WIRELESS VEHICLE TO HOME (V2H) TECHNOLOGY

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Abstract.

This research investigates the capabilities of EVs in Vehicle to Housing scenarios, wherein the vehicle acts as a home energy storage system and backup power in the case of a power outage or a more common power distribution system failure. Houses are one of the largest energy consumers in modern world. By employing electricity generated from renewable sources, widespread use of electric vehicles could contribute in decarbonization. The suggested method optimally schedules connected electric automobiles alongside autonomously run appliances in a real-time context.

Keywords. home energy storage system, EVs (Electric Vehicles), decarbonization, power outage, renewable sources.

1. INTRODUCTION

The electrification of transportation is a vital component in attaining global CO2 emissions reductions. The immediate consequence of such electrification will be both a challenge in terms of increasing demand for electricity and a chance in regards of converting vehicles into energetic resource that can assist the power grid. Climate change and the growing demand for oil, which is now the dominant energy source in the transportation business, are causing the automotive world and sectors to adapt.Only electric vehicles will not be sufficient to achieve the country's energy system down to lower cost for generation; renewable energy must also be explored in enabling an efficient way to generate energy.

2. WPT AND V2H TECHNOLOGY

Wireless Power Transfer (WPT): Wireless Transmission systems transfer power from a source to a load without the need of cables. WPTs are appealing for many industrial applications due to their advantages over wired designs, including as no exposed wires, convenience of charging, and efficient transmission of power.Some companies are interested in using WPTs to charge the on-board batteries of electric vehicles (EVs), and efforts are underway to develop and improve the numerous topologies required. A low-cost inductive coupling between two coils designed as the transmitting and receiving coils enables WPT.

V2H/B technology: Moreover, as renewable energy grows in popularity, fluctuating production allows for some excess power and, on rare occasions, a power need. To supplement this, electric cars can be used to receive and transmit power to homes and structures. An electric car can be used to provide electricity in the event of a power outage or blackout, in addition to providing renewable energy. It presents a solution for energy storage that helps both the EV market and grids.It is simple to set up for charging in both homes and offices. Looking at the market, V2G technology, for example, is expected to grow at a rapid rate. Given the rapid rise of electric vehicle charging stations around the world, the V2G technology market is expected to reach $17.27 billion by 2027. V2G's versatility is also expected to contribute to this expansion. The future of electric vehicle charging is smart charging.

3. THE PROPOSED VEHICLE TO HOME WPT

The proposed system in this scenario is a power transfer system from vehicle to residence, with high frequency inverters on the vehicle side by converting DC power from the EV's battery to high frequency AC power.The high frequency magnetic flux subsequently induces the high frequency power to the secondary coil. The AC is rectified to dc on the receiving end. Afterward, it's amplified and delivered to the home's battery storage system.

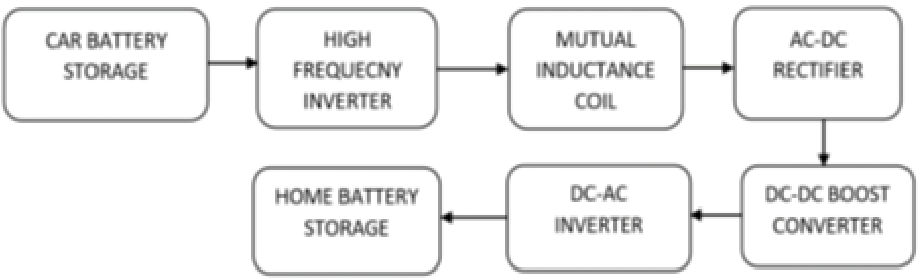


Figure 3. Block diagram of the proposed vehicle to home system.

3.1. MATLAB Simulation Model

In this MatLab simulation, a dc battery supply is present on the transmitting side, and the dc power is converted to a high frequency ac and transmitted to the primary side of the coil through a high frequency inverter.The secondary side of the coil is excited with a high frequency ac power due to mutual inductance acting between the coils, and the coil parameters are set accordingly. The high frequency ac power is supplied to the rectifier, which produces a fluctuating dc power. The fluctuating dc power is delivered to a dc-dc boost converter, which boosts the dc voltage to a stable 220V. A suitable inverter is then used to convert this voltage to a 50Hz ac voltage. The standard stabilizers of the house battery storage are given ac power of 220V, 50Hz, 2A, which can be delivered to the home/buildings during power fluctuations or power outages.

