ENERGY HARVESTING USING AUTOMOBILE CHARGERS WITH WIRELESS POWER TRANSFER

***Mr. M. J. Murali*[1], *Mr. A. R. Aravind*[2], *Mr. Ashok. P*[3]. *Mr. Dinesh. P. S*[4],**

[1]Assistant Professor, Dept. of EEE, Prince Shri Venkateshwara Padmavathy Engineering College, Chennai

[2]Assistant Professor, Dept. of ECE, Prince Shri Venkateshwara Padmavathy Engineering College, Chennai

[3]Assistant Professor, Dept. of ECE, Prince Shri Venkateshwara Padmavathy Engineering College, Chennai

[4]Assistant Professor, Dept. of ECE, Prince Shri Venkateshwara Padmavathy Engineering College, Chennai

muralimj22@gmail.com

***Abstract*—Wireless sensor networks (WSNs) have played an important role in many monitoring and surveillance applications including environmental sensing, target tracking, structural health monitoring. As conventional sensors are powered by batteries, the limited battery capacity obstructs the large-scale deployment of WSNs. In this , Smart Energy generation and distribution system is implemented. The power is generated from the engine heat of the vehicle using peltier sensor and power is transferred to the load using WPT Using internet , the cost for the generated power is updated to the server and it is used for filling fuel.**

***Keyword*-Wireless Power Transfer, magnetic induction, peltier sensor, booster, resonance, internet**

I. INTRODUCTION

WSNs remains a main performance bottleneck in their real deployments, since wireless data transmission consumes substantial sensor energy. To mitigate the limited energy problem in sensor networks, researchers proposed many different efficient approaches. One method is to enable sensors to harvest ambient energy from their surroundings such as solar energy, vibration energy, and wind energy. However, the temporally and spatially varying nature of renewable energy resources makes the prediction of sensor energy harvesting rates very difficult. For instance, it is shown that the energy generating rates in sunny, cloudy and shadowy days can vary by up to three orders of magnitude in a solar harvesting system. Moreover, the harvesting energy sources are intermittent and not always available. Such unpredictability and intermittency pose enormous challenges in the efficient usage of harvested energy for various monitoring or surveillance tasks.

A recent breakthrough in the wireless power transfer echnique based on strongly coupled magnetic resonances has drawn plenty of attentions in the research community demonstrated that it is possible to achieve an approximate 40% efficiency of wireless power transfer for powering a 60W light bulb from a distance of two meters without any wire lines and plugs . Industry research further achieved a 75% efficiency of wireless power transfer for transferring 60W of power over a distance of up to two to three feet . Several commercial products based on the wireless energy transfer technology now are available in markets such as sensors, RFIDs, cell phones, and auto vehicles . It is reported that the wireless energy transfer market is expected to grow from just $216 million in 2013 to $8.5 billion in 2018. Armed with this advanced technology, sensors can be charged at steady and high charging rates. Another breakthrough in the ultra-fast charging battery materials further fuels the feasibility of the wireless power transfer technique.

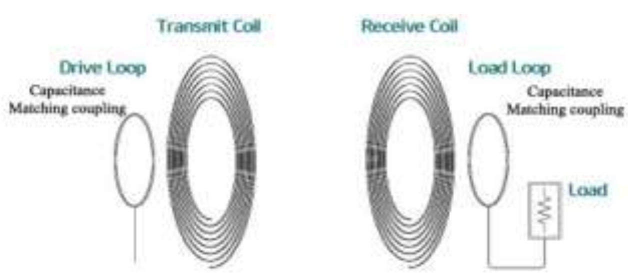

Fig-1: Magnetic coupling

Scientists from MIT implemented an ultra-fast charging in material *LiFePO*4, which can be charged at a rate as high as 400 *Coulombs* per second . The duration of fully-charging a battery thus can be shortened to a few seconds. Therefore, wireless power charging is a very promising technique to prolong the lifetime of WSNs.

