ErgoSoft

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ABSTRACT

This project pretends to facilitate the process of knowledge construction of REBA and RULA methods in job analysis evaluation used in ergonomics, all that by using information technologies. Software allows users to evaluate jobs in a graphical and logical way with the purpose of eliminate risks of injuries and accidents with workers, as well as to improve worker's quality of life and increasing job comfort; this can be performed by visualizing and evaluating different corporal positions producing risk conditions or even injuries.

Nowadays educational software is very important in teaching-learning processes. Unfortunately, often this kind of software is very expensive. The purpose of this project is to explore ITCC technological capacities to save time and software costs and, at the same time to gain experience in software development.

RESUMEN

Este proyecto pretende facilitar el proceso de la construcción de conocimiento de los métodos de evaluación de puestos de trabajo REBA y RULA en Ergonomía, utilizando las nuevas tecnologías de la información. El software permite al usuario de una manera grafica y lógica evaluar puestos de trabajo con el fin de eliminar riesgos de lesiones y accidentes a los trabajadores, así como mejorar la calidad de vida de los mismos y aumentar el confort laboral, esto visualizando y evaluando las diferentes posiciones corporales que producen las condiciones de riesgo.

El software educativo es de gran importancia en el proceso enseñanza aprendizaje. Por desgracia muchas veces este software tiene un costo muy alto. Se buscara explotar las capacidades tecnológicas con que cuenta el ITCC para ahorrarse el costo mencionado y al mismo tiempo ganar experiencia en el desarrollo de software.

Palabras clave: *Análisis ergonómico del trabajo, desarrollo de software ergonómico.*

1. INTRODUCTION

The importance of Information and Communications Technologies is undeniable (ICTs), this fact can't be ignored in the education sector; use of this type of technology allows the facilitation of the teaching-learning process. Ernesto Lecourtois in his article "Educational Software Use, Necessity or satisfaction?" mentioned how modern society demands to its citizens to be more and more prepare to challenges that they have to face up in their labor and/or familiar daily life, educators work becomes the pillar on which the transformation of the future generations rests, generations that successfully know how to confront assigned tasks to them; a tool helpful to fulfill this challenge definitively is the computer, this allows educators to develop new learning methods; on this point it is where educational software is pertinent.

At the moment we are facing transcendental technological consequences that force social changes, use of new technologies is more accelerated day by day; it is mentioned with insistence that this is a knowledge society, understood this as the behavior of better informed people with an uncertain future but decided to face up the challenges. Multidisciplinary concept is present in educators and students because it reflects its presence in any place and time.

The Mexican 2007-2012 Sectorial Education Program, establishes in its third objective that: "To impel the development and use of information and communication technologies in the educative system to support the learning of the students, to extend their competences in life and to favor their insertion in the society of the knowledge" and determines: "Didactic use of information and communication technologies, so that Mexico participates successfully in the society of the knowledge. Investigation, scientific and technological development and incorporation of technologies in the classrooms to support learning of the students will be promoted widely. Scientific and technological formation will be fortified starting from basic education, thus, this will contribute to the development of activities of investigation and production in these fields in Mexico"

Educative software is defined as "software destined to schooling and auto learning and, in addition, it allows the development of certain cognitive abilities, as well as it makes depth differences between existent pedagogical philosophies, thus, there are a wide range of approaches for creation of educative software taking in consideration different types of interaction that would have to exist between actors of the teaching-learning process: educator, beginner, knowledge, computer".

At present there are an endless number of investigations that endorse the use of ICTs in the educative process as an important part of the pedagogical process; next, some articles are mentioned:

a. Latapi Sarre, Pablo. (2004). Mexican State educative politic since 1992.
b. López, María; Espinoza de los Monteros, Adolfo and Flores, Katiuzka. (2006). Perception on the information and communication technologies in the educators of a Mexican university: the South University Center of the University of Guadalajara.
c. López, Susana and Flores, Marcelo (2006). The neoliberal educative reforms in Latin America.
d. Lozano Díaz, Antonia (2004). Intelligent classroom: towards a new educative paradigm?
e. Martínez, Rubén; Montero, Yolanda and Pedrosa, María Eugenia. (2001). Computer and classroom activities: some perspectives in the general basic education in Buenos Aires province.
f. Organista, Javier and Backhoff, Eduardo. (2002). Opinion of students on the use of didactic supports on line in a university course.
g. Vázquez, Ángel and Manassero, María Antonia (2007). Extra-curricular activities related to science and the technology.
h. Waldegg Casanova, Guillermina (2002). Use of new technologies for teaching and learning science.

