INTERNATIONAL ELECTROTECHNICAL COMMISSION

MULTIMEDIA SYSTEMS AND EQUIPMENT – MULTIMEDIA E-PUBLISHING AND E-BOOK TECHNOLOGIES – TEXTURE MAP FOR AUDITORY PRESENTATION OF PRINTED TEXTS

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The text of this standard is based on the following documents:

FDIS	Report on voting
100/XX/FDIS	100/XX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

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INTRODUCTION

Information interchange via printed documents between blind or visually impaired people has been carried out by using Braille. However, in order to be able to read Braille, particular tuition is required. Learning Braille is very difficult for aged as well as visually non-impaired people.

Printed documents with texts and text-encoded texture maps can be interchanged by ordinary circulation or publication mechanisms. They are readable as ordinary printed materials and comprehensible by blind or visually impaired people with the support of decoding and auditory presentation equipment.

Today, interchanging of printed documents has become wide-spread and international. The text-encoding scheme to generate a texture map should therefore be standardized at an international level.

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MULTIMEDIA SYSTEMS AND EQUIPMENT – MULTIMEDIA E-PUBLISHING AND E-BOOK TECHNOLOGIES – TEXTURE MAP FOR AUDITORY PRESENTATION OF PRINTED TEXTS

1 Scope

In order to generate a texture map for auditory presentation of printed text information, this International Standard specifies

- a text encoding scheme to generate a texture map;
- a physical shape and dimension of the texture map for printing;
- additional features for texture map printing;
- texture map decoding and an auditory presentation of decoded texts.

These specifications enable the interchange of documents and publications between visually impaired and non-impaired people.

2 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

2.1
texture map
two dimensional cell patterns which include alignment lines and a data matrix which is generated from text data compression and error correction encoding

2.2
auditory presentation equipment
equipment including an engine to carry out a text-to-speech

3 Texture map

3.1 Names of elements

A shape and names of a texture map are indicated in Figure 1. The shape represents that of M size in Table 1.

