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Impact Computation of Electric and Magnetic Field on Farmers Working Near High Voltage Transmission Lines in Pakistan by Developing Software

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ABSTRACT

In this revolutionized era, electricity has become an essential necessity of humans. People all over the world are concerned about the effects of HVTL (high voltage transmission lines) and their severe effects impacting on their health. Over the last two decades, developed countries have become increasingly concerned about an increase in electromagnetic fields, which poses health risks. The electromagnetic field emitted by HVTL will cause a low current to pass through the bodies. The electricity system produces low frequency electromagnetic field, which lead to the health hazards. The critical problem to those who are living near HVTL, therefore our fundamental task is to let them aware of the risk. Due to harmful exposures of electric and magnetic field, farmers working under HVTL or having their residences, suffering through severe effects in the form of different diseases. The main aim behind this research is to design GUI based software having two parts which helps to bring output of the electromagnetic field exposures with the help of various parameters includes different weather conditions affecting electric field, how people of different ages are being affected through it, identification of the regions need further protection by developing a proper mathematical model. Two approaches were used, one is to interface GUI with different sensors and second is user define function. On the basis of output EMF it will be able to find out the possible disease by using the data of WHO, ICNIRP and the data which is collected from surveys of different regions.

Keywords: Electromagnetic Radiations; High Voltage Transmission Lines; IIOT; Diseases; International Commission on Non-Ionizing Radiation Protection (ICNIRP); International Radiations Protection Association (IRPA)

INTRODUCTION

By developing population of the world, towns and metropolitan regions are extending, different developments started close to high voltage overhead power transmission lines. The improvement of energy demand has expanded the need for sending massive amount of energy over significant distances. Massive transmission lines courses of action with high voltage and stream levels produce huge proportion of electric and magnetic fields stresses which impact the human and the close by things organized at ground surfaces. This should explore the impacts of electromagnetic fields close to the transmission lines on human health (Kulkarni et al. 2012). Electromagnetic field (EF & MF), produced by high voltage power transmission lines, are exceptionally significant components that are altogether considered by power utilities during the lines' plan and maintenance. The essential impacts of EMF are related to health issues due to short-term, midterm and long-term exposure of transmission lines and causing a safety risk for groups working close to HVT lines (Milutinov et al. 2008). Usually, electromagnetic fields created by transmission lines cause's severe impacts for both human beings and metal entities. If the human bodies are experienced to outrageous electromagnetic fields, its principal impact is the making of electric current inside the body. Magnetic and electric fields change, in their effects, when they pass across the group of living beings at low frequencies. An electric field directed on exposed individual deliveries to ground while the magnetic field invades the body starting a magnetic flux that produces possible electric fields inside the body and after that also induced the current density that causes the change of protein level in human body, DNA syntheses, heart brokenness and possible nervous impacts which are really harmful for humans (Hossam-Eldin et al. 2012).

Environmental change may offensively impact power supply sufficiency by decreasing the generation and transmission capacity while at the same time expanding power demand (Bartos et al. 2015). Maximum heat and dry spell can hinder power generation, that impact the limitations of current carrying capacity of HVT lines, (Sathye et al. 2011) which caused to increment the peak loads. As air carbon concentrations increases, due to high heat and with higher frequency, events are predictable to happen of dry cell, implying that power system might be place below more stress for lengthier time phases (Parry et al. 2007). Future deficiency conditions might limit the power supply of the power plants which operates at base load, which need a dependable stock for cooling the water (Van Vliet et al. 2012). Moreover, extreme warmth might reduce the power output that are generated by the main sources of energy like by using turbine (Harto et al 2012), which develop fewer useful as air produced, solar cells as well. These cells drop proficiency when the temperature of air is too much high as a result of extended carrier recombination rate (Koch et al. 2009).

Due to above reason, it may say that temperature change the ampacity of power line which cause to reduce the magnetic field. Similarly, the climate change also impacts the electromagnetic fields. If the air surrounding the conductors of HVT lines is filled by raindrops, the permittivity of air is converted into composite permittivity (Spallina et al 2013). Simultaneously the mechanism of the dielectric constant likewise changes which caused to change level of voltage gradient as well as the dominated electric field will also be change at ground level. The water drops which are present at the surface of insulator caused to produce flashover or electrical breakdown due to electric field intensity. Similarly, the contamination and moisture cause the electrical breakdown at present voltage, consequently influences unwavering quality of force conveyance. As per IRPA guidelines, the openness ranges are 30 KV/m applicable for short time frame of working day and 10KV/m for entire working day for related exposure (Utama et al. 2018; Sirait et al. 1995).

In several countries, the International Commission on Non-Ionizing Radiation Protection and Institute of Electrical and Electronics Engineers standard organizations have been commonly recognized and executed. Only the acute effects have been identified, according to WHO overview section, the IEEE and ICNIRP are the two international exposure procedures that are (ICNIRP 2010) considered defending the effects occurs due to EMFs (WHO 2007).

