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ASSISTED PROCEDURE FOR MONITORING AND IMPROVING OCULO-MOTOR BEHAVIOR FOR PRESCHOOL CHILDREN

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Abstract: *The paper presents a new and efficient method to evaluate both the visual field and acuity and body equilibrium for children aged between 4 and 7 years, in order to detect and to correct any problems at an age when it can be done very effectively yet. The method invokes to test the children by inducing an imbalance, different degree, while he has to react to different stimuli. The originality of the research refers to the software interface for generating light stimuli as virtual LEDs and for the children reaction evaluation, associated to the way in which the different degree of destabilization can be induced. This method proved to be efficient one and it could be successfully applied in the future in scholar or kindergarten screening activities*

Key words: *stimulus, LED, visual acuity, equilibrium*

1. Introduction

Visual acuity and body equilibrium both play a crucial role in the life quality, referring to the safety, comfort and efficiency. For this reason, any ocular pathologies or body stability diseases affect strongly negatively the life quality. By the point of view of the vision quality, the chromatically and 3D view are strictly related to the human eye health and to a good correlation between both eyes [1], [2]. Another important aspect related to the visual function is the visual field, especially the central and peripheral vision and accommodation capacity, for a better perception and identification of the 3D objects [3].

On the other side, the body equilibrium is very important, it being strongly influenced by the center of mass, considering also the weight of the segments arms and legs [4]. From this point of view, the body equilibrium is affected by the support base, the stability depending on the base support surface [4], [5], [6]. As a result, the research has focused on a growing extent in the last years on the monitoring and improving the vestibular and motor system for the equilibrium preservation in case of the head movement [7], [8].

Both visual acuity and body equilibrium are interrelated, some diseases of the visual system can influence the stability when standing and walking to an extent equal to or even higher than some mechanical disturbances, such as vibrations [9].

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If for adults such as vision or balance problems are very difficult and too late to be solved, for children it can be effectively and successfully corrected in time. By the point of view of vision function, the strabismus and amblyopia are the most known diseases that can be solved due to some visual training exercises [10]. In terms of body equilibrium and balance, the method of training and sportive activities practicing proved to be very efficient, especially for children [11], [12].

2. Used equipment and applied procedure

Due to the fact that for children the rehabilitation in case of any diseases on visual system or body equilibrium proved to be much easier, more and more studies have focused on this topic. More exactly, more and more research has been dedicated to develop and to apply different efficient methods to prevent and to solve this kind of problems among children.

In this idea, our research focused on developing a new method for children evaluation standpoint vision function versus body equilibrium. The aim is to find if this could or not to be applied as screening procedure in the future. In this order, the research is focused to apply the proposed method for children aged between 4 and 7 years. The reason for establishing this category of age is that in this period the correction of any vision or body equilibrium problems is the most efficient. Until now, the proposed method was applied to a child, aged 4.5 years, two issues being tracked. First was to test the visual acuity and field and second to determine the reaction time, these in condition of different degrees of instability inducing.

This proposed method was tested to the boy of 4.5 years, using two main equipments: a destabilization system, as a plate with 3 degrees of difficulty (figure 1): by destabilizing in one plane (lateral or sagittal) (figure 1,a), in two planes (both lateral and sagittal) (figure 1, b) and total destabilization (figure 1,c), meaning four different degrees of destabilization. Taking into account the established testing methodology, thus means that each evaluation session invoked 12 tests cycles (three different positions for each degree of destabilization). A time of 3 minutes was established for each testing cycle. The reason for which the timing was established to be of 3 minutes was that it could be enough for a complete test of the visual field and acuity. For lower timing, the rate would be too alert one for a child and the test would be irrelevant related to the visual function. A greater timing would have led to the child's risk of boredom during the test.

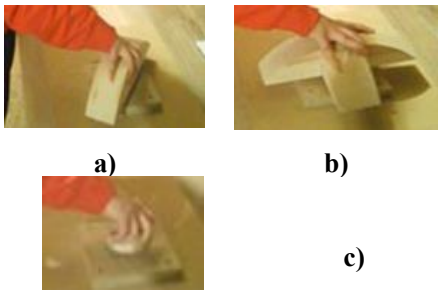

Fig. 1. *The used destabilization system*

The second indispensable equipment was a Laptop, Intel Core i3 processor, 2.4 GHz, on which were performed some tests on visual acuity and field in different condition of destabilization (figure 2).

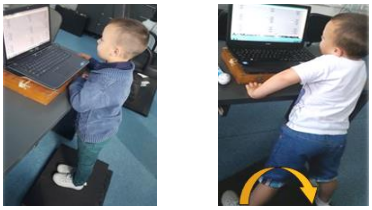

Fig. 2 *The used Laptop for the tests*

For a proper and complete evaluation it was proceed to test the child three times per day: in the morning, in the afternoon and in the evening, in similar conditions, meaning three test sessions. One test session consisted of acuity and visual field testing by inducing different degrees of destabilization: in the first step, without any kind of destabilization, then using the first destabilization element (figure 1,a), the second destabilization element (figure 1,b) and the total destabilization element (figure 1,c). Each testing step was achieved by disposing on the destabilization board, in three positions (small base, figure 3,a, medium base, figure 3,b and large base, figure 3,c). To apply the proposed method, a convention was established, related to the childôs age: for less than 5 years, he allowed to lean table, otherwise he not allowed.

