

Estimation of Efficiency enhancement Techniques for Power Electronics thorough Hybrid Electric Vehicle Drive Trains

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Abstract—It is noticeable that carrying division uses huge amount of universal lubricate & releases large rate of greenhouse gases. It causes severe problems like air contamination, global warming & fuel deficiency. In past twenty years by means of consulting all govt. regulatory, researchers & automobile companies are looking for an substitute to decrease greenhouse gases releases & implementing a proficient model for the utilization of lubricate property. So many researches shown stirring the drive train is the hope in moving motors manufacturing. Because of business measures and mechanical issues, hybridizing is a most moving motor option. This dissertation is a summary of the record of competence upgrading in conditions of fusion electrical system techniques, power utilizations, battery converter technologies, and cruise choice are discussed. And the strengths of technologies for Hybrid Electric Vehicles to decrease greenhouse gases releases & Total lubricants utilization, are mentioned deeply. And the lastly, other practical problems and business matters with this proposed ideas are also discussed here.

Key Terms—Lubricants, EV Vehicles, HEVs, Vehicle Drives, Power Electronics.

INTRODUCTION

The words like global warming , green house effect and renewable power in our regular life. These terms are considered worldwide environmental degradation seriously. Though, while severe concern arrives, the daily life & value of living things will transform hugely. These are main essentials of the planet life style, the shipping business acting central part in day by day life. It shows belongings on, except not partial to, the universal surroundings, worldwide Green House Gases & their recreation, daily life issues. In 1900 the early years, a model of contemporary shipping distorted the earth. Now days, about 30 lakhs happy fusion

electric motor (Heavy) users on the earth & still further possible customers altering lubricants utilization on the earth.

In all the countries petroleum is the major lubricant for transportation, this utilizes nearly 21 percent of the cumulative energy usage. From 2000, transportation industry is using huge amount of petroleum lubricants than any other industry. As displayed in Figures below. 1 and 2, Vehicles are using approximately 2/3 of the lubricants in North America. Coming to the CO₂ release quantity, the shipping motor field releasing about 50% of the cumulative release. And considering few rich areas in upcoming years, their shipping motors count will reaches to huge amount in the coming 40-50 years, which count is approximately five timers than present figure [1]-[7].

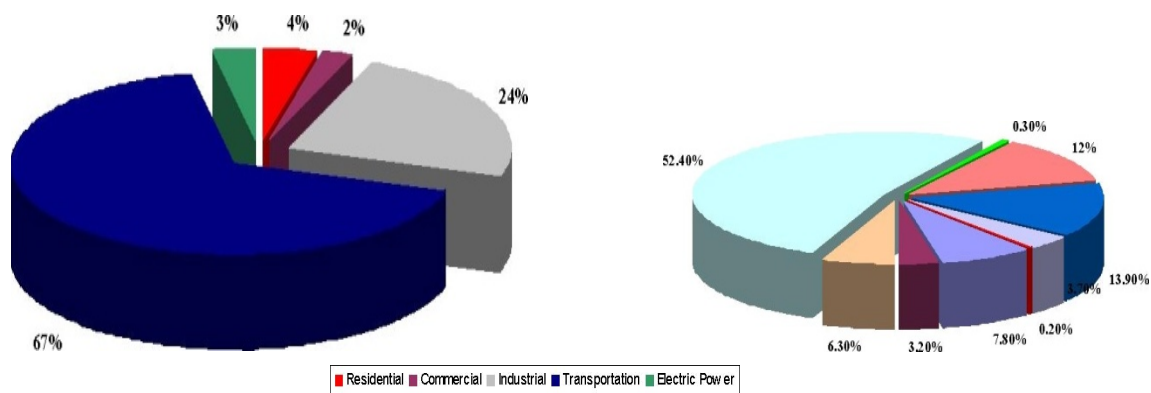


Fig. 1. Oil utilization % by different sectors in 2006. Fig. 2. CO₂ releases in 2006

Ecological stress & financial system issues vehicle developers & officials are determined to discover the features of Heavy Electrical Vehicles & further difficult motors. The two key global vehicle developers by many years familiarity in North America, Hero designed & named as “*Insight*”, the earlier Heavy Electrical Vehicle to be purchased in North America. Next in Japan , Toyota also launched one Heavy Electrical Vehicle named as “*Prius*”, in the year 2000. Then later so many years, the Toyota now came up with its own HEV. More the execution of the cross SUVs, which by the way stand for nearly 29% of cumulative sales sold in North America.

