While Demibold, Bold, Extrabold and Black weights are for Display purpose.

Figure 24 Representation of Artha font weights
- We have defined the limit of lowest point size that can be used for each weight. This testing helps to understand maximum lowest point size at which font can still remain readable and legible.

<table>
<thead>
<tr>
<th>Font Style</th>
<th>Recommended Lowest Point Sizes for Each Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Artha Light 7pt</td>
<td>Recommended lowest point sizes for each weight</td>
</tr>
<tr>
<td>Artha Book 8pt</td>
<td>Recommended lowest point sizes for each weight</td>
</tr>
<tr>
<td>Artha Regular 9pt</td>
<td>Recommended lowest point sizes for each weight</td>
</tr>
<tr>
<td>Artha Medium 10pt</td>
<td>Recommended lowest point sizes for each weight</td>
</tr>
<tr>
<td>Artha Demibold 11pt</td>
<td>Recommended lowest point sizes for each weight</td>
</tr>
<tr>
<td>Artha Bold 12pt</td>
<td>Recommended lowest point sizes for each weight</td>
</tr>
<tr>
<td>Artha Extrabold 13pt</td>
<td>Recommended lowest point sizes for each weight</td>
</tr>
<tr>
<td>Artha Black 14pt</td>
<td>Recommended lowest point sizes for each weight</td>
</tr>
</tbody>
</table>

Figure 2.5 Readability and legibility of recommended lowest point size of each weight
10. Font Usage
We tried to set a page of Hindi financial newspaper in Artha to get a feel of font with newspaper design. The below composition has use of all weights of Artha for display size as well as body text.

![Figure 26: Use of Artha for newspaper design](image)

- **Newspaper use**

  For Newspaper body text content occupancy, Artha has been tested with currently used two Modulated newspaper fonts named CDAC Surekh and Shreelipi 701. It is also tested along with two Monolinear fonts named CDAC Yogesh and Firang by setting the text with the same content. In testing sample, fonts are compared by matching their character heights and not the point size. The below testing sample proves that Artha occupies lesser space in column size compared to both Monolinear and Modulated font samples because of its slightly condensed structure and larger stroke width to character base height ratio.
Figure 27: Content space comparison of Monolinear and Modulated fonts with Artha 3

[Note: Fonts are compared by matching their base character heights.]
The beauty of Devanāgarī is that; for single conjunct can be written in two or more ways. The book, ‘Handbook of Devanāgarī Glyphs’ lists down the number conjuncts, their ways to be written and number of glyphs required to construct the conjunct while designing a Devanāgarī font. The book was type set in Monolinear (Firang) and Modulated (Artha). Their inter comparison shows the advantages that a Modulated font has over Monolinear font while designing text conjuncts. Here are two conjunct cases from ‘Handbook of Devanāgarī Glyphs’ by Dr. Girish Dalvi. It efficiently portrays the possible character variation of single conjunct. It also talks about the visual difference that can be observed while designing vertical conjuncts in Modular as well as Monolinear font with their comparisons.

Figure.28 Pages from ‘Handbook of Devanāgarī Glyphs’ by Dr. Girish Dalvi
Above example shows for conjunct like क्र there could be 5 different interpretations or for conjunct like क्र्य there could be 10 different writing interpretations possible. It would be a really complex to make all the interpretations possible on single keyboard. The comparison of these conjuncts in Firang and Artha can also show how modulated font can balance space with complex conjunct character structures also than Monolinear font.

- Online usage
Since we also considered the online usage, font has been in the process of being hinted and the preliminary results are promising. The font gives very good legibility across mediums such as LCDs, CRTs and TVs.

11. Conclusion
(1) We feel, using Artha font text will occupy lesser space in news columns and hence more content could be incorporated in smaller space of columns. To certain extent, this might help to improve the economy of newspaper by saving the space required for content. This saved space can be effectively used for more content and hence indirectly improves effectiveness of newspaper.
(2) Due to its semi-handwritten structure, larger stroke width to base height ratio, moderate modulation of strokes and large counter spaces; Artha is perhaps more legible and readable at smaller sizes.
(3) Developed type design has balance in simple structure of characters, tracking and leading in the font. We feel it will help in improving reader’s reading pace.
(4) Although the font has been carefully designed in terms of its forms and curves; it does not draw reader’s attention to its design. Perhaps it gives importance to the content, news or information in newspaper.
(5) The design takes inspiration from traditional reed-pen dimensionality and hence it could give reader a ‘feel’ of traditional Devanāgarī while retaining a look of contemporary Devanāgarī typeface.
(6) The lesser modulation in stroke widths, large character base height and larger counters has helped Artha in promising legibility required for onscreen reading across different types of digital screen displays. Hinting has further helped in finished rendering at different sizes on screen. Hence Artha could also be used for online usage of newspaper.
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