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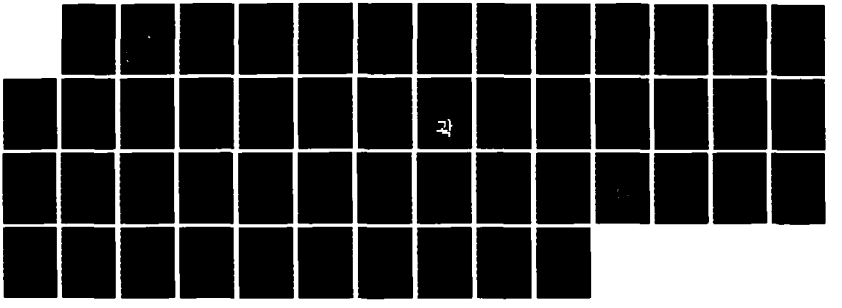

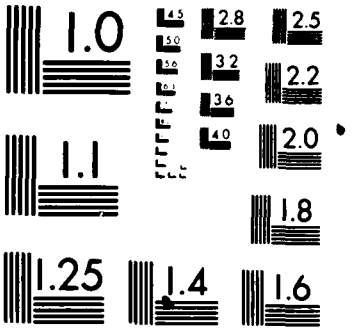

NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

A SYSTEM FOR KOREAN CHARACTER USAGE
ON A GRAPHICS LASER PRINTER

by

Jang Hun Lee

June 1986

Thesis Advisor: Michael J. Zyda

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There is a current desire by Korean students at the Naval Postgraduate School (NPS) for using available computer systems for editing and printing the Korean character set (Hangul) for official reports and correspondence. Handwritten texts are not acceptable alternatives. There is an additional need to retrofit high performance western-produced computers for use by Koreans. This study attempts to attack both problems through the development of a Korean word processor on a U.S. computer, the Silicon Graphics, Inc. IRIS workstation, and an output capability on a U.S. produced laser printer, the QMS-1200.

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A System For Korean Character Usage On A Graphics Laser Printer

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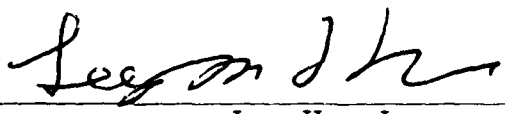
Author: 
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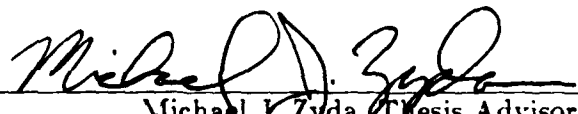
Approved by: 
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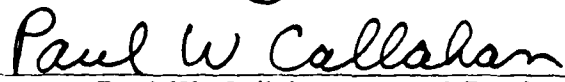
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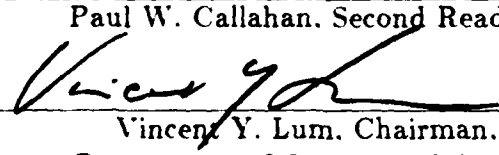
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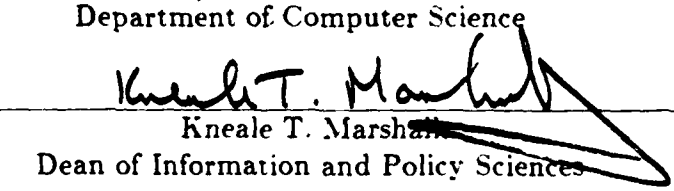
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ABSTRACT

There is a current desire by Korean students at the Naval Postgraduate School (NPS) for using available computer systems for editing and printing the Korean character set (Hangul) for official reports and correspondence. Handwritten texts are not acceptable alternatives. There is an additional need to retrofit high performance western-produced computers for use by Koreans. This study attempts to attack both problems through the development of a Korean word processor on a U.S. computer, the Silicon Graphics, Inc. IRIS workstation, and an output capability on a U.S. produced laser printer, the QMS-1200.

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I. INTRODUCTION

There is a current desire by Korean students at the Naval Postgraduate School (NPS) for using available computer systems for editing and printing the Korean character set (Hangul) for official reports and correspondence. Handwritten texts are not acceptable alternatives. There is an additional need to retrofit high performance western-produced computers for use by Koreans. This study attempts to attack both problems through the development of a Korean word processor on a U.S. computer, the Silicon Graphics, Inc. IRIS workstation, and an output capability on a U.S. produced laser printer, the QMS-1200.

A. REQUIREMENTS OF KOREAN WORD PROCESSOR

The development of a non-Roman word processor is an important research effort, because the currently developed Korean, Japanese and Chinese word processors are not convenient for general use due to the many different combinations of fundamental characters i.e., top, side, and bottom combinations. Until now, most of the Korean students of the NPS have experienced difficulty when sending official documents to Korean government agencies. The Korean word processor we have developed required the examination of three major problems :

- How to develop a Korean font for printing on a graphics Laser printer.
- How to use the Korean font for word processing.
- How to use the Korean font on an interactive, western produced graphics system.

B. CHARACTERISTICS OF KOREAN (HANGUL)

The Korean written language is called *Hangul*. It is a phonetic system, in the sense that letters represent sound. The Hangul characters are written by syllabic groupings into square clusters.

Hangul is the only script known to have been designed by a committee. It was invented in 1443 by a group of scholars under King Sejong(1419-1450) in response to an explicit royal directive to create a native alphabet from scratch. To harmonize with the square shape of Chinese characters, the Hangul are designed to be grouped into square clusters of two, three, or occasionally four fundamental characters. Each cluster represents one spoken syllable of the language. Figure 1.1 shows the basic Korean characters. There are 14 fundamental consonants, 5 combined consonants, 10 fundamental vowels, and 4 combined vowels [Ref. 1].

The composite Korean letter may consist of the first sound and final sound, or first sound, second sound, and final sound. Figure 1.2 shows the position of each consonant and vowel in the composite Korean letter. That Figure also shows the possible characters for each position. The Korean letter contains the 11 compound sound consonants and 7 compound sound vowels. The position of each

character into a composite Korean letter called " *Mohaseuki* ", is determined by a small set of rules. These rules are shown in Figure 1.2. The Korean composite letter has two three fundamental structure forms, i.e., C1V1, C1V2, and C1V1V2. More complicated letters are produced by the sequential addition of C and V, such as C1V1C2, C1V2C2, and C1V1V2C2. The number of all the characters produced exceeds 24,000. This quantity of characters makes the automatic recognition of Korean characters difficult [Ref. 2].

