

## Wireless EV Charging Station

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### Abstract

*Higher standards for the ease, safety, and dependability of electric vehicle charging have been proposed in recent years due to the fast development of the electrical vehicle (EV) of the new energy business. Resonant inductive coupling is used to charge wirelessly transmitted power. With the aid of Arduino, the transformer may be reconfigured to transfer energy with less energy loss and less strain on the primary circuit. With minimal energy loss, the primary can transmit enough power from the battery to the secondary under the supervision of an IR sensor and relay. The chargeable battery, which is electrically connected to the secondary circuit through the air core transformer, is then supplied with electricity. Buses might be charged when they wait at the bus station for shuttle bus services. It may also be used in parking lots for rental taxis. As a result, electric buses only require a small amount of power to reach the next stop. This results in a smaller battery life and significantly lower costs for electric vehicles. With the use of this technology, charging stations may be used effectively for pre-planned routes and stops, cutting down on charging time. Advances in sensing technology and display units make electric vehicles more dependable even in adverse weather conditions like rain and snow.*

**Keywords-**Electrical Vehicle, Resonant inductive charging, Arduino Consumption, Time of Charging.

### INTRODUCTION

We can transmit electric power to the electric car on the principle of resonant magnetic coupling. The transformer is an inductive coil. Two inductive coils—the transmitter coil (primary coil) and the receiver coil (secondary coil)—are used in the construction to provide the electromagnetic coupling that can result in flux and EMF. The electric car will then start charging after receiving power wirelessly. In applications requiring considerable power, such as stationary electric vehicles and plug-in electric vehicles, wireless charging devices can be used. When compared to plug-in charging systems, wireless charging systems are more user-friendly, dependable, and simple. To increase range and provide enough battery storage, stationary mode of operation is adopted. Therefore, even when

the vehicle is in steady state, this strategy enables the electrical charging of battery storage devices. The distance between the source and receiver's air gaps and the coil alignment are utilised to calculate the power transmission efficiency. The air gap distance in small automobiles is between 150 and 300 mm, and it increases for large passenger vehicles. For better controlling and displaying the data in our employed system, we designed a fully automatic controlled system with an LCD display and an IR sensor. The EV identifying device is programmed into the Arduino Uno ATmega328 in way. When an IR reader for Arduino is used, data is sent to the Arduino. The output and input data

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Received Date: June 14, 2023  
Accepted Date: August 04 2023  
Published Date: August 16, 2023

**Citation:** Khumes Halmare, Nandini Kawade, Anjali Kurkut, Avinash Chavhan Wireless EV Charging Station. International Journal of Electronics Automation. 2023; 1(1): 30–37p.

are checked with the IR data, and all data are displayed on a liquid crystal display [LCD] before the relay is turned on. The charging transmitter coil is ON when the relay is ON. The electromagnetic flux is then produced, and charging begins as soon as the receiver coils are energised. For the demonstration, we're using an LED light on the reception coil to show that the transmitter coil is indeed detecting the signal. The relay and transmitter coil turn off when the timer expires. With more than 1.3 million EVs on the road worldwide, public charging networks for EVs are expanding [1]. It has become important to establish a plan for how to prioritise EVs charging from a single network, especially if the power source is restricted, as in the case of renewable energy, whether for financial reasons (more price per KWh for a faster charge) or for pure priority. We can build a pollution-free environment now. In addition to the fact that vehicles account for 60% of all CO<sub>2</sub> emissions annually, our fast-paced way of life is also hampered by the lack of petroleum products soon. In order to minimise the scarcity of petroleum products and to reduce pollution, vehicle manufacturers are increasing their research and production of electric vehicles. The most potential sustainable transportation technology for addressing the social, economic, and environmental issues related to internal combustion engine vehicles is electric automobiles. For electric vehicles to be more fully integrated into the transportation sector, new charging techniques must be researched and developed. The most promising technique for charging electric vehicles wirelessly while they are moving is inductive power transfer, which can be used to power the motors and/or charge the batteries of an electric vehicle. The primary issue with electric vehicles right now is the lack of charging stations, and this will be particularly problematic in India, which is classified as a developing nation. In this essay, we'll talk about wireless battery chargers and PV (photovoltaic panel/solar panel) charging stations for electric vehicles.