Vehicle developers continually try to remain up to speed by severe ecological system & increasing console necessities of clients, to make their profits. Toyota newly developed its concept zero emission vehicle, the “*Hybrid I*”, shows potential “Appropriate environmental equipment at the center of Toyota's idea of the potential, “*Hybrid I*” gives not only an environmentally superior motivating practice, but a entirely pioneering method for soothe” [8].

BASIC HEV DRIVE TRAIN SYSTEM CONFIGURATIONS

The forward motion force of Heavy Electrical Vehicles arrives commencing greater than two types of power cargo space sources & one of them ought to be an stimulating basis. In totaling, mixing & EV with the inner burning steam engine is the mainly realistic way of understanding a cross method, earlier than the clean Electric Vehicle ultimately as viable. Based on the

dissimilar mixings of stimulating grip , motorized grip, Heavy Electrical Vehicles be regularly alienated into 3 essential measures: Parallel, Series, and Parallel-Series united as shown in Figure. 3,4, and 5, in that order [9].

For the type sequence Heavy Electrical Vehicles pattern, as shown in Fig. 3, consists of 2 distinctions power banks are joint in series. It is important to note here that the electric motor offers the only traction making it an electric-intensive truck, which is added, fit for urban dynamically. The I.C.E works at its best process limits like committed initiator, maintaining the succession accuse, by gathering the condition of indict necessities [10]. On the whole competence of a sequence Heavy Electrical Vehicle is around 30 percent, since the short competence of the I.C.E & additional scientific aspects, such as succession ability & force instruct bunch.

For the type parallel Heavy Electrical Vehicle pattern, is shown in Fig. 4, the motor consists of 2 grip generators, together mechanical and electric. The parallel configuration provides huge autonomy to select mix of grip generators. With cumulating parallel and series grip generators, lesser locomotive be able to be utilized. Further, a parallel Heavy Electrical Vehicle development needs an fuel of a small capacity with respect to series Heavy Electric Vehicles, this shows the force instruct crowd as little. Hence, more competence lies, in 40-45% range and achieving also made easy [11]-[13].

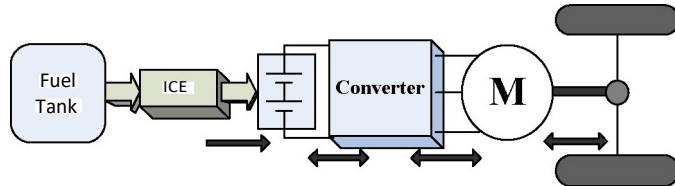


Fig. 3. Series Heavy Electric Vehicle Configuration .

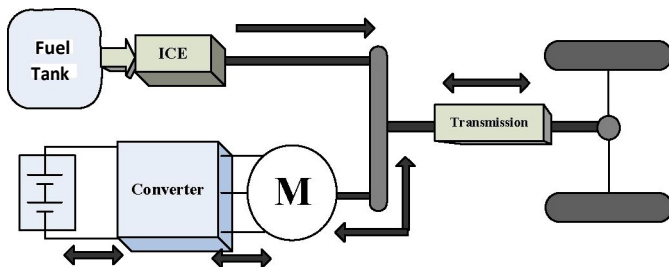


Fig. 4. Parallel Heavy Electric Vehicle Configuration.

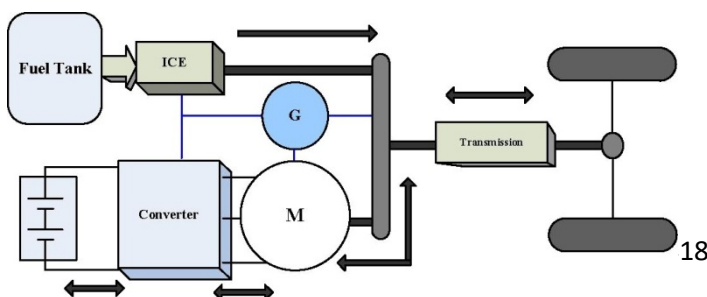


Fig. 5. Series-Parallel Heavy Electric Vehicle Configuration.

