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DESIGN OF WIRELESS METHOD FOR ONLINE ELECTRICAL VEHICLE

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ABSTRACT

For example, the On-Line Electric Vehicle (OLEV) is a new way to get around that runs on energy and gets power from power receivers hidden underground. The OLEV's battery can be charged while the vehicle is moving, which is different from regular electric vehicles that need a lot of downtime to be charged. The OLEV should be thought about as a possible option for the next wave of electric public buses. The prototype of the bus built on OLEVs has been made, and the process of making it available to the public will now begin. This project shows a working model and an optimization method for setting up the power receivers and figuring out the battery capacity of an OLEV system that runs on a set route with wireless battery control.

INTRODUCTION

1.1 BACKGROUND

1.2 In the past few years, automakers and academics have come up with a lot of different ideas for a new electric transportation system to meet the needs of the market, society, and the economy. Even though some companies have already shown ideas and examples for electric cars like "plug-in" electric cars, the goods can't be sold just yet because of technical and financial issues.

1.3 The energy stored in most electric cars on the market so far comes from batteries.

1.4 Getting the energy back into the battery is similar to how IC-engine vehicles are charged. The motor in the vehicle uses the electric power saved in the battery connected to the car, and the battery is charged at a charging point. There are, however, some technical issues with

1.5 electric cars that work in this way.

1.6 First, the distance you can drive for a fee is small. Unlike the IC engine, the battery can only hold a certain amount of power. Because of this, the electric car needs to stop at charging stations more often to get more power. Adding more batteries to the car is one way to fix this issue. The battery is big, heavy, and costs a lot, so this approach might not work.

1.7 Also, the present answer can't be sold in stores because it takes a long time to charge. In general, it takes at least two hours to charge a plug-in car. This long charging time makes the vehicle less useful and also needs a lot of space for the charging station to hold cars while they are being charged.

1.8 The On-Line Electric Vehicle (OLEV) is a new idea for an electric transportation system that gets around the problems with present electric cars.

1.9 ON-LINE ELECTRIC VEHICLE(OLEV)

The On-Line Electric Vehicle (OLEV) shown is a new type of electric vehicle.

a way for vehicles to get power from power receivers (shown as "Power Line" in the figure) that are buried underground.

Power receivers, which are inductive wires hidden in the road, make a magnetic field that gives the car the energy it needs. The power pick-up unit that is mounted under the vehicle gets electricity from a distance and sends it to either the vehicle's motor or the battery to charge it. The buried wires carry electricity to the OLEV all the time, whether it is moving or not. So, the OLEV makes it easier to fit electric vehicles with batteries that aren't too heavy or big.

The OLEV is being thought about as a possible option for the next wave of electric public buses. The OLEV-based bus prototype has been made, and now the process of making it available to the public is moving forward. One of the most important things that needs to be done before the system can be sold commercially is figuring out how to best place the power receivers on the road (Figure 1.1) and what the right battery size is. The most important design element is getting enough power to the bus with the power receivers, given the lines and bus operation rules.

The starting infrastructure cost is also affected by how the power sources are distributed and the size of the batteries. Since the OLEV is based on a new idea, not much study has been written about it yet. OLEV technology has come a long way. The inductive power supply (IPS) system now has a power source, transformers, power supply lines, pick-up modules, and a governor. It shows how the OLEV's design idea fits with Axiomatic Design Theory.

They described systems design issues in the OLEV and economic benefit of the system. However, they focus on the hardware of the vehicle and do not rigorously treat the OLEV as a vehicle transmitters- road integrated system.

1.10 GOAL OF THE PAPER ANDPROBLEM STATEMENT

As a first step in developing the allocation model, we present the OLEV system circulating on a fixed route in this paper . The stations loading/unloading passengers are also pre- defined. Also, we assume that the vehicle operates with a pre-defined velocity profile, and therefore the speed of the vehicle at a specific location on the route is deterministically defined.

We assume that the road condition such as up- hill or down-hill angles on the route is also given. With the information, the required energy for the vehicle at a specific point can be evaluated . The installation cost of each power transmitter unit and the power requirement are mathematically analysed. Although the deterministic assumption and given settings may not perfectly reflect the characteristics of an actual mass transportation system operating in a city, the model could be applied to the OLEV operating in a specialized environment.

