

S P E C I F I C A T I O N

TITLE OF INVENTION: Character Recognition System, Character Recognition Program, and Character Recognition Method

TECHNICAL FIELD

[0001] The present invention relates to a character recognition system.

BACKGROUND ART

[0002] Optical character recognition systems for optical capture and recognition of characters printed on paper have been provided conventionally; for example, there are such disclosures at Patent Reference Nos. 1 and 2, below.

[0003] On the other hand, there is demand for recognition by way of image data such as might take place through screen capture of characters displayed on a display of a computer for transfer of data between or among systems and/or applications, as is disclosed at Patent Reference No. 3, below.

PRIOR ART REFERENCES

PATENT REFERENCES

[0004] Patent Reference No. 1: Japanese Patent Application Publication Kokai No. 2008-305126

Patent Reference No. 2: Japanese Patent Application Publication Kokai No. 2010-26805

Patent Reference No. 3: Japanese Patent Application Publication Kokai No. 2011-81537

SUMMARY OF INVENTION

PROBLEM TO BE SOLVED BY INVENTION

[0005] However, because dot resolution of characters displayed on a display is coarser than that of characters printed on paper, where conventional optical character recognition techniques have been employed this has sometimes caused a sharp decline in recognition rate. Particularly where small characters have been

employed to increase the amount of data displayed, character recognition rate has been extremely low.

[0006] The present invention was conceived in light of such problems, it being an object thereof to provide a character recognition system permitting characters displayed on a display of a computer to be recognized with a high success rate.

MEANS FOR SOLVING PROBLEM

[0007] To solve the foregoing problems, in the context of a character recognition system for recognition of a character displayed on a display of a computer, a character recognition system associated with the present invention is characterized in that it comprises a storage device that stores, for a prescribed display font and character size combination, a recognition dictionary having information pertaining to arrangement of constituent dots making up each character of a corresponding display font and character size; a font check unit that carries out screen capture to obtain, from a video memory, image data pertaining to a recognition target character displayed at the display, and that obtains the display font and the character size of the recognition target character based on whether there is a perfect match with information pertaining to arrangement of constituent dots making up a corresponding recognition target character; and a character recognition unit that carries out screen capture to obtain, from the video memory, image data pertaining to the recognition target character displayed at the display and that cross-references the recognition dictionary and uses a recognition dictionary pertaining to a display font and character size combination identical to the display font and character size of the recognition target character obtained by the font check unit to identify the recognition target character based on whether there is a perfect match with information pertaining to arrangement of constituent dots making up a corresponding recognition target character.

[0008] Furthermore, in the context of a character recognition program for causing a character displayed on a display to be recognized by a computer, a character recognition program associated with the present invention is characterized in that it causes the computer to execute a recognition dictionary creation step in which, for a prescribed display font and character size combination, a recognition dictionary is created which has information pertaining to arrangement of constituent dots making up each character of a corresponding display font and character size; a font check step in which screen capture is carried out to obtain, from a video memory, image data pertaining to a recognition target character displayed at the display, and in which the display font and the character size of the recognition target character are obtained based on whether there is a perfect match with information pertaining to arrangement of constituent dots making up a corresponding recognition target character; and a character recognition step in which screen capture is carried out to obtain, from the video memory, image data pertaining to the recognition target character displayed at the display and in which the recognition dictionary is cross-referenced and a recognition dictionary is used which pertains to a display font and character size combination identical to the display font and character size of the recognition target character obtained at the font check step to identify the recognition target character based on whether there is a perfect match with information

pertaining to arrangement of constituent dots making up a corresponding recognition target character.