TABLE 1. Levels for common people (ICNIRP 2010)

	Ranges	MF strengths (A m1)	Magnetic flux density (tesla)	EF strengths (KV m1)
1	3-10000 KHz	21	$2.7*10^5$	$8.3*10^2$
2	0.4 – 3 KHz	$6.4*10^4$ /f	$8*10^2$ /f	$2.5*10^2$ /f
3	50 – 400 Hz	$1.6*10^2$	$2*10^2$	$2.5*10^2$ /f
4	25 – 50 Hz	$1.6*10^2$	$2*10^4$	5
5	25 – 50 Hz	$4*10^3$ /f	$5*10^3$ /f	5
6	1-8HZ	$3.2*10^4/f^2$	$4*10^2/f^2$	5

ICNIRP has set the limits rule dependent on two classes to be specific for the overall population and word related exposure line. The occupationally uncovered population is comprised of grown-ups who are ordinarily uncovered under known conditions and are instructed to perceive likely danger and play it safe. The overall population, on the other hand, includes people of all ages and health status updates, as well as individuals who are particularly susceptible. Public members are sometimes unaware of their EMF exposure. Furthermore, persons in the public cannot be forced to take precautions to limit or avoid exposure (ICNIRP 2010).

The nervous system of your body can be affected by electromagnetic fields, and cells can be destroyed. One symptom of very high EMF exposure may be cancer and irregular growths. High levels of electromagnetic radiation are emitted by power lines. These harmful man-made EMFs interfere with the natural electromagnetic fields that exist inside humans in a destructed way. Cell function is disrupted, DNA strands are broken, and the immune system is weakened. Digestive problems, nausea exhaustion, , anxiety, burning skin or prickling, rashes, muscle pain, insomnia, headaches and dizziness are all symptoms of biological disturbances. They often lead to more severe disorders in children, pregnant women, and the old age people. Exposure to electric, magnetic and electromagnetic fields (EMF), if they are strong enough, can have short-term health consequences for nerve stimulation, dizziness, seeing light flashes, and experiencing tingling or pain can result with exposure to powerful low frequency fields. Strong enough radiofrequency fields can cause bodily tissue to heat up, causing tissue and organ damage. The limits of exposure of both radiofrequency and low frequency field have been established, below which these acute effects do not occur. Exposure to low degrees of radiation experienced in the climate doesn't cause prompt health impacts, yet is a minor supporter of our general disease hazard that is cancer (Fernie et al. 2005). Many forms of carcinogenic air emissions, such as fuel exhaust, flame hindrance in furniture, unintended waste products of industries, and so on, bind these ions to the aerosol particles. The charged contamination particles are then conveyed as much as 7 kilometers downwind of the electrical cable by the breeze and store in the lungs at a far higher rate than uncharged contamination particles. As per the crown impact hazard study, up to 400 extra instances of cellular breakdown in the lungs mortality and 3000 extra instances of cardiovascular and respiratory disease, as well as aggravated asthma (Lee et al. 1982), may occur annually among the 2.7 million people who live near high voltage transmission lines (Suman et al. 2018). Coming up next is a comprehensive rundown of adverse health results with overhead high voltage electrical lines exposure over a major period (Yuan et al. 2015).

Childhood leukemia is a relatively rare disease. Every year, approximately 4 out of 100,000 children aged 0 to 14 are diagnosed with childhood leukemia. Furthermore, average magnetic field exposures in dwellings exceeding 0.3 or 0.4 T are uncommon (Yuan et al. 2015). According to these studies, children exposed to magnetic fields greater than 0.3 to 0.4 T are twice as likely to acquire leukemia as children exposed to lower fields (ICNIRP et al. 2013). EMFs have been linked to a number of negative in vivo consequences, including heart difficulties, chest pain, and cardiovascular system abnormalities (Wartenberg et al. 1993). Because it has the potential to create critical alterations and negative effects in biological systems, lifelong exposure to EMF is becoming the focus of major scientific inquiry. Thermal and non-thermal biological effects of EMF are distinguished. The heat generated by EMFs in a specific location is referred to as thermal effects. The non-thermal radiations emitted by the brain and other body organs are normally absorbed by the skin and other superficial tissues, resulting in a minor increase in temperature. Non-thermal mechanisms are those that aren't directly linked to the temperature change, but are instead linked to other changes in the tissues as a result of the quantity of energy absorbed. The children having greater risk who living close to HVTL have high hazard of childhood cancer called leukemia, through numerous scientific and medical research. People who live, work, or attend to school in close quarters are more likely to get certain malignancies. Alzheimer's disease and dementia have been linked to exposure to high-voltage overhead cables. Alzheimer's disease risk rises to 4.9 times that of the average rate, and dementia risk rises to 2.5 times that of the normal rate. The long-term health consequences remain unknown. The study of the long-term health impacts of (long-term) EMF exposure below the exposure limits is still underway. Children exposed to magnetic fields larger than 0.3 to 0.4 µT may have a higher risk of developing leukemia, through scientific studies comparing groups of children who live near and distant from an overhead power line.

