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Multimode Operation of Bidirectional Wireless Electric Vehicle Charging Station

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ABSTRACT: As the use of electric vehicles increases nowadays, simultaneously there is a demand for charging stations also get increases. In this paper we proposed an advanced wireless charging technology which is employed to charge the vehicle wirelessly using inductive coupling method, the aim of this system to get the electric vehicle charged wirelessly in multimode operations of input power sources with bidirectional charging facilities. The power source of the charging station will be available in three forms solar (PV) source, Ac Supply and DC Generator. The input sources are monitored continuously with the help of voltage sensing unit, and periodic operation of input source as solar, AC (grid), diesel generator if solar source is available our system automatically switch into solar if solar source is not available it will automatically switch over to AC (grid) like vice versa to DG. By this method we can save energy and also, we can guarantee the availability of the input source all time. On additional feature a bidirectional charging was proposed which get charged and it will give charge to other vehicle in bidirectional method. All we have to do now is park the electric vehicle in the charging station.

KEYWORDS: Electric vehicle, Charging station, Wireless power transfer (WPT), Solar, Grid, Diesel generator (DG), bidirectional.

I.INTRODUCTION

Wireless Power Transfer (WPT) is a potential technology for wirelessly transmitting electric energy from a transmitter to a receiver. Due to its numerous advantages over wired connections, WPT is a popular choice for many industrial applications. The advantages include the elimination of wires, ease of charging, and power transmission that is smooth even under adverse conditions. Nicola Tesla first proposed the concept of wireless power transmission (WPT) near the end of the nineteenth century. He created a wireless lighting bulb that received electrical energy via wireless transmission. Tesla employed two metal plates that were in close proximity to one another. The bulb was turned on by passing high-frequency Alternative Current (AC) potentials between these two plates. However, while adopting WPT technology, several complications arose. One of the key concerns is that when distances rise, the minimal power density and low transfer efficiencies have an impact. As a result, WPT technology has been upgraded, and "strong coupled" coils are now employed while charging wirelessly at a distance of more than 2 m. There are two main types of WPT technologies, Inductive Power Transfer (IPT) and Capacitive Power Transfer (CPT). In this system inductive power transfer is used.

INDUCTIVE POWER TRANSFER: Faraday's law of induction is the foundation of IPT. The mutual induction of magnetic fields between the transmitter and receiver coils is used to enable wireless power transmission. When the main AC supply is connected to the transmitter coil, an AC magnetic field is created that passes through the reception coil, moving electrons in the receiving coil and causing AC power output. To charge the EV's energy storage system, this AC output is rectified and filtered. Frequency, mutual inductance, and the distance between the transmitter and receiver coils all influence the amount of power delivered. IWC's operating frequency ranges from 19 to 50 kHz.

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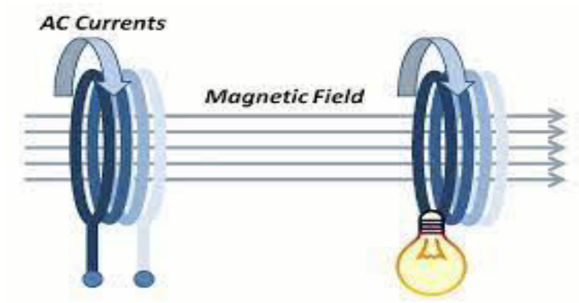

Figure 1: Inductive Power Transfer

II.PREVAILING SYSTEM

At present electrical vehicles are being launched with semiconductive charging i.e., wired charging. Semiconductive charging by cable consists of manually connecting a conductor between the charging station and the electric vehicle. Looking on the dimensions of the cable, the present flows through this wired affiliation, permitting terribly high charging capacities. During this technique we have a tendency to face heap of difficulties just like the charging cords were totally different model it's going to not fix to all or any kind of vehicles and differing types of voltage outputs, collectively it's too heavy to keep up the charging station and overpriced too.

DISADVANTAGES:
1. At present electrical vehicles are being launched with semi conductive charging i.e., wired charging.
2. Semi conductive charging by cable consists of manually connecting a conductor between the charging station and also the vehicle.
3. Looking on the dimensions of the cable, the present flows through this wired affiliation, permitting terribly high charging capacities.

III.EFFICIENT COMMUNICATION

In our planned technique we tend to introduced a wireless power transfer technology that is an increased version of smartphone charging with many variations. Wireless power charging permits an electrical vehicle [EV] to charge without the necessity of cables. In addition to it multimode input sources with bidirectional charging were planned. Multimode input consisting of Solar PV, AC (grid) and DG that are connected with relay unitand output power of all supplies are going to be monitored using the voltage sensors and the available best source of energy is going to be utilized and provide continuous power source to the charging station. On further there to a bidirectional wireless charger was designed that has capable of reverse charging in figure 2 its clearly mentioned.

ADVANTAGES:
1. Efficient utilization of accessible energy source
2. Eco Friendly – inexperienced Energy.
3.Wireless Technology which is simple to use.
4.Reduce the risk of shock.

