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COMPUTER HAZARD: A POTENTIAL IMPEDIMENT TO THE GROWTH OF INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) IN NIGERIA

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Abstract

The well-orchestrated new millennium (year 2000) problem in computer-based economy has gone without any noticeable negative imprint as envisaged, and computer users have had sigh of relief. With Information and Communication Technology (ICT) still dictating pace in many sectors, the number of computer users is on the increase with full readiness to exploit all possible gains of this information age. In this paper, the authors bring into limelight health implication of the increase in computer application as a result of electromagnetic radiation from the monitor coupled with the attitude of computer users in Nigeria and the negative influence it could have on the application of ICT facilities in the country if not quickly tackled.

1. Introduction

It is axiomatic that every adventure has both positive and negative effects. The combined effort of electronic engineers and computer scientists that brings about programmable computer machines is yet to exhaust applauds when telecommunication was added to it thereby producing Information and Communication Technology (ICT). These three distinct fields have collectively under the term ICT revolutionize our life's and will continue to do so for at least half a century to come. Information and Communication Technology (ICT) has essentially modified the telecommunication industries resulting in what is known as Value Added Network Services (VANS) which are market driven services operated in the same capacities of existing Public Telephone Switched Network (PTSN) or Public Telephone Data Network (PSDN) infrastructures. Some of the products of VANS are Cellular Telephony and Internet.

The ICT revolution has also led to the development of many computer application softwares such as Internet Explorer and Netscape Navigator for browsing, and Microsoft Outlook and Netscape Composer for mailing, and numerous other application softwares and programming languages developed to take advantage of the increasing capability of the computer hardware as a whole and microprocessors in particular. The list is seemingly endless and achievement is tremendous. However, the relative ease with which the year 2000 (Y2K) problem was tackled may not be applicable in the case of problem that will result from emission of electromagnetic radiation by the computer monitor, which is the focus of this paper. It shall discuss in this paper the principle of electromagnetic emission by the computer monitors and their effects on the computer operator/user.

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2. Computer popularity

Oguntoye (1996) noted: "As to be expected, computer-based technology has begun to dominate the domains of even domestic and office items such as cars, copiers, washing machines, telephone systems and the various media of information". Also the Federal Government of Nigeria declared in her 'National Policy on Education' that: "In recognition of the prominent role of Information and Communication Technology in advancing knowledge and skills necessary for effective functioning in the modern world, there is urgent need to integrate Information and Communication Technology into education in Nigeria" (FRN, 2004). More so, with the application of ICT to many developmental concerns (Ndukwe, et al, 2006) and increase in the number of tertiary institutions offering computer based courses like Computer Science, Information Technology and Computer Engineering together with emergence of applications such as Multi-media capacity, Internet connectivity and Computer Networking, computer popularity is on the increase and it is rapidly replacing electronic gadgets in homes. In this regard Microsoft (2007) said:

> "As online computer systems become more popular, televisions and computers are increasingly integrated. Such technologies combine the capabilities of personal computers, television, DVD players, and in some cases telephones, and greatly expand the kinds of services that can be provided. For example, computer-like hard drives in set-top recorders automatically store a TV program as it is being received so that the consumer can pause live TV, replay a scene, or skip ahead. For programs that consumers want to record for future viewing, a hard drive makes it possible to store a number of shows. Some set-top devices offer Internet access through a dial-up modem or broadband connection. Others allow the consumer to browse the World Wide Web on their TV screen. When a device has a hard drive and a broadband connection, consumers may be able to download a specific program, opening the way for true video on demand. Consumers may eventually need only one system or device, known as an information appliance, which they could use for entertainment, communication, shopping, and banking in the convenience of their home".

Again, since the usefulness of computer surpasses those of domestic electronic devices both in terms of fun and learning, it suggests that man-machine rapport will increase in terms of time and proximity. Furthermore, based on cost consideration, the type of monitor expected to be in wider use in Nigeria is the Cathode Ray Tube (CRT). Again, with the availability of object-oriented programming languages, many people with computers will be attracted to the world of programming via these simplified programming softwares. Likewise, the number of applications software users had geometrically increased because of impact of ICT on the society, and many children are glued to the monitor for games and educational purposes.

