

Design and Development Trends for Universal Design Fonts in Japan -with a focus on the font manufacturer, Iwata Corporation

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Background This study examines the development and commercialization of a font based on the universal design theory. The font uses a horizontal and vertical alignment that can be read by the visually impaired, a group which has previously been ignored by font designers. For foreigners, children, and the visually impaired, similar fonts can be hard to distinguish when reading and writing with the existing Japanese typeset. We therefore looked at Iwata's UD font, which is easier to read than existing UD fonts. In addition, this study is the first attempt to explore the development of a UD font aimed specifically at increased legibility and which can also be combined with textbook development for the visually impaired. The study also provides relevant institutions and firms with fundamental data on the benefits of UD fonts.

Methods Most information about UD font development in this study has been collected from three organizations: Morisawa Inc., a Japanese font company; Iwata Corporation, and Jiyou Kobo. Motoya, Typebank, Iwata Corporation, which manufactured the first commercial UD fonts on the market, provided data to explain the sample font that is used as a fundamental building block in the development of UD fonts. The company also allowed us to look at different examples of font design and development. These examples include the display of fonts in printed material and on digital screen displays for PCs and mobile devices. Using representative UD fonts, we examined which fonts are more or less easily read in different contexts; we also looked at different cases to show how design can be used to alleviate discomfort in reading.

Results This study investigates how to design and produce fonts that are suitable for the visually impaired in Japan. It also examines the approach and design methods used by font developers prior to the development of Iwata's UD font by summarizing relevant cases. Currently, Japan uses Chinese characters, Hiragana and Katakana; Korea uses Hangul and Chinese characters; and China uses Chinese characters and simplified characters. As the font structure (font type and glyph) of Chinese characters is the same in all three countries, the fundamental design elements can also be shared. UD font designs for the general population, the visually impaired (mainly those with amblyopia and low vision), and older people with weak vision are also discussed in this paper. The results will be shared with China and Korea.

Conclusion The anticipated outcome of this study can be summarized as follows. First, the development of the Hangul UD font, with its increased readability, reinforces learning effects by decreasing user fatigue. Because of its distinctiveness, the font can deliver more information in a smaller space compared with existing fonts; it can also be used for small screens such as those found on mobile devices. Secondly, the developed font will be widely used not just by the visually impaired, but also by the general population because it is easy to read. In addition, this font can meet the special needs of groups such as the elderly. Thirdly, the research makes suggestions that may help in the future development of a font capable of incorporating typography compatible with both the Hangul and the Roman alphabets as well as offering an easily readable font design and typography for people with amblyopia in an aging society. Fourthly, this research examines fonts that can be customized to meet the textbook printing needs of special schools for the visually impaired, the hearing impaired, and the mentally impaired. In addition, through investigation and review, Iwata's new UD font is expected to be useful in diverse fields including education for amblyopic or low-vision students, and people with multiple disabilities where textbooks and teaching methods are attuned to each individual's disability characteristics and developmental stage.

Keywords Universal design font, Iwata, Typeface, Trend

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1. Introduction

Over the past 140 years, print fonts in East Asia have been developed with the general population in mind. The visually impaired and older people with poor eyesight have been excluded. People can share happiness by helping each other and coexisting together and it has no frontier. Talk about barrier-free or universal design has recently become more common, with the ideas being implemented in diverse areas including architecture, commodities and colors. However, the design of font characters has not yet been looked at from the universal design perspective despite the fact that fonts are used by everyone. This can be attributed to the fact that the visually impaired are a minority, or to an over-emphasis on economic development. A lack of kindness to people is another undeniable reason. The Japanese Ophthalmological Society has stated that the number of visually-impaired people was about 1.64 million in 2007 and will reach a peak of 2.02 million in 2030, as society grows older. The Japanese Barrier-Free Textbooks Act was enacted in 2008 to help children and students with low vision (that is, eyesight in the range between 0.1 and 0.5 after correction). This group includes approximately 1.45 million. Although one or two Japanese font manufacturers do sell fonts for the visually impaired under the UD font name, no such examples exist in China or in Korea. In addition, data-based research on the fonts used for print display is currently insufficient.

This is especially the case in the field of education for the visually impaired (mainly people with amblyopia and low vision) or hearing-impaired students (including people with multiple disabilities). In these cases, there is heavy dependence on visual information; here, both speed in understanding and the occurrence of fatigue differ according to the quality of the font. There is, therefore, a strong demand for the careful design of easy-to-read fonts.

2. Method

2. 1. Iwata Corporation

The Iwata Corporation was founded with the express purpose of developing and selling digital fonts. In 1920, Iwata Matrix was established as a limited company. This later became the Iwata Matrix Works Corporation. The company introduced the Benton engraving machine in the 1950s to achieve highly-accurate, mass-produced sample text. The largest sample manufacturing company in Japan today, the company has also produced customized sample fonts for the Donga Chosun newspapers. The company became the Iwata Corporation in 2001. It currently has 22 employees working in areas from font design to engineering and marketing.

