



GRAVITAB
SENSOMOTORIC EXPERIENCE

English edition

SZÉCHENYI 



HUNGARIAN
GOVERNMENT

European Union
European Regional
Development Fund



INVESTING IN YOUR FUTURE

GRAVITAB



We wanted to make mental and physical abilities measurable and long-term traceable to a limited extent using traditional testing tools. How can we perform effective and accurate aptitude testing, mental health assessment in people, even in their homes, without the stressful situation associated with clinical trials? Instead of a traditional diagnostic tool, we aimed to create an interactive game. The process of play, as a spontaneous, self-forgetful activity, provides an excellent opportunity to examine concentration, sensorimotor abilities, and other hard-to-measure areas. It was important that the tool be applicable to people of all ages and abilities.

ELEMENTS OF THE SYSTEM

HARDWARE

The hardware part of the GraviTab game is a 40-centimeter-diameter, circular, hand-held skill game in which the user tilts a metal ball in a track system according to the selected task type by tilting the board. An LED was placed in each node of the hexagonal grid-shaped path system to illuminate the selected task in red, green, and orange. For example, in “Collect and Avoid in Game”, the goal is to “collect” all the points that light up in green bypassing the nodes that light up in red. In addition to the multicolor LEDs, an induction coil was placed in the nodes to sense the passage of the metal ball. Passes through the node are timestamped in the web server database, so the entire process of the game being played can be reproduced later, which is the basis of the evaluation process. In addition to passing through the nodes, the fine movements performed by the device - the tilting of the board - are measured with a gyroscope built into the device. The data of this is also stored in the online database, on the basis of which the analysis of the player’s movements can be realized. Did you consciously, firmly, move the ball with gentle movements, or did you try to solve the task with possible, high-swinging tilts? The process of problem solving and the related - continuously recorded - movements are the two layers of information, which can be combined to reveal interesting correlations about reaction times, memory, eye-hand coordination, and problem-solving ability.

MOBILE APPLICATION

GraviTab as a physical device was treated as a hardware peripheral at the start of development hours. The fewer logic we wanted to embed in the device itself, we installed the entire program logic in the mobile application and the server-side application for easier development. On a hardware device connected via Bluetooth, similarly to an interactive screen, we only wanted to display the task issued by the mobile application, as well as detect the user’s movement, the progress of the task solution with sensors, and send the sensor data to the mobile application.

ONLINE DATABASE

The mobile application is connected to a database server developed in the Laravel system. Players’ results are stored on the web server as a username. These data can later be used for comparison and follow-up studies. The data stored on the server can be accessed by physicians at any time, so they can even monitor the condition of their patients remotely.



HOW IT WORKS?