[0009] Furthermore, in the context of a character recognition method for recognizing a character displayed on a display of a computer, a character recognition method associated with the present invention is characterized in that it comprises a recognition dictionary creation operation in which, for a prescribed display font and character size combination, a recognition dictionary is created which has information pertaining to arrangement of constituent dots making up each character of a corresponding display font and character size; a font check operation in which screen capture is carried out to obtain, from a video memory, image data pertaining to a recognition target character displayed at the display, and in which the display font and the character size of the recognition target character are obtained based on whether there is a perfect match with information pertaining to arrangement of constituent dots making up a corresponding recognition target character; and a character recognition operation in which screen capture is carried out to obtain, from the video memory, image data pertaining to the recognition target character displayed at the display and in which the recognition dictionary is cross-referenced and a recognition dictionary is used which pertains to a display font and character size combination identical to the display font and character size of the recognition target character obtained at the font check operation to identify the recognition target character based on whether there is a perfect match with information pertaining to arrangement of constituent dots making up a corresponding recognition target character.

BENEFIT OF THE INVENTION

[0010] The present invention makes it possible to carry out highly accurate character recognition even for characters of low resolution which are displayed at a display of a computer.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] [FIG. 1] FIG. 1 is a schematic diagram showing in simplified fashion the constitution of a character recognition system associated with an embodiment of the present invention.

[FIG. 2] FIG. 2 is a drawing showing the content of a recognition dictionary associated with an embodiment of the present invention.

[FIG. 3] FIG. 3 is a block diagram showing in simplified fashion the functionalities at a character recognition system associated with an embodiment of the present invention.

[FIG. 4] FIG. 4 is a flowchart showing flow of recognition dictionary creation processing associated with an embodiment of the present invention.

[FIG. 5] FIG. 5 is a flowchart showing flow of character recognition processing associated with an embodiment of the present invention.

[FIG. 6] FIG. 6 is a drawing for describing character recognition processing associated with an embodiment of the present invention.

EMBODIMENTS FOR CARRYING OUT THE INVENTION

[0012] Below, character recognition systems which are embodiments of the present invention are described in detail with reference to the drawings. FIG. 1 is a schematic diagram showing in simplified fashion the constitution of a character recognition system associated with the present embodiment. FIG. 2 is a drawing showing the content of a recognition dictionary associated with the present embodiment. FIG. 3 is a block diagram showing in simplified fashion the functionalities at a character recognition system associated with the present embodiment.

[0013] As shown in FIG. 1, character recognition system 1 is provided with computer body 10, display 30 which is a display device that displays information output from computer body 10, and input device 32 comprising a keyboard, mouse, and/or the like for causing information to be input to computer body 10.

[0014] Character recognition system 1 associated with the present embodiment is characterized in that it is a system for recognition of character(s) displayed at display 30, and that when performing character recognition it carries out not optical recognition of character(s) but identification of character(s) based on whether information pertaining to arrangement of constituent dot(s) making up character(s) is a perfect match. Description of the present embodiment will be carried out in terms of an example in which recognition is carried out with respect

to characters displayed at a prescribed recognition target region within a window displayed at display 30 by an application A.

[0015] Computer body 10 is equipped with central processing unit(s) (CPU) or other such arithmetic unit(s) 11 for carrying out various types of operations, as well as hard disc drive(s) (HDD) for storing various types of information, and/or random access memory or memories (RAM) capable of being used as a work area during arithmetic processing, or other such storage device(s) 12.

[0016] Storage device 12 is provided with program storage unit(s) 121 for storing OS(es) (operating system(s)), character recognition program(s), recognition dictionary creation program(s), font check program(s), application A, and various other programs installed at computer body 10; recognition dictionary DB(s) 122 for storing recognition dictionary or dictionaries used when performing character recognition; font check dictionary DB(s) 123 for carrying out font checking; and video memory or memories 125 for temporarily storing content of screen(s) displayed at display(s) 30.

[0017] With respect to program storage unit 121, character recognition programs are programs for carrying out execution of processing for character recognition, described below; recognition dictionary creation programs are programs for carrying out execution of processing for creation of recognition dictionaries, described below. Furthermore, font check programs are programs for obtaining information pertaining to display font(s) and character size(s) of recognition target character(s) during recognition dictionary creation or character recognition.

