

A System for Engaging Older Adults in Maintaining an Active and Healthy Life Through Games

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- Rapidly aging population and high prevalence of age-related conditions, are increasing burdens on health care systems.
- Games are a useful tool in producing positive healthcare outcomes (World Health Organisation).
- Games are already applied in different domains: rehabilitation, improving mental and physical state, hyperactivity disorders.
- Aggregate health, oral health and wellbeing parameters with cognitive games for maintaining and improving the physical and mental status of the older adults.

General Characteristics

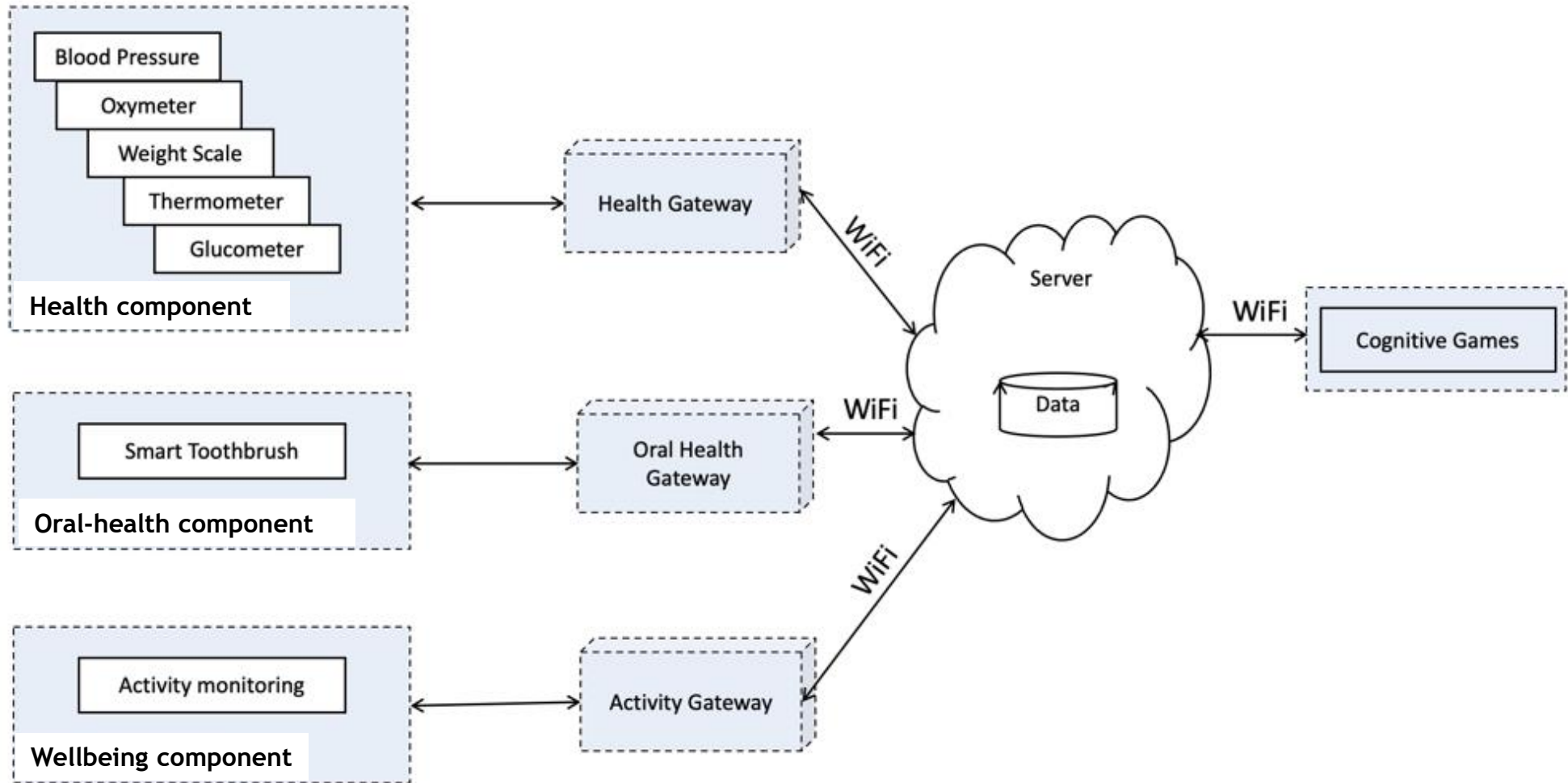
- Existing games were designed to train cognitive functions: attention, visual memory, observation, language, computation and orientation.
- MERITT system: combines health, oral health and wellbeing parameters with cognitive games.
- These parameters are integrated into cognitive games through points.
- They will award the user, getting him the possibility to obtain a higher place in the game leaderboard.
- Older adults will be motivated to maintain an active and healthy life.

