International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-5, January 2020

Tribrid Renewable Energy Charging System for Electric Cars

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Abstract**:** ***Vehicles which run on fossil fuel are the most polluting grids in the world. Electric vehicles (EVs) are invented to cut greenhouse gas emissions. Hybrid electric cars are considered as clean and green source of driving. Just switching to renewable energy based hybrid electric vehicles for manufacturing would slash emissions by 65 per cent, according to Transport & Environment. Due to integration of various factors, like environmental concerns, very high prices of oil and the potential for peak oil, need to develop much clean alternative fuels and high end power systems for automobile has become a top priority for all governments around the word as well as vehicle manufacturers around the world. Tribrid Renewable Energy charging system for electric vehicles is an idea for the generation of electric power for EVs using integrated photovoltaic cells, micro wind turbines and piezoelectric system to electric power pistons. This Tribrid Renewable Energy charging system for electric vehicles is advanced technologies and efficient uses of them are reviewed in a comparative way and the same are presented in this paper. Along with this the recent trends in research and development for the advancement in technology of optimum energy utilization systems for future security of energy is presented.***

Keywords: tribrid energy system; Electrical Vehicles; Piezoelectric; Micro-wind mills; PV system.

I. INTRODUCATION

The full-fledged proliferation of EVs is anticipated, in an effort to prevent global warming. However, ensuring the electric power needed to charge EVs presents an obstacle to EV proliferation. By enabling electricity storage, the tribrid energy storage system aims to encourage energy self-sufficiency and contribute to a low-carbon era by enabling EVs to run on electricity generated from sunlight, micro-wind mills and piezoelectric array. At the same time, this will contribute to the optimization of energy supply and demand through network controls, such as through virtual power plant (VPP).

Manuscript received on January 02, 2020.
Revised Manuscript received on January 15, 2020.
Manuscript published on January 30, 2020.
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II. PROPOSED METHODDOLOGY

The tribrid energy storage system—efficiently connects PV array, piezoelectric system and micro-wind mill array to storage batteries. The electricity generated by tribrid enerdy system can not only be used to run EVs, but it can also be used in the home such as through virtual power plant (VPP). This system is very efficient and it provides a DC link to batteries which enables the movement of electricity charge Between EV batteries and storage batteries. The result of this is that when an EV is absent, the generated power from tribrid system can be stored into storage batteries. On the other hand when the EV is present, the power stored can be transferred to the EV from the storage batteries, that enables carbon-free operation of the vehicle. Additionally to this, in case of the event of outage the power, the storage battery and the EV's large-capacity battery as well can be utilized as a backup, even providing much greater peace of mind. In this way this system enables high level of self-sufficiency based on tribird energy power generation for not only homes but also vehicles. The outcome of this is, we expect the system to encourage the proliferation of EVs and give its significant contribution to improving the global environment.

Fig.1 shows systematic representation of Tribrid Renewable Energy charging system for electric vehicles. This system is used for generation of electric power for EVs using integrated photovoltaic cells, micro wind turbines and piezoelectric system to electric power pistons.

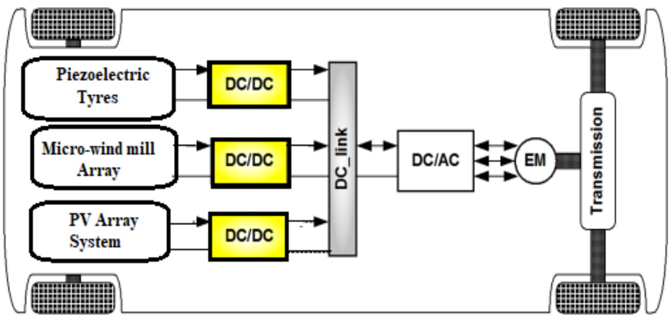

Fig.1. Tribrid Energy Harvesting System for EVs

The photovoltaic cells are exposed to sunlight and receive augmented power generation. Fig.2 the array has as inputs the radiation and temperature values as well as the resultant current drained. Also showed are the booster converter to control the PV array operating point which receives the voltage from the PV and the DC bus and the DC bus corresponding current. The converter is controlled through the duty factor which receives the power and voltage from the array as its inputs.

The PV array is further decoupled in several blocks. The model incorporates the possibility to define different combinations of parallel/series arrangements based on the characteristics of one panel. One Kilowatt PV Solar System is connected in parallel to supply the produced electricity to the EV. The energy flow depends on the electrical power consumption by EV and the power produced by the PV.

