AN OVERVIEW OF BURIED POWER LINE FOR ROADWAY-POWERED ELECTRIC VEHICLE SYSTEM

Dasari Venkatesh*, Jimmy Singla
School of Computer Science and Engineering
Lovely Professional University
Phagwara,Punjab, india.

***Abstract*—This paper mainly explains about the implementation and advantages of using buried power line for roadway-powered electric vehicles and OLEV (Online Electric Vehicle System). Most importantly it discusses about the cost efficiency of the online electric vehicle system and some of the results of various simulations are explained.**

***Keywords*—Buried powerlines, online vehicle system,wireless method of power tranfer,Buried power lines.**

I. INTRODUCTION

In the current era of technology involved in transportation system, we can see the electricity driven vehicles like tesla electric cars having a huge impact in the future. The electricity driven vehicles were first introduced with a focus on reducing the usage of fossil fuels such a diesel and petroleum that are the major cause for the increase in the level of carbon monoxide (CO) and other harmful gases in the environment. However, these electricity driven vehicles have their own downsides one of them being battery (charge, capacity and weight). This paper explains how that situation could be tackled with the use of Buried powerline for the Roadway-powered electric vehicle system and OLEV (Online Electric Vehicle System). A company named KAIST came up with the idea of OLEV to solve the battery problems in electricity-powered vehicles. The main objective of OLEV is to keep the battery of vehicle charged all the time either its in motion or at a full stop. In order to achieve this, the powerlines must be buried under the road at a certain dept so that the charge produced can reach the vehicle moving on it. However, the prerequisite for this implementation is to do excavation and then bury those powerlines which are linked to a power relay system at equal distances between them. This is a huge barrier for the commercialisation of this concept as the budget for excavation of roads that are already laid would be huge. Once the initial stage is done, the operation and maintenance cost would be significantly low compared to the budget for initial stage.
The picture below explains the basic working mechanism of how the online electric vehicle gets charged while it is at halt.

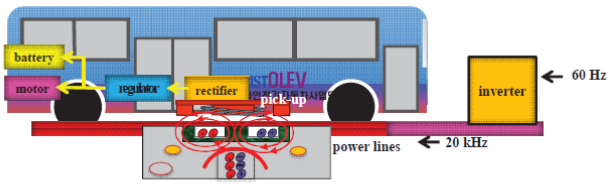


Fig. 1. Online Electric Vehicle (OLEV) system

The major components used for the implementation of OLEV (Online Electric Vehicle System) are a battery that is stored the vehicle for storing the electricity charge, an electric motor situated right under the battery to reduce the random electric discharges during wireless transfer, a regulator for controlling the flow of electricity from buried powerlines to the battery in the vehicle, a rectifier to connect the vehicle to the powerlines buried in the road and finally an inverter for the conversion of electricity.

.

II. ONLINE ELECTRIC VEHICLE SYSTEM (OLEV)

OLEV is an unique wireless power transfer system the utilizes magnetic field which is generated by the powerlines buried under the road and converts it into the electric charge that powers up the battery in the vehicle that is connected to the road while at halt or in motion.The OLEV system is basically comprised of a battery, an electric motor, a regulator and an inverter with a rectifier connecting them. The inverter is the important segements the helps

to convert the electricity for the road coming flowing into the battery safely. An input power of 60HZ could be converted into an output of 20 KHZ with the help of inverter.

The electricity is flowing through the road with the help of powerlines which is made up of core blocks of ferrite and few other mechanical components including

a magnetic flux in active state and in a shape facing the road direction.

The are a few pick up modules located under every online electric vehicle which is used to connect the vehicle to the powerline module and initiate the electricity flow and charge the battery in the vehicle. At this stage , most of the work is done by the rectifier component that helps to convert Alternating current t(AC) into Direct current (DC) . The rectifier is located in the pickup module which reduces the time it takes for the current conversion. The following picture explains the basic structure of the pickup module and powerline module of the online electric vehicle system(OLEV).

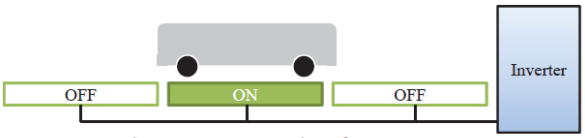


Fig. 2. Segment operation of OLEV system

The following picture shows the isometric view of the convertional OLEV powerline segment.

