



User documentation

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Introduction

At the start of the project, we identified that there is a need to create software that can automatically detect whether a user is perceiving appearing objects in their visual field and if so, whether they are able to track these objects. So far this diagnostics and training has been done manually by the individuals, and the results were concluded by the individuals' interpretation. Thus, an objective assessment was nearly impossible to be done, and a follow-up, meaning repeating the same exercise multiple times to see whether there have been improvements, was impossible to do.

The idea of the project is to use a commercially available eye-tracking system and develop specific software for our target audience to do these assessments and training. By creating the application, the professional can have instant feedback on the clients' functional vision. In addition, these results are stored and can be compared to previous training sessions. This allows the professional to have a more accurate assessment and follow-up of the clients' progression.

So far, the software currently available needs the client to do a motor action in order to react to the visual stimulus on the screen. Using an eye-tracker, this can be done automatically in our application, and no motor skills of the client are mandatory in order to carry out the assessment.

The different partners collaborating in this project have a wide knowledge and experience in the different fields. For the project to be successful, it needs experts in the following fields:

- Software engineering and development
- Orthoptist experts
- Experience in the special needs education
- Testers (both as educators and end-user)

Features and limitations

The target audience for the application are people with MDVI. However, adding some levels and paying attention to specific colours and contrasts, also people with VI and CVI are able to use the software.

Having said this, during our testing we noticed that with some specific visual impairments, the eye tracker does not recognise the iris, and thus makes the application unusable in these cases. The cases noted during testing were users with ptosis, a strong nystagmus and loss of central vision. A certain level of visual acuity is needed in order to discriminate the target.

There are additional requirements that influence the use of eye-tracking systems. The distance to the eye tracker and/or the screen is very important. The ideal distance to the eye tracker is 45 to 95 cm (Tobii) and 30 to 65 cm (GazePoint GP3). The screen size to be used is also limited to a maximum size of 27", as the eye tracker cannot cope with bigger screen sizes. In order to get consistent results, it is important to carry out the assessments in the same conditions (Distance, screen size, brightness, etc.)

There are also some hardware requirements for the application and eye tracker to run smoothly. We recommend a PC system running on Windows 10 or 11 and the CPU should be at least an Intel i5 7th Generation or similar. An additional graphics card is not mandatory but can improve performance.

Using the system in sunlight should be avoided, as the UV from the sun can decrease the accuracy. Both systems, Tobii and GazePoint, use UV lights in order to determine the iris.

Getting started

In this chapter we'll explain how to set up the eye-tracker and the needed software. The application will try to connect to Tobii, if it's not found it will check for OpenGaze API supported devices – finally if no devices are found the mouse will be used.

Tobii 5

Since Tobii 5 is a device for the consumer market, the setup is pretty straight forward.

Hardware

The best setup is to use the included attachment with the Velcro strips to attach the Tobii 5 to the bottom of your screen. The device attaches magnetically to this piece. Finally, plug the USB cable into a free USB-plug on your computer.



Software

After plugging Tobii 5 into a USB port of your computer, Windows should automatically download the needed drivers from Windows Update and the Tobii Experience app from the Microsoft Store.

In case this does not happen automatically, you can manually download the needed software from their website:

- <https://gaming.tobii.com/getstarted/> or
- <https://tech.tobii.com/get-started/>