In this paper, we employ multiple mobile chargers (i.e., charging vehicles) to replenish sensor energy in a large-scale WSN for a given monitoring period *T* so Most existing studies on sensor charging scheduling employ mobile chargers to charge all sensors periodically.

II. WITRICITY

WiTricity is nowadays the latest and the most trending technology when we consider wireless power transmission. The based fundamental used in this technology is the magnetic resonant coupling. This is because two resonant objects of the same resonant frequency tend to exchange energy more efficiently to a considerable amount of distance.

WiTricity power sources are actually devices that are specially designed magnetic resonators. These magnetic resonators can be used for efficiently transferring power over distances via the magnetic near-field. In the above figure of WiTricity power source, the left side is connected to AC power or we can call it the primary side. The blue lines represent the magnetic near field induced by the power source because of the primary connection. The yellow lines represent the flow of energy from the source to the WiTricity capture coil or the secondary coil. We can see that the bulb glows as the current is induced in the secondary coil which is the result of magnetic resonant induction coupling.

III. BASIC TERMS RELATED TO WITRICITY

A. Magnetic Induction

Magnetic flux, in simple terms is any area that has a magnetic field passing through it. Changing magnetic flux induces an electric current in conductor in vicinity of it. Magnetic flux can be altered either by varying the strength of magnetic field or by motion of conductor through the magnetic field. Such generation of an electric current in a conductor is called as Magnetic Induction.

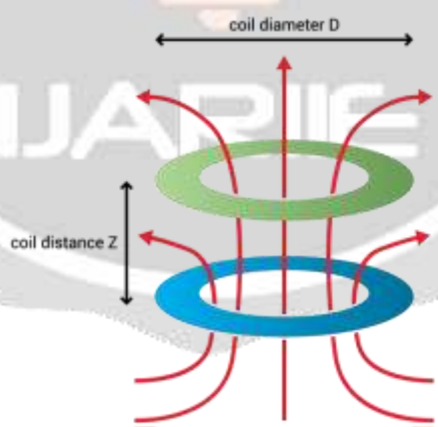

Fig-2: Magnetic Induction between Primary and Secondary Coils

Some examples of devices based on magnetic induction are electric transformers and electric generators. When alternating current is passed through a loop of conducting material, it generates oscillating magnetic field in the vicinity of it. Oscillating magnetic field indicates change in the strength of magnetic field. When another conducting loop is brought closer to the first one, it captures some portion of this oscillating magnetic field. Thus electric current is induced in it which can be used to power devices. Electric transformers works on this principle.

In case of electric generators, wire loop inside the generator is mechanically driven by some source of rotary motion. This wire loop spins in a magnetic field. Thus electric is current produced in the wire. The principle of magnetic induction can be used for the transfer of electrical power without any physical contact in between.

B. Electro-dynamic Induction

In this electrical energy is transferred from one circuit to another by the principle of induction[8]. In this the distance between is coils must small. The receiving unit will pick up the transmitted energy efficiently when the frequency is matched. Use of resonators also increases the efficiency. The receiving and sending units must be adjacent to each to avoid losses. To further improve the performance a non sinusoidal wave is transmitted. The coils used are solenoids with capacitor, this helps to tune the receiver frequency to that of the transmitter.

