

# Developing Intelligent Software for Diagnosing Computer-Related Health Issues

HSIN-CHIEH WU<sup>a</sup> and TOLY CHEN<sup>b\*</sup>

<sup>a</sup>Department of Industrial Engineering and Management  
Chaoyang University of Technology  
No.168, Jifong East Road, Wufong Township, Taichung County  
Taiwan, R.O.C.

<sup>b</sup>Department of Industrial Engineering and Systems Management  
Feng Chia University  
No. 100, Wenhwa Road, Seatwen, Taichung City  
Taiwan, R.O.C.

[http://home.kimo.com.tw/tolynet/index\\_e.html](http://home.kimo.com.tw/tolynet/index_e.html)

*Abstract:* - In order to prevent the computer-related health problems in computer users, OSHA has developed a computer workstation checklist. This checklist is divided into six parts, including working postures, seat, keyboard/mouse, monitor, work area, and accessories. It can be used to check the health issues of the computer work settings. The developed intelligent software in this study was based on the OSHA's checklist. We added actual pictures to enhance readability. Besides, text modifications were made for fitting the culture in Taiwan. Finally, specific recommendations were designed to be automatically provided by interactive interface after finishing the diagnosing. This software not only helps people to check their computer work settings by themselves but also assists in improvement of the computer-related risk factors while using a computer.

*Key-Words:* - Artificial intelligence; Musculoskeletal disorders; Health care; Ergonomics; Computer users

## 1 Introduction

Because of the development of computer technology, office workers can save the working time and increase the productivity by using computer. With the increase of computer usage, the complaints about musculoskeletal disorders have become more and more in the workplace. Fogleman and Brogmus [1] examined compensation data from 1986 to 1993 and concluded that although computer mouse related claims represented a small proportion of claims for cumulative injuries to the upper extremities, the proportion increased rapidly over that period. Rizzo (1994) indicated that computer-related cumulative trauma disorders (CTDs) was an important occupational hazard of the information age [2]. IOSH (Institute of Occupational Safety and Health) in Taiwan surveyed 125 computer workers and found that 98.4% of them had visual discomfort and about 70% of them had local musculoskeletal disorders [3].

Since computer work only demands little muscle group effort and small energy consumption, it is hard to occur sudden injuries. But the computer work may lead to cumulative-effort traumas. The possible occupational injuries include decreasing eyesight, low back pain, shoulder and neck disorders, carpal tunnel syndrome, and etc. In

general, most people are not aware of the potential risk factors in their usual computer work. Keegan [4] indicated that sitting for a long time with crooked back may lead to low back pain. Prolonged or repetitive exposure to postures involving deviation from neutral joint positions has been associated with development of musculoskeletal discomfort and injury [5].

Besides, there are also other factors, such as unsuitable chair design, no effective support to back, muscle fatigue, and abnormal or unnatural postures, leading to musculoskeletal disorders [6]. In order to prevent computer workers from health problems, this study tried to develop intelligent software, which can help computer users to diagnose the potential risk factors associated with computer work conditions. It was expected to decrease the occurrence possibility of the occupational diseases associated with the computer work.

## 2 Problem Specification

In order to prevent the computer-related health problems, OSHA [7] has developed a computer workstation checklist that comprises six categories, i.e. working postures, seat, monitor, work area,

keyboard/mouse, and accessories. Each category had several queries, and the answer options for each query were 'Yes' and 'No'. If the answer is 'No', it implies that there is a risk factor associated with the corresponding category. Although the OSHA's Computer Workstations Checklist has covered most risk factors about computer work, it still has some drawbacks, as the following statement:

### **2.1 Lack of Interactive Feedback**

After filling all the queries of the OSHA's checklist, the respondent can only know whether there exists any risk factor in the computer work condition, but he/she still can't understand how to improve the unsuitable work condition. At this situation, it's necessary to invite ergonomics specialists to help, but it will spend a lot of time and money.

