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TITLE: “The Development of a Mobile Health Platform and Naturalistic Game Applications for Health Assessment, Intervention, and Evaluation”

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14. ABSTRACT The goal of this project was to develop a prototype of a game based assessment and develop a normative data base for remote measurement and monitoring of real time neurocognitive functioning among active duty military service personnel. Due to a dramatic rise in mild traumatic brain injuries (It is estimated that 20% of all combat troops will experience a concussion while deployed) increased emphasis has rightly been placed on finding ways to assess cognitive deficits and ameliorate its symptoms. The effects of traumatic brain injury are often associated with other dysfunctional conditions, specifically, chronic pain and PTSD. Posttraumatic stress (PTSD) is another prevalent problems that results in cognitive deficits and affects approximately three hundred thousand U.S. troops who have served in the wars in Iraq and Afghanistan.					
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“The Development of a Mobile Health Platform and Naturalistic Game Applications for Health Assessment, Intervention, and Evaluation”

**PI: Dr. Carmen Russoniello, Center for Applied Psychophysiology
East Carolina University**

Award No. W81XWH -12-2-0096, EDMS 5571

Final Report December 29, 2015

1. Body:

The goal of this project was to develop a prototype of a game based assessment and develop a normative data base for remote measurement and monitoring of real time neurocognitive functioning among active duty military service personnel.

Due to a dramatic rise in mild traumatic brain injuries (It is estimated that 20% of all combat troops will experience a concussion while deployed) increased emphasis has rightly been placed on finding ways to assess cognitive deficits and ameliorate its symptoms. The effects of traumatic brain injury are often associated with other dysfunctional conditions, specifically, chronic pain and PTSD. Posttraumatic stress (PTSD) is another prevalent problems that results in cognitive deficits and affects approximately three hundred thousand U.S. troops who have served in the wars in Iraq and Afghanistan.

Anticipated Benefits

Both mTBI and PTSD dramatically affect all aspects of cognition and, in turn, overall performance. Pen and paper tests have been the standard measure in neurocognitive assessment until recently when studies suggested that automated assessments could provide additional detail such as subtle cognitive deficits stemming from different types of concussion. Neither testing technique is as readily accessible in the field and therefore have limited applicability. Neurocognitive assessment on a cell phone that can capture data in the field on repeated occasions are needed. This project involves the development and testing of a game based neurocognitive assessment that is accessible, reliable, accurate, and enjoyable. The inexpensive, mobile phone based, assessment of cognition will be downloadable as an App and become immediately accessible to thousands of military personnel as well as millions of community residents. Once normative data is developed strategies to predict, prevent and treat cognitive decline will be greatly enhanced. In studies conducted in our lab we discovered that off the shelf casual video games video games could improve cognitive functioning in the short term as well as increase mood and decrease stress.

Commercial Applications

People in general are concerned about their performance and appreciate ways to measure it when they can. Heart rate monitors and pedometers and video arcades are a few examples. The proposed game will provide an opportunity to assess cognitive performance and quantify the results. Military personnel are acutely aware of the need to perform at optimum levels and understand the benefit of being able to be “tested” and the performance report. Humans often compete among each other and games with the ultimate goal of increasing performance. The proposed game App can be used across the spectrum in the military from Wounded Warriors who could use it to measure and monitor cognitive changes caused or exacerbated by their condition to Special Operation personnel who can use the assessment to measure and monitor their cognitive status. Health care practitioners will be able to make more accurate recommendations for treatment and decisions about soldiers’ cognitive fitness level for duty.

There are multiple markets for this neurocognitive assessment video game in addition to the military. By changing the story line, Apps can be designed to assess the elderly where cognitive decline is of great concern. Those suffering from mTBI and PTSD in the community will also benefit by having the ability to measure their cognitive status. People in general who are interested in assessing their cognitive fitness level represent a large consumer market.

It is our intention to complete the original proposed study with Marines to establish baseline data for future comparisons. We intend to further develop the game into a popular and challenging game that can improve cognition as well as assess its performance.

Identification and Significance of the Problem or Opportunity

Department of Defense statistics on TBI severity indicate that 27,862 were counted in the year 2009, and about 78% (21,859) of these were considered mild (available at <http://www.dvbic.org/TBI-Numbers.aspx>). These same percentages hold when data was compared from 2003-2009 in which over 134,476 mTBIs were reported. These statistics were gathered in military facilities only and are considered a low estimate of the real total.

Due to this dramatic rise in mild traumatic brain injuries (It is estimated that 20% of all combat troops will experience a concussion while deployed) increased emphasis has rightly been placed on finding ways to diagnose and improve mTBI. The effects of traumatic brain injury are often, unfortunately, associated with other dysfunctional conditions, specifically, chronic pain (81.5%) and PTSD (68.2%). Symptoms associated post-concussion can increase the probability of PTSD and sabotage the effectiveness of cognitive behavioral intervention strategies and psychotherapy in general. It is now theorized that even subtle attentional or memory deficits might affect learning or other aspects of the intervention process #. While the frequency and duration of the symptoms are related to injury severity there is a significant emotional component. The intertwined symptoms create a conundrum when trying to ascertain methods to assess the condition and apply appropriate treatments. According to the Army Gold Book⁵ most

concussions heal spontaneously but a good percentage develop persistent symptoms that can cause cognitive dysfunction as well as to reduce Soldier performance and readiness.

In a workshop several years back, hosted by then TATRC director Col. Karl Friedl, spoke to cognitive performance, its relevance to the military and its importance in the therapy process. Dr. Jennifer Vasterling a Harvard Medical School Psychiatrist noted that compromised cognitive abilities can undermine the entire therapy process. Hence, the importance of establishing quantitative markers of cognitive performance that can be used by practitioners to establish baseline, and measure the effectiveness of an intervention. Quantitative Cognitive enables healthcare staff to start treatment earlier, monitor its effectiveness more closely, and make more accurate return-to-duty decisions. Col. Friedl specifically addressed the need for reliable and accurate, technologically based, neurocognitive testing that are unobtrusive and even fun. "If it's fun, individuals will be more motivated and the results could be more accurate," he said. Currently the military uses pen and paper and automated, PC-based, neurocognitive tests.

Technical Objective

To develop, pilot, and deploy a mobile gaming platform that permits assessment and monitoring of cognitive functioning among military service members with conditions that impair these cognitive functions.

Proposed Neurocognitive Assessment Tool Description

The proposed neurocognitive assessment tool will be implemented in the form of a mobile application for iOS, WP7 or Android platform.

The application will be designed based on client-server application framework concept. The application will consist of two major components – client application and server application. Client application will be installed on the target mobile devices (Smart phones and Tablets with Android OS).

The mobile application will perform the following functionality:

1. Capture user's personal and biometric information
2. Perform NCA testing
3. Upload raw test data along with personal and biometric information to the server
4. Retrieve selected NCA test results
5. Display NCA results

The server application will consist of the following components:

1. Remote database management services with server data storage (e.g. MySQL database)
2. NCA reporting web application for professional personnel

The server application will perform the following functionality:

1. Download raw test data along with personal and biometric information from mobile clients
2. Store downloaded data in the remote database storage
3. Retrieve NCA test results and upload to mobile clients based on their queries for NCA reports
4. Retrieve selected NCA test results based on queries from the professional personnel
5. Display NCA results in web browsers requested by professional personnel
6. Send test notes, comments and recommendations to the clients via email or secure text messages.

NCA tool will implement assessment of the following factors:

Factor	Description	Measures
Simple Reaction Time	Time to respond to any visual or auditory stimulus	<ul style="list-style-type: none"> - Reaction time (ms) - False reaction (%) - Missed reaction (%)
Recognition Reaction Time	Time to respond to a specific visual or auditory stimulus	<ul style="list-style-type: none"> - Reaction time (ms) - False reaction (%) - Wrong recognition (%)
Choice Reaction Time	Time to commit selective response to alternative visual or auditory stimuli	<ul style="list-style-type: none"> - Reaction time (ms) - False reaction (%) - Wrong recognition (%)
Selective Attention	Ability to respond to selected stimuli while ignoring distractions	<ul style="list-style-type: none"> - Response time (ms) - Mistakes (%)
Sustained Attention	Ability to maintain attention over an extended period of time (until response becomes too slow and/or making too many errors)	<ul style="list-style-type: none"> - Duration (sec)
Attention Capacity	Ability to keep objects in working memory	<ul style="list-style-type: none"> - Capacity (a.u.) - Mistakes (%)
Divided Attention	Ability to perform at least two tasks simultaneously	<ul style="list-style-type: none"> - Response time(ms) - False reaction (%) - Wrong reaction (%)

All these tests are embedded in the game scenario requiring specific actions. While the user will be playing an enjoyable stimulating game, the application will measure all required parameters of the incorporated psychometric tests.

3. ACCOMPLISHMENTS: We completed the prototype and bench testing of game based neurocognitive assessment (professional and client Apps for android based

smart phones and tablets) as well as all associated administration and user manuals (ATTACHED). Unfortunately, we were unable to secure all the appropriate human subjects approvals before the grant expired. We intend to gather normative data in the near future acknowledging there is no DoD support.



Statement of Work

ID	Task	Total Hours	Status
1	<u>Architectural Design:</u>		

1.1	Write Detailed Project Specification	80	DONE
1.2	Develop System Functional Design	80	DONE
1.3	Select Server / DBMS Platform, create Detailed Database Structure	20	DONE
1.4	Design Web-services Functional Architecture	20	DONE
2	<u>GUI Design & Development:</u>		
2.1	Design Application GUI Mockup (SketchFlow) for Sys Admin WS, Professional WS, Testing app	160	DONE
2.2	Create NCA game design	30	DONE
2.3	Develop game artwork elements (layouts, graphical assets)	100	DONE
2.4	Develop Mobile NCA System Administrator GUI XAML (Expression Blend)	20	DONE
2.5	Develop Mobile NCA Professional Workstation GUI XAML (Expression Blend)	40	DONE
2.6	Develop Mobile NCA Tablet Testing Application GUI XAML (Expression Blend)	40	DONE
3	<u>Neurocognitive Assessment Implementation:</u>		
3.1	Select cognitive assessment methods, design NCA tests	100	DONE
3.2	Development of NCA software modules, testing	250	DONE
4	<u>Back-End Server Implementation:</u>		
4.1	Create Database Tables and Stored Procedures	100	DONE
4.2	Implement and test Web-services Module	80	DONE
4.3	Implement and test Mobile NCA System Administrator Application	100	DONE
4.4	Implement and test Mobile NCA Professional Workstation Application	140	DONE

5	<u>Tablet NCA Application Implementation:</u>		
5.1	Implement Tablet NCA Application Framework and integrate with Server DBMS	100	DONE
5.2	Implement NCA Game Module	150	DONE
5.3	Implement NCA Reporting Modules	40	DONE
5.4	Tablet NCA Application Comprehensive Testing	100	DONE
6	<u>System Integration</u>		
6.1	System Integration & Testing	60	DONE
6.2	Verification (Bench testing + Report writing)	100	DONE
7	<u>Baseline Data Collection</u>		
7.1	IRBs, Scientific Reviews Committee Meetings, grant management	350	90%
7.2	Focus group testing	0	0%
7.2	Recruit Subjects and Administer Tests	0	0%
7.3	Analyze Data	0	0%
7.4	Graduate students and Co-PIs	600	
	Compile Quarterly and Annual reports	100	100%
	PROJECT TOTAL:	2940	

What opportunities for training and professional development has the project provided?

We attended the 49th Annual Conference of the Association for Applied Psychophysiology in Austin, Texas March, 2015 (2 students participated).

Attended 48th Annual Conference of the Association for Applied Psychophysiology in Savannah, GA March, 2014 (4 students participated)

Attended Workshop on filing patents and trademarks hosted by the US Patent Office. Alexandria Virginia

How were the results disseminated to communities of interest?

We presented a poster at annual conference of the Association for Applied Psychophysiology in Savannah, GA March, 2014

What was the impact on the development of the principal discipline(s) of the project?

The potential impact is immense, as a quantitative measure of TBI is needed for diagnosis and treatment specificity. The neurocognitive assessment developed in this project is designed to have the ability to differentiate between levels of TBI using naturalistic quantitative methods. As such it will provide invaluable guidance to professionals and individuals on their neurocognitive status and whether or not methods to improve it are working.

What was the impact on other disciplines?

Many disciplines in physical, mental health, i.e. psychology, psychiatry, primary care, nursing will be affected. Other disciplines such as neurology, and neuroscience will also be impacted.

What was the impact on technology transfer?

East Carolina University is reviewing contracts with contractors but does not see and potential for intellectual property.

Creative Cybernetics, Inc. A mobile health technology company was created as a result of the work on this project and others. The business is still in the start up phase and not currently selling any products.

What was the impact on society beyond science and technology?

This product is simple to use and will have many uses including the ability to determine the level of TBI in military personnel, athletes and others. The product provides results that are easy to interpret making it possible for individuals to do self-assessment. Our goal is to now create a game based on the new assessment that will be designed to improve the areas it assesses

4. CHANGES/PROBLEMS: The Project Director/Principal Investigator (PD/PI) "Nothing to Report,"

Changes in approach and reasons for change

"Nothing to Report"

Actual or anticipated problems or delays and actions or plans to resolve them

The project received ECU IRB approval in February of 2012 but due to a number of personnel and organizational changes at Camp Lejeune Naval hospital, including the deployment of LCDR Evans a neuropsychologist and PI on the study. ECU and US Navy IRBs have recently reached a reciprocal agreement. Our intent is re-submit the proposal to ECU/USN for approval and complete the normative data collection phase. It is acknowledged that this study will be without the support of the DoD.

Changes that had a significant impact on expenditures

"Nothing to report"

Significant changes in use or care of human subjects, vertebrate animals, biohazards, and/or select agents

"Nothing to report"

Significant changes in use or care of human subjects

"Nothing to report"

Significant changes in use or care of vertebrate animals

"Nothing to report"

Significant changes in use of biohazards and/or select agents

"Nothing to report"

5. PRODUCTS: List any products resulting from the project during the reporting period.

Mobile Naturalistic Neurocognitive Assessment, Client and professional Apps.

Publications, conference papers, and presentations

Poster: Evans, J., Russoniello, C. V., Bart-Knauer, B., Murray, N., & Laing, B. (2014). The Development of a Mobile Naturalistic Cognitive Assessment. Applied Psychophysiology and Biofeedback Annual Conference, Savannah, Ga.

Journal publications.

Evans, J., Russoniello, C. V., Bart-Knauer, B., Murray, N., & Laing, B. (2014). The Development of a Mobile Naturalistic Cognitive Assessment. *Applied Psychophysiology and Biofeedback*, 39, 313.

Books or other non-periodical, one-time publications.

"Nothing to report"

Other publications, conference papers, and presentations.

“Nothing to Report”

Website(s) or other Internet site(s)

“Nothing to report”

Technologies or techniques

“Nothing to report”

Inventions, patent applications, and/or licenses

There have been no patent applications and/or licenses that have resulted from the research.

Other Product

software;

PARTICIPANTS & OTHER COLLABORATING ORGANIZATIONS

What individuals have worked on the project?

Name:	Carmen Russoniello
Project Role:	PI/PD
Researcher Identifier (e.g. ORCID ID):	1
Nearest person month worked:	12/15
Contribution to Project:	Dr. Russoniello is PI and PD.
Funding Support:	

Name:	Nick Murray
Project Role:	Co-PI
Researcher Identifier (e.g. ORCID ID):	1
Nearest person month worked:	12/15
Contribution to Project:	Dr. Murray assisted with bench testing of the neurocognitive device and managed conflict of interest between ECU and Creative Cybernetics the subcontractor.
Funding Support:	1.5 months at 100%

Example:

Name:	Brenton Laing
Project Role:	Graduate Student
Researcher Identifier (e.g. ORCID ID):	1
Nearest person month worked:	6/2014
Contribution to Project:	Mr. Laing assisted in the bench testing of the neurocognitive assessment
Funding Support:	Masters level GA 20 hours per week

Has there been a change in the active other support of the PD/PI(s) or senior/key personnel since the last reporting period?

"Nothing to Report."

What other organizations were involved as partners?

Creative Cybernetics, Inc. Sub Contractor

Description of Neurocognitive Tests

In this document full details on performing neurocognitive testing are presented including input data, functional logic, computation and output data.

1. Simple Reaction Time

1.1. Cognitive Domain

This test evaluates:

- Attention
- Visuo-motor response timing

1.2. Test Description

This test evaluates the ability to produce simple motor reaction to non-specific visual stimuli. It quantitatively evaluates the time of such reaction. The program repetitively generates visual stimuli (any objects – simple like a color circle or complex like images) at any random moments within certain time range (5 – 15 sec).

Each stimulus is visible for only a short period of time (no longer than 1 sec). The subject must hit the target on touch-screen or any button on the keyboard as fast as possible upon getting the stimulus.

The program gets two time stamps: (a) at the moment of producing a stimulus and (b) at the moment of responding. The program measures time stamps with 1 ms time resolution. It calculates the time difference between these two stamps. This difference is **Reaction Time**.

The program checks if the subject responds too early: (a) before the stimulus occurs or (b) earlier than known fastest possible reaction. This is called **False Reaction**.

If the subject does not respond by the end of trial, it is called **Missed Reaction**.

The program does not measure reaction time in case of False Reaction and Missed Reaction.

1.3. Test Logic Flowchart

The key test logic flowchart is illustrated on Fig. 3.

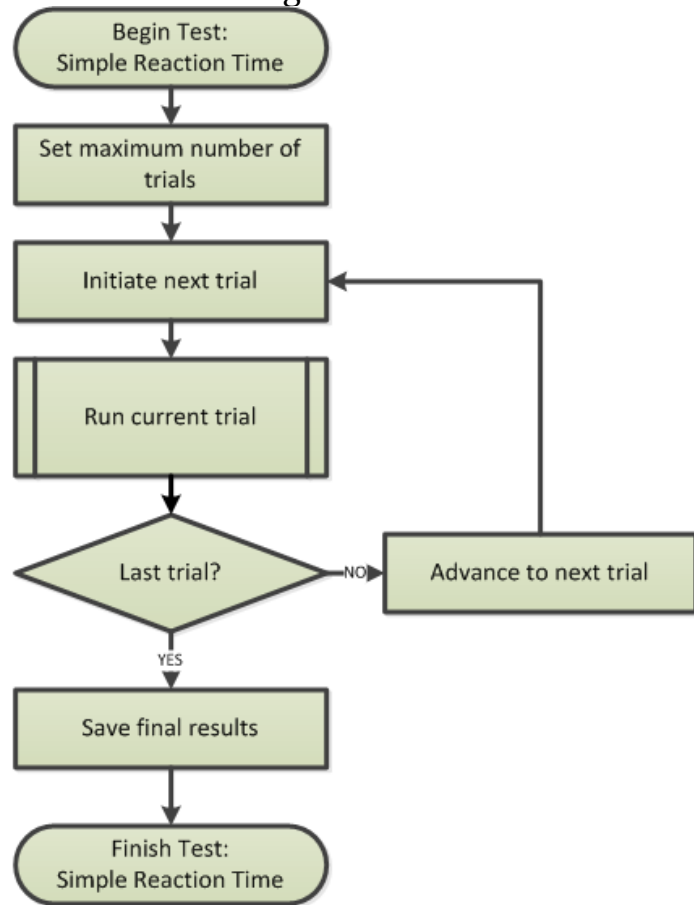


FIG. 3

The test trial logic is illustrated on Fig. 4.

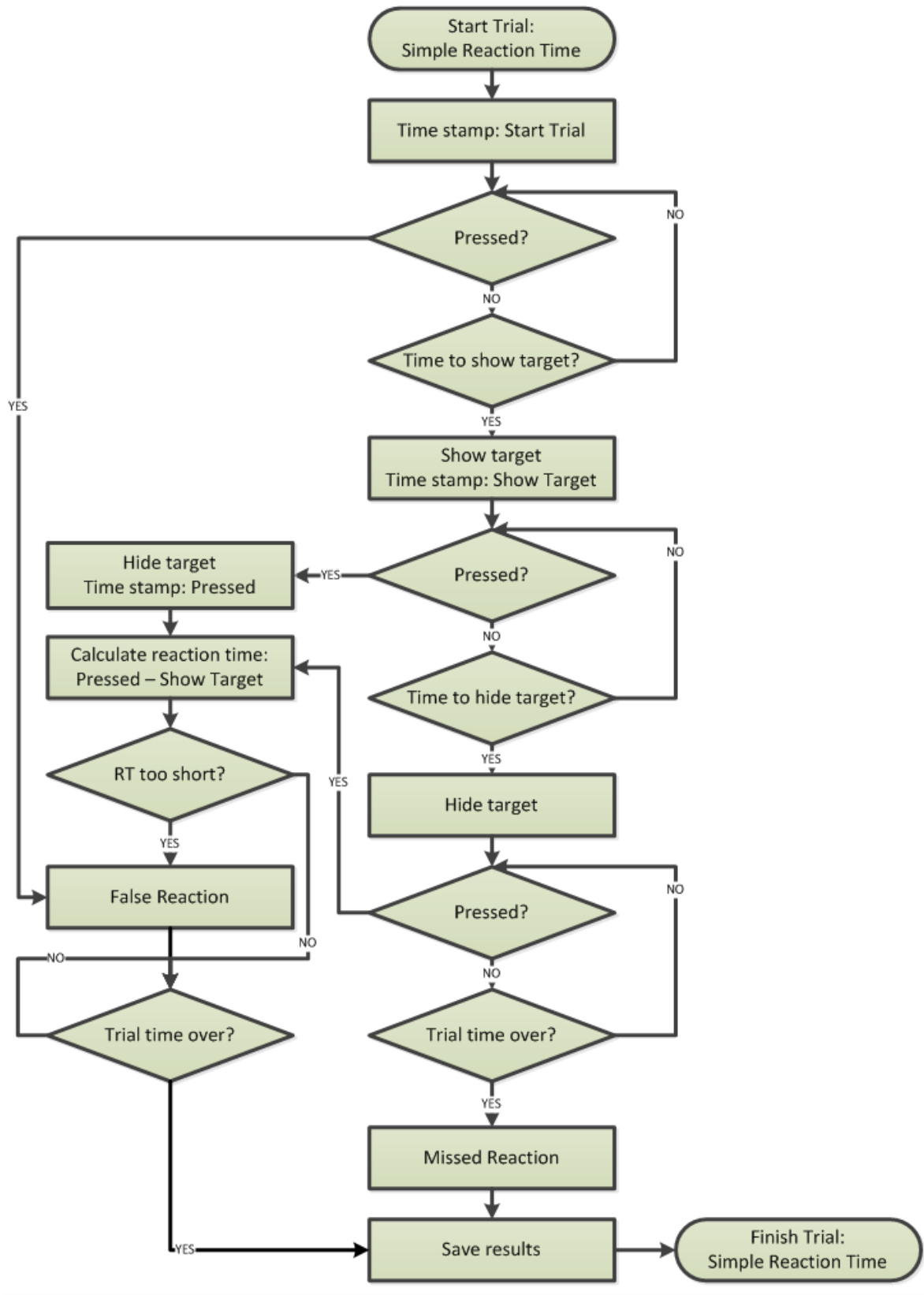


FIG. 4

1.4. Input Parameters

The following parameters are used to perform this test:

Parameter	Description	Default Value
Number Of Trials	Total number of test repetitions	20
Minimum Trial Time	The shortest time interval between trials	3000
Maximum Trial Time	The longest time interval between trials	5000
Target Exposure Time	The time when target is visible	500
Threshold Reaction Time	The shortest reaction time considered normal	150

These parameters are set and stored in program configuration and can be modified by the system administrator on the server. Each client application reads this configuration before each testing session.

All times are measured in milliseconds.

1.5. Recorded Data

The following data is recorded and sent to the server for analysis:

Test Settings	Current values of test settings described in 3.1.4.
Reaction Time (RT)	Array of reaction times in ms: -1 means false reaction -999 means missed reaction

1.6. Test Results and Calculations

The following parameters are calculated by the server when test data is submitted for analysis:

Trial Count (TC)	Total number of trials in the test.
Mean Reaction Time (MRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions and missed reactions are excluded.
False Reaction Count (FRC)	Total number of false reactions stored in the array of reaction times.
Percent of False Reactions (%FR)	Percentage value of false reactions to the total number of trials: %FR = FRC / TC * 100
Missed Reaction Count (MRC)	Total number of missed reactions stored in the array of reaction times.
Percent of Missed Reactions (%MR)	Percentage value of missed reactions to the total number of trials: %MR = MRC / TC * 100
Mistake Count (MC)	Total number of erroneous reactions is calculated as a sum of false reaction count and missed reaction count MC = FRC + MRC
Percent of Mistakes (%M)	Percentage value of erroneous reactions to the total number of trials: %M = %FR + %MR

The testing procedure is repeated a preset number of times (e.g. 20 times). During this process it measures all Reaction Times and calculates an Average Reaction Time as main test output parameter. It also counts the total number of False Reactions and Missed Reactions and presents them as % ratio to the total number of tests.

2. Recognition Reaction Time

2.1. Cognitive Domain

This test evaluates:

- **Response inhibition**
- Processing speed
- Motor speed

2.2. Test Description

This test evaluates the ability to recognize specific types of visual stimuli and produce simple motor reaction to specific recognized visual stimuli and inhibit such reaction in response to alternative stimuli. It quantitatively evaluates the time of such reaction.

The program repetitively and randomly generates visual stimuli of two alternative types (any objects – simple like color circles and squares or complex like different images) at any random moments within certain time range (5 – 15 sec).

Each stimulus is visible for only a short period of time (no longer than 1 sec).

The subject must hit the target on touch-screen or any button on the keyboard as fast as possible upon getting stimuli of one type and ignore stimuli of the alternative type.

The program gets two time stamps: (a) at the moment of producing a stimulus and (b) at the moment of responding. The program measures time stamps with 1 ms time resolution. It calculates the time difference between these two stamps. This difference is **Reaction Time**.

The program checks if the subject responds too early: (a) before the stimulus occurs or (b) earlier than known fastest possible reaction. This is called **False Reaction**.

If the subject does not respond by the end of trial, it is called **Missed Reaction**.

The program checks if the subject makes wrong response: (a) hits the target that must be ignored or (b) ignores the target that must be hit. This is called **Wrong Recognition**.

The program does not measure reaction time in case of False Reaction and Missed Reaction. It also records if recognition was right or wrong.

2.3. Test Logic Flowchart

The key test logic flowchart is illustrated on Fig. 5.

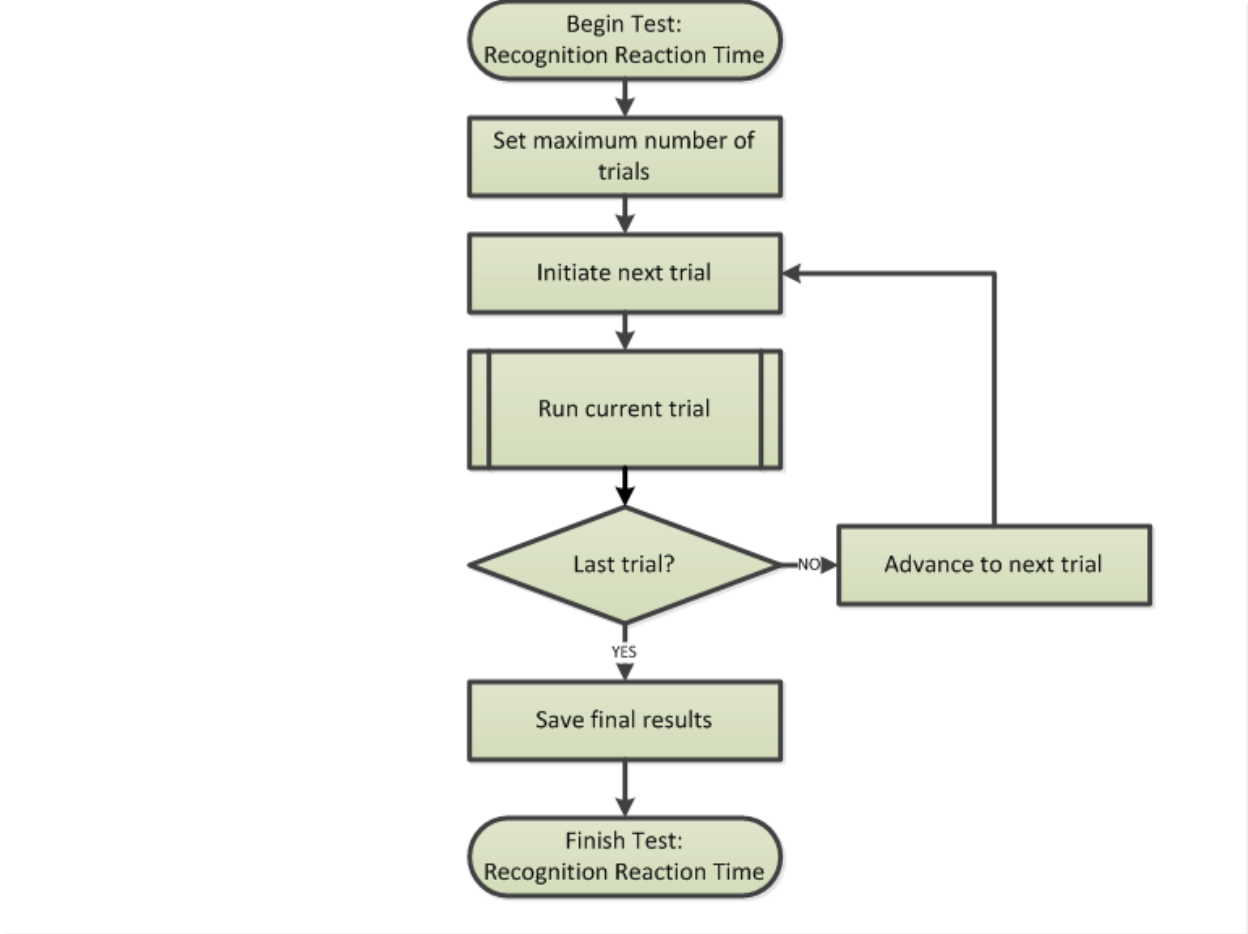


FIG. 5

The test trial logic is illustrated on Fig. 6.

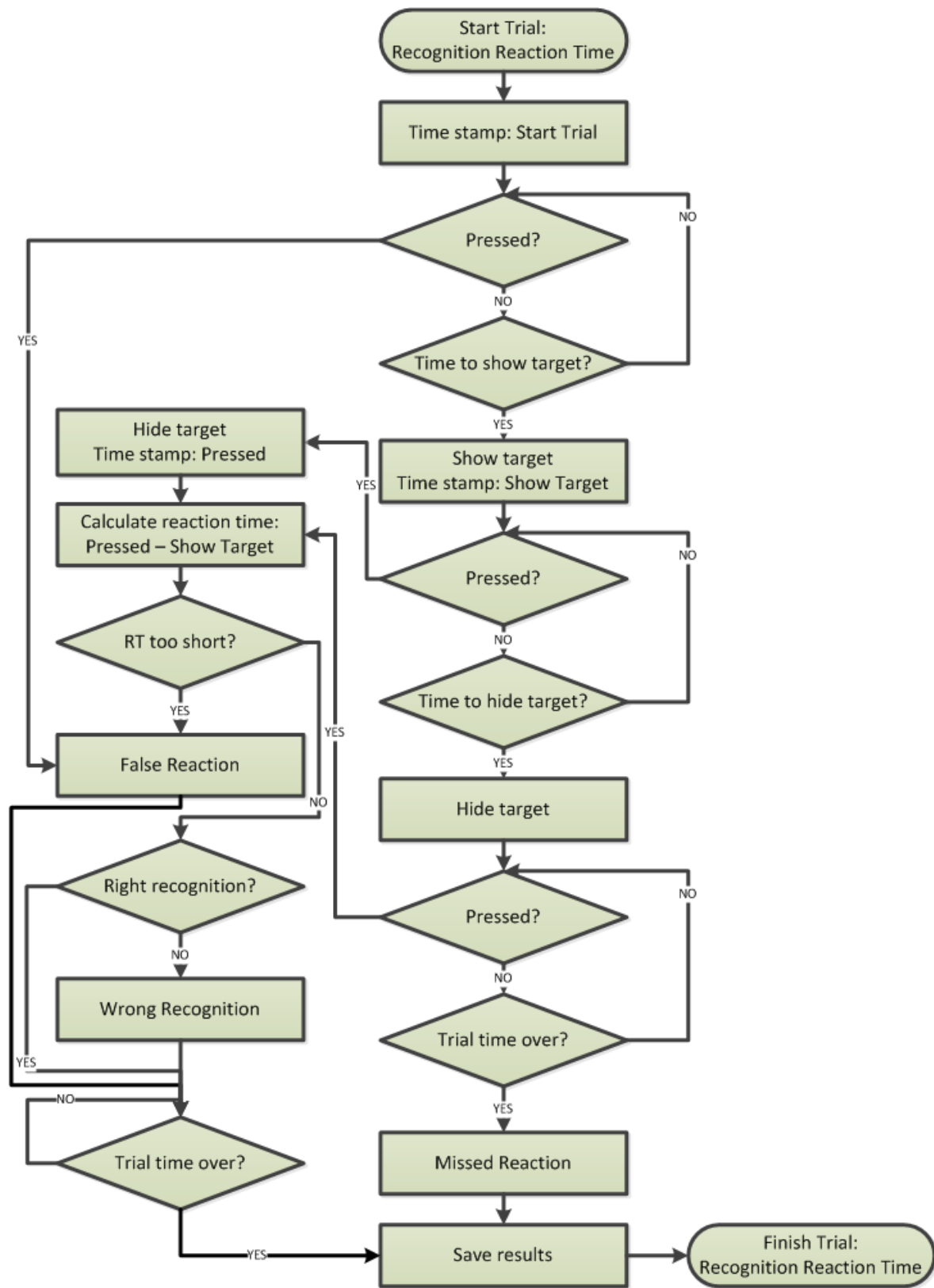


FIG. 6

2.4. Input Parameters

The following parameters are used to perform this test:

Parameter	Description	Default Value
Number Of Trials	Total number of test repetitions	200
Minimum Trial Time	The shortest time interval between trials	3000
Maximum Trial Time	The longest time interval between trials	5000
Target Exposure Time	The time when target is visible	500
Threshold Reaction Time	The shortest reaction time considered normal	180

These parameters are set and stored in program configuration and can be modified by the system administrator on the server. Each client application reads this configuration before each testing session.

All times are measured in milliseconds.

2.5. Recorded Data

The following data is recorded and sent to the server for analysis:

Test Settings	Current values of test settings described in 3.2.4.
Reaction Time (RT)	Array of reaction times in ms: -1 means false reaction -999 means missed reaction
Recognition	Array of Boolean values (TRUE or FALSE) representing right or wrong recognition of respective trials

2.6. Test Results and Calculations

The following parameters are calculated by the server when test data is submitted for analysis:

Trial Count (TC)	Total number of trials in the test.
Mean Recognition Reaction Time (MRRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions, missed reactions and wrong recognitions are excluded.
False Reaction Count (FRC)	Total number of false reactions stored in the array of reaction times.
Percent of False Reactions (%FR)	Percentage value of false reactions to the total number of trials: $\%FR = FRC / TC * 100$
Missed Reaction Count (MRC)	Total number of missed reactions stored in the array of reaction times.
Percent of Missed Reactions (%MR)	Percentage value of missed reactions to the total number of trials: $\%MR = MRC / TC * 100$
Wrong Recognition Count (WRC)	Total number of trials having wrong recognition mistakes.
Percent of Wrong Recognitions (%WR)	Percentage value of wrong recognitions to the total number of trials: $\%WR = WRC / TC * 100$
Mistake Count (MC)	Total number of erroneous reactions is calculated as a sum of false reaction count, missed reaction count and wrong recognition count $EC = FRC + MRC + WRC$
Percent of Mistakes (%M)	Percentage value of erroneous reactions to the total number of trials: $\%M = \%FR + \%MR + \%WR$

3. Choice Reaction Time

3.1. Cognitive Domain

This test evaluates:

- Alternating attention
- Processing speed
- Motor speed

3.2. Test Description

This test evaluates the ability to recognize specific types of visual stimuli and produce different motor reaction to specific recognized visual stimuli. It quantitatively evaluates the time of such reaction.

The program repetitively and randomly generates visual stimuli of two alternative types (any objects – simple like color circles or squares or complex like different images) at any random moments within certain time range (5 – 15 sec).

Each stimulus is visible for only a short period of time (no longer than 1 sec). The subject must respond differently to appearance of targets of different types: hit the target on touch-screen with a single or double tap or press one of two dedicated buttons on the keyboard as fast as possible upon getting stimuli of the alternative types.

The program gets two time stamps: (a) at the moment of producing a stimulus and (b) at the moment of responding. The program measures time stamps with 1 ms time resolution. It calculates the time difference between these two stamps. This difference is **Reaction Time**.

The program checks if the subject responds too early: (a) before the stimulus occurs or (b) earlier than known fastest possible reaction. This is called **False Reaction**.

If the subject does not respond by the end of trial, it is called **Missed Reaction**.

The program checks if the subject makes wrong response - hits the target with wrong button (or touch type). This is called **Wrong Choice**.

The program does not measure reaction time in case of False Reaction and Missed Reaction. It also records if choice was right or wrong.

3.3. Test Logic Flowchart

The key test logic flowchart is illustrated on Fig. 7.

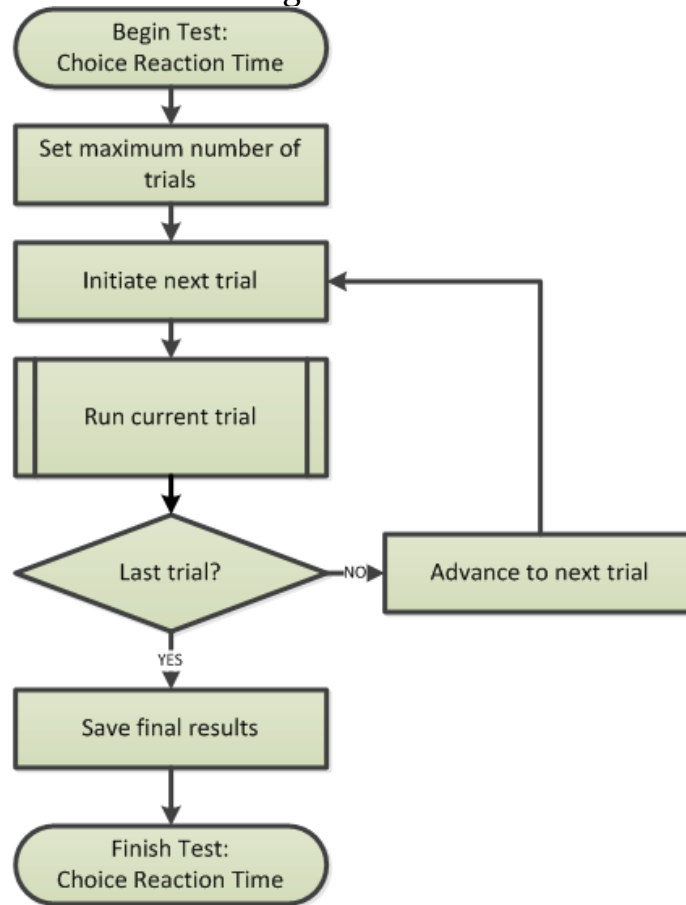


FIG. 7

The test trial logic is illustrated on Fig. 8.

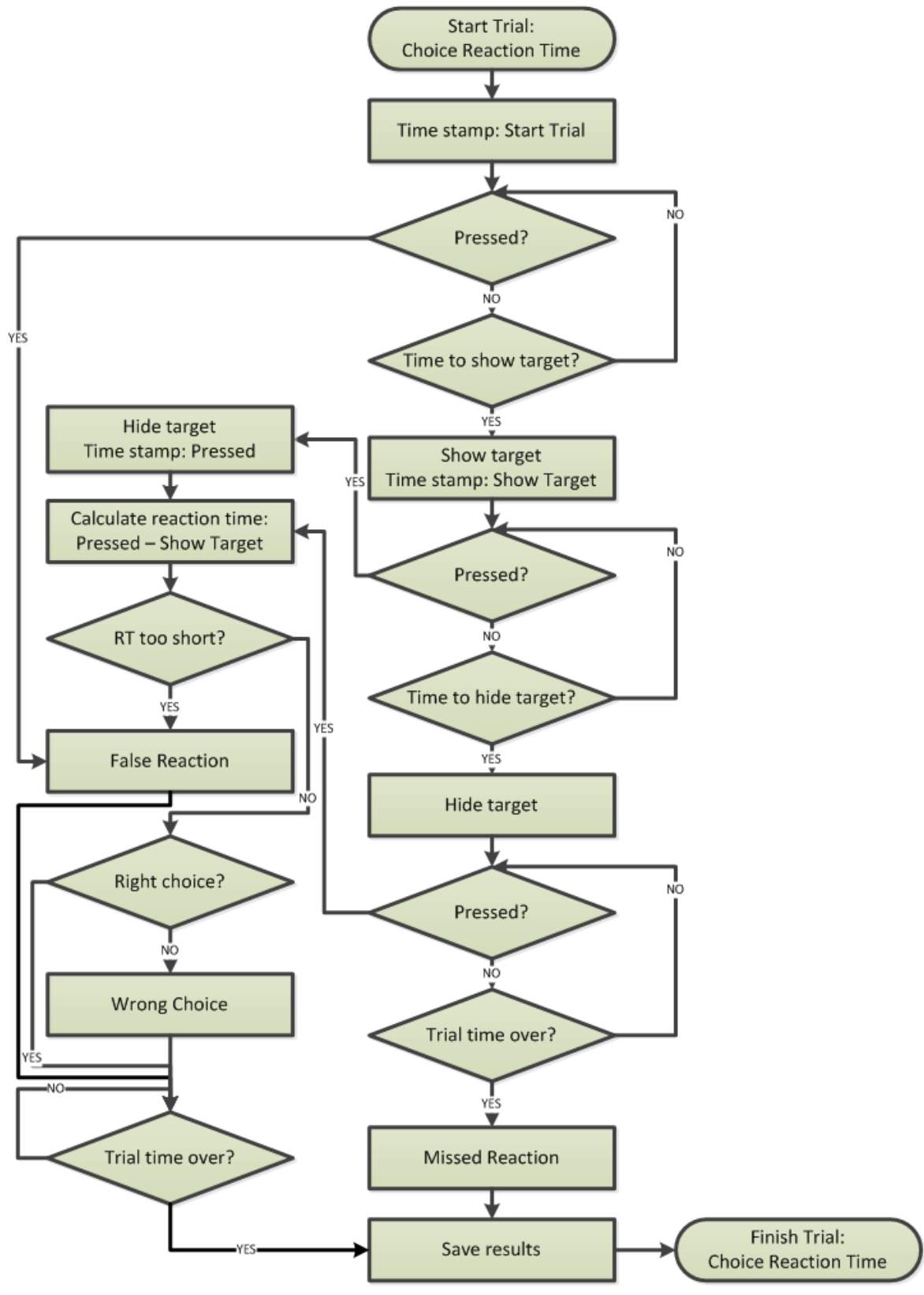


FIG. 8

3.4. Input Parameters

The following parameters are used to perform this test:

Parameter	Description	Default Value
Number Of Trials	Total number of test repetitions	20
Minimum Trial Time	The shortest time interval between trials	3000
Maximum Trial Time	The longest time interval between trials	5000
Target Exposure Time	The time when target is visible	500
Threshold Reaction Time	The shortest reaction time considered normal	200

These parameters are set and stored in program configuration and can be modified by the system administrator on the server. Each client application reads this configuration before each testing session. All times are measured in milliseconds.

3.5. Recorded Data

The following data is recorded and sent to the server for analysis:

Test Settings	Current values of test settings described in 3.3.4.
Reaction Time (RT)	Array of reaction times in ms: -1 means false reaction -999 means missed reaction
Choice	Array of Boolean values (TRUE or FALSE) representing right or wrong choice of respective trials

3.6. Test Results and Calculations

The following parameters are calculated by the server when test data is submitted for analysis:

Trial Count (TC)	Total number of trials in the test.
Mean Choice Reaction Time (MCRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions, missed reactions and wrong choices are excluded.
False Reaction Count (FRC)	Total number of false reactions stored in the array of reaction times.
Percent of False Reactions (%FR)	Percentage value of false reactions to the total number of trials: $\%FR = FRC / TC * 100$
Missed Reaction Count (MRC)	Total number of missed reactions stored in the array of reaction times.
Percent of Missed Reactions (%MR)	Percentage value of missed reactions to the total number of trials: $\%MR = MRC / TC * 100$
Wrong Choice Count (WCC)	Total number of trials having wrong choice mistakes.
Percent of Wrong Choices (%WC)	Percentage value of wrong choices to the total number of trials: $\%WR = WRC / TC * 100$
Mistake Count (MC)	Total number of erroneous reactions is calculated as a sum of false reaction count, missed reaction count and wrong choice count $EC = FRC + MRC + WCC$
Percent of Mistakes (%M)	Percentage value of erroneous reactions to the total number of trials: $\%M = \%FR + \%MR + \%WC$

4. Selective Attention

4.1. Cognitive Domain

This test evaluates:

- Selective attention
- Concentration
- Processing speed
- Motor speed

4.2. Test Description

This test evaluates the ability to recognize selected types of visual stimuli and produce different motor reactions to recognized visual stimuli while ignoring distractions.

It quantitatively evaluates the time of motor reactions.

The program repetitively and randomly generates groups of visual stimuli of different kinds (e.g. 9 different geometric figures where any but one figure can be duplicated) placed in the 3 by 3 grid at a preset time interval (e.g. 5 sec). One of those objects is the target. Targets cannot be duplicated within one matrix.

Target type is randomly selected and presented to the subject in every trial.

Stimuli are visible for only a short period of time (no longer than 1 sec).

The subject must respond with selective action which recognizes the target.

When touch-screen is used, the subject must tap the target on the screen.

Otherwise predetermined key must be pressed on the keyboard.

The program gets two time stamps: (a) at the moment of producing a stimulus and (b) at the moment of responding. The program measures time stamps with 1 ms time resolution. It calculates the time difference between these two stamps. This difference is **Reaction Time**.

The program checks if the subject responds too early: (a) before the stimulus occurs or (b) earlier than known fastest possible reaction. This is called **False Reaction**.

If the subject does not respond by the end of trial, it is called **Missed Reaction**.

The program checks if the subject makes wrong response - hits the target with wrong button (or touch spot). This is called **Wrong Choice**. The program does not measure reaction time in case of False Reaction and Missed Reaction. It also records if choice was right or wrong.

4.3. Test Logic Flowchart

The key test logic flowchart is illustrated on Fig. 9.

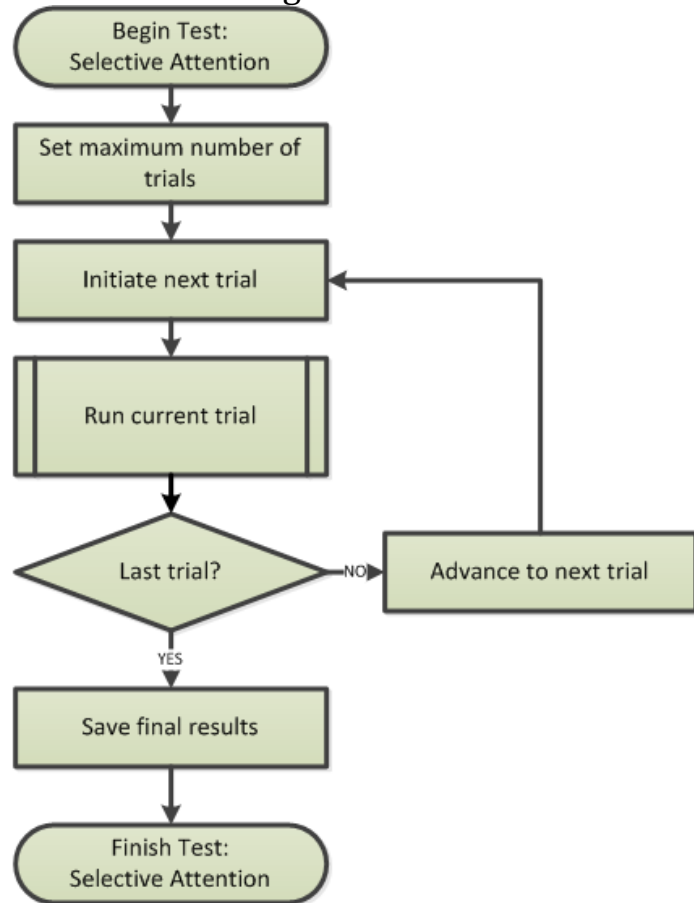


FIG. 9

The test trial logic is illustrated on Fig. 10.

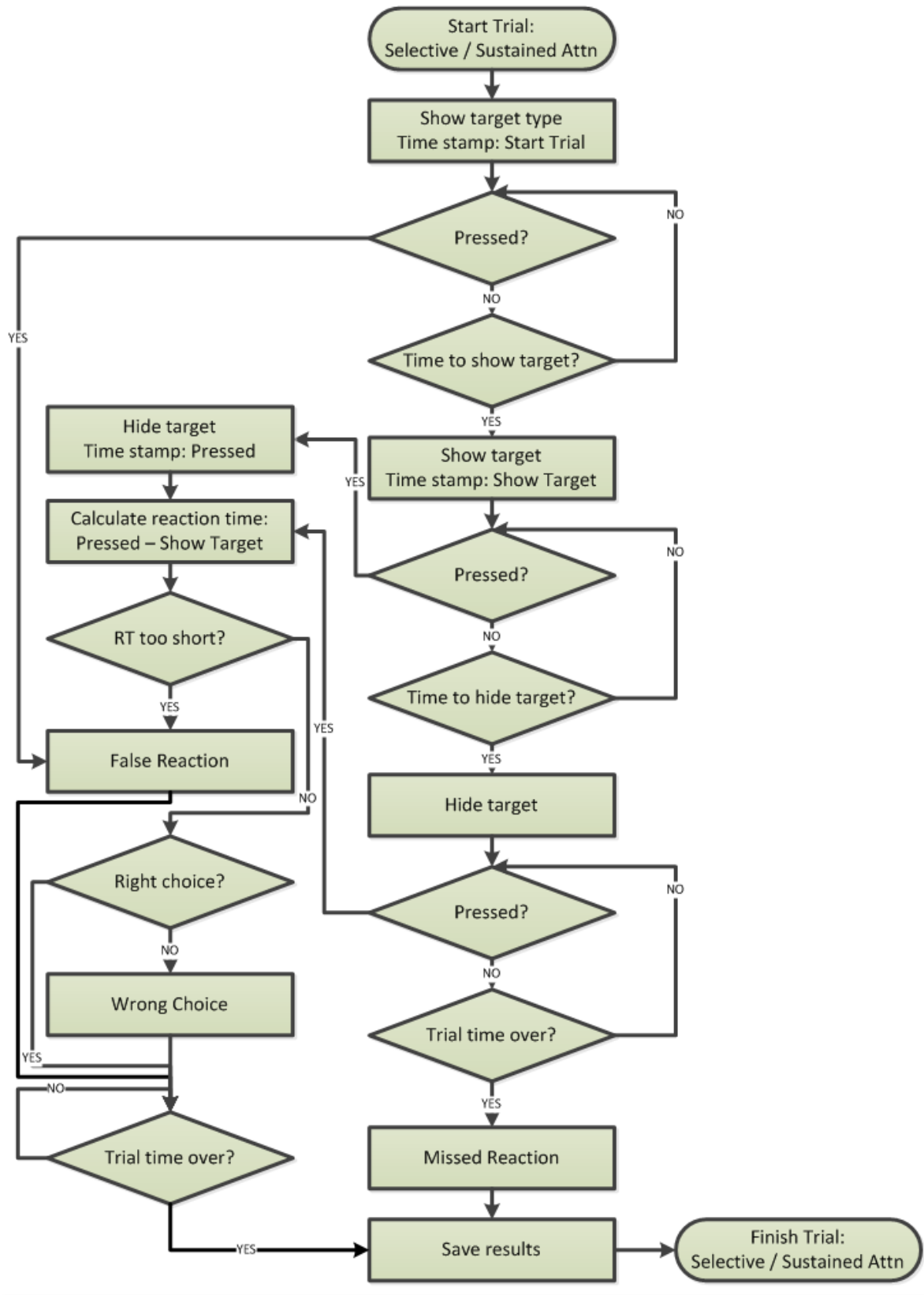


FIG. 10

4.4. Input Parameters

The following parameters are used to perform this test:

Parameter	Description	Default Value
Number Of Trials	Total number of test repetitions	20
Trial Time	Time interval between trials	5000
Target Exposure Time	The time when target is visible	500
Threshold Reaction Time	The shortest reaction time considered normal	200

These parameters are set and stored in program configuration and can be modified by the system administrator on the server. Each client application reads this configuration before each testing session. All times are measured in milliseconds.

4.5. Recorded Data

The following data is recorded and sent to the server for analysis:

Test Settings	Current values of test settings described in 3.4.4.
Reaction Time (RT)	Array of reaction times in ms: -1 means false reaction -999 means missed reaction
Choice	Array of Boolean values (TRUE or FALSE) representing right or wrong choice of respective trials

4.6. Test Results and Calculations

The following parameters are calculated by the server when test data is submitted for analysis:

Trial Count (TC)	Total number of trials completed in the test.
-------------------------	---

Mean Selective Reaction Time (MSRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions, missed reactions and wrong choices are excluded.
False Reaction Count (FRC)	Total number of false reactions stored in the array of reaction times.
Percent of False Reactions (%FR)	Percentage value of false reactions to the total number of trials: $\%FR = FRC / TC * 100$
Missed Reaction Count (MRC)	Total number of missed reactions stored in the array of reaction times.
Percent of Missed Reactions (%MR)	Percentage value of missed reactions to the total number of trials: $\%MR = MRC / TC * 100$
Wrong Choice Count (WCC)	Total number of trials having wrong choice mistakes.
Percent of Wrong Choices (%WC)	Percentage value of wrong choices to the total number of trials: $\%WR = WRC / TC * 100$
Mistake Count (MC)	Total number of erroneous reactions is calculated as a sum of false reaction count, missed reaction count and wrong choice count $EC = FRC + MRC + WCC$
Percent of Mistakes (%M)	Percentage value of erroneous reactions to the total number of trials: $\%M = \%FR + \%MR + \%WC$

5. Sustained Attention

5.1. Cognitive Domain

This test evaluates:

- Sustained attention
- Concentration
- Processing speed
- Motor speed

5.2. Test Description

This test evaluates the ability to:

- 1) Recognize selected types of visual stimuli and produce different motor reactions to recognized visual stimuli while ignoring distractions;
- 2) Maintain attention over an extended period of time until response becomes too slow and/or making too many mistakes.

It quantitatively evaluates the time of motor reactions.

The program repetitively and randomly generates groups of visual stimuli of different kinds (e.g. 9 different geometric figures where any but one figure can be duplicated) placed in the 3 by 3 grid at a preset time interval (e.g. 5 sec). One of those objects is the target. Targets cannot be duplicated within one matrix.

Target type is randomly selected and presented to the subject in every trial. Stimuli are visible for only a short period of time (no longer than 1 sec).