In this paper will be reported an educative software able to facilitate teaching of the ergonomic methods REBA (Rapid Entire Body Assesment) and RULA (Rapid Upper Limb Assesment) for workstations evaluation.

2. EXPOSITION OF THE PROBLEM

The course of Ergonomics is part of the specialty in Quality and Productivity of the Industrial Engineering degree of the Technological Institute of Cuauhtémoc City (ITCC). A fundamental part of this science is job analysis since the results that are obtain give us rules to identify risks of labor injuries and/or points of continuous improvement. In order to obtain these ergonomic analyses there are some techniques, among them the most recognized by its easiness of use are RULA and REBA.

The techniques previously mentioned are taught at present making use of formats and tables that were elaborated for such aim by the authors of these techniques, which represent in fact a learning process of little motivation for students; since nowadays they are used to use keyboard and monitor instead of pencil and paper. On the other hand, once learned the techniques' principles it is needed to look for better means to apply them in a faster and more convenient way and, in this context, is when the use of the Information and Communication techniques are applied.

By mean of the software creation “ErgoSoft” it is pretended to improve the learning process in a classroom, by making use of ICTs, as well as to provide to students a tool in agreement with this time, so that, they can be more effective in their working future.

3. PROJECT JUSTIFICATION

Educative software is very important in the teaching-learning process; unfortunately it is very expensive, most of the time out of budget for a public school. It’s pretended to operate some technological capacities of the ITCC, whereupon this institution could save money improve education, and at the same time, gain experience in software development.

4. SOFTWARE DEVELOPMENT

In this section the development procedure of ErgoSoft will be described.

4.1 DRAWINGS

In order to provide a very intuitive application of the ergonomic methods, a large amount of drawings were performed, the methodology is mention next:

1. Once the three-dimensional human body drawing is obtained from an autocad library (figure 1), it is send to a new autocad document where the necessary changes were made according to the required posture for the ergonomic software.

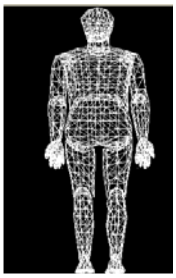

Figure 1. Tridimensional human body image (AUTOCAD)

2. As a following step a different layer is placed in each part of the body, identifying them with colors in order to carry out the task in a more practical and productive way (figure 2).

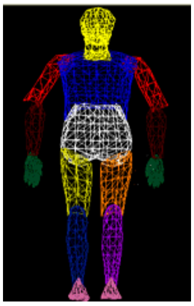

Figure 2. Step 2 in drawings generation process.

3. After having obtained the complete human body with each defined layer, each part of the drawing is cut according to the layer related to the corresponding task, so it can be turn and change according to the wished movements (figure 3).

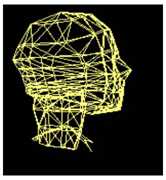

Figure 3. Step 3 in drawings generation process.

4. For this development the command COPY (CO) was used, with this, the drawing is duplicated in a sequence, in order to obtain later, the desire movement (figure 4).

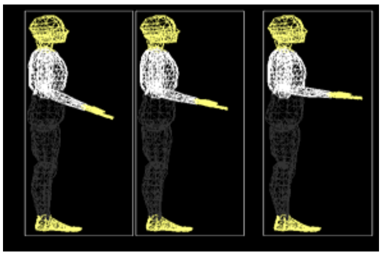

Figure 4. Phase 4 in drawings generation process.

5. For different postures the autocad command ROTATE (RO) is used to give movement to the head without moving body, arms, legs or wrists. By using the tool bar VIEW it facilitates the task of drawing a solid figure (see figure 5).

