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AI4HealthyAging: AI to prevent aging-related diseases

The consortium, led by Capgemini and made up of 15 scientific-technological entities, has harnessed the full power of AI for early detection and clinical decision-making

Early detection and data-driven clinical decision-making are some of the major challenges medicine faces when addressing aging-related diseases, such as stroke or heart failure. Reliable and transparent AI has great potential to unlock these challenges.

AI4HealthyAging is a project meant to improve the early detection of aging-related diseases using AI. It is carried out by a public-private consortium consisting of 15 entities and funded under the 2021 AI R&D Missions program by the Spanish Ministry of Economic Affairs and Digital Transformation.

The consortium, coordinated by Capgemini, designs and develops intelligent solutions that enable the early detection of neurological, motor, and degenerative diseases associated with aging

Client: Research consortium

Region: Spain

Industry: Healthcare

Client Challenge: Using AI for the early detection of age-related diseases with transparency, reliability, and privacy.

Solution: Designing and developing intelligent solutions for the early diagnosis of stroke and heart failure, as well as federated learning solutions.

Benefits:

- Scalable solution
- Enhanced security for sensitive information
- Algorithms achieve over 85% accuracy in controlled environments

and take rapid action. These systems support decision-making for elderly patients with conditions such as heart failure, stroke, sarcopenia, Parkinson's disease, cognitive impairment associated with hearing loss, and other neurodegenerative diseases.

Additionally, the project includes cross-cutting activities primarily focused on federated learning, the design and development of explainability methods—which allow human users to understand and trust the results created by AI algorithms—and bias detection and mitigation techniques. Capgemini has coordinated the initiative and been responsible for the development of two key work packages: an early warning system for heart failure and stroke as well as federated and explainable AI for advanced medical applications.

Federated and explainable AI for advanced medical applications

Federated learning in healthcare has revolutionized the way AI models are trained, enabling collaboration between multiple entities without compromising data privacy. The decentralized approach used in this project is fundamental for medical research and AI-assisted diagnosis, as it allows hospitals, clinics, and institutions to share knowledge without the need to transfer sensitive data. In this context, the implementation of advanced security mechanisms, such as chaotic encryption, further reinforces the confidentiality and integrity of the information.

Since medical data contains highly sensitive information, ensuring its security is a priority. By not requiring the transfer of data to central servers, but rather training models locally and only sharing update parameters, the risk of leaks or unauthorized access is reduced. This fosters trust among both patients and healthcare professionals in AI's ability to improve treatments and diagnoses.

From a social perspective, hospitals with less infrastructure can benefit from models built from data gathered from multiple entities without compromising their privacy. In this way, AI is democratized, reducing inequalities in healthcare. From an ethical standpoint, the use of federated learning with advanced security measures promotes transparency and compliance with privacy regulations.

Additionally, AI models have been developed that incorporate explainability methods, allowing healthcare professionals to understand and validate predictions, which reinforces trust and facilitates their integration into clinical and regulatory environments. Specifically, the consortium has created informative cards that provide both data information (Data Cards) and model information (Model Cards). This environment has also been enhanced with large language models to enable queries and support decision-making.

> "The application of AI for the early detection and treatment of highly prevalent diseases among the elderly has delivered tangible results with strong potential for adoption within the healthcare system, spanning both complex medical services and primary-level interventions."
>
> **Miguel Arjona, R&D Director at Capgemini Engineering Spain**

Early warning system for heart failure and stroke

The system's development is based on monitoring Inertial Measurement Unit (IMU) motion sensors and electrocardiograms (ECG) to estimate the recovery level of patients with stroke or heart failure. This approach represents a non-invasive solution that allows evaluation of patient progress without the need for complex or uncomfortable medical procedures. This is especially relevant for individuals with fragile health conditions who may experience anxiety or discomfort with traditional monitoring methods that require constant hospital visits.

Additionally, the implementation of this technology is key to improving access to healthcare for vulnerable populations. With the use of IMU and ECG sensors, these patients can be monitored remotely, reducing the need for frequent transfers and alleviating the economic and logistical burden for them, their caregivers, and the healthcare system in general.

Another key benefit of this project is its ability to generate real-time data, which enables the estimation of a patient's recovery level and predicting their evolution. In the case of patients who have suffered a stroke, IMU sensor-based motion analysis provides detailed information about the recovery of mobility, coordination, and overall motor function.

For patients with heart failure, the use of ECG as a continuous monitoring tool allows the evaluation of a heart's electrical activity, anomaly detection, and the precise adjustment of treatments. By combining this data with prediction algorithms, doctors can anticipate complications and modify medication according to each patient's specific needs.

Artificial Intelligence for the Early Diagnosis and Treatment of Highly Prevalent Diseases in Aging is a project funded by the R&D Missions in Artificial Intelligence Program of the Ministry of Economic Affairs and Digital Transformation (MIA.2021.M02.0007)

Financiado por la Unión Europea NextGenerationEU

MINISTERIO DE ASUNTOS ECONÓMICOS Y TRANSFORMACIÓN DIGITAL

Plan de Recuperación, Transformación y Resiliencia

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