

Human Brain with Emr of Cell Phone

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ABSTRACT: Electromagnetic radiation produce by cell phone and the relationship with the human's health is not a new matter. From the time when the used of mobile (cell) phone had increased rapidly over the long-ago, people are becoming more concern with their health when dealing with the electromagnetic radiation. This type of radiation would leads to heating of body tissue at particular rate called the thermal radiation. Thermal radiation, it depends on the signal frequency of the energy, the power density of the radio frequency field that beats the body and the polarization of wave, the result of thermal distribution image generated by cell phone towards human head from thermal imaging camera. The analysis is conducted in a laboratory with average of 45 minutes talking hour with two different types of mobile phone having internal and external antenna.

Keywords: Air tube Headsets, DARPA, EMR, Radio frequency, SAR, Thermal Camera,

I. INTRODUCTION

The cell phone is an important device in our life. The number of mobile phone users has increased recently. Approximately there are around 1.6 billion cell phone users throughout the world and the numbers are increasing [6]. Cell phone radio frequency used to exchange a few words has the ability to penetrate through semi-solid substances like meat, and living tissue to a distance proportional to its power density [11]. It also can cause dielectric heating effect or thermal effect [6]. Thermal effect is basically the temperature rise in the body cause of energy absorption from oscillating electric fields or electromagnetic radiation [3]. Thermal radiation is generated when heat from the movement of charged particles within atoms of the cell phone's case is converted to electromagnetic radiation. Thermal radiation of the cell phone also related to the specific absorption rate (SAR). It is defined as the rate of radio frequency (RF) power absorbed per unit mass by any part of the body. SAR values are dependent on the separation distance between the body and the cell phone. The nearer the distances of the radiation to the human head, the higher the SAR values [2]. RF is emitted by the cell phone antenna. An antenna is a transducer designed to transmit or receive electromagnetic waves [3]. Studies show that RF radiation has the ability to cause biological damage through heating effects [5]. Moreover it has been observed by cell phone users that symptoms like headaches, earaches, blurring of vision, short term memory loss, numbing, irritated, burning sensations, bad sleep, electromagnetic reaction, exhaustion and nervousness [4]. Thermal effect has been reported to cause temperature rise at the skin near ear skull region. In Europe, the European Union Council has adopted the recommendations made by International Commission on Non Ionizing Radiation Protection. These recommendations set a SAR limit of 2.0 W/kg in 10g of

The results taken by University Malaysia Sarawak, Malaysia, Faculty of Engineering show that an increased of heat especially at the place near the ear skull after 45 minutes of operation. When comparing both different types of mobile phone, mobile phone with external antenna produce more heat compared to mobile phone with internal antenna. By considering the result and thermal camera invented by DARPA (Defense Advanced Research Project Agency) it will possible to disconnect call /switch off cell phone when temperature inside head increased due to radiation.

1.1 ELECTROMAGNETIC RADIATION

The World Health Organization (WHO) defines electromagnetic fields on its WebPages dedicated to the concerns regarding the increasing presence of this form of radiation. In essence, an electromagnetic field is comprised of two components, one being an electric field generated by differences in voltage and another being a magnetic field generated by the flow of current. The field propagates at the speed of light (300,000 kilometers per second or 186,000 miles per second) in waves of a certain length that oscillate at a certain frequency (number of oscillations or cycles per second). In the electromagnetic range, gamma rays given off by radioactive materials, cosmic rays, and X-rays are all dangerous to humans and other organisms because of the relatively high energy "quanta" (packets) they carry (high frequency or short-wavelength waves). Such rays lead to "dangerous radiation" (ionizing; i.e., with an ability to break bonds between molecules). Mobile phone systems also act in the electromagnetic range (sometimes referred to as "microwave" or "radiofrequency"), however, the frequency (energy "quanta") of the longer-wavelength waves associated with this technology is lower (and therefore safer to humans) and regarded as "non-ionizing"

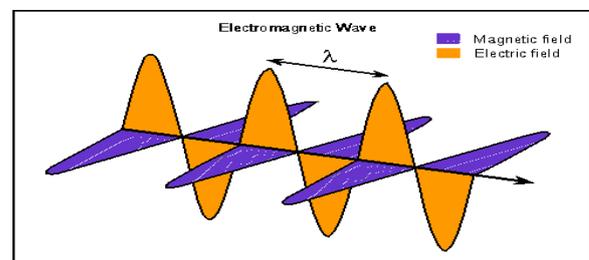


Figure 1.1: Electromagnetic Radiations

1.2 TYPES OF ELECTROMAGNETIC RADIATION

Ionizing radiation - This type of radiation contains enough electromagnetic energy to strip atoms and molecules from the tissue and alter chemical reactions in the body. Gamma rays and X-rays are two forms of ionizing radiation. We know they cause damage, which is why we wear a lead vest when X-rays are taken of our bodies.