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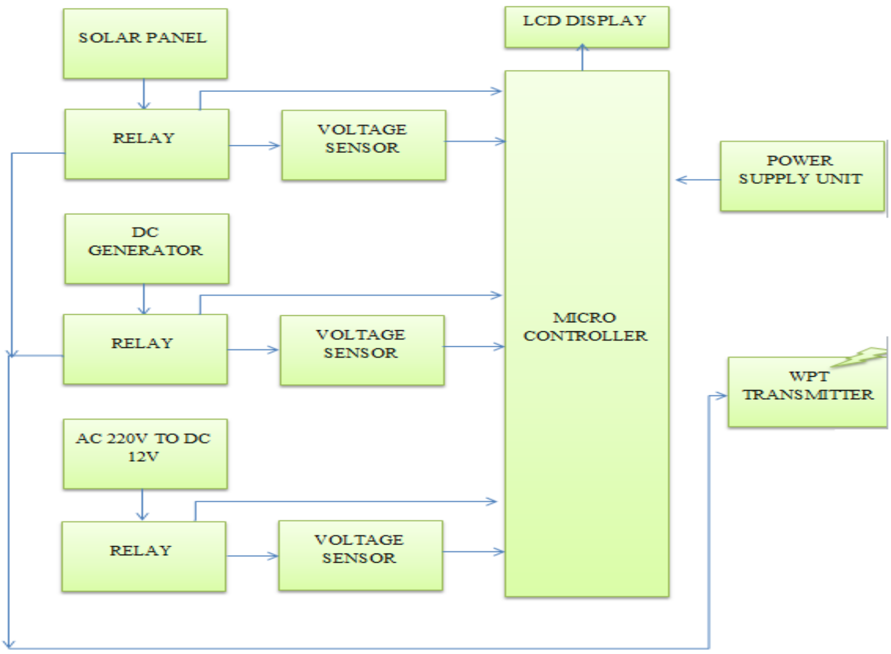

Figure 2: Proposed System Block Diagram – Multimode WPT Transfer

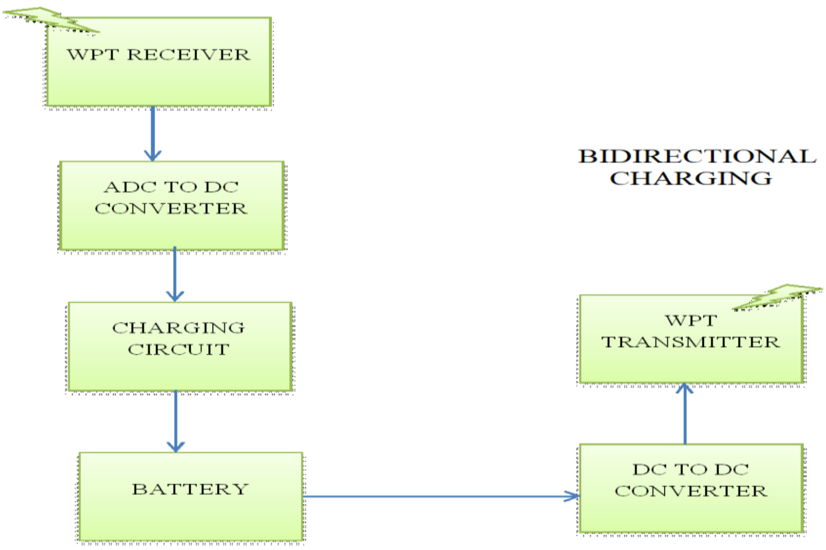

Figure 3: Proposed System Block Diagram – Multimode WPT Receiver

IV.HARDWARE AND SOFTWARE DESCRIPTIONS

COMPONENTS USED:

1.Arduino Uno (Microcontroller-ATmega328P).
2.Relay Modules (5V, 10A 2-Channel, Controlled directly with 3.3V or 5V logic signals).
3.Infrared sensor module.
4.Transformer (230/12 V, 0.5 A, Stepdown).
5.LCD Display.

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6.Dc to Dc Boost Converter Power Module (XL6009 module).
7.Potentiometers (10K ohms).
8.Wireless Power Transfer Coils (Model: XKT-412).
9.Solar Panel (6Watts panel).
10.Batteries (li-ion, lead acid).