3.2. Simulation Design Parameters

Table 3. The table depicts the list of components used and their specification respectively

COMPONENTS	NO'S	SPECIFICATION
dc battery source	1	300v
IGBT switches	8	-
diode	5	-
not gate	2	-
mutual inductance	1	**L1:** 8.79e-5(H)
		L2: 1.251e-5(H)
series rlc circuit (c)	4	**C1:** 3.98e-8(F)
		C2: 2.78e-8(F)
		C3, C4: 220e-6(F)
series rlc circuit (l)	1	**L1:** 1e-3(H)
series rlc circuit (c)	2	**R1, R2:** 100(Ω)
mosfet	1	-
pulse generators	3	**PG1, PG2: period=**1/85000(sec)
		pulse width= 75%
		PG3:period=1/50(sec)
		pulse width= 50%
voltage measurement	5	-
current measurement	5	-

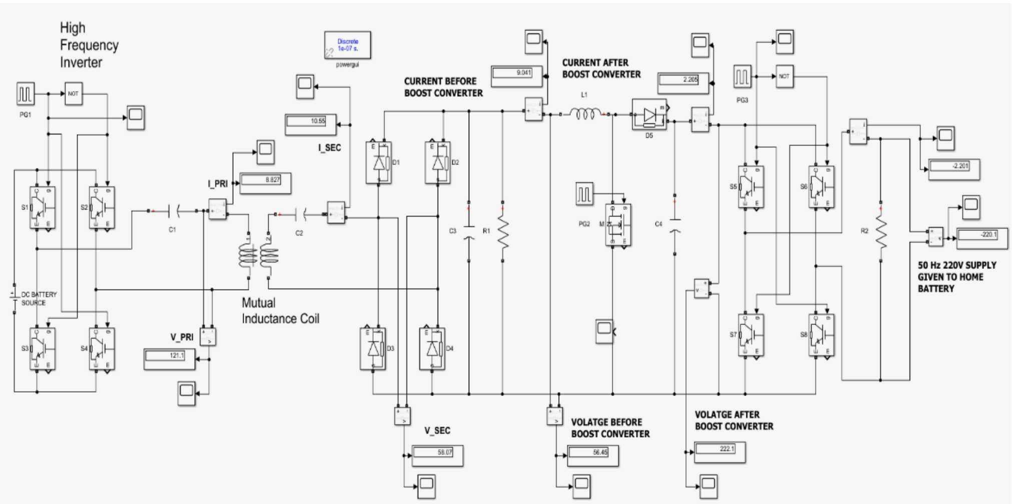
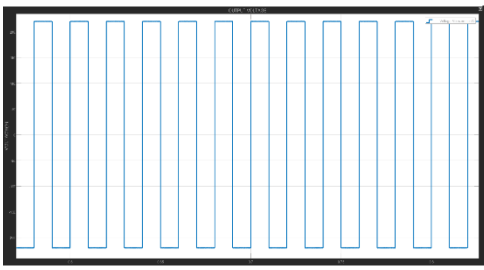


Figure 3.1. Simulation circuit

3.3. SimulationOutput



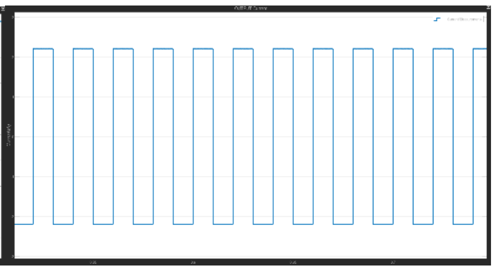


FIGURE 3.2. Voltage Output **FIGURE 3.3.** Current Output

4. ANSYS COIL DESIGN

The coil for the above proposed project is designed in ANSYS Electronics DeskTop (EDT), where a planar helix coil with a defined radius of the wire with a 5mm starting radius is designed. The design is done in the ANSYS EDT software's Maxwell 3D Design included application. The coil is made of standard copper and has 36 segments per turn. The transmitting and receiving coils' excitation are specified correspondingly. For the coil and the air region, the mesh analysis uses default initial mesh values. In the analysis stage, a solution path is added. select the parameter that will be used in the analysis Set up the necessary results section, then validate the model and execute the analysis.

4.1. Maxwell 3D design

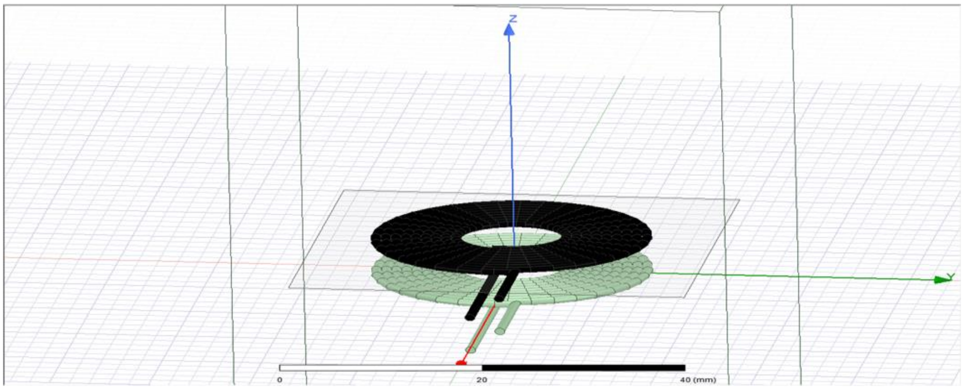


Figure 4.1. The model design of the coil proposed

A helical coil is drawn from the pre-defined structure in the draw menu option. The green coil represents the transmitting side and the black coil represents the receiving coil of the system. The leads are drawn to the coil to give current excitation. An air environment is set to given to satisfy the boundary condition of the coil. 5mm distance is placed between the two coils. Excitation of about 6A of current is given to the coil and the necessary mesh is set-up along with a correct solution setup with the results. The field overlays are defined by a rectangular sheet between the two coils so as to get the vector and magnitude results as the outcome. A tabular output is setup by optimetrics and parametrics option in the project manager to get the tabular output of inductance and coupling coefficient.

