# A Model to Detect and Minimize of Mobile Radiation using IoT

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***Abstract*** **-** Smart phones became a prominent part of everyday work and personal life. The Smartphone users range worldwide is increasing day-by-day. Currently, individuals of all ages using smart phones with web connectivity. The use of internet and data communication is growing with a great extent. However, this massive culture shift in personal technology delivers an endless stream of information that negatively impacts us psychologically – being coupled to feeling anxiety, stress, concentration, sleep etc. There are a lot of established facts that the radiation emitted from the portable phones and antennas can negatively impact on human health. There are some long term adverse effects with a long time exposure to mobile phone radiation. Mobile phone operates at different frequencies using Electro-magnetic waves which are responsible for effective communication. These waves have several effects on the human body as well as our daily lives. The effects of electromagnetic waves cause several issues and diseases in the human body like cancer. As of now, the type of cancer caused by these waves has enlarged, because mobile users have increased. Owing to the importance of human life, this paper will address how humans are exposed to mobile SIM radiation among the huge number of users. The proposal consists of an automatic system which detects radiation from a group of Mobile SIM users and provides a solution to minimize the radiation.

***Keywords*** **-** EM (Electromagnetic) Radiation, ICNIRP, RF Radiation Detector, Mobile Jammer

## I. INTRODUCTION

With the advancement of technology and innovation, most of the things are connected to the web around the world. The Internet of Things helps us in developing most of the applications for human lives and provides more over comfort. Over the years, mobile communication has evolved from the primary generation (1G) to the fourth generation (4G) mobile systems. The tiny size, ease of use and class of GSM mobile phones are the key reasons why it's dominated the telecommunication market around the world. At the present state of mobile phone deployment and therefore the annual increase within the variety of individuals that are using them, billions of individuals are exposed to radiation from mobile phones around the world. The number of Smartphone users worldwide is foreseen to grow by one billion during a time span of five years, which suggests the number of Smartphone users within the globe is foreseen to achieve a pair of 0.7 billion by 2019. As per the stats, the typical mobile phone user checks their device 47 times on a daily basis. 85th of individuals check their phones while speaking with friends and family. Increase in the usage of growth of smart phones and using more than 2 Sims in the mobile handsets. As of nowadays, most of the mobile users use a twin SIM that ends up in a rise in radiation emission by virtually a factor of 2X as compared to one SIM. Mobile operators use radiofrequency waves within vary of 300MHz-3GHz which will be harmful to the human body [1]. Many surveys and scholars concluded in their findings that radiation emitted by mobile phone handsets is harmful to the human lives. Long time exposure to this kind of mobile phone radiation will have negative impact on a psychological behaviour of the human. Many Experimental results reveal that, when the number of radiating sources increases the amount of emitted radiation also increases [2].Electromagnetic wave emitted by mobile phone handsets depends on many factors like temperature and humidness, its wavelength etc. based on the temperature and humidity, the EM waves that emit some kind of radiation. Therefore, it's required to extract the worth of electrical (E) -field (volts/meter) from the individual frequency parts of the GSM bands like 0.9 GHz, 1.8 GHz, 2.1 GHz, and 3.5 GHz to be compared with ICNIRP level. Our goal is to provide a safer environment by minimizing the radiation which impacts the human kind. The proposal system minimizes the impact of radiation on human health by limiting mobile phone usage. Therefore, the most interest for this project is to live the mobile signal from the base stations, are principally near to the community covering the GSM bands of 0.9 GHz, 1.8 GHz, 2.1 GHz, and 3.5 GHz. This paper describes that the project is completed beneath the subsequent modules:

1. Design the RF detector system that receives the mobile operative frequencies and changing to DC voltage.
2. Interfacing the detector system to the microcontroller and wifi-shield.
3. Design and transfer the software onto the cloud platform so as to observe the RF values.
4. Calculate the typical frequencies with regard to temperature and limitation values.
5. Decreasing operative performance on the mobiles with respect system limitations.
6. Design and develop a graphical interface to watch the projected system performance.

**Problem Statement** - Radiation emitted from many mobile Sims from crowded areas like colleges, film theatres, and

working institutes. The people that are in crowded places are being exposed to the radiation emitted by the mobile SIMs that causes unhealthy effects on human life like brain cancer, cell injury, and heart issues.

## II. RELATED WORK

A real-time monitoring system is a manual detection system monitoring the continual exposure of electromagnetic radiations that are radiated by cellular base stations antennas and in addition mobile units and totally different RF sources of radiation levels. Monitoring and comparison with Federal Communications Commission and in addition ICNIRP levels are prescribed for the general public [3].In this work, the arm controller monitors the RF radiation values and manual description of comparison with ICNIRP limitations. The arm controller will tune the received frequencies to digital values and show the results. The real time radiation monitoring system is an embedded set up. In this embedded system, the receiving frequency vary of the receiver antenna is in between 80 MHz to 2.5 GHz.

