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WIRELESS POWER TRANSMISSION IN WIRELESS SENSOR NETWORK USING INDUCTIVE COUPLING

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Abstract— **The number of wireless sensor network deployments for real life applications has rapidly increased. Still, the energy problem remains one of the major barriers somehow preventing the complete exploitation of this technology. Sensor nodes are typically powered by batteries with a limited lifetime and, even when additional energy can be harvested from the external environment (e.g., through solar cells or piezo-electric mechanisms), it remains a limited resource to be consumed judiciously. All sensors present in wireless sensor network are battery operated devices which have limited battery power. After the deployment of sensor devices it is impossible to replace each and every battery present in the network. To make wireless sensor network always active, a wireless power transmission method is used. Wireless power transfer is nothing but transferring the power from source to destination without use of wires. Why we are going to wireless power transfer (WPT) it provide reliable power transmission and low maintenance cost. There are 3 major types of wireless power transfer are Short range (Inductive coupling), Medium range (Resonant coupling), long range (Microwave power transfer). It is cheap and efficient. The faults which are occurred by the wired transmission can be avoided by this wireless transfer .It is eco-friendly which is the major necessity today. Also we can avoid the problem of e-waste. Just imagine the future with wireless electricity, where there will be no need of cables and transmission lines. In this paper we are considering about the wireless power transmission using inductive coupling method.**

Keywords- Wireless Sensor Network (WSN), Inductive coupling, Microwave power transmission, Resonance, Tesla theory, Wireless Power Transmission.

I. INTRODUCTION

A sensor network is comprised of a number of low-power devices with sensing and computing capability. In many sensor network systems, the power supply for the network nodes is usually a deplorable power source, such as batteries. Wireless Power Transmission (WPT) is the efficient transmission of electric power from one point to another trough vacuum or an atmosphere without the use of wire or any other substance. This can be used for applications where either an instantaneous amount or a continuous delivery of energy is needed, but where conventional wires are unaffordable, inconvenient, expensive, hazardous, unwanted or impossible. The power can be transmitted using Inductive coupling for short range, Resonant Induction for mid-range and Electromagnetic wave power transfer for high range. WPT is a technology that can transport power to locations, which are otherwise not possible or impractical to reach. Charging low power devices and eventually mid power devices by means of inductive coupling could be the next big thing.

The objective of this project is to design and construct a method to transmit wireless electrical power through space and charge a designated low power device. The system will work by using resonant coils to transmit power from an AC line to a resistive load. Investigation of various geometrical and physical form factors evaluated in order to increase coupling between transmitter and receiver. A success in doing so would eliminate the use of cables in the charging process thus making it simpler and easier to charge a low power device. It would also ensure the safety of the device since it would eliminate the risk of short circuit. The objective also includes the prospect of charging multiple low power devices simultaneously using a single source which would use a single power outlet.

II.WIRELESS SENSOR NETWORK

Wireless Sensor Networks (WSNs) can be defined as a self-configured and infrastructure less wireless networks to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants and to cooperatively pass their data through the network to a main location or sink where the data can be observed and analysed. A sink or base station acts like an interface between users and the network. One can retrieve required information from the network by injecting queries and gathering results from the sink. Typically a wireless sensor network contains hundreds of thousands of sensor nodes. The sensor nodes can communicate among themselves using radio signals.

A wireless sensor node is equipped with sensing and computing devices, radio transceivers and power components. The individual nodes in a wireless sensor network (WSN) are

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inherently resource constrained: they have limited processing speed, storage capacity, and communication bandwidth. After the sensor nodes are deployed, they are responsible for self-organizing an appropriate network infrastructure often with multi-hop communication with them. Then the onboard sensors start collecting information of interest.

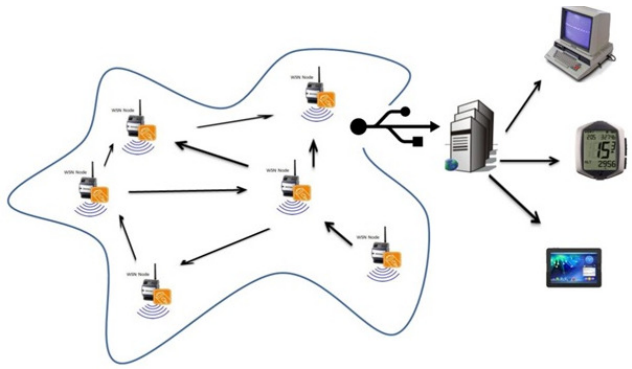

Figure: 1 Wireless sensor Network

Wireless sensor devices also respond to queries sent from a "control site" to perform specific instructions or provide sensing samples. The working mode of the sensor nodes may be either continuous or event driven. Global Positioning System (GPS) and local positioning algorithms can be used to obtain location and positioning information.