The city government of Seoul recentlyadopted the OLEV technology to the trolley circulating in the amusement park as a test case before applying for an actual mass transportation . The vehicle is running at a speed between 20-40 km/h on the circular route with 2.18km. The main purpose of this deployment was to test the reliability of the new technology, and the cost was not considered as a primary issue. As a result, the transmitter allocation and battery size, which directly impact the total system cost, were not optimized for the systemyet.

Once the reliability is proven and the system is extended to a longer route, the cost issue is expected to be crucial . Then the optimization method proposed in this paper could be applied. Moreover, the value of the model and optimization method presented in this paper is not limited to the system circulating on a fixed route. This model could be used as a mathematical foundation and it could be extended to more realistic and complex system to be used for a mass transportation.

2. CONCEPT OF OLEV SYSTEM

2.1 ONLINE ELECTRIC VEHICLE

The wireless power transfer system for the OLEV is composed of an inverter, an inductive cable , a pickup device, a capacitor , a battery , and a motor as shown in Fig. 3.1. Power from the 60 - Hz supply is converted to a frequency of 20 kHz by the inverter , and a current of 200A flows through the inductive cable . The magnetic flux generated from the cable is collected by the pickup device to generate dc power for the vehicle motor.

When a vehicle is operating on a road with a power transmitter installed, as shown in the lower part of Fig.3.1 , the power pickup device installed underneath the vehicle remotely collects electricity from the transmitter and distributes the power either to the motor or to the battery or both , depending on the power requirement of the motor and the charging level of the battery .

However , when the OLEV is running where no power transmitter unit is installed , the motor in the vehicle uses the power from the battery . This situation is shown in the upper part of Fig. 2.1. The wireless power transmission technology enables the motor to receive power remotely while the vehicle is operating on the road hence, the vehicle does notneed to be idle while recharging the battery.

As a result, the OLEV does not need to carry a heavy and bulky battery . The disadvantage ofthe OLEV is the initial investment cost. Compared with the existing plug - in electric vehicle system , the OLEV requires a significant initial investment to build the power transmitters . However, this initial cost can be offset by the reduced battery size and increased operating time by eliminating the recharging downtime of the vehicles.

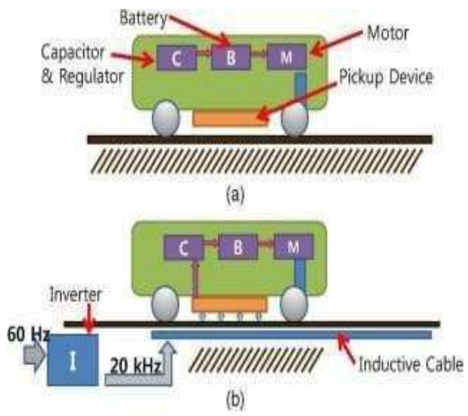

Fig. 2.1. OLEV system. Charging and depleting the energy in the battery.

(a) A vehicle is operating without transmitter unit ,(b)A vehicle is operating withtransmitter unit

Investigating this trade-off is critical in the commercialization of the OLEV system. More specifically , there is a trade-off between the capacity of the battery and allocation of the power transmitters . If the vehicle has a battery with a large capacity , fewertransmitters are needed.

The OLEV - based shuttle buses are running at a speed between 20 - 40 km/h on the circular route, with a total length of 2.85 km. The authors found two major issues in the current deployment of the OLEV-based shuttle buses.

However , a vehicle with a small battery may require more frequent recharges ; thus , more transmitters should be installed. As the costs of the battery and power transmitters account for a significant portion of the total investment cost of the OLEV , the trade-off should be carefully analysed . To position optimally the transmitters and determine the battery capacity , the energy consumption rate of the vehicle and the charging rate of the power transmitters shouldbe quantitatively modelled.

Furthermore, the model should consider the physical constraints in installing the power transmitters. For example, a road on a bridge or on an overpass may not have enough space for power transmitters . The quantitative model evaluating the optimal battery size and the placement of the power transmitters shouldconsider these physical constraints.

2.2. WIRELESS ENERGY TRANSFERSYSTEM

Progressing from left to right on the top line of the diagram, the input power to the system is usually either wall power (AC mains) which is converted to DC in an AC/DC

rectifier block , or alternatively, a DC voltage directly from a battery or other DC supply. In high power applications a power factor correction stage may also be included in this block. A high efficiency switching amplifier converts the DC voltage into an RF voltage waveform used to drive the source resonator. Often an impedance matching network (IMN) is used to efficiently couple the amplifier output to the source resonator while enabling efficient switching - amplifier operation. Class D or E switching amplifiers are suitable inmany applications and generally require an inductive load impedance for highest efficiency.