The subject must respond with selective action which recognizes the target.

When touch-screen is used, the subject must tap the target on the screen.

Otherwise predetermined key must be pressed on the keyboard.

The program gets two time stamps: (a) at the moment of producing a stimulus and (b) at the moment of responding. The program measures time stamps with 1 ms time resolution. It calculates the time difference between these two stamps. This difference is **Reaction Time**.

The program checks if the subject responds too early: (a) before the stimulus occurs or (b) earlier than known fastest possible reaction. This is called **False Reaction**.

If the subject does not respond by the end of trial, it is called **Missed Reaction**.

The program checks if the subject makes wrong response - hits the target with wrong button (or touch spot). This is called **Wrong Choice**.

The program does not measure reaction time in case of False Reaction and Missed Reaction. It also records if choice was right or wrong.

5.3. Test Logic Flowchart

The key test logic flowchart is illustrated on Fig. 11.

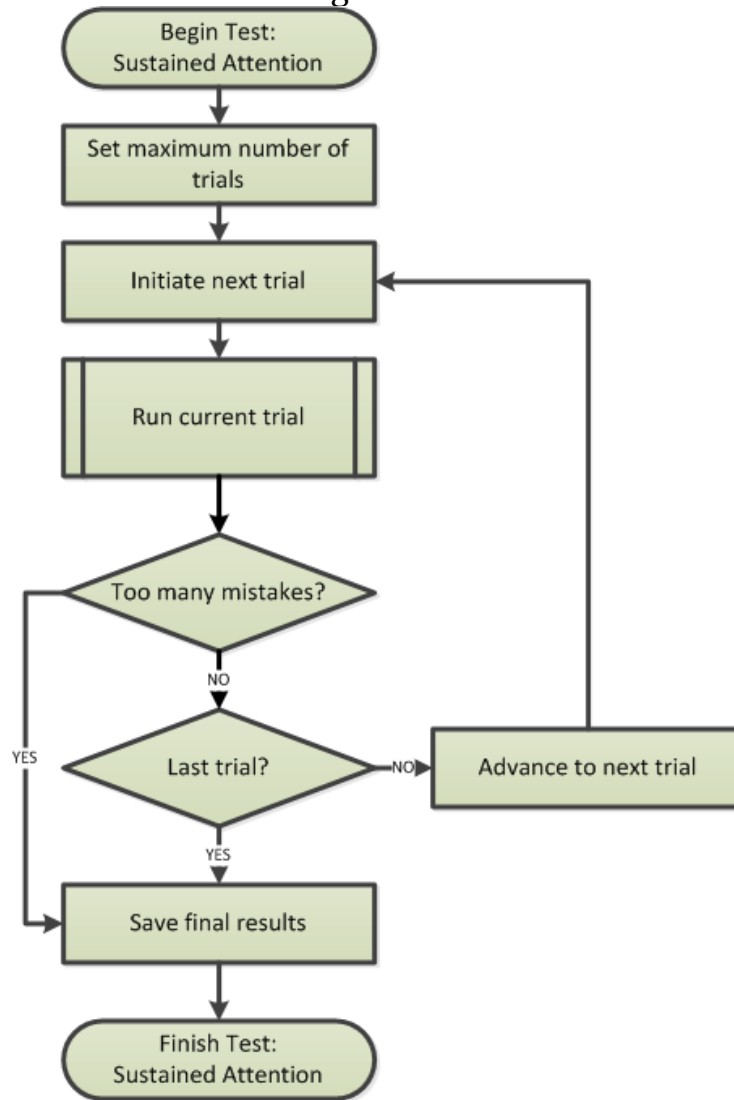


FIG. 11

The test trial logic is illustrated on Fig. 12.

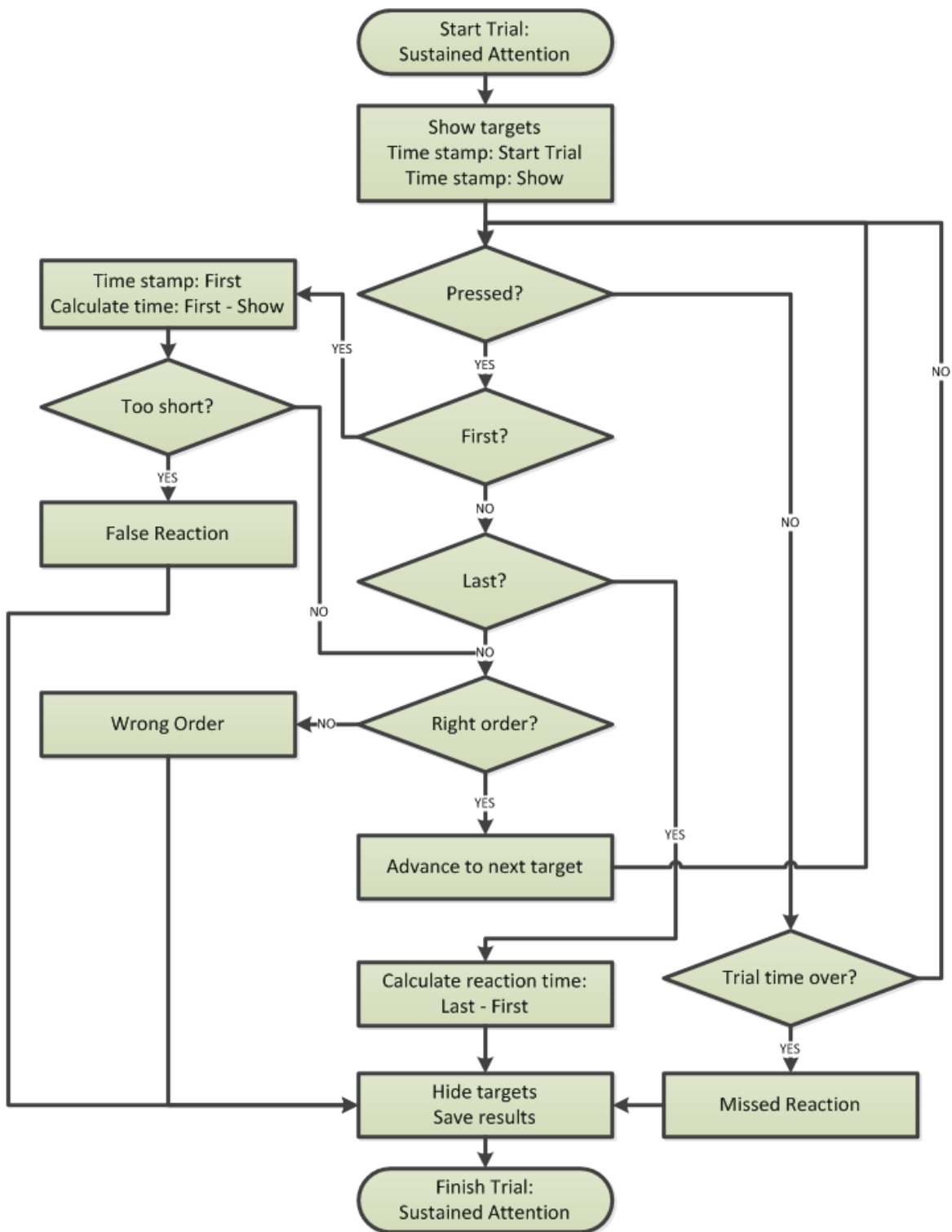


FIG. 12

5.4. Input Parameters

The following parameters are used to perform this test:

Parameter	Description	Default Value
Number Of Trials	Total number of test repetitions	20
Trial Time	Time interval between trials	15000
Target Exposure Time	The time when target is visible	10000
Threshold Reaction Time	The shortest reaction time considered normal	5000
Critical Level Of Mistakes	Percentage of mistakes made causing test to stop	30

These parameters are set and stored in program configuration and can be modified by the system administrator on the server. Each client application reads this configuration before each testing session.

All times are measured in milliseconds.

5.5. Recorded Data

The following data is recorded and sent to the server for analysis:

Test Settings	Current values of test settings described in 3.4.4.
Reaction Time (RT)	Array of reaction times in ms: -1 means false reaction -999 means missed reaction
Choice	Array of Boolean values (TRUE or FALSE) representing right or wrong choice of respective trials

5.6. Test Results and Calculations

The following parameters are calculated by the server when test data is submitted for analysis:

Trial Count (TC)	Total number of trials completed in the test.
Sustained Duration	Total duration of test the subject sustained performing.
Mean Selective Reaction Time (MSRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions, missed reactions and wrong choices are excluded.
False Reaction Count (FRC)	Total number of false reactions stored in the array of reaction times.
Percent of False Reactions (%FR)	Percentage value of false reactions to the total number of trials: $\%FR = FRC / TC * 100$
Missed Reaction Count (MRC)	Total number of missed reactions stored in the array of reaction times.
Percent of Missed Reactions (%MR)	Percentage value of missed reactions to the total number of trials: $\%MR = MRC / TC * 100$
Wrong Choice Count (WCC)	Total number of trials having wrong choice mistakes.
Percent of Wrong Choices (%WC)	Percentage value of wrong choices to the total number of trials: $\%WR = WRC / TC * 100$
Mistake Count (MC)	Total number of erroneous reactions is calculated as a sum of false reaction count, missed reaction count and wrong choice count $EC = FRC + MRC + WCC$
Percent of Mistakes (%M)	Percentage value of erroneous reactions to the total number of trials: $\%M = \%FR + \%MR + \%WC$

6. Attention Capacity

6.1. Cognitive Domain

This test evaluates:

- Spatial processing
- Visuo-spatial working memory

6.2. Test Description

This test evaluates the ability to keep multiple objects in working memory. It quantitatively evaluates the maximum number of objects effectively kept in working memory.

The program repetitively generates one or more visual stimuli – targets (e.g. geometric figures or images) randomly placed in any cells of the 3 by 4 grid at a preset time interval (e.g. 5 sec). The number of targets may not be more than 5 at a time.

Stimuli are visible for only a short period of time (no longer than 1 sec). Once the targets disappear, the subject must tap the places on the grid in case of using touch-screen display or hit specific buttons on the keyboard which represent the cells of the grid where the subject remembers the objects were (e.g. F keys ranging from 'F1' to 'F12').

The subject must respond as fast as possible to complete the trial within a preset time interval.

The program gets two time stamps: (a) at the moment when targets disappear and (b) at the moment of when last response occurred. The program measures time stamps with 1 ms time resolution. It calculates the time difference between these two stamps. This difference is **Reaction Time**.

The program checks if the subject responds too early: (a) before the stimuli were shown and then disappeared. This is called **False Reaction**.

If the subject does not respond by the end of trial, it is called **Missed Reaction**.

The program checks if the subject makes wrong responses - hits the targets with wrong buttons (or touch spots). This is called **Wrong Choice**.

The program does not measure reaction time in case of False Reaction and Missed Reaction.

It records total number of wrong choices compared to the total number of targets.

6.3. Test Logic Flowchart

The key test logic flowchart is illustrated on Fig. 13.

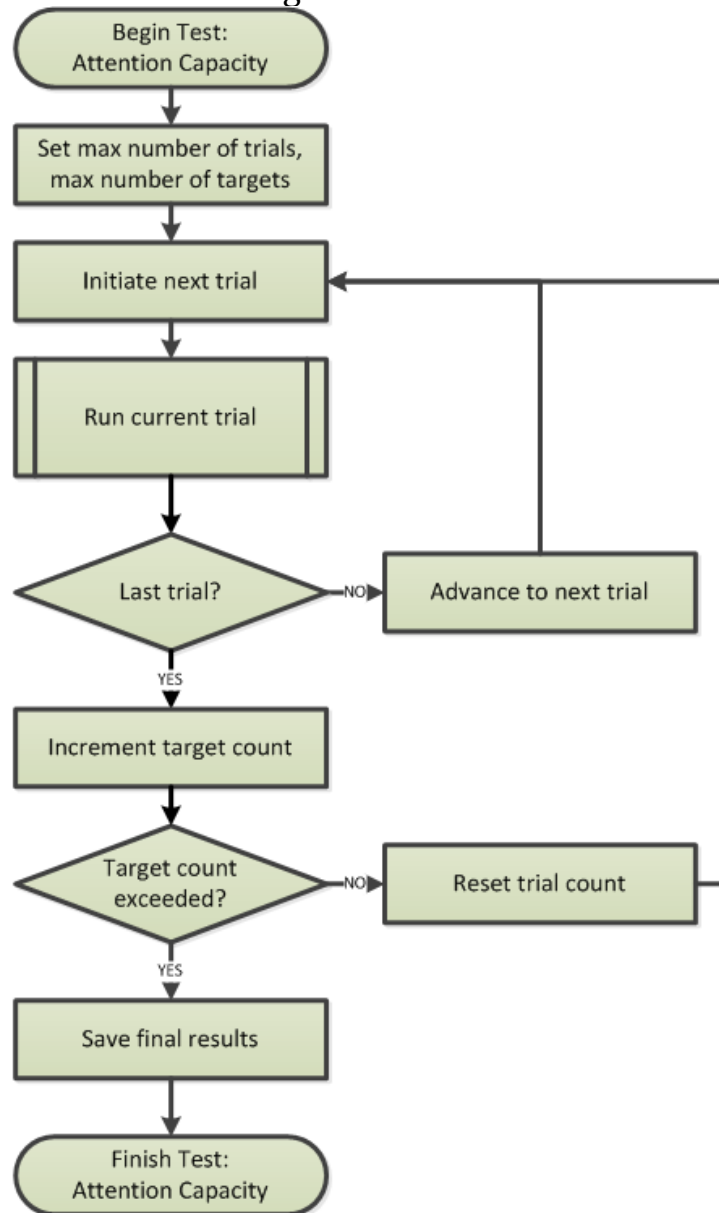


FIG. 13

The test trial logic is illustrated on Fig. 14.

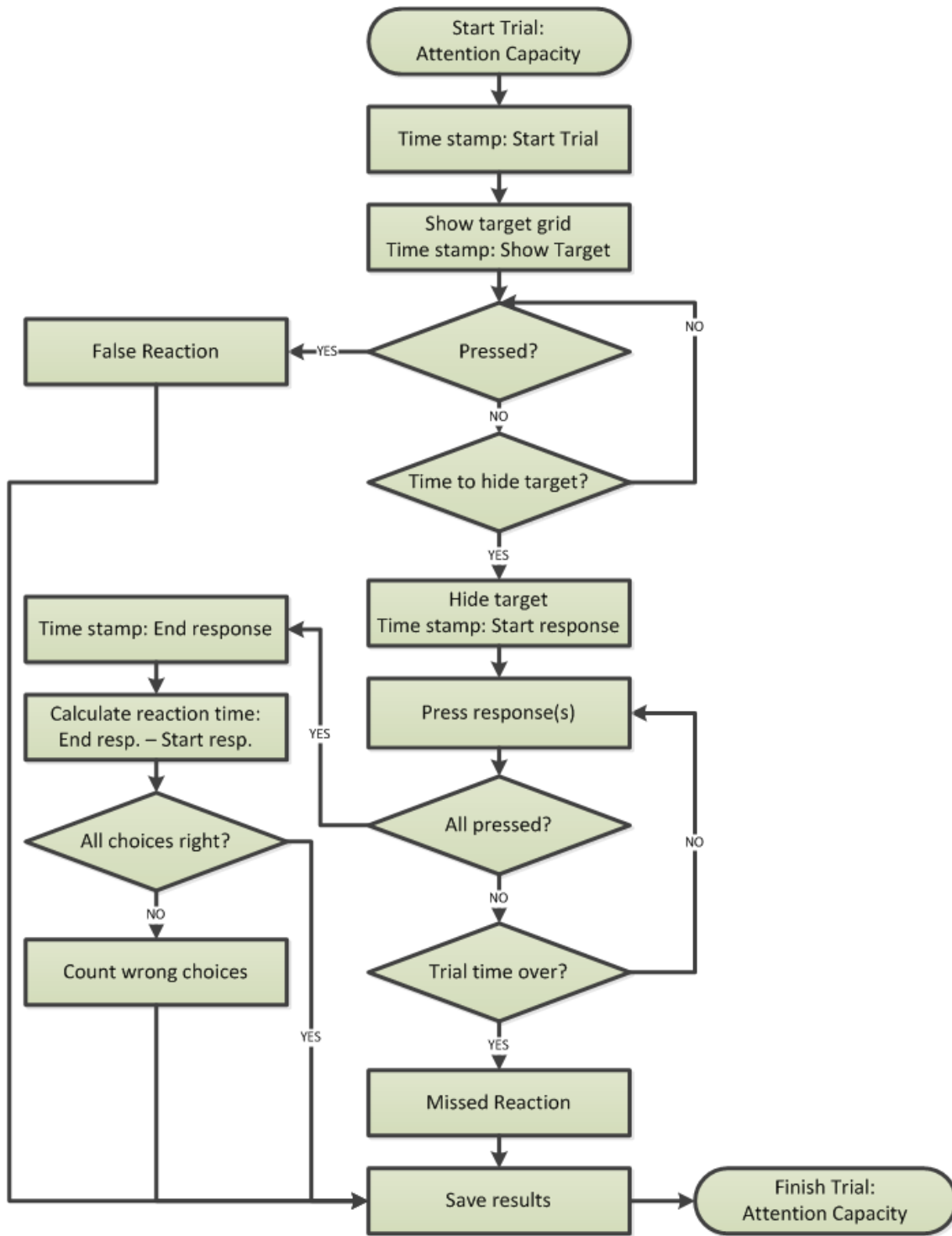


FIG. 14

6.4. Input Parameters

The following parameters are used to perform this test:

Parameter	Description	Default Value
Number Of Trials	Total number of test repetitions for each number of targets	20
Trial Time	Time interval between trials	5000
Target Exposure Time	The time when target is visible	2000
Maximum Number Of Targets	The maximum number of targets to evaluate working memory capacity	5

These parameters are set and stored in program configuration and can be modified by the system administrator on the server. Each client application reads this configuration before each testing session.

All times are measured in milliseconds.

The total number of trials in this test is calculated as **Number Of Trials** multiplied by **Maximum Number Of Targets**.

6.5. Recorded Data

The following data is recorded and sent to the server for analysis:

Test Settings	Current values of test settings described in 3.5.4.
Number of Targets	Array of numbers of targets in each trial
Reaction Time (RT)	Array of reaction times in ms: -1 means false reaction -999 means missed reaction
Mistakes	Array of the total number of wrong choices made in each trial

6.6. Test Results and Calculations

The following parameters are calculated by the server when test data is submitted for analysis:

Trial Count (TC)	Total number of trials completed in the test.
Attention Capacity	Maximum number of objects effectively (avoiding choice mistakes) kept in working memory
Mean Selective Reaction Time (MSRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions and missed reactions are excluded.
False Reaction Count (FRC)	Total number of false reactions stored in the array of reaction times.
Percent of False Reactions (%FR)	Percentage value of false reactions to the total number of trials: $\%FR = FRC / TC * 100$
Missed Reaction Count (MRC)	Total number of missed reactions stored in the array of reaction times.
Percent of Missed Reactions (%MR)	Percentage value of missed reactions to the total number of trials: $\%MR = MRC / TC * 100$
Wrong Choice Count (WCC)	Total number of trials having choice mistakes.
Percent of Wrong Choices (%WC)	Percentage value of wrong choices to the total number of trials: $\%WR = WRC / TC * 100$

**Mistake Count
(MC)**

Total number of erroneous reactions is calculated as a sum of false reaction count, missed reaction count and wrong choice count

$$EC = FRC + MRC + WCC$$

**Percent of Mistakes
(%M)**

Percentage value of erroneous reactions to the total number of trials:

$$\%M = \%FR + \%MR + \%WC$$

7. Divided Attention

7.1. Cognitive Domain

This test evaluates:

- Directed attention
- Executive attention

7.2. Test Description

This test evaluates the ability to perform at least two tasks simultaneously. The program concurrently performs two testing processes:

- 1) Simple reaction time test
- 2) Recognition reaction time test (modified)

All trials of recognition reaction time are performed at preset pace (e.g. every 5 sec). Randomly (from every 2nd to every 5th trial) recognition reaction time trials are replaced with single reaction time test trials.

The details on simple reaction time are described in Section 3.1. The details on recognition reaction time are described in Section 3.2.

The subject must react to both types of stimuli using different keys on the keyboard or tapping different spots on touch-screen display.

The program records the results of both tests in one array of data specifying the type of each test trial recorded.

7.3. Test Logic Flowchart

The key test logic flowchart is illustrated on Fig. 15.

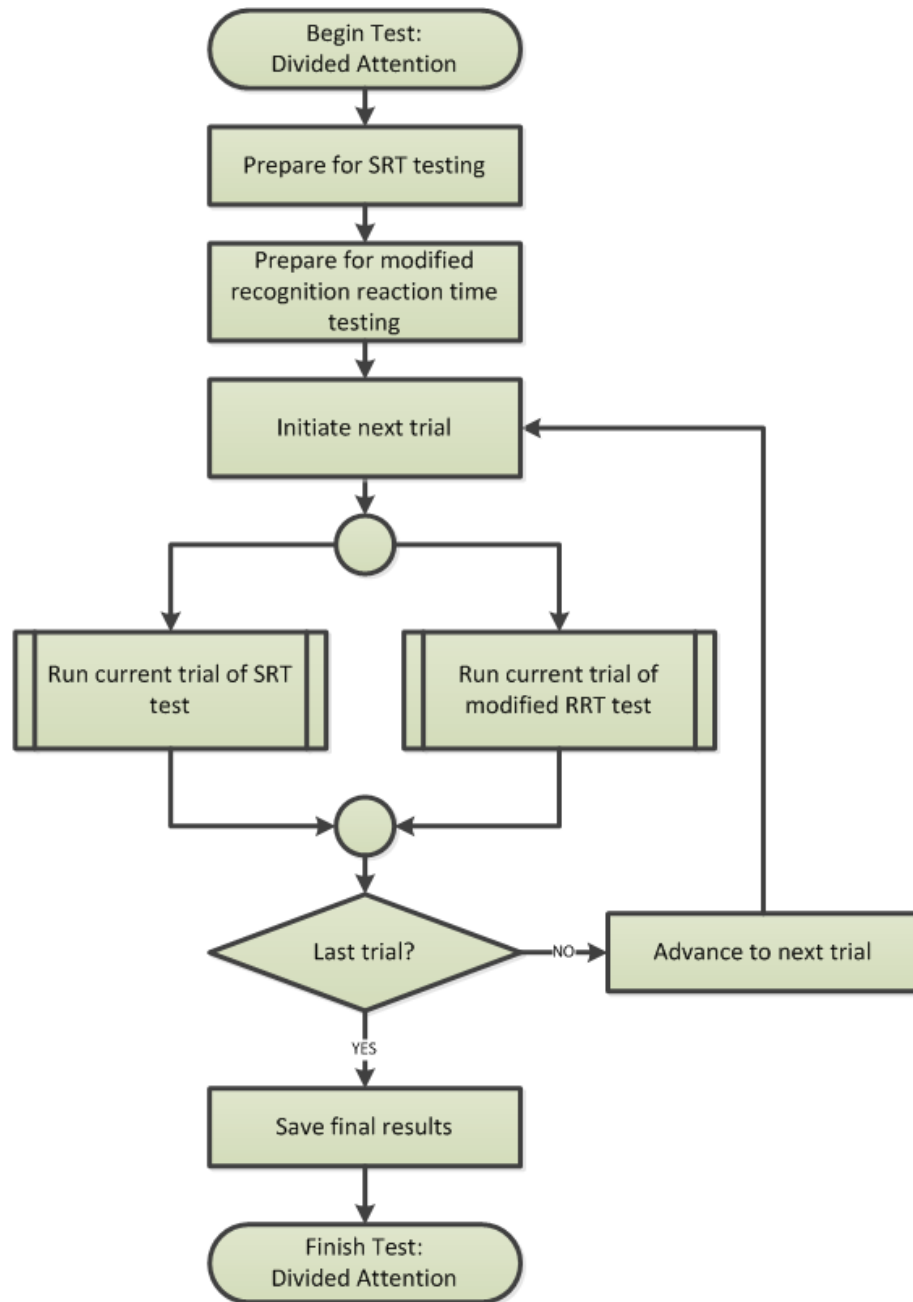


FIG. 15

7.4. Input Parameters

The following parameters are used to perform this test:

Parameter	Description	Default Value
-----------	-------------	---------------

Number Of Trials	Total number of test repetitions for each number of targets	20
Trial Time	Time interval between trials	5000
Target Exposure Time	The time when target is visible	500
Threshold Simple Reaction Time	The shortest simple reaction time considered normal	150
Threshold Recognition Reaction Time	The shortest recognition reaction time considered normal	180

These parameters are set and stored in program configuration and can be modified by the system administrator on the server. Each client application reads this configuration before each testing session. All times are measured in milliseconds.

7.5. Recorded Data

The following data is recorded and sent to the server for analysis:

Test Settings	Current values of test settings described in 3.6.4.
Reaction Time (RT)	Array of reaction times in ms: -1 means false reaction -999 means missed reaction
Recognition	Array of Boolean values (TRUE or FALSE) representing right or wrong recognition of respective trials TRUE is always recorded for SRT trials
Test Type	Array of test type values: - Simple Reaction Time - Recognition Reaction Time

7.6. Test Results and Calculations

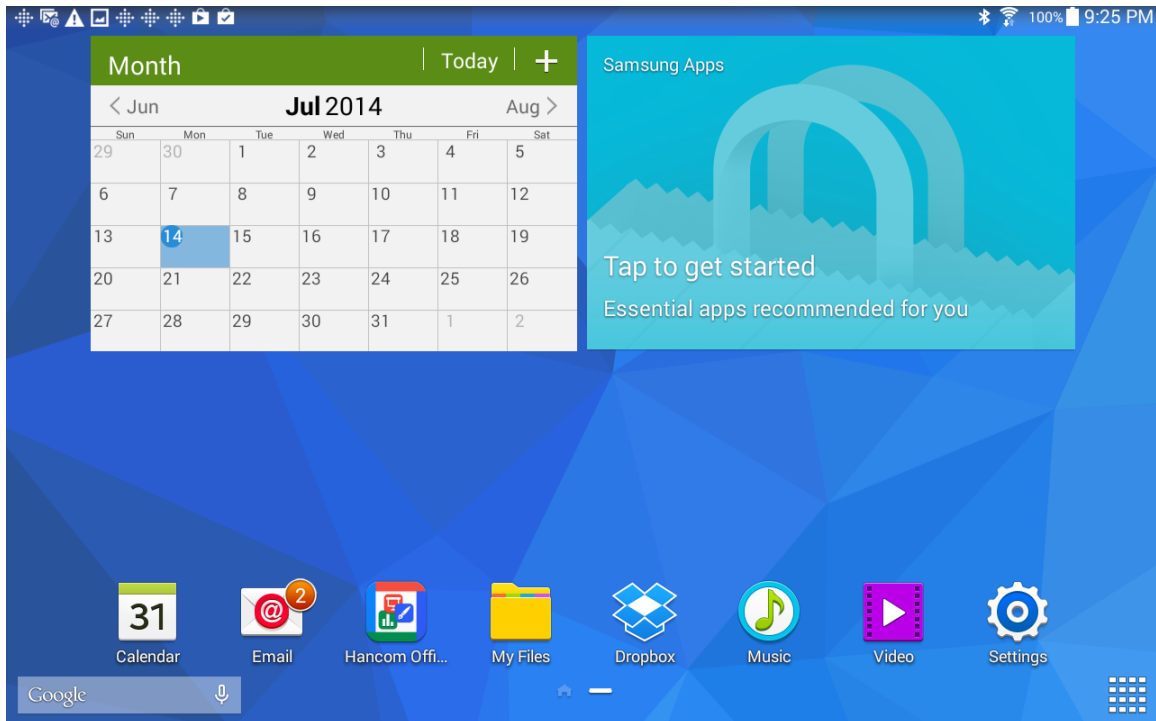
The following parameters are calculated by the server when test data is submitted for analysis:

Trial Count (TC)	Total number of trials completed in the test.
Mean Simple Reaction Time (MRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions and missed reactions are excluded.
Mean Recognition Reaction Time (MRRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions, missed reactions and wrong recognitions are excluded.
False Reaction Count (FRC)	Total number of false reactions of any test type stored in the array of reaction times.
Percent of False Reactions (%FR)	Percentage value of false reactions of any test type to the total number of trials: %FR = FRC / TC * 100
Missed Reaction Count (MRC)	Total number of missed reactions of any test type stored in the array of reaction times.
Percent of Missed Reactions (%MR)	Percentage value of missed reactions of any test type to the total number of trials: %MR = MRC / TC * 100
Wrong Recognition Count (WRC)	Total number of trials of RRT test having wrong recognition mistakes.
Percent of Wrong Recognitions (%WR)	Percentage value of wrong recognitions to the total number of trials: %WR = WRC / TC * 100
Mistake Count (MC)	Total number of erroneous reactions is calculated as a sum of false reaction count, missed reaction count and wrong choice count EC = FRC + MRC + WCC
Percent of Mistakes (%M)	Percentage value of erroneous reactions to the total number of trials: %M = %FR + %MR + %WC

Appendix B Installation Instructions

UNINSTALL THE OLDER VERSION OF THE VIRTUAL QUARTERBACK APP

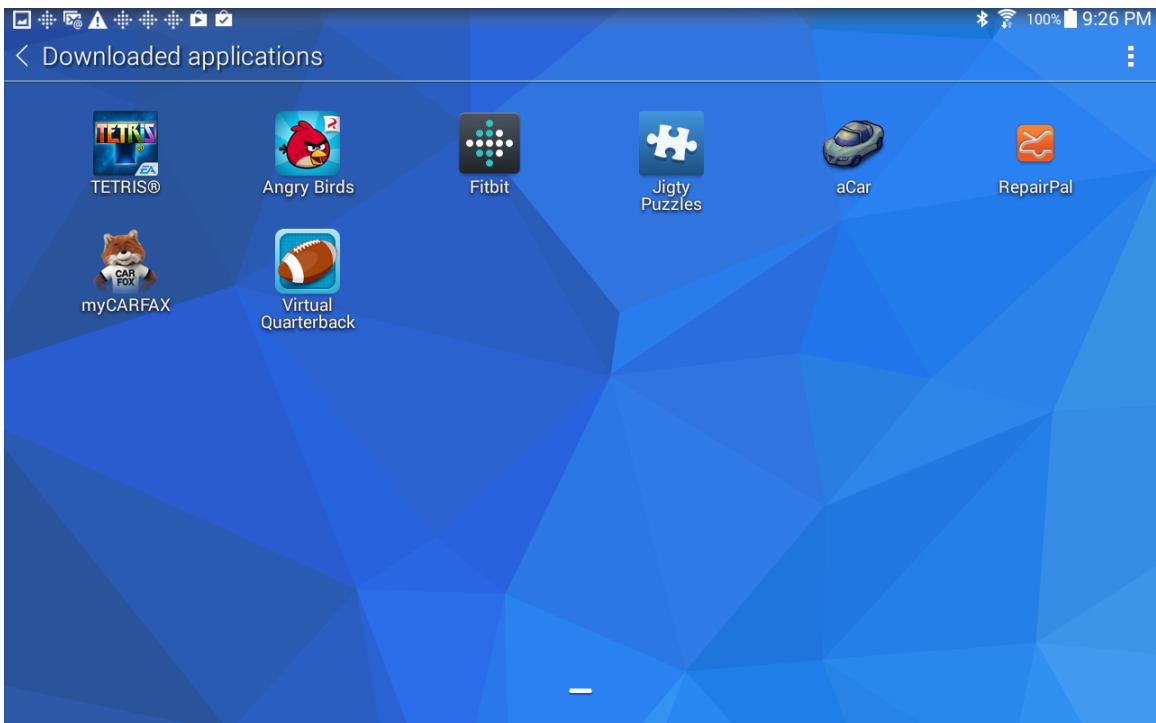
1. Open the Android device:



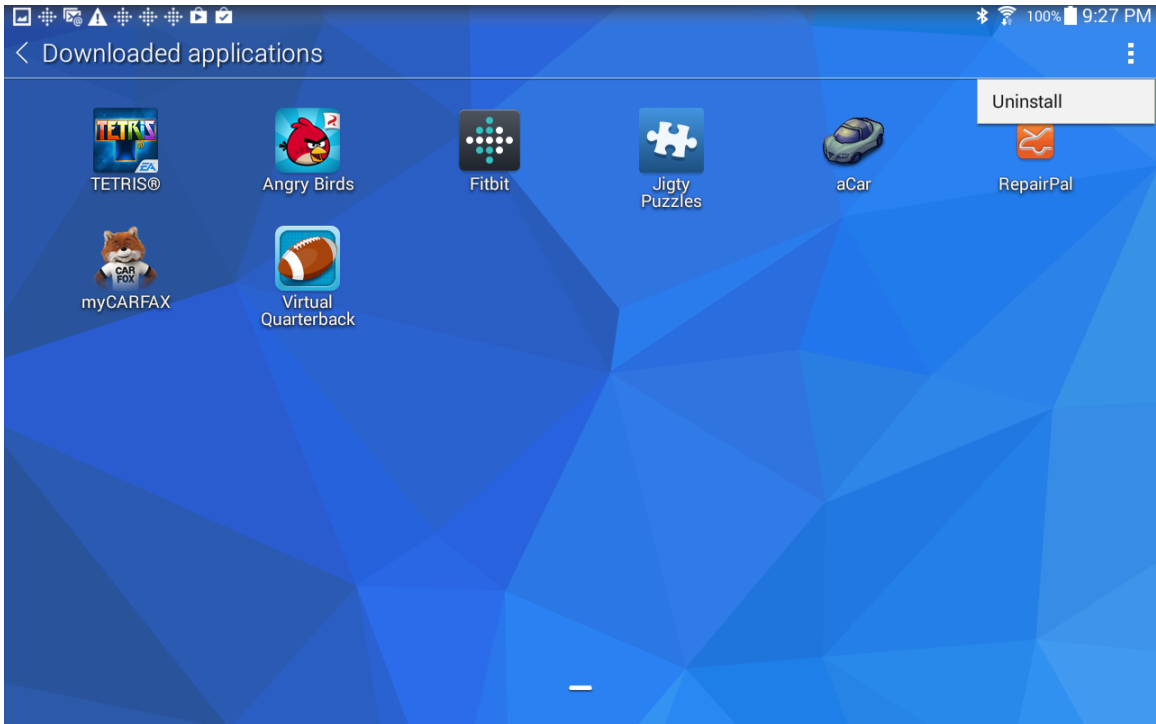
2. Tap the grid icon in the bottom right corner:



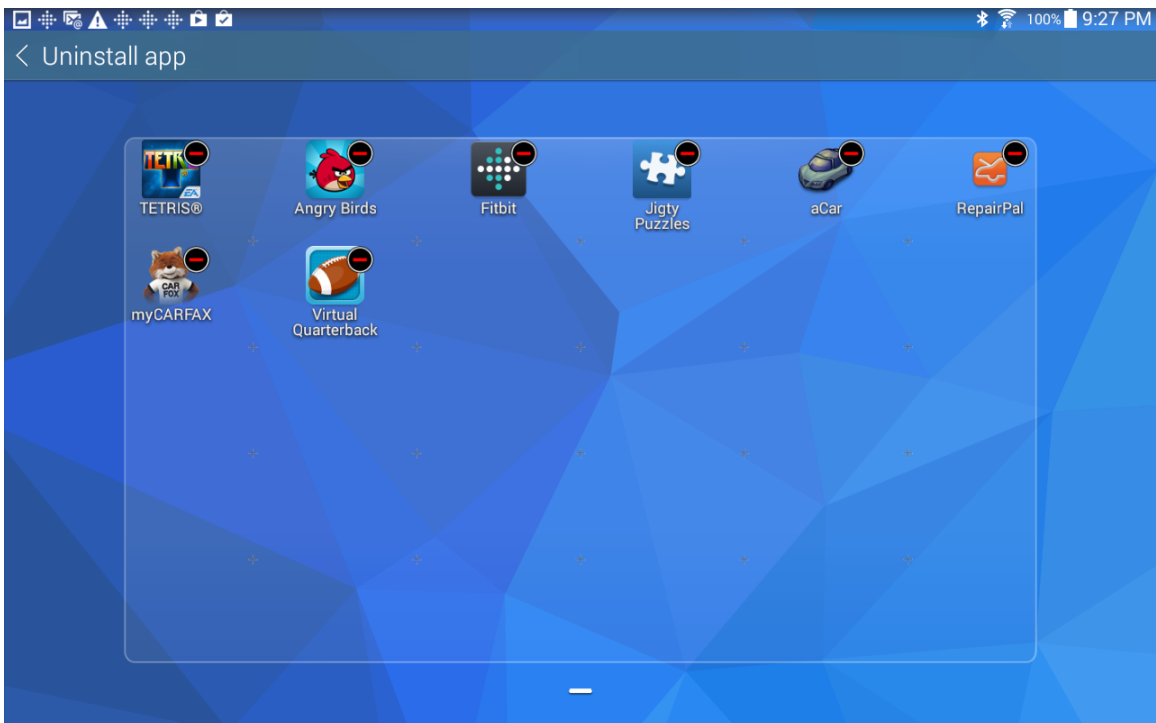
3. Tap the **Downloaded apps** tab.



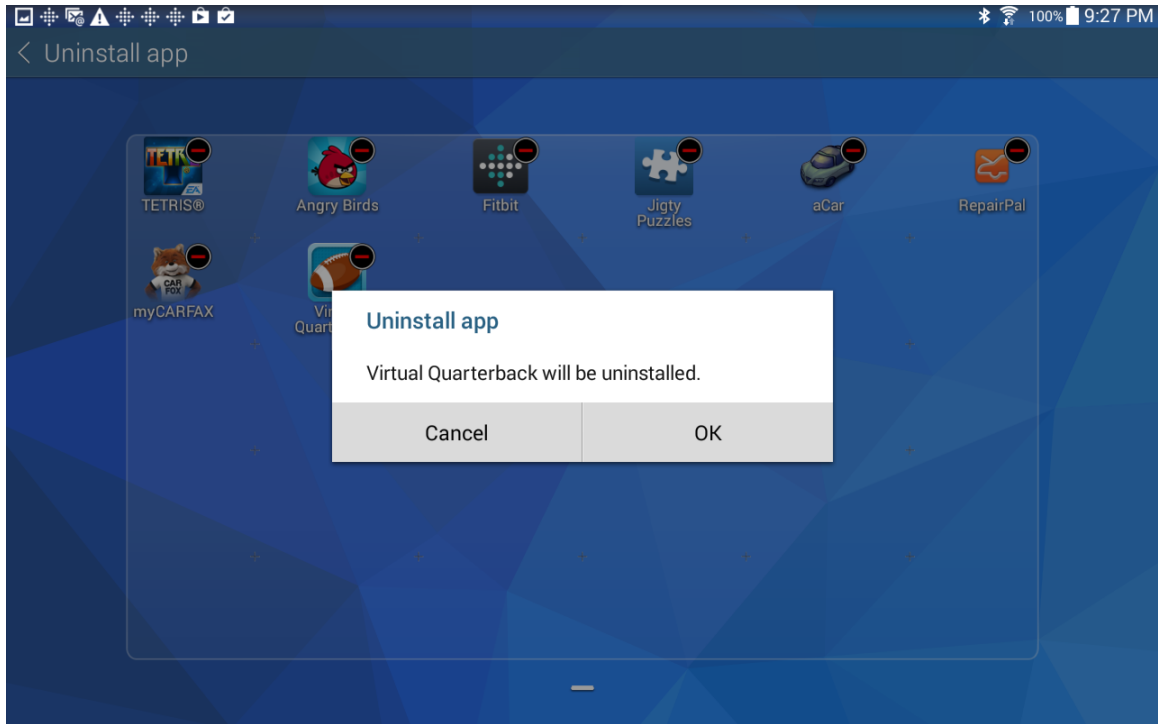
4. Tap the popup menu icon (three vertical white dots) in the upper right corner:



5. Tap the **Uninstall** menu option:



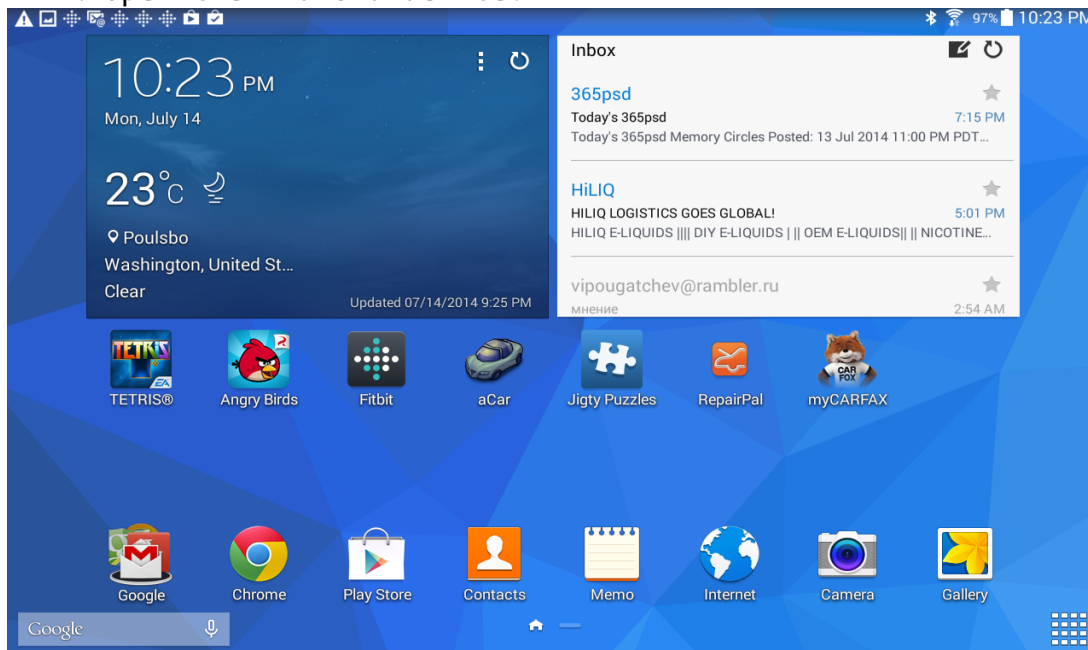
6. Tap the **Virtual Quarterback** icon:



7. Click **OK** to confirm uninstallation.
8. Return to the home screen.

INSTALL A NEW VERSION OF THE VIRTUAL QUARTERBACK APP

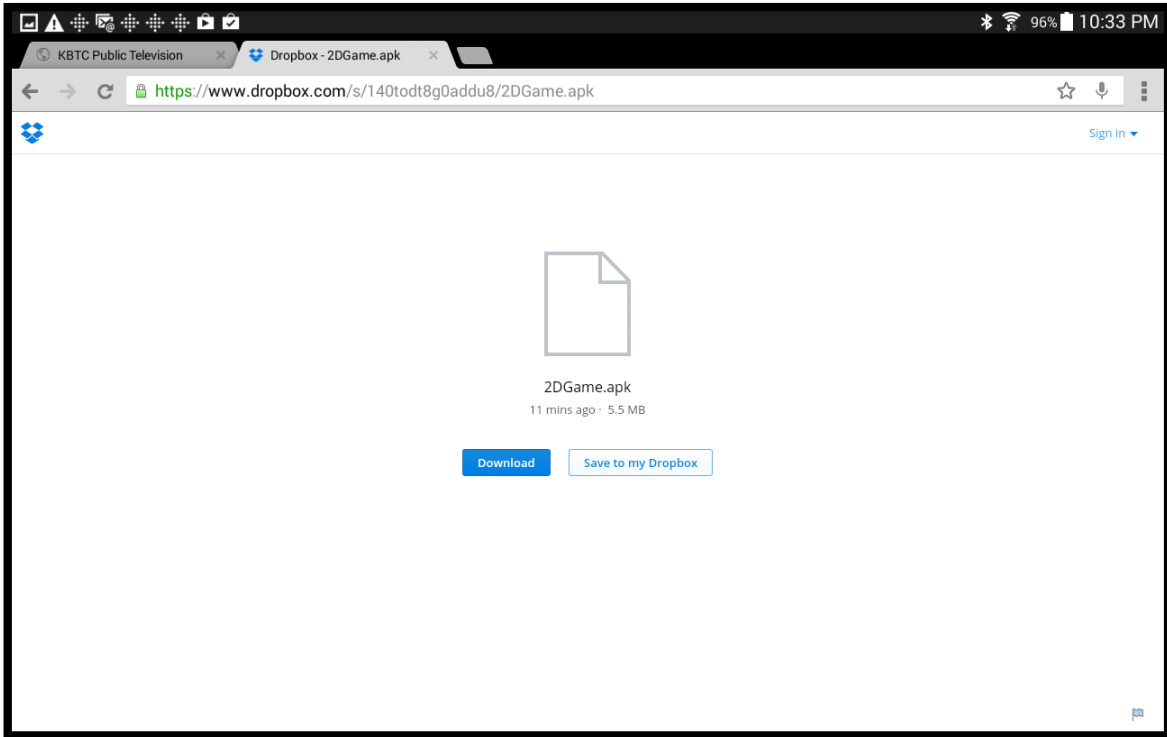
1. Open the Android device:



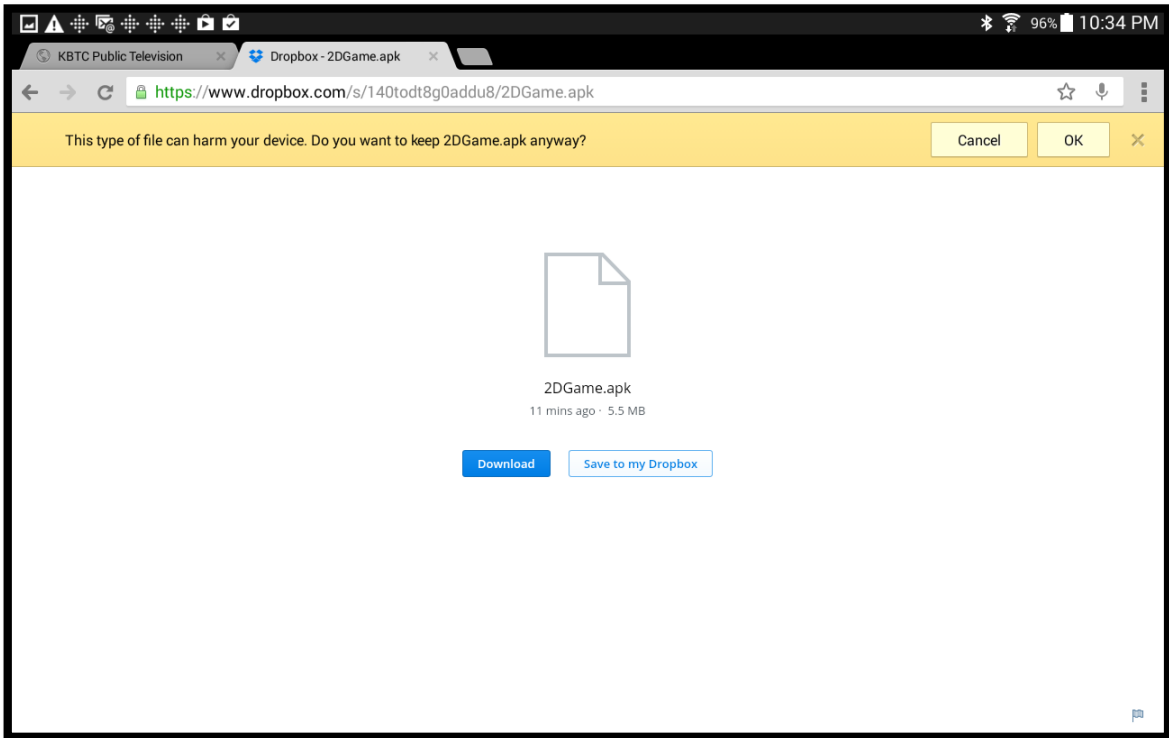
2. Tap the **Chrome** browser icon.

