

EFFECT OF ELECTROMAGNETIC RADIATIONS ON HUMANS: A STUDY

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Abstract- A complete analysis of electromagnetic radiations has been done for the electronic devices that have become a part of human life. All the devices have been studied for their maximum level of emissions and the distance at which they have minimal effect. Following these surveys a layout has been proposed for an ideal 18*15 living room such that there is minimum effect of harmful radiations even if it is fully equipped with the electronic items. Medical aspects have been studied for the effect of the EM waves along with the latest inventions on shielding these waves. A future idea has been added for the use of stray microwaves in the atmosphere with the help of a receiver that could convert them into current and subsequently be used for saving power.

Keywords-electromagnetic radiations, milli gauss, humans, effects, diseases, zero distance, prevention

I. INTRODUCTION

Electromagnetic fields surround the man in more than the ways one can even think of. Man tried to explore the electronics for the ease of his survival and though he succeeded but simultaneously an environment has been created from where electromagnetic rays are getting radiated. Such radiations are making humans prone to many physical and neurological diseases. The core of the earth is made up of molten iron -nickel and the ionosphere layer of atmosphere is an electrically charged layer. The resonance between the molten core of earth and the charged ionosphere results in pulses with average frequencies of 10 Hz. On exposure to these pulses for even small time periods result in discomfort or fatal [1]. Even human body is a bioelectric system (brain and heart). Exposure to such radiations result in rupture of the electrical system of body and this may result in death.

II. SOURCES OF ELECTROMAGNETIC RADIATIONS

The growing need of modernization in the late twentieth century posed a severe danger of higher rate of EM waves being absorbed by the human body. The invention and increasing use of latest electronic devices such as televisions, microwaves, power lines, hair dryers, digital watches and most importantly cellular phones has created even worse conditions. These devices emit high frequency electromagnetic radiations. These devices are designed in such a way that alternating current is converted into direct current to minimize the power but in doing so the frequency of the EM waves being emitted increases. These EM waves are even more dangerous when at a distance of 20 meters. Not only this, these can cause

biological defects also. They can burn the body cells and also convert the molecules involved in various body reactions into ions, which changes the body reactions. Low-level exposure to such radiations may lead to abdominal pain, diarrhea, constipation and more severely mutations in DNA. Even small metal incorporated in our clothes may lead to various cancers and tumors during sleep. The human body is still during the sleep period and fields generate in the metal pieces from the radiations of electronic devices around us leading to the EM radiations having direct contact with the body.

EM waves are basically of two types; low frequency and high frequency. Generally low frequency waves do not affect much. These are the high frequency waves emitted from microwaves, power lines and cellular phones which are most disastrous [2].

III. HEALTH HAZARDS BY EM WAVES

EM waves biologically disturb the human body system. Most prominent are their effects on brain, heart and pregnant ladies. Exposure of more than 10mG (mili gauss) results in breast cancer and brain tumor. If the exposure is increased beyond 16mG it may result in increased chances of miscarriages. These were the effects of high frequency radiations. Even low frequency radiations may result in hormonal problems. The hormone 'melatonin' production is disturbed and cause Alzheimer's disease, Parkinson's disease and many cardiac, neurological and ophthalmological diseases. Genetic damage is the most severe damage that can't be repaired even after many generations as it took place in Bhopal Gas Tragedy in India in 1984 [1].

EFFECT ON GENES: Many of the diseases are related to the damage of genes or DNA. Once a DNA is changed it reproduces itself and result in first stage of cancer. Low frequency waves and radio frequency waves interfere with the communication system of the cells and as a result promote the chances of growth of cancer. It even sometimes leads to the damage of DNA strands leading to complete loss of hereditary characteristics. Still there are conflicts among various scientists on whether there is any effect on genes and ultimately on cell physiology [3].

NEUROLOGICAL EFFECTS: The exposure of EM waves lead to the death of neurons in brain. There is a protein named melatonin that is produced in brain that provides immunity to the brain against many diseases like Alzheimer. Exposure to low frequency leads to the lowering in the level of melatonin production. Thus immunity against such diseases is lost. Not only the calcium level of brain cells gets reduced which results in adding up the reduced level of oxygen which may lead to comma state of mind. Along with that some toxins are produced in brain nerves which may lead to the blockage leading to death of the person. These also distort the electrical currents being produced in the brain nerves for the overall control that may cause paralysis [4].

PHYSIOLOGICAL STRESS ON HUMAN BODY: Human body has been so designed so as to get adapted to all the atmospheric changes very easily. It can easily face changes in pressure, temperature, humidity and other changes in surroundings. But on exposure to EM waves the stress proteins are released at a high pace and on longer exposure these proteins fail to prevent the body from the damage being caused to it. Even exposure of 5-10mG may lead to the damage of these proteins.

