Design of O-T-G Charging system for Next-Gen Electric Vehicles

Santhosh M[1], Mr.Vasanthaseelan S[2].

[1]*Dept. of Automobile engineering, SNS College of Technology, Coimbatore-35,*
[2]*Assistant Professor, Dept. of Automobile Engineering, SNS College of technology, Tamilnadu, India*

---***---

Abstract - *In a modern world, the E-Vehicles are one of the greatest revolutions in the automobile field. As it reduces the pollution in the environment in a large amount. As we are near to the extinction of using petroleum products thus the world is moving to the some other form of energy for the utilization of the vehicles. It is that electrical source of energy which is used for the functioning of the vehicles. Even in an electrical vehicle the battery is to be recharged at a certain level to run the vehicles. At first the charging system of the vehicles came with the plug-in type of charging the cars. Later the inventions were made in charging the cars wirelessly. In wireless car charging system the car will start to charge itself when it were been parked in a certain charging lane. But in my project I'm going to implement the on the go charging lane for vehicles. In this system the vehicle will starts automatically in motion (Driving).*

Key Words: **On the go charging system, Electrical cars usages, Ease the usage of the Electrical vehicles, Reduce in the environmental pollution**

1. INTRODUCTION

The main idea of the project is to fabricate the charging system to charge the electric vehicles during its movement. By having this there is no car can be left low availability of charge for driving. The charging of the vehicle is done by means of the mutual induction principle. Wireless charging uses a process called electromagnetic induction to transfer energy. On the ground there is a pad

in which electricity is passed through a coil of wire to generate a magnetic field. This is then transferred to a receiver on the underside of the car. If the technology

Works it could mean that drivers can top up their car as they drive along meaning there could be longer periods between charging. Wireless charging roads could be developed to recharge electric cars while they drive along to solve some issues with limited infrastructure to support ownership of these vehicles. These system is been introduced to charge the cars automatically while driving. The charging system will automatically stops charging when it completely charges then it will starts to charge when it reaches a certain lower level of battery. These were controlled by means of sensors and relays. Drivers of electric vehicles should be able to charge their car in the future while they are driving. This shall be enabled via inductive charging. Hereby, alternating current generates a magnetic field within a charging plate, which induces the current into the vehicle. The alternating current is transformed into direct current and is fed into the battery.

This type of charging system for the car will provide ease in using the E vehicles for the passengers. As it charges the car automatically while in driving. There is no need in wasting the time separately for charging the cars in a specific place. Even no cars will be left on low charge as the charging stations are far apart. Having the lane which will charge the car even in driving will enhance the usage of the E-Vehicles and thus reduces the environmental pollution.

2. SELECTION OF COMPONENTS

Before you begin to format your paper, first write and save the content as a separate text file. Keep your text and graphic files separate until after the text has been formatted and styled. Do not use hard tabs, and limit use of hard returns to only one return at the end of a paragraph. Do not add any kind of pagination anywhere in the paper. Do not number text heads-the template will do that for you.

Finally, complete content and organizational editing before formatting. Please take note of the following items when proofreading spelling and grammar:

2.1 ELECTRIC VEHICLES

An electric vehicle, also called an EV, uses one or more electric motors or traction motors for propulsion. An electric vehicle may be powered through a collector system by electricity from off-vehicle sources, or may be self-contained with a battery, solar panels or an electric generator to convert fuel to electricity. EVs include, but are not limited to, road and rail vehicles, surface and underwater vessels, electric aircraft and electric spacecraft.

Although EVs have few direct emissions, all rely on energy created through electricity generation, and will usually emit pollution and generate waste, unless it is generated by renewable source power plants. Since EVs use whatever electricity is delivered by their electrical utility/grid operator, EVs can be made more or less efficient, polluting and expensive to run, by modifying the electrical generating stations. This would be done by an electrical utility under a government energy policy, in a timescale negotiated between utilities and government.

Fossil fuel vehicle efficiency and pollution standards take years to filter through a nation's fleet of vehicles. New efficiency and pollution standards rely on the purchase of new vehicles, often as the current vehicles already on the road reach their end-of-life. Only a few nations set a retirement age for old vehicles, such as Japan or Singapore, forcing periodic upgrading of all vehicles already on the road.

