【CLAIMS】

~~Claim 1. A diagnosis assistant method for assisting diagnosis of a target cardiovascular disease based on a fundus image, comprising:~~

~~obtaining a target fundus image of a testee;~~

~~obtaining cardiovascular disease diagnosis assistant information associated with the target cardiovascular disease based on the target fundus image and a cardiovascular disease diagnosis assistant neural network model, the cardiovascular disease diagnosis assistant neural network model storing correlations between fundus images and the cardiovascular disease diagnosis assistant information and including a plurality of convolutional neural network layers; and~~

~~outputting the cardiovascular disease diagnosis assistant information and instruction information determined based on a pre-stored relation corresponding to the cardiovascular disease diagnosis assistant information;~~

~~wherein the cardiovascular disease diagnosis assistant information includes at least one of (i) grade information which includes a grade selected from a plurality of grades indicating an extent of risk of the target cardiovascular disease, (ii) score information for determining a risk of the target cardiovascular disease, or (iii) risk information which indicates whether the testee is included in a risk group associated with the target cardiovascular disease or not.~~

~~Claim 2. The diagnosis assistant method of claim 1, further comprising:~~

~~reconstructing the target fundus image so that a vessel element included in the target fundus image is highlighted for facilitating the diagnosis of the target fundus image,~~

~~wherein the cardiovascular disease diagnosis assistant information is obtained based on the reconstructed target fundus image.~~

~~Claim 3. The diagnosis assistant method of claim 2, wherein:~~

~~the reconstructing of the target fundus image further comprises,~~

~~performing pre-processing which highlights a region at which the vessel included in the target fundus image is distributed.~~

~~Claim 4. The diagnosis assistant method of claim 2, wherein:~~

~~the reconstructing of the target fundus image further comprises,~~

~~extracting a region at which the vessel included in the target fundus image is distributed.~~

~~Claim 5. The diagnosis assistant method of claim 1, wherein:~~

~~the target cardiovascular disease is a coronary artery disease.~~

~~Claim 6. The diagnosis assistant method of claim 5, wherein:~~

~~the grade information is coronary artery disease risk grade information which describes a risk for the coronary artery disease,~~

~~the score information is coronary artery disease calcium score information, and~~

~~the risk information is coronary artery disease risk information which indicates whether the testee is included in a high-risk group of the coronary artery disease.~~

~~Claim 7. The diagnosis assistant method of claim 1, wherein:~~

~~the cardiovascular disease diagnosis assistant neural network model is trained to output the cardiovascular disease diagnosis assistant information based on the fundus image, using fundus image training data including a plurality of fundus images on which a diagnosis assistant information label is assigned.~~

~~Claim 8. The diagnosis assistant method of claim 1, wherein:~~

~~the obtaining of the cardiovascular disease diagnosis assistant information further comprises,~~

~~obtaining a class activation map for the cardiovascular disease diagnosis assistant information according to the target fundus image.~~

~~Claim 9. The diagnosis assistant method of claim 8, wherein:~~

~~the outputting of the cardiovascular disease diagnosis assistant information of the testee further comprises,~~

~~outputting a feature map associated with the cardiovascular disease assistant information, which is generated based on the class activation map,~~

~~wherein the feature map is provided in a form which corresponds to the target fundus image, and~~

~~wherein the feature map shows a feature region associated with the cardiovascular disease diagnosis assistant information.~~

~~Claim 10. The diagnosis assistant method of claim 9, wherein:~~

~~the outputting of the cardiovascular disease diagnosis assistant information further comprises,~~

~~outputting the target fundus image and the feature map being overlapped.~~

~~Claim 11. The diagnosis assistant method of claim 1, further comprising:~~

~~obtaining eye disease diagnosis assistant information based on the target fundus image and the cardiovascular disease diagnosis assistant neural network model which is trained to obtain the eye disease diagnosis information based on the fundus images.~~

~~Claim 12. The diagnosis assistant method of claim 1,~~

~~wherein the cardiovascular disease diagnosis assistant information is obtained based on a reconstructed target fundus image which is obtained by performing a reconstruction highlighting a vessel element on the target fundus image, and~~

~~wherein the cardiovascular disease diagnosis assistant neural network model is trained using fundus image training data including a plurality of fundus images of which the vessel element is highlighted and a plurality of cardiovascular disease diagnosis assistant labels assigned on the plurality of fundus images.~~

~~Claim 13. A cardiovascular disease diagnosis assistant device which assists a diagnosis of a target cardiovascular disease using a fundus image, comprising:~~