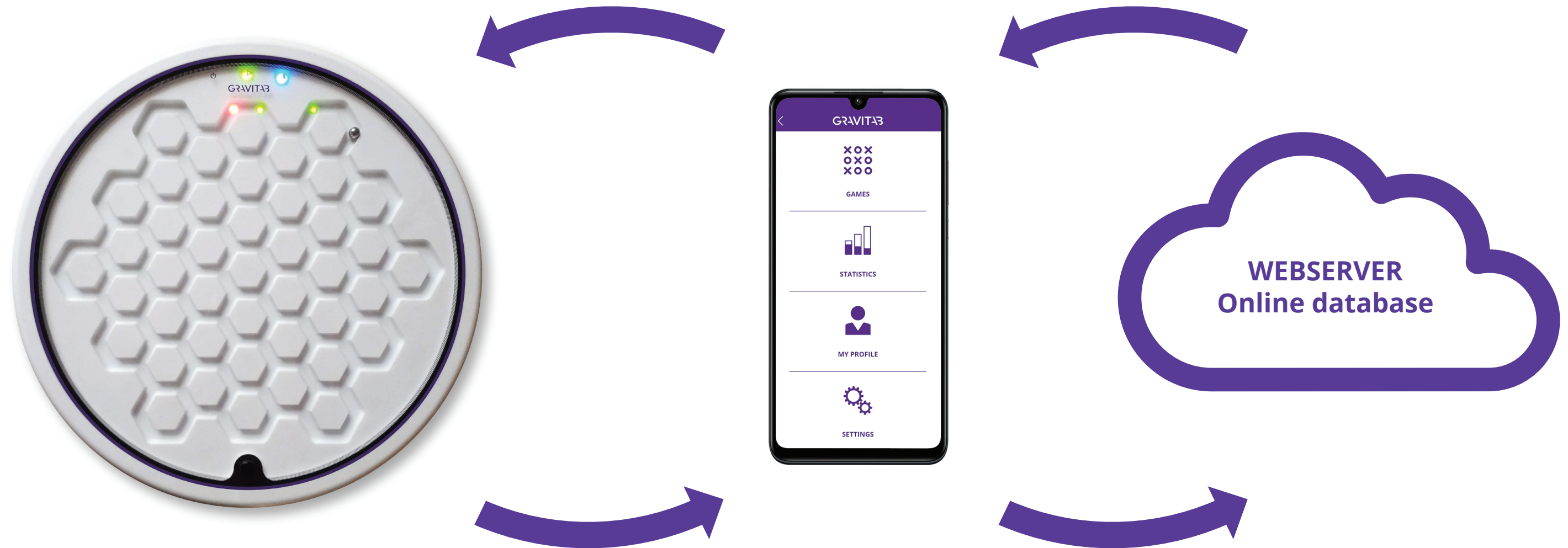


Run the selected game from the mobile app

- You can start using the device after logging in
- The mobile phone controls the LEDs that light up during the game, which can glow red, green, orange.

Compare game results with values stored in the online database

- User with previous game score
- With the average of the user's previous results
- Average of reference group (users of the same age and health status as the user)



Submit sensor data to the app, view game results

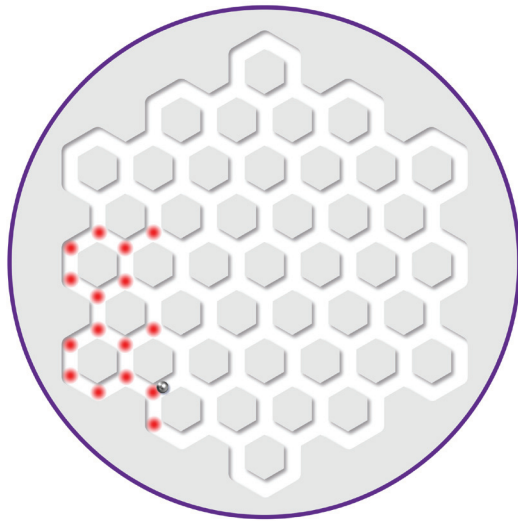
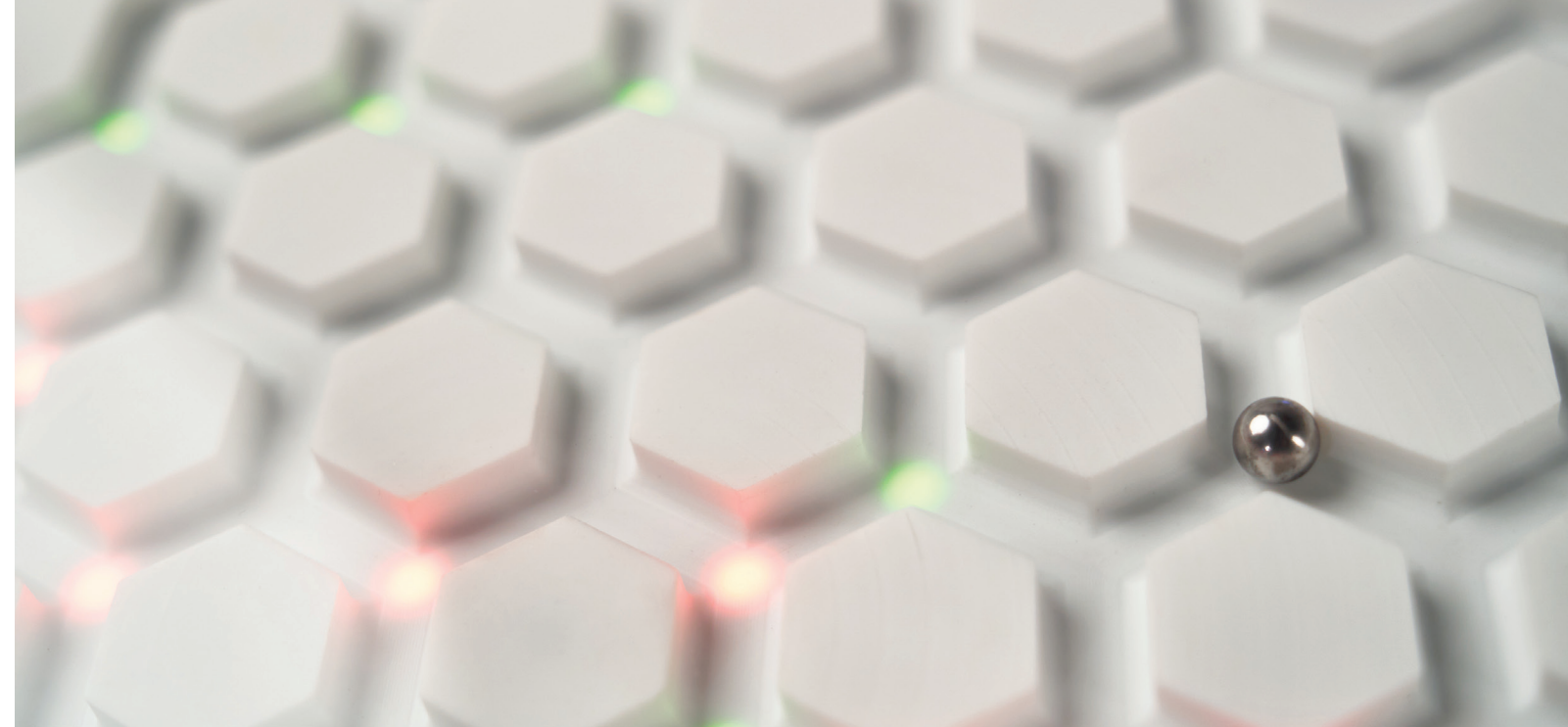
- Analysis of the path of the ball with sensors located in the nodes
- The time spent solving the task
- Characteristics of table movement based on gyroscope data (tilt, nod, rotate)

