Cognitive function and mental health diagnosis device and method

Mental health diagnosis device and method

Patent title	Transcript drawing test device and method for evaluating cognitive impairment, and recording medium containing same	**Inventor**	Korea Institute of Science and Technology / Choi Ji-hyun and five more
Patent application No.	KR 10-2020-0018323(2020.02.14)	**Authority status**	Unpublished
Patent title	Method for measuring power of memory and concentration on basis of recognition memory	**Inventor**	Korea Institute of Science and Technology / Choi Ji-hyun
Patent application No.	KR 10-2020-0001359(2020.01.06)	**Authority status**	Unpublished
Patent title	Brain function evaluation device using binocular competition, method therefor, and recording medium containing same	**Inventor**	Korea Institute of Science and Technology / Choi Ji-hyun and two more
Patent application No.	KR 10-2018-0009396(2018.01.25)/10-2066737(2020.01.09)	**Authority status**	Registered
Patent title	Device and method for diagnosing neurological diseases using virtual reality	**Inventor**	Samsung Life Public Welfare Foundation / Na Deok-ryul and six more
Patent application No.	KR 10-2017-0037050(2017.03.23)/10-1983279(2019.05.22)	**Authority status**	Registered

Technicality

Technology overview

A cognitive function diagnosis technology reduces the mental/physical stress of patients by diagnosing neurological diseases such as dementia easily and rapidly through cognitive function tests such as impulsivity, spatial memory power, spatiotemporal processing ability, and concentration on the basis of the need to select risk groups for cognitive impairment, and greatly improves accuracy and economy.

Depending on the diagnosis method, this technology can be used for ① virtual reality (VR), ② video-based eye tracking, ③ an application, ④ a digital pen data technology, and can be applied to healthcare services (mobile, wearable devices and the like) and VR kits for self-diagnosis.

Development background and problem to be solved

- With the global aging population, the number of dementia patients is rapidly increasing, and social costs are increasing thereby.
- Methods for diagnosing dementia include psychological questionnaires, brain imaging, blood and cerebrospinal fluid analyses, biomarkers, and tests for brainwaves. The dementia diagnosing methods entail cost burden on patients and long-term mental/physical suffering.

Excellence and discrimination of technology

▶ Excellence of technology

- The cost burden and long-term mental/physical pain of dementia diagnoses are reduced, and thus a simple and accurate diagnosis within 20 minutes is possible.
- **Virtual reality diagnosis**: Comprehensive diagnosis based on daily life is possible by building a virtual space. The technology can also be used for cognitive interventional treatment.
- **Video-based eye tracking diagnosis**: Comprehensive evaluation based on daily life is possible regardless of the academic background or age.
- **Application diagnosis**: Easy early diagnosis and comparison of changes in cognitive functions are possible.
- **Digital pen data diagnosis**: Evaluation after quantifying and evaluating natural detailed cognitive activities in a process of performing copy-drawing is possible.

▶ Discrimination of technology

- It is possible to monitor the stage of dementia as the technology not only diagnoses dementia and neurological diseases, but also provides information on changes in the functions of each cognitive area.
- Collection and analysis time and cost are reduced by accumulating quantitative data and distribution for an unspecified number of neurocognitive abilities.
- Virtual reality, video, and picture-based diagnoses can be used as a cognitive test tool that can be easily accessed by anyone around the world.

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Implementation method

According to the present invention,

- **Virtual reality diagnosis**: Through a method for diagnosing neurological disease dementia using virtual reality, the problem for diagnosing neurological diseases is displayed in a virtual reality environment through a display, and a user's motion is detected and evaluated.
- **Video-based eye tracking diagnosis**: After outputting an image to a subject's eyes, an image that won the binocular competition is judged by tracking the subject's gaze or measuring brainwaves, and the brain function is evaluated according to the judgment.
- **Digital pen diagnosis**: Detailed cognitive activities, such as a drawing area, a drawing configuration, and determining the order of images, which occur while a patient with dementia performs copy-drawing are quantitatively evaluated.
- **Application-based diagnosis**: After accessing the web or application and undergoing a user setting step, it is possible to select one of a color impulsivity test, a BIS self-diagnosis questionnaire, and an n-back-based memory test and perform a self-diagnosis for 5 minutes to obtain a test result.