Applications of wireless sensor network

Wireless sensor networks have gained considerable popularity due to their flexibility in solving problems in different application domains and have the potential to change our lives Overview of Wireless Sensor Network 5 in many different ways. WSNs have been successfully applied in various application domains such as:

Military applications: Wireless sensor networks be likely an integral part of military command, control, communications, computing, intelligence, battlefield surveillance, reconnaissance and targeting systems.

Area monitoring: In area monitoring, the sensor nodes are deployed over a region where some phenomenon is to be monitored. When the sensors detect the event being monitored (heat, pressure etc), the event is reported to one of the base stations, which then takes appropriate action.

Transportation: Real-time traffic information is being collected by WSNs to later feed transportation models and alert drivers of congestion and traffic problems.

Health applications: Some of the health applications for sensor networks are supporting interfaces for the disabled, integrated patient monitoring, diagnostics, and drug administration in hospitals, tele-monitoring of human physiological data, and tracking & monitoring doctors or patients inside a hospital.

Environmental sensing: The term Environmental Sensor Networks has developed to cover many applications of WSNs to earth science research. This includes sensing volcanoes, oceans, glaciers, forests etc. Some other major areas are listed below:

- Air pollution monitoring
- Forest fires detection
- Greenhouse monitoring
- Landslide detection

Structural monitoring: Wireless sensors can be utilized to monitor the movement within buildings and infrastructure such as bridges, flyovers, embankments, tunnels etc enabling Engineering practices to monitor assets remotely without the need for costly site visits.

Industrial monitoring: Wireless sensor networks have been developed for machinery condition-based maintenance (CBM) as they offer significant cost savings and enable new functionalities. In wired systems, the installation of enough sensors is often limited by the cost of wiring.

Agricultural sector: using a wireless network frees the farmer from the maintenance of wiring in a difficult environment. Irrigation automation enables more efficient water use and reduces waste.

III.TYPES OF WIRELESS POWER TRANSFER

There are three types of wireless transmission of power based on the distance

- Short Range- Inductive Coupling
- Mid Range- Resonant Inductive Coupling
- Large Range- Microwave Power Transmission

1. Inductive Coupling

Inductive or Magnetic coupling works on the principle of electromagnetism. When a wire is proximity to a magnetic field, it generates a magnetic field in that wire. Transferring energy between wires through magnetic fields is inductive coupling.

If a portion of the magnetic flux established by one circuit interlinks with the second circuit, then two circuits are coupled magnetically and the energy may be transferred from one circuit to the another circuit. This energy transfer is performed by the transfer of the magnetic field which is common to the both circuits. In electrical engineering, two conductors are referred to as mutual-inductively coupled or magnetically coupled when they are configured such that change in current flow through one wire induces a voltage across the end of the other wire through electromagnetic induction. The amount of inductive coupling between two conductors is measured by their mutual inductance.

1.1 Inductive Charging

Inductive charging uses the electromagnetic field to transfer energy between two objects. A charging station sends energy through inductive coupling to an electrical device, which stores the energy in the batteries. Because there is a

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small gap between the two coils, inductive charging is one kind of short- distance wireless energy transfer.

Induction chargers typically use an induction coil to create an alternating electromagnetic field from within a charging base station, and a second induction coil in the portable device takes power from the electromagnetic field and converts it back into electrical current to charge the battery. The two induction coils in proximity combine to form an electrical transformer. Greater distances can be achieved when the inductive charging system uses resonant inductive coupling.

2. Resonant Inductive Coupling

The capacitor and inductor to form the resonator. The capacitor act as a electric field and inductor act as a magnetic field. Capacitor is connected parallel the coil. Resonance makes two objects interact very strongly. The power transmission is done only when the resonance condition satisfied. Resonance is the phenomenon in which the reactance of the capacitance and the inductance should be equal.

