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Design Methods of Hangeul Slanted Cursive Font

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Abstract— This study explores the absence of italics in Hangeul (Korean) fonts, a feature present in the Latin alphabet but lacking in Korean fonts. While italics provide emphasis in Latin text, Hangeul achieves similar effects using various font types, thicknesses, underlining, and emphasis points. However, these font variations and punctuation marks may disrupt reading flow. Existing methods, such as slanting options in editing software ("fake italic" when using Hangeul), may compromise visual aesthetics. To remedy this, like italics, Korean fonts need slanting and cursive elements. The study proposes a 6-step design method for slanted cursive Hangeul fonts, covering (1) skeleton extraction, (2) combining skeletons, (3) stroke weight, (4) slanted format, (5) cursive elements, and (6) visual flow adjustments. Applying this method to the design of Hangeul slanted cursive fonts, the study underscores the importance of determining optimal slant and cursive font degrees while considering subjective designer aesthetics.

Keywords-Hangeul (Korean) Character, Typeface Design Method, Slanted Cursive Font, Italic Font, Font Skeleton Extraction

I. INTRODUCTION

Italics are primarily used to emphasize or distinguish specific words from others in the text. However, Hangeul lacks slanted cursive fonts equivalent to the italics in the Latin alphabet, such as slanted cursive and cursive line fonts. To compensate for the absence of italics, Hangeul employs different shapes or thicknesses of fonts, underlining, emphasis marks, or de-squared letterform fonts. Unfortunately, these measures have limitations in providing a smooth appearance to sentences, as they distort the shape of letters by tilting them using editing software rather than being fonts developed in harmony with body text fonts. Therefore, there is a need to develop Hangeul fonts corresponding to italics in the Latin alphabet, necessitating specific guidelines. If slanted cursive fonts are introduced within a font family, it will add an italicizing function while preserving the body text's impression. However, Hangeul characters derive their meaning and shape from the combination of vowels and consonants, grouped left and right or top and bottom within a square or non-square frame. This distinction includes various considerations, impacting not only the formative shape but also the visual stability of the flow. In this study, the research proposes an approach for designing slanted cursive fonts by combining the skeleton of existing characters with handwritten elements. This aims to create Hangeul Slanted Cursive fonts that can be used similarly to italics, providing a design method for the typeface.

II. COMPARISON OF DISTINCTION AND EMPHASIS METHODS OF KOREAN, CHINESE, JAPANESE, AND LATIN ALPHABETS AND PROBLEMS WITH HANGEUL

Punctuation marks are mostly used for the purpose of emphasis or distinction in Hanzi (Chinese characters), Kanji (Japanese characters), and Hangeul (Korean characters). Since Hanzi, Kanji, and Hangeul do not have separate italicized fonts, the emphasis and distinction of words relies on changes in font thickness, font shapes, or forced tilting. In Mariko Takagi's essay on Kanji, Hiragana, Katakana and the Latin alphabet, she mentioned that Katakana was used for foreign words, onomatopoeic and mimetic words in mixed typesetting [1]. In particular, she noted, "Hiragana is used for function words, grammatical endings and particles, while names and specific terms of non-Chinese origin, onomatopoeia and exclamations are written in Katakana..." (284; cf. [2,3]). Additionally, Katakana is primarily used for the notation of special words when it is mixed with Kanji and Hiragana, so it is difficult to say Katakana is a syllabary specifically for emphasis. But special attention was paid to the structure of its letterforms that reveal a difference in terms of formation and skeleton. In addition to its distinctive features, however, attention was also paid to its similarities with other syllabaries as well. An example of different letterforms used for emphasis in Hangeul was found in the Korean edition of Noordzij [2]. In the book, the author used letterforms that were different from those used in Figure 1 (a). Another example of letterforms was found in the Korean edition of Baudrillard [3] and shown in Figure 1 (b), where square and de-squared letterforms were used for the sake of distinction.

Figure 1. (a) Different Font used for Emphasis, (b) de-Squared Letterform Emphasis on Hangeul.