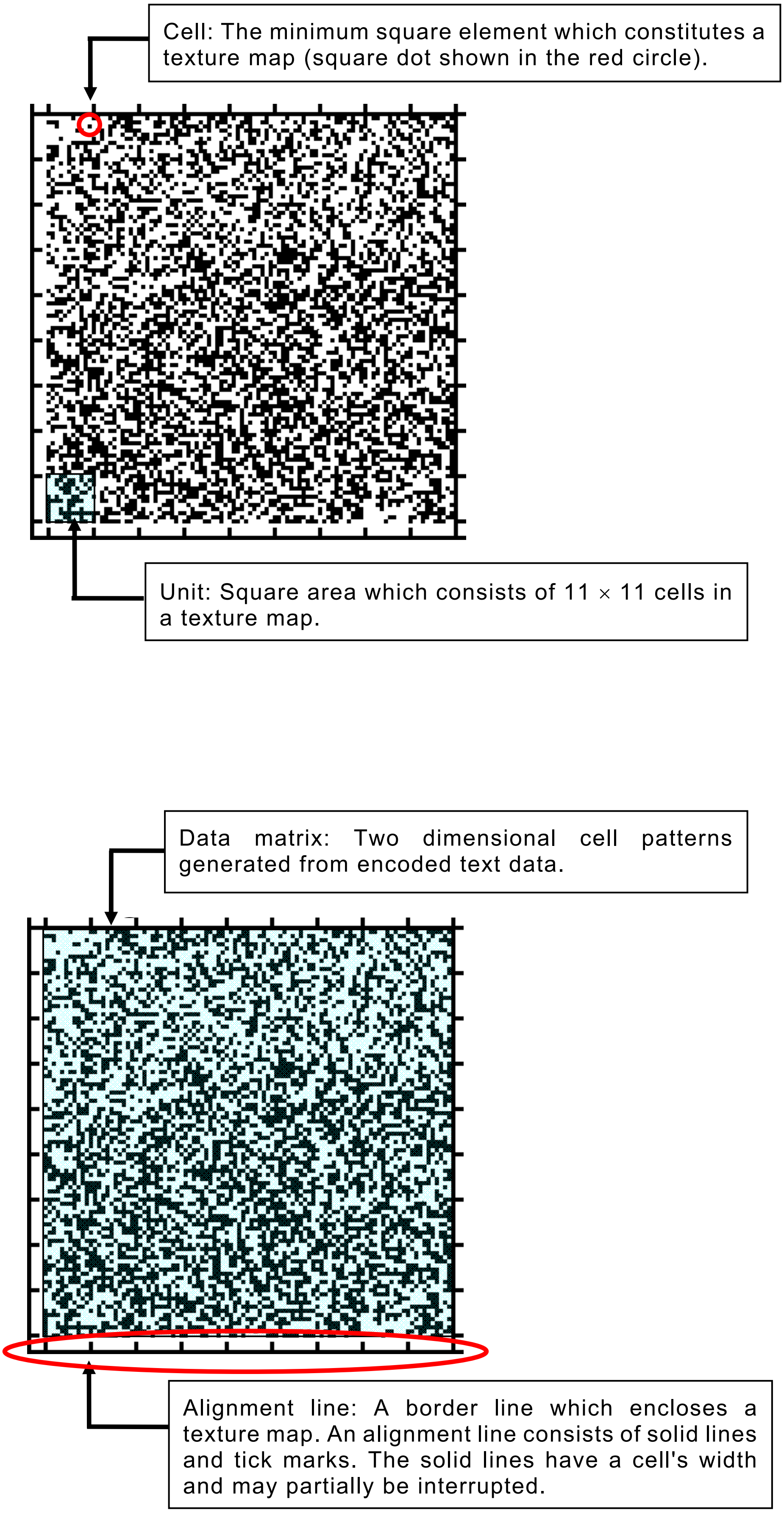


Figure 1 – Shape and elements of a texture map

3.2 Size and data volume

Texture maps have four sizes: XS, S, M and L. The corresponding data volumes are shown in Table 1.

Table 1 – Sizes and data volume of texture maps

Size	Number of cells	Number of units	Dimensions at printing mm	Error correction level	Data volume (Double byte characters)
XS	40 × 40	3 × 3	6,8× 6,8	strong	41
				medium	48
				weak	51
S	73 × 73	6 × 6	12,4×12,4	strong	250
				medium	298
				weak	329
M	106 × 106	9 × 9	17,9×17,9	strong	651
				medium	768
				weak	840
L	117 × 117	10 × 10	19,8×19,8	strong	793
				medium	921
				weak	1 027

NOTE 1 Number of cells: Cells including alignment line.

NOTE 2 Dimensions at printing: Dimensions of a BMP (bitmap) image created by the SpeechioSymbol function at printing with 600 dpi resolution.

NOTE 3 Error correction: One of the 3 levels of error correction: strong, medium and weak, is specified by the SpeechioEncode function at encoding texts to a texture map.

NOTE 4 Data volume: The values in Table 1 depend on a compression of text data.

3.3 Encoding scheme of a texture map from texts

The process of generating a texture map from texts is shown in Figure 2. The SpeechioEncode function encodes input texts to create cell data that are stored in a buffer called bit string. Then, the SpeechioSymbol function processes the buffered cell data to generates image data of a texture map.