2.2 CHARGING OF E-VEHICLES

Electric vehicles are plugged for charging on the existing electrical grid infrastructure, but sometimes the electrical infrastructure is inadequate for supporting this additional energy demand of high power fast charging stations. Moreover, the presence of several concurrent charging requests could cause overload conditions in local nodes of the grid, if the charging processes of the PEVs are not properly managed and scheduled. One alternative to fast charging stations is to have mobile charging systems (MCSs)with a high storage Capacity and a mobile charging system for electric vehicles is presented in these stations can be a solution when the electrical infrastructure of the local grid is unable to support high power fast charging stations

2.3. PLUG-IN CHARGING:

A plug-in electric vehicle (PEV) is any motor vehicle that can be recharged from any external source of electricity, such as wall sockets, and the electricity stored in the rechargeable battery packs drives or contributes to drive the wheels. PEV is a subcategory of electric vehicles that includes all-electric or battery electric vehicles (BEVs), plug-in hybrid vehicles, (PHEVs), and electric vehicle conversions of hybrid electric vehicles and conventional internal combustion engine vehicles.

Cumulative global sales of highway-capable light-duty pure electric vehicles passed one million units in total, globally, in September 2016. Cumulative global sales of plug-in cars and utility vans totaled over 2 million by the end of 2016, of which 38% were sold in 2016, and the 3 million milestones was achieved in November 2017.

As of January 2018, the world's top selling plug-in electric cars is the Nissan Leaf, with global sales of more than 300,000 units. As of June 2016, it was followed by the all-electric Tesla Model S with about 129,400 units sold worldwide, the Chevrolet Volt plug-in hybrid, which together with its sibling the Opel/Vauxhall Ampera has combined global sales of about 117,300 units, the Mitsubishi Outlander P-HEV with about 107,400 units, and the Prius Plug-in Hybrid with over 75,400 units.

2.4. STATIC WIRELESS CHARGING:

Wireless charging is a popular upcoming technology with uses ranging from mobile phone charging through to electric vehicle (EV) charging. Large air gaps found in current EV wireless charging systems (WCS) pose a hurdle of its success. Air gaps in WCS cause issues in regards to efficiency, power transfer and electromagnetic compatibility (EMC) leakage issues. A static In-Wheel WCS (IW-WCS) is presented which significantly reduces the issues associated with large air gaps. A small scale laboratory prototype; utilizing a standard 10mm steel reinforced tire, has been created and compared to a typical 30mm air gap. The IW-WCS has been investigated by experimental and finite element method (FEM) based electro-magnetic field simulation methods to validate performance

2.5 .DYNAMIC WIRELESS CHARGING:

Dynamic wireless charging of electric vehicles (EVs) is becoming a preferred method since it enables power exchange between the vehicle and the grid while the vehicle is moving. In this article, we present mobile energy disseminators (MED), a new concept, that can facilitate EVs to extend their range in a typical urban scenario. Our proposed method exploits Inter-Vehicle communications in order to eco-route electric vehicles taking advantage of the existence of MEDs. Combining modern communications between vehicles and state of the art technologies on energy transfer, vehicles can extend their travel time without the need for large batteries or extremely costly infrastructure. Furthermore, by applying intelligent decision mechanisms we can further improve the performance of the method.

2.6. EMBEDDED SYSTEM:

An embedded system is a controller programmed and controlled by a real-time operating system (RTOS) with a dedicated function within a larger mechanical or electrical system, often with real-time computing constraints. It is embedded as part of a complete device often including hardware and mechanical parts. Embedded systems control many devices in common use today. Ninety-eight percent of all microprocessors manufactured are used in embedded systems.

2.7. MICROCONTROLLER

The microcontroller controls the AC to DC convertor and the relay switch. The relay switches which allows the current charges to flow across it when the battery charge is low and stops flowing of charges across it when the battery percentage is high. The function of this relay switches, AC to DC convertor and induction plates functions where been controlled by the microcontroller.

A Microcontroller is a small computer on a single integrated circuit containing a processor core, memory, and programmable input/output peripherals. Program memory in the form of Ferroelectric RAM is also often used included on chip as well as a typically small amount of RAM. Microcontrollers are designed for embedded applications, in contrast to the microprocessors used in personal computers or other general purposes applications consisting if discrete chips.

