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Analysis of Radiation Emitted from the Smart Mobiles Screens in the Dark Rooms

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Abstract: ***The required radiation analysis of the smart mobiles screens which have become associated with us as a fundamental and important communication implement in facilitating with our daily lives. Despite the many types of smart phones sold in the local markets, the study was dedicated to the selection of mobiles common to use by the people of Iraq for the purpose of analysis radiation emitted from these mobiles screens are: (A) SAMSUNG– Galaxy, (B). SAMSUNG-S7 edge)C) HUWAEI (D) I – Phone. The emitted radiation spectra of these mobiles screens analyzed the UV-Visible Spectrophotometer, manufactured by LABOMED, INC. American origin located in the central laboratories at the University of Basra, Iraq. The results obtained after determining the wavelengths emitted from the mobiles screens covering the majority of the UV region and the whole visible area are: (190, 200, 300, 400, 500 600, 700 nm). The spectra are recorded by the device detector where the absorption of UV and visible regions are ranged between (0.257) as the lowest value and (2.175) as the highest value for the mobiles under study, while the absorption of the source of the device are ranged between (0.008) as the lowest value and (0.121) for the highest value. The UV radiation region is recorded the highest value of (6.53 eV) at the wavelength (190 nm). The results of this work confirm the emission of harmful UV radiation on human health, especially when using smart mobiles in the dark rooms at night and near the eyes of the users.***

1. Introduction

The electromagnetic spectrum is a continuum of all electromagnetic waves arranged according to frequency and wavelength. The sun, earth, and other bodies radiate electromagnetic energy of varying wavelengths. Electromagnetic energy passes through space at the speed of light in the form of sinusoidal waves.

Light is a particular type of electromagnetic radiation that can be seen and sensed by the human eye, but this energy exists at a wide range of wavelengths. The micron is the basic unit for measuring the wavelength of electomagnetic waves. The spectrum of waves is divided into sections based on wavelength. The shortest waves are gamma rays, which have wavelengths of 10^{-6} microns or less. The longest waves are radio waves, which have wavelengths of many kilometers [1]. The range of visible consists of the narrow portion of the spectrum, from 0.4 microns (blue) to 0.7 microns (red), as show in the figure (1);

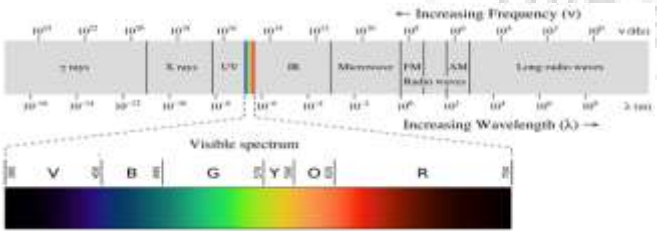

Figure 1: The electromagnetic spectrum

The effect of mobile phone radiation on human health is a subject of interest and study worldwide, as a result of the enormous increase in mobile phone usage throughout the world. As of 2015, there were 7.4 billion subscriptions worldwide, though the actual number of users is lower as many users own more than one mobile phone.

Mobile phones use electromagnetic fields to establish a wireless communication link to the nearest base station. Electromagnetic waves go out and come into a mobile phone through its antenna. That antenna is located very close to the user's head, and people have naturally wondered about the health effects of radiation from mobile phones since their inception. Some users of mobile phones and similar devices have reported feeling various non-specific symptoms during and after use. Studies have failed to link any of these symptoms to electromagnetic exposure [2]. Figure (2) shows the emission of electromagnetic radiation from the mobile screen.