Below figure illustrates a contrast of total competence of parallel and series Heavy Electrical Vehicles constrain guide techniques. As there are 2 different channels for flow of the power, the efficiency of parallel Heavy Electric Vehicle technique will be multiplied with 2. This is evident that the parallel Heavy Electric Vehicle type configuration has achieved high efficiency. And due to series Heavy Electrical Vehicles electrical intensive configuration, they are very much suited for urban and rural driving. While, parallel Heavy Electrical Vehicles are very much suited for highway driving.

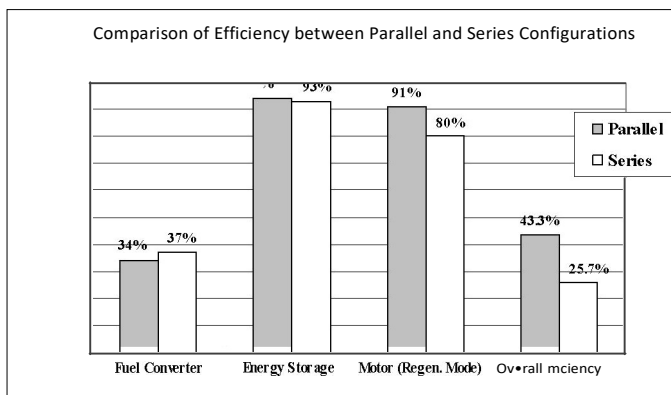


Fig. 6. Comparison of Efficiency between Parallel and Series Configuration

Now including a motorized block in the middle of source & drive unit, Parallel-Series Heavy Electrical Vehicles gives advantages of a Parallel Heavy Electrical Vehicles and Series Heavy Electrical Vehicles look into Figure. 5. Apart from advantages of Parallel and Series Heavy Electrical Vehicles configurations they have disadvantages. The real time practical difficulty of the broad plan & its implementation is huge.

Type model may use in DC/DC converter; this is corresponding a stable control fill for the Ultra Capacitor. The largely charge of the ‘C’ may be expressed by the below equation:

$$C = n \frac{Crated}{n_s}$$

I. DESCRIPTION OF POWER STORAGE METHOD

The major problems of Heavy E V developers are that Increasing design competence & also decreasing the automobile manufacturing cost. Since, from PBA to NiMH storages, & from ultra capacitors – fly wheels for lots of years numerous storage units developers are tried to improve ESS competence & power mass. And, good EMS for Heavy Electrical Vehicles are designed to have superior utilization of partial stimulating power that is in the automobiles. Now a days, storages are manufactured in the rating of 30-90 Ah [14].

But, to obtain good output compared to regular automobiles, Heavy Electric Vehicles should have strength power storages, at energy capacity

2-4 kW/L. As a result, we can't neglect the price issue.

Providentially along quick changes in of Li-Ion, NiMH, & NiCd series topologies, cost changes of 3-5 percent can be feasible. Generally, it is clear that above said batteries are most likely happening to the the majority appropriate power storage devices for upcoming all types of automobiles. Apart, the outstanding existence merits of these storage devices are definitely set for the future Heavy Electric Vehicles. Also, the NiMH storage results in minor competence whenever charging & discharging times, that to NiCd, NiMH requires fewer control. Apart, these two storages are matched below storage power techniques; these be planned to utilize complete power of the power sources. Let, the trendy charge depleting (CD) Heavy Electrical Vehicles organize plan. With above strategy, the on the whole competence is enhanced around 6 percent that to the multi-speed equivalent Heavy Electrical Vehicles open organize policy, which is measured as top competent organize methods. By saying the Lithium Ion and NiMH storages are rationally free from the maintenance; they don't have deadly deep items, plus they be completely ecological. Because of these ecologically responsive individuality puts in a potential storage growth. In other side, intended for long-duty fusion EVs, Energy Storage Systems methods carry benefits for Heavy Electric Vehicles business. Ultra capacitor & fly wheel both latent, best adjustable for large storage systems.