Microcontrollers are used in automatically controlled products and devices, such as automobile engine control systems, implantable medical devices, remote controls, office machines, appliances, power tools, toys and other embedded systems. By reducing the size and cost compared to a design that uses a separate microprocessor, memory, and input/output devices, microcontrollers make it economical to digitally control even more devices and processes. Mixed signal microcontrollers are common, integrating analog components needed to control non-digital electronic system

Some microcontrollers may use four-bit words and operate at frequencies as low as 4 kHz, for low power consumption (single-digit mill watts or microwatts). They generally have the ability to retain functionality while waiting for an event such as a button press or other interrupt; power consumption while sleeping (CPU clock and most peripherals off) may be just Nano watts, making many of them well suited for long lasting battery applications. Other microcontrollers may serve performance-critical roles, where they may need to act more like a digital signal processor (DSP), with higher clock speeds and power consumption

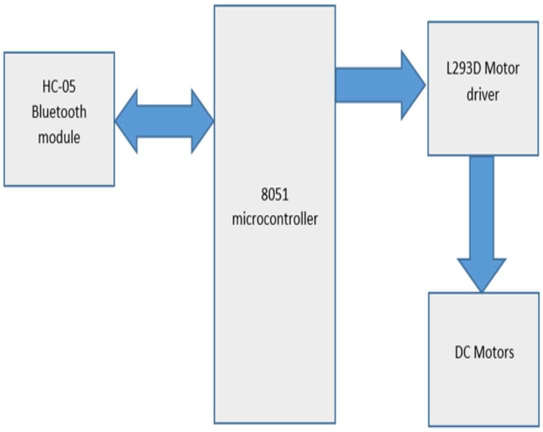


FIG 1. MICROCONTROLLER

2.8 PIC CONTROLLER

PIC CONTROLLER USED-PICI6F877A/887

The PIC16F877A/887 Development Board can be used to evaluate and demonstrate the capabilities of Microchip PIC16F877A/887 microcontroller. In this development board compatible with 16F/18F series of microcontroller. The MCU socket on board provides support for 40 pin DIP package of PIC16F877A/887 controller. The board is designed for general purpose applications and includes a variety of hardware to exercise microcontroller peripherals. It is a fantastic tool for code debugging, development and prototyping. The components used in this board are of high quality and the PCB is high quality two layer PTH PCB, which makes this board especially durable. When you start using the PIC16F877A/887 Development Board you will find it to be one of the best development tools available for PIC16F877A/887 controller.

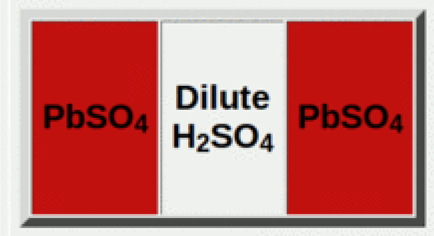
FIG 2.PIC CONTROLLER

FIG 3. PROCESSOR

2.9. LEAD ACID BATTERY

AP12-1.3(12V/1.3Ah)

1) DISCHARGE



Fully discharged: two identical lead sulphate plates

In the discharged state both the positive and negative plates become lead(II) sulphate ($PbSO_4$), and the electrolyte loses much of its dissolved sulphuric acid and becomes primarily water. The discharge process is driven by the pronounced reduction in energy when 2 H^+(aq) (hydrated protons) of the acid react with O^{2-} ions of PbO_2 to form the strong O-H bonds in H_2O (ca. -880 kJ per 18 g of water). This highly exergonic process also compensates for the energetically unfavorable formation of Pb^{2+}(aq) ions or lead sulphate ($PbSO_4$(s))

NEGATIVE PLATE REACTION

$Pb(s) + HSO^-_4(aq) \rightarrow PbSO_4(s) + H^+(aq) + 2e^-$ The release of two conducting electrons gives the lead electrode a negative charge

As electrons accumulate they create an electric field which attracts hydrogen ions and repels sulfate ions, leading to a double-layer near the surface. The hydrogen ions screen the charged electrode from the solution which limits further reaction unless charge is allowed to flow out of electrode.