The clustering feature of Korean creates problems for the Korean typewriters because it requires the letters to assume different shapes and positions depending on the surrounding context. Figure 1.3 shows the typing sequence of the eight-letter word "Han-gug-oe," meaning "Korean language." The fourth and sixth characters are the same but one of them is written at the top of the syllable cluster while the other ends up at the bottom. Figure 1.3 shows the actual composite text required. The graphic forms shown in square boxes are superimposed on each other to build the syllabic clusters. Typing each new letter necessitates revising the form and placement of letters that were previously typed, an action impossible for a mechanical typewriter but easy for a computer display.[Ref. 2]

	Fundamental Characters	Combined Characters
Consonants	ㄱ ㄴ ㄷ ㄹ ㅁ ㅂ ㅅ ㅇ ㅈ ㅊ ㅋ ㅌ ㅍ ㅎ	ㄲ ㄸ ㅃ ㅆ ㅉ
Vowels	ㅏ ㅑ ㅓ ㅕ ㅗ ㅛ ㅜ ㅠ ㅡ ㅣ	ㅐ ㅒ ㅔ ㅖ

Figure 1.1 Korean Characters(Hangul)

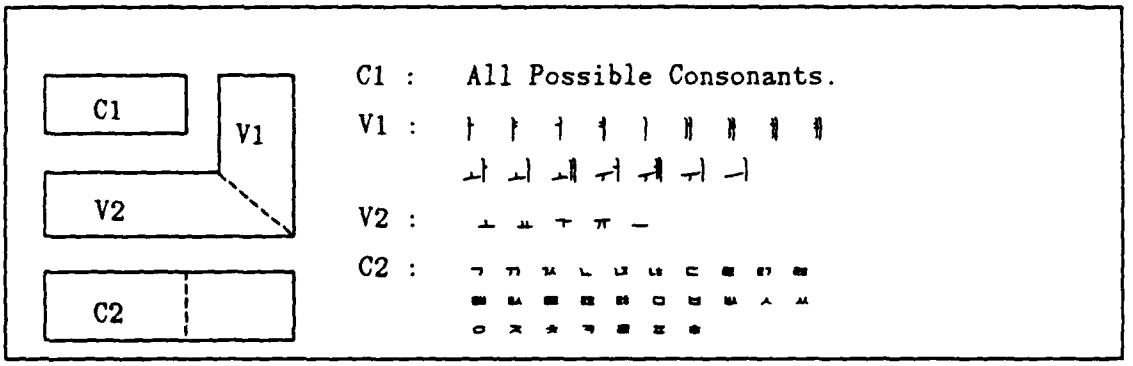


Figure 1.2 Allowed Fundamental and Combined Characterts
For the Korean Composite Letter

Hangul Typed	Text Display	Fragments Used in Text Display
*	*	*
ㅏ	*ㅏ	* ㅏ
ㄴ	*안	* ㅏ ㄴ
ㄱ	*안ㄱ	* ㅏ ㄴ ㄱ
ㅜ	*안구	* ㅏ ㄴ ㄱ ㅜ
ㄱ	*안국	* ㅏ ㄴ ㄱ ㅜ ㄱ
ㅇ	*안국ㅇ	* ㅏ ㄴ ㄱ ㅜ ㄱ ㅇ
ㅣ	*안국ㅇㅣ	* ㅏ ㄴ ㄱ ㅜ ㄱ ㅇ ㅣ

Figure 1.3 Korean Letters Display

C. DESIRABLE SYSTEM CHARACTERISTICS

1. System Must be Quick and Efficient

The Korean word processor we have developed is heavily goal-orientated; that is, the author is more interested in the finished product than he is in the generation process. However, for the user, the process of creating Korean documents can be as important, or even more important, than the finished typing documents. Therefore, this system must be able to create and edit the Korean documents quickly and efficiently or the system will not be used.[Ref. 3]

2. System Must be Intuitive

The system must have a natural intuitive approach for typing Hangul letters. The importance of this cannot be over estimated: no matter how efficient the system is at producing Korean documents, if the user feels uncomfortable in the Hangul word processor he will go elsewhere.

3. System Must Be Convenient

The system must offer the user greater convenience than is currently offered by handwriting or typewriting. Human beings tend to ignore systems that may be of great advantage to them simply because they are slightly inconvenient to use.

4. System Must Accommodate Unskilled Users

The user generally will have little expertise typing Hangul characters. This is understandable as the author who requires the typing or editing of a Korean file is only using the system as a tool. Therefore a Hangul word processor system must be able to be used by the untrained, inexperienced and even disinterested.

5. System Must Produce a High Quality Product

The user's work generally can be classed as esoteric and thus its quality cannot be quantified. The printed paper must be of good quality and the Korean characters produced must be crisp, clear and in a well-defined font. Therefore this system must be capable of outputing to a quality graphics printer, ideally a laser printer or to a good quality dot matrix printer. The laser printer is the preferred output device.

6. Ease of Modification

Documents in Korean are subject to frequent change for many reasons, i.e., missing words, mistyping or revision to their parts. Handwriting or typing do not always allow corrections without some lessening of the output quality. Therefore, this word processor system must be capable of modifying the contents of documents at any time after the original typing process.

7. Ease of Reproduction

The documents may need to be reproduced many times, depending on the requirements. Typewriten works usually are not reproduced with the original quality. Hence this system must be able to store and hence, reproduce the Korean documents.

II. PROBLEMS IN EDITING KOREAN

A. BACKGROUND DESCRIPTION

The group of Korean students at NPS is the largest group in the international community except for US students. There have been an average of 65 Korean students for the past 4 years.

These students have to send grades and quarterly report to each service headquarters at the end of each quarter. To do this, they have to write or type Korean. Most of the Korean students have had the experience of having problems editing Korean documents. No Korean typewriters or word processors are available at NPS.

B. HANDWRITING

Handwriting is probably the most common method to produce Korean documents both in the official and private environments. Most of the Korean students at NPS have had this type of experience in editing Korean.

The advantage of handwriting is that is very convenient and no significant cost is involved in setting up the system. This system is completely convenient to the author, since it requires no special equipment and can be any place at any time. The user can also select the size of papers to produce the appropriate

documents. The main disadvantage with this method is that the quality is dependent on the handwriter.

TABLE 2.1 - SUMMARY HANDWRITING	
Characteristic	Achievement of Goal
Quick and Efficient	Might be only quick
Intuitive	No
Convenient	Very
Accommodate Unskilled Users	Yes
Quality Product	User dependent - quality not guaranteed
Ease of Modification	Complete rewrite required
Ease of Reproduction	Complete rewrite required

C. USAGE OF THE TYPEWRITER

The Korean typewriter is very similar to the Roman character typewriter. The main difference is the positioning of elemental characters in each letter. The Roman typewriter has only one combination of letters, side by side. The Korean typewriter has three different combinations such as side by side, top by bottom, and top by side by bottom (See Figure 1.2).

There are two main advantages to the typewriter over handwriting. They are convenience and no significant skill of usage. It is a portable system. Korean documents can be produced on a typewriter at any reasonable time and place. Most Korean people are familiar with this system, as it is common in Korea. There are two disadvantages. The first is the difficulty in correcting mistakes. The second is poor reproducability of the product.