The Ultra capacitor also called the "Double Layer" capacitor. UCs have a tiny worth of opposition, and soaring power thickness. UC's capacitance(C) lies between 399-799 F. the equivalent UC model is shown in Fig. 7. UC

C = Cumulative value of capacitance; C_{rated} = individual capacitor capacitance; np = parallel strings number of a capacitor, and n = series capacitors number in each string.

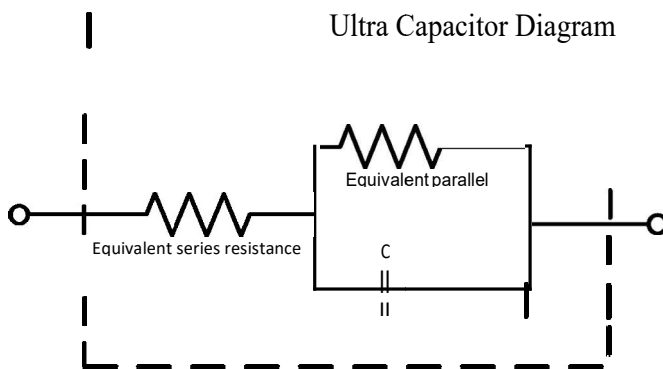


Fig. 7 Ultra Capacitor Diagram

Built with materials which are not environmental harmfulness, FWESS gives boundless features of great drive solidity, good life cycle & good consistency, these things fine matched with long automobiles & town shipment vehicles. Now a day, owed with extensive perfection at counting solidity, FWESS is likely substitute aimed at trivial automobiles. Enhanced FWESSs are proved that they attain great spinning accelerations, of range of 39999-49999 RPM, & can produce 799-999 WHRS., control grades of 149-199 in KW. Below Fig.8 shows the components of FWESS. The corporeal limits like resistance, blade apathy & system apathy, all rivalled with Capacitors & Resistors [15].

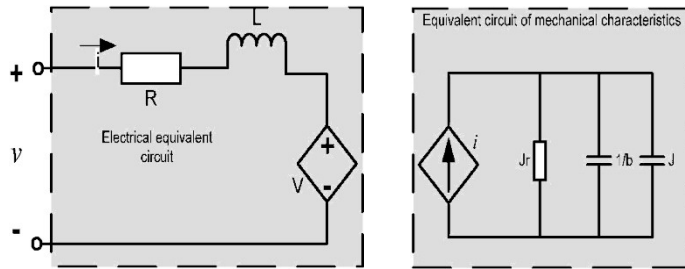


Fig.8 Components of FWESS.

Secondary power packing devices joining Ultra Capacitor & Direct to Direct changer simply appreciated. The Heavy Electric Vehicle successively in town initiative series nearly 29 percent energy finances advance was established by assistance with both Ultra Capacitor and FWESS unit. Along with that if we use Ultra Capacitor and FWESS combination, high energy necessities of a long power

EV's & more complex voltage necessities for combined military applications electric vehicles suitably pleased [16]-[18].

The good planned drive controlling plans & progressive microcontroller methods become Hybrid Electric Vehicles very applied. Presently main study attention was located on bright regulator approaches like uncertain reasoning regulator plan, adaptive regulator plan, and impartial system built regulator procedures. An enhanced power-control mechanisms reduces power necessity for Heavy Electric Vehicles & continues top show below different capacity settings. while the automobile reveals failure by tolerant added valuable drive starting recreating slowing through retaining a elegant artificial neutral network rational sum of reformative drive can be improved.