2. 2. Iwata's Fonts

2. 2. 1. Customized Japanese Font with a New Design

Customized fonts are not common in Japan even when syntax font is excluded. This is due to the large number of words in Japanese. The development of new fonts involves enormous time and cost resources. For example, the cost of manufacturing a single Japanese font is

approximately 50 million yen.

2. 2. 2. Partial Modification of Design, Based on The Company's Font

Partial modification of a company's font is common in practice. This can enhance a company's competitiveness through differentiation from its competitors by building an individual font shape and type.



Figure 1 Using Development of Chinese characters for writing sequence, using independent Kana font

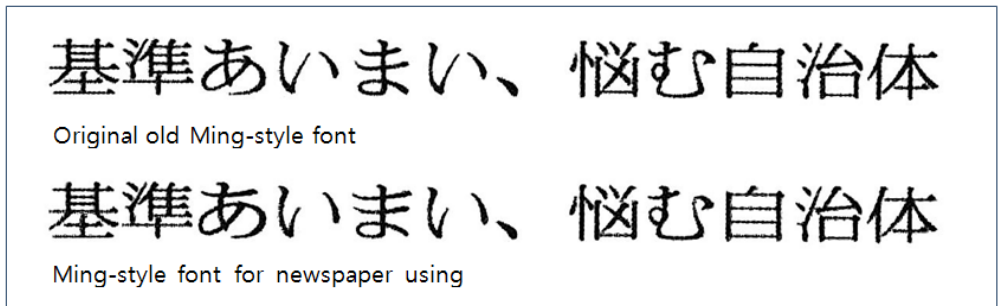


Figure 2 The paper's Partial change in Kana font, Chinese characters as original

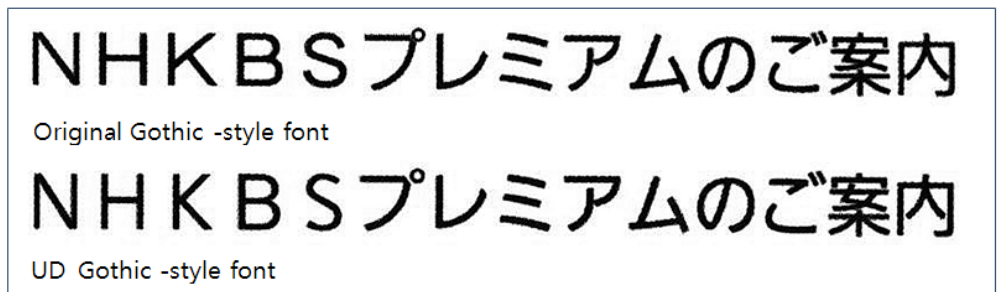


Figure 3 Partial design change in Chinese characters and Kana font; phrase completely changed

2. 2. 3. Font Thickness that Varies According to the Print Environment

From film engraving to computer-to-plate (CTP) and high-definition printing, font weight can be reduced. The outline of a font that has a thicker weight can now be fully depicted. However, where a font with adequate thickness does not exist, the company dealt with special order to respond to the weight.

2. 2. 4. Foreign Fonts

Names of people and places, and company logos and symbols have been added to font sets.

These are used by publishing companies, autonomous entities, public offices and private companies. A particular example relates to newspaper companies who developed fonts to represent the names of Chinese athletes participating in international sports events.

2. 2. 5. Special Font Sets

In order to meet the usage and standards of each company, publishing companies use AJ1-4~6 and JISX0208 specifications, newspaper companies use U-PRESS, and financial firms use post-computer font sets (FUJITSU, HITACHI, NEC, and IBM). In addition, company-exclusive font sets, such as ARIB and MUSIC, and foreign font sets have also been manufactured.

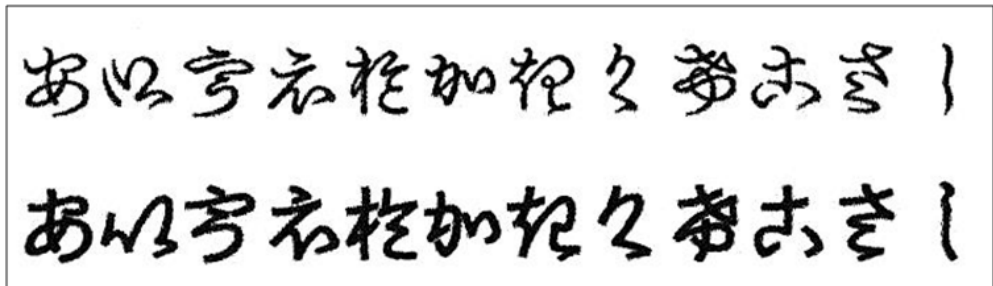


Figure 4 Example of Kana font included in HITACHI font set

2. 2. 6. Bitmap (dot) Font

Bitmap or dot font, used by electronic manufacturers, is loaded with liquid crystal. The font is used for home appliances, audio devices, car navigation, industrial machines, and so on. Currently, this font is very widely used due to its small file size, high speed, and ease of use and programming. In Japan, for example, fonts with 12 to 100 dots per inch (dpi) are manufactured for use in bank automated teller machines (ATMs). For checkbook printing, a dot font is used, which prints 2000 lines a minute with 240 dpi.