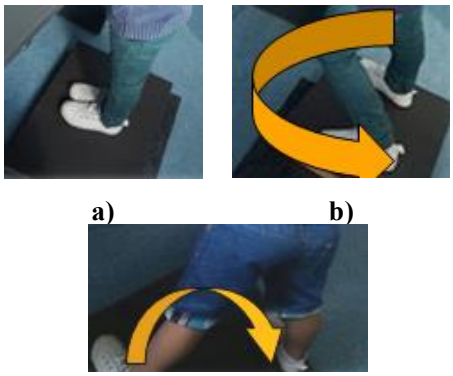

Fig. 3. *Disposing in the three position on the destabilization plate*

Referring to the test, the evaluation method proposed to establish the following procedure for a test cycle: the child had to see and to react of a randomly virtual light stimulus. For the test relevance, it was established a number of 9 stimuli (as virtual LEDs), disposed on the entire laptopôs screen, these being of different colours and light intensity. On the top were disposed the LEDs high intensity, on the middle the LEDs with medium intensity and on the bottom the LEDs of minimum intensity. The most important aspect was that the child did not know at all when and what stimulus will enable the next moment, he must keeping the eyes fixed in the center of the screen all testing cycle long. The child reaction must consist of mouse-click on a virtual micro-switch disposed in the right stimulus activated (figure 4).

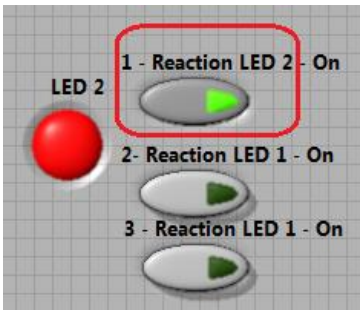

Fig. 4. *Example of virtual switch to validate the perception of light stimulus*

To avoid any situation in which the child could observe the stimulus but he does not have time to react by mouse clicking or in which a decline of attention may occur, the following rule has been established: during a testing cycle, the child may have no more than 3 chances, the same stimulus being able to turn on many times in the cycle.

3. Software interface developing for the testing procedure

The most important aspect of the proposed evaluation method was to develop and to test a software application, as interface, that is one practical, friendly, easy to use by any child, that can be used on a larger sample of children.

For this reason, it was used the LabVIEW graphical programming

environment. As programming, the algorithm was based on using a specific function, referring to a While-Loop conditioning (figure 5). Thus means that while a condition is achieved (cycle test running), the While-Loop structure has to prevent rolling off the test during a cycle.

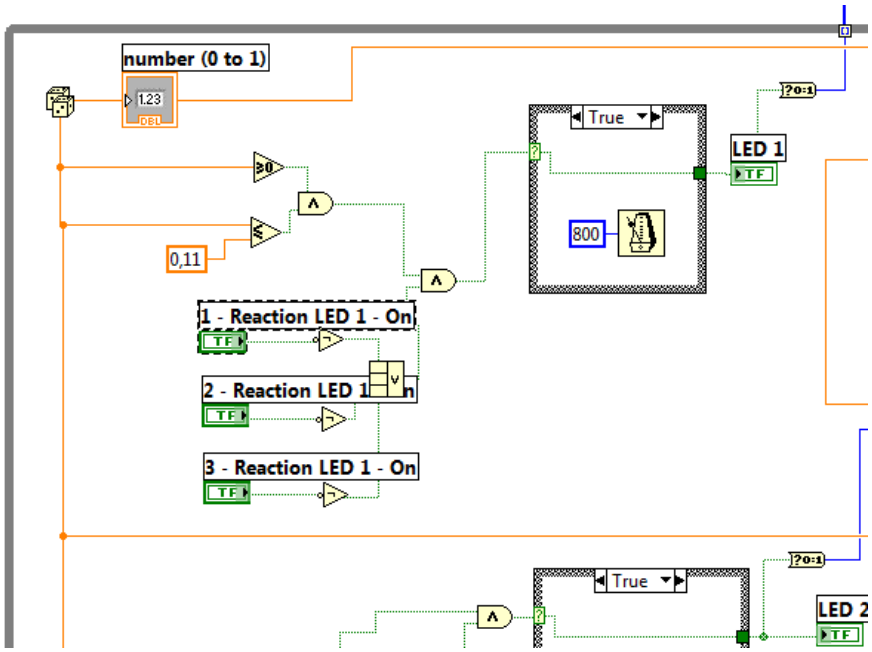

Fig. 5. *The While-Loop main programming structure for continuously testing running*

When the established test timing is over, the cycle stops. For a better timing monitoring, a virtual pulse generator was programmed (figure 6), having a pre-established frequency, which is obtained based on a time constant that defines the tact frequency, calculated in the current moment (*i*). It must be compared with the testôs duration.