~~a fundus image obtaining unit configured to obtain a target fundus image of a testee; and~~

~~at least one processor configured to:~~

~~obtain cardiovascular disease diagnosis assistant information associated with the target cardiovascular disease based on the target fundus image and a cardiovascular disease diagnosis assistant neural network model, the cardiovascular disease diagnosis assistant neural network model storing correlations between fundus images and the cardiovascular disease diagnosis assistant information and including a plurality of convolutional neural network layers, and~~

output the cardiovascular disease diagnosis assistant information and instruction information determined based on a pre-stored relation corresponding to the cardiovascular disease diagnosis assistant information,

wherein the cardiovascular disease diagnosis assistant information includes at least one of (i) grade information which includes a grade selected from a plurality of grades indicating an extent of risk of the target cardiovascular disease, (ii) score information for determining a risk of the target cardiovascular disease, or (iii) risk information which indicates whether the testee is included in a risk group associated with the target cardiovascular disease or not.

Claim 14. The cardiovascular disease diagnosis assistant device of claim 13,

wherein the at least one processor is further configured to reconstruct the target fundus image so that a vessel element included in the target fundus image is highlighted, to facilitate the diagnosis of the target heart disease, and

wherein the cardiovascular disease diagnosis assistant information is obtained based on the reconstructed target fundus image.

Claim 15. The cardiovascular disease diagnosis assistant device of claim 13, wherein:

the target cardiovascular disease is a coronary artery disease, and

the grade information is coronary artery disease risk grade information which describes a risk for the coronary artery disease,

the score information is coronary artery disease calcium score information, and

the risk information is coronary artery disease risk information which indicates whether the testee is included in a high-risk group of the coronary artery disease.

Claim 16. The cardiovascular disease diagnosis assistant device of claim 13, wherein the at least one processor is further configured to:

obtain a class activation map for the cardiovascular disease diagnosis assistant information according to the target fundus image, and

output a feature map associated with the cardiovascular disease assistant information,

~~wherein the feature map is generated based on the class activation map and provided in a form which corresponds to the target fundus image, and~~

~~wherein the feature map shows a feature region associated with the cardiovascular disease diagnosis assistant information.~~

~~Claim 17. The cardiovascular disease diagnosis assistant device of claim 13, wherein the at least one processor is further configured to:~~

~~obtains eye disease diagnosis assistant information based on the target fundus image and the cardiovascular disease diagnosis assistant neural network model which is trained to obtain the eye disease diagnosis assistant information based on the fundus images, and~~

~~output the eye disease diagnosis assistant information.~~

~~Claim 18. A computer-readable recording medium, characterized in storing a program according to claims 1 to 12.~~

Claim 1. A diagnosis assistant method for assisting diagnosis of at least one of disease based on a fundus image, comprising:

obtaining a target fundus image of a testee;

obtaining first diagnosis assistant information based on the target fundus image using first neural network model;

obtaining second diagnosis assistant information based on the target fundus image using second neural network model; and

outputting disease diagnosis assistant information based on the first diagnosis assistant information and the second diagnosis assistant information;

wherein the first neural network model and the second neural network model are trained either independently or dependently, considering the relevance between the first diagnosis assistant information and the second diagnosis assistant information,

wherein the first neural network model and the second neural network model are trained based on at least some common a plurality of training data, and

wherein the plurality of training data are selected from diagnostic information label, findings information label and peripheral information label.

Claim 2. The diagnosis assistant method of claim 1,

wherein the first diagnosis assistant information is diagnosis assistant information for first disease,

wherein the second diagnosis assistant information is diagnosis assistant information for second disease, and

wherein the first disease and the second disease are different diseases.

Claim 3. The diagnosis assistant method of claim 2, wherein the first disease is cardiovascular disease.

Claim 4. The diagnosis assistant method of claim 2, wherein the second disease is kidney disease.

Claim 5. The diagnosis assistant method of claim 1,

wherein the diagnostic information label includes a label for presence or absence of a specific disease,

wherein the findings information label includes a label for abnormalities in a specific area, and

wherein the peripheral information label includes at least one of label for at least one of age, gender or left eye - right eye information.

Claim 6. The diagnosis assistant method of claim 3, wherein:

wherein the first diagnosis assistant information includes at least one of grade information indicating the risk for the first disease, score information indicating numerical value used for diagnosis of the first disease or abnormal information indicating belonging to a risk group for the first disease, and

wherein the second diagnosis assistant information includes at least one of grade information indicating the risk for the second disease, score information indicating numerical value used for diagnosis of the second disease or abnormal information indicating belonging to a risk group for the second disease.