5122

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The difference created by using the emphasis mark plays more than just the emphasizing function; it can convey the author's intentions. The italicized Latin alphabet is vertically tilted to the right, giving the impression that the speed of the author's speech (words) has been reflected in the typeface. This is comparable to the handwriting fonts that make a text more personal and intimate due to the impression of letters written by hand. In this case, the fonts play the role of emphasis in the text, while at the same time representing the voice of the speaker (author). It is similar to cursive Chinese characters where the speed of the writer's writing is reflected in the characters, and the difference of speed among different writers itself can be the writer's unique form of expression. While the Latin alphabet uses italics for emphasis, Hangeul characters do not have a typeface specifically dedicated for emphasis. Therefore, emphasis is applied mostly by using certain punctuation marks, and for the letterforms themselves, font weight is changed with thickness, or underlining and emphasis marks are used to add different effects to the letterforms. Hangeul sometimes uses "fake italics" [4], by which the fonts are forcefully tilted or slanted to look similar to the italicized Latin alphabet. This situation calls for the development of letterforms that could be used for emphasis, instead of using existing letterforms for temporary replacement of italics (Table 1).

Table 1. Hangeul, Latin alphabet, Hanji, Kanji Fonts Style Classification for Expression of Emphasis.

Classification	Hangeul	Latin	Hanzi	Kanji
Font Style	Buri (Serif style)	Serif	Songti (Serif style)	Minchotai (Serif style)
	Minburi (Sans-serif Style)	Sans-serif	Heiti (Sans-serif Style)	Goshikkutai (Sans-serif style)
Expression fonts	None	Italic, Oblique	None	None
Alternative methods for expressing emphasis method	Punctuation mark, Font (Temporary) for Emphasis	Punctuation mark	Punctuation mark, Font (Temporary) for Emphasis	Punctuation mark, Font (Temporary) for Emphasis
Alternative (Temporary) methods using fonts for emphasis	1) Font weight (e.g., Bold, Black, Light) 2) Letterform (Slant and different letterform)	None	1) Font weight (e.g., Bold, Black, Light) 2) Letterform (Slant and different letterform)	1) Font weight (e.g., Bold, Black, Light) 2) Letterform (Slant and different letterform)
Needed for fonts to exclusively communicate emphasis	1) Need to develop fonts for emphasis	Already exist	1) Need to develop fonts for emphasis	1) Need to develop fonts for emphasis 2) It might be possible with use of katakana

III. THE DIRECTION OF CREATING SLANTED CURSIVE HANGEUL TYPEFACE IN COMPARISON WITH ITALICS AND OBLIQUES OF THE LATIN ALPHABET

Italics are used in a sentence mixed with regular fonts, and they are used to emphasize certain words. They are ideal for emphasis, because they look similar to regular fonts while at the same time, they can distinguish words from others in the sentence. Weber [5] discussed fake italics and true italics, and explained italics are not simply slanted to distinguish them from regular fonts. According to Weber, italics must meet two requirements: slant and flow.

A single feature in-and-of-itself only has half the potential needed to fully realise the italic form. Consequently, a 'true' italic can only be the result of several factors. It is neither 'just connected' nor exclusively 'just inclined'. Instead it could be both sloped and connected at the same time, and various other formal characteristics could play a role, too. (8), Each letter of any typeface meant to be taken seriously is related to handwriting, to some degree. By this, I refer to forms written with a pen or other similar tool. In most italic fonts, these handwritten roots are more pronounced than in other typefaces. The development of writing is of particular importance here. (11)

It can be regarded as true italics only when the fonts adequately reflect the rules regarding the connection of strokes and slant, which means that the fonts are reflecting the style of naturally flowing handwriting. In other words, italics are not just about applying slant to regular fonts; they are reflecting the traces and strokes and movement that are generated by writing. Haslam [6] asserted, "(Italics are) ... letters which slope forward and may be linked by connectives so that the letters flow into one another..." He went on to explain that italics were fonts with slant and continuous flow. They are slanted fonts marked by the continuous flow in each character itself as well as the flow moving from one character to the next, and they also reflect the flow coming from the continuation of handwritten letters. Strizver [7] described italics and obliques as follows:

…Italics are an angled typeface that has different design characteristics from its upright, Roman companion. Many italics have a somewhat calligraphic appearance, especially those that are designed for a serif typeface. Italics designed for a sans serif type style are often quite similar to their upright companion with the exception of a few (or more) differing characters, such as the lowercase a, g, and/or the f. Obliques, on the other hand, are simply slanted versions of their roman companion with no major design differences, other than their angle. They are most often found in sans serif typeface families, although not all sans serifs have obliques as opposed to italics, as noted above...