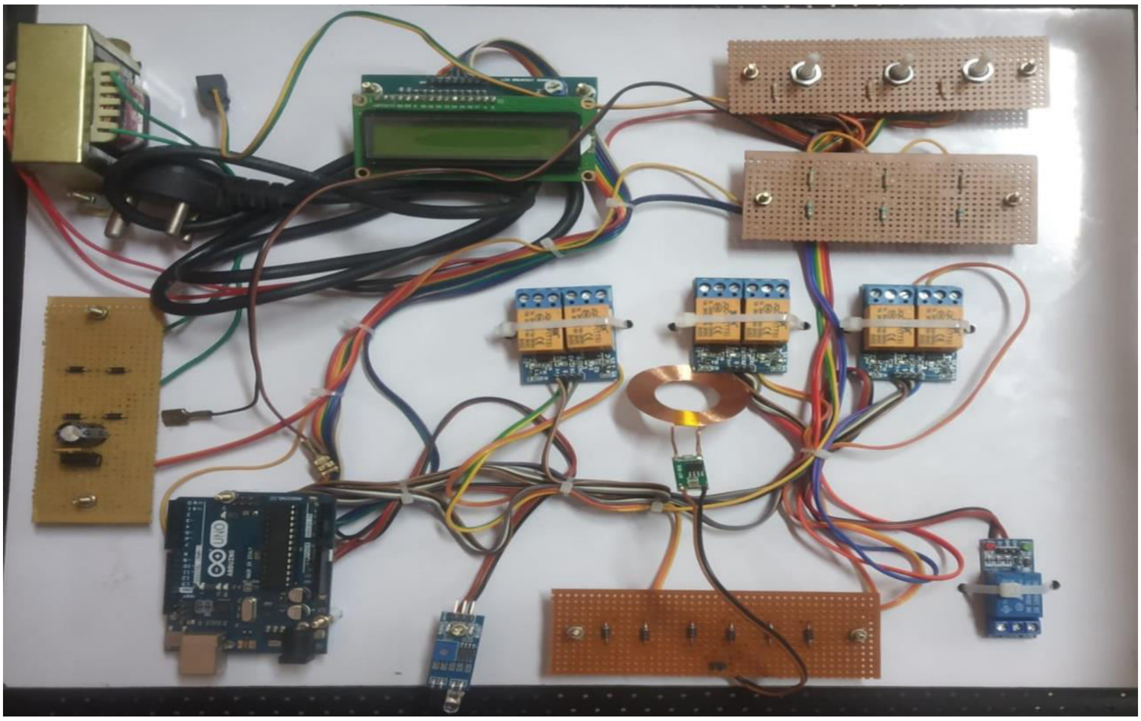

Figure 4: Hardware setup transmitting end.

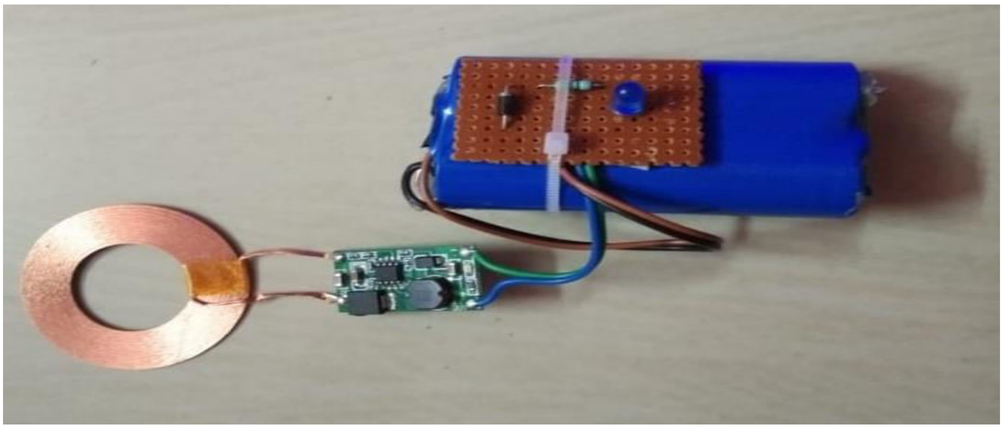

Figure 5: Receiver end coil at EV1

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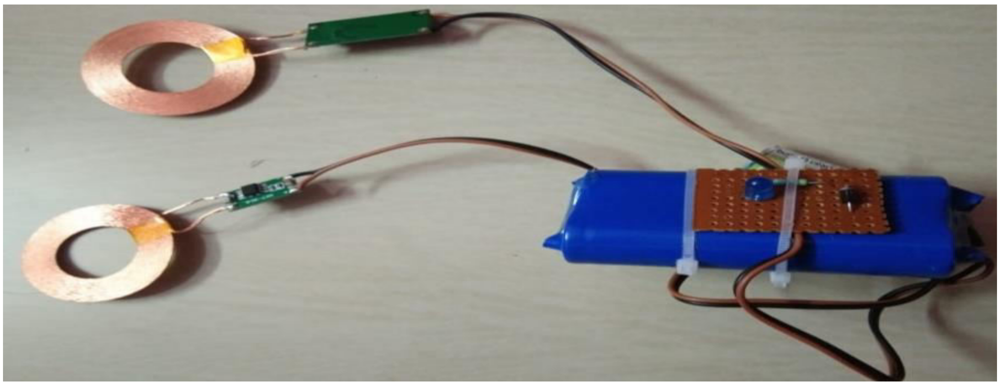

Figure 6: Bidirectional power transfer circuit at EV2 (v to v)

SOFTWARE DESCRIPTIONS: Development platform used - Arduino IDE
Programming language used- Embedded C

