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WIRELESS-POWER FOR AIMD'S

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ABSTRACT

We created a prototype of a device that can charge Active implantable medical devices (AIMDs) wirelessly. AIMDs mostly relies on no-rechargeable battery which are designed to last long. Like in case of pacemaker, it can last for 8 to 9 years than a surgery is needed to replace the battery. With the concept of wireless charging of AIMDs we can help the patient avoid a surgery.

I. INTRODUCTION

Currently medical science is developing at a very high pace but often there are some small problems that goes by over looked even by the experts in the field. One of such problem that we took to work on was charging the implanted devices wirelessly. AIMDs or Active implantable medical devices are devices that are implanted in patient's body and requires power to operate, for example pacemaker. Currently this device has battery inside them which can often last for 9 to 10 years but once they run out of power then they are needed to be replaced surgically. But imagine if we could recharge those batter without performing any kind of surgery on the patient's body. We were able to make a prototype of such device which was capable of transmitting and receiving power wirelessly even if there was a dense opaque blockage between the transmitter and the receiver. This device has huge potential in not only in medical but also in different type of applications, but AIMDs was our primary goal. This device uses a norm fluctuating magnetic field - where the frequency can be controlled by the user and not a beam of electromagnetic wave with high amplitude therefore it is not cancerogenic and there is no issue to use it inside a human body.

II. USES AND FUTURE POTENTIAL

Active implantable medical devices or AIMDs are devices that are implanted inside the body of patient and requires power to operate like for example - pacemakers, drug delivery pumps or neurostimulators are examples of AIMDs. AIMDs is the future of medical science. As our technology is developing, we are uncovering new method where we see that in near future, we might be replacing our failed organ with a mechanical organ or we might be implanting devices that assists the organ helping it to perform better. Implantation devices for brain that help with mental disorders is already here. If those devices don't find a way to transmit power wirelessly then with every implantation of those devices, we will increase crowd at hospitals as those patients will have to come back to the hospital to surgically replace their batteries after some interval of time every time their batteries run out of power. Our devices can easily solve this problem by charging those AIMDs wirelessly using fluctuating magnetic field. There are many possible methods of transmitting power wirelessly but we chose fluctuating magnetic field although it's range is less than the rest of the methods because - firstly unlike other methods which is cancerogenic in nature this method is very safe to use in patients body and secondly it is more cost efficient to build this devices. We can implement this technology in different field for different applications too, like charging electrical vehicle or charging cell phone or laptops etc.

III. ADVANTAGES OF WIRELESS POWER TRANSFER

- An electrical distribution system, based on this method would eliminate the need for an charging cable making working desks on offices more neat.
- System would help patient with Active implantable medical devices getting the coast down as replacement of battery is not required anymore.
- If done on large scale it will get rid of charging point for electric vehicles as the charger can simply be hidden under ground while charging vehicles wirelessly.
- When the technology reaches it's supreme state one single device will be charging multiple device wirelessly meters apart.
- It can charge many devices at once and the user don't have go through the process of connecting and disconnecting cables, hence saving our time.

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IV. WORKING PRINCIPAL

The prototype designed by our team can supply charge to any device wirelessly. the device takes 6 volts at 1 amp and can transfer that power wirelessly to any device around 1 foot away. This device can also be used with the Active implantable medical devices but the device which is to receive power will have to cover their components with metal cage so that the fluctuating magnetic field that carries the power don't interfere with the components and make it malfunction.

4.1. The prototype consists of two basic parts

•**1st part** – The device is taking low voltage (6v) and 1amp of Current but after passing it through the joule thief circuit the voltage is increase to a great extent. Then there is spark gap which is basically used for controlling the voltage of the primary coil, it also helps by providing some time to the capacitor to get charged. Once the capacitor is charged the charge is released as a spark.

The current passes through the primary coil and as the voltage is high the magnetic field is strong and the secondary coil – which is the device where the power is to be transmitted wirelessly, collects the energy by eddy current. So, it's like a transformer without a core, and the primary coil and secondary coil are free to move with respect to each other but only in a given range.