System Description

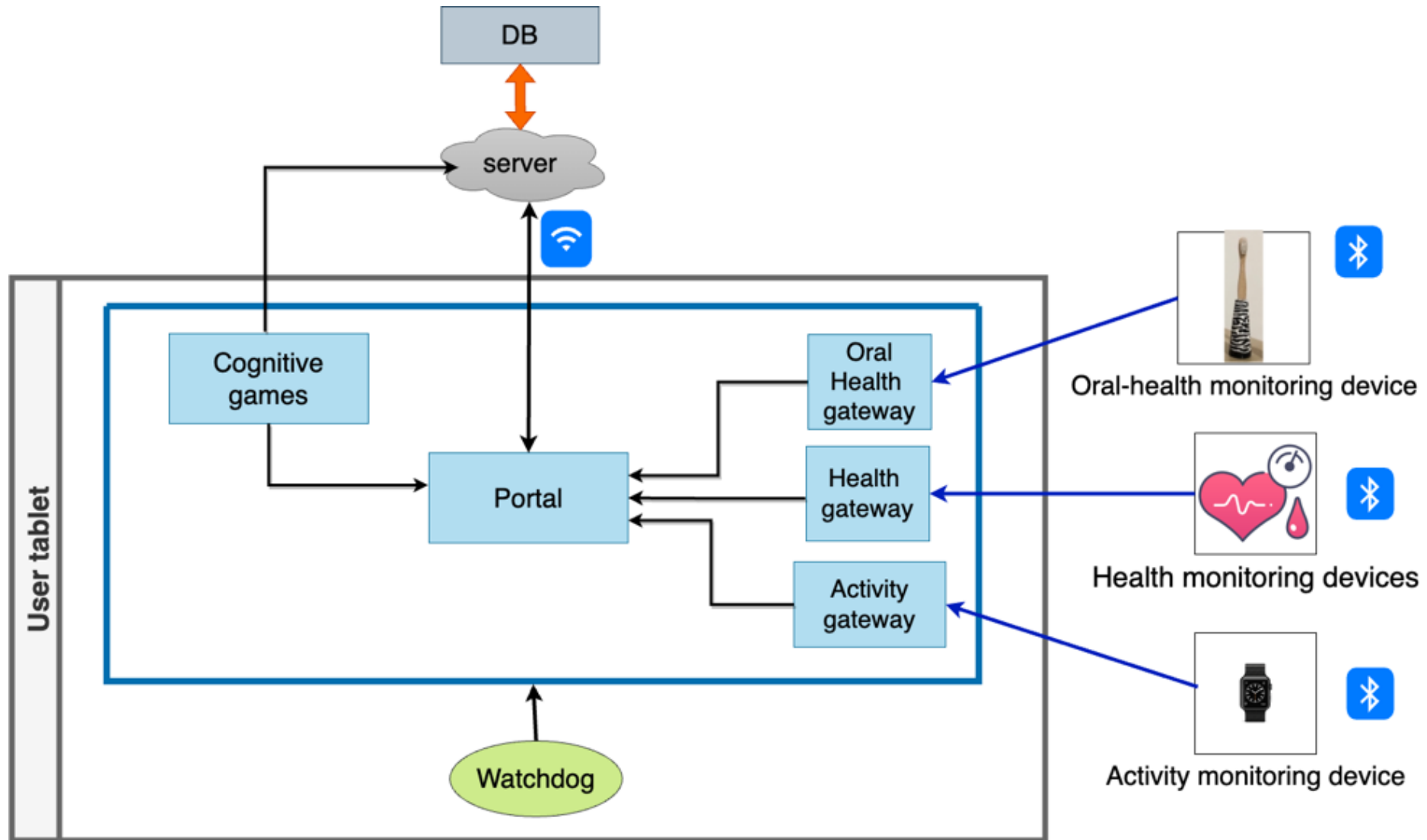
- MERITT system: client-server architecture
 1. **Health component:** health parameters from health devices: BLE health devices: A&D Medical blood pressure monitor, A&D Medical Thermometer, Accu-Chek Instant blood glucose meter, A&D Medical weight scale and oximeter,
 2. **Oral health component:** parameters relating to brushing using an intelligent toothbrush (developed in house),
 3. **Wellbeing component:** parameters for activity monitoring: Xiaomi Mi Band 3,
 4. **Games** for monitoring and improving health and cognitive aspects.