## LITERATURE REVIEW

Static and dynamic EV charging stations come in two different varieties. The holy grail of electric vehicle technology is the dynamic wireless charging system, which allows the car to be charged while it is moving. In static charging, the automobile is charged when it is in a static position. In order to provide wireless charging stations while a car is moving, we must ensure that the transmitter is already constructed into the road. Because of the increased expense, author [7] instead employed static EV charging stations.

Inductive coupling and resonant inductive coupling are the two primary techniques that are frequently used for near field power transfer. Resonant inductive coupling is chosen because it improves power factor and quality factor. Inductive coupling is only suited for short distances since the coupling coefficient decreases as the air space between the coils widens. [1]

To transfer power wirelessly, there are at least two magnetic couplers in a WPT system. For higher efficiency, it is important to have high coupling coefficient  $k$  and quality factor  $Q$ . Besides the frequency, the coupling coefficient  $k$  is significantly affected by the design of the magnetic couplers, which is considered one of the most important factors in a WPT system. With similar dimensions and materials, different coupler geometry and configuration will have a significant difference of coupling coefficient. A better coupler design may lead to a 50%-100% improvement compared with some non-optimal designs. [2]

In the study by [3] author discussed about wireless battery chargers and PV (photovoltaic panel/solar panel) charging stations for electric vehicles. Here, we employ a brand-new QDQ (Quad D quadrature)-QDQ coil design to improve power transfer efficiency at acceptable misalignment. 2 sets of - 4 adjustment Q coils are used in the QDQ-QDQ construction, which is housed inside 1 D coil. JMEG FEM software was used to create the coil and calculate the inductive parameter. MATLAB was used to evaluate the calculation's overall performance from PV to DC battery storage. [3]

The several wireless power transfer (WPT) techniques for charging electric vehicles are briefly discussed by [4] along with some scientific strategies and examples. A 3D design was also shown together with an experimentally realised inductive wireless power transmission prototype. Finally, a few upcoming points are briefly highlighted.

In the study by [5], a charging network strategy based on category prioritisation suggested. The important element of the network logic was time-multiplexing the power supply utilising controllers, which will allow the network to manage which EV receives more time being supplied with power and this control structure will also eliminate the state-of-charge bias. The strategy was tested in a scenario of a solar-powered, shaded office parking lot. Simulation and experimentation were used to verify the control logic. The simulation and experimentation were successful, and the results showed that this time-multiplexing method can allow the EV charging station to give priority to some EVs so they can charge more quickly and prevent the SOC from acting as the main drive in a situation where there is a limited amount of power. [6]

The analysis approach for a Dynamic Wireless Charging system used to assess the power and energy needs for charging electric vehicles as they travel along a section of the A-381 Highway in Cadiz, Spain, was presented in the paper by [8]. The study demonstrated the strong correlation between the speed of energy transmission to electric vehicles and the wide range of power and energy demands associated with daily traffic.

The future of current and emerging battery technology for battery electric vehicles (BEVs) is evaluated in the article by [9]. Based on battery performance and cost over the short, medium, and long term, five different battery technologies were evaluated. Driving cycle models were used to evaluate how batteries will affect BEVs' long-term performance in terms of energy, the environment, and the economy.