Figure 2: The emission of electromagnetic radiation from the mobile screen

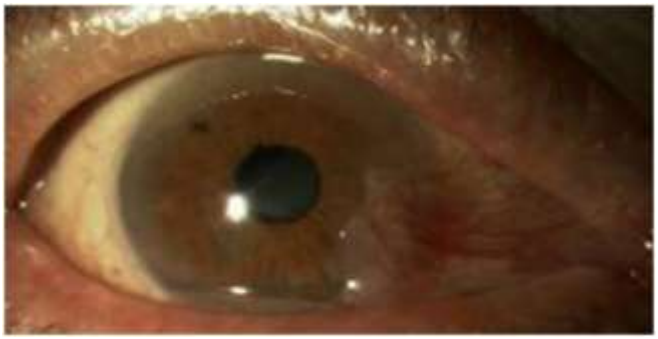

Figure 3: Eye diseases due to exposure to (UV) rays emitted from the sun

Germany's "Good Vision" association warned against the danger of ultraviolet (UV) rays on the eye, as it can cause painful inflammation in the retina and cornea in case of

high density or prolonged exposure without protection which cause a permanent damage to the eyes.

The associations pointed out that the sun can be infested with sunburn after a day in the open air, for example, through redness of the eye or feeling tight in the eye muscle or increase the secretion of tears. In this case the eye should be relaxed by not being exposed to sunlight for a few days as shown in figure (3).

The two types of (UV) rays are (UV-A) and (UV-B). Over time, the effects of (UV) rays may help cause a number of eye problems. **(UV-A**) can hurt your central vision. It can damage the macula, a part of the retina at the back of your eye. The front part of your eye (the cornea and the lens) absorbs most (UV-B) rays, but these rays may cause even more damage to your eyes than (UV-A) rays [3].

The purpose of this research is to analyze the radiation emitted from the smart mobiles screens in the dark rooms where the radiation emitted within the electromagnetic spectrum. The study was dedicated to the selection of mobiles common to use by the people of Iraq.

2. Experimental

Samples of (4) mobiles are used widely for in Iraq and available in local markets where they are marked with the following letters (A, B, C, D) as follows:

Mobile (A) – SAMSUNG – Galaxy, Mobile (B)- SAMSUNG-S7 edge
Mobile I – HUWAEI, Mobile- (D). I – Phone

The dimensions of the mobiles screens under study were measured and arranged in the table (1):

Table 1: Dimensions and areas of mobiles screens under study

Screen Dimensions	Mobile (A) SAMSUNG Galaxy	Mobile (B) SAMSUNG S7 edge	Mobile (C) HUWAEI	Mobile (D) I - PHONE
Length (cm)	10	12	11	10.5
Width (cm)	6	8	7	6
Area $(cm)^2$	60	96	77	63

Using a spectrophotometer to analyze the spectra of radiation emitted from these mobiles screens by the UV-Visible device manufactured by LABOMED, INC. Which is located in the central laboratories in the Faculty of Agriculture at the University of Basra is shown in the following figure (4).

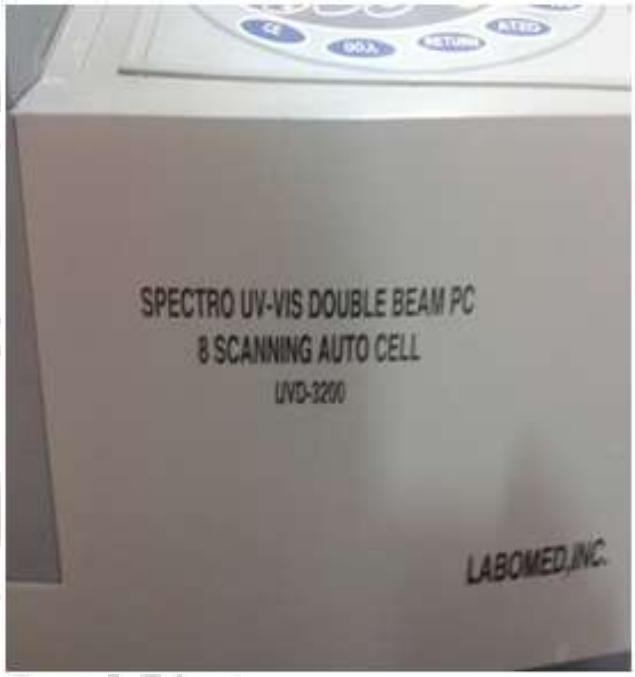

Figure 4: The UV- Visible spectrophotometer instrument.

