IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified ⁜ Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 10, Issue 4, April 2023

DOI: 10.17148/IARJSET.2023.10427

Modified E-Vehicle Using CVT

Mr. Hemant Bind[1], Ms. Kirti Takpire[2], Mr. Kartik Pimpalkar[3], Prof. Pawan Kurwade[4]

UG Student (Mech. Engg.), Dept. of Mechanical Engineering, Sipna COET, Amravati, Maharashtra, India[1-3]

Assistant Professor, Dept. of Mechanical Engineering, Sipna COET, Amravati, Maharashtra, India[4]

Abstract: In recent times, earth is suffering from huge pollution, which is caused due to traditional IC engine vehicles. So, the entire world is moving to a new trend of electric vehicles, which is pollution-free and higher efficient over traditional vehicles (IC engine vehicle). Transport electrification is one of the most significant areas of study by the industrialists over the past years. Electric vehicles (EVs) are taking over market share of traditional internal combustion engine vehicles. The growing attractiveness of EVs contributes to a higher number of charging stations, with significant grid impacts. Innumerable operational approaches, as well as methods of grid integration, are being developed to reduce the negative effects of EV charging and to optimize the benefits of EV grid integration. In this study, the developments on electric vehicles and its customization over a period of time till now have been delivered. This research work is based on numerous batteries used in Electric Vehicles (EV), several drive systems with its benefits and charging methodologies in recent time has been made along with its Cons to provide better knowledge for researchers to promote substantial augmentation of EV.

An individual need not be an automobile designer to comprehend that the lesser fuel a motor devours the better it is, and the less poisons delivered, and the cleaner the air we inhale. Lamentably, enhancing the variables in that mathematical statement is getting to be progressively troublesome. To accomplish extra mileage changes, we have started to concentrate on expanding productivity in ranges where enhancements are significantly more troublesome and expensive to attain to - to a great extent on powertrain segments, for example, the transmission This stems from the way that transmissions work over a scope of force conditions, for example, low speed-high torque to fast low torque, and in addition through an assortment of apparatus proportions. To accomplish picks up here, we have tested the traditional speculation connected with powertrain capacities and plans.

Keywords: E-vehicle, CVT, Transmission system, Battery.

I. INTRODUCTION

In recent times, electric vehicles (EV) are gaining popularity, and the reasons behind this are many. The most eminent one is their contribution in reducing greenhouse gas (GHG) emissions. In 2009, the transportation sector emitted 25% of the GHGs produced by energy related sectors. EVs, with enough penetration in the transportation sector, are expected to reduce that figure, but this is not the only reason bringing this century old and once dead concept back to life, this time as a commercially viable and available product. As a vehicle, an EV is quiet, easy to operate, and does not have the fuel costs associated with conventional vehicles. As an urban transport mode, it is highly useful. It does not use any stored energy or cause any emission while idling, is capable of frequent start-stop driving, provides the total torque from the start up, and does not require trips to the gas station. It does not contribute either to any of the smog making the city air highly polluted. The instant torque makes it highly preferable for motor sports. The quietness and low infrared signature make it useful in military use as well. The power sector is going through a changing phase where renewable sources are gaining momentum. The next generation power grid, called ‘smart grid’ is also being developed. EVs are being considered a major contributor to this new power system comprised of renewable generating facilities and advanced grid systems. All these have led to a renewed interest and development in this mode of transport.

A Continuously variable transmission (CVT) is a transmission which can change stepless through an infinite number of effective gear ratios between maximum and minimum values. This contrasts with other mechanical transmissions that only allow a few different distinct gear ratios to be selected. The flexibility of a CVT allows the driving shaft to maintain a constant angular velocity over a range of output velocities. In the most common CVT system, there are two V-belt pulleys that are split perpendicular to their axes of rotation, with a V-belt running between them. The gear ratio is changed by moving the two sections of one pulley closer together and the two sections of the other pulley farther apart. Due to the V-shaped cross section of the belt, this causes the belt to ride higher on one pulley and lower on the other. Doing these changes the effective diameters of the pulleys, which changes the overall gear ratio. The V-belt needs to be very stiff in the pulley's axial direction to make only short radial movements while sliding in and out of the pulleys Invalid source specified. This can be achieved by a chain and not by homogeneous rubber.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified ⁜ Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 10, Issue 4, April 2023

DOI: 10.17148/IARJSET.2023.10427

To dive out of the pulleys one side of the belt must push. This again can be done only with a chain. Each element of the chain has conical sides, which perfectly fit to the pulley if the belt is running on the outermost radius. As the belt moves into the pulleys the contact area gets smaller.