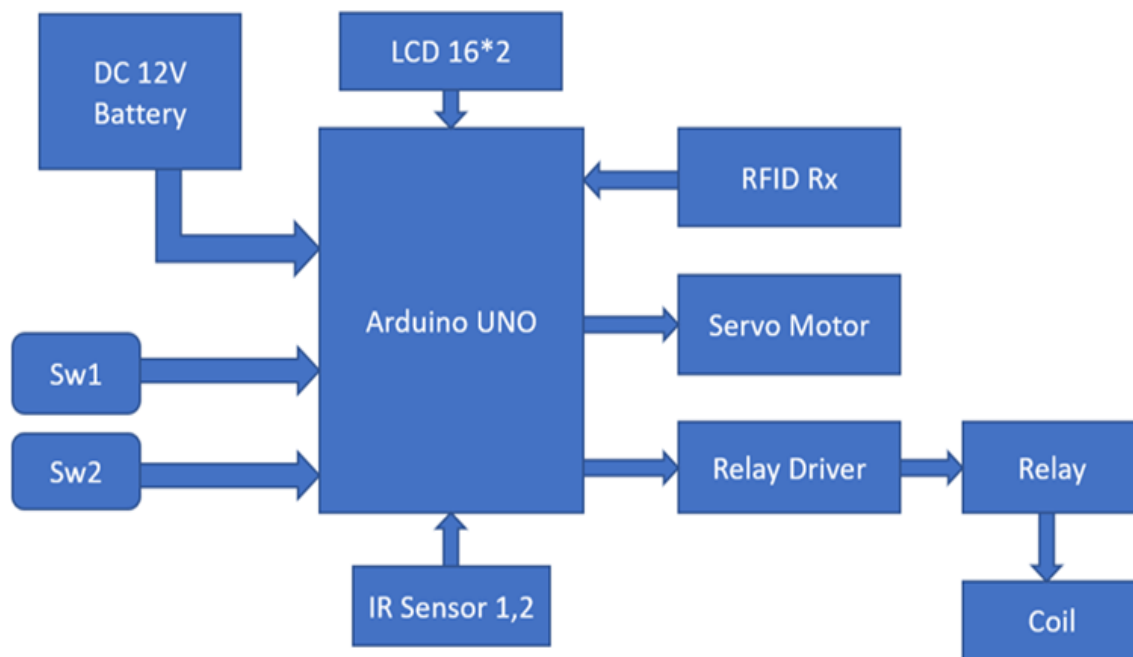
## **Development**

### ***Theory***

The fundamentals of wireless charging are identical to those of a transformer. The transmitter coil and reception coil are the two coils that are employed. The transmitter coil is supplied with high frequency alternating current, which is created from the DC supply. The receiver coil is shut off and produces AC power because of the alternating magnetic field that is created. Nevertheless, maintaining the resonance frequency between the transmitter and receiver coils is crucial for effective wireless charging. To keep the transmitter coil and reception coil's resonance frequency intact. The resonant frequency compensation network is then implemented on both sides to maintain. The author [11] experimentally showed effective nonradiative power transfer at distances up to 8 times the coils' radius using self-resonant coils in a tightly coupled environment. Over distances greater than 2 metres, they were able to transmit 60 watts with an efficiency of about 40%. We provide a mathematical model of the power transfer that, to within 5%, reproduces the findings of the experiment. Finally, the receiver side power was transferred to the battery for charging. The Arduino Uno ATmega328 in this has been programmed. The relay for the power supply to the gearbox coil is turned on by Arduino when the car approaches the charging site, as detected by the IR sensor by emitting rays and receiving signals at the reception point. The LCD and Arduino are linked, and the LCD shows the data and the charging spot on the screen as shown in Figure 1.

## **METHODS & MATERIALS**

Anodes, cathodes, electrolyte solutions, as well as the most pertinent components, are all covered in the review presented by [10]. We also discuss significant prospects for R&D of advanced lithium-ion battery technology for demanding use, such as EV and load-leveling possibilities.



**Figure 1.** Block Diagram of the system

### Circuit Diagram

The circuit diagram of the proposed system is presented in Figure 2.

### Methodology

The system mode working mechanism is explained through a flow chart as shown in Figure 3.

1. *Identify the wireless EV charging station's functional needs:* The first stage is to determine the functional needs, which include the type of charging station that is more efficient and cost-effective. Based on this, we learned that resonant inductive charging is the most effective one. Based on that, we looked for coils that we needed. Appropriate coil positioning is also crucial for charging a vehicle or a car, IR sensors are used to determine the position of the vehicle. If it is not in the proper position, charging won't begin. Before beginning this process, the customer must pay the unit's vehicle fee. Select the hardware components: The second step is to select the necessary hardware components for the wireless EV charging station, this includes Arduino Uno (Atmega 328), Servo motor is used because it has 360 degree rotation.
2. *Resonant inductive coils for efficient charging, a servo motor with 360-degree rotation, a relay, a relay driver, two IR sensors to determine the location of the car, and more are all employed.* automobile for transmitter coil (For payment) Radio frequency identification User must scan their card to receive payment. A LCD (16\*2) will show how much time is left on their charge, whether their card was detected, and the fee. Create the wireless EV charging station: After choosing the hardware components, the following step is to create the wireless EV charging station. First, we must create a stable platform to charge the vehicle without endangering the station, the driver, or the vehicle itself. The platform must support the weight of the car, relay, servo motor, and other components, so it must be at the proper height. Connect the components as shown in the circuit diagram.
3. *Compose the programme:* The next step is to write the software after the hardware parts and design are finished. Programming the Arduino Ide controller, which uses coils to determine a car's location before charging it, is part of this process.
4. *Assess the EV charging station without wires:* The wireless EV charging station must be tested after the software is created to make sure it complies with the functional specifications.