Tobii Experience Driver v1.81

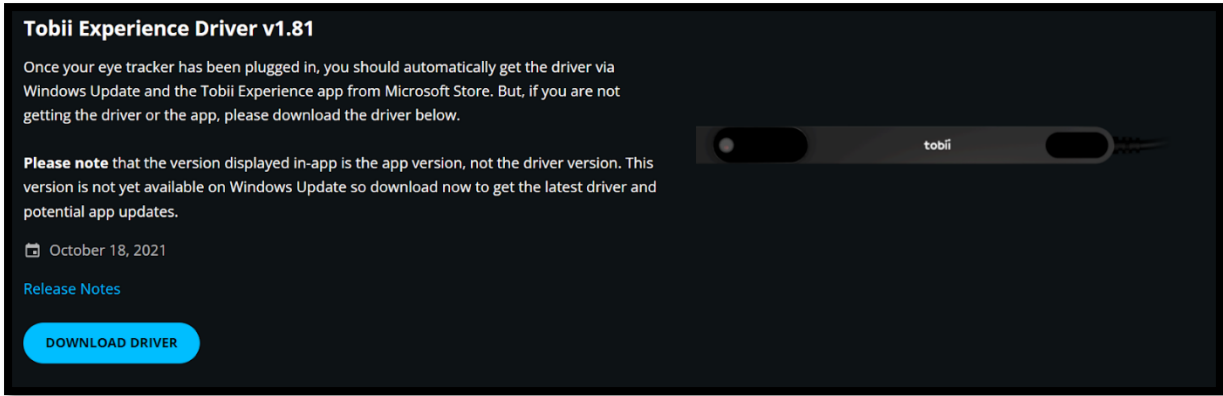
Once your eye tracker has been plugged in, you should automatically get the driver via Windows Update and the Tobii Experience app from Microsoft Store. But, if you are not getting the driver or the app, please download the driver below.

Please note that the version displayed in-app is the app version, not the driver version. This version is not yet available on Windows Update so download now to get the latest driver and potential app updates.

📅 October 18, 2021

[Release Notes](#)

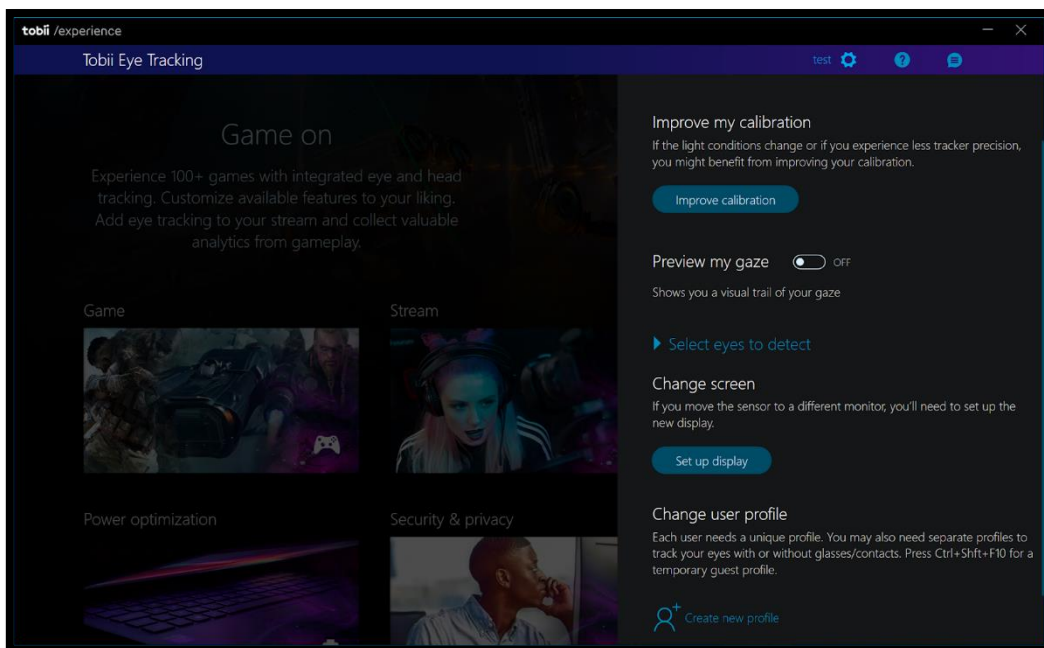
[DOWNLOAD DRIVER](#)



Calibration

Open Tobii Experience and create a new profile. The calibration process is very straightforward. Look at each blue dot until it explodes. In total there are 7 dots which need to be looked at for the calibration.

After calibration is done enter your username. In the main window, you can click on your username and select “Improve calibration” to get better results. “Preview my gaze” shows a white halo around the location you are currently looking at. **“Select eyes to detect” allows you to switch to monocular gaze tracking.** Finally you can also select which screen the eye tracking should be applied to using “Change screen”.



Gazepoint

Setting up the Gazepoint GP3 is a little more tedious but still quick and easy.