So as to tune the actual frequency in the RF 2052, the display section which consists of CDEEC RF computer client software (Visual Basic 2010), can choose needed frequency and span (required bandwidth) and is fed to the ARM controller through USB cable. The ARM controller consists of Fractional-N algorithmic rule technique, which is able to convert the chosen frequency and span into its corresponding digital worth and is fed to the RF 2052. Then, the RF 2052 can tune that frequency and fed to the Si 4362 and it'll estimate the radiated power and is regenerate in to the digital format. It's fed to the ARM controller [4]. The ARM controller compares the received power level from Si 4362 with the Federal Communications Commission standards power level. If the power level is over that of the FCC standard levels, it'll be treated as dangerous level and every one corresponding frequency wise power level fed to the show section through USB cable. The radiated power is in dangerous zone. It's capable of measure the radiated power ranging from 80 MHz to 2.5 GHz. Currently, the radiated emissions from the GSM tower are detected by the spectrum analyzer that mobile frequency band network systems. However, spectrum analyzer does not have any provision to broadcast or transmit any data obtained within the field over the net. In addition, the data measured by spectrum analyzer is offline and not true time results. It's difficult to offer a real image of the electromagnetic (EM) radiation level within the supposed atmosphere. Electromagnetic radiation should not exceed the radiation limit proposed by ICNIRP [4]. A developed software application performs radio monitoring so as to inform the general public regarding the levels of the electromagnetic radiation from the antenna parks. The application implements a strong algorithmic rule supported the functions of the spectrum analyzer. The public, through a web-site, gets informed with the problems concerning the electromagnetic radiation produced by wireless telecommunications systems [5]. A completely automatic distributed multi-instrument RF radiation measuring system that monitors on a true time basis, the electromagnetic radiation emitted by antenna parks. The key feature of this technique is that the on-line operation capability, its simple configurability through a network and therefore the automatic adaptation of the running software application to any configuration modification. A project enforced by the Mobile Radio Communications Laboratory of the National Technical University of Athens for the Hellenic Civil Aviation Authority is that the design, development and installation of an automatic monitoring system of the radiofrequency radiation levels. The system is based on the client –server architecture, whereas a great deal of parameters are taken into consideration throughout the design, like it's absolutely configurability via a local network, its flexibility concerning the kind and therefore the range of the measuring devices in operation and also the measurement procedure parameters[5].

## III. PROPOSED WORK

The actual existing work depicts that using fibre optics; rather than microwave links will minimize some type of radiation. During this Project, the automated proposed system which detects the (EM) electromagnetic radiation level and compares with the ICNIRP values and minimize the frequencies by changing from high vary frequencies to low vary frequencies. It is tough to present a true image of the electromagnetic (EM) radiation level within the supposed atmosphere. Electromagnetic radiation shouldn't exceed the radiation limit proposed by ICNIRP. The proposed system consists of an antenna that receives the electromagnetic frequency signals through RF detector. The received signals are to be extracted for the electric field intensity in terms of dB/Vμm. The Arduino Microcontroller sends the information using Wi-Fi- ESP8266 into the cloud. The cloud server database contains the ICNIRP limits(X factor). This X value is to be compared with the experimental field strengths(Y factor) dB/Vμm. The ICNIRP limit of electrical field strength( X factor) is 155 dB/Vμm covering the GSM bands of 0.9GHz, 1.8 GHz, 2.1 GHz ,2.4 GHz, and 3.5GHz.The cloud server shows the triggered voltage values and passes a signal once it exceeds the ICNIRP limits. The mobile jammer minimizes the bandwidth to 2G frequencies bandwidth in order to provide the general public exposure to the EMF radiations is somewhat reduced within the network coverage space. The mobile users inside the coverage space can allowable to attend phone calls, but with noise, and allows to send text messaging etc. This method is proposed for when a large variety of mobile users in a coverage space of emitting a lot of radiation. It's an automatic system that controls and minimizes the radiation that may be useful to human life. Every technical system has facing some pros and cons issues. This proposed system has some limitations in detail:

**Advantages –**

- Minimize the Radiation effected by humans so he will use the mobile with no fears.

- Able to trace of electrical field intensity values and monitors it simply at anytime.
- Simple and feasible one.

**Disadvantages** –
- User intimate with a poor service in comparison to the particular services from mobile.
- Cost-Effective.
- Noise impulse of the system is tends to be very little high.