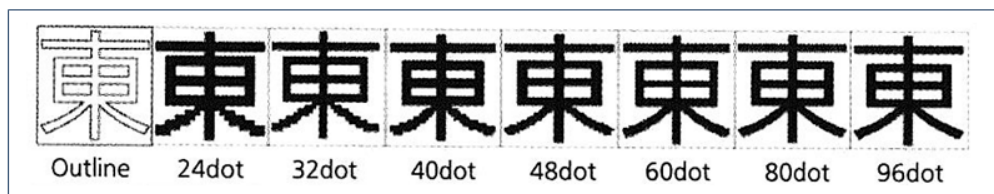


Figure 5 Outline and dot font

2. 2. 7. Special Font Format

This is a font format that fits the client's development environment; here, bitmap font is often used.

2. 2. 8. Price of Font

In general, open-type package fonts are sold at 18,000 yen.

For specially-ordered fonts, the manufacturing cost is 5000 yen, plus roll-up expenses of between 150,000 and 200,000 yen, which includes inspection, font data conversion, and so

on. The expected cost of introducing one font to a large publishing or newspaper company ranges from a few hundred to a few thousand yen for the outline font, including transfer rights that enable the company to make free use of the font.

The cost of a bitmap font ranges from tens to millions of yen. Licensing is determined according to the ordering company, with type-exclusive licenses, warranties, and so on. □ Royalty fees range from a few yen, to thousands and, in some cases, millions of yen. Royalty fees are approximately one yen for each font.

2. 3. Font Design Procedures

2. 3. 1. Rough Design

Designs are first sketched word by word. In the case of a Ming-style font, a minimum of 600 Chinese characters are required. The manufacture of thousands of fonts is necessary for the He font.



Figure 6 Rough design

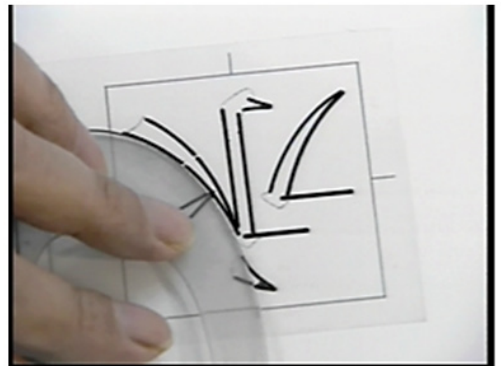


Figure 7 Ink work

2. 3. 2. Ink Work

For easy scanning, the outline of the outer shape is first accurately delineated. The inside of the outlined font is then colored using ink stick.

2. 3. 3. Scanning

The scanned fonts are digitized into TIFT format using Windows. The scanner has a 400 dpi resolution, as in most home scanners, since modifications are expected later in the process.

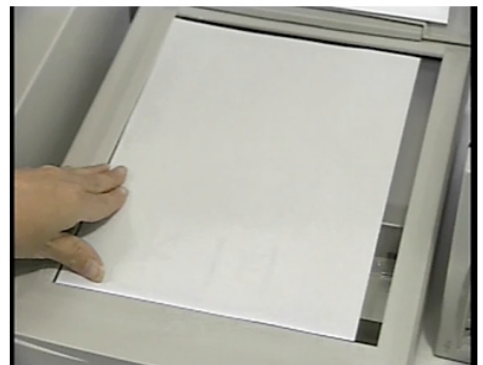


Figure 8 Scanning

2. 3. 4. Bitmap Data Conversion

The TIFT format data are converted to independent bitmap SC data.



Figure 9 Bitmap data conversion

2. 3. 5. Outline Data Conversion

The SC data are then converted to the independent outline data called IK data. At this stage, unnecessary dirt generated during scanning is dealt with.

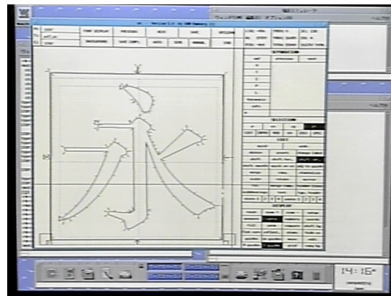


Figure 10 Outline data conversion

2. 3. 6. Modifications

Outline (IK data) is modified and corrected using exclusive IKARUS editing software. By making both the straight and curved lines of the scanned font data more beautiful, and by removing unnecessary data, the program enhances the appearance of the font, word by word, under the direction of the designer.

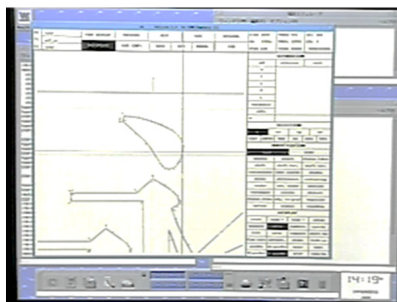


Figure 11 Modifications

2. 3. 7. Print Check

After printing the digitized fonts, the appearance of the font is checked.



Figure 12 Print check

2. 3. 8. Inspection by the Designer

The designer checks each word, one by one, and suggests further modifications or corrections, as required.



Figure 13 Inspection by the designer

2. 3. 9. Further Modification

Changes are made as per the designer's instructions. The inspection and modification cycles are repeated until the designer indicates final approval.

