Dynamic Vehicle Charging System

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***Abstract*—Electric vehicles are considered as best replacement of fuel engines, because they are powered by fossil fuels, they use a lot of non-renewable energy sources, which means at some point in the future, the fuel will no longer be available. So EVs is helpful to reduce green-house gas emissions and increasing fuel prices, especially for the CO2 reduction, air pollution and alternative energy perspective. Wireless electric vehicle charging systems (WEVCS) can be a potential alternative technology to charge the electric vehicles (EVs) without any plug-in problems. However, electric vehicle requires several key issues resolved in view of the heavy weight, bulky volume, and limited driving distance so, the innovative on-road dynamic wireless charging technology for electric vehicle. Dynamic wireless charging systems are being developed to supply energy to the EV during its motion. So it is preferred method since it enables power exchange between the vehicle and the grid while the vehicle is moving. By usingInductive charging (also known as wireless charging or cordless charging) is a type of wireless power transfer. It uses electromagnetic induction to provide electricity to portable devices. Inductive charging is also used in vehicles, power tools.**

***Index Terms*— Dynamic wireless charging,Electric vehicles, Electromagnetic induction,Inductivecharging.**

1. INTRODUCTION

Wireless Charging Systems (WCS) have been proposed in high-power applications, including EVs, and also plug-in electric vehicles in stationaryapplications. In comparison with plug-in charging systems, WCS can bring more advantages in the form of simplicity, reliability, and user friendliness. The possibility to charge electric vehicles while driving is called dynamic vehicle charging.

Dynamic wireless charging is gaining more ground, since it enables power exchange between the vehicle and the grid while the vehicle is moving.

But in Wireless EVs have some challenges like limited power transfer, high efficiency, shorter range, implementation on existing roads. By this method we can charge our vehicle while in motion and we can use it for long distances also and the vehicle need less volume of battery, we can get rid of expensive batteries. Air gap and coil alignment these both are the hurdles of WCS. The air gap varies according to the vehicle size. In this paper we are going to explain various methods and outlines on current development and this project is the extension of Dynamic vehicle charging here we include toll system and Node to Node communication to get access to the road.

2.WIRELESS POWER TRANSFER METHODS

2.1 Basic Principle:

The Schematic diagram of WCS is illustrated in the Fig.1.To get power from transmitter to receiver coil we need AC/DC and DC/AC Converters to get high frequency power and we need to include BMS (Battery Management system) to ensure stable operation and to reduce the leakage and improve the magnetic flux.

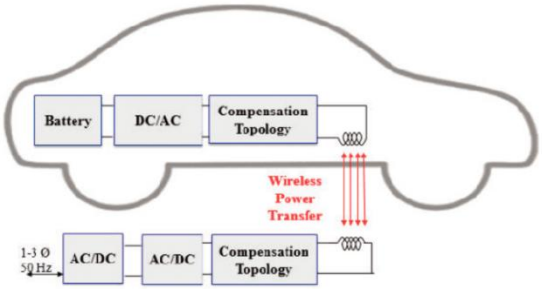

Fig. 1. Block diagram of Wireless charging system in EVs

2.2 Inductive power transfer:

Inductive Power Transfer is a technology that makes it possible to transfer power and digital data without mechanical or electrical contact and it use inductive

coupling between two circuits as the basis of its operation. It transfers the power without any physical link. There are two circuits, primary circuit having power source and secondary circuit are connected with a battery and the circuits are in the form of coils to get magnetic field. The primary coil generates electromagneticwave which transmits the power across the field and the receiver gets cut by the waves then when there is a change in transmitter primary current, this induces a voltage in the secondary or receiver coil. The voltage which is in the secondary coil is used to charge the battery or any other circuit required.This method is depends upon the size, shape and distance between the coils.