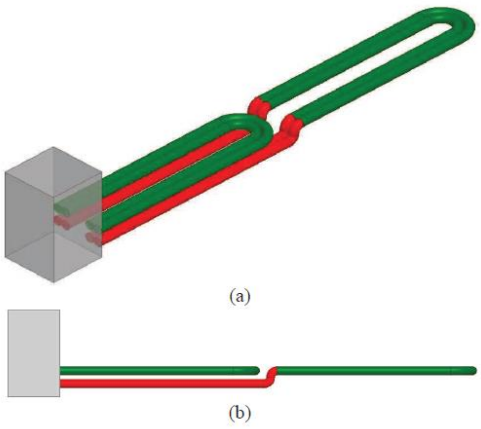
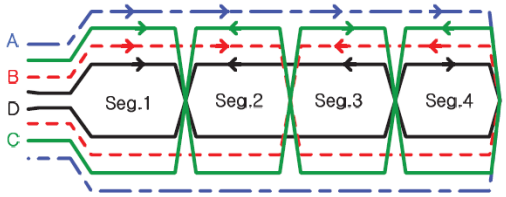


Fig. 3. Conventional OLEV power line segments (a) isometric view and (b) side view

III. SEGMENT OPERATIONS

As explained in the picture above the powerline segement that is buried under the road is connected to long electricity carrying wires extending throughout the road. The component that controls the powerline segment is the inverter. It is responsible to powering on the segment whenever a vehicle approaches the powerline segement. The inverter is designed in such a way that when any vehicle comes at a full stop in its specific range, it automatically triggers the powerline segment and signals the rectifier to connect itself to the power line segment inorder to start the flow of electricity. The following diagram explains the functioning of the powerline segment and working instructions of the inverter.

–



(a)

Direction			Segment			
B loop	C loop	D loop	#1	#2	#3	#4
Forward	**Forward**	**Forward**	**on**	off	off	off
Forward	Reverse	Reverse	off	**on**	off	off
Reverse	**Forward**	Reverse	off	off	**on**	off
Reverse	Reverse	**Forward**	off	off	off	**on**

(b)

The first design explains how the electricity from different powerlines is distributed among the powerline modules and their segments with the help of long buried electric wires.

Since the electricity is cycling between the segments, the wastage is power is kept to a minimal. It also depends on the distance between each power module. The more the distance between is, the more the amount of electricity required is going to be to keep the powerline segments active at all times. When the first segment is turned on , the magnetic field travelling in between the segments gets caught in a superloop which cancels eachother out thus converting the electricity into AC currents.

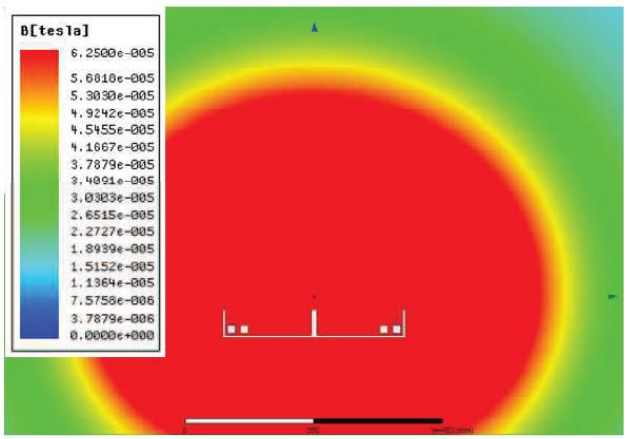
1) 2-segmentimplementation

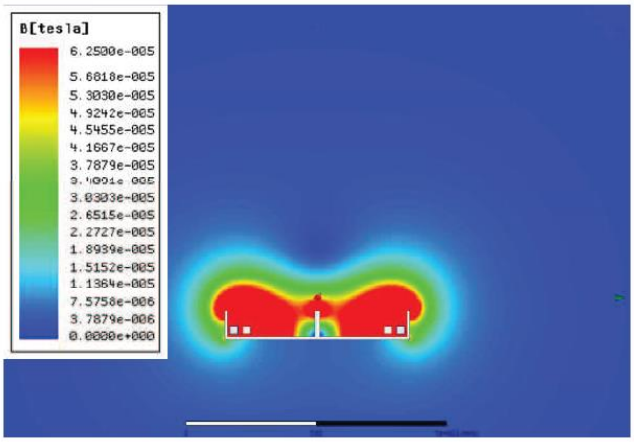
In this 2-segment operation, as shown in the picture above, we use two half current cables that includes loop for A and another loop for B. In order to power on the first segment, the same Alternating current is sent to both A loop and B loop. As a result, the superposition of the magnetic field occurs that ultimately ends up cancelling out each other which further helps for the activation of the second segment.

For the activation of the second segment, the alternating current of opposite phase which almost has a phase angle of 180 degrees. As a result,the cancellation of magnetic fields of both A and B takes place and causes superposition in the second segment. The same procedure would take place in the third segment implementation.