Table 4. Design parameters of the Maxwell 3D coil

PARAMETER	PRIMARY COIL	SECONDARY COIL
Polygon Segment	0	0
Polygon Radius	0.5 Mm	0.5 Mm
Starting Helix Radius	5mm	5mm
Radius Change	1.01mm	1.01mm
Pitch	0	0
Turns	9	9
Material	Copper	Copper

4.2. ANSYS Results

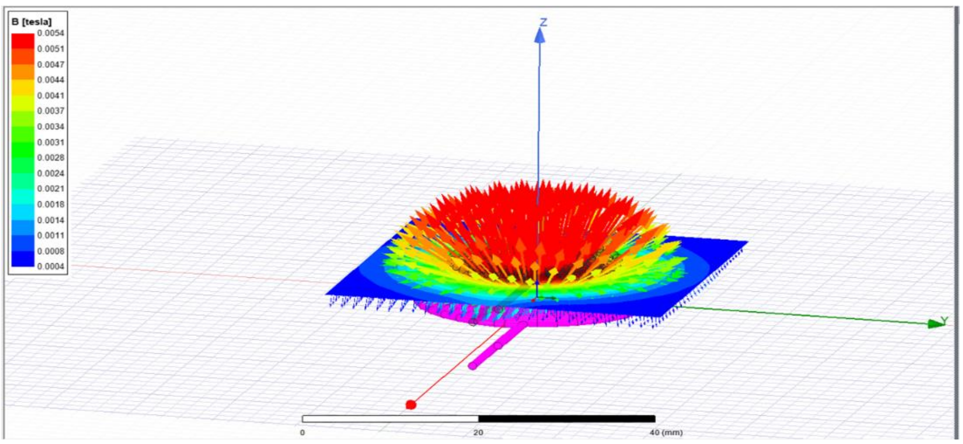


Figure 4.2. Vector and Magnitude Field Results

L Table 1

	Coil_Distance [mm]	Matrix1.L(RX_IN,RX_IN) [nH] Setup1 : LastAdaptive	Matrix1.L(TX_IN,RX_IN) [nH] Setup1 : LastAdaptive	Matrix1.L(RX_IN,TX_IN) [nH] Setup1 : LastAdaptive	Matrix1.L(TX_IN,TX_IN) [uH] Setup1 : LastAdaptive
1	5.000000	230.481972	-147.077256	-147.077256	1.057736
2	10.000000	229.673702	-60.012783	-60.012783	1.057797
3	15.000000	228.351333	-26.409440	-26.409440	1.057535
4	20.000000	227.259928	-12.257496	-12.257496	1.057785

Figure 4.3. Tabular Result of Coupling Coefficient at Variable Distance of Two Coils

Coupling Coeff Table 1

	Coil_Distance [mm]	Matrix1.CplCoef(RX_IN,RX_IN) Setup1 : LastAdaptive	Matrix1.CplCoef(TX_IN,RX_IN) Setup1 : LastAdaptive	Matrix1.CplCoef(RX_IN,TX_IN) Setup1 : LastAdaptive	Matrix1.CplCoef(TX_IN,TX_IN) Setup1 : LastAdaptive
1	5.000000	1.000000	-0.297878	-0.297878	1.000000
2	10.000000	1.000000	-0.121755	-0.121755	1.000000
3	15.000000	1.000000	-0.053742	-0.053742	1.000000
4	20.000000	1.000000	-0.025000	-0.025000	1.000000

Figure 4.4. Tabular Result for Self and Mutual Inductance of Primary and Secondary Coil at Variable Distance of Two Coils

5. CONCLUSION

The simulation for wireless vehicle to home technology is performed in MatLab / simulink simulation software, and the results are provided in this paper. In addition to the simulation, the coil design was developed using the ANSYS Electronic DeskTop software's Maxwell 3d application. A planar spiral coil is design with the necessary condition and the flux linkage result is viewed by analysing the coil and the vector results as well as the tabular results are presented in this paper. Amid concerns about global environmental problems, the spread of smart houses that can carry out energy management by combining solar photovoltaic system and battery storage contributes to the realization of low carbon society.

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Biographies

S.P. Vedavalli (Subramani Paneer Selvam Vedavalli) received B.E degree in EEE from Anna University, Chennai in 2008. M.E Degree in Power Electronics and Drives from Anna University, Chennai in 2010. Currently, Pursuing Ph.D. degree in Electrical Engineering from Anna University, Chennai. Her research interests include Power Converters, Renewable energy, E-Vehicle, etc... Now She is working as an Assistant Professor, Department of Electrical and Electronics Engineering, St. Joseph's College of Engineering, Chennai, India. She had published few papers in international journals.

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