She mentions that, even though italics and obliques have in common that they are slanted to the right, italics have the flow of handwriting while obliques are simply slanted types of regular fonts. The slanted Hangeul typefaces are similar to the italic and oblique of the Roman counterpart except the angle of slant is different; they have a vertical direction of flow similar to calligraphy, making it resemble handwriting. In his book on handwriting in Hanguel manuscripts Park Byeong-chun (朴炳

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千) [8] described the calligraphies used in manuscripts as follows:

Having been written by famous calligraphers or court scribes of the time, the Hangeul calligraphies in manuscripts demonstrate excellent formativeness in terms of their typefaces and they are referenced by today's calligraphers and used for the development of fonts... Titles on book covers were mostly written in Chinese in regular script style, but in the book, *Seohanyeonui*, it was written in a slightly semi-cursive style. But the Hangeul titles in the main body text of the books were written in the Hangeul cursive. *Gwonseonmun* and *Seonjoyeongeon* were written in regular script and *King Danjong the Great* in cursive script, but they did not have any record of Chinese book titles. (64–65)

He is explaining how both regular and cursive scripts were used in Chinese book titles on book covers, while in the main body text, the Hangeul book titles were written in cursive. Other calligraphic letterings show a difference in font forms, and they are believed to have been intended to distinguish words when mixed with other letterings on paper. The cursive scripts in *King Danjong the Great*, *Seolwon Maejeon*, *Jeongsa Giram*, and *Joya Cheomjae* have been reviewed for this paper because they have clear angles on the horizontal and vertical strokes. In *King Danjong*, the strokes show a 12-degree of horizontal angle, but zero degrees on the vertical angle. In *Joya Cheomjae*, the horizontal strokes have a 10-degree angle and the vertical strokes, zero degrees. When written in the top-to-bottom style, the vertical angle maintains zero degrees, but the horizontal angle —which clearly show the speed of strokes and handwriting— goes up by 10–12 degrees from left to right (Figure 2).
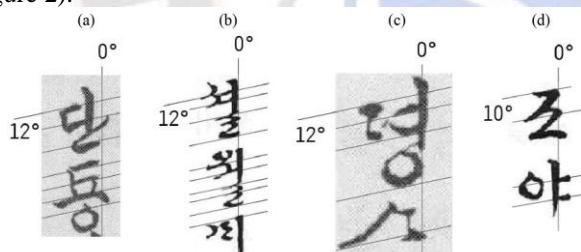
Figure 2. Horizontal and Vertical Stroke Slope of Korean Vertical Brush Strokes: (a) King Danjong the Great, (b) Seolwon Maejeon, (c) Jeongsa Giram, (d) Joya Cheomjae

Hangeul typefaces were released between the 1990s and 2000 when Hangeul typefaces for the digital era were dynamically developed: *MSugiHeulim* (1991, Korean Ministry of Culture, Sports and Tourism), which is a cursive typeface with thin strokes, and *TTPenC: Tae Penheulim* (1995, Tae System, Seoul, Korea). These two typefaces are examined to identify the difference between slanted and cursive fonts. For the slanted fonts, non-ornamental and thin Minburi (Sans-serif) typeface *SM Segothic* (1991, Jikjisoft, Seoul, Korea) was selected and tilted at a 12-degree angle. Both *MsugiHeulim* and *TSTPenC: Tae Penheulim* typefaces are characterized by the resemblance to handwriting, and they are horizontally tilted at a 10-degree angle, but vertically, they are tilted at a zero-degree angle (Figure 3).
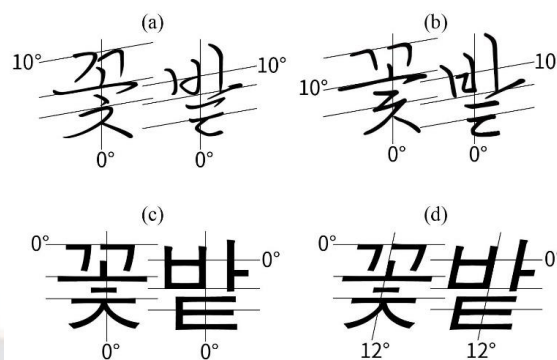
Figure 3. Hangeul Buri and Cursive, Minburi and Slanted: (a) MsugiHeulim, (b) TSTPenC: Tae Penheulim, (c) SM Segothic, (d) SM segothic Slanted