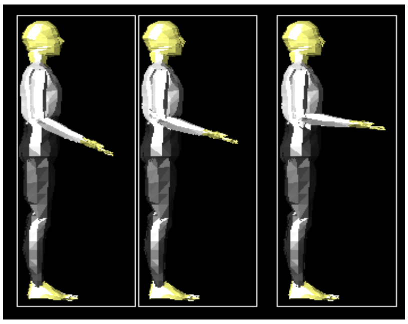

Figure 5. Phase 5 in drawings generation process.

6. When drawings for each movement were finished, they were copied to Paint's Windows Program by using the print screen key on the computer keyboard (figure 6).

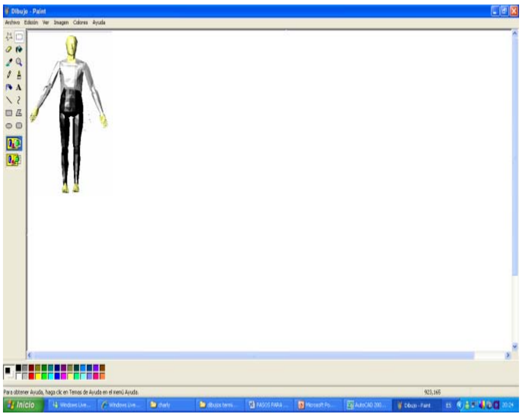

Figure 6. Phase 6 in drawings generation process.

7. Next, each image is cut making it to coincide to a previously determined size pattern (figure 7).

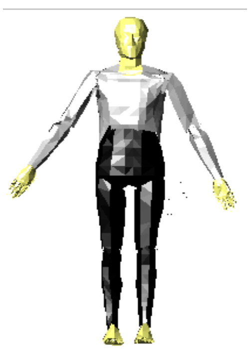

Figure 7. Final drawing example.

8. Once the desired image is obtained it is saved in PNG format for its later use in the ergonomic software (ErgoSoft).

4.2 Development Software Tool

In order to develop ErgoSoft, Visual J# 2005 was used; which is part of the suite of Microsoft Visual Studio 2005. Microsoft Visual J# 2005 allows developers to use the syntax of Java language to generate applications and services that will be executed in the .NET Framework. Visual J# integrates the syntax of Java in the Integrated Development Environment (IDE) of Visual Studio®. Visual J# also admits most of the functionality of J++ 6.0®, including the extensions of Microsoft. Visual J# is not a tool to develop applications that will be executed in a virtual machine of Java. The applications and services generated with Visual J# will be only executed in .NET Framework. Visual J# has been developed independently by Microsoft. It is not authenticated nor approved by Sun Microsystems, Inc.

Due to Visual J# is integrated with the IDE of Visual Studio, programmers of Visual J# can use Visual Studio shells to create services Web XML, pages of Web Forms and Windows Forms applications. The used methodology is that of the object-oriented programming.

The Object-oriented programming (OOP) is a programming paradigm that uses objects and their interactions to design applications and computer programs. It is based on several techniques, including inheritance, modularity, polymorphism and encapsulation. Its use became popular at the beginning of the decade of 1990. At the moment there are many programming languages that support OOP.

4.3 Graphic User Interface

The Graphic User Interface (GUI) is the part of the software which the end user will interact. Consider that the software is in a developing phase and the captured screen may not be representative of the aspect that will have the final software.

The program so far is divided in four main classes per method. The first class is an inherited class of System.Windows.Forms; here there are all the GUI elements. The second form is called data; here there is all data that is handled in the program and also the necessary methods to get to it. Also there is a class called drawings, in which are located the instances that make references to graphical objects and the methods to access to them. Finally the class called file in which are found the required methods to save and open files.

4.4 Results

The first screen when opening ErgoSoft gives the opportunity to select REBA or RULA methods, in this article the REBA method will be explained first, this is the one that is used en positions where the worker uses his entire body or is standing.

REBA

In this section the different screens that are integrated in the REBA part of the educative software will be presented, it is important to mention that each position (when applies) shows a movement that allows the user to choose the position present in the task. The first screen shown when the REBA method is selected (figure 8) is the one that allows the evaluation of the trunk positions, and, in addition to determine if there is torsion or lateral inclination. In the top right part, the score is accumulated according to the selection of positions and in the bottom right part there is a button that has the option to go to the following screen even though the trunk evaluation has not been finished or begun.