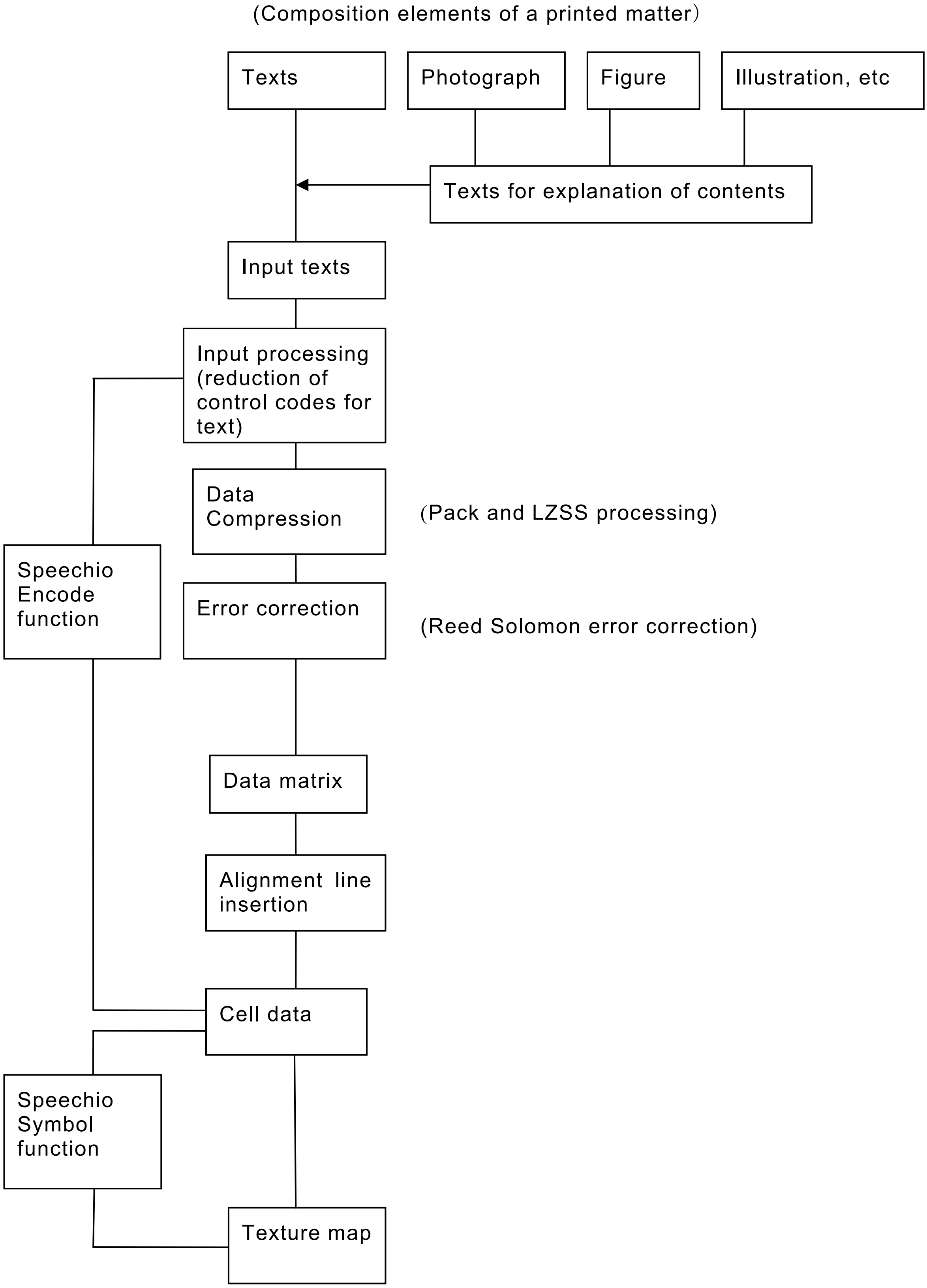


Figure 2 – Process of generating texture map from texts

3.3.1 Processing by SpeechioEncode function

3.3.1.1 Input processing

Input texts represented by Shift JIS code (JIS X 0208) are processed to remove the control codes for text: 0x01 through 0x08, 0x0b, 0x0c, 0x0e through 0x1f and 0x7f (hexa decimal representation). Input text data are delimited by 0x00.

Some control codes for speech are added in the input processing. See Annex A.

3.3.1.2 Data compression

The input processed text data are compressed by pack and LZSS processing

a) Pack processing

2 byte codes of Katakana and other characters are converted to the corresponding 1 byte codes. The sequence of the codes converted from 2 byte Katakana or other characters is identified by the Katakana mode identifier SO(0x0e) or default mode identifier SUB(0x1a)) respectively at the beginning of the sequence. The sequence of 1 byte code of Hankaku characters is identified by the Hankaku mode identifier SI(0x0f) at the beginning of the sequence.

b) LZSS processing.

The LZSS algorithm with slide dictionary of 1024 byte length is employed. Character codes are processed byte by byte and stored in the output buffer from the MSB of the first byte. When the last byte of the output buffer has unused bits, they will be filled with “0”.

The position and length of matched characters are indicated by the preceding 2 bits “10”, and 10 bits unsigned integer of the offset from the beginning of slide dictionary and 3 bits unsigned integer of the actual length minus 2.

3.3.1.3 Error correction

The Reed Solomon error correction using Galois field GF(2048) is employed. An example of the error correction encoding is shown in Annex D.

3.3.1.4 Data matrix

The error corrected data are allocated into units consists of 11 x 11 cells to configure a data matrix.

3.3.1.5 Alignment line insertion

Alignment lines are inserted to the data matrix to create cell data, which show the values of cells (“0” (0x30) for white cell, “1” (0x31) for black cell) from the top left to the bottom right of a texture map. The cell data are stored in a buffer called bit string.

3.3.1.6 SpeechioEncode function

The SpeechioEncode function is shown below:

SpeechioEncode

```
short__stdcall SpeechioEncode(
  char data_type[],
  char cell_type[],
  char recover_level[],
```

```
    char copyright[],
    short data_size,
    unsigned char data_code[],
    char path_name[],
    unsigned char bit_string[]
  );
```

Functionarity

Encoding of input texts

Argument value

```
  data_type
    Type of text data
    =”T” (Japanese text, shift-JIS), ”E” (English text, ascii)
  cell_type
    Size of texture map
    ="s"(XS)/="S"(S)/="m"(M)/="M"(L)
  recover_level
    Strength of error correction
    ="S"(strong)/="N"(medium)/="P"(weak)
```

NOTE "N"(medium)is recommended for ordinary printing quality of a texture map. For poor printing quality, "S"(strong) is required.

```
  data_size
    Byte number of input data
  data_code
    Input data
  bit_string
    Buffer for encoded data
```

NOTE The area for the buffer has to be reserved for the calling side.

Returned value

```
  >0  Normal end : encode data put away to bit_string
  =0  Error : failure of encoding
  <0  Data volume over : =(byte number of over flow) ×-1)
```

3.3.2 Processing by SpeechioSymbol function

3.3.2.1 Generation of bitmap image

The cell data stored in a buffer called bit string are processed to create a texture map where a cell is configured with 4 x 4 pixels.

3.3.2.2 SpeechioSymbol function

The SpeechioSymbol function is shown below:

SpeechioSymbol

```
  short __stdcall SpeechioSymbol(
    short col,
    short row,
    unsigned char symbol_data[]
  );
```

Functionarity

Generating (symbolizing) a texture map from encoded data.

Argument value

```
col
  Number of cells for horizontal symbol
  =40(XS)/=73(S)/=106(M)/=117(L)
Row
  Number of cells for vertical symbol
  =40(XS)/=73(S)/=106(M)/=117(L)
symbol_data
  Designated bit_string generated by SpeechioEncode function
```

Returned value

```
=0  Normal end
<0  Error
```

3.4 Decoding scheme of a texture map to texts

The process of generating texts from a texture map is shown in Figure 3.