3. Microwave Power Transmission

This is the long range power transmission. The power can be transmitted to a long distance up to kilometers. There are three steps involved in thus method. First one is electrical energy is converted to microwave energy. Then the microwave is captured using rectanna. Then the microwave is converted into electrical energy. Ac cannot be directly converted to microwave energy. Ac is converted to dc. Then the dc is converted to microwave using magnetron.

IV.WORKNG PRINCIPLE:

Witricity works on the principle of mutual inductance between two coils. The transmitter coil is connected to the ac supply and the receiver coil is connected to the load or batteries. When the power is switched on the transmitter coil is to convert electricity into magnetic field which is oscillating at particular frequency. Then the second coil at the receiver end to convert magnetic field into electricity.
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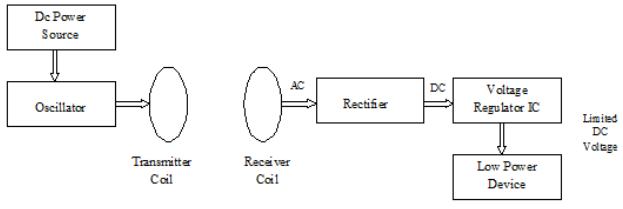

Figure: 2 Inductive Coupling

The power can be transferred from transmitter coil to receiver coil due to faraday of electromagnetic induction. The current entering at one end and leaving at another end of coil is determined by dot rule. The number of turns in the primary and secondary winding is may be equal.

V. WITRICITY IN WIRELESS SENSOR NETWORK

The wireless sensor networks consist of multiple nodes in same area but different locations, so we need to have only one source coil and many receiver coil. The source coil is connected to the power supply. The source coil gets energized and then the electromagnetic field is created in the source coil.

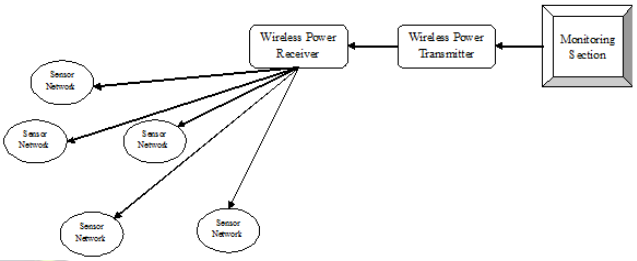

Figure: 3 Wireless power transmissions in WSN

The receiver coil receives the magnetic wave and it induces the electric power in the receiver coil. The power flow is not only in a unidirectional it is a Omni directional.

VI. RESULTS AND CONCLUSION:

Here the mat- lab results shows that when there is increase in distance the charging current will be reduced. The achievable efficiency for inductive transmission structures with varying distance and size. As a conclusion inductive power transmission in a large space is very inefficient. On the other hand inductive power transmission at a surface can be efficient as conventional power suplies

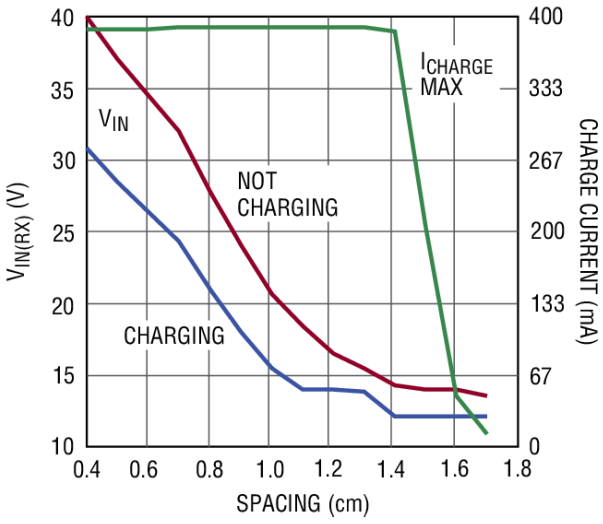

Figure: 4 Wireless Charge Current Vs Spacing

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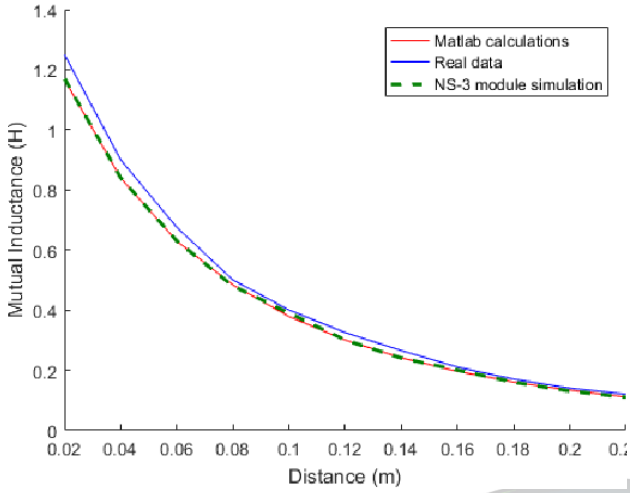