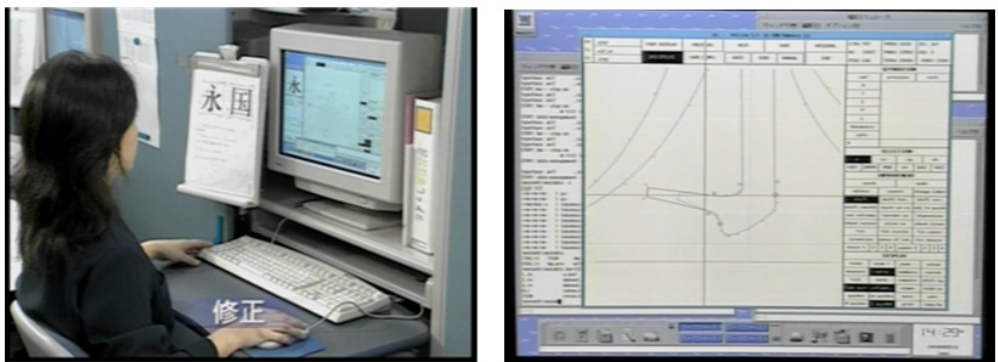


Figure 14 Further modification

2. 3. 10. Making the Elements Table

In order to make words with more than 10,000 Chinese characters, the elements (strokes) that compose a word are made part by part, by referring to the previously created 600 words. By combining elements, a number of words (Chinese characters) can be made. However, Hiragana, Katakana, the Latin alphabet, Arabic numbers and non-Chinese character elements cannot be made in this way; each character must be made separately.

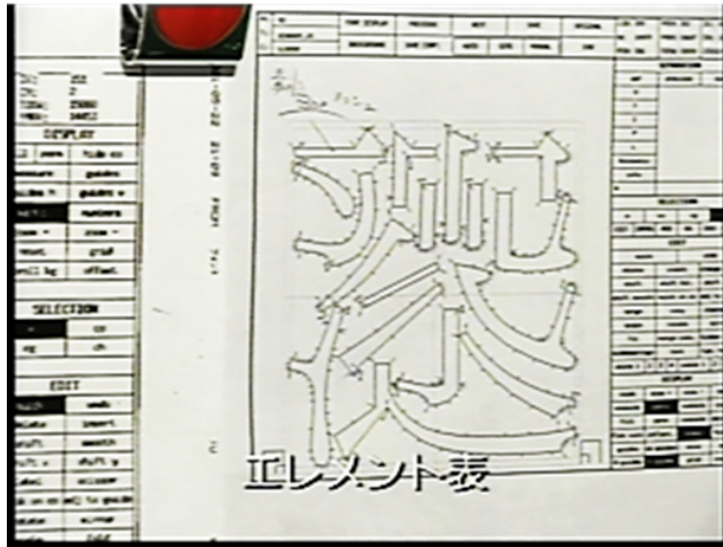


Figure 15 Making the elements table

2. 3. 11. Font Display and Printing Verification

IK data are treated and converted into font data so they can be used in computers. It should be noted that there are hundreds of font verification methods in each stage. The average time required for the completion of a single font is between two and five years.

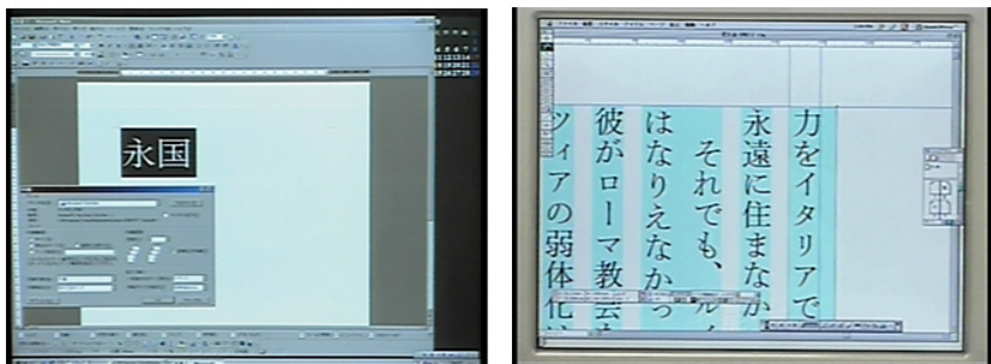


Figure 16 Font display and printing verification

3. Future Trends for Font Development

3. 1. Font Format

Original composite format (OCF) and character identifier (CID) data formats are no longer used. They have been replaced by True Type (Windows) and Open Type (Mac) fonts.

3. 2. Design

In the case of Iwata, over half of its development is focused on UD fonts, especially the UD Gothic type.

3. 3. Reason for Targeting Font Makers

Printing companies and publishers have many concerns with changing technology. In particular, due to the economic downturn, they are trying to escape from the so-called recession of font development. Fonts have to work with diverse display media. Examples range from bitmap to outline fonts with 50 dpi resolution to high resolution (over 300 dpi) fonts for smartphones. Other examples include LCD and electric paper, and the use of anti-aliasing techniques that minimize the aliasing (broken pattern) which occurs when displaying high-resolution signals on low-resolution devices. The development of these fonts is used to differentiate the company from the competition, putting as much weight on design as function. In addition, development of fonts for multiple languages is underway (e.g., Arabic, Indian, and Cyrillic fonts). This will have a major impact on overseas marketing.