### **2.2 Evaluation with Paper Checklist**

Nowadays, people usually like to apply the time-saving and money-saving methods in every thing, even using checklist to evaluate the work conditions. The OSHA's checklist can be downloaded as a PDF file, which required to be printed out for checking the possible risk factors in the work settings. If a lot of workers need to be evaluated, it will take great manpower, money, and time. In the economic viewpoint, it is more superior to make evaluations without papers, and the workers can check their work conditions by themselves through a computer-aided tool.

### **2.3 The Description Was Too Difficult**

The content of OSHA's checklist is hard to be understood, because it was designed for ergonomic specialists. General workers may be not able to do self-checking with the OSHA's checklist. In addition, if the checklist can't lead users to evaluate their work condition completely and accurately, the effectiveness of the evaluation results will be questioned.

## **3 Problem Solutions**

This study adopted the Computer Workstations Checklist developed by OSHA as the basis of the computerized diagnosing tool. We tried to develop intelligent self-checking software to solve the above-mentioned three problems. This software was expected to overcome the drawbacks of the OSHA's checklist by the following solutions:

### **3.1 To Increase the Readability**

To simplify the content of OSHA's checklist was the first step of establishing a computerized checklist. In order to suit for the general computer workers in Taiwan, the culture background and experience of the workers in the real workplace were considered in modifying the statement of the check queries. Besides, we also inserted actual pictures for each query in the checklist. All these efforts were expected to let users easily understand what the suitable work settings are and what the improper work conditions are.

### **3.2 Computerized Checklist**

In order to increase the application range, the Microsoft Office software was taken as the platform for establishing a computerized checklist. The developed application software was coded by Excel VBA. It can be used to aid computer workers checking their work conditions and then recording the current situation without papers. The developed software was applicable to the popular Windows operation system.

### **3.3 Applying the 'MultiPage Control'**

In order to increase the usability, the Multipage Control was applied in the interface design of the developed intelligent self-checking software. The advantages were that the user could jump to any category easily and he/she could fill in the check items quickly. This interface was more superior to that of the traditional paper checklist.

### **3.4 To Provide the Save Function**

The developed self-checking software included six categories and totally 30 queries. If the user wants to check all the queries at one time, it may take a long time. In order to let the user have more flexibility to perform the self-checking, this study provided the save function for recording the checked items in the hard disk of the computer. Besides, the checked results can be opened and rewritten again next time.

### **3.5 Providing the recommendations**

According to the available ergonomics rules [8-13], we prepared the improvement recommendations for the corresponding check results that had health issues. After the user checked some items and click

the 'Recommendations' button, the software will automatically list the specific recommendations for the checked items through the application program of Microsoft Word. At the same time, the user can save and print out these recommendations easily. Of course, the user can return to the self-checking window when he/she closes the Microsoft Word program.

## 4 Results and Discussions

After a lot of testing and modifications, the computer workstation self-checking software has already developed. Because the software was coded by Excel VBA, it must be executed in the Excel program. The operation procedures are illustrated and explained as the following:

Step 1: To begin a new self-checking, you should open the self-checking software and click the 'New' button, as shown in Fig. 1.

Step 2: After finishing the step1, the self-checking multipage window will show and the user can start to answer the queries, as shown in Fig. 2. At this stage, the user should check his/her postures and current computer workstation and choose either 'Yes' or 'No' for each query.

Step 3: After answering some queries, the user can click the 'Update' bottom, and the number of the checked items and the numbers of the found risk factors would display. For example, when the user had answered all the 30 queries and clicked 'Update', the numbers of the checked items will be 30, as shown in Fig. 3.

Step 4: After filling in all the 30 queries, the user can press the 'Conclusion' button; it will appear a short conclusion, as show in Fig. 4.