Architecture

- MERITT system: client-server architecture

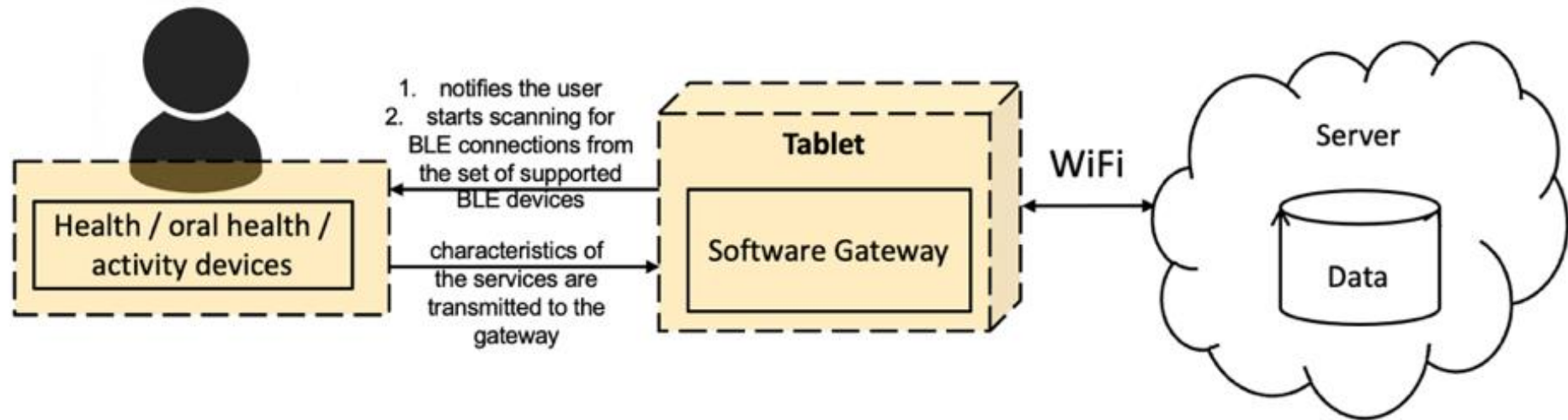


Software components



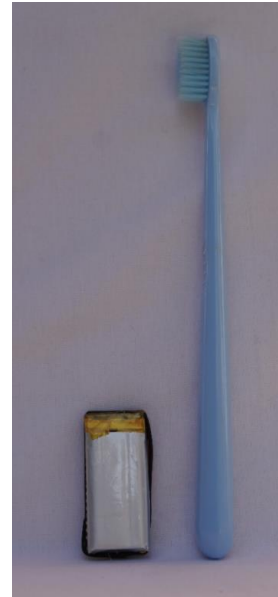
Structure of the software gateway

It receives data from the corresponding device through the BLE connection, sends data to the tablet that is further transmitted to the server.



Manual toothbrush
&
Microcontroller board with:

- Accelerometer
- Gyroscope
- Magnetometer
- Battery
- USB battery charger
- BLE



Rendering - Autodesk
Fusion 360

Oral-Health Component



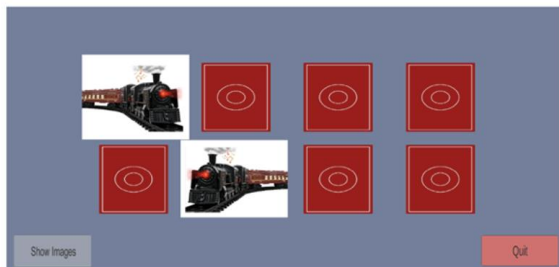
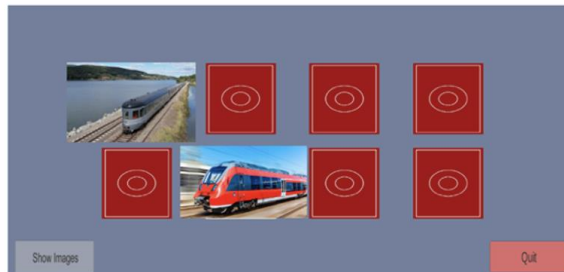
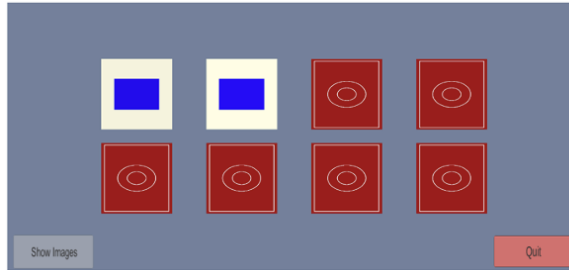
Magnetic
tape



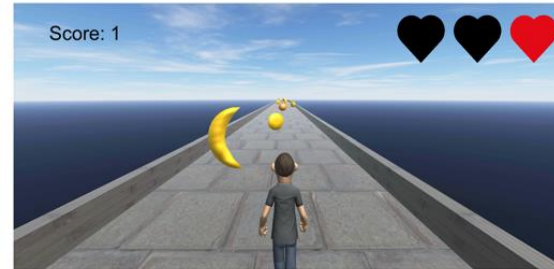
Games

Games: implemented in Unity 3D engine

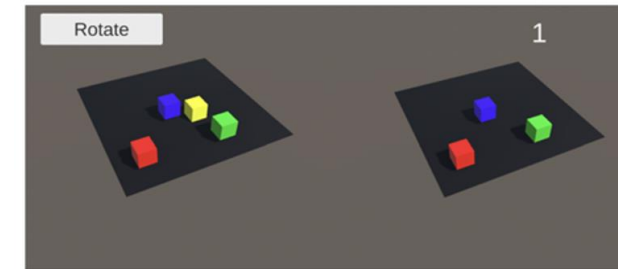
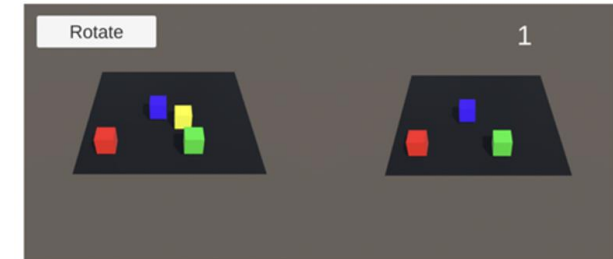
Match Game



Collect Objects



Get Differences



- Inside the games: **speech commands** are used: for requesting help, adjusting the game settings and to navigate between the different pages of the game: “Help me”, “Go to home page”, “Start new game”.
- **Implementation:**
 - *Automatic Speech Recognition: Google speech-to-text service,*
 - *Natural Language Understanding and Dialog Management: wit.ai,*
 - *Text to Speech: ResponsiveVoice.JS.*

Games

To motivate users to have an active and healthy life, a ***score_factor*** is computed from health, oral health and wellbeing parameters.

The ***score_factor*** will award the user, getting him the possibility to obtain a higher place for the game leaderboard.

if (blood pressure, oxygen, blood sugar and duration of brushing have normal values - compared with the values from previous week)

if(number_of_steps <= 1000)

score_factor = 0.75

else

if(number_of_steps <= 1200)

