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# of Low Power Energy Transfer System through Aerial Technology using Simulation CAD-FEKO

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I. ABSTRACT

The suggested study focuses in particular on the challenges of power transfer. As wireless power transfer eliminates the need for cords to transmit electricity, it allows us to simplify our systems. Comparing this approach to other systems , our system can increase proficiency, reduce energy crisis, and lessen power loss. Wires are never used in wireless power transmission, therefore mishaps and electric shocks in the home are reduced. Instead of using cables in this manner, we are employing a dipole antenna to transmit power.

Keywords: Antenna Arrays, VCO, Amplifier , Dipole Aerial , Electric Converter, friis transmission formula , Radiation Pattern, wireless power transfer, CAD FEKO

1. INTRODUCTION

Between the transmitter and receiver sides, electrical energy is transmitted via WPT or WET,without using any physical cords, [2,3]. Inductive and resonant WPT are the two main varieties that are available. Resonant wireless charging is a compelling candidate for future technology since it provides significant user benefits. Resonant wireless power transfer, as opposed to inductive charging, allows power transfer within a flexible proximate distance from the transmitter rather than requiring the transmitter and receiver to be physically touching. Moreover, a resonant charge enables the simultaneous charging of numerous devices with various sizes and power requirements. As the number of wirelessly chargeable devices continues to rise, this flexibility and greater user ease will become more and more crucial. Inductive charging, often known as wireless charging or cordless charging, is a type of wireless power transfer. Emitting electricity through electromagnetic induction enables portable devices. Inductive charging is used in cars, power tools, electric toothbrushes, and medical equipment.Inductive charging is pricy, complex, and less effective. We can use long-range WPT systems, where electricity is transferred by microwaves, to get around this. Effective power transmission is ensured by highly directional antenna systems.

Without the use of wires that transmit current, Wireless Power Transfer (WPT) enables the delivery of power across an air gap (Fig 1). Without physical connectors or wires, WPT may transfer power from an AC source to suitable batteries or devices. WPT can recharge a variety of devices, including smartphones, tablets, drones, cars, and even transportation-related machinery.. Far-field and near-field WPT systems are divided into separate groups. A dipole aerial is made up of two parts, which are typically metal wires or rods. Power controllers, converters, and nodes cause loss.So, We are utilising a half wave Dipole aerial array in the specified configuration. A dipole is the most basic and typical type of aerial. The most common building parts for a dipole aerial are two identical conducting elements, like metal wires or rods. The half wave dipole antenna is the most popular and fundamental type of dipole aerial. As its name suggests, the half wave dipole is half a wavelength long. Given the length of this antenna, the fair length of the dipole has no impact on the input impedance.

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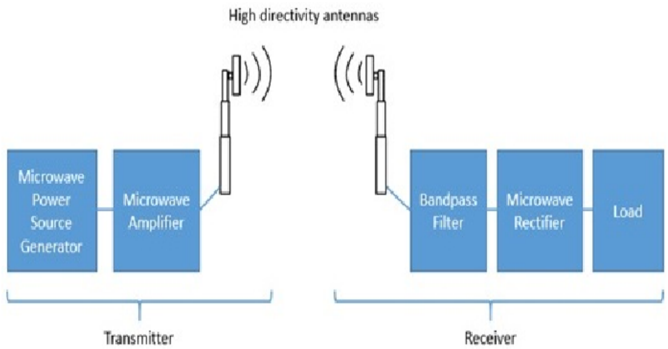

Fig.1 fundamental wireless power transmission design

(Image courtesy form reference 8)

2. METHODOLOGY:

The process of the suggested system is depicted in the block diagram (Fig. 2).

Transmitting Aerial : The array of aerials used in the transmitting side's design must meet the following criteria: The power source for the transmitting aerial is first obtained from the power source or another energy-harvesting system, such as one that uses solar energy, wind energy, thermal energy etc. The half wave dipole's frequency range of operation is between 3KHz and 300GHz. While the frequency we receive from the mains is 50Hz, the requirement for our design is 1.8MHz. Therefore, we are using the AD8362 IC to change the frequency from low to high. Step down transformers can cut power without changing frequency since the array of antennas uses more energy. Using coaxial cables, power is transmitted to the antenna.