The mobiles are placed in the chamber of the Spectrophotometer Analyzer at (10cm) away from the detector, so that the screen of each phone is displayed in front of the detector as an alternative to the source of the analyzer as shown in figure (5):

3. Results

The following wavelengths of the instrument spectrum were recorded without using mobiles which are (190, 200, 300, 400, 500 600, 700 nm), absorption values were recorded by the detector and the photon energies associated with each wavelength were calculated by using the following relationship [4[. The results are arranged in table (2);

$$E = \frac{h \cdot c}{\lambda}$$

Where,
(E) = Photon Energy (eV)
(h) = Plank's Constant (j.s)
(c) = Velocity of Light (cm/s)
(λ) = Wavelength (cm)

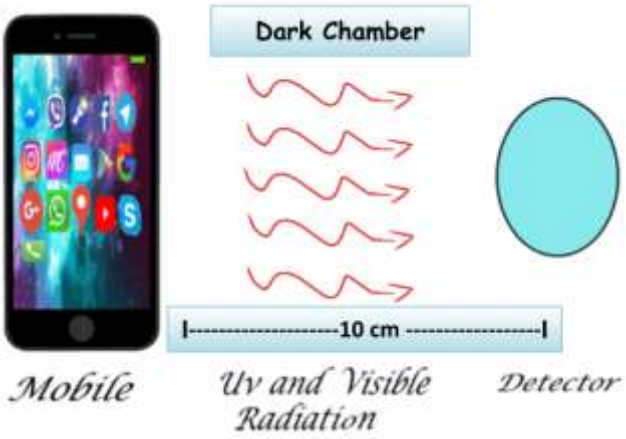

Figure 5: A diagram showing the mobile location for the detector inside the dark chamber of the device.

The relationship between the photons energy associated with their wavelengths shown in table (2) is illustrated in figure (6):

Table 2: The measurements of absorption and photon energy for each wavelength

Wavelength,(λ) (nm)	Photon Energy (eV)	Instrument Spectrum Absorption (a.u.)
190	6.53	0.110
200	6.20	0.079
300	4.14	0.121
400	3.10	0.072
500	2.48	0.034
600	2.06	0.017
700	1.77	0.008

The absorptions values for each sample of the four selected mobiles (A, B, C, D) are recorded in addition to the absorption value of device spectrum analyzer at each wavelength are arranged in table (3).

The absorptions values for each sample of the four selected mobile (A, B, C, D) were calculated with all wavelengths in table (3) are shown in figure (7):

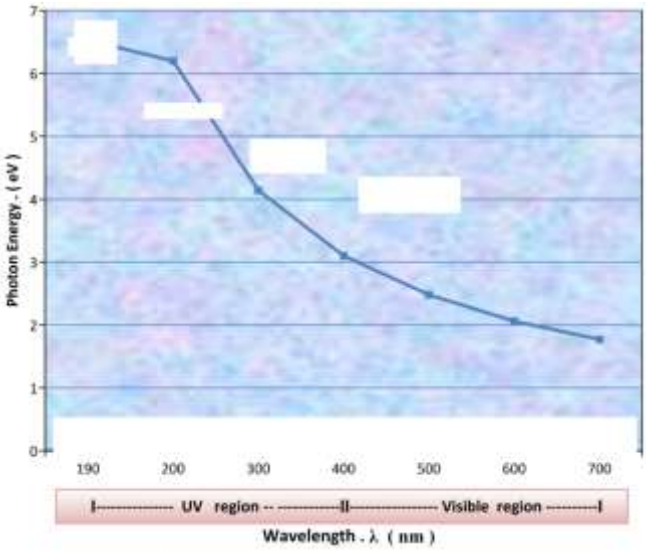

Figure 6: The photon energies associated with their wavelengths.