V. MATLAB SIMULATION & RESULTS

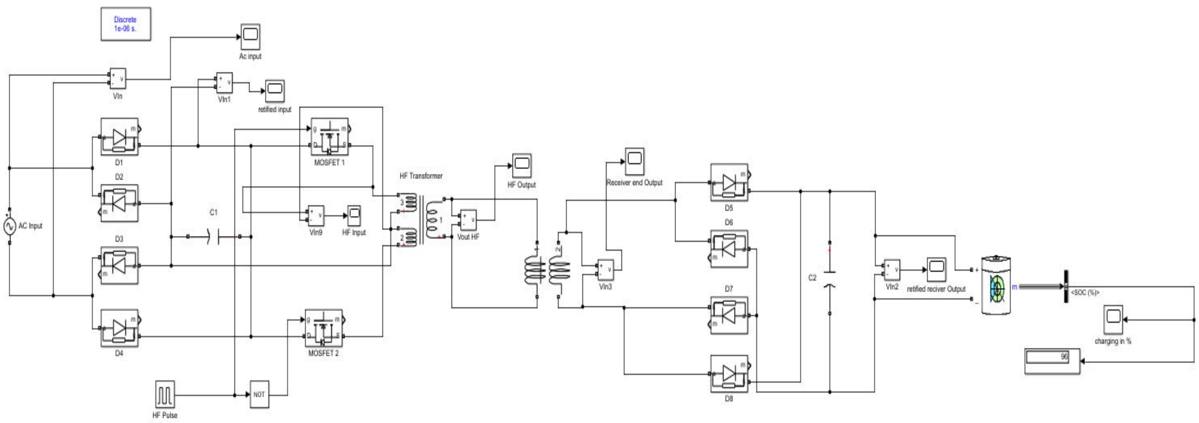

Figure 7: Simulated Diagram of Electric vehicle charging from AC source (grid)

In figure 7 simulation proceeds with the charging of electric vehicle from ac source. At the stage 1 energy from the ac (grid) is 230V AC it then rectified, at the stage 2 it is inverted using an inverter circuit, at stage 3 the frequency of the inverted wave from is increased using high frequency transformer, at stage 4 the wireless power transfer takes place, at stage 5 the output at receiver end is rectified and used for charging the vehicle.

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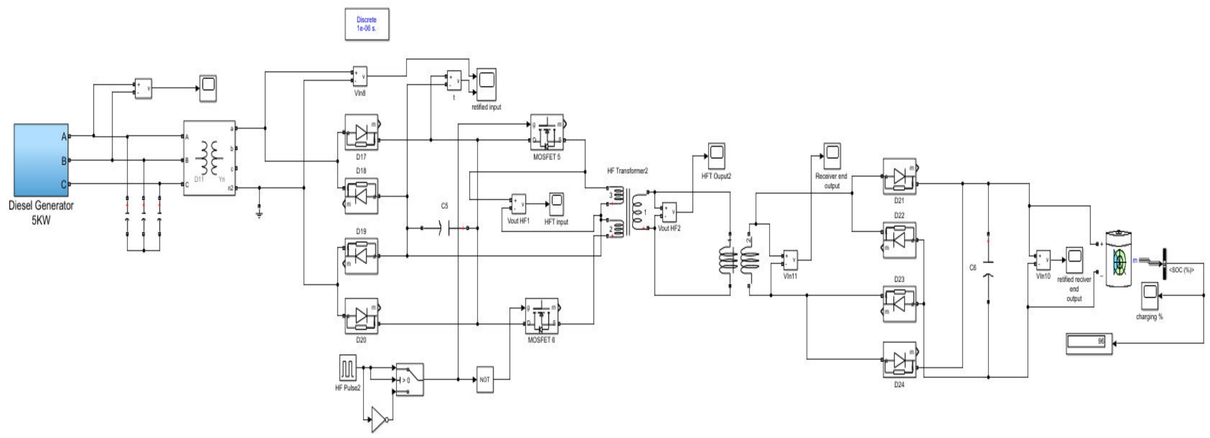

Figure 8: Simulated Diagram of Electric Vehicle Charging Using Diesel Generator

In figure 8 simulation proceeds with the charging of electric vehicle from diesel generator. At the stage 1 energy from the diesel generator (AC) is rectified, at the stage 2 it is inverted using an inverter circuit, at stage3 the frequency of the inverted wave from is increased using high frequency transformer, at stage 4 the wireless power transfer takes place, at stage 5 the output at receiver end is rectified and used for charging the vehicle.

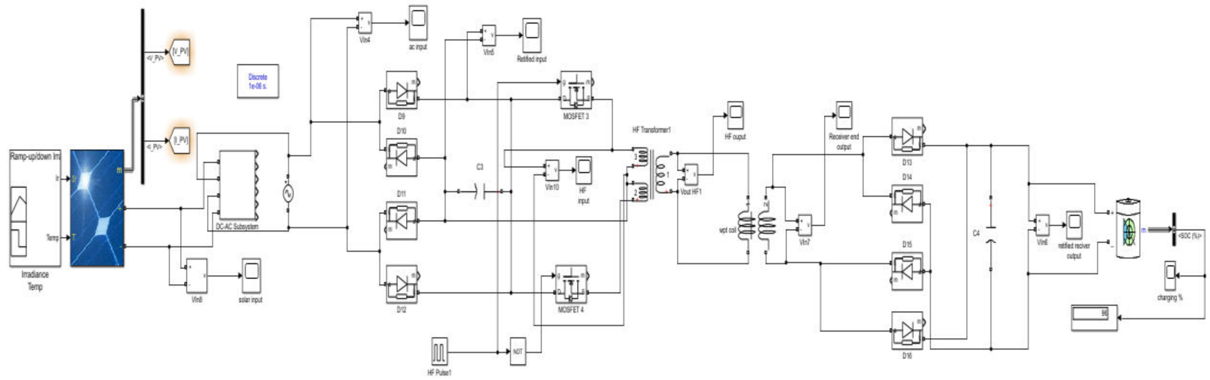

Figure 9: Simulated Diagram of Electric Vehicle Charging Using Solar Energy (PV)

