



# Seamless Wireless EV Charging for Fleet Operators

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**Abstract** - Vehicles have become an important part of the daily life of human beings. The transportation is made more easier and simpler by using vehicles. The gasoline vehicles have been used by the humans for more than few decades. The gasoline vehicles emit more harmful chemicals like carbon monoxide, formaldehyde, and Nitrogen dioxide that are really dangerous and they cause high temperature rise in the atmosphere, causing global warming. The use of unlimited fossil fuels led to the reduction in availability of fossil fuels. Switching to electric vehicles is one of the best solutions for overcoming the disadvantages of gasoline vehicles. Many studies have been conducted on the various Electric charging strategies. The most effective way to charge an electric vehicle is wirelessly, and many forms of wireless charging are currently the subject of research. In our project, we talk about how to charge an electric car while it's moving. The principle here is the Mutual induction between the primary and the secondary coils. Power is stored in the battery and is charged while the car is moving. Also, when the vehicle starts charging, an alert notification is sent to the provided phone number with the assistance of GSM module which shows the battery percentage and charging of the vehicle. This novel approach can get around the main drawback of electric vehicles. Using this way of charging, the limited battery range, longer charging times, low efficiency can be overcome.

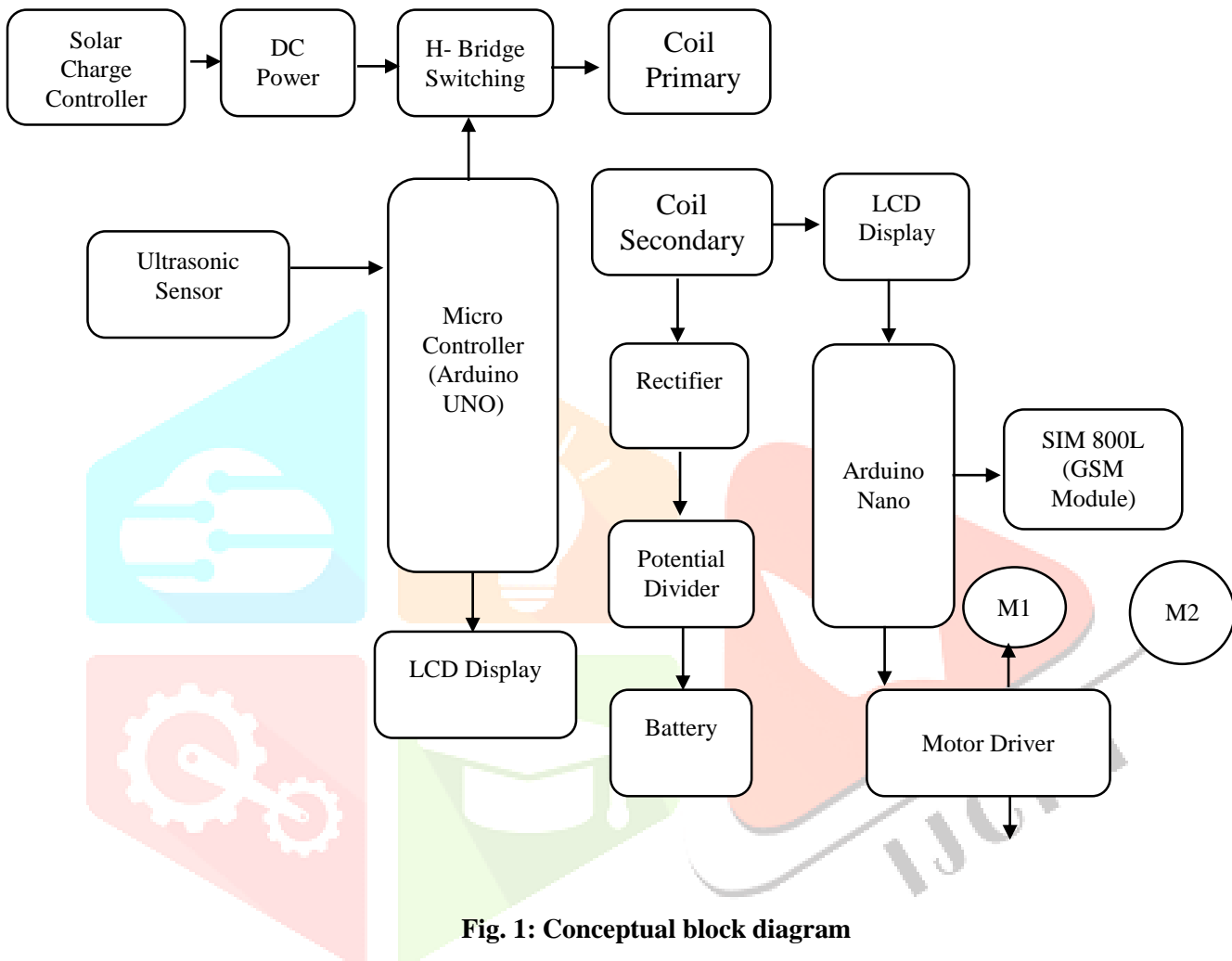
**Keywords**— Wireless charging; electric vehicles; dynamic charging.