The main purpose of this research work is to analyze & calculate harmful exposures for electric and magnetic field on farmers working under HVT lines or having their residences especially in rural areas, suffering through severe unseen effects in the form of different diseases. These problems are real facing by massive creatures and figuring out to overcome these complications in a way of making a GUI based model on LABVIEW to identify the effects of different weather conditions on electric field and evaluating the safe limits for each weather condition by developing a proper mathematical model of electric and magnetic field on different conditions, based on distance effect, temperature & humidity effects and droplet effects. Identifying the major consequences of the exposures of electric field on humans working under it with the help of medical researches. Conduct different surveys to analyze what sort of diseases people are suffering having different exposure ranges and living time duration from specifically village areas .e.g headache, cancer, leukemia etc. through medical study and with the help of doctors.

Calculations essentially is the separate part of this research which will actually be determined by the given data, and then we will particularly see whether at that any given electric field and magnetic field, what kind of diseases can be medically possible, which is quite significant. When we do the comparative analysis of the calculations with the medical base study, then we would definitely be able to know what kind of diseases really are for all intents and purposes possible in an indirect way. Then it will analyze the technical data that if the transmission line specifically is 11KV having magnetic field 1 µT then what kind of diseases are really possible in the area by it. The diseases to find in this data will basically be then compared to the survey forms of the real time data of these areas if these diseases are faced in the area or not and also compared with the ranges of World Health Organization. The data in the survey forms i.e., ampacity, height of tower, numbers of conductors in kind of real time data will be helping in calculating up the magnetic field and electric field.

METHODOLOGY

The current study was carried out by measuring electric and magnetic field in various locations. When compared to the standard limits, these measurements are meaningful. It is a summary of the frequency level exposure guidelines. ICNIRP last updated these guidelines in April 1998 .

TABLE 2. Exposure guidelines according to the frequency levels (ICNIRP 2010)

Limits	MF (µT)	EF(V/m)
Working exposure limits	500	10000
Public exposure limits	100	5000

For transmission lines, every estimation was made with expanding distance from the instrument or overhead line, every 10m away from the line and the deliberate information were recorded. The data we used in the calculations is given in the Table 3.

TABLE 3. The measured EF &MF close 230 KV power transmission lines (ICNIRP 2010)

Distance (m)	MF(µT)	EF(V/m)
50	3	400
40	6	600
30	10	800
20	2	1500
10	3	4000
beneath	6	8000

People are consistently presented to electromagnetic fields (EMF) produced from such sources as electric transmission lines. Individuals are exceptionally worried about the impacts of high voltage transmission lines on their health. Plausible danger for leukemia, bosom disease, neuropsychological problems and conceptive results has been accounted for because of this openness. The referenced issue just influences individuals who are ceaselessly presented to discharge radiations, for example, laborers in High voltage substations (SS) laborers and individuals who are under transmission lines for quite a while. The estimations were done in most plausible spaces of focused energy fields. Wires' weight carries them nearer to the ground in the center place of the range. The descending uprooting for a 230kV line with a range of 300m is around 11-11.5 m (the wire's droop) (IEEE 2012). The results of measurements near some TLs and inside SSs are shown in tables 1–4. These previous results show that the field intensity is lower than the standard thresholds about 40m away from the TLs. However, there is a potential danger for palaces that are beneath the lines, particularly public areas such as parks where people spend a lot of time. We collected the data for the effects of temperature on for all intents and purposes electric field, as to what would be the effect of kind of extreme hot or cold weather on the transmission line. For example, 11KV line will expand in hot weather, and its conductor size will increase thus also increasing the electric field. After calculations, we will really be able to literally find out that if the weather particularly is fogy, dew drops or raining, that what particularly is the effect of all of these on the transmission line. The results of these calculations will generally make up for the mathematical model. This is a list of formulas to calculate the current density, magnetic field and electric field.

MAGNETIC FIELD DENSITY OF POWER LINES

To calculate the distance effect on power transmission lines that explain how change in distance caused to vary both electric field and magnetic field as well as current density, we make a proper mathematical model of single circuit (SC) and double circuit (DC) configurations of high voltage transmission lines (HVTL). For example, a 500KV single circuit horizontal configuration consists of three conductors and according to figure 2.1 the conductor at point B represent by O as a reference point. Here 'ɸr' is represented by the angle between horizontal distance and the distance between any point of reference 'R','s' is represented by the distances of any of two conductors and 'I' is the ampacity of transmission lines as shown in figure 1.