Receiving Aerial : The load that uses the power source will be put in the receiving portion. Therefore, the power and

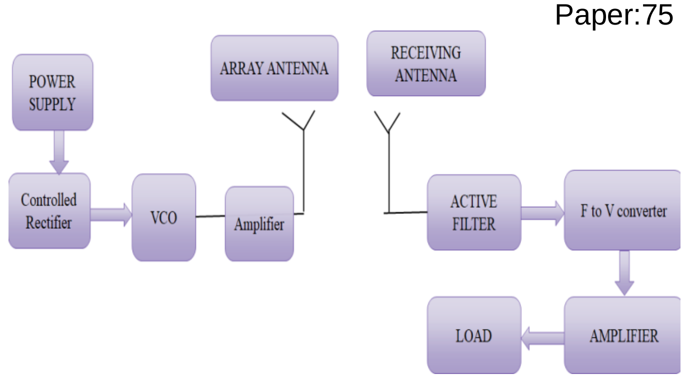

Fig 2 Block Diagram

frequency settings should be changed to suit the needs of the load. So, before the load, cyclo converters and power converters are used to change frequency and power from high to low.

4. SIMULATION OF AERIAL DESIGN:

The aerial is created and simulated using the CAD FEKO tool. We can make a solver-ready input file for Solver simulations using CADFEKO. The Feko component known as CADFEKO enables the creation of complicated CAD geometry using simple primitives (such as cuboids and polygons) and the application of boolean operations (such as union and subtract) on the geometry. Various industry-standard formats can be used to import or export complex geometry models and mesh models. Utilize a component from the list of platforms and antennas in the component library to speed up development. Using CAD FEKO, an array of half wave dipoles is designed. The antenna's structure has been designed to meet the requirements required for the research and to create the desired outcomes.

The design specification for a dipole antenna is shown in Table 1 which brief dipole array with radome. Table 2 explains the ground plane and radome whereas Table 3 shows the PEC specifications.

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Dipole_array_with_radome

dipole_arm_height	0.9in
dipole_radius	0.1in
lumped_gap_height	0.1in
dx	3in
dy	3in
dipole_airbox_zsize	4in
dipole_airbox_zshift	1.15in
radome_thickness	1.1in

Table 1: Dipole array with radome

Name	Type	Value	Units
Relative Permittivity	Simple	1	
Relative Permeability	Simple	1	
Bulk Conductivity	Simple	1e+030	siemens/m
Dielectric Loss Tangent	Simple	0	
Magnetic Loss Tangent	Simple	0	
Magnetic Saturation	Simple	0	tesla
Lande G Factor	Simple	2	
Delta H	Simple	0	A_per_meter
· Measured Frequency	Simple	9.4e+009	Hz
Mass Density	Simple	0	kg/m^3

Table 2: Ground plane and radome

Name	Value	Unit	Evaluated Value
Name	SurfApprox1		
Type	Surface Approximation Based		
Region	On Selection		
Surface Deviation	0.01	in	0.01in
Normal Deviation	45	deg	45deg
Aspect Ratio	10		10
Surface Representation Priority	High		

Table 3: PEC Specifications

5. SIMULATION RESULTS:

The outcomes of the simulation from CAD FEKO are depicted in the ensuing figures:

5.1. A DIPOLE AT 600MHZ

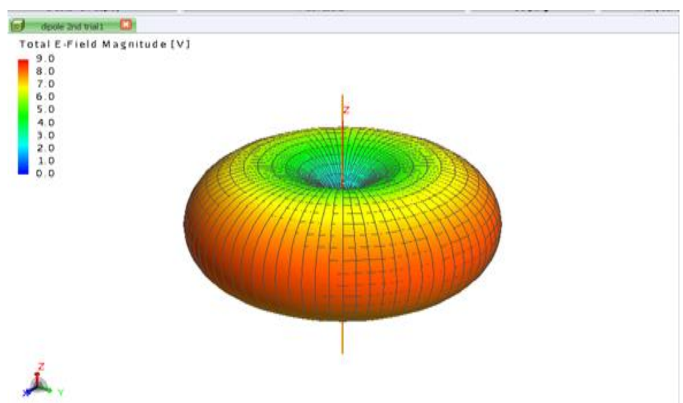

Fig 3 Graphical representation for 600 MHZ dipole

5.2. A DIPOLE AT 800MHZ

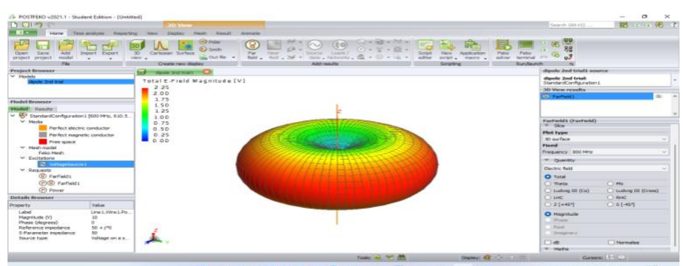

Fig 4 Graphical representation for 600 MHZ dipole

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5.3. A DIPOLE ELECTRIC FIELD B/W 600MHZ TO 800MHZ

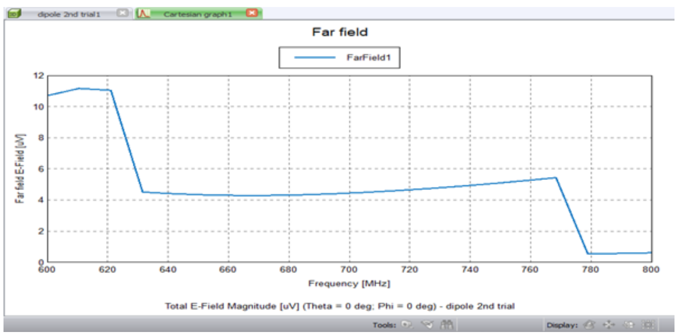

Fig 5 Graphical representation for Electric Field Between 600 and 800 MHZ

5.4. ARRAY OF DIPOLE FAR FIELD E-FIELD MAGNITUDE

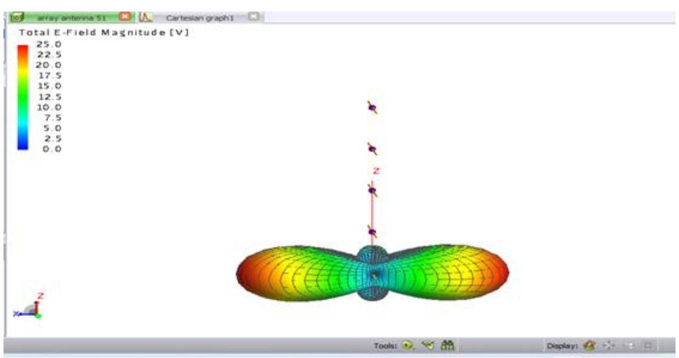

Fig 6 : Graphical representation for Dipole far field E-field Magnitude

5.5. TOTAL GAIN

Antenna gain is the difference between an antenna's actual emissions and a theoretical antenna's ability to emit more or less in any direction. If a perfect sphere could be built, an antenna would radiate uniformly in all directions.The provided graph shows the overall gain (Fig 7)

