Graphene-Based Wireless Power Transmission: Charge as u drive

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Abstract.
Many automotive industries aim to limit their impact on the environment and transform the mobility of automobiles into a sustainable mode of transportation. Electric vehicles seem to be key milestones in this regard. This paper intends to introduce a "Charge as you drive "- a newly evolved concept that can be used to overcome limitations of existing electric vehicles and aid in better battery management.

Wireless power involving a high-efficiency charging system that uses Magnetic Resonance Coupling to generate electricity could revolutionize the highway transportation system. With this statergy, when using a fairly small battery pack,a vehicle effectively has an limitless electrical range, which can significantly reduce the consumption of oil.These coils are powered by Graphene-based Solar Panels. As solar power is renewable, infinite, eco-friendly and also considered to be a form of energy that is much safer to use. Thus, by introducing the above-proposed solution in Electric Vehicles, the obstacles of charging range, time, and cost can be easily mitigated.

Keywords: Magnetic Resonance Coupling, Graphene-based Solar Panel, Wireless Power Transmission

1 Introduction

According to the Environmental Protection Agency, 75% of carbon-monoxide comes from automobiles. These automotive vechicles emit a wide variety of gases and solid matter, causing changes in air and global climate.Burning large quantitites of fossil fuels, such as gasoline and diesel used in motor cars, has caused global temeratures to increase by 0.6 degree Celsius, or 1 degree F. The pollutant emissions from these vehicles contribute to unhealthy, immediate and long-term effects on the environment as well as human health. This has its effect on wildlife, sea levels, and natural landscapes as well.

With the world becoming more eco-conscious, automobile industries aim at limiting their impact on the fossil fuel-driven internal combustion engines, by introducing the vehicles powered by Electric motor. Electric vehicles recognized as a future of mobility is an attempt to help reduce gas emissions and improve air quality. They offer a key path achieving in greater than 80% reduction in global warming, oil dependency and smog formation. More the Electric vehicles on the road, the lower the production of harmful gases and hence lower the pollution rate.

Unlike the conventional fuel-driven automobiles, Electric vehicles can be powered using batteries which acts like a 'Gas tank'. These vehicles are fitted with onboard batteries which stores and uses the energy needed to power a set of electric motors, which ultimately gives the car the acceleration. The batteries used powers all the electronic devices in the vehicle. It can be either recycled or used elsewhere after a a battery has worn out, as it will still have nearly 70-80 percent of its original energy capacity. The controller controls the amount of power the batteries get, so that the engine doesnot burnout. Because electric vehicles use an electric motor, the driver can take advantage of the momentum of the motor when applying pressure on the brakes. The forward momentum of the motor can be used to recharge the battery as well. When the vehicle is stationary, there is no electrical current being processed, so no energy is being used up. One of the electric vehicle's main feature is that they can be plugged into off-board charging power sources. These vehilces are powered from the electricity by regenerative braking, as well.

However, charging of electric vehicle battery through charger and wire is inconvenient, hazardous and expensive. Although, these plug-in Electric vehicles are burdened by the need for cable and plug charger, with this system user has to physically plugin for charging purposes. In addition to these, batteries seem to be the limiting factors as recharging these batteries takes time. On a single charge, these vehicles can travel about only 100miles on an average.

In this paper, we propose an innovative idea of Wireless Power Transfer using the principle of Magnetic Resonance Coupling to overcome the limitations of existing electric vehicles. Dynamic charging will allow the transportation sector to supply a very latge fraction of the energy and greatly reduce petroleum consumption. Transmitting coils embedded in the highway are powered by Graphene-based Solar Panels. Solar cells require materials that are conductive and allow light to get through, Graphene is used here due to its superb conductivity and optical transparency. A layer of graphene has an optical transparency of 97.7%.

The proposed model would be onetime investment, revolutionizing the highway transportation system. This is a wonderful idea which can be implemented or the government can undertake this as a huge project and completely change the Indian approach towards electrification for transportation

The organization of the rest of the paper is as follows. Section II describes the basic principle of magnetic resonance coupling, section III explains the proposed methodology and experimental results for the proposed model are briefed in section IV and conclusions in section V.

1.1 Magnetic Resonance Coupling

The inductively coupled power system consists of two coils called L1 and L2, respectively the transmitter coil and the receiver coil, all of which come from a magnetically coupled inductor system. A magnetic field is created in the receiver coil by an alternating current in the transmitter coil that induce a voltage. For charging purposes, this voltage can be used[6]

The efficiency of the power transfer depends on the relation between the inductors and their quality. The link between the inducers (z) and D2 / D ratios is determined. bAlso defining the relation between the structure and the angle of the coils.