II. POWER ELECTRONICS & TRACTION MOTOR CHOICE

The principal contest with Heavy Electric Vehicles growth separately after carrying prevailing & upcoming tools collected is to consume the record constant most dependable routine & deal utmost contented powerful capability with rational price. Progressive power electronic systems & power-driven engines show main roles in taking Heavy Electrical Vehicles into fair having above-mentioned brilliance and consistency [19]. Particularly coming days once Heavy Electrical Vehicles grow to a extra intensive assembly additional PED (Power Electronic

Devices) clearly complicated. Hence competence matter, dependability matter and scheming condensed PED (Power Electronic Devices) grow into key contests.

Innovative converter plans of power electronics & mechanism for control applied with Heavy Electric Vehicles to stunned many practical issues. As a famous competence perfection schemes easy converting schemes may be applied in Heavy Electric Vehicles power electronic converters (Both AC-DC, DC-DC) for reducing change pressures & to inferior sum swapping damages. Outcomes in the studies of blends of soft- swapping techniques with different types of engines show that soft swapping is suggested for Heavy Electric Vehicles. Heavy Electric Vehicles used in town timings are confirmed drive reserves of 4 to 5 percent. Equally once Soft-Swapping executed with Heavy Electrical Vehicles which are used on freeway like Highway savings of 2 Percent power is waste to associated with the execution difficulty & prices. [20]

Hence in recent days focused study linked with new DC to DC & DC to AC converter plans & requests with Heavy Electrical Vehicles are now a prevalent issue. Embattled new converters for power electronics would take advantages like more competence, slight capacity, two-way flow of power, Rate of voltage flow is high, and automatic flow of power, to run into desires of ecologically friendly Heavy Electric Vehicles. Ex:- In prospective plug-in Heavy Electric Vehicles procedure of this is shown in Fig. 9 [21].

Because of above features high level DC to DC converters, presenting the clamped-capacitor scheme surely have less cost.

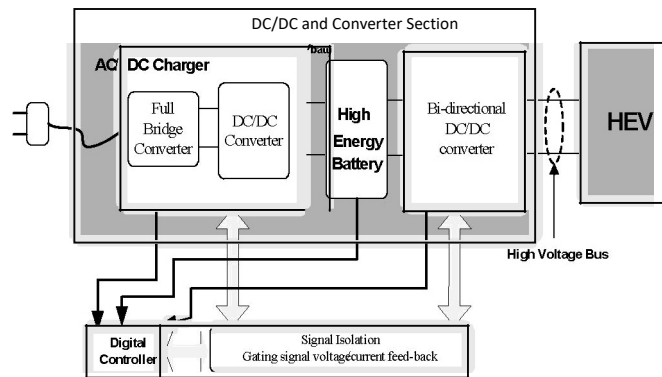
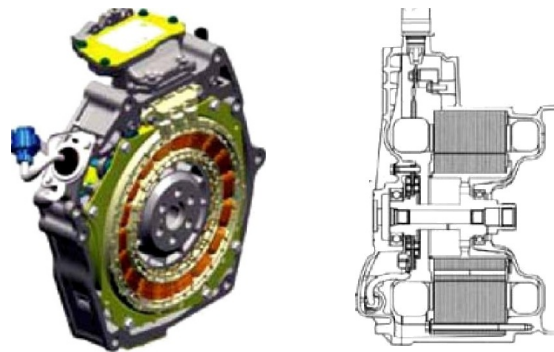


Fig. 9. Plug-in HEV power system overview.

The statistic that the heart of every HEV system is the electric propulsion engine. There are four standard kinds of electric motors available. They are proposed switched reluctance motor

(SRM), DC motor, permanent magnet (PM) brushless engine, and the popular AC induction motor (IM). Hence choosing of a suitable Heavy Electric Vehicles EPS (Electric Propulsion System) needs thoughtful deliberation. Now a day research says the A.C IM and PM engine are 2 readily implemented contenders. An Induction Motor become apparent optimal since of IM's consistency, short preservation, small price & operational abilities in forceful surroundings. Permanent Magnet brushless engine. Though is widely exploited in current Heavy Electric Vehicle plans owing its well-lit mass, minor size, advanced competence & fast temperature indulgence. Fig. 10 shows A cross sectional vision of a Permanent Magnet brushless engine

Fig. 10. A cross sectional vision of a PM brushless engine design [24], [25]



Few series Heavy Electric Vehicle models utilize Permanent Magnet engine as committed maker. It works at a pre-designed, enhanced action for getting more competence. Since the prolonged hurry variety skill, engine work & energy competence. Though taking a choice among

Induction Motor and Permanent Magnet brushless plans become critical for manufacturers [22], [23].

