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Wireless Power Transmission to Multiple Devices

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ABSTRACT

This project work deals with wireless energy subject. Wireless power transfer or wireless energy transmission is the transmission of electrical power from a power source to a consuming device without using discrete manmade conductors. It is a generic term that refers to a number of different power transmission technologies that use time-varying electro-magnetic field. Wireless transmission is useful to power electrical devices in cases where interconnecting wires are inconvenient, hazardous, or are not possible. In wireless power transfer, a transmitter device connected to a power source, such as the mains power line, transmits power by electromagnetic fields across the space to one or more receiver devices, where it is converted back to electric power and utilized.

In general, the efficiency of wireless power system will be very poor because of generating huge electro-magnetic field. To generate such a huge field, lot of current must be pumped in to the energy transmitting coil, where as power receiving coil may not receive all the energy that is induced in the power transmitting coil. Depending up on the distance between the two coils, some of its energy will be received by the secondary coil. If the secondary coil is kept very close to the primary coil, more than 70% energy can be captured by the secondary coil. As the distance is increased, accordingly power losses also will be increased.

So here the wireless power transmission concept is designed to operate multiple devices individually. The devices connected here for demonstration purpose are mobile charging, LED light and a DC motor. As the concept is designed a proto type module, the wireless power is not sufficient to operate all the devices at a time. So the loads are demonstrated to operate one at a time individually. If there's one bit of transformational technology in the mobile world today, it is wireless charging. Just as the world got a hang of using micro USB to charge everything and anything excluding Apple, the next best thing came along which is the wireless charging.

Wireless energy works on the principle of electromagnetic induction. Coils of wire in the transmitter (coil) create a magnetic field as the current passes through. This field can induce an electrical current in an adjacent coil of wire without actually touching it. If this wire is part of a battery charging circuit, then you have wireless charging or it can be connected to any device to operate it directly.

KEYWORDS: *wireless transmitter, wireless receiver, microcontroller, regulated power supply*

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INTRODUCTION

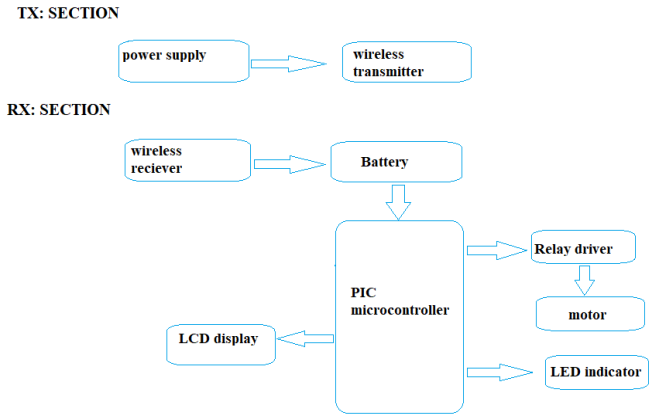
This amazing project work falls under the subject of wireless energy, which creates electromagnetic field by which energy will be transferred from one coil to another coil without any conducting wires. The power transmitting coil as well as power receiving coil both must be arranged parallel to each other at certain distance. Depending up on the power source, power transmitting range can be increased to a maximum distance of 4 to 5 centimeters. As any normal charging pad thickness will not be more than 0.5 to 1 cm's, this kind of free wireless energy sources can be utilized without wiring. Since it is a prototype module, here low power transmitter is designed and hence the range will be less than 3.5 to 4 cm.

Since this project work proves basic theory of wireless energy source by incorporating Electromagnetic field coils, little energy is transmitted to a distance of nearly 4 – 5 cm's. During our trail runs, we found that around 120 milli amps current is obtained at a source voltage of 5 approximately. With this low voltage and low current it is difficult to charge the mobile battery quickly as it also depends on the mAh value of the battery. So in the project time is not the consideration but to charge the mobile phone wirelessly.

Wireless Charging provides a convenient, safe, and reliable way to charge and power millions of electrical devices at home, in the workplace and in industry. By eliminating the use of physical connectors and cables, wireless charging provides a number of efficiency, cost and safety advantages over the traditional charging cable.