**Limitations –**
- The system is ready to calculate frequencies up to 3 GHz.
- The residential covering space up to 10-100 Sqmts.
- Delay in operating of the model for efficient calculations on real-time standards.
- It covers all the GSM bands frequencies.

## IV. SYSTEM ARCHITECTURE

The main system design deals with the most important elements of the hardware. It consists of rectangular patch antenna that is in a position to receive the all sorts of frequencies covering the GSM band frequency. The RF radiation detector circuit, rectangular patch antenna, Arduino microcontroller, Wi-Fi- protect, and mobile jammer circuit. The rectangular patch antenna acts as a receiver sensing element to receive a signal from mobile handsets. The microcontroller received the input voltage from the RF detector and converted it to E-field value. Additionally, WiFi shield is that the medium hub to attach the Arduino to cloud IoT platform through web. The extracted E field data would be plotted for every frequency within the cloud IoT platform and saved within the server. The cloud server runs an algorithmic rule so as to communicate with the mobile jammer module for minimizing the frequencies to a safe-level. As a result, the user will access the information via any internet enabled devices. The general block diagram for the IoT mobile radiation detection system is as shown within the figure one. Next, the system elements are going to be explained thoroughly in terms of design and architecture.

**A. RF detector System -** The first component of the system is that the mobile phone detection circuit during which the AD 8312 is employed as an RF signals detector ranged from low frequencies up to GSM bands. This detection is perceived by rectangular patch antenna connected to the AD 8312 as inverted input, and also the alternative input accustomed calibrate the circuit for optimum detection with completely different wave lengths. That optimal detection has been achieved with a maximum detection range by selecting the optimum resist ance (R3) value to be 220 KΩ without the necessity for resetting the sensing apart of AD 8312. Electromagnetic RF radiation was detected via detection circuit, once active phones are addressed by the capacitance that is functioning as a detector for this RF signal. When the capacitor in the circuit which detects the RF signals and passes it on to the inputs of AD 8312 sensor. After that, the output signal of AD 8312 is converted E-field digital values.

**B. Arduino Microcontroller -** In this system of hypothetical model, we are tend to using Arduino Uno microcontroller board that has advantageous options in which microcontroller Arduino Uno board is based on the AT mega 328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller, simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery [7]. The ESP 8266 Wi-Fi shield module is embedded with the microcontroller and 3V circuit to manage the regulation output DC voltage. The ESP 8266 Wi-Fi shield module is embedded with the microcontroller and 3V circuit to manage the regulation output DC voltage.

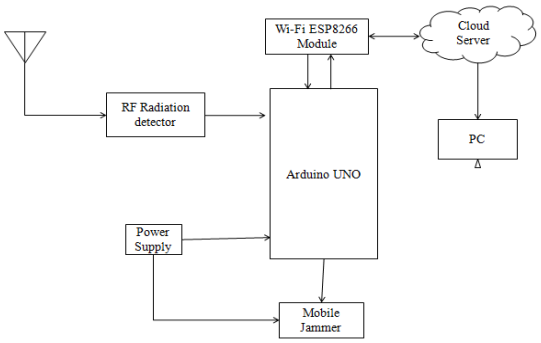


Figure 1: Block diagram of Mobile Radiation Detection and Minimization Model

**C. GUI Control Panel** - The GUI control panel is designed and deployed with respect to the cloud environment. Create the input variables from the microcontroller and in Arduino IDE platform helps to monitor the values by uploading the sketch. The control panel is only for the display purpose to observe and predict the RF values in future aspects.

**D. Mobile Jammer Circuit** - Signal passes through the filters in the circuit detection system and are filtered as per the bandwidths. Separate filters are accustomed detect uplink and downlink frequencies of the band. The uplink frequencies are used as input to the trigger that outputs a relentless DC voltage. The downlink frequencies are amplified and are so added with noise and transmitted. The triggering circuit consists of a full wave rectifier, a switch and a 5V DC supply connected to the switch. The switch works as a comparator to match input voltage with mounted threshold value. If the input is bigger than threshold value, the output 5V supply is connected to it. The filtered signal after passing through the full wave rectifier are continuously more than 1V. On passing through the switch of threshold voltage 1V, outputs a 5V DC voltage if the amplitude of the rectified wave is greater than 1V or else

the output is 0V. The voltage from the trigger circuit allows the jamming circuit. The 5V supply from the trigger circuit enables the subsystem (subsystem works only if it is triggered by positive voltage) which amplifies and adds noise to the signal and transmits it. If there's no trigger, the output are going to be 0V creating the jammer circuit to be inactive. If a particular frequency is detected by the filters, then the triggering circuit gets triggered and enables the jammer. The full wave rectifier is used for triggering the jammer circuit to jam the preferred signals and is a promising method to significantly trigger the jammer circuit.