TABLE 2.2 - SUMMARY USAGE OF THE TYPEWRITER	
Characteristic	Achievement of Goal
Quick and Efficient	Maybe
Intuitive	Yes
Convenient	Yes
Accommodate Unskilled Users	Training desired
Quality Product	Good
Ease of Modification	Retype required
Ease of Reproduction	Complete retype required or Photocopying

III. WORD PROCESSOR DEVELOPMENT TECHNOLOGY

A. KOREAN FONT DEVELOPMENT

The Korean characters are usually divided into fundamental, combination, compound consonants and vowels. The principles for developing a Korean font (character pattern) for a dot matrix printer and graphics display are similar to other fonts.

1. Font for the Graphics Screen

Most western computer systems use the ASCII code, and a standard keyboard. When a key is hit on that keyboard, that key is translated into some display corresponding to that character. One type of display frequently seen is a matrix of dots layed out in a pattern [Ref. 4: pp. 39-49].

The Silicon Graphics, Inc. IRIS-2400 has such a capability. The dot matrix definition of the IRIS's standard Roman characters are 7x9 bitmaps (7 dots long by 9 dots high). The development of a Korean font requires larger bitmaps. The Hangul letters of our system are designed to be 20 bits by 21 bits for the composite letter. Figure 3.1 shows the position and size of each type of composite letter. Figure 3.2 shows the sample Hangul letter that means "box" in English.

The first sound characters are located in the top left part of the Hangul composite letter. These were designed as 10x8 bitmaps, with 2 bits of X-offset and 11 bits of Y-offset. The skip width of each character is 12 bits. The second sound characters are divided into two different types, i.e., the type 1 characters are located at the right side of the first sound and the type 2 characters are located at the bottom of the first sound as shown in Figure 3.1. The second sound characters are also divided into two different character sizes and positions depending on the type of character. Figure 1.2 shows two type of vowels, type 1 as V1 and type 2 as V2. Both types of vowel (second sound) have *their own offset* and skip width as shown Table 3.1. The final sound characters are also divided into two types as are the second sound vowels. That position is the same as for the second sound, but the sizes are different with the second sound, even though the shape of characters is the same. The reason for the different sizes of the second sound and the final sound is that the composite Hangul letter has to be a square cluster. The third sound characters are divided into two different types for position only, i.e., the size of both characters are the same. The size of these characters are slightly smaller than the first sound, and the offsets of both types are in Table 3.1.

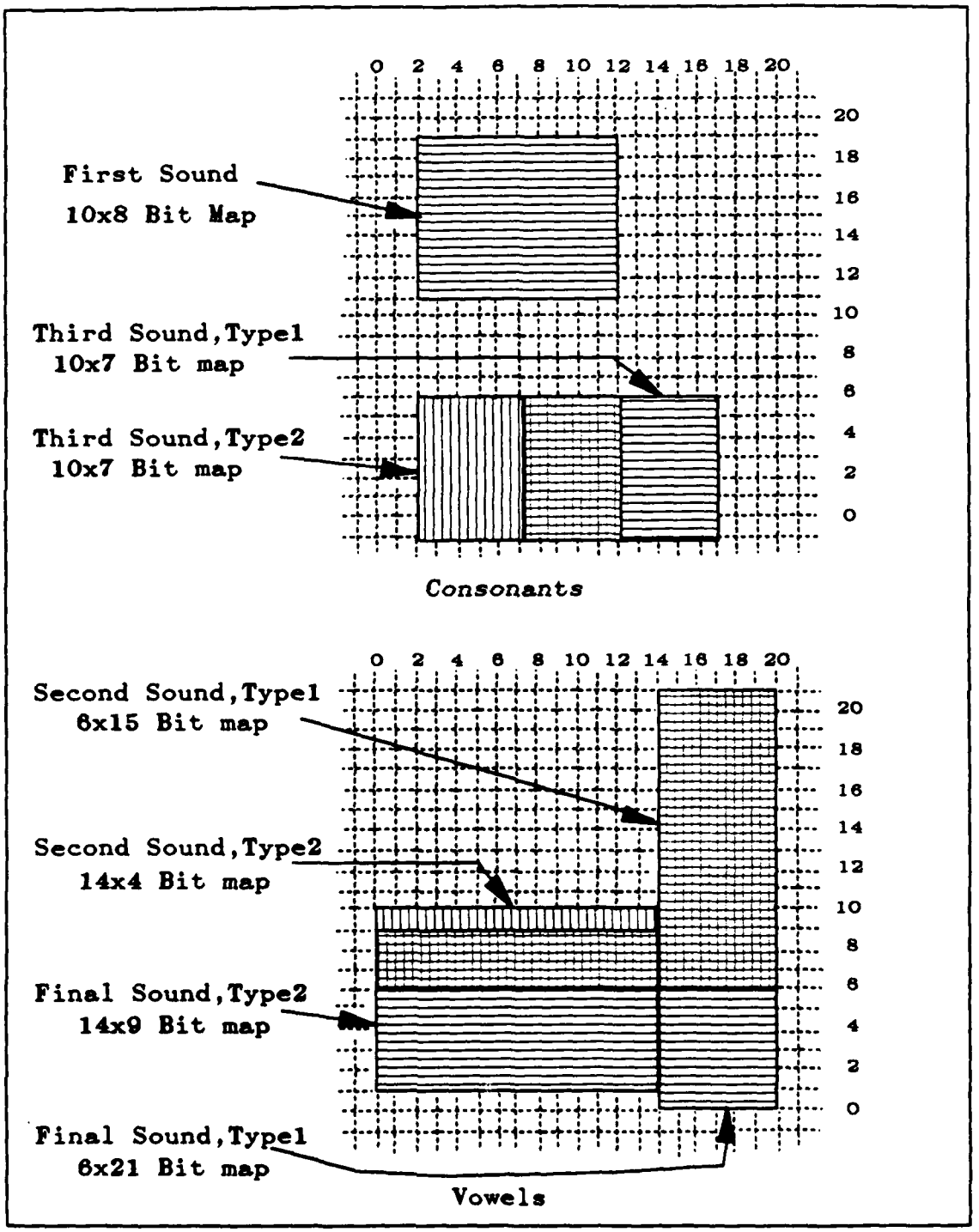


Figure 3.1 Position and size of the font for the Graphics Screen

TABLE 3.1 - OFFSET OF FONTS					
Type of Character		Bit Map	X-Offset	Y-Offset	Skip Width
First Sound Consonants		10 x 8	2	11	12
Second Sound Vowels	Type 1	6 x 15	0	6	7
	Type 2	14 x 4	-12	6	2
Final Sound	Type 1	6 x 21	0	0	11
	Type 2	14 x 8	-12	1	6
Third Sound Consonants		10 x 6	-12	-1	5