3. Input the following URL address to download the app:

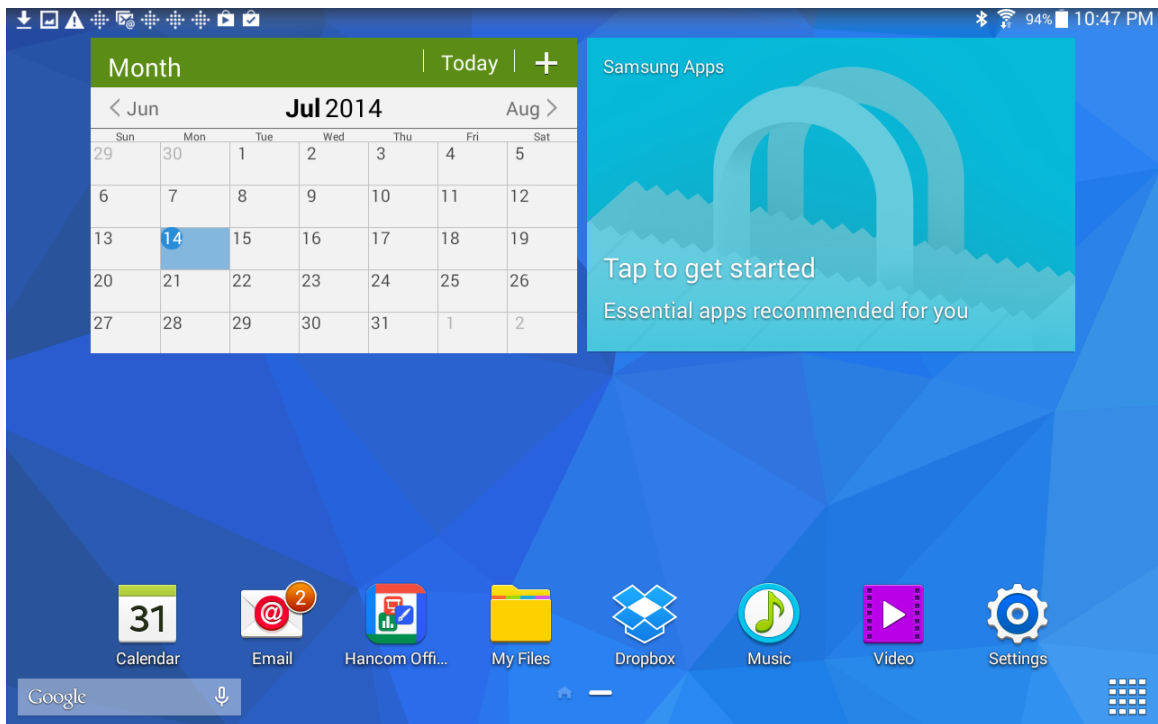
<https://www.dropbox.com/s/140todt8g0addu8/2DGame.apk>



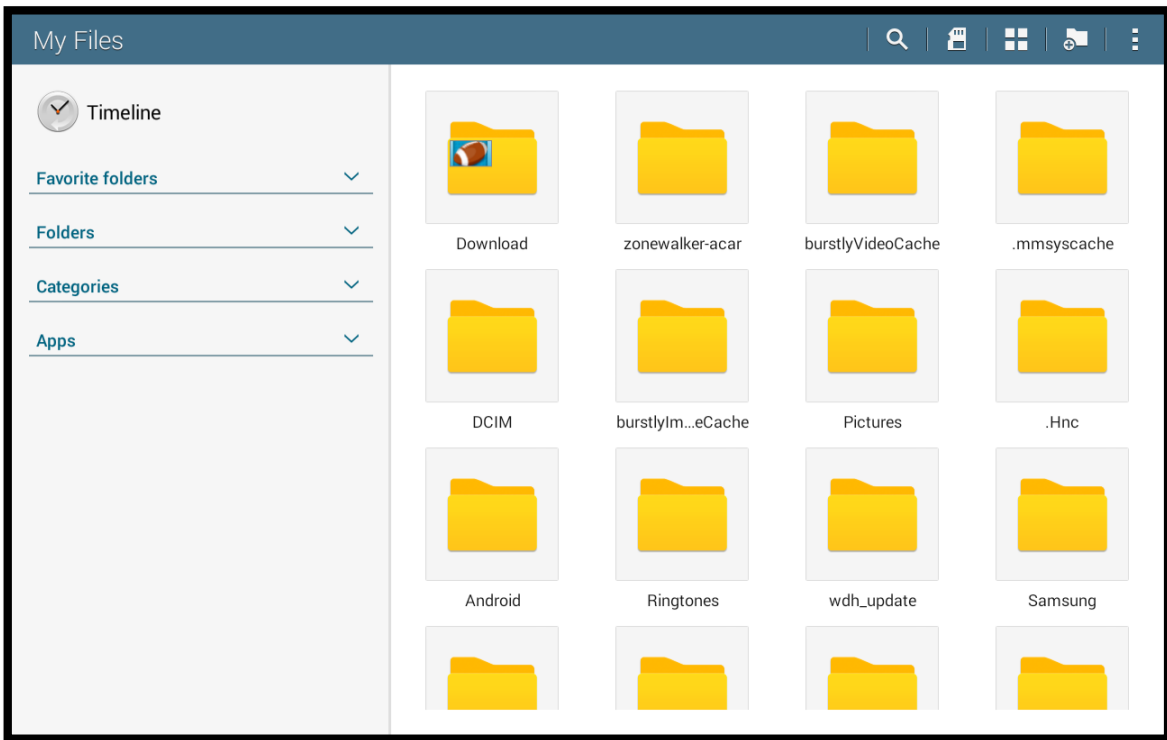
4. Tap the **Download** button:



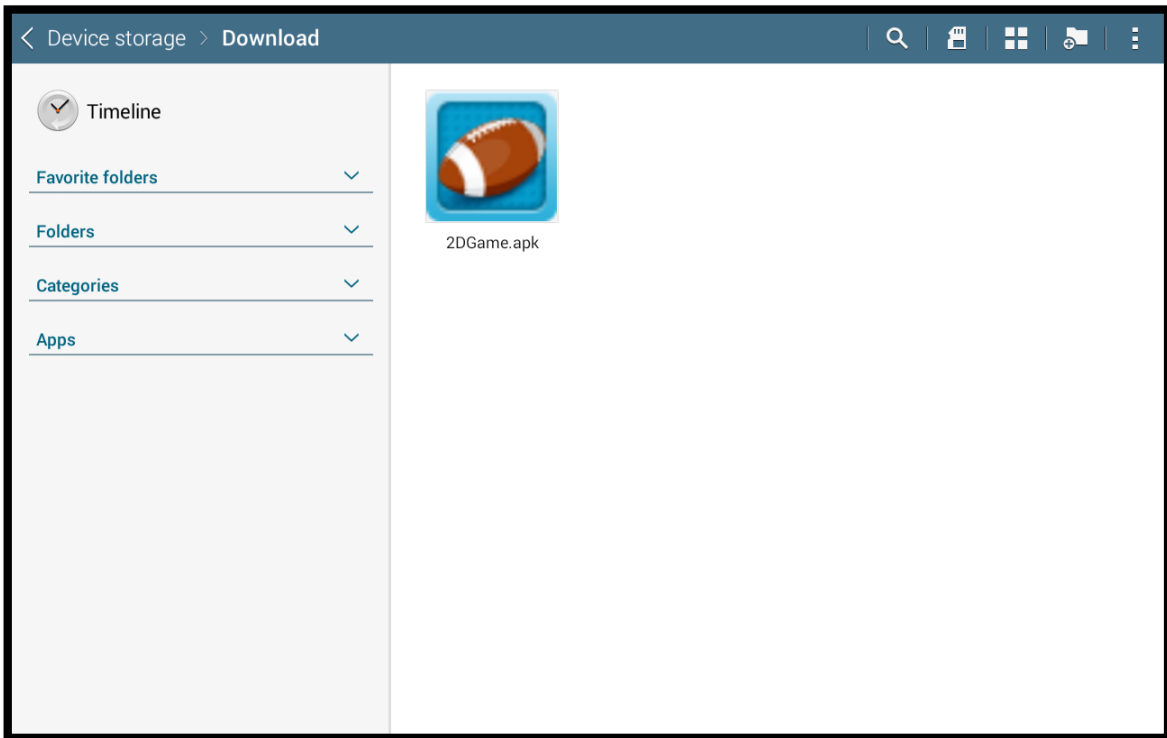
5. Tap **OK** to confirm the app download.
6. Wait till the app is downloaded.
7. Find the **My Files** icon on the screen:



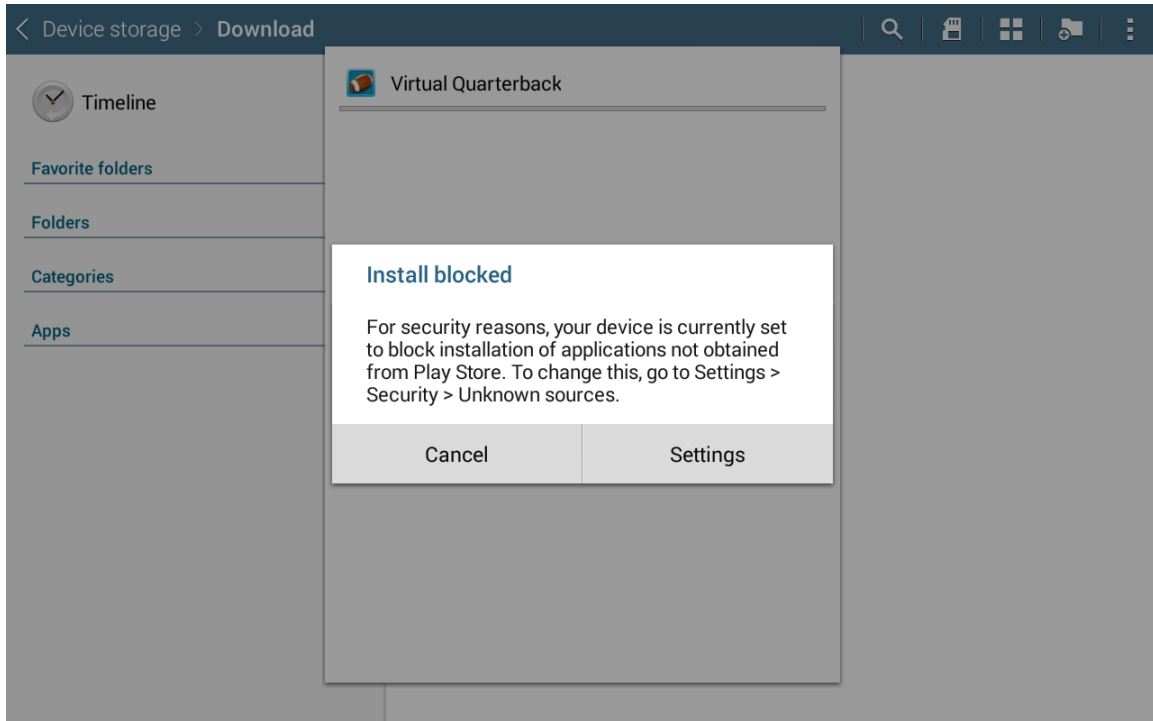
8. Tap this icon:



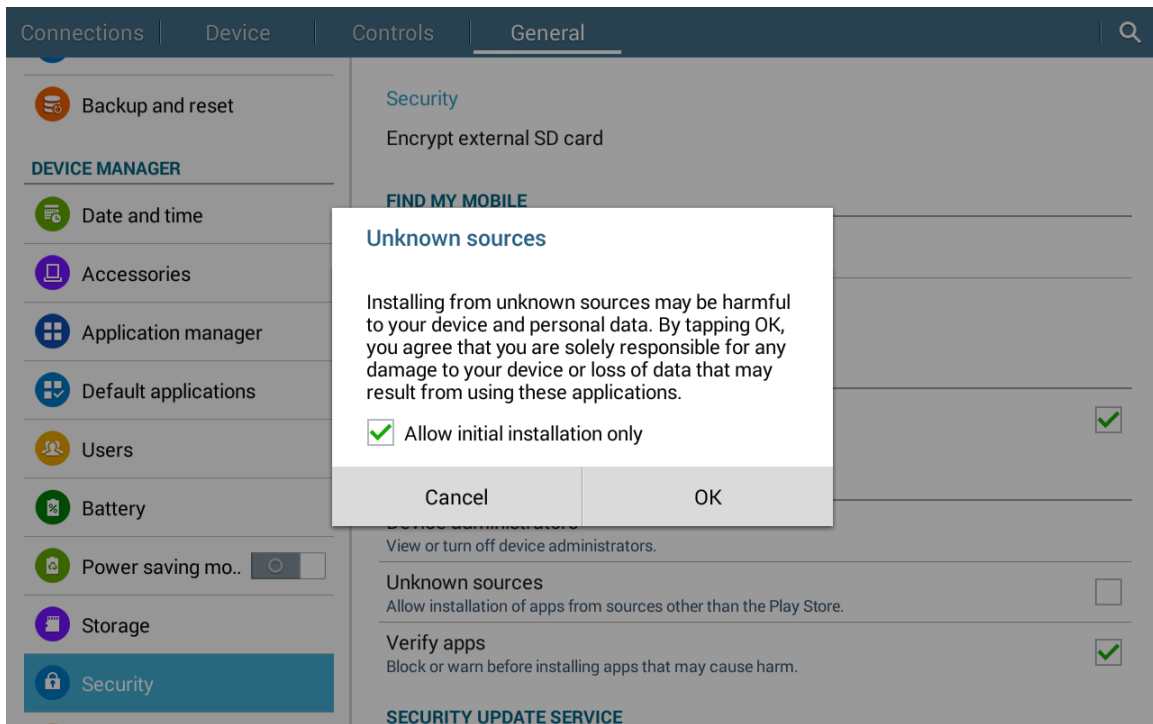
9. Tap the **Download** icon:



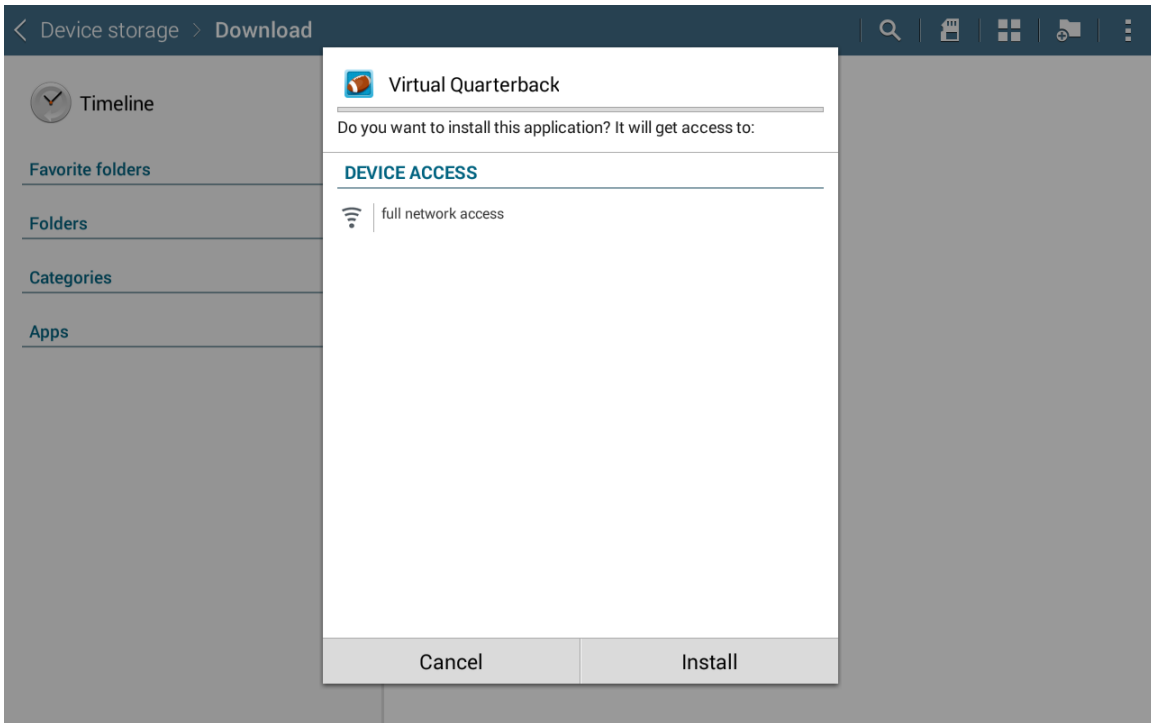
10. Tap the **2dGame.apk** icon:



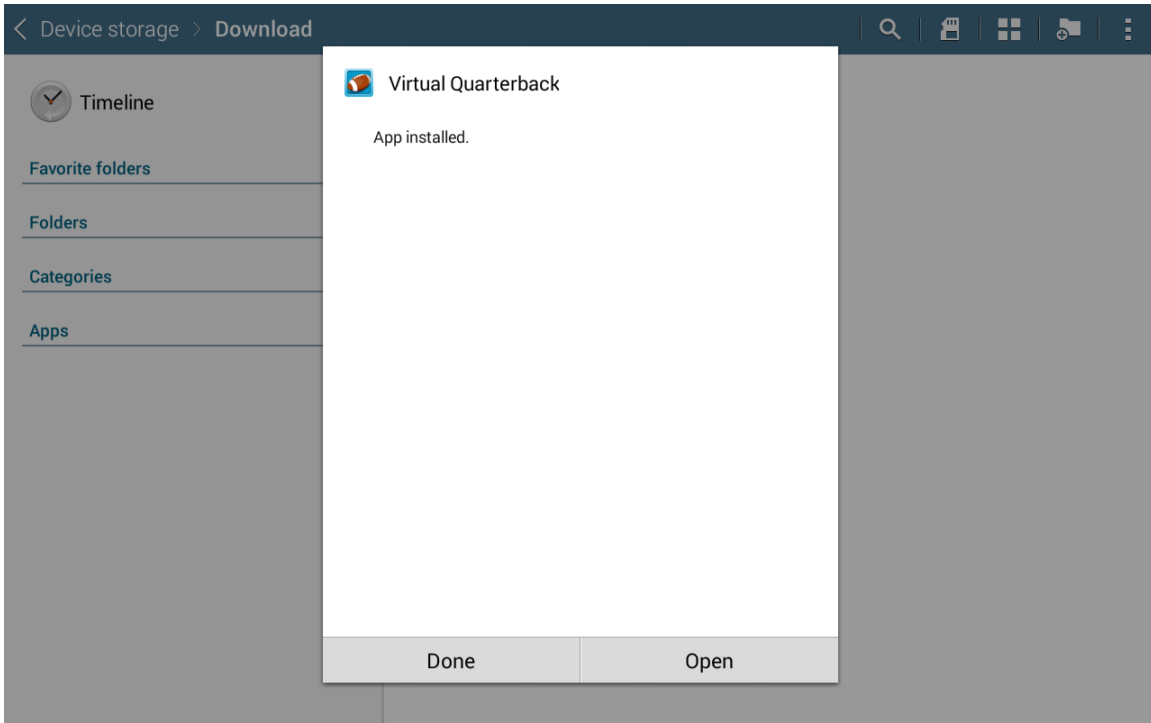
11. Tap the **Settings** button:



12. Tap the **OK** button:



13. Tap the **Install** button:



14. Tap the **Done** button.

15. Once the device returns to the home screen, tap the grid icon in the bottom right corner:



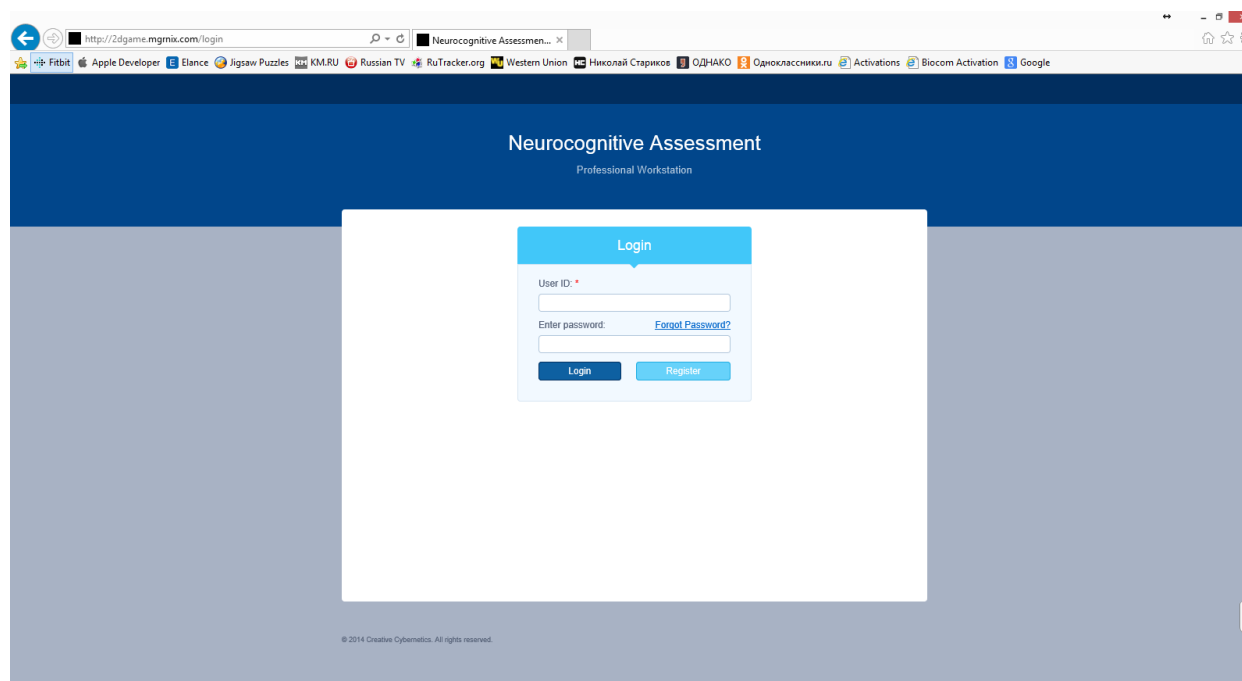
16. Tap the **Virtual Quarterback** icon to start the app.

mNCA Professional User Workstation Application

1. Start professional user application



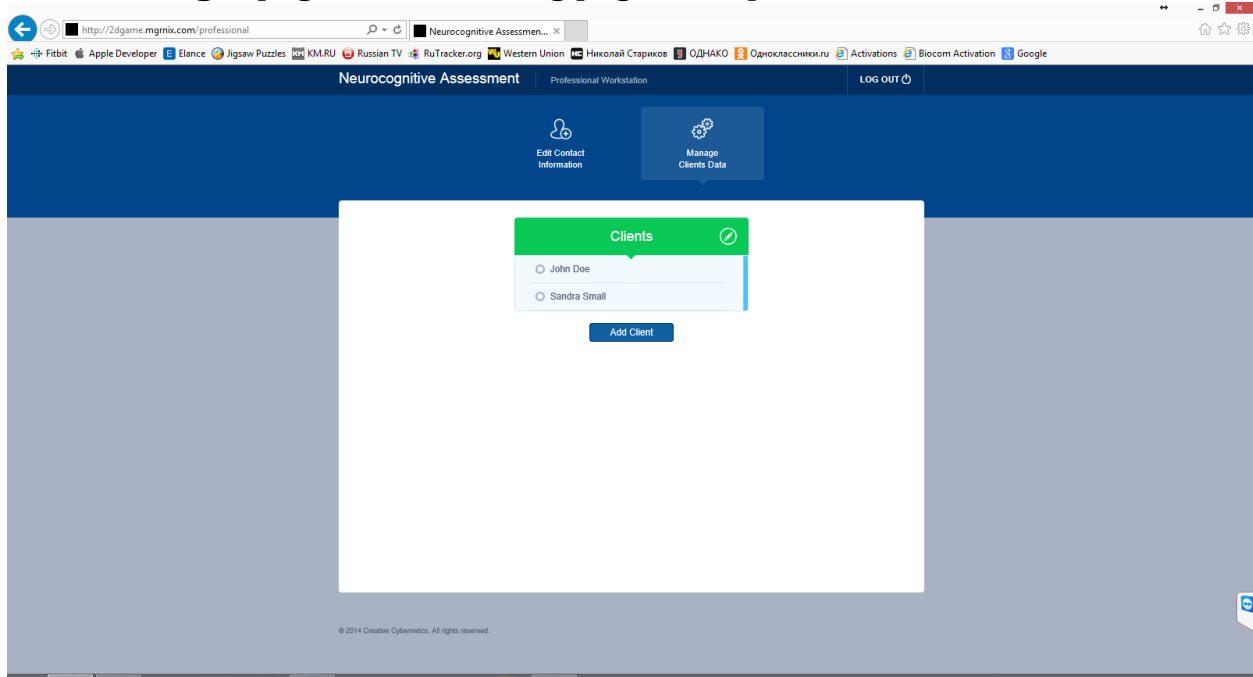
Double-click this icon to start the professional user workstation. The following page will open:



Here returning users may log into the application. New users may register in the system.

2. Login a professional user

Enter your **User ID** (contact email address) and **Password**.
Click the **Login** page. The following page will open:



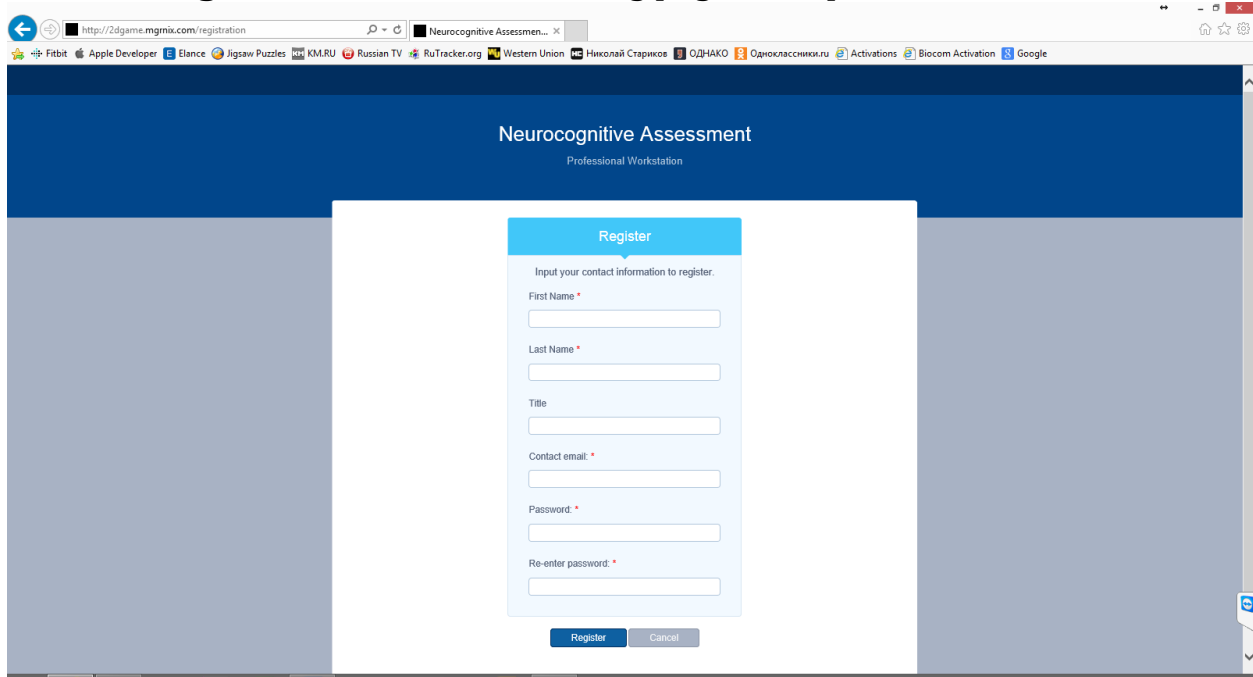
3. Close the application

Return to the home page.
Click the **Log Out** link.

4. Register a new professional user

Return to the login page.

Click the **Register** button. The following page will open:



The screenshot shows a web browser window with the URL <http://2dgame.mgmix.com/registration>. The page title is "Neurocognitive Assessment" and the subtitle is "Professional Workstation". The main content is a registration form with a blue header "Register" and a light blue background. The form contains the following fields:

- Input your contact information to register.
- First Name *
- Last Name *
- Title
- Contact email: *
- Password: *
- Re-enter password: *

At the bottom of the form, there are two buttons: "Register" and "Cancel".

Fill out the form.

Click the **Register** button. The application will return to the login page.

Once the system administrator activates your account, you will receive a special email notification automatically sent to your contact email address specified during account creation.

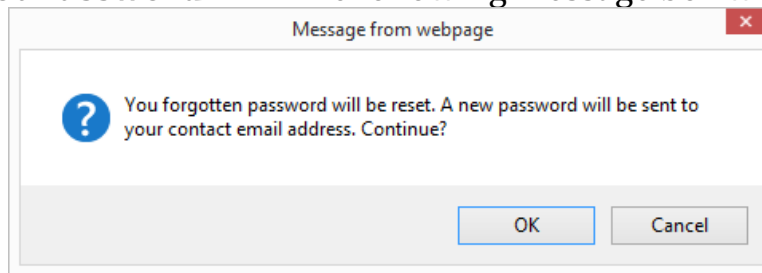
5. Reset the forgotten password

If you forgot your password, you may reset it. For security reason the system cannot read passwords. Instead it resets the forgotten password and replaces it with an automatically generated password, which will serve as a temporary one. The server will send it to your contact email address. It is recommended to change this temporary password to something more meaningful upon successful logon.

Open the logon page.

Input **User ID** (contact email address).

Click the **Forgot Password** link. The following message box will open:



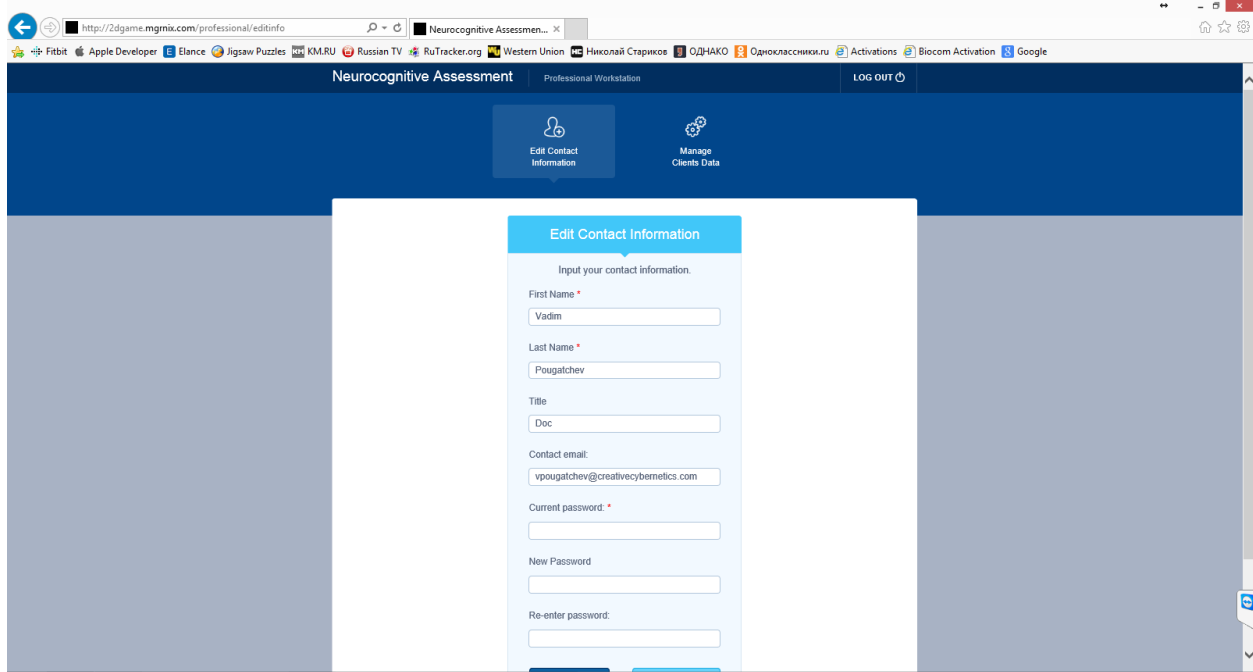
Click the **OK** button.

Wait for an email from the system administrator to get a temporary password then try to login.

6. Edit professional user's information

Return to the home page.

Click the **Edit Contact Information** button. The following page will open:



The screenshot shows a web browser window with the URL <http://2dgame.mgmix.com/professional/editinfo>. The page title is "Neurocognitive Assessment" and the user is logged in as "Professional Workstation". The page has a dark blue header with a "LOG OUT" button. Below the header, there are two buttons: "Edit Contact Information" (selected) and "Manage Clients Data". The main content area is a white form titled "Edit Contact Information" with a blue header. The form contains the following fields:

- Input your contact information.
- First Name * (Vadim)
- Last Name * (Pougatchev)
- Title (Doc)
- Contact email: (vpougatchev@creativitybermetics.com)
- Current password: *
- New Password
- Re-enter password:

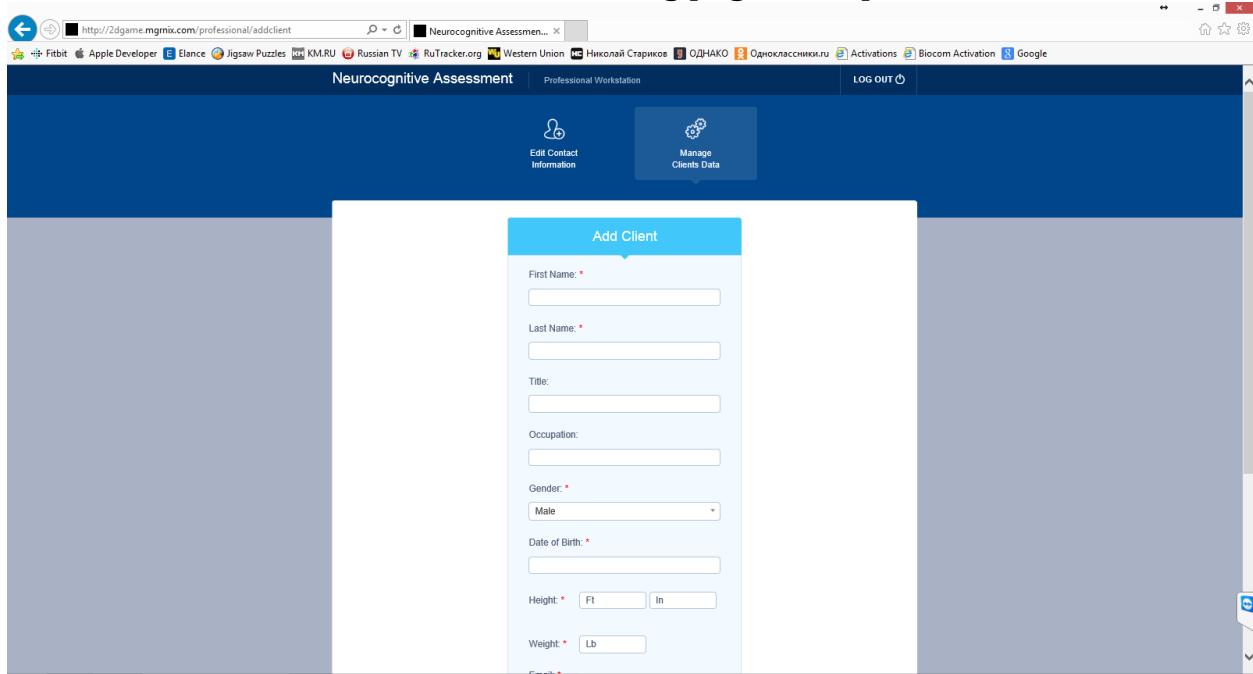
Change any information in the form.

Click the **Save** button. The application will return to the home page.

7. Add a new client

Return to the home page.

Click the **Add Client** button. The following page will open:



The screenshot shows a web browser window with the URL <http://2dgame.mgmix.com/professional/addclient>. The page title is "Neurocognitive Assessment" and the user is logged in as "Professional Workstation". The page has a dark blue header with a "LOG OUT" button. Below the header, there are two buttons: "Edit Contact Information" and "Manage Clients Data". The "Add Client" form is centered on the page and contains the following fields:

- First Name: *
- Last Name: *
- Title:
- Occupation:
- Gender: * (Dropdown menu with "Male" selected)
- Date of Birth: *
- Height: * (Fields for Ft and In)
- Weight: * (Field for Lb)

Fill out the form.

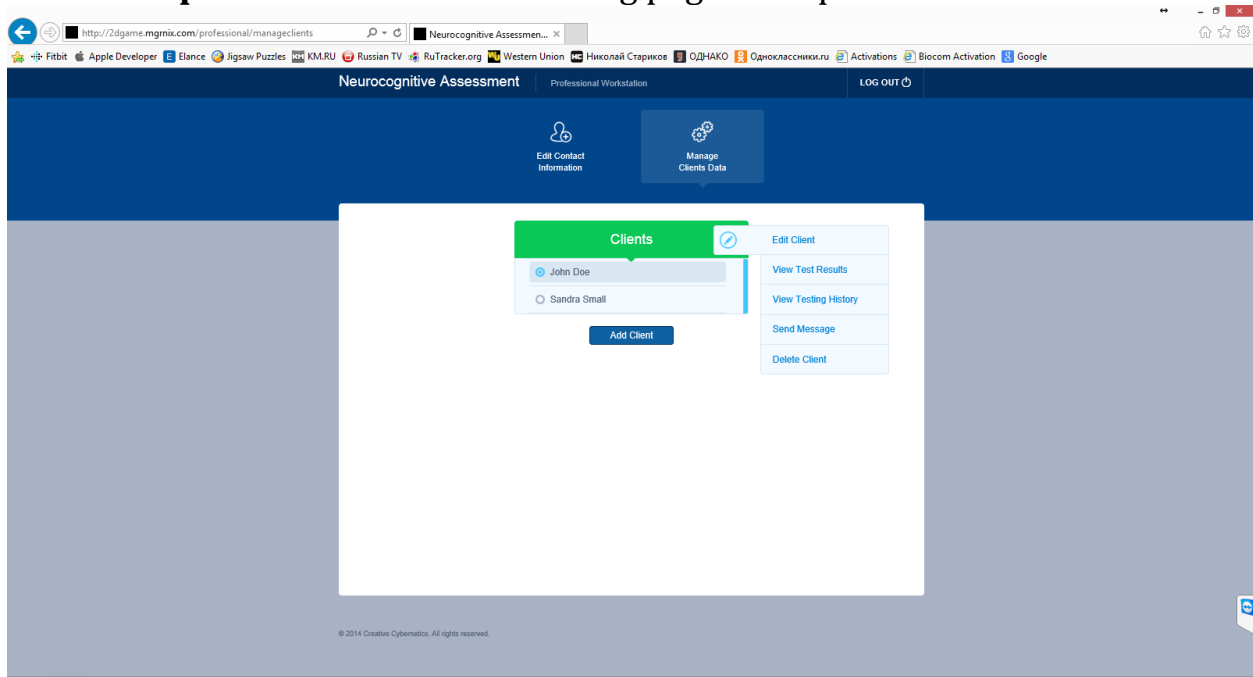
Click the **Create** button. The application will return to the home page and show a new client on the client list.

8. Edit the selected client

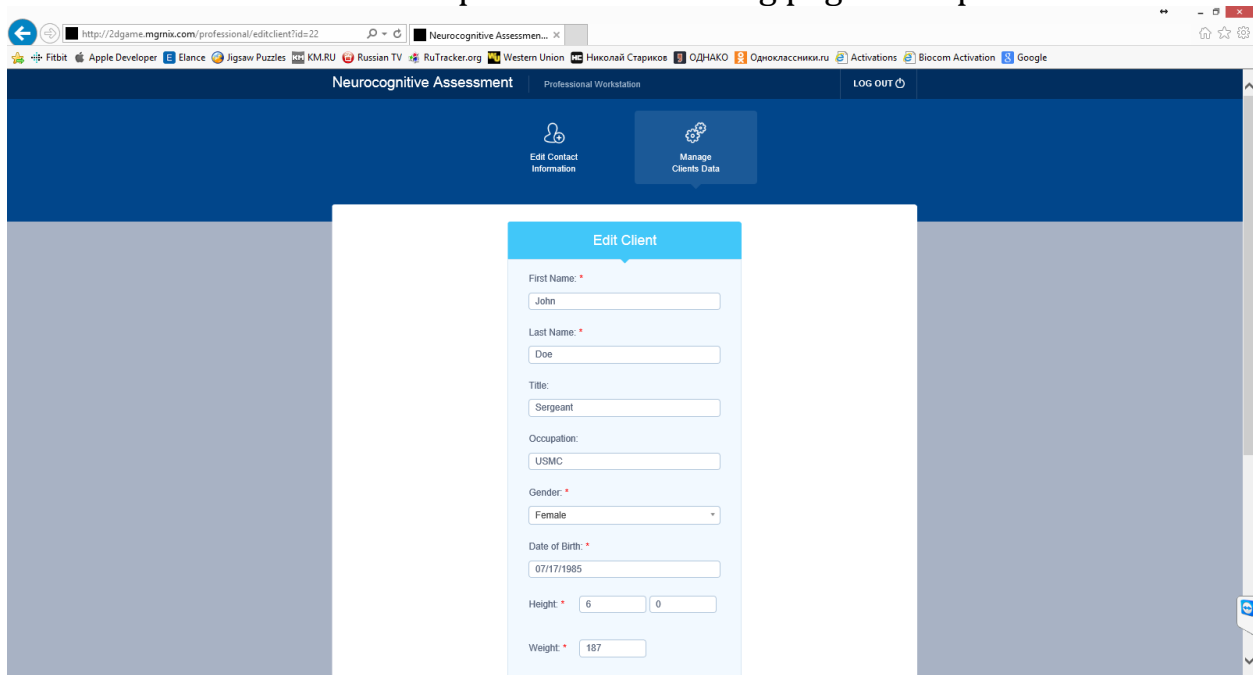
Return to the home page.

Select a client from the list.

Click the **Operation** icon. The following page will open:



Click the **Edit Client** menu option. The following page will open:



Edit any information in the form.

Click the **Save Changes** button. The application will return to the home page.

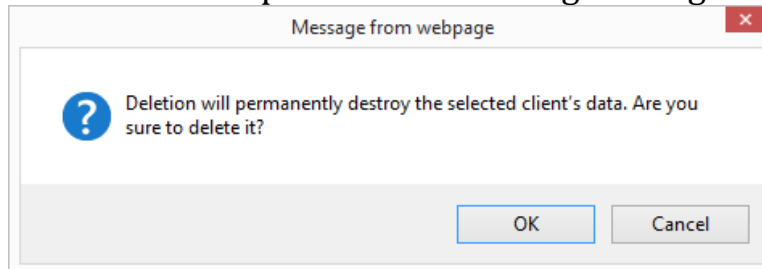
9. Delete the existing client

Return to the home page.

Select a client from the list.

Click the **Operation** icon.

Click the **Delete Client** menu option. The following message box will open:



Click the **OK** button. The application will return to the home page and update the client list.

10. View test results

Return to the home page.

Select a client from the list.

Click the **Operation** icon.

Click the **View Test Results** menu option. The following page will open:

The screenshot shows a web browser window displaying the 'Neurocognitive Assessment' application. The page title is 'Neurocognitive Assessment' and the user is logged in as 'Professional Workstation'. The main content area is a white modal window titled 'Test Results' for client 'John Doe'. The modal displays the following information:

- Name: John Doe, UserSex: Female, Age: 28, Rank: Sergeant, Height: 6-0, Weight: 187
- Occupation: USMC
- Test Date: July 12, 2014 2:40 pm
- Test Type: Simple Reaction Time
- Simple Reaction Time: 07/12/14 2:40 pm
- Trial Count: 3
- Mean Reaction Time: 347.8
- False Reaction Count: 0
- Percent of False Reactions: 0
- Missed Reaction Count: 0.4
- Percent of Missed Reactions: 9
- Mistake Count: 0.4
- Percent of Mistakes: 9

At the bottom of the modal, there are three buttons: 'Print Test Results', 'Export Test Data', and 'Send Message'. A 'Go back' button is located at the bottom right of the modal. The background of the application is a dark blue header with 'Neurocognitive Assessment' and 'Professional Workstation' text, and a 'LOG OUT' button. There are also two menu icons: 'Edit Contact Information' and 'Manage Clients Data'. The footer of the application shows '© 2014 Creative Cybernetics. All rights reserved.'

Select any test date from the dropdown menu on the left side.

Select any neurocognitive test type from the dropdown menu on the right side.

The test results will automatically update.

Click the **Go Back** button to return to the home page.

Click the **Print Test Results** button to print the displayed test results. The following page will open:

Neurocognitive Assessment Report

Name: John Doe Sex: Female
 Title/Rank: Sergeant Age: 28
 Occupation: USMC Height: 6-0
 Date / Time: 07/11/14 12:48 pm Weight: 167

Single Reaction Time
 Mean Simple Reaction Time (ms): 451.24
 False Reactions: 0.6 (2.4%) Missed Reactions: 0.6 (2.13%)
 Total Mistakes: 1.2 (5.55%)
 Trial Count: 15

Recognition Reaction Time
 Mean Recognition Reaction Time (ms): 555.8
 False Reactions: 0 (0%) Missed Reactions: 0.0 (0.13%)
 Wrong Recognitions: 1.0 (9.07%) Total Mistakes: 2.6 (115%)
 Trial Count: 15

Choice Reaction Time
 Mean Choice Reaction Time (ms):
 False Reactions: 0 (0%) Missed Reactions: 0.2 (0.2%)
 Wrong Choice: 9.6 (72.95%) Total Mistakes: 9.8 (73.75%)
 Trial Count: 15

Selective Attention
 Mean Selective Reaction Time (ms): 676.4
 False Reactions: 0 (0%) Missed Reactions: 0 (0%)
 Wrong Choice: 0 (0%) Total Mistakes: 0 (0%)
 Trial Count: 5

Sustained Attention
 Mean Selective Reaction Time (ms): 11151.5
 Sustained Duration (secs): 360
 False Reactions: 0 (0%) Missed Reactions: 0 (0%)
 Wrong Choice: 1 (20%) Total Mistakes: 1 (20%)
 Trial Count: 5

Attention Capacity
 Mean Selective Reaction Time (ms): 2051.16
 Attention Capacity: 3

Click the **Print** button to start report printing.
 Click the **Close** button to close this page and return to the report page.
 Click the **Export Test Data** button. The application will generate and open a new Excel sheet containing the results of the selected test.

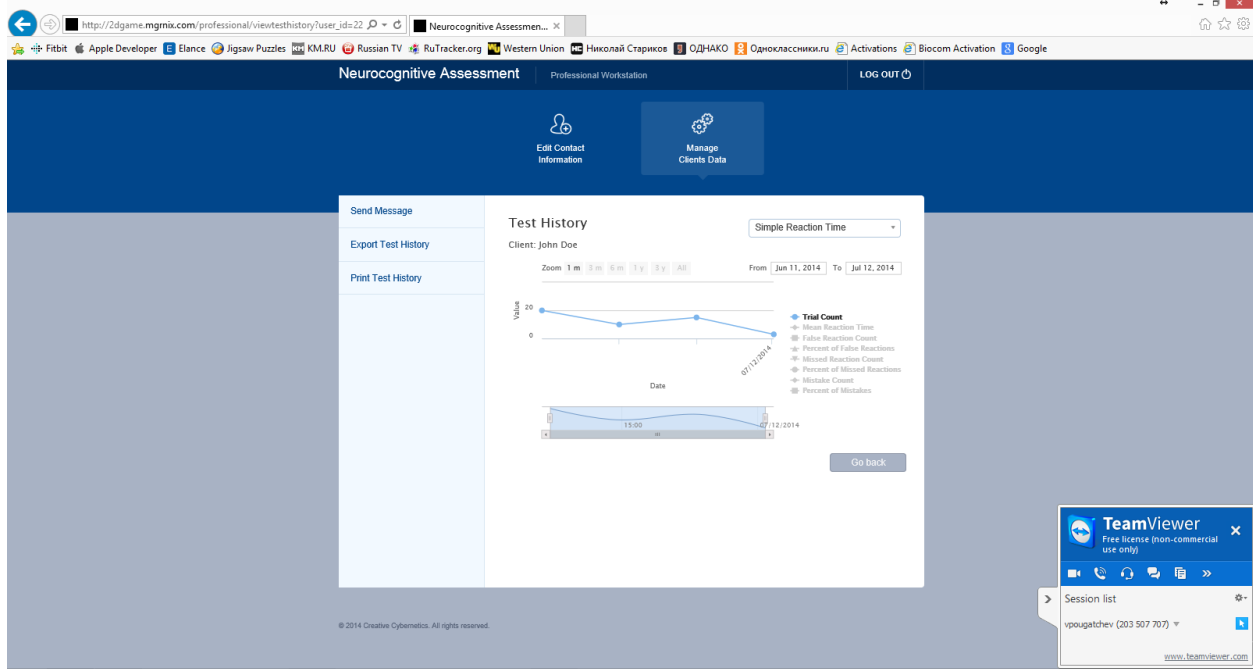
11. View testing history

Return to the home page.

Select a client from the list.

Click the **Operation** icon.

Click the **View Testing History** menu option. The following page will open:



Select any neurocognitive test type from the dropdown menu on the right side.

Select an appropriate time span from the **Zoom** options.

Select any measured parameters of the current test type from the legend on the right side to display them on the chart.

Use the time control at the bottom of the chart to adjust time span of the chart. The test results will automatically update.

Click the **Go Back** button to return to the home page.

Click the **Print Test History** button to print the displayed test results.

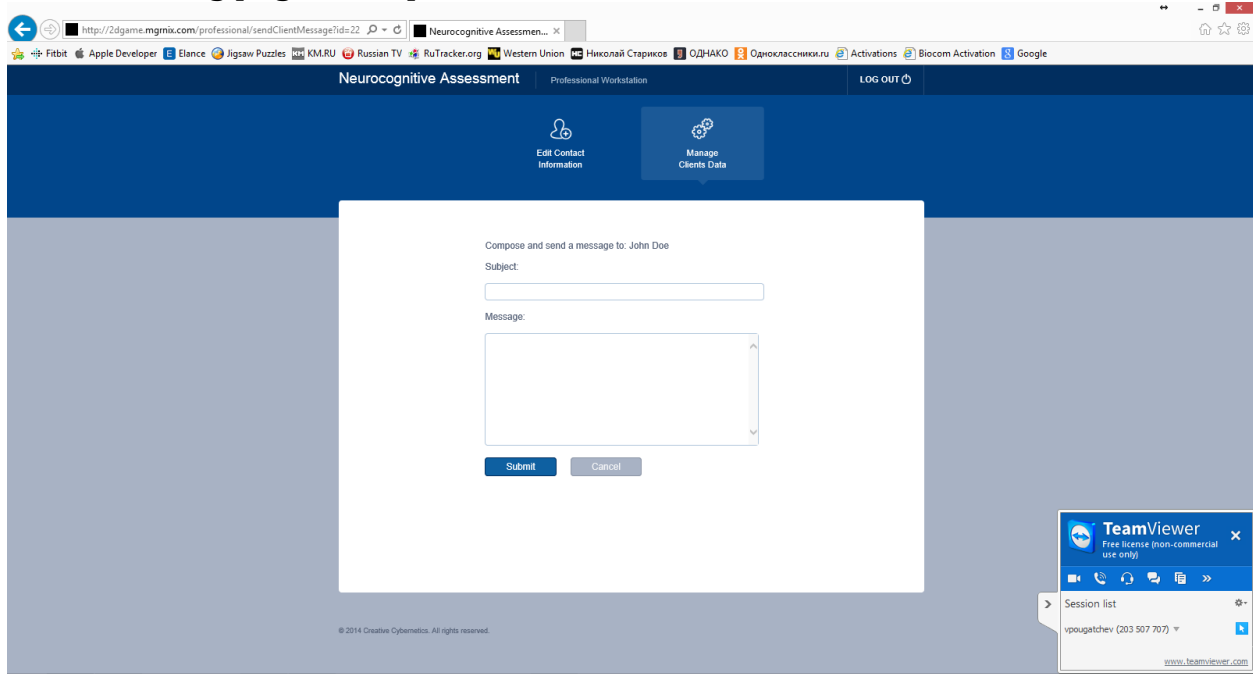
Click the **Print** button to start report printing.

Click the **Close** button to close this page and return to the report page.

Click the **Export Test Data** button. The application will generate and open a new Excel sheet containing the results of the selected test.

12. Send a professional advice

When you are on any page where there is the **Send Message** button, click it. The following page will open:



Type the subject of this message.

Type the body of the message.

Click the **Submit** button.

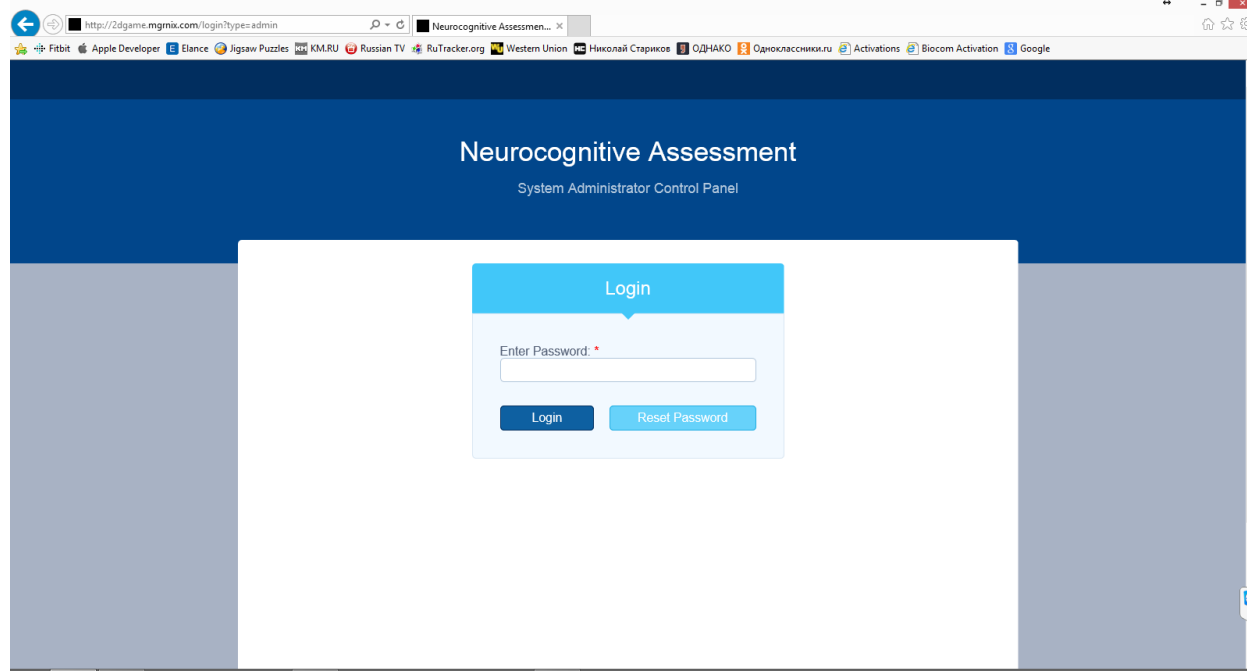
The application will send this message to the client and return to the home page.

mNCA System Administrator Control Panel

1. Start system administrator web-application

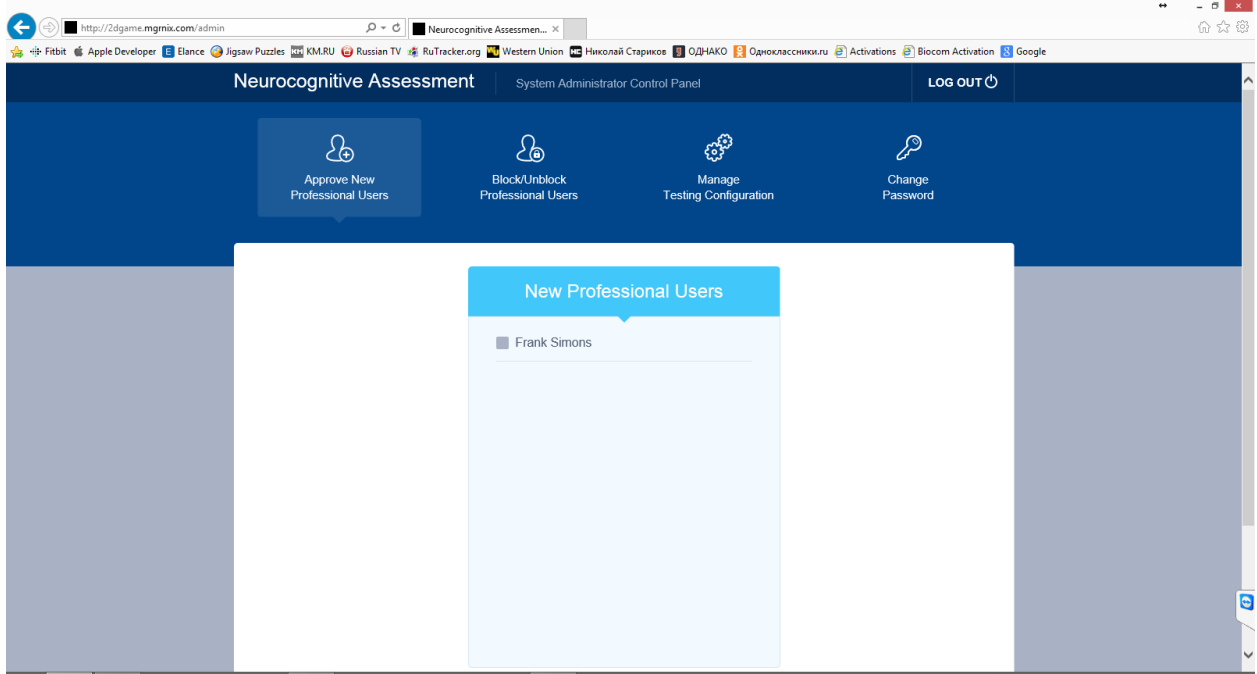


Double-click this icon to start the system administrator control panel. The following page will open:



Enter the system administrator's **Password**.

Press the **Login** button. The following page will open:



This is the application home page.

2. Close system administrator web-application

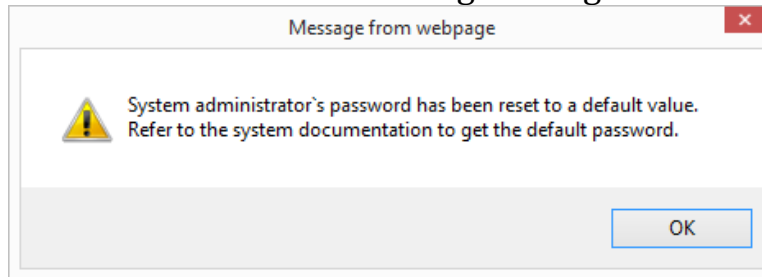
Click **LOG OUT** link.

3. Reset administrator's password

The system administrator may change their password to a custom one and later forget it. The system allows for resetting it to the default value hard coded into it. This default password is provided to the system administrator in the documentation, which **MUST** be kept in a restricted secure location.

Open the application login page.

Click **Reset Password** button. The following message box will open:



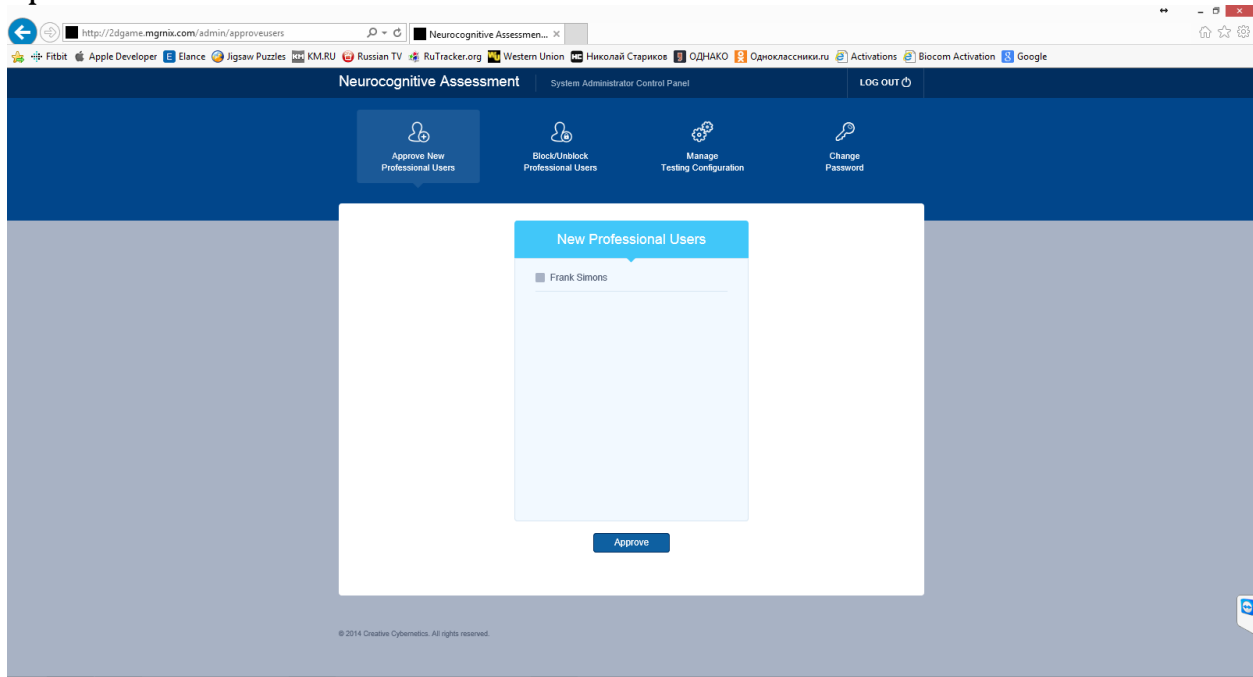
Click **OK** button.

4. Approve new professional users

The system administrator may approve the access of new professional users to the system.

Return to the home page.

Click the **Approve New Professional Users** button. The following page will open:



Set checkboxes to the left of the respective user names to enable their access to the system.

