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CERTIFICATE OF GRANT

INNOVATION PATENT

Patent number: 2020101450

The Commissioner of Patents has granted the above patent on 12 August 2020, and certifies that the below particulars have been registered in the Register of Patents.

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Title of invention:

RETINAL VASCULAR DISEASE DETECTION FROM RETINAL FUNDUS IMAGES USING MACHINE LEARNING

Name of inventor(s):

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Term of Patent:

Eight years from 23 July 2020

NOTE: This Innovation Patent cannot be enforced unless and until it has been examined by the Commissioner of Patents and a Certificate of Examination has been issued. See sections 120(1A) and 129A of the Patents Act 1990, set out on the reverse of this document.

COMMONWEALTH OF AUSTRALIA AUSTRALIA PATENT OFFICE

Dated this 12th day of August 2020

Commissioner of Patents

Retinal vascular disease detection from retinal fundus images using machine learning

Abstract

RETINAL VASCULAR DISEASE DETECTION FROM RETINAL FUNDUS IMAGES USING MACHINE LEARNING ABSTRACT One of the essential senses in the human body is the eyesight. A human existence is meaningful in the world only by the vision. So any malfunction in the vision of the human eye has to be handled with highest priority. So even in the world, there are number of scientific technologies implement lot of changes in biomedical field, the technology related to vision finds its significance. The researchers proven that the vision blurriness or the vision loss not only caused by the change in human eye power but also reflects malfunction of other parts of the body. As, the blood vessels that carry blood oxygen flow through the body and especially the blood vessels that is at the back of the eye connects to the heart. So even the heart related disorder also reflects in the eye. Not only heart, other functions like liver, kidney and inflammatory disease reflect in human eye. So detection of retinal vascular disease is very essential. For this function, the fundus images from the retina are observed by fundus camera and then only the luminous green is considered to undergo processing. CLAHE is deployed to categorize pixels of similar characteristics and noise is removed by filters. By deploying machine learning, mean-C threshold method with convolution, computation is performed and non-vessel images are removed. By making accurate predictions, the eye-care specialist can make proper diagnosis and give good consultation to the patients. 1 P a g e RETINAL VASCULAR DISEASE DETECTION FROM RETINAL FUNDUS IMAGES USING MACHINE LEARNING Diagram ELIMINATE NON-VESE AGE &DISPLAYPREDICTION Fig.1 Block diagram 1|P a g e

Classifications

A61B3/12 Objective types, i.e. instruments for examining the eyes independent of the patients' perceptions or reactions for looking at the eye fundus, e.g. ophthalmoscopes

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Worldwide applications

2020 • AU

Application AU2020101450A events

2020-07-23 • Application filed by B M S Rani Ms, Bobbillapati Suneetha Ms, H Bhavani Naga Prasanna Ms, Mikkili Divyasree Ms, Pittala Chandra Shaker Dr, Vallabhuni Vijay Dr, Vallabhuni Rajeev Ratna Mr

2020-07-23 • Priority to AU2020101450A

2020-08-27 • Application granted

2020-08-27 • Publication of AU2020101450A4

Info: Legal events, Similar documents, Priority and Related Applications

External links: Espacenet, Global Dossier, Discuss

Claims (5)

Hide Dependent

RETINAL VASCULAR DISEASE DETECTION FROM RETINAL FUNDUS IMAGES USING MACHINE LEARNING CLAIMS

1. A well-established high-end fundus camera equipment to capture the vascular images behind the eye.
2. Image processing algorithm for finding vascular disease.
3. Classification algorithm to find retinal vascular disease.
4. High end computer system required to deploy computing and imaging techniques.
5. Appropriate machine learning algorithm implemented to make predictions such that the eye-specialist can make proper diagnosis and give good consultation to the patients.