Table 3: The absorption values for the device spectrum analyzer and mobiles screens radiations under study with their wavelengths

Wavelength (λ),(nm)	Instrument Spect. Absor (a.u.)	Mobile (A) SAMSUNG Galaxy (a.u.)	Mobile (B) SAMSUNG S7 edge (a.u.)	Mobile (C) HUWAEI (a.u.)	Mobile (D) I – PHONE (a.u)
190	0.110	0.257	0.344	0.367	0.366
200	0.079	0.266	0.549	0.543	0.545
300	0.121	0.290	0.935	0.943	0.942
400	0.072	1.148	1.184	1.069	1.078
500	0.034	1.734	1.759	1.747	1.745
600	0.017	2.009	2.055	2.034	2.035
700	0.008	2.082	2.175	2.156	2.154

4. Discussion

Returning to the figure (6), the photon energy is highest in the UV region (6.53 eV) at wavelength (190 nm) and reduced to (3.10 eV) at wavelength (400 nm) , while in the visible region it is reached to the minimum value (1.77eV) at wavelength (700 nm), indicating the risk of UV radiation associated with wavelengths (190 - 400 nm) than those in Visible region.

These figures correspond to the information that the UV region with the wavelengths which are used in the spectrophotometer (190-400 nm) are indicated as UV-A, UV-B, and part of UV-C [5] as show in this table;

Name	Abbreviation	Wavelength (nm)	Photon energy (eV, aJ)	Notes / alternative names
Ultraviolet A	UVA	315–400	3.10–3.94, 0.497–0.631	Long-wave, black light, not absorbed by the ozone layer
Ultraviolet B	UVB	280–315	3.94–4.43, 0.631–0.710	Medium-wave, mostly absorbed by the ozone layer
Ultraviolet C	UVC	100–280	4.43–12.4, 0.710–1.987	Short-wave, germicidal, completely absorbed by the ozone layer and atmosphere

Mobile (A) - SAMSUNG – Galaxy**eliboM ,** (B) - SAMSUNG-S7 edge
Mobile (C) - HUWAEI, Mobile - (D). I – Phone

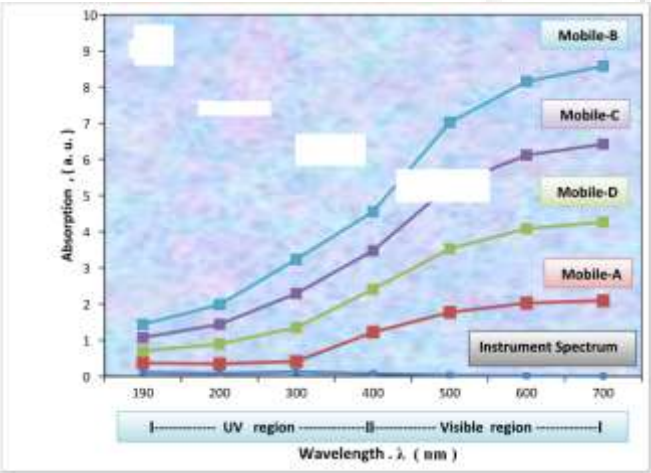

Figure 7: The relationship between the absorptions and their wavelengths for the device spectrum analyzer and mobiles screens radiations under study.

Figure (7) show the relationship between absorptions and their wavelengths for the spectrum analyzer device and for the four mobiles (A, B, C, D) under study. The absorption values in the UV region with wavelengths ranging between (190 – 400nm) changes their values from (0.110) as the highest value to (0.072) as the lowest value for the spectrum analyzer device. While the absorption values ranged between (0.344) as the lowest value to the (1.184) as the highest value for the mobiles under study (A, B, C, D), indicating the emission UV radiation from mobiles in large proportions compared to the source of the device itself.

Figure (7) confirmed when the area of the mobile screen increases, the amount of radiation emitted from the screen will increase, so the model (B) has the highest value of the emitted radiation, where its screen area is ($96cm^2$) followed by the mobile (C) then the mobile (D) and the lowest value is the mobile (A) where its screen area is ($60cm^2$).

5. Conclusions

It is clear from the above that the detector of the spectrophotometer are recorded absorptions of the radiation from the screens of mobiles under test (A, B, C, D), which lies within the ultraviolet region.

The results of this work confirm the emission of (UV) radiation from the mobiles screens under test, which are harmful to human health, especially when using smart mobiles in the dark rooms at night near the eyes of the user.

Therefore, in the end, I call on ophthalmologists to support this research in the detection of cases between the ages of (10 to 50) years when they use their mobiles excessively at night and for long periods.

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