3. 4. Font Set Expansion

The development of font sets for post-computer use is mainly carried out by large conglomerate and electronic manufacturers. Examples include HITACHI (KEIS), FUJITSU (JEF), NEC (JIPS), IBM, etc.

For the Japanese government's electronic use, an IPA Ming-style font was developed under the aegis of the Ministry of Economy and IPA (IT Promotion Agency) in Japan. This font set, containing over 60,000 words, combines fonts from the Family Register and Basic Resident registration cards. The former contains 55,270 Chinese characters, whereas the latter is a high-security, integrated circuit (IC) card that can be issued easily by the community, city or prefecture in which a citizen resides. The font forms the basis for electronic government and electronic municipal communities, and is aimed at enhancing the convenience and effectiveness of government administration.

3. 5. Development of New Functions

According to new regulations for the Ideographic Variation Sequence (IVS), a new function has been introduced since Unicode 5.1 with the purpose of presenting variant characters, which have different shapes despite their identical pronunciation and meaning.

According to new regulations, operating system (OS), input method (IM) and font are involved. In the current computer OS environment, Windows 7 and Mac OS 10.6 are compatible. As for the IM of software that inputs fonts to the computer, Acrobat 9, Notepad in Windows 7 and Text Editor in Mac OS 10.6 are compatible. Iwata's Open Type (Win, Mac) font Pro6/6N series and the Kotsuka Ming-style font (Pro6N, etc.) are compatible. Support for IVS has been announced by Microsoft and the next version of Office products.

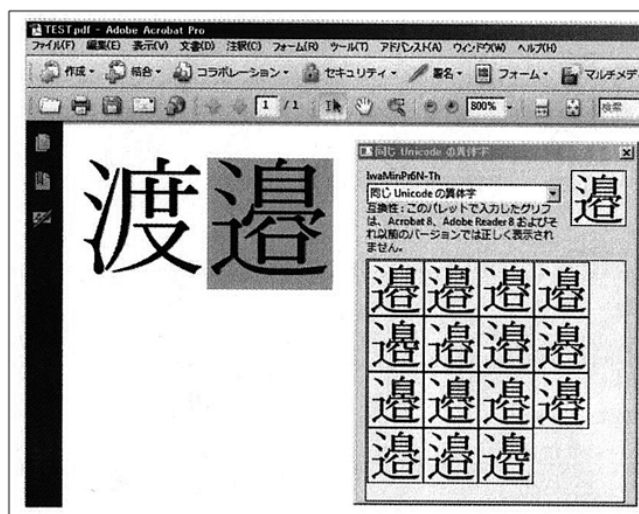


Figure 17 Display example of variant character under IVS (Windows XP, Acrobat 9, Iwata Ming-style font Pro6R)

4. Universal designfonts

4. 1. What is Universal Design?

Universal design (UD) is a design concept that aims at a product being used by as many people as possible regardless of their age or ability. The idea, which was first suggested by Ronald L. Mace at North Carolina State University in the 1990s, was introduced to central and local government in Japan about 20 years ago. Currently, UD has become a requirement in a variety of fields including manufacturing and the environment.

4. 2. What is a UD Font?

UD fonts are designed to be legible to as many people as possible. The idea of legible fonts can be traced back to 1938 when the Iwata Corporation created a Ming-style font for a newspaper. Since then, manufacturers and newspaper companies have continued to try to make fonts more legible. The widely-used Pyoung font was born as a result.

