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E-Highway: A Future Transportation

Vikash Singh Yadav[1*], Jai Vashisth[2], R. S. Desai[3]

[1,2]*Student, Department of Electrical Engineering, Bharati Vidyapeeth (Deemed to be) University, College of Engineering, Pune, India*

[3]*Professor, Department of Electrical Engineering, Bharati Vidyapeeth (Deemed to be) University, College of Engineering, Pune, India*

*Corresponding author: vikas200598@gmail.com

***Abstract*: There is an increase demand in EV which will play a major role in future of road transport. While commercial Electric Vehicle existing today have their uptake has been limited due to limited battery range, lack of charging convenience and high purchasing cost. As cities expand and affluence rises, traffic congestion is becoming problematic. To respond to these core challenges facing the transportation sector, the E-highway is twice as efficient as internal combustion engines. The innovation includes transition from personal combustion powered vehicles towards grid-powered transportation. This innovation supplies trucks with power from overhead contact line. This reduces local air pollution and contributes significantly to the decarbonization of the transport sector.**

***Keywords*: E-Highway, Electric vehicles.**

1. Introduction

As a part of study present in Transportation Energy data book, World petroleum consumption in 2015 was 95.3 million barrel per day and the share of transportation consumption was 86.2%. The latest study in Environmental Protection Agency states that powering personal and commercial vehicles prompts complex impact with pollution. Due to the expected growth in demand for transport, the International Transport Forum estimates that global emission from road freight transport will grow from 1.36 gigatons of Carbon dioxide in 2015 to 2.40 gigatons by 2050.

An electrically augmented road has been pointed out as a key factor for tackling some of today's main challenges, such as global warming, air pollution and eco-system degradation. While numerous studies have investigated the potential of electrifying passenger, less focus has been on how road freight transport could be powered in a sustainable future. This study looks at Electric Road system in comparison to the current diesel system. E-highway system combines the efficiency of electrified railroads with the flexibility of trucks into an innovative freight traffic solution that is efficient, economical and environmentally friendly.

Shifting freight transport to rail has its limitation. Recharging is time consuming. Simply increasing battery size is technologically complicated and presently cost prohibited. Instead of drawing power from an internal combustion engine motor, catenary cables drawn from grid - connected power plants, potentially using a combination of renewable energy and Carbon sequestration for fossil fuel combustion, bringing cleaner power directly. Hybrid diesel-electric trucks are fitted with rods that are raised when entering the roads with overhead electric lines at speeds up to 60mph. This innovation supplies trucks with power from an overhead contact line. This reduces local air pollution and contributes significantly to the decarbonization of the transport sector.

2. Literature Survey

1) K. Adam; M. Müller-Mienack; M. Paun; G. Sanchis; K. Strunz et al., e-highway 2050 project is aimed at overcoming the uncertainties of the planning horizon through a modular approach of five-year periods and comprises the topics: power generation and consumption, power source placement, power flow calculation, corridor and architecture mapping and study of implementation. Besides the challenges of engineering, also issues of governance, economics, stakeholder acceptance, social welfare and the environment are given particular consideration. Thirdly, it was described how work packages are structured and interact to support an efficient study project that integrates the interests of the involved stakeholders.

2) Zhang Bin; Fang Pin; Xu Guoqing et al., In the 1980's - 1990's hybrid development, the focus primarily was on low emissions. In the latest development focus has changed to reducing the dependence on fuels. In this paper, the fuel consumption of trucks is investigated. Diesel module and road cycle module for truck are developed so that ADVISOR can be applied to the simulation of hybrid electric truck and plug-in hybrid electric truck. Then simulations are carried out for the two different trucks respectively with the new modules. Analysis of the simulations shows that the plug-in hybrid electric truck is a better choice for some special condition. In shipside cycle, the fuel consumption of plug-in hybrid electric truck is even less than hybrid electric truck by 52.3%

3) T. H. Pham; J. T. B. A. Kessels; P. P. J. van den Bosch; R. G. M. Huisman et al., In the considered hybrid truck, the energy management strategy utilizes the battery to reduce the fuel consumption and the associated emissions. As the battery life is limited, the vehicle owner will suffer from extra costs for battery replacement. Henceforth, it is necessary to guarantee

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sufficient battery life. This paper develops a quasi-static battery cycle-life model and formulates a model-based integrated energy management (IEM) strategy. This IEM strategy optimizes the power split (between the ICE and the MG) and the operation of the clutch system to minimize the hybrid truck fuel consumption while guaranteeing the requested battery life. The problem of fuel minimization with battery life guarantee is analytically solved using optimal control theory.