LOSS OF IMMUNITY: Human body has an immune system against the radiations, pathogens and germs cultivating in the body. EM waves in the atmosphere result in the release of substances like histamine that result in internal swelling of body and also inflammation. These result in hypersensitivity and damage of many organs. Even many cells get ruptured and produce ions which result in chemical reactions within the body that may cause irritation [5].

EFFECT ON PREGNANT LADIES: Cellular phones emit microwave radiation in the spectrum region of 800-900 MHz. The rate at which radiation is absorbed is measured by the Specific Absorption Rate (SAR) expressed in (W/Kg). Electronic fetal heart rate monitoring is commonly used to assess fetal well-being. Biological effects that result from heating of tissues by RF energy are referred to as "thermal" effects. However studies indicate that biological effects may be caused without heating of tissues referred to as "non-thermal effect". The „thermal" effect is the principle by which microwave ovens cook food. The eye and the testes are particularly vulnerable due to relative lack of blood flow to dissipate the excessive heat load. Studies show that environmental levels of RF energy are below levels necessary to produce a „thermal" effect. Non-Thermal Effects comprises of Membrane Effects, Blood-Brain Barrier, Signal Transduction Effects, Cell proliferative Responses, Immune System Effect, Nervous System and Effect on Neurotransmitters. So it can be concluded that mobile phones are probably safe to use in pregnancy. Although reassuring about the safety of the technology in the short term, impossible to reach conclusive evidence regarding long term cumulative effects. Hands-free kit can reduce the SAR for your head while you're on the phone but may increase the

SAR for the rest of your body, something you might want to avoid while you are pregnant [6][7].

IV. EXPERIMENTAL RESULTS

The EM waves are generated from every electronic device but devices like television and microwaves produce it even when they are turned off while lamps and tubes produce only when they are in use. The value of field at 4mts away from a microwave is 6.5 mG. As we have already discussed such amount of exposure is enough for physiological stress and can cause dizziness in the humans. Even cell phones are prohibited near petrol pumps. The reason being the radiations coming out of it that may lead to fire. A simple experiment can demonstrate the strength of the radiations coming out of the cells. Take a pan and put some aluminum foil in it and pour petrol drops over it. Then bring a cellular mobile near it and call on that mobile. When the cell rings the radiations come out of it and it starts burning the aluminum foil after about 5 minutes and it catches fire after about 8 minutes.

The worst effect is made upon by power lines and the transmitters placed in the public places. People living in the surroundings generally feel impatience and stress throughout the day. They are most prone to the diseases like cancers and tumors along with neurological disorders. Even at a distance of about 100 meters, there is an average intensity of about 28mG EM radiations [8]. Such a high intensity can lead to cancers, tumors, cardiac attacks, impotency and miscarriages. It also leads to memory loss, mental depression and nervous impairment. Such an intensity also affects the vision loss due to cataracts or burning and pressure on the eye. Even underground power lines are not that safe and they also produce large electromagnetic fields.

EFFECT ON PLANTS AND ULTIMATELY ON HUMANS: In a study in Michigan, it was found that plants grown near a large communication antenna grew unusually quickly. The antenna radiated out the microwaves and thus it was concluded that microwaves or simply electromagnetic waves speed up the cell division. This cell division is generally not a benevolent factor. They affect the humans in the same way as cell division in such a manner would produce many disorders in the human body [1], [9].

Not only this, there are many indirect effects on human body due to effects on plants as these radiations affect our food. When radiations pass through them many molecules convert into ions and as a result toxicity increases. Such food items may lead to cancer. Meat is most affected by such radiations. Till the meat is processed for eating it becomes full of radioactive and radiated material. The main reason for this is that the amount of radiations and radioactive material in the body get increased as it is passed from grass on to herbivores and then to carnivores [1].

