Electric Heavy Vehicle Transportation Highway (By Catenary System)

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Abstract This paper provide a review of the latest work in the sector of electric vehicle. The transport Sector massively depends on Non-Renewable Sources. Continuous release of harmful substances in the surrounding by the vehicle should be confined and restore with alternative transportation. Electric Highway is one of efficient Solution. It is modern technology of electrical road systems. It is a technique in which electricity is taken from power grid through dynamic Pantograph which is attached with overhead transmission line. Thus, EV's with a combination of Electric Highway can charge the battery in dynamic motion and reduce the time of recharging of a vehicle. Shortly, the paper introduces some features of EV, their limitation and one of the effective alternate modern solution considering the well-being of the environment.

1. INTRODUCTION

As electric vehicle boost the automobile sector but having some demerits like the Electrical heavy vehicle is not preferable for long distance travelling and it requires more charging time of the battery , also more battery capacity is required [3,5,10]. So the main aim of the paper proposal is to overcome these demerits . For that we are making the working model . The system is used in this model is similar to the system used in Electric train ,i.e. catenary system (In that system the current is collected from the overhead transmission line with the help of pantograph and gives to the motor and vehicle will runs) [2].Vehicles like trucks and hybrid trucks can instantly charge it's battery using the power line [2]. The sensors inside the trucks takes for an electric contact line then truck automatically lift it's pantograph and contact with electric line or else if there is no such sensor the driver manually set the position. The pantograph transfer these energy to electric motors as well as the charge the battery .When there is no power line the truck can runs on battery . Due to E-highway zero emission possible reduces CO2 emission [13] .Currently the E-highway are more flexible to truck transport as these are the major transports vehicle for goods and services [1,4] . Even the existing roads can be upgraded with E-highway structure because of this project crude oil imports can be reduce and save the cost of fuel [1,4].

2. OBJECTIVE

- EV's are able to travel for long distances [5].
- No extra Charging time is required.[9,14].

3. LITERATURE SURVEY

1. The world's originally zapped street (June 2016) - which charges the batteries of electric vehicles and trucks as they roll over it - has opened close to Stockholm, Sweden [4,10]. The street extends 1.2 miles and is important for an administration driven arrangement to zap almost 12,500 miles of roads and roadways the nation over [10].

2. In August 2017, Siemens Mobility was commision by the province of Hesse to fabricate an upward contact line for charged cargo transport on a ten-killometer stretch of expressway. With this field trail, the E-Highway is being tried on a public parkway in Germany interestingly.

3. The ELISA (ELektrifizierter, Innovativer Schwerverkehr auf Autobahnen that means zapped, inventive weighty vehicle traffic on motorways) was the primary show to be initiated in May 2019. This venture, drove by the Road Authority Hessen Mobil, is situated between the urban areas of Darmstadt and Frankfurt on motorway A5 [4,6,10].

4. PROPOSED SYSTEM

An Electric Road System (ERS) in which electrical energy is transferred during motion from the road to the electric vehicle for both propulsion and charging of battery which is a technology concept with great potential for reducing dependency on conventional sources and increased energy efficiency in the transport sector [1,9,12] as shown in fig.10.ERS is stated as dynamic power transfers from the road to the vehicle when the vehicle is in running condition and could be achieved through different power transfer technologies from the road to the vehicle [1,6]. In this paper we have used the Catenary System technology on which Electric train runs , however we have used Two Line AC System (230 AC). This power is collected through Pantograph and Rectifier is used to convert 230 AC into 12 volt DC (Fig 7) and by utilising this electrical Power, battery is charged and able to drive the vehicle [2,7] as shown in fig 1. In this technology we can used small capacity battery (12V-7AH lead acid battery)(Fig.8) hence overall weight as well as initial cost of the vehicle is also reduced. It reduces the Static charging time of the electric vehicle and increase the range of travelling distance of heavy vehicle. When Pantograph is disconnected or any obstacles in overhead system does not affect the operation of the vehicle because change over takes place and battery will be ON state and further drive the Vehicle. The Model works on the following three conditions that is

1)If the Supply is ON that time vehicle will run and battery will charge simultaneously [6,9].

2)If the supply is Cut OFF that time vehicle will working on battery supply only [6,9].

3)If the vehicle is on standstill position that time battery will be charging [9].