(Printed matter with texture map)

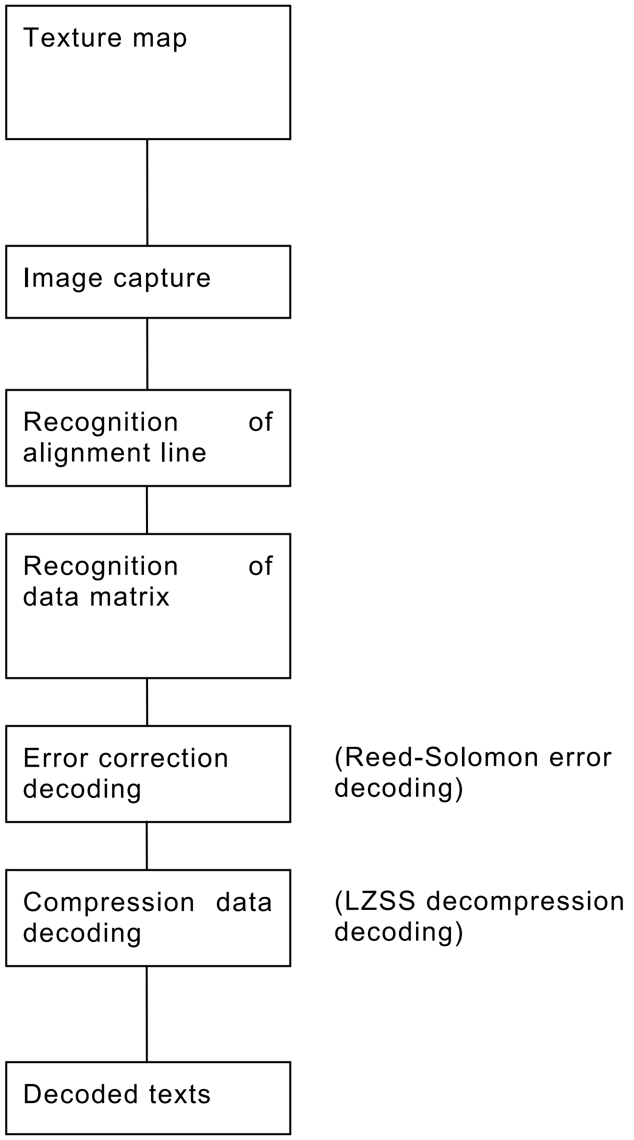


Figure 3 – Process of text-decoding from texture map

3.5 Example of use of the functions

As an example of use of SpeechioEncode and SpeechioSymbol functions, Windows library "Speechio dll" with the API funcions is shown. The Speechio dll (200 KB) can be downloaded at
http://www.y-adagio.com/public/committees/iec_tc100_ags/data/IEC62665/Speechio.dll

```
/**************************************************************

*
* Example of use  of SpeechioEncode and SpeechioSymbol functions
* Link to Speechio.lib file. "Speechio.dll" is allocated to a
* given/transmitted holder (system holder or program holder)
*
**************************************************************/
#include <stdio.h>
#include <string.h>
#include "Speechio.h"/* declaration of function prototype, header of
definitional
SP_MAX_BIT_SIZE */
int main(void){
unsigned char text[] = " example of generated texture map";
/* input text data */
unsigned char bit_str[SP_MAX_BIT_SIZE];/* bit_string buffer */
short rc;/*variables of returned value of function*/

/* encoding process/*
rc = SpeechioEncode( "T", "m", "N", "", (short)strlen(text), text, "",
bit_str);
if(rc <= 0){
if(rc == 0)
printf( "failure of encoding process\n");
else if(rc < 0)
printf( "%hd byte over\n", -rc)
return 1;
}

/* process of generating texture map image /*
rc = SpeechioSymbol(106, 106, bit_str);
if(rc < 0){
printf("failure of image generating process\n");
return 1;
}

 printf("texture map image is transferred to clipboard\n");

return 0;
}
```

Example of the description of header file "Speechio.h" is shown below:

```
/**************************************************************

*  Speechio.h

**************************************************************/

#defineMAX_DATA_SIZE4096/* max length of data_code */

#defineMAX_BIT_SIZE19600/* max length of bit_string */
```

```
short __stdcall SpeechioEncode(
char data_type[],
char cell_type[],
char recover_level[],
char copyright[],
short data_size,
unsigned char data_code[],
char path_name[],
unsigned char bit_string[]
);

short __stdcall SpeechioSymbol(
short col,
short row,
unsigned char symbol_data[]
);

/*
-----------------------------------------------------------------
SpeechioEncode
    Encodes input texts to create cell data.
SpeechioSymbol
    Creates bit image of a texture map and forward it to clipboard.
-----------------------------------------------------------------
*/
```

4 Printing of texture map image

4.1 General

It is necessary to print a texture map at an appropriate position with a correct size on paper, because an auditory presentation equipment read the texture map at a fixed position.

4.2 Size of image

Cells are composed of 4 × 4 pixels of the texture map BMP (bitmap) image. An auditory presentation equipment is designed to read a texture map printed on paper with a 600 dpi resolution. The image size of the texture map printed with a 600 dpi on paper is shown in Table 2.