Italic and oblique fonts have in common that they are used for emphasis, but the difference is that, while oblique fonts are simply a tilted form of fonts, italic fonts contain traces of handwriting. In other words, although the two types of fonts play the role of emphasis within sentences, they render different impressions, which could possibly result in a difference in the intended meaning by writers. In his paper presentation on typography Ahn [9] noted, "The shape of letters perceived as objects have a greater impact on the meaning of the words, thereby adding more significance or changing the meaning...". In other words, the function of fonts can be more than emphasis, and the impression of the fonts is likely to affect the message they are carrying. It means that, even though the fonts can function to add emphasis, they can also affect the message depending on which fonts are used. Making a similar point, Yoo [10] described italics and obliques as follows:

(Both italics and obliques are) slanted letterforms and function to add emphasis in sentences, but while the italic style is mainly found in serif fonts, oblique style is mostly related to sans serif fonts. The oblique style simply looks like a slanted version of letters and strokes, but italic style has an important difference resulting from its unique design characteristics. Today, however, these two terms are not only used interchangeably even within the oblique sans serif style, there is also a movement to design true italics to realize the balance and harmony of the letters rather than simply applying slant to them… (240)

Italics and obliques look similar in that they are both vertically tilted to the right, and slanted Hangeul fonts also have a similar inclination. Due to the vertical direction of Hangeul writing, cursive Hangeul fonts are horizontally tilted at about 10–12 degrees, but the vertical slant angle is zero. Adjustment of the slant angle is necessary because most sentences written in Hangeul are written horizontally. In other words, it is necessary to adjust the vertical angle of the cursive to be suitable for the horizontal direction of writing. The degree of the adjusted angle should remain more or less the same as the angle used in italics and obliques, but, since the existing horizontal angle of zero degrees opens the possibility of a wide range of changes, the adjustment angle should be considered within the range of 0–5 degrees so that the appearance of handwriting is not affected (Table 2).

5124

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Table 2. Horizontal and Vertical Angles in Italic, Oblique, Hangeul Slanted and Cursive.

Present state (Angles)		
Angles	Horizontal	Vertical
Italic	0 degrees	10 to 12-degrees
Oblique	0 degrees	10 to 12-degrees
Hangeul Slanted	0 degrees	10 to 12-degrees
Hangeul Cursive	10 to 12-degrees	0 degrees
Suggestion (Angles)		
Angles	Horizontal	Vertical
Italic	0 degrees	10 to 12-degrees
Oblique	0 degrees	10 to 12-degrees
Hangeul Slanted	0 degrees	10 to 12-degrees
Hangeul Cursive	0 to 5-degrees	10 to 12-degrees