## 1. INTRODUCTION

Tracing back to the 19<sup>th</sup> century, the electric vehicle has evolved a lot. India began its EV revolution after 2015. Despite the fact that Indian customers first took their time embracing electric two wheelers, the world's largest and fastest growing two- wheeler market is currently found in India. Two and three wheelers are currently driving India's Electric Vehicle revolution. As a result of recent spike in price of gas and diesel, many last mile delivery companies are switching to EVs. Fleet aggregators have been significant actors in the EV industry, driving the last mile delivery of hundreds of cargo fleets. Soon we can see EVs dominating our automobile industry. More mileage, more battery life, better engine conditions, ground clearance, etc. are always a priority for vehicle consumers. New technologies will be required to accommodate this expanding demand. The growing EV market always demands for more safer, reliable and convenient approach to recharge the vehicle battery. The existing conductive charging approach requires to high power charging approach requires to high power charging devices or charging stations to recharge the vehicle within a short time. Also, incompatible plug receptacles also cause an additional inconvenience among different EV models, thus limiting the fast development of EV's. Wireless Power Transfer (WPT) is one of the promising solutions to an extent for these requirements. This paper aims at Dynamic Wireless Charging which is an application of

Faraday's Laws of Mutual Induction. We do aim at the charging of EV even while it's moving. When the Electric vehicle enters the road where the coils are embedded, the primary coil gets activated. By mutual induction, power gets transferred to secondary coil attached at the base of the EV which will then get stored in the battery attached to the EV. We do aim at charging a miniature model of the project at the same time seeking more focus on this area. Some researchers have paid attention to the charging tools to improve the vehicle's global autonomy and efficiency.