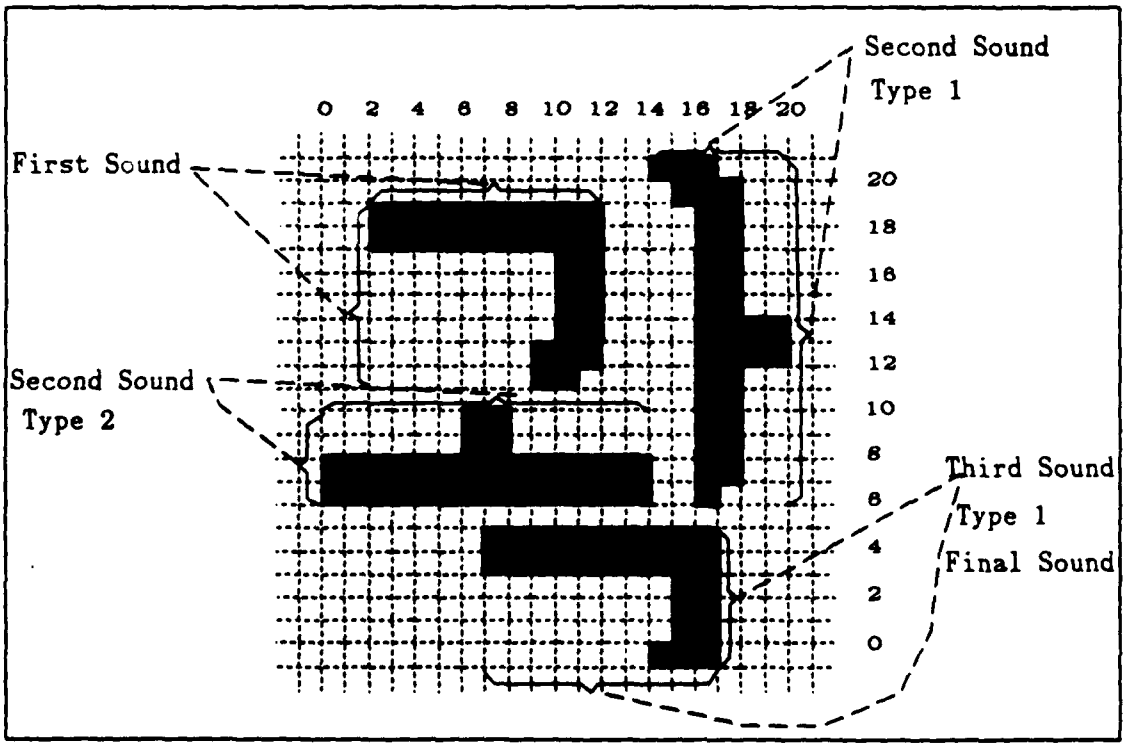


Figure 3.2 Sample Font(means "BOX" in English)

2. Font for the Laser printer

The laser printer fonts are similar to the graphic screen fonts. but the size of each character is twice as large. The Lasergrafix 1200 laser printer has two different font orientations, Landscape and Portrait. Consequently. both font orientations were developed. Table 4.2 represents the sizes and offsets of the landscape font for the laser printer.

TABLE 3.2 - SIZE Of FONTS For the LASER PRINTER

Type of Character	Bit Map	X Offset	Y Offset	Skip Width
First Sound Consonants	20x16	4	22	24
Second Sound Type1 Vowels	12x30	0	12	14
Second Sound Type2 Vowels	24x8	-24	12	4
Final Sound Type1 Vowels	12x42	0	0	22
Final Sound Type2 Vowels	28x16	-24	2	12
Third Sound Consonants	20x12	-24	-2	10

B. KEYBOARD DEVELOPMENT

The keyboard is the main input to the computer. The user gives all his directions from the keyboard. and he also uses it to key in the documents and new text for insertion and modification.[Ref. 4: pp. 28-39] The western standard

keyboard uses the ASCII code. i.e., a one byte piece of data. The Korean typewriter has two different consonants i.e., first sound (19 consonants) and third sound (14 consonants), and two different vowels i.e., final sound (14 vowels) and second sound (14 vowels).

The Korean word processor we have developed only has 14 fundamental consonants and 5 combined consonants as first sound, and 10 fundamental vowels and 4 combined vowels. The third sound consonants and other combined and compound characters are generated by system software by entering the character by character as " *Pooluseuki* " (see Figure 1.3 Korean letter display). During the document editing process, the word processor provides a Korean keyboard display for the user. The position of Korean keys are same as for the Korean typewriter. Table 3.3 shows the conversion of standard keyboard Roman characters to Korean characters. The functional keys of the word processor are similar to those of the UNIX editor " **vi** " (In particular control "F" and "B" for screen movements. "x","DELETE", and "dd" for deletion. "i" for insertion, and "ESC","RETRN" and "SHIFT" keys).

TABLE3.3 - KEYBOARD CONVERSION To KOREAN CHARACTERS

ROMAN	ASCII	HANGUL	CLASS	ROMAN	ASCII	HANGUL	CLASS
!	33	ᆞ	3rd sound	"	34	ᅣ	2nd sound
#	35	ᅧ	2nd sound	$	36	ㄱ	3rd sound
%	37	ㄴ	3rd sound	&	38	ㄷ	3rd sound
'	39	ㄹ	3rd sound	(	40	ㅁ	3rd sound
)	41	ㅇ	3rd sound	*	42	ㅓ	2nd sound
+	43	ㅕ	2nd sound	,	44	,	other
-	45	ㅡ	2nd sound	.	46	.	other
/	47	ㅅ	3rd sound	0	48	ㅗ	2nd sound
1	49	ㅛ	2nd sound	2	50	ㅜ	2nd sound
3	51	ㅠ	2nd sound	4	52	ㅏ	2nd sound
5	53	ㅐ	2nd sound	6	54	ㅑ	2nd sound
7	55	ㅒ	2nd sound	8	56	ㅔ	2nd sound
9	57	ㅖ	2nd sound	:	58	ㅚ	fnl sound
;	59	ㅘ	2nd sound	<	60	ㅙ	2nd sound
=	61	ㅝ	2nd sound	>	62	ㅞ	2nd sound
?	63	?	other	@	64	ㅁ	3rd sound
A	65	ㅢ	fnl sound	B	66	ㅠ	fnl sound
C	67	ㅣ	fnl sound	D	68	ㅜ	fnl sound
E	69	ㄸ	1st sound	F	70	ㅟ	fnl sound
G	71	ㅆ	3rd sound	H	72	ㅎ	3rd sound
I	73	ㅑ	3rd sound	J	74	ㅓ	3rd sound
K	75	ㅋ	3rd sound	L	76	ㅁ	3rd sound
M	77	ㅡ	3rd sound	N	78	ㅁ	3rd sound
O	79	ㅐ	fnl sound	P	80	ㅔ	fnl sound
Q	81	ㅃ	1st sound	R	82	ㅋ	1st sound
S	83	ㅁ	3rd sound	T	84	ㅌ	1st sound
U	85	ㅡ	3rd sound	V	86	ㅁ	3rd sound
W	87	ㅉ	1st sound	X	88	ㅍ	3rd sound
Y	89	ㅟ	fnl sound	Z	90	ㅡ	3rd sound
[	91	(	other	\	92	ㅅ	3rd sound
]	93	)	other		94		not used
_	95	ㅅ	3rd sound	`	96	ㅁ	3rd sound
a	97	ㅁ	1st sound	b	98	ㅠ	fnl sound
c	99	ㅅ	1st sound	d	100	ㅇ	1st sound
e	101	ㄷ	1st sound	f	102	ㅁ	1st sound
g	103	ㅅ	1st sound	h	104	ㅗ	fnl sound
i	105	ㅣ	fnl sound	j	106	ㅓ	fnl sound
k	107	ㅏ	fnl sound	l	108	ㅣ	fnl sound
m	109	ㅡ	fnl sound	n	110	ㅜ	fnl sound
o	111	ㅔ	fnl sound	p	112	ㅖ	fnl sound
q	113	ㅂ	1st sound	r	114	ㄱ	1st sound
s	115	ㄴ	1st sound	t	116	ㅅ	1st sound
u	117	ㅓ	fnl sound	v	118	ㅍ	1st sound
w	119	ㅈ	1st sound	x	120	ㅌ	1st sound
y	121	ㅛ	fnl sound	z	122	ㅋ	1st sound
{	123	ㅢ	2nd sound	|	124	ㅁ	3rd sound
}	125	ㅣ	2nd sound	~	126	ㅍ	3rd sound