IV. METHODS TO DESIGN HANGEUL SLANT AND CURSIVE FONTS DERIVED FROM CASE ANALYSIS

Ryu's typeface *Willow* [11] shows the word "달아래" has a horizontal slant angle of 10–12 degrees and a vertical angle of zero. This is similar to the slant used for vertical writing direction in the previous literature. In other words, the typeface reflected the slant of the existing cursive font. The *Ficta* typeface used by Kwon [12] shows a horizontal slant angel of 10 degree and vertical angle of zero, which is reflecting the angle of existing cursive fonts like the *Willow* font. However, there are traces that show a new interpretation was made during the creation of the typeface about the connection between strokes and the strokes reflecting the flow of handwriting. In particular, the vowel "ㅓ" and the finishing consonant "ㅎ" in the character "렁" shows that the regular handwriting expression was reflected in connecting the finishing stroke of the vowel to the first stroke of the next consonant, "ㅎ", but in *Ficta,* the connection is made to the stroke that is closer to the finishing stroke of the consonant. Considering the traces of handwriting, the adjustment took into account the appearance of connecting lines between strokes in narrow spaces. (Figure 4).
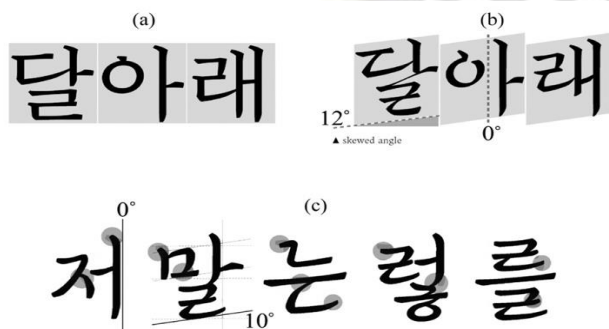

Figure 4. *Willow*: (a) Regular, (b) Cursive *Ficta*: Horizontal 10 degrees, vertical 0 degrees, and contain traces of handwriting, (c) *Ficta*: Horizontal 10 degrees, vertical 0 degrees, and contain traces of handwriting.

When two types of regular and cursive fonts with different forms and shapes characteristics are together in a typesetting (mixed), they might look distinct from each other. But the difference between two types (forms and shapes) of fonts makes it difficult to recognize them as fonts that belong to the same font family. In other words, they must have formative similarity in order to be used together within the same typesetting. To this end, the slant angle of the cursive was applied to the regular font before the skeleton was extracted. While reflecting the angle of existing cursive fonts, a skeleton with the same cursive angle was applied to the ornamental font from the Buri font family (Buri: serif style) and non-ornamental font from the Minburi font family (Minburi: Sans-serif style). They stand out from the regular fonts due to the slanted angle, but to ensure an even horizontal text line for the sentence, the horizontal angle has to be adjusted only slightly, and the vertical angle also has to be adjusted to the similar degree as italics or oblique (Figure 5).
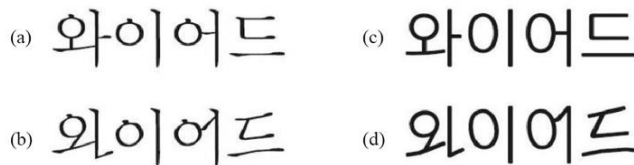

Figure 5. (a) Buri (Serif style) Regular font, (b) Apply to Slanted Cursive Buri, (c) Minburi (Sans-serif Style) Regular font (d) Apply to Slanted Cursive Minburi

V. DESIGN METHOD FOR SLANTED CURSIVE HANGEUL FONTS: APPLYING SLANT AND HANDWRITING THROUGH SKELETONIZATION OF HANGEUL FONT CHARACTERS

The impression of a font can generally be distinguished based on its form, thickness, spacing, and structure. Shapes can be categorized into serif (Ming) and sans-serif (Gothic) styles based on the presence or absence of serifs, while thickness can be used to differentiate fonts for titles and body text [13]. The combination of consonants and vowels influences spacing, giving rise to distinct spatial characteristics. However, the font's structure (skeleton), a crucial aspect of its impression, is not directly visible and requires an extraction process and the skeleton is determined by identifying the line form adjacent to the inner center from the stroke's outer contour. In other words, the line serving as the stroke's center, based on the outline, is considered the skeleton. Identifying the skeleton is a meticulous task for each character, and given that Korean Alphabet design involves creating 11,172 characters through the combination of Jamo (consonant and vowel), a careful verification and judgment of font similarity are essential at the beginning of the design process [14]. While skeleton extraction is generally automated, achieving a clear skeleton remains a challenge. Assessing similarity with an unclear skeleton makes discernment challenging. This must be manually extracted, and the results should be consistent regardless of the extractor. Therefore, the extraction method should be simple, clear, and consistent. To address this, previous research cases were examined, experiments were conducted on skeleton extraction, and the feasibility of two modules, the application of double circle extraction modules, was suggested by applying the module to the outline. A circle, having the same diameter from any direction, is suitable for finding a clear center from the outer