Due to concerns regarding climate change and greenhouse gas emissions as well as depletion of fossil fuels, renewable energy sources have great potential as alternative energy sources in energy systems. Renewable energy sources such as solar and wind are intermittent and fluctuating. Hence, energy storage systems are important parts of the renewable energy sector. Energy storage is particularly significant for electricity generation from solar, wind, tidal, and ocean thermal energy conversion technology, in order to ensure availability of electricity at all times. The use of electricity storage is warranted by capacity restrictions of grids. To exploit wind energy, wind turbines are installed in large numbers in regions where the wind potential is high. When the wind turbines work simultaneously, the grid may not be able to transmit the produced electricity and the wind turbines may be forced to shut down. Thermal energy storage can be achieved with a wide variety of technologies. Depending on the specific technology, thermal energy storage allows excess thermal energy to be stored and used hours or days or months later, at scales ranging from individual processes, buildings, and multiuser buildings to districts, cities, and regions. In this chapter, energy storage technologies are described and assessed, focusing on electrical and thermal storage.

The lead–acid battery consists of two electrodes submerged in an electrolyte of sulfuric acid. The positive electrode is made of grains of metallic lead oxide, while the negative electrode is attached to a grid of metallic lead. Lead–acid batteries are classified into two types: flooded and valve-regulated. Flooded lead–acid batteries are less expensive but require more maintenance and ventilation than the valve-regulated lead–acid batteries. Lead–acid batteries are commonly used for renewable energy systems, largely because they can be easily transported, and they have relatively low costs.

However, these batteries have some challenges, including low numbers of charging–discharging cycles over their lifetimes, low discharge intensities, restricted lifetimes, and slow charging rates [6]. More advanced lead–acid batteries are continually being introduced. New lead–acid batteries utilize carbon on the negative electrode to create a supercapacitor negative electrode. In these batteries, the positive electrode does not undergo any change in its chemical process, and no chemical process occurs at the negative electrode. As a result, the positive electrode is less subject to corrosion, leading to longer lifetimes and higher efficiencies than conventional lead–acid batteries. Lead–acid batteries are the dominant market for lead.

II. LITERATURE REVIEW

1. A Study on Barriers to Adoption of Electric Vehicles - August 2022 Manjula. B. C, Shilpa. B. S, Sundaresh. M, Adoption of green & sustainable technologies in the transport sector is the need of the hour. High initial price charging time & limited range are the obstacles towards the adoption and diffusion of electronic vehicles. In the process of reducing the pollutions world is searching for every alternative to reduce the emissions and find the solutions to the alternative energies. The study aims to find out those barriers to the adoption of electric vehicles. The article is contemporary and examines the different factors that affect a consumer's adoption of an EV.

2. Research on Charging and Discharging Dispatching Strategy for Electric Vehicles Wang Yong, Bian Haihong, Wang Chunning, September 2015, The Open Fuels & Energy Science Journal 8(1):176-182 The popularity of electric vehicles may lead to negative effects on the power system if the charging procedures of plug-in electric vehicles (PEVs) are uncoordinated. In order to solve the problem, the hierarchical and zonal dispatching architecture and a new bi-level optimization model are respectively presented for the charging/discharging schedules of the PEVs. Two highly efficient commercial solvers, AMPL/IPOPT and AMPL/CPLEX respectively, are employed to solve the developed optimization problem. Finally, the testing IEEE system consisting of 5 agents and 30 nodes is adopted to illustrate the characteristics of the model and solving method presented in this paper.