C. HANGUL EDITING TECHNOLOGY

There are 6 possible Korean composite letters, i.e., C1V1, C1V2, C1V1V2, C1V1C2, C1V2C2, and C1V1V2C2, as was discussed above. The word processor assigns an index value to each type of elemental character, which can be used to recognize the composite character. When the word processor user enters any character on the the keyboard, the system validates the keystroke and displays the correct Korean composite. The keystroke validation process is quite complicated.

There are two different combinations in the case of two successive consonants, i.e., previous consonant becoming the elemental third sound and the before previous consonant becoming the compound third sound. The validation of combination depends on the sum of the index values for each composite letter. The system checks the sum of the index value to determine the two different cases. If it is 30 or 35, then system converts the last two characters to second and third sound characters simultaneously. The system has the matching procedure for converting final sound vowels and first sound consonants to second and third sound characters. If the sum of the index is not 30 or 35, the system combines the last two consonants into one third sound character. This process checks for valid combinations.

There is only one way to make a compound vowel. If two vowels are entered in succession, they are checked and then, if valid, are displayed as one character of the final sound from the Korean font. Korean has only 7 valid compound

vowels. If the entered character becomes the third sound, then this compound vowel is changed to the second sound.

The word processor system we have developed is similar to the UNIX " **vi** " editor. This is because the active functions i.e., cursor movement, deletion, insertion, and page control are the same character sequences as **vi**. The cursor movement is different from Roman characters since the skip width of each Korean character is different. Cursor movement is dependent on the entered character. The system provides the skip width of each character, the cursor movement amount, through use of a recognition procedure (See Table 3.1). The number of characters on one line is not fixed because the Korean letter combination has 6 different types. The line length is controlled by the available paper size.

This system does not allow line copy and line replacement as in **vi**. Insertion can be done by input mode through menu selection or by hitting the character "i" as in **vi**. Deletion can be done by the "delete" key during insertion, or by hitting the character "x" or "dd" for one character or one line respectively. Page control can be done by control "B" or "F" for screen backward or forward. More detailed information can be found in Appendix B.

D. PRINTING DOCUMENTS

The developed Korean fonts can be printed by a dot matrix printer or by a laser printer. This system was developed for a Laser printer that is available from the IRIS system. The Korean fonts are loaded to a Lasergrafix 1200 printer on a

VAX computer system. Document printing is performed by a simple command on the VAX after the file has been transferred from the IRIS to the VAX.

Font definitions and other required addressing information are stored in the Laser printer's RAM Memory in blocks of 1024 bytes. An individual character definition can be stored in its entirely in one block or in multiple blocks. Font definitions contain up to 128 characters. The Korean font in this system has 94 characters (See Table 3.3). Using the height and width in dots of a bitmap, the number of 16-bit words of RAM required to store a single character was computed as follows [Ref. 5]:

((width + 15) / 16) * height) = number of 16-bit words required

Number of bytes = 2 * words

We designed two different Korean fonts for printing Korean documents. Each font is downloaded to the RAM of the Laser printer as either a Landscape or Portrait orientation. One of the fonts is the regular size Korean font, and the other is twice as big. Appendix C shows a sample of a Korean document using the regular size of font.

IV. RECOMMENDATION AND CONCLUSIONS

The Korean word processor system has two limitations. The first is that Roman characters cannot be included in the output. Other interested students may wish to modify the system to inculde this feature. Secondly, only 1,000 lines of output are allowed due to memory space limitations. However, several files can be created and concatenated for more voluminous output.

There are additional features that would greatly enhance the abilities of the Korean word processor. The following additions to the system are recommended:

- the ability to edit Korean with Roman characters.
- the ability to use Hangul letters with in OZDRAW (a system developed by Steven J. Firth and Michael J. Zyda.
- the ability to enhance the editor to be more like **vi** . i.e.. text line copy. move some lines of text. edit text without insertion mode. etc..
- the ability to print with special command as in VAX TROFF **me**.

The Korean word processor has succeeded in becoming a popular method for Korean students to edit Hangul documents with high quality. The impressive graphic capabilities of the IRIS series and Figure processor that were developed by Professor Michael J. Zyda. has enabled Hangul document creation and editing to be carried out in real time.