Component wrapping & connections remain similarly authoritative matters is essential to discussed once production through upcoming motorized energy electronics & engine initiatives [19]. While the unified tapas/variation has been about for a though power electronics has not yet changed to a step somewhere vehicles may be grasped. Ideal wrapping of power electronic subsystems & electromechanical is a applied subject it frequently doubts automobile producers. Also plentiful problems too happen in mixing many radars & regulator subsystems in order to completely appreciate great show electric engine energies [26].

PRESENT & FUTURE HEAVY ELECTRIC VEHICLES TECHNIQUES

Presently having an ecological closeness & a maximum competent Heavy Electric Vehicles in attention some outstanding growth Heavy Electric Vehicles era is probable. Since distinctive Heavy Electric Vehicles drive train formations to in-

wheel engines oil budget perfections & Green House Gasses emission drops simply. Ex:- For expand drive train competence altered terrestrial tackle structures are magnificently planned & established. The slide was sited confidential in the engine for circumvent damages happening through motorized energy broadcast. While a small modification can expand the drive train competence by minimum expense. Study should regularly through for having advancements in HEV's.

By the start of the in-wheel automobile machinery the electric power engine is limited with controls for decrease the drive missing during spread. Heavy Electric Vehicles strategy & expansion is discernibly touching near an additional capable imminent [27]. Though for these designs few must be discussed. Ex:- For understand 4x4 drive, four in wheel engine motors are required where these will need more mass. Furthermore, the synchronization is a big problem.

CONCLUSION

In this discussion a summary of the competence improvement of Heavy Electric Vehicles are studied & discoursed in depth. In adding a complete argument between present & future Heavy Electric Vehicles drive train techniques, ESS (energy storage systems), PMS (power management strategies), Engine motor choosing problems, power electronic converter models, additional detailed to Heavy Electric Vehicles drive trains are offered. Matching the advantages & disadvantages of numerous said tools some Heavy Electric Vehicles commercialization matters are too discussed.

Automobile industry is a fast emerging. It is tough for offering good deduction to the Heavy Electric Vehicles schemes in overall. Though enormous abilities in Asia, North America, and Europe surely signify a talented imminent for innovative electric thrust built vehicular plans.

REFERENCES

- [1] R. D. Strattan, "The electrifying future of the hybrid automobile," *IEEE Potentials*, vol. 23, no. 3, pp. 3-7, Aug. 2004.
- [2] C. C. Chan, "An overview of electric vehicle technology," *Proc. of the IEEE*, vol. 81, no. 9, pp. 1202-1213, Sept. 1993.
- [3] S. S. Williamson and A. Emadi, "Fuel cell vehicles: opportunities and challenges," in *Proc. IEEE Power Engineering Society (PES) General Meeting*, Denver, CO, June 2004, vol. 2, pp. 1640-1645.
- [4] C. C. Chan, "The state of the art of electric and hybrid vehicles," *Proc. of the IEEE*, vol. 90, no. 2, pp.247-275, Feb. 2002.
- [5] T. H. Ortmeroy and P. Pillay, "Trends in transportation sector technology energy usage and greenhouse gas emission," *Proc. of the IEEE*, vol. 89, no.12, pp.1837-1847, Dec. 2001.
- [6] "Annual energy review 2006," *Energy Information Administration*, Washington DC, DOE/EIA-0384 (2006), June 2007.
- [7] M. J. Riezenman, "Engineering the EV future," *IEEE Spectrum*, vol. 35, no. 11, pp.18-

