Wireless Charging of Electric Vehicle While Driving

Saravanan S
Assistant Professor, Department of Mechatronics Engineering, M.A.M. School of Engineering, Chennai Trunk Road, Siruganur, Tiruchirappalli

Arunkumar A
Student, Department of Mechatronics Engineering, M.A.M. School of Engineering, Chennai Trunk Road, Siruganur, Tiruchirappalli.

Halila Nasifa G
Student, Department of Mechatronics Engineering, M.A.M. School of Engineering, Chennai Trunk Road, Siruganur, Tiruchirappalli.

Rajeshwari A
Student, Department of Mechatronics Engineering, M.A.M. School of Engineering, Chennai Trunk Road, Siruganur, Tiruchirappalli.

Tholkappiyan K
Student, Department of Mechatronics Engineering, M.A.M. School of Engineering, Chennai Trunk Road, Siruganur, Tiruchirappalli.

Abstract- Worldwide, the use of static wireless charging to recharge electric vehicles (EVs) is growing in popularity. However, an EV's range is limited when fully charged. To extend its range, more batteries will be required. EVs now have dynamic wireless charging, which significantly extends their driving range and eliminates the need for bulky batteries. Some contemporary EVs are escaping this predicament. However, dynamic WPT will progressively eliminate the necessity for static WPT and plug-in charging, allowing an electric vehicle to have an infinite range. An electric vehicle can be charged while being driven, eliminating the need to stop and consider charging it again. In the future, EV batteries may also be removed by using this technique.

Keywords – WPT,EVs

I. INTRODUCTION

The history of electric vehicles began in 1996 when General Motors produced the first electric car in history. However, since the introduction of EVs by Nissan and Chevrolet, EV manufacturers have embarked on an amazing technological journey, winning over consumers' understanding that their products pose no environmental risks. Additionally, switching to electric vehicles is seen as a major step toward improving fuel efficiency, preserving the environment, and reducing reliance on fossil fuels. Due of this significant benefit, numero us automakers have begun to make massive efforts to mouloud .Denai was the associate editor in charge of organizing the manuscript's assessment and granting publication approval. S-S (series-series) WPT system with a resonance frequency ranging from 40 kHz to 85 kHz. They discovered that light-duty EV applications are a better fit for the WPT technology. However, the problem of dynamic charging is one of the major obstacles EV manufacturers must overcome. Since EVs may now be charged wirelessly, two very efficient WPT methods have been developed. They are resonant inductive power transfer (RIPT) and capacitive wireless power transfer (CWPT). According to certain studies, inductive charging has significantly higher efficiency and power density than capacitive charging [5]. Furthermore, the diameter of the coupling coils has a substantial impact on the inductive characteristics [6]. Many researchers are attempting to transfer the most power possible to the receiving pad in order to boost the overall efficiency

Misalignment while operating the EV is the other element influencing overall efficiency. An increase in the misalignment between the transmitter and receiver coils will result in a loss in efficiency [8, 9]. In contrast to the misalignment-free situation, the coupling coefficient in [10] study drops from 0.2 to 1.6 given a 20% misalignment between the coils. Reducing leakage flux and aligning magnetic fields can be accomplished with different kinds of shielding material. According to observations, ferrite objects limit magnetic fields and do not harm nearby things [11]. Ferrite shapes are also influenced by the coil. They can be square, rectangular, T-core, U-core, E-core, Double U, circular, circular striated, and striated blocks [12].

II. PROPOSED ALGORITHM

The problems associated with range anxiety, inadequate battery capacity, and lost space due to high battery sizes can be overcome via WCS of EVs. Despite this, dynamic WCS still faces a number of difficulties, including poorer efficiency, heavier construction, electromagnetic compatibility, longer charging times, and lesser power transfer. Nevertheless, dynamic WCS has been studied as a means of overcoming anxiety's lower range while providing a continuous charging source. This technology makes it possible to charge the battery storage device while the electric vehicle is moving. In this instance, the car requires less battery storage capacity. The purpose of Wireless Charging Units (WCUs) is to use mutual induction to provide electricity to vehicles passing over them when they are being charged wirelessly.