APPENDIX A - PSEUDO CODE OF HANGUL WORD

The following pseudo code contains the major parts of the Hangul word processor program on the IRIS 2400. Not covered are the Korean font generation processing and Laser print usage.

```
main
{
    title();                /* make object of title picture and display it   */
    preface();              /* make object of screen and then read file of
                               introduction, and then display introductions */
    initializations;        /* initialize the some strings for edit korean
                               characters and index for while loop           */
    make objects;           /* make all objects i.e., each information's
                               boxes contents                                */
    font define;            /* korean.title, hangul.dis, and
                               hangul.iris for displaying                    */
    display main menu and explainations;

    while(TRUE)
    {
      switch(menuselection)
      {
          /* see the following detail procedure */
        case CREATEFILE:
            createfile();       /* enter the create file mode    */
          /* see the following detail procedure */
        case EDITFILE:
            editfile();         /* enter the edit file mode      */
          /* see the following detail procedure */
        case HELP:
            help();             /* make object and read help
                                   script files, and then
                                   display it with menu 3        */
        case EXIT:
            exit from system;
        default:
            break;
```

```
        } /* end of switch */

        display main menu and explainations:

    } /* end of while */

} /* end of main program */


createfile()
{
    get_filename();              /* get the file name */
    korean_box();                /* make korean editing box bobject */
    key_display(&keyboard);      /* make key board object */
    initialization:
    display main frame with menu1 and keyboard:
    while(TRUE)
    {
        if menucontrol=FALSE then
        {
            get keyboard value;
            if value=ESC then
                menucontrol=TRUE;
        } /* end of if.. */

        if control=INPUT then
        {
            if value=DELETE then
            {
                delete previous value;
                change offset;
                change temporary string;
                decrease character pointer;
            }
            else
                if valid input character then
                {
                    put current value to temporary string;
                    increase character pointer;
                } /* end of if... */
            END IF

            if last and current values are both consonants then
```

```
{
    if valid combination offset  then
    {
        find matching vowel and consonant;
        change the temporary string;
    }
    else
    {
        if valid compound consonant  then
        {
            find matching comound consonant;
            change the temporay string;
        }
        else
            display seperately;
    }
    END IF
    change the previous and before value;
} /*  end of if..  */
else if last and curent values are both vowels  then
{
    if valid compound vowel  then
    {
        find matching compound vowel;
        change the temporary string;
    } /*  end of if...  */
    else
        display seperately;
    END IF
    change the previous and before value;
} /*  end of if-else  */
else if last=consonant and current=vowel  then
{
    increase offset;
    change the previous and before value;
} /*  end of if-else-else  */
else
    change the offset;      /*  depend upon situations  */
END IF

strcpy(line[index], tempt);
edit object:                /*  korean main box object  */
if value=RETURN or end_of_line  then
```

```
        {
            edit object:
            change the cursor position:
            re_initialization;
        } /* end of if... */
        END IF

        if line pointer meet bottom of screen  then
        {
            edit object:        /* get the new screen with last
                                   three line strings              */
            change skip pointer;
        } /* end of if ... */
        END IF
    } /* end of IF statement */
    else
        while(TRUE)
        {
            switch(menuselection)
            {
                case INPUTMODE:
                    {
                        control=INPUT:
                        menucontrol=FALSE;
                    }
                case SAVE:
                    savefile(filename);
                case HELP:
                    help();
                case RETURN :
                    {
                        savefile(autosave);
                        return;
                    }
                case EXIT:
                    exit from system:
                default:
                    break;
            } /* end of switch */
            display main frame with keyboard:
        } /* end of while loop */
    END IF
} /* end of procedure */
```

```
editfile()
{
    get_filename();              /* get the file name for reading a
                                    file to edit korean letter          */
    korean_box();                /* make object for main frame of
                                    korean editing                      */
    key_display(&keyboard);      /* make key board displaying object */
    initializations;
    display main box with informations and menu 2;

    while(TRUE)
    {
        if menucontrol=FALSE then
        {
            read keyboard device value;
            if value=ESC then
                menucontrol=TRUE;
            else
            {
                distinguish entered character;
                switch(value)
                {
                    case ``F':
                        {
                            foreward screen;
                            change skip pointer;
                            re_initializations;
                        } /* end of control F case */
                    case ``B':
                        {
                            backward screen;
                            change skip pointer;
                            re_initializations;
                        } /* end of control B case */
                    case `x':
                            if valid deletion then
                            {
                                delete current character;
                                shift one char. to left;
                            }
                            else
                                ring the bell;
                            END IF
```

```
case 'd':
     {
          get additional character:
          if value = 'd' then
          {
               delete one line string;
               shift next line to up;
          }
          else
               ring the bell:
     } /* end of deletion of line case */
case 'i':
          editcontrol = TRUE;
case 'h':
          if not 1st column then
               move cursor one char. to left:
          else
               ring the bell:
          END IF
case 'j':
          if not bottom of screen then
               move cursor one line to down:
          else
          {
               shift one line to up:
               display next line at bottom:
          }
          END IF
case 'k':
          if not top of screen then
               move cursor one line to up:
          else
          {
               shift one line to down:
               display previous line at top:
           }
           END IF
case 'l':
           if not end of line then
               move cursor one char. to right:
           else
               ring the bell:
           END IF
```

```
                default:
                        break:
            } /* end of switch */

            strcpy(tempt, line[index]);

        } /* end of IF-ELSE statement */

        while(editcontrol=TRUE)
        {
            /* except the folowing areas:
               in case value=RETURN or meet end of line
               then string in right side of current cursor
               move to next line. Therefore, following
               lines of scripts are shift one line to down */

            if value = ESC then
                editcontrol = FALSE:
            else
                /* almost same as createfile() procedure */
                insert some hangul:
            END IF

            /* almost similiar with createfile() procedure */
            display main frame with informations;

        } /* end of while loop */

} /* end of IF . i.e., menucontrol=FALSE case */
else
{
    display main frame with menu and key board;
    switch(menuselection)
    {
        case EXIT_MENU:
            {
                sdisplay information instead of menu;
                menucontrol=FALSE;
                queue reset;
            } /* end of exit_menu case */
        case SAVE:
            savefile(filename);          /* save current contents */
        case HELP:
```

```
                    help();          /* display the help menu */
                case RETURN:
                    display main menu with explainations:
                    return;
                case EXIT:
                    exit system:
                default:
                    break;
            } /* end of switch */

        } /* end of IF-ELSE i.e.. menucontrol=TRUE case */

    } /* end of while loop i.e.. main loop */

} /* end of procedure editfile() */
```

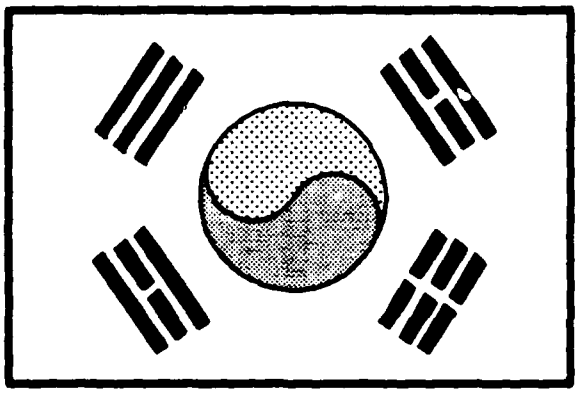
APPENDIX B – USER'S MANUAL

This appendix contains the Korean Word Processor User's Manual. This manual describes the capabilities of the system, its usage and detailed instructions on its operation. This appendix is designed to be a document that will be used by people who wish to generate Korean documents.