Step 5: When clicking the 'Recommendations' button, it will open the Microsoft Word program and list all the recommendations, including the items that have health issues and the items that have no health problems. The potential risks and the suggested improvement actions are also given. We take the third category (Monitor) for example, if the user selects 'No' for query 3-1 and then selects 'Yes' for queries 3-2 and 3-3, the recommendations generated by the software are shown in Table 1.

The ratings of the satisfaction grades for evaluating the developed intelligent self-checking software are shown in Fig. 5. The value of the bar chart is the average rating grade of the 20 workers, which were randomly selected from one of the famous semiconductor manufacturing company in Taiwan. Grade '1' means the worst and grade '5'

means the best. There were seven dimensions of the satisfaction evaluation, i.e. (1) the interface is easy to be operated, (2) the text is clear and easy, (3) the pictures can display the right messages and can be understood quickly, (4) the software can provide specific and useful recommendations, (5) the size of text is proper, (6) the displayed colours are nice, and (7) the overall software is helpful to you. In Fig. 7, the highest mean grade of all the satisfaction ratings is 4.6 for 'the displayed colours are nice', and the others are at least 4.0 grades. The software has already reached the originally expected goal. It can be used by general computer users to diagnose their computer work conditions and to improve the health issues. It also provided useful recommendations to improve the inadequate work settings.

However, there are still some limitations to this developed intelligent self-checking software. The evidences to explain the relations between the risk factors and the health problems are still required to be provided in the software in the future. Besides, the options for every evaluative item in the software were only 'Yes' and 'No'. It may need more options for various situations in the real world. Therefore, further studies about quantification of the ergonomic risk factors and their effects are demanded.

## 5 Conclusion

This study modified the OSHA's computer workstation checklist and then computerized it. The computer users can check their computer workstations by the developed intelligent software. This developed intelligent software can help computer users to identify the potential risk factors associated with the computer work conditions and to improve these improper work settings as soon as possible. It can be considered as a useful electrical tool to prevent computer users from the computer-related health problems.

The developed software can't respond to different levels of risk factors. It still lacks quantitative data to interpret different levels of ergonomic risk factor. More studies are required to understand whether different levels of risk factors lead to different degrees of MSDs.

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Table 1. The illustrations of the recommendations for queries 3-1, 3-2, and 3-3.

**3-1. Top of the screen is near by the level line of eyes, so you don't low or face upward your head in watching screen?**

Because your answer was 'No', the possible effects were musculoskeletal disorders on the neck and visual fatigue.

**Recommendations:**

1. To change the screen height, let the top of the screen is near by the level line of eyes, besides the screen must face the body and then you can see the screen clearly without turn your head.
2. If you can't watch the screen in natural posture, please remind yourself to take a break frequently, and turn around the neck slowly while resting.

**3-2. The distance between monitor and eyes is suitable, you can watch the screen without forward or backward your trunk?**

Because your answer was 'Yes', there were no health problems.

**Recommendations: None.**

**3-3. The monitor is forward to you, you can watch the monitor clearly without let your trunk turning right or left?**

Because your answer was 'Yes', there were no health problems.

**Recommendations: None.**

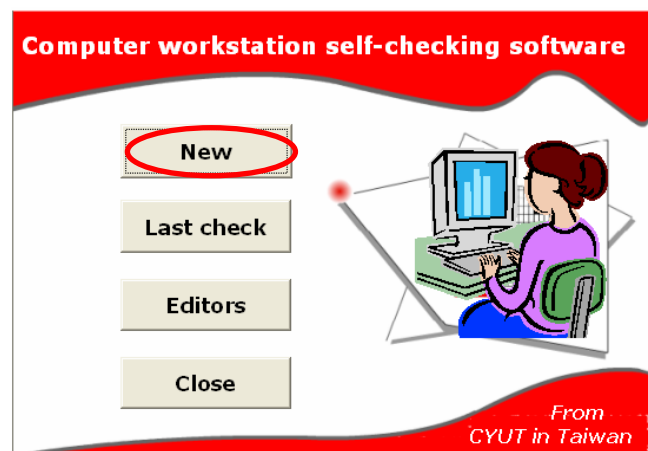


Fig. 1. The main frame of the self-checking software.