Non-ionizing radiation - Non-ionizing radiation is typically safe. It causes some heating effect, but usually not enough to cause any type of long-term damage to tissue. Radio-frequency energy, visible light and microwave radiation are considered non-ionizing. Electromagnetic Spectrum

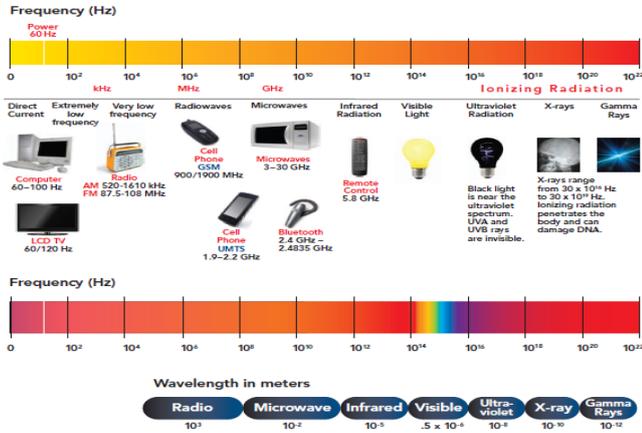


Figure 1.2: Electromagnetic radiation types.

II LITERATURE REVIEW

2.1 GLOBAL SYSTEM FOR MOBILE COMMUNICATION (GSM)

Global system for mobile communication (GSM) is a digital wireless communication protocol for mobile phones and was developed in the early 1980's. GSM also provided useful features like security, authentication and the invention of the SIM card. GSM networks operate in four different frequency ranges which are 900 MHz band, 1800 MHz band, 850 MHz band and 1900 MHz band. GSM 900 and GSM 1800 standard is the most commonly used standard. 850 MHz band and 1900 MHz band is introduced because the 900 MHz and 1800 MHz frequency bands were already allocated. GSM 1800 standard provide more bandwidth and less power requirements than GSM 900 MHz. The transmission power in the mobile phone is limited to a maximum of 2 watts in GSM 850 and GSM 900 while maximum power of 1 watt in GSM 1800 and GSM 1900. The specifications of GSM 900 and GSM 1800 are shown in Table 2.1.

Table 2.1: Specification of the GSM 900 and GSM 1800

| Specification | GSM 900 | GSM 1800 |
|-------------------------------------|---------------|---------------|
| Downlink Frequencies | 935-960 MHz | 1710-1785 MHz |
| Uplink Frequencies | 890-915 MHz | 1805-1880 MHz |
| Channel Spacing | 200 kHz | 200 kHz |
| Modulation | GMSK | GMSK |
| Typical Mobile Transmit Power | 2W | 1W |
| Maximum Base station transmit power | 320W | 20W |
| Maximum Distance | 35 km | 8 km |
| Speech Encoding | LPC (13 kbit) | LPC (13 kbit) |
| Bit rate | 270 kbps | 270 kbps |

2.2 RADIO FREQUENCY AND SAR

Radio frequency has the ability to penetrate through semi-solid substances like meat, and living tissue to a distance proportional to its power density. This ability will cause dielectric heating on the tissue of the human

body. Dielectric heating also calls thermal effect. Thermal effects are the temperature rise in the body cause of energy absorption from oscillating electric fields. The force produced by an electric field on charged objects will generate electric currents. Thermal effect from the high intensity radio frequency of mobile phone will cause heating at the skin near the ear skull region. Temperature at the skin will continuously increase until it is balanced at certain level when the heat will then be absorbed by the flow of blood to others part of body. Several minutes was taken for the radiated skin part temperature to reach the equilibrium temperature. The equilibrium temperature will be determined by calculating the average power absorbed which also called Specific Absorption Rate (SAR). Figure 2.1 shows the continuous of high intensity radiation of radio frequency toward the skin near the ear skull region [9].