Software

On the packaging tube of the GazePoint GP3 you'll find instructions for the first-time setup. Use the included password to download the GazePoint software from their website:

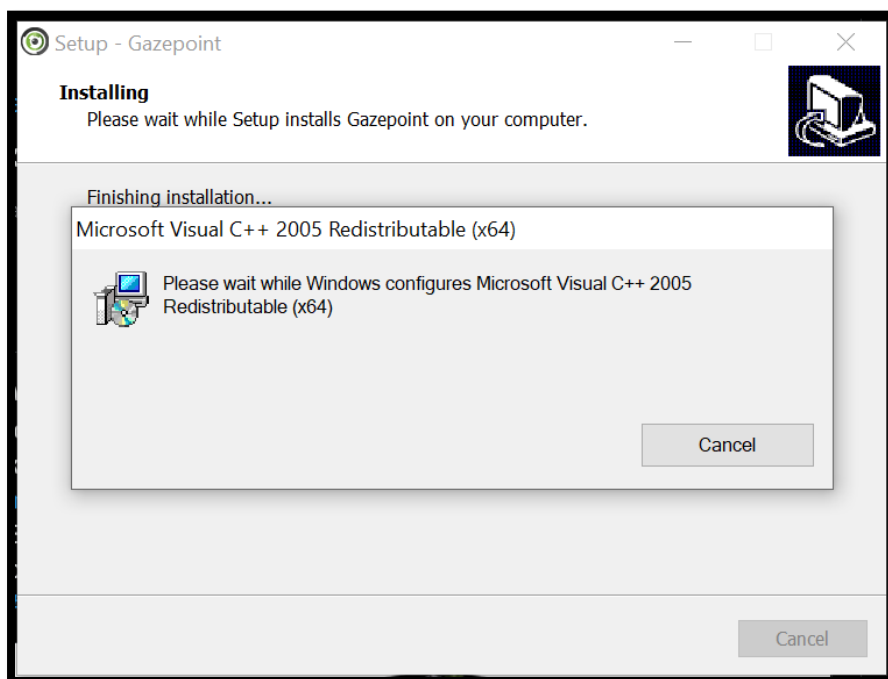
- <https://www.gazept.com/downloads/>

Note: You should install the software before plugging in the device.

The following software and tools will be installed:

- GazePoint Control
- GazePoint Analysis
- GazePoint API
- Hardware drivers
- User manuals

During the installation, simply choose the default options.



Hardware (Device)

Unpack the GazePoint GP3 and the additional pieces. Attach the Eye tracker to the included tripod. The GP3 should point towards your eyes at an upwards angle. Position the device below the screen, centred and as close as possible to the bottom edge. The GazePoint website states that the unit should be positioned 30cm below eye level and 65cm away. The eye tracker works well in low light conditions but excessive sunlight illumination directly into the device can have a negative impact.

To avoid reflection in the case that the user is wearing glasses, tilt the eye tracer towards the eyes at a steeper angle.

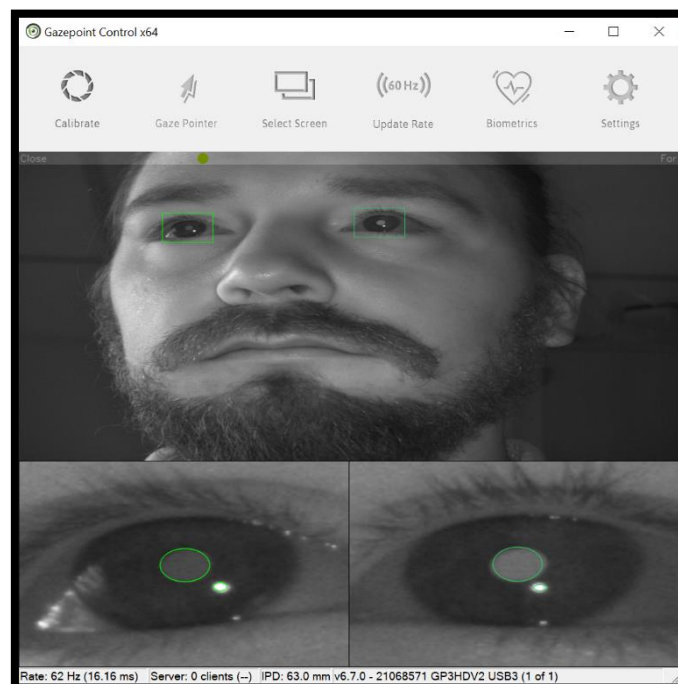
Finally plug the two USB cables into free USB-ports on your computer.