3. RFID TOLL SYSTEM

RFID is a Radio Frequency Identification card which produces data in the form of radio frequency waves and the reader gets the data. The data in the RFID card get transmitted to the RC522 module through the antenna in the form of electromagnetic waves.Maximum range of RFID is 1.5m. When a vehicle comes within a certain distance the scanner is able send the signals and read the tag then the identification code of the vehicle is gets Entered into the data then it get access to that road. Most of RFID reader operates at13.66Hz and it Ranges between 10cm to 1m. If we want high range then we use ultra-frequency readers it can read from 3 to 6meters.The Toll system is illustrated in Fig.2

4.NODE TO NODE COMMUNICATION

Node to Node communication is done with the Esp-Now which is developed by Espressif. This technology is introduced to communicate between controllers.

Node to Node communication types:

- Unicasting
- Multicasting
- Broadcasting
- Any casting

The frequency range is 2.4GHz. It can transmit small messages up to 250bytes.

Here we use two NodeMCUs one as master and another one as slave. When a particular vehicle is entered through toll plaza the data is transferred into the master NodeMCU and commands the salve which is present in the car to activate the relay. It makes the car get the power through road wirelessly.

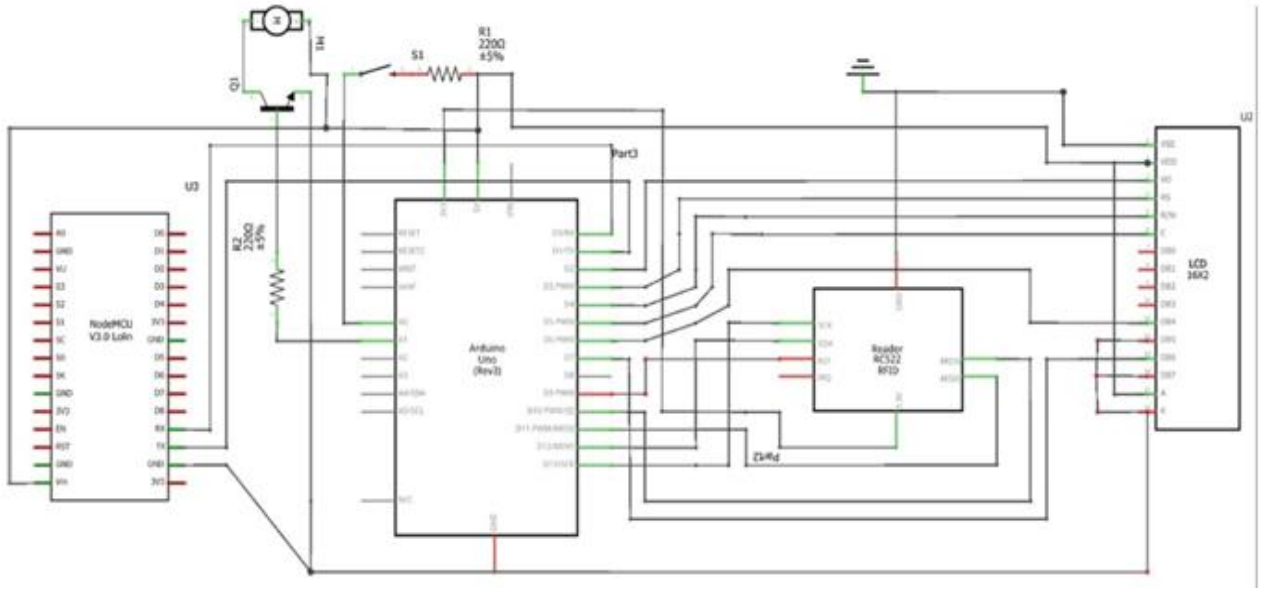

Fig. 2.Schematic Diagram of RFID Toll System

5. WORKING

Initially when RFID card gets read by RC522 the data is transmitted to RFID reader and passes message Arduino Uno.The Arduino displays the vehicle number connected to the RFID card.Simultaneously the Arduino sends the data to NodeMCU to obtain node to node communication and turns the connected pin of salve NodeMCU to the ON state.