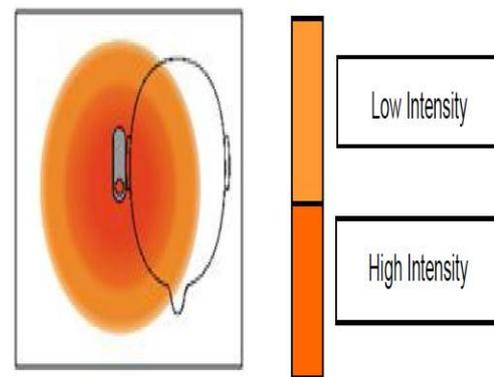


Figure 2.1: High Intensity Radiation of Radio Frequency toward the Skin near the Ear Skull Region

Specific Absorption Rate (SAR) is a dissymmetric quantity which is defined as the rate of RF power absorbed per unit mass by any part of the body. SAR value commonly is determined either 1g or 10g of simulated biological tissue in the shape of a cube. SAR value normally specified at the maximum transmission power. Transmission power will be higher when the mobile phone is used at the area with very low field strength of received signals [11]. SAR values are dependent on the separation distance of the body and the mobile phones. As the distance of the body and mobile phones is closed, the SAR values will be higher and vice versa.

2.2 BASIC THERMAL CAMERA

All thermal cameras consist of the same basic elements as shown in figure 2.2:

- A lens made of special material that focuses thermal energy onto a detector.
- A detector that is sensitive to IR energy.
- Electronics and signal processing elements that translate the energy gathered by the detector and convert it into a video signal that can be displayed on a monitor

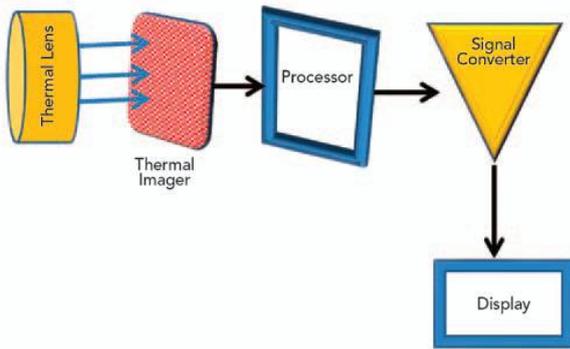


Figure 2.2: Basic block diagram for Thermal Camera.

IR energy barely passes through conventional lens glass, so thermal cameras have to use lenses made out of different materials that are expensive compared to standard glass. Two of the most commonly used lens materials are germanium and zinc selenide. Both of these materials are highly transmissive of IR radiation, meaning that thermal energy passes through them with great efficiency. Germanium has the highest index of refraction of any commonly used IR transmitting materials. It is a very popular material for systems operating in the 3-5 or 8-12 μm spectral regions. Germanium blocks ultraviolet (UV) and visible light up to about 2 μm . It is the best material for transmitting allowing up to 95% of the energy to flow through the lens. However, germanium has the property of thermal runaway, meaning that the transmission factor decreases as temperature increases. Because of this feature, thermal cameras incorporating germanium lens material should be used in areas at temperatures below 158° F (70°C).

2.4 LIMITING EXPOSURE TO HARMFUL CELL PHONE RADIATION

By means of following tips it is somewhat possible to minimize the risk of radiation towards human being

1. Turn on loud speaker.
2. SMS's only.
3. Select the offline mode.
4. From left ear to right ear.
5. Avoid narrow space.
6. Note the signal.
7. Do not stay long.
8. Reduce play around with the Smartphone.
9. Keep your cell phone when not connected.
10. Do not pocket the phone.
11. Do not put the phone in bed.
12. Buy cell phone with low radiation rating.
13. Avoid children
14. Use an Air Tube Headset

2.5 DARPA (DEFENSE ADVANCED RESEARCH PROJECT AGENCY) INVENTION

Thermal imaging shows how the world looks at infrared wavelengths of 8 to 12 micrometers. At those wavelengths, people, warm-blooded animals, and operating engines glow brightly against the cooler background of plants and soil. Firefighters use thermal imaging cameras to identify dangerous hot spots. Soldiers use them to check what might be lurking in the brush, especially in dim light.