3. Evaluation of Electric Power Losses of an Induction Motor Driving a Compact Electric Vehicle at Change of Parameters and Loads 03-04 October 2019 Svilen Rachev; Dimo Stefanov; Lyubomir Dimitrov; Dimitrina Koeva, Everything in an electric car is subject to maximum energy savings. A condition for the development of electric vehicles is the use of suitably designed electric motors as a driving component of the electromechanical system. At present, in electric vehicles induction motors are mainly used for better efficiency and due to their known advantages. Paper deals with evaluation of the combined influence of changing the equivalent circuit parameters and the total moment of inertia on the electric power losses in a compact electric car drive in the dynamic modes arisen. Simulations have been performed using an appropriate mathematical model of electromechanical system.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified ⁜ Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 10, Issue 4, April 2023

DOI: 10.17148/IARJSET.2023.10427

4. Modeling and Power Management of Electric Vehicle Charging System '28-30 October 2021' Pravat Kumar Ray; Anindya Bharatee; Samarpita Panda; I Nyoman Wahyu Satiawan, The aim of this paper is to simulate a charging station consisting of a renewable energy source (Photo Voltaic array) and a microgrid to supply power, and to study the station's power management schemes so that the microgrid experiences the least stress. The design of the station is such that the power flow occurs in both Grid to Vehicle (G2V) and Vehicle to Grid (V2G) directions. Due to this bidirectional nature of the charging station, not only is the pressure on the grids reduced but also the Electric Vehicle itself can be used to stabilize the grid during unequal production of power and load demand. The power flow in this entire system is decided by the mode of operation which depends on the load demand, microgrid production, and the State of Charge of the Electric Vehicle. The recommended power flow scheme for charging an electric vehicle is validated through MATLAB/Simulink results.

5. Key issues in life cycle assessment of electric vehicles 17-20 November 2013 Gerfried Jungmeier; Jennifer B. Dunn; Amgad Elgowainy; Enver Doruk Özdemir; Simone Ehrenberger; Hans Jörg Althaus; Rolf Widmer, Electric vehicles have the potential to substitute for conventional vehicles and to contribute to the sustainable development of the transportation sector worldwide, e.g. reduction of greenhouse gas and particle emissions. Based on LCA activities in the 17 member countries, the International Energy Agency (IEA) Implementing Agreement on Hybrid and Electric Vehicles (IA-HEV) works in a Task on the LCA of electric vehicles. In this Task 19 "Life Cycle Assessment of Electric Vehicles — From raw material resources to waste management of vehicles with an electric drivetrain" the key issues of applying LCA to EVs & HEVs are identified and applied in various case studies. The following seven categories of key issues were identified, analysed and applied in "best practice" applications: 1) General issues, 2) Life cycle modelling, 3) Vehicle cycle (production — use — end of life), 4) Fuel cycle (electricity production), 5) Inventory analyses, 6) Impact assessment and 7) Reference system. For these seven key issues the main relevant factors were identified, reviewed and verified in international "best practice" applications.

III. IDENTIFIED PROBLEM, AIM AND OBJECTIVE

- **Identified Problem:**

i. The sudden jerk of a vehicle after accelerating from rest position which can cause accidents.
ii. Disconnection of power supply from battery to the motor after applying the brake.

- **Aim:** To solve an identified problem (Sudden jerk and disconnection of power supply).

- **Objective:**

i. Understanding the different aspects of the Electric Vehicle and its working.
ii. To analyze the comparative study between Electric and fuel operated vehicles.
iii. To study the perceptions and expectations of potential, for alternative technologies in automobiles.
iv. To identify the problem in existing E-vehicle and resolving it.