In figure 9 simulation proceeds with the charging of electric vehicle from solar energy. At the initial stage energy from the solar energy (DC) is boosted using a DC to AC booster circuit, at the stage 1 output from the inverter circuit is rectified, at the stage 2 it is inverted using an inverter circuit, at stage3 the frequency of the inverted wave from is increased using high frequency transformer, at stage 4 the wireless power transfer takes place, at stage 5 the output at receiver end is rectified and used for charging the vehicle.

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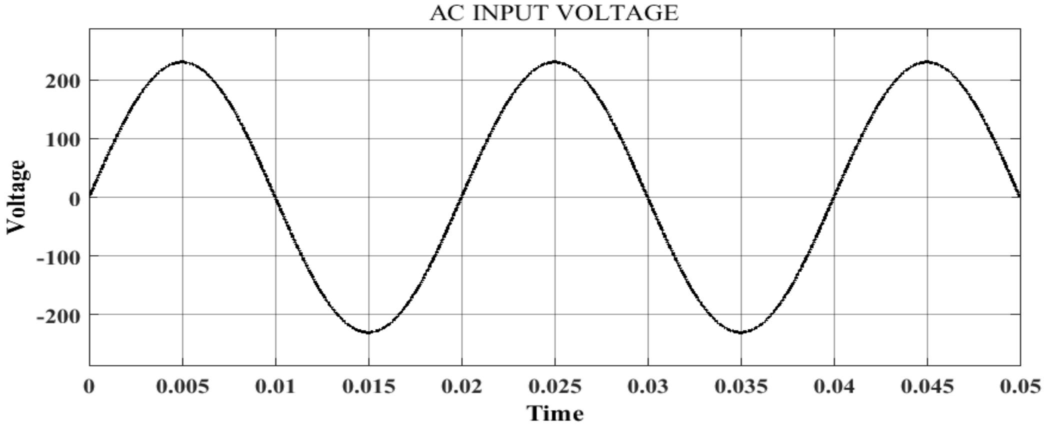

Figure 10: Simulated Waveform of AC Input Voltage.

From the figure 10 we can infer that the sinusoidal voltage obtained from grid (AC) and the value we obtained from the waveform is 230V AC.

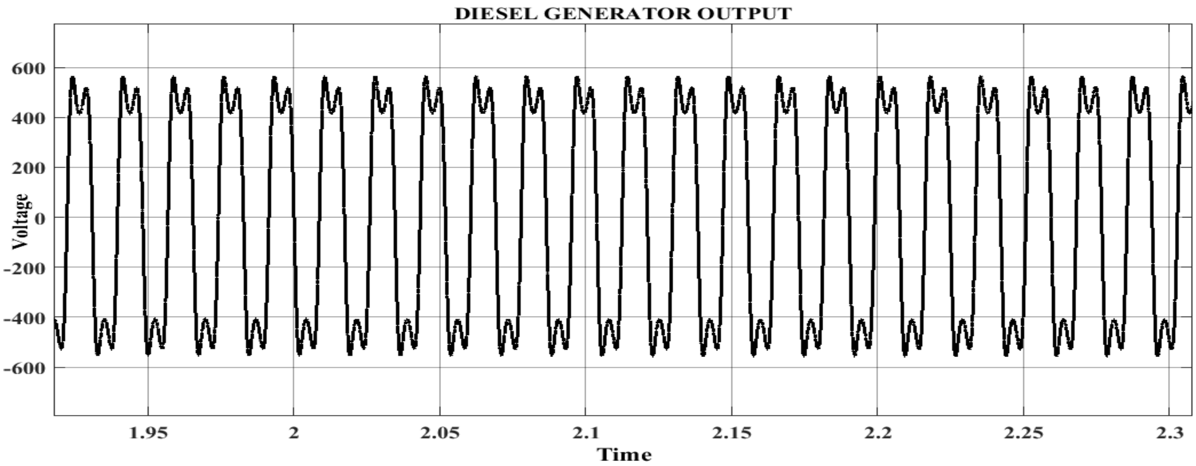

Figure 11: Simulated Waveform of Diesel Generator Output Voltage.

The figure 11 shows the time vs voltage waveform of the sinusoidal voltage that is obtained from the diesel generator.