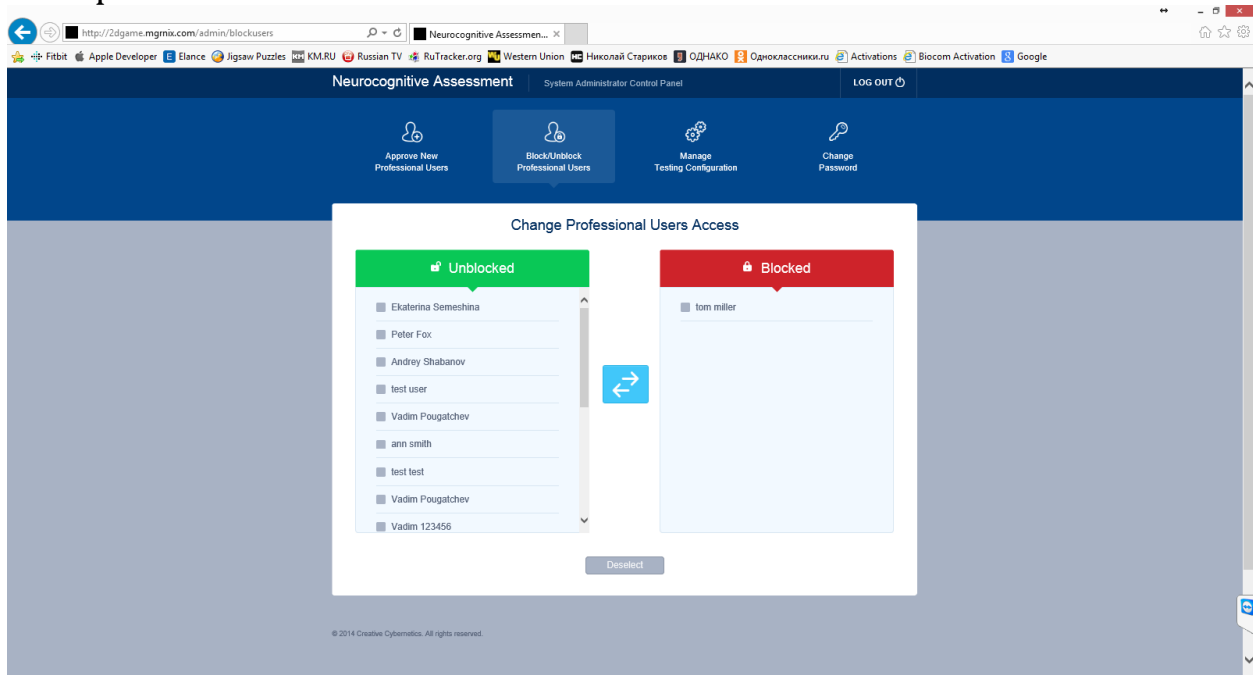
Click the **Approve** button. The application will return to the home page.

5. Block / Unblock professional users

The system administrator may change access of the professional users to the system.

Return to the home page.

Click the **Block / Unblock Professional Users** button. The following page will open:



Set checkboxes to the left of respective user names on the left and/or right panel to enable or disable their access to the system.

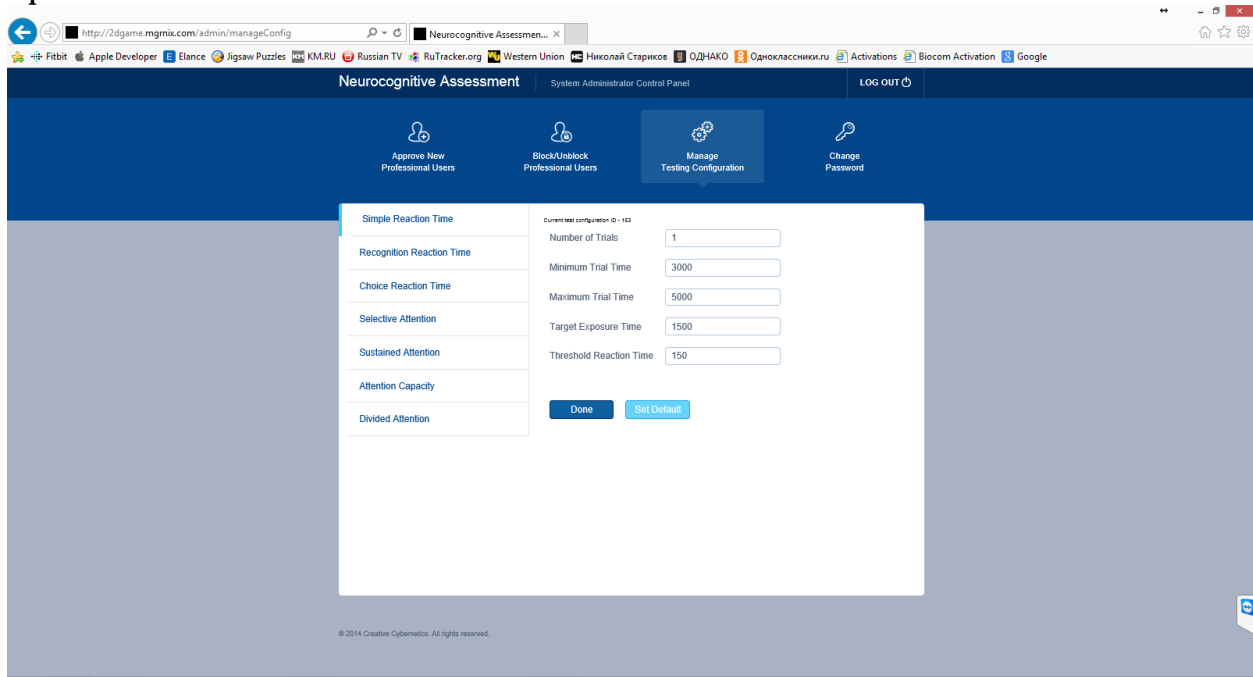
Click the **Update** button.

6. Manage testing configuration

The system administrator may modify various parameters of neurocognitive tests to be used by clients.

Return to the home page.

Click the **Manage Testing Configuration** button. The following page will open:



Press respective tabs to access different neurocognitive test settings.

Use respective controls to change configuration parameters.

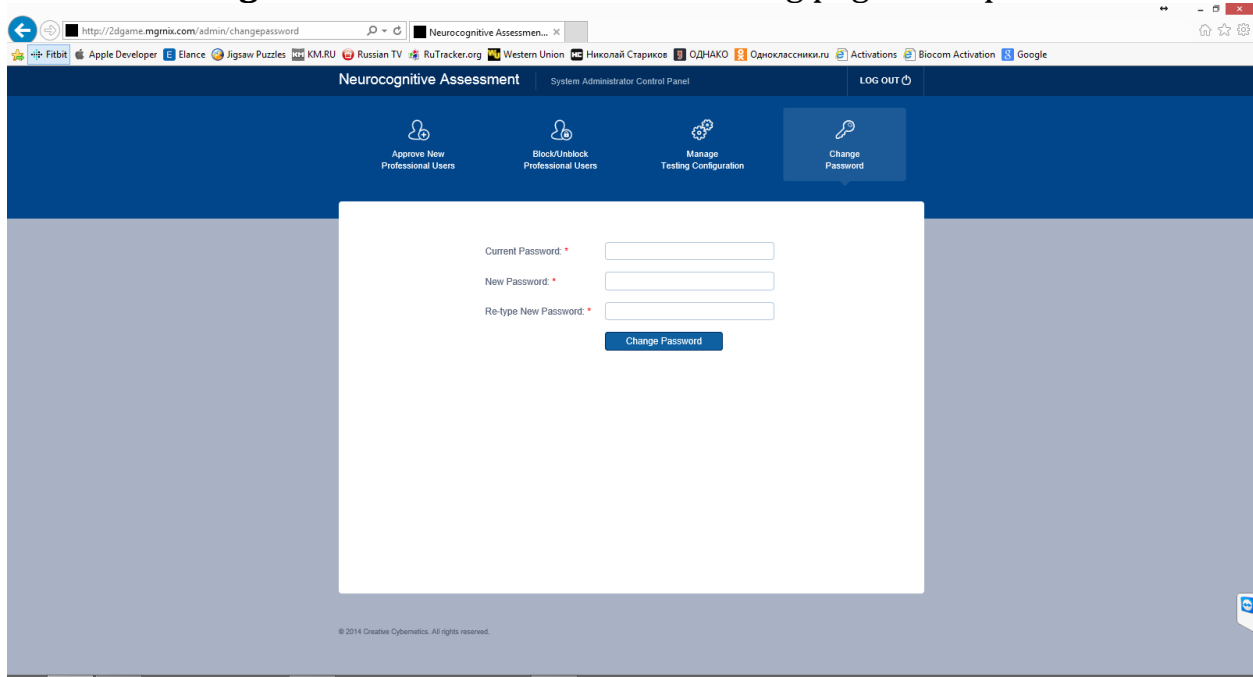
Click the **Done** button.

7. Change administrator's password

The system administrator may change own password to increase system security.

Return to the home page.

Click the **Change Password** button. The following page will open:



The screenshot shows a web browser window with the URL <http://2dgame.mgmix.com/admin/changepassword>. The page title is "Neurocognitive Assessment" and the subtitle is "System Administrator Control Panel". The page features a dark blue header with a "LOG OUT" button. Below the header is a navigation bar with four icons: "Approve New Professional Users", "Block/Unblock Professional Users", "Manage Testing Configuration", and "Change Password". The "Change Password" button is highlighted. The main content area is a white form with three input fields: "Current Password", "New Password", and "Re-type New Password". Each field has a red asterisk indicating it is required. Below the fields is a blue "Change Password" button. At the bottom of the page, there is a copyright notice: "© 2014 Creative Cybernetics. All rights reserved."

Input the current password.

Input a new password.

Re-type a new password.

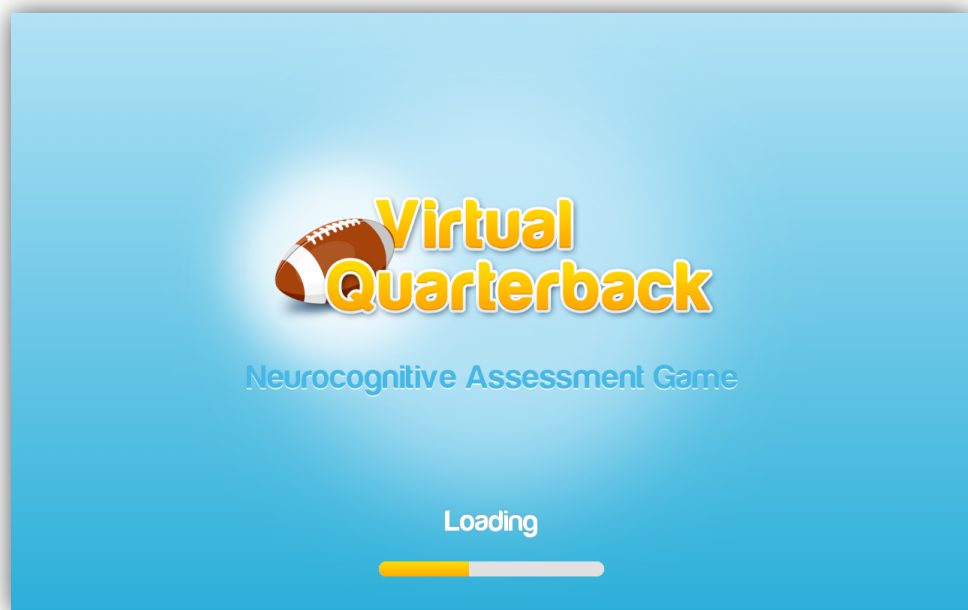
Click the **Change Password** button.

VIRTUAL QUARTERBACK APPLICATION Mobile Neurocognitive Assessment Tool

1. Start the application



Tap this icon to start the application.
The following title screen will open for a few seconds:



Once the app is loaded, open the following screen opens:



2. Logon the existing user

Once the logon screen opens, you need to log onto the application:

Input your email address registered with the mNCA system as a **USER ID**.

Input your password.

Tap the **Logon** button.

The following screen will open:



This is your application home screen. It always shows the results of the most recent testing.

3. Reset a forgotten password

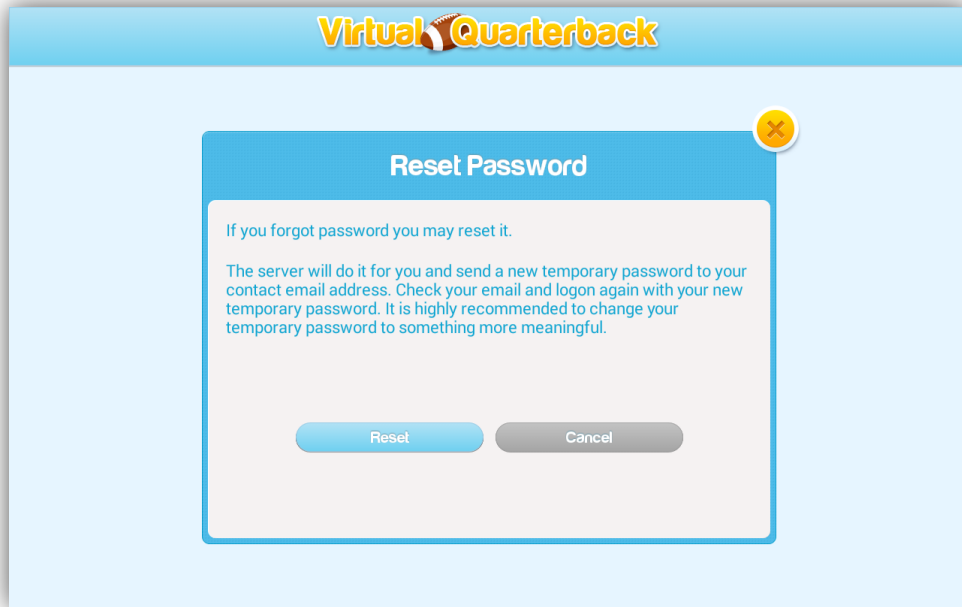
If you forgot your password, you may reset it. The server will automatically generate a temporary password and send it to your contact email address. It is recommended to change this temporary password to something more meaningful upon successful logon.

Get to the logon screen.

Input your email address registered with the mNCA system as a **USER ID**.

Tap the **Reset Password** button.

The following page will open:



Tap the **Reset** button.

Wait for an email from the system administrator to get a temporary password then try to logon.

4. Edit your personal profile

To edit your personal profile information you must be on the home screen.

Tap the **Profile** button. The following screen will open:



Change the data shown on this screen if needed.

Tap the **Continue** button. The following screen will open:

The screenshot shows the 'Edit Profile' screen within the Virtual Quarterback app. At the top, the app's logo 'Virtual Quarterback' is displayed in a blue header. Below the header, the title 'Edit Profile' is centered. Underneath the title, the instruction 'Enter Your biometric information here' is shown. The form contains several fields: 'Sex' with 'Male' and 'Female' options; 'Date of Birth' with three input fields containing '6', '16', and '1985'; 'Height' with two input fields containing '6' and '0'; and 'Weight' with one input field containing '187.0'. At the bottom of the form, there are two buttons: a grey 'Back' button with a left arrow and a blue 'Continue' button with a right arrow.

Change any data in respective entry fields if needed.

Tap the **Continue** button. The following screen will open:

The screenshot shows the 'Update Profile' screen within the Virtual Quarterback app. At the top, the app's logo 'Virtual Quarterback' is displayed in a blue header. Below the header, the title 'Update Profile' is centered. Underneath the title, the instruction 'To change your password, enter your current password then enter and re-type a new password.' is shown. The form contains three password input fields: 'Current Password:', 'New Password:', and 'Re-type Password:'. At the bottom of the form, there are two buttons: a grey 'Back' button with a left arrow and a blue 'Update Profile' button with a right arrow.

Enter your current password.

If you want to change your current password enter your new password and re-enter it. Otherwise leave these two data fields blank.

Tap the **Update Profile** button.

The application will bring back to the home screen.

5. Conduct a new test

A new testing procedure is considered completed when all neurocognitive tests are done. If the testing process was interrupted by switching to any other application, the current test will resume when you open the app again. It will start at the beginning of the current level of the game. If the current test is not finished by midnight, it gets abandoned and a new testing procedure will engage next time.

To run a new neurocognitive assessment test, you must be on the home screen.

Tap the **New Test** button on the bottom menu bar (the **Continue** button will be there instead if there is incomplete testing procedure pending.) The following screen will open:



Read the instructions.

Tap **Begin Test** button. The following screen will open:



This screen provides the instructions to perform a simple reaction time test. There will be five levels of the game providing this type of the test. Each level has a preset number of trials. With each new level the number of spots where the receiver will appear will be increased.

Read the test instructions.

Tap the **Begin Drill** button. The following screen will open:

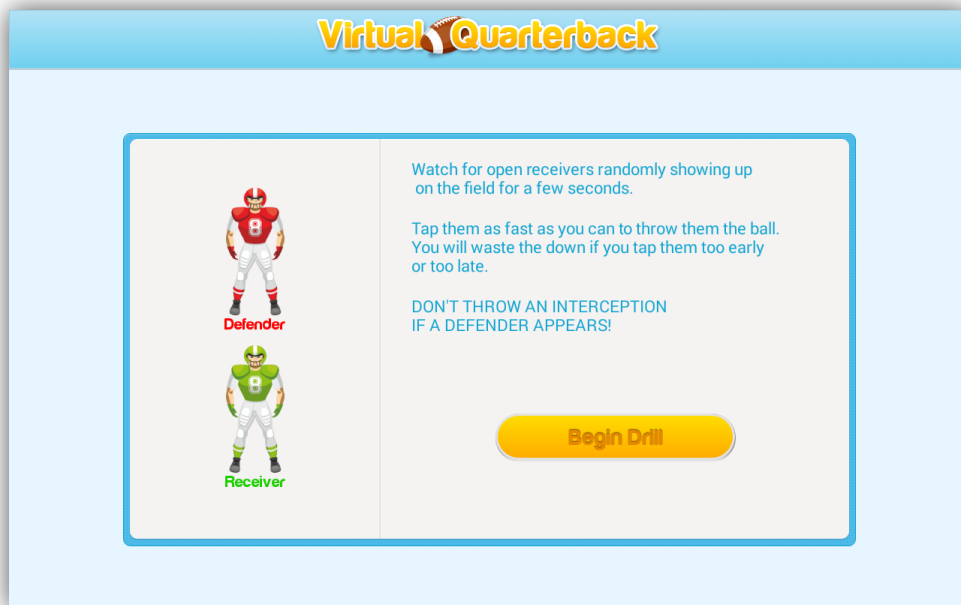


When a receiver appears, tap the screen as quickly as possible. Repeat this process till the drill is over.

Upon completion of each level of this test the following summary screen will open:



Tap the **Continue** button to advance to the next level. Once all levels of the current test type are complete the following screen will open:



This screen provides the instructions to perform a recognition reaction time test. There will be five levels of the game providing this type of the test. Each level has a preset number of trials. With each new level the number of spots where the receiver will appear will be increased.

Read the test instructions.

Tap the **Begin Drill** button. The following screen will open showing a green or red player:



Tap the screen if a green receiver shows up. Don't tap it when a red defender appears. Repeat this process till the drill is over.

Upon completion of each level of this test the following summary screen will open:



Tap the **Continue** button to advance to the next level. When all levels of the current test type are complete the following screen will open:



This screen provides the instructions to perform a choice reaction time test. There will be five levels of the game providing this type of the test. Each level has a preset number of trials. With each new level the number of spots where the receiver will appear will be increased.

Read the test instructions.

Tap the **Begin Drill** button. The following screen will open showing pairs of a green receiver and a red defender randomly standing one behind the other:



Single tap the screen if a green receiver is in front of the pair. Double tap the screen if a red defender is in front.

Repeat this process till the drill is over.

Upon completion of each level of this test the following summary screen will open:



Tap the **Continue** button to advance to the next level. When all levels of the current test type are complete the following screen will open:



This screen provides the instructions to perform a selective attention test. There will be only one level of the game providing this type of the test. It has a preset number of trials.

Read the test instructions.

Tap the **Begin Drill** button. The following screen will open:



Tap the red receiver on the screen.
Repeat this process till the drill is over.
Upon completion of this test type the following summary screen will open:



Tap the **Continue** button to advance to the next test. The following screen will open:



This screen provides the instructions to perform a sustained attention test. There will be only one level of the game providing this type of the test. It has a preset large number of trials to ensure challenging the sustained performance.

Read the test instructions.

Tap the **Begin Drill** button. The following screen will open:



There will be up to 12 positions on the field where receivers will appear with randomly chosen numbers on their jerseys.

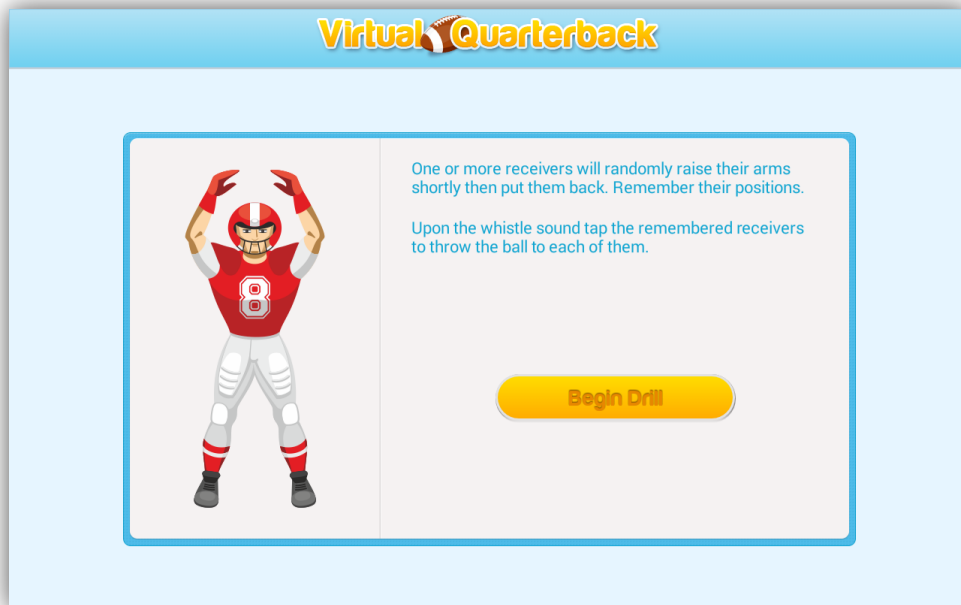
Tap the receivers in their ascending sequential order as quickly as possible to throw them balls.

Repeat this process till the drill is over.

Upon completion of this test the following summary screen will open:



Tap the **Continue** button to advance to the next test. The following screen will open:



This screen provides the instructions to perform an attention capacity test. There will be five levels of the game providing this type of the test. Each level has a preset number of trials. With each new level the number of receivers raising their hands will be increased.

Read the test instructions.

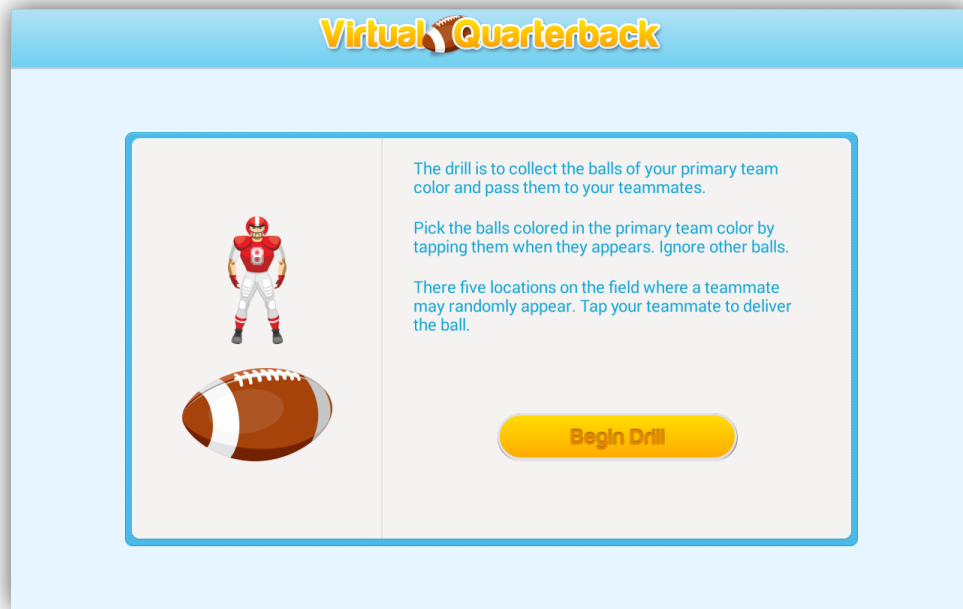
Tap the **Begin Drill** button. The following screen will open:



One or more receivers will raise their hands for a moment and then lower them. Recall those receivers and tap them as quickly as possible. Repeat this process till the drill is over. Upon completion of each level of this test the following summary screen will open:



Tap the **Continue** button to advance to the next level. When all levels of the current test type are complete the following screen will open:



This screen provides the instructions to perform a divided attention test. There will be one level of the game providing this type of the test with a preset number of trials.

Read the test instructions.

Tap the **Begin Drill** button. The following screen will open:

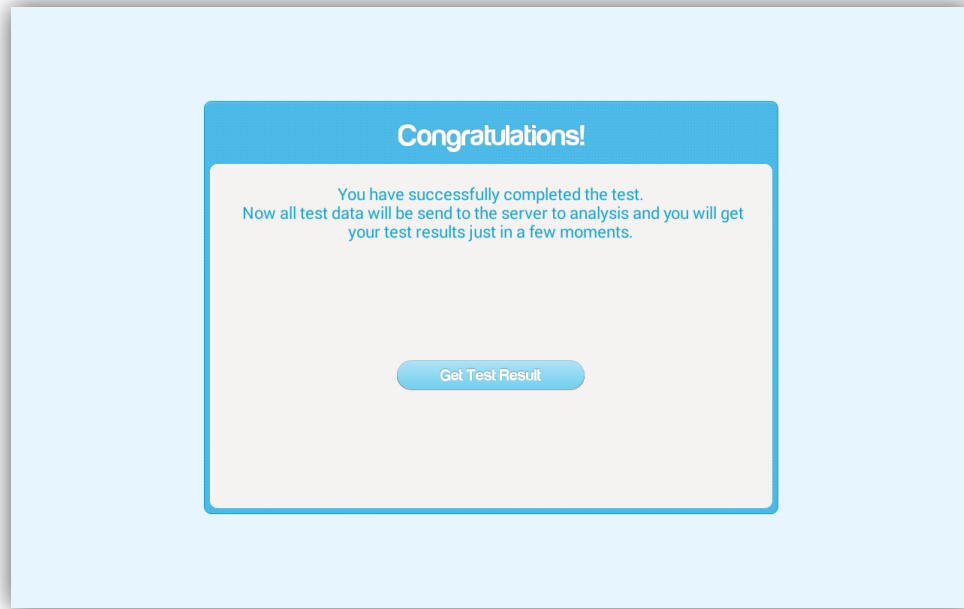




Tap the receiver as quickly as possible to throw him a ball.
Tap the red ball when it appears. Don't tap the blue balls.
Repeat this process till the drill is over.
Upon completion of each level of this test the following summary screen will open:



Tap the **Continue** button to conclude the test. The following screen will open:



Now the test is over.

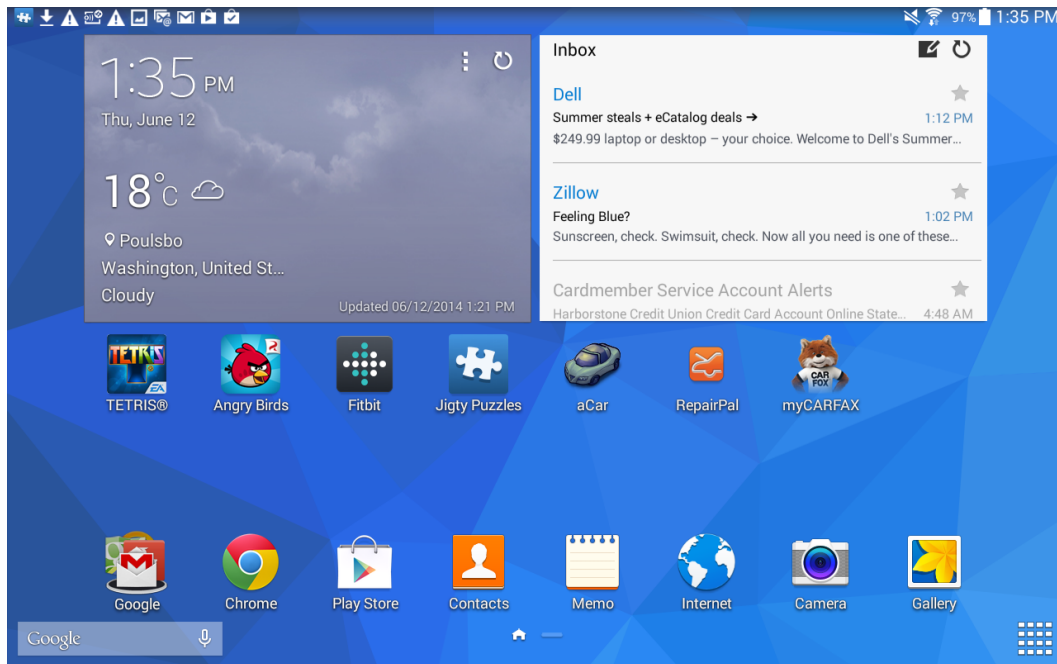
Tap the **Get Test Results** button. The application will open the home screen showing the new test results.

Appendix F

RUNNING AN MNCA MOBILE APP ON AN ANDROID TABLET

How to find and run the mNCA app on the tablet.

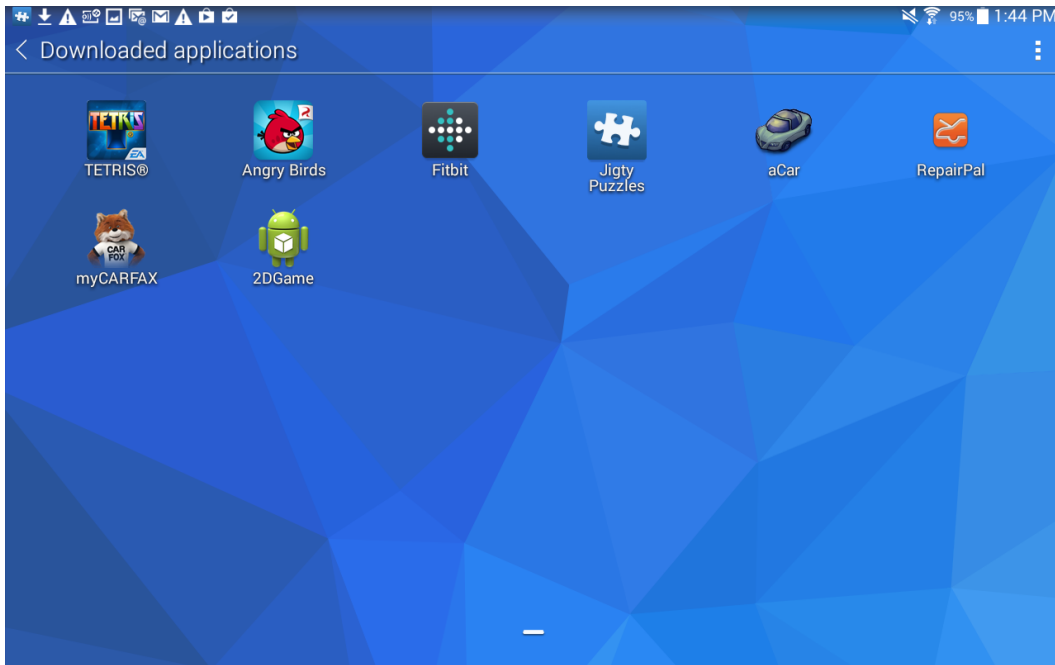
1. Press the HOME button (middle button at the bottom of the device) to wake up the tablet.
2. Sweep the screen to unlock it.



3. Tap the "grid" icon in the bottom right corner to bring all application icons.



4. Select the “Downloaded Apps” tab.



5. Tap the “2DGame” icon to start the mNCA app.

How to log into the app.

1. Start the app as described above. It may be already started but left in the background mode. To check it out, press the MENU button to the left of the HOME button (below the screen). Android will show the ribbon at the bottom of the screen listing all apps in memory. If the “2DGame” icon is there tap it to bring the app forward.



2. Input “cvrussoniello@creativecybernetics.com” as a User ID and tap the “Next” button on the screen keyboard. Use the “Sym” button to access special symbols.
3. Input “qwerty_123456” as a password.
4. Tap the “Logon” button.



5. This is the main home page showing the last testing results.

How to edit a user profile.

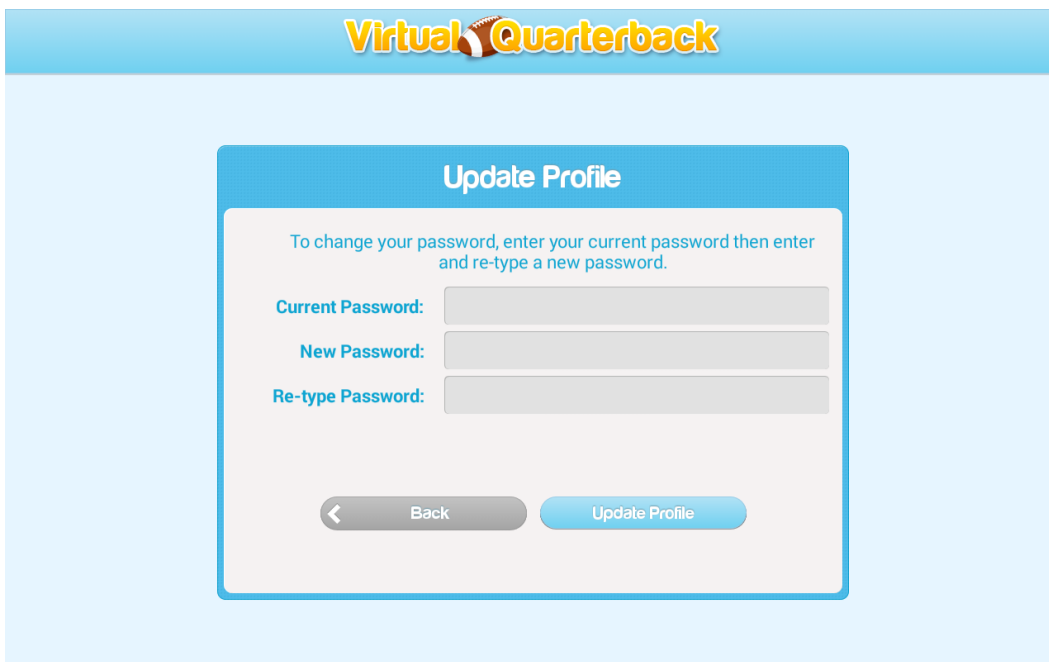
1. To view or edit your user profile, tap the “Profile” button.



2. Enter the information if needed, then tap the “Continue” button.



3. Enter the information if needed, then tap the “Continue” button.



4. Enter the information if needed, then tap the “Update Profile” button.
5. Press the BACK button to the right of the HOME button (below the screen) to return to the home screen of the app.

How to run a new test.

1. To start a new test, tap the “New Test”



2. Tap the “Begin Test” button. The simple reaction test instruction will open.



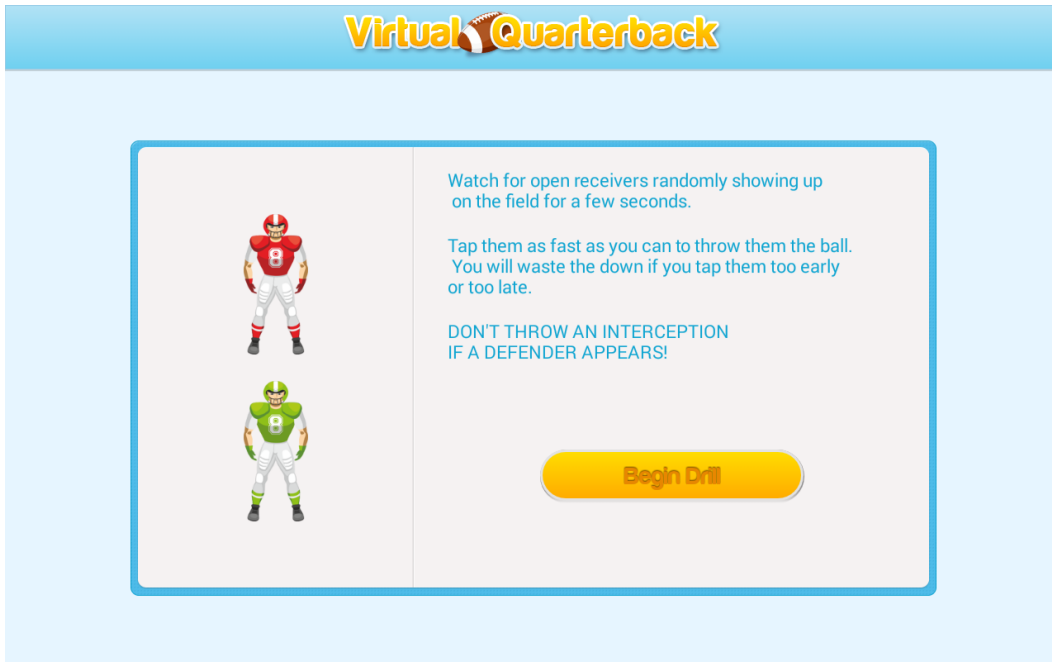
3. Tap the “Begin Drill” button. A loading game page will open.
4. Tap the “Start Game” button. Football receivers will randomly appear on the screen.



5. Tap on them quickly until the drill summary opens.



6. Tap the “Continue” button to proceed. The recognition reaction time test instruction will open.



7. Tap the “Begin Drill” button. A loading game page will open.
8. Tap the “Start Game” button. Football players (green or blue) will randomly appear on the screen.



9. Tap the green players but do not tap the blue ones. Repeat tapping until a drill summary opens.



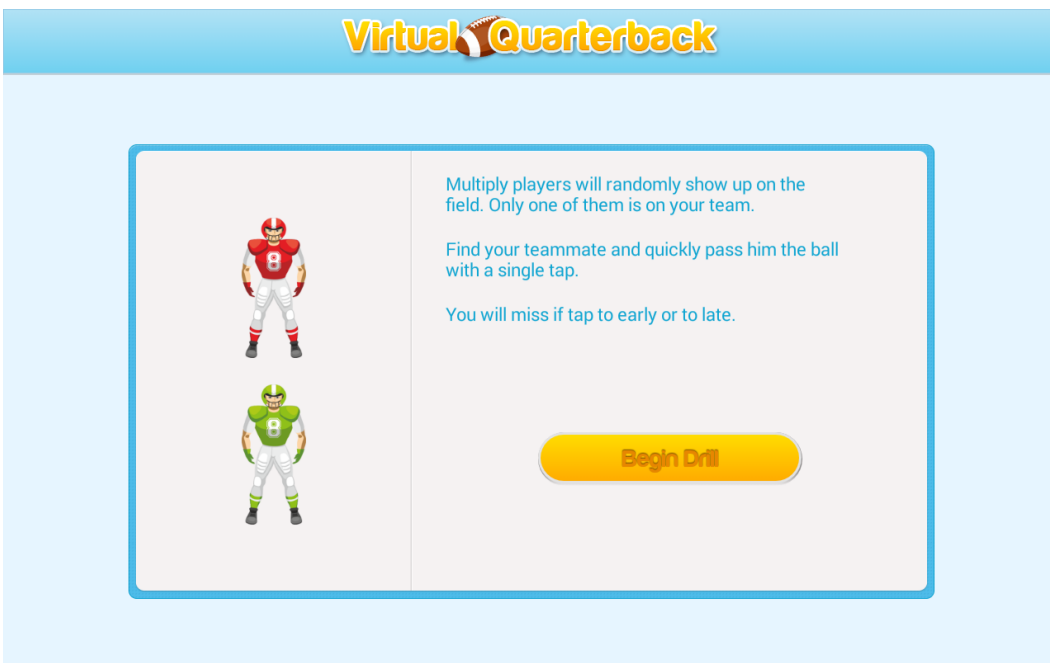
10. Tap the “Continue” button to proceed. The choice reaction time test instruction will open.



11. Tap the “Begin Drill” button. A loading game page will open.
12. Tap the “Start Game” button. Football players (green or blue) will randomly appear on the screen.



13. Single-tap the green players. Double-tap the blue ones. Repeat tapping until a drill summary opens.
14. Tap the “Continue” button to proceed. The selective attention test instruction will open.



15. Tap the “Begin Drill” button. A loading game page will open.
16. Tap the “Start Game” button. Multiple players will randomly appear on the screen.



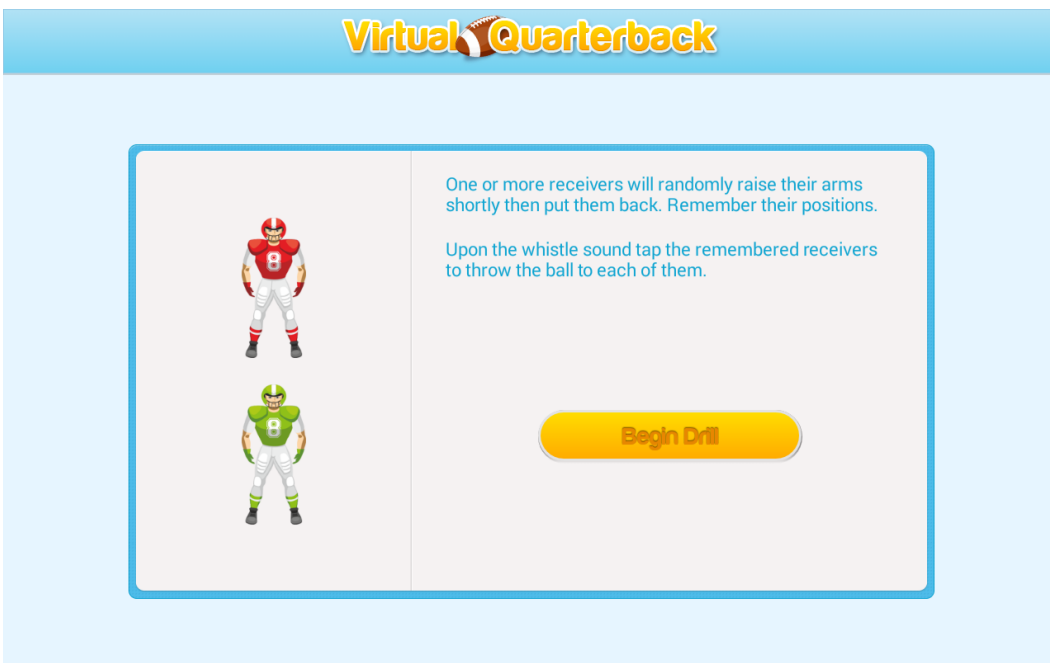
17. Quickly find a green player among blue ones and tap him. Repeat tapping until a drill summary opens.
18. Tap the “Continue” button to proceed. The sustained attention test instruction will open.



19. Tap the “Begin Drill” button. A loading game page will open.
20. Tap the “Start Game” button. Multiple players with the numbers on their backs will randomly appear on the screen.



21. Tap them in the ascending order as fast as possible. Repeat tapping until a drill summary opens.
22. Tap the “Continue” button to proceed. The attention capacity test instruction will open.



23. Tap the “Begin Drill” button. A loading game page will open.
24. Tap the “Start Game” button. Multiple players (red and yellow) will randomly appear on the screen for a few seconds.

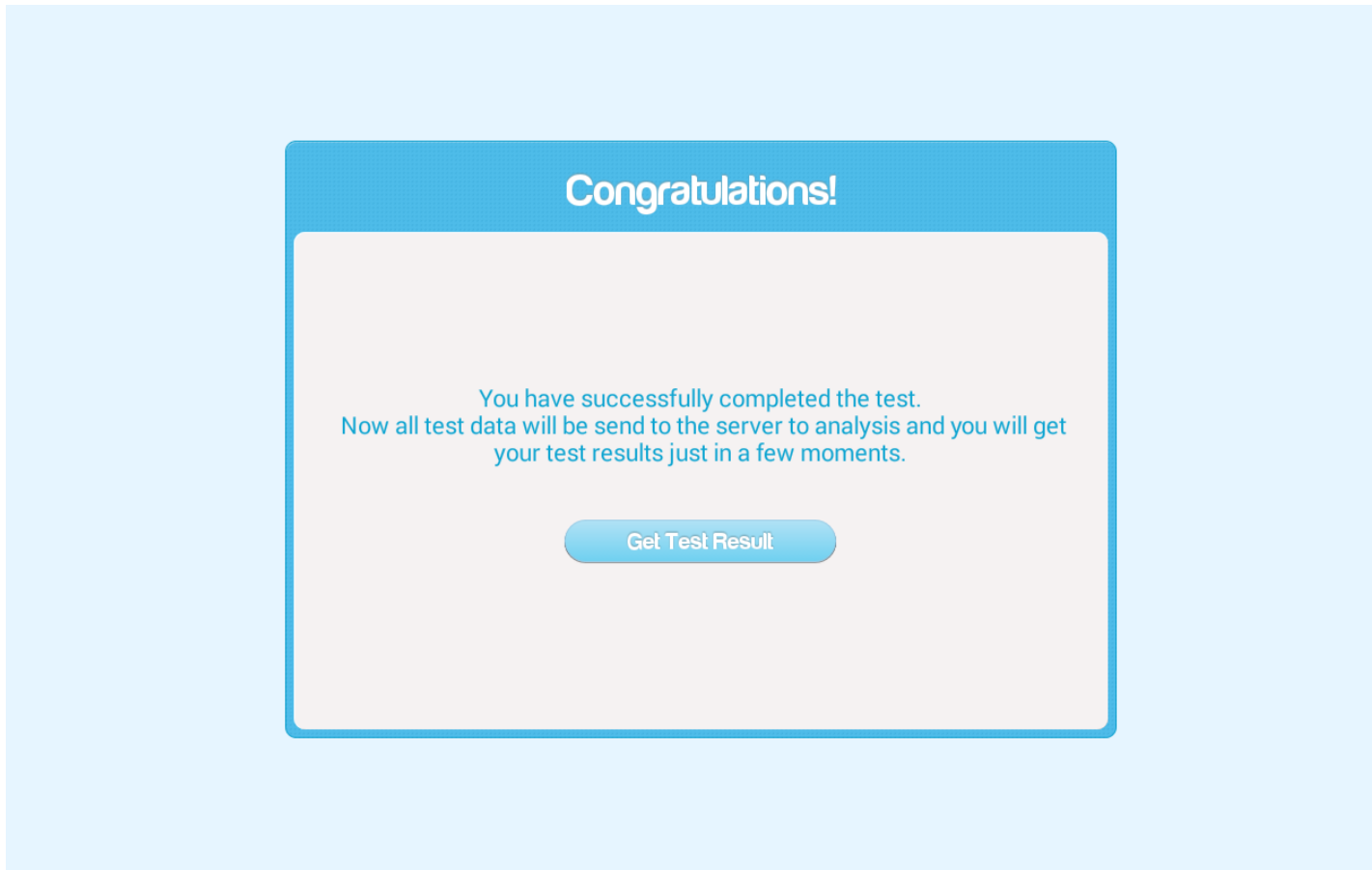


25. Remember where the yellow ones are.
26. Wait till all of them become red then tap those who were yellow just a moment ago.
27. Repeat tapping till a drill summary opens.
28. Tap the “Continue” button to proceed. The divided attention test instruction will open.



29. Tap the “Begin Drill” button. A loading game page will open.
30. Tap the “Start Game” button.
31. Tap when red players appear.
32. When green or blue players appear, tap green ones but ignore blue ones.

33. Repeat tapping till a drill summary opens.
34. Tap the “Continue” button to proceed to the final summary.



35. Tap the “Get Test Results” button to return to the main menu screen which displays the final test results.

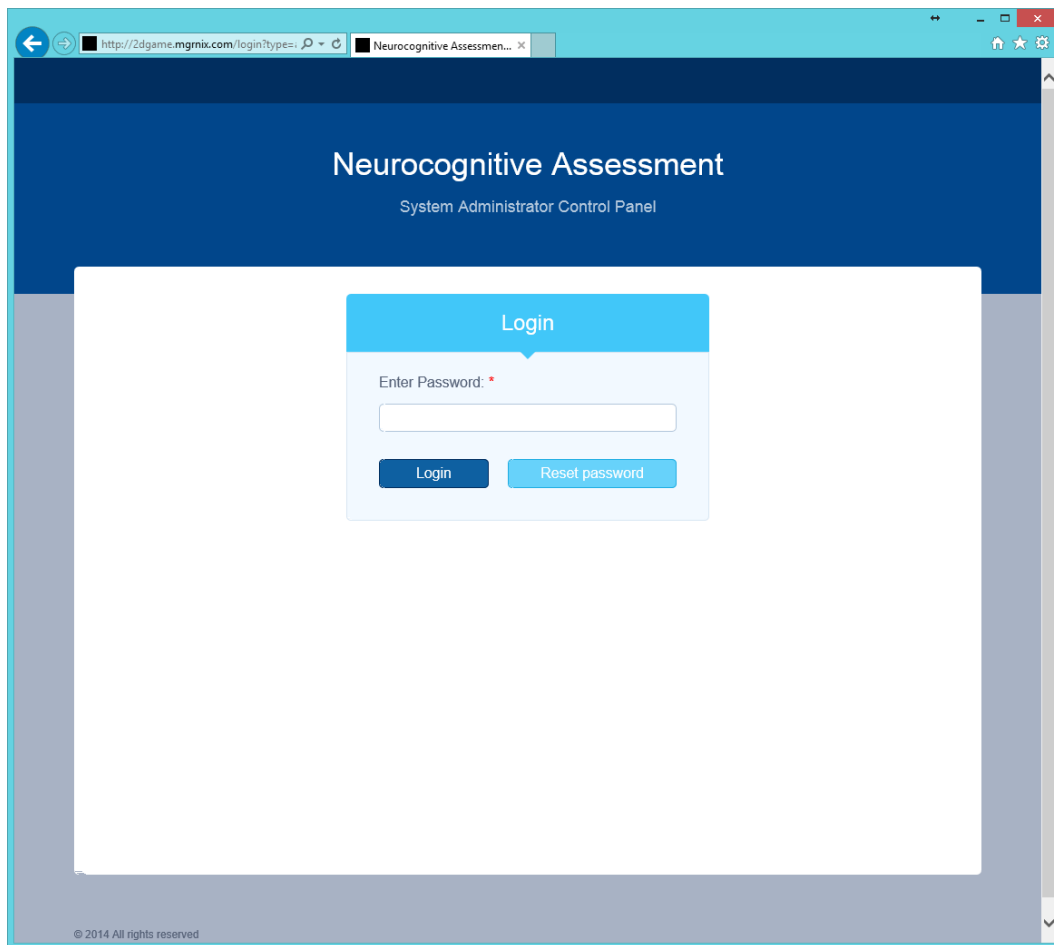
Appendix F RUNNING THE MNCA SYSTEM ADMINISTRATOR APP IN A WEB BROWSER

How to log into the app.

6. Open your default web browser (this instruction assumes using Microsoft Internet Explorer).
7. Input the following web link to access the mNCA System Administrator application:

<http://2dgame.mgrnix.com/login?type=admin>

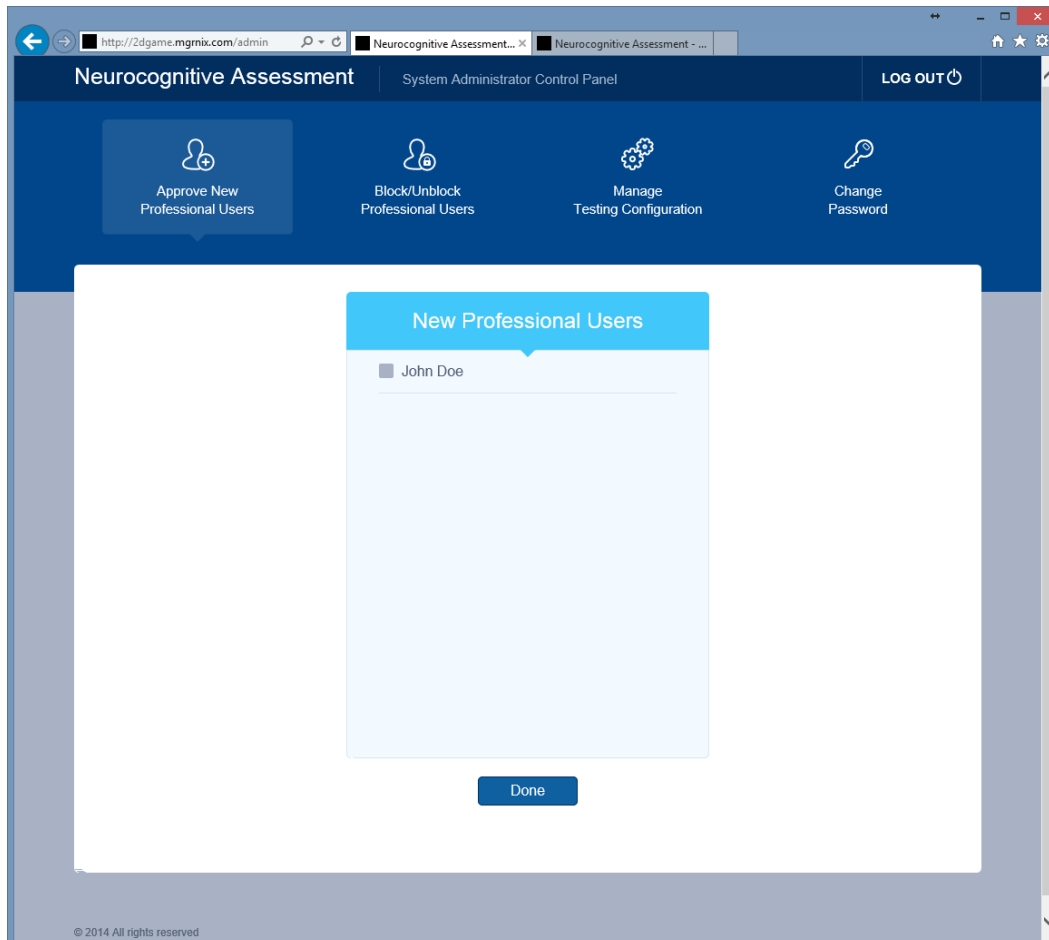
8. The following page will open:



9. Input "ABCdef_123456" (without quotes) as a password, then click the "Login" button. The home page will open.

How to approve a new professional user.