But today's thermal imaging cameras are big and expensive standard military versions resemble binoculars and cost thousands of dollars. Civilian models used by firefighters and contractors cost \$1000 or more and may weigh a few kilograms. Key problems are the high cost, large size, and power requirements of the infrared-sensitive sensors needed to record images at wavelengths about 20 times longer than visible light. To overcome those problems, DARPA is paying Raytheon Vision Systems \$13.4 million over three years to develop ways to make the sensors small and cheap enough to be integrated into phones. Soon every US soldier could have a thermal imaging camera in their back pocket.

2.6 ENVI-BROWN TUBE AIRCOM TECHNOLOGY BLUETUBE-AIRTUBE-RF3 HEADSET

"With regards to the advice that hands-free kits be used, there are conflicting results. Some studies suggest that radiation exposure, if it exists, could actually be higher because the ear piece is closer to the brain... Advice on the use of hands-free kits is being revised and national guidelines are due to be published later this year." - Martin Whild, Assistant Information Officer for the National Radiological Protection Board which advises both the public and government on the risks of radiation. (Evening Times London, England April 30, 2004) The Anti-Radiation Air-tube Headset offers the safest alternative on the marketplace today as shown in figure 2.4.



Figure 2.4: Blue tube/Air tube Headsets

The Anti-Radiation Air-tube headset incorporates a few features that other headsets simply don't have: a special AirCom sound-delivery tube that may reduce electromagnetic radiation, a tangle-free cord, only available with tangle free chord in ear bud style, and a unique earpiece system.

2.7 BLOCK SYSTEM TO DISCONNECT CALL WHEN TEMP. INSIDE HEAD ABOVE SPECIFIED LIMIT

On the basis of thermal image camera invented by DARPA, by means of its small size like button of shirt it will possible to make use of it in cell phone to measure temperature inside brain. Then by means of electronic circuit the measure temperature will compare with the standard one and if it is greater than standard then either disconnect the call or switch off cell phone.

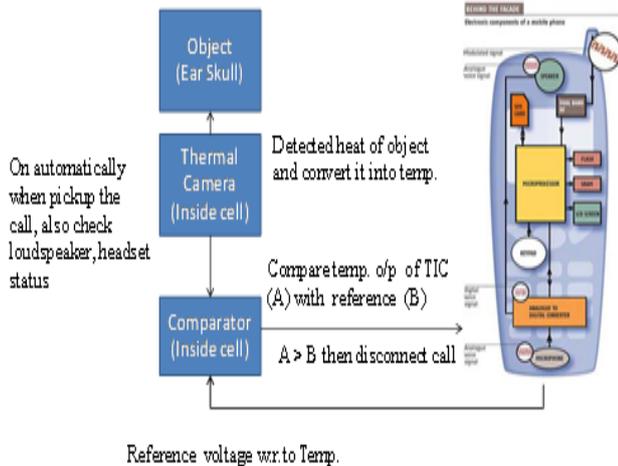


Figure 2.5: Block Diagram to disconnect call when brain temperature above normal range.

As shown in figure 2.5., when call will be pickup, Thermal Camera inside cell phone will turn on automatically, if loud speaker is not switch on and considering that cell phone hold near ear. Loud speaker on means consider cell phone won't near ear. When Thermal Image Camera switch on it will detect the heat of object in front of it and convert it into temperature. Then this temperature in terms of voltage compare with reference voltage with respect to temperature in comparator. If object temperature is greater than reference (i.e. normal range at which tissue will not burn) the output of comparator goes low/high as per logic. This output will be use for turn of RF switch (i.e. disconnect incoming call).

III CONCLUSION

The analysis done by University Malaysia Sarawak, Malaysia faculties that the human head can absorbed the radiation from the mobile phone easily. This radiation is so-called the thermal radiation where the human head temperature increase significantly as the talking hour (period of time using the mobile phone) increased. Mobile hand phone with external antenna and serving GSM 900 shows high increase after 15 minutes operation compared to mobile phone with internal antenna and serving GSM 1800. Features study will on the basis of thermal image camera invented by DARPA, by means of its small size like button of shirt it will possible to make use of it in cell phone to measure temperature inside brain. Then by means of electronic circuit the measure temperature will compare with the standard one and if it is greater than standard then either disconnect the call or switch off cell phone.

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Website

American Cancer Society (www.cancer.org)
National Cancer Institute (www.cancer.gov)