## V. METHODOLOGY

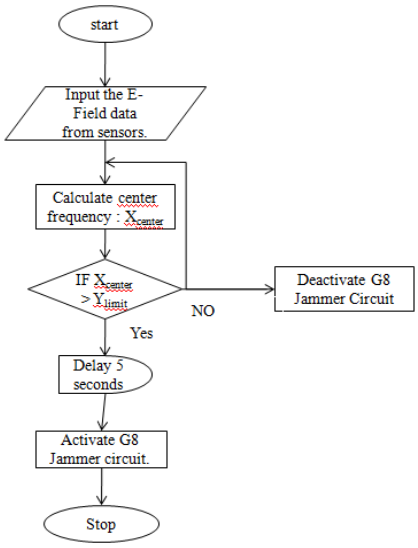


Figure 2: Radiation Minimization Flowchart

The proposed packaging is deployed in the huge mobile phones usage areas. Then it performs its behaviour instantly.

1. The RF detector receives the input signals and converts into extractable E-field limit values which are input to the algorithm.
2. Calculating the center frequency($X_{center}$) from different frequencies.
3. Initialise counter=0
4. $X_{center}$=0
5. Comparing center frequency ($X_{center}$) with the ICNIRP limitations ($Y_{Limit}$).
6. If $X_{center}$>$Y_{limit}$
7. Delay counter by 5 seconds i.e.,counter= 5s
8. Trigger active Mobile Jammer module.
9. Else
10. Inactive Mobile Jammer module.
11. Go to Step -2
12. Stop.

## VI. RESULTS

The proposed model has been calibrated with an existing system in the market. The below table shows comparison between existing system and proposed model parameters. Based on the evaluated results, the E-field strength value shows some deviation with the field values. The experimental results determines that the number of radiating sources increases , then the radiation exposure to human is also high. So that the radiation exposure is calculated using number of radiating sources (mobile handsets) and the different operating frequencies on different band sizes. The % of deviation E-field value with the existing model is approximately ~2% [11].

Table 1: Estimated results using Spectrum analyzer and Horn antenna and proposed model

| Operating frequencies (GHz) | Existing model | Proposed Model | %of Deviation of E-field value |
|---|---|---|---|
| 0.9 | 110.51 | 108.11 | 2.17 |
| 1.8 | 110.91 | 110.12 | 0.06 |
| 2.1 | 113.90 | 113.90 | 0.47 |
| 3.5 | 119.67 | 119.42 | 0.25 |

The results are calculated using the formula,
E= AF+V
Where E= E-field value (dBµV/m), AF= Antenna Factor (dB/m), V= Input voltage of the RF detector (dBµV).

Table 2: Estimated E-field values on a group of mobile SIMs

| Operating Frequencies (GHz) | $X_{center}$ Frequency | E-Field Value | $X_{center}$ >$Y_{limit}$ | New E-Field value |
|---|---|---|---|---|
| 0.9 | 1795 | 107.5 | 0 | 107.5 |
| 1.8 | 1747.5 | 110.57 | 0 | 110.57 |
| 2.1 | 1842.5 | 121.28 | 0 | 121.28 |
| 3.5 | 2355 | 156.21 | 1 | 151.63 |

Therefore the E-field values for the band frequencies of 0.9GHz, 1.5 GHz, 2.5 GHz, and 3.5 GHz. The following are the estimated results from the different operating frequencies [10].
The New e-field value is calculated using estimated results and the jammer continually blocks the 3.5 GHz frequency because the ICNIRP limit is Y limit is 155 dBµV/m .The center frequency is compared with the ICNIRP limit and gives the true/false results on to the controller. Then the mobile jammer triggers system and minimize the frequencies for the true values which results generating new calibrated E-field values. The above results are the estimated results from the hypothesis model are taken into considerations for the implementation of the project.

## VII. CONCLUSION AND FUTURE SCOPE

In this paper we have presented a hypothesis that concludes the radiation emitted by mobile phone handsets is hazardous to human life and it greatly impacts the human lifestyle in future. The proposed system hypothesis will surely reduce the impact by minimizing the mobile phone usage in restricted areas. The proposed hypothesis will take a control on high radiation emitting frequencies. The RF radiation detector acts smart enough in dealing with these types of

radiations as per the room temperature and humidity. System able to detect GSM, CDMA band frequencies and it is easy to plot the frequencies on the cloud panel. Further implementation needed for the detection of LTE bands frequencies because of more mobile phone users using LTE, VOLTE bands in future. In addition to examination halls, this work is applicable in meeting rooms, private conferences or any areas in which the using of mobile phones is extremely constrained.

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