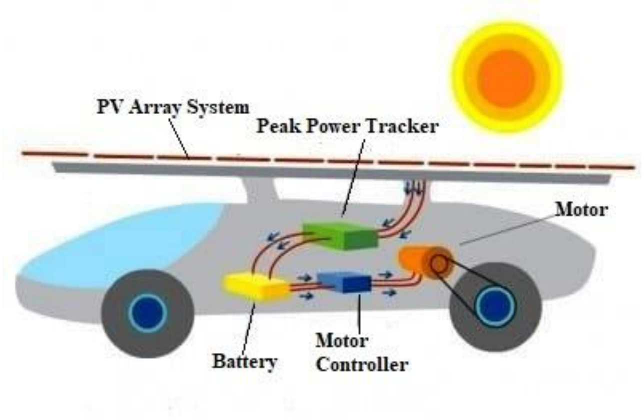

Fig.2. PV System for EVs

There is still a need to generate more clean power that allows the maximum range of a vehicle to be extended with minimal environmental concerns. Small wind turbine is basically used for micro-generation, as compared to large commercial ones, which are found in wind farms, with much more higher individual power output. The definition of "small wind" given by the Canadian Wind Energy Association (CanWEA) as ranging from less than 1000 Watt (1 kW) turbines to up to 300 kW turbines. The smaller turbines can be as small as a 50 Watt auxiliary power generator. In our prototype, the generators for small wind turbines usually are DC generators. For charging of battery ,the direct current output of them and power inverters for conversion of the power to AC but at constant frequency. It is possible to design small wind turbines to work at low wind speeds, but a minimum wind speed of 4 meters per second (13 ft/s) in general is required. Often Small units are having direct drive generators, lifetime bearings, direct current output and use a vane to point into the wind.The array of micro wind mills are provided to all-over sides of EV. Each micro wind mill is a horizontal axis type foldable and internal structure with EV in which micro wind mill comes 'In and Out' through remote control. This nacelle consisting of a high as well as low speed shaft, electrical generator, gearbox and the auxiliary devices. Fig.3 shows micro wind mill array. In the slow shaft end the rotor is assembled and it consists of a steel hub with blades. To always maintain the axis of the machine parallel to the direction of the wind (yaw orientation) the nacelle is able to rotate. Eenergy so produced is carried to the conversion group which is located within an electrical cabin located close to the tower though electrical cables. The generator used is nothing but a DC generator having permanent magnets. The deployment of energy into the national grid is done with the help of a frequency DC/AC converter, that is presenting an intermediate DC circuit in separating the voltage values and frequency values; with deployment (as per the nominal values of the electric grid) into the grid. The wind turbine is having a drum brake which is used to stop turbine in case of emergency situation like extreme gust events or like over speeding. In scenario of occurrence of over speeding and mechanical danger of blades, the turbine is having a system having the capacity of moving the blades in order to put on safety position; and it is obvious that the machine is stopped. Control unit that is based on microprocessor controls and monitors all the functions. The aim of shell of the nacelle is to protect all of its components from environmental factors like dust, rain, snow, heat from sun, etc.

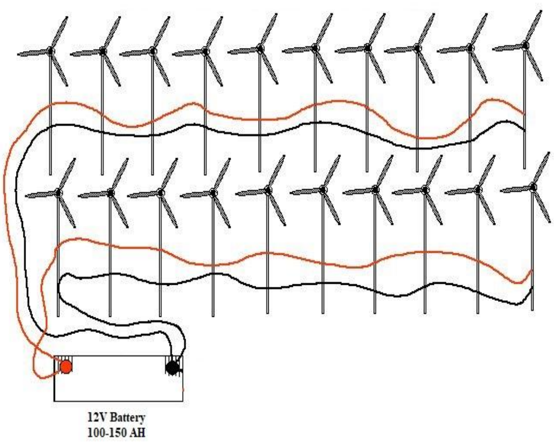

Fig.3. Micro-wind mill array System for EVs

When the charge balance within a crystal matrix of material is disturbed, results in occurrence of piezoelectric effect. In the lack of applied stress on the material, the positive and negative charges evenly distributed evenly and hence there is no potential difference.

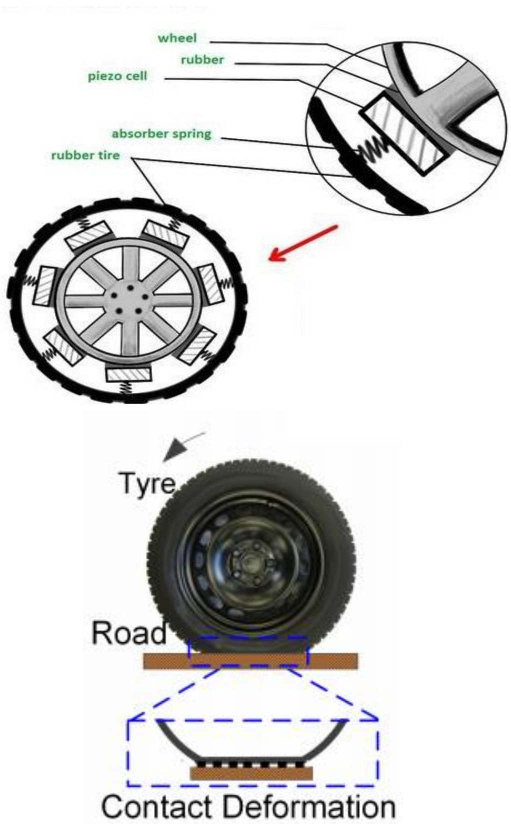

Fig.4. Piezoelectric tiers for EV

III. RESULT ANALYSIS

With the slight change of lattice, the charge imbalance creates a difference. This generated current is too small and could cause only a small electric shock. Inside a pneumatic tire of a motor vehicle a piezoelectric array is mounted and flexed or distorted during every revolution of the tire. Piezoelectric devices are having inherent nature and due to this, distortion creates an electron flow.