Table 2 – Size of printed texture map

Size	Number of cell	Size when converted to 600 dpi mm

XS	40 × 40	40 × 4 × 25,4 / 600 = 6,77
S	73 × 73	73 × 4 × 25,4 / 600 = 12,36
M	106 × 106	106 × 4 × 25,4 / 600 = 17,95
L	117 × 117	117 × 4 × 25,4 / 600 = 19,81

In case of a higher image resolution, the size of printing of the texture map image shall be the same as shown in Table 2.

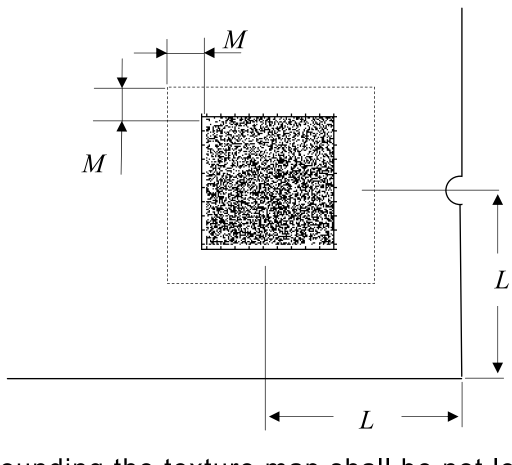
4.3 Position of the texture map and margin on paper

It is necessary to print the texture map at an appropriate position. When using such a camera scanner as shown in Fogure C.5, the position is more flexible.

The texture map is normally positioned at the bottom right. Regardless of the size of the texture map, the centre position shall be 25±0.5 mm from the right edge and bottom edge of the paper. Overlap with another character or another picture should be avoided. To recognize the texture map the white margin surrounding it should be more than 4 mm, as shown in Figure 5.

If there is a reason for not wanting to position the texture map at the bottom right, it is possible to position it at the bottom left or top left or top right. The auditory presentation equipment can recognize a texture map orientation automatically. A right angle rotation of paper is not a problem, but the position of paper is important in order to insert the auditory presentation equipment properly, as shown in Figure 6.

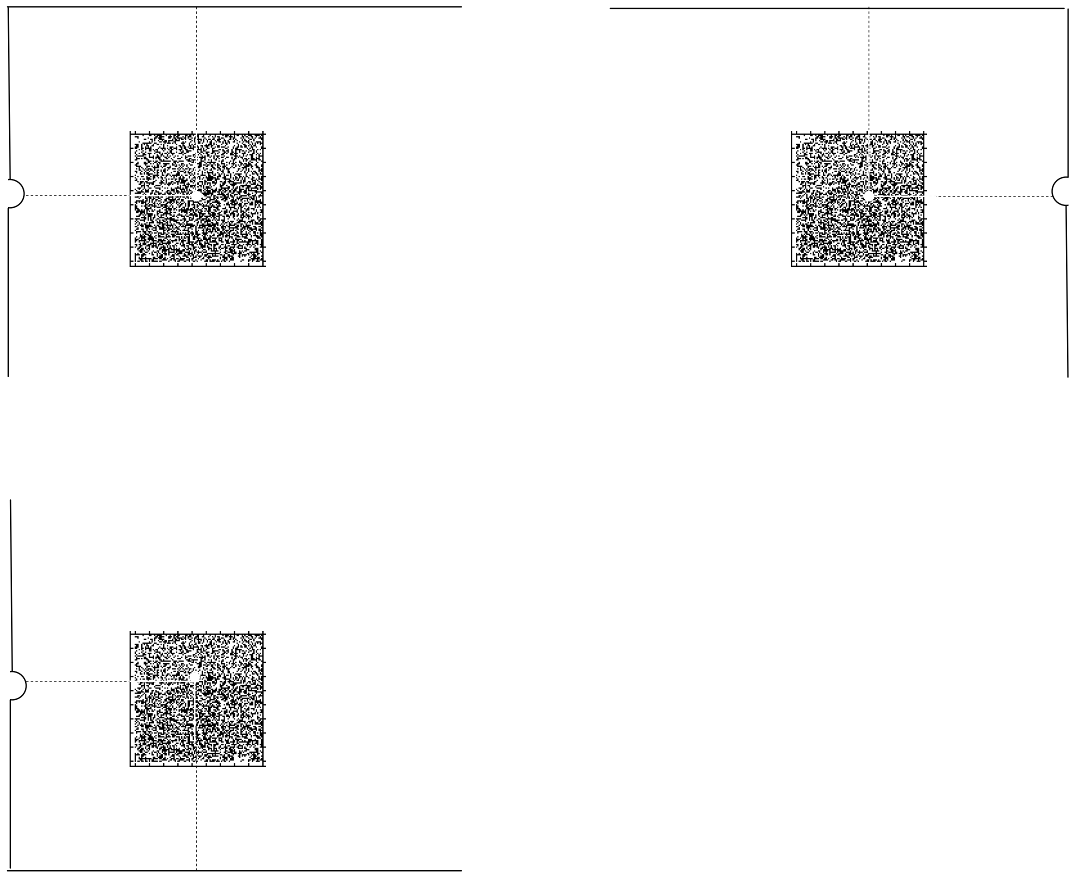
Dimensions in millimetres



The margin surrounding the texture map shall be not less than 4 mm.