IV. BLOCK DIAGRAM

A.Transmitting side

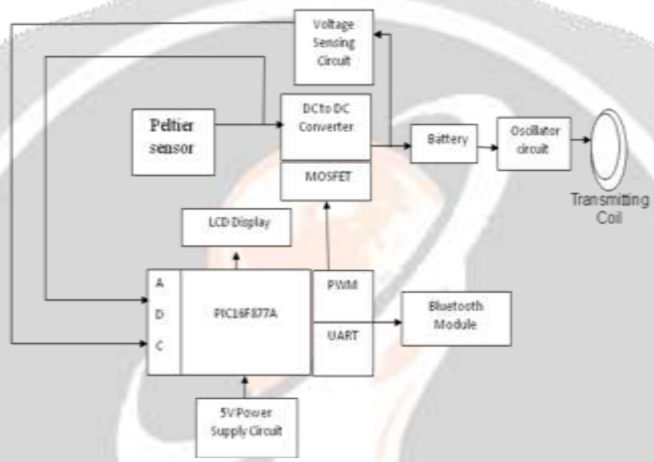

Fig. 3: Block diagram of transmitting side

Peltier sensor is used for generation of energy from the engine heat. The generated energy is very low, so the boost converter is used to increase the voltage level by using PWM technique with microcontroller. The increased voltage is stored in battery for energy transfer to the transmitter coil. When the receiver coil cuts the magnetic flux from transmitter coil, by the principle of magnetic induction ,the power is transferred wirelessly .The transferred voltage is updated via Bluetooth module to the server to maintain user details and to convert the transmitted power to equivalent cost for free fuel.

B. Receiving side

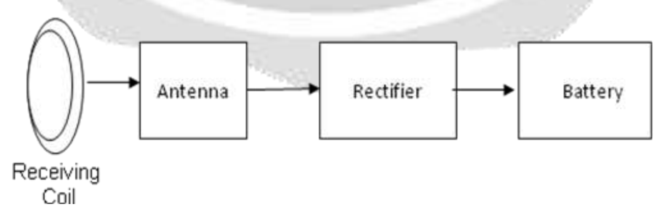

Fig. 4 - Receiving section of road side

C. Internet section

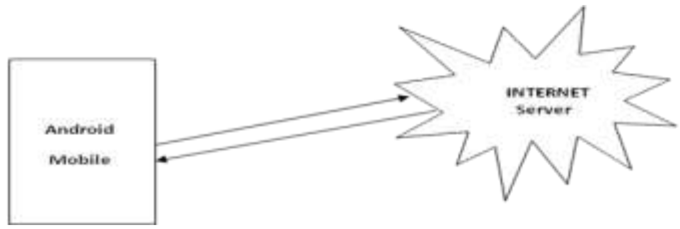

Fig. 5 – Internet to server

From the peltier sensor the obtained output is DC. Here the controller used is PIC16F877A, which collect the input voltage and current rating of the peltier sensor and depending on the design of dc-dc boost converter the pwn signal is generated automatically by the controller and hence the output voltage is increased. The output voltage of the booster converter is stored in the battery of the car. The PIC controller transfers the obtained ratings of power to the App and server using Bluetooth module via internet. In fig 5, the application in the android mobile displays the amount of power transferred to the grid and it is only for the reference for the user. The same amount is registered in the server page for each and every user. The equivalent cost is calculated for the respective power in the server and can be used for refilling of fuel.

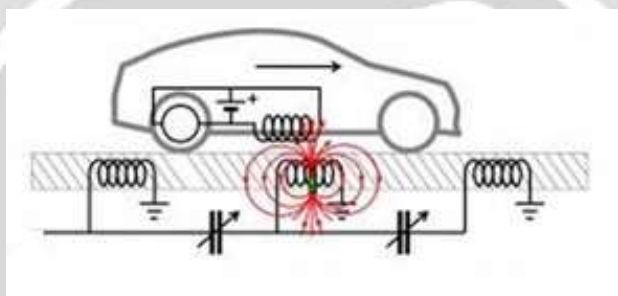

Fig. 6 – Power transferred from vehicle to road side coils

V. HARDWARE ELEMENTS

A. Peltier Sensor

Peltier sensor is the device which is used for direct conversion of temperature differences to electric voltage and vice versa. A thermoelectric device creates voltage when there is a different temperature on each side. Conversely, when a voltage is applied to it, it creates a temperature difference. A peltier cooler is a cooler that uses a peltier element (TEC).