The outputs of these devices i.e. piezoelectric devices are connected to an electric circuit so that it transfer the high voltage, low amperage electricity produced by the devices into low voltage, high amperage electricity. This into low voltage, high amperage electricity is compatible with the electrical system of motor vehicles. It can be achieved by mounting a piezoelectric array in one or more tiers of vehicle. During every revolution, the tire is flexed and piezoelectric elements gets distorted and energy gets generated, when vehicle is driving down the road. Energy is delivered by electric cricket to the vehicle's electrical system. Yet different attempts have been there to basically do the same thing like mounting the electrical generators on the axel of the vehicle to generate electricity during braking. Second example is observed in attempting of extracting energy from the shock absorbers of motor vehicles. Different trials have also been made for incorporating electrical generators in the wheel.

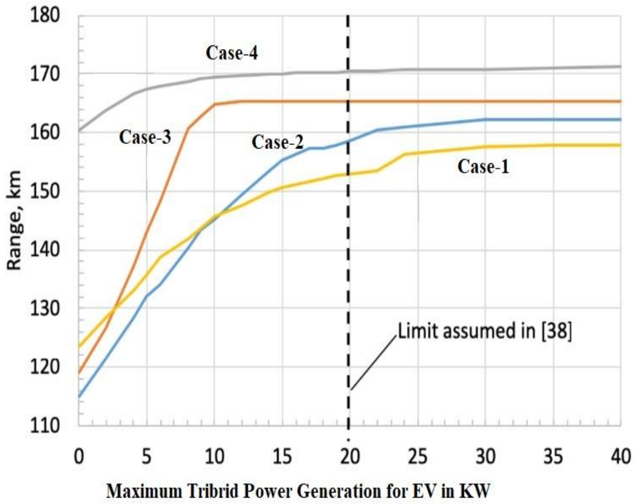

Fig.5. Power Generation for EVs

Range in Km	Tribrid Renewable Energy Charging system for Electric Cars			
	Solar	Wind	Piezoelectric	Km
Case-1	25	12	10	142
Case-2	28	15	13	150
Case-3	34	20	18	155
Case-4	40	25	22	160

The outcome the model shows is the driving distance got when battery is discharged down to some specific value of SOC i.e the state of charge. At the driving wheels the traction power is given as below_

$$P_{Wheels} = \left[\mu_{rr} m_v g cos\alpha + \frac{1}{2}\rho A C_d v(t)^2 + m_v g sin\alpha + (m_v + m_I) a(t)\right] v(t)$$

In the above equation, square bracket terms represent rolling resistance, aerodynamic drag, grading resistance, and linear acceleration, respectively. As per the authors of [40], mI, that is representing a fictitious mass in account of rotating component's inertia, and it can be expressed in following manner

$$m_I = m_c\left(0.04 + 0.0025G^2\right)$$

PWheels can be positive or negative as well and we should be note that. In case of first scenario, energy to the motor is being provided by the battery pack. On the other hand in the second case scenario, representative of the regenerative braking mode, to charge the battery the energy flows from the wheels, as shown in Figure 6. Thus, PMotor,out is can be given in the following:

$$P_{Motor,out} = \frac{P_{Wheels}}{\eta_{tr}} \text{ if } P_{Wheels} > 0$$

$$P_{Motor,out} = P_{Wheels}\eta_{tr}\eta_{rb} \text{ if } P_{Wheels} < 0$$

In the above equation, ηtr is the transmission efficiency while ηrb is the regenerative braking efficiency that identifies the % of the total braking power which can recovered actually, with the help of the following equation:

$$\eta_{rb} = \frac{P_{Recoverable}}{P_{Wheels}}$$

IV. CONCLUSION

The paper presents a discussion on Tribrid Renewable Energy charging system for EVs is made suitable by enabling electricity storage, the tribrid energy storage system's moto is encouraging self-sufficiency of energy and contributing to a low-carbon era. This is being achieved simply through enabling EVs allowing to run on electricity generated with the use of sunlight, piezoelectric array along with micro-wind mills. In this generation, low power micr The fundamental benefits of tribrid system are high reliability, lower cost with addon of clean-green power.

In this connection, the paper should act as, evolutionary step in the EVs charging system.

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Retrieval Number: D9195118419/2020©BEIESP
DOI:10.35940/ijrte.D9195.018520
Journal Website: www.ijrte.org

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