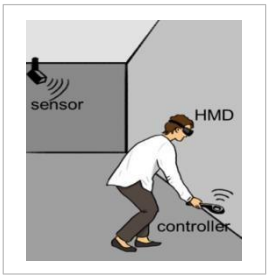

Figure 1 Virtual reality diagnosis

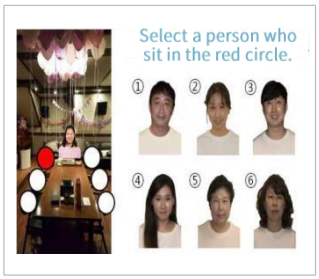

Figure 2 Video-based eye tracking diagnosis

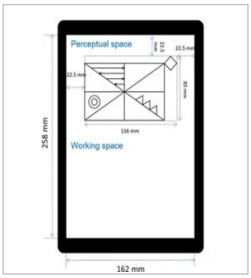

Figure 3 Digital pen diagnosis

Figure 4 Application-based diagnosis

Degree of technology completion (TRL)

Degree of technology completion: TRL6 (Full Scale prototype development stage)

TRL1	TRL2	TRL3	TRL4	TRL5	TRL6	TRL7	TRL8	TRL9
Technical principle presentation	Technology concept setting	Technology concept verification	Lab Scale prototype development	Implementation environment application experiment	Full Scale prototype development	Quasi-commercial product development	Commercial product development	Commercial product implementation

Utilization

Utilization field and applied product

Utilization field

- End-user customized healthcare field
- Hospital placement medical device field
- Self-diagnosis field for dissemination to public institutions
- Insurance company simple group inspection and continuous monitoring field

Figure 1 Dementia prevention education for public institutions

Applied product

- Healthcare app
- Healthcare web service
- Psychological test kit
- Self-diagnosis VR kit

Figure 2 Wearable device

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Technology trend

- For the diagnosis of dementia, cerebrovascular diseases and brain atrophy can be investigated through brain imaging (MRI). However, confirmation is possible only when the brain atrophy is quite advanced, and thus the technology is difficult to use for early diagnosis purposes. Thus, when dementia symptoms appear, various biomarkers are utilized to find an exact etiology.
- Representative Alzheimer-related clinical trials are centered on multinational companies in developed countries such as the United States, and the proportion of clinical trials supported in Korea is still insignificant. However, Korea is showing some achievements, such as launching the world's 4th Alzheimer's diagnostic contrast agent, in the diagnostic field.

Family patent status

Application nation	Application No. (Application date) / Registration No.	Title of the invention
KOR	KR10-2018-0019642(2018.02.20) / 10-2114540(2020.05.18)	Cognitive recycling swarm robot using self-organization, and robot system and cognitive rehabilitation method using same
PCT (EU, USA)	PCT/KR2018/003203 (2018.03.20)	Neurological disorder diagnosis device and method which use virtual reality

Market prospect

Target market size and prospect

- The number of dementia patients in Korea is expected to increase rapidly from 700,000 in 2017 to about 3 million in 2050 due to the high rate of dementia compared to the elderly population as the aging rate is accelerating.
- The dementia treatment agent market is also growing rapidly, and according to the Persistence Market Research, the global dementia treatment market is estimated to reach USD 21.1 billion (KRW 25 trillion) in 2020, but this is a forecast limited to only the treatment agent market. The World Alzheimer's Report expects that dementia-related costs reach USD 2 trillion (KRW 2400 trillion).

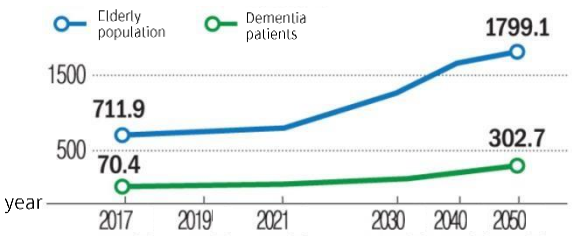

Figure 1 **Growth trend of the elderly and dementia population (unit: 10,000 people)**

<Data: Statistics Korea, Ministry of Health and Welfare, Central Dementia Center >

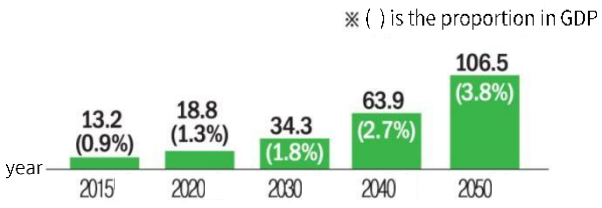

Figure 2 **Trends of national dementia management cost increases (unit: KRW trillion)**

<Data: Statistics Korea, Ministry of Health and Welfare, Central Dementia Center >

Technology transfer query

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Technology transfer process