score_factor = 1.25

else

score_factor = 1.75

endIf

endIf

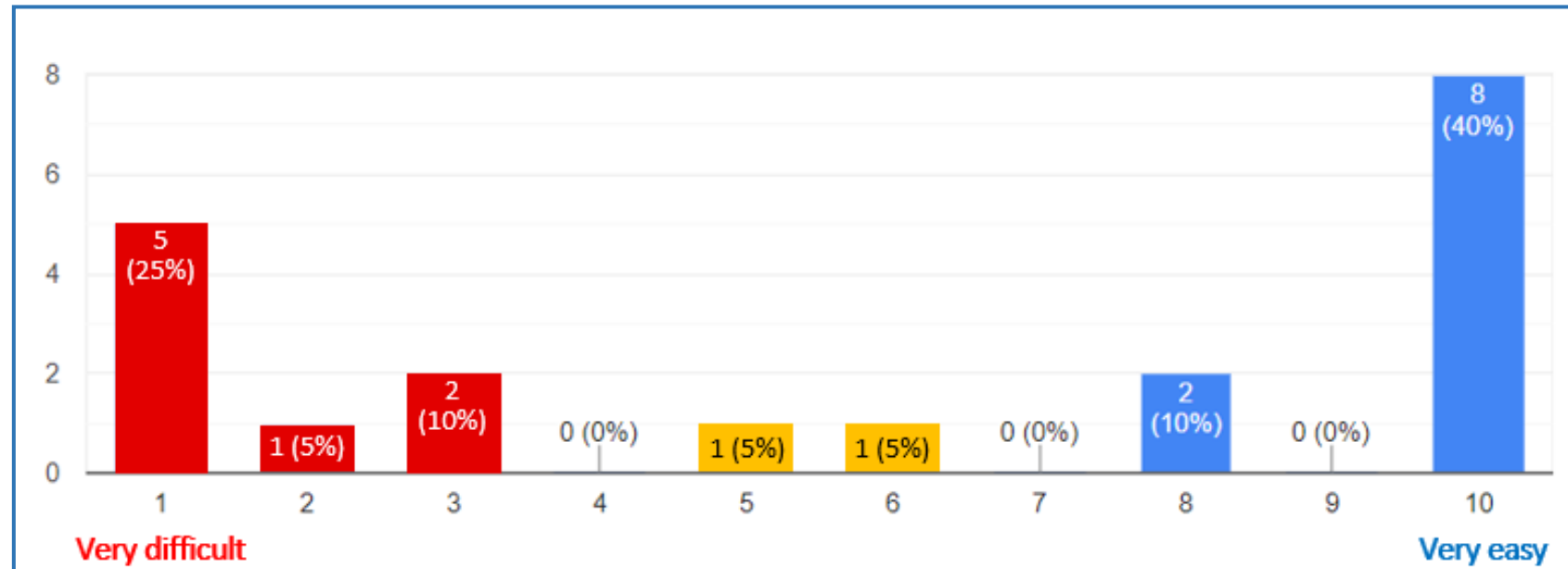
else

score_factor = 1

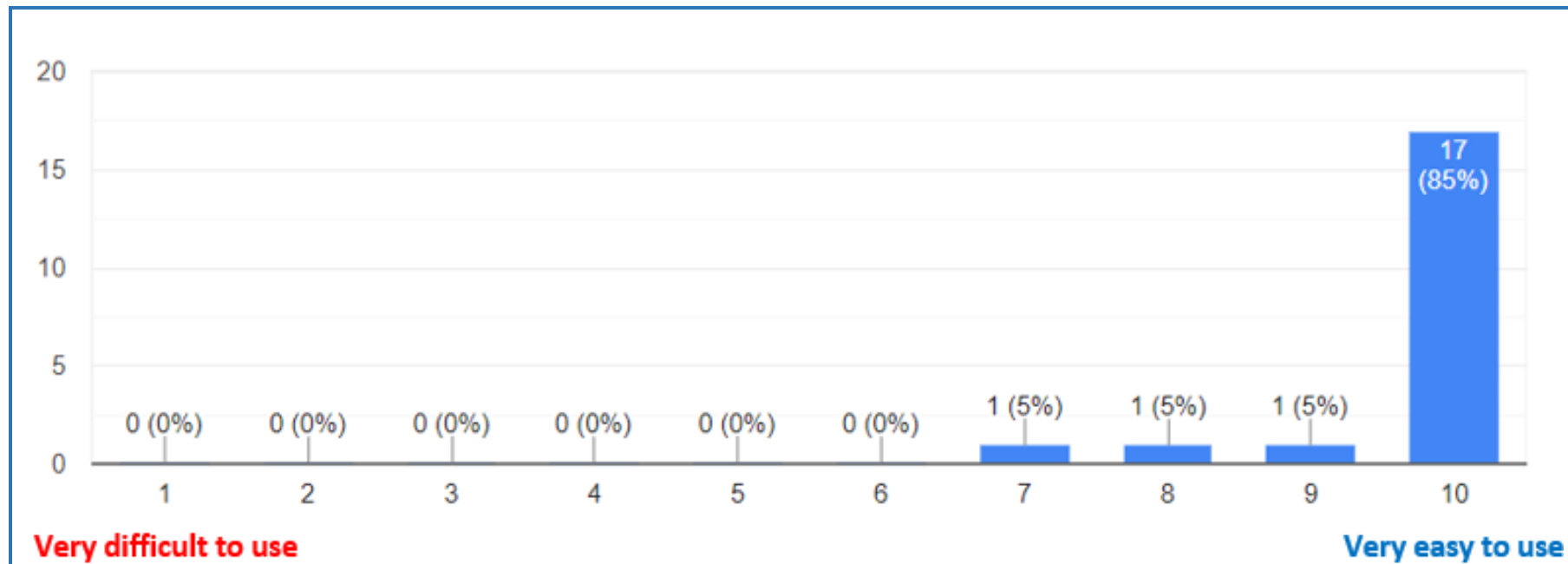
endIf

- 20 older adults were involved: six males and four females, are retired and above 65 years old with ages ranging between 65 and 80.
- Uses commercial medical devices to keep track of relevant physiological parameter: blood glucose and blood pressure levels.
- Most of them do not engage in regular physical activities but keep physically active by working inside the house and in the garden.
- 13 participants reported to keeping mentally active by engaging in crossword puzzles, Scrabble, and computer games.