IV. TYPES OF EV

EVs can run solely on electric propulsion, or they can have an ICE working alongside it. Having only batteries as energy source constitutes the basic kind of EV, but there are kinds that can employ other energy source modes. These can be called hybrid EVs (HEVs). The International Electrotechnical Commission's Technical Committee 69 (Electric Road Vehicles) proposed that vehicles using two or more types of energy source, storage or converters can be called as an HEV as long as at least one of those provide electrical energy. This definition makes a lot of combinations possible for HEVs like ICE and battery Therefore, the common population and specialists both started calling vehicles with an ICE and electric motor combination HEVs. These terminologies have become widely accepted and according to this norm, EVs can be categorized as follows:

i. Battery Electric Vehicle (BEV)
ii. ii. Hybrid Electric Vehicle (HEV)
iii. Plug-in Hybrid Electric Vehicle (PHEV)
iv. iv. Fuel Cell Electric Vehicle (FCEV)

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified ⁜ Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 10, Issue 4, April 2023

DOI: 10.17148/IARJSET.2023.10427

V. CONTINUOUSLY VARIABLE TRANSMISSION (CVT)

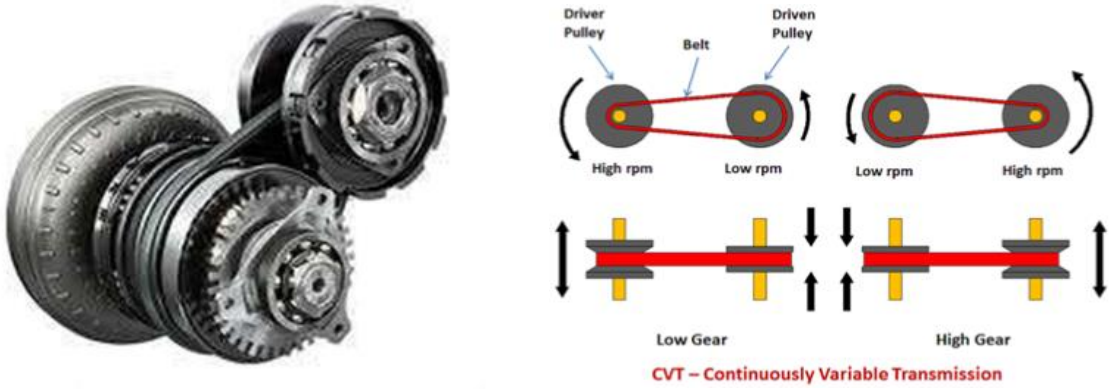
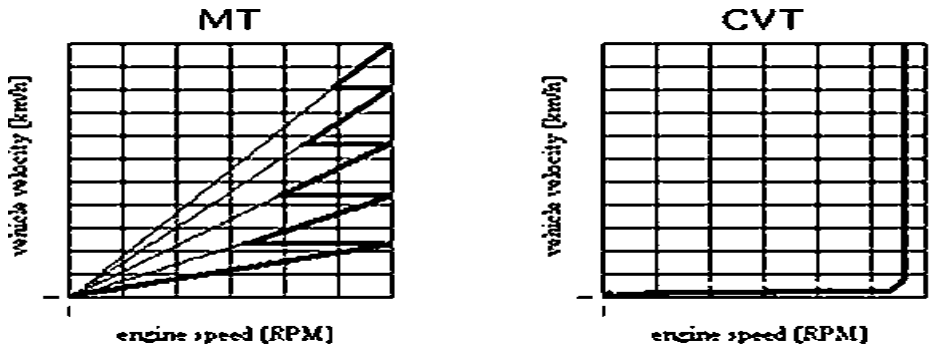


Figure: Operation of CVT

A CVT is a very simple concept. It has two pulleys and one steel belt that connects the two. The diameters of these two pulleys are able to be changed so that an infinite number of torque ratios are possible for the output shaft. This allows for the perfect torque ratio to always be available for optimum acceleration and/or fuel efficiency. CVT is a transmission having a speed ratio that can be varied continuously over its allowable range. Its speed ratio may take on any value between its operational limits, i.e., an infinite number of ratios are possible. A gearbox transmission, on the other hand, has a discrete number of fixed speed ratios. The term continuously variable transmission also usually implies that torque may be controlled independently of speed ratio and vice versa. In other words, the torque converter of the conventional automobile should not be considered a CVT because the speed ratio is set by the torque transmitted. As the distance between the pulleys and the length of the belt does not change, both pulleys must be adjusted (one bigger, the other smaller) simultaneously to maintain the proper amount of tension on the belt. Simple CVTs combining a centrifugal drive pulley with a spring-loaded driven pulley often use belt tension to affect the conforming adjustments in the driven pulley. The V-belt needs to be very stiff in the pulley's axial direction to make only short radial movements while sliding in and out of the pulleys. The radial thickness of the belt is a compromise between the maximum gear ratio and torque. Steel-reinforced V-belts are sufficient for low-mass, low-torque applications like utility vehicles and snowmobiles, but higher-mass and -torque applications such as automobiles require a chain.

