WIRELESS POWER TRANSMISSION

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Abstract - In recent days, Wireless Power Transfer (WPT) and harvesting energy received lots of attentions due to the necessity of having a flexible, suitable and secure source of energy. With the explosion of wireless technologies including wireless sensor network (WSN) like internet of things, such intelligent systems had highlighted this need. Wireless power transfer is a key technology to enable any device operation without replacing their batteries, often challenging due to cost of replacement and the difficulty to reach inaccessible areas. Anyhow wireless power transfer is being considered as eco-friendly. This also removes the need to dispose dead batteries. Inductive coupling can be used to charge the low power devices quickly and effectively without the help of wires. This method is done by using charging a resonant coil from AC and then transmitting subsequent power to the resistive load. In this case, oscillating circuit is used in the conversion of DC to AC in order to transmit the magnetic field by passing frequency and inducing the receiver coil. The system is designed and constructed as two parts. They are Transmitter part and Receiver part. To calculate the inductive coupling between the transmitter oil and receiver coil, Ampere's Law, Biot-Savart's Law and Faraday's Law are used as per the requirement.

Keywords - Rectenna, Microwave, Charging, Power transmission, Resonance, Current.

1. INTRODUCTION:

The main objective of their project is to develop a device for wireless power transfer. At first, the concept of wireless power transfer was evolved by Nikola Tesla. This can make a remarkable change in the field of the electrical engineering which eliminates the use of conventional copper cables and current carrying wires. This concept tells about the development of transferring power within a small range. It is built upon using an electronic circuit which converts AC 230V 50Hz to AC 12V, high frequency. The secondary coil develops voltage of HF 12 volts. The power transfer is done from the primary to the secondary within a distance of 5cm (approx). Then the transfer is seen as the primary transmits. The secondary receives the power to run load.

In the transmitter side AC to DC filter, HF inverter, HF transformer and primary copper coil is being used. The transmitter coil has 7 turns and the secondary one with 36 turns. The HF transformer is used to convert 230V 50Hz AC into 12V 25KHz AC. In the same way, in the receiver side, receiving coil, bridge rectifier, filter, voltage regulator and load is used. The rectifier is used to convert AC received by the secondary oil
into DC. The filtering is used to remove the unwanted AC ripples from the rectifier. To avoid the damage of the component the supply to the load should be regulated. Hence, LM7805 voltage regulator is used to regulate the voltage given to the load. This technique is able to use in many applications such as to charge a mobile phone, ipod, laptop battery, propeller clock etc

2. **EXISTING SYSTEM:**

The existing methodology for wireless power transfer is QI STANDARD. This method is used for low power applications by using an inductive coupling. In this method power transfer efficiency depends on quality factor of an induction coil, coupling coefficient, distance between transmitter and receiver, impact of core used for the coil. In wireless power transfer, according to coupling it is classified as near field and far field power transmission i.e Inductive and Magnetic resonance coupling respectively.

Qi Standard method is primarily used on inductive coupling where coupling between transmitter and receiver is short range. The power transferred from transmitter to receiver by exciting dc on a transmitter coil, it generates magnetic field which induces a voltage in receiver circuit. This voltage is used to charge any device or battery. In Qi standard, it can transfer low power of 5W, operating frequency lies between 100-200KHZ and distance between transmitter and receiver is 5mm.

In this method, the communication between transmission and receiver is done in the form of packets. This method is done in accordance with the Qi Standard. This communication process can be known as data structure. The power receiver uses to communicate a message to the power transmitter. The packet used here consists of a preamble, a header byte, a message and a checksum. After the transmitter is powered it sends analogy pings every 420ms to check the presence of receiver.

3. **PROPOSED SYSTEM:**

There is several wireless charging techniques. Two of them are OI WIRELESS CHARGING and A4WP WIRELESS CHARGING. The Qi Wireless Charging is used to transfer energy supply over a distance of 1.6 inches. It has two types Low Power and Medium Power. Low Power can deliver 0.5 watts power and frequency is about 110 to 205KHZ. It is mostly used in domestic portable devices like mobile phones, music players, and Bluetooth earpieces. High Power can deliver up to 120 Watts and frequency is about 80 to 300KHZ. It consists of two elements Base Station and Mobile Devices. Base Station provides wireless transmission using inductive power. It has a flat surface. The device is placed on the top of this surface. Mobile Devices consumes the transmitted power. It is used to charge the battery in mobile phones. If the coupling between transmitter and receiver is as high as possible then efficiency is as high as possible. If the device is placed on a particular position to charge is called GUIDED POSITION. If the device is placed at anywhere in a wide area by using multiple transmitter coils is called PLACEMENT ANYWHERE. A4WP Wireless Charging is used to deliver power over a large area in a wireless charging. It is unnecessary to place device in a particular position. By using single power transmitter it charge many devices at a time. It uses the same magnetic inductive technique using this we can charge devices with in the inductor ring. It also allows
the Z-axis charging placement i.e. the chargers can be built deeper into other objects. Some of features of Wireless Power Transfer is, it is used in high frequency range of 6.78MHZ. It avoids inductive heating using lower frequencies. CONTROL/MANAGEMENT PROTOCOL is uses a frequencies of 2.4GHZ ISM (Industrial Scientific and Medical) band. It is used in smart phones and other electronic items. POWER RECEIVING UNIT is used to transfer the power from transmitter to receiver.

