Wireless Transportation System Using SMFIR Technology

Hemanth K S[1], Ambika[2], Bhavana M[3], Devaraj G. S[4], Suma[5]
[1, 2, 3, 4] Dept of Electronics and Communication
[5] Professor, Dept of Electronics and Communication
[1, 2, 3, 4, 5] Vidya Vikas Institute of Engineering and Technology, Mysore, India.

Abstract- *The trend towards electric vehicle is one of the efforts to reduce the consumption of energy and to minimize the negative environmental impact on earth. However, there are several issues to commercialize electric vehicle. The large capacity, weight, expensive price, short life time and charging time of batteries are the most important obstacles. On-Line Electric Vehicle (OLEV) is an innovative electric powered transportation system which remotely picks up electricity from power transmitter buried under ground. The core technology of OLEV is based on SMFIR (Shaped Magnetic Field in Resonance). The input supply frequency is converted to a very high frequency at inverter stage and this high frequency current flow through the power line. The magnetic flux generated from the power lines is gathered at the pick-up module and then rectified. The rectified output energy is stored in a battery and used for driving the motor. OLEV requires only a minimal battery capacity which can consequently minimize the weight and price of vehicle and power station.*

Keywords- Capacitive Proximity sensor, Inductive Proximity sensor, Servo motor

I. INTRODUCTION

The usage of cables and wires is the preferred choice to connect a source to a load. It is a simple and efficient method to transfer electrical energy and it is suitable for most of today's applications since the loads, whether in industry or in our homes, are stationary and motionless. However, as technology advances, products are becoming smaller and portable. Relying on a cable connected to a power outlet to obtain energy may not be a practical solution any more. New applications are being developed and introduced that are mobile and require a continuous or semi-continuous power supply.

Therefore, having a direct cable connection may limit their freedom of movement and in some cases may not be a safe option.

The research and development in hybrid and electrical vehicles is on the rise due to the increase in oil prices and to environmental concerns. These vehicles have an on-board battery that can provide power partially or entirely for the entire trip duration.

Although a direct cable connection to a power outlet is suitable to a certain degree to provide power and recharge the batteries, more options will be available if that power was supplied wirelessly without cables and contacts. The vehicle, for example, could be powered 'on the go' while it is moving. The risk of electric shock and sparks is highly reduced since no contacts are used, maintenance requirements are also reduced since there is wear and tear involved in the powering and charging process.

In wireless transfer of electrical energy, instead of using conductive cables and wires, electrical energy is converted to another form that can be transferred through a certain media without the need for conductive wires. A simple example of transferring energy wirelessly is the use of radio waves to transfer information such as sound, video and data. A voltage signal representing the information to be transferred is generated in a radio station. It is then transformed into an electromagnetic energy signal and beamed into the air, spreading in all directions. The electromagnetic energy signal is picked up by an antenna at a reduced energy level and then transformed back into an electrical voltage signal and the information is extracted afterwards. Wireless transfer of energy or wireless power transfer may seem as an alternative method to power todays and the future's applications.

II. LITERATURE SURVEY

1] Dynamic Wireless Power Transfer System For EV To Simplify Ground Facilities Power Control Based On Vehicle Side Information
Authors: Katsuhiro Hata, Takehiro Imura, Yoichi Hori. Published in: 2015

The Implement Proposed A Control Method Based On The Primary Voltage Estimation Using Only Vehicle- side

Information To Simplify Ground Facilities On A Dynamic Wireless power transportation System.

2] Coupling Tuning Based Impedance Matching for Maximum Wireless Power Transfer Efficiency.
Authors: Surajit Das Barman, Ahmad Wasif Reza, Narendra kumar
Published in: 2016

Present an impedance matching approach based on coupling tuning at both the transmitting and the receiving sides to improve and maximize the transfer efficiency of a resonant coupled WPT system without changing the operating frequency.

3] Wireless power transmission Authors: Paras joshi
Published in: 2017

The concept of wireless power transmission offers grater possibilities for transmitting power with minimum losses. This could reduce our society's dependency of on batteries, which are currently heavy and expensive.

4] Location Planning for Dynamic Wireless Charging Systems for Electric Airport Passenger Buses
Authors: Stefan Helber, Justine Broihan, Young Jae Jang, Peter Hecker and Thomas Feuerle
Published in:2018

We concentrate on the power supply for apron buses and analyses the location planning problem related to the distribution of the required power supply and wireless charging units in the apron road system.

Motivation

A conventional electric vehicle that requires significant recharging downtime, the battery in the OLEV can be charged while the vehicle is in motion. The OLEV is considered as a potential solution for the next- generation electric public transportation system.Our country is still relies on the transportation using fossil fuels in spite of being costlier and environmental issues. Hence designing and integrating the system which will charge electric vehicle on motion to increase the speed and reduce battery size.