V. STUDY AND RESULTS

S. No.	Devices	Value of Electric Field in V/m(Volt/meter)	Zero Radiation Distance in m(meters)
1.	Wifi Router	6.50	40.00
2.	Cordless Phone	6.50	13.00
3.	Wifi In Laptop	5.50	2.50
4.	Microwave	7.00	100.00
5.	Mobile	19.00	170.00
6.	Tip Of Earphone	6.75	2.60
7.	Bluetooth Headset	4.50	2.12

TABLE I

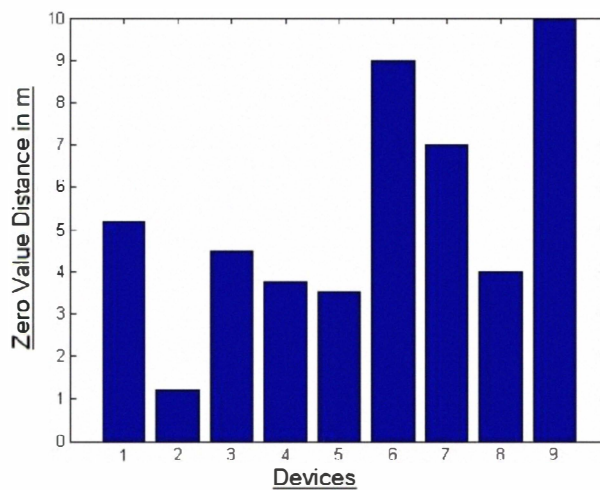


Fig. 2 Zero distance of magnetic field with respect to devices

S. No.	Devices	Value Of Magnetic Field in mG	Zero Radiation Distance in m
1.	CRT screen	26.00	5.20
2.	LCD	1.20	1.20
3.	Tape Recorder	19.00	4.50
4.	Speaker	56.00	3.75
5.	Aquarium	50.00	5.53
6.	Power Switching Clock	80.00	9.00
7.	Audio Receiver	50.00	7.00
8.	Kitchen Appliances	15.00	4.00
9.	Power Converters	100.00	10.00