- Two weeks in testing for some components of the MERITT platform:
 - portal interface,
 - part of the health devices (blood pressure, thermometer),
 - oral-health device (toothbrush),
 - games.
- To evaluate the robustness of the implementation and to collect users' feedback for the fine-tuning of the platform prior to more extensive pilot studies.

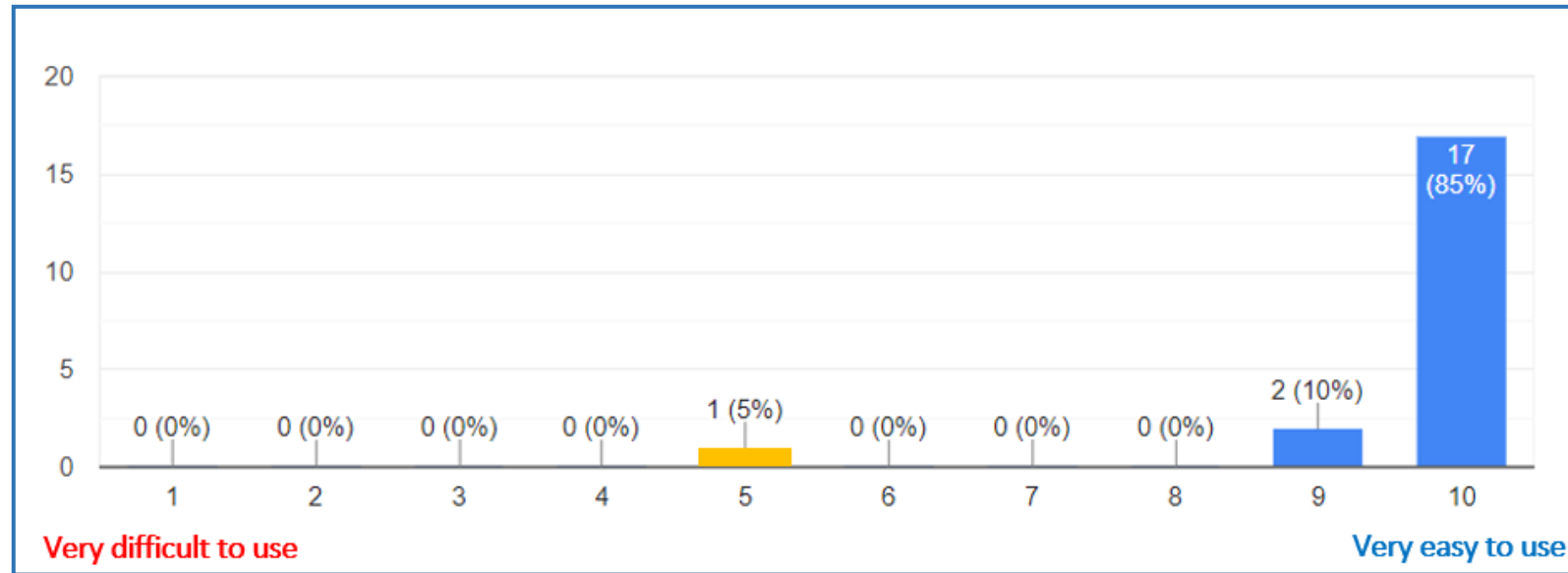
- The feedback of the older adults was acquired using a dedicated questionnaire.
- The tablet with the MERITT interface was considered by half of the users easy and very easy to use.



