CLAIMS

1. A character recognition apparatus comprising:

character height direction range detecting means for detecting a character height direction range as a range in a character height direction perpendicular to a character width direction in a character string from an object image which is a gray-scale image and in which the character string is picked up that contains a plurality of characters arranged in a character width direction;

character width direction range detecting means for detecting a character width direction range as a range in the character width direction in which characters of the character string are arranged, from the object image;

character center candidate range determining means for determining a character center candidate range for each character of the character string as an area which contains a center of the character height direction range in the character height direction and contains a center of the character width direction range in the character width direction in the object image;

character candidate area setting means for setting a plurality of rectangular character candidate areas in which an intersection of diagonal lines coincides with each point of the character center candidate range;

character recognition means for carrying out character recognition processing to each of a part of the plurality of character candidate areas of the object image, and acquiring a character recognition result for each of the plurality of character candidate areas to each of characters of the character string; and

character recognition result determining

means for determining a character recognition result for each character of the character string from the character recognition results of the plurality of character candidate areas.

2. The character recognition apparatus according to claim 1, wherein the character height direction range detecting means generates a first projection histogram which is a distribution of a summation of brightness values of pixels arranged in the character width direction and calculated in each position to the object image in the character height direction, carries out smoothing processing to the first projection histogram to calculate first smoothed data, and detects an upper end and a lower end in the character height direction range as positions in which a sign of a difference between the first projection histogram and the smoothed data is inverted.

3. The character recognition apparatus according to claim 1 or 2, wherein the character width direction range detecting means generates a second projection histogram which is a distribution of a summation of brightness values of pixels that are arranged in the character height direction and that is calculated for each position in the character width direction of the object image, and carries out the smoothing processing to the second projection histogram to calculate second smoothed data, detects a start point candidate and an end point candidate from the positions where a sign of a difference between the second projection histogram and the second smoothed data is inverted, selects a start point in the character width direction range of each character of the character string from among the start point candidates, and selects an end point in the character width direction range of each character

of the character string from among the end point candidates.

4. The character recognition apparatus according to any one of claims 1 to 3, wherein the object image is a plate area image in which a number plate is picked up, or an image obtained by carrying out image processing to the plate area image.

5. The character recognition apparatus according to any one of claims 1 to 3, wherein the object image is an image obtained by carrying out preprocessing to a plate area image in which a number plate is picked up, and

wherein the preprocessing carries out a brightness correction processing that restrains brightness of a part having high brightness values of the plate area image, and carries out a linear conversion such that an average of brightness values of the pixels and a standard deviation become predetermined values, respectively; differential filter processing to an image obtained by the brightness correction processing to generate an edge image; filling processing to fill an inside of a character contour which is contained in the edge image; and removing processing to an image obtained by the filling processing to remove a low frequency component.

6. A character recognition method comprising:

detecting a character height direction range as a range in a character height direction perpendicular to a character width direction in a character string from an object image which is a gray-scale image and in which the character string is picked up that contains characters arranged in the

character width direction;

detecting a character width direction range as a range in a character width direction in which characters of the character string are arranged, from the object image;

determining a character center candidate range to each character of the character string as an area which contains a center of the character height direction range and contains a center of the character width direction range in the character width direction for the object image;

setting a plurality of rectangular character candidate areas, in each of which an intersection of diagonal lines coincides with each of points of the character center candidate range;

carrying out character recognition processing to each of a part of the plurality of character candidate areas of the object image, and acquiring a character recognition result for each of the plurality of character candidate areas to each of characters of the character string; and

determining a character recognition result for each character of the character string from the character recognition results of each of the plurality of character candidate areas.

CLAIMS

1. A character recognition apparatus comprising:

preprocessing means for carrying out preprocessing to an area image to generate an object image in which a low frequency component in a character width direction is removed;

character height direction range detecting means for detecting a character height direction range as a range in a character height direction perpendicular to the character width direction in a character string from the object image which is a gray-scale image and in which the character string is picked up that contains a plurality of characters arranged in a character width direction;

character width direction range detecting means for detecting a character width direction range as a range in the character width direction in which characters of the character string are arranged, from the object image;

character center candidate range determining means for determining a character center candidate range for each character of the character string as an area which contains a center of the character height direction range in the character height direction and contains a center of the character width direction range in the character width direction in the object image;

character candidate area setting means for setting a plurality of rectangular character candidate areas in which an intersection of diagonal lines coincides with each point of the character center candidate range;

character recognition means for carrying out character recognition processing to each of a part of the plurality of character candidate areas of the object image, and acquiring a character recognition result for each of the plurality of character candidate areas to each of characters of the character string; and

character recognition result determining means for determining a character recognition result for each character of the character string from the character recognition results of the plurality of character candidate areas.

2. The character recognition apparatus according to claim 1, wherein the character height direction range detecting means generates a first projection histogram which is a distribution of a summation of brightness values of pixels arranged in the character width direction and calculated in each position to the object image in the character height direction, carries out smoothing processing to the first projection histogram to calculate first smoothed data, and detects an upper end and a lower end in the character height direction range as positions in which a sign of a difference between the first projection histogram and the smoothed data is inverted.

3. The character recognition apparatus according to claim 1 or 2, wherein the character width direction range detecting means generates a second projection histogram which is a distribution of a

summation of brightness values of pixels that are arranged in the character height direction and that is calculated for each position in the character width direction of the object image, and carries out the smoothing processing to the second projection histogram to calculate second smoothed data, detects a start point candidate and an end point candidate from the positions where a sign of a difference between the second projection histogram and the second smoothed data is inverted, selects a start point in the character width direction range of each character of the character string from among the start point candidates, and selects an end point in the character width direction range of each character of the character string from among the end point candidates.

4. The character recognition apparatus according to any one of claims 1 to 3, wherein the object image is a plate area image in which a number plate is picked up, or an image obtained by carrying out image processing to the plate area image.

5. The character recognition apparatus according to any one of claims 1 to 3, wherein the object image is an image obtained by carrying out the preprocessing to the area image which is a plate area image in which a number plate is picked up, and

wherein the preprocessing means carries out a brightness correction processing that restrains brightness of a part having high brightness values of the plate area image, and carries out a linear conversion such that an average of brightness values of the pixels and a standard deviation become predetermined values, respectively; differential filter processing to an image obtained by the brightness correction processing to generate an edge image; filling processing to fill an inside of a character contour which is contained in the edge image; and removing processing to an image obtained by the filling processing to remove the low frequency component.

6. A character recognition method comprising:

carrying out preprocessing to an area image to generate an object image in which a low frequency component in a character width direction is removed;

detecting a character height direction range as a range in a character height direction perpendicular to the character width direction in a character string from the object image which is a gray-scale image and in which the character string is picked up that contains characters arranged in the character width direction;

detecting a character width direction range as a range in a character width direction in which characters of the character string are arranged, from the object image;

determining a character center candidate range to each character of the character string as an area which contains a center of the character height direction range and contains a center of the character width direction range in the character width direction for

the object image;

setting a plurality of rectangular character candidate areas, in each of which an intersection of diagonal lines coincides with each of points of the character center candidate range;

carrying out character recognition processing to each of a part of the plurality of character candidate areas of the object image, and acquiring a character recognition result for each of the plurality of character candidate areas to each of characters of the character string; and

determining a character recognition result for each character of the character string from the character recognition results of each of the plurality of character candidate areas.