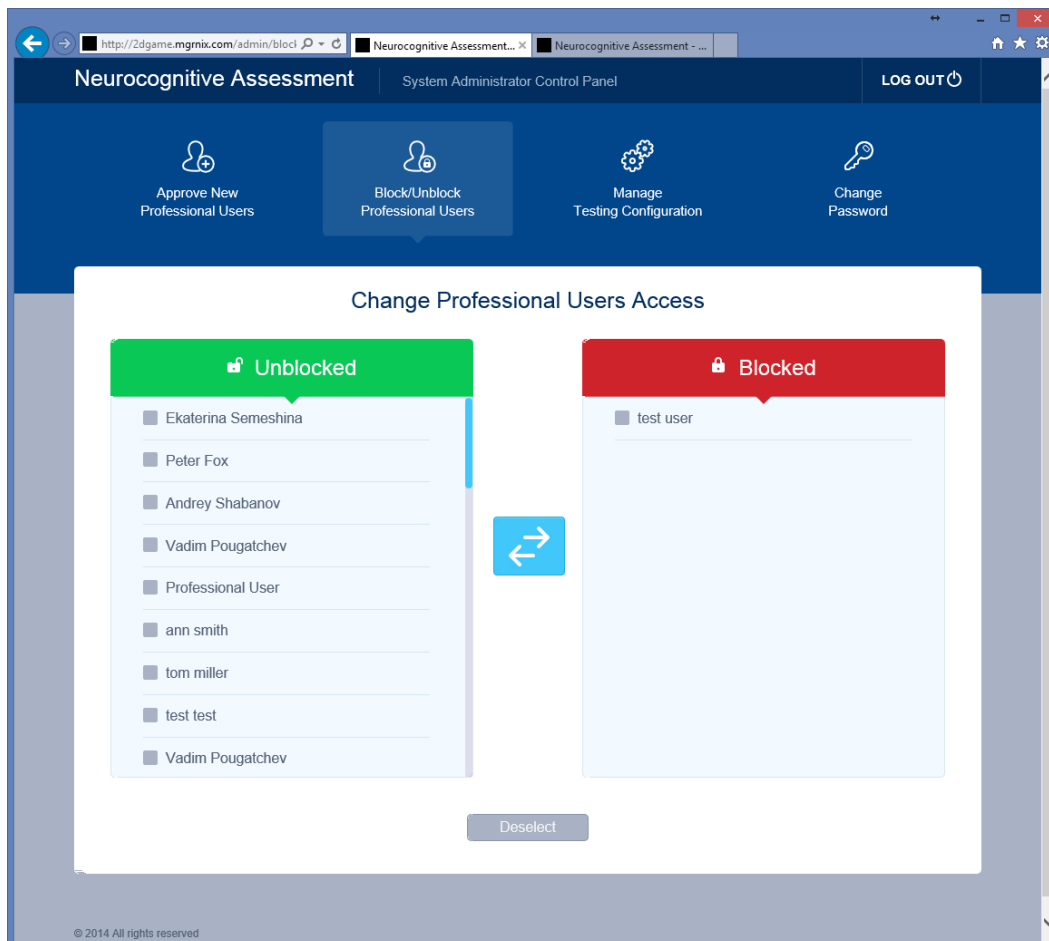
1. Log into the app as described above.
2. If the app is open and you are on a different page, click the “Approve New Professional Users” button.
3. Wait till the following home page opens.



10. If you have a new professional user account just created and needing approval, its name will appear on the list here.
11. Put a checkmark to an appropriate name the click the “Done” button.
12. Wait till the app opens the home page.

How to block / unblock professional users to access the mNCA system.

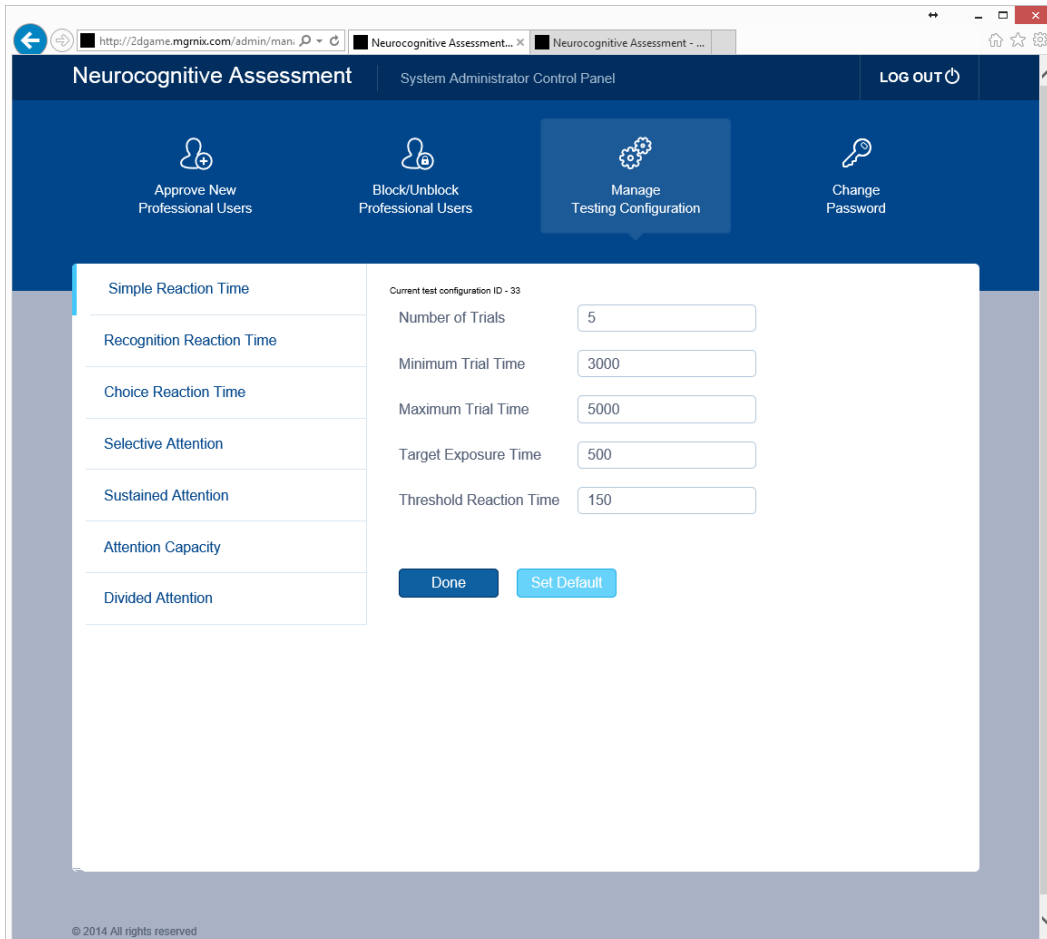
1. Click the “Block/Unblock Professional Users” button.
2. Wait till the following page opens:



3. To block users: put checkmarks to appropriate user names on the left panel then click the “Exchange” button.
4. To unblock users: put checkmarks to appropriate user names on the right panel then click the “Exchange” button.

How to change NC testing configuration.

1. Click the “Block/Unblock Professional Users” button.
2. Wait till the following page opens:



3. Click one of the tabs on the left side of the form to select an appropriate NC test.
4. Modify any current test parameters.
5. Repeat steps 3 and 4 for any of other NC tests.
6. Click the “Done” button to save the new configuration.

How to log out of the app.

1. Click the “Logout” button.
2. Wait till the app open the login page.
3. Close the browser if needed.

MOBILE NATURALISTIC NEUROCOGNITIVE ASSESSMENT

Project Specification

(With Alternative Game Skin to Demonstrate Flexibility of the Product)

1. System Purpose

This project is to develop an Internet based client-server system for neurocognitive assessment of target individuals, evaluation aspects of their mental health and intervention by providing professional advice.

System Architecture, Functions and Data Structure

1.1. Categories of Users

There will be the following categories of users of the proposed system:

1. Individuals who need regular assessment of their neurocognitive function and receive health care advice from mental health professionals.
2. Mental health professionals who need ability to access the results of neurocognitive testing self-administered by target individuals to perform professional evaluation of the assessment results and provide their professional advice to those individuals.
3. System administrator.

1.2. System Architecture

The system is based on the standard client-server architecture, illustrated with the Figure 1.

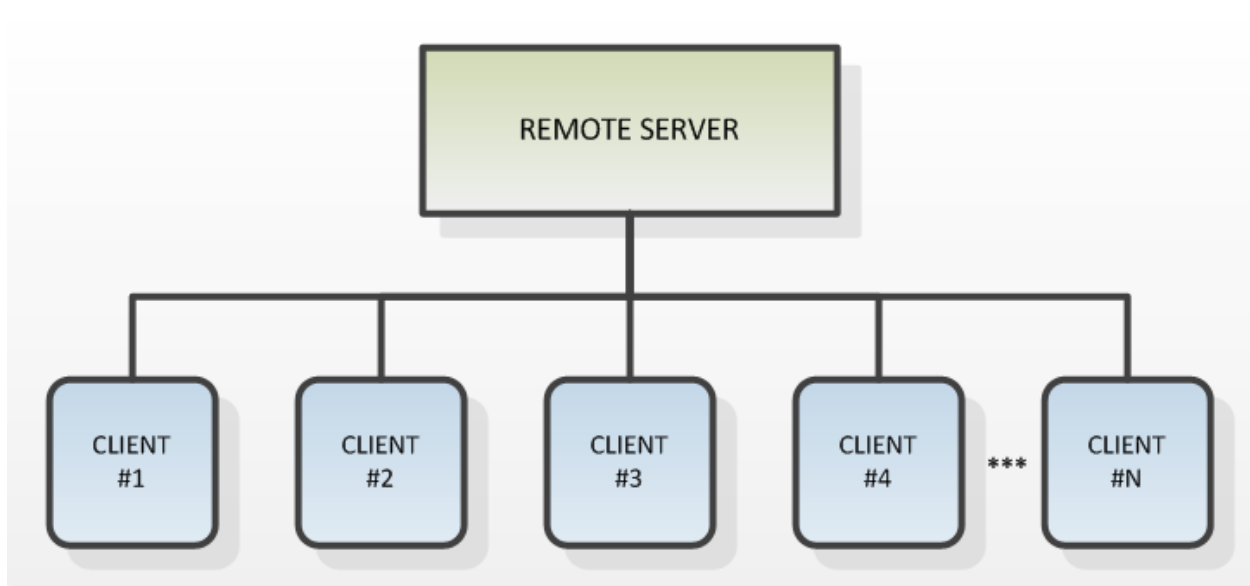


FIG. 1

Remote server carries out the following functions:

1. Accumulate and store clients' personal information and results of neurocognitive tests carried out by the clients
2. Perform analysis of test results and generate assessment reports requested by both categories of users
3. Perform data queries received from professional users and save resulting data in specified file formats
4. Send generated assessment reports to the users requesting them
5. Send information (intervention advices) generated by health professional users to the clients

Clients carry out the following functions:

1. Obtain client's personal information and send it to the server
2. Conduct neurocognitive tests and save test data to the server
3. Query selected assessment results or their history data from the server and display to the client
4. Receive information (intervention advices) from the server and display to the client

1.3. System Hardware Architecture

The system hardware architecture is illustrated on the Figure 2.

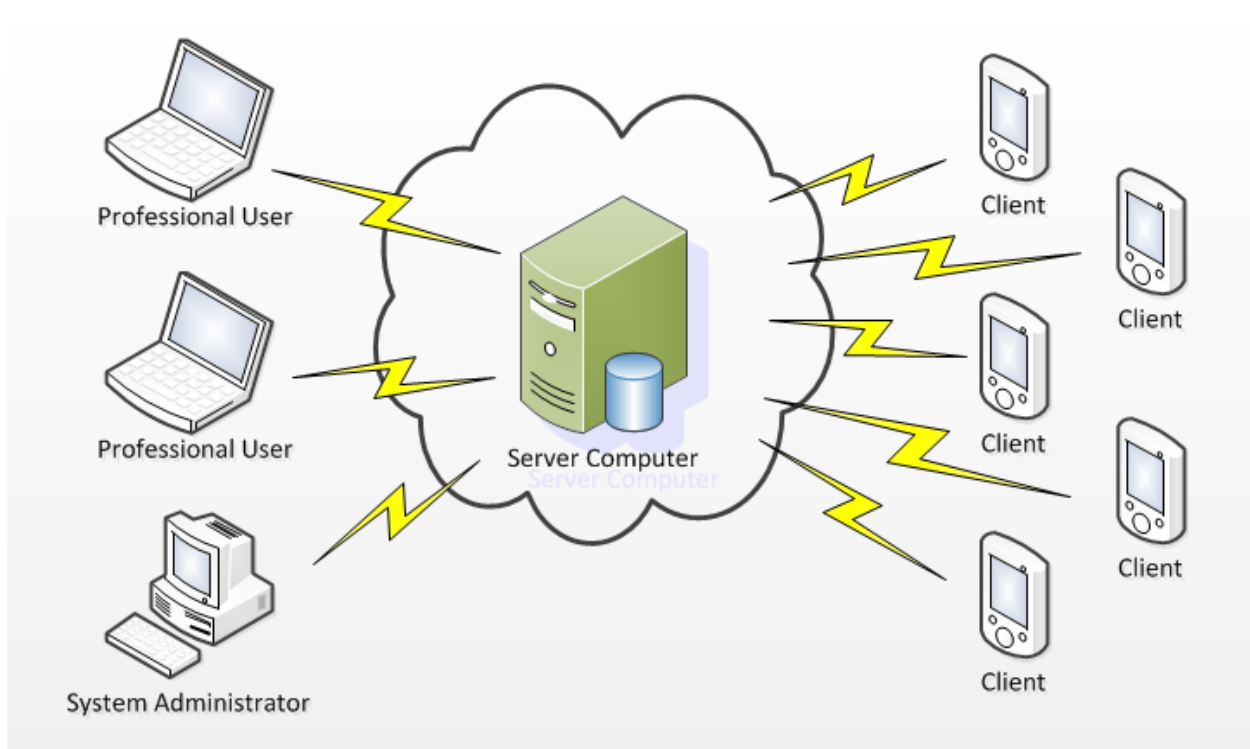


FIG. 2

Individual users (clients) will use smartphones (iPhone) with special client application installed, which will perform all required functionality. This mobile application will communicate with the server by means of secure Internet transactions.

Professional users will use standard computers with Internet browsers like Internet Explorer, Firefox, Chrome, etc. to access to the system functionality by means of running a secure web application for professional users.

System administrator will use standard remote access to the server to manage the server application software and database. These functions are standard and are not part of the system being described.

Besides system administrator will use a secure web application for system administrators to perform specific administrative tasks.

1.4. System Function Overview

1.4.1. System Administrator Functions

The following functions will be performed by a special web application running on the server through a default web browser on administrator's computer:

Login Administrator	There is only one system administrator user. Their Used ID is predefined as “Admin” and default password is “123456”. However this password may be changed to more secure one.
Reset Administrator’s Password	The administrator may reset the system administrator’s password to the factory setting.
Block / Unblock Clients	Administrator may block any individual users (clients) to prevent their access to the system. Any blocked client can be unblocked.
Block / Unblock Professional Users	Administrator may block any professional users to prevent their access to the system. Any blocked professional user can be unblocked.
Approve New Clients	Administrator may approve or decline any new client who tries to create a new account. If approved, a special email is automatically sent to the user providing the User ID (registered contact email address) and automatically generated temporary password.
Approve New Professional User	Administrator may approve or decline any new professional user who tries to create a new professional account. If approved, a special email is automatically sent to the user providing the User ID (registered contact email address) and automatically generated temporary password.
Manage Testing Configuration	Neurocognitive testing procedure has many important settings which determine how testing process works. It is the system administrator’s responsibility to manage those settings to ensure their validity.
Change Administrator’s Password	The administrator may change their password at any time using this function.

1.4.2. Professional User Functions

The following functions will be performed by a web application running on the server through a default web browser on the user's computer:

Register New Professional User

A new professional user must create a new free account with the system to be able to access its functionality.

The professional user must provide own identification information (as described in Section 5.2.2.) for secure access. Contact email address will be used as User ID for secure login.

Creation of professional user accounts is moderated by the system administrator to avoid strangers to access sensitive personal and health information of the clients. Once the account is approved the system will send a confirmation email to provided contact email address giving the User ID (contact email address) and a temporary password. The user will be prompted to change password upon first login.

Login Existing User

An existing professional user must log into the system to access its functionality. The user must provide own contact email address and password to login.

Reset Password

A professional user may forget own password. The system may reset it by user's request. New password will be sent to the user's contact email address.

Edit Contact Information

A professional user may modify own personal information provided while creating an account. This information is described in Section 5.2.4.

View List of Clients

A professional user may view the list of all individual users (clients) to choose and open any particular user record for further use.

View Test Results

A professional user may view the results of any test of the selected client conducted earlier and stored on the server. The details on the content of test reports are described in Section 5.2.5.

View Testing History

A professional user may view the results of tests of the selected client conducted earlier in the form of history progress report. The details on the content of progress reports are described in Section 5.2.6. The history may be shown in different time ranges: 1 month, 3 months, 6 months, 1 year and 3 years.

Send Professional Advice

Professionals may send advisory information to individual users when necessary. This information will be delivered to the individual user's contact email address and viewed with a standard Mail application outside of this system.

Export Test Data

A professional user may export test data of any selected individual user into Excel file and save it on user's computer. The exported data may include: individual user's personal information, all detailed test results or test summary results. The details on content of exported data are described in Section 5.2.8.

1.4.3. Client Functions

The following functions will be performed by a client mobile application running under iOS (Version 5 and higher):

Register New User

A new individual user must create a new free account with the system to be able to access its functionality.

The individual user must provide own personal information (as described in Section 5.3.2.) along with password for secure access. Contact email address will be used as User ID for secure login.

Creation of individual user accounts is moderated by the system administrator to avoid strangers to access the system. Once the account is approved the system will send a confirmation email to provided contact email address giving the User ID (contact email address) and a temporary password. The user will be prompted to change password upon first login.

Login Existing User	An existing individual user must log into the system to access its functionality. The user must provide own contact email address and password to login.
Reset Password	An individual user may forget own password. The system may reset it by user's request. New password will be sent to the user's contact email address.
Edit Personal Information	An individual user may modify own personal information provided while creating an account. This information is described in Section 5.3.5.
Conduct Neurocognitive Test	An individual user may take a neurocognitive test at any time. The test is in fact a series of various simple neurocognitive tests combined into one testing scenario implemented in an attractive interactive game. The details on the nature of testing as well as testing procedure are described in Section 5.3.6.
View Test Results	An individual user may view the results of test just conducted as well as any test conducted earlier and stored on the server. The details on the content of test reports are described in Sections 5.3.7. and 5.3.8.
View Testing History	An individual user may view the results of tests conducted earlier in the form of history progress report. The details on the content of progress reports are described in Section 5.3.8. The history may be shown in different time ranges: 1 month, 3 months, 6 months, 1 year and 3 years.
Receive Professional Advice	Professionals may send advisory information to individual users when necessary. This information will be delivered to the contact email address and viewed with a standard Mail application outside of this system.

1.5. Data Structures

1.5.1. System Administrator

Contact Email	String	40 characters
Password	String	40 characters

1.5.2. Professional User

First Name	String	40 characters
Last Name	String	40 characters
Title	String	40 characters
Contact Email	String	40 characters
Password	String	40 characters
Date / Time Created	DateTime	8 bytes
Status	Enumeration: (Int)	4 bytes
	- Pending Approval	
	- Active	
	- Suspended	

1.5.3. Individual User

First Name	String	40 characters
Last Name	String	40 characters
Title / Rank	String	40 characters
Occupation	String	80 characters
DOB	DateTime	8 bytes
Gender	Enumeration: (Int)	4 bytes
	- Male	
	- Female	
Height (inches)	Integer	4 bytes
Weight (pounds)	Float	8 bytes
Contact Email	String	40 characters
Password	String	40 characters
Date / Time Created	DateTime	8 bytes

Status	Enumeration: (Int)	4 bytes
	- Pending Approval	
	- Active	
	- Suspended	

1.5.4. Test Results

Date / Time Of Test	DateTime	8 bytes
Status	Enumeration: (Int)	4 bytes
	- Locked	
	- Unlocked	
	- Invalid	
User Comment	String	1000 characters
Professional Comment	String	1000 characters
Conclusion	String	1000 characters
Test Data	Structure	See below
Test Results	Structure	See below

1.5.5. Test Data

The following structure holds each test data:

Simple Reaction Time:

Test Settings	Structure described in 3.1.4.	20 bytes
Reaction Time (ms)	Array of Integers	Dynamic
	-1 – false reaction	
	-999 – missed reaction	

Recognition Reaction Time:

Test Settings	Structure described in 3.2.4.	20 bytes
Reaction Time (ms)	Array of Integers	Dynamic
	-1 – false reaction	
	-999 – missed reaction	

Recognition	Array of BOOL: - FALSE - TRUE	Dynamic
Choice Reaction Time:		
Test Settings	Structure described in 3.3.4.	20 bytes
Reaction Time (ms)	Array of Integers -1 – false reaction -999 – missed reaction	Dynamic
Choice	Array of BOOL: - FALSE - TRUE	Dynamic
Selective Attention:		
Test Settings	Structure described in 3.4.4.	20 bytes
Reaction Time (ms)	Array of Integers -1 – false reaction -999 – missed reaction	Dynamic
Choice	Array of BOOL: - FALSE - TRUE	Dynamic
Sustained Attention:		
Test Settings	Structure described in 3.4.4.	20 bytes
Reaction Time (ms)	Array of Integers -1 – false reaction -999 – missed reaction	Dynamic
Choice	Array of BOOL: - FALSE - TRUE	Dynamic
Attention Capacity:		
Test Settings	Structure described in 3.5.4.	16 bytes
Number Of Targets	Array of Integers (values from 1 to 5)	Dynamic

Reaction Time (ms)	Array of Integers -1 – false reaction -999 – missed reaction	Dynamic
Number of Mistakes	Array of Integers (values from 0 to 5)	Dynamic
Divided Attention:		
Test Settings	Structure described in 3.6.4.	20 bytes
Test Type	Array of Enumerations (Int): - Simple Reaction Time - Recognition Reaction Time	Dynamic
Reaction Time (ms)	Array of Integers -1 – false reaction -999 – missed reaction	Dynamic
Recognition	Array of BOOL: - FALSE - TRUE (always set for simple reaction time)	Dynamic

1.5.6. Test Results

The following structure holds test results:

Simple Reaction Time:

Trial Count	Integer	4 bytes
Mean Reaction Time (ms)	Float	8 bytes
False Reaction Count	Integer	4 bytes
Percent of False Reactions	Float	8 bytes
Missed Reaction Count	Integer	4 bytes
Percent of Missed Reactions	Float	8 bytes
Mistake Count	Integer	4 bytes
Percent of Mistakes	Float	8 bytes

Recognition Reaction Time:

Trial Count	Integer	4 bytes
Mean Recognition Reaction Time (ms)	Float	8 bytes
False Reaction Count	Integer	4 bytes
Percent of False Reactions	Float	8 bytes
Missed Reaction Count	Integer	4 bytes
Percent of Missed Reactions	Float	8 bytes
Wrong Recognition Count	Integer	4 bytes
Percent of Wrong Recognitions	Float	8 bytes
Mistake Count	Integer	4 bytes
Percent of Mistakes	Float	8 bytes

Choice Reaction Time:

Trial Count	Integer	4 bytes
Mean Choice Reaction Time (ms)	Float	8 bytes
False Reaction Count	Integer	4 bytes
Percent of False Reactions	Float	8 bytes
Missed Reaction Count	Integer	4 bytes
Percent of Missed Reactions	Float	8 bytes
Wrong Choice Count	Integer	4 bytes
Percent of Wrong Choices	Float	8 bytes
Mistake Count	Integer	4 bytes
Percent of Mistakes	Float	8 bytes

Selective Attention:

Trial Count	Integer	4 bytes
Mean Selective Reaction Time (ms)	Float	8 bytes
False Reaction Count	Integer	4 bytes
Percent of False Reactions	Float	8 bytes
Missed Reaction Count	Integer	4 bytes
Percent of Missed Reactions	Float	8 bytes

Wrong Choice Count	Integer	4 bytes
Percent of Wrong Choices	Float	8 bytes
Mistake Count	Integer	4 bytes
Percent of Mistakes	Float	8 bytes

Sustained Attention:

Trial Count	Integer	4 bytes
Sustained Duration (sec)	Integer	4 bytes
Mean Selective Reaction Time (ms)	Float	8 bytes
False Reaction Count	Integer	4 bytes
Percent of False Reactions	Float	8 bytes
Missed Reaction Count	Integer	4 bytes
Percent of Missed Reactions	Float	8 bytes
Wrong Choice Count	Integer	4 bytes
Percent of Wrong Choices	Float	8 bytes
Mistake Count	Integer	4 bytes
Percent of Mistakes	Float	8 bytes

Attention Capacity:

Trial Count	Integer	4 bytes
Attention Capacity	Integer	4 bytes
Mean Selective Reaction Time (ms)	Float	8 bytes
False Reaction Count	Integer	4 bytes
Percent of False Reactions	Float	8 bytes
Missed Reaction Count	Integer	4 bytes
Percent of Missed Reactions	Float	8 bytes
Wrong Choice Count	Integer	4 bytes
Percent of Wrong Choices	Float	8 bytes
Mistake Count	Integer	4 bytes
Percent of Mistakes	Float	8 bytes

Divided Attention:

Trial Count	Integer	4 bytes
Mean Simple Reaction Time (ms)	Float	8 bytes
Mean Recognition Reaction Time (ms)	Float	8 bytes
False Reaction Count	Integer	4 bytes
Percent of False Reactions	Float	8 bytes
Missed Reaction Count	Integer	4 bytes
Percent of Missed Reactions	Float	8 bytes
Wrong Choice Count	Integer	4 bytes
Percent of Wrong Choices	Float	8 bytes
Mistake Count	Integer	4 bytes
Percent of Mistakes	Float	8 bytes

2. Functional Description of Neurocognitive Tests

In this section full details on performing neurocognitive testing are presented including input data, functional logic, computation and output data.

2.1. Simple Reaction Time

2.1.1. Cognitive Domain

This test evaluates:

- Attention
- Visuo-motor response timing

2.1.2. Test Description

This test evaluates the ability to produce simple motor reaction to non-specific visual stimuli. It quantitatively evaluates the time of such reaction. The program repetitively generates visual stimuli (any objects – simple like a color circle or complex like images) at any random moments within certain time range (5 – 15 sec).

Each stimulus is visible for only a short period of time (no longer than 1 sec). The subject must hit the target on touch-screen or any button on the keyboard as fast as possible upon getting the stimulus.

The program gets two time stamps: (a) at the moment of producing a stimulus and (b) at the moment of responding. The program measures time stamps with 1 ms time resolution. It calculates the time difference between these two stamps. This difference is **Reaction Time**.

The program checks if the subject responds too early: (a) before the stimulus occurs or (b) earlier than known fastest possible reaction. This is called **False Reaction**.

If the subject does not respond by the end of trial, it is called **Missed Reaction**.

The program does not measure reaction time in case of False Reaction and Missed Reaction.

2.1.3. Test Logic Flowchart

The key test logic flowchart is illustrated on Fig. 3.

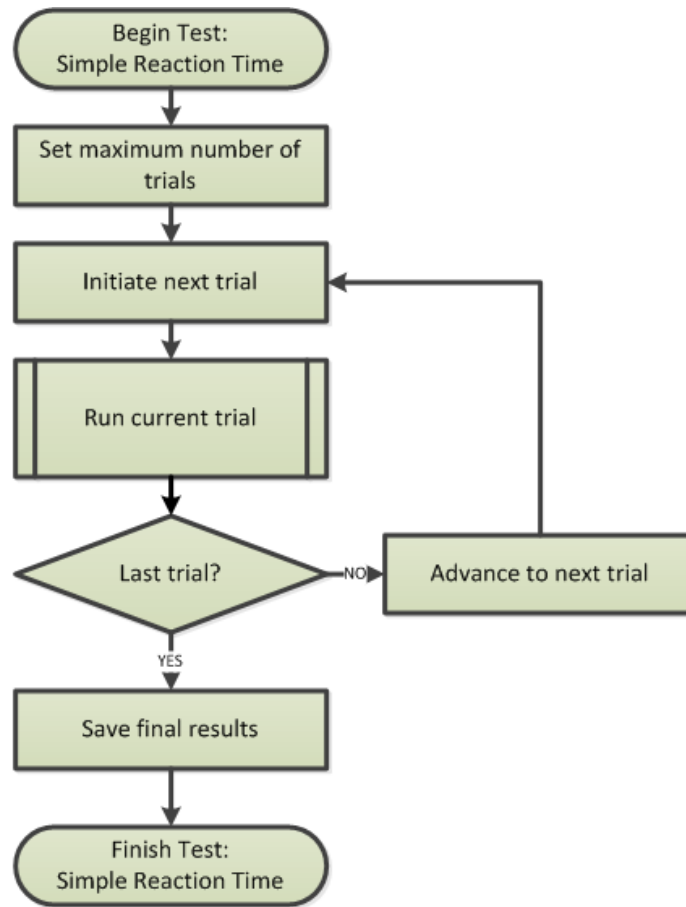


FIG. 3

The test trial logic is illustrated on Fig. 4.

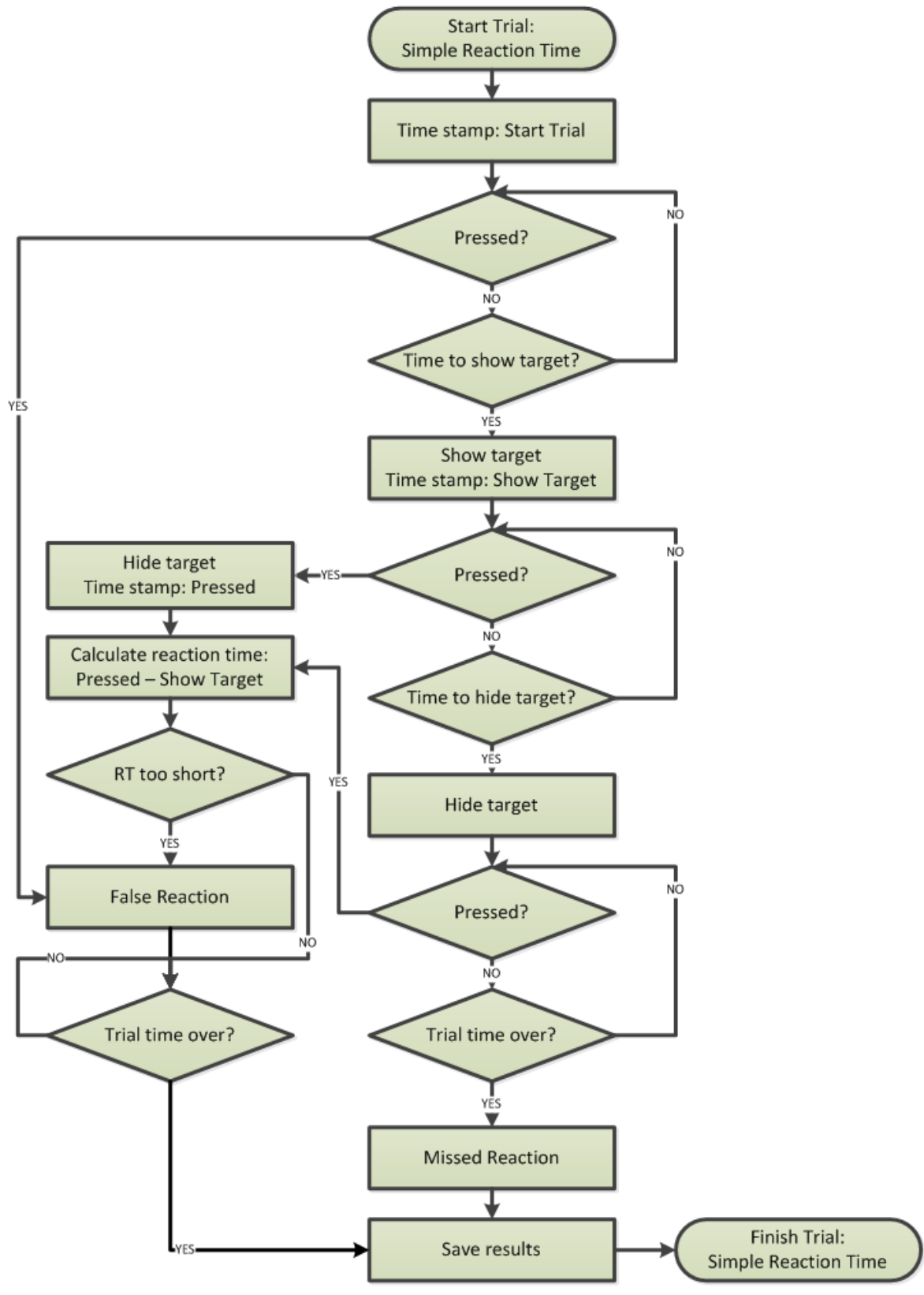


FIG. 4

2.1.4. Input Parameters

The following parameters are used to perform this test:

Parameter	Description	Default Value
Number Of Trials	Total number of test repetitions	20
Minimum Trial Time	The shortest time interval between trials	3000
Maximum Trial Time	The longest time interval between trials	5000
Target Exposure Time	The time when target is visible	500
Threshold Reaction Time	The shortest reaction time considered normal	150

These parameters are set and stored in program configuration and can be modified by the system administrator on the server. Each client application reads this configuration before each testing session.

All times are measured in milliseconds.

2.1.5. Recorded Data

The following data is recorded and sent to the server for analysis:

Test Settings	Current values of test settings described in 3.1.4.
Reaction Time (RT)	Array of reaction times in ms: -1 means false reaction -999 means missed reaction

2.1.6. Test Results and Calculations

The following parameters are calculated by the server when test data is submitted for analysis:

Trial Count (TC)	Total number of trials in the test.
Mean Reaction Time (MRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions and missed reactions are excluded.

False Reaction Count (FRC)	Total number of false reactions stored in the array of reaction times.
Percent of False Reactions (%FR)	Percentage value of false reactions to the total number of trials: %FR = FRC / TC * 100
Missed Reaction Count (MRC)	Total number of missed reactions stored in the array of reaction times.
Percent of Missed Reactions (%MR)	Percentage value of missed reactions to the total number of trials: %MR = MRC / TC * 100
Mistake Count (MC)	Total number of erroneous reactions is calculated as a sum of false reaction count and missed reaction count MC = FRC + MRC
Percent of Mistakes (%M)	Percentage value of erroneous reactions to the total number of trials: %M = %FR + %MR

The testing procedure is repeated a preset number of times (e.g. 20 times). During this process it measures all Reaction Times and calculates an Average Reaction Time as main test output parameter. It also counts the total number of False Reactions and Missed Reactions and presents them as % ratio to the total number of tests.

2.2. Recognition Reaction Time

2.2.1. Cognitive Domain

This test evaluates:

- **Response inhibition**
- Processing speed
- Motor speed

2.2.2. Test Description

This test evaluates the ability to recognize specific types of visual stimuli and produce simple motor reaction to specific recognized visual stimuli and inhibit such reaction in response to alternative stimuli. It quantitatively evaluates the time of such reaction.

The program repetitively and randomly generates visual stimuli of two alternative types (any objects – simple like color circles and squares or complex like different images) at any random moments within certain time range (5 – 15 sec).

Each stimulus is visible for only a short period of time (no longer than 1 sec). The subject must hit the target on touch-screen or any button on the keyboard as fast as possible upon getting stimuli of one type and ignore stimuli of the alternative type.

The program gets two time stamps: (a) at the moment of producing a stimulus and (b) at the moment of responding. The program measures time stamps with 1 ms time resolution. It calculates the time difference between these two stamps. This difference is **Reaction Time**.

The program checks if the subject responds too early: (a) before the stimulus occurs or (b) earlier than known fastest possible reaction. This is called **False Reaction**.

If the subject does not respond by the end of trial, it is called **Missed Reaction**.

The program checks if the subject makes wrong response: (a) hits the target that must be ignored or (b) ignores the target that must be hit. This is called **Wrong Recognition**.

The program does not measure reaction time in case of False Reaction and Missed Reaction. It also records if recognition was right or wrong.

2.2.3. Test Logic Flowchart

The key test logic flowchart is illustrated on Fig. 5.

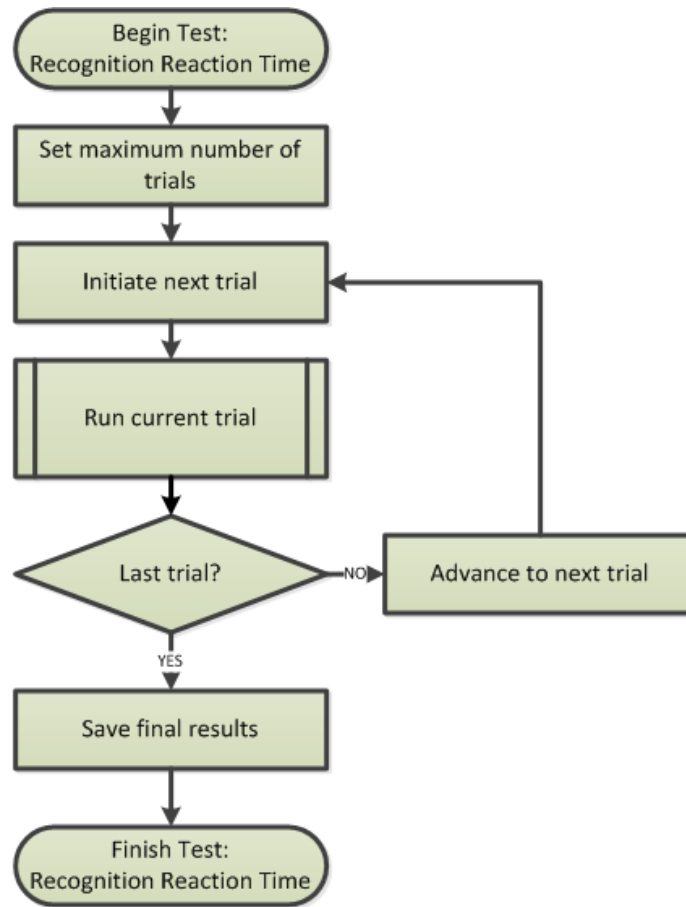


FIG. 5

The test trial logic is illustrated on Fig. 6.

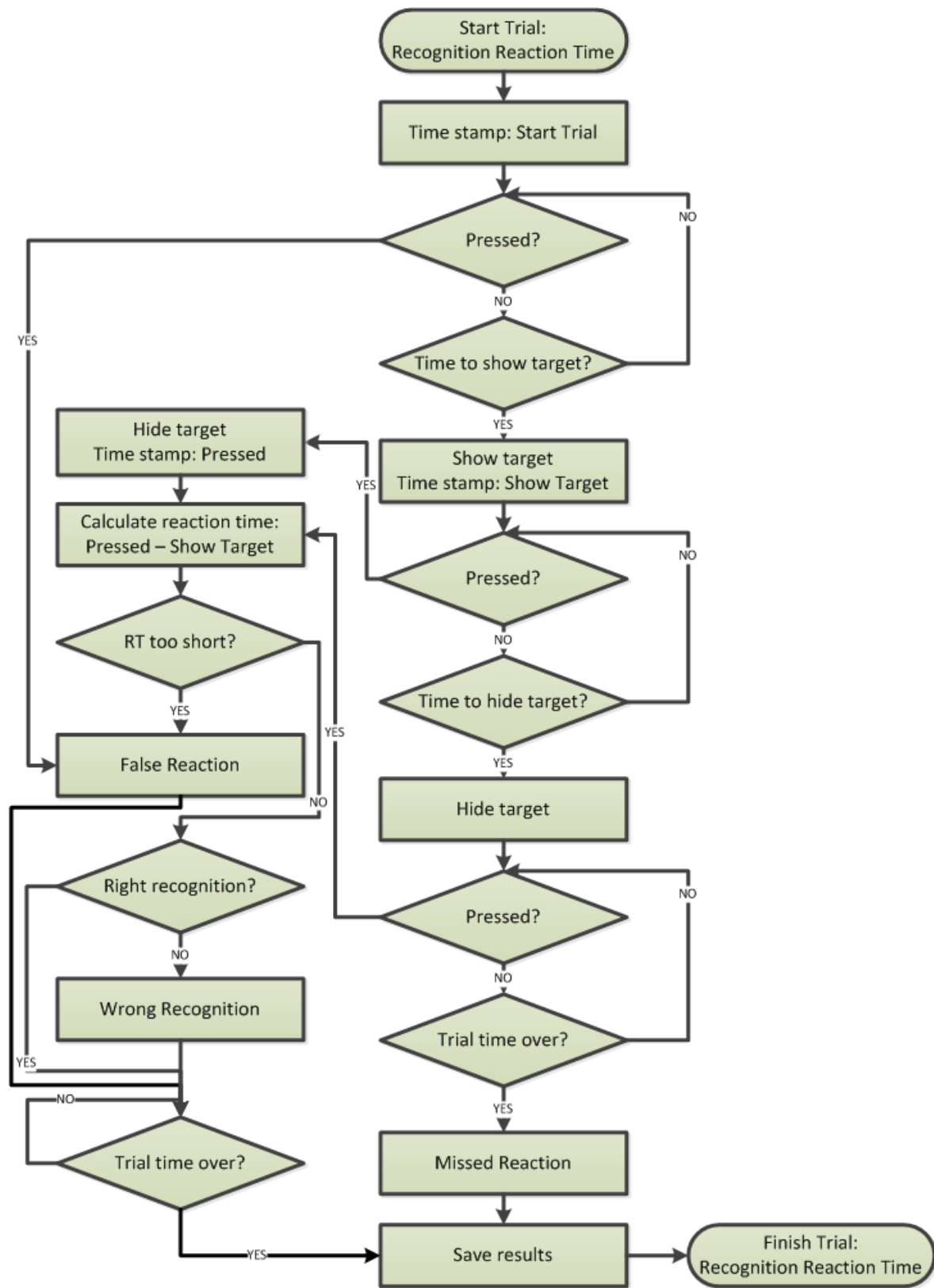


FIG. 6

2.2.4. Input Parameters

The following parameters are used to perform this test:

Parameter	Description	Default Value
Number Of Trials	Total number of test repetitions	200
Minimum Trial Time	The shortest time interval between trials	3000
Maximum Trial Time	The longest time interval between trials	5000
Target Exposure Time	The time when target is visible	500
Threshold Reaction Time	The shortest reaction time considered normal	180

These parameters are set and stored in program configuration and can be modified by the system administrator on the server. Each client application reads this configuration before each testing session.

All times are measured in milliseconds.

2.2.5. Recorded Data

The following data is recorded and sent to the server for analysis:

Test Settings	Current values of test settings described in 3.2.4.
Reaction Time (RT)	Array of reaction times in ms: -1 means false reaction -999 means missed reaction
Recognition	Array of Boolean values (TRUE or FALSE) representing right or wrong recognition of respective trials

2.2.6. Test Results and Calculations

The following parameters are calculated by the server when test data is submitted for analysis:

Trial Count (TC)	Total number of trials in the test.
-------------------------	-------------------------------------

Mean Recognition Reaction Time (MRRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions, missed reactions and wrong recognitions are excluded.
False Reaction Count (FRC)	Total number of false reactions stored in the array of reaction times.
Percent of False Reactions (%FR)	Percentage value of false reactions to the total number of trials: %FR = FRC / TC * 100
Missed Reaction Count (MRC)	Total number of missed reactions stored in the array of reaction times.
Percent of Missed Reactions (%MR)	Percentage value of missed reactions to the total number of trials: %MR = MRC / TC * 100
Wrong Recognition Count (WRC)	Total number of trials having wrong recognition mistakes.
Percent of Wrong Recognitions (%WR)	Percentage value of wrong recognitions to the total number of trials: %WR = WRC / TC * 100
Mistake Count (MC)	Total number of erroneous reactions is calculated as a sum of false reaction count, missed reaction count and wrong recognition count EC = FRC + MRC + WRC
Percent of Mistakes (%M)	Percentage value of erroneous reactions to the total number of trials: %M = %FR + %MR + %WR

2.3. Choice Reaction Time

2.3.1. Cognitive Domain

This test evaluates:

- **Alternating attention**
- Processing speed

- Motor speed

2.3.2. Test Description

This test evaluates the ability to recognize specific types of visual stimuli and produce different motor reaction to specific recognized visual stimuli. It quantitatively evaluates the time of such reaction.

The program repetitively and randomly generates visual stimuli of two alternative types (any objects – simple like color circles or squares or complex like different images) at any random moments within certain time range (5 – 15 sec).

Each stimulus is visible for only a short period of time (no longer than 1 sec). The subject must respond differently to appearance of targets of different types: hit the target on touch-screen with a single or double tap or press one of two dedicated buttons on the keyboard as fast as possible upon getting stimuli of the alternative types.

The program gets two time stamps: (a) at the moment of producing a stimulus and (b) at the moment of responding. The program measures time stamps with 1 ms time resolution. It calculates the time difference between these two stamps. This difference is **Reaction Time**.

The program checks if the subject responds too early: (a) before the stimulus occurs or (b) earlier than known fastest possible reaction. This is called **False Reaction**.

If the subject does not respond by the end of trial, it is called **Missed Reaction**.

The program checks if the subject makes wrong response - hits the target with wrong button (or touch type). This is called **Wrong Choice**.

The program does not measure reaction time in case of False Reaction and Missed Reaction. It also records if choice was right or wrong.

2.3.3. Test Logic Flowchart

The key test logic flowchart is illustrated on Fig. 7.

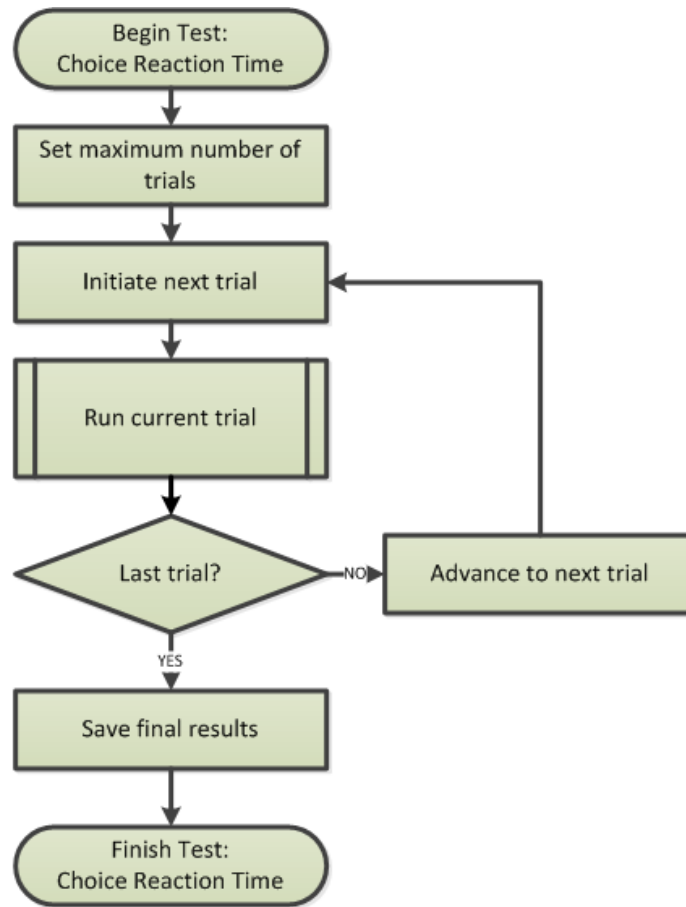


FIG. 7

The test trial logic is illustrated on Fig. 8.

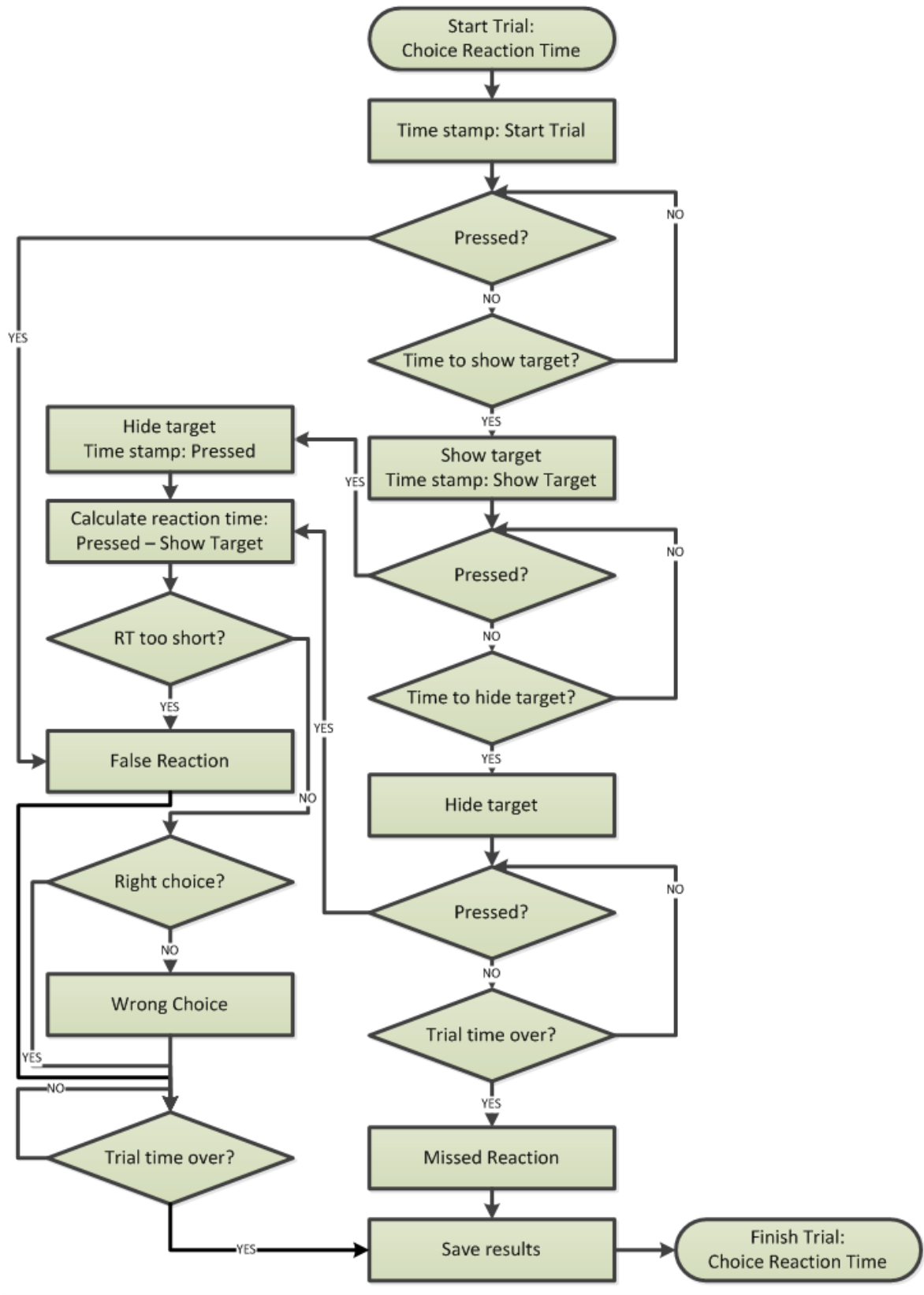


FIG. 8

2.3.4. Input Parameters

The following parameters are used to perform this test:

Parameter	Description	Default Value
Number Of Trials	Total number of test repetitions	20
Minimum Trial Time	The shortest time interval between trials	3000
Maximum Trial Time	The longest time interval between trials	5000
Target Exposure Time	The time when target is visible	500
Threshold Reaction Time	The shortest reaction time considered normal	200

These parameters are set and stored in program configuration and can be modified by the system administrator on the server. Each client application reads this configuration before each testing session.

All times are measured in milliseconds.

2.3.5. Recorded Data

The following data is recorded and sent to the server for analysis:

Test Settings	Current values of test settings described in 3.3.4.
Reaction Time (RT)	Array of reaction times in ms: -1 means false reaction -999 means missed reaction
Choice	Array of Boolean values (TRUE or FALSE) representing right or wrong choice of respective trials

2.3.6. Test Results and Calculations

The following parameters are calculated by the server when test data is submitted for analysis:

Trial Count (TC)	Total number of trials in the test.
-------------------------	-------------------------------------

Mean Choice Reaction Time (MCRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions, missed reactions and wrong choices are excluded.
False Reaction Count (FRC)	Total number of false reactions stored in the array of reaction times.
Percent of False Reactions (%FR)	Percentage value of false reactions to the total number of trials: %FR = FRC / TC * 100
Missed Reaction Count (MRC)	Total number of missed reactions stored in the array of reaction times.
Percent of Missed Reactions (%MR)	Percentage value of missed reactions to the total number of trials: %MR = MRC / TC * 100
Wrong Choice Count (WCC)	Total number of trials having wrong choice mistakes.
Percent of Wrong Choices (%WC)	Percentage value of wrong choices to the total number of trials: %WR = WRC / TC * 100
Mistake Count (MC)	Total number of erroneous reactions is calculated as a sum of false reaction count, missed reaction count and wrong choice count EC = FRC + MRC + WCC
Percent of Mistakes (%M)	Percentage value of erroneous reactions to the total number of trials: %M = %FR + %MR + %WC

2.4. Selective Attention

2.4.1. Cognitive Domain

This test evaluates:

- **Selective attention**
- **Concentration**
- Processing speed

- Motor speed

2.4.2. Test Description

This test evaluates the ability to recognize selected types of visual stimuli and produce different motor reactions to recognized visual stimuli while ignoring distractions.

It quantitatively evaluates the time of motor reactions.

The program repetitively and randomly generates groups of visual stimuli of different kinds (e.g. 9 different geometric figures where any but one figure can be duplicated) placed in the 3 by 3 grid at a preset time interval (e.g. 5 sec). One of those objects is the target. Targets cannot be duplicated within one matrix.

Target type is randomly selected and presented to the subject in every trial.

Stimuli are visible for only a short period of time (no longer than 1 sec).

The subject must respond with selective action which recognizes the target.

When touch-screen is used, the subject must tap the target on the screen.

Otherwise predetermined key must be pressed on the keyboard.

The program gets two time stamps: (a) at the moment of producing a stimulus and (b) at the moment of responding. The program measures time stamps with 1 ms time resolution. It calculates the time difference between these two stamps. This difference is **Reaction Time**.

The program checks if the subject responds too early: (a) before the stimulus occurs or (b) earlier than known fastest possible reaction. This is called **False Reaction**.

If the subject does not respond by the end of trial, it is called **Missed Reaction**.

The program checks if the subject makes wrong response - hits the target with wrong button (or touch spot). This is called **Wrong Choice**.

The program does not measure reaction time in case of False Reaction and Missed Reaction. It also records if choice was right or wrong.

2.4.3. Test Logic Flowchart

The key test logic flowchart is illustrated on Fig. 9.