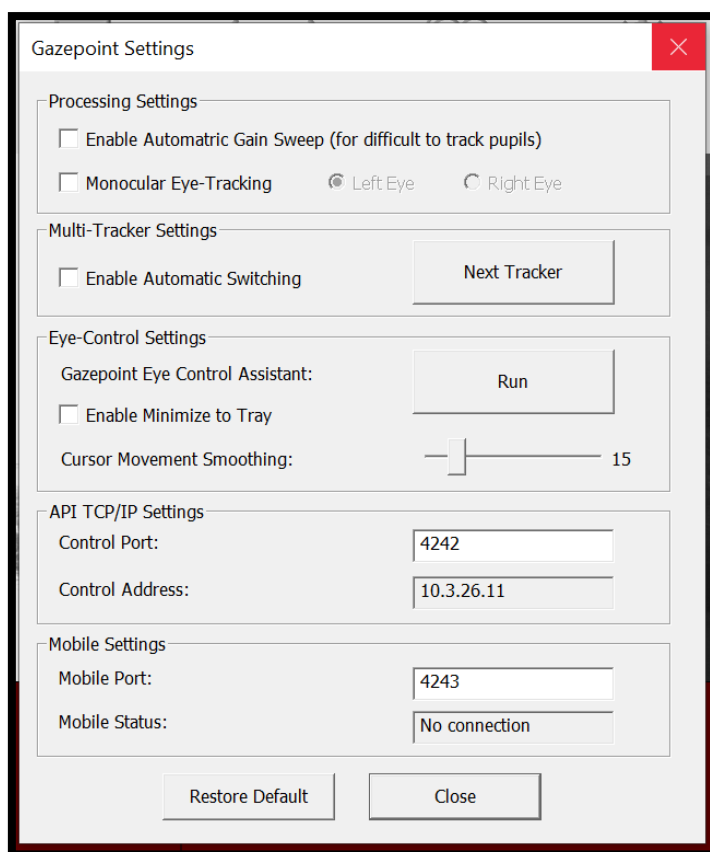
<https://www.gazept.com/tutorials/>



Calibration

Open Gazept Control and verify that the eyes are being detected correctly. This is indicated by a green circle around the eyes. ***Adjust your position so that the horizontal dot is green and is in the approximate centre of the slider.*** If you are using multiple monitors, you can switch between them using the “Select Screen” button.





Additional advanced settings can be modified in the “Settings” screen. **Especially “Monocular Eye-Tracking” may be relevant for our use case.** Note that the GazePoint control program needs to be running and the control port (Settings > API TCP/IP Settings > Control port) should be the default 4242 - otherwise the Opeye2 application will not detect the eye-tracker.

When all is set you can click the “Calibrate” button. A white dot will move on a black background. Keep looking at the dot until the process is finished. The dot will visit 5 specific locations on the screen.

On the final screen you can test the accuracy of the calibration.



On this screen you can use the following shortcuts to perform additional actions:

- 'C' to repeat calibration
- '5' or '9' point calibration
- 'U' to undo calibration
- 'S' to play a sound at each point
- 'M' to view marker tracking
- '+' or '-' to modify animation time 'D' for default (2 seconds)
- 'Esc', 'Left click' or 'Right click' to close this screen

Further details can be found in the "Gazepoint Control.pdf" which you can find by navigating to Start > Gazepoint.

Ideas to calibrate with clients that are not able to see the dots on the screen.

- Using a stick with an LED light attached at the end, the professional can point to the dot on the screen. This will help the client see the LED light, which again represents the dot on the screen.
- A stick with a coloured object (not too big) can help the client see the object representing the dot on the screen.