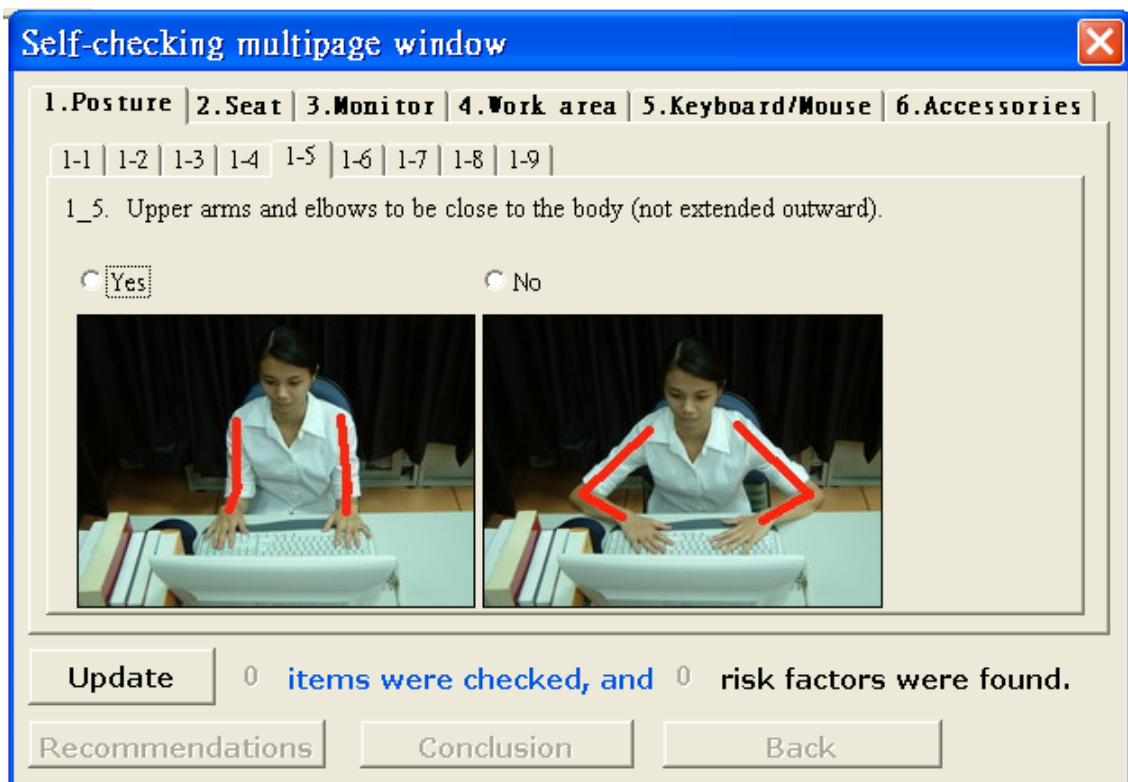


Fig. 2. The interface of the self-checking multipage window.