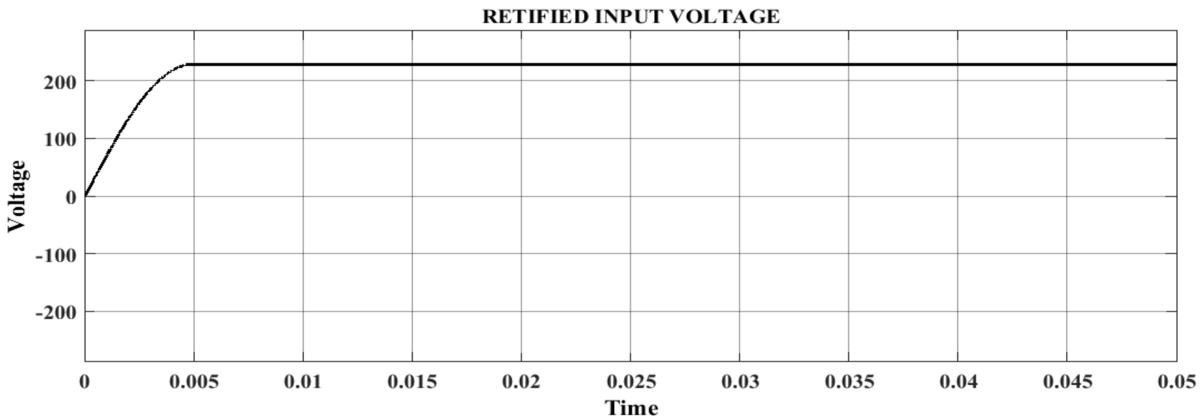

Figure 12: Simulated Waveform of Rectified Input Voltage.

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The figure 12 shows the time vs voltage waveform of the rectified input voltage that is obtained after the process of rectification 230V DC.

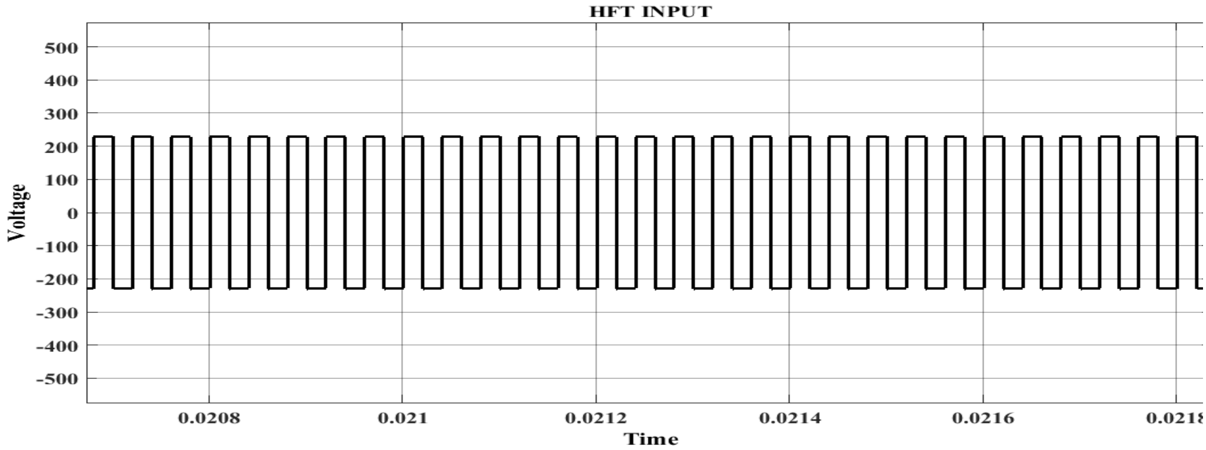

Figure 13: Simulated Waveform of Rectified Input Voltage.

We infer the time vs voltage wave from the figure 13, the waveform shows the frequency of the sinusoidal wave from which is to be stepped up using high frequency transformer (HFT).

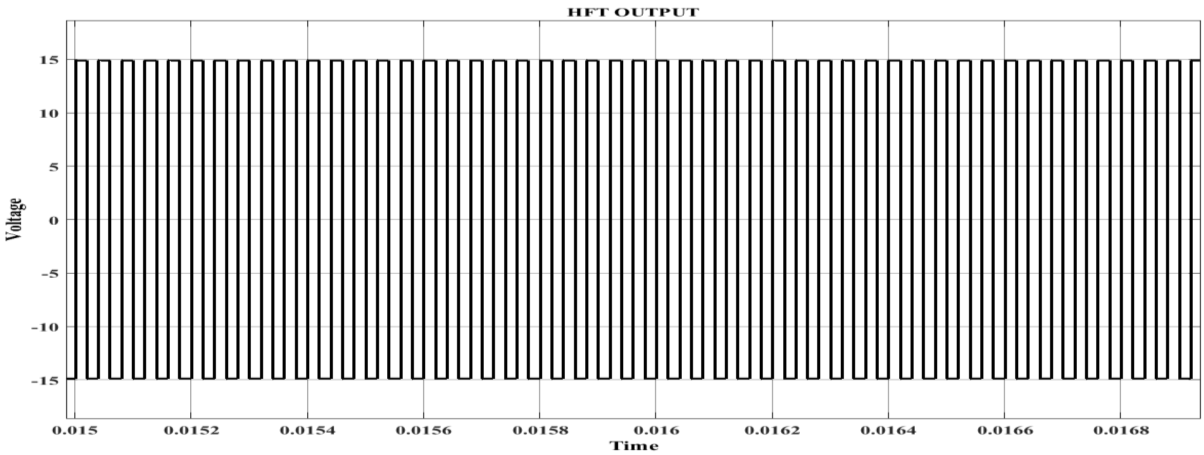

Figure 14: Simulated Waveform of High Frequency Output.