- 20, Nov. 1998.
- [8] Toyota Concept Vehicle Sector, "The Hybrid X concept vehicle," Toyota Motor Sales U.S.A., Inc., 2006-2007, available online:
 - [9] A. Emadi, K. Rajashekara, S. S. Williamson, and S. M. Lukic, "Topological overview of hybrid electric and fuel cell vehicular power system architectures and configurations," *IEEE Trans. on Vehicular Technology*, vol. 54, no. 3, pp. 763-770, May 2005.
 - [10] G. Maggetto and J. Van Mierlo, "Electric and hybrid electric vehicle: a Survey," *IEE Seminar on Electric, Hybrid Electric, and Fuel Cell Vehicles*, Durham, UK, April 2005, pp. 1-11.
 - [11] S. S. Williamson and Ali Emadi, "Comparative assessment of hybrid electric and fuel cell vehicles based on comprehensive well-to-wheels efficiency analysis," *IEEE Trans. on Vehicular Technology*, vol. 54, no. 3, pp. 856-862, May 2005.
 - [12] F. An and D. Santini, "Assessing tank-to-wheel efficiencies of advanced technology vehicles," in Proc. *World Congress*, Detroit, MI, March, 2003.
 - [13] T. Hany, H. Iwano, and H. Ooba, "A study of the power transfer systems for HEVs," in Proc. *NW World Congress*, Detroit, MI, April 2006.
 - [14] I. Menjak, P. H. Gow, D. A. Corrigan, S. Venkatesan, S. K. Dhar, R. C. Stempel, and S. R. Ovshinsky, "Advanced Ovonic high-power nickel-metal hydride batteries for hybrid electric vehicle applications," in Proc. *IEEE 13" Annual Battery Conf. on Applications and Advances*, Long Beach, CA, Jan. 1998, pp. 13-18.
 - [15] C. Hearn, M. Flynn, M. Lewis, R. Thompson, B. Murphy, and R. Longoria, "Low cost flywheel energy storage for a fuel cell powered transit bus," in Proc. *IEEE Vehicle Power and Propulsion Conf.*, Arlington, TX, Sept. 2007.
 - [16] D. W. Swett and J. G. Blanche IV, "Flywheel charging module for energy storage used in high-voltage pulsed and multi-mode mobility hybrid electric military vehicle power system," in Proc. *IEEE 26" International Power Modulator Symposium and High-Voltage Workshop*, San Francisco, CA, May 2004, pp. 153-156.

Reddy,C.Harikrishna,N.Ravisankar Reddy,Y.V.Siva Reddy,C.Harinatha Reddy "Design of battery management System for electric vehical Based on IOT" *Neuro Quantology*, Vol. 20, Issue22, pp. 1955-1962,December 2022

29.[B. Kiran Kumar](#), [Y. V. Siva Reddy](#),[M. Vijaya Kumar](#) "Neuro Fuzzy Controller for DTC of Induction Motor Using Multilevel Inverter with SVM" [Journal of Circuits, Systems and Computers](#),Volume 30, Issue 14,November 2021.

30. G. Sreenivasa Reddy, T. Bramhananda Reddy, M. Vijaya Kumar "Analysis of Medium Scale Solar PV System Performance onGrid tied single-stage Conversion System" *Advances in Engineering, Management and Sciences*J. Mech. Cont.& Math. Sci., Special Issue, No.-3, pp 97-113, September2019

31.S. Nithya Lavanya, T. Bramhananda Reddy, M. Vijay Kumar "Low Computational Burden And FixedSwitching Frequency Random Pwm TechniquesFor Vector Controlled Induction

Motor Drive” Journal of Mechanics of Continua And Mathematical Sciences, Special Issue, No.-5, January (2020) pp 227-239.

32. S.L.V Sravan Kumar, N.Ravishankar Reddy, M.Vijay kumar, “Low-Stress and Efficiency Design of Integrated BoostSeries Parallel Fly-Back Converters” Journal of Europeen des SystemsAutomatistes (JESA), Vol.53, No.3, June,2020, pp.393-401

33. Mahamkali Ranjit, Teegala Bramhananda Reddy,Munagala Suryakalavathi, “Performance of Decoupled and Nearest Sub Hexagonal Center Random PWM Techniques for Open-End Winding Induction Motor Drive” Jour of Adv research in Dynamical & Control Systems, Volume-10, Issue-12 PP.396-405 August 2018.