3. Block Diagram

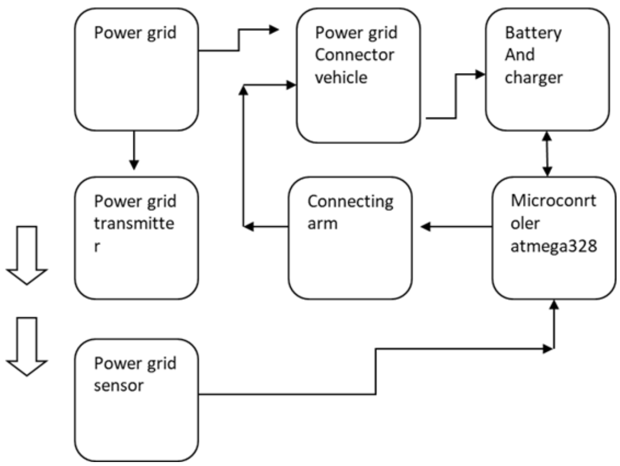

Fig. 1. Block diagram of the system

A. Description

Power grid: A power grid, is an interconnected network for delivering electricity from producers to consumers. It consists of:

- Generating stations that produce electric power
- Electrical substations for stepping electrical voltage up for transmission, or down for distribution.
- High voltage transmission lines that carry power from distant sources to demand-centers.
- Distribution lines that connect individual customers.

Power grid sensors: Smart grid sensors enable the remote monitoring of equipment such as transformers and power lines and the demand-side management of resources on an energy smart grid. The power for each sensor is derived from the electric utility or from a battery.

Microcontroller ATmega328: The ATmega328 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture.

By executing powerful instructions in a single clock cycle, the ATmega328 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed.

Connecting arms: A connecting rod is a rigid member which connects a piston to a crank or crankshaft in a reciprocating engine. Together with the crank, it forms a simple mechanism that converts, rotating motion into reciprocating motion.

4. Methodologies

We are using transmitter and receiver circuit in our project. Both circuits are connected with each other by Wireless (RF) communication. Working of each circuit is as follows,

A. Transmitter (Vehicle Motion Control Unit)

Vehicle motion will be controlled by the switches. We will move vehicle forward and backward with help of the push to switches of transmitter circuit. Switches are connected to the IC HT12E. This IC takes the output from the switches and gives it to the RF transmitter module. RF transmitter module works on frequency 433MHz. whenever we press any switch this data will send to the RF receiver by the RF transmitter. The whole transmitter circuit required 5v supply that’s why we will use 7805 IC to get proper 5v supply to all (IC, RF transmitter).

B. Receiver

At receiver side we are using RF receiver HT12D, L293D and microcontroller ATMEGA328.

RF receiver will receive incoming data from the RF transmitter and gives it to the HT12D IC. HT12D gives its output to the L293D. L293D is the motor driver IC. This will drive the DC motors were used for Vehicle demonstration. According to the input data from RF transmitter, we can control the direction of the vehicle.

While vehicle is moving, IR sensor will wait for the overhead electrical lines to start. When lines detected, controller will turn on the Servo motor. With the help of this servo motor, battery charger connector will connect to the supply lines. Battery charger circuit will start getting electricity from lines and converts it to charge the battery; Microcontroller keeps monitoring the battery level. With this battery monitoring we can maintain the proper charging and life of the battery. Our circuit will control the over and under charging of the battery. When microcontroller detects the end of the electric line, it will operate the servo motor to take back the battery connectors from the electric line.