Dynamic WPT in the mean of mutual induction is thoroughly studied in this paper. Then, Ansys Maxwell software displays the modeling of the transmitter coil, receiver coil, and WPT simulation. Ansys Maxwell is modeling and simulation software that analyzes electrical components commonly found in electric machines, transformers, wireless charging, and many other applications. Use a mathematical equation to validate the output data as a result. This is also where load power and efficiency are computed. The amount of electricity that an electric vehicle (EV) may gather from the charging lane while driving over it, as well as the additional distance it can go using this used power, are finally computed.

Numerous studies have been conducted on the simulation and computation of transmitter and receiver coils.

A. TRANSMITTER COIL AND RECEIVER COIL

There are different shapes of coil used in WPT systems. Among them, the circular coil is the most effective structure in high- frequency wireless transfers [27] as there are no sharp edges. So, the eddy current is kept to minimum [12]. The high magnetic field produced by the coil causes better where 'a' is the center of the coil to the center of the pitch of the coil and 'c' is the pitch of the coil.Since the geometry of the transmitter coil and receiver coil are the same, the self-inductance of each coil will also be the same.

After solving the (1), the value of self-inductance is obtained at 176.624μH. This value is evaluated for both self-inductance of transmitter coil, L_1 and receiver coil, L_2. Length of the wire of the coil, $l = \frac{\pi N(D_{out}+D_{in})}{2} = 21.06$m

1) CALCULATION OF MUTUAL INDUCTANCE OF COILS

Mutual induction, M is the most important parameter of this work. Because from the mutual inductance the power transfer can be calculated to the receiving end and further work is depending on this value. Mutual induction depends on the magnetic field between the coils and any change in the

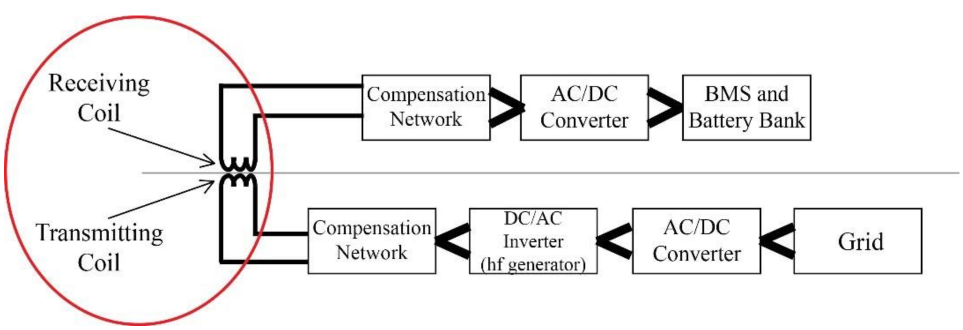

FIGURE 2. Block diagram of grid-to-vehicle (G2V) wireless charging system for an EV.

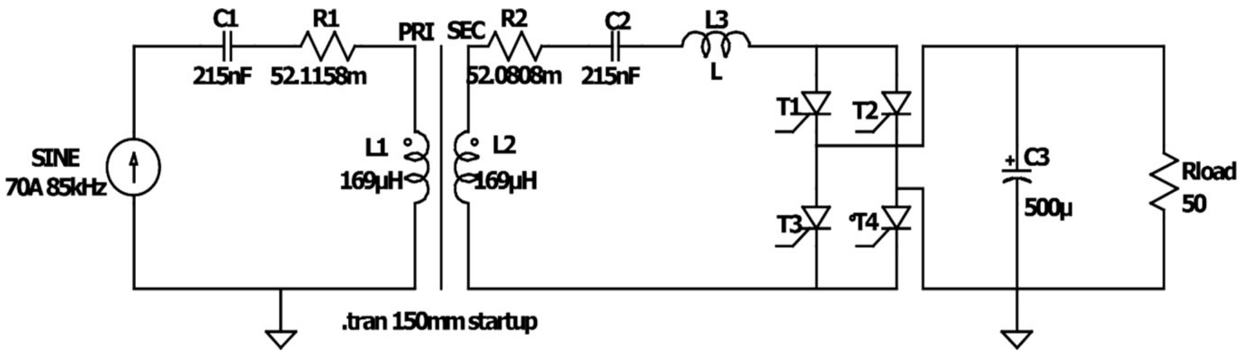

FIGURE 3. Circuit representation for RIPT system.