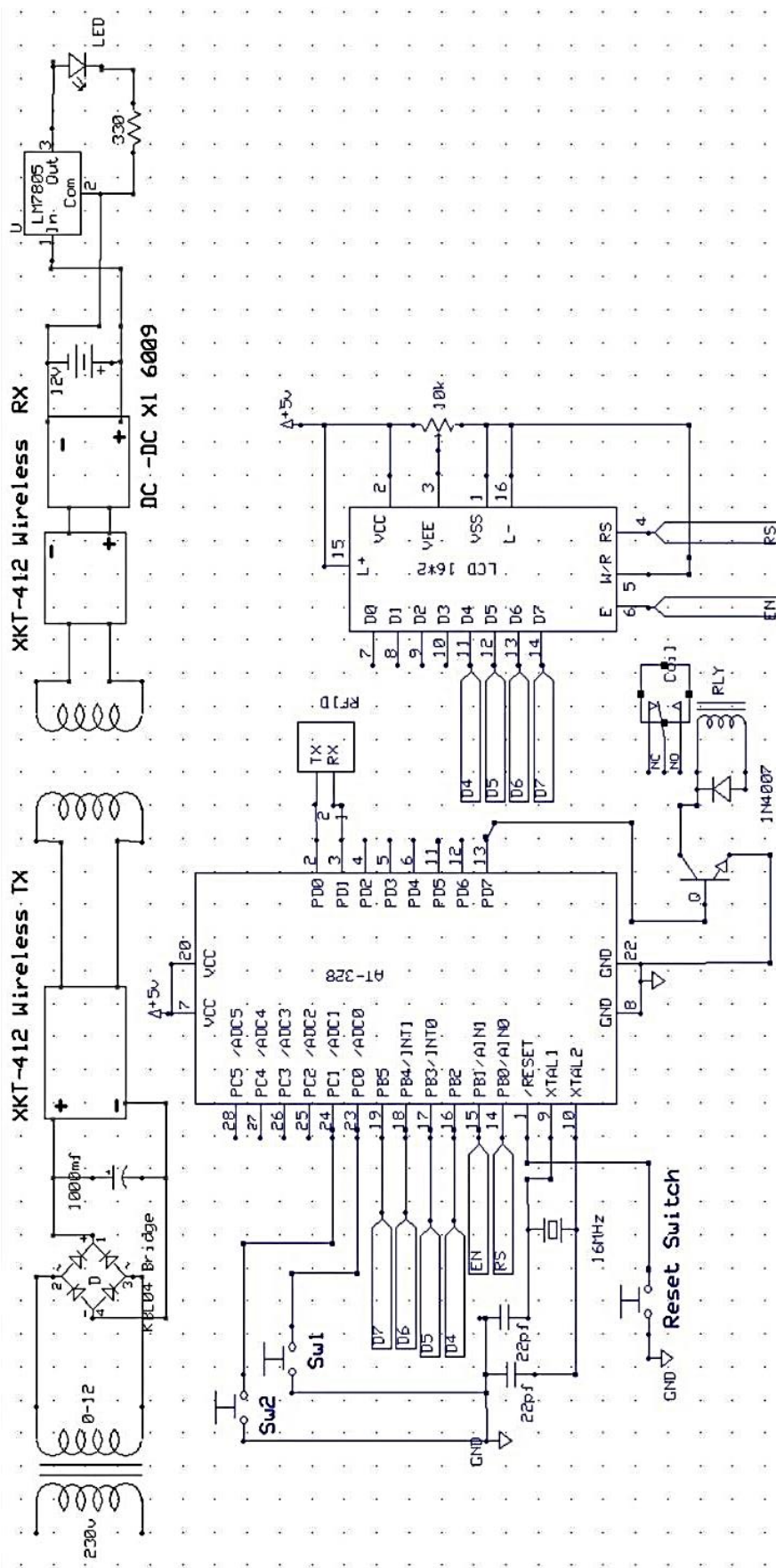
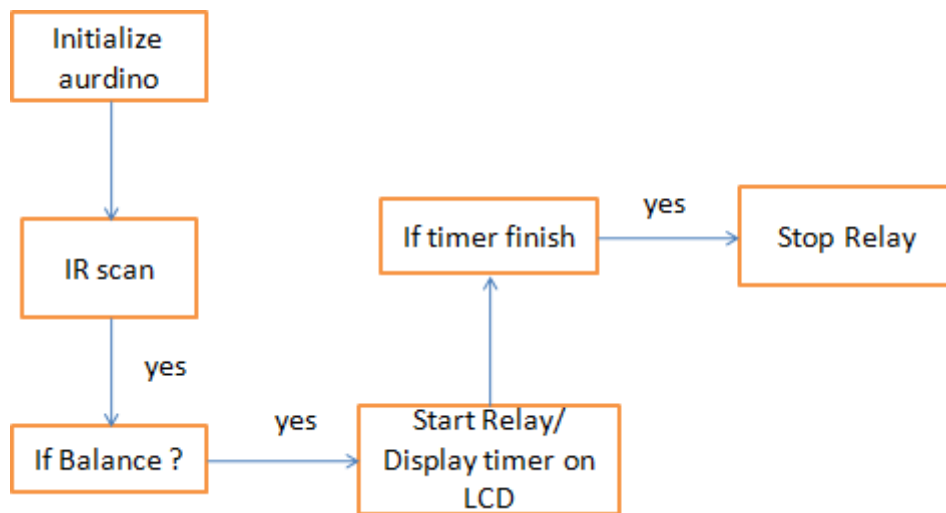


