



Multi-position ergonomic computer workstation design to increase comfort of computer work



Sisay A. Workineh^{*}, Hiroshi Yamaura

Dept. of Mechanical and Control Engineering, Tokyo Institute of Technology, 2-12-1 Ookayama, Meguro-ku, Tokyo 158-8552, Japan

ARTICLE INFO

Article history:

Received 10 December 2014

Received in revised form

21 October 2015

Accepted 25 October 2015

Available online 7 November 2015

Keywords:

Design

Multi-position

Seated work

Computer workstation

Ergonomics

Comfort

ABSTRACT

This paper presents a new design of computer workstation that is aimed at increasing the comfort of a user working for long periods at a computer. As we have become a society that spends a lot of time working on computers, the computer workstation needs to provide comfort to users. Discomfort and an improper position can negatively affect overall health and productivity. A new type of ergonomic computer workstation, which allows users to sit in multiple working positions, is proposed in order to provide better comfort to people who spend a long time sitting at their workstations. We have designed and developed a new multi-position ergonomic computer workstation which has 19 degrees of freedom and which can accommodate from 5th to 95th percentile human size. Four types of working position (upright, lean-back, zero-gravity and lean-forward) are preset by choosing different angular positions of the workstation parts. Positions of the workstation parts can be changed by controlling the actuators. These four positions were used to evaluate the comfort of the workstation. Subjective and objective evaluations, including comparison of the prototype and standard computer setup, were carried out using human subjects and ergonomic principles. Results showed that the new workstation is much more comfortable, supporting the body in a balanced way. Users have the freedom to stretch and relax in different working positions before they feel any noticeable discomfort; as a result, it lets users work for a longer period without strain, thus resulting in higher productivity.

© 2015 Elsevier B.V. All rights reserved.

1. Introduction

Nowadays, the computer is an integral part of our lives. We use computers to do almost every kind of work in our companies and institutions, and even in our homes. When one talks about computer work, the computer chair and desk are the two most important parts after the computer itself. As we have become a society that sits for a greater proportion of the day, it has made the office chair a critical component in determining our overall comfort and health. So, these tools need to provide comfort, since discomfort can negatively affect overall health and productivity, especially for people who work very long hours each day (Karlqvist et al., 2002; Safe Work, 2004).

An uncomfortable computer workspace can cause problems with regard to health and productivity. Discomfort and an improper sitting position for long periods leads to pain around the neck, shoulders, lower back, arms, wrists, legs and other parts of the

body. Discomfort also facilitates repetitive strain injury (RSI) in the long term (Andersen et al., 2011; Safe Work, 2004). In 2006, nearly half a million people in the UK suffered from some form of RSI (RSI Awareness, 2011). The productivity of people who work for very long periods each day will be reduced due to the uncomfortable workplace. Moreover, seat discomfort is not limited to computer work, but also distresses aircraft pilots (Goossens et al., 2000), wheelchair users (Chugo et al., 2013; Northwest Regional SCIS, 2004), car drivers and any type of worker that spends a prolonged time in a seated position.

Allie and Kokot (2005) researched the benefits of using an adjustable chair to increase comfort and fix users in a good posture. Supporting workers with high performance chairs positively affects comfort and productivity. So, designing a comfortable office chair which can make posture adjustments in order to maintain comfort was recommended. Bush et al. (1999) measured human movement in the seated position and different chairs in terms of fit, movement and support during changes in recline and spinal curvature to evaluate the performance of office chairs: the performance was different for different chairs. From a different perspective, Robertson et al. (2009) studied the effect of ergonomic training and

^{*} Corresponding author.

E-mail address: workineh.s.ac@m.titech.ac.jp (S.A. Workineh).

chair intervention on musculoskeletal risk by assigning people to one of three groups: ‘people with training and adjustable chair’, ‘people with training only’ and ‘other people’. The training changed the behavior of people to help them use the office chair properly and decrease musculoskeletal risk. On the other hand, adjustable keyboard and mouse support improved the comfort level of fingers and lower back (Park et al., 2000) while inclination of a keyboard affected the comfort of neck and head (Asundi et al., 2012). Similarly, the impact of different reclined seating postures on typing performance and comfort for people with lower back pain was investigated (Haynes and Williams, 2008). Different postures had an impact on typing performance, but the authors suggested that further experiments with improved fixtures should be done.