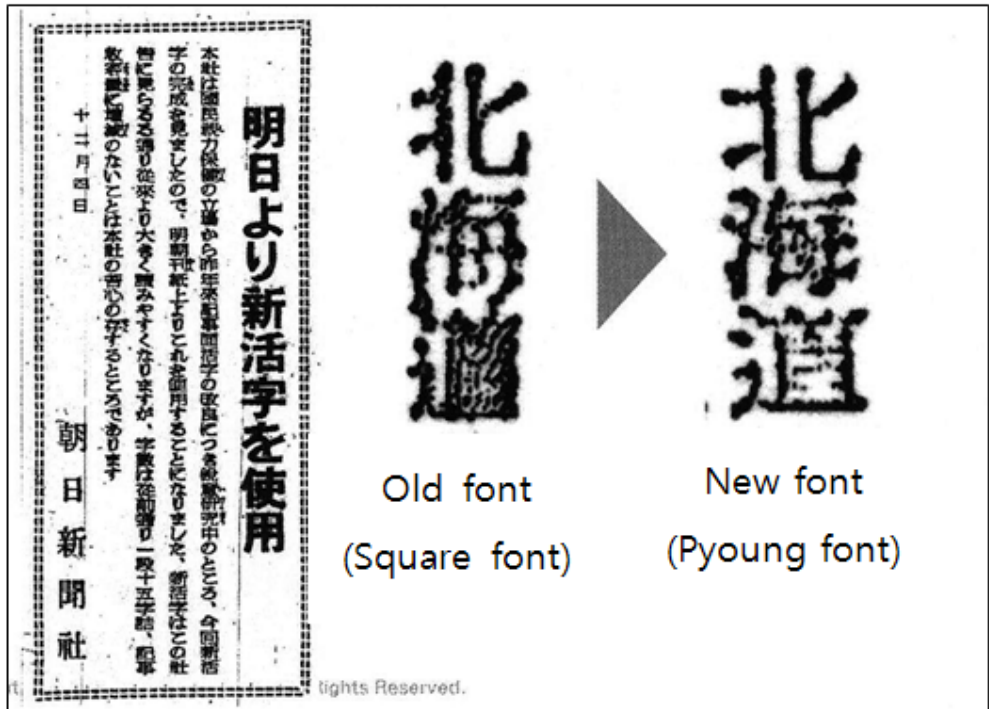


Figure 18 Asahi Newspaper in 1941, Old font (square font) December 4th, 1941 vs new font (Pyoung font) December 5th, 1941

4. 3. Iwata's UD Font

Iwata's UD font was first launched as a package font in December 2006. The font was developed in cooperation with the electronic manufacturer Panasonic. Use of the font was mandatory in all Panasonic product promotion displays, in the product name, the product manual, and so on. The target was horizontal alignment, with a short sentence of less than ten words and motion display for silk print. The goal was to design a font that could be identified at a glance, that was easy to decipher, and that was simple, beautiful, and easy to read.

4. 4. Two Reasons for Using Iwata's UD Font

One reason for using Iwata's UD font is the decline in average sight in the ageing population; the second is the miniaturization of fonts required by lighter weight and smaller products. In other words, eyesight is deteriorating in society as a whole, while the display fonts used are getting smaller and smaller. Consequently, font legibility has become a critical issue.

4. 5. Examples of UD Font Usage

Panasonic is remarkable in that it uses the UD font not only as its company font, but also as its color, user interface and in its products. Following the increase in digital broadcasting, dissatisfaction with the small Ming-style font used for television broadcasting has increased. A UD Gothic type font was used in order to resolve the complaint.

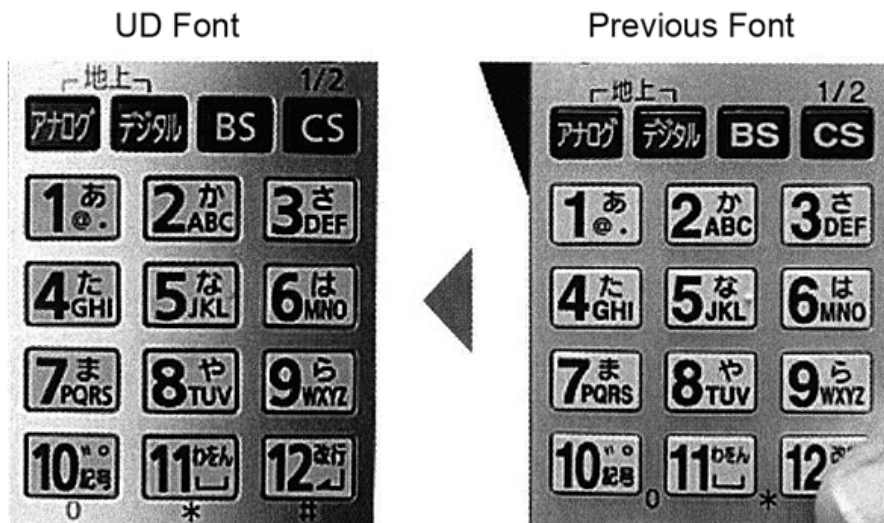


Figure 19 Remote control unit



Figure 20 Introduction of television broadcasting program in newspaper

5. Development Examples

We use the example of a joint development between the Shinano Mainichi Newspaper in Nagano Prefecture and the Iwata Corporation. The development background is the aging profile of newspaper subscribers in Nagano Prefecture and the emaciation of the font due to changes in the newspaper's print environment and the CTP resolution being changed to 1200 dpi. To improve legibility, it was necessary to revise the font design itself in addition to increasing font size. Would it be possible to use the pilot Ming-style font from the UD exhibition in the newspaper? The joint venture began when the paper asked Iwata Corporation to provide a print test of the font for the newspaper.

5. 1. Flowchart of Manufacturing Process

5. 1. 1. Investigation of Usage Condition

A variety of conditions under which the font would be used were investigated. In particular, the purpose (document type), typeset system (font size, vertical/horizontal typeset, space between the lines, and space between the fonts), resolution (1200 dpi), printing method (CTP), and so on, were examined.

The vertical-to-horizontal ratio of the UD Ming-style font for the newspaper is over 70 percent. In general, the vertical-to-horizontal ratio of Ming-style fonts ranges between 30 and 50 percent.