Submit game results to the online database

The results are stored on a user-by-user basis, allowing for long-term, follow-up studies and comparisons of results from users in the same age group.

GAME TYPES

A wide variety of tasks can be developed for GraviTab. When designing the types of tasks, we tried to be able to offer opportunities to users with extremely different intellectual abilities with tasks of different complexity. Game types allow the measurement of different abilities, an important aspect of each was to create the possibility of “self-forgotten” play, so that the user does not experience the tasks as a standard, result-oriented measurement, but dominates the gaming experience and the measurement itself is an unnoticed process in the background. . Of course, the listed game types can be further developed and varied as desired.

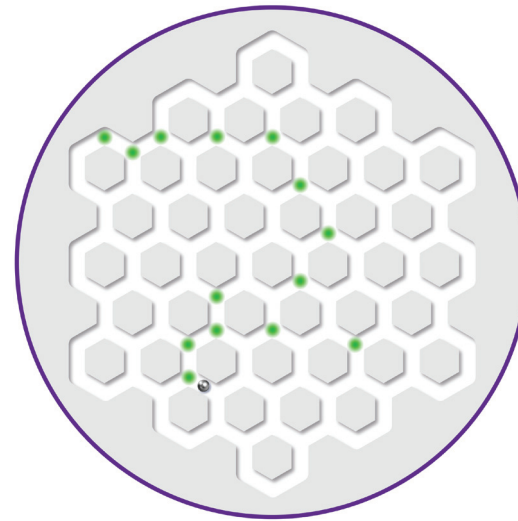


PAINTER

The simplest game, the tool is recommended for the first time users. At the start of the game, no LEDs in the track system are lit. As you move the ball, the LEDs on each affected node will light up. In this way, by passing the ball through the track system, each node LED can be turned on. The game ends when all LEDs on the board are lit.