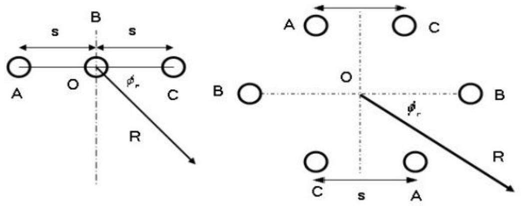

FIGURE 1. Arrangement of conductors of SC and DC configurations on HVTL

EXPERIMENT EQUIPMENT

Now, according to the above configurations the magnetic field of single and double circuit transmission lines will be

$$B = \frac{I\mu S}{2\pi R}\sqrt{\frac{S^2+3R^2}{S^4-2R^2S^2\cos 2\emptyset r+R^4}} \tag{1}$$

Similarly magnetic field density of 220KV double circuit line configuration is,

$$E = -j\,\frac{S.I.r.\sigma.\mu}{4\pi.R.\varepsilon o.\varepsilon r}\sqrt{\frac{S^2+3R^2}{S^4-2R^2S^2\cos 2\emptyset r+R^4}} \tag{2}$$

DROPLET OR RAINDROP EFFECT ON MAGNETIC FIELD

To measure the impact of raindrops on HVTL we make a model having air space length 500 meter, 50 meter height and 200 meter width. When it rains, the air space will be loaded up with water, and when it doesn't rain, it will be loaded up with neat air. Since downpour is a water drop, the medium is a dielectric material made out of water drops and neat air. The permittivity, which is referred to as composite permittivity, determines the composition of this composite medium.

$$\varepsilon = \left[\frac{\epsilon_1 * \frac{a}{a_1}}{1+\frac{\epsilon_1}{\epsilon_2} * \frac{a_2}{a_1}}\right] \tag{3}$$

Here ϵ_1 is the permittivity of water, ϵ_2 is the permittivity of air, a_2 is represent by distance from conductor of HVTL to the point of reference, a_1 is represent by the distance from earth to point of reference and is the total distance from the earth to conductor of power transmission line.

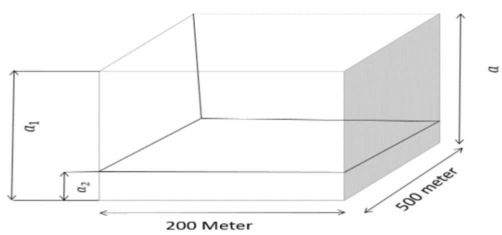

FIGURE 2. Sequence of EHVTL filled air space by water

Now, by using equation (1) and (3) we can calculate the impact of water drops on SC HV power transmission line.

$$E = -j\,\frac{\sigma.\mu.S.I.r}{4\pi.R.\left[\frac{\epsilon_1 * \frac{a}{a_1}}{1+\frac{\epsilon_1}{\epsilon_2} * \frac{a_2}{a_1}}\right]}\sqrt{\frac{3R^2+S^2}{R^4-2R^2S^2\cos 2\emptyset r+S^4}} \tag{4}$$

Similarly, for double circuit lines,

$$E = -j\,\frac{3\sqrt{2}\mu.R.S^2.I.\sigma.r}{4\pi R\left[\frac{\epsilon_1 * \frac{a}{a_1}}{1+\frac{\epsilon_1}{\epsilon_2} * \frac{a_2}{a_1}}\right]}\sqrt{\frac{R^4+S^4}{R^{12}-2R^6S^6\cos 6\emptyset r+S^{12}}} \tag{5}$$

TEMPERATURE EFFECTS ON MAGNETIC FIELD DENSITY

Heat gain due to electrical loading is a function of given conductor resistance and the ampacity 'I' flow through the conductor [22].

$$q_j = I^2 R(\text{cond}) \tag{6}$$

By rearranging this equation the rated ampacity will be

$$I = \sqrt{\frac{q_j}{R(\text{cond})}} \tag{7}$$

$$\text{Heat gain} = q_j = q_c + q_r - q_s \tag{8}$$

Where, q_c is the loss of heat due to convection, q_j is the heat gain due to the rated ampacity, q_s is the heat gain from solar radiations and q_r loss of heat due to radiations (Gupta et al. 2012).

