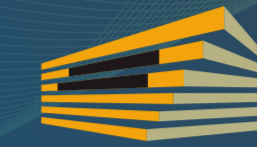


PROGNOSIS

System (software) for remote assessment of the vocal tract to early detection and monitoring of neurodegenerative pathologies (Alzheimer's disease) based on the voice



TYPE OF R+D RESULT

- New technology
- New product
- New service
- New knowledge or skill



COMMERCIAL MATURITY LEVEL

- Conceptual idea
- Proof of concept (design)
- Validated in a controlled environment
- Validated in a real environment
- Successfully implanted



PROTECTION LEVEL

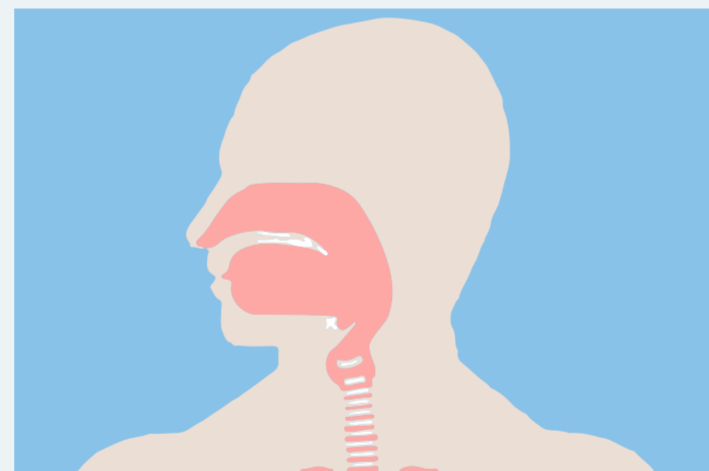
- Non-applicable
- Patent
- Software
- Know-how
- Utility model

Description of the solution. Problem solved

Alzheimer's disease (AD) cannot be easily diagnosed. Initially, diagnosis is done by doing numerous medical tests that discard that all the symptoms are related to other pathologies. This diagnosis process begins with a studio of the health records where the physician assesses the patients' and their family health history.

Next, a neuropsychological examination is done in order to confirm that existing symptoms correspond to some kind of dementia. There is a large amount of detection tests to carry out this study. In any case, age and the chances of suffering other disorders must be taken into account.

Generally, if patient presents clinical symptoms and deterioration of two or more cognitive functions and, once a second disease as a cause of the dementia has been discarded, more sophisticated studies for supporting the diagnoses are used, they are neuroimaging studies. These studies are classified in two groups.



On the first group we find structural neuroimaging studies, that are primary based on computed tomography scan (TAC) and magnetic resonance imaging (MRI), which allow to exclude structural lesions as the main cause of dementia. On the second group, we find functional neuroimaging studies such as single-photon emission computed tomography (SPECT) and positron emission tomography (PET.) Neuroimaging studies are tools that help to confirm suspected diagnosis, but they are not definitive tests to confirm the disease.

Another test is the use of biological markers for diagnosis, in which samples are obtained by a lumbar puncture where cerebrospinal fluid is extracted in order to find a reduction of beta-amyloid and an increase of the tau protein to support the diagnosis.

Finally, it may be necessary a test based on histopathologic criteria, which mainly quantifies senile plaques and neurofibrillary tangles, typical of this disease. The higher number of tests for detection, the higher reliability of the diagnosis. Currently, diagnosis is produced when the disease has already manifest-

ed. Diagnosis on early stage of AD is a problematic task since patients and family tend to ignore or attribute to age-related changes the first clinical manifestations. Generally, it takes 2 to 3 years for patients to go to doctor after symptoms appear.

In this context, PROGNOSIS project proposes to develop a non-invasive automated tool, based on digital processing of spontaneous speech for early detection of AD and monitoring of patients.

Currently, the Institute for Technology Development and Innovation in Communications (IDeTIC) is carrying out an observational study for healthy individuals and patients suffering from Alzheimer to learn about their evolution over time in order to validate that voice alterations may announce the disease's presence. This study is allowing to create a patient database that is vital for testing the system. The objective of this study is to guarantee that the system does not have false negative results (undiagnosed patients.) On the contrary, it would allow an adjusted error margin concerning to false-positive results (healthy individuals wrongly diagnosed), that once complementary tests would be carried out, could be discarded.

Fields of commercial application

The following target sectors may be interested in acquiring and exploiting the system:

- Medical equipment manufacturers.
 - Pharmaceutical industry.
 - Companies specialised in developing or providing voice processing services via internet or mobile devices such as automated voice recognition or speaker recognition.
 - Health insurance industry.
 - Private clinics interested in high-tech service differentiation.
- Potential users:
- Specialized medical professionals: Neurologists.
 - Medicine professionals: primary health care.
 - Public healthcare systems and private clinics.

Market opportunity

Nowadays, around 47 million people is affected by Alzheimer. This is a progressive neurodegenerative disease, which needs a proper treatment in order to avoid a significant, irreversible mental decline.

Technology is increasingly used in computed assessments in order to detect cognitive changes. In this sense, voice processing poses technological challenges such as the machines' capacity to recognise natural speech and reading non-structured data. However, large companies such as IBM, Google or

Amazon are working on it; so, there is a huge potential for the use of early detection and control of Alzheimer's disease by studying the patients' voices.

Also, research data suggests that dementia can be early detected by studying eye movement disorders or problems with sense of smell on affected individuals. In this context, the software for assessing vocal tract may contribute, in case it is effective, to multimodal studies involving several tests as the aforementioned.

One of the main advantages of the project PROGNOSIS is that this application is able to be applied remotely, "mechanising" detection of these pathologies, which differs from current methods that need a specialist to be present during the tests. This project fits in the future assistance paradigm based on the TELE-CARE and TELEMEDICINE systems.

Competitive advantage

The project PROGNOSIS is based on the assumption that speech use presents a gradual decline throughout Alzheimer's disease. Also, manifestation and severity of language deficit is correlated with the severity of the type of dementia, which is manifested in early stage of the disease. In addition to this, a relevant fact for early detection is the abnormal expression of the emotional states suffered by AD patients.

This software intends to provide global assessment of a speech sample, that is calculated in a automated and objective way, allowing to document the state of the patient. This assessment will be obtained by analysing jointly three aspects of speech: 1) acoustic voice assessment, 2) emotional load assessment and 3) different speech features. This joint evaluation of the three aspects of speech is new in diagnosis and monitoring of AD patients, since there are no previous references of this use.

Concerning to other early detection tests of Alzheimer, this proposed system (at the expense of its utility) has the following advantages:

- Accessibility: On-line system available at any time (24/7) and from anywhere (patient's location is not important).
- Usability: Intuitive an easy-to-use design, assisted by sound and text messages that guide user during the process.
- Universality: Patient can speak in any language.
- Acceptability: System does not discriminate patients because of their cultural level, since it does not require to go through reading tests, which contributes to its acceptance among users.

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- Autonomy: It does not require the presence of specialised doctors, although they must interpret the resulting assessment.
- Convenience: It does not require any kind of instruments, being therefore non-invasive for patients.

Resources needed to be implemented

Proofs of concept still need to be done, as well as performing clinical research and defining the development of products and services.