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contour of the outline. Detailed elements of the font, including serif, stem, connection, fold, curvature and rounded stem, were concretized by providing the number of modules to be used, the stroke intersection point, the steps of curvature, and the reference angle for the rounded stem. For this experiment, we designed extraction modules and conducted experiments to extract skeletons directly. Subsequently, we revealed and proposed specific factors for font discrimination based on the skeleton. Although the appearance of a font contains traces of writing, these traces may be weakened or sharply interrupted, cleaned up, or transformed by applying geometric shapes during the refining process. Therefore, in the finalization of the font through various iterations, the skeleton must be extracted from the confirmed font outline, which may have undergone diverse paths of transformation. This involved separating the strokes that intersect to extract the skeleton and rejoining the separated skeleton (Table 3).

Table 3. Conditions for Skeleton Extraction Experiment on Target Fonts.

Requirements	HY Shin Myeong-jo	HY Jung Gothic
Font classification	Buri, Batang font (Myeongjo font)	Minburi, Dotum font (Gothic font)
Extraction program	Adobe Illustrator	Adobe Illustrator
line thickness	0.25pt	0.25pt
Font size	550pt	550pt
Line format	Straight line, curve (round line, roll)	Straight line, curve (round line, roll)

For the skeleton extraction experiment, the target fonts chosen were *HY Shin Myeongjo* for serif and *HY Jung Gothic* for sans-serif. Adobe Illustrator was employed as the tool for extraction. To achieve a thin skeleton line, the font size was enlarged to 550pt, and the program's thinnest line, 0.25pt, was used for the extraction experiment. The emphasis was on two aspects: (1) clear skeleton line extraction and (2) an easy and straightforward method. Unlike automated skeleton extraction, when done manually by a person, variations may arise depending on the extractor's tendencies or precision, making it challenging to arrive at a clear judgment [15]. Therefore, the extraction method should be simple and straightforward. There is particular concern about diverse extraction results in areas where strokes intersect, overlap, or involve curves. To draw a line from the outer outline of the font to the central point inside, it is essential to find the exact center of the outline. This process should not rely on the judgment of the extractor's eye alone; instead, it requires a clear and objective criterion. A module was devised to serve as a simple, clear standard. This module utilizes circles, vertical, and horizontal lines. Circles, with their uniform diameter and equal area in all directions, are suitable for establishing a central reference point. Double circles of the same size are placed side by side and fixed, vertical and horizontal lines pass through their centers shown in Figure 6 (a). By employing two modules, the outer edges of the module

circles were aligned to touch the outline of the font's contour line. The central point where the module's vertical and horizontal lines intersect was used to find the skeleton line. When the horizontal and vertical angles of the two circles are arbitrarily determined by the extractor, various interpretations of the skeleton results may arise. To ensure consistent and clear skeleton extraction, the angles were standardized to be vertical and horizontal when placing the modules. In cases where strokes intersect and bend, the skeleton line was extracted from the starting point of the first stroke to the ending point, and then the central point of the next stroke was identified for the subsequent skeleton line extraction. From the perspective of the contour line flow, a bent stroke may be perceived as a single continued stroke. However, these two strokes have different directions, requiring separation for individual extraction. In the case of *Gulim* (curvature), where the flow of subsequent strokes is maintained, it should be perceived and extracted as a single stroke. Therefore, they should be considered as a single stroke to ensure the continuity of the skeleton line extraction. However, depending on the number of modules, the performance of extraction may vary. That is, the number of modules was applied according to the directionality of the strokes: (1) 1 each for vertical and horizontal in the 1st level, (2) 2 each for the 2nd level, and (3) 3 each for the 3rd level. The results showed that as the number of modules increased from the 1st to the 3rd level, the skeleton extraction closely resembled the original font's *Gulim* flow shown in Figure 6 (g). However, the level of *Gulim* flow present in the font should determine the appropriate level of application, and the skeleton of the *Gulim* should be extracted according to the stage that matches the flow of the font's contour line. For the round stems, a reference line was applied by placing horizontal and vertical lines at the center, spaced at 22.5-degree intervals (Table 4). The modules were arranged parallel to this reference line, extracting rounded lines passing through the center (Figure 6).

