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Near Field Inductive Wireless Charger Optimum Efficiency and Multi Level Device Charger

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Abstract: Wireless Power Transfer (WPT) is these days distinctive to us in a wide range of territories of innovation and in a wide range of structures and sorts. The innovative ranges fluctuate from the urgent biomedical innovation to consumer electronics, for example, electric vehicle, wireless charging units and many more. Wireless power transmission is helpful in circumstances where prompt or ceaseless exchange of power is alluring yet interconnecting wires are troublesome, unsafe. The wireless charging gets one of a kind in its range of innovation in view of its effectiveness which is the most vital parameter under thought. This makes the wireless charging exchange unique in relation to other data exchange techniques. Wireless power frameworks for near field energy transfer, are commonly delegated either inductive or resonant. The wireless power transmission outperforming productivity is the ideal method to transfer the power wirelessly and control up the low power gadgets, for example, Mobile telephones, little fans, and any microcontroller unit. The wireless power transfer technique incorporates a transmitter unit with a yield loop which exchanges power wirelessly to the recipient which will charge the low power gadgets with high efficiency.
Keywords: Wireless Power Transfer (WPT), Electromagnetic induction, near field energy transfer, voltage transfer efficiency, Inductive Wireless Power Transfer (IWPT), Resonant wireless power transfer (RWPT).

I. INTRODUCTION

Wireless Power Transfer (WPT) is a strategy to exchange the power without utilizing wires or conduits. It is for the most part valuable where exchange of power is unrealistic utilizing conductors. This technology mainly works on the principle of electromagnetic induction. Electromagnetic induction works on the principle of a primary coil generating a magnetic field which produces an attractive field and an optional loop being inside that field so a current is induced inside its coils. This results the comparatively short-range due to the amount of power required to generate an electromagnetic field.

Wireless power systems for near field energy transfer, are typically classified as either inductive or resonant. In an inductive wireless charging system, the primary coil and secondary coil of the system are not directly connected. In a wireless charging system, the effectiveness and the measure of energy transferred to the output are influenced by the source (i.e. transmitter) and load (i.e. receiver) impedances. The main downside of presently existing wireless power transfer systems for consumer applications are, amongst others, the comparatively low overall efficiency and the limited power transfer ability. This outcomes in long charging circumstances which hampers the boundless utilization of the wireless power exchange innovation. To overcome these problems, various improvements have been done in the proposed system.

There should be a charging solution to eliminate the need for the hazardous electrical wires, which needs a lot of efforts to organize them. This solution can provide us with the simplified way of charging the day to day usage electronic equipment. This solution can also provide us to travel with only one charging unit that charges our mobile phones, laptops, toothbrush, hair trimmer and many others simultaneously.

II. RELATED WORK

In the field of biomedical electronics, the implants with low-efficiency in WPT applications may cause discomfort and possible complications for the patients using it. This paper exhibits a shut frame logical answer for the ideal load that accomplishes the greatest conceivable power productivity. The reported power efficiency in such systems is between 30 to 50% [2].

Resonant wireless power transfer (RWPT), compared with conventional inductive power transfer, the frequency of RWPT is usually much higher. To cut down the frequency of resonance while sustaining the transfer efficiency constant at the same transfer distances, two solutions are proposed and realized in this paper. There are two methods of reducing the resonant frequency: increasing the inductance and increasing the capacitance. The condition of reducing the resonant frequency is to maintain similar transfer efficiency

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at the same distance. This paper states that, increasing the turn number of the resonant coils can effectively cut down the frequency of resonance and maintain similar transfer efficiency. A large turn number of the resonant coils also results in bulkiness and the advantage over the case of using the field-shaping technique is missing [3].

In [4] a wireless power receiver is developed which is capable of charging from either a Qi or a PMA or a proprietary resonant charger operating at 6.78 MHz power is converted though a single power path with no switches in the ac network. The overall size of the receiver is compatible with mobile phone requirements and comparable to commercial Qi solutions on the market today. It is fully self-powered, allowing charging from the dead-battery condition with no modifications to the mobile phone design. The circuits such as clock recovery circuit and buck regulator circuit makes these systems bulky and complex.

In [5] a synchronous rectifier is proposed with a simple control scheme and demonstrated that an implementation on an off-the-shelf and low-cost microcontroller is feasible. A calculation of the efficiency improvement was made based on a detailed circuit. The paper [6] portrays how roadway difficulties are being met and frameworks the issues that still exist and the arrangements designers are finding them. Inductive Power Transfer (IPT) includes the coupling of at least two loops: when coupled a current in one curl reasons an incited voltage in the other to power some application. Such power transfer is clean, unaffected by chemicals or dirt, and has the capacity to transform many engineering procedures. The biggest encounter for IPT systems today is carriage for both public and private vehicles on networks of railways and roadways in every country in the world. IPT offers the opportunity to power these vehicles electrically using electric wires under the ground to provide power, charge, and alignment means for cars, buses, and trains. This paper reviews the important fundamentals required to develop high-power IPT systems.