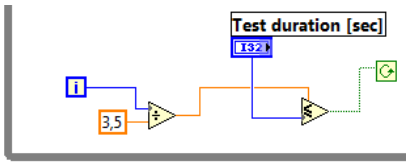

Fig. 6. *The pulse generator for test running conditioning*

while *i* is lower than the test duration, the cycle runs. When *i* becomes equal than the established duration, the test stops automatically. The integer variable *Test Duration* can be set by the user depending on the age category of the tested subject and on the LEDs turning on frequency. If the subject is aged less than 6 years, then the test will last 3 minutes. For ages older than 6 years, the test can last 4 to 6 minutes. Inside the While-Loop structure, it was programmed a mathematical function for random number generation, between 0 and 1. Depending on the current value of the random number, the programming routine sets on (randomly) one of the 9 light stimuli, as state LEDs. A LED is gray if turned off and coloured if

turned on (in function of the random number current value returned, different LEDs can be turned on). It may have a higher or lower contrast, different colour.

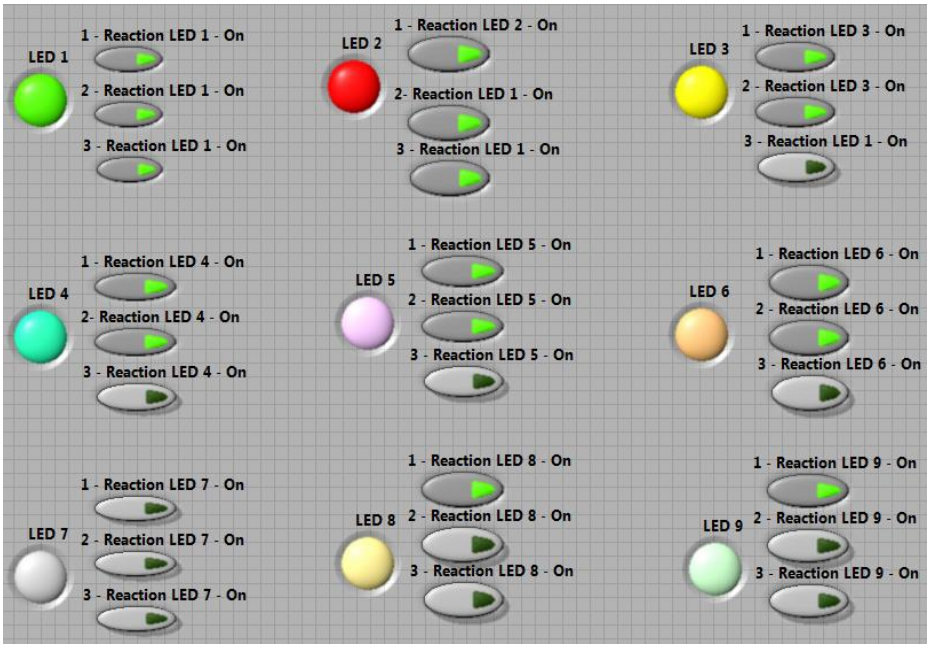

Fig. 7. *The software interface showing the results after a test cycle*

The software interface was built to be a friendly one, attractive to children, for this reason stimuli shape and colour were chosen so as to resemble coloured sprinkles (figure 7).

4. Results and conclusion

It was observed that the child was quite attentive and attracted to the tests, considering these as a computer game. He proved a better attention for the morning session and a weaker attention for the evening session, proved by the number of mistakes. This was explained by the fact that in the morning the subject is more careful and he manifests maximum of interest (being rested).

Due to the test resuming in similar destabilization condition, it was observed (via software interface results after each testing cycle) that for large base the number of mistakes was greater than for small base. Thus has meant that for the tested subject, the better stability and thus better response to the test was for small and medium base.

Referring to the childôs reaction, stability and behaviour, it could be found that he does not have any balance maintaining or visual problems.

As negative aspects it could be observed at a certain time a tendency to cheat: he turned off the micro-switches too much time after the LESs turned on, meaning the risk to affect the evaluationôs accuracy. To solve this kind of problem, the research will propose to improve the software application. Thus could mean introducing some aspects for validation through on mouse micro-switches (this action must

take place in a determined time interval, depending by the childôs ages).

How the tests went and the fact that it was possible to draw clear conclusions very quickly about the health of the child tested led to the following conclusion: In the future, the proposed evaluation method could be successfully for large sample of children, in activities like scholar or pre-scholar screening. These types of activities will be able to focus on prevention. The proposed method could be useful also in casuistic, for special situations related to vision and/or body stability diseases. This kind of activities could address the rehabilitation, very efficient in case of children. In this case, the evaluation procedure will associate to some activities like ocular gymnastics and sportive activities or locomotor recovery (strip or plate walking etc.).

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