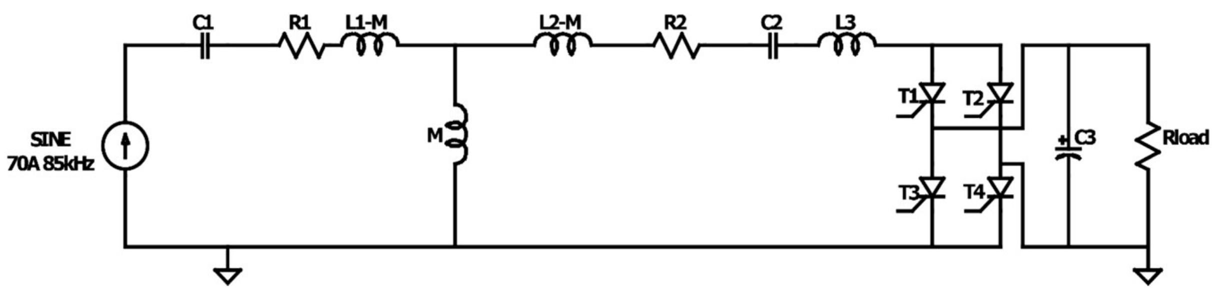

FIGURE 4. Equivalent circuit diagram for given self-inductance and mutual inductance

vertical and horizontal displacement varies its value [31], [32]. For the calculation of mutual induction, let R_t and R_r repre- sents the radius of the current filaments in the transmitter and receiver coils as shown in Fig. 7. Here, the subscripts 't' and 'r' are integers from 1 to 18 i.e., the turn each of coil such Here, I_{Trms} is the RMS value of the input current in the transmitter end.

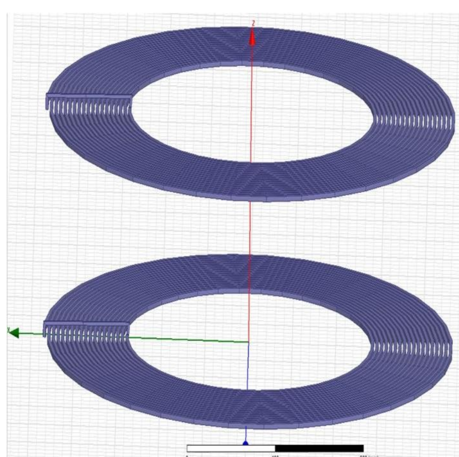

FIGURE 5. Transmitter coil and receiver coil.

III. EXPERIMENT AND RESULT

Following the mutual induction simulation, simulated data, which displays the variation of magnetic

The result of solving this equation is (0.10492 2)W 0.20984 W, which is the total load power for a single transmitter coil while the receiver coil is in motion. For WPT, a 3 km charging lane track is suggested. As seen in Fig. 8, 500 transmitter coils will be installed for a distance of 1 km on the track if the distance between the transmitter coils is 2 m. flow in tandem with the expanding air gap. As the distance between the coils increases, the region for the transmitter coil's magnetic flux density gets smaller. The area of magnetic flux density that the receiver receives consequently gets smaller. The self- inductance and mutual-inductance of the transmitter and receiver coils were measured, and it was discovered that Table 2's calculated and simulated values were nearly identical

IV.CONCLUSION

WPT research is becoming more and more popular these days. This paper develops an efficient WPT technology called as RIPT and compares the most well-known ones. The transmitter and receiver coil frequencies are resonant when using the RIPT technique. It illustrates how alignment issues and air gaps impact the WPT when the EV is being driven in the charging lane. In order to observe the decrease in mutual inductance for air gap and horizontal movement between the coils in the x- and y-axes, WPT is first simulated using the Ansoft Maxwell 3D simulation program. The output data is then checked using mathematical equations. We cover here the equations for voltage, current, coupling coefficient, self-inductance, and mutual inductance. The load power and efficiency calculation for the 150 mm air gap is displayed. It is simple to calculate how long it will take an EV battery to fully charge based on the load power. Thus, a model is created to observe how power is transferred at various speeds and, ultimately, to determine how far an EV can travel while using this amount of electricity. However, the EV's speed also affects how well the reception pad can absorb electricity from the transmitter pad. To send more power to the receiving end, shielding materials such as aluminum plates and ferrite planner can be utilized. This research contributes to our understanding of EV wireless charging.

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