that additionally records the number plate information specified based on the input from the operator and the feature point extracted from the number plate image in association with each other, in the learning data set.

In this way, the relationship between the acquired number plate image and the number plate information specified by the visual determination of the operator is accumulated in the learning data set with an operation of a toll road. Therefore, the specifying accuracy based on the comparison of the feature points can be improved during the operation.

[0011]

Further, according to a fifth aspect of the present invention, there is provided a billing system (1) including: the number plate information specifying device described above; a reader device (32) that reads user identification information for identifying a user to be billed, from an information recording medium attached to a vehicle; and a number plate recognition device (30) that performs OCR processing on a number plate image acquired through a camera (33) and extracts number plate information from the number plate image.

In this way, in the billing system, when performing the billing processing by the reader device, it is possible to extract the number plate information, based on

not only the number plate specifying processing by the number plate information specifying device but also a normal OCR processing.

[0012]

Further, according to a sixth aspect of the present invention, the number plate recognition device transmits the number plate image to the number plate information specifying device in a case where the number plate information cannot be extracted from the number plate image, as a result of the OCR processing.

In this way, the number plate image from which the number plate information can be extracted by the OCR processing does not become a target of the number plate information specifying processing by the number plate information specifying device. Therefore, the processing load of the number plate information specifying device can be reduced.

[0013]

Further, according to a seventh aspect of the present invention, the number plate recognition device transmits the number plate image to the number plate information specifying device in a case where first number plate information extracted from the number plate image by the OCR processing and second number plate information read from the information recording medium do not coincide

Claims

[Claim 1]

A number plate information specifying device comprising:

an image acquisition unit that acquires a number plate image;

a feature point extraction unit that extracts a feature point of the number plate image;

a similarity calculation unit that refers to a learning data set in which a plurality of feature points and a plurality of pieces of number plate information are recorded in association with each other, and calculates similarity of each feature point recorded in the learning data set to the feature point extracted from the number plate image;

a vote value calculation unit that calculates a vote value that is obtained by aggregating the similarity of each feature point recorded in the learning data set for each number plate information recorded in the learning data set; and

a specifying unit that specifies number plate information having a highest vote value as number plate information that is displayed on the number plate image.

[Claim 2]

The number plate information specifying device according to claim 1, wherein the specifying unit receives input of number plate information that is shown on the number plate image from an operator in a case where the highest vote value is equal to or less than a predetermined threshold value.

[Claim 3]

The number plate information specifying device according to claim 1 or 2, wherein in a case where the highest vote value is equal to or less than a predetermined threshold value, the specifying unit notifies an operator of the number plate information having the highest vote value and the number plate image, and receives, from the operator, input of information indicating a determination result as to whether or not the number plate information having the highest vote value is to be specified as the number plate information that is displayed on the number plate image.

[Claim 4]

The number plate information specifying device according to claim 2 or 3, further comprising:

a learning unit that additionally records the number plate information specified based on the input from the

operator and the feature point extracted from the number plate image in association with each other, in the learning data set.

[Claim 5]

A billing system comprising:

the number plate information specifying device according to any one of claims 1 to 4;

a reader device that reads user identification information for identifying a user to be billed and the number plate information recorded in an information recording medium, from the information recording medium attached to a vehicle; and

a number plate recognition device that performs OCR processing on a number plate image acquired through a camera and extracts number plate information from the number plate image,

wherein the number plate recognition device sends the number plate image to the number plate information specifying device when the OCR processing on the number plate image is failed,

wherein the number plate information specifying device specifies the number plate information that is displayed on the number plate image received from the number plate recognition device, and sends the specified number plate information to the number plate recognition device,

wherein the number plate recognition device performs billing processing when the number plate information extraced from the number plate image by the OCR processing coincides with the number plate information recorded in the information recording medium or when the number plate information specified by the number plate information specifying device coincides with the number plate information recorded in the information recording medium.

[Claim 6]

The billing system according to claim 5, wherein the number plate recognition device transmits the number plate image to the number plate information specifying device in a case where the number plate information cannot be extracted from the number plate image, as a result of the OCR processing.

[Claim 7]

The billing system according to claim 5 or 6, wherein the number plate recognition device

transmits the number plate image to the number plate information specifying device in a case where first number plate information extracted from the number plate image by the OCR processing and second number plate information read from the information recording medium do not coincide with each other.

[Claim 8]

A number plate information specifying method comprising:

a step of acquiring, by a number plate information specifying device, a number plate image;

a step of extracting, by the number plate information specifying device, a feature point of the number plate image;

a step of referring, by the number plate information specifying device, to a learning data set in which a plurality of feature points and a plurality of pieces of number plate information are recorded in association with each other, and calculating similarity of each feature point recorded in the learning data set to the feature point extracted from the number plate image;

a step of calculating, by the number plate information specifying device, a vote value that is obtained by aggregating the similarity of each feature point recorded in the learning data set for each number plate information recorded in the learning data set; and

a step of specifying, by the number plate information specifying device, number plate information having a highest vote value as number plate information that is displayed on the number plate image.

[Claim 9]

A program that causes a computer of a number plate information specifying device to execute:

a step of acquiring a number plate image;

a step of extracting a feature point of the number plate image;

a step of referring to a learning data set in which a plurality of feature points and a plurality of pieces of number plate information are recorded in association with each other, and calculating similarity of each feature point recorded in the learning data set to the feature point extracted from the number plate image;

a step of calculating a vote value that is obtained by aggregating the similarity of each feature point recorded in the learning data set for each number plate information recorded in the learning data set; and

a step of specifying number plate information having a highest vote value as number plate information that is displayed on the number plate image.