Problem Statement

One of the biggest issues around the world in recent years is environmental problems. Every country tries to adopt green technologies which offer the potential to improve the air quality in currently polluted environment and which will save money by reducing fossil fuel consumption. By transitioning to sustainable technologies, such as solar and wind power, we can achieve energy independence and stabilize human-induced climate change. Increasing transportation efficiency is the best place to start efforts to reduce emissions of carbon diox ide (CO2), which is a primary culprit in global warming. Situation a method for reducing the CO2 is of greater importance. Even though recent developments have been focused on the development of electric vehicles the commercial deployment of electric vehicles has lagged behind due to technological issues in associated with the battery including: bulky size and weight, low power capacity ,limited range, long recharging time, short life expectancy and high cost, compared to gasoline powered cars within the same range.

III. METHODOLOGY

The trend towards electric vehicle is one of the efforts to reduce the consumption of energy and to minimize the negative environmental impact on earth. However, there are several issues to commercialize electric vehicle. The large capacity, weight, expensive price, short life time and charging time of batteries are the most important obstacles. On-Line Electric Vehicle (OLEV) is an innovative electric powered transportation system which remotely picks up electricity from power transmitter buried under ground. The core technology of OLEV is based on SMFIR (Shaped Magnetic Field in Resonance). The input supply frequency is converted to a very high frequency at inverter stage and this high frequency current flow through the power line. The magnetic flux generated from the power lines is gathered at the pick-up module and then rectified. The rectified output energy is stored in a battery and used for driving the motor. OLEV requires only a minimal battery capacity which can consequently minimize the weight and price of vehicle and power station. The supply to the LC oscillator is DC which is obtained from voltage regulator. LC Oscillator output frequency ranges from 40 - 50 kHz as shown in the below Fig1.1. High frequency oscillator is the main working circuit for the occurrence of efficient energy transfer mechanism. This causes generation of magnetic flux in power line only if IR sensor senses the secondary coil. The energy will transfer at resonance and specific shape of magnetic field. The transferred energy is picked up by the pick-upmodule which is incorporated beneath the vehicle. The induced voltage is rectified and filtered for charging the battery. The charge controller circuit will control and protect the battery from the overcharging and deep discharging.

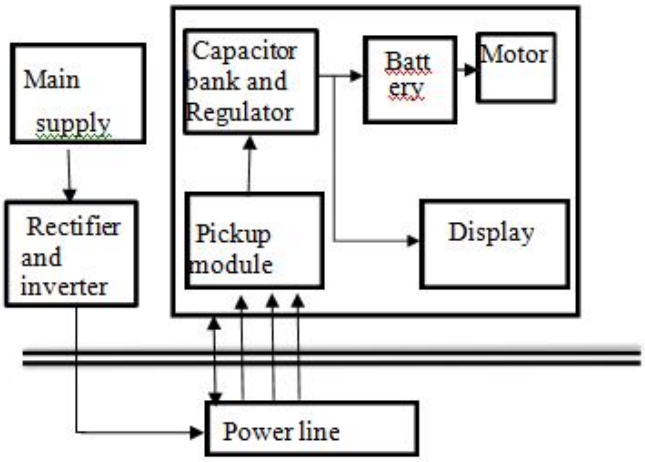

Fig 1.1: Block Diagram

IV. IMPLEMENTATION

Shaped Magnetic Field In Resonance (SMFIR): This section deals with main principle where the energy transfer mechanism takes place.

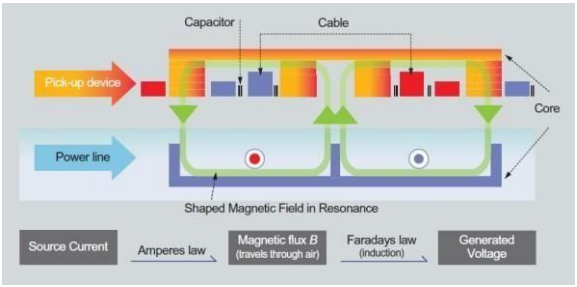

Fig 1.2: Block diagram of SMFIR

The design of power lines and the pickup module are the key technologies for effective power transfer. According to the direction of the magnetic flux at the pick-up module noncontact power transfer can be classified as vertical magnetic flux type and horizontal magnetic flux type as shown in Fig 1.2.

The above Fig shows the vertical and horizontal magnetic flux type of power lines and pickup module. In vertical there are two power lines with opposite current directions underneath the road surface forming a current loop. Due to the current in the power lines, magnetic flux is induced around each power line.Between the power lines the magnetic fluxes from the two power lines are added. The pickup module catches the vertical magnetic flux through copper coils around the ferrite core. This type has the advantage of efficient power transfer because the direction of the magnetic flux from the power lines is the same as the direction of the flux to the pickup module. Horizontal magnetic flux types are of less efficient as there is no adding of flux in the center portion.