Claim 7. The diagnosis assistant method of claim 3,

wherein the grade information indicating the risk for the first disease is based on coronary artery disease risk grade information selected from a plurality of grade information for indicating a risk for the coronary artery disease, and

wherein the score information indicating numerical value used for diagnosis of the first disease is based on coronary artery disease calcium score information used to determine a risk for the coronary artery disease.

Claim 8. The diagnosis assistant method of claim 1, wherein:

the first diagnosis assistant information includes a plurality of information among the grade information indicating the risk for the first disease, the score information indicating numerical value used for diagnosis of the first disease or the abnormal information indicating belonging to a risk group for the first disease,

obtaining first diagnosis assistant information comprises:

determining whether the plurality of information matches; and

obtaining the first diagnosis assistant information based on the matching result of the plurality of information.

Claim 9. A diagnosis assistant device which assists a diagnosis of at least one of disease using a fundus image, comprising:

memory unit; and

at least one processor that controls the memory unit,

wherein the at least one processor configured to:

obtain first diagnosis assistant information based on a target fundus image using first neural network model,

obtain second diagnosis assistant information based on the target fundus image using second neural network model, and

output disease diagnosis assistant information based on the first diagnosis assistant information and the second diagnosis assistant information,

wherein the first neural network model and the second neural network model are trained either independently or dependently, considering the relevance between the first diagnosis assistant information and the second diagnosis assistant information,

wherein the first neural network model and the second neural network model are trained based on at least some common a plurality of training data, and

wherein the plurality of training data are selected from diagnostic information label, findings information label and peripheral information label.

Claim 10. The diagnosis assistant device of claim 9,

wherein the first diagnosis assistant information is diagnosis assistant information for first disease,

wherein the second diagnosis assistant information is diagnosis assistant information for second disease, and

wherein the first disease and the second disease are different diseases.

Claim 11. The diagnosis assistant device of claim 10, wherein the first disease is cardiovascular disease.

Claim 12. The diagnosis assistant device of claim 10, wherein the second disease is kidney disease.

Claim 13. The diagnosis assistant device of claim 9,

wherein the diagnostic information label includes a label for presence or absence of a specific disease,

wherein the findings information label includes a label for abnormalities in a specific area, and

wherein the peripheral information label includes at least one of label for at least one of age, gender or left eye - right eye information.

Claim14. The diagnosis assistant device of claim 11,

wherein the first diagnosis assistant information includes at least one of grade information indicating the risk for the first disease, score information indicating numerical value used for diagnosis of the first disease or abnormal information indicating belonging to a risk group for the first disease, and

wherein the second diagnosis assistant information includes at least one of grade information indicating the risk for the second disease, score information indicating numerical value used for diagnosis of the second disease or abnormal information indicating belonging to a risk group for the second disease.

Claim 15. The diagnosis assistant device of claim 11,

wherein the grade information indicating the risk for the first disease is based on coronary artery disease risk grade information selected from a plurality of grade information for indicating a risk for the coronary artery disease, and

wherein the score information indicating numerical value used for diagnosis of the first disease is based on coronary artery disease calcium score information used to determine a risk for the coronary artery disease.

Claim 16. A diagnosis assistant method for assisting diagnosis of cardiovascular disease based on a fundus image performed by a cardiovascular disease diagnosis assistant device, comprising:

wherein the cardiovascular disease diagnosis assistant device includes first model and second model,

obtaining feature values based on a target fundus image of a testee using the first model; and

obtaining cardiovascular disease diagnosis assistant information by using the feature values and other factor as input to the second model,

wherein the other factor includes at least one of information for an age of the testee, information for a gender of the testee, information for smoking status of the testee, information

for hyperlipidemia condition of the testee, information for blood pressure condition of the testee or information for diabetic condition of the testee.

Claim 17. A cardiovascular disease diagnosis assistant device which assists a diagnosis of cardiovascular disease using a fundus image, comprising:

memory unit; and

at least one processor that controls the memory unit,

wherein the cardiovascular disease diagnosis assistant device includes first model and second model, and

wherein the at least one processor configured to:

obtain feature values based on a target fundus image of a testee using the first model; and

obtain cardiovascular disease diagnosis assistant information by using the feature values and other factor as input to the second model,

wherein the other factor includes at least one of information for an age of the testee, information for a gender of the testee, information for smoking status of the testee, information for hyperlipidemia condition of the testee, information for blood pressure condition of the testee or information for diabetic condition of the testee.

Claim 18. A computer-readable recording medium, characterized in storing a program according to claims 1 to 8 and 16.