Opeye2 application

First use

- Project Files: <https://github.com/Opeye-erasmus/OPEYE2>
- Executable .exe: www.opeye.eu

For the program to run on the computer, DirectX version 11 or 12 is needed and .NET Framework 3.5. Either Windows 7, 10 or 11 work.

There is no need to install the software, only copy/paste the content from the platform onto your computer and run opeye.exe.

Before you can choose any activity it is mandatory to create a profile. It is possible to create multiple profiles. The data is stored under AppData\Local\Opeye2\Saved\SaveGames

Contrasts are predefined in order to ensure a high contrast value. The target and background colour can be switched. The different colour pairs and contrasts used are:

White <-> Black

Light Green <-> Black

Dark Green <-> White

Yellow <-> Black

Yellow <-> Dark blue

Red <-> Black

Purple <-> Yellow

Main menu

Welcome to OpEye for MDVI!

Evaluate and train your visual skills through different exercises that require visual tracking, searching and detecting different objects.

To start first register or log in, then choose one of three options on the screen: Smooth Pursuit, Visual Field and Saccades. Each contains a sequence of exercises with different levels of difficulty.

The entrance page of each exercise contains a description, configuration button, start button and results button.

Exit exercise by pressing Q without saving the results, and Spacebar to save the results and keep track of your progress.

Comments

For each exercise and recording it is possible to leave comments for each result. To view or edit the comments, you simply need to hover with the mouse cursor over the result and start typing.

Recordings

To review a recording of an exercise, one simply needs to click on the desired result, and the replay will start. If you want to stop the replay, you simply need to press Q.

Smooth Pursuit

Track the visual target as long as you can

The smooth pursuit application aims on the one hand at evaluating and assessing the functional vision of a person with VI, MDVI or CVI. On the other hand it provides training in basic visual skills and thus improves their use of functional vision.

Evaluation

Purpose of exercise

The evaluation exercises are designed to evaluate the functional vision of a person with MDVI or VI. This evaluation is supposed to be done at the beginning and the end of training the basic visual skill - smooth pursuit. There are 3 levels available determining the speed of the object.

Initial training to focus on the screen and abstract stimuli might be required before using the application for MDVI.

An object (abstract object, smiley, etc.) appears in the centre of the screen and travels in one of the eight directions at a steady speed in a straight line to the other side. The user's gaze should follow the object all the time. The professional can check visual presentation of the user's gaze during the exercise using the translucent halo included. Afterwards, the professional can replay the exercise and check the gaze following again. This can be done by simply clicking on the results line.

The difference between the three different levels is the speed of the target.

Configuration:

In the settings menu of the exercise, different colours/contrasts can be selected as well as the direction of the target. The different direction settings are:

- Horizontal
- Vertical

- Diagonal
- Any (chooses any of the 3 previous directions)
- Fully random (the target moves freely on the screen)

The target size can be chosen in this menu.

Results:

- Time seen (Total time in seconds, the client has stared at the target)
- Time not seen (Total time in seconds, the client has not stared at the target)
- Direction is the value chosen in the settings menu

The goal is to improve the 'Time seen' with further use of training games.

The list of results is in chronological order, the newest on top of the list.

In the city

Purpose of the exercise

The aim of this application is to train the basic visual skill - smooth pursuit. There are a total of 9 levels which can be selected by the user or professional. The choice of the level changes the complexity of the background image and/or speed of the moving object.

- Level 1 (S1): Static background colour; slow speed
- Level 2 (S2): Buildings with the same colour; slow speed
- Level 3 (S3): Buildings with different colours; slow speed
- Level 4 (M1): Static background colour; medium speed
- Level 5 (M2): Buildings with the same colour; medium speed
- Level 6 (M3): Buildings with different colours; medium speed
- Level 7 (F1): Static background colour; fast speed
- Level 8 (F2): Buildings with the same colour; fast speed
- Level 9 (F3): Buildings with different colours; fast speed

The user is supposed to follow the object with his gaze. If the user is not looking at the object, the object goes back to the centre and starts shaking in order to attract the user's attention. As soon as the user looks again at the object, this object starts moving again in random directions.