[0018] Recognition dictionary DB 122 stores recognition dictionaries, a separate recognition dictionary being created for each display font and character size combination. Content of recognition dictionary records pertaining to recognition dictionaries will be described with reference to FIG. 2. Each record within recognition dictionary DB 122 comprises the following items: “dictionary ID”,

“display font”, “character size”, “character code”, “dot arrangement within border”, “border size”, and “border position”.

[0019] “Dictionary IDs” are identifiers for the respective recognition dictionaries, the identifier being identical when the display font and character size combination is the same, and the identifier being different when at least one of the display font and the character size is different. “Display font”, “character size”, and “character code” are the display font, character size, and character code of the character based on which the record in question was created.

[0020] “Dot arrangement within border” is information pertaining to position(s) for arrangement of dots within the smallest rectangular border containing all constituent dots making up the character for which the dictionary in question was created. For example, if locations where black dots are arranged are indicated by “1”, and location of blank spaces where black dots are not arranged are indicated by “0”, this might be such that each row as one proceeds from the upper left to the lower right within the rectangular border is stored in the format “00110101110000”.

[0021] “Border size” is information pertaining to the vertical and horizontal sizes (numbers of dots) of the aforementioned smallest rectangular border. “Border position” is the distance from the baseline (bottommost line which serves as reference) to the bottom of the aforementioned smallest rectangular border. In accordance with the present embodiment, the items “dot arrangement within border”, “border size”, and “border position” correspond to information pertaining to arrangement of constituent dots making up a character.

[0022] Font check dictionaries stored within font check dictionary DB 123 are dictionaries for obtaining information pertaining to display font(s) and character size(s) of recognition target character(s) during recognition dictionary creation or character recognition. The same information that the foregoing recognition

dictionaries have for all sizes of all fonts installed on computer body 10, font check dictionaries have as well, except that font check dictionaries only have information for a small number of prescribed check characters; e.g., a i u e o, or the like.

[0023] Next, functionalities of character recognition system 1 will be described with reference to FIG. 3. As shown in same drawing, character recognition system 1 is provided with font check unit 20 having functionality for recognizing display font and character size of characters displayed at display 30; dictionary creation unit 21 having functionality for creating the aforementioned recognition dictionaries in advance; and character recognition unit 25 having functionality for carrying out character recognition.

[0024] The functionalities of these respective units are implemented as a result of execution by arithmetic unit(s) 11 of font check program(s), recognition dictionary creation program(s), and character recognition program(s) within program storage unit(s) 121.

[0025] Next, flow of processing for creation of recognition dictionaries stored at recognition dictionary DB 122 will moreover be described with reference to FIG. 4. FIG. 4 is a flowchart showing flow of recognition dictionary creation processing associated with the present embodiment.

[0026] Recognition dictionary creation is carried out prior to character recognition processing, described below, recognition dictionary or dictionaries being created by dictionary creation unit 21 for the display font and character size combination(s) at recognition target character(s) on which recognition is about to be carried out. Of course, if a recognition dictionary has already been created for the same display font and character size combination, there is no need to create the dictionary again, it being sufficient to use the recognition dictionary that has already been stored.

[0027] During recognition dictionary creation, recognition dictionary creation program(s) are executed at computer body 10. First, at S11, display font and character size of the recognition dictionary being created are obtained. The obtaining of this character size and so forth is carried out by launching font check program(s).

[0028] Because the recognition dictionary or dictionaries created here are recognition dictionary or dictionaries for display font and character size combination(s) at recognition target character(s) displayed within prescribed recognition target region(s) within window(s) displayed by application A, font check program(s) can automatically identify display font(s) and character size(s) of such recognition target character(s) by cross-referencing font check dictionary or dictionaries stored at font check dictionary DB 123.

[0029] More specifically, font check unit 20 obtains image data pertaining to recognition target character(s) from video memory 125 by means of screen capture, and cross-references font check dictionary DB 123 to extract therefrom character(s) for which information pertaining to arrangement of constituent dot(s) making up recognition target character(s) is a perfect match. This makes it possible for character(s) having the same font(s) and the same size(s) as the recognition target character(s) to be identified, and allows information pertaining to display font(s) and character size(s) of character(s) displayed at the recognition target region to be obtained.

