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A Digital Health Platform for Remote Cognitive Functions Monitoring and Training of Older People in Southern Switzerland: a Development Study

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1 INTRODUCTION

The aging population is resulting in a worldwide rising prevalence of individuals experiencing cognitive decline, whether it be normal age-related changes or pathological conditions. Early signs of cognitive impairment often remain undiagnosed leading to delayed intervention. In addition, a shortage of preventive measures leaves many vulnerable to cognitive decline, despite the effectiveness of lifestyle adjustments and cognitive training in enhancing brain function.

Serious games are games designed with a primary focus on education or skill development and they have emerged as a promising tool for the cognitive training and cognitive assessment of older people. The novelty of our research is the use of such games not only for the training, but also to monitor cognitive performances of seniors receiving nursing care at home.

2 METHODS

A participatory approach has been applied to the development process of a set of games and a monitoring platform, involving a multidisciplinary research team (research nurse, engineers and software developers), a neuropsychologist, seniors, and geriatric nurses. The study comprises four stages (Fig.1). Firstly, a literature review was undertaken followed by qualitative interviews conducted with both geriatric nurses and seniors to explore needs and preferences. Findings informed the development of six serious games for the cognitive training of seniors receiving home care and a platform that allows nurses to monitor changes. Usability tests and a workshop with seniors and geriatric nurses were conducted to gain feedback along the development process. In the next phases of the project (WP3/WP4), the games and the platform will be implemented in clinical practice with home care users and nurses.

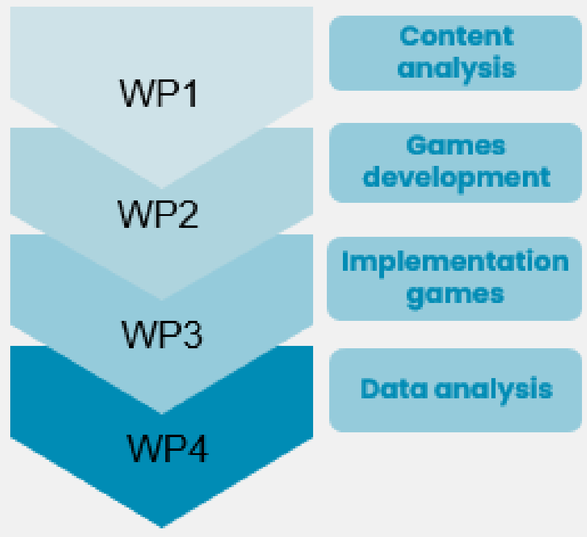

Figure 1: Work packages of the project

3 RESULTS

To train seniors, six different serious games were developed to stimulate multiple cognitive functions, including memory, attention, and executive functions, among other cognitive abilities. The developed games are: "Find the word", "Remember a sequence", "Jigsaw", "Whack-a-mole", "Three towers" and "Labyrinth". The games, developed in a 2D format with Unity software, are grouped in an application named *beSerious,* which features a tour of European capitals as thematic framework and runs on tablets.

Exploring the state-of-the-art, asking feedback and investigating potential users' needs was of paramount importance in order to tailor the games, especially considering that the level of digital literacy and digital skills among this specific population can vary greatly. For example, the labyrinth (maze) game requires players to move a car from the staring gate to the finish line by identifying the correct route. During the development of this game, the incorporation of a control mechanism featuring four directional arrows to be tapped was deemed more appropriate than a direct tapping on the car to facilitate movements (Fig.2).

Games were finally tested via usability tests and a workshop with a group of seniors. Participants varied in age and ability in the use of a tablet. Overall, they liked the experience and the challenges provided by the games, they understood the broader aim (cognitive functions training) and the rules of the games and could complete the tasks required. When asked they provided feedback on graphical elements (icons and colours) and made suggestions for improvements. The tablet appeared to be functional and relatively easy to use even for those that were novice to the digital technology.