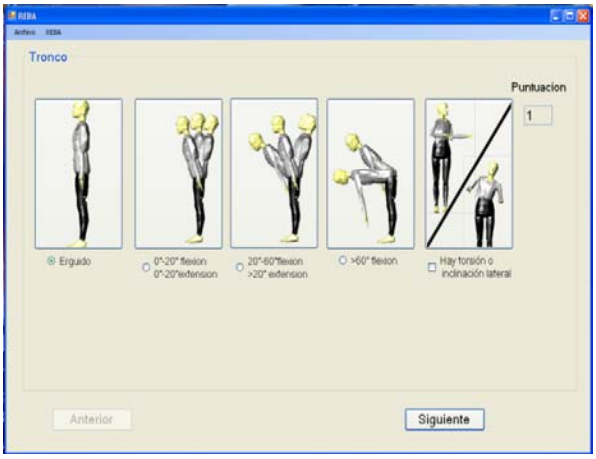

Figure 8. Trunk evaluation screen in REBA.

The following screen is shown in figure 9, it is the one referring to the neck's position, and adding in this screen a button in the bottom left part that allows the user to return to the previous screen.

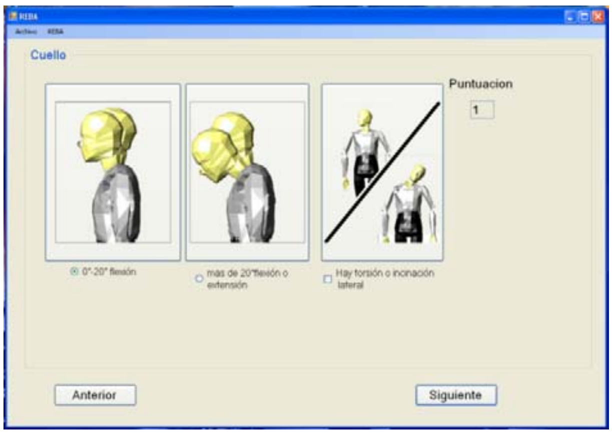

Figure 9. Neck evaluation screen in REBA.

Figure 10 shows the third screen in which the positions of the legs are divided in two parts, first the one referring to the support, and next the one referring to the knees' flexion.

Figure 10. Legs evaluation screen in REBA.

The next screen evaluates the loads and force related to the task, also an extra point is given if the task has fast instauration. In this screen the score is on the top left part of the screen.

Figure 11. Load/Force evaluation screen in REBA.

In the fourth screen (figure 12) four arm positions are presented for their evaluation and also three more positions that included the existence of abduction or rotation, the shoulder rise and the existence of support or posture in favor of gravity.

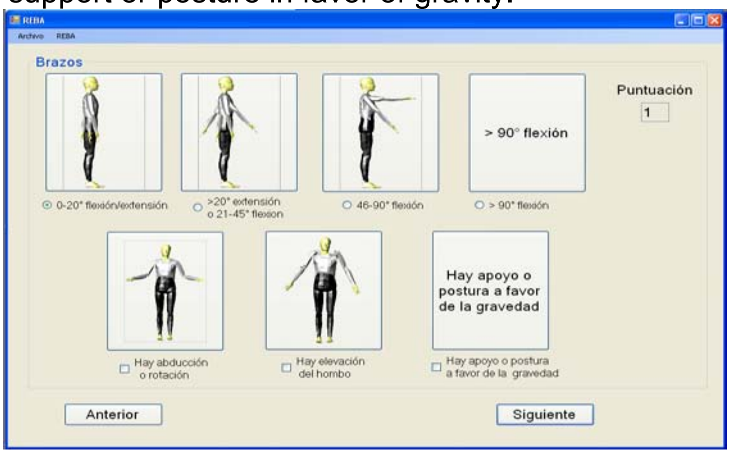

Figure 12. Arms evaluation screen in REBA.

The next screen (figure 13) shows the figures related to forearm position evaluation.