Table 4. Extraction conditions and number of extraction modules utilized.

Number of extraction modules utilized	
Use of 2 beaks	1 each at the beginning and end: total of 2 beaks
Use 2 endings	1 each at the beginning and end: total of 2
Use 2-3 stems	1 each at the beginning, middle, and end: total of 2-3
Use 2 bends	1 each at the start and end: total of 2
Use 3 rolls	1 each at the beginning, middle, and end: total of 3 rolls
Use 2 beeps	1 at the beginning and 1 at the end: total of 2
Use of 16 round stems	1 each horizontally, 1 vertically, and 12 diagonally 22.5 degrees: total of 16

Based on the comprehensive experiments, the conditions for skeleton extraction and the number of utilized extraction modules were summarized. When judging regular and handwritten styles, it is essential to consider the movement and flow of writing based on traces left by hand movements. In other words, even in fonts categorized as regular styles, if traces of handwritten flow are visible but do not significantly impact the overall impression, they should be categorized as regular styles

5126

rather than cursive styles. Handwriting should be distinguished by emphasizing the continuity of stroke flow and the presence of linking traces, reflecting the characteristics of handwriting tools.
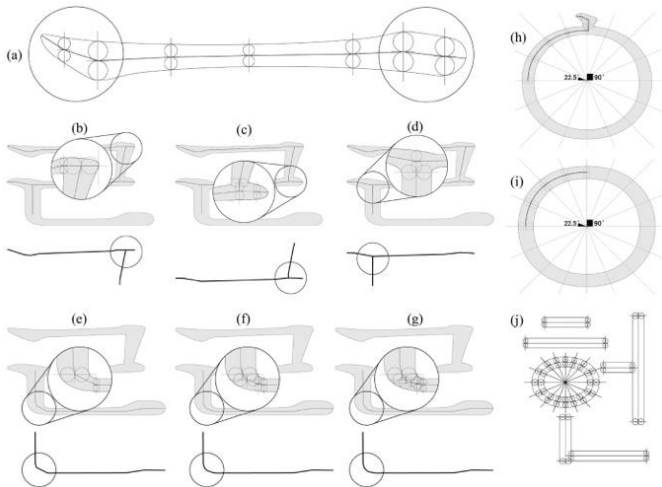

Figure 6. (a) Applying the Double Circle Extractor Module angle by unifying the horizontal and vertical angles, ((b), (c), (d) Extraction of fold stem skeleton, (e), (f), (g) Extraction of curvature skeleton, (h), (i) Angle for extracting rounded stems degree, (j) Example for extraction of stroke form font outline.

In cursive fonts, if traces of handwriting flow and the continuousness of strokes are evident, they should be categorized as cursive fonts. Therefore, the priority should be given to the movement and flow of handwriting. Additionally, even in regular fonts, if there is a strong expression of handwriting flow, it may be appropriate to categorize them as handwritten fonts. Ultimately, it is essential to prioritize the movement and flow of handwriting to make a clear distinction. Not only that, but also the slant resulting from the movement of handwriting must be consider. Hangeul is mostly written and typeset horizontally; therefore, it is essential to align the cursive traces, movements, and slant to be suitable for horizontal writing. For the experiment of designing a slanted cursive typeface with an angle suitable for the horizontal direction of writing, fonts were selected after reviewing regular and cursive fonts as the target fonts. The selected fonts are Minburi (Sans-serif style) Regular Font and *Sandoll Gothic Neo,* Cursive Font: *MSugiHeulim.* A non-ornamental Minburi (Sans-serif style) typeface was chosen as the target for the experiment because the fonts from this typeface are easier to apply a slant angle to, and the skeleton could be extracted more accurately than ornamental fonts from the buri typeface. Emphasizing the importance of determining optimal slant and cursive font degrees considering subjective designer aesthetics, the skeletons of the two fonts were extracted, and through combining, reflected a cursive form to achieve an appropriate slant. Angles of 10 degrees for horizontal strokes and 5 degrees for vertical strokes were applied. After adjusting the stroke thickness in this skeleton, connecting lines between strokes were expressed. This is considered a characteristic that reveals the natural connections between strokes seen in cursive handwriting. The study proposes extracting the skeleton from the font's outlines and applying slant with cursive in a 6-step design method for Hangeul slanted cursive fonts. The steps include (1) skeleton extraction, (2) combining skeletons, (3)

