Use, Overuse and Abuse of Digital Display Devices: A Critical Counterpoise

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Abstract—.The use of electronic devices in the society is on rise and is expected to follow the same trend in the time to come. The digital display devices are being used for work, business as well as for leisure activities by all age groups of the population. Their use seems indispensible. Although these devices offer great advantages, however, these are not free from ill effects especially if not used judiciously. This paper comprehensively reviews the adverse effects of digital display terminals and precautions to avoid them.

Index Terms— Augmented Reality, Computer Vision Syndrome, Digital Display Terminal, Digital Eye Strain, Mixed Reality, Screen Time, Virtual Reality.

1 Introduction

Use of computers and visual display terminals (VDT) has become essential. It has developed from the stationary devices such as desktop on the table to the portable devices such as laptop. These devices have grown further handy and mobile in the form of smart phones in the pockets and palmtop.

Viewing the visual display terminal has different properties and configurations than the printed material. These produce stress on the eyes. The eye discomfort with the use of visual display terminal was first described in 1973 by Hultgren and Knave.[1] Visual display terminals demand prolonged near vision tasks. VDT based tasks are different from other near vision tasks because of influence peculiar to its use.

Digital electronic devices with visual display affect the eyes differently than the printed materials. The viewing distance, blink pattern and required gaze angles have been observed to be different for the two. It has been demonstrated that the visual display terminal is associated with the reduced frequency of eye blinking that leads to dry eye.[2],[3],[4] The small size of portable screens requires small font sizes resulting in closer viewing distances. Also, the letters are not as precise and clearly defined in the VDT as they are in print matter. The contrast of the letters to the background is not pronounced which is further affected by the glare and the reflections on the screen. [5] All these factors make the viewing uncomfortable for the eyes. It puts more demand for eye focusing and accommodation in eyes. The technological advancements have given birth to Digital Eye Syndrome or Computer Vision Syndrome, an array of clinical symptoms related to prolonged and uninterrupted viewing of VDT.[6]

2 Blue Light Hypothesis

Short wavelengths are harmful to the eyes. The blue light comprises of wavelengths between 380 and 500 nm approximately. Human cornea absorbs short wavelengths below 295nm and the eye lens absorbs below 400nm wavelengths. It protects the human retina from damaging effect of short wavelengths.

Most of the visual display devices create light which is called as "Blue Light". The blue light tricks the mind into believing that it is still day. This response inhibits the melatonin production, the chemical that is related with the sleep. There is no conclusive evidence that support the fact that low levels of radiations emitted from visual display terminals are a potential risk to the operator.

3 Digital Eye Syndrome

Increased use of near vision devices such as smart phones predisposes to the Digital Eye Syndrome. Lightening is a critical factor significantly affecting the health of the eyes. The equipoise between screen brightness and the surrounding brightness is highly desired. All sources of light in the peripheral field of view surrounding the visual display screen including the desk lamps, overhead lights and windows may be a cause of discomfort if not controlled strategically. Surrounding objects produce their images on the display screen in the form of reflections. Long service hours and increased service years also have a cumulative effect. The microenvironment including high temperature, low relative humidity and air draft exert a significant effect. Personal factors including age, sex and nicotine use does modify the response. [7]Device related factors such as height and angle of visual display terminal, flicker frequency, screen resolution, background and text color are critical in producing adverse effects. In children,

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increased screen time adversely affects the vasculature. Majority of the children reported burning, itching and blurring after using a digital electronic device.

4 Wearable Technology

Head up display was introduced in use for military and commercial aviation. However, now it is incorporated in motor vehicle navigation system also. [6] Though these devices offer the advantage of reduced eye movement away from the direction of the travel. However, if projected image lies in a different direction or at a different distance than the perceived distance from the real fixation target, then it results in conflicting stimuli. Wrist mounted display devices present extremely small sized text as the screen area is limited in the range of 3-4cm approximately. Wearable technological gadgets are being used for personal as well as business purpose. These are primarily used as communication gadget.

5 Virtual Reality

Virtual Reality devices are one step ahead of computers. In this technology instead of using a screen in front, the viewers are able to interact with the 3D world. VR generally refers to the computer technology that uses VR head gears to create a stimulated environment. The application of VR includes academic research, designing, business and entertainment. Virtual Reality replaces the real world environment with simulates ones. Further advancements in the form of Augmented Reality utilize computer-generated sensory inputs to generate augmented live direct or indirect view of the real world environment. Mixed reality is an amalgamation of the real and virtual world in the form of Mixed or Hybrid reality in which physical and digital items co-exist. The technology integrates virtual inputs into real-life spaces. The stereoscopic 3-D shows slightly different images to the right and the left eyes to create 3-D effect. A dreaming with open eyes effect is created by "photonic lightfield chip".

6 Recommendations

- As a preventive approach, take occasional rest or alternate task breaks to minimize stress. Take a break after every 10 minutes.
- In case of use of visual display devices at night, either wear blue-blocking glasses or use filter for blue/green wavelength at night.
- The display terminal should be 60-100cm away from the eye. The height of the screen should be lower than the operator's eyes to permit viewing vertically down by 0-16 degrees to decrease the width of the palpebral fissure, and hence the exposed ocular surface area.
- Regular eye check-up should be done as a preventive measure to detect any effect on the eyes at an early stage.
- Operator position in relation to the screen should be such that the operator is not facing an unshaded window and operator's back is not to an unshaded window.
- Control the illumination and the reflections by proper room arrangement and workstation design. Use curtains, blinds or adjustable shades to appropriately control the light levels according to the day light.
- The position of the display screen of the computer should be perpendicular to the light source and the windows. The devices that permit the screens to swivel horizontally and tilt vertically permit adjustments to allow the operator to choose an appropriate viewing angle.
- The lightening needs to be controlled to minimize the reflections and glare on the screen and maximize the screen visibility. [8] Proper lightening design and visual display terminal placement should be considered to achieve this. Filters may help to achieve the lightening balance, however, they can not be considered as a substitute to poor lightening design.
- Increase the distance between operator and terminal and also increase the distance between adjoining terminals to minimize potential exposure to electromagnetic radiations.

4 Conclusion

Innovations and developments in digital display technologies have been remarkable. Research is required to define the safe use, curtail the over use and avoid the misuse of these devices. Guidelines and recommendations for use of digital display devices are to be substantiated with research evidence. Caution is to be exercised during the use of existing visual display terminals and the newer technologies to develop with time.

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