The above simulated output figure 14 shows the increased frequency output from the high frequency transformer. This output from the high frequency transformer is used for increasing the frequency for wireless power transfer.

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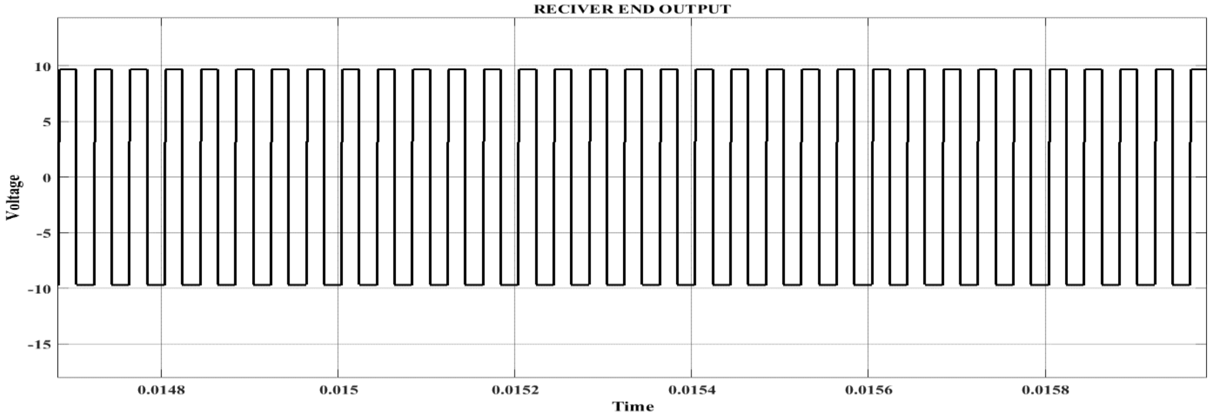

Figure 15: Simulated Waveform of Receiver end output.

The simulated waveform of figure 15 infer us the output voltage vs time waveform at the receiver end coil. Then this output is rectified to obtain the DC output. The voltage at receiving end coil is 10V AC.

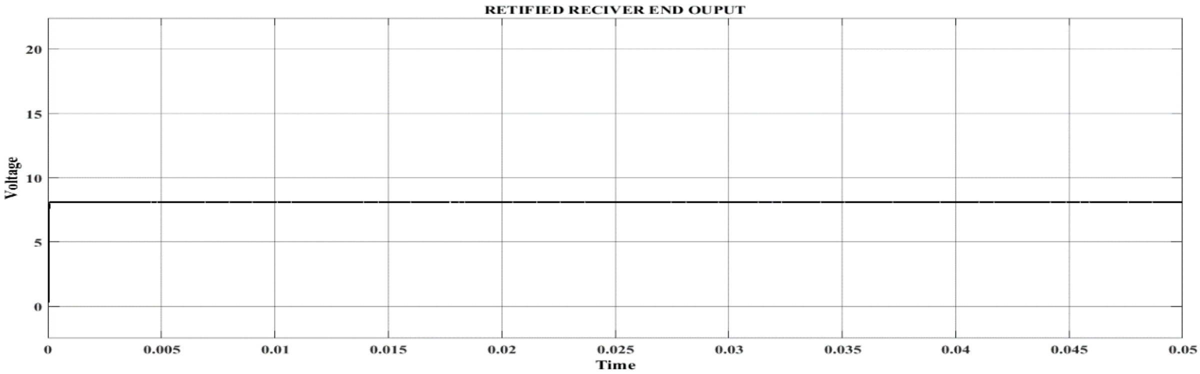

Figure 16: Simulated Waveform of Rectified Receiver end output

The figure 16 is the rectified output from the rectification circuit. this rectified output is used for charging the battery present in electric vehicle. The voltage value at the rectified receiver end is 9V DC.

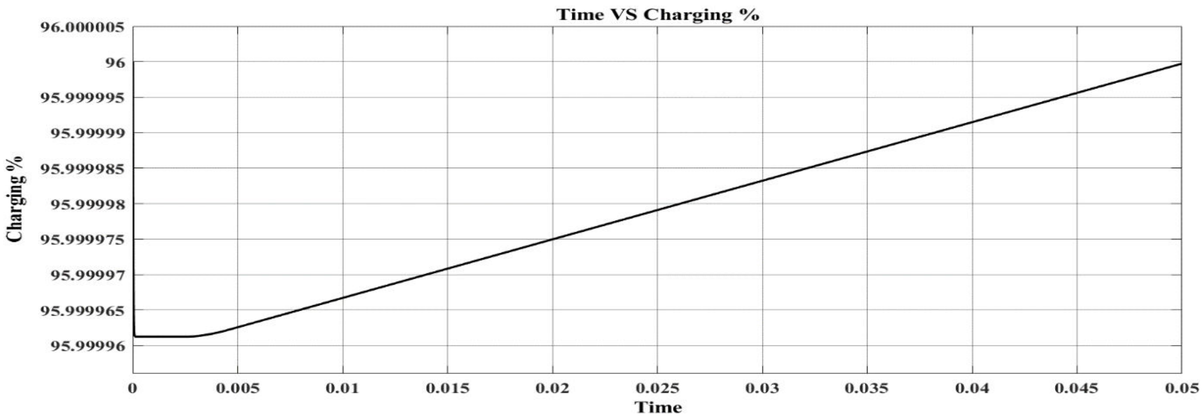

Figure 17: Simulated Waveform of Charing the Battery

The figure 17 describes the waveform of battery charging with respect to time, The graph infers the percentage of charging of the battery.