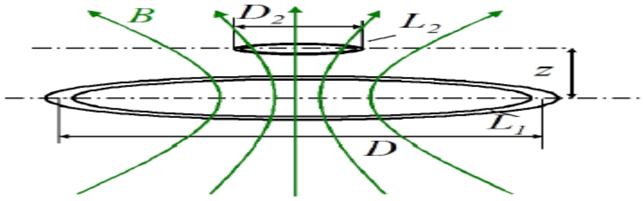

Fig 1. Magnetically coupled inductor

2 Methodology

Electrification for transport was a major concern for energy , resources, the environment and many other factors. Wireless power transfer technology plays an important role in this connection by eliminating all the problem with charging. A key difference is that a transformer / receiver are replaced by loosely coupled coil systems between a wireless power transmission and conventional gas-fuelled vehicles. The series of coils connected to an electrical current would be embedded onto the highway, and the receiving coils would be attached to the vehicle bottom. On the road would be built up the series of coils connected to an electric current and the receiving coils would be attached to the base of the vehicle. This echoes with the pace of the vehicle. Power can be transferred to the battery without significant energy losses if the operating frequency of the battery is between 50 and 95% of the frequency. Fig . 1 shows magnetic fields that continuously transmit the electricity to charge the battery. The solar panels are powered by Graphene-based transmission coils. In order for the transmission coil to be powered by a primary compensation network, the Dc power produced from solar panel is converted to high frequency Graphene, the thinnest material known to people with good conducting, optical clarity and very high strength, is used to improve the efficiency of sun cells. These solar graphic cells also can be used to extract electricity from raindrops. Unfair weather like rain and snow therefore has no effect on the load capacity[1].

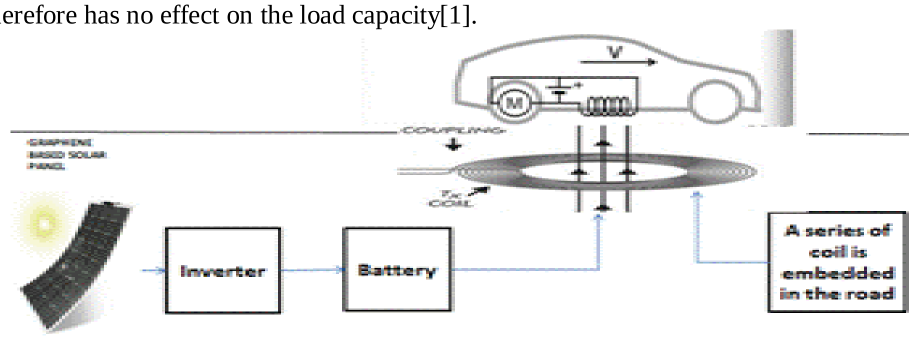

Fig 2. Wireless Power Transmission

Figure 3.shows the vertical magnetic flux of the transmitter and receiver coil. From this magnetic flux path, where loops are generated and the receiving coil receives the vertical magnetic flux that is fitted at the bottom of the electric vehicle, a high frequency power source is distributed through transmitting coil. The transmit and

receive coil is 60 cm wide. The transmitting coil and the surface of the road has an air gap of 20cm between them. To transfer 100kw of power, five 20kw pickup modular is to be installed in the electric vehicles.

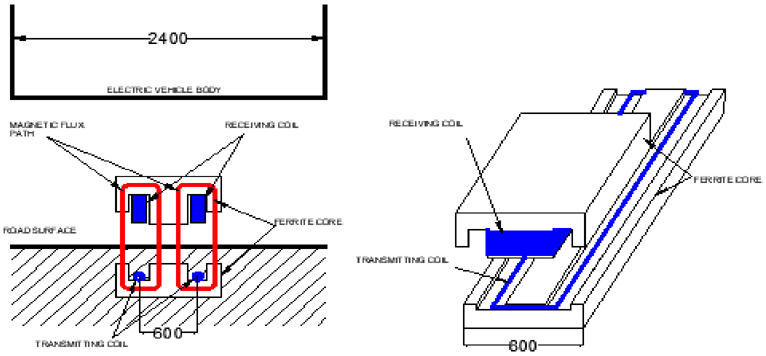

Figure 3.detail design

2.1 Design process

The magnetic induction coupling compresses of two stages which are as discussed below,

2.1.1.Wireless Power Transmission between the Coils:

A resonant wireless transmission network comprises magnetically coupled transmitting, receiving coils and various electronic control circuits. The resistance of the coil essentially increases as the frequency changes. It is therefore important to design a low loss belt that helps improve the quality factor. The constant current source shown in figure shows the wireless power transfer system. (a) the simple passive elements shown in the Figure. (b) the transmetting and receiving coil inductances, where the LS and the LR are, may be designed. When a transmitter coil is driven by the source (M is a mutual inductance and k a magnetic coupling coefficient), the transmitting and receiving coils shall be magnetically coupled. For maximum power transference, the condensers CS and CR are connected in series with each coil in the model. The internal resistances of each coil are RS and RR, and the load resistant is RL. The model can be used to calculate the loop impedance of the ZS transmitter and the ZR receiver loop impedance

$$Z_s = R_s + \frac{1}{j\omega C_s + j\omega L_s} \qquad (1)$$

$$Z_R = R_R + R_L + \frac{1}{j\omega C_R + j\omega L_R} \qquad (2)$$

Where the source current is IS and IR, respectively the load current. The PL transmitted power can be calculated with the real power transfer efficiency η

$$P_L = R_e\{V_L \cdot I_R^*\} = \frac{\omega^2 M^2 . R_L . I_S . I_S^*}{Z_R . Z_R^*} \qquad (3)$$

$$n = \frac{R_e\{V_L.I_R^*\}}{R_e\{V_S.I_S^*\}} \tag{4}$$

$$n = \frac{\omega^2 M^2 .R_L}{R_e\{Z_S Z_R Z_R^* + \omega^2 M^2 .Z_R^*\}} \tag{5}$$

Figure (b) demonstrates both the efficiency of power transfer and the transmission of power from the illustration case. The power transfer efficiency is dependent on the parameters of the passive circuit and operating frequency, and the performance of the power transmission is typically maximized at the resonant frequency.

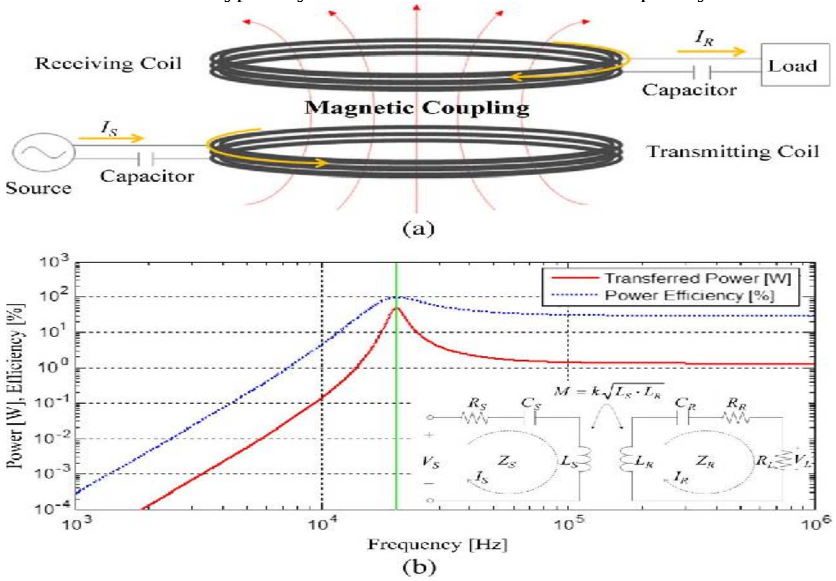

Fig 3 (a)WPT system configuration. (b) The analogous circuit model, load transfer power and efficiency of the actual transmitted power; the coil resonance frequencies are set at 20 kHz with the transmission power being 50 W at the resonant frequency.

2.1.2.Generation Of Power From Graphene Based Solar Panels:

The Solar Panel, based on Graphene, converts sunlight into DC electricity, acting as a source for powering the connecting coils. Solar panels may be wired in series or in parallel respectively to increase voltage or current.A 12-volt solar panel's Rated terminal voltage is typically around 17.0 volts, but this voltage can be reduced to around 13 to 15 volts as required for charging by the use of a Solar Regulator. Solar Regulators or Charge Controllers have the purpose of regulating the current from the solar panels and ensuring the correct supply of the power to the inverter without damaging it. In order to drive the transmitter through an inverter network, the dc voltage is converted to a high frequency alternative current. Reflected sunlight and different conditions of temperature raise the output current by 25 percent above a solar panel's average output. The solar regulator must be sized in such a way that 125 per cent of the rated short circuit current of the solar panel can be handled. The solar panel based on graphene can also be used to obtain power from the impact of the raindrops. The gout is not pure water. They contain salts which dissociate themselves into ions. The positively charged ions will bind to the surface of Graphene and get enriched in delocalized electrons. The consequence of this process is a double layer of electrons and positively charged ions. This difference in associated potential is sufficient to generate a voltage and the current needed to power coupling coils. So solar panels will operate in all climatic conditions with the aid of graphene[8].