The primary coil are embedded into the road concrete at a certain distance with high voltage, high frequency AC source and the secondary coil is mounted underneath the vehicles. When the EVs pass over the transmitter, it receives a magnetic field through a receiver coil and converts it to DC to the charge the vehicle by using the power converter. The Wireless power transform is illustrated in Fig.4

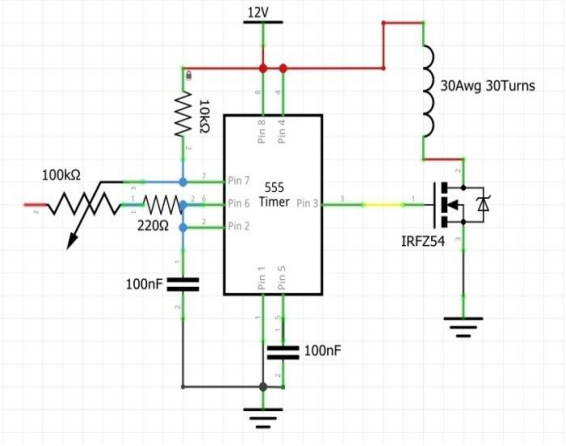

Fig. 4.Wireless power transfer Circuit

The coils which are present in the road are in segmented form if we want it long roads then it will be arranged in large segments with morewindings made of copper. Here we use 555 Timer IC and potentiometer and a mosfet IRFZ5.It get the power from 8th pin and excess power discharged from discharge(7th) pin, output from 3rd pin.

Both primary and secondary coils have some specifications like certain cross sectional area, Quality factor, Inductance, Number of turns and certain diameter of both inner and outer part of coil.

Windings		Primary	Secondary
Number of turns(N)		25	43
Diameter(mm)	Inner	48	30
	Outer	130	105
Cross sectional area of the copper(mm^2)		1.5	0.64
Inductance(µH)	Calculated	60	122
	Simulated	59	124
	Measured	59	123
Quality Factor(Q)@100KHz		185	107

Table. I Specifications of the transmitter and receiver coils

6. RESULT AND DISCUSSION

At first we use RFID tag to get access to that road when we keep RFID tag near to the RFID reader it give access to the vehicle and we can see the data in display after that the power transmission is started in road and car gets power by the circuit which is present in the car by Inductive power transfer method.

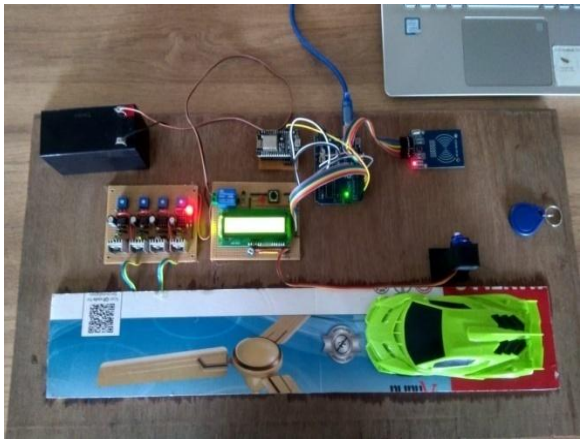

Fig.5 Dynamic Vehicle Charging System

When car completes the raid in that certain road again by using RFID system it getaccess to exit and the power transmission also stops. So when there is a vehicle in that road then only the power is transmitted or elsethe power supply is stopped.

These are the advantages:

Smaller number of batteries and reduces the capital cost.Frequent charging of batteries prevents battery depletion and longer life.Unlimited mobility and no recharging hassles.Low installation and maintenance requirements.Very short delay regarding the moving of the vehicles.

Future Scope is with the help of a self-driving car in future, it will help to create the perfect alignment between the transmitter and receiver coils which can significantly improve the overall power transfer efficiency and Increase the range.

7. CONCLUSION

This paper presents a basic overview of the WEVCS for dynamic applications with current researched technology. In addition, we added the Toll system and node to node communication, which have been utilized in best way. Health and safety issues have been raised and current developments in international standards are tabled for WEVCS, with current research and development from a variety of public and private organizations. Here we included the node to node which is useful to get a data of each vehicle

and prevent from no other vehicles are passing through the road.

Finally, upcoming future technologies are investigated and simulated with the utilization of WPT. Overall, the latest developments in the area of WEVCS are included in this article.

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