In [7] In this article, we present an emerging technology—inductive power transfer (IPT)—that holds the key to more convenient charging by means of contactless or wireless power transfer through induction. We review the fundamentals of the IPT technology and its history and also present some considerations for designing IPT systems for static and dynamic vehicle charging. In [8] the transmitter and receiver loops are arranged in conventional way. An AC current in the transmitter loop creates magnetic field, which prompts a voltage in the receiver loop used to control the load. Inductive power transmission in a bigger separation is extremely wasteful. Just low power levels, which are not helpful for customer applications like charging or enlightenment, can be transmitted without squandering critical measure of energy. Possible applications could be industrial, e.g. for sensors, which requires only low power.

III. PROPOSED SYSTEM

The system diagram of the project has been given in figure 1, for the Transmitter, Receiver. The Figure 2 explains the Arduino Mega 2560 interfacing block diagram. The Figure 1 indicates the proposed system, in the transmitter side the 230 V, 50 Hz ac signal is converted into 12 V at the frequency of 25 KHz.

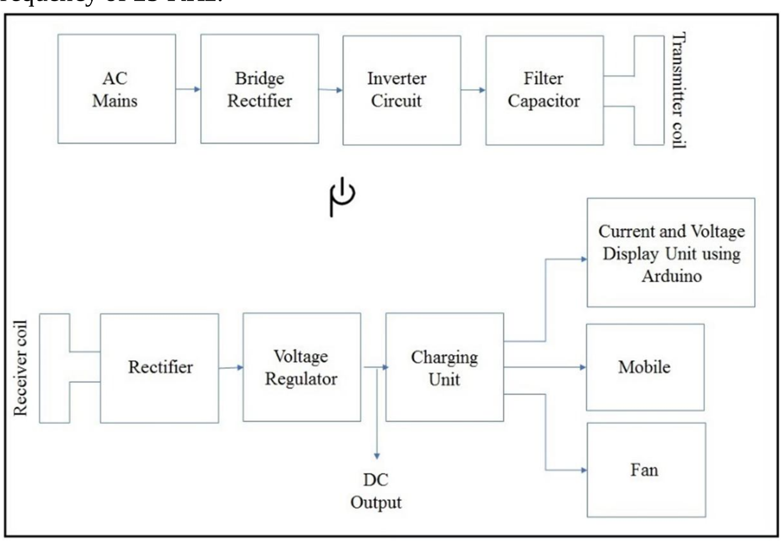

Fig. 1 System Block Diagram

An AC to AC converter is used that uses a Bridge rectifier for lowering down the 230 Volts signal, An Inverter circuit converts the Bridge output is given to a pair of transistors, which is a self-oscillating circuit where the two transistors are driving in differing phase by feedback from the output circuit. Finally, the filter capacitor smoothens out the inverter output signal.

A transmitting coil has an AC flowing through it generating magnetic field perpendicular to the flow of current. Thus, when another coil is placed in its vicinity, it will induce current in another coil. The transmitter to receiver coil turns ratio is kept at 1:3.

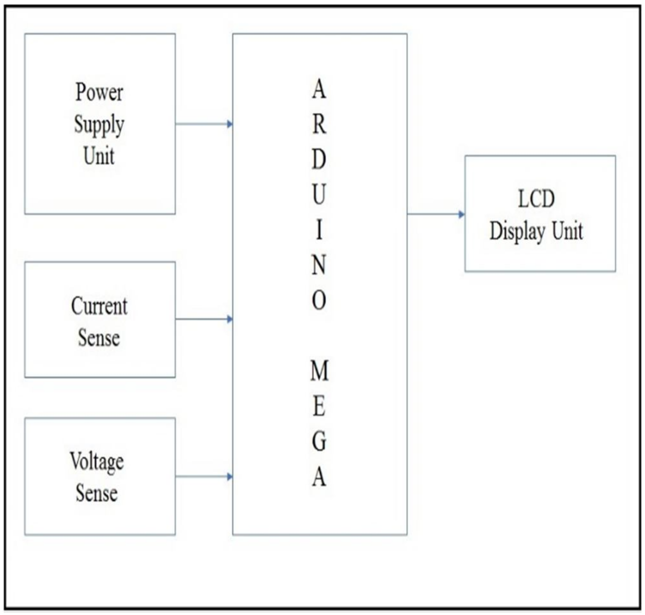

Fig. 2 Arduino Interfacing Block Diagram

After the current flow is established in the receiving coil, the proper current conversion circuits such as rectifier and voltage regulators are used to obtain a smooth output. This current will be the DC current which will be used to power the mobile phone, Microcontroller unit and low power fan.