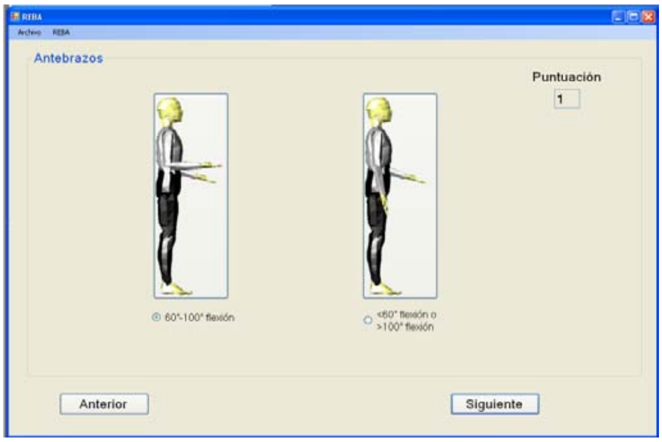

Figure 13. Forearm evaluation screen in REBA.

In the sixth screen (figure 14) wrist positions are evaluated, including extra points if there is wrist torsion or wrist deviation.

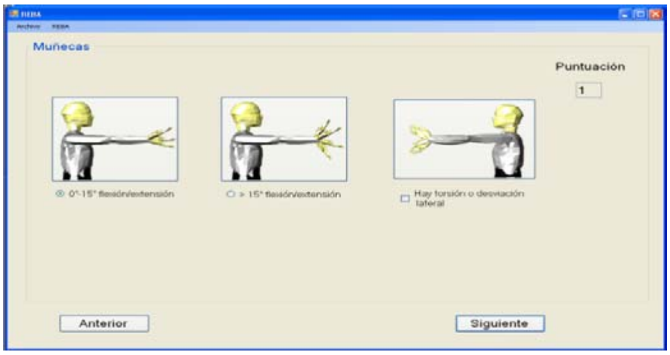

Figure 14. Wrists evaluation screen in REBA.

The following screen (figure 15) implies the evaluation of the holding that goes from a good holding with suitable handles and a strong hold, to an inconvenience and/or uncertain holding for the worker, without handles where the handling is unacceptable using other parts of the body.

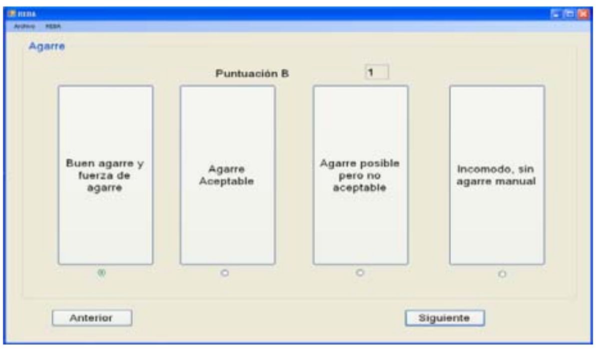

Figure 15. Holding evaluation screen in REBA.

The following screen (figure 16) is the final one, where the conditions in which the activity occurs are evaluated and the final score altogether with the partial scores are presented also the interpretation of the REBA score, which corresponds to a risk level that implies an action as well.

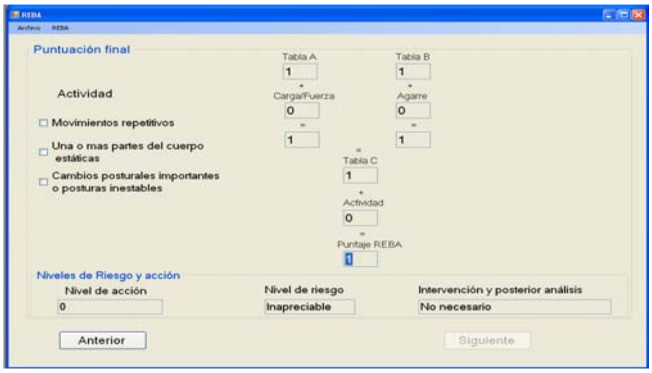

Figure 16. Activity evaluation and final score screen in REBA.