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VI.CONCLUSION

This paper deals with wireless power transfer for the purpose of charging an electric vehicle in an electric vehicle charging station. In addition to it multimode operation is performed. The word multimode deals with multiple power sources for charging the electric vehicle in the charging station. The best among the (Solar, Grid, DG) power sources are used for the operation of electric vehicle charging station. Solar power is preferred to the most as it is renewable source of energy, in case of unavailability Grid or DG is chosen. In case of unavailability of all the power sources for emergency purpose bidirectional charging is implemented for charging an EV from EV (V2V). If there is no load connected to the electric vehicle charging station the power obtained from the solar energy is stored or can be sent to the grid. In future RFID- based payment and self-serviced entry and exit gates to keep the station becoming narrow. This could be the future of electric vehicle charging station.

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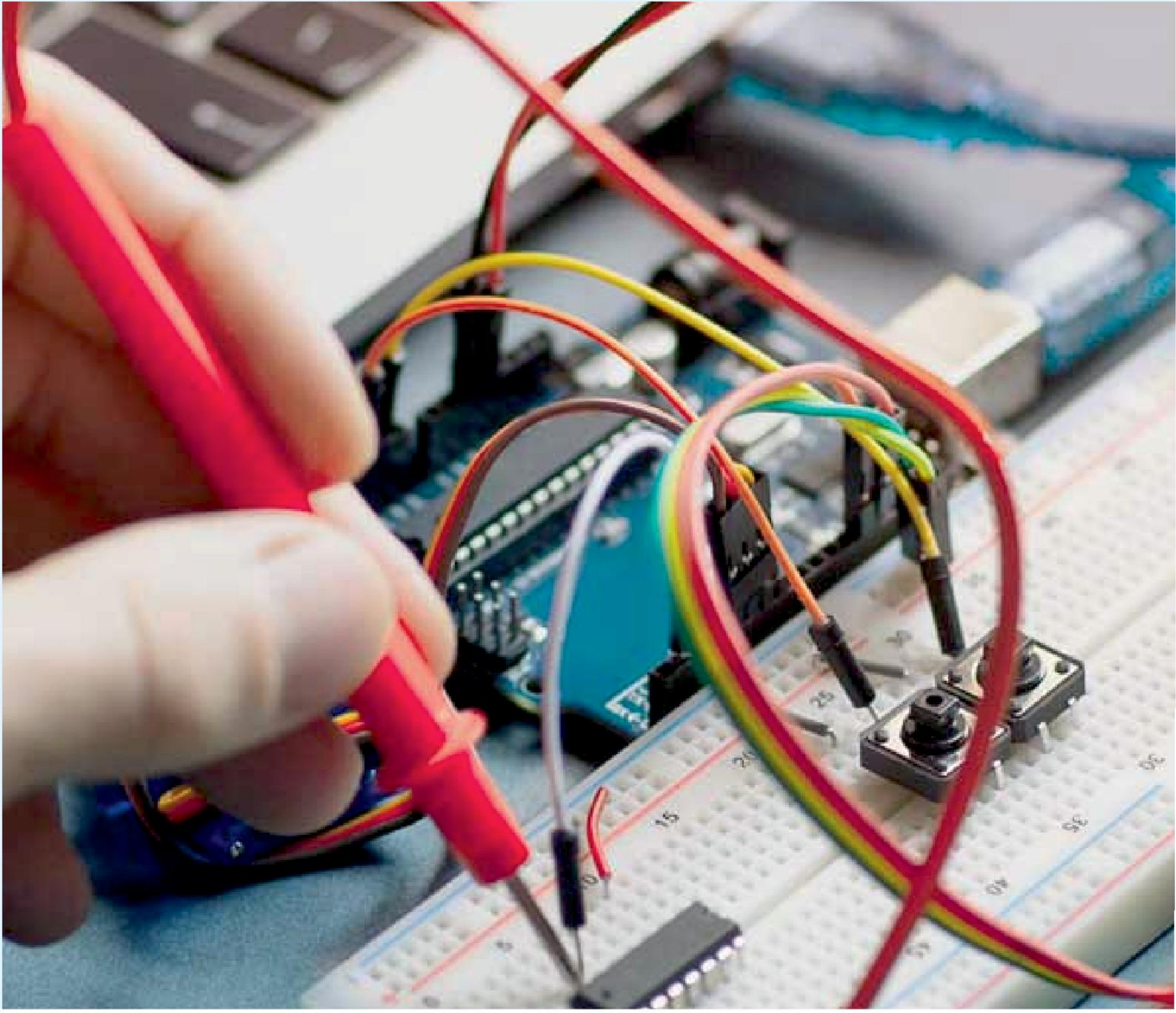

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