Purpose of the game: Learning to use the tool, having fun

Degree of difficulty: 1

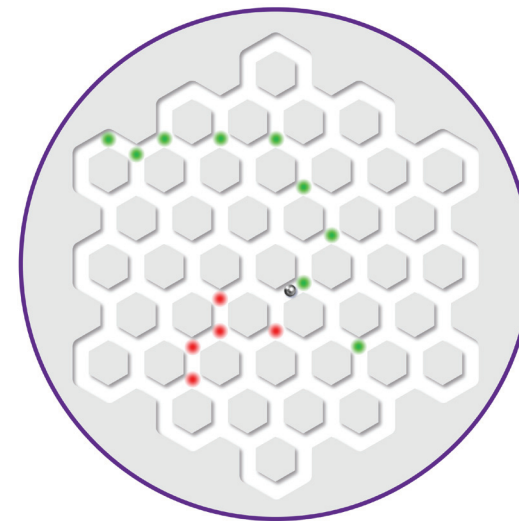


COLLECT ALL

At the start of the game, a certain number of green LEDs will light up on the field. By moving the ball, these LEDs must be “assembled”. When the ball passes through a green LED, the LED goes out. The game ends when no LED is lit.

Purpose of the game: Testing eye-hand coordination

Degree of difficulty: 3-6

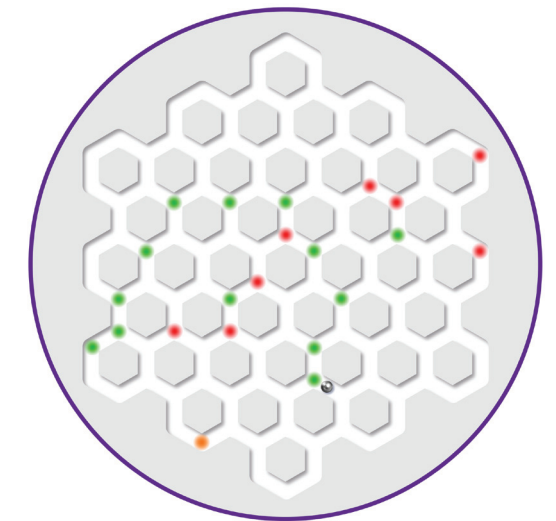


TOUCH ONLY ONCE

A more complicated version of the “Collect All” type of game where the green LEDs to be collected should only be touched once. Once the ball has passed through the green LED, it will turn red and should not be touched more than once. Touching the red LEDs will deduct points or end the game.

Purpose of the game: Eye-hand coordination, concentration testing

Degree of difficulty: 5-8

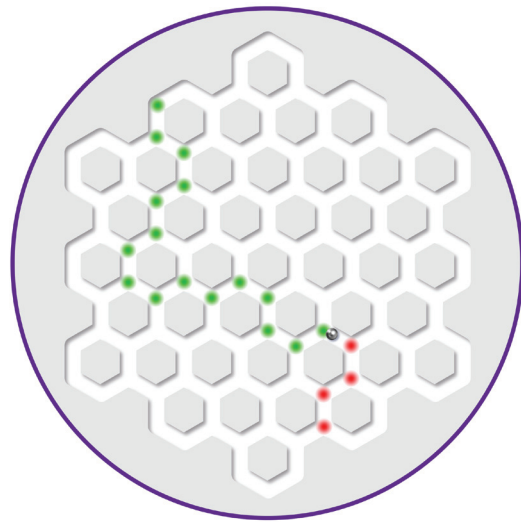


AVOID AND COLLECT

A more complicated version of the “Collect All” type of game, where in addition to the green LEDs to be collected, the red LEDs to avoid also light up on the field. Touching the red LEDs will deduct points or end the game.