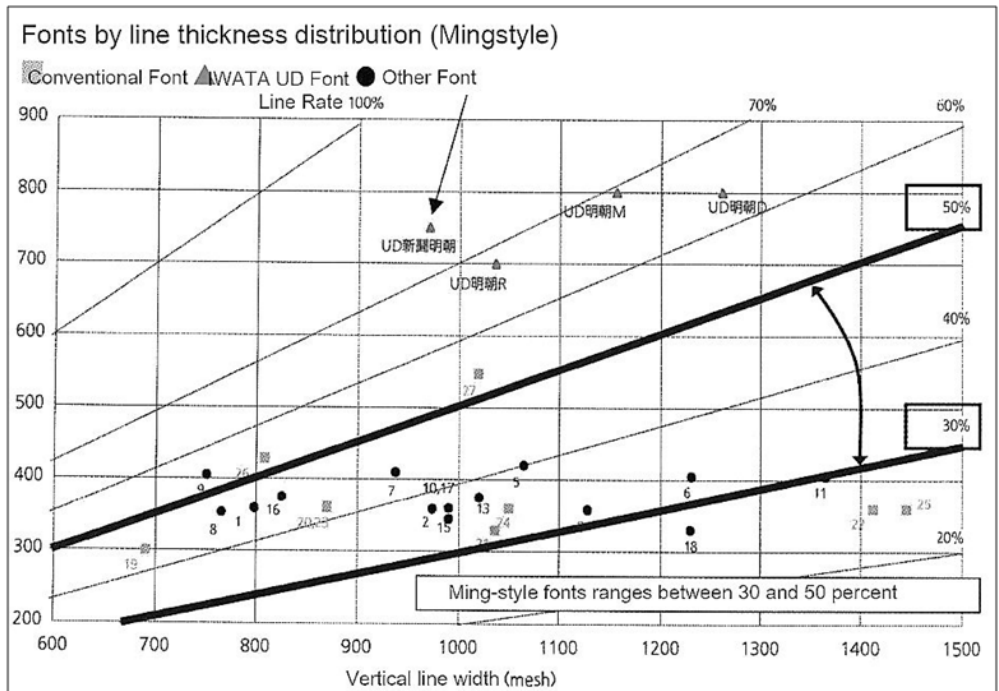


Figure 21 Distribution of line width of each font (Ming-style font) Existing Iwata Ming-style font Iwata UD Ming-style font Other company

5. 1. 2. Production of Sample Font (1)

This is a sample design to determine the basic system. The number of words manufactured was between ten and a few hundred. The concentration seen on the page, the vertical-to-horizontal ratio, and the control of weight according to the number of pages were considered. To ensure a harmonious design, the real body ratio of Chinese characters, the balancing of Chinese characters and Kana font, and the English and Arabic numbers were all considered.

5. 1. 3. Evaluation (1)

A number of diverse methods were introduced in the experiment to ensure an accurate and appropriate evaluation. Test samples were made separately for sentences with many Chinese characters and those with few Chinese characters. Font size, font face and vertical/horizontal alignment were evaluated. With regards to text alignment (vertical alignment is the default in Japan), horizontal alignment was also checked. Testers were chosen from within the newspaper company and Iwata.

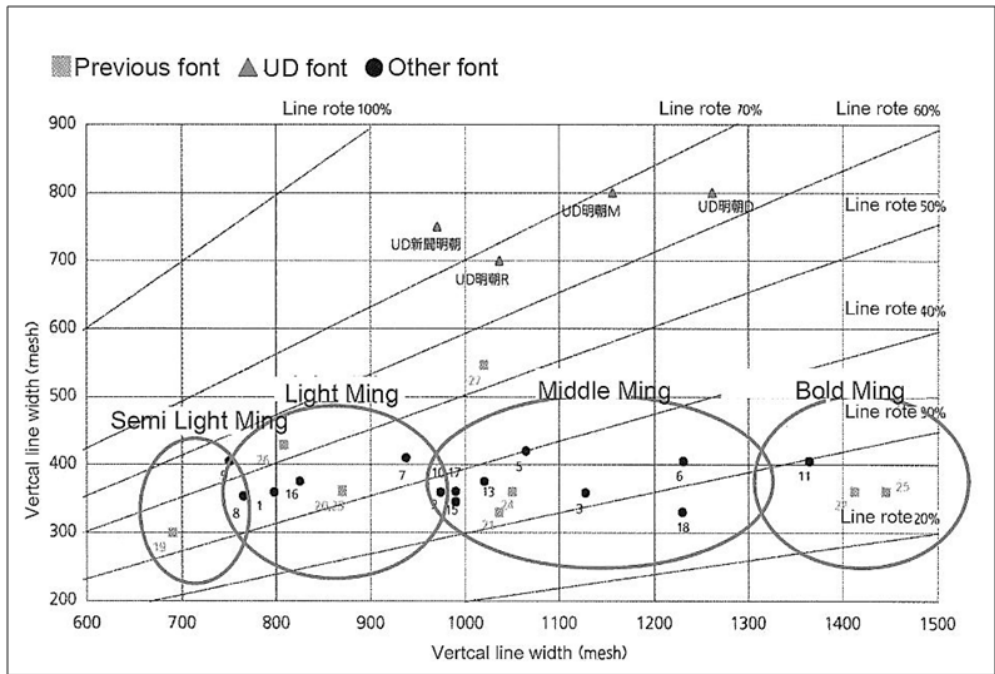


Figure 22 Simulation of font size and weight

5. 1. 4. Production of Sample Font (2)

At this stage, the manufacturing method for the font was agreed, including any modifications arising from the first evaluation. The sample font design included approximately 500 words with the highest frequency and these determined the elements. Once the font was completed, the design took into account whether the proposed use was for printing or for screen display. Following the evaluation results, the design was revised according to the feedback.