[0030] Note that since this processing for cross-referencing of font check dictionary DB 123 to extract characters is identical to processing for character recognition, described below, detailed description thereof is omitted. Furthermore, because font check dictionaries are dictionaries for only a small number of check characters, it is necessary that characters be input by an operator in advance or that some other operation be carried out such as will make it possible for such

check character(s) to be displayed as recognition target character(s) within recognition target region(s) during font checking.

[0031] Unlike conventional optical character recognition, identification of a character is carried out in the present embodiment based on whether information pertaining to position(s) for arrangement of constituent dots making up the character is a perfect match, the character being identified as a different character if display font and/or character size is different. For this reason, it is necessary that the recognition dictionaries also be such that a separate recognition dictionary is created for each display font and character size combination. Note that where physically possible, it is also permissible that the font check at S11 be carried out manually through configuration procedures performed by a human operator.

[0032] Next, processing proceeds to S12, where characters of the display font and character size obtained at S11 are sequentially displayed at display 30 (video memory 125). The characters displayed here are all characters installed at computer body 10 which are of the display font and character size in question. More specifically, while details will vary depending on the display font, this might for example be all characters included in the JIS non-kanji set, JIS level-1 kanji set, and JIS level-2 kanji set.

[0033] At S13, when the first character is displayed, setting of the border is carried out. This border is the smallest rectangular border which contains all constituent dots making up the displayed character. Next, at S14, the recognition dictionary record is stored at recognition dictionary DB 122 together with information pertaining to arrangement of dots within the border. More specifically, the content of the recognition dictionary record is the information described above; i.e., “dictionary ID”, “display font”, “character size”, “character code”, “dot arrangement within border”, “border size”, and “border position”.

[0034] Next, at S15, determination is made as to whether dictionary storage has been completed for all characters of the display font and character size combination in question, and if there is/are still character(s) for which storage has not yet been carried out, then processing returns to S12, and the processing at S12 through S14 is repeated, to carry out dictionary storage of the next character. At S15, if it is determined that dictionary storage has been carried out for all characters, then recognition dictionary storage for the display font and character size combination in question is complete.

[0035] There is no need for such recognition dictionary creation to be carried out in advance for all character sizes of all display fonts possessed by the OS at computer body 10, it being sufficient to carry out recognition dictionary creation for all characters of the display font and character size combination(s) possessed by the character(s) displayed within the recognition target region(s) at the time that character recognition is carried out.

[0036] Next, flow of character recognition processing associated with the present embodiment will be described with reference to FIG. 5 and FIG 6. FIG. 5 is a flowchart showing flow of character recognition processing associated with the present embodiment. FIG. 6 is a drawing for describing character recognition processing associated with the present embodiment.

[0037] First, at S21, display font(s) and character size(s) of recognition target character(s) are obtained. The obtaining of such character size(s) and so forth is carried out by launching font check program(s), processing being identical to that described above with reference to S11. Furthermore, where character recognition processing is carried out without interruption following recognition dictionary creation, because display font and character size will already have been obtained at S11, S21 may be omitted.

- [0038] As a result of obtaining this display font and this character size, it is possible to determine which recognition dictionary among the recognition dictionaries stored at recognition dictionary DB 122 should be used for the character recognition which is about to be carried out.
- [0039] Next, at S22, setting of border(s) for recognition target character(s) is carried out. More specifically, image data pertaining to the recognition target region of application A is obtained from video memory 125, and after division to permit separate processing for each character displayed within the region in question, for each character the smallest rectangular border which contains all of the constituent dots making up that character is set. FIG. 6 shows how the smallest rectangular border for each character has been set.
- [0040] At S23, filtering of characters based on information pertaining to “border size” (primary screening) is carried out. That is, of the characters within the recognition dictionary, character(s) for which the border size is the same as that set for the recognition target character are extracted therefrom.
- [0041] Next, at S24, determination is made as to whether a single character was identified based on the screening that was performed at S23. If the result of primary screening was a single character, then because the recognition target character can be identified as that character, character recognition processing is complete.
- [0042] If it is determined that it was not identified at S24, then processing proceeds to S25, where filtering of characters based on information pertaining to “dot arrangement within border” (secondary screening) is carried out. That is, of the characters that were extracted as a result of primary screening, character(s) for which the dot arrangement position(s) within the border is the same as the arrangement position(s) set for the recognition target character are extracted therefrom.