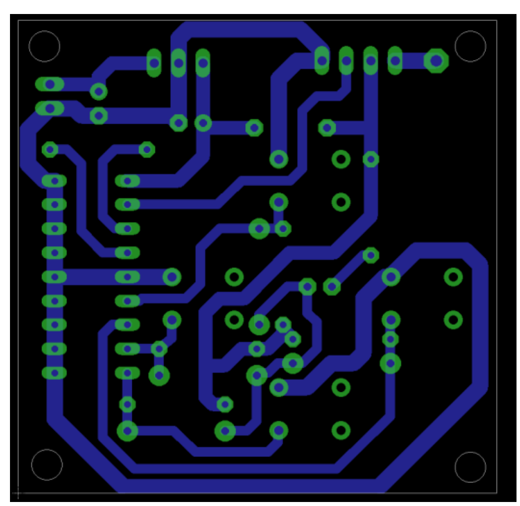

Fig. 2. Layout of transmitter

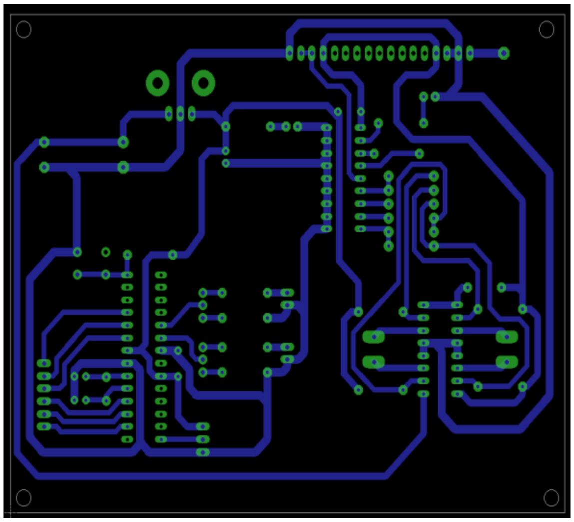

Fig. 3. Layout of receiver

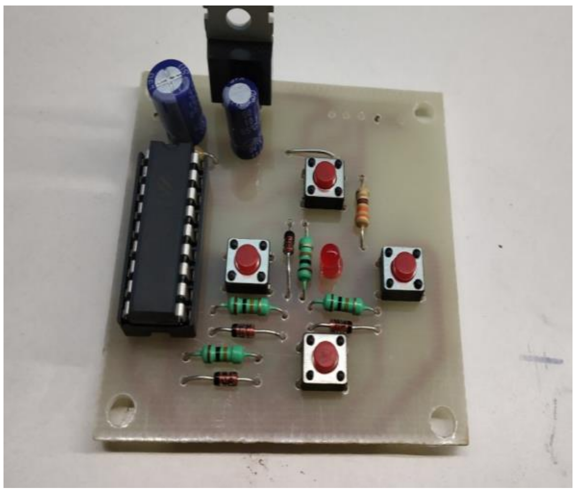

Fig. 4. Transmitter kit

5. Economic Aspect

An E-Highway project involves three primary costs: construction, power supply and maintenance. Construction is a fixed capital cost, while supply power and maintenance are subject to electricity price and usage of roads. One challenge from shifting away from petroleum based transport system is replacing the gas tax, which partially funds road maintenance. A demand based rate system combining the concept of smart meter and a fast lane highway pass, incorporated into the E-Highway pricing scheme, could easily remedy this problem. For a fee, vehicle-fueled by non-electric sources could pay for the time savings advantage of driving in the electric lane, which is expected to be less congested.

Cost recovery measures may be further mitigated by the cost savings achieved through the safety co-benefits of the E-Highway system. The Automated vehicle features proposed are expected to dramatically reduce the number of collisions, through large reduction in human error. This allows benefits vehicle insurance premiums, auto repairs and to health care.

6. Conclusion

Considering the demand of a global population, there is a need to create an efficient and a safer driving experience. Our strategy aims to alleviate reduction of greenhouse gases such as CO_2, NOx and particulate matter emissions as well as to increase efficiency of heavy trucks. The E-Highway advances in battery storage and car electronics with emerging techniques of wirelessly charging moving vehicles and cutting edge vehicle automation to create a cleaner and safer roadway. The E-Highway users realizes cost savings by moving away from a gas tax to an amount of travel tax and travel law incentives. These potential benefits can improve further if the electric grid powering the roadway aggressively switches to renewable energy generation. This will identify and overcome the key issues areas, encourage adoption and build the supply chain for more economical deployment across the state's highway system. Eventually the E-Highways will criss cross the land, offering the truck driver's a fast, clean and a safe way to travel.

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