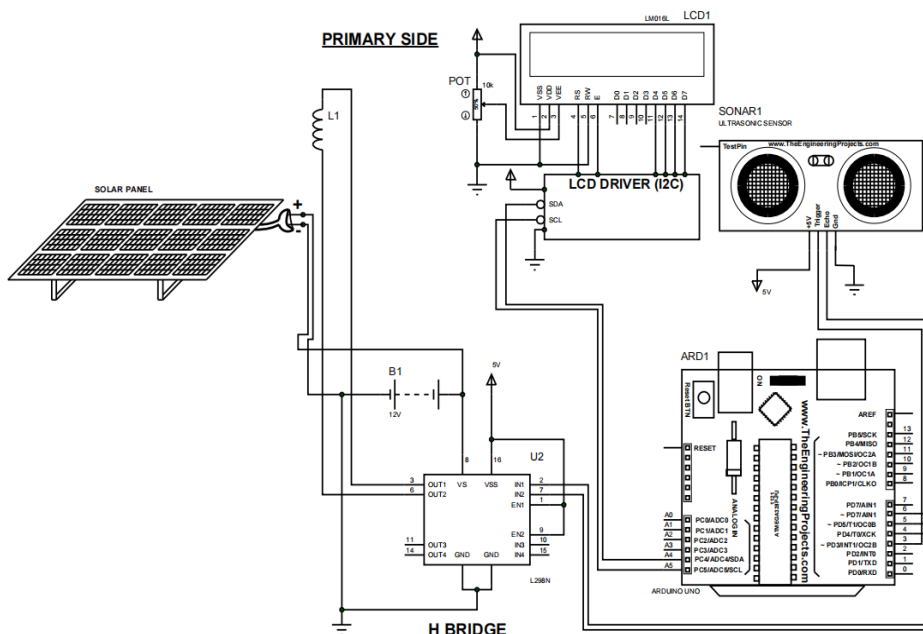
## 2. PROPOSED METHODOLOGIES



**Fig. 1: Conceptual block diagram**

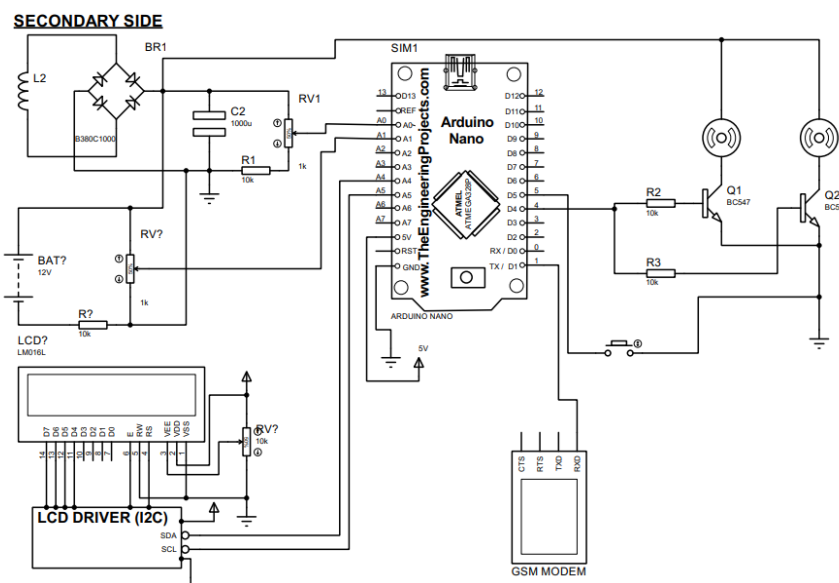
The schematic block diagram of dynamic wireless EV charging is shown in Figure 1. An ultrasonic sensor detects the presence of the car while it is on the charging pad or coil. The H-bridge (which is used to convert the DC to Variable AC) is then turned on by the microcontroller to function as a switch. The primary coil is excited by the 12V dc power from the solar charge controller or any other renewable sources. Mutual induction occurs in between the primary and secondary coil. The secondary coil, sometimes referred to as the receiver coil, is located on the car and is connected to a full bridge rectifier to rectify the AC voltage before being stored in the battery. The microcontroller receives a 5-volt feed from the battery to power the GSM module and LCD display. Here, the LCD display will show if the vehicle is charging and the current state of the battery percentage. The GSM module will then assist in relaying the message, which will include the battery level and if it is currently charging, to a given phone number via SMS. The two motors (M1 & M2) that moves the vehicle will be operated with assistance from the motor driver.

### 3. SYSTEM DESCRIPTION



**Fig. 2: Circuit diagram of the proposed model**

The circuit design of the primary side is presented in Fig 2. In order to charge the 12V battery, a renewable source ie, a 12V solar panel is used. Here we will use an H\_ bridge motor driver to convert the 12V DC into the variable AC. A 12V battery supply is connected to the corresponding pins of the H-bridge driver- pins 12V and ground respectively. For the working of the H-bridge driver a 5V supply is provided. The pins IN1 and IN2 of the H- bridge driver is connected to microcontroller (Arduino Uno) pins 6 & 5 respectively. Ultrasonic sensor and LCD display is also connected to microcontroller. An LCD driver is used to drive the LCD display. The analog pins A4 & A5 of the microcontroller is connected to the LCD driver pins SDA and SCL respectively. A voltage regulator is also used to convert the 12V battery supply. A 5V supply is provided to the microcontroller, ultra sonic sensor, LCD display and H-bridge driver by a voltage regulator.