[0043] Next, at S26, determination is made as to whether a single character was identified based on the screening that was performed at S25, character recognition being complete if it was so determined, and processing proceeding to S27 where tertiary screening is carried out if it is not so determined. For example, if the recognition target character is the character “ ’ ” or the character “ , ”, because these have the same “border size” and the same “dot arrangement within border”, processing would proceed to S27. At S27, screening of characters is carried out based on information pertaining to “border position”, and the character is identified.

[0044] In the event that there are a plurality of characters within the recognition target region, the processing at S23 through S27 may be repeated for each character. Furthermore, during the font check at S21, in the event that there are a plurality of display font and character size combinations within the recognition target region, a plurality of recognition dictionaries may be cross-referenced to carry out character recognition.

[0045] Furthermore, the order in which the aforementioned screening is carried out may be changed as appropriate. Furthermore, whereas at the foregoing embodiment the smallest rectangular border was set before using “border size”, “border position”, and “dot arrangement within border” to carry out character recognition, any of various other types of information may be used as “information pertaining to arrangement of dot(s) constituting character(s)” for the purpose of carrying out character recognition, it being possible, for example, to use the number of black dots at the first line within the border, or the like, therefor.

[0046] Above, a character recognition system associated with the present embodiment has been described, the present embodiment making it possible to carry out character recognition with a recognition rate of approximately 100% as a result of

carrying out recognition of character(s) displayed at display 30 based on information pertaining to arrangement of dot(s) constituting character(s).

[0047] The recognition character target(s) associated with the present embodiment being character(s) displayed at display 30 (video memory 125) of computer body 10, because there are no dirty locations or locations of voids as would be the case with characters printed on paper, it is possible to definitively identify character(s) based on information pertaining to dot arrangement.

[0048] But because dot arrangement will be different if the display font and/or character size of a character is different, when carrying out character recognition in accordance with the present embodiment it is necessary that display font(s) and character size(s) of recognition target character(s) first be ascertained in advance, and that creation of recognition dictionary or dictionaries and execution of character recognition processing be carried out thereafter for the identical display font and character size combination(s).

[0049] Furthermore, by employing a plurality of types of information pertaining to arrangement of dot(s) constituting character(s) and carrying out screening in stages as in the present embodiment, it will be possible to achieve reduction in processing load associated with character recognition and to carry out character recognition quickly and with high efficiency.

[0050] Next, variations on the present embodiment will be described. First, where character(s) displayed at display 30 are character(s) which have been subjected to antialiasing processing, if prior to carrying out processing for the aforementioned font checking, recognition dictionary creation, character recognition, and the like, dot(s) of other than specified saturation and/or other than specified brightness are subtracted using the same threshold from character image data, it will be possible to carry out character recognition in such fashion as to be unaffected by antialiasing processing.

[0051] Furthermore, where character(s) displayed at display 30 are character(s) which have been subjected to underlining, bolding or other such character decoration, if, during recognition dictionary and font check dictionary creation, creation thereof is carried out such that recognition dictionary record(s) for character(s) subjected to the same character decoration are added thereto, it will also be possible to definitively carry out character recognition with respect to decorated characters.

[0052] Furthermore, even where half-width character(s) are included thereat, by creating recognition dictionary or dictionaries for half-width character(s), it will be possible to definitively carry out character recognition thereof.

[0053] While embodiments of the present invention have been described above, modes of carrying out the present invention are not limited to the foregoing embodiments, a great many further variations being possible without departing from the gist of the present invention. For example, whereas a single computer was used to implement a character recognition system in the foregoing embodiment, this may be implemented such that there is distributed processing by a plurality of computers.