At the end of the game a smiley appears on the screen if the object has been followed for a certain amount of time. (The evaluator will stop the exercise manually with the space bar)

Settings:

- The object's colour can be chosen and the predefined background colour will be applied to ensure a good contrast. Only in the levels with different colours of the buildings, the background is not affected.
- Shape -> Different shapes can be chosen for the object (circle, balloon, house; ...)



- Size -> Small, medium and big can be chosen as the size of the object

Results:

- Time seen (Total time in seconds, the client has stared at the target)
- Time not seen (Total time in seconds, the client has not stared at the target)

The list of results is in chronological order, the newest on top of the list.

In the classroom

Purpose of the application

Target starts to move, when the user looks at its centre. The target moves in different directions without considering the tracking of the gaze. After a few seconds it randomly changes to a different shape (triangle, rectangle, circle). The aim is that the user counts the amount of times the shape of the object has changed. At the end of the game, the user or professional enters the number of changes detected by the user.

- Level 1 (S1): Static background colour; slow speed
- Level 2 (S2): Blackboard with little details and good contrast; slow speed
- Level 3 (S3): Blackboard with complex details; slow speed
- Level 4 (M1): Static background colour; medium speed
- Level 5 (M2): Blackboard with little details and good contrast; medium speed
- Level 6 (M3): Blackboard with complex details; medium speed
- Level 7 (F1): Static background colour; fast speed
- Level 8 (F2): Blackboard with little details and good contrast; fast speed
- Level 9 (F3): Blackboard with complex details; fast speed

Settings

- In settings we can choose the frequency of shape changes per training:
 - o Low : The shape changes randomly between 2-5 times
 - o Medium : The shape changes randomly between 6 - 9 times
 - o High: The shape changes randomly between 10 -13 times
- The colour and contrast can be chosen for the levels with a static background.
- Size -> The target size can also be adjusted in the settings menu.

Results

- Time seen (Total time in seconds, the client has stared at the target)
- Time not seen (Total time in seconds, the client has not stared at the target)
- Guessed number of changes seen correctly (Yes/No)

The list of results is in chronological order, the newest on top of the list.

Visual field

Evaluation

Static dots

This exercise helps to evaluate the central vision field and detect possible scotomas.

Before the exercise starts, the user needs to focus on the central target on the screen. After 1.5 seconds a peripheral target appears on the screen. As soon as the user has looked at this peripheral target (for 1.5 seconds), it disappears and the user needs to focus again on the central target.

By pressing the spacebar, eye tracking data is saved and gives information about the users mean time of finding the peripheral targets. The goal is to observe parts of the screen where the user might not see the peripheral targets. After viewing 20 targets (5 for each region), the exercise ends automatically and shows the FOV image.

Configuration

- Different colours and contrasts can be selected
- Size - The size of the peripheral target can be changed to small, medium or big

Results

- Time elapsed - Total time of the exercise
- Mean time to seek stimulus - Time in seconds that the user took to find the peripheral target

Moving dots

The aim of this exercise is to evaluate the extent of the central vision field

Before the exercise starts, the user has to look at the main target which appears in the centre of the screen. Another peripheral target slowly moves towards the central target and as soon as the user detects the peripheral target, he has to look at it.

With pressing the spacebar, eye tracking data is saved and the exercise stops. Otherwise, if all the objects appeared on the screen, the exercise ends.

Configuration

- Size - Small, medium and big
- Different contrasts and colours can be selected

Results

A graph displaying an approximation of the central visual field.

Saccades application

Evaluation

Purpose of the application

The evaluation exercise shows 2 circles in a horizontal line. One of them has a ring around indicating the circle that the user has to look at. The user has to gaze at the circle with the ring within 5 seconds (configurable in the settings menu) for a duration of at least 2 seconds. If the user does not look at that circle within the given time, it will count as a slow hit. For the exercise to continue, the user has nevertheless to look at the circle with the ring in order to switch circles. Then the counter restarts and waits for the user to focus on the new circle with a ring.

The app measures the precision and speed of focusing on the target while eye shifting. If the gaze stops before the second circle, the saccade is hypometric, and if the gaze stops over the circle is hypermetric). If the gaze stops on the circle, the saccades are precise.