In this research, a new workstation capable of multiple working positions that follows the posture of a user was proposed in order to increase comfort. Thus, the objective of this research was to design a new multi-position ergonomic computer workstation which can support the body in multiple positions to provide better comfort for long periods of work at a computer and, as a result, make a user healthy and productive. The chair and desk were joined by implementing an ergonomic design. Fig. 1 shows the proposed design of the workstation.

2. Design

2.1. Ergonomic design of the workstation

Ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human

well-being and overall system performance (International Ergonomics Association, 2012). The computer workstation interacts with the user; thus, the design of this interaction determines the comfort and performance of the user. The ergonomic design mainly focused on mechanisms for multiple working positions and flexibility of the workstation. Moreover, the shape and form of each part were also considered in the design procedure. The aesthetics and the space occupied by the whole workstation were also taken into account during the design. The workstation was designed to have simple and effective mechanisms that efficiently provide proper comfort to all body parts.

While sitting, people have a tendency to change positions—for example, extending or bending legs, extending or bending arms, leaning back or forward, etc. However, the common standard chair doesn't allow such kinds of position change due to its inflexible design. Nonetheless, users try to change positions as much as possible. This attempt leads to an improper sitting posture, which results in pain. Working at a computer for long periods of time in an improper sitting position can lead to repetitive strain injury (Robertson et al., 2013). Therefore, a new design for a flexible workstation was essential to allow multiple changes in working position.

The layout of the proposed workstation main parts is shown in Fig. 2(a). These parts need to be combined by an ergonomic flexible mechanism. The main parts are the headrest, backrest, armrest, seat, footrest, keyboard and monitor.

All the mechanisms of the workstation were designed separately for each main part. Fig. 2(b) shows assembly of all the mechanisms and skeleton of the workstation. In total, the workstation had 19 degrees of freedom (DOF). The backrest (1DOF), seat (1DOF), footrest (3DOF) and monitor post (2DOF) were driven by

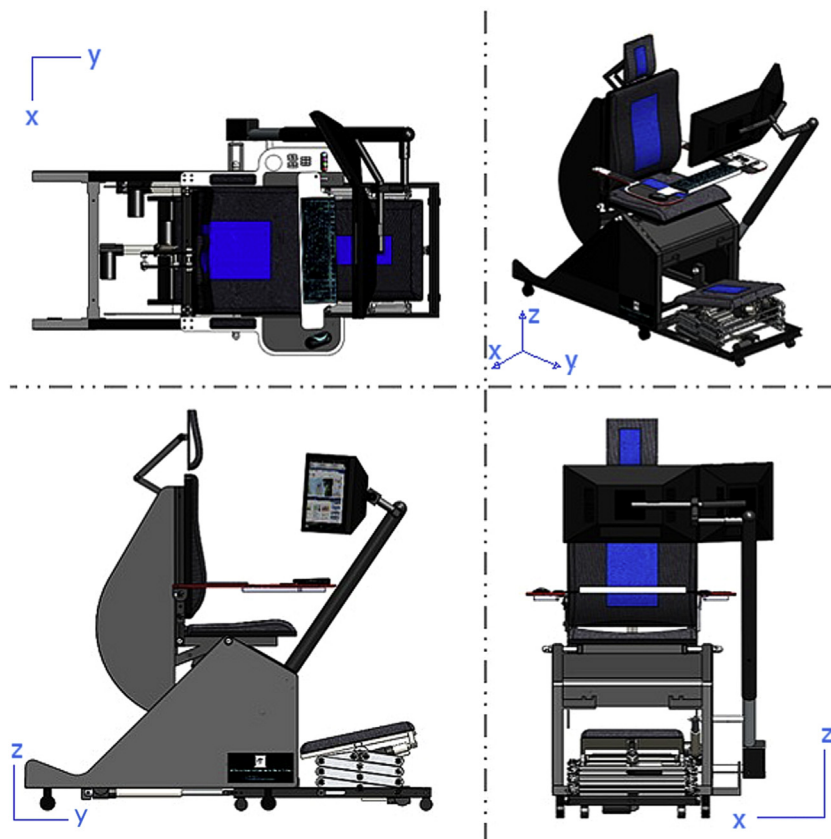


Fig. 1. Proposed workstation design.

Download English Version:

<https://daneshyari.com/en/article/1095800>

Download Persian Version:

<https://daneshyari.com/article/1095800>

[Daneshyari.com](https://daneshyari.com)