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RETINAL VASCULAR DISEASE DETECTION FROM RETINAL FUNDUS IMAGES 23 Jul 2020

USING MACHINE LEARNING

Diagram 2020101450

Fig.1 Block diagram

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Fig. 2 Detailed Process flow diagram

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Description

RETINAL VASCULAR DISEASE DETECTION FROM RETINAL FUNDUS IMAGES USING MACHINE LEARNING

Diagram

ELIMINATE NON-VESE AGE &DISPLAYPREDICTION

Fig.1 Block diagram

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RETINAL VASCULAR DISEASE DETECTION FROM RETINAL FUNDUS IMAGES USING MACHINE LEARNING

Description

Field of the Invention

Field of the invention related to Computer Science Engineering.

Human eye not only gives vision but also reflects the status of health condition in the body. Clinically proven that many disease identifications were from the analysis of the retinal fundus image. Particularly, the blood vessel behind the eye, connecting heart reflects the condition of the artery walls. Even the diabetes, hypertension, and inflammatory disease in other parts of the body also reflected in the blood vessel at the back of an eye. So, in this invention, machine learning is deployed to detect the retinal vascular disease from retinal fundus images to predict accurate information on the retina and makes the eye care specialist to drive the patient with correct consultation.

Background and prior art of the invention:

When it comes to human eye, optical testing for vision was once found a common treatment related to eye in medical field. But today, it just goes beyond that where many disease identifications can be predicted based on the fundus image in the retina.

Researchers have proven that blurred vision or the blindness is not only caused by the changes of the eye power. Even the retinal vascular disease when not treated may lead to the blurred vision or the blindness.

Diabetic retinopathy is the variation of sugar levels affecting the tissues which are light sensitive behind the eyes. The initial symptoms may cause mild blurriness in the vision. It is the abnormalities that are found in the tissue of the blood vessel found at the back of the eye retina.

1| P a g e

As it reflects in the retina, with the help of the fundus images, the identification of the problem can be made easier to diagnose and make appropriate treatment. If left undiagnosed, it may lead to bleeding, swelling and may cause more symptoms finally resulting in the loss of the vision.

If the eyes show swelling, it may also reflect that there is a problem with the functioning of liver, heart and even kidneys.

Arterial disease is a vascular disease affecting blood vessels that takes blood from heart to all different parts of the body. It can be identified by the fundus images of retina. The earlier identified, proper therapy can be done and treated.

Variation in the levels of bilirubin may reflect changes in the eye reflecting the liver problem. It shows the symptom ofjaundice and if detected earlier, proper medication can be done. Even the problems in gall bladder and bile ducts also exhibit the symptoms in the eye. The change in blood flow damages tissue and should be treated in prior stages.

Fundus images are caught by fundus camera and have different modes of operation. It captures, colour, image and in general it is a practical instrument to perform angiography.

Though sequence image capturing of blood flow in the vessels where in practice in 20th century, technology development of digital photography helps to provide better information.

Fundus photography, not only done in human but also can be deployed for the animals and has tremendous utilization in veterinary research.

Apart from fundus photography capture, segmentation is another technology implemented in biomedical field to gather pixel having similar characteristics and analyze it.

Threshold image processing is one of the simplest and efficient techniques to be deployed in segmentation.

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Summary of the invention:

The retinal vascular disease is detected from fundus image of retina using machine learning. Apart from the human vision defect caused by eye power variation alone, now a days, different parts of the body function also reflect in the eye. From the fundus images of the blood vessels that were captured at the back of the eye, it is possible to predict the cause of the disorder in the human body. In this invention, from the fundus image caught, only green image chosen, and it is processed. The pre-processing is done to separate different pixels based on their characteristics by adopting Contrast Limited Adaptive Histogram Equalization method and then the unwanted portion or the noise is removed. By implementing mean-C thresholding method, extraction of the retinal blood vessel data is performed, which is a segmentation process by performing convolution. Then the post-processing is to eliminate the other pixels that are not required for diagnosis. By this process, the machine learns the training set and the test data and can make predictions that the eye-care specialist can examine the reason for the disorder and can give proper consultation to the patients.

Objective of the invention:

By obtaining the fundus retinal image, retinal vascular disease is detected deploying the machine learning. The blood vessels that carry the blood with oxygen flows through different parts of the body and especially from the retinal vascular fundus image behind the eye, machine learning can predict the disorder and it assist the eye-specialist to make proper diagnosis and treatment for the patients.