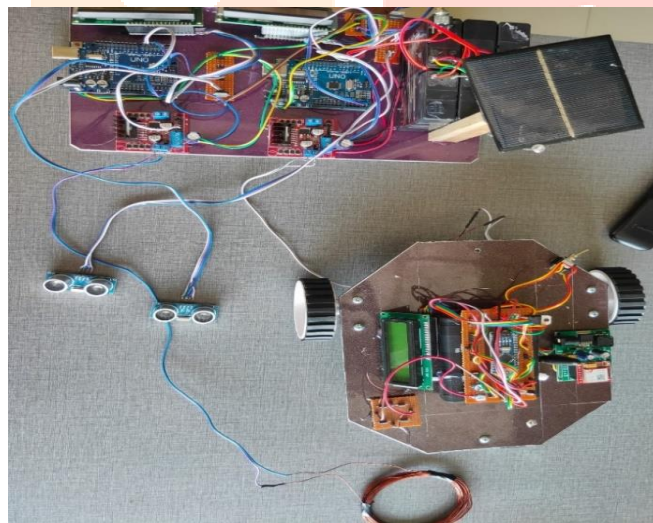


**Fig. 2.1: Circuit diagram of secondary side**

The secondary receives the sufficient voltage from the primary coil. The secondary coil is connected to a rectifier circuit which converts the AC supply to DC. The rectified DC supply is directly connected to the vehicle battery. A potentiometer is connected across the rectifier circuit which is also connected to the Arduino NANO microcontroller (A0). This Microcontroller connection helps to identify whether mutual induction has taken place or not. A second potentiometer is also connected across the vehicle battery which is also connected with the microcontroller (pin A1 ). This microcontroller connection is used to read the battery percentage. The analog pins A4 and A5 is to be connected to the LCD driver pins SDA and SCL correspondingly. The LCD driver is connected with LCD display to drive the display properly. The 2 motors are connected with microcontroller pins D5 and D4 by using 2 transistors and the power supply is taken from the vehicle battery. A switch is connected for the ON/OFF process of the vehicle motors. In order to show the charging update, a programmed SMS alert is sent to the vehicle owner's mobile via a GSM module. The GSM module pin RXD is connected with the microcontroller pin TX/D

#### 4. HARDWARE

In the Figure 3 illustrates the full hardware model with the primary side and secondary side. LCD display, ultrasonic sensor, rectifier, H-bridge, solar panel, microcontrollers, battery and coils make up the hardware. The controller used here is Arduino Uno and Nano. The board provides six pins for connecting to the LCD display, and two of those pins—pins five and six—are connected the H-bridge.



**Fig. 3: Hardware Model**

When the pin 5 is triggered, the signal will flow in positive direction, and the pin 4 is activated the signal flow in negative way. Thus, a continuous square wave is formed. To induce the emf, the square wave will connect to the secondary. The emf is then transformed to voltage and rectified using a full bridge rectifier. Here, the voltage can reach up to 12V, and an ultrasonic sensor is employed to turn on the controller. Pin 3 (the trigger) and Pin 4 are provided the pins on the ultrasonic sensor (Echo). When the trigger pin will activate the voltage give it to transmitter. The receiver will receive the ultrasonic that the transmitter transmits. A programme is also used to specify the reflected ultrasonics' precise velocity,  $v=f\lambda$ , on the IC. The intended output (cm) is delivered depending on the time period during which the echo or pulse is generated. The charging is initiated if the distance is less than 30 cm. If not, it is in the off state. The pins on the board 10,11,12,13 which are



connected to the pins of D4, D5, D6, D7 of LCD display. The bridge rectifier being used in this instance is a static device with no pins attached. Pins 8 (register select) and 9 (enable) are permanently attached to it. A pulse is sent to the echo point to measure the distance and it will issue a directive to charge the vehicle if the distance is less than 30 cm. The two inputs act concurrently at that point. In 1 sec 120 trigger is occurring (60 for activation and 60 for another activation) to acquire 50 hz Continuously, 100 trigger pulses are delivered. One pulse is delivered every 10 milliseconds, which means there will be 50 pulses in a second. With respect to this an AC wave is created to occur induction the coil will pick up it.