Now the equation (6) gives the rated ampacity of conductor based on heat transfer

$$I = \sqrt{\frac{\pi \bar{h} D(Tc - Ta) + \pi \varepsilon \sigma D(Tc^4 - Ta^4) - \delta D a_S}{Tc.\bar{R}}} \tag{9}$$

Here $\bar{h}$ is represent the average heat transfer coefficient, 'D' is conductor diameter, 'Tc' conductor temperature, 'Ta' current temperature, 'ε' conductor surface emissivity, 'σ' is the Boltzmann's constant, 'δ' is the incident solar radiations and conductor surface absorptivity. Now, by using equation (1) the magnetic field density which shows the impact of varying temperature is

$$B = \frac{\mu S}{2\pi R} \sqrt{\frac{\frac{3R^2 + S^2}{R^4 - 2R^2 S^2 \cos 2\emptyset r + S^4} *}{\frac{\pi \bar{h} D(Tc - Ta) + \pi \varepsilon \sigma D(Tc^4 - Ta^4) - \delta D a_S}{Tc.\bar{R}}}} \tag{10}$$

Similarly, for equation (2)

$$B = \frac{3\sqrt{2}\mu R S^2}{2\pi} \sqrt{\frac{\frac{R^4 + S^4}{R^{12} - 2R^6 S^6 \cos 6\emptyset r + S^{12}} *}{\frac{\pi \bar{h} D(Tc - Ta) + \pi \varepsilon \sigma D(Tc^4 - Ta^4) - \delta D a_S}{Tc.\bar{R}}}} \tag{11}$$

THE INDUCED ELECTRIC FIELD

The electric field will be induced due to above magnetic field in the structure may be considered as homogenous cylinder, according to Faradays Law.(Trlep et al 2009) (Hossam-eldin et al. 2012).

$$E = (\partial B / \partial t) * (r/2) \tag{12}$$

'r' is represent by the distance from the homogenous cylinder where electric field is induced.

$$E = -j\omega B * (r/2) \tag{13}$$

Now, by using equation (1) and (13) we can calculate the effect of change in distance which caused to change the electric field of single circuit power transmission line.

$$E = -j \frac{\sigma.\mu.S.I.r}{4\pi.\varepsilon o.\varepsilon r.R} \sqrt{\frac{3R^2 + S^2}{R^4 - 2R^2 S^2 \cos 2\emptyset r + S^4}} \tag{14}$$

For double circuit power transmission lines,

$$E = -j \frac{3\sqrt{2}\mu.R.S^2.I.\sigma.r}{4\pi.\epsilon o.\epsilon r.R} \sqrt{\frac{R^4 + S^4}{R^{12} - 2R^6 S^6 \cos 6\emptyset r + S^{12}}} \tag{15}$$

TEMPERATURE EFFECTS ON ELECTRIC FIELD

By rearranging equation (11) and (15) we can calculate the impacts of temperature on EF

$$E = -j \frac{\sigma.r}{4\epsilon o.\epsilon r} \frac{\mu S}{\pi R} \sqrt{\frac{\frac{3R^2 + S^2}{R^4 - 2R^2 S^2 \cos 2\emptyset r + S^4} *}{\frac{\pi \bar{h} D(Tc - Ta) + \pi \varepsilon \sigma D(Tc^4 - Ta^4) - \delta D a_S}{Tc.\bar{R}}}} \tag{16}$$

Similarly, for double circuit power lines

$$E = -j \frac{\sigma.r}{4\epsilon o.\epsilon r} \frac{3\sqrt{2}\mu R S^2}{\pi} \sqrt{\frac{\frac{R^4 + S^4}{R^{12} - 2R^6 S^6 \cos 6\emptyset r + S^{12}} *}{\frac{\pi \bar{h} D(Tc - Ta) + \pi \varepsilon \sigma D(Tc^4 - Ta^4) - \delta D a_S}{Tc.\bar{R}}}} \tag{17}$$

A detailed analysis was carried out to i

DROPLET OR RAINDROP EFFECTS ON ELECTRIC FIELD

The presence of water drops on the outside of conductor caused to build the electric field because of which electric breakdown happen. An analysis that has been directed to show the effect of water droplets on the conductor surface because of haze, downpour dew and so on causing incomplete discharge and dry arcs which brings about complete flashover (Sarang et al. 2008).

Now, by comparing equations (3) and (16), we can calculate the effect of droplets on electric field of single circuit power transmission lines.

$$E = -j \frac{\sigma.r\mu S}{4\pi R \left[\frac{\epsilon_1 * \frac{a}{a_1}}{1 + \frac{\epsilon_1}{\epsilon_2} * \frac{a_2}{a_1}}\right]} \sqrt{\frac{\frac{3R^2 + S^2}{R^4 - 2R^2 S^2 \cos 2\emptyset r + S^4} *}{\frac{\pi \bar{h} D(Tc - Ta) + \pi \varepsilon \sigma D(Tc^4 - Ta^4) - \delta D a_S}{Tc.\bar{R}}}} \tag{18}$$

Similarly, for double circuit power transmission lines,

$$E = -j \frac{3\sqrt{2}\mu R S^2 \sigma.r}{4\pi \left[\frac{\epsilon_1 * \frac{a}{a_1}}{1 + \frac{\epsilon_1}{\epsilon_2} * \frac{a_2}{a_1}}\right]} \sqrt{\frac{\frac{R^4 + S^4}{R^{12} - 2R^6 S^6 \cos 6\emptyset r + S^{12}} *}{\frac{\pi \bar{h} D(Tc - Ta) + \pi \varepsilon \sigma D(Tc^4 - Ta^4) - \delta D a_S}{Tc.\bar{R}}}} \tag{19}$$