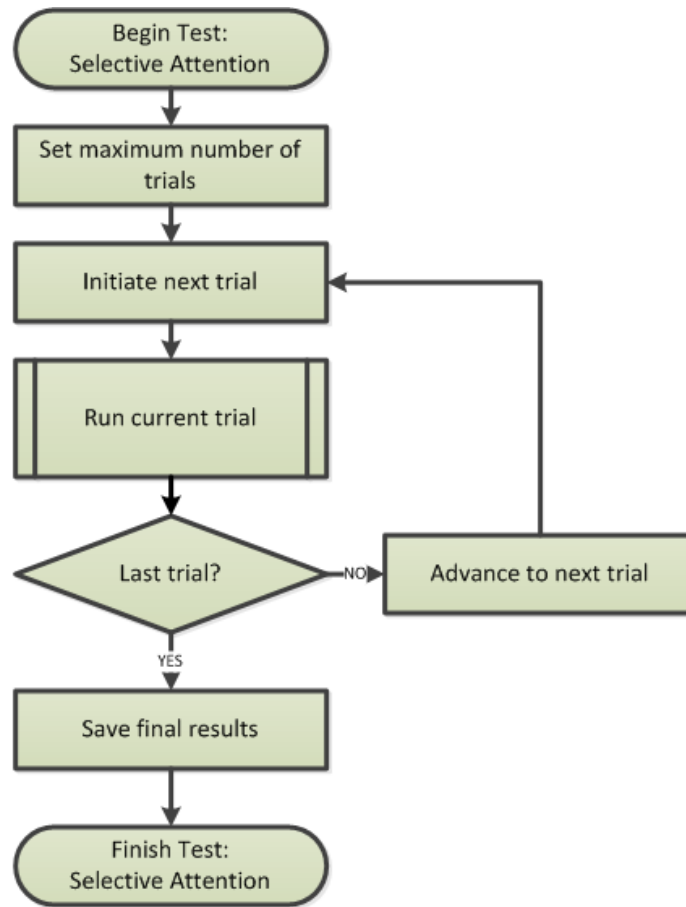


FIG. 9

The test trial logic is illustrated on Fig. 10.

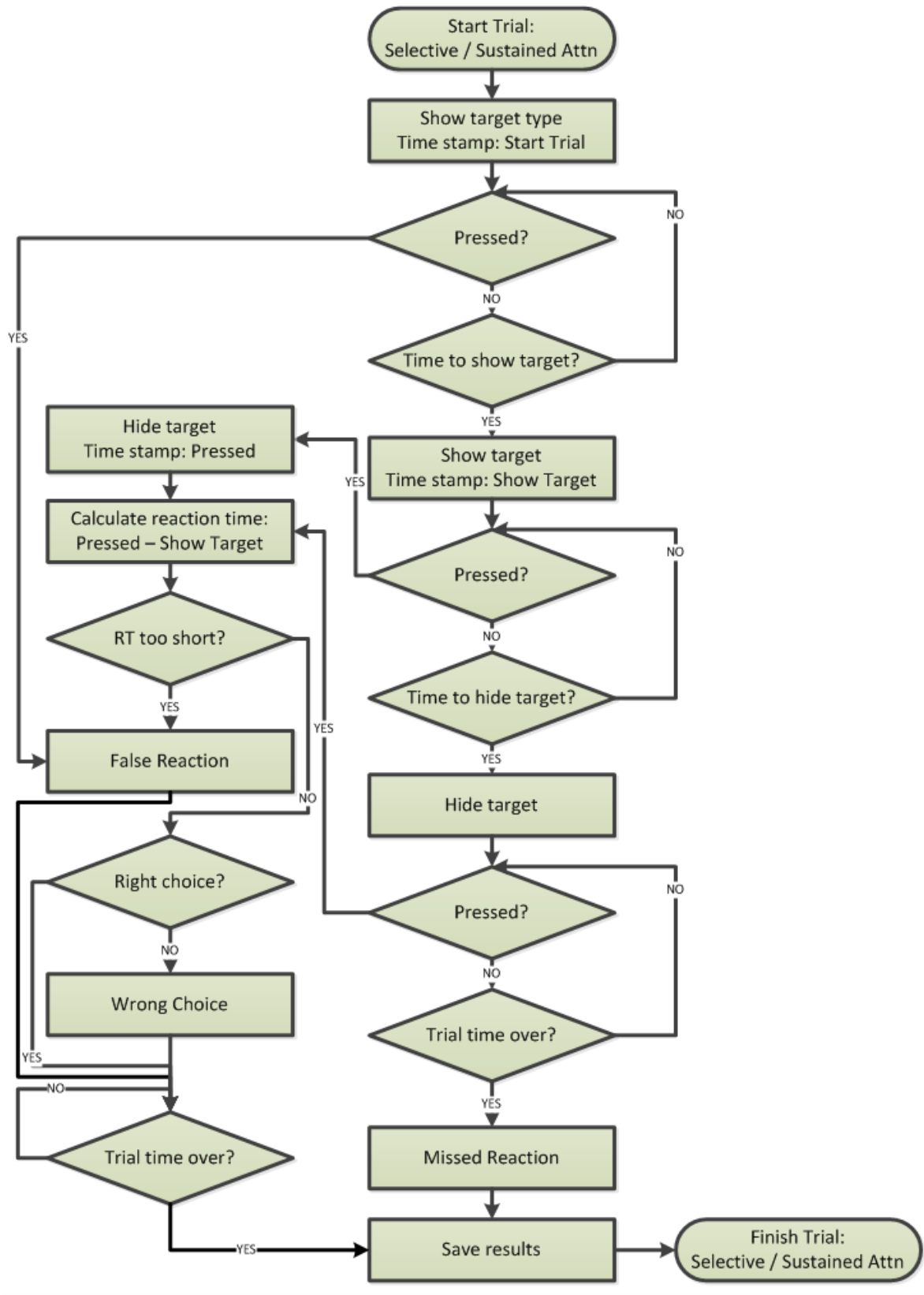


FIG. 10

2.4.4. Input Parameters

The following parameters are used to perform this test:

Parameter	Description	Default Value
Number Of Trials	Total number of test repetitions	20
Trial Time	Time interval between trials	5000
Target Exposure Time	The time when target is visible	500
Threshold Reaction Time	The shortest reaction time considered normal	200

These parameters are set and stored in program configuration and can be modified by the system administrator on the server. Each client application reads this configuration before each testing session.

All times are measured in milliseconds.

2.4.5. Recorded Data

The following data is recorded and sent to the server for analysis:

Test Settings	Current values of test settings described in 3.4.4.
Reaction Time (RT)	Array of reaction times in ms: -1 means false reaction -999 means missed reaction
Choice	Array of Boolean values (TRUE or FALSE) representing right or wrong choice of respective trials

2.4.6. Test Results and Calculations

The following parameters are calculated by the server when test data is submitted for analysis:

Trial Count (TC)	Total number of trials completed in the test.
-------------------------	---

Mean Selective Reaction Time (MSRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions, missed reactions and wrong choices are excluded.
False Reaction Count (FRC)	Total number of false reactions stored in the array of reaction times.
Percent of False Reactions (%FR)	Percentage value of false reactions to the total number of trials: %FR = FRC / TC * 100
Missed Reaction Count (MRC)	Total number of missed reactions stored in the array of reaction times.
Percent of Missed Reactions (%MR)	Percentage value of missed reactions to the total number of trials: %MR = MRC / TC * 100
Wrong Choice Count (WCC)	Total number of trials having wrong choice mistakes.
Percent of Wrong Choices (%WC)	Percentage value of wrong choices to the total number of trials: %WR = WRC / TC * 100
Mistake Count (MC)	Total number of erroneous reactions is calculated as a sum of false reaction count, missed reaction count and wrong choice count EC = FRC + MRC + WCC
Percent of Mistakes (%M)	Percentage value of erroneous reactions to the total number of trials: %M = %FR + %MR + %WC

2.5. Sustained Attention

2.5.1. Cognitive Domain

This test evaluates:

- **Sustained attention**
- **Concentration**
- Processing speed

- Motor speed

2.5.2. Test Description

This test evaluates the ability to:

- 3) Recognize selected types of visual stimuli and produce different motor reactions to recognized visual stimuli while ignoring distractions;
- 4) Maintain attention over an extended period of time until response becomes too slow and/or making too many mistakes.

It quantitatively evaluates the time of motor reactions.

The program repetitively and randomly generates groups of visual stimuli of different kinds (e.g. 9 different geometric figures where any but one figure can be duplicated) placed in the 3 by 3 grid at a preset time interval (e.g. 5 sec). One of those objects is the target. Targets cannot be duplicated within one matrix.

Target type is randomly selected and presented to the subject in every trial. Stimuli are visible for only a short period of time (no longer than 1 sec). The subject must respond with selective action which recognizes the target. When touch-screen is used, the subject must tap the target on the screen. Otherwise predetermined key must be pressed on the keyboard.

The program gets two time stamps: (a) at the moment of producing a stimulus and (b) at the moment of responding. The program measures time stamps with 1 ms time resolution. It calculates the time difference between these two stamps. This difference is **Reaction Time**.

The program checks if the subject responds too early: (a) before the stimulus occurs or (b) earlier than known fastest possible reaction. This is called **False Reaction**.

If the subject does not respond by the end of trial, it is called **Missed Reaction**.

The program checks if the subject makes wrong response - hits the target with wrong button (or touch spot). This is called **Wrong Choice**.

The program does not measure reaction time in case of False Reaction and Missed Reaction. It also records if choice was right or wrong.

2.5.3. Test Logic Flowchart

The key test logic flowchart is illustrated on Fig. 11.

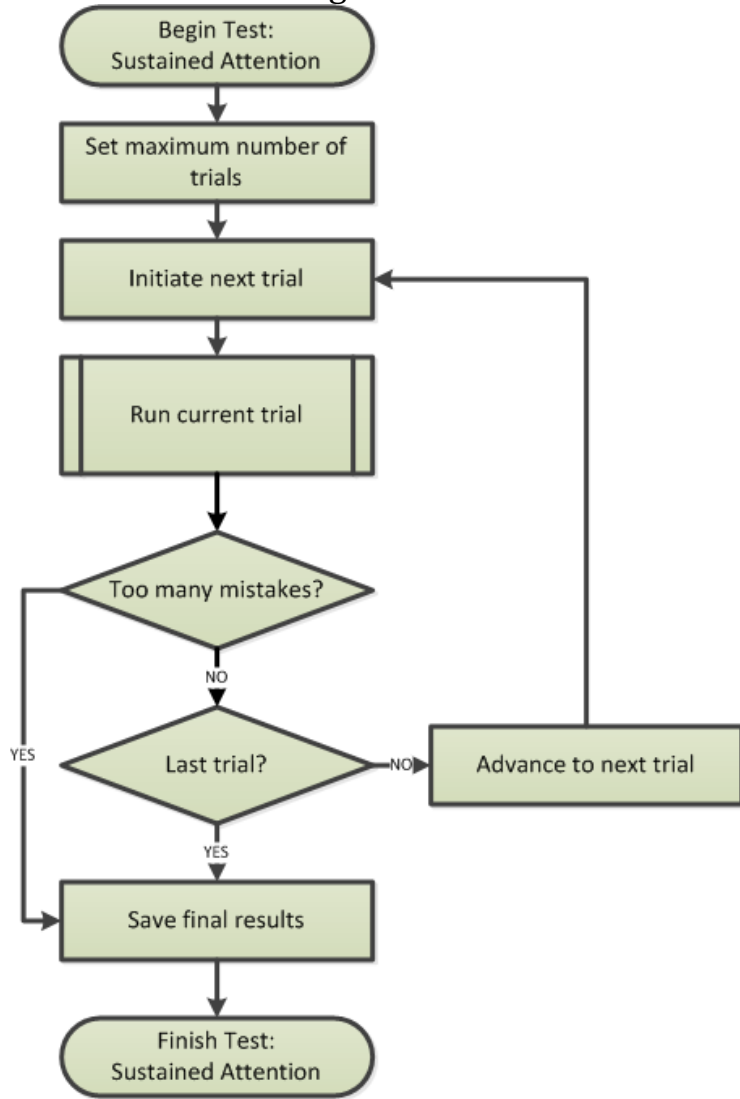


FIG. 11

The test trial logic is illustrated on Fig. 12.

2.5.4. Input Parameters

The following parameters are used to perform this test:

Parameter	Description	Default Value
Number Of Trials	Total number of test repetitions	20
Trial Time	Time interval between trials	15000
Target Exposure Time	The time when target is visible	10000
Threshold Reaction Time	The shortest reaction time considered normal	5000
Critical Level Of Mistakes	Percentage of mistakes made causing test to stop	30

These parameters are set and stored in program configuration and can be modified by the system administrator on the server. Each client application reads this configuration before each testing session.

All times are measured in milliseconds.

2.5.5. Recorded Data

The following data is recorded and sent to the server for analysis:

Test Settings	Current values of test settings described in 3.4.4.
Reaction Time (RT)	Array of reaction times in ms: -1 means false reaction -999 means missed reaction
Choice	Array of Boolean values (TRUE or FALSE) representing right or wrong choice of respective trials

2.5.6. Test Results and Calculations

The following parameters are calculated by the server when test data is submitted for analysis:

Trial Count (TC)	Total number of trials completed in the test.
Sustained Duration	Total duration of test the subject sustained performing.

Mean Selective Reaction Time (MSRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions, missed reactions and wrong choices are excluded.
False Reaction Count (FRC)	Total number of false reactions stored in the array of reaction times.
Percent of False Reactions (%FR)	Percentage value of false reactions to the total number of trials: %FR = FRC / TC * 100
Missed Reaction Count (MRC)	Total number of missed reactions stored in the array of reaction times.
Percent of Missed Reactions (%MR)	Percentage value of missed reactions to the total number of trials: %MR = MRC / TC * 100
Wrong Choice Count (WCC)	Total number of trials having wrong choice mistakes.
Percent of Wrong Choices (%WC)	Percentage value of wrong choices to the total number of trials: %WR = WRC / TC * 100
Mistake Count (MC)	Total number of erroneous reactions is calculated as a sum of false reaction count, missed reaction count and wrong choice count EC = FRC + MRC + WCC
Percent of Mistakes (%M)	Percentage value of erroneous reactions to the total number of trials: %M = %FR + %MR + %WC

2.6. Attention Capacity

2.6.1. Cognitive Domain

This test evaluates:

- Spatial processing
- Visuo-spatial working memory

2.6.2. Test Description

This test evaluates the ability to keep multiple objects in working memory. It quantitatively evaluates the maximum number of objects effectively kept in working memory.

The program repetitively generates one or more visual stimuli – targets (e.g. geometric figures or images) randomly placed in any cells of the 3 by 4 grid at a preset time interval (e.g. 5 sec). The number of targets may not be more than 5 at a time.

Stimuli are visible for only a short period of time (no longer than 1 sec).

Once the targets disappear, the subject must tap the places on the grid in case of using touch-screen display or hit specific buttons on the keyboard which represent the cells of the grid where the subject remembers the objects were (e.g. F keys ranging from 'F1' to 'F12').

The subject must respond as fast as possible to complete the trial within a preset time interval.

The program gets two time stamps: (a) at the moment when targets disappear and (b) at the moment of when last response occurred. The program measures time stamps with 1 ms time resolution. It calculates the time difference between these two stamps. This difference is **Reaction Time**.

The program checks if the subject responds too early: (a) before the stimuli were shown and then disappeared. This is called **False Reaction**.

If the subject does not respond by the end of trial, it is called **Missed Reaction**.

The program checks if the subject makes wrong responses - hits the targets with wrong buttons (or touch spots). This is called **Wrong Choice**.

The program does not measure reaction time in case of False Reaction and Missed Reaction.

It records total number of wrong choices compared to the total number of targets.

2.6.3. Test Logic Flowchart

The key test logic flowchart is illustrated on Fig. 13.

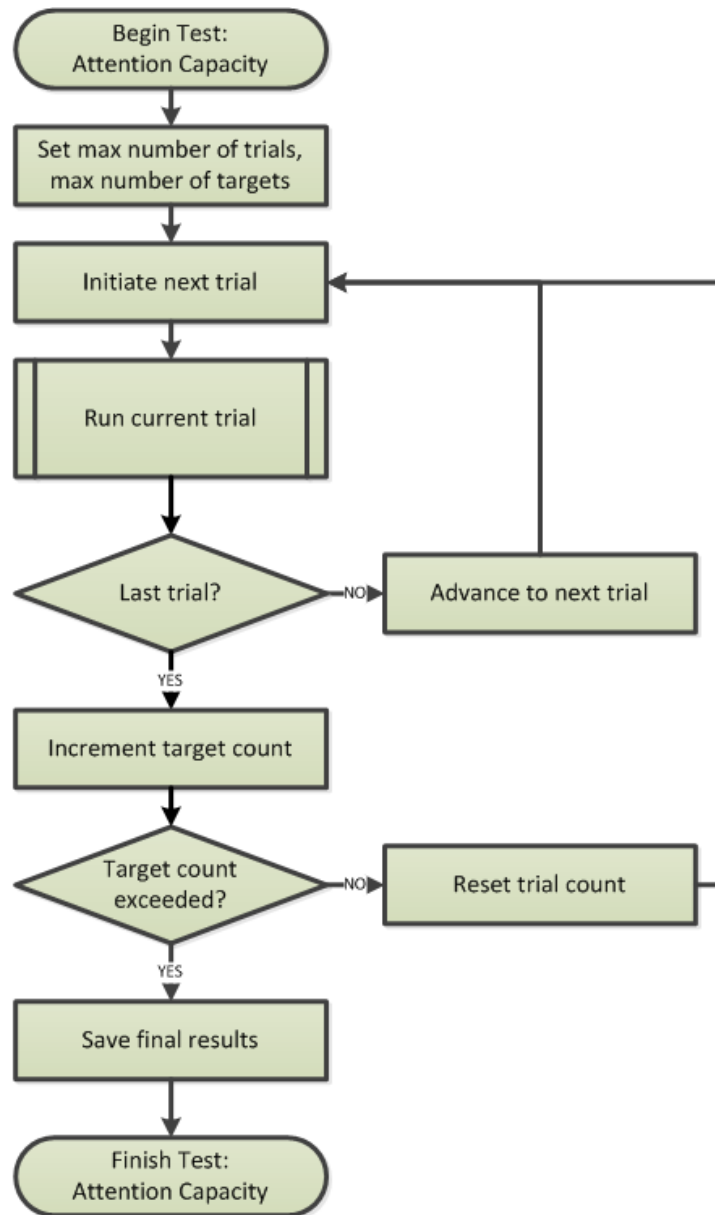


FIG. 13

The test trial logic is illustrated on Fig. 14.

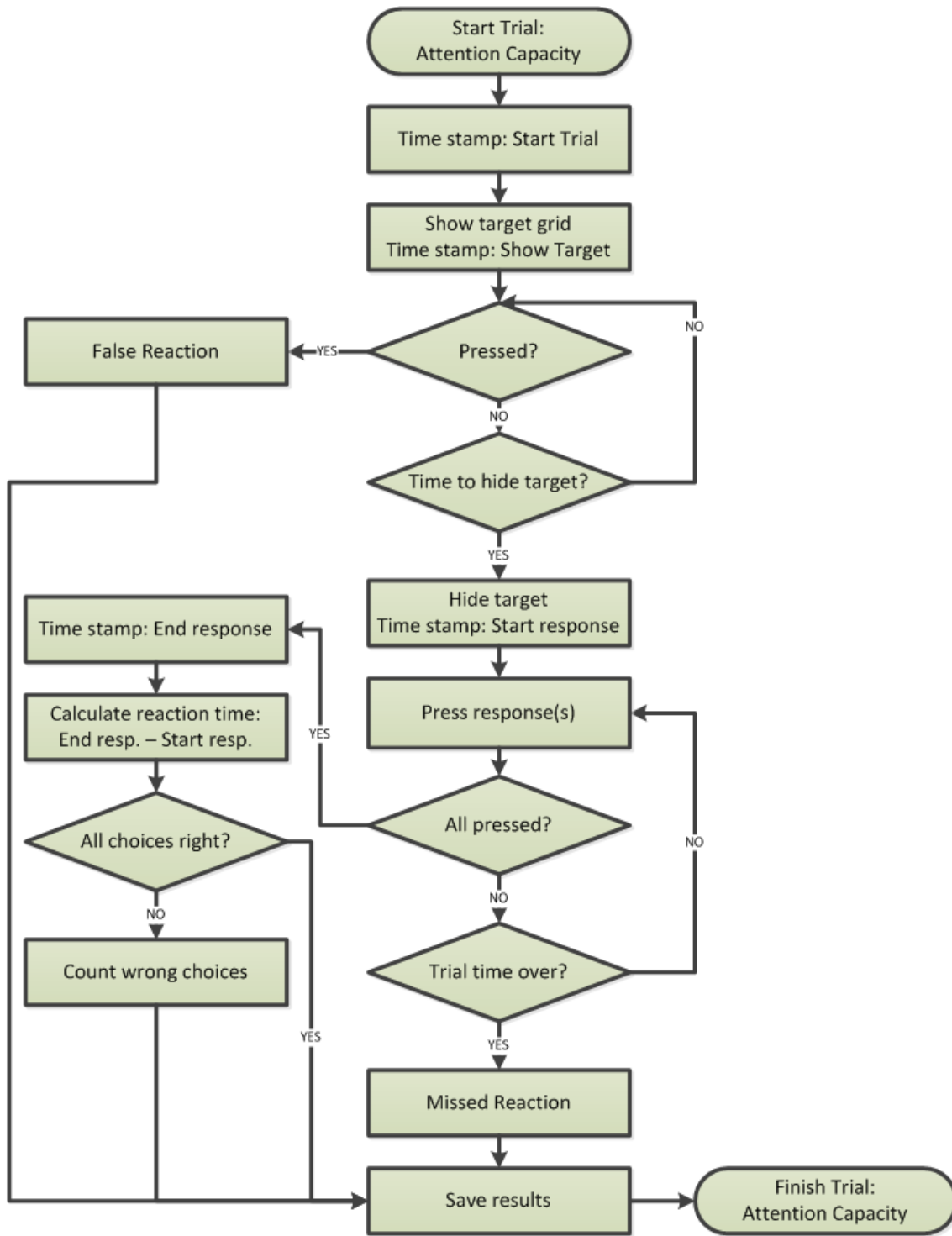


FIG. 14

2.6.4. Input Parameters

The following parameters are used to perform this test:

Parameter	Description	Default Value
Number Of Trials	Total number of test repetitions for each number of targets	20
Trial Time	Time interval between trials	5000
Target Exposure Time	The time when target is visible	2000
Maximum Number Of Targets	The maximum number of targets to evaluate working memory capacity	5

These parameters are set and stored in program configuration and can be modified by the system administrator on the server. Each client application reads this configuration before each testing session.

All times are measured in milliseconds.

The total number of trials in this test is calculated as **Number Of Trials** multiplied by **Maximum Number Of Targets**.

2.6.5. Recorded Data

The following data is recorded and sent to the server for analysis:

Test Settings	Current values of test settings described in 3.5.4.
Number of Targets	Array of numbers of targets in each trial
Reaction Time (RT)	Array of reaction times in ms: -1 means false reaction -999 means missed reaction
Mistakes	Array of the total number of wrong choices made in each trial

2.6.6. Test Results and Calculations

The following parameters are calculated by the server when test data is submitted for analysis:

Trial Count (TC)	Total number of trials completed in the test.
Attention Capacity	Maximum number of objects effectively (avoiding choice mistakes) kept in working memory

Mean Selective Reaction Time (MSRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions and missed reactions are excluded.
False Reaction Count (FRC)	Total number of false reactions stored in the array of reaction times.
Percent of False Reactions (%FR)	Percentage value of false reactions to the total number of trials: %FR = FRC / TC * 100
Missed Reaction Count (MRC)	Total number of missed reactions stored in the array of reaction times.
Percent of Missed Reactions (%MR)	Percentage value of missed reactions to the total number of trials: %MR = MRC / TC * 100
Wrong Choice Count (WCC)	Total number of trials having choice mistakes.
Percent of Wrong Choices (%WC)	Percentage value of wrong choices to the total number of trials: %WR = WRC / TC * 100
Mistake Count (MC)	Total number of erroneous reactions is calculated as a sum of false reaction count, missed reaction count and wrong choice count EC = FRC + MRC + WCC
Percent of Mistakes (%M)	Percentage value of erroneous reactions to the total number of trials: %M = %FR + %MR + %WC

2.7. Divided Attention

2.7.1. Cognitive Domain

This test evaluates:

- Directed attention
- Executive attention

2.7.2. Test Description

This test evaluates the ability to perform at least two tasks simultaneously.

The program concurrently performs two testing processes:

- 3) Simple reaction time test
- 4) Recognition reaction time test (modified)

All trials of recognition reaction time are performed at preset pace (e.g. every 5 sec). Randomly (from every 2nd to every 5th trial) recognition reaction time trials are replaced with single reaction time test trials.

The details on simple reaction time are described in Section 3.1. The details on recognition reaction time are described in Section 3.2.

The subject must react to both types of stimuli using different keys on the keyboard or tapping different spots on touch-screen display.

The program records the results of both tests in one array of data specifying the type of each test trial recorded.

2.7.3. Test Logic Flowchart

The key test logic flowchart is illustrated on Fig. 15.

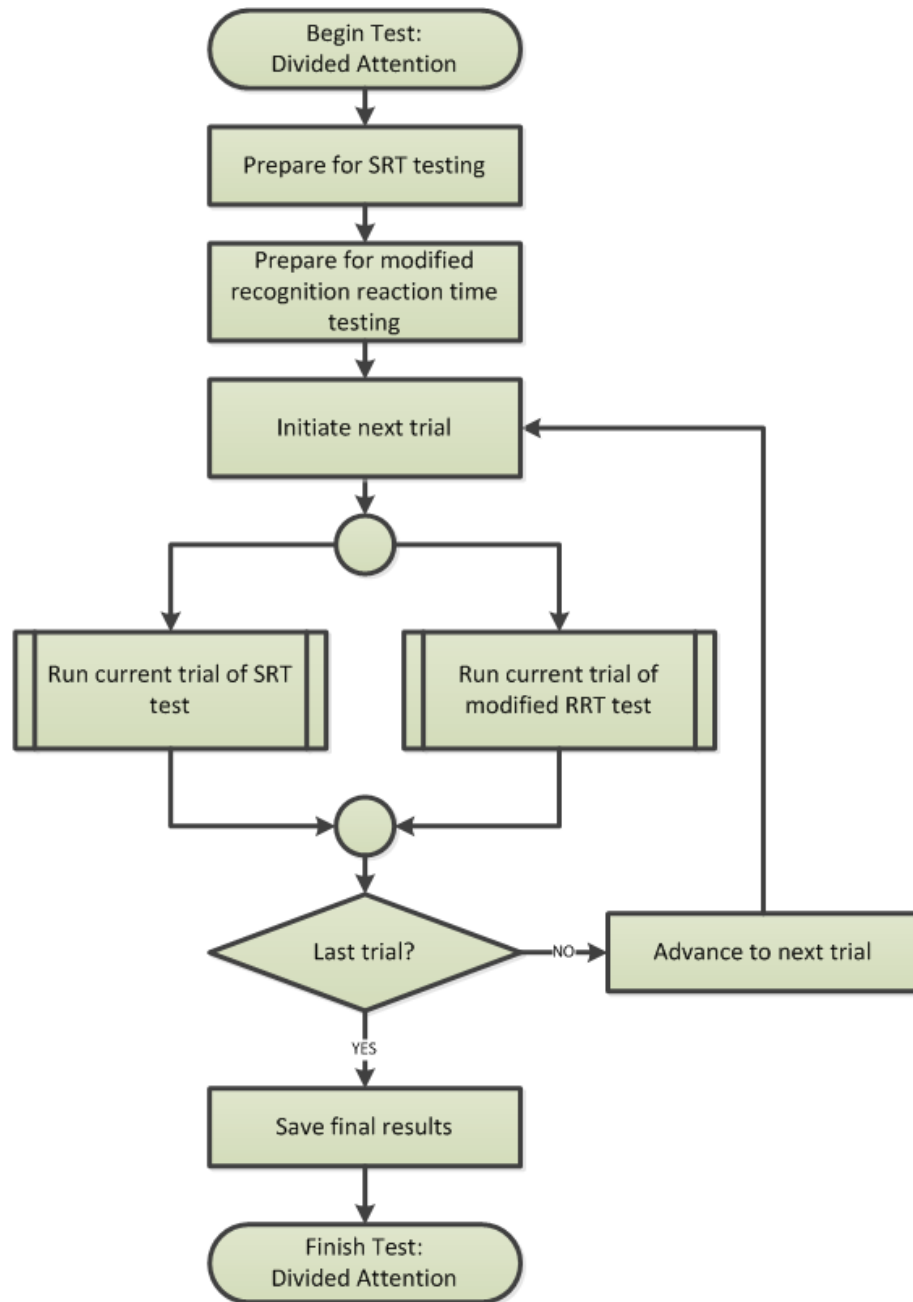


FIG. 15

2.7.4. Input Parameters

The following parameters are used to perform this test:

Parameter	Description	Default Value
Number Of Trials	Total number of test repetitions for each	20

	number of targets	
Trial Time	Time interval between trials	5000
Target Exposure Time	The time when target is visible	500
Threshold Simple Reaction Time	The shortest simple reaction time considered normal	150
Threshold Recognition Reaction Time	The shortest recognition reaction time considered normal	180

These parameters are set and stored in program configuration and can be modified by the system administrator on the server. Each client application reads this configuration before each testing session.

All times are measured in milliseconds.

2.7.5. Recorded Data

The following data is recorded and sent to the server for analysis:

Test Settings	Current values of test settings described in 3.6.4.
Reaction Time (RT)	Array of reaction times in ms: -1 means false reaction -999 means missed reaction
Recognition	Array of Boolean values (TRUE or FALSE) representing right or wrong recognition of respective trials TRUE is always recorded for SRT trials
Test Type	Array of test type values: - Simple Reaction Time - Recognition Reaction Time

2.7.6. Test Results and Calculations

The following parameters are calculated by the server when test data is submitted for analysis:

Trial Count (TC)	Total number of trials completed in the test.
-------------------------	---

Mean Simple Reaction Time (MRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions and missed reactions are excluded.
Mean Recognition Reaction Time (MRRT)	Calculated as an average value of all RT stored in the array of reaction times. False reactions, missed reactions and wrong recognitions are excluded.
False Reaction Count (FRC)	Total number of false reactions of any test type stored in the array of reaction times.
Percent of False Reactions (%FR)	Percentage value of false reactions of any test type to the total number of trials: %FR = FRC / TC * 100
Missed Reaction Count (MRC)	Total number of missed reactions of any test type stored in the array of reaction times.
Percent of Missed Reactions (%MR)	Percentage value of missed reactions of any test type to the total number of trials: %MR = MRC / TC * 100
Wrong Recognition Count (WRC)	Total number of trials of RRT test having wrong recognition mistakes.
Percent of Wrong Recognitions (%WR)	Percentage value of wrong recognitions to the total number of trials: %WR = WRC / TC * 100
Mistake Count (MC)	Total number of erroneous reactions is calculated as a sum of false reaction count, missed reaction count and wrong choice count EC = FRC + MRC + WCC
Percent of Mistakes (%M)	Percentage value of erroneous reactions to the total number of trials: %M = %FR + %MR + %WC

3. Testing Procedure And Game Scenario

The application performs neurocognitive function testing as one non-interrupted procedure which carries out all listed tests running one after another.

The testing procedure is implemented in the form of interactive game where all neurocognitive tests are naturally embedded in the game scenario.

A player acts as a soldier at a training camp practicing to fight terrorists in urban environment with minimal casualties among civilians.

The soldier is armed with an automatic rifle and under-barrel grenade launcher.

Single taps on the screen will cause rifle shots. Double taps will cause launching grenades.

There are 23 levels of the game. They implement the following neurocognitive tests:

Game Levels	Test Type
1 – 5	Simple Reaction Time
6 – 10	Recognition Reaction Time
11 – 15	Choice Reaction Time
16	Selective Attention
17	Sustained Attention
18 – 22	Attention Capacity
23	Divided Attention

All variable settings specified below are set in the program configuration.

The game can be paused at any time and resumed later.

The results of the game will be analyzed when all levels are completed.

3.1. Level 1 through Level 5 - Simple Reaction Time

Background:

A wall of the building with one or more windows is displayed. The total number of windows starts with one at the Level 1 and increments by one at each next level.

Targets:

A figure of terrorist shows up in the window(s) at random time intervals. The figure remains visible only within a preset period of time. If more than one window is in the wall, the figure may randomly appear in any of them.

Objective:

Shoot figures as quickly as possible with a rifle.

Premature shots do not increment the trial count.

The grenade launcher is not armed at this level.

The total number of target appearances at each level is preconfigured.

Scoring:

Reward Points: +10

Premature Reaction Penalty Points: -20

Missed Reaction Penalty Points: -20

3.2. Level 6 through Level 10 – Recognition Reaction Time

Background:

Same as at Levels 1 through 5

Targets:

Two types of figures: terrorists or civilians. Their behavior is identical to Levels 1 - 5. Terrorists or civilians appear randomly.

Objective:

Shoot terrorists with a rifle as fast as possible but preserve civilians.

Premature shots do not increment the trial count.

The grenade launcher is not armed at this level.

The total number of target appearances at each level is preconfigured.

Scoring:

Reward Points: +10

Premature Reaction Penalty Points: -20

Missed Reaction Penalty Points: -20

Wrong Recognition Penalty Points: -50

3.3. Level 11 through Level 15 – Choice Reaction Time

Background:

Same as at Levels 1 through 5

Targets:

Two types of figures: single terrorists or groups of armored terrorists. Their behavior is identical to Levels 1 - 5. Single terrorists or groups appear randomly.

Objective:

Shoot single terrorists with a rifle as fast as possible. Blow the armored groups of terrorists with a grenade launcher.

Shooting at armored groups with a rifle (Wrong Choice “A”) will not hurt them.

Shooting at single terrorists with grenades is considered as inappropriate use of ammo (Wrong Choice “B”).

Premature shots do not increment the trial count.

The total number of target appearances at each level is preconfigured.

Scoring:

Reward Points (Single Terrorist):	+20
Reward Points (Armored Group):	+100
Premature Reaction Penalty Points:	-20
Missed Reaction Penalty Points:	-20
Wrong Choice “A” Penalty Points:	-50
Wrong Choice “B” Penalty Points:	-20

3.4. Level 16 – Selective Attention

Background:

The building has 9 windows forming a 3 x 3 grid.

Targets:

Nine figures show up in all windows at a preset time interval and remain visible for only preset time.

Only one figure out of nine is a terrorist, whose location is randomly selected among all 9 windows.

Objective:

Shoot terrorists with a rifle as fast as possible.

Premature shots do not increment the trial count. The total number of target appearances at each level is preconfigured.

Scoring:

Reward Points:	+20
Premature Reaction Penalty Points:	-20
Missed Reaction Penalty Points:	-20
Wrong Recognition Penalty Points:	-50

3.5. Level 17 – Sustained Attention

Background:

The building has 24 windows forming a 4 x 6 grid.

Targets:

24 shooting targets randomly numbered from 01 to 24 show up in all windows at a preset time interval and remain visible for only preset time.

Objective:

Shoot all targets with a rifle in ascending order. When all targets are hit, full reward is received.

Breaking the order of targets immediately stops the trial and all targets disappear.

Premature shots do not increment the trial count.

Shooting too slow may cause some targets to remain. The task is incomplete.

The total number of trials is set up in program configuration. It is large enough to test sustained attention.

Making too many mistakes may prematurely stop this test.

Scoring:

Full Reward Points: +100

Premature Reaction Penalty Points: -20

Incomplete Task Penalty Points: -20

Wrong Order Recognition Penalty Points: -50

3.6. Level 18 through Level 22 – Attention Capacity

Background:

The building has 12 windows forming a 3 x 4 grid.

Targets:

All windows are closed with blinds. At a preset time intervals all blinds instantly open for a preset period of time to reveal location of terrorist figures in those windows randomly selected. The number of terrorists begins with one at the Level 18 and increases by one at each next level.

Objective:

Shoot all terrorists with a rifle through the blinds tapping the windows where the terrorist are.

Shooting at wrong window is considered a wrong shot.

Premature shots do not increment the trial count.

If the total number of shots is less than the number of terrorists in the trial, the trial is considered as incomplete.

The total number of trials is set up in program configuration.

Scoring:

Reward Points Per Each Target: +20

Premature Reaction Penalty Points: -20

Incomplete Task Penalty Points (Each Remaining -20

Target):
Wrong Shot Penalty Points (Each): -20

3.7. Level 23 – Divided Attention

At this level the player must perform two different tasks concurrently:

Task A: Shoot single terrorists randomly appearing in one of five windows as on Level 5;

Task B: Collect ammo by picking suitable ammo from the stream of different types of ammo periodically appearing on the screen.

Background:

The background image is identical to Level 5. A special ammo pick-up spot is added to the background where ammos will appear.

Targets:

Task A: A figure of terrorist shows up randomly in any of five windows at random time intervals. The figure remains visible only within a preset period of time.

Task B: A piece of one of two types of ammo appears on the ammo pickup spot every preset time interval for a preset time frame. One type is good while the other is not appropriate.

Objective:

Perform two tasks simultaneously: shoot terrorists in the windows when they appear and pickup appropriate ammo every time it appears in the ammo spot. The player is given 10 rounds initially, but more terrorists must be shot.

Therefore it is essential to perform the second task properly.

Premature shots or ammo pickups do not increment the trial count.

The grenade launcher is not armed at this level.

All trials of both types of tasks are combined in one group. The total number of trials is preconfigured.

Scoring:

Reward Points (Task A): +10

Reward Points (Task B): +20

Premature Reaction (Task A and B) Penalty Points: -20

Missed Shot or Pickup Penalty Points: -20

Wrong Pickup Penalty Points (Each): -20

4. Detailed Description of System Functionality and User Interface

4.1. System Administrator Functionality

The following section describes the functionality of a special web application serving as a system administrator control panel.


This application should be run in Internet Explorer.

4.1.1. Starting System Administrator Application

The system administrator's control panel application is web-based, so it runs through a web browser (Internet Explorer).

The application must perform secure transactions using web-services to ensure high level of information security while being transported through the Internet.

The system installation procedure creates a desktop shortcut icon.

User Actions	System Actions
 <ol style="list-style-type: none">1. Double-click this icon to start the system administrator control panel.	<ol style="list-style-type: none">2. Open the following page:

The screenshot shows a dark gray rectangular window titled "Neurocognitive Assessment System Administrator Control Panel". Inside the window, the text "Enter password:" is followed by a password input field containing six dots. To the right of the input field is a "Logon" button. Below the input field and "Logon" button is a "Reset Password" button.

3. Enter system administrator's **Password**.
4. Press **LOGON** button.

5. Check if the password entered matches one stored in the database, or display:

Wrong password!

6. Otherwise open the HOME page:

User Actions	System Actions
Neurocognitive Assessment - System Administrator Control Panel Logout	
	Block / Unblock Clients
	Block / Unblock Professional Users
	Approve New Clients
	Approve New Professional Users
	Manage Testing Configuration
	Change Password

4.1.2. Closing System Administrator's Application

User Actions	System Actions
<ol style="list-style-type: none"> 1. Return to the HOME page. 2. Press LOGOUT link. 	<ol style="list-style-type: none"> 3. Close the application and return to the login page.

4.1.3. Resetting Administrator's Password

The system administrator may change their password to a custom one and later forget it. The system allows for resetting it to the default value hard coded into it. This default password is provided to the system administrator in the documentation, which **MUST** be kept in a restricted secure location.

User Actions	System Actions
--------------	----------------

1. Press **RESET PASSWORD** button on the login page.

2. Get default password stored in the database and set to the system.

3. Show the following message:



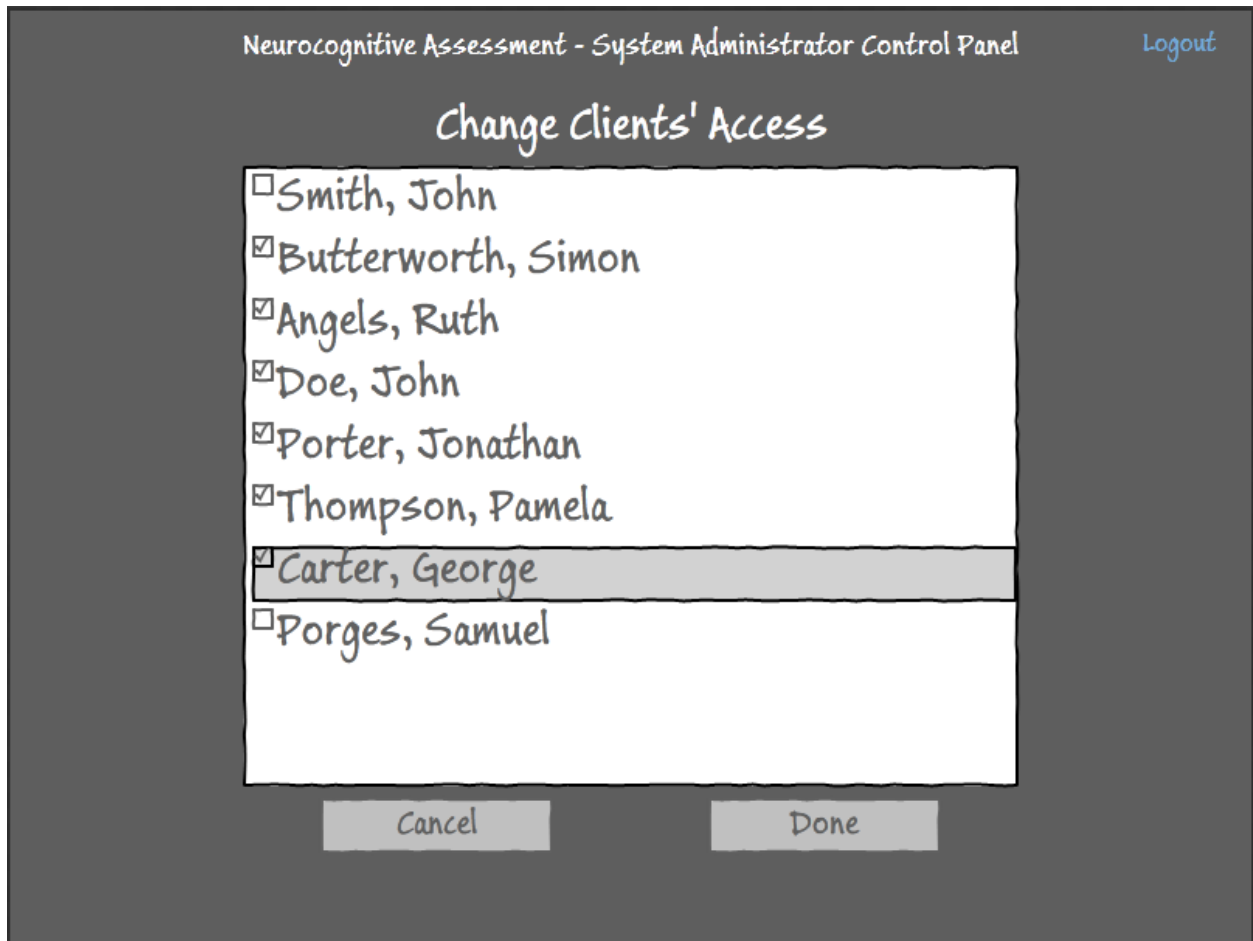
4. Press OK button.

5. Close the message and open the login page.

4.1.4. Block / Unblock Clients

The system administrator may change access of the clients to the system.

User Actions	System Actions
<ol style="list-style-type: none">1. Return to the HOME page.2. Press BLOCK / UNBLOCK CLIENTS button.	<ol style="list-style-type: none">3. Request current list of clients and their access settings from the database.4. Open the following page:



5. Set checkboxes to the left of respective client names to enable or disable their access to the system.
6. Press **DONE** button.
7. Save changes in the database.
8. Return to the HOME page.
9. Press **CANCEL** button.
10. Discard changes.
11. Return to the HOME page.

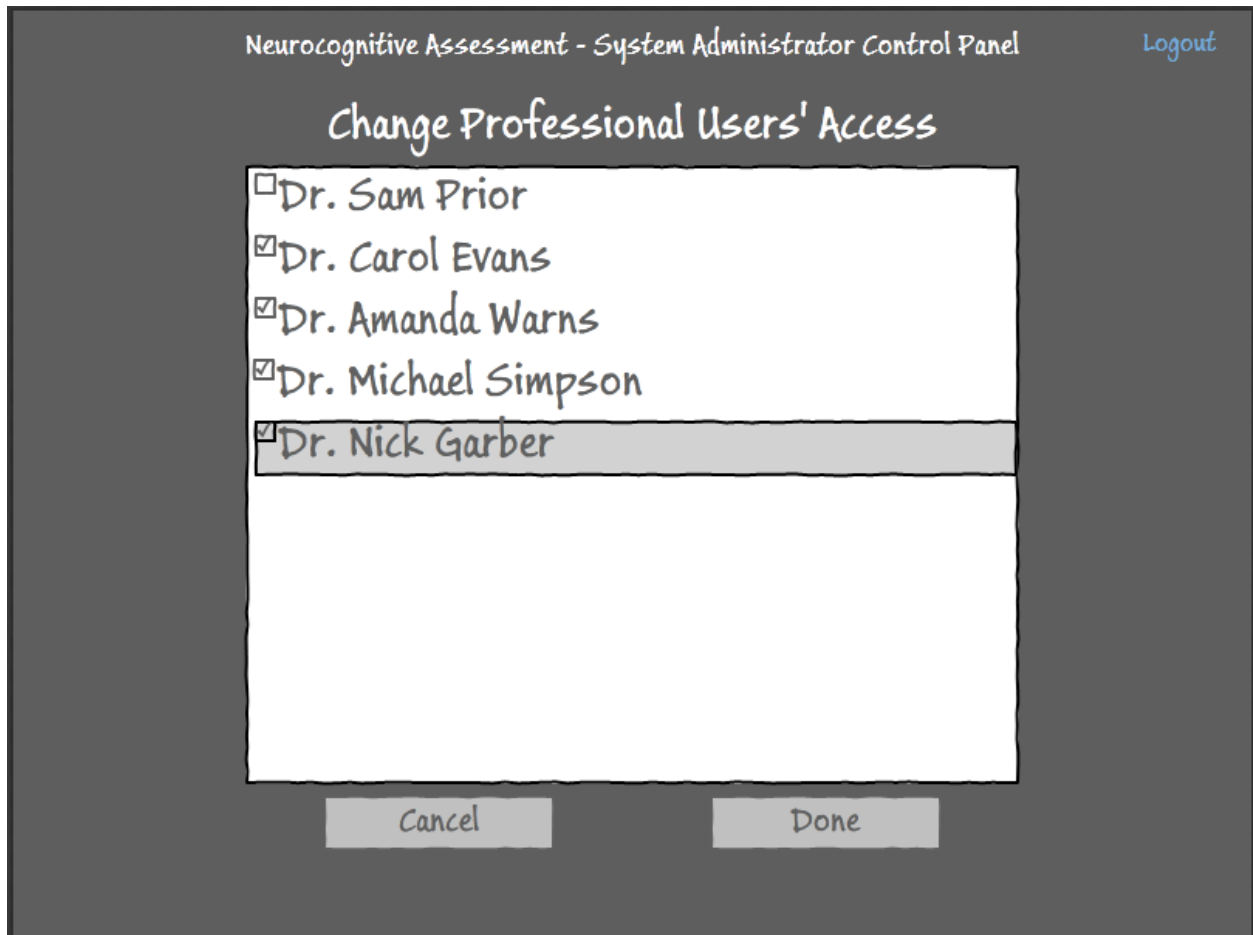
4.1.5. Block / Unblock Professional Users

The system administrator may change access of the professional users to the system.

User Actions	System Actions
1. Return to the HOME page.	3. Request current list of

2. Press **BLOCK / UNBLOCK PROFESSIONAL USERS** button.

4. Open the following page:
professional users and their access settings from the database.



5. Set checkboxes to the left of respective user names to enable or disable their access to the system.
6. Press **DONE** button.
7. Save changes in the database.
8. Return to the HOME page.
9. Press **CANCEL** button.
10. Discard changes.
11. Return to the HOME page.

4.1.6. Approve New Clients

The system administrator may approve access of new clients to the system.

User Actions

System Actions

1. Return to the HOME page.
2. Press **APPROVE NEW CLIENTS** button.

3. Request the list of new clients from the database.
4. Open the following page:

Neurocognitive Assessment - System Administrator Control Panel Logout

Approve New Clients

<input checked="" type="checkbox"/>	Smith, Karen
<input type="checkbox"/>	McDonald, Peter
<input checked="" type="checkbox"/>	Williams, Richard

5. Set checkboxes to the left of respective client names to enable their access to the system.

6. Press **DONE** button.

9. Press **CANCEL** button.

7. Save changes in the database.

8. Return to the HOME page.

10. Discard changes.

11. Return to the HOME page.

4.1.7. Approve New Professional Users

The system administrator may approve access of new professional users to the system.

User Actions

1. Return to the HOME page.
2. Press **APPROVE NEW PROFESSIONAL USERS** button.

System Actions

3. Request the list of new professional users from the database.
4. Open the following page:

Neurocognitive Assessment - System Administrator Control Panel [Logout](#)

Approve New Professional Users

<input checked="" type="checkbox"/>	Dr. Paul Simon
<input type="checkbox"/>	Dr. Elizabeth Hopkins

Cancel Done

5. Set checkboxes to the left of respective user names to enable their access to the system.
6. Press **DONE** button.
7. Save changes in the database.
8. Return to the HOME page.
9. Press **CANCEL** button.
10. Discard changes.
11. Return to the HOME page.

4.1.8. Manage Testing Configuration

The system administrator may modify various parameters of neurocognitive tests to be used by clients.

User Actions	System Actions
--------------	----------------

1. Return to the HOME page.
2. Press **MANAGE TESTING CONFIGURATION** button.

3. Request the set of test configuration settings from the database.
4. Open the following page:

Neurocognitive Assessment - System Administrator Control Panel Logout

Testing Configuration

Selective Attention	Sustained Attention	Attention Capacity	Divided Attention
Simple Reaction Time	Recognition Reaction Time	Choice Reaction Time	
Number of trials:		<input type="text" value="20"/>	
Minimum trial time (ms):		<input type="text" value="3000"/>	
Maximum trial time (ms):		<input type="text" value="5000"/>	
Target exposure time (ms):		<input type="text" value="500"/>	
Threshold reaction time (ms):		<input type="text" value="150"/>	

5. Press respective tabs to access different neurocognitive test settings.

6. Open respective tabs:

Testing Configuration

Selective Attention	Sustained Attention	Attention Capacity	Divided Attention
Simple Reaction Time	Recognition Reaction Time	Choice Reaction Time	
Number of trials:	<input type="text" value="20"/>		
Minimum trial time (ms):	<input type="text" value="3000"/>		
Maximum trial time (ms):	<input type="text" value="5000"/>		
Target exposure time (ms):	<input type="text" value="500"/>		
Threshold reaction time (ms):	<input type="text" value="180"/>		

Set Default

Cancel

Done

Testing Configuration

Selective Attention	Sustained Attention	Attention Capacity	Divided Attention
Simple Reaction Time		Recognition Reaction Time	Choice Reaction Time
Number of trials:	<input type="text" value="20"/>		
Minimum trial time (ms):	<input type="text" value="3000"/>		
Maximum trial time (ms):	<input type="text" value="5000"/>		
Target exposure time (ms):	<input type="text" value="500"/>		
Threshold reaction time (ms):	<input type="text" value="200"/>		

Set Default

Cancel

Done

Testing Configuration

Simple Reaction Time	Recognition Reaction Time	Choice Reaction Time	
Selective Attention	Sustained Attention	Attention Capacity	Divided Attention
Number of trials:		<input type="text" value="20"/>	
Trial time (ms):		<input type="text" value="5000"/>	
Target exposure time (ms):		<input type="text" value="500"/>	
Threshold reaction time (ms):		<input type="text" value="200"/>	

Set Default

Cancel

Done

Testing Configuration

Simple Reaction Time		Recognition Reaction Time		Choice Reaction Time	
Selective Attention		Sustained Attention		Attention Capacity	
Number of trials:	<input type="text" value="20"/>				
Trial time (ms):	<input type="text" value="15000"/>				
Target exposure time (ms):	<input type="text" value="10000"/>				
Threshold reaction time (ms):	<input type="text" value="5000"/>				
Critical level of mistakes (%):	<input type="text" value="30"/>				

Set Default

Cancel

Done

Testing Configuration

Simple Reaction Time		Recognition Reaction Time		Choice Reaction Time	
Selective Attention		Sustained Attention		Attention Capacity	
		Divided Attention			
Number of trials:	<input type="text" value="20"/>				
Trial time (ms):	<input type="text" value="5000"/>				
Target exposure time (ms):	<input type="text" value="2000"/>				
Maximum number of targets:	<input type="text" value="5"/>				

Set Default

Cancel

Done

Neurocognitive Assessment - System Administrator Control Panel Logout

Testing Configuration

Simple Reaction Time		Recognition Reaction Time		Choice Reaction Time	
Selective Attention		Sustained Attention		Divided Attention	
Number of trials:				<input type="text" value="20"/>	
Trial time (ms):				<input type="text" value="5000"/>	
Target exposure time (ms):				<input type="text" value="500"/>	
Threshold simple reaction time (ms):				<input type="text" value="150"/>	
Threshold recognition reaction time (ms):				<input type="text" value="180"/>	

7. Use respective controls to change configuration parameters.

9. Press **SET DEFAULT** button.

11. Press **CANCEL** button.

14. Press **DONE** button.

8. Check if entered values are valid. Controls prevent from entering invalid values.

10. Set all configuration parameters to their default values provided by the system.

12. Discard changes made.

13. Return to HOME page.

15. Save changes made.

16. Return to HOME page.

4.1.9. Change Administrator's Password

The system administrator may change own password to increase system security.

User Actions	System Actions
--------------	----------------

1. Return to the HOME page.
2. Press **CHANGE PASSWORD** button.

3. Open the following page:

The screenshot shows a web interface titled "Neurocognitive Assessment - System Administrator Control Panel" with a "Logout" link in the top right. The main heading is "Change Administrator's Password". Below this, there are three input fields: "Current Password:", "New Password:", and "Re-type New Password:". At the bottom, there are two buttons: "Cancel" and "Change Password".

4. Input current password.
5. Input new password.
6. Re-type new password.
7. Press **CHANGE PASSWORD** button.

8. Check if all password entries are valid or display respective messages:
 - a. *Wrong current password.*
 - b. *New password must differ from the current one.*
 - c. *Password must include letters, numbers and special symbols.*
 - d. *New passwords are not*

User Actions

System Actions

11. Press **CANCEL** button.

identical.

9. If no validity issues, save new password in the database.

10. Return to HOME page.

12. Disregard changes and return to HOME page.

5.2. Professional User Functionality

The following section describes the functionality of a special web application providing access to neurocognitive assessment data for professional users. This application should be run in Internet Explorer.

5.2.1. Starting Professional User Application

The professional user application is web-based, so it runs through a web browser (Internet Explorer).

The application must perform secure transactions using web-services to ensure high level of information security while being transported through the Internet.

The system installation procedure creates a desktop shortcut icon.

User Actions

System Actions



1. Double-click this icon to start the professional user workstation.

2. Open the following page:

User Actions

System Actions

Neurocognitive Assessment
Professional Workstation

User ID:

Password:

Logon

Forgot Password Register

Here returning user may log into the application. New users may register in the system.

5.2.2. Logging on Existing Professional User

If you are an existing professional user, you may log into the application from the default logon page.