The IMN serves to transform the source resonator impedance , loaded by the coupling to the device resonator and output load , into such an impedance for the source amplifier. The magnetic field generated by the source resonator couples to the device resonator, exciting the resonator and causing energy to build up in it. This energy is coupled out of the device resonator to do useful work, for example, directly powering a load or charging a battery. A second IMN may be used here to efficiently couple energy from the resonator to the load. It may transform the actual load impedance into an effective load impedance seen by the device resonator which more closely matches the loading for optimum efficiency (Equation) .For loads requiring a DC voltage, a rectifier converts the received AC power back into DC. In the earliest work at MIT, the impedance matching was accomplished by inductively coupling into the source resonator and out of the device resonator [3]. This approach provides a way to tune theinput coupling, andtherefore the input impedance, by adjusting the alignment between the source input coupling coil and the source resonator, and similarly , a way to tune the output coupling, and therefore the output impedance,by adjusting the alignmentbetween the device output coupling coil andthe device resonator.

With proper adjustment of the coupling values, it was possible to achieve power transfer efficiencies approaching the optimum possible efficiency (Equation). Figure 2.2 shows a schematic representation of an inductive coupling approach to impedance matching. In this circuit g M is adjusted to properly load the source resonator with the generator's output resistance.The device resonator is similarly loaded by adjusting L M the mutual coupling to the load.

Series capacitors may be needed in the input andoutput coupling coils to improve efficiency unless the reactance's of the coupling inductors are much less than the generator and load resistances. It is also possible to directly connect the generator and load to the respective resonators with a variety of IMNs.

These generally comprise components (capacitors and inductors) that are arranged in "T" and/or "pi" configurations.

The values of these components may be chosen for optimum efficiency at a particular source-to- device coupling and load condition ("fixed tuned" impedance matching) or they may be adjustable to provide higher performance over a range of source-to-device positions and load conditions ("tunable" impedance matching).

The requirements of the particular application will determine which approach is most appropriate from a performance and cost perspective. A common question about wireless charging is: How efficient is it? The end-to-end efficiency of a wireless energy transfer system is the product of the wireless efficiency (see Physics of Highly Resonant Power Transfer for an explanation) and the efficiency of the electronics (RF amplifier, rectifier and any other power conversion stages, if needed). In high power applications, such as charging of plug - in hybrid vehicles, end-to-end efficiencies (AC input to DC output) greater than 90% have been demonstrated .

Such efficiencies require that each stage in the system have an efficiency at 97-98% or greater. Careful design in each stage is required to minimize losses in order to achieve such performance. In mobile electronic devices, space is usually of at most importance, soincorporating resonators into them generally involves some trade-offs in resonator size and system efficiency to accommodate the space restrictions. Also, the application use-case may involve a wider range of magnetic coupling between source and device which can also present a challenge for the design of the impedance matching networks. However, coil-to-coil efficiencies of 90% or more and end-to-end efficiencies over 80% are achievable in these lower power applications.

STEPS FOR WIRELESS VEHICLE

Step 1 Set stopping criterion.

Step 2 Create a population of particles with random positions and velocities.

Step 3 Calculate the fitness value of each particle's position according to the fitness function.

Step 4 If a particle's current position is better than its previous best position, update current best position.

Step 5 Find the global best particle.

Step 6 if stopping criteria is satisfied, go to Step 10; else, continue.

Step 7 Update particles' velocities according to the given formulae of their own best position and global best position.

Step 8 Move particles to their new position according to current position and updated velocity.

Step 9 Go to Step 3.

Step 10 Terminate.

5) Repeat steps 2 to 4 until the termination criteria are met

CONCLUSION:

The electric vehicle system called OLEV with the wireless power transfer technology developed. The OLEV is an innovative electric transportation system that remotely picks up electricity from power transmitters buried underground. The OLEV mainly consists of vehicles and power transmitters installed under the road. As the battery in the vehicle can be remotely charged while in motion, the vehicle does not need to stop at the charging station, and recharging time is significantly reduced. We logically analyze the trade off between the battery size and the positions of the power transmitters on the route.

FUTURE ENHANCEMENT

In this paper , we have assumed that the vehiclesfollow a regulated vehicle profile .
This assumption may work for the vehicles operating in a controlled environment, if the method is applied to a system operating in a normal traffic environment, velocity variability should be considered.

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