IV. RESULTS AND DISCUSSION

This section describes the Electrical parameters of the system, pictorial view of the implemented system where the fan module, smartphone and Arduino module is working fine as per the proposed concept. This section also has a graphical representation of the voltages measured at different distances of the transmitter and receiver coils.

TABLE I
Electrical Parameter Obtained Result

Parameter	Value
Input Voltage (Transmitter Coil)	230 V
Input Frequency (Transmitter Coil)	50 Hz
Output Voltage (Transmitting Coil)	12 V
Output Frequency (Transmitting Coil)	25 KHz
Input Voltage (Receiver Coil)	40 V
Output current	450 mA
Voltages Taken for Output Application	12 V, 5 V

The Following shown figure 3, figure 4 and figure 5, shows the implementation of the proposed concept.

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Fig. 3 Wireless Power Transfer for Fan

Figure 3 shows the wireless power transfer for fan module; a 12 V DC fan is used here. The figure shows the ON State of the DC Fan. The Figure 4 shows the implementation of wireless power transfer for mobile phones. The figure 5 below shows the implementation for the wireless power transfer for microcontroller unit.

Fig. 4 Wireless Power Transfer for Mobile

Where, the Current and the Voltage is displayed on the LCD Module in ON State, refer figure 5 (a).

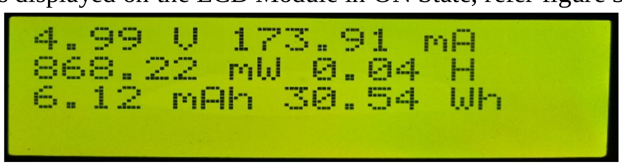

Fig. 5 (a) The Voltage and Current Display at the micro- controller side

The figure above explains that the voltage given from the output of the voltage regulator is given to the analog pin A0 of Arduino. Thus, it is displaying 4.99 V and current here increases upto 450 mA. The current value is obtained from the current sensor from Pin A1 in Arduino board. The Wattage, Ampere Hour (mAH) and Watt Hour (WH) values are calculated from the voltage and current values thus displaying respectively.

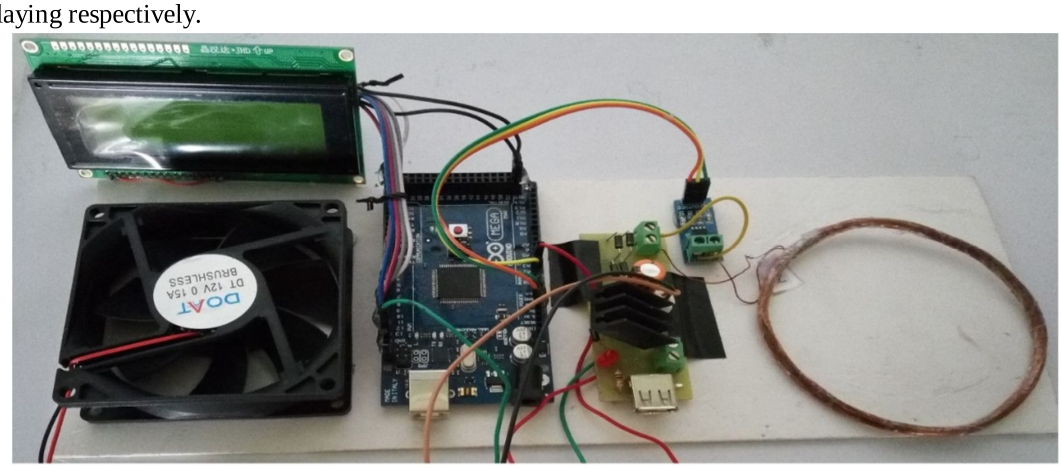

Fig. 5 (b) Wireless Power Transfer for micro-controller Unit

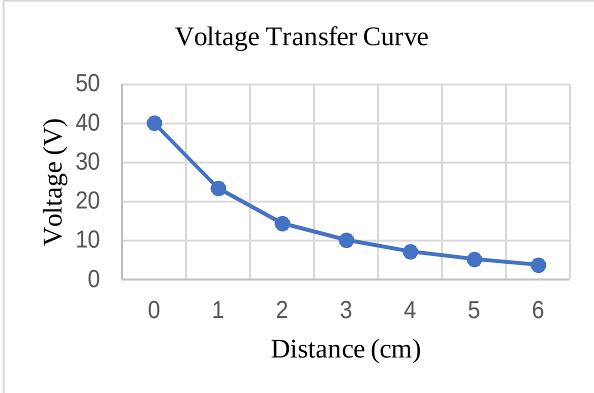

Fig. 6: Voltages obtained at various distance’s.