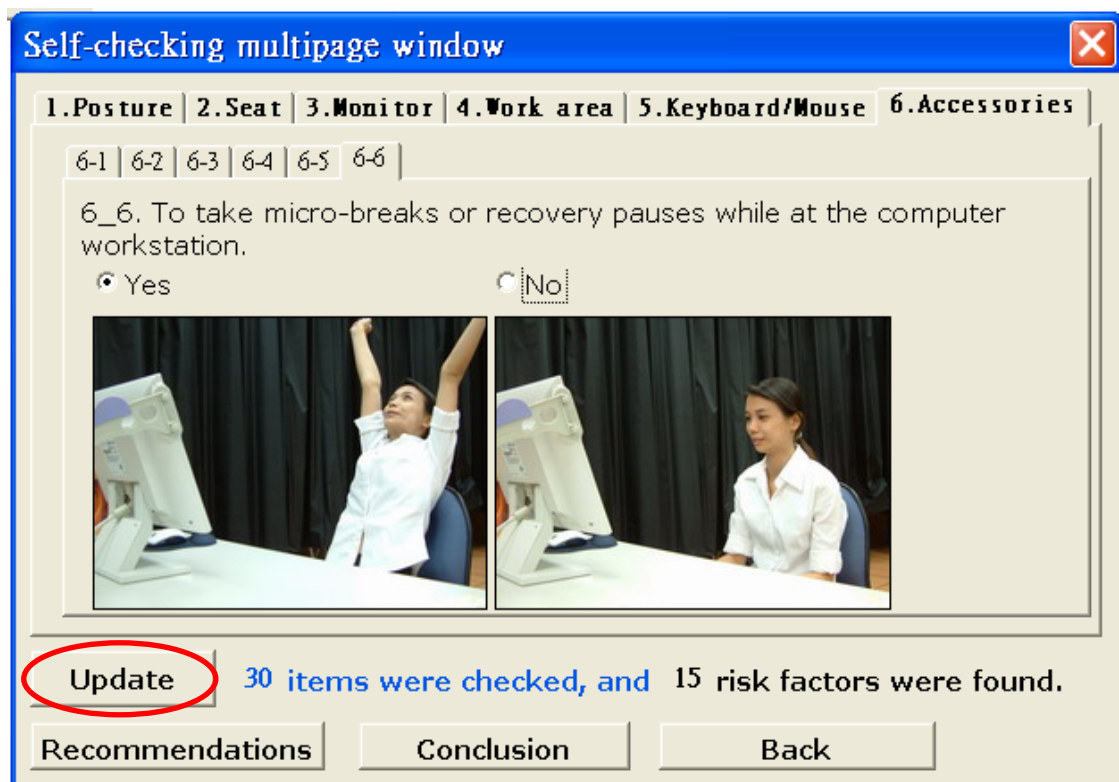


Fig. 3. The illustration of displaying the checked numbers.