Statement of the invention

By using fundus camera, the blood vessel that takes the oxygen blood to different parts of the body and especially from the one that is located at the back of the eye, the fundus images are observed. The images obtained will be in the red, blue, and green colored image. But due to the poor luminous, red, and blue are considered and green color is taken for the processing. To enhance the contrast of the image, it is divided into many small pixels of similar characteristics by using CLAHE and filtering performed by removing noise. Next the segmentation or the extraction of blood vessels is done by mean-C threshold method. This is done by finding the

3|P a g e window size of the mean and image that is enhanced is performed convolution with the mean image. By subtraction method of convolution network, the difference image by subtracting mean and the enhanced image is obtained and it will be the threshold constant value of C and the complement of it is calculated, which gives the blood vessel extraction. Later the other pixels which are not of vessel type are eliminated. By adopting this machine learning, predictions are made, and it is easy to make proper diagnosis and perform appropriate treatment of the patients by the eye-specialist.

BRIEF DESCRIPTION OF THE SYSTEM OF DRAWINGS

Fig 1: Block diagram Fig. 2 Detailed Process flow diagram

DETAILED DESCRIPTION OF THE SYSTEM

Fig.1 shows the block diagram of the retinal vascular disease detection using fundus images deploying machine learning. The retinal image in the back of the eye is accurately observed by fundus camera. The observed image will be of three colours namely red, blue, and green. Red and blue has low contrast and green has high luminous. So green colour image is only considered for processing. So, after observing the fundus image, only green image is selected. The contrast is enhanced and normalized by CLAHE. The unwanted noise is also removed by using filters. It is then deployed with machine learning, where the machine must learn the data's to make predictions. So, there is a need to do a desired feature extraction of blood vessels. By applying appropriate convolution networks and subtraction method, difference image obtained will be a threshold constant value C and computation is carried out with the threshold image. All the other blood vessels are eliminated and now the machine will be trained with desired features and give predictions that eye-specialist will be able to make diagnosis and give appropriate treatment to the patients. Fig.2 shows the detailed description of the process in the detection of retinal vascular disease using fundus image and using machine learning. The risk factors of diabetes, hypertension, high cholesterol, thickening of artery walls and many inflammatory pain and diseases exhibit their symptom in the eye. The retina vascular that carries the blood is examined to detect any diseases

4|P a g e so that treatment can made in earlier symptoms. Fundus camera captures the inner lining of the eyeball including the retina, which is light sensitive. Optic disc and macula also observed. It is the complete documentation that captures everything related to patient retina. It will be a record where the changes in the retina during certain period also detected. Thus, the eye specialist will be able to process this information. For the processing, the medical image that has been captured will be in red, blue and green. The green image is more luminous and so it is processed. By using CLAHE, the image is segregated into number of pixels and are grouped based on similar characteristics. The noise is eliminated by using filters. This is the image enhancement in the pre-processing. Then it must be segmented where features are

extracted by mean-C threshold, applying convolution and subtraction. In this segmentation, the enhanced image is convolved with a mean window size that is selected. By using subtraction method, the difference image obtained between convolved image and enhanced image. This gives the threshold of constant C to be computed by complementing. Even the non-vessel image pixels are also eliminated. The machine learning is trained with this data and can make predictions that the eye specialist will be able to perform diagnosis and provide appropriate treatment for the patients.