INDUCTIVE POWER TRANSMISSION uses inductive coupling between two circuits. Its operation is similar to its name. It couple between transmitters to receiver by using inductive coupling. The transformer has 2 paths primary and secondary. Primary coil is in power source and Secondary coil is in batteries. Primary and Secondary circuits are coupled in inductive coils to increase the magnetic field. Inductive Power Transmission efficiency depends on Inductor size, Inductor shape, Distance between coils, Coil resistance.

![Block Diagram](image)

**Fig 2**: Block Diagram

3.1. **RECTIFIER:**
Rectifier is an electronic device. It convert alternating current to direct current. Bridge rectifier is essential for this method because it has good stability and it shows full wave rectification.

![DC Voltage Rectification](image)

**Fig 3**: DC Voltage Rectification

3.2. **HF TRANSFORMER:**
Transformer is an electrical device it transfer energy from one circuit to another by magnetic coupling. High frequency transformers transfer electric power with frequency 20 and 100KHZ. It is normally used in high voltage power transmission to transmit power over large distance. It is available in thumbnail sized coupling transformer in a microphone.
3.3. TRANSMITTER CIRCUIT:
In wireless power transfer transmitter or base station has either 12V or 19V DC that is given to the half bridge rectifier circuit which has two IGBTs to convert DC to AC. The AC effects the emf in primary coil in the secondary coil of magnetic induction.

3.4. RECEIVER CIRCUIT:
In receiver side AC to DC is connected. It convert DC-DC which convert regulated DC from unregulated. Proper regulated is involved in battery charger which act as bridge between wireless power receiver circuit and the battery of the device.

3.5. FILTERS:
Filters are used to remove unwanted frequency from the signal and allow wanted frequency. In this filters capacitance filter is very useful method. Because it is used in high voltage and low current power supplies.

3.6. VOLTAGE REGULATOR:
Voltage Regulator is automatically used to maintain a constant voltage level and it is also regulate one or more AC or DC voltages. It can protect from short circuiting the device. By using external components it
can adjust both current and voltage. It can produce 1A output current.

![Voltage regulator](Image)

**Fig 7: Voltage regulator**

4. **OPERATION:**

Transformer works on the basis of half bridge and double line frequency. Half bridge rectifier converts the given AC input signal into DC through resistor. During half cycle capacitor gets charged and Q1 starts conducting. Q1 transmitter is biased by the one of the feedback winding coil of the transformer. The current passes through the primary coil of capacitor to the ground. During another half cycle Q2 transistor starts conducting and it is biased by another feedback winding coil of the transformer. The current flows from the capacitor to the primary coil that is connected to the negative of the Q2 transistor. Thus in both half cycle the current direction is opposite and the biasing of transformer feedback winding is done automatically. So we don’t know which coil is biasing. In primary coil the current produced during both half cycles generate AC in secondary coil. It produces 25 KHz of frequency because the transistors are fast switching devices. This feeds to secondary of transformer through copper winding L1. By using EMF (principle of transformer) L1 transfers 25 KHz to L2. The voltage in L2 is connected to bridge rectifier and it converts into DC. It is filtered by electrolytic capacitor of 1000 micro farads. This DC voltage is regulated by a regulator of IC LM7805 to get 5volt constant. Again it is filtered through a capacitor of 10 micro farads. The output generated by the circuit is used for battery charging.

![WPT Circuit diagram](Image)

**Fig 8: WPT Circuit diagram**
5. ADVANTAGES:

1) Wireless Power Transfer gives the convenience of charging.
2) It is effective way to transfer power in any medium convenient.
3) It doesn't require bunch of wires.
4) It is eco-friendly and removes the need to dispose dead batteries.
5) It does not reproduce any sparkle and electric shock.
6) It is rust free, safe and effortless.
7) It has less consumption of electricity.
8) It is easy way to charge the device.

6. CONCLUSION:

As per the survey done on Automatic Wireless Charger by using an Inductive coupling method low power devices can be charged at a short distance (few CM). There are various types of methods to transfer power wirelessly that is Inductive coupling, Magnetic resonance coupling and Microwave with rectenna. Among all these methods Inductive coupling is one of the best methods to transfer power safely and efficiently. Inductive coupling emphasizes that by varying the magnetic flux between two inductive coils to transfer energy from the source to load. Inductive coupling is working under the principle of Electromagnetism, where magnetic flux from one coil interlinks the second coil. To transfer energy to moderate distance, “Resonance” is added in the inductive coupling. Resonance is where primary and secondary is operated at the same resonant frequency to transfer energy to moderate distances. This is achieved by the adding the resonant circuit in the primary and secondary side. The energy transfer is based on the range between primary and secondary coil, operating frequency and the amount of transmitted power.

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