TABLE II

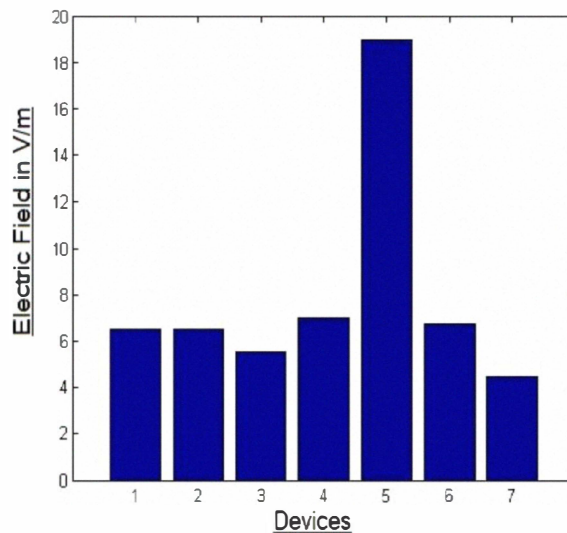


Fig. 3 Electric field with respect to devices

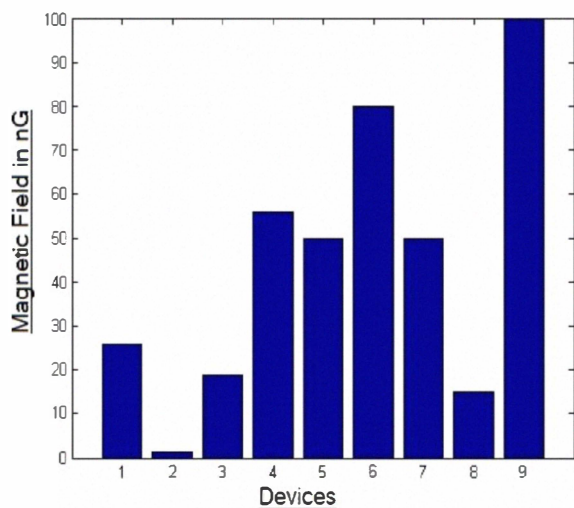


Fig. 1 Fig. 2 Magnetic field with respect to devices

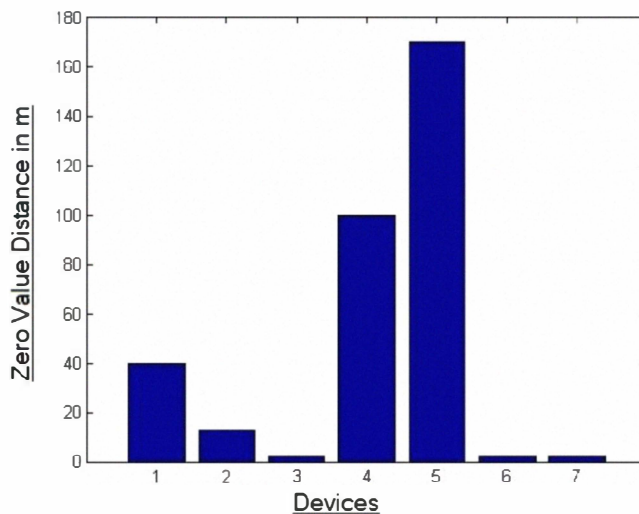


Fig. 4 Zero distance of electric field with respect to devices

Experiments have been carried out for the maximum intensity of electromagnetic radiations and the distance after which there would be negligible amount of radiations coming out of the devices. Gauss meter or a flux meter is a device used for determining the EMR at any distance. It can be measured in various units (V/m, mG). At first the gauss meter is placed in the proximity of the device and checked for the value. This is the maximum radiation coming out from a device. Then gauss meter is moved away from the device up to the distance the radiations remain the of the same intensity(in mG) and the respective distance is noted down. Then on applying the inverse square law [10] the distance is calculated at which the radiations would approximately disappear. The TABLE I and TABLE II describe the maximum radiations" intensity in the first column i.e. the intensity of radiations in the proximity of the device and the corresponding distances at which there would be approximately zero radiation effect have been tabulated in the second column.

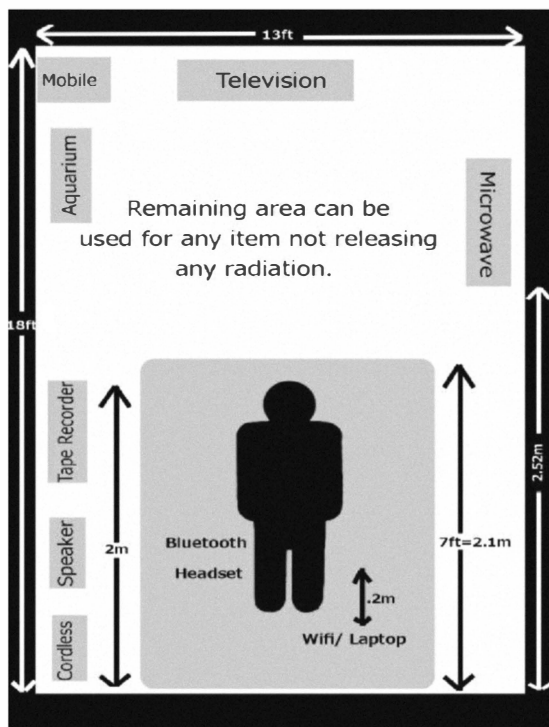


Fig. 3 Layout of 18*15 ft² room

Then on the basis of the above study, graphs have been plotted for pictorial representation. Fig.1 and Fig.3 describe the highest value of radiations emitted from the corresponding devices or it can be called the radiations in the proximity while the Fig.2 and Fig.4 describe the distance up to which there would be the effect of the radiations according to the minimum tolerable values for a young man. As the

So far, the distance up to which the radiations from each electronic device would travel, has been measured. For a matter of fact a young man has the safe limit of absorption up to 10mG and for a child it is 3mG.

Based upon this information, the distances have been derived

for the radiations to acquire the 10mG value and from those distances; a layout of an 18*15 ft² living room has been proposed for minimum effect of electronic devices. Room consists of all the common household devices with minimum effect on the man that can be seated anywhere within an area of 7*7 ft². from the calculations done, it has been found that cellular phones pose the maximum threat to the humans and thus be kept at the far most places.

VI. HOW TO PREVENT THE RADIATIONS

When science has created such a situation, solution to these radiations is also there in science. There have been hard studies regarding the prevention or decreasing the effect of EM waves. Inventions are being coming up in various areas of the world. The major invention is of HARAPAD. Following it there were EMR shields which work for almost all the electronic devices. Before going on to applications there arises a question that how an electromagnetic shield actually works.

EMF Shielding: Electromagnetic radiation consists of coupled electric and magnetic fields. The electric field produces forces on the charge carrier within the conductor. As soon as an electric field is applied to the surface of an ideal conductor, it induces a current that causes displacement of charge inside the conductor that cancels the applied field inside, at which point the current stops. Similarly, varying magnetic fields generate eddy currents that act to cancel the applied magnetic field. The result is that electromagnetic radiation is reflected from the surface of the conductor. Internal fields stay inside, and external fields stay outside [11].

VII. SOME APPLICATIONS

HARAPAD: Laptops emit a high magnetic field from the base, and annoying heat. HARAPAD is designed to act as a shield from magnetic field. A layer of high-tech radiation shielding material incorporated into the pad contains the field and reduces heat by increasing dissipation to the environment. The electromagnetic radiations coming up from laptops are 100 times higher value than the safer limit. This can even cause infertility as it affects the quantity of sperm production. So to avoid such situations we can use HARAPAD which is a form of sheet that can be used below laptops. It shields up to 80% of electromagnetic radiations coming out. When it was studied and tested it was found that a laptop gives out 131mG of radiations on an average while on covering its base with HARAPAD screen it decreases to an average of 24mG [12].