The centre position of the texture map shall be arranged at 25±0.5 mm from the edge of the paper.

Figure 4 – Positioning of texture map and margin in paper



The centre position of the texture map shall be arranged at 25±0.5 mm from the edge of the paper.

Right angle rotation of the texture map is automatically detected by the auditory presentation equipment.

Figure 5 – Example of texture map arrangement

Annex A
(informative)

Input processing (Japanese texts)

A.1 General

The auditory presentation equipment synthesizes voice from text data encoded in a texture map. If the text dada contain control codes for text, the text-to-speech cannot correctly be worked. Those control codes for text have to be removed in the input processing.

For the text-to-speech some voice properties (male/female or etc.) can be specified and a particular pronunciation of Kanji can be specified by adding control codes for speech in the input processing.

A.2 Removal of control codes for text

For appropriate text-to-speech working, the control codes for text: 0x01 through 0x08, 0x0b, 0x0c, 0x0e through 0x1f and 0x7f (hexa decimal representation of Shift JIS code, JIS X 0208) have to be removed. In the auditory presentation equipment, tab (0x09) is converted to Toten (end of sentence in Japanese) and line feed (0x0a) is converted to 0x0d0a and to Kuten (pause in sentence in Japanese).

Other special characters that cannot correspond to an appropriate text-to-speech should be removed from input texts.

A.3 Specification of particular pronunciation of Kanji

When input texts include Kanji characters that should be converted to voice with a particular pronunciation by the auditory presentation equipment, the pronunciation of Kanji(s) can be specified by succeeding a colon and the Hankaku Katakana string representing the pronunciation. The sequence of Kanji(s), a colon and the Hankaku Katakana string shall be enclosed in a parenthesis, as shown below:

(Kanji(s):Hankaku Katakana string representing the Kanji(s) pronunciation)

Example
((金田一君:ｶﾈﾀﾞﾊｼﾞﾒｸﾝ))

When input texts include alpha-numeric characters that should be converted to voice with a particular pronunciation by the auditory presentation equipment, the alpha-numeric characters shall be replaced with corresponding Kanji(s) or Zenkaku Katakana(s). Then the pronunciation shall be specified by succeeding a colon and the Hankaku Katakana string representing the pronunciation. The sequence of Kanji(s) or Zenkaku Katakana(s), a colon and the Hankaku Katakana string shall be enclosed in a parenthesis.

A.4 Specification of voice properties

In the auditory presentation equipment, some voice properties can be specified by adding control codes for speech just preceding a sentence of texts. The control code for speech can be specified in each sentence for controlling its voice properties. It is possible, for example, that the first sentence is spoken in a male voice and the second sentence in a female voice.

The control codes for speech are shown in Table A.1

Table A.1 – Control codes for speech

Voice property	Control code	Value	Coding of control characters
Voice quality	^V0	male voice(default)	^V=0x16
	^V1	female voice	
Pitch	^H0	Level 0 (minimum)	^H=0x08
	^H1	Level 1	
	^H2	Level 2	
	^H3	Level 3 (default male voice)	
	^H4	Level 4 (default female voice)	
	^H5	Level 5	
	^H6	Level 6	
	^H7	Level 7 (maximum)	
Loudness	^P0	Level 0 (minimum)	^P=0x10
	^P1	Level 1	
	^P2	Level 2	
	^P3	Level 3	
	^P4	Level 4 (default)	
	^P5	Level 5	
	^P6	Level 6	
	^P7	Level 7 (maximum)	
NOTE: Control code consists of control characters and a succeeding numerical.			

To the sentence without control codes in its beginning, control codes of the preceding sentence apply. Examples of the control codes for speech are shown below:
^V0^H3^P4 (male voice, pitch level 3, loudness level 4)
^V1^H4 (female voice, pitch level 4)
^V0^H3 (male voice, pitch level 3)

If no control code is specified, the default values of voice properties in Table A.1 apply. It is the case equivalent to the specification of voice properties with control codes ^V0^H3^P4 (male voice, pitch level 3, loudness level 4).

The auditory presentation equipment identifies the end of a sentence by the characters or character strings shown in Table A.2 and separates each sentence from input texts.

Table A.2 – Characters (character strings) for identifying the end of a sentence

。)	。)	?)	?)	!)	!)	。
。]	。]	?]	?]	!]	!]	。
。]	。]	?]	?]	!]	!]	?
。}	。}	?}	?}	!}	!}	?

。〉	。〉	？〉	?〉	！〉	!〉	!
。》	。》	？》	?》	！》	!》	!
。」	。」	？」	?」	！」	!」	CR+LF
。』	。』	？』	?』	！』	!』	
。】	。】	？】	?】	！】	!】	
。）	。)	？）	?)	！）	!)	
。］	。]	？］	?]	！］	!]	
。｝	。}	？｝	?}	！｝	!}	
。｣	。｣	？｣	?｣	！｣	!｣	
。”	。”	？”	?"	！”	!"	
。’	。'	？’	?'	！’	!'	