Figure 6 represents the voltage transfer efficiency at different distances. The proposed system gives efficiency more than 100 % and charges devices at two different voltage levels one at a time.

V. CONCLUSION

Wireless power transfer is a method of transferring the power wirelessly. This idea eliminates the need of wires and chargers for each electronic device. The proposed wireless power transfer system, consisting of the microcontroller unit with the voltage and current sensing circuits interfaced, has been successfully implemented providing a general solution for low power devices. The proposed system works on the inductive power transfer method allows to implement a very simple design with low cost. The system was able to charge the mobile at the distance up to 5 cm. Here, the successful implementation of the three modules, that are, DC Fan, Mobile Phone, Microcontroller unit has been done. This system can charge devices with different voltage levels i.e at 5V and at 12 V.

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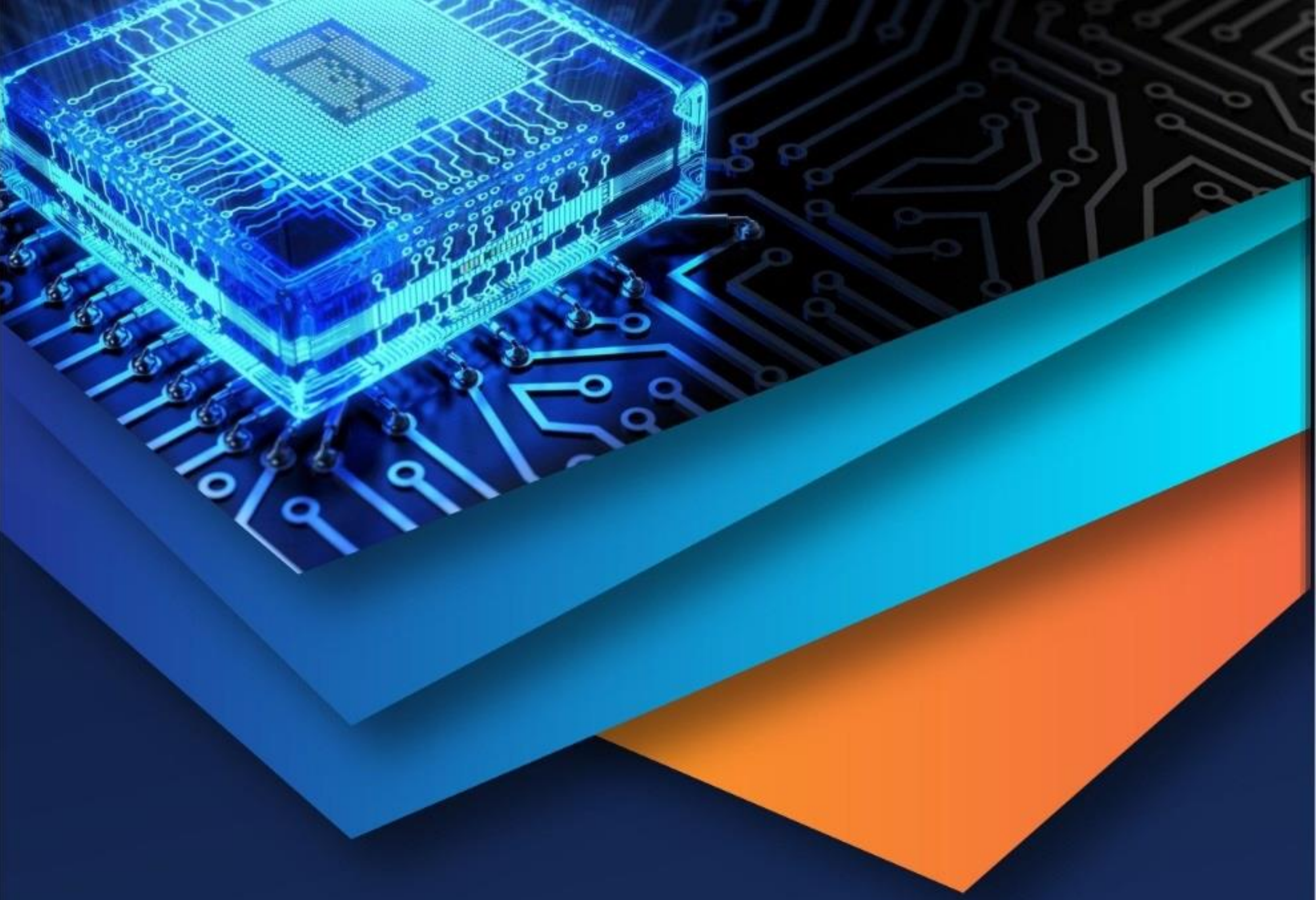

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