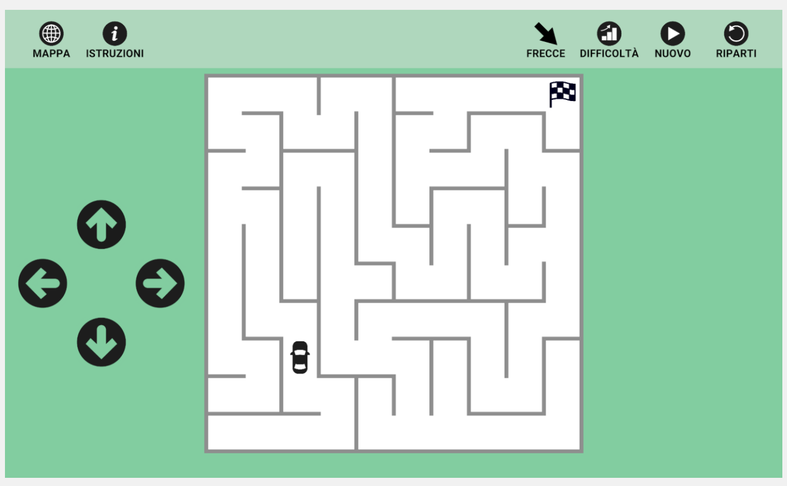

Figure 2: Labyrinth game

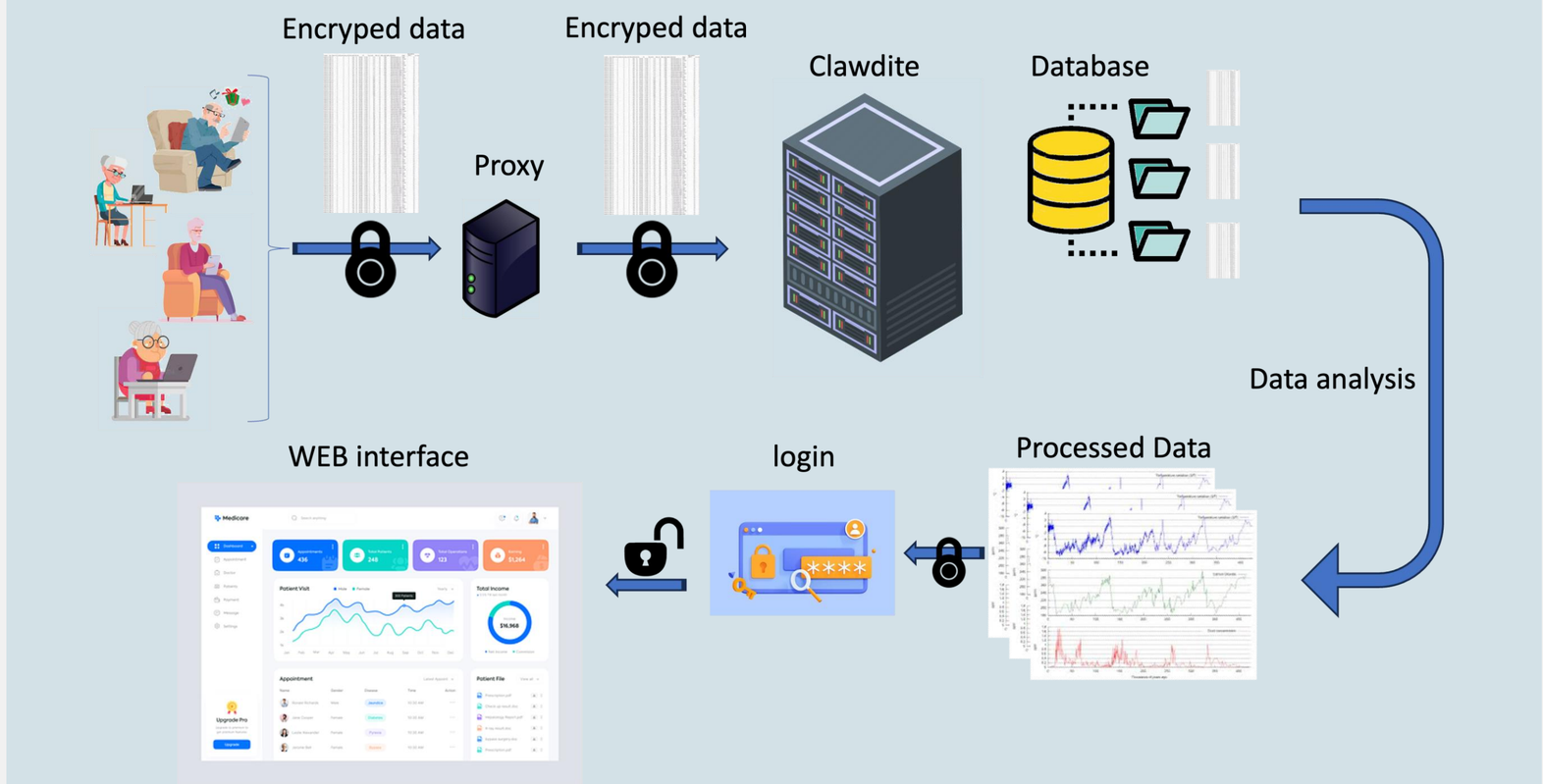

Figure 3: Data acquisition system architecture and web platform

In relation to the web platform that allows nurses to monitor the performances of seniors, a system of data acquisition, data analysis and a web platform was designed. The in-house developed platform Clawdite serves as the repository for data generated by the users while playing. Additionally, a dedicated web interface has been developed to present key insights and games performances to nurses.

Specifically, while a patient is playing a set of game-dependent data are saved locally on the device and then sent to a proprietary server, which collects all data in a database. Data are indexed per user and accessible only to members of the research team. Examples of data collected are frequency of use, duration of the game session, number of errors, number of attempts, and touch screen coordinates. All data are analysed to compute different parameters sensitive to the patient's cognitive status. A web-based application shows the players' performances to home care nurses in the form of tables, plots, and possible alerts (Fig.3).

4 CONCLUSION

The promising findings highlight the importance of engaging prospective end-users throughout the developmental phases of digital health products. This inclusive approach can anticipate identifying technical flaws and implementation challenges. By incorporating feedback and insights from future target users early in the development process, game designers and software developers can effectively address potential issues and optimise the overall user experience. Thus, ensuring the alignment of digital health products with user preferences and needs and enhancing adoption and engagement upon release. This is a perfect example of a digital health system: it originates from the needs of the patients, empowers healthcare professionals to implement ad-hoc strategies to address those needs, and, at the same time, fosters the generation of knowledge.

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