3. Computer monitor and electromagnetic radiation

Of the three types of monitors available, the CRT is more popular owing to factors such as cost and being first in existence. However, the Liquid Crystal Display (LCD) type is gaining popularity because of its lightweight and portability, while the plasma screen has size to its advantage, nonetheless it cannot compete well with CRT in use due to high cost and fragility. Data collected in the two tertiary institutions and business centres mentioned above

confirmed our observation that most monitors in the tertiary institutions meant for learning purposes are CRT high emission (vertically and horizontally curved surface) types, though gradually been replaced with low emission (horizontally curved but vertically flat) types and all the ones in use by the business centres are CRT high emission types.

In terms of technique, the CRT monitor is the same with domestic CRT television. It is made up of vacuum tube with electron gun at one end and a convex surface screen coated with phosphorous at the inner end. When heated the electron gun emits stream of high-speed electrons that are attracted to the screen end by an electric field created inside the tube. While the electrons move the focus controls, and the deflection coil steers the beam to a specific point on the phosphorous screen. The phosphorous glows when struck by the beam presenting fluorescence-like illumination. The level of brightness depends on the amount of beam striking the screen at a particular time.

The agent of attraction in the vacuum tube is the electric field created by about 35 kV Anode voltage (Scott, 1995; Geoffrey, 1971). The electric field is radiated electromagnetically to the outer surface of the tube with the tube material as the medium. The quantity of the electromagnetic emission on the surface of the tube is governed by Equations 1-3 (Wilhelm, 1982):

$$E_Z = E_O e^{-x/\delta} e^{-jx/\delta} \quad .....(1)$$

$$H_Y = H_O e^{-x/\delta} e^{-jx/\delta} \quad .....(2)$$

$$and\ I_Z = I_O e^{-x/\delta} e^{-jx/\delta} \quad .....(3)$$

where $E_{Z,}\ H_{Y,}\ and\ I_Z$ are electric field, magnetic field and current density at the surface of the tube while E_O, H_o and I_O are the equivalent of the same parameter at the inner surface. χ is the area of curvature of the tube surface (a factor that makes the tube high or low emission type) and δ is the depth of penetration or skin depth which is usually a function of frequency expressed as

$$\delta = \frac{1}{\left((\pi f \mu \sigma)^{1/2}\right)} \quad \ldots(4)$$

where σ is conductivity of the material, f is the frequency, and μ is permeability

However, on getting out of the tube surface, air is encountered as another medium, meaning that from the source to the computer user three media are passed, namely: the vacuum, the tube material, and the air. Out of the three media only two have effect on the electromagnetic emission since the vacuum medium does not affect the signal in anyway. The tube material is the medium of the electromagnetic emission from the inner side of the tube to its surface while air acts as the medium from the surface of the monitor to any point u in the vicinity. From the above explanation the magnitude of electric field at the surface of the monitor, and the magnitude at any point u in the vicinity could be expressed by Equation 5.

$$E_U = E_Z e^{-x/\delta} e^{-jx/\delta} \quad \ldots(5)$$

From these expressions, it is seen that the magnitude of the electromagnetic emission decreases exponentially with distance and that only about thirty seven percent escapes to the surface, hence at a certain point its effect diminishes (Scott, 1995). The diminishing effect accounts for reason why no alarm has been raised in the case of television for viewers usually sit at some distance away from it unlike the case of computer machine where the operator/user is required to sit closer to it for most of the time.

To compute the magnitude of electromagnetic emission at any point *s* (monitor surface) or *u* (user), we need to determine the electric field strength using Equation 6 (Simon *et al.*, 1965; Gordon, 1992).

$$E_O = \frac{\theta}{4\pi \in_O r^2} \quad \left(NC^{-1}\right) \quad \ldots(6)$$

From Equation 6, we can determine E_o, having known the charge (θ), permittivity of free space ($\in_o$) and radius (r) of the hypothetical spherical surface. Hence Equation 1 can be used for determining the electric field at the tube surface while magnetic field and current density can be computed using Equations 2 and 3 respectively.

Each of the above expressions requires physical measurement to determine the minimum distance between the computer user and the monitor. However, a rough estimate can be made based on an empirical evaluation.

4. Types of electromagnetic radiation

There are two types of electromagnetic emissions as applied to computer monitor: these are extremely low frequency (ELF) and very low frequency (VLF). They consist of radio frequencies below that used for normal broadcasting. These two emissions come in two forms-electric and magnetic – and the ELF magnetic emission is the worse of the two. From Equation 6, we can see that the smaller the frequency the higher the depth of penetration and from Equations 1 and 2, the higher the electric or magnetic radiation especially when χ is less than δ.