Finally it is important to say that in all screens on the top there is a File Menu (Figure 17) that includes the option to open a new or previous file, as well as the options save and save as and finally the option to quit the program. On the other hand there is a Menu for REBA (Figure 18) that includes the option to go to the different screens that conforms the REBA part of ErgoSoft.

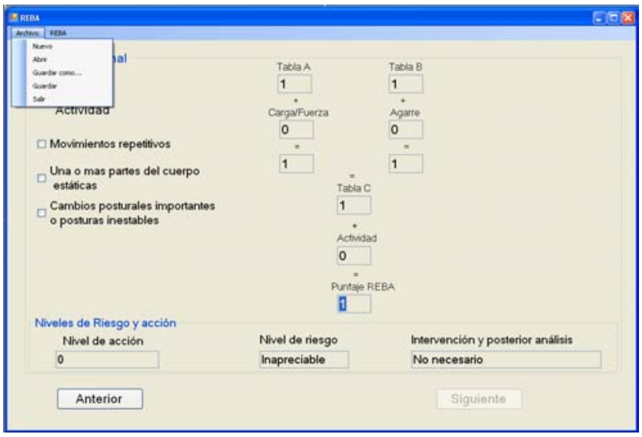

Figure 17. Menu 1 screen in REBA.

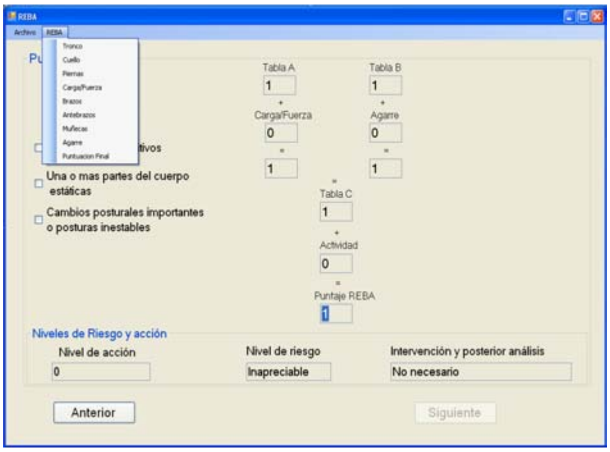

Figure 18. Menu 2 screen in REBA.

RULA

In the first screen (figure 19) four arm positions are shown, also three more options that include the existence of abduction or rotation, rise shoulders and support existence.

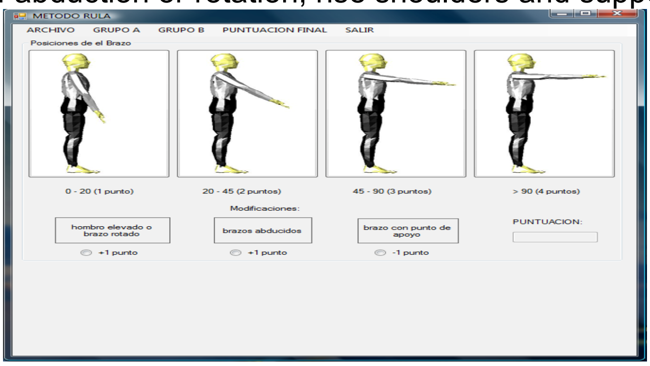

Figure 19. Window to evaluate arms positions in RULA.

In the following screen (figure 20) the position of the forearm is evaluated and an adjustment is made if the arm is working crossing the medium line of the body or if the arm is working outside the corporal area.

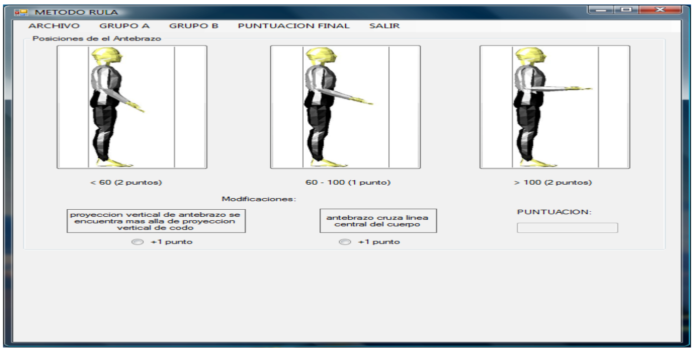

Figure 20. Window to evaluate forearms positions in RULA.

