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Illumination Effect on the Human Performance in Hci Environment

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Abstract

Technological growth boasted the use of computers in almost every field, which keeps on increasing. Today industrial survey, feedback, online teaching, the entrance exam, tutorial became a very common trend. The online preparation for the entrance exam, tutorial and even the competitive exam are also preferred to be done through on line by just clicking the option of the multiple questions. In India most of the exams like PSUs, Bank Job, Railway recruitment board, entrance exams etc are taking the online paper for job. The preparation of such competitive exam needs devoting more time on computers for practicing online sample papers [1]. The Human performance during HCI depends on many factor like sitting posture, design of computer hardware used, display unit of computer etc. The display unit directly show the effect on the human eye within few minutes which is normally felt by the user. The human eye gets fatigue by continuous use of computer. In this study the focus is on the effect of illumination of computer display unit on human eye and how ambience illumination affects human performance in a human computer interaction environment. In general, visual performance increased with increasing contrast ratio. Screen luminance combination also played an important role on visual performance. Further, there might be interaction effect between screen luminance combination and contrast ratio on visual performance. It is further concluded that the ambient illumination required to satisfactorily carry out the work in conjunction with different human computer interaction environment is found to be 300-500 lx.

Keywords:- Visual fatigue, Visual display unit, illumination, glare.

1.INTRODUCTION

The uses of computer in modern society take a rapid growth. Over the past 20 years, the personal computer has become widely used, both in the office and at home. People use computers to write documents, maintain databases, manage finances, draw diagrams and graphics, make presentations, compile mailing lists, search computer databases, write application programs, use the internet and myriad other tasks. Both commercial and non commercial firm take the help of online feedback and survey to know the reality regarding their product or their services by that they can provide better services in the future or rectify their shortcoming so that they can stand the competitive atmosphere. There are lots of online job available based on surveying, data entry, form filling, and data analysis, research studies, problem solution, social awareness, learning etc. Many of the house wife and other people are doing such jobs as their part time or full time job [2]. The principal information output device and means to interact with the computer for the user is the visual display or "monitor." Display technology used for monitors has been the CRT, LCD, VDT, TFT, Cathode ray tube (CRT). There are some drawbacks to this technology, however. CRT monitors are bulky and very heavy, with sizable electrical power requirements. The liquid crystal display (LCD) lower power consumption, lighter weight, and smaller physical size. The LED backlight is a newer technology for LCD displays that uses light-emitting diodes instead of a fluorescent lamp. The LED produces white light, but uses no mercury.

With the increasing use of computers at both work and home, the duration of use of the eyes is increasing, but rest time for the eyes is becoming scarcer. Such prolonged viewing has been a concern in the recent past and will continue to grow as a topic of importance to human factors researchers [3]. Chi and Lin (1998) have reported that visual fatigue or computer vision syndrome (CVS) is the most common complaint of video display terminal (VDT), sometimes also referred to as a visual display unit (VDU) users and it is estimated that 50% of operators of VDTs are affected by visual fatigue [4,5]. The advent of light-weight laptop computers has further increased the application of computers in various applications which are very novel in the industry. We cannot hope to cover the lighting implications of all these various situations, but the general principles discussed here should be applied in most of the circumstances. It is undoubtedly a matter of great concern and importance to have some literature survey of the researches which has been carried out in the past in the topic of the interest.

Benz et al. (1983) showed that 40% of VDT users prefer illuminance between 200 and 400 lx; while 45% prefer illuminance between 400 and 600 lx [6]. A researcher recommended 150–500 lux for CRT work, while other recommends levels between 300-500 lx for reading [7].

2. Materials and Method

2.1 Light

Light, according to the Illumination Engineering Society (IES), is "radiant energy that is capable of exciting the retina and producing a visual sensation". The visible spectrum ranges from about 380-780 nanometer.

Consider a source of some luminous intensity emitting luminous flux in all directions. Imagine the source as being placed inside the sphere. The amount of light striking at any point inside the surface of the sphere is called illumination or illuminance. It is measured in terms of luminous flux per unit area. Whereas 1 lumen per square meter is called lux(lx), an SI unit. One foot candle equals 10.76 lx, whereas an accepted practice is to use 1fc = 10 lx.

Inverse Square Law: The amount of illumination striking a surface from a point source follows the inverse square law.

$$\text{Illuminance (lx)} = \frac{\text{candle power (cd)}}{D^2}$$

2.2 Concept of visibility

Visibility refers to how well something can be seen by the human eye. Both contrast and luminance are important for visibility. Another factor is the size of the target and exposure time to the target. Larger improvement in visual performance can be achieved by proper contrast and illumination ratio. Subjects performed better with higher screen luminance combination on low contrast ratio [6].

To the optical engineer, light is simply a very small part of the electromagnetic spectrum between ultraviolet and infrared radiation. The visible portion of the electromagnetic spectrum extends from about 380 to about 780 nanometers (nm), as shown in Figure 1.1.