From smart phones, to hand-held industrial devices and heavy-duty equipment applications, wireless power maintains safe, continuous, and reliable transfer of power to ensure all varieties of devices and equipment are charged and ready to go at a moment's notice. The detailed functional description is provided in following chapter and the following are the important building blocks used in this system

BLOCK DIAGRAM



WIRELESS POWER TRANSFER

These techniques can transport energy longer distances but must be aimed at the receiver. Proposed applications for this type are solar power satellites, and wireless powered drone aircraft. An important issue associated with all wireless power systems is limiting the exposure of people and other living things to potentially injurious electromagnetic fields.

Wireless power transmission" is a collective term that refers to a number of different technologies for transmitting power by means of time-varying electromagnetic fields. The technologies, listed in the table below, differ in the distance over which they can transmit power efficiently, whether the transmitter must be aimed (directed) at the receiver, and in the type of electromagnetic energy they use: time varying electric fields, magnetic fields, radio waves, microwaves, or infrared or visible light waves

In general a wireless power system consists of a "transmitter" device connected to a source of power such as mains power lines, which converts the power to a time-varying electromagnetic field, and one or more "receiver" devices which receive the power and convert it back to DC or AC electric power which is consumed by an electrical load. In the transmitter the input power is converted to an oscillating electromagnetic field by some type of "antenna" device.

In 1897, Nikola Tesla discovered that he could transmit up to 20 MV or more power wirelessly. This was done by sending a signal into the upper stratosphere at a frequency of 925 Hz to distances thousands of miles away from the transmitter, as stated in his "System of Transmitting Electrical Energy" patent. Wireless power transfer (WPT) receivers are devices that can wirelessly transmit power to electrical devices. This is a proof of concept technology that paves the way for charging cell phones, laptops, and many other electronic devices wirelessly. Wireless power technology is in high demand because of its convenience to consumer and industrial marketplaces. The goal of the device prototype is to eventually cost less than $100.00

Inductive coupling

Energy transfer - due to Mutual Induction.

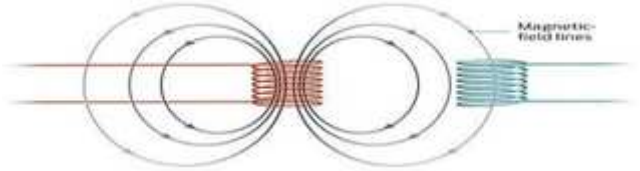


fig: 2.16 Inductive coupling

- Primary and secondary coils- not connected with wires. Transformer is also an example
- Energy transfer devices are usually air-cored
- Wireless Charging Pad(WCP),electric brushes are some examples
- On a WCP, the devices are to be kept, battery will be automatically charged.

Resonance Inductive Coupling (RIC)

Combination of inductive coupling and resonance Resonance makes two objects interact very strongly

- Coil provides the inductance
- Capacitor is connected parallel to the coil

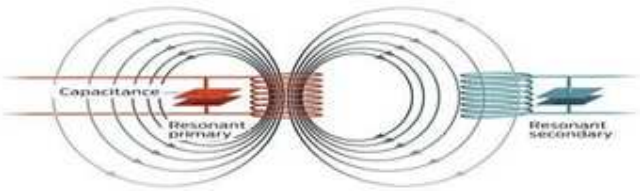


fig:2.17 Resonance Inductive Coupling

- Energy will be shifting back and forth between magnetic field surrounding the coil and electric field around the capacitor
- High resonant frequency

RIC vs. inductive coupling

- RIC is highly efficient
- RIC has much greater range than inductive coupling
- RIC is directional when compared to inductive coupling
- RIC can be one-to-many. But usually inductive coupling is one-to-one

WORKING:

Wireless power transmission (WPT) is an efficient way for the transmission of electric power from one point to another through air without the use of wire. By using WPT, power can be transmitted using inductive coupling for short range, resonant induction for mid-range. By using this technology, it is possible to supply power to places, where it is difficult to run conventional wires. Currently, the use of inductive coupling is an important subject and there by many scientists across the world are concentrating to develop efficient power transmitters.