Next screen (figure 21) is where the position of the wrist is evaluated; including the analysis in case of radial or ulnar deviation and if a turn of the wrist exists.

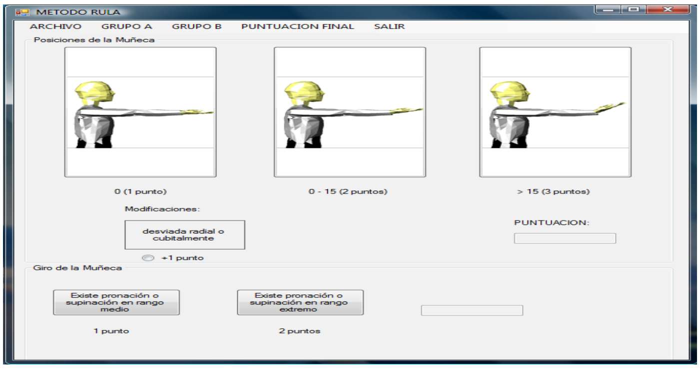

Figure 21. Window to evaluate wrists positions in RULA.

In the fourth screen (figure 22) the options to evaluate the neck are presented, including an adjustment if the neck is turned or inclined to any side.

Figure 22. Window to evaluate neck positions in RULA.

Next (figure 23), the position of the trunk is evaluated, including an adjustment en case of torsion and/or trunk inclination.

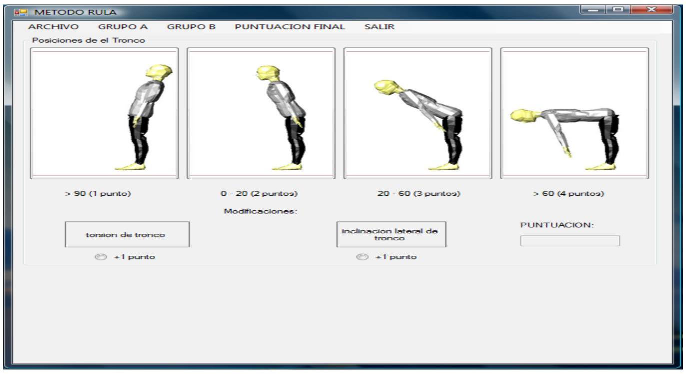

Figure 23. Window to evaluate trunk positions in RULA.

The last window (figure 24) displays the exerted evaluation of muscular activity and loads, as well as the final scores of each one of the body areas and total the final score of the evaluation.

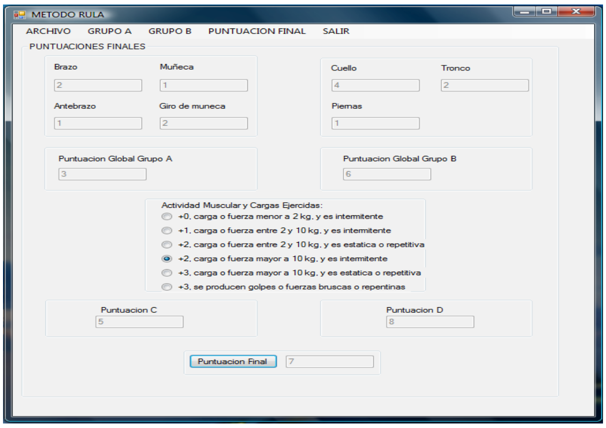

Figure 24. Final score window in RULA.

5. CONCLUSIONS

At the present state of ErgoSoft development the most important achievements are:

- The creation of an ample set of images developed in Autocad, which in conjunction they describe visually the different positions included in the ergonomic evaluation methods.
- An already functional software skeleton developed in Visual Studio 2005, which implements the ergonomic evaluation methods REBA and RULA producing as a final result a table that includes the score for each body part and the corresponding recommendation. This software skeleton is under a permanent improvement process feed with commentaries from ergonomics specialists and the proper software validation process.

- Deep work documentation has been made that will be used to create technical reports, user manuals, etc.; this will allow giving faith of the software capacities.

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