POSITIVE PLATE REACTION

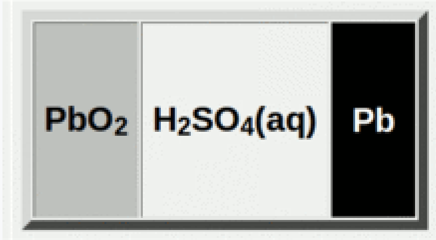
$PbO_2(s) + HSO^-_4(aq) + 3H^+(aq) + 2e^- \rightarrow PbSO_4(s) + 2H_2O(l)$

Taking advantage of the metallic conductivity of PbO_2. The total reaction can be written as

$Pb(s) + PbO_2(s) + 2H_2SO_4(aq) \rightarrow 2PbSO_4(s) + 2H_2O(l) = 2.05$ V

The net energy released per mol (207 g) of Pb(s) converted to $PbSO_4$(s), or per 36 g of water formed, is ca. 400 kJ. The sum of the molecular masses of the reactants is 642.6 g/mol, so theoretically a cell can produce two faradays of charge (192,971 coulombs) from 642.6 g of reactants, or 83.4 ampere-hours per kilogram (or 13.9 ampere-hours per kilogram for a 12-volt battery). For a 2 volts cell, this comes to 167 watt-hours per kilogram of reactants, but a lead–acid cell in practice gives only 30–40 watt-hours per kilogram of battery, due to the mass of the water and other constituent parts.

2) CHARGING



Fully recharged: Lead negative plate, Lead dioxide positive plate and Sulphuric acid electrolyte

In the fully charged state, the negative plate consists of lead, and the positive plate lead dioxide, with the electrolyte of concentrated Sulphuric acid, which stores most of the chemical energy.

Overcharging with high charging voltages generates oxygen and hydrogen gas by electrolysis of water, which is lost to the cell. The design of some types of lead-acid battery allows the electrolyte level to be inspected and topped up with any water that has been lost.

Due to the freezing-point depression of the electrolyte, as the battery discharges and the concentration of Sulphuric acid decreases, the electrolyte is more likely to freeze during winter weather when discharged.

3) ION MOTION

During discharge, H^+ produced at the negative plates moves into the electrolyte solution and then is consumed into the positive plates, while HSO^-_4 is consumed at both plates. The reverse occurs during charge. This motion can be by electrically driven proton flow or Grotthuss mechanism, or by diffusion through the medium, or by flow of a liquid electrolyte medium. Since the density is greater when the sulphuric acid concentration is higher, the liquid will tend to circulate by convection. Therefore, a liquid-medium cell tends to rapidly discharge and rapidly charge more efficiently than an otherwise similar gel cell.

FIG 4.LEAD ACID BATTERY

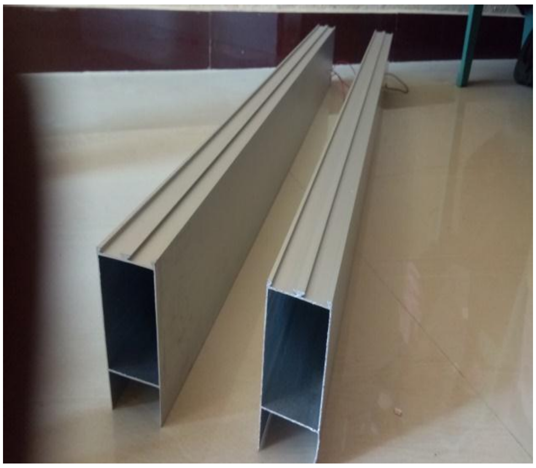


Fig 5.ALUMINUM CHANNEL

2.10. ALUMINUM CONDUCTORS

Aluminum is the most widely used non-ferrous metal. The global production of aluminum in 2016 was 58.8 million metric tons. It exceeded that of any other metal except iron (1,231 million metric tons).

