A Technique for Hybrid Energy Storage System using Artificial Neural Network

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Abstract- Hybrid Energy Storage System for electric vehicles poses a considerable challenge for improvement in efficiency for charging. In this paper, we demonstrate the application of a Hybrid Energy Storage System using Artificial Neural Network. Here we can see the different parameters changes like super-capacitor and Li-ion battery Power, Supercapacitor current, voltage, dc voltage etc.Artificial Neural Network to enhance the results obtained using the PI controlled techniques. It reduces the calculation complexity of the system by reducing the values of Kp and Ki calculations. The neural network promotes self-learning capability of the system and also improves the system by reducing any fluctuations if any. Here we are using the artificial neural network and it is having many advantages it will get improved performance when properly tuned and also it requires less tuning effort than conventional controllers.

Keywords- Energy Storage System, Supercapacitor current,Li-ion battery Power, artificial neural network

I. INTRODUCTION

It consists of three main neuron layers: the input layer, the hidden layer, and the output layer of the ANN architecture. You can find the ANN model in various topologies. Neural networks are biological brain computing models. [1][2] An adult human's biological brain consists of several billion cells. They would stretch for several hundred miles if all the neurons in one adult human brain were laid out end-to-end. While each neuron is functionally easy, through adjustable, direct connections, the neurons are massively interconnected [3]. DC-DC converters which assume a significant job in hybrid energy storage system have been grown quickly throughout the years. Through a progression of advancements, a variety of DC-DC converters are made [4]. These systems can be separated into disconnected worldwide improvement and on-line nearby streamlining. For disconnected worldwide enhancement, it is important to acquire the best power dispersion between various sources. [5] In the meantime, for on-line nearby improvement, accurate predication driving conditions is important. [6][7].

Because of the contamination brought about by petroleum product, new energy sources have been ceaselessly created. These days, installed energy storage systems in current age electric vehicles are for the most part dependent on the Li-ions batteries which, with high energy thickness, can give long separation continuance to electric vehicles [8]. While contrasted with the super capacitor, the reaction of Li-ions batteries is slower than that of super capacitors [9].Hybrid renewable energy systems are well-developed power generation centers that are used to electrify rural regions as the grid cannot be extended to rural areas. The fuel price for standard sources of energy is increasing day by day. So, the situation is so we need to move towards renewable sources of energy [10].

II. PROPOSED METHODOLOGY

Artificial neural systems are the showing of the human personality with the clearest definition and building squares are neurons. There are around 100 billion neurons in the human cerebrum. Every neuron has an affiliation point some place in the scope of 1,000 and 100,000. In the human personality, information is put away in order to be circled, and we can extricate more than one piece of this information when basic from our memory in parallel. We are not stirred up when we express that a human personality is included a large number of, ground-breaking parallel processors. In multi-layer fake neural systems, there are in like manner neurons set thusly to the human personality. Every neuron is related with various neurons with explicit coefficients. In the midst of getting ready, information is spread to these affiliation centers with the objective that the system is discovered.

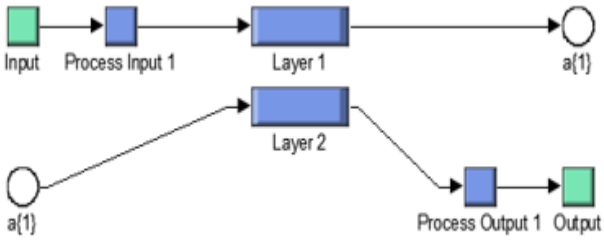

Fig.1: Artificial Neural Network layer network

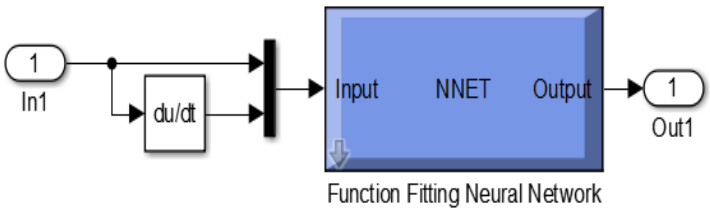

Fig.2: ANN Subsystem

The system configuration has an information layer, covered layer (there can be multiple) and the output layer. It is in like manner called MLP (Multi-Layer Perceptron) in light of the

various layers. The covered layer can be seen as a "refining layer" that distils a bit of the huge precedents from the wellsprings of information and passes it onto the accompanying layer to see. It makes the system faster and beneficial by perceiving only the critical information from the wellsprings of information overlooking the redundant information.

III. IMPLEMENTATION

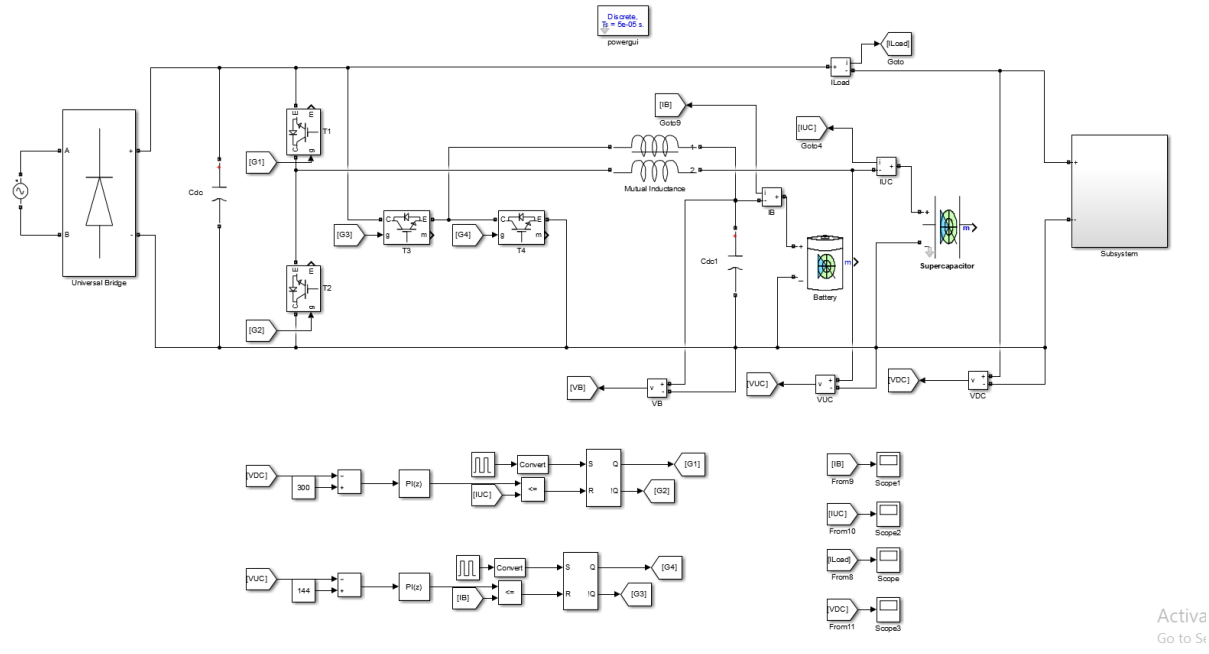

Fig.3: Hybrid energy storage system applied to electric vehicles in PI model

The above figure shows the Hybrid energy storage system applied to electric vehicles in PI model, it consisting of a bridge rectifier super capacitor battery and sub system, here we are adding the proportional integral controller.