THE

KOREAN WORD PROCESSOR

USER'S MANUAL



By

Major LEE, Jang Hun

ROK Army

A. INTRODUCTION TO THE SYSTEM

The KOREAN WORD PROCESSOR system is designed to operate on the IRIS workstation manufactured by Silicon Graphics Inc. This system was developed by Jang Hun Lee in June 1986 at the Naval Postgraduate School, Monterey, California. The aim of this system is to provide a capability for Korean document generation. This system provides an interactive editing capability with such features as the creation, the editing, and the printing of Korean documents. This system has been designed so that the user can efficiently operate the system with little or no experience of Korean typewriter usage.

The system requirements for the Korean word processor are:

(1) an IRIS workstation,

(2) the IRIS mouse and standard keyboard,

(3) a graphics printer capable of quality graphics production (a laser printer is the preferred printer).

Figure B-1 shows the system features. Figure B-2 shows the system menus.

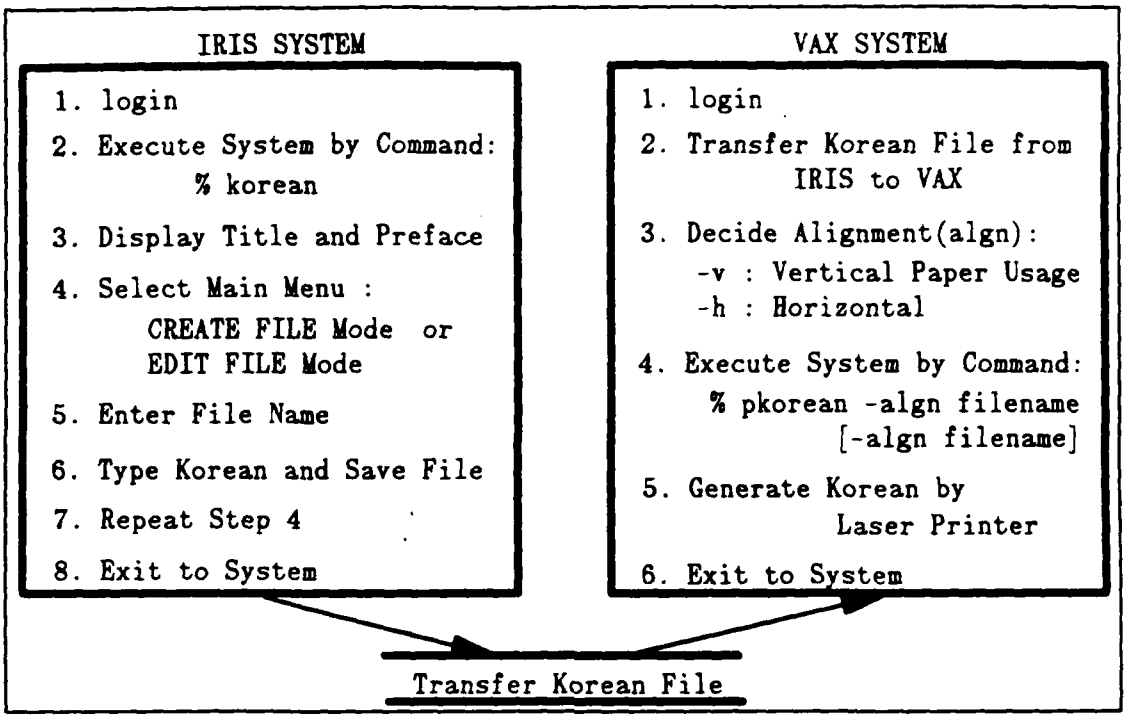


Figure B-1 Korean Word Processing System Feature

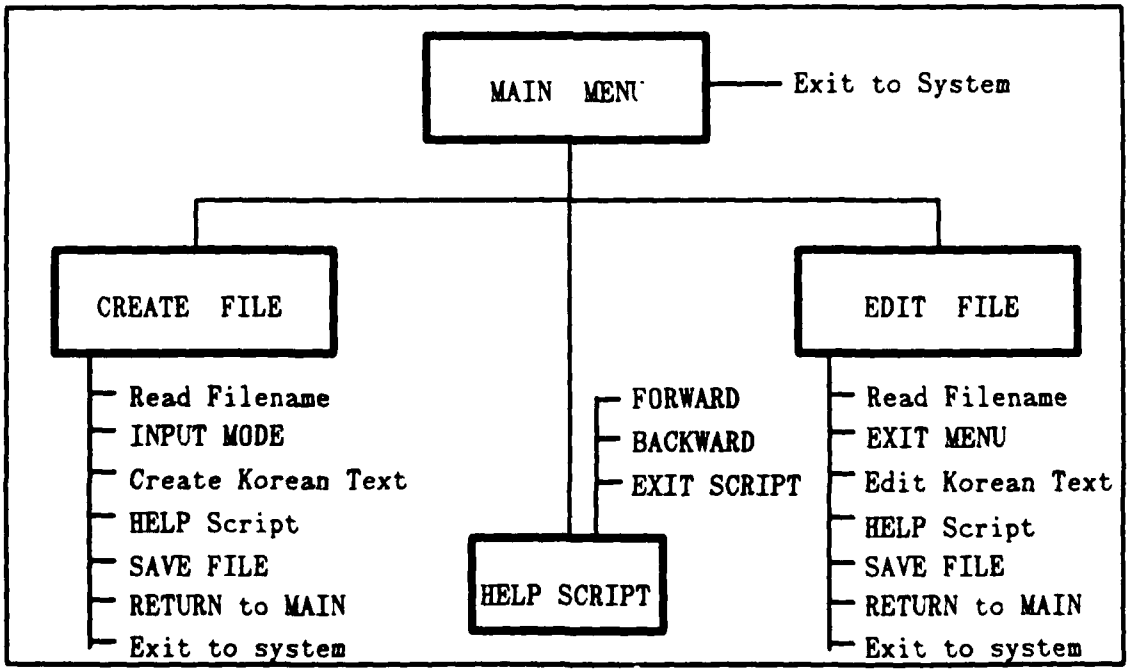


Figure B-2 System Menus and Functional Structure

B. USAGE OF SYSTEM

The Korean word processor is invoked on the IRIS system by the command:

korean

Note, no command line arguments are needed. This system allows two alignments of the paper, the Landscape orientation or the Portrait orientation. This orientation can be selected after the creation of the document on the IRIS system. The system provides information about the next command selection on the screen in a step by step fashion. The system also displays a Korean keyboard that matches the standard keyboard. The IRIS Mouse buttons are used for menu selection. During the menu option, the left button is activated for scrolling up, the middle button for selection, and the right button for scrolling down the menu.

Once a document is completed, the Korean text must be stored in a file for printing. The Korean word processor does not print the Korean directly. The Korean file on the IRIS must be transferred to the VAX system upon completion of the editing. File transfer is accomplished via the **ftp** program locally.