Aluminum is almost always alloyed, which markedly improves its mechanical properties, especially when tempered. For example, the common aluminum foils and beverage cans are alloys of 92% to 99% aluminum. The main alloying agents are copper, zinc, magnesium, manganese, and silicon (e.g., duralumin) with the levels of other metals in a few percent by weight. Density: 2.7 g/cm^3

The major uses for aluminum metal are In:

- Transportation (automobiles, aircraft, trucks, railway cars, marine vessels, bicycles, spacecraft, etc.). Aluminum is used because of its low density;
- Packaging (cans, foil, frame etc.). Aluminum is used because it is non-toxic, non-adsorptive, and splinter-proof;
- Building and construction (windows, doors, siding, building wire, sheathing, roofing, etc.). Since steel is cheaper, Aluminum is used when lightness, corrosion resistance, or engineering features are important;
- Electricity-related uses (conductor alloys, motors and generators, transformers, capacitors, etc.). Aluminum is used because it is relatively cheap, highly conductive, has adequate mechanical strength and low density, and resists corrosion;

3. WORKING PRINCIPLE

In a modern world the usage of electric vehicles has been growing day by day. As the usage of E-vehicles is growing day by day the major key for usage of E-Vehicle has to increase gradually. So thus the charging stations were implemented certain places. But still due to lack of availability of the charging stations in roadsides the usage of E-vehicles is been reduced.

Later the wireless charging of the cars were been used where we can charge our car whenever we needed. Thus it's been static the dynamic charging for the cars were been introduced.

Where the road surface is been acts as a transmitter of charge to the E-Vehicles and the cars receives the charge and stores in the battery. The road is lied with the conductors which is been used to supply the electric current continuously. Where the AC current is converted into DC current by means of AC to DC convertor. Later it's been stored in the car battery for later purposes.

Here separate lane is been laid for charging of the vehicles where it's been fully electrified. The car starts charging when it enters the lane and it has battery percentage below 45% and it won't get charged when the battery percentage is full.

Here the conductors are of the copper coil which induces the electric current at the road. The principle of magnetic induction is been used in this operation. When the EMF is induced then there is a change in the magnetic field on the coil. Thus there is the production of the electric current which is used for the charging

4. IMPLEMENTATION OF PROJECT

The project is implemented in such a way of a prototype model of a car and a lay road.

Where the aluminum is used as a conductor which supplies the electric current to the E- Vehicles wirelessly. In this the car is made to run over a conductor which is been electrified, so that the conductor which present in the Car roll over the aluminum conductor. So that the current flow through the conductor towards the cars battery. The current stored in the cars battery. Then the current is used to run vehicle.

In general the Aluminum conductor acts like road surface which is electrified to supply electric current.

FIG 6. PROTOTYPE MODEL OF OTG CHARGING SYSTEM

5. PROJECT OUTCOME

A.CONTIBUTION TO SOCIETY/ENVIRONMENT

- To give the pollution free environment for the society.
- Even the electricity for the car charging too provided by means of the solar energy. Seamless to use electric vehicle as energy is adequately available for charging the cars.
- The dynamic electric vehicle charging (DEVC) system can charge electric vehicles as they drive over the charger.
- If electric cars could recharge while driving down a highway, it would virtually eliminate concerns about their range and lower their cost, perhaps making electricity the standard fuel for vehicles.

6. CONCLUSIONS

The On-The-Go charging system for the Electric vehicles is been used to get charged the E-vehicles while driving itself. We don't have to waste time for charging our E-vehicle; we can charge the vehicles in our travelling itself. This will save our time and had a large impact for using E-Vehicles in future.

This will be Eco-Friendly which do not produce any pollution to environment and easy to use. As we are running out of fossil fuels this will encourage most of the people to use the E- vehicles.

FIG 7. PROTOTYPE MODEL

REFERENCES

[1] S.Y.R. Hui and W.W.C Ho, [2005] "A new generation of universal contactless battery charging platform for portable Consumer Electronic equipment," 'IEEE Trans. Power Electronics', vol. 20, pp. 620-627.

[2]S. Brehaut and F. Costa [2006], "Gate driving of high power IGBT by wireless transmission," 'International Power Electronics Motion Control, 2006', 5th 'IEEE IPEMC 2006. Conference record of the 2006 IEEE', pp. 1-5, vol.1.

[3] O. Lucia, L. A. Barragan, J. M. Burdio, O. Jiménez, and D. Navarro[2011], "A versatile power electronics test-bench architecture applied to domestic induction heating," 'IEEE Trans. on Industrial Electronics', vol. 58, no. 3, pp. 998-1007.