Annex B
(informative)

Input processing (English texts)

Identifying a page boundary, input texts in a page are encoded to a texture map. If a sentence contain a page boundary, it is dealt with in the next page.

The end of sentence is identified by the character strings shown in Table B.1. In case of a duplication of the character strings, the last character string specifies the end of sentence. However, an abbreviation or acronym with "." (see Table B.2) do not identify the end of sentence. After the end of sentence, NULL (0x00) is inserted as a delimiter.

Table B.1 – Characters (character strings) for identifying the end of a sentence

"." + SP（0x2e + 0x20）	":" + SP（0x3a + 0x20）
"!" + SP（0x21 + 0x20）	";" + SP（0x3b + 0x20）
"?" + SP（0x3f + 0x20）	CR + LF（0x0d + 0x0a）

Table B.2 – Abbreviation or acronym with "."

Mr.	Ans.	Dec.
Mrs.	Jan.	Mt.
Ms.	Feb.	LTD.
Dr.	Mar.	Ltd.
Jr.	Apr.	INC.
A.D.	May.	Inc.
B.C.	Jun.	Co.
a.m.	Jul.	vs.
p.m.	Aug.	VS.
U.S.	Sep.	St.
U.S.A.	Oct.	Vol.
N.Y.	Nov.	Aus.

In tables, descriptions in a cell are dealt with as a sentence.

Annex C
(informative)

Notch, auditory presentation equipment, and etc.

C.1 Notch to designate a texture map position

It is recommended to make a notch in an edge of paper to designate a texture map position for blind people as shown in Figure C.1. The notch is cut out by using ordinary punching tools for paper binding.

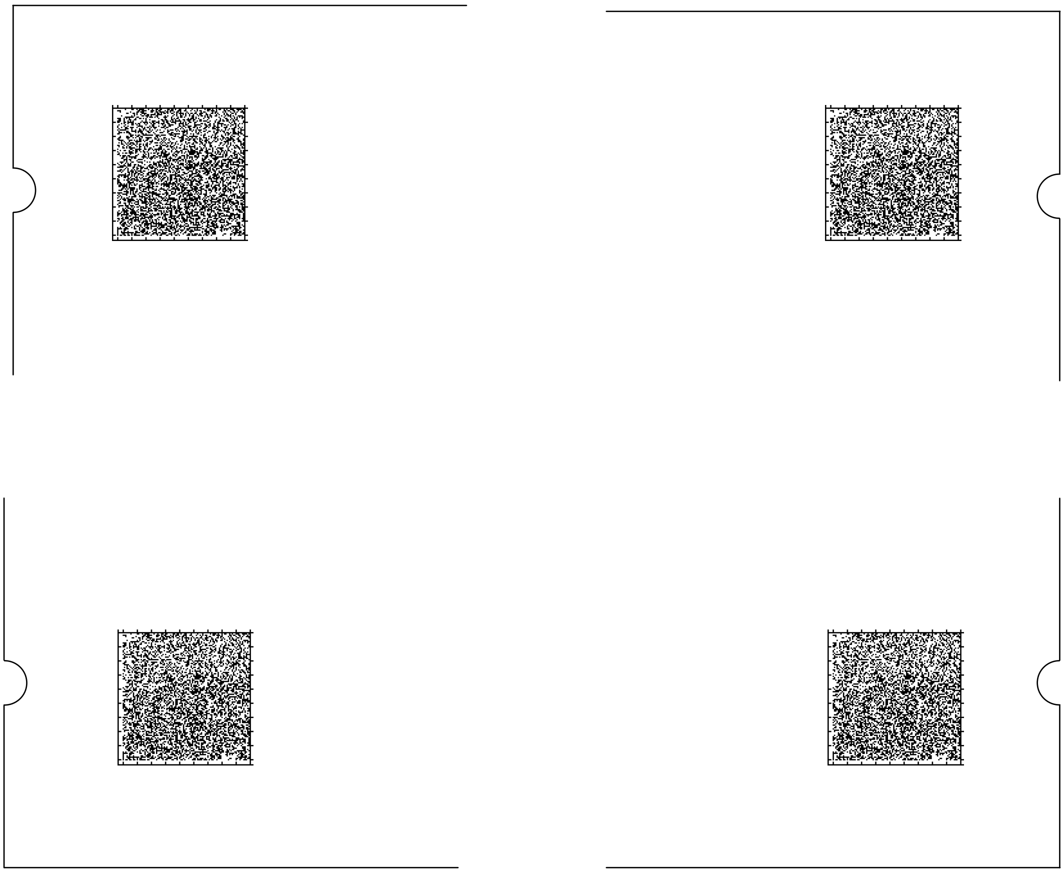


Figure C. 1 – Notch to designate a texture map position

C.2 Printing paper

An appropriate paper for printing a texture map is specified in IEC 62875 to maintain a printing quality.

C.3 Printing and printer

A texture map shall be printed with a resolution of 600 dpi or more.