EXPLANATION OF REFERENCE NUMERALS

[0054]	1	Character recognition system
	10	Computer body
	11	Arithmetic unit
	12	Storage device
	121	Program storage unit
	122	Recognition dictionary DB
	123	Font check dictionary DB
	125	Video memory
	20	Font check unit
	21	Dictionary creation unit

25	Character recognition unit
30	Display
32	Input device

CLAIMS

[CLAIM 1]

In the context of a character recognition system for recognition of a character displayed on a display of a computer, a character recognition system characterized in that it comprises:

a storage device that stores, for a prescribed display font and character size combination, a recognition dictionary having information pertaining to arrangement of constituent dots making up each character of a corresponding display font and character size;

a font check unit that carries out screen capture to obtain, from a video memory, image data pertaining to a recognition target character displayed at the display, and that obtains the display font and the character size of the recognition target character based on whether there is a perfect match with information pertaining to arrangement of constituent dots making up a corresponding recognition target character; and

a character recognition unit that carries out screen capture to obtain, from the video memory, image data pertaining to the recognition target character displayed at the display and that cross-references the recognition dictionary and uses a recognition dictionary pertaining to a display font and character size combination identical to the display font and character size of the recognition target character obtained by the font check unit to identify the recognition target character based on whether there is a perfect match with information pertaining to arrangement of constituent dots making up a corresponding recognition target character.

[CLAIM 2]

A character recognition system according to claim 1 characterized in that it comprises a dictionary creation unit that creates the recognition dictionary by obtaining information pertaining to arrangement of constituent dots making up each character as characters, each of which is of

a display font and character size identical to the display font and character size of the recognition target character obtained by the font check unit, are sequentially caused to be displayed at the video memory.

[CLAIM 3]

A character recognition system according to claim 1 or 2 characterized in that the storage device stores a font check dictionary having information pertaining to arrangement of constituent dots for all sizes of all fonts installed on the computer body but only for check characters; and

the font check unit cross-references the font check dictionary to obtain the display font and the character size of the recognition target character.

[CLAIM 4]

In the context of a character recognition program for causing a character displayed on a display to be recognized by a computer, a character recognition program characterized in that it causes the computer to execute:

a recognition dictionary creation step in which, for a prescribed display font and character size combination, a recognition dictionary is created which has information pertaining to arrangement of constituent dots making up each character of a corresponding display font and character size;

a font check step in which screen capture is carried out to obtain, from a video memory, image data pertaining to a recognition target character displayed at the display, and in which the display font and the character size of the recognition target character are obtained based on whether there is a perfect match with information pertaining to arrangement of constituent dots making up a corresponding recognition target character; and

a character recognition step in which screen capture is carried out to obtain, from the video memory, image data pertaining to the recognition target character displayed at the display and in which the recognition dictionary is

cross-referenced and a recognition dictionary is used which pertains to a display font and character size combination identical to the display font and character size of the recognition target character obtained at the font check step to identify the recognition target character based on whether there is a perfect match with information pertaining to arrangement of constituent dots making up a corresponding recognition target character.

[CLAIM 5]

In the context of a character recognition method for recognizing a character displayed on a display of a computer, a character recognition method characterized in that it comprises:

a recognition dictionary creation operation in which, for a prescribed display font and character size combination, a recognition dictionary is created which has information pertaining to arrangement of constituent dots making up each character of a corresponding display font and character size;

a font check operation in which screen capture is carried out to obtain, from a video memory, image data pertaining to a recognition target character displayed at the display, and in which the display font and the character size of the recognition target character are obtained based on whether there is a perfect match with information pertaining to arrangement of constituent dots making up a corresponding recognition target character; and

a character recognition operation in which screen capture is carried out to obtain, from the video memory, image data pertaining to the recognition target character displayed at the display and in which the recognition dictionary is cross-referenced and a recognition dictionary is used which pertains to a display font and character size combination identical to the display font and character size of the recognition target character obtained at the font check operation to identify the recognition target character based on whether there is a perfect match with information pertaining to arrangement of constituent dots making up a corresponding recognition target character.