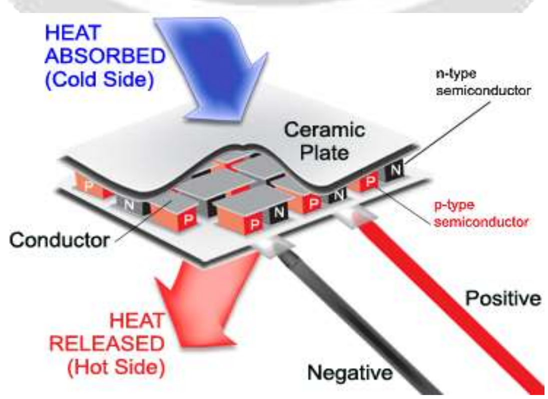

Fig. 7- Peltier sensor

In the fig.7,This is a "padded" TEC Peltier elements come in various forms and shapes. Typically, they consist of a larger amount of thermocouples arranged in rectangular form, and packaged between two thin ceramic plates.

B. Boost Converter

The Switched mode supplies can be used for many purposes including DC to DC converters. Often, although a DC supply, such as a battery may be available, its available voltage is not suitable for the system being supplied. For example, the motors used in driving electric automobiles require much higher voltages, in the region of 500V, than could be supplied by a battery alone.

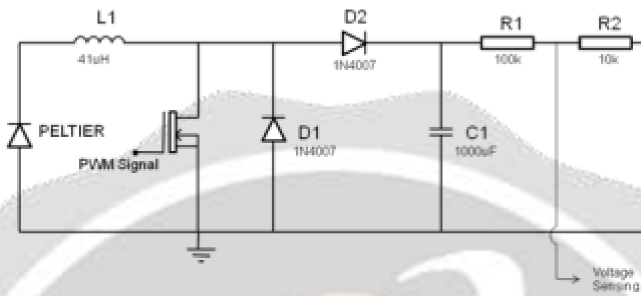

Fig. 8- DC-DC Boost converter

The current path during the low period of the switching square wave cycle. As the MOSFET is rapidly turned off the sudden drop in current causes L1 to produce a back e.m.f. in the opposite polarity to the voltage across L1 during the on period, to keep current flowing. This results in two voltages, the supply voltage V_{IN} and the back e.m.f.(V_L) across L1 in series with each other as shown in fig 8.

This higher voltage (V_{IN} +V_L), now that there is no current path through the MOSFET, forward biases D1. The resulting current through D1 charges up C1 to V_{IN} +V_L minus the small forward voltage drop across D1, and also supplies the Maximum output voltage to output.

C. Transmitting & Receiving coils

Wireless Power Transmission using inductive coupling, is one of the effective ways to transfer power between points without the use of conventional wire system. Wireless power transmission is effective in areas where wire system is unreachable or impossible. The power is transferred using inductive coupling, resonant induction or electromagnetic wave transmission depending on whether its short range, mid-range or high range.

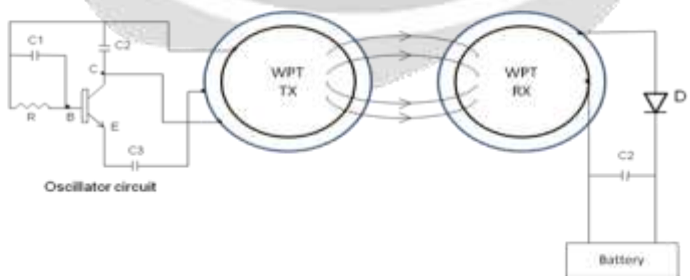

Fig. 9- Transmitting coil and road side receiving coil.

In the fig.9, the moving car has the transmitting coil which consists of oscillator circuit and at the road side the receiving coils are kept for the wireless power transmission. An electronic oscillator is an electronic circuit that produces a periodic, oscillating electronic signal, often a sine wave or a square wave. Oscillators convert direct current (DC) from a power supply to an alternating current (AC) signal. In this RC oscillator is used where the RC oscillator is a type of feedback oscillator, they consist of an amplifying device, a transistor, vacuum tube, or op-amp, with some of its output energy fed back into its input through a network of resistors and capacitors, an RC network, to achieve positive feedback, causing it to generate an oscillating sinusoidal voltage. The frequency in which the power is transmitted is 20 KHz. By making multiple dynamic motion of transmitting coil, the energy transferred is more and maximum power is obtained.