The instructor can check the visual presentation of the user's gaze afterwards (using the recorded video) and compare it with the location of the target and decide whether it is hypometric or hypermetric.

Configuration

- Different contrasts
- Time to seek stimulus
- Target size
- Distance of targets

Results

- Undershoots -> Number of times the saccade movement was too short
- Overshoots -> Number of times the saccade movement was too far
- Perfect -> Amount of precise saccade movement
- Fast Hits -> Number of times focusing the target was quicker than the value entered in the configuration 'Time to seek stimulus'
- Slow hits -> Number of times focusing the target was slower than the value entered in the configuration 'Time to seek stimulus'

Fish

Purpose of the application

Two fish will appear in the pond. The goal is to watch the fish, so they won't escape the pond. With shifting gaze on both of the fish, they stay in the pond until the end of the game. The fish slowly start to move if they are not observed for a certain amount of time and eventually jump into the pond and end the game unsuccessful before time.

The faster the selected speed is, the faster the user has to shift gaze between the fish to keep them in the pond.

With pressing spacebar, the results are saved.

Configuration

- Speed (slow, medium or fast)

Results

- Max seek leap - Slowest time in seconds when switching focus between fish
- Min seek leap - Fastest time in seconds when switching focus between fish
- Laps - Number of laps that the fish have done while being ignored
- Speed - Slow, medium or fast speed of the fish

Frog

Purpose of the application

A frog appears on the upper left part of the screen on the first water lily. The goal is to help the frog get to the end of the water lily path, which is on the lower right corner of the screen. The user has to focus on the frog, to make it jump on the next water lily. If the frog is not observed for a certain amount of time, it eventually jumps out of the screen and ends the game before time.

With pressing spacebar, the results are saved.

Configuration

- Contrast - Different contrast options for the frog and the background
- Details - Little, some or a bunch of details in the background picture

Results

- Mean time between fixations - The mean time in seconds the user took to focus on the frog
- Max time - The longest time in seconds the user took to focus on the frog
- Min time - The shortest time in seconds the user took to focus on the frog

Words

Purpose of the application

One line of stars appears on the screen. The first star the user has to look at is highlighted in a different colour. As soon as the focus is on the highlighted star, the hidden letter is revealed and the following star is highlighted. After revealing the whole word, another line of stars appears below. (3 lines/words)

The language defined in the profile settings determines the words used in this exercise.

With pressing spacebar, the results are saved. The goal is to improve the speed for revealing the letters.



Configuration

- Different colours and contrasts can be chosen
- Number of letters (3 – 8)
- Size of letters - Small, medium or big

Results

- Mean time in seconds to reveal letters
- Mean time to reveal words

Market & Wardrobe

Purpose of the application

The aim of these exercises is to look for objects in two different settings. In the market setting, vegetables and fruits need to be found on the market. In the wardrobe setting, different pieces of clothing need to be found in a wardrobe.

At the beginning the object that needs to be found is shown on the screen. If during the exercise the user does no longer remember which object needs to be found, the shortcut 'Tab' will show the object once more. The number of objects to find is indefinite, and the professional needs to stop the exercise manually using the spacebar.

Configuration

Style:

- Dark or illuminated scene

Results

- Max time in seconds - Maximum time it took to find the object
- Min time in seconds - Minimum time it took to find the object

Glossary:

- VI: Visual impairment is a term used to describe a significant loss of vision that cannot be fully corrected with glasses, contact lenses, medication, or surgery. This condition can range from partial sightedness (low vision) to total blindness, and it may affect one's ability to perform everyday tasks.
- MDVI: Multiple Disabilities and Visual Impairment refers to a condition in which a person experiences significant impairments in vision, along with one or more additional disabilities. These concurrent disabilities can encompass cognitive, physical, behavioural, or sensory impairments, and they create a complex array of challenges that require specialized, multifaceted support.
- CVI: Cerebral Visual Impairment (CVI) is a neurological disorder that affects the visual processing centers in the brain, resulting in difficulties with visual perception. While the eyes may be physically healthy, the brain has trouble interpreting visual information due to damage or malformation. This can impact the individual's ability to understand and interact with their visual environment.