MÉTODOS PARA LA DESCRIPCIÓN DE EXÁMENES DE CAMPO VISUAL

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Título de la Invención: Métodos para la descripción de exámenes de campo visual

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Palabras clave: Inteligencia Artificial; campo visual, procesamiento de imágenes; crecimiento de regiones

Keywords: Artificial Intelligence, Field of View, Image Processing, Region Growth.

Importancia Académica y Contexto:

La innovación en la tecnología médica es fundamental para el avance de la ciencia y la mejora de la calidad de vida de las personas. Esta patente representa un avance significativo en la oftalmología y tiene implicaciones profundas en la investigación académica y la práctica clínica.

Este método introduce un sistema innovador que permite describir exámenes de campo visual mediante el uso de algoritmos avanzados. El proceso implica generar matrices numéricas basadas en niveles de significancia estadística y aplicar métodos de clasificación multiclase para interpretar los resultados de las imágenes de campo visual. Este enfoque no solo mejora la precisión y la eficiencia en la descripción de los exámenes, sino que también es capaz de ser ejecutado en computadoras con capacidades de cálculo reducidas, lo cual es crucial para su adopción en diversas instalaciones médicas con recursos tecnológicos limitados.

La importancia de esta invención en el contexto académico radica en su capacidad para impulsar nuevas investigaciones en el campo de la oftalmología y más allá. Al proporcionar una herramienta robusta y precisa para el análisis de exámenes de campo visual, esta tecnología ofrece a los investigadores una base sólida sobre la

cual desarrollar estudios adicionales y mejorar los diagnósticos de enfermedades visuales. Además, el uso de métodos estadísticos y de clasificación puede inspirar investigaciones en otras áreas del procesamiento de imágenes médicas y el análisis de datos visuales.

La invención no solo beneficia a los investigadores en oftalmología, sino que también tiene el potencial de impactar positivamente a la comunidad científica en general. Las metodologías presentadas pueden ser adaptadas para diversas aplicaciones médicas, lo que fomenta la interdisciplinariedad y la colaboración entre científicos de distintos campos. La capacidad de esta tecnología para ser operada en computadoras con capacidades limitadas facilita su uso en una amplia gama de entornos, desde grandes centros de investigación hasta clínicas rurales con recursos tecnológicos más restringidos.

La posibilidad de obtener diagnósticos más rápidos y precisos no solo mejora la calidad de la atención al paciente, sino que también optimiza los recursos disponibles en las instituciones médicas. Esto es especialmente relevante en países en desarrollo, donde la accesibilidad a tecnologías avanzadas puede ser limitada.

Además de sus beneficios directos en la oftalmología, esta invención tiene el potencial de influir en otras áreas relacionadas. En el ámbito de la telemedicina, la capacidad de este método para ser ejecutado en dispositivos con capacidades modestas facilita diagnósticos remotos con una mayor precisión, extendiendo el alcance de los servicios médicos a áreas geográficamente aisladas.

En el campo de la inteligencia artificial y el aprendizaje automático, la aplicación de técnicas de clasificación multiclase y crecimiento de región en imágenes médicas abre nuevas oportunidades para mejorar los algoritmos destinados a la interpretación de datos visuales. Esto puede llevar a avances significativos en el desarrollo de herramientas automatizadas para el análisis de imágenes médicas, beneficiando una amplia gama de disciplinas médicas.

Finalmente, en la educación médica, la disponibilidad de herramientas avanzadas como esta puede ser integrada en los programas de formación, proporcionando a los estudiantes experiencia práctica con tecnología de vanguardia y preparándolos mejor para enfrentar los desafíos del diagnóstico médico en el futuro.

Referencias y recursos Adicionales

Anexo A. BXP19-W005

COLOMBIA
Bogotá
Medellín
Barranquilla
Bucaramanga

JAPÓN
Tokio

ANEXO A
Documentos principales no patente

No.	Título	Link
P1	Standard Automated Perimetry	https://eyewiki.aao.org/Standard_Automated_Perimetry
P2	Interpretation of Automated Perimetry for Glaucoma by Neural Network	http://iovs.arvojournals.org/data/journals/iovs/933407/3362.pdf