At the receiving side of the road, the collective coils are connected to a battery which gets charged and diode D is provided in order to prevent reverse supply from battery. Thus the inverter circuit is used for the conversion of DC to AC and can be used to grid.

Internet Section

The information can be sent & received anywhere from the world through internet. The data such as voltage, current, power and user details are transmitted from the transmitting coil to the receiving coil. A Bluetooth module is connected to the PIC16F877A, which transmit the sensed data to the android application and through internet, the data's are sent to the server.

Fig. 10- Information through internet.

In Fig.10 shows, the android application in which the user login with the details and information's are synced with the server via internet. The server is linked with all the fuel stations, where the equivalent cost for the each user is loaded in the server with the respective user account. When the user want to fill up the fuel for the vehicle, the cost for which the energy is generated by the vehicle could be redeemed. Thus the heat energy produced from the vehicle is in turn efficiently used to fill fuel again using the medium of internet.

ADVANTAGES

- Mobile WPT.
- Power transfer is done from vehicle to load.
- The energy obtained is not affected by any climatic conditions.
- The power failure due to short circuit and fault on cables would never exist in this transmission.

CONCLUSION & FUTURE SCOPE

The multiple mobile charges are used efficiently to harvest the energy dissipated from the engine. Thus the smart energy generation and the distribution of energy by WPT is implemented. In future, Moving wireless energy across great distance (far field). Microwaves will be used to transmit electricity to earth from solar power station on the moon. Rectenna is a rectifying antenna which is used to convert microwave into direct electricity.

REFERENCES

[1] I. F. Akyildiz, W. Su, Y. Sankarasubramaniam, and E. Cayirci, "Wireless sensor networks: A survey," *Comput. Netw., vol. 38, pp. 393–422,*Mar. 2002.

[2] G. Anastasi, M. Conti, M. D. Francesco, and A. Passarella, "Energy conservation in wireless sensor networks: A survey," *Ad Hoc Netw.*, vol. 7, no. 3, pp. 537–568, May 2009.

[3] J. Chang and L. Tassiulas, "Maximum lifetime routing in wireless sensornetworks," *IEEE/ACM Trans. Netw., vol. 12, no. 4, pp. 609–619,*Aug. 2004.

[4] D. R. Cox, "Prediction by exponentially weighted moving average andrelated methods," *J. R. Stat. Soc., vol. 23, no. 2, pp. 414–422, 1961*.

[5] GreenOrbs: A Long-Term Kilo-Scale Wireless Sensor Network System in the Forest. [Online]. Available: http://www.greenorbs.org

[6] X. Jiang, J. Polastre, and D. Culler, "Perpetual environmentally powered sensor networks," in *Proc. IEEE 4th Int. Symp. Inf. Process. Sens. Netw.,*2005, pp. 463–468

[7] Siqi Li, *Member, IEEE, and Chunting Chris Mi, Fellow, IEEE*, "Wireless Power Transfer for Electric Vehicle Applications," VOL. 3, NO. 1, MARCH 2015.

[8] Wenzheng Xu, *Member, IEEE, Weifa Liang, Senior Member, IEEE, Xiaola Lin, and* Guoqiang Mao, *Senior Member, IEEE*, "Efficient Scheduling of Multiple Mobile Chargers for Wireless Sensor Networks" IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 65, NO. 9, SEPTEMBER 2016.

[9] L. Xie *et al., "On renewable sensor networks with wireless energy transfer:* The multi-node case," in *Proc. 9th IEEE Annu. Commun. Soc. Conf. Sens., Mesh Ad Hoc Commun. Netw., 2012, pp. 10–18.*

[10] M. Zhao, J. Li, and Y. Yang, "Joint mobile energy replenishment and data gathering in wireless rechargeable sensor networks," in *Proc. IEEE 23rdInt. Teletraffic Congr., 2011, pp. 238–245.*