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Similar Documents

Publication	Publication Date	Title
CN108771530B	2021-03-30	Fundus lesion screening system based on deep neural network
Li et al.	2000	Fundus image features extraction
Nayak et al.	2009	Automatic identification of diabetic maculopathy stages using fundus images
Raman et al.	2016	Proposed retinal abnormality detection and classification approach: Computer aided detection for diabetic retinopathy by machine learning approaches
Omar et al.	2017	Automatic diabetic retinopathy detection and classification system
Patil et al.	2016	An efficient method of detecting exudates in diabetic retinopathy: Using texture edge features
AU2020101450A4	2020-08-27	Retinal vascular disease detection from retinal fundus images using machine learning
Dhivyaa et al.	2019	An effective detection mechanism for localizing macular region and grading maculopathy
Burewar et al.	2018	Diabetic Retinopathy Detection by Retinal segmentation with Region merging using CNN
Mondal et al.	2020	Blood vessel detection from Retinal fundas images using GIFKCN classifier
Aslan et al.	2018	Segmentation of retinal blood vessel using gabor filter and extreme learning machines
Saravanan et al.	2013	Automated red lesion detection in diabetic retinopathy
Mengko et al.	2009	Image Processing in Retinal Angiography: Extracting Angiographical Features without the Requirement of Contrast Agents.
Buchanan et al.	2008	Contextual detection of diabetic pathology in wide-field retinal angiograms
Rajan et al.	2018	Retinal image processing and classification using convolutional neural networks
Wahid et al.	2019	A dual step strategy for retinal thin vessel enhancement/extraction
Poonkasem et al.	2019	Detection of Hard Exudates in Fundus Images Using Convolutional Neural Networks
Ghebrechristos et al.	2017	RetiNet—Feature Extractor for Learning Patterns of Diabetic Retinopathy and Age-Related Macular Degeneration from Publicly Available Datasets
Shami et al.	2014	Better detection of retinal abnormalities by accurate detection of blood vessels in retina
AU2020100868A4	2020-08-13	Automatic diabetic retinopathy detection and estimation from multispectral images using machine learning algorithms
Sugasri et al.	2020	Screening System for Early Detection of Diabetic Retinopathy
Datta et al.	2020	Detection of Eye Ailments Using Segmentation of Blood Vessels from Eye Fundus Image
Gadriye et al.	2014	System for diagnosis of diabetic retinopathy using neural network
Ammal et al.	2018	Prognostic Anatomization of Glaucomatous eye by Disarticulationof Optic Disc and Optic Cup
Asokan et al.	2016	Computer aided approach for detection of age related macular degeneration from retinal fundus images

Priority And Related Applications

Priority Applications (1)

Application	Priority date	Filing date	Title
AU2020101450A	2020-07-23	2020-07-23	Retinal vascular disease detection from retinal fundus images using machine learning

Applications Claiming Priority (1)

Application	Filing date	Title
AU2020101450A	2020-07-23	Retinal vascular disease detection from retinal fundus images using machine learning

Legal Events

Date	Code	Title	Description
2020-08-27	FGI	Letters patent sealed or granted (innovation patent)	

Concepts

machine-extracted

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Name	Image	Sections	Count	Query match
machine learning		title,claims,abstract,description	18	0.000

Retinal vascular disease	title,claims,abstract,description	15	0.000
detection method	title,claims,abstract,description	10	0.000
retinal	title,claims,abstract,description	10	0.000
retinal	title,claims,abstract,description	10	0.000
all-trans-retinaldehyde	title,claims,abstract,description	9	0.000
retinal	title,claims,abstract,description	9	0.000
diagram	claims,abstract,description	10	0.000
diagnosis	claims,abstract,description	7	0.000
method	claims,description	7	0.000
vascular	claims,description	3	0.000
vascular disease	claims,description	2	0.000
calculation algorithm	claims	2	0.000
classification algorithm	claims	1	0.000
imaging method	claims	1	0.000
Blood Vessels	abstract,description	13	0.000
Retina	abstract,description	11	0.000
eyesight	abstract,description	10	0.000
disease	abstract,description	7	0.000
Blood	abstract,description	5	0.000
blood	abstract,description	5	0.000
blindness	abstract,description	3	0.000
inflammatory disease	abstract,description	3	0.000
oxygen 	abstract,description	3	0.000
oxygen	abstract,description	3	0.000
oxygen	abstract,description	3	0.000
Kidney Disease	abstract	1	0.000
liver disease	abstract	1	0.000
visual impairment	abstract	1	0.000

Show all concepts from the description section

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