Anexo B. BXP19-W005

ANEXO B

Referencias principales

Documentos de patente

No.	Patente/Número de publicación	Título	Resumen	Titular/Nombre del solicitante
1	US2019090733A1	Optical Coherence Tomography-Based Ophthalmic Testing Methods, Devices And Systems	In accordance with one aspect of the present invention, an optical coherence tomography-based ophthalmic testing center system includes an optical coherence tomography instrument comprising an eyepiece for receiving at least one eye of a user or subject; a light source that outputs light that is directed through the eyepiece into the user's or subject's eye, an interferometer configured to produce optical interference using light reflected from the user's/subject's eye, an optical detector disposed so as to detect said optical interference; and a processing unit coupled to the detector. The ophthalmic testing center system can be configured to perform a multitude of self-administered functional and/or structural ophthalmic tests and output the test data	DOHENY EYE INSTITUTE (LOS ANGELES, US)

2	US9462945B1	System And Methods For Automatic Processing Of Digital Retinal Images In Conjunction With An Imaging Device	Systems and methods of obtaining and recording fundus images by minimally trained persons, which includes a camera for obtaining images of a fundus of a subject's eye, in combination with mathematical methods to assign real time image quality classification to the images obtained based upon a set of criteria. The classified images will be further processed if the classified images are of sufficient image quality for clinical interpretation by machine-coded and/or human-based methods. Such systems and methods can thus automatically determine whether the quality of a retinal image is sufficient for computer-based eye disease screening. The system integrates global histogram features, textural features, and vessel density, as well as a local non-reference perceptual sharpness metric. A partial least square (PLS) classifier is trained to distinguish low quality images from normal quality images.	VISIONQUEST BIOMEDICAL LLC (US)
3	US8474978B2	Pattern Analysis Of Retinal Maps For The Diagnosis Of Optic Nerve Diseases By Optical Coherence Tomography	Methods for analyzing retinal tomography maps to detect patterns of optic nerve diseases such as glaucoma, optic neuritis, anterior ischemic optic neuropathy are disclosed in this invention. The areas of mapping include the macula centered on the fovea, and the region centered on the optic nerve head. The retinal layers that are analyzed include the nerve fiber, ganglion cell, inner plexiform and inner nuclear layers and their combinations. The overall retinal thickness can also be analyzed. Pattern analysis are applied to the	UNIV SOUTHERN CALIFORNIA (US)

			maps to create single parameter for diagnosis and progression analysis of glaucoma and optic neuropathy.	
4	US8787638B2	Method And Device For Retinal Image Analysis	The present application provides methods and devices for diagnosing and/or predicting the presence, progression and/or treatment effect of a disease characterized by retinal pathological changes in a subject.	UNIV HONG KONG CHINESE (CN)
5	WO2018069768A2	Systems And Methods For Detection Of Ocular Disease	Disclosed herein are computer systems for, in part, image processing. Also disclosed herein are systems for processing ocular images of multiple imaging modalities to detect ocular diseases. Also disclosed herein are method comprising systems as described herein.	TRANSLATUM MEDICUS INC (CA)
6	WO2018143180A1	Image Processing Device And Image Processing Program	The present invention addresses the technical problem of providing an imaging processing device and an image processing program which efficiently present an analysis result. The image processing device according the present disclosure is for processing an image of a subject eye, and is characterized by comprising: an image acquisition means for acquiring the image of the subject eye; a diagnosis means for obtaining a diagnosis result of the subject eye on the basis of the image acquired by the image acquisition means; and a display control means for changing the display mode of a display means on the basis of the diagnosis result. Accordingly, an analysis result can be efficiently presented.	NIDEK CO LTD (JP)

7	US2019043193A1	Systems And Methods Using Weighted-Ensemble Supervised-Learning For Automatic Detection Of Retinal Disease From Tomograms	Disclosed herein are systems, methods, and devices for classifying retinal tomograms according to disease type, state, and stage. The disclosed invention details systems, methods, and devices to perform the aforementioned classification based on weighted-linkage of an ensemble of machine learning models. In some parts, each model is trained on a training data set and tested on a test dataset. In other parts, the models are ranked based on classification performance, and model weights are assigned based on model rank. To classify a tomogram, that tomogram is presented to each model of the ensemble for classification, yielding a probabilistic classification score—of each model. Using the model weights, a weighted-average of the individual model-generated probabilistic scores is computed and used for the classification.	RETINA AI LLC (US)
8	US7841718B2	Apparatus And Method For Assessing Retinal Damage	The invention administers an objective clinical test to an eye that measures the visual sensitivity of the superior retina and the inferior retina, by alternately presenting a stimulus pair comprising a shaped superior light stimulus and a shaped inferior light stimulus that are horizontal mirror images of one another and have shapes encompassing visual field defects. The shaped superior and inferior light stimuli stimulate pupillary responses whose amplitudes are measured. A cycle-averaged pupillary response balance and a luminance ratio are computed for	UNIV NEW YORK STATE RES FOUND (US)

			each presentation of a stimulus pair. A stimulus pair response curve is computed by fitting cycle-averaged pupillary response balances to a sigmoid function of the luminance ratios. A balanced luminance ratio at which the cycle-averaged pupillary response balance is equal to about zero is computed from the sigmoid function. The balanced luminance ratio is indicative of the presence and location of retinal nerve damage.	