Microwave Oven Window: It's the metal screen behind the window. An EM radiation shield, merely needs to be a metal screen with smaller holes than the wavelength of the radiation to be reflected. You might notice satellite dishes have similar screens, with larger holes for longer wavelengths. It comprises of two transparent panels, an intermediate microwave-blocking screen and a transparent thermoplastic adhesive

filling the space between the panels. The interior panel is very thin and the thickness of the thermoplastic adhesive panel barely exceeds that of the screen. The thinness of the interior panel plus adjacent adhesive minimizes the leakage of microwaves. The whole system at the whole reduces the level of radiations to a large extent [13].

RFID Blocking WALLET: The RFID tags in identification cards have been shown to be insecure. Attackers are able to read and copy information stored on these tags to create copies they can use themselves. These RFID locking Wallets ensure that cards with RFID tags within the wallet can not be read while the wallet is closed. These actually prevent any RF to pass through. It has room for six credit cards, your cash, business cards and the ID [14].

Computer Security: It specifies electromagnetic shielding for computers and keyboards to prevent passive monitoring of keyboard emissions that would allow passwords to be captured; consumer keyboards do not offer this protection primarily because of the prohibitive cost [15].

RF shielding is also used to protect medical and laboratory equipment to provide protection against interfering signals, including AM, FM, TV, emergency services, dispatch, pagers, ESMR, cellular, and PCS. It can also be used to protect the equipment at the AM, FM or TV broadcast facilities.

VIII. ANOTHER VIEW OF RADIATIONS

Till now it has been discussed a lot regarding the ill effects of EM waves but every thing has its positive face also. In the same manner there is a field of medicine where EM waves have been used since ancient times for curing of many diseases. In the late 19th century medical science started to develop and one major reason behind this was the use of electromagnetic radiations in decaying undesired cells and tissues that lead to diseases. The revolution came out when "Racameir" and "Pravaz" demonstrated the destruction of uterine cancer by using the method of electric field heating. Electro puncture was another technique used to destroy unwanted tissues through a pin tip needle. This technique involves the use of needle or a knife directly touching the tissue to be burned. This technique is much effective in destroying tumors, cancer cells and fungal growths [16]. Even blood clotting is enhanced using caustic effect of electricity. The technique even helped in muscle relaxation and help people from muscular pain and strains. The same technique is used in burning fat tissues also [17], [18].

Diathermy is another method to use these waves. It involves deep heating to destroy the cells and help in diseases like arthritis, poliomyelitis and pelvic diseases [19].

IX. FUTURE PROSPECTS:

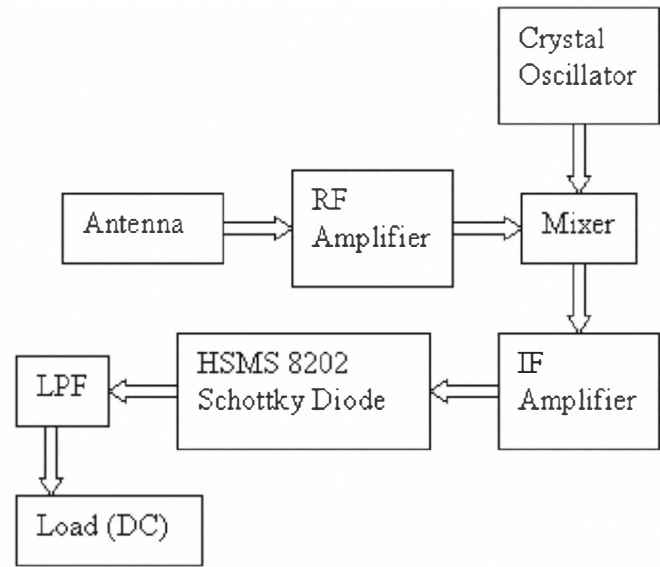


Fig. 4 Block diagram

The atmosphere is full of stray microwaves which are of no use. Moreover they are polluting the surroundings. The waves emitted from electronic devices, towers, power lines and mobiles are all sources of radiations which lie in microwave region. Power can be generated using these stray fields by receiving and then subsequently amplifying by RF amplifier. The amplified wave is then passed to a mixer which is followed by an IF amplifier. Now this wave is passed through a SCHOTTKY diode [20] which converts RF wave directly into current. This system is a combination of rectenna and super heterodyne receiver to directly convert the microwaves into current [21]. This current can be accordingly amplified or modulated to be used for loads and devices [22], [23].

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