[4] M. Ibrahim, L. Bernard, L. Pichon, A. Razek, J. Houivet and O. Cayol[2015], "Advanced modeling of a 2-kw series–series resonating inductive charger for real electric vehicle," 'IEEE Trans. on Vehicular Technology', vol. 64, no. 2, pp. 421–430.

[5] A. J. Moradewicz and M. P. Kazmierkowski [2010], "Contactless energy transfer system with FPGA-controlled resonant converter," 'IEEE Trans. Ind. Electron', vol. 57, no. 9, pp. 3181–3190, Sep. 2010.

[6] S. Williamson, A. Khaligh, S. Oh, and A. Emadi[2005], "Impact of energy storage device selection on the overall drive train efficiency and performance of heavy-duty hybrid vehicles," in Proc. 'IEEE Vehicle Power Propulsion Conf'., pp. 381–390.

[7] Y. Zhang, Z. Jiang, and X. Yu[2008], "Control strategies for battery/supercapacitor hybrid energy storage systems," in Proc. 'IEEE Energy 2030 Conf.', pp. 1–6.

[8] Y. Zhang, L. Wu, X. Hu, and H. Liang[2008], "Model and control for supercapacitor-based energy storage system

for metro vehicles," in Proc. 'Int. Conf. Elect. Mach. Syst', pp. 2695–2697.

[9] Y. Lu, H. Hess, and D. Edwards[2007], "Adaptive control of an ultracapacitor energy storage system for hybrid electric vehicles," in Proc.'IEEE Elect. Mach. Drives Conf', vol. 1, pp. 129–133.

[10] Z. Li, O. Onar, A. Khaligh, and E. Schaltz [2009], "Design and control of a multiple input dc/dc converter for battery/ultra-capacitor based electric vehicle power system," in Proc. '24th IEEE Appl. Power Electron. Conf. Expo', pp. 591–596.

[11] Hui Zhi (Zak) Beh, Grant A. Covic, and John T. Boys[2015] "Wireless Fleet Charging System for Electric Bicycles" 'IEEE journal of emerging and selected topics in power electronics', vol. 3, no. 1.

[12] H. H. Wu, J. T. Boys, and G. A. Covic [2010], "An AC processing pickup for IPT systems," 'IEEE Trans. Power Electron'. vol.25, no. 5, pp. 1275– 1284.

[13] H. H. Wu, G. A. Covic, J. T. Boys, and D. J. Robertson [2011], "A series-tuned inductive-power-transfer pickup with a controllable AC-voltage output," 'IEEE Trans. Power Electron'. vol. 26, no. 1, pp. 98–109.

[14] J. Sallan, J. L. Villa, A. Llombart, and J. F. Sanz[2009], "Optimal design of ICPT systems applied to electric vehicle battery charge," 'IEEE Trans. Ind. Electron'., vol. 56, no. 6, pp. 2140–2149.

[15] K. Swain, M. J. Neath, U. K. Madawala, and D. J. Thrima with ana[2012], "A dynamic multivariable state-space model for bidirectional inductive power transfer systems," 'IEEE Trans. Power Electron'., vol. 27, no. 11, pp. 4772– 4780.

[16]D.Promiti[2013],"Coordinatingrendezvouspointsforinductivepowertransfer between electric vehicles to increase effective driving distance," in Proceedings of the 2nd 'International Conference on Connected Vehicles and Expo (ICCVE)', Las Vegas, USA.

[17] C. Donna, M. K. Kara, and K. Moby [2013], "The electric vehicle charging station location problem: A parking-based assignment method for Seattle," in Proceedings of the '92nd Annual Meeting of the Transportation Research Board'.

[18] I. Frade, A. Ribeiro, G. Goncalves, and A. Antunes [2011], "Optimal location of charging stations for electric vehicles in a neighborhood in Lisbon, Portugal," in 'Transportation Research Record: Journal of the Transportation Research Board', No. 2252: 91-98.

[19] N. Lagraa, M. B. Yagoubi, S. Benkouider et al [2010], "Localization technique in vanets uses clustering (lvc)," 'IJCSI'.

[20] M. Neaimeh, G. Hill, Y. Hubner, and P. Blythe[2013], "Routing systems to extend the driving range of electric vehicles," 'Intelligent Transport Systems, IET', vol. 7, no. 3, pp. 327–336.