Purpose of the game: Eye-hand coordination, concentration testing, logic ability testing

Degree of difficulty: 5-10

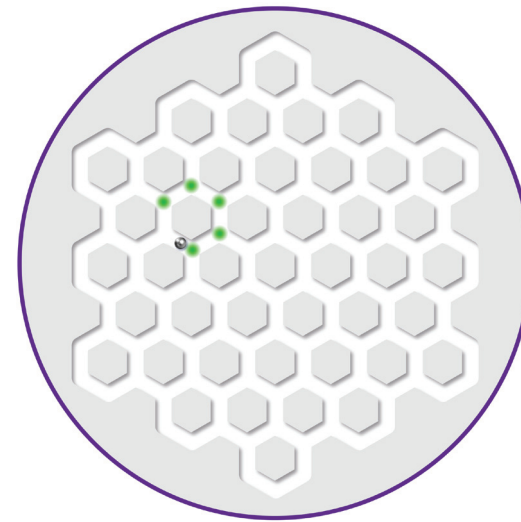


GO THROUGHOUT THE LINE

When you start the game, an image of a predefined route will appear on the board. On this route, the ball must be rolled through as quickly as possible without leaving the designated course.

Purpose of the game: to test eye-hand coordination

Degree of difficulty: 3-10

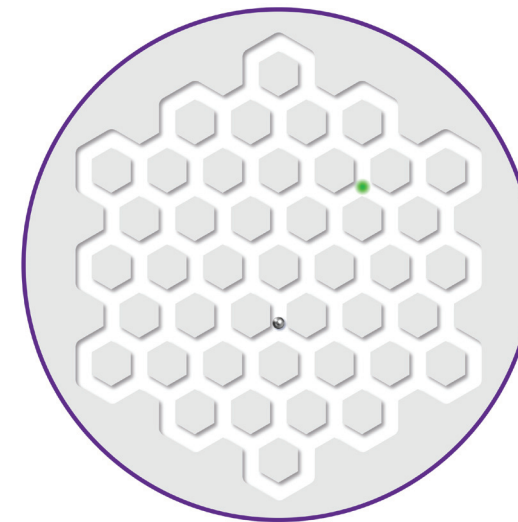


MEMORY GAME

The object of the game is to test short-term memory. At the start of the game, an image of a shape is drawn from the illuminated LEDs (eg line, cross, hexagon, star). This shape will go out in a few seconds. The user must find the location of the shape from memory and draw a picture of the shape with the ball. When the ball touches the LED in the shape, it lights up again, helping the user draw more points.

Purpose of the game: memory, eye-hand coordination testing

Degree of difficulty: 3-10

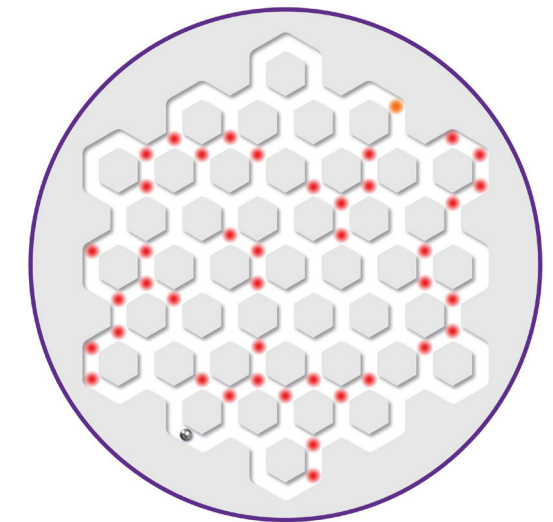


REFLEX GAME

Reflex game is a very simple and easy to understand game, it can be used well in any target group. At the start of the game, a piece of LED lights up on the field, this must be collected with the ball as quickly as possible. At the moment of the catch, another LED at another point on the board will light up to be collected. This task is repeated 10-20 times during the game. During the test, we measure how quickly the user responds to the LED that lights up at another point on the board and whether the board is tilted in the right direction.

Purpose of the game: reflex, eye-hand coordination testing

Degree of difficulty: 1



LABYRINTH

At the start of the game, the ball is located on one edge of the course system. From this position, the ball must be passed through the "maze" drawn from the red LEDs and the target orange LED must be collected without touching the red LEDs.