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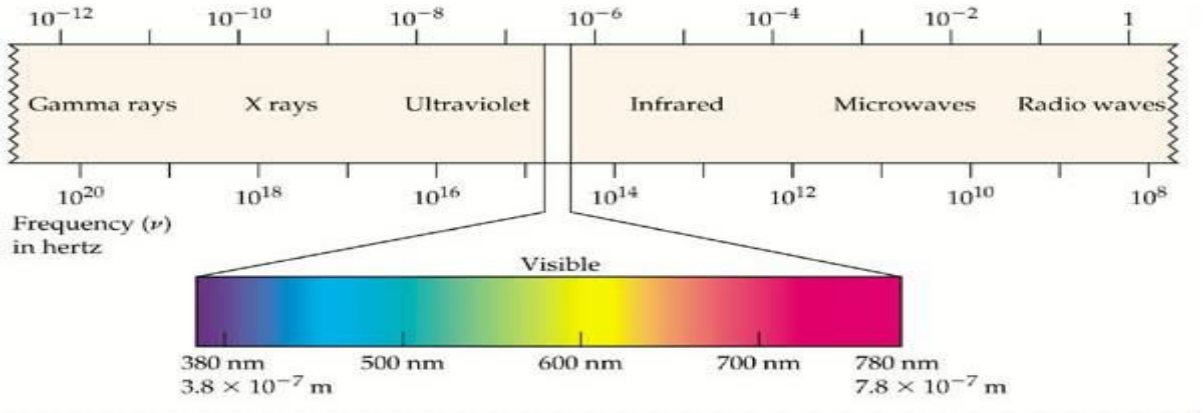

Fig 1.1

The radiation in this region is absorbed by the photoreceptors of the human visual system and thereby initiates the process of seeing. Variations in wavelength within the visible spectrum give rise to the perception of color. Violets being around 400 nm, blending into the blues around 450 nm, greens around 500 nm, the yellow-oranges around 600 nm, and the reds around 700 nm. The eyes cannot see colors unless the ambient illumination is above the 3 candela per square meter.

2.3 Glare

Glare is produced by brightness within the field of vision that is sufficiently greater than the luminance to which the eyes are adapted so as to cause annoyance, discomfort, or loss in visual performance and visibility. Direct glare is caused by light source in the field of view and reflected glare is caused by light being reflected by a surface in the field of view.

It is very important to establish viewing conditions that minimize stress to our eyes by minimizing reflections, controlling ambient light, establishing a suitable surround, and establishing a comfortable viewing distance, adjusting brightness, adjusting contrast and adjusting the reflection angle.

The 50 subjects performing the same task on different visual display units for duration of one hour are examined and questioned about their experience, stress, discomfort and problems while performing the task. The observation was made on the basis of the experience faced by the subjects. The effects of screen type, ambient illumination, and target/background color combination on visual identification performance and subjective preference for visual display terminal (VDT) screen characteristics. Visual performance was better under 450 lx ambient illumination, versus, 200 lx. Though lower ambient illumination (200 lx) was rated slightly more preferable (not statistically significant) than normal ambient illumination (450 lx), subjects performed better under the latter condition, particularly for the TFT-LCD screen [9]. The effects of ambient illumination and screen luminance combination on character identification performance of thin film transistor liquid-crystal displays(TFT-LCD) monitors. Results showed that character identification performance was not significantly affected by ambient illumination at office levels. The results seem to indicate that character identification under relatively high ambient illumination is more affected by background luminance of the screen than contrast ratio or contrast sensitivity. Therefore, considering screen luminance combination and contrast ratio simultaneously may be more appropriate than considering contrast ratio alone [11]. The effects of light source, ambient illuminance, character size, and interline spacing on visual performance and visual fatigue in using commercial electronic paper displays. The results were able to provide some guidelines for consumers to choose a suitable electronic paper according to their lighting conditions, ambient illumination at 700 lx and greater ambient illumination such as 1500 lx may be even better for E-paper. Accuracy was highest for 1500 lx ambient illumination [12].

The results indicated that the significant performance improvement of all subjects occurred at 52 lux on the search time and at 62 lux on the subjective visual fatigue. Therefore, the minimum ambient illumination requirement for legible electronic-paper display can be synthesized at 62 lux. This minimum point of ambient illumination for the young and the elderly represents that the reflective-type display started presenting its better legibility and the subjective visual fatigue started decreasing [13].

CONCLUSION

From the above research it may be concluded that the ambient illumination required to satisfactorily carry out the work in conjunction with different human computer interaction environment is found to be 300-500 lx. Although some studies suggest that as we increase the ambient illumination levels the ease of doing the work increases but up to some extent i.e. levels upto which glare does not happens which may cause discomfort and erroneous work. People expend additional effort at lower illumination levels to maintain their performance.

Higher screen luminance combination would be better on low contrast ratio and lower screen luminance combination would be better on high contrast ratio.

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