User Actions

1. Enter **User ID** (contact email address) and **Password**.
2. Press **LOGON** button.

System Actions

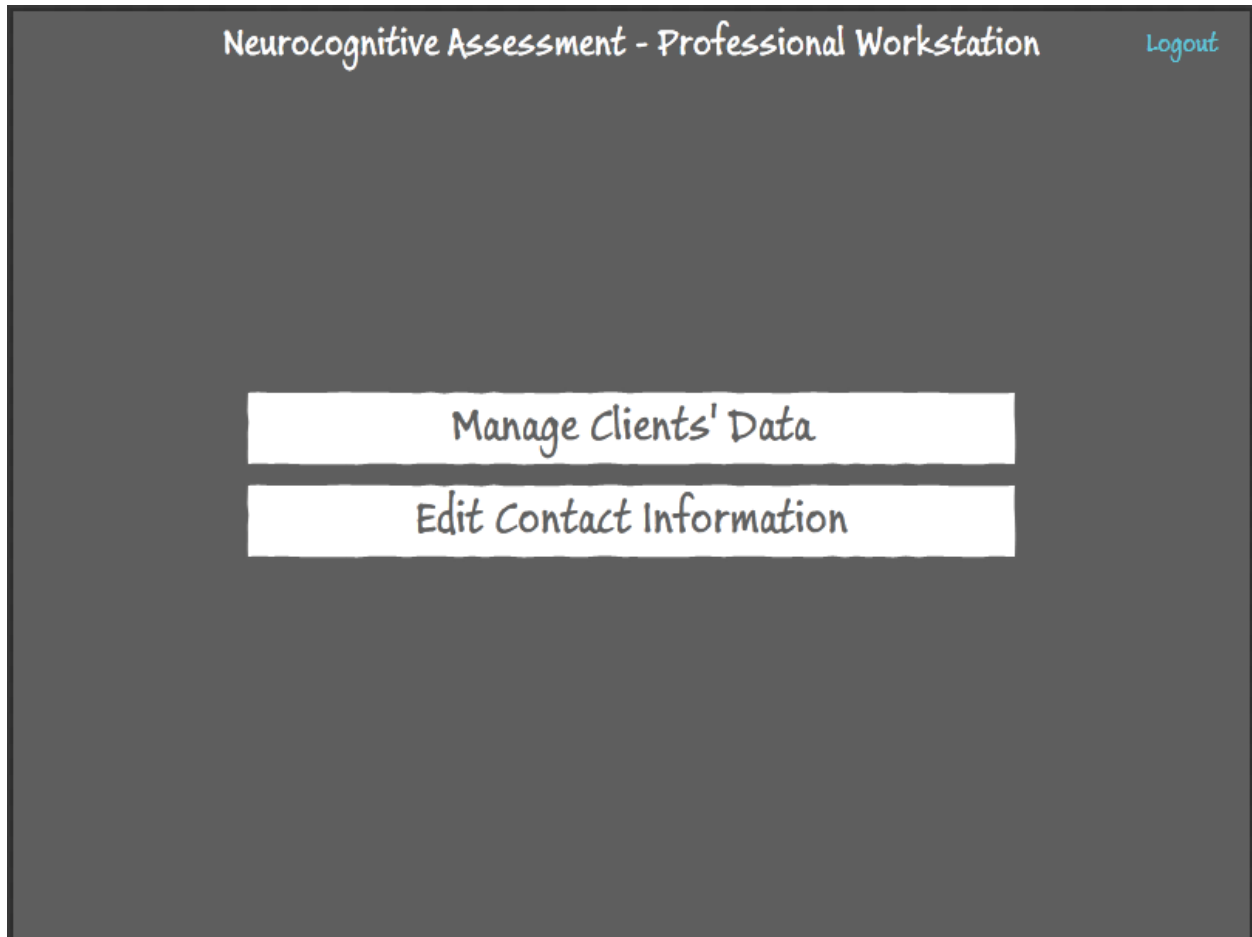
3. Check if the User ID / Password combination entered matches one stored in the database, or display this message:

Wrong User ID or password!

User Actions

System Actions

4. Otherwise open the HOME page:



5.2.3. Closing Professional User Workstation

User Actions

System Actions

1. Return to the HOME page.
2. Press **LOGOUT** link.
3. Close the application and return to the login page.

5.2.4. Registering New Professional User

User Actions

System Actions

1. Return to the logon page.
2. Press **REGISTER** button.
3. Open the following page:

Neurocognitive Assessment - Professional Workstation [Logout](#)

Input your contact information to register.

First name:

Last name:

Title:

Contact email:

Password:

Re-enter password:

4. Press **CANCEL** button.

5. Abort registration procedure and return to the logon page.

6. Input first and last names.

7. Input title.

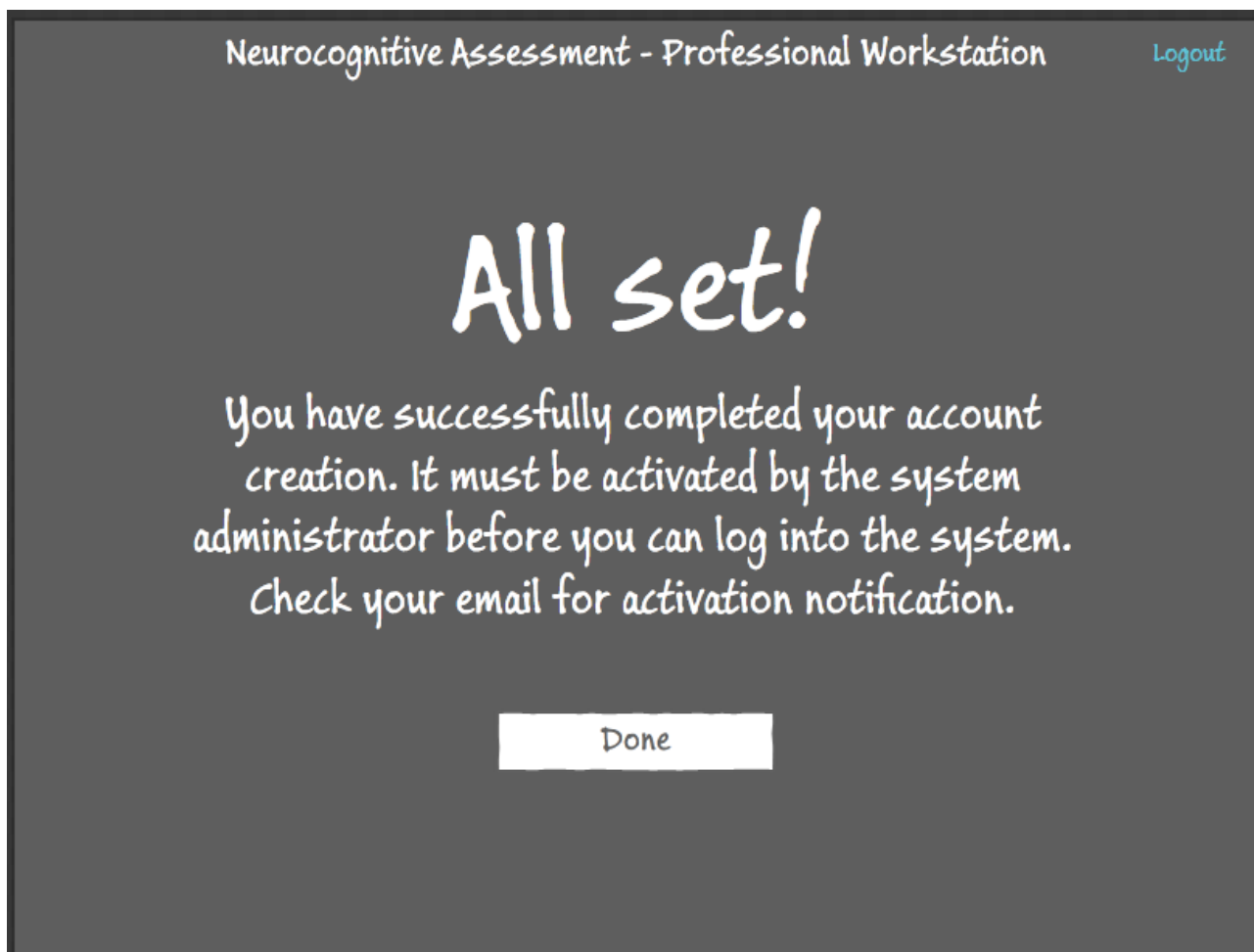
8. Input contact email (it will be used as a User ID).

User Actions

9. Input a strong password (minimum 8 symbols including at least one number and at least one special symbol).
10. Re-type the password.
11. Press **REGISTER** button.

System Actions

12. Check if contact email address has valid format, or display this message:
Wrong email address format!
13. Check if the email address is not already in the database, or display this message:
Such email address is already registered. Please provide a unique address.
14. Open the following page:



15. Press **DONE** button.

16. Return to the logon page.

Once the system administrator activates your account, you will receive a special email notification automatically sent to your contact email address specified during account creation.

5.2.5. Reset Forgotten Password

If you forgot your password, you may reset it. For security reason the system cannot read passwords. Instead it resets the forgotten password and replaces it with an automatically generated password, which will serve as a temporary one. The server will send it to your contact email address. It is recommended to change this temporary password to something more meaningful upon successful logon.

User Actions	System Actions
<ol style="list-style-type: none">1. Open the logon page.2. Input User ID (contact email address).3. Press RESET PASSWORD button.	<ol style="list-style-type: none">4. Check if the User ID exists in the database, or display this message: <i>Unknown User ID!</i>5. Display the following prompt:



6. Press **NO** button.

8. Press **YES** button.

7. Cancel password reset procedure and return to the logon page.

9. Send request to reset password.

10. Reset password in the database.

11. Send an email to the contact email address providing the reset password.

12. Open the logon page.

Wait for an email from the system administrator to get a temporary password then try to login.

5.2.6. Edit Professional User's Information

To edit personal profile information, you must be on the home screen.

User Actions

1. Press **EDIT CONTACT INFORMATION** button.

System Actions

2. Read the logged professional user's information from the database and initialize the form.
3. Open the following page:

Neurocognitive Assessment - Professional Workstation [Logout](#)

Input your contact information.

First name:

Last name:

Title:

Contact email:

Current password:

New password:

Re-enter password:

4. Press **CANCEL** button.

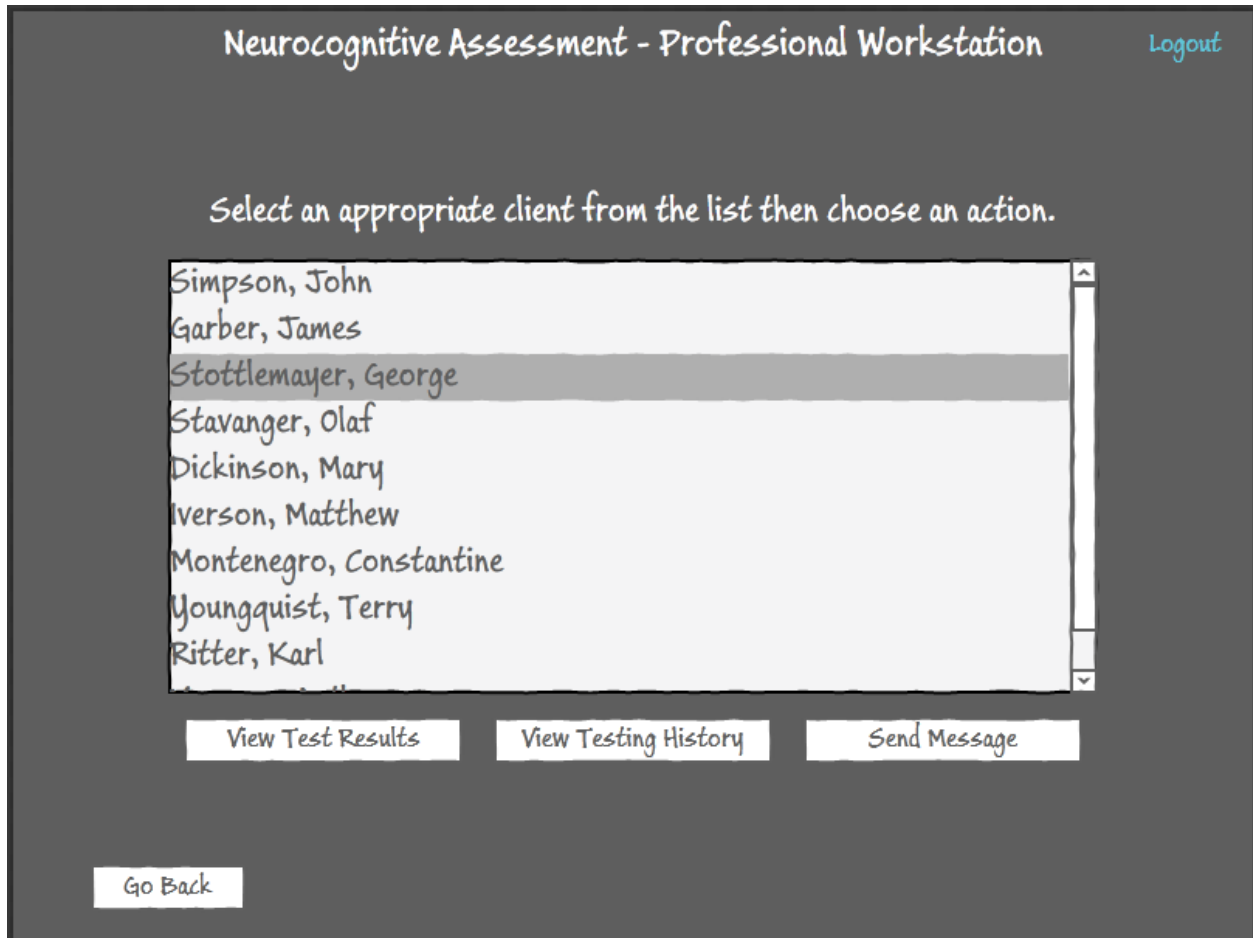
5. Discard changes and return to the **HOME** page.

User Actions	System Actions
<ul style="list-style-type: none"> 6. Change the content of any data fields if necessary. Contact email address is read-only. 7. Password fields may remain empty if password is not to be changed. Otherwise all three password fields must be properly filled out. 8. Press UPDATE button. 	<ul style="list-style-type: none"> 9. Check if first and last names are not blank, or display this message: <i>First and last names cannot be blank!</i> 10. Check if all numerical entries are in valid ranges. Controls prevent from entering invalid values. 11. Check if all password entries are valid (or empty) or display respective messages: <ul style="list-style-type: none"> a. <i>Wrong current password.</i> b. <i>New password must differ from the current one.</i> c. <i>Password must include letters, numbers and special symbols.</i> d. <i>Wrong current password.</i> e. <i>Passwords entered are not the same.</i> 12. Save the information in the database. 13. Return to the HOME page.

5.2.7. View Test Results

To access clients data stored in the system, you must be on the home screen.

User Actions	System Actions
<ul style="list-style-type: none"> 1. Press MANAGE CLIENTS' DATA button. 	<ul style="list-style-type: none"> 2. Read the list of clients from the database. 3. Open the following page:



4. Press **GO BACK** button.
5. Return to the HOME page.
6. Select the desired client name from the list.
8. Retrieve the latest test data record of the selected client from the database.
7. Press **VIEW TEST RESULTS** button.
9. Open the following page:

Neurocognitive Assessment - Professional Workstation [Logout](#)

July 15, 2012 10:30 am Simple Reaction Time

Name: John Simpson	Sex: Male Age: 21
Rank: Corporal	US Marines
Height: 5-11	Weight: 164
Simple Reaction Time - 07/15/2012 10:30 am	
Trial Count:	20
Mean Reaction Time (ms):	158
False Reactions:	2 (10%)
Missed Reactions:	1 (5%)
Total Mistakes:	3 (15%)
<p><i>Normal reaction time (<200 ms). Acceptable mistake count. Attention level is acceptable. Visuo-motor reaction is normal.</i></p>	

Send Message
Export Test Data
Print Test Results

[Go Back](#)

10. Press **GO BACK** button.

12. Use **DATE / TIME** dropdown menu to select a desired test date/time.

14. Use **TEST TYPE** dropdown menu to select a desired test type.

16. Press **PRINT TEST RESULTS** button.

11. Return to the previous page.

13. Update the chart.

15. Update the chart.

17. Open a new browser window containing the test report specifically formatted for printing:

Neurocognitive Assessment Report

Name: John Simpson Sex: Male
Title / Rank: Corporal Age: 21
Occupation: US Marines Height: 5-11
Date / Time: 07/15/2012 10:30 am Weight: 164

Simple Reaction Time

Mean Simple Reaction Time (ms): 158 [<200]
False Reactions: 2 (10%) Missed Reactions: 1 (5%)
Total Mistakes: 3 (15%)
Trial Count: 20
Conclusion: Reaction time - normal (<200 ms). Mistake count - acceptable. Attention level - acceptable. Visuo-motor reaction - normal.

Recognition Reaction Time

Mean Recognition Reaction Time (ms): 181 [<250]
False Reactions: 2 (10%) Missed Reactions: 1 (5%)
Wrong Recognitions: 0 (0%) Total Mistakes: 3 (15%)
Trial Count: 20
Conclusion: Reaction time - normal (<250 ms). Mistake count - acceptable. Response inhibition - normal. Processing speed - normal. Visuo-motor reaction - normal.

Choice Reaction Time

Mean Choice Reaction Time (ms): 190 [<280]
False Reactions: 2 (10%) Missed Reactions: 1 (5%)
Wrong Choice: 1 (5%) Total Mistakes: 4 (20%)
Trial Count: 20
Conclusion: Reaction time - normal (<280 ms). Mistake count - acceptable. Alternating attention - acceptable. Processing speed - acceptable. Visuo-motor reaction - normal.

Selective Attention

Mean Selective Reaction Time (ms): 200 [<280]
False Reactions: 1 (5%) Missed Reactions: 0 (0%)
Wrong Choice: 0 (0%) Total Mistakes: 1 (5%)
Trial Count: 20
Conclusion: Reaction time - normal (<280 ms). Mistake count - acceptable. Selective attention - normal. Concentration - normal. Processing speed - normal. Visuo-motor reaction - normal.

Name: John Simpson Date / Time: 07/15/2012 10:30 am

Sustained Attention

Mean Selective Reaction Time (ms): 200 [<280]
Sustained Duration (sec): 360
False Reactions: 3 (10%) Missed Reactions: 0 (0%)
Wrong Choice: 6 (20%) Total Mistakes: 9 (30%)
Trial Count: 30
Conclusion: Reaction time - normal (<280 ms). Mistake count - acceptable. Sustained attention - acceptable. Concentration - normal. Processing speed - normal. Visuo-motor reaction - normal.

Attention Capacity

Mean Selective Reaction Time (ms): 200 [<280]
Attention Capacity: 4 [>4]
False Reactions: 0 (0%) Missed Reactions: 0 (0%)
Wrong Choice: 4 (20%) Total Mistakes: 4 (20%)
Trial Count: 20
Conclusion: Reaction time - normal (<280 ms). Mistake count - acceptable. Spatial processing - normal. Visuo-spatial working memory - decreased.

Divided Attention

Mean Simple Reaction Time (ms): 162 [<180]
Mean Recognition Reaction Time (ms): 188 [<200]
False Reactions: 0 (0%) Missed Reactions: 0 (0%)
Wrong Recognition: 4 (20%) Total Mistakes: 4 (20%)
Trial Count: 20
Conclusion: Reaction time - normal (<250 ms). Mistake count - acceptable. Directed attention - normal. Executive attention - normal.

Overall Test Conclusion: Overall neurocognitive abilities are within normal range. Regular follow-up testing is recommended.

Print

Close

User Actions

1. Press **CLOSE** button.

System Actions

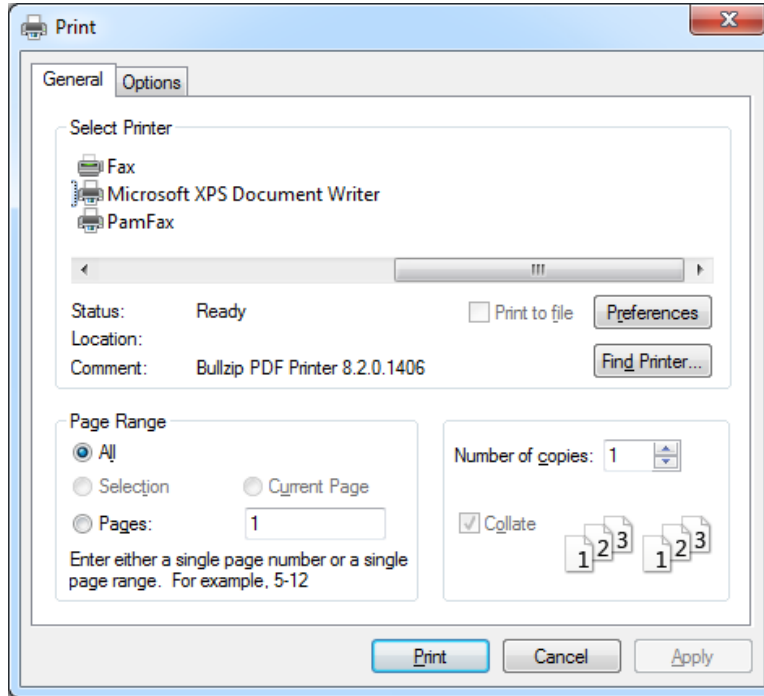
2. Immediately close the active window containing report.

User Actions

3. Press **PRINT** button.

System Actions

4. Bring a standard Windows printer selection dialog box:



5. Press **PRINT** button.

6. Start printing.

5.2.8. View Testing History

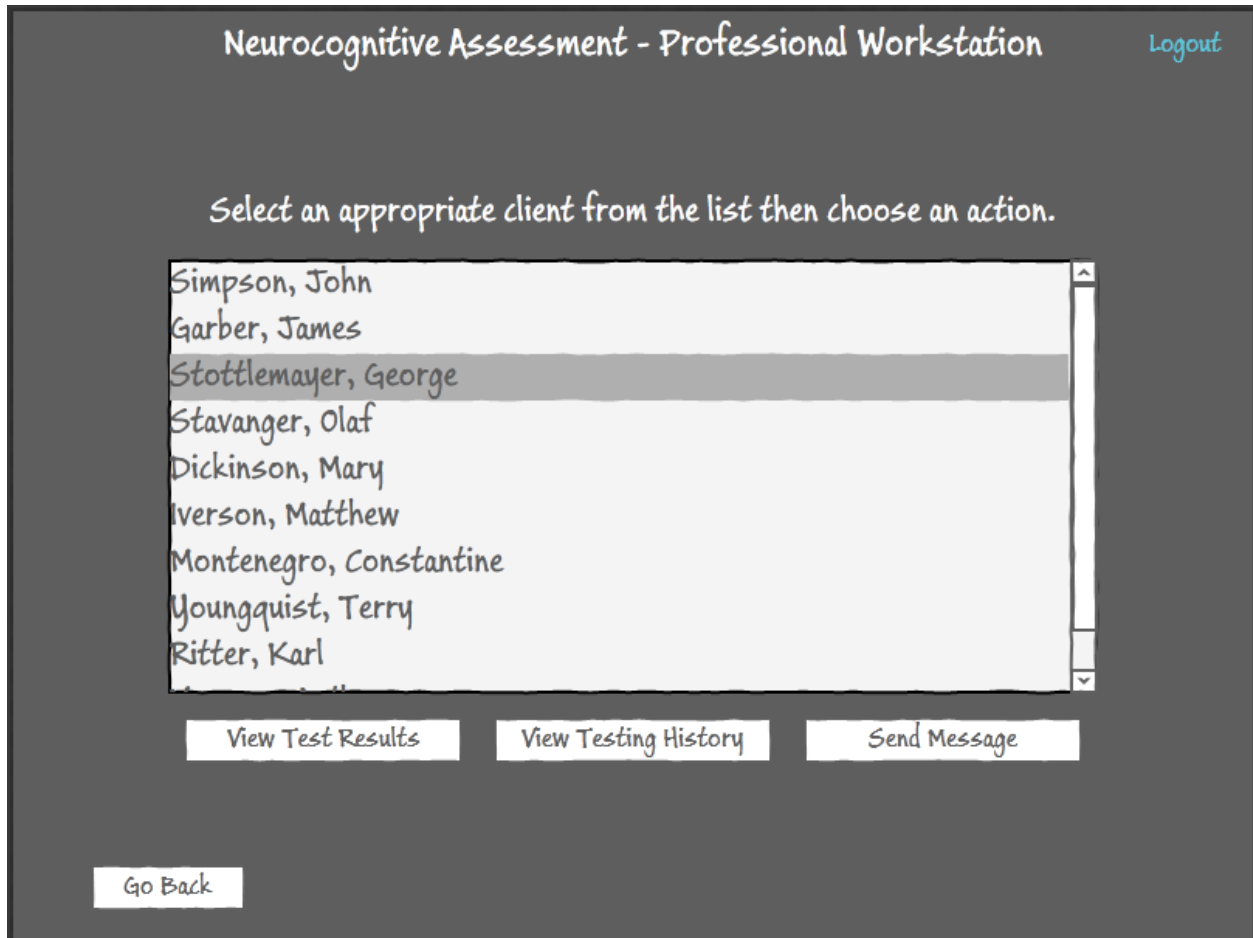
To access clients data stored in the system, you must be on the home screen.

User Actions

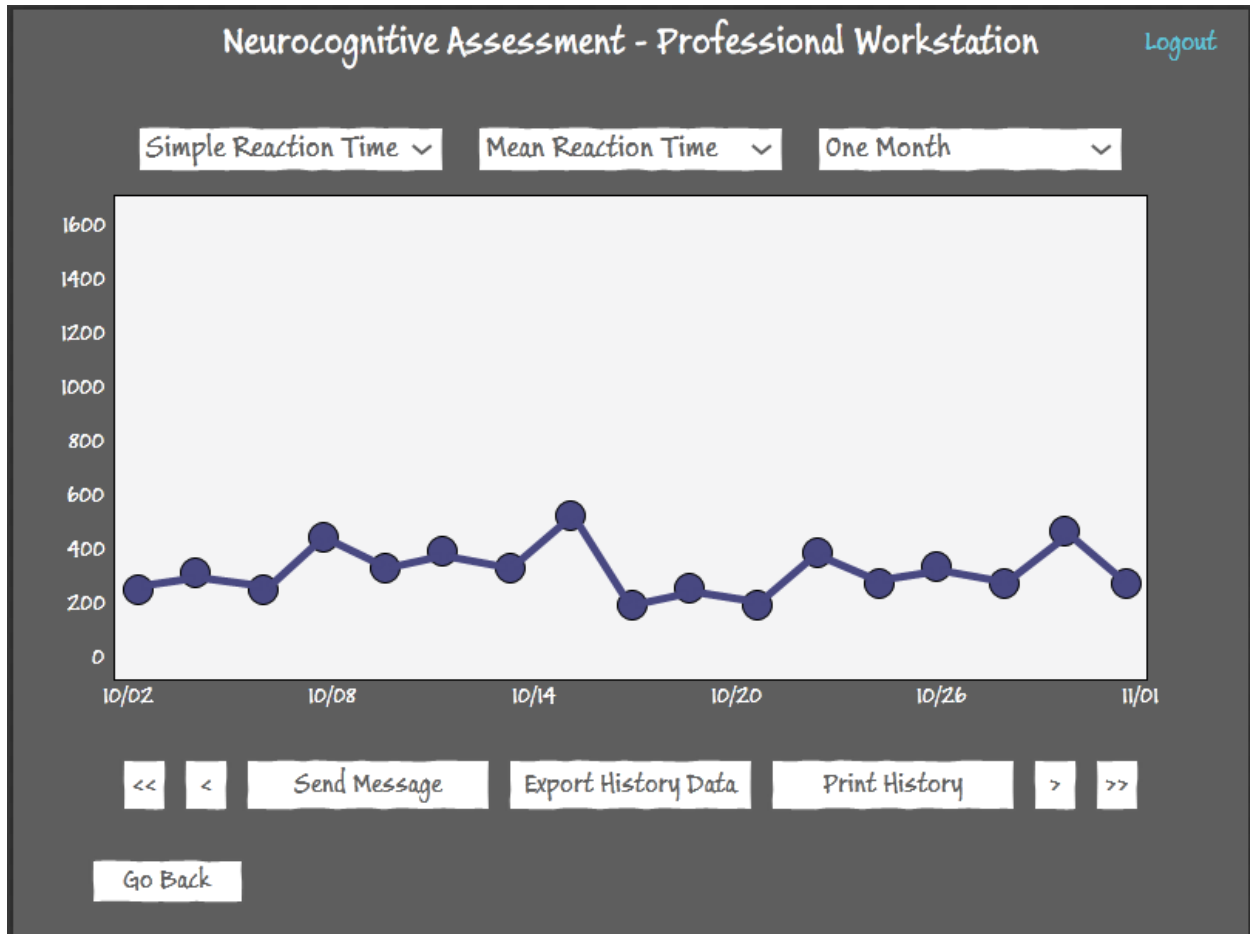
1. Press **MANAGE CLIENTS' DATA** button.

System Actions

2. Read the list of clients from the database.
3. Open the following page:



4. Press **GO BACK** button.
5. Return to the previous page.
6. Select the desired client name from the list.
8. Retrieve all test data record of the selected client from the database.
7. Press **VIEW TESTING HISTORY** button.
9. Open the following page:



10. Press **GO BACK** button.

12. Use **TEST TYPE** dropdown menu to select a desired test type.

14. Use **TEST PARAMETER** dropdown menu to select a desired parameter of the currently selected test type.

16. Use **TIME INTERVAL** dropdown menu to select a desired time interval from the following options: **ONE MONTH, THREE MONTHS, SIX MONTHS, ONE YEAR** or **THREE YEARS**.

11. Return to the previous page.

13. Update the history chart.

15. Update the history chart.

17. Update the history chart.

User Actions	System Actions
18. Press [<<] button to move the history chart backward to the beginning of data record.	19. Update the history chart.
20. Press [<] button to move the history chart backward for a half of the selected time interval.	21. Update the history chart.
22. Press [>] button to move the history chart forward for a half of the selected time interval.	23. Update the history chart.
24. Press [>>] button to move the history chart forward to the end of data record.	25. Update the history chart.
26. Press PRINT TEST RESULTS button.	27. Open a new browser window containing the testing history report specifically formatted for printing.
28. Press CLOSE button in the active window.	29. Immediately close the active window containing report.
30. Press PRINT button in this window.	31. Bring a standard Windows printer selection dialog box.
32. Press PRINT button in this box.	33. Start printing.

5.2.8. Send Professional Advice

User Actions	System Actions
1. Move to the client selection page or view test results page or view testing history page.	3. Get client's contact email address from the database.
2. Press SEND MESSAGE button.	4. Open the following page:

Neurocognitive Assessment - Professional Workstation Logout

Compose and send a message to: John Simpson

Subject:

Your last test results are OK. Please keep following my recommendations and take your tests on daily basis if possible.
 Please let me know if you have any questions.

5. Press **CANCEL** button.
6. Abort sending a message and return to one of those three pages which sending messages was called from.
7. Input the subject of this message. If the subject line is empty, the application uses "No subject" string.
8. Compose your email.
9. Press **SEND MESSAGE** button.
10. Send the email to the selected client.
11. Return to one of those three pages which sending messages was called from.

5.2.9. Export Selected Test Results and History Data

There are two options to export test data in Excel file:

1. Export selected test data
2. Export test history data

User Actions	System Actions
<ol style="list-style-type: none">1. Get to the selected test results view page.2. Press EXPORT TEST DATA button.4. Enter the export Excel file name and choose its location.5. Press SAVE button.	<ol style="list-style-type: none">3. Open a standard Windows Save As dialog box to specify the target Excel file name and location.6. Generate a new Excel worksheet named with the test date and time, e.g. “July 15, 2012 10:30 am” which looks like:

User Actions

System Actions

	A	B	C	D	E	F	G	
1	Neurocognitive Assessment - Professional Workstation							
2								
3	Client Name:	John Simpson						
4	Title / Rank:	Corporal						
5	Occupation:	US Marines						
6	Sex:	Male						
7	Date Of Birth:	10/6/1991						
8	Height (ft-in):	5-11						
9	Weight (lb):	164						
10								
11	Test Date / Time	7/15/2012 10:30						
12								
13	Simple Reaction Time		Value	% of Total				
14	Mean Reaction Time (ms):		158					
15	False Reactions:		2	10				
16	Missed Reactions:		1	5				
17	Total Mistakes:		3	15				
18	Total Count:		20					
19								
20	Recognition Reaction Time		Value	% of Total				
21	Mean Reaction Time (ms):		181					
22	False Reactions:		2	10				
23	Missed Reactions:		1	5				
24	Wrong Recognitions:		0	0				
25	Total Mistakes:		3	15				
26	Total Count:		20					
27								
28	Choice Reaction Time		Value	% of Total				
29	Mean Reaction Time (ms):		190					
30	False Reactions:		2	10				
31	Missed Reactions:		1	5				
32	Wrong Choices:		1	5				
33	Total Mistakes:		4	20				
34	Total Count:		20					
35								
36	Selective Attention		Value	% of Total				
37	Mean Reaction Time (ms):		200					
38	False Reactions:		1	5				
39	Missed Reactions:		0	0				
40	Wrong Choices:		0	0				
41	Total Mistakes:		1	5				
42	Total Count:		20					
43								
44	Sustained Attention		Value	% of Total				
45	Mean Reaction Time (ms):		200					
46	Sustained Duration (sec):		360					
47	False Reactions:		3	10				
48	Missed Reactions:		0	0				
49	Wrong Choices:		6	20				
50	Total Mistakes:		9	30				
51	Total Count:		30					
52								
53	Attention Capacity		Value	% of Total				
54	Mean Reaction Time (ms):		200					
55	Attention Capacity		4					
56	False Reactions:		0	0				
57	Missed Reactions:		0	0				
58	Wrong Choices:		4	20				
59	Total Mistakes:		4	20				
60	Total Count:		20					
61								
62	Divided Attention		Value	% of Total				
63	Mean Simple Reaction Time (ms):		162					
64	Mean Recognition Reaction Time (188					
65	False Reactions:		0	0				
66	Missed Reactions:		0	0				
67	Wrong Recognitions:		4	20				
68	Total Mistakes:		4	20				
69	Total Count:		20					

User Actions	System Actions
--------------	----------------

- Return to the selected test data view page.

User Actions	System Actions
--------------	----------------

- Get to the test history view page.
- Press **EXPORT HISTORY DATA** button.
-
- Enter the export Excel file name and choose its location.
- Press **SAVE** button.

- Open a standard Windows Save As dialog box to specify the target Excel file name and location.
-
- Generate a series of Excel worksheet named with the test dates and times, e.g. “**July 15, 2012 10:30 am**” which look like shown above.

5.3. Individual User Functionality

The following section describes functionality of a mobile application providing neurocognitive testing capabilities to individual users in the form of a mobile game.

This application should be run on iPhone 4 / 4s / 5 and iPad / 2.

5.3.1. Starting Mobile Application

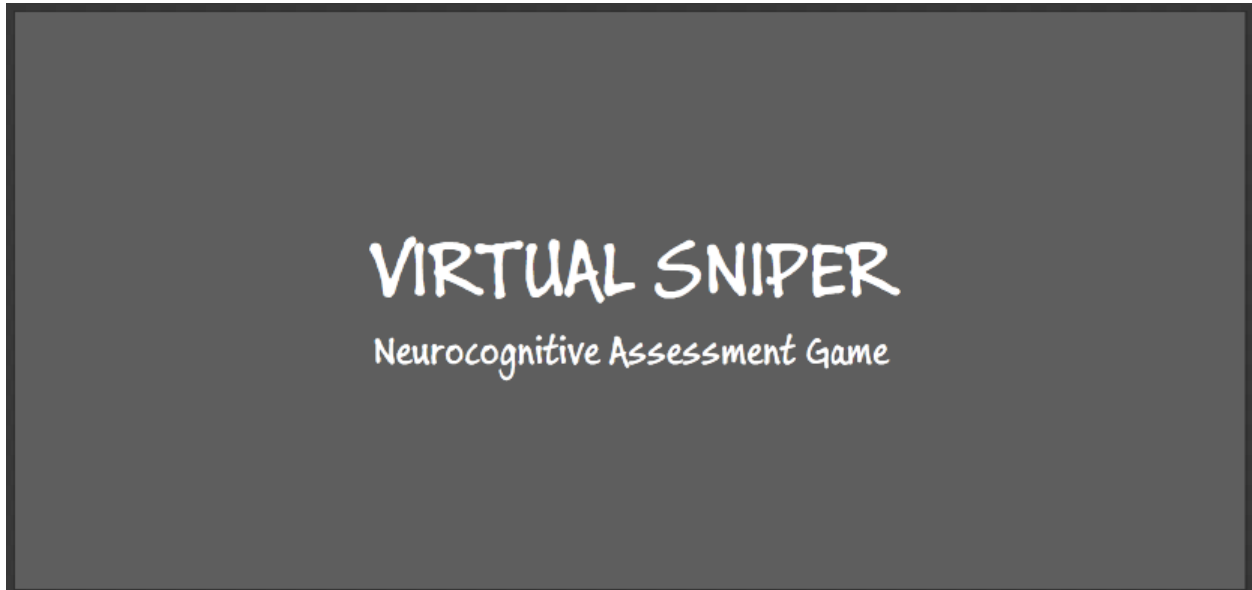
The application installation procedure creates a shortcut icon on the home screen of iPhone / iPad device.

User Actions	System Actions
--------------	----------------

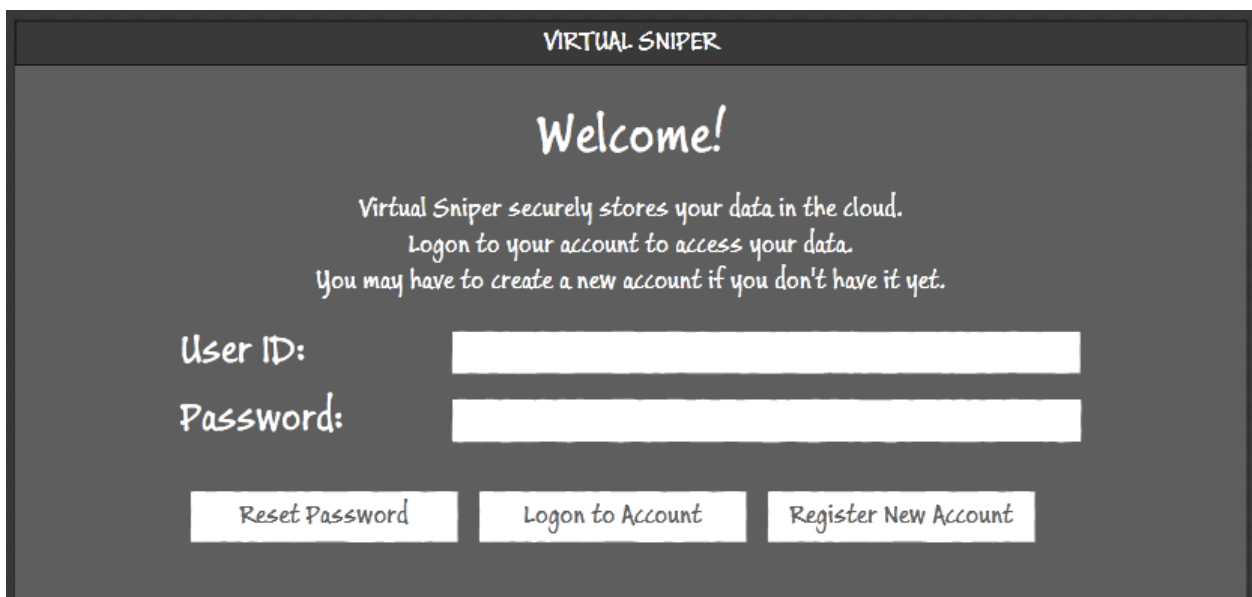


- Tap this icon to start the application.

- Start application.
- If it is not in the memory already, open the following screen for a few seconds while the app is being loaded:



4. Once the app is loaded, open the following logon screen opens:



The application handles sensitive and information therefore it automatically logs out every time the user brings it to the background and does not open it again within 15 minutes.

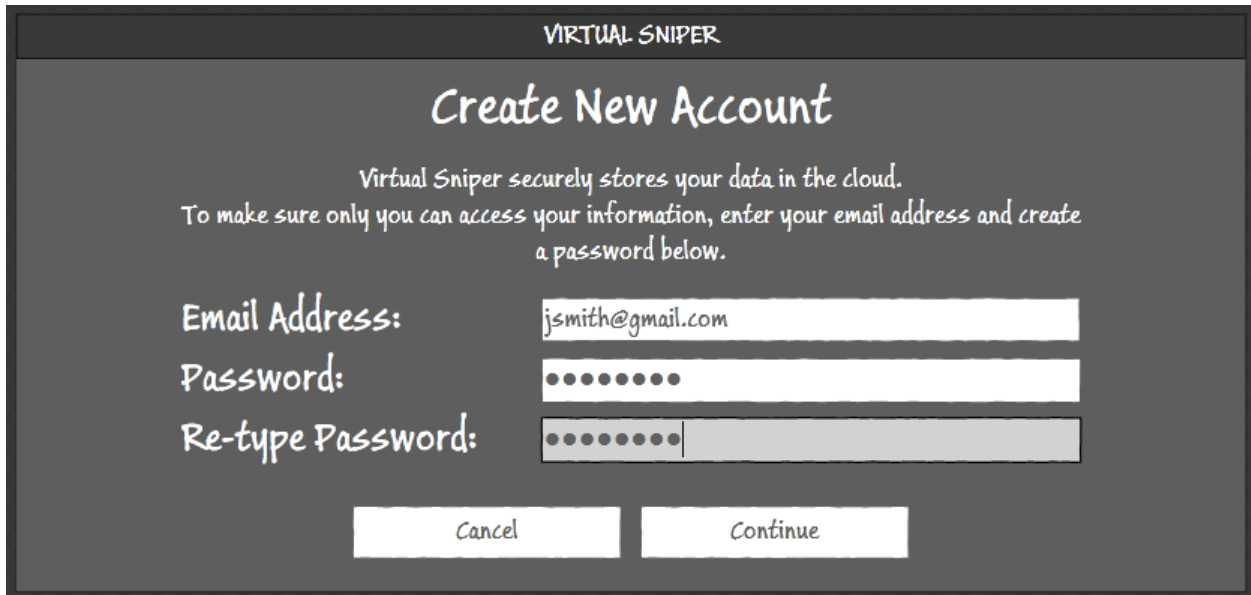
5.3.2. Registering New User

If you do not have your account yet, it must be created by registration procedure.

User Actions	System Actions
--------------	----------------

1. Get to the logon screen.
2. Tap **REGISTER NEW ACCOUNT** button.

3. Open the following screen:



4. Tap **CANCEL** button.
6. Input your contact email address.
7. Input a strong password (minimum 8 symbols including at least one number and at least one special symbol).
8. Re-type the password.
9. Tap **CONTINUE** button.

5. Abort account creation and return to the logon screen.

10. Check if email address format is valid, or display this message:

Wrong email address format or address is empty!

11. Check if entered passwords are valid, or display any of relevant messages:

- a. ***Password is empty!***
- b. ***Password must include letters, numbers and special symbols.***
- c. ***Passwords entered are not the same.***

User Actions

System Actions

12. If no validity issues, open the following screen:

VIRTUAL SNIPER

Create New Account

Enter your personal information here.

First Name:

Last Name:

Title / Rank:

Occupation:

13. Tap **BACK** button.

15. Input personal data.

16. Tap **CONTINUE** button.

14. Return to previous screen.

17. Check if first or last name are not blank, or display this message:

First and last names cannot be blank.

18. If no validity issues, open the following screen:

VIRTUAL SNIPER

Create New Account

Enter your biometric information here.

Sex:

Date of Birth:

Height:

Weight:

19. Tap **BACK** button.

21. Select proper sex.

22. Input date of birth.

23. Input height and weight.

24. Tap **CREATE ACCOUNT** button.

20. Return to previous screen.

25. Check if numerical entries are valid. The controls provide means for validity check.

26. Check if the email address provided is not in the database, or display this message:

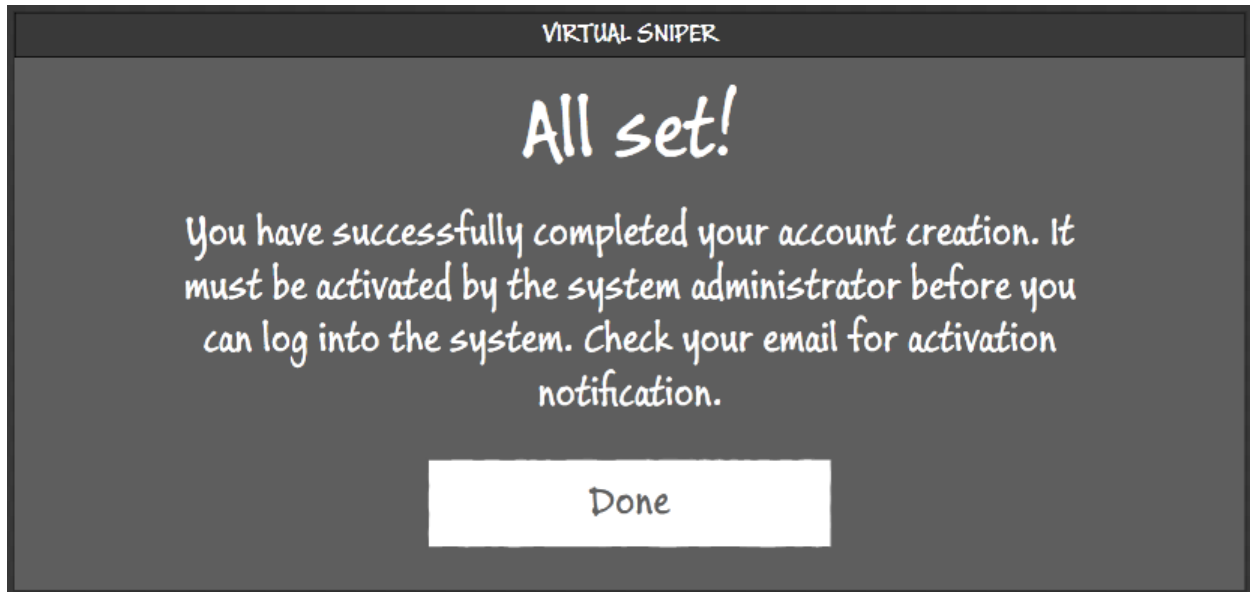
This email address is already registered with the system. Please provide a unique email address.

27. If email address is accepted, create new account in the database.

28. Open the following screen:

User Actions

System Actions



29. Tap **DONE** button.

30. Return to the logon screen.

Once the system administrator activates your account, you will receive a special email notification automatically sent to your contact email address specified during account creation.

5.3.3. Logging on Existing User

Once the logon screen opens, you may log onto the application.

User Actions

System Actions

1. Get to the logon screen.
2. Input email address as a **USER ID**.
3. Input your password.
4. Tap **LOGON TO ACCOUNT** button.

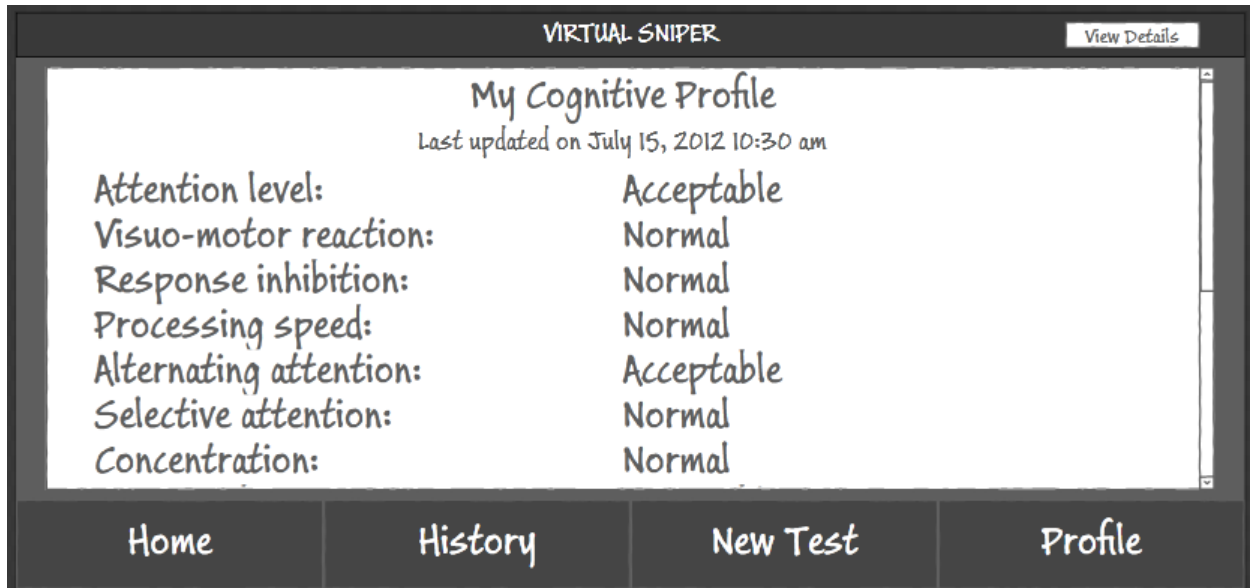
5. Check if contact email exists in the database and password is correct, or display this message:

Wrong email address or password entered. Please try again.

6. If logon is successful, read last test data from the database.
7. Open the following screen:

User Actions

System Actions



This is your application home screen. It may contain no testing information if you have not performed any testing yet.

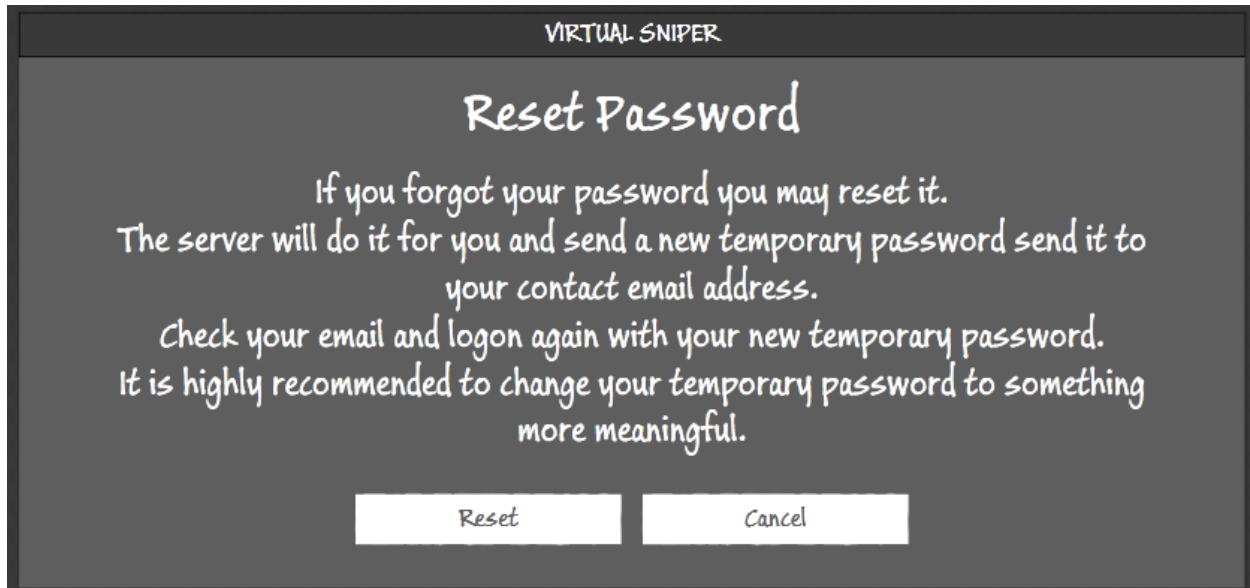
5.3.4. Resetting Forgotten Password

If you forgot your password, you may reset it. The server will automatically generate a temporary password and send it to your contact email address. It is recommended to change this temporary password to something more meaningful upon successful logon.

User Actions

System Actions

1. Get to the logon screen.
2. Input email address as a **USER ID**.
3. Tap **RESET PASSWORD** button.
4. Open the following screen:



5. Tap **CANCEL** button.

7. Tap **RESET** button.

6. Abort resetting password and return to the logon screen.

8. Check if contact email exists in the database, or display this message:

Wrong email address entered. Please try again.

9. If the email address is correct, generate a new password and save it in the record.

10. Generate and send an email address to the contact email address containing the reset password.

11. Return to the logon screen.

Wait for an email from the system administrator to get a temporary password then try to logon.

5.3.5. Editing Personal Profile

To edit personal profile information, you must be on the home screen.

User Actions

1. Get to the home screen.
2. Tap **PROFILE** button on the bottom menu bar.

System Actions

3. Read the user's personal information and initialize the edit form.
4. Open the following screen:

VIRTUAL SNIPER

Edit Profile

Enter your personal information here.

First Name:

Last Name:

Title / Rank:

Occupation:

5. Tap **CANCEL** button.
7. Change the data shown on this screen if needed.
8. Tap **CONTINUE** button.

6. Abort editing the profile and return to the home screen.
9. Check if first or last name are not blank, or display this message:
First and last names cannot be blank.
10. If no validity issues, open the following screen:

User Actions

System Actions

VIRTUAL SNIPER

Edit Profile

Enter your biometric information here.

Sex:

Date of Birth:

Height:

Weight:

11. Tap **BACK** button.

13. Change any data in respective entry fields if needed.

14. Tap **CONTINUE** button.

12. Return to previous screen.

15. Check if numerical entries are valid. The controls provide means for validity check.

16. Open the following screen:

VIRTUAL SNIPER

Update Profile

To change your password, enter your current password then enter and re-type a new password.

Current Password:

New Password:

Re-type Password:

17. Tap **BACK** button.

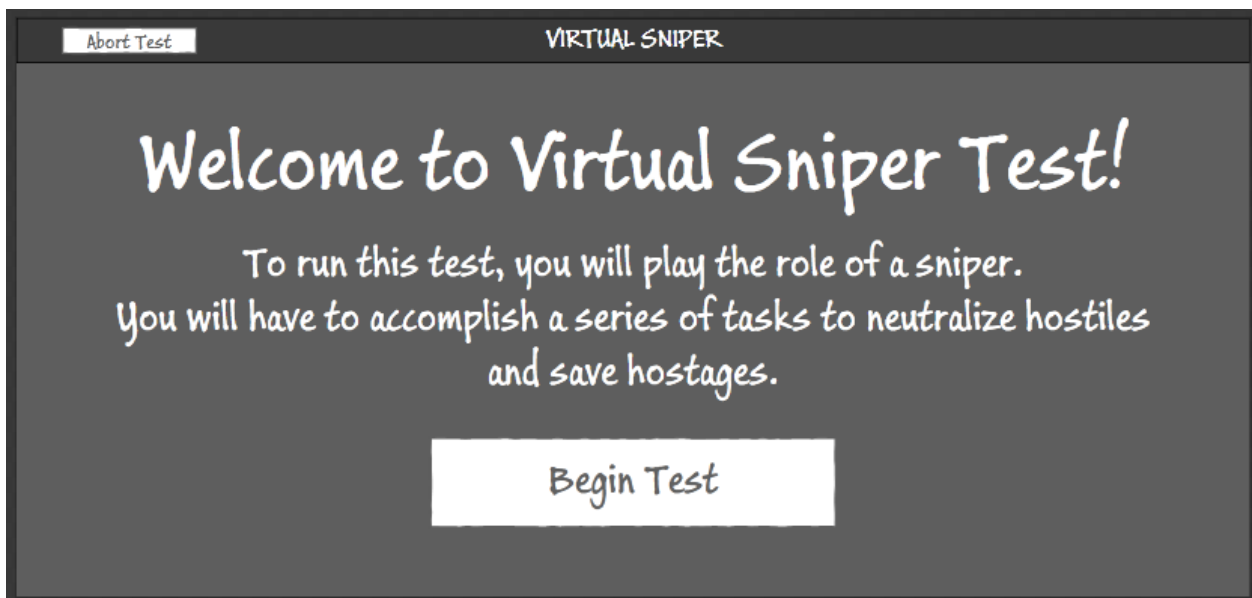
18. Return to previous screen.