CURRENT DENSITY

A Current density can be found by the conductivity of given structure and induced EF as (Sarang et al. 2009).

$$J = \sigma * E \tag{20}$$

$$J = \pi * r \tag{21}$$

Now, by using equation (1) we can calculate the impact of current density of SC power lines

$$J = \pi . r . f . \sigma . \frac{\mu SI}{2\pi R} \sqrt{\frac{3R^2+S^2}{R^4-2R^2S^2\cos 2\emptyset r+S^4}} \tag{22}$$

For double circuit transmission lines,

$$J = r.f.\sigma.\frac{3\sqrt{2}\mu RS^2 I}{2} \sqrt{\frac{R^4+S^4}{R^{12}-2R^6S^6\cos 6\emptyset r+S^{12}}} \tag{23}$$

TEMPERATURE EFFECTS ON CURRENT DENSITY

A By equation (10) and (21) we can calculate the temperature effects on SC power line,

$$J = rf\sigma\frac{\mu S}{2R} \sqrt{\frac{3R^2+S^2}{R^4-2R^2S^2\cos 2\emptyset r+S^4} * \frac{\pi\bar{h}D(Tc-Ta)+\pi\varepsilon\sigma D(Tc^4-Ta^4)-\delta Da_S}{Tc.\bar{R}}} \tag{24}$$

Similarly, for double circuit power lines the current density will be,

$$J = rf\sigma\frac{3\sqrt{2}\mu RS^2}{2} \sqrt{\frac{R^4+S^4}{R^{12}-2R^6S^6\cos 6\emptyset r+S^{12}} * \frac{\pi\bar{h}D(Tc-Ta)+\pi\varepsilon\sigma D(Tc^4-Ta^4)-\delta Da_S}{Tc.\bar{R}}} \tag{25}$$

EXPERIMENTAL SETUP

SOFTWARE IMPLEMENTATION

The main part of this research work is based on lab-view based software. In which we are taking different inputs such as, basic information which is necessary for the calculations of electric field and magnetic field, from survey part. We have taken technical data of high voltage transmission line, for example 11kv, 33kv, 66kv lines etc. This GUI is bases on two parts to take data as an input, user define and interfacing with sensors. For this purpose, we use enable button and three sensors for interfacing.

Sensors

SR04T ultrasonic sensor, used to fluctuate field as for distance. An ultrasonic distance sensor works by passing on ultrasound waves. These ultrasound waves get reflected back by a thing and the ultrasonic sensor recognizes them. By timing how since quite a while ago passed among sending and getting the sound waves, you can calculate the distance between the sensor and a thing.

DHT22, used to measure temperature and humidity. The DHT22 is a fundamental, insignificant cost progressed temperature and moistness sensor. It uses a capacitive tenacity sensor and a thermistor to measure the including air, and lets out a mechanized sign on the data pin (no straightforward information pins required). It's really simple to use, yet requires wary intending to grab data. The lone real burden of this sensor is you can simply get new data from it once at customary stretches, so while using library, sensor readings can be up to 2 seconds old.

As the water drop impacts the conductor, its permittivity changed shifting the attractive field. The water profundity can be assessed from the base force proportion between the fluorescence signal and the reference signal when the test is checked in plane. The sensor can likewise assess both the size and the situation of a water drop. A serious level of segregation of a water drop from different annoyances, for example, oil and surface inconsistencies has been illustrated.

The front window of the software consist of all the personal and technical data, including name, CNIC number, age, gender, province. The technical data consist of transmission type in KV, circuit types such as single circuit and double circuit, exposure duration, line angle, twin bundle. A single circuit transmission line has three arrangements of conductors, while a double circuit transmission line has two free circuits of a similar construction, with each circuit comprised of three arrangements of conductors. Apart from the personal and technical data another button that is "enable sensor "which when turn on enables the sensors attached with the software and vise-versa for disable sensor. Another initialized option of forward button for next window and reset for restoring the data.

FIGURE 3. Sensors setup interfacing with software

IMPLEMENTATION OF EQUATIONS

Electric and magnetic field are being calculated based on above high voltage transmission lines by using different formulae. Temperature, humidity, distance and droplets have different formulae and their effects are calculated individually as mentioned above. Here we have introduced the capacity of twin bundle since we can regularly see the transmission lines where rather than a solitary conductor for each stage different conductors per stage are being utilized.

A metallic design called spacers bunches the conduits of a stage. These spaces help to keep a steady distance between the conductors all through their length, try not to conflict of conductors among themselves and furthermore permitting them to be associated in equal. Each stage can have two, three, or four conductors. It works for 220kv transmission line and double circuit.