- The blood pressure meter was easy to use with the majority considering that it is very easy to use.
- Possibility of accessing the measurement history and compare the measured values in time.

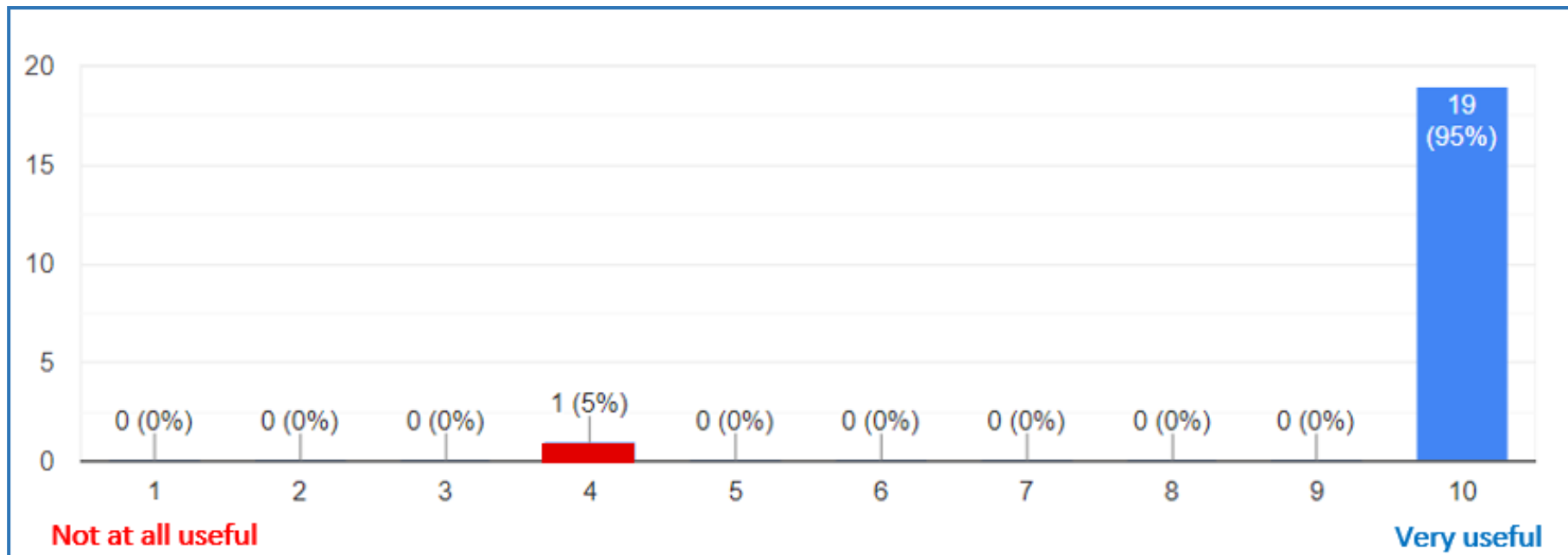


- Easy of use of the **thermometer**

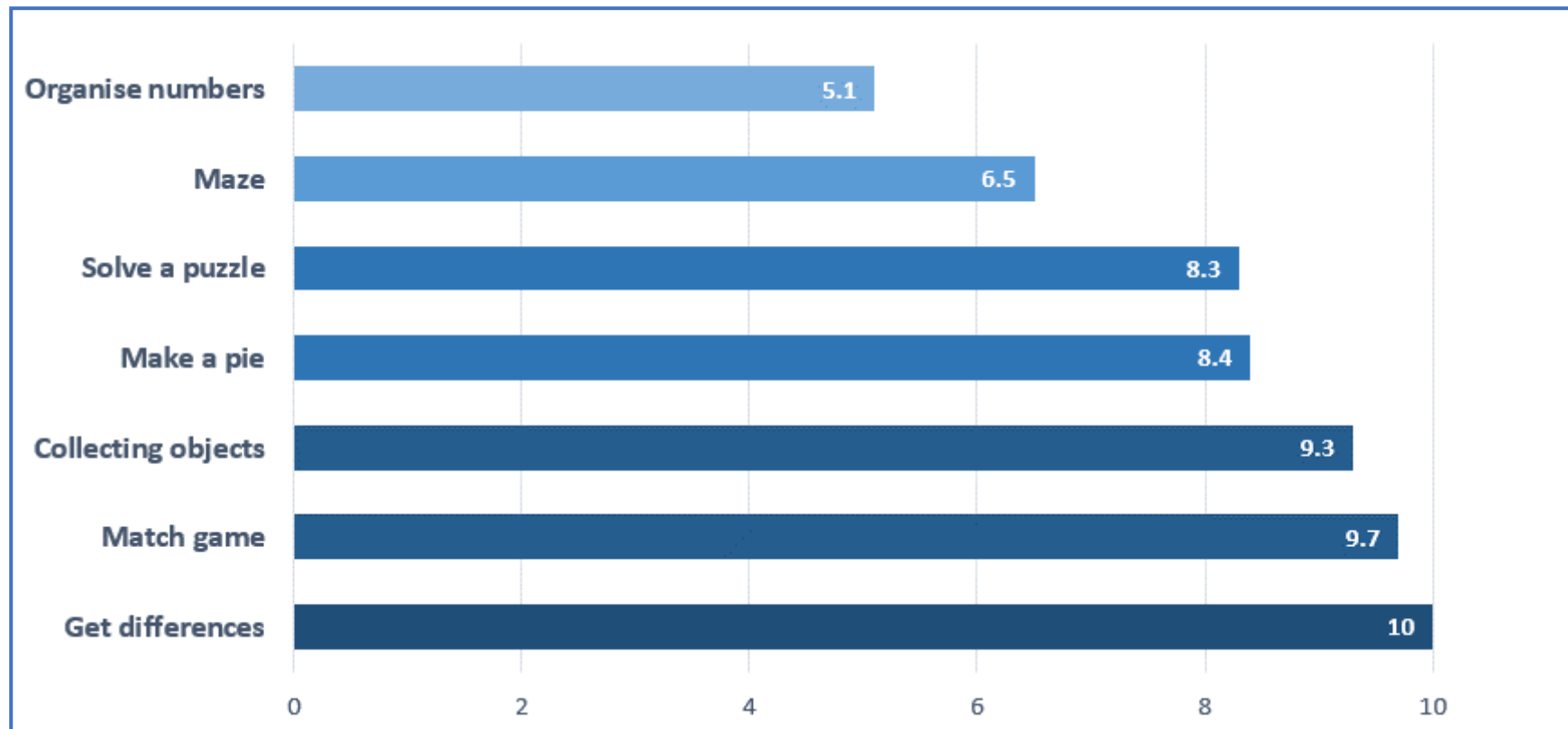


- Easy of use of the **weight scale and oximeter**.
- The oxymeter was considered useful by all participants suffering from cardiovascular diseases and asthma.
- The display of the recorded measurements on the MERITT interface was considered by 60% of the participants to be difficult to interpret because of overlapping values.

- Smart toothbrush: simplicity, straightforwardness and comfort.
- Disadvantaged: the lack of an electric motor to turn the head of the brush.



- Games: highly appreciated, they believed they are well made and intuitive.



- **Conclusions**

- Presents a system that combines health, oral health and wellbeing parameters with cognitive games.
- Parameters are integrated into cognitive games through points to award the user to obtain a higher place for the game leaderboard.
- The evaluation of the system is performed using 20 older adults over a period of two weeks for testing part of the system.

- **Future work**

- Improve games:
 - more levels,
 - more complex games,
 - simple games like Sudoku, Chess,
 - settings for speed and time,
 - virtual coach: that will adapt levels of the game to the user preferences and performances to motivate them in achieving their goals.

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Thank You



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