User Actions	System Actions
<p>19.If needed, enter your current password, then enter your new password and re-enter it. Or leave these data fields blank if you do not need to change your password.</p> <p>20.Tap UPDATE PROFILE button.</p>	<p>21.Check if password entries are valid, or display an appropriate message:</p> <ul style="list-style-type: none"> a. <i>Password must include letters, numbers and special symbols.</i> b. <i>Wrong current password.</i> c. <i>Passwords entered are not the same.</i> <p>22.If there are no validity issues, save the updated information in the database and return to the home screen.</p>

5.3.6. Conducting New Test

To run a new neurocognitive assessment test, you must be on the home screen.

User Actions	System Actions
<ol style="list-style-type: none"> 1. Get to the home screen. 2. Tap NEW TEST button on the bottom menu bar. 	<ol style="list-style-type: none"> 3. Read the app test settings. 4. Open the following screen:



User Actions

5. Tap **ABORT TEST** button.

7. Read the instructions.

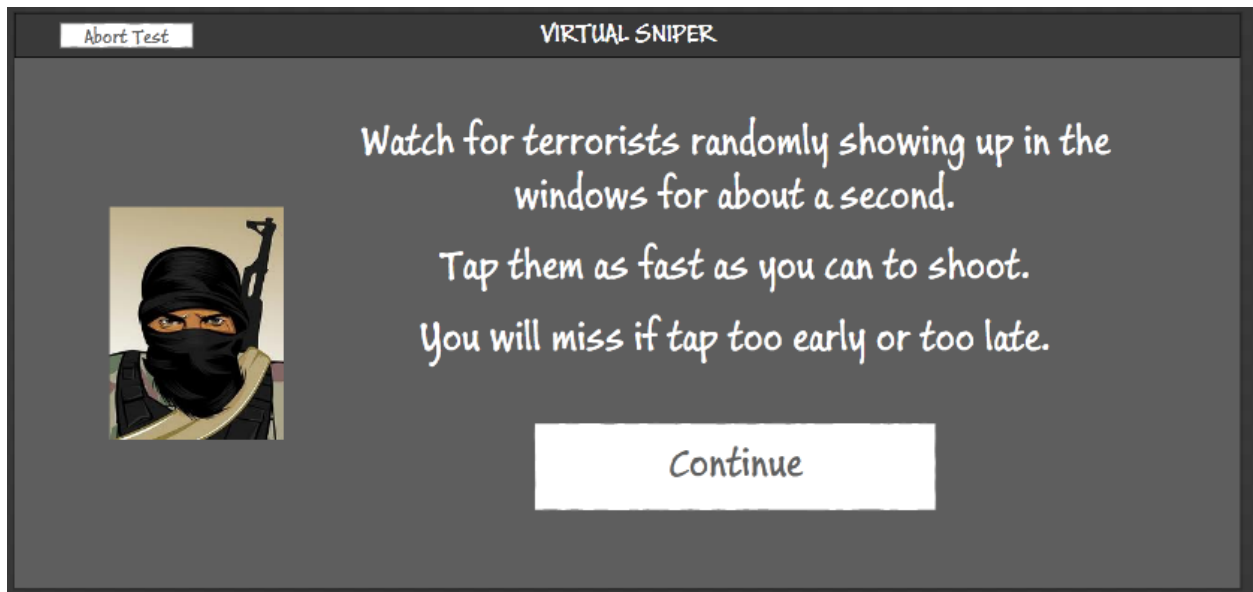
8. Tap **BEGIN TEST** button.

System Actions

6. Terminate the test and return to the home screen.

This action can be done at any time throughout the entire testing procedure.

9. Open the following screen:



This screen provides the instructions to perform a simple reaction time test. There will be five levels of the game providing this type of the test. Each level has a preset number of trials.

10. Read the test instructions.

11. Tap **CONTINUE** button.

12. Open the following screen:

User Actions

System Actions



Depending on the current game level there will be 1 to 5 windows in the building. A hostile figure will randomly appear in any of them in each trial.

13. Tap the hostile as quickly as possible.

14. Count and display the following parameters throughout the trials of this test in accordance with the game and test description:

- Game Level
- Game Score
- Number of Hits (Good shots)
- Number of Misses (Mistakes)
- Number of Trials Left
- Reaction Times

15. Upon completion of each level of this test, open the following summary screen:

User Actions

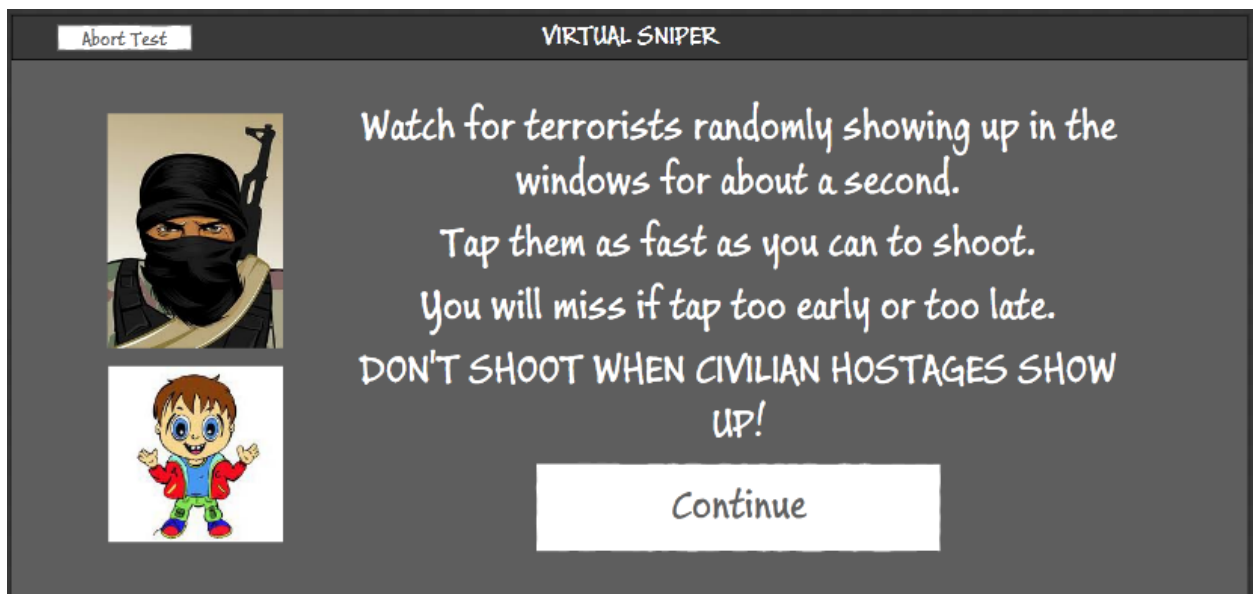
System Actions



This summary displays cumulative game score as well as cumulative counts for all levels of this test.

15. Tap **CONTINUE** button to advance to the next test.

16. Open the following screen:



This screen provides the instructions to perform a recognition reaction time test. There will be five levels of the game providing this type of the test. Each level has a preset number of trials.

User Actions

17. Read the test instructions.
18. Tap **CONTINUE** button.

System Actions

19. Open the following screen:



Depending on the current game level there will be 1 to 5 windows in the building. A figure of the hostile or hostage object will randomly appear in any of them in each trial.

20. Tap the hostiles as quickly as possible.
21. Don't shoot the hostages.

22. Count and display the following parameters throughout the trials of this test in accordance with the game and test description:

- Game Level
- Game Score
- Number of Hits (Good shots)
- Number of Misses (Mistakes)
- Number of Wrong Shots (Shooting at hostages)
- Number of Trials Left
- Reaction Times

23. Upon completion of each level of this test, open the following summary screen:

User Actions

System Actions

Abort Test VIRTUAL SNIPER

Level 06 complete!

Current Score:	580	
Total Trials Played:	20	
Reaction Time (ms):	198	
False Reactions:	2	10%
Missed Reactions:	1	5%
Wrong Reactions:	1	5%
Total Mistakes:	4	20%


Continue

This summary displays cumulative game score as well as cumulative counts for all levels of this test.

24. Tap **CONTINUE** button to advance to the next test.

25. Open the following screen:

Abort Test VIRTUAL SNIPER



Watch for single terrorists or armored groups randomly showing up in the windows.
Shoot single targets with single taps.
Launch grenades at armored groups with double-taps.
You will miss if tap too early or too late.

Continue

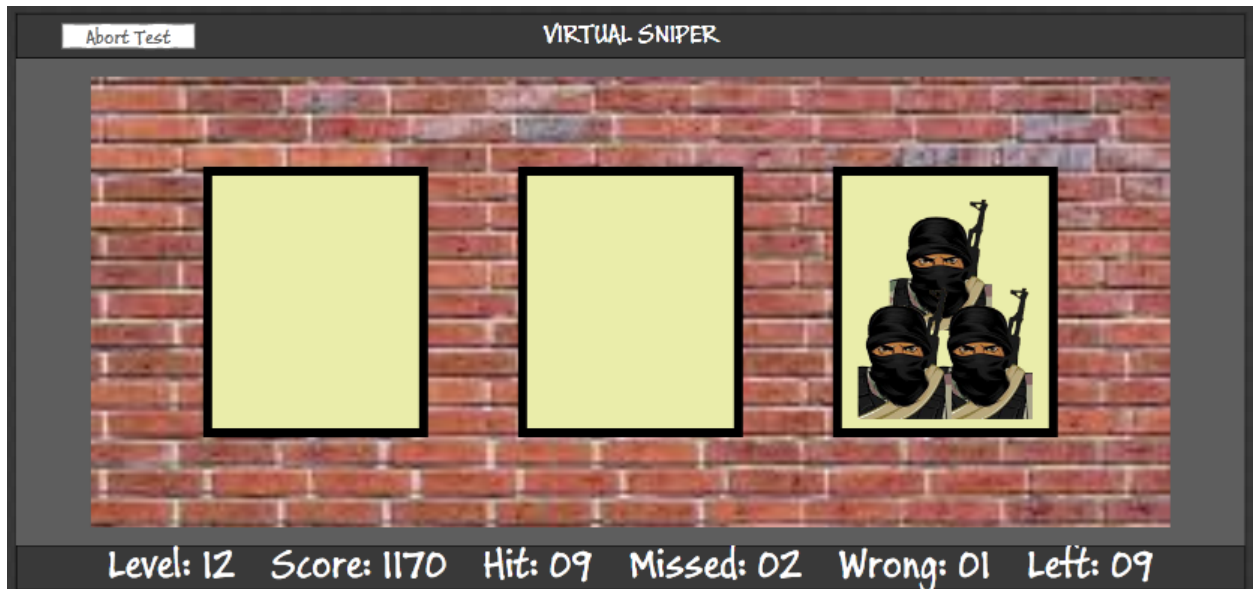
This screen provides the instructions to perform a choice reaction time test. There will be five levels of the game providing this type of the test. Each level has a preset number of trials.

User Actions

26. Read the test instructions.
27. Tap **CONTINUE** button.

System Actions

28. Open the following screen:



Depending on the current game level there will be 1 to 5 windows in the building. A single figure of the hostile or a group of armored hostiles will randomly appear in any of them in each trial.

User Actions

29. Tap the single hostiles as quickly as possible.
30. Double-tap the groups of armored hostiles to shoot them with grenades.

System Actions

31. Count and display the following parameters throughout the trials of this test in accordance with the game and test description:
 - Game Level
 - Game Score
 - Number of Hits (Good shots)
 - Number of Misses (Mistakes)
 - Number of Wrong Shots (Shooting with a wrong weapon)
 - Number of Trials Left
 - Reaction Times
32. Upon completion of each level of this test, open the following summary screen:



This summary displays cumulative game score as well as cumulative counts for all levels of this test.

33. Tap **CONTINUE** button to advance to the next test.


34. Open the following screen:

User Actions


System Actions

Abort Test

VIRTUAL SNIPER



Multiple people will randomly show up in the windows. Only one of them is a terrorist.
Find the terrorist as quickly as possible and shoot him with a single tap.
You will miss if tap too early or too late.



Continue

This screen provides the instructions to perform a selective attention test. There will be only one level of the game providing this type of the test. It has a preset number of trials.


35. Read the test instructions.

36. Tap **CONTINUE** button.

37. Open the following screen:

Abort Test

VIRTUAL SNIPER



Level: 16 Score: 1530 Hit: 08 Missed: 02 Wrong: 01 Left: 10

There will be 9 windows in the building. A single figure will appear in each window but only one of them will be a hostile.

User Actions

38. Tap the single hostiles as quickly as possible.

System Actions

39. Count and display the following parameters throughout the trials of this test in accordance with the game and test description:

- Game Level
- Game Score
- Number of Hits (Good shots)
- Number of Misses (Mistakes)
- Number of Wrong Shots (Shooting at hostages)
- Number of Trials Left
- Reaction Times

40. Upon completion of each level of this test, open the following summary screen:



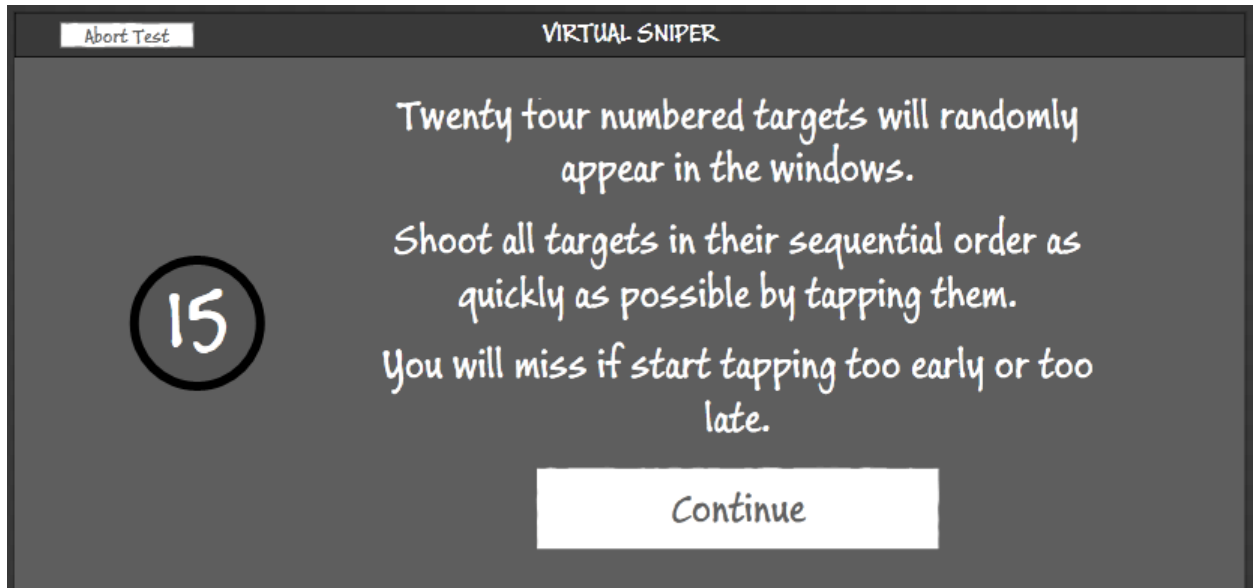
This summary displays cumulative game score as well as cumulative counts for this test.

41. Tap **CONTINUE** button to advance to the next test.

42. Open the following screen:

User Actions

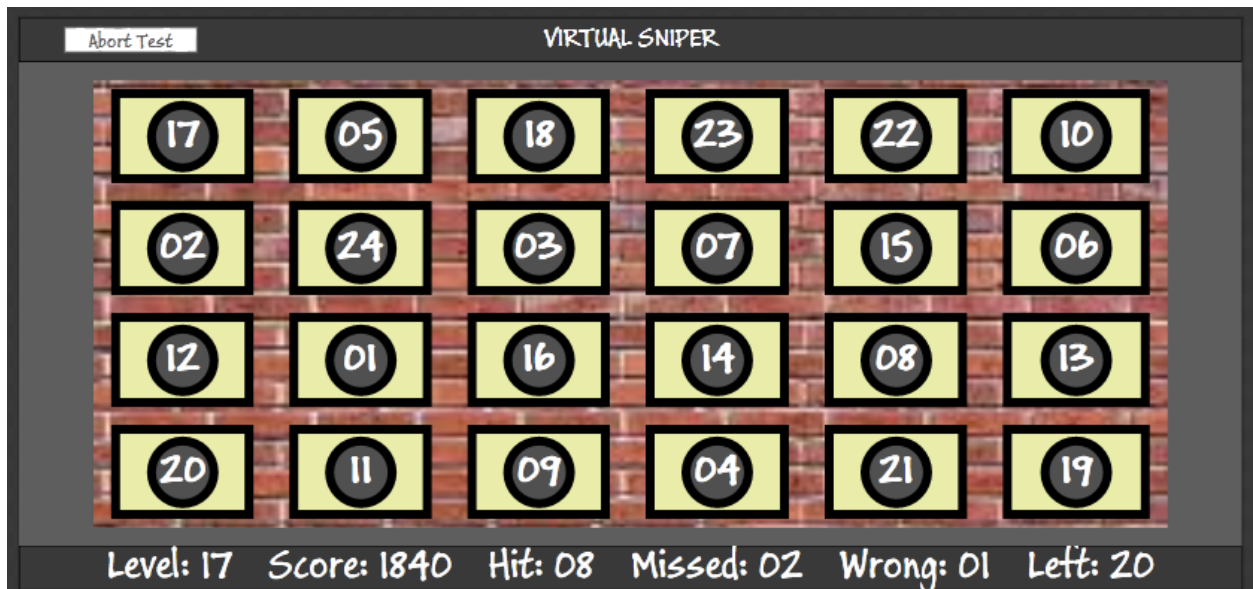
System Actions



This screen provides the instructions to perform a sustained attention test. There will be only one level of the game providing this type of the test. It has a preset large number of trials to ensure challenging the sustained performance.

43. Read the test instructions.
44. Tap **CONTINUE** button.

45. Open the following screen:



There will be 24 windows in the building. A numbered target will appear in each window. The numbers are randomly distributed among the targets.

User Actions

46. Tap all targets in their ascending sequential order as quickly as possible.

System Actions

47. The trial will be immediately terminated once the order of numbers is broken.
48. Count and display the following parameters throughout the trials of this test in accordance with the game and test description:
- Game Level
 - Game Score
 - Number of Hits (Successfully completed trials)
 - Number of Misses (Mistakes)
 - Number of Wrong Shots (Broken orders)
 - Number of Trials Left
 - Reaction Times
 - Sustained Duration
49. Upon completion of each level of this test, open the following summary screen:



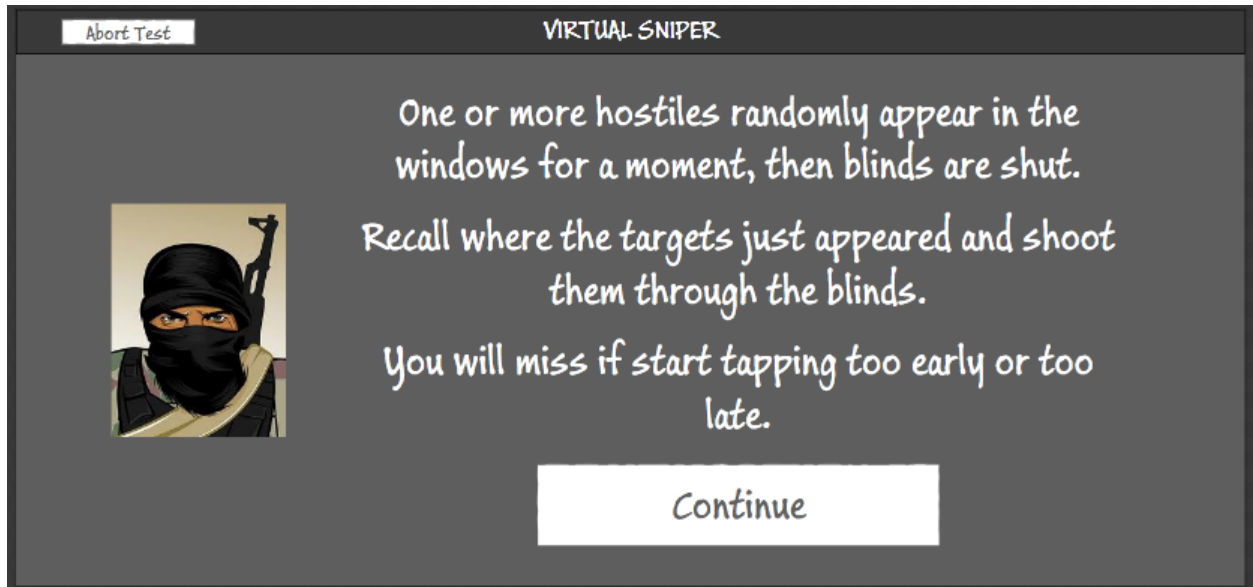
This summary displays cumulative game score as well as cumulative counts for this test.

User Actions

50. Tap **CONTINUE** button to advance to the next test.

System Actions

51. Open the following screen:

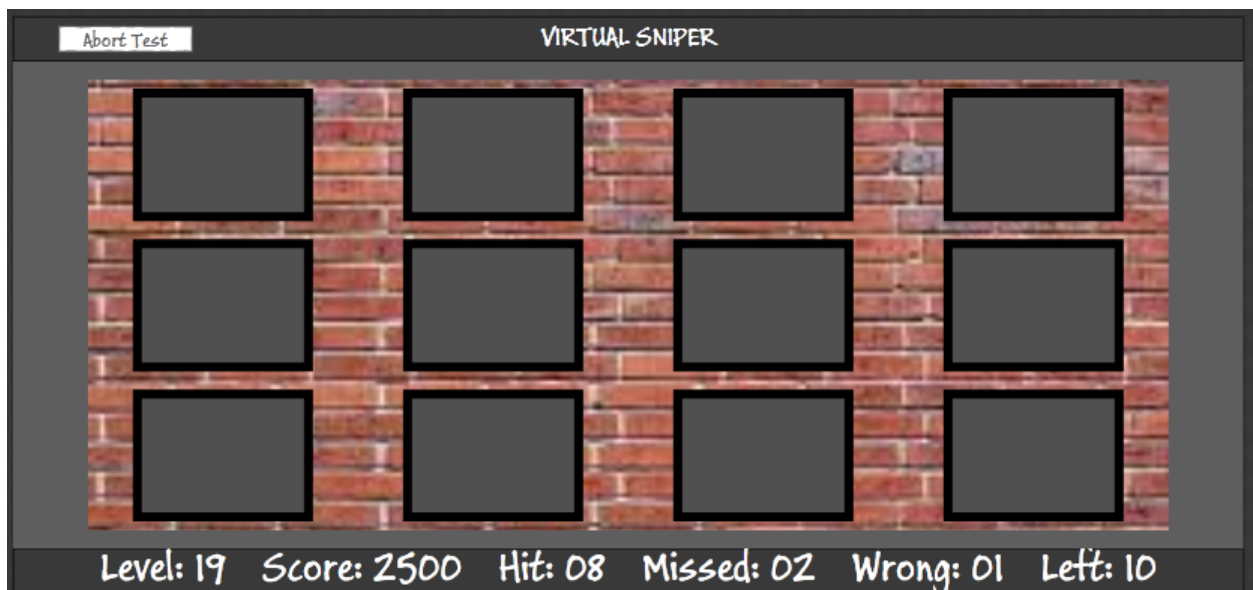


This screen provides the instructions to perform an attention capacity test. There will be five levels of the game providing this type of the test. Each level has a preset number of trials.

52. Read the test instructions.

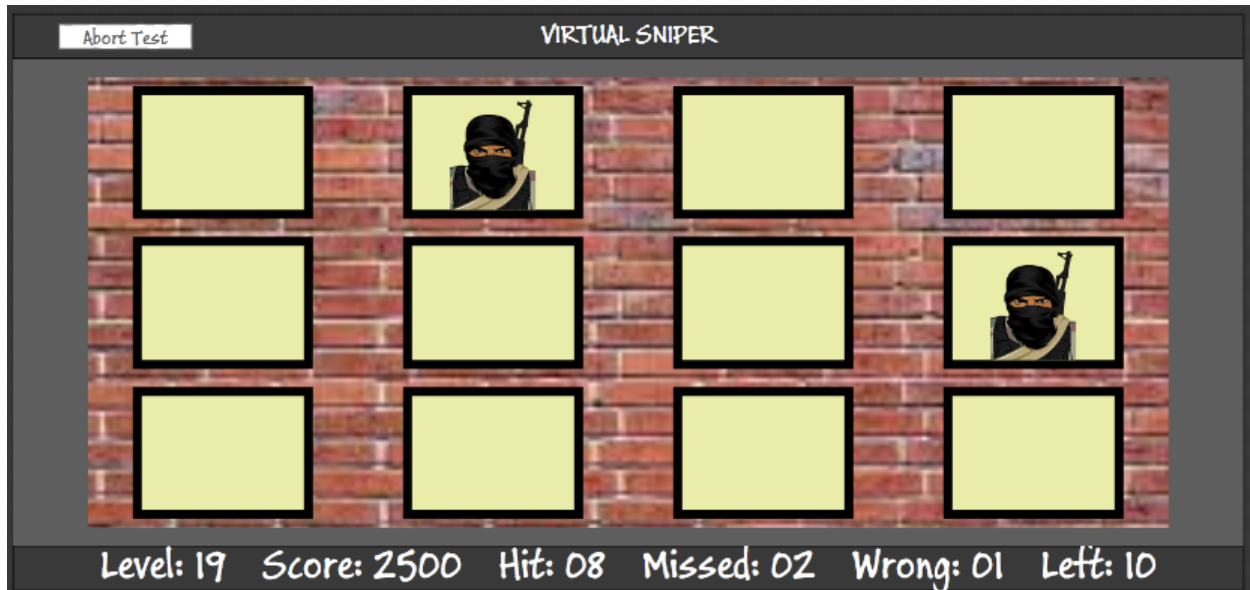
53. Tap **CONTINUE** button.

54. Open the following screen:



User Actions

System Actions



There will be 12 windows in the building. All windows are normally with shut blinds. At random moments all blinds suddenly open showing from 1 to 5 hostiles randomly distributed among the windows. The number of hostiles starts with one and increases with each next level of the game. After a preset time all blinds are momentarily shut again hiding the hostiles.

55. Recall the positions of the hostiles.
56. Tap respective windows as quickly as possible to shoot the hostiles through the blinds.

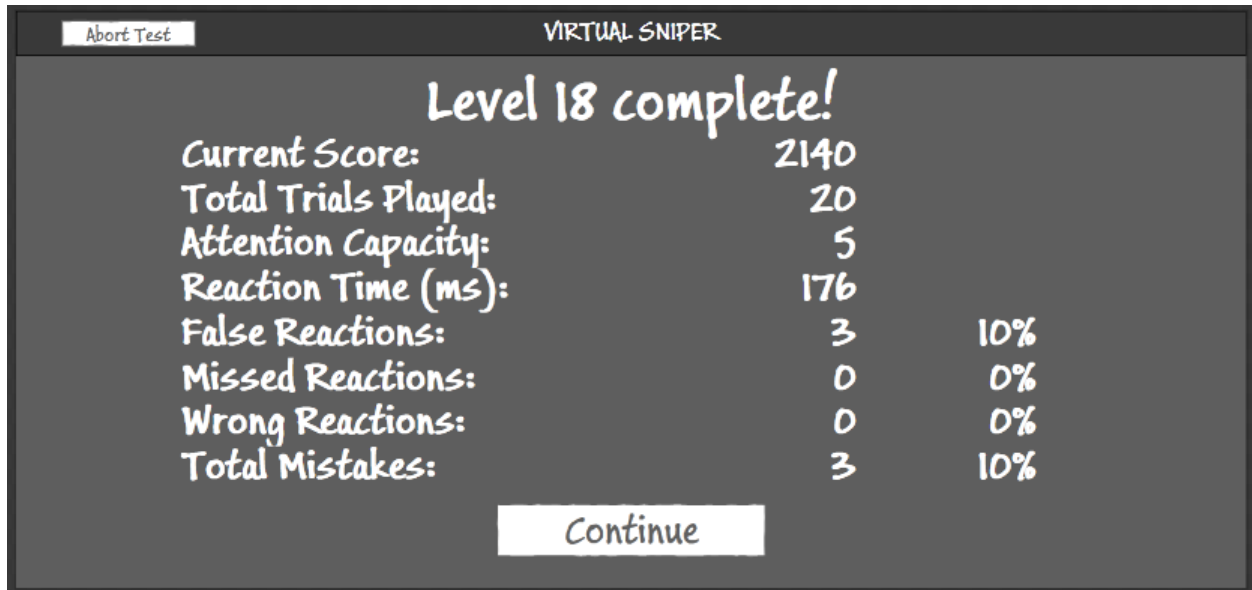
57. Count and display the following parameters throughout the trials of this test in accordance with the game and test description:

- Game Level
- Game Score
- Number of Hits (Successfully completed trials)
- Number of Misses (Mistakes)
- Number of Wrong Shots (Shooting at empty windows)
- Number of Trials Left
- Reaction Times
- Attention Capacity

58. Upon completion of each level of this test, open the following summary screen:

User Actions

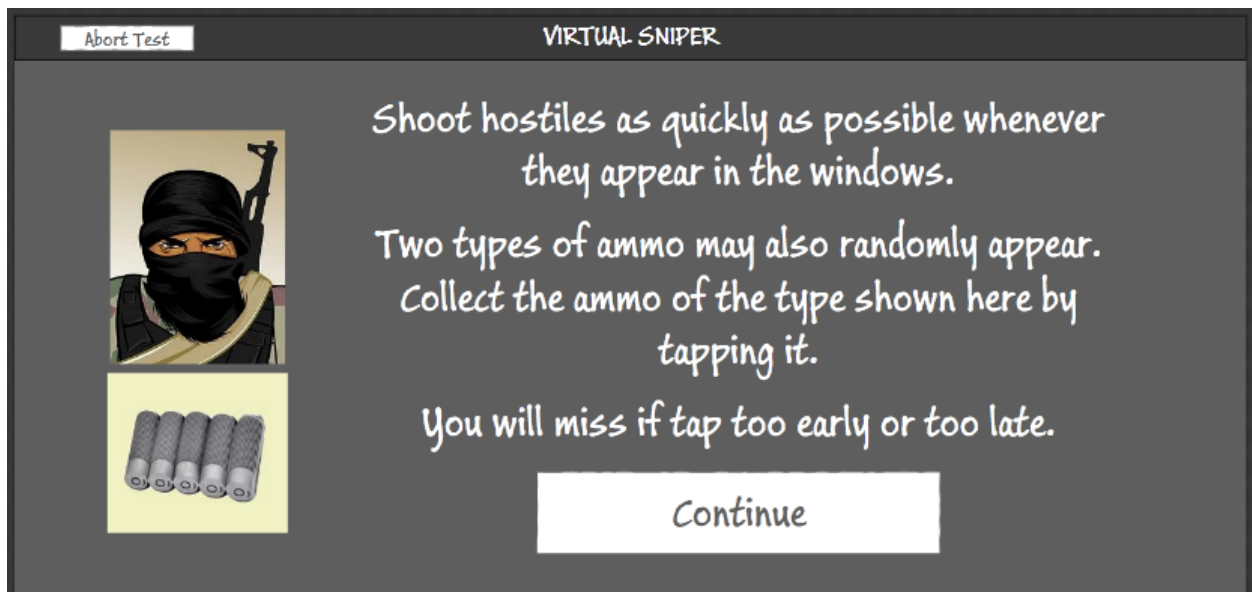
System Actions



This summary displays cumulative game score as well as cumulative counts for all levels of this test.

59. Tap **CONTINUE** button to advance to the next test.

60. Open the following screen:



This screen provides the instructions to perform a divided attention test. There will be one level of the game providing this type of the test with a preset number of trials.

User Actions

61. Read the test instructions.
62. Tap **CONTINUE** button.

System Actions

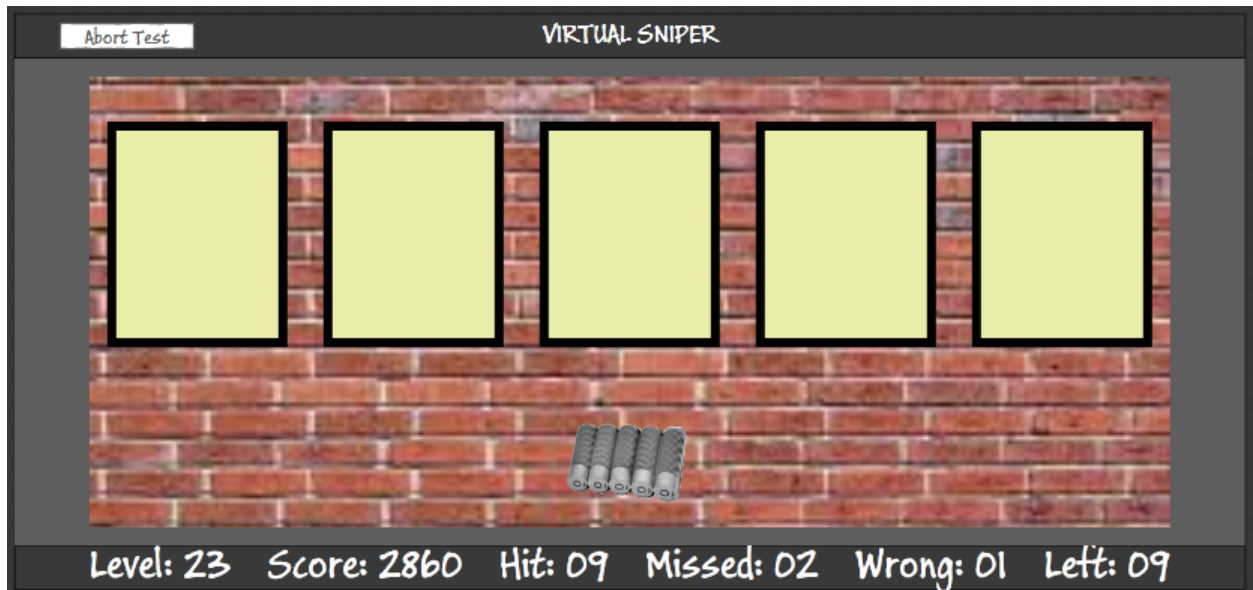
63. Open the following screen:



There will be 5 windows in the building. A figure of the hostile will randomly appear in any of them in each trial.

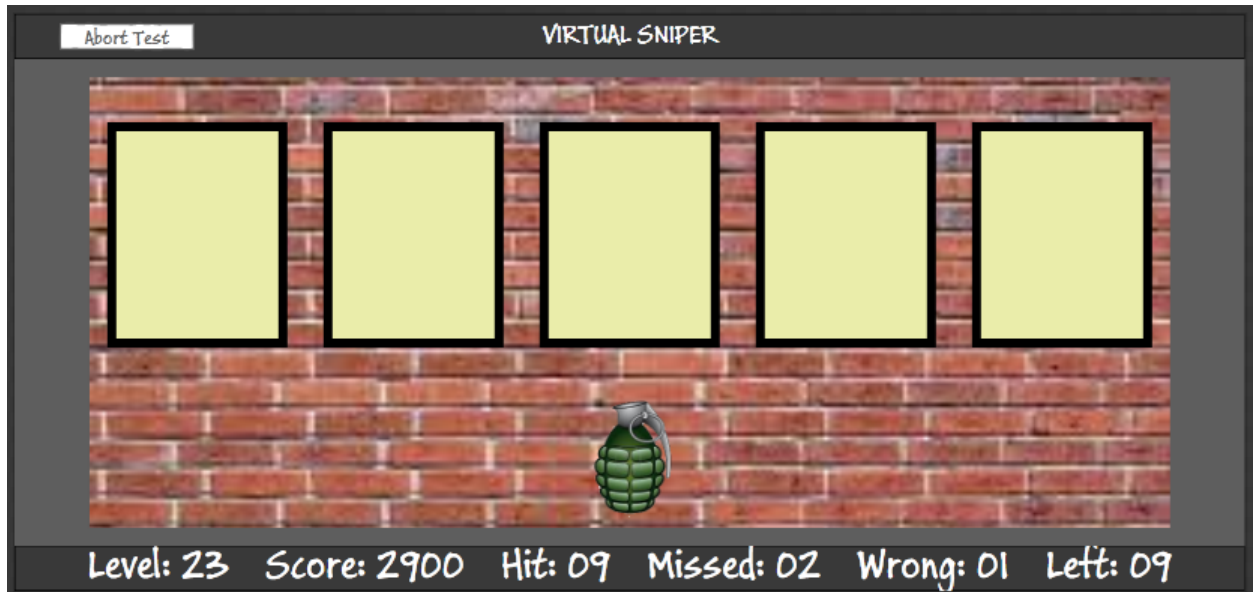
64. Tap the hostiles as quickly as possible.

65. Also from time to time one of two types of ammos will concurrently appear on the screen:



User Actions

System Actions



66. Tap the ammos of the first type.

67. Don't tap the ammos of the second type.

68. Count and display the following parameters throughout the trials of this test in accordance with the game and test description:

- Game Level
- Game Score
- Number of Hits (Successful shots and ammo picks)
- Number of Misses (Mistakes)
- Number of Wrong Shots (Wrong ammo picks)
- Number of Trials Left
- Reaction Times

69. Upon completion of each level of this test, open the following summary screen:

User Actions

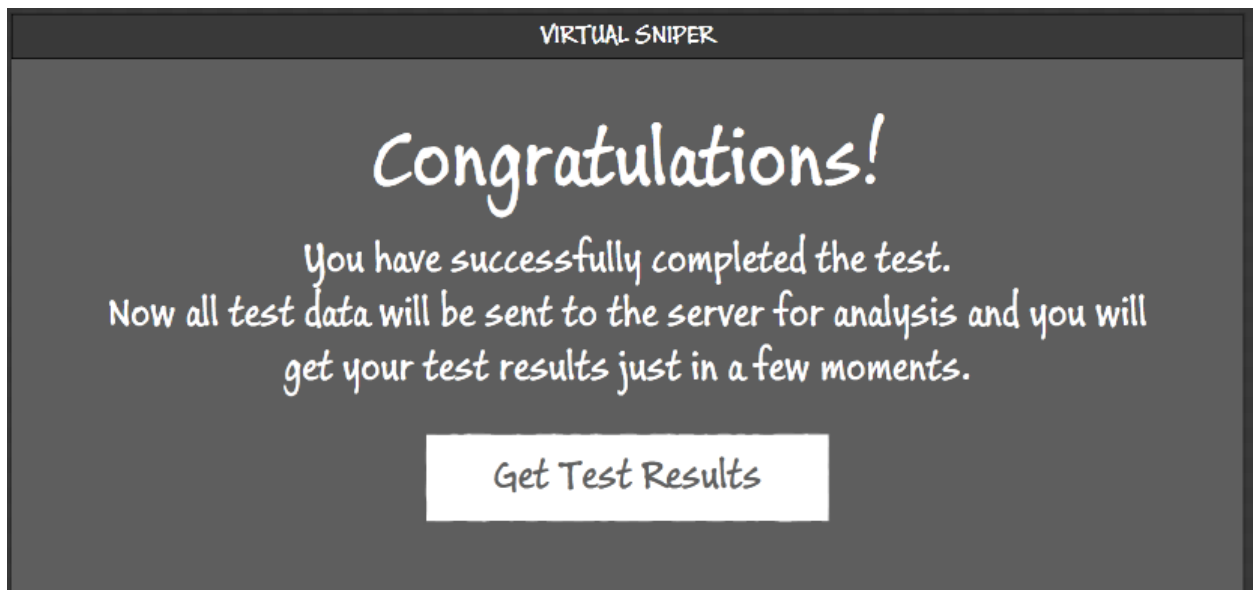
System Actions



This summary displays cumulative game score as well as cumulative counts for all levels of this test.

70. Tap **CONTINUE** button to conclude the test.

71. Open the following screen:



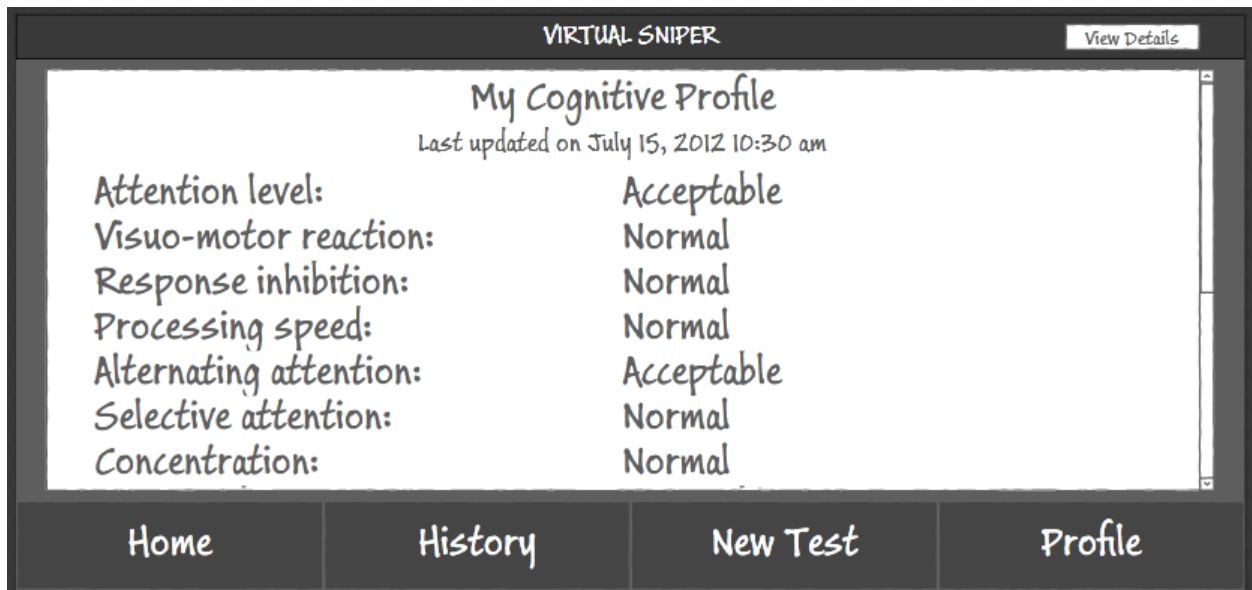
Now the test is over.

User Actions	System Actions
72. Tap GET TEST RESULTS button.	73. Send collected test data to the server. 74. Perform data analysis. 75. Save data and results in the database. 76. Retrieve the results and put them in the view form. 77. Return to the home screen and display test results.

5.3.7. Viewing Last Test Results

To view the results of your neurocognitive assessment, you must be on the home screen.

User Actions	System Actions
1. Get to the home screen.	2. Retrieve the last test results and initialize the view. 3. Open the following screen:

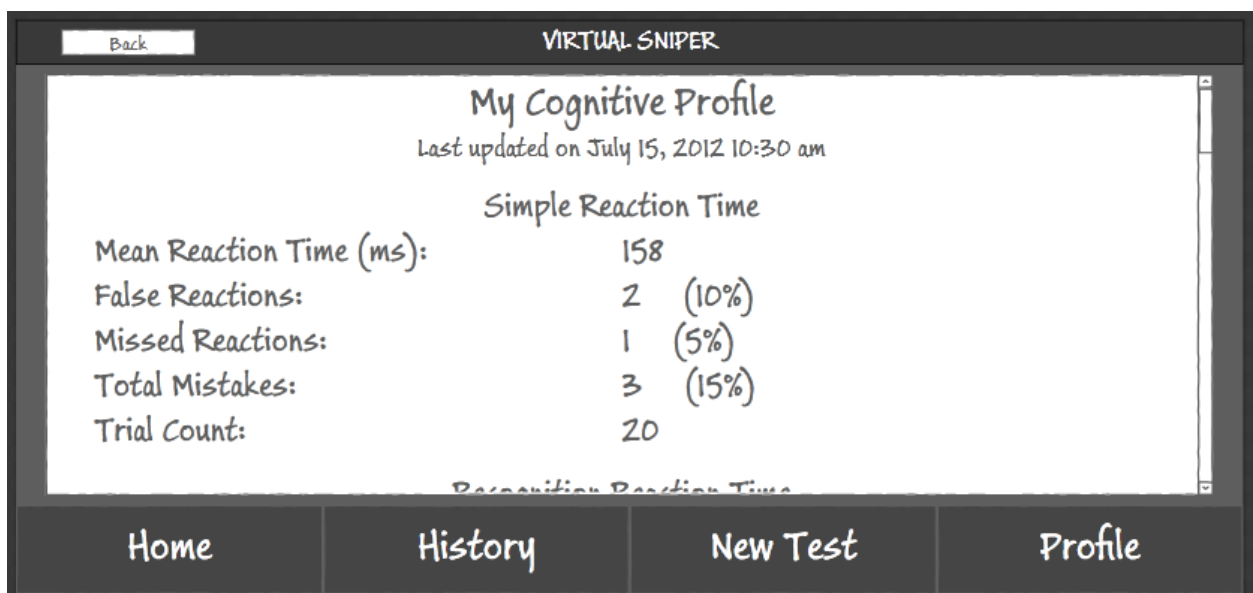


User Actions

System Actions

The home screen always shows the results of the last test. In fact it shows the results of analysis of the collected test data providing the information about various cognitive functions. This information is provided by the server (a) upon completing the analysis of the last new test data or (b) upon logging onto the system.

4. Scroll the view up and down to see all test results.
5. Tap **VIEW DETAILS** button.
6. Open the following screen:



7. Scroll the view up and down to see all test data.
8. Tap **BACK** button.
9. Return to the home screen.

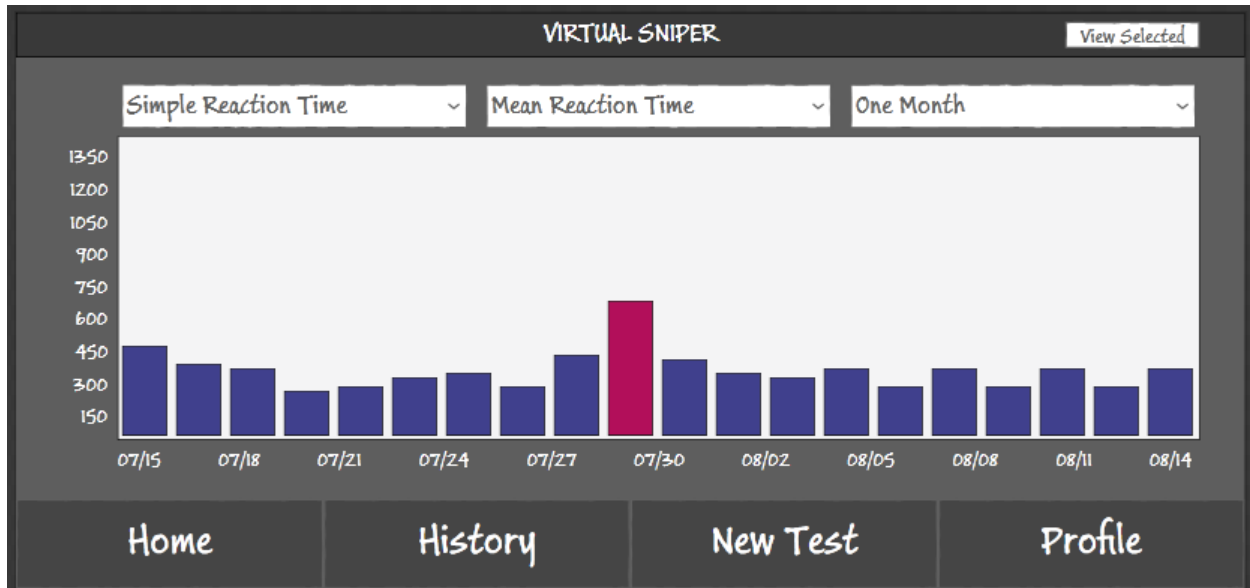
5.3.8. Viewing Test History

To view the history of all test results, you must be on the home screen.

User Actions

System Actions

1. Get to the home screen.
2. Tap **HISTORY** button.
3. Retrieve all available test data and assessment results from the database and initialize the view.
4. Open the following screen:



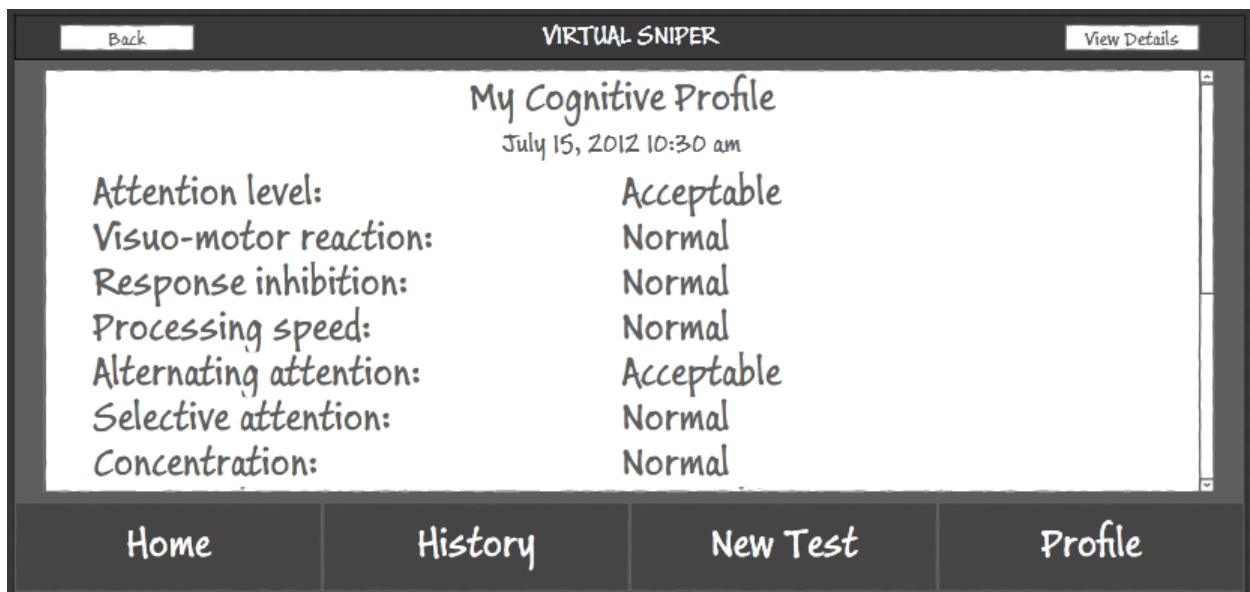
This screen displays a bar chart showing the history of one selected test parameter within certain time range.

5. Use the test type dropdown menu (when necessary) to select any of the following test types integrated in the assessment:
 - Simple Reaction Time
 - Recognition Reaction Time
 - Choice Reaction Time
 - Selective Attention
 - Sustained Attention
 - Attention Capacity
 - Divided Attention
6. Update the history chart showing the most recent testing history.
7. Use the test parameter dropdown menu (when necessary) to select any of the test parameters specific to the selected test type.
8. Update the history chart showing the most recent testing history.

User Actions

System Actions

9. Use the time range dropdown menu (when necessary) to select any of the following time ranges:
 - One Month
 - Three Months
 - Six Months
 - One Year
 - Three Years
11. Sweep the chart left or right to view the history if the existing data does not fit the screen.
13. Tap any bar on the chart to select it for viewing the results of the selected test.
14. Tap **VIEW SELECTED** button.
10. Update the history chart showing the most recent testing history.
12. Update the history chart.
15. Get test data of the selected test.
16. Open the following screen:



This screen shows the results of the selected test. In fact it shows the results of the analysis of collected test data providing the information about various cognitive functions. This information is provided by the server along with the test data.

17. Tap **BACK** button.

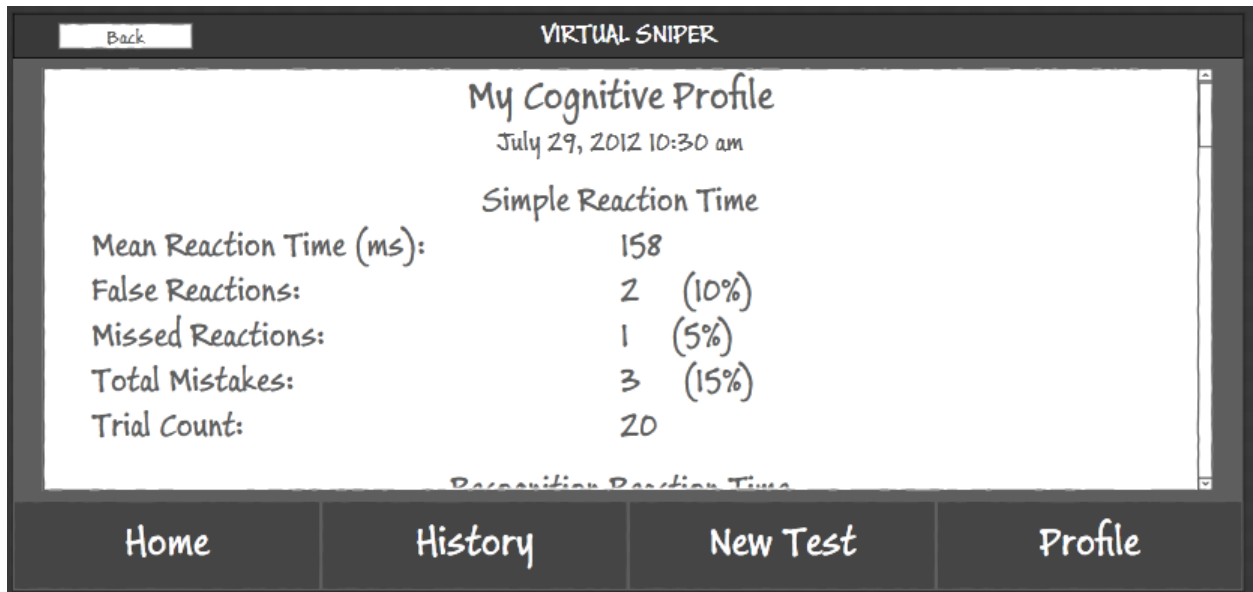
18. Return to the history chart screen.

User Actions

19. Scroll the view up and down to see all test results.
20. Tap **VIEW DETAILS** button.

System Actions

21. Open the following screen:



22. Tap **BACK** button.

23. Return to the selected results screen.

24. Scroll the view up and down to see all test data.