Essentially wireless power transfer uses electromagnetic fields to safely transfer power from a transmitting source to a receiving device for the purposes of charging (or recharging) a battery. And as the name suggests, it does so without the use of a physical connection

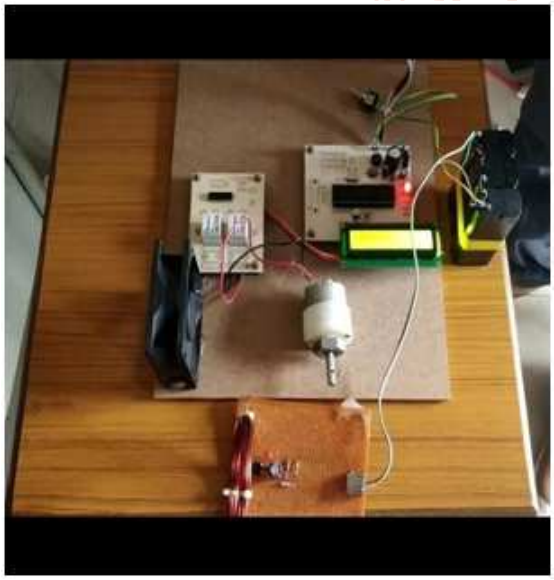
- Mains voltage is converted into high frequency alternating current (AC).
- The alternating current (AC) is sent to the transmitter coil by the transmitter circuit. The alternating current

then induces a time varying magnetic field in the transmitter coil.

- Alternating current flowing within the transmitter coil induces a magnetic field which extends to the receiver coil (when within a specified distance).
- The magnetic field generates current within the receiver coil of the device. The process whereby energy is transmitted between the transmitter and receiver coil is also referred to as magnetic or resonant coupling and is achieved by both coils resonating at the same frequency.
- Current flowing within the receiver coil is converted into direct current (DC) by the receiver circuit, which can then be used to operate the device

WORKING MODULE:

Transmitter section



Receiver section

RESULT:

Resonance promises the ability to charging more than one device at a time. How this is achieved from a technical point of view will depend on the coil geometry of the respective system, but nonetheless it provides an added convenience for larger transmitter surfaces such as table tops or work benches

CONCLUSION:

The project work Titled **"wireless power transmission to multiple devices"** is successfully designed & developed, the design, analysis and implementation of wireless power transmission for multiple devices have been discussed. There are few major functional benefits of using Resonant wireless power transfer systems compared to systems based on traditional magnetic induction. The first is the flexibility in the relative orientations of the source and device during operation. This flexibility widens the application space as well as it makes the system easier and more convenient to use. Secondly, a single source can be used to transfer energy to more than one device wirelessly, even when the devices have different power requirements.

The power rating of the system directly couples with magnetizing current which creates the alternating flux density. In the electromagnetic induction-type wireless power transmission, the magnetic field distribution according to the relative positions of the transmit and receive coils and the power transmission efficiency are very important. The results of HFSS simulations using the ECG sensor were compared with the actual measurement results. If the distance between the coils was maintained less than 2 cm, the voltage that the receive coil could deliver was more than 4.8 V, and the transmission efficiency was approximately 1.5%. Simulations showed that the transmission efficiency could be maintained relatively stable, regardless of the degree of alignment between the transmit and receive coils; the results were verified using an animal model. As the simulation results indicate there are three major facts directly involved with system efficiency.

They are the accuracy of the resonance frequency, the resonance mismatch between transmitter and the receiver and the coupling coefficient. Secondly, a single source can be used to transfer energy to more than one device wirelessly, even when the devices have different power requirements. These results provide enough evidence that there is a probable chance for the commercial development of wireless power transfer for some specified applications. The implementation of resonant inductive coupling wireless power transmission was presented by analyzing the technological developments

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