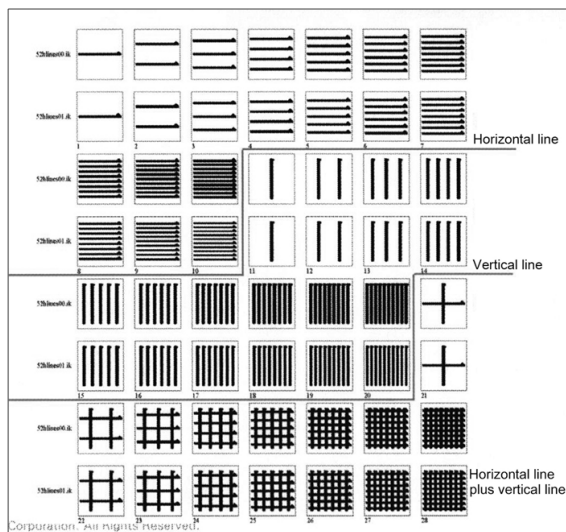


Figure 23 Line weight that can be controlled according to the stroke count

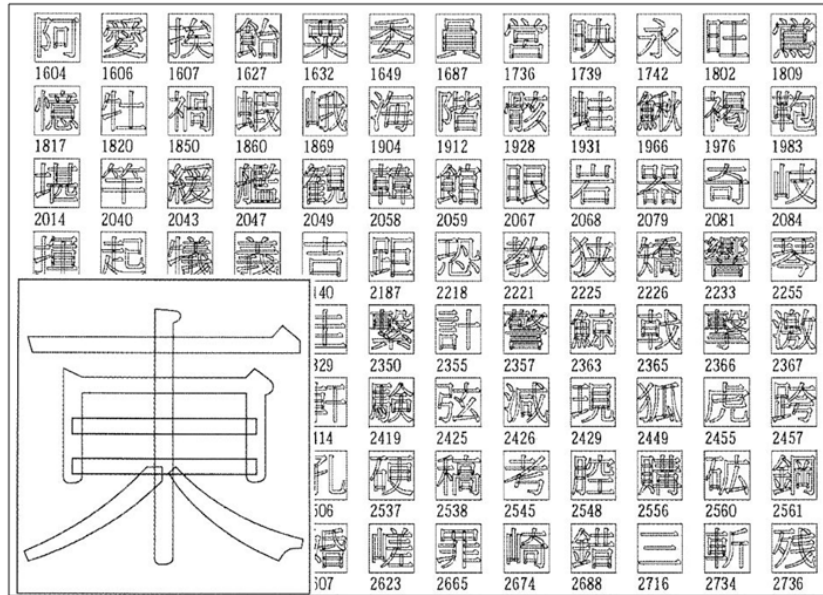


Figure 24 Primary characters that can be decomposed on a part by part basis

5. 1. 5. Evaluation (2)

Material printed using the rotary press was evaluated. This mirrored the actual practice of printing the newspaper. The evaluation method was the same as the first evaluation, but the testers were outsiders, rather than employees. Newspaper subscribers with some typographical knowledge were selected for the role. Twenty-six students, eight older people (over 65) and 270 residents of Nagano Prefecture were chosen as evaluators.

5. 1. 6. Font Manufacturing

The font was then made for commercial use. Beginning with approximately 600 words, it has been expanded to cover JIS and other fonts. Seventeen thousands words were manufactured by decomposing elements. A highly-experienced designer examined the fonts; this review was followed by a second and third correction and review cycle before the font was digitized.

15 2009年(平成21年)7月19日(日曜日) 信濃 信濃

信毎の文字 目に優しく

ユニバーサルデザイン(UD)文字に

21日の夕刊から

横線太くのびのびと

誰もが使いやすいデザイン

ぼ ← **ぼ**
3 ← 3
6 ← 6

明 ← **真田三代**
明 ← **真田三代**

完成した文字 ← 手書きの模写

①文字がでるまで
②完成も刷り確認
③打ち戻り確認
④アタマもハシオンに打ち戻り確認
⑤アタマもハシオンに打ち戻り確認

文字がでるまで

Figure 25 Commercialization for paper media

6. Conclusion

This study has examined and summarized examples of UD font development by the Iwata Corporation. The development of UD fonts is expected to take place in Korea in the near future and its use in the education field there is also anticipated. Iwata's UD font can express more information than existing fonts and is also easier for the disabled to use. In addition, it will be widely adopted for commercial use not only by the visually impaired, but also by both the older and the general population as it is an easily recognizable font. We expect that Iwata's UD fonts will include diverse types of fonts in the future. The design of these fonts will focus on readability and effectiveness at the designated font size.

Characters are said to symbolize the cultural spirit of a nation. There is no better way for the study of a nation's character than to understand the culture of that country.

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