【CLAIMS】

【Claim 1】

An identification card authenticity determining method based on deep learning, the identification card authenticity determining method comprising:

inputting identification card data to a feature information extraction model to extract pieces of feature information for a plurality of different indicators for checking authenticity of the identification card, from the identification card data;

inputting the feature information extracted for each indicator to a classification model implemented with a neural network algorithm to determine authenticity of the identification card; and

when it is determined that the identification card is falsified, extracting a class activation map, where a falsification region is activated on the identification card data, from the feature information extracted for each indicator, the falsification region being a region corresponding to an indicator used for determining that the identification card is falsified,

wherein the extracting the class activation map comprises:

assigning a weight of the classification model to each feature information extracted for each indicator to activate each feature information; and

combining the activated each feature information to generate the class activation map where the falsification region is activated,

wherein the indicator for checking authenticity of the identification card

comprises at least one of hologram information in the identification card, reflected light information in the identification card, shadow information in the identification card, or Moire pattern information, and

wherein the indicator used to determine the authenticity of the identification card among the plurality of indicators is obtained from the class activation map to provide to a user.

【Claim 2】

The identification card authenticity determining method of claim 1, wherein the determining the authenticity of the identification card comprises, when a probability value output from the classification model is less than a predetermined threshold value, determining that the identification card is falsified.

【Claim 3】

The identification card authenticity determining method of claim 1, wherein the classification model comprises a soft max layer assigning a weight to the feature information extracted for each indicator to calculate a probability value representing the authenticity or not of the identification card.

【Claim 4】

The identification card authenticity determining method of claim 1, wherein the classification model comprises a global average pooling layer applying a sampling filter having a predetermined size to each feature information to average pixel values included in a region corresponding to the sampling filter, thereby decreasing dimensions of the

feature information extracted for each indicator.

【Claim 5】

The identification card authenticity determining method of claim 1, wherein the feature information extraction model comprises n (where n is an integer of 2 or more) number of convolution layers applying a convolution filter having a predetermined size to the identification card data to generate the feature information for each indicator and applying an activation function to the feature information generated for each indicator to assign a nonlinear characteristic to the feature information generated for each indicator, the n convolution layers being sequentially arranged.

【Claim 6】

The identification card authenticity determining method of claim 1, wherein the feature information extraction model comprises m (where m is an integer of more than 1) number of pooling layers respectively disposed at output terminals of at least one of n number of convolution layers generating the feature information for each indicator from the identification card data, the m pooling layers applying a sampling filter having a predetermined size to the feature information generated for each indicator to reduce a dimension.

【Claim 7】

The identification card authenticity determining method of claim 1, wherein the indicator for checking authenticity of the identification card further comprises at least one of face data included in the identification card or reference information included in

the identification card.

【Claim 8】

The identification card authenticity determining method of claim 1, wherein the feature information is a feature map having an image form or a feature vector obtained by inputting the identification card data to the feature information extraction model.

【Claim 9】

An identification card authenticity determining apparatus based on deep learning, the identification card authenticity determining apparatus comprising:

a feature information extractor configured to input identification card data, obtained by capturing an identification card, to a feature information extraction model to extract pieces of feature information for a plurality of different indicators for checking authenticity of the identification card, from the identification card data;

a determiner configured to input the feature information extracted for each indicator to a classification model implemented with a neural network algorithm to determine authenticity of the identification card; and

a falsification region extractor configured to extract a class activation map, where a falsification region is activated on the identification card data, from the feature information extracted for each indicator when it is determined that the identification card is falsified, the falsification region being a region corresponding to an indicator used for determining that the identification card is falsified,

wherein the falsification region extractor comprises:

an activator configured to assign a weight of the classification model to each feature information extracted for each indicator to activate each feature information; and

a generator configured to combine the activated each feature information to generate the class activation map where the falsification region is activated,

wherein the indicator for checking authenticity of the identification card comprises at least one of hologram information in the identification card, reflected light information in the identification card, shadow information in the identification card, or Moire pattern information, and

wherein the indicator used to determine the authenticity of the identification card among the plurality of indicators is obtained from the class activation map to provide to a user.

【Claim 10】

The identification card authenticity determining apparatus of claim 9, wherein the determiner determines that the identification card is falsified when a probability value output from the classification model is less than a predetermined threshold value.

【Claim 11】

The identification card authenticity determining apparatus of claim 9, wherein the classification model comprises a soft max layer assigning a weight to the feature information extracted for each indicator to calculate a probability value representing the authenticity or not of the identification card.

【Claim 12】

The identification card authenticity determining apparatus of claim 9, wherein the classification model comprises a global average pooling layer applying a sampling filter having a predetermined size to each feature information to average pixel values included in a region corresponding to the sampling filter, thereby decreasing dimensions of the feature information extracted for each indicator.

【Claim 13】

The identification card authenticity determining apparatus of claim 9, wherein the feature information extraction model comprises n (where n is an integer of 2 or more) number of convolution layers applying a convolution filter having a predetermined size to the identification card data to generate the feature information for each indicator and applying an activation function to the feature information generated for each indicator to assign a nonlinear characteristic to the feature information generated for each indicator, the n convolution layers being sequentially arranged.

【Claim 14】

The identification card authenticity determining apparatus of claim 9, wherein the feature information extraction model comprises m (where m is an integer of more than 1) number of pooling layers respectively disposed at output terminals of at least one of n number of convolution layers generating the feature information for each indicator from the identification card data, the m pooling layers applying a sampling filter having a predetermined size to the feature information generated for each indicator to reduce a dimension.

【Claim 15】

The identification card authenticity determining apparatus of claim 9, wherein the indicator for checking authenticity of the identification card further comprises at least one of face data included in the identification card or reference information included in the identification card.