5. Effect of ELF and VLF on the body

Although ELF magnetic emissions are more threatening, nevertheless both of them interact with the natural electric activities of the body cells but in varying degrees. Scott (1995) says:

> 'Another trend in green monitor designed is to minimize the user's exposure to potentially harmful electromagnetic fields. Several medical studies indicate that these electromagnetic emissions may cause health problems, such as miscarriages, birth

> defects and cancer. Time risk may be low, but if you spend a third of your day (or more) in front of a computer monitor, that risk is increased'.

The reason is that the emissions interact with the electrical activities of the human body, especially new tissues. Apart from this, there is a less hazardous one called "Screen glare". Screen glare causes eye strain and victims soon resort to use of lens to provide visual aid (Scott 1995).

6. Data collection

As part of the data collection technique, questionnaire were issued within the Federal Polytechnic Bauchi, Abubakar Tafawa Balewa University, Bauchi, private computer training institutions/schools and the 'business centres' within Bauchi metropolis to know computer users' knowledge of the effects of electromagnetic emission and the preventive techniques available. The responses were analyzed together with the laboratory measurement taken and solutions to these effects are proffered.

7. Results and data analyses

The analysis of data collected within elite class of Abubakar Tafawa Balewa University, Bauchi and Federal Polytechnic, Bauchi shows that 50% of the respondents are unaware of any hazard that may result from close association with computer machine. About 80% of those that are aware of computer hazard can only name one of such hazards, which is sight defect, and this forms 40% of total respondents. Only 30% know how to prevent the hazard. None of the respondents knows of the other problems as stated in section 5. above. In fact, 65% of the respondents are not aware that radiation is more pronounced at the sides and back of the CRT monitor. Our observations of the sitting arrangements in most of the offices and business centres visited corroborate the peoples lack of knowledge of more electromagnetic radiations at the side and back of the CRT monitor, because seats are not more than 0.3 - 0.6m away from the back of the monitors.

Physical measurements in computer laboratories show that an average eye can see normal front at about 2.4m away from the monitor and that the computer keyboard and mouse cable can go up to 1.6m on the average. Furthermore, all the business centres and training schools visited use only high emission curve screen CRT monitors with only 10 percent of the offices visited in the two institutions mentioned above use LCD monitors.

8. Challenges and fall-out of hazard

The information above shows that people are grossly uninformed of numerous health hazards associated with frequent contact with the computer machines even though these hazards are totally preventable. The challenges here are three, namely: (i) how to increase awareness of the hazard among the populace, (ii) its implications, and (iii) suggest ways of preventing such occurrence. These challenges are crucial owing to the fact that should one or more member of a family or business organizations contact any of the hazards, the superstitious belief that computer is a "witch" will be made stronger resulting in the following:

i. Number of computer users at homes, offices and industries will decline.
ii. Large sums of money will be needed by individual and organizations on medical treatment and/ or litigation.
iii. It will have adverse effect on economy.
iv. Information transfer and acquisition would become poor.
v. Technological retrogression will set in because the existing infrastructure would have to be replaced, that is, do away with computers, and in the alternative government and private organization would have to invest largely on computer friendliness and anti-superstitious belief campaign.

9. Guidelines for prevention

i. Go for low-emission CRT or flat screen TFT monitors or LCD monitorS.
ii. Stay at least 0.9m away from the sides and back of the CRT monitors.
iii. Use anti-glare screen on your computer for it cuts ELF and VLF thereby reducing these hazards including eye strain.
iv. Spend less than eight hours daily with CRT monitors except low-emission type.

It is recommended that these guidelines be complied with always.

9. Conclusion and recommendations

With the present level of computer literacy in particular and application of ICT in general in Nigeria, Multi-media computers are gradually replacing domestic electronic appliances. The number of people with access to computer has increased and man-machine interaction has also increased. This created both economic and social positive effects plus a host of others. The economic effects are; family economic planning, research, word and data processing, desktop publishing on both commercial and non-commercial bases together with application of computer in educational instructions. On the social aspects, the use of Internets has increase social interaction, exchange of idea, information transmission, availability of computer games for recreational purposes and cultural identity. The following recommendations regarding computer hazard can be made:

i. Government should intensify campaign at enlightening the populace on the dangers of using curve-screen high emission CRT monitors and of sitting close to it.
ii. Government should publicize the guidelines above as a preventive measure.
iii. Government should enforce compliance with the guidelines in all governmental offices and industries through appropriate agencies.
iv. Enact law to punish offenders
v. Organizations should be encouraged to use low-emission CRT or LCD monitors through subsidy or interest-free loan to purchase such monitors.

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