### 5. RESULTS AND ANALYSIS

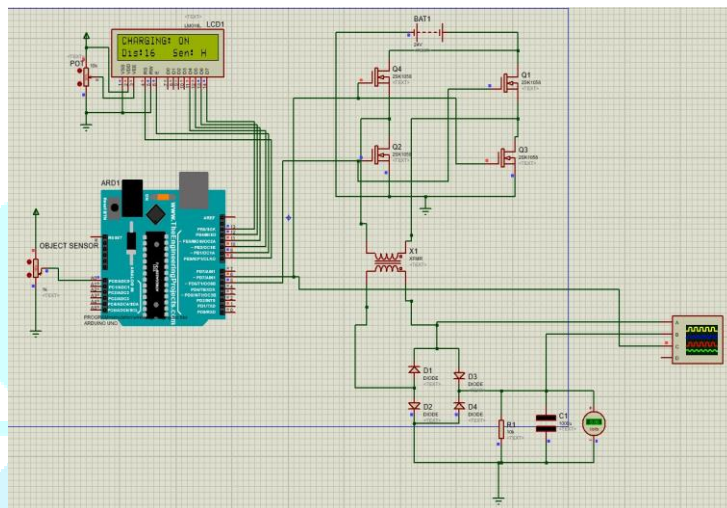


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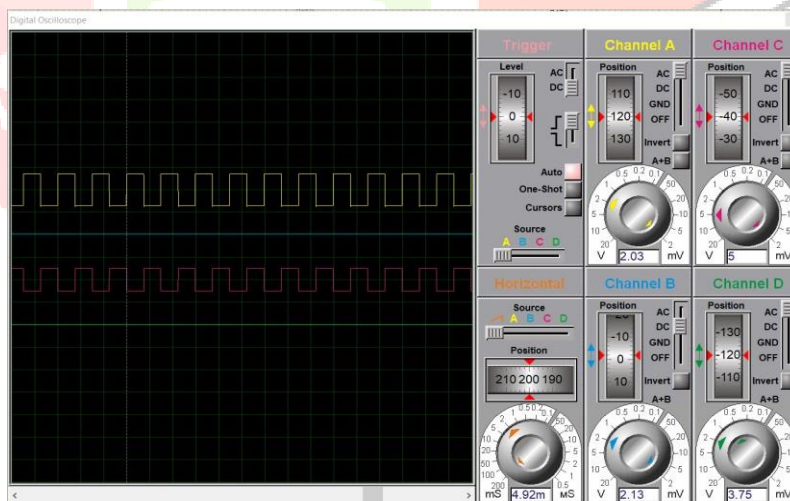
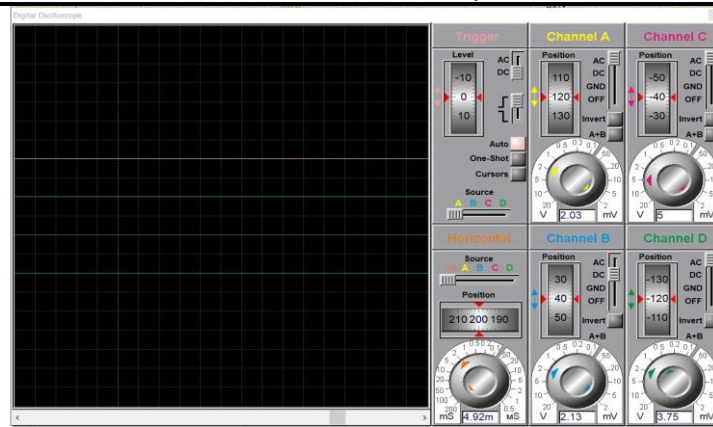


Fig.4.1: while on charging

Fig. 3 showed that charging was underway. The induction between the two coils is represented by these square waves.



**Fig. 4.2: No charging**

Fig. 4 demonstrated that no charging was taking place, and no vehicles were present.

## 6. CONCLUSION

It's definitely a fact that Dynamic Wireless Charging will transform the entire automobile industry. The auto manufactures, battery manufactures, EV software developers, programmers, spare parts manufactures, charging stations managers, retailers, researchers, etc. are always going to benefit from the developing EV industry. By 2030 or by 2050, it's expected that India will always have a strong market share across several categories of vehicles. However, there are several technical and logistical challenges that must be overcome before dynamic wireless EV charging can become a widespread reality. These include developing more efficient and reliable wireless charging systems, addressing safety concerns and creating standardized protocols for interoperability between different charging networks. Despite these challenges the ongoing research and development in the field of dynamic wireless EV charging are encourage and is likely that will see significant advancement in the technology in the coming year. Dynamic wireless EV charging has the potential to make a substantial contribution to the transition to a more sustainable and decarbonized transportation system with ongoing investment and collaboration between business, government, and related researched institutions.

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