Figure: 5 Mutual Inductance Vs Distance

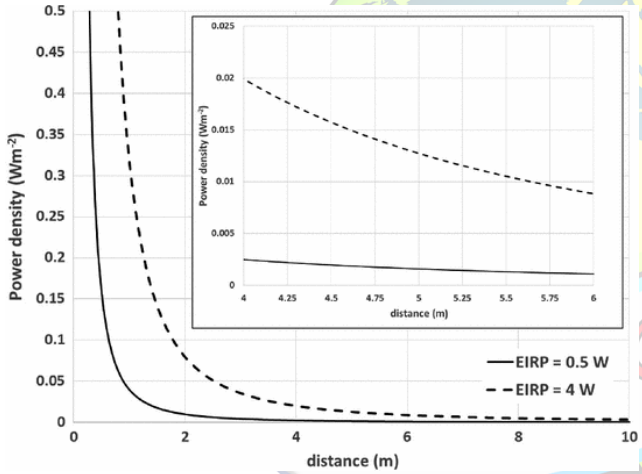

Figure: 6 Power Density Vs Distance

VII. LIMITATIONS

Wireless power transmission must satisfy certain condition like resonance if the condition is not satisfied there is no power transmission take place .There is a loss of power transmission if there is a strong Ferro magnetic substance. In wireless power transmission the initial cost is high. It requires standard material to avoid over heating problem. The power can be transmitted only over a certain distance.

REFERENCES

[1] An article published in the Science Magazine as "Wireless Power Transfer via Strongly Coupled Magnetic Resonance" by Andre kurs, Science 317,83(2007)
[2] Wireless Electricity Generation and Transmission: A Focus on TeslaCoil, haldia institute of technology.
[3] M. Dionigi and M. Mongiardo, "CAD of Efficient Wireless Power Transmission systems," Microwave Symposium Digest (MTT), IEEE MTT-S Int., Jun. 2011, pp.1-4.
[4] S. Cheon et al., "Circuit-Model-Based Analysis of a Wireless Energy Transfer System via Coupled Magnetic Resonances," IEEE Trans.Ind.Electron., vol. 58, no. 7, pp. 2906-2914, Jul. 2011.
[5] Ren,v-j;li,,chang-k,"3.5ghz rectifying antenna for wireless power transmission," IEEE Transactions on electronic letters,vol.43,pp.602-603,29may,2007.
[6] Tesla, Nikola, "The True Wireless". Electrical Experimenter, May 1919
[7] A. Kurs et al., "Wireless Power Transfer via Strongly Coupled Magnetic Resonances" in Science 317 (5834), 83. 6 July 2007. [5] B. Wells, U.S patent 6,972,543
[8] K. Finkenzeller. RFID Handbook: Fundamentals and Applications in Contactless Smart
Cards and Identification. Wiley, 2003.
[9] J. Jewett and R. Serway. Physics for scientists and engineers with modern physics. pg 840
Brooks/Cole, 2007.
[10] P. Sample, T. Meyer, J. Smith, "Analysis, Experimental Results, and Range Adaptation of Magnetically Coupled Resonators for Wireless Power Transfer," Industrial Electronics, IEEE Transactions on , vol.PP, no.99, pp.1-1, 0 doi: 10.1109/TIE.2010.2046002
[11] Paul Horowitz and Winfield Hill, The Art of Electronics, 2nd Ed. Cambridge, England: Cambridge Univ. Press, 1989.
[12] D. Chattopadhyay, Electronics (fundamentals And Applications) 7th Ed. New Dehli, India: New Age Pub., 2006.
[13] W. C. Brown (1996, January). The History of Wireless Power Transmission: Solar energy [Online] Available: http://www.sciencedirect.com/science/article/pii/0038092X9500080B
[14] Dr. Morris Kesler (2013) Highly Resonant Wireless Power Transfer: Safe, Efficient, and over Distance [Online] Available: http://www.witricity.com/assets/highly-resonant-power-transferkesler-witricity-2013.pdf