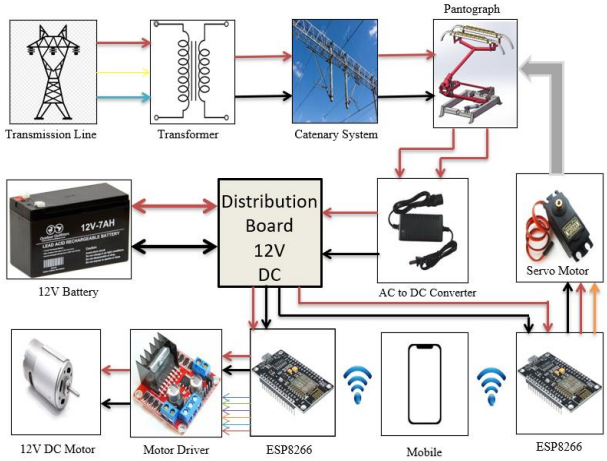

Fig 1. Wiring diagram.

4. METHODOLOGY

In our project we have given 230V AC to overhead Transmission line which is taken through supply. When pantograph is connected to transmission line, current is transfer to the rectifier (to convert AC current to DC current) and then provide to motor of the Vehicle [2,7]. Simultaneously current is also provided to battery for charging. It means at the same time vehicle is running on the supply as well as battery is charging [6,10]. We have used change over that is Switch for operational changes. Whenever the overhead supply is turned off, battery will be on and drive the vehicle without any delay in the motion of the vehicle [6]. For the operation of vehicle we have used Rover Controller which is control by software in the mobile as shown in fig 2. Vehicle wheels movements in either forward or reversed direction and it left or right directions is controlled through mobile app. Similarly the operation of pantograph (i.e. lifting up and down) is done through software on mobile app. We have provide indicator on the vehicle which gives indication if pantograph is connected or not. We have used battery indicator which also gives voltage reading to indicate amount of battery charge in case of pantograph is in operational state and vice-versa (Fig.9).

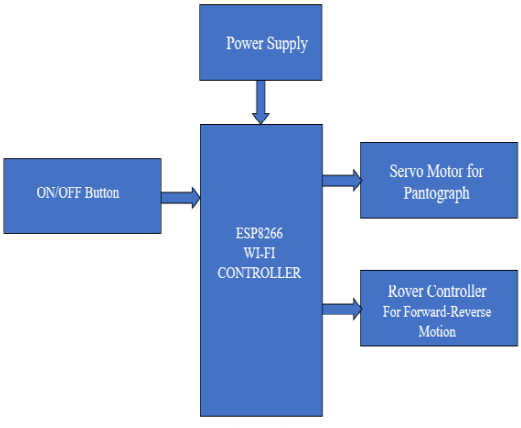

Fig 2. Block diagram .

5. COMPONENT DESCRIPTION

5.1 PANTORGAPH

Used to collect current through overhead line and given to further for operation. Pantograph directly transfer the current from the overhead transmission line to electric motor of the truck [2].

Fig 3. Sample Pantograph

5.2 SERVO MOTOR

This Tower Pro MG996R Digital Metal Gear High Torque Servo Motor (180 Degree Rotation)features metal equipping coming about in extra11kg slowing down force in a little bundle. The outfitting and engine have likewise been moved up to work on dead data transmission and jogging. The unit comes total with 30cm wire and 3 pin 'S' type female header connector that fits most collectors, including GWS, Cirrus, Corona, Berg, Spektrum and Hitec.

Specifications for Digital Metal Gear High Torque Servo Motor of Tower Pro MG996R

- Operating voltage: 4.8 V - 7.3 V
- Rated Current : 500 mA – 900 mA (6V)
- Stall Current : 2.5 A (6V)
- Temperature range in degree celcius :[0 ºC – 55 ºC]
- Control System: Analog
- Operating Angle: 180degree
- Required Pulse: 900us-2100us
- Operating speed: 0.18 s/60º (4.8 V), 0.14 s/60º (6 V)
- Stall torque: 9.9 kgf·cm (4.8 V), 10.9 kgf·cm (6 V)

Fig 4. Servo Motor.

5.3 ESP8266

ESP8266 is a computer on a chip. It is an integrated chip that is usually a part of an embedded system [8,11]. It is a self contained, independent and yet function as a tiny, dedicated computer [8,11]. It also supports IOT Applications due to built-in Wifi [8,11] (Fig.5).

ESP8266 SPECIFICATION

- Microcontroller: Tensilica 32-bit RISC CPU Xtensa LX106
- Operating Voltage: 3.3V
- Input Voltage: 7-12V
- Digital I/O Pins (DIO): 16
- Analog Input Pins (ADC): 1
- UARTs: 1
- SPIs: 1
- I2Cs: 1
- Flash Memory: 4 MB
- SRAM: 64 KB
- Clock Speed: 80 MHz
- USB-TTL in view of CP2102 is incorporated locally available, Enabling Plug n Play .
- PCB Antenna Small Sized module to fit insightfully inside your IoT projects .

Fig 5. ESP2866 Microcontroller .

5.3 ROVER CONTROLLER

Rover control is used to move robot in forward or reverse direction or in left or right direction for moving to robot in desired direction rover is used [11].The pin connection of Rover Controller and ESP8266 (Fig. 6).