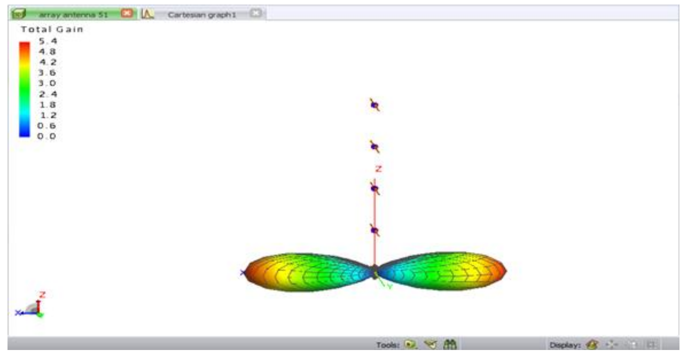

Fig 7: Graphical representation for Total Gain

5.6. DIRECTIVITY

This parameter indicates the rate of radiation emission in a specific direction. If an aerial's radiation pattern isn't directed in all directions, or in its Omni direction, it won't be able to travel far. Fig. 8 displays a graphic illustration of directivity.

Directivity is calculated by,

$$D = \frac{4\pi}{\int_0^{2\pi}\int_0^{\pi}|P(\theta,\Phi)|^2 sin\theta d\theta d\Phi}$$

$$\boldsymbol{D} = \frac{\boldsymbol{P(\theta,\Phi)_{max}}}{\boldsymbol{p(\theta,\Phi)_{av}}}$$

Where, D – directivity
$P(\theta,\Phi)$ - Power density

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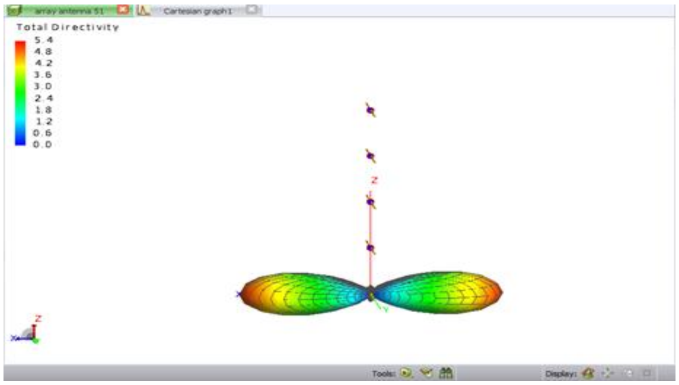

Fig 8 : Graphical representation for Directivity

5.7. E-FIELD MAGNITUDE

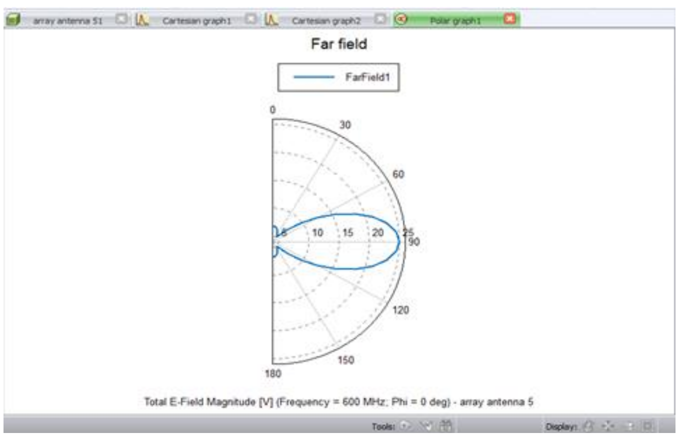

Fig 9 : Graphical representation for E-field Magnitude

5.8. ARRAY OF 15 DIPOLE

This is the narrow radiation pattern of array 15 dipole antenna.