TEMPERATURE AND HUMIDITY

This is a next tab where we set the values of the following to get the electric field, magnetic field, humidity, ambient temperature and current density through color indicator red, black and green.
The following functions and their values are:

Distance between two conductors of line It is denoted with S. it is a distance between two conductors of high transmission lines and vary from place to place and country to country. We have almost 2.8m to 3m distance between the lines.

CONDUCTOR

Conductor is a wire comprised of numerous aluminum strands around a steel center that together convey power. A conductor is hung between transmission structures. A packaged conductor is at least two conductors associated with increment the limit of a transmission line.

Average Heat Transfer Coefficient

It is denoted with h. Heat-transfer coefficient is equal to the heat flow denoted with Q across the heat-transfer surface divided by the average temperature Δt (higher temperature -lower temperature) and the area of the heat transfer surface (F). The value of h is 0.8

INCIDENT SOLAR RADIATION

Sun radiation (Gg) is the brilliant sun powered energy that hits the world's surface and is imply as "worldwide radiation" on a surface (W m−2) Occurrence solar radiation to typical alludes to sun powered radiation falling opposite on a surface, i.e., having a point of 90° to the surface. The value is 550W/m2.

EMISSIVITY

It is the proportion of the energy transmitted from a material's surface to that emanated from an ideal producer, known as a blackbody, at a similar temperature and frequency and under similar review conditions. Here its value is 0.8. Temperature of conductor is 75 degree which must be greater than ambient temperature that is 50 degree. In pure resistance within an AC circuit the current and voltage will oscillate in phase, that is, when the current is at its maximum the voltage will also be at its maximum, hence there is no phase shift. In addition, the resistance value is not affected by the height of the frequency. This is known as ac resistance and the value used here is 30ohms. A conductor offers a greater resistance to the flow of alternating current (AC) than it does to direct current (DC). The magnitude of the increase is usually expressed as an "AC/DC".

ABSORPTIVITY

This factor is the ratio of how much of the incident solar radiation hitting a conductor will be absorbed versus reflected back. As a conductor ages and its surface darkens from pollution and oxidation, both the emissivity and the absorptivity will increase. Its value is approx. 0.8.

DIAMETER & RADICAL DISTANCE

It depends on the type of wire.

CONDUCTIVITY

The degree to which a specified material conducts electricity, calculated as the ratio of the current density in the material to the electric field which causes the flow of current. The value of conductivity is 10 S/m.

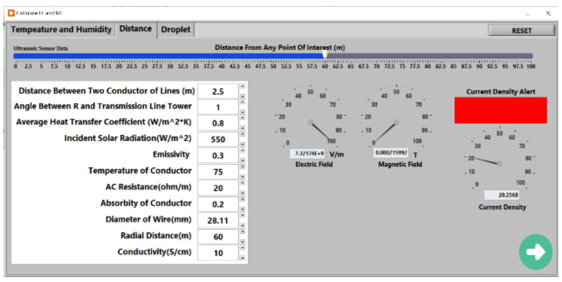

FIGURE 4. Distance based calculations

Electric and magnetic field both are changed in distance and temperature effect. In Comparison part we find current density through software which tell us the amount of electric and magnetic field effected on our body. With the help of calculated field we set the probability of the diseases keeping the 'WHO' reference. Current density alert, this indicates whether the current density is below the set point or above or equal to the point. For this purpose, we set different ranges which indicates the impact of current density by using different color's indicators.

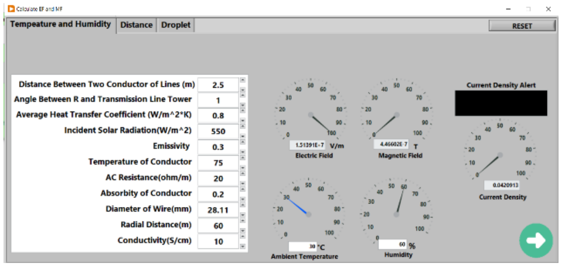

FIGURE 5. Temperature based calculations

Droplet tab having three parameters: Distance from earth to point of reference that is 8m. Then distance from point of reference to first conductor which is 52m an overall distance combination of above two distances. Change in radial distance(r) changes the distance from any point of interest. Change in ambient temperature changes the ampacity leads to change in field and so effects the temperature. Droplet changes with respect to composite permittivity.

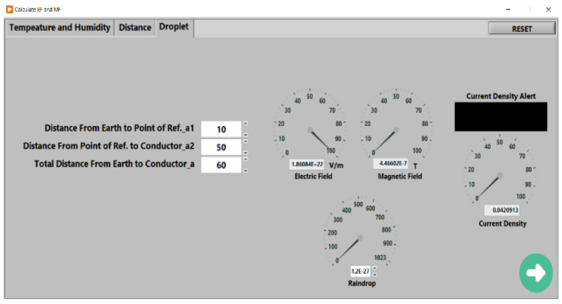

FIGURE 6. Droplets based calculations

RESULT AND DISCUSSIONS

SURVEY RESULTS

Survey conducted in Punjab and KPK federal regions to determine the average results of the diseases diagnosed in people living under the high voltage transmission lines. We have designed the survey forms to identify the actual diseases they are suffering through electric and magnetic fields due to overhead lines and come up with the following results summarized in graphical form.