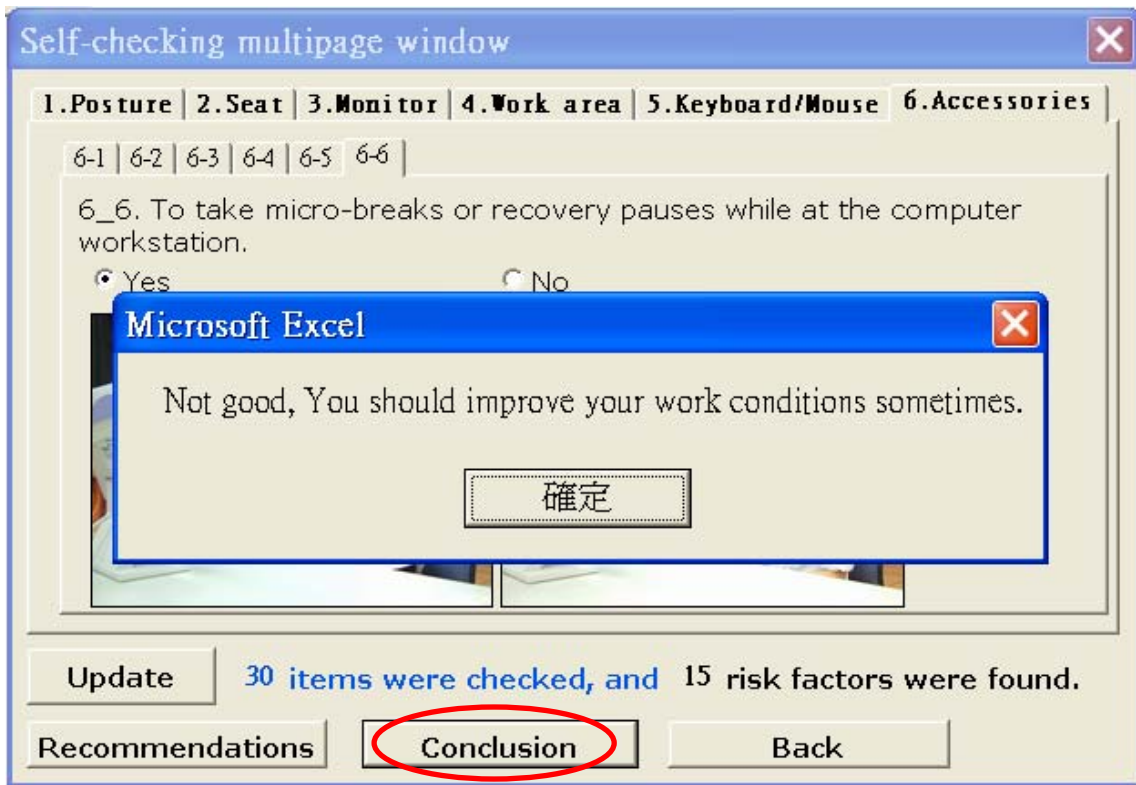


Fig. 4. The illustration of displaying the statement of conclusion.

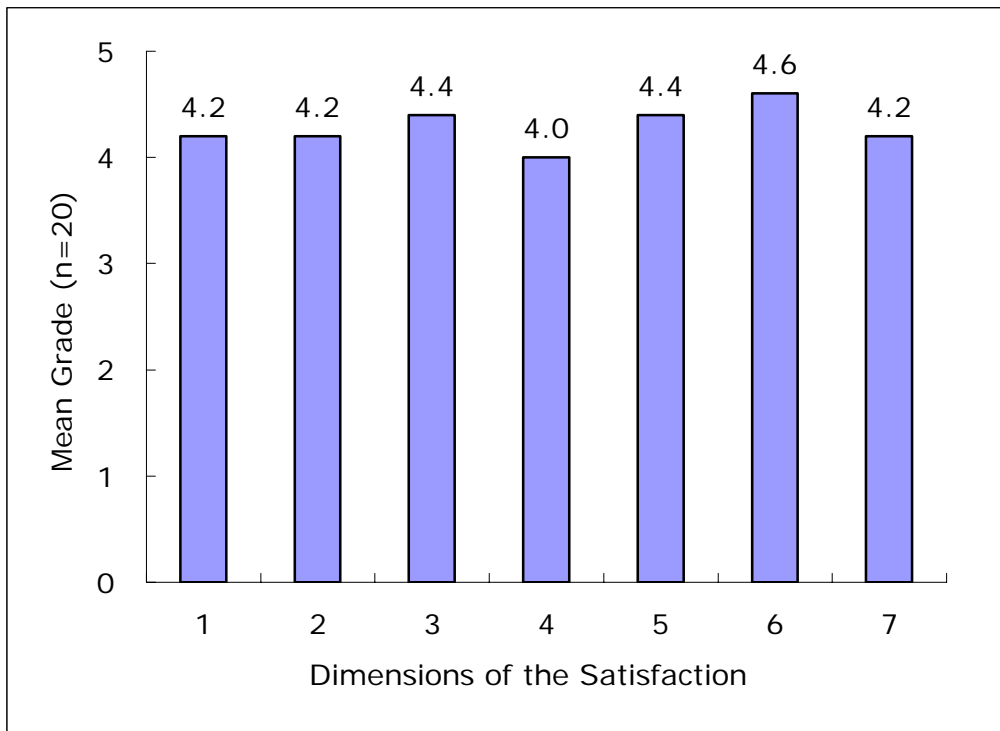


Fig. 5. The satisfaction ratings for the developed software.