Segmentation Method:

In order to reduce the consumption of power segmentation method is used.

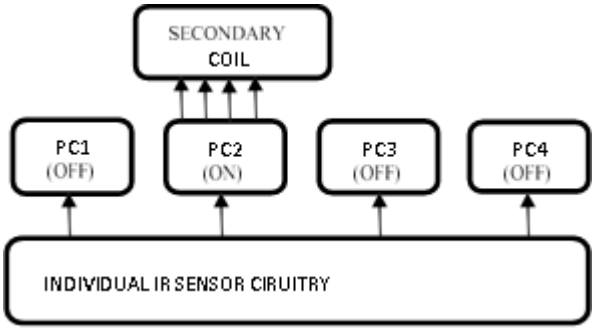

Fig 1.3: Block Diagram of Segmentation Process

When the oscillator is directly connected to primary coil the continuous power is drawn from oscillator irrespective of vehicle detection, this lead into wastage of power or over consumption of power, hence solution to be determined such that depending upon the vehicle detection the primary coil should turn on.

The primary coil is divided into several coils called segments for these segments individual IR circuitry and relay driver is connected, since sensor and relay arrangement is connected in series with oscillator as soon as the sensor detects the vehicle primary coil is turned on, the secondary coil receives transmitted flux and voltage will be induced.

Referring to the Fig 1.3 PC stands for primary coil and SC stands for secondary coil. We used four primary coils which constitutes four segments. When the IR sensor senses the secondary coil the situated IR sensor primary coil segment is made automatically on and energy will get transferred to secondary coil which is placed beneath the vehicle.

When the vehicle moves away from IR sensor, sensor stops sensing the vehicle since sensor and oscillator are connected in series oscillator connection with coil disconnects and energy transfer will not take place. IR sensor circuitry is powered by individual battery arrangement. Referring to the Fig 1.3 only primary coil 2 is made ON since the vehicle is above that particular coil and since the vehicle is not detected by any other coils all other primary coils were OFF representing segmentation method.

V. ADVANTAGES, LIMITATIONS AND APPLICATIONS

Advantages

- 1/5th the battery size of battery powered vehicles.
- No need to build expensive recharge facilities that cost 5 times more than electrical vehicles plug in stations.
- Increases safety and convenience, eliminates the risk of electrocution.
- Creation of eco-friendly transportation system.
- Economically superior than previous electric vehicles.

Limitations

- Laying underground coils where the population density is so spares is expensive.
- Designing a system to charge consumers for the electricity they use.
- Our current electrical grid may not support mass market adaptation of online charging vehicles.

Applications

- Bus rapid transit systems (BRT)
- Airport terminal buses
- Seaport drayage trucks and rubber- tired gantries (RTGs)
- Commercial and industrial trucks
- Campus shuttles and parks

VI. CONCLUSION

The proposed project is a ground-breaking technology that accelerates the development of purely electric vehicles as a viable option for future transportation systems, be they personal vehicles or public transit.

This is accomplished by solving technological issues that limit the commercialization of electric vehicles such as price, weight, volume, driving distance, and lack of charging infrastructure. Electric vehicle receives power wirelessly through the application of the "Shaped Magnetic Field in Resonance (SMFIR)" technology. SMFIR is a new technology introduced by KAIST that enables electric vehicles to transfer electricity wirelessly from the road surface while moving. Power comes from the electrical cables buried under the surface of the road, creating magnetic fields. There is a receiving device installed on the underbody of the electric vehicle that converts these fields into electricity. The length of power strips installed under the road is generally 5%-15% of the entire road, requiring only a few sections of the road to be rebuilt with the embedded cables.

This project implementation leads into installation of small battery (one-third of the size of the battery equipped with a regular electric car). The vehicle complies with the international electromagnetic fields (EMF) standards of 62.5 mg, within the margin of safety level necessary for human health. The road has a smart function as well, to distinguish electric vehicles from regular cars—the segment technology is employed to control the power supply by switching on the power strip when electric vehicles pass along, but switching it off for other vehicles, thereby preventing EMF exposure and standby power consumption.

VII. FUTURE SCOPE

- The future scope of this project is enhanced applications with addition of required features.
- One such application is to wirelessly drive the vehicle without using battery technology.
- Application of MPPT algorithm between load and pick up module may result in maximum energy transfer to the load.
- Incorporating road with new technologies such as solar roadways and many more, road may harness the energy from the environment.
- Thus this energy transfer mechanism will give maximum efficiency power transfer with less loss.

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