The VAX system provides the ability to print Korean by the following command:

pkorean -alignment filename [**-alignment filename**]

Where alignment is : **v** for vertical paper (Portrait orientation font), and

h for horizontal paper (Landscape orientation font).

C. CREATE FILE MODE

This mode is used to create a Korean file without editing. The system requests the file name when the user selects this mode. The menu for this mode is displayed after entering the filename, i.e., INPUT MODE, SAVE FILE, HELP, RETURN MAIN, and EXIT.

In INPUT MODE, the main window on the screen displays Hangul characters when the user hits keys in accordance with Hangul keyboard that is displayed on the bottom of the screen. The mouse is not necessary at this time. This system maps standard ASCII characters on the keyboard to the Korean characters indicated on the display. The cursor indicates the position of the next Korean character. When the user hits the **return** key or the cursor meets the end of a line (indicated on the screen as vertical red line), the cursor moves to the first column of the next line to indicate the next character position. When the Hangul text meets the bottom line, then the last 3 lines of text move to the top of screen and the cursor indicates the next character position. If the user hits the escape key (ESC), then the system provides a menu which shows the user how to obtain other functions. This system also provides an autosave file function when the user incorrectly selects the RETURN MAIN or EXIT menu items without saving the file. The deletion of a Korean character can be accomplished only at the current line. If the user hits the **DELETE** key, then the last character typed is deleted. This deletion removes the complete Hangul letter in accordance with the rule of combinations, i.e., if the deleted character is the third sound character, then the

system provides one complete letter without the third sound (combination changed from C1V1C2 to C1V1).

In the SAVE FILE option, the system provides the capability for outputing the Korean text into a named file. This procedure also provides an **autosave** mechanism when the user exits this mode without saving the created Korean file.

In the HELP option, the system has help scripts that are useful. This script provides detailed information about system usage. Help text scrolling is controlled by a menu, i.e., FORWARD, BACKWARD, and EXIT HELP.

In RETURN MAIN, the system provides the first menu for getting the EDIT FILE mode or CREATE FILE mode again. The created Korean script is saved into the '**autosave**' file to protect the loos of the script.

This system exits when user selects the EXIT mode in menu.

D. EDIT FILE MODE

The purpose of this mode of the main menu is to edit an existing Korean file. The system requests a filename after this mode has been selected. The menu for this mode is displayed after reading and displaying the named Korean file. The menu includes five items: EXIT MENU, SAVE FILE, HELP, RETURN MAIN, and EXIT.

This option provides the settings of various key functions at the bottom of the screen when the user selects EXIT MENU in this menu. The usage of this editing

system is similar to the VAX **vi** system. The Korean word processor allows the following keys at this time:

- **'i'** : the ability to insert some Korean text from the current cursor point. The insertion mode provides the same ability as CREATE FILE mode until the user hits the escape key (ESC).

- **'h'** : the ability to move the cursor to the left one character position. The keyboard bell is rung when the cursor can not be moved further.

- **'j'** : the ability to move the cursor to one line down. The system provides the ability to shift each line upward when the cursor meets the bottom of a line. The keyboard bell is rung when the cursor can not be moved.

- **'k'** : the ability to move the cursor to one line up. The system provides the ability to shift each line of text down when the cursor meets the top line of the screen. The keyboard bell rings when the cursor can not be moved.

- **'l'** : the ability to move the cursor to the right one character position. The Keyboard bell rings when the cursor meets the end of the line.

- **'x'** : the ability to delete one character at the current cursor position. The screen immediately displays the changed Korean text in that line.

- **'dd'** : the ability to delete one line of Korean text at the current cursor position. The screen immediately provides the changed Korean text.

- **'^F'** : the ability to scroll forward one screen. If the Korean file has another page of script, then the screen displays the next page of text with last 2 lines of text from the previous page. Otherwise the system rings the bell.

- **'^B'** : the ability to scroll backward one screen. If the Korean file has a previous page of script, then the screen is changed to show the first 2 lines of text on the screen. If the remaining Korean text lines are not enough to fill one page on the screen, then the screen displays from the first line of text at top of screen. Otherwise, the system rings the bell.

The system returns to the menu when the user hits the escape key (ESC). The other menu items are similar to the CREATE FILE mode.

E. USAGE OF THE LASER PRINTER

The Korean word processor that is invoked under command, **korean** on the IRIS system, does not actually print the Korean characters produced by the user. Instead it produces a file, named by the user, that can be printed later by a print utility called **pkorean**. The **pkorean** command is invoked on the VAX system. Therefore, the user must transfer the created Korean file to the VAX system when the user wishes to print Korean.

The command used to print a file produced by Korean is the following:

pkorean -alignment filename [**-alignment filename**]

Where alignment is : **v** for vertical paper usage, and

h for horizontal paper usage.

Note that more than one file can be printed in this manner, as long as the correct number of alignment values are placed in the appropriate places.

For example to print the file '**regulation**' with a vertical alignment, as well as file '**janghun**' with a horizontal alignment, the following command would be issued:

pkorean -v regulation -h janghun

APPENDIX C - SAMPLE KOREAN PRINTING

할일이 많은 당신, 큰일을 할 당신들이여.

만주는 누구의 땅 입니까? 혼후하의 바람이 하늘을 가르고 한대성 고목림이 청록의 무늬를 이룬, 무한히 넓은 가능성의 땅 만주는 누구의 땅 입니까? 세계의 심장부, 아시아의 안방, 때고애 대륙의 씩씩한 기상이 잉태되었던 만주는 진정 누구의 땅 입니까 ?

드넓은 벌판을 휘달리며 비로서 세상에 문명의 씨를 뿌리던 최초의 반도의 남단을 벗어나지 못하고 국경과 국경에 갇혀 옹그리고 있던 사람들이 있었으니 그들은 우리들의 할아버지, 우리들 피의 할아버지 였읍니다. 사천년 이상 우리의 보금자리, 민족 문화의 터전이었던

만주, 그 땅의 임자는 다름아닌 바로 우리들인 것 입니다. 반도의 한 귀퉁이에서 비좁게 살아오느라 어느새 상상력 조차도 우리가 드디어 떨치며 날아오를 때가 되었읍니다. 통일이 될 것입니다. 만주로 나아갈 것입니다. 중국의 하북성 일대, 바이칼호에서 캄차카 반도에 이르기 까지 우리가 다시 돌아가는 날, 새로운 세계사는 다시 시작될 것입니다.

이런 것들이 결코 헛된 망상일 수는 없읍니다. 내일은 오늘의 결과이기도 하지만 오늘의 할일을 결정하는 이유이기도 하듯이, 영광된 미래에의 비젼을 강한 믿음처럼 품고 있을때 그러한 미래도 훨씬 빨리 올 수있는 까닭입니다.

(육사신보 팔육년 신년호)

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