The direction of the current flow in A loop is controlled by the direction of the current flow in B loop.In the same way, if there is a four segment implementation, same alternating power is sent for A loop to the 4 th loop which is B.

The following picture explains the magnetic field distribution during the segement operations in powerline module

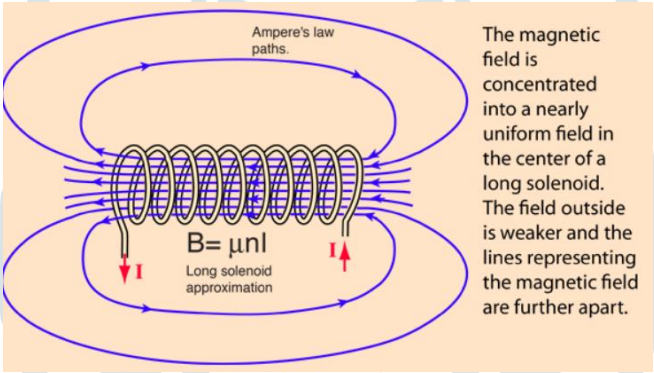




As per the results from the simulation, the average flux in the magnetic field is 50cm, 100cm, 150cm from the surface of the road was 15.2Mg.

An inverter works by applying a DC power source that is unidirectional and its main purpose is to mimic AC current. Inverters are basically oscillators which are capable of shifting the Direct current power source. This helps to create a square wave effectively.

Most of the electronic devices now a days require an approximate sine wave. So almost all kinds of inverters contain some additional components that helps to create a pure sine wave to remove all the anomalies and approximations.



The expression given above, we can derive the formula for ‘n’ which is number of turns per unit length which is n=N/L. It is also known as “turn density’.The magnetic field is denoted by ‘B’ and it is directly proportional to the current I. The current I is the amount of current that is passing through the buried powerlines. The length is taken for a solenoid of infinite length which in this case is the length of coils in our power module and rectifier.

IV. CONCLUSION

In this paper, we explained the working of an Online Electric Vehicle System (OLEV) . The paper also explained the working of segmentation implementation in powerline modules and intake module of the vehicle that powers the vehicle.

Although this system is very effective when it comes to cost, the initial investment would be a lot more that it takes to maintain the system since this methods requires us to remove all the paved roads in order

To bury the powerlines in them which would cause a huge traffic problems in the initial stages but once the system is implements , it becomes extremely cost efficient.

REFERENCES

[1] PATH team, "Roadway powered electric vehicle project track construction and testing programphase 3D, "Partners for Advanced Transit and Highways (PATH) research reports (http://www.path.berkeley.edu), Mar.1994.

[2] J. Shin, B. Song, S. Lee, S. Shin, Y. Kim, G. Jung and S. Jeon, "Contactless power transfer systems for on-line electric vehicle (OLEV),"in*Proc.IEEEInt.ElectricVehicleConf.*,Mar.2012,pp.1-4.

[3] S. Shin, J. Shin, Y. Kim, S. Lee, B. Song, G. Jung and S. Jeon, "Hybrid inverter segmentation control for online electric vehicle," in *Proc. IEEE Int. Electric Vehicle Conf.*, Mar. 2012, pp.1-6.

[4] J. Shin, S. Shin, Y. Kim, S. Lee, B. Song and G. Jung, "Optimal current control of a wireless power transfer system for high power efficiency," in *Proc. IEEE Int. Conf. Electrical Systems for Aircraft, Railway and Ship Propulsion*, Oct. 2012, pp.1-4.

[5] B. Song, J. Shin, S. Lee, S. Shin, Y. Kim, S. Jeon and G. Jung, "Design of a high power transfer pickup for on-line electric vehicle (OLEV)" in *Proc. IEEE Int. Electric Vehicle Conf.*, Mar. 2012, pp.1-4.

[6] J. Shin, S. Shin, Y. Kim, S. Ahn, S. Lee, G. Jung, S. Jeon and D. Cho, "Design and implementation of shaped magnetic resonance based wireless power transfer system for roadway-powered moving electric vehicles," *IEEE Trans. Ind. Electron.*, inpress

[7] Singla, Jimmy, and Raman Goyal. "A systematic way of affine transformation using image registration." International Journal of Infomation Technology and Knowledge Management 5 (2012): 239-243.

[8] Singla, Jimmy. "Technique of Image Registration in Digital Image Processing: a Review." International Journal of Information Technology and Knowledge Management 5.2 (2012): 239-243.

[9] Gupta, Shaveta, and Jimmy Singla. "A component-based approach for test case generation." International Journal of Information Technology 5.2 (2012): 239-243.