Ratio Range: Ratio range is one of the most important parameters of a CVT in terms of characterizing it for possible applications. Ratio range is defined as the numerical ratio of the maximum to the minimum output speeds possible for a given fixed input speed. For example, if a CVT can be controlled to operate between 3000 and 1000 rpm for a given fixed input speed, its ratio range is 3.0. Ratio range is usually more significant than the speed ratios themselves since the latter can normally be adjusted, if necessary, by other components in the driveline. The ratio range of an IVT is infinite since it is calculated as a finite ratio divided by zero.

Need: An experiment was done, with two different cars with same engine capacity and same model. The only difference was the transmission system. In one car we have used manual transmission system whereas on other hand we have used CVT transmission system. An observation was done by taking these cars from 0 to 100 km/hr. The following graph is the given outcome,



IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified ⁜ Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 10, Issue 4, April 2023

DOI: 10.17148/IARJSET.2023.10427

i. When we engage the first gear in manual transmission, the rpm reaches to certain value, the horizontal straight line represents the time delay in changing the gear, which contains power loss of the engine.
ii. When we engage the first gear in CVT transmission, as the rpm increases the speed also increases. As there is no requirement of changing gears in CVT.
iii. Hence, the CVT transmission is more efficient, reliable and cost efficient for the autocar makers.

VI. METHODOLOGY

Electric vehicles are drastically cleaner than conventional gasoline vehicles. Even the burliest models with the biggest batteries account for less carbon emissions over a life's use than nearly every gasoline-powered vehicle, no matter how small. As the CVT based electric vehicle is better compared to a standard electric vehicle because it eliminates the problem of a quick jerk of vehicle while accelerating from rest position.

Working Principle: When throttle of vehicle gets twisted;

i. Controller takes and regulates electrical energy from batteries.
ii. With the controller set, the batteries then send a certain amount of electrical energy to the motor (according to the depth of pressure on the throttle).
iii. Electric motor converts electrical energy into mechanical energy (rotation).
iv. Rotation of the motor rotor rotates the transmission, which is a CVT in this case, so the wheels turn and then the vehicle moves.

Components Used:

i. Lead-Acid Battery (48 V 38 Amp)
ii. ii. BLDC Motor (48 V)
iii. Chassis
iv. Continuous Variable Transmission (CVT)
v. DC to DC Controller
vi. vi. Wiring Harness

VII. CONCLUSION

EVs have great potential of becoming the future of transport while saving this planet from imminent calamities caused by global warming. They are a viable alternative to conventional vehicles that depend directly on the diminishing fossil fuel reserves. The EV types, configurations, energy sources, motors, power conversion and charging technologies for EVs have been discussed in detail in this paper. The key technologies of each section have been reviewed and their characteristics have been presented. The impacts EVs cause in different sectors have been discussed as well, along with the huge possibilities they hold to promote a better and greener energy system by collaborating with smart grid and facilitating the integration of renewable sources. Limitations of current EVs have been listed along with probable solutions to overcome these shortcomings. The current optimization techniques and control algorithms have also been included. A brief overview of the current EV market has been presented. Finally, trends and ways of future developments have been assessed followed by the outcomes of this paper to summarize the whole text, providing a clear picture of this sector and the areas in need of further research.