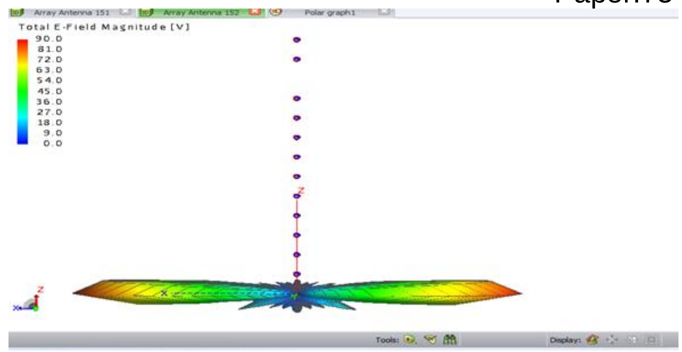

Fig 10 Graphical representation for Array of 15 Dipole

5.9. E-FIELD IN POLAR

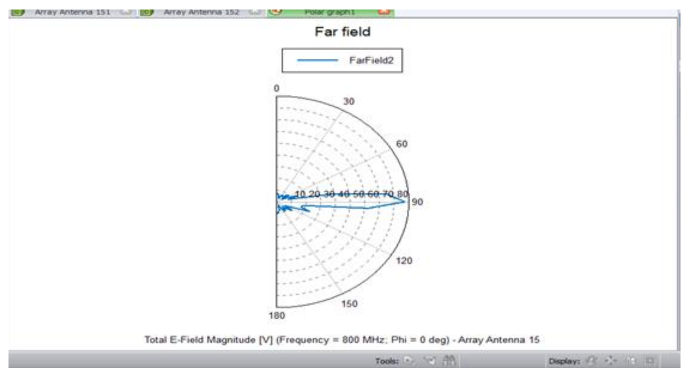

Fig 11 : Graphical representation E-field in Polar

5.10. GAIN

The ability of an antenna to focus the power that a transmitter provides to it in the direction of a target is measured as antenna gain. Antenna gain is graphically represented here (Fig 12)

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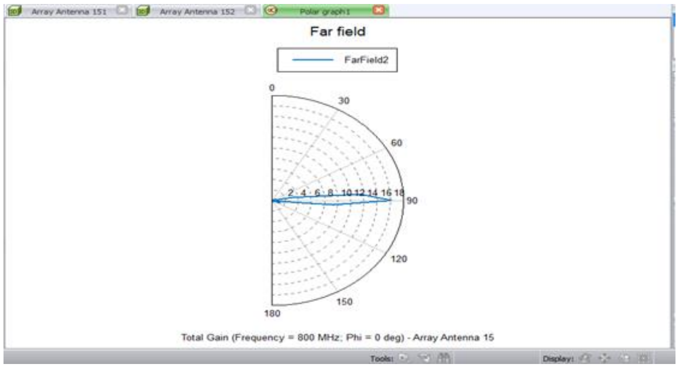

Fig 12 : Graphical representation for Antenna Gain

5.11 Calculation of Power

The Friss transmission formula provides the parameters needed to compute received power as well as the relationship between sent power and received power. [9]

Friss transmission formula

$$\frac{P_r}{P_t} = \frac{A_r A_t}{d^2 \lambda^2}$$

where:
P_t=transmitting aerial power.
P_r=receiving aerial power.
A_r = aperture of the receiving aerial
A_t = aperture of the transmitting aerial.
D =distance between aerial
λ = wavelength of the input signal.

The power at the receiver is calculated by using the formula,

$$P\ at\ Rx \frac{(P\ at\ Tx)(G\ of\ Tx) \big/ G\ of\ Rx\ \boldsymbol{\lambda}^2}{4\pi L D^2}$$

Where
P = Power
G = Gain
λ = wavelength of the input signal.
Rx = Receiver
Tx = Transmitter
L = Length
D = Diameter

6. ADVANTAGES:

- When a wireless power transmission system is implemented, high-tension power transmission line cables, towers, and substations are completely eliminated.
- No wires and e-waste.
- Need for battery is been eliminated.
- Harmless
- Maintains Low cost
- High proficiency

7. CONCLUSION:

This paper comes to the conclusion that the WPT system is very efficient as we do not need any cable connection for transmitting electrical power inside the house for charging and for household accessories. This can be accomplished using an advantage of easy implementation and less expensive. Due to this wireless transmission efficiency will build, energy crisis can be decreased, low loss, better than conventional wired transfer. . In near future, world will be totally remote. And we can make use of renewable energy sources like solar, wind etc. for making power in future. This system will reduce accidents like cable breakage and transformer explosions.

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