Purpose of the game: eye-hand coordination, concentration testing, logic ability testing

Degree of difficulty: 5-10



DISPLAY OF GAME RESULTS

The Android application that logs in, runs games, and displays results provides the following features:

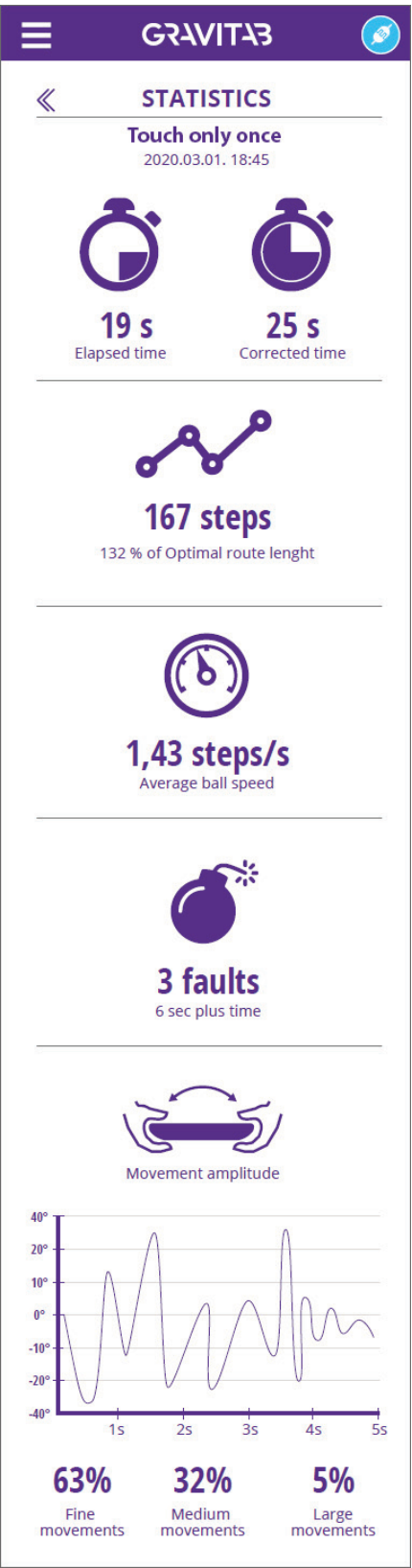
- Login (the subject logs in on their own or their doctor logs in on behalf of the patient)
- Game management: we have developed different games for different test areas (reflex, memory, concentration, etc.), from which the user can choose which one he wants to play with.
- During the game, the Android application controls the GraviTab hardware device, the application turns off the LEDs according to the selected task, and detects the goals achieved during the game.

Statistics

After the game is over, you can see a quick statistic of the results, which includes:

- Game time, error time corrected game time
- Number of steps (passing through a node with the ball), its ratio to the minimum number of steps
- Average ball speed
- Number of errors
- Amplitude of the tilt of the board - plotted on a graph, percentage of fine, medium and large movements

The application transmits all information related to the games to the database of the web server assigned to the given user, which can be used for comparative tests and analyzes later.



Online database

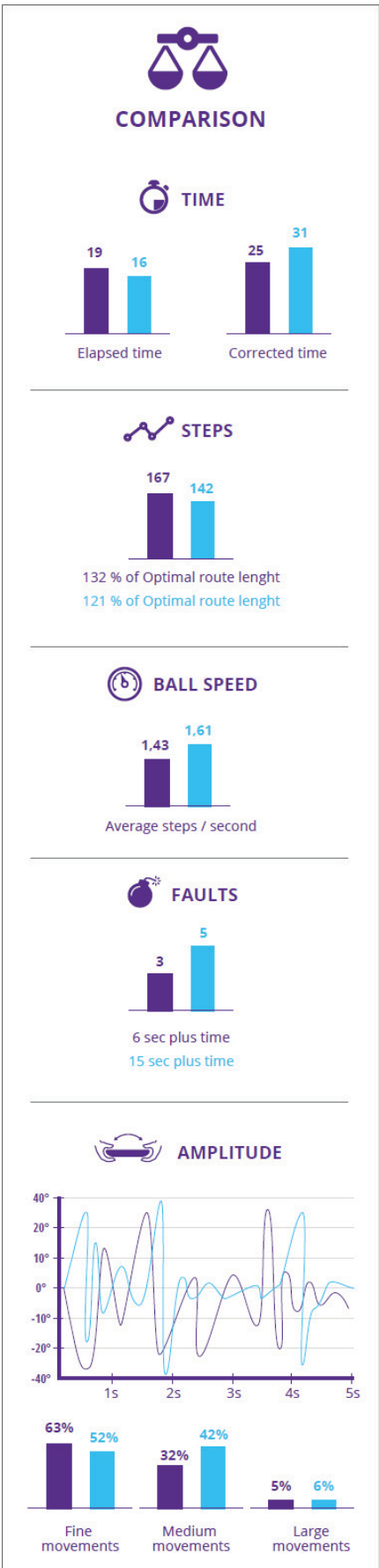
After completing a game, the mobile application sends all game data to the web server, where it is stored in an online database. These can be retrieved at any time, from anywhere, and are suitable for analyzes and long-term follow-up studies. The following data is stored in the database:

- User information
- Game type, ID
- Game date
- Playing time
- Achieved game goals
- Mistakes
- Crossing nodes with a time stamp
- Recording movements with the board based on gyroscope data

Comparison

To compare a user's game results, the Comparison feature must be selected in the application, where the user can compare their performance with their own previous game results or the results of their reference group. By reference group we mean people of the same age, gender and health status as the user.

However, in order to carry out such a comparison effectively, it is necessary to test a large number of people, only in this way can we collect a representative amount of data. Our long-term goal is to have standardized results as well, which can be a good starting point for assessing the condition of any patient.



FIELDS OF APPLICATION

The ability to play and play ideally accompanies a person throughout his life. In the case of children, it is an important element of mental and physical development, in adulthood it provides the opportunity for active recreation and regeneration. It helps to preserve the mental state in old age.

The GraviTab sensor motor development game and diagnostic tool combines the benefits of in-depth manual action with a multi-user digital world. Part of the GraviTab hardware is a real, tangible game of skill in which the user tilts a metal ball in a track system according to the type of task selected by tilting the board. Issuing tasks and completing the game is already done by a smartphone app. This allows for measurability in the skill development game, a comparison of the user's performance in the same task type with their previous performance and their peers playing with GraviTab. The GraviTab tool is also excellent for suitability tests, with targeted task types appropriate to the field.

More information about the project is available at www.gravitab.com



ANALYSIS OF CHILD DEVELOPMENT

Health-conscious parents want to monitor their child's development, so that if there is any deviation from the values typical of healthy children, they can take steps in the field of development and catching up as soon as possible. The GraviTab tool to be developed provides a wide range of options for testing different abilities using different game types. The values stored in the system's online database - the sum of the results achieved by other users - provide an opportunity to compare and detect significant differences from the median values.

The development of a disabled child and the monitoring of changes in his or her condition require increased attention from parents. It is the responsibility of the parents to constantly monitor, follow the development of the child's abilities and share this with the treating physician. The GraviTab device allows an objective assessment, be it of movement coordination, reflex, or memory, so the doctor can find out about the child's condition even without a personal meeting.



TEST OF SUITABILITY FOR WORK

GraviTab is an excellent tool for assessing the skills of those working in critical workplaces (heavy machine operators, drivers, soldiers, pilots). The surveys are carried out by a specialist company or by the employer's own medical staff.

Suitability tests are performed by professionals, so the use of the device - in front of home users - takes place in an optimal environment, with the selection of the appropriate game types and constant supervision. The results assigned to the reference groups are integrated into the GraviTab database, from which standardized values can be obtained after the appropriate number of tests.

Among the institutional users, the Armed Forces occupies a special place, as they have the highest level of employability requirements when applying for pilot training and special units.



SENIOR CARE

Caring for the elderly and keeping their mental and physical abilities for as long as possible is a fundamental goal of any modern society. Caring for and caring for the elderly in the family is typically the responsibility of the active age generation. For the elderly, the GraviTab device to be developed can be useful not only as a measuring tool, but also as a game and a fun pastime. And in-game, unnoticed measurements allow you to track user status changes. GraviTab's advanced gyroscopic sensors effectively detect even the slightest discrepancy in delicate movements, so that Parkinson's disease, for example, can be detected at a very early stage. Tasks that test memory and concentration can be used to determine the development of Alzheimer's disease. The results of the tests can be checked by active family members, compared with the average values of the reference group, and in case of deterioration of the results, they can be shared with the GP.



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