Working through this project, we managed to explore a vast pool of knowledge in the field of Automobiles and its component-parts. It also provided us with valuable experience on power transmission. we became aware of work criterion, challenges & other activities performed during the research practice and the project implementation. This project has helped us to gain lot of technical as well as practical knowledge. The Study of CVTs gave us a handful knowledge about its component-parts and design criterion and its performance parameters. At present, CVTs are only being used in a fewer no. of vehicles but the applications & pros of CVT could only be improved based on R&D. As automobile manufacturers continue to develop CVTs, more and more vehicles will use them, and also performance and fuel efficiency will continue to increase inevitably. This sense of development will lead to increased sales which, in turn, will prompt further R&D, and the cycle will keep repeating. Cruising development of CVTs will foster competition among the manufacturers which in turn lowers manufacturing costs. The CVT has only just begun to blossom.

IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified ⁜ Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 10, Issue 4, April 2023

DOI: 10.17148/IARJSET.2023.10427

REFERENCES

[1] M.A. Kluger and D.R. Fussner, "An Overview of Current CVT Mechanisms, Forces and Efficiencies" Symposium, pg. 81-88 SAE, 1997. SAE Paper No. 970688, in SAE SP-1241.

[2] S. Sakaguchi, E. Kimura and K. Yamamoto: "Development of an Engine-CVT Integrated Control System" SAE Paper No. 1999-01-0754, in SAE SP-1440, Transmission and Driveline Systems Symposium, pg. 171-179 SAE.

[3] Hybrid V-Belt for a CVT – Advanced Numerical Model Considering Block Tilting and Pulley Deformation" SAE Paper No. 1999-01-0751, in SAE SP-1440, Transmission and Driveline System Symposium, pg. 143-153 SAE.

[4] Hyunjae Yoo; Seung-Ki Sul; Yongho Park; Jongchan Jeong, "System Integration and Power-Flow Management for a Series Hybrid Electric Vehicle Using Supercapacitors and Batteries", IEEE Trans. on Industry Applications, Vol. 44, Issue 1, Jan.-Feb. 2008, pp. 108 – 114.

[5] Haddoun, A.; Benbouzid, M. E. H.; Diallo, D.; Abdessemed, R.; Ghouili, J.; Srairi, K., "A Loss-Minimization DTC Scheme for EV Induction Motors", IEEE Trans on Vehicular Technology, Vol. 56(1), Jan. 2007, pp. 81 – 88.

[6] Affanni, A.; Bellini, A.; Franceschini, G.; Guglielmi, P.; Tassoni, C., "Battery choice and management for new-generation electric vehicles", IEEE Trans. on Industrial Electronics, Vol. 52(5), Oct. 2005, pp. 1343 – 1349.

[7] Rahman, K.M.; Fahimi, B.; Suresh, G.; Rajarathnam, A.V.; Ehsani, M., "Advantages of switched reluctance motor applications to EV and HEV: design and control issues", IEEE Transactions on Industry Applications, Vol. 36, Issue 1, Jan.-Feb. 2000, pp. 111 – 121.

[8] Jones, W.D., "Putting Electricity Where the Rubber Meets the Road [NEWS]", IEEE Spectrum, Vol. 44, Issue 7, July 2007, pp. 18 – 20.

[9] Wang Yong, Bian Haihong, Wang Chunning, "Research on Charging and Discharging Dispatching Strategy for Electric Vehicles" The Open Fuels & Energy Science Journal 8(1):176-182 September 2015

[10] Xiaoqiao Zeng, Matthew Li, Deia Abd El-Hady, Wael Alshitari. Abdullah S Al-Boaami. Jun Lu. "Commercialization of lead acid battery technologies for electric vehicles Advanced Energy Materials" 9 (27), 1900161,2019.

[11] Allan Cooper; Patrick Moseley, "Progress in the Development of Lead-Acid Batteries for Hybrid Electric Vehicles", Vol. 56(1), 06-08 September 2006, pp. 1343 – 1349.

[12] Gerfried Jungmeier; Jennifer B. Dunn; Amgad Elgowainy; "Key issues in life cycle assessment of electric vehicles", Vol. 49, 20 November 2013, pp. 11 – 12.