•**2nd part** – The second part of the prototype is the part which is used for receiving the energy. It simply consists of a coil which receives the power but depending on the requirement of the device a voltage converter can be used that will convert its incoming alternating current to direct current.

4.2. In-depth of the working

The device take input of 6 volt at 1-amp direct current then it provides that power to the Joule thief circuit, Joule thief circuit converts that low voltage DC to high voltage alternating current than a rectifier circuit is used to convert that high voltage AC to high voltage direct current. A capacitor is then used to store the current, now if we connect the primary coil directly then the capacitor will not get charged and the voltage across the coil will be low and as it connected to DC source the coil will not generate fluctuating magnetic field and hence no current will be received at secondary coil. Therefore, a spark gap is used in middle which allow the capacitor to get charged. Once the capacitor is charged enough that a spark can be made for the current to jump the air gap then a spark appears in the gap connecting the circuit. As there is some time gap between the sparks the coil can be said is receiving an alternating current and hence the coil can generate a fluctuating magnetic field. On the receiving end the current received is of high volt low amp the value varies depending on the distance between the emitter device and the receiving end. Now a basic power converter circuit can be used to convert that power to the required volt. There is some loss of power as the power was transmitted wirelessly but we have sent the power to a device were connecting a cable to charge the device was not an option.

4.3. Parts of the prototype

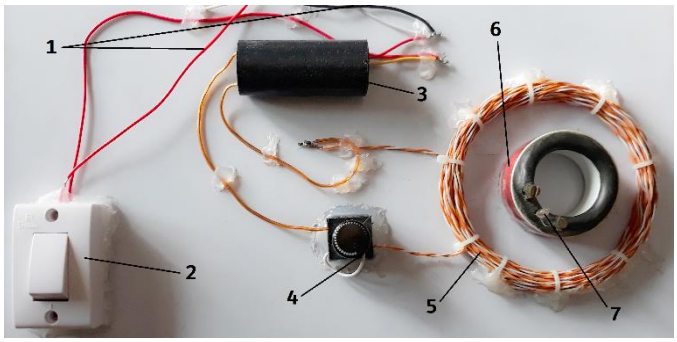

Fig. 1.Image of the prototype

- Part 1. Power Input – The two wire through which the power of 6 volt and 1 amp is supplied.
- Part 2. Switch – It is used for turning on or off the device.
- Part 3. Voltage Amplifier – It consists of a Joule thief circuit a rectifying circuit and a 2 microfarad 650v capacitor. The final voltage output is more than 650v as the final voltage that comes out depends on how much the capacitor got charged which in return depends on the air gap in the spark gap.

- Part 4. Spark Gap – The spark gap used here is a DIY adjustable spark gap. We can increase or decrease the gap between the terminals. If we increase the gap then the capacitor will have to get more charged to make a spark of that size and hence the voltage will be high but the frequency will drop and if we decrease the gap then the voltage will be low but the frequency will be high.
- Part 5. Primary Coil – This is the coil that receives the high voltage Alternating Current and makes a powerful fluctuating magnetic field.
- Part 6. Secondary Coil – This is the coil that receives its power from the primary coil via fluctuating magnetic field. The voltage on the terminal of this coil depends on the adjustment of the spark gap and its distance from the primary coil. But the voltage is usually very high, so to use it practically a circuit can be used that takes the high volt of the secondary coil passes it through a transformer to drop down its voltage and uses a rectifier to make it dc and capacitors to make the voltage more stable.
- Part 7. Lamp – A lamp is used here to demonstrate that the secondary coil is receiving power.

V. CONCLUSIONS

We designed a prototype of a device that is capable of transmitting and receiving power wirelessly via the help of fluctuating magnetic field. The power intake is DC in nature but the power received at the receiver's end is AC in nature so at receiver end a rectifier is needed. Once the power is rectified at recovers end then it can be used for many different types of applications like charging an implanted device in patient's body. This method is by far more superior than current method which requires the patient to change the battery of the implanted devices surgically. Apart from AIMDs this technology can also be used to create large benches where there is fluctuating magnetic fields all above it surface and user can charge their laptops and cellular devices just by putting them on the table.

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