The printing quality can be satisfied by an ordinary offset printers or electrographic laser printers. Some inkjet printers may have a possibility to produce such a poor image of texture map as cannot be decoded correctly, due to a blot of ink. It can be expected, however, that an inkjet printer with a higher resolution will soon be developed.

C.4 Copy

A copied texture map cannot sometimes be decoded correctly due to a degradation of image quality. It can be expected, however, that a copier with a higher resolution will soon be developed.

C.5 Extension to a texture map

In Figure 1, a texture map has solid alignment lines on four sides. Regarding alignment lines, the following extensions can be introduced.

a) A texture map has broken alignment lines on two sides as shown in Figure C.2.

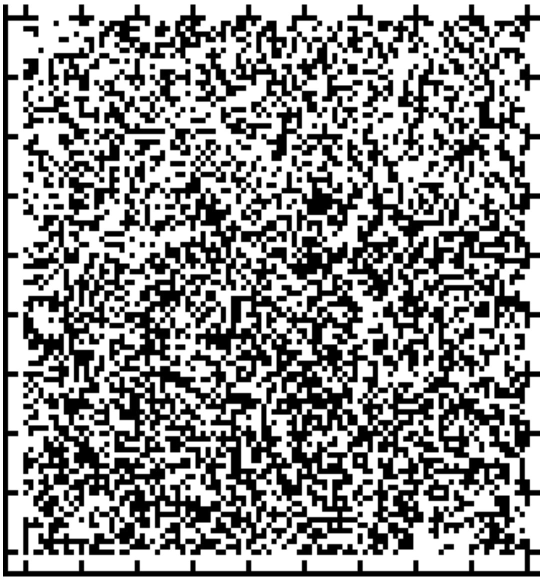


Figure C. 2 – A texture map with broken alignment lines on two sides

b) A texture map has a broken line on four sides as shown in Figure C.3**.**

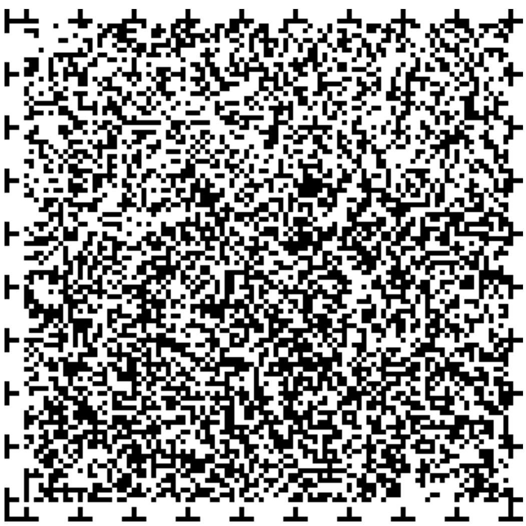


Figure C. 3 – A texture map with broken alignment lines on four sides

C.6 Examples of auditory presentation equipment

An example of auditory presentation equipment is shown in Figure C.4.A paper with a printed texture map is inserted into the gap of the equipment and the texture map is captured by a CCD camera in the equipment. The data is converted into a voice using the text-to-speech functionality within the equipment.

Figure C.4a – Front view

Figure C.4b – Rear view

Figure C. 4 – An example of auditory presentation equipment: Speechio (TM)

Another example of auditory presentation equipment is shown in Figure C.5, where a camera scanner captures a printed texture map on paper and installed software in a personal computer (PC) decodes the texture map and carries out text-to-speech.

Figure C.5a – Camera scanner

Figure C.5b – PC and camera scanner

Figure C. 5 – Another example of auditory presentation equipment: Speechio Plus (TM)

Annex D
(informative)

Example of Reed Solomon error correction encoding using Galois field GF(2048)

D.1 Example of Reed Solomon error correction encoding

As an example, a program of Reed Solomon error correction encoding using Galois field GF(2048) in the library "Speechio dll" is shown:

```
/****************************************************************************/
#include <stdio.h>

#defineTRUE1
#defineFALSE0
//#defineGF256
#defineGF2048
typedef unsigned shortushort;

/*----------------------------------------------------------------------------
*Public Function
*---------------------------------------------------------------------------*/
void InitLogTables(int power);
int GFmul(int p1, int p2);
int GFdiv(int p1, int p2);
void CalcChecks(ushort poly[],ushort sym[],int dsize,int csize);
int CorrectErrs(ushort sym[],int dsize,int csize);

/*----------------------------------------------------------------------------
*Internal Function
*---------------------------------------------------------------------------*/
static void CalcSyndromes(ushort sym[], int size, int rssize, int isize, int v);
static int NormlzToeplitz(int size);
static void SolveToeplitz(int size);
static int ChienSearch(int size);
static void ErrLocInit(int size);

/*----------------------------------------------------------------------------
*Internal value
*---------------------------------------------------------------------------*/

#ifdef_DYNAMIC_INITIALIZE
static ushort gfpwr[GF];
static ushort gflog[GF];
#else
#include "GFTable.c"
#endif
static int gf_power;
static int gf_dim;
static int gf_1;
static int gf_2;
static const int power2[]={1,2,4,8,16,32,64,128,256,512,1024,2048};

//unsigned char sym[255*8];
/*********************************以降省略*****************************************/
```

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