Transmitter circuit:

The module of the transmitter is a direct power supply connected to an oscillator a coil . The transmitting coil generates an oscillating magnetic field from the A.C current during this operation, which transforms the electrical supply into a high-frequency alternating current.

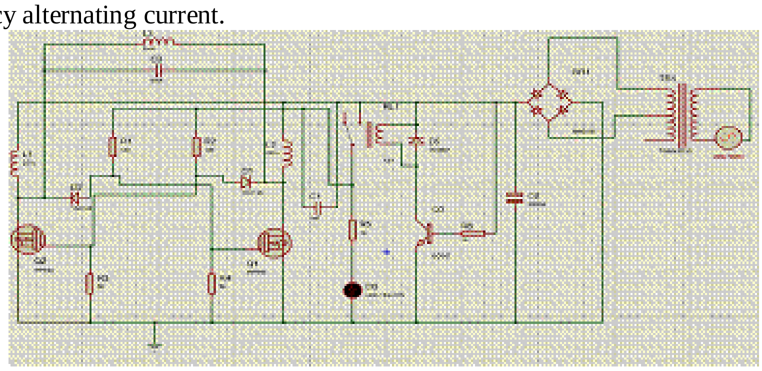

Fig 4.transmitter circuit

Receiver circuits:

This receiving module consists of a voltage regulator to provide a constant voltage and connecting voltage to the battery mounted in an electric vehicle[7]. It receives all its power in the magnetic field produced by the transmission coil of the receiver version of a wireless power transfer device.

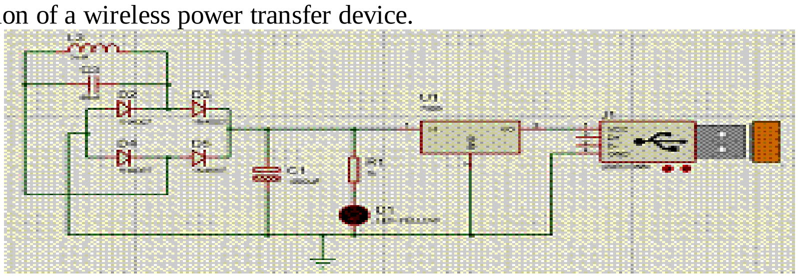

Figure 5.receiver circuit

3 Experimental Results

Table.1.Output Voltage Measurement of the Transmitter Module

Parameter	Voltage Type	Theoretical Value (V)	Actual Value (V)
Transformer Output	AC	12	11
Rectifier Output	DC	11.9	11
Oscillator output	AC	11.9	11.5

From the above table analysis, we get to know that the transformer output will give 11v but expected is 12v.same way rectifier will give11.5v and the oscillator will give 10V.

3.1 Critical pointing

Coupling between two coils increases with decreasing distances between two resonators this trench is roughly proportional to increases in device efficiency with shorter distances.

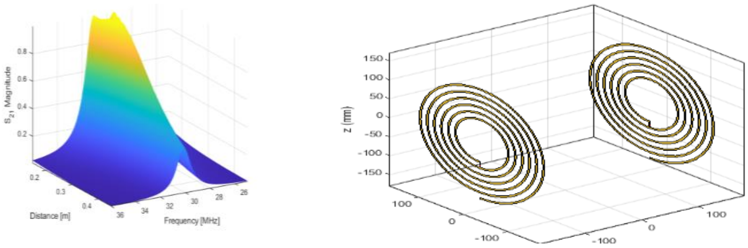

Figure 6. Matlab distance simulation vs Frequency analysis & Spiral to Spiral Power Transfer System The full wireless power transfer system consists of two components: the transmitter (Tx) and the receiver (Rx). To optimize the transmission capacity, choose identical resonators for both transmitter and receiver. The wireless power transfer device is here developed as a linear series.

Table 2: Transfer efficiency test result

Distance (cm)	Transfer Efficiency (%)
0	96
6	80
11	75
16	68
21	55
26	48

From table 2 we can get to know that as distance increases and frequency decreases and transfer efficiency decreases

4.Conclusion

Transportation based on fuel has caused enormous pollution problems. In the present case, the use of electric vehicles offers an eco-friendly alternative but suffers from a major downside when it comes to charging. So our proposed model - 'Ride as U-Drive' is used to provide an beneficial alternative to wireless vehicle charging. The coupling coils are powered using graphene-based solar cells where graphene increases the solar cell's performance . The analysis of radiations produced by the coupling coils does not affect the human health nor vehicles performance**.**

For a wireless charging Electric Vehicle a safe zone should always be established. When an automobile is usually made of steel, a very strong defensive material, the magnetic flow density must be assured to comply with the safety requirements at usual positions such as standing outside the car or inside the vehicle.

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