Data collected real time from 200 people in various regions, male ratio exceeding the female numbers from the age group of 33 to 63. At the time weather temperature was 20-25 degree Celsius, and the nominal voltage transmission was mostly 220V in different regions. According to the real time data collected from the different geographical regions, many people working under HVT lines or residing in rural areas are suffering through severe unseen effects in the form of various diseases as a result of harmful electric and magnetic field exposures. The problems most people faced was headache, cancer, leukemia etc. and their moderate level is about 50 to 60%. People faced most of the problems in the evening time. None of the people on the field felt any severe form of disease. The diseases people described most were blood pressure, diabetes, skin problems. Anxiety attacks, depressions, lack of focus, while depression was mostly faced by the people and at moderate level.

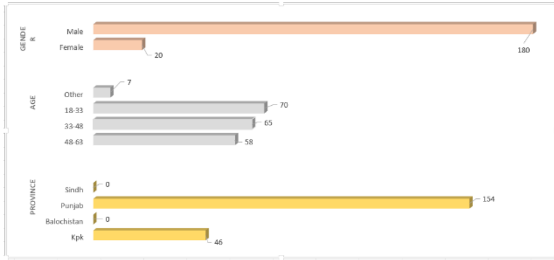

FIGURE 7. Survey based comparison

SOFTWARE RESULTS

Candidate information comprised of all the personal information taken as user input in the first tab, living time period may vary from less than 3 hours to greater than 7 hours. Technical information includes all the technical data of transmission line. Line angle depends on tower type, for e.g. SGM tower has line angle of 0-1 degree, if we increase or decrease it would give error. Here the survey button indicates the highest and lowest possible diseases from the survey conducted in different regions. If it's not turned on means the diseases possibilities are from WHO research paper. Highest possibilities are the top most diseases which a person can highly suffer on the mentioned conditions and lowest possible diseases which a person can suffer on lower level on the same conditions mentioned above.

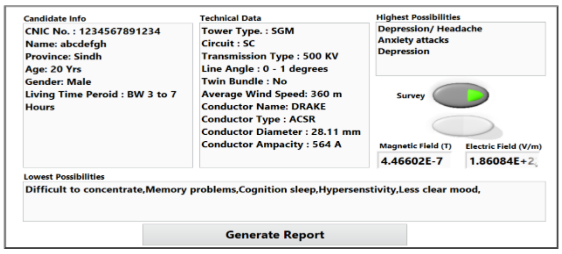

FIGURE 8. Report of survey based comparison

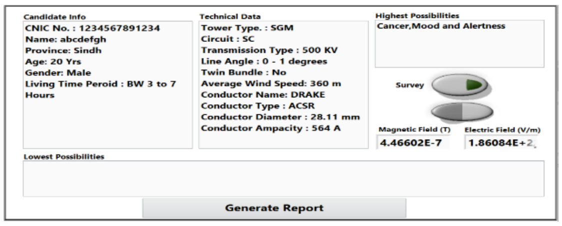

FIGURE 9. Report of WHO based comparison

CONCLUSION

The HVTL generates electric and magnetic fields, which combine to produce electromagnetic radiations. The electromagnetic radiation produced by the HVTL has a variety of effects on the human body. Long-term exposure to the electromagnetic field generated by HVTL increases the risk of workers and residents living nearby experiencing health-related difficulties such as fatigue, neuropsychological disorders such as depression, and adverse anxiety issues, which could be extremely dangerous in the future due to prolonged exposure without adequate experience. The issues are becoming increasingly dangerous as a result of increased supply demand about the effects of HVTL. This might lead to significant and long-term issues. Due to harmful exposures of electromagnetic fields, many farmers working below high voltage power transmission lines or having their residences especially in rural areas, suffering through severe unseen effects in the form of different diseases. The electricity system yields very low frequency electric and magnetic fields, which goes below non-ionizing radiations which can cause health impacts and posture health dangers. These tumors are: leukemia or blood malignancy, lymphoma which debilitates the resistant arrangement of the body to harmful conditions, anxious issues prompting cerebrum harm like Alzheimer infection, bosom disease in both female and male and a few other risky conditions too various to even think about identifying here. Software has been developed by using LAB view, in which sensors are interfaced. The software can continuously monitored and measured the impact of electric and magnetic field on human being and generate the report on the probable threats faced.

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DECLARATION OF COMPETING INTEREST

None

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