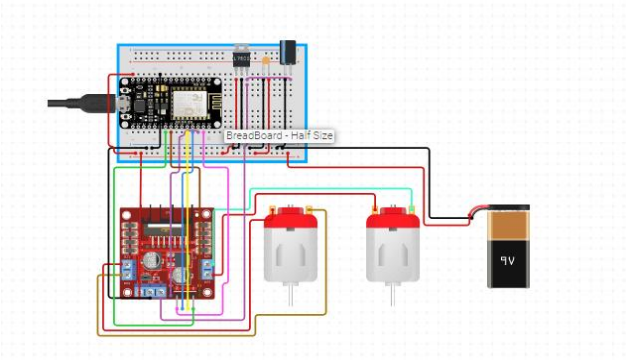

Fig 6. Rover controller

5.4 RECTIFIER

It takes current from overhead transmission line (230 V AC) and converts to 12V-1.7 AH DC and provides to the motor of the vehicle.

Fig 7. 12 V-1.7A Adapter

5.5 POWER SUPPLY

Provide power to E-Vehicle to drive the motor as well as to Arduino of pantograph. When pantograph is connected to overhead line , battery is in recharging condition.[9,10,11]

Fig 8. 12V-7AH Lead Acid Rechargeable Battery

5.6 BATTERY PERCENTAGE INDICATOR

This Indicator indicates the amount of battery charged as well as Voltage Rating.

Fig. 9. Battery Percentage Indicator

6. RESULT , DISCUSSION AND PERFORMANCE ANALYSIS

This module provides a successful result which is obtained from proposed method. Vehicle is in operation due to overhead flowing current and simultaneously charge the battery. Indicators are used to show mode in which vehicle is running i.e, on battery or without battery on direct supply. Precautions are taken to avoid contact of AC and DC Equipment.
Hence, Heavy Vehicle long transportation is easily accessible and no extra charging time required for battery charging.

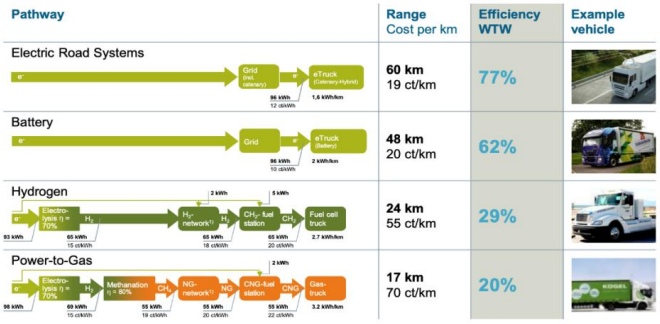

Fig. 10. Efficiency Of Vehicels

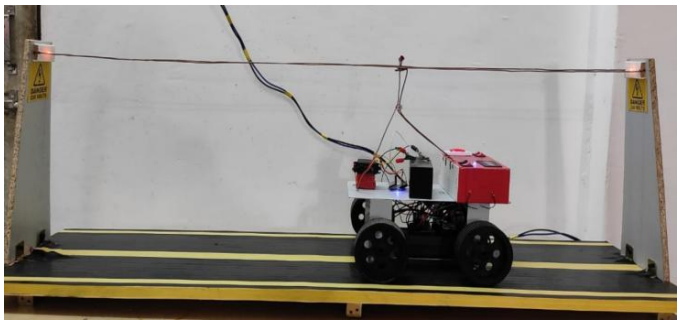

Fig. 11. Actual Model

7. CONCLUSION

Electric Highway framework not just works on the advantage of diminishing the unsafe Green house gases outflows into the air yet in addition works on the country's economy by its real System. This cutting edge energizing expressway is two times as rational as gas powered motors. Aside from this, it is a silent framework which turns out as an eco-accommodating strategy in transportation area. Contrast with that of Non-Renewable petrol based transportation , running expense is less in E-Highway Catenary System that is power utilization is less.

The world's first electrified road that recharges the batteries of cars and trucks driving on it has been opened in Sweden. Germany has presented the main electric expressway on its motorway framework to re-energize cross breed trucks as they drive. In Rail technology used in Germany, the path of vehicle cannot be changed while in catenary System we can change the lane in dynamic motion by taking pantograph downward. Also, the fault detection and fault recovery in catenary system is easy as compared to rail technology. During monsoon, the rail technology is less effective and not safe as water is clog on the surface of track.

The thought behind the e-expressway framework is to expand the effectiveness of jolted trucks and expanding the country's economy by lessening the utilization of non-renewable energy source. Thus, here we conclude that Electric heavy vehicle able to travel long distances as well as charging time of vehicle is reduced.

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