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Documentos no patente

No.	Título	Link
1	Classifying Patterns of Localized Glaucomatous Visual	https://www.semanticscholar.org/paper/Classifying-patterns-of-localized-glaucomatous-on-Sihota-Gupta/e4a7fde4687ad1cec4f176ecbf5aa1f237980b20

Referencias secundarias

Documentos de patente

No.	Patente/Número de publicación	Título	Resumen	Titular/Nombre del solicitante
1	US10064548B2	Method And Apparatus For Sensory Field Assessment	A method for assessing the function of at least one sensory field of a subject, and apparatus and systems for carrying out the method, the method comprising: using a display, presenting stimuli to selected locations of the sensory field, the selected locations being centered at points on a sampling grid spanning a portion of the sensory field, wherein the individual stimuli if presented simultaneously at the sampling grid points would overlap in the space defined by the sensory dimensions of the field; using a sensor, detecting responses in the subject's sensory field evoked by the stimuli; and processing the detected responses to relate them to the function of the subject's sensory field at the selected locations.	AUSTALIAN NATIONAL UNIV (AU)
2	US9826896B2	Image Processing Apparatus, Image Processing Method, And Storage Medium	An image processing apparatus includes a detecting unit configured to execute structural analysis on a tomographic image acquired by an acquiring unit and detect an abnormal portion of the eye; and a display control unit configured to cause a displaying unit to display a finding of the abnormal portion detected by the detecting unit, as a sentence or a word in a manner superimposed on the tomographic image.	CANON KK (JP)

3	US20170293356A1	Methods And Systems For Obtaining, Analyzing, And Generating Vision Performance Data And Modifying Media Based On The Vision Performance Data	The present specification describes methods and systems for modifying a media, such as Virtual Reality, Augmented Reality, or Mixed Reality (VR/AR/MxR) media based on a vision profile and a target application. In embodiments of the specification, a Sensory Data Exchange (SDE) is created that enables identification of various vision profiles for users and user groups. The SDE may be utilized to modify one or more media in accordance with each type of user and/or user group.	VIZZARIO INC (US)
4	US8487775B2	Method And Apparatus For Determining And Analyzing A Location Of Visual Interest	A method of analyzing data based on the physiological orientation of a driver is provided. Data is descriptive of a driver's gaze-direction is processing and criteria defining a location of driver interest is determined. Based on the determined criteria, gaze-direction instances are classified as either on-location or off-location. The classified instances can then be used for further analysis, generally relating to times of elevated driver workload and not driver drowsiness. The classified instances are transformed into one of two binary values (e.g., 1 and 0) representative of whether the respective classified instance is on or off location. The uses of a binary value makes processing and analysis of the data faster and more efficient. Furthermore, classification of at least some of the off-location gaze direction instances can be inferred from the failure to meet the determined criteria for being classified as an on-location driver gaze direction instance.	VOLVO TECHNOLOGY CORP (SE)

5	US8348429B2	Optical Coherence Tomography Device, Method, And System	In accordance with one aspect of the present invention, an optical coherence tomography instrument comprises an eyepiece for receiving at least one eye of a user is provided; a light source that outputs light that is directed through the eyepiece into the user's eye; an interferometer configured to produce optical interference using light reflected from the user's eye; an optical detector disposed so as to detect said optical interference; and electronics coupled to the detector. The electronics can be configured to perform a risk assessment analysis based on optical coherence tomography measurements obtained using the interferometer. An output device can be electrically coupled to the electronics, and may be configured to output the risk assessment to the user through the output device. The optical coherence tomography instrument can be self-administered, and the eyepiece can be a monocular system or a binocular system.	DOHENY EYE INST (US)