Figure 2. Circuit diagram of the proposed system.



**Figure 3.** Flowchart of the proposed system.

**Calculation**

The values were compared with the previous standard model for newly introduced technology as shown in Table 1.

**Table 1.** Comparison of traditional method & prototype method.

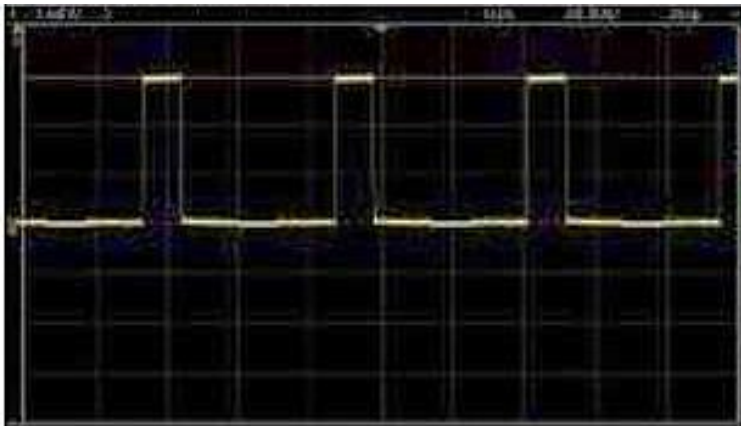
Calculation for standard model	Calculation for this prototype model
Tata Nexon EV by using Fast DC charger of 7.2KW Battery: 40.5kwh and the current is 15 A at 220 v Battery Rating = $40.5/7.2=5.625$ hours It will need 30 units to get charge the vehicle $30 \text{ unit} * 9 = 270 \text{ Rs}$	Battery rating =40 kwh Current rating = 15 A Battery charger = $230 \text{ v} * 15 \text{ A} = 3450 \sim 3.4 \text{ kw}$ Charging time required = $40/3.4=11.7$ hours It will need 30 units to get charge the vehicle $30 \text{ unit} * 9 = 270 \text{ Rs}$

**Result**

The results were shown in Figure 4 & Figure 5.



**Figure 4.** Rectified Output Signal.



**Figure 5.** Arduino Pulse to Optocouplers.

### Model Images

The proposed prototype is presented in Figure 6 & Figure 7. The prototype compared with standard model in Table 2.



**Figure 6.** Transmitter and receiver coil alignment.



**Figure 7.** Working model.

**Table 2.** Result outcome of standard Model & Prototype proposed in terms of current & Voltage.

Sr No	Model	Charging time to get full charged	Current	Voltage	Units
1.	Standard model	6 hrs	15 A	220 v	30
2.	Prototype model	11.7 hrs	15 A	230 v	30

## CONCLUSION

A new area of research and development for EV charging is wireless power transfer. In order to increase wireless charging performance for high-frequency applications, we demonstrated the effectiveness of resonant inductive coupling for EV charging. Various coil alignment methods were explored, and an RFID method was introduced as a kind of practical, cost-effective solution for making WPT intelligent. The result outcome of standard Model & Prototype proposed in terms of current & Voltage were analysed.

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