stroke weight, (4) slanted angles, (5) cursive elements, and (6) visual flow adjustments (Figure 7).
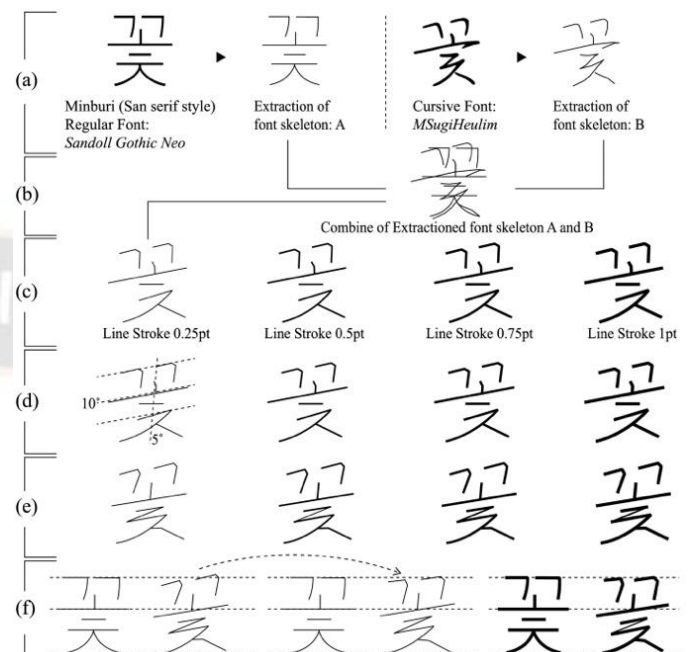

Figure 7. Step 6 of the method of Hangeul Slanted Cursive font design Details (a) skeleton extraction, (b) combining skeletons, (c) stroke weight, (d) slanted angles, (e) cursive elements, (f) visual flow adjustments.

VI. CONCLUSION

This study suggests the necessity of designing an italic glyph that plays the same role as the Latin alphabet for Hangeul and proposes a 6-step design method by which fonts are designed and presented as examples. The difference between italics and obliques of the Latin alphabet was examined and cases were analyzed to identify the slanting method that reflects handwriting and the slant angle that is suitable for the horizontal writing direction of Hangeul, before proposing a method applicable to the design of Hangeul slanted cursive fonts. Some specific accomplishments of this study include: The Module for Double Circle Extraction was utilized to extract a line-type skeleton from the font's outlines at the center. Through experiments involving overlapping strokes, bending points of strokes, and circular outlines, a method for extracting the skeleton was proposed. In particular, it was emphasized that caution must be taken to preserve the delicacy of the hand when extracting the skeleton from fonts containing traces of handwriting. identifying the 10 degrees of horizontal angle and 5 degrees of vertical angle as the most suitable for designing slanted cursive fonts and emphasizing handwritten elements by expressing natural connections between strokes and strokes to create a sense of handwriting. This study attempted to maintain the shape of connecting lines instead of entirely eliminating them within the range in order not to have a significant effect on the legibility of characters. Considering the limitations of the designer's subjective sense of aesthetics being inevitably reflected in font design, identifying the optimal degrees of the slant and cursive fonts is an important guideline presented by this study. The prototype through a 6-step design method was developed, and these six steps are: (1) skeleton extraction, (2)

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combining skeletons, (3) stroke weight, (4) slanted angles, (5) cursive elements, (6) visual flow adjustments. Since this study aimed to present the method of designing slanted cursive fonts, the formative aesthetics and completeness of the fonts presented as prototypes were still insufficient and remain to be studied further. The goal of a follow-up study will be to complete a set of typefaces for body text including slanted cursive fonts based on the methodology proposed in this study.

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5128