6	US8256897B2	Circular Profile Mapping And Display Of Retinal Parameters	Certain diseases of the retina are diagnosed by circular profile analysis of retinal parameters, such as thickness. Retinal thickness around a user-defined circle on the retina is measured by various ophthalmological techniques and—+mapped to a circular profile map. The circular profile map does not use segmentation of measurement data into arbitrary arcs, and thickness is mapped to a quasi-continuous range of display bands. The circular profile map is superimposed on a fundus image, or other two-dimensional image of the retina, allowing association of the circular profile map with the presence of blood vessels and other anatomical features. The simultaneous display of a series of circular profile maps generated from sets of measurement data taken at different times permits the ready visualization of the progression of retinal abnormalities.	TOPCON MEDICAL SYSTEM INC (US)

7	US8210681B2	Method And Device For Assessing The Field Of Vision	The invention relates to a method for assessing the field of vision, wherein FDF stimuli are produced and detected by a person using the at least one eye to be examined. The invention is based on the object of providing a novel method and a device in order to efficiently assess the field of vision of a person and/or in order to recognize early signs of disease processes, which can lead to limitations in the field of vision. For this purpose, the invention provides that the production of the FDF stimuli is carried out by utilizing a computer-controlled system for the efficient determination of the vision and that the respective FDF stimulus is generated by utilizing an imaging device.	FLANAGAN JOAN (CA); HEIDELBERG ENGINEERING GMBH (DE)

8	US20110190657A1	Glaucoma Combinatorial Analysis	The subject invention relates to combinatorial analyses of data from two or more diagnostic tests for the detection of eye diseases, simplified interpretation of test results, and assessment of disease stage and rate of change. Of particular interest is to develop combinatorial analyses to improve glaucoma detection and progression rate assessment based on combinations of structural and functional tests. More specifically, approaches are described where data of one or more tests and their normative database are converted to the distribution and scale of another test for further analysis to detect glaucomatous damage; approaches are also described where data of more than one tests are used to assess stage index and rate of change; in addition, methods for displaying the combinatorial analysis results are disclosed.	ZEISS CARL MEDITEC INC (US)

9	US6735331B1	Method And Apparatus For Early Detection And Classification Of Retinal Pathologies	A method and apparatus for early detection and classification of retinal pathologies, especially glaucoma and macular edema. The method comprises; (a) illuminating predetermined locations on the retina; (b) receiving light returning from predetermined locations; (c) generating a series of primary graphs corresponding to the light intensity with respect to retinal depth of predetermined locations on the retina; (d) separating the component curves of said graphs; (e) analyzing said component curves to produce data including data corresponding to the front slope and/or the back slope, and/or the area of at least one of said component curves; (f) comparing said data to analogous pre-specified data.	TALIA TECHNOLOGY LTD (IL)

10	WO9916010A1	Automated Visual Inspection System And Process For Detecting And Classifying Defects	An automated visual inspection system and process are disclosed. The system (10) includes an imaging system (12) operable to provide image data and a precision positioning system (14) operable to move the imaging system (12) to scan an object (16). A processing and control engine is coupled to receive the image data and to provide control signals to the precision positioning system (14) and other components. The processing and control engine pre-processes the image data, represents the image using descriptors, compares the descriptors to information in a knowledge base and detects and classifies defects based upon results of the comparison. The processing and control engine also associates a confidence level with the classification of the defect. In one embodiment, if the confidence level is not above a specified tolerance, the processing and control engine alerts an operator and provides a best option as to the classification of the defect, accepts a confirmation or alternate classification from the operator, and adds information to the knowledge base after a decision is made. In another embodiment, the imaging system (12) provides structured, reflected light intensity as part of the image data, and the processing and control engine recovers three-dimensional spatial information based upon the reflected light intensity.	INTELLIGENT REASONING SYSTEM (US)

11	US5864384A	Visual Field Testing Method And Apparatus Using Virtual Reality	A method and apparatus are disclosed for using Virtual Reality for testing and quantifying visual information from the eye, the visual pathways, and the brain. Head-gear configuration allows the patient to observe a field of view into which sequenced test stimuli are presented by an excitation device commanded by a computer. Interactive sensory feedback both to and from the patient enables computer-driven presentation and modulation of test stimuli to measure with precision such parameters as visual field performance, visual acuity, and color vision. Using the system allows the patient unprecedented freedom of movement of the head and body, thus minimizing or even eliminating the stress and fatigue common with conventional non-Virtual Reality visual field testing systems.	MASSENGILL R KEMP; MCCLURE RICHARD J

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Documentos no patente

No.	Título	Link
1	Interpreting Visual Fields	Link
2	Classification of Visual Field Abnormalities in the Ocular Hypertension Treatment Study	Link
3	Visual fields interpretation in glaucoma: a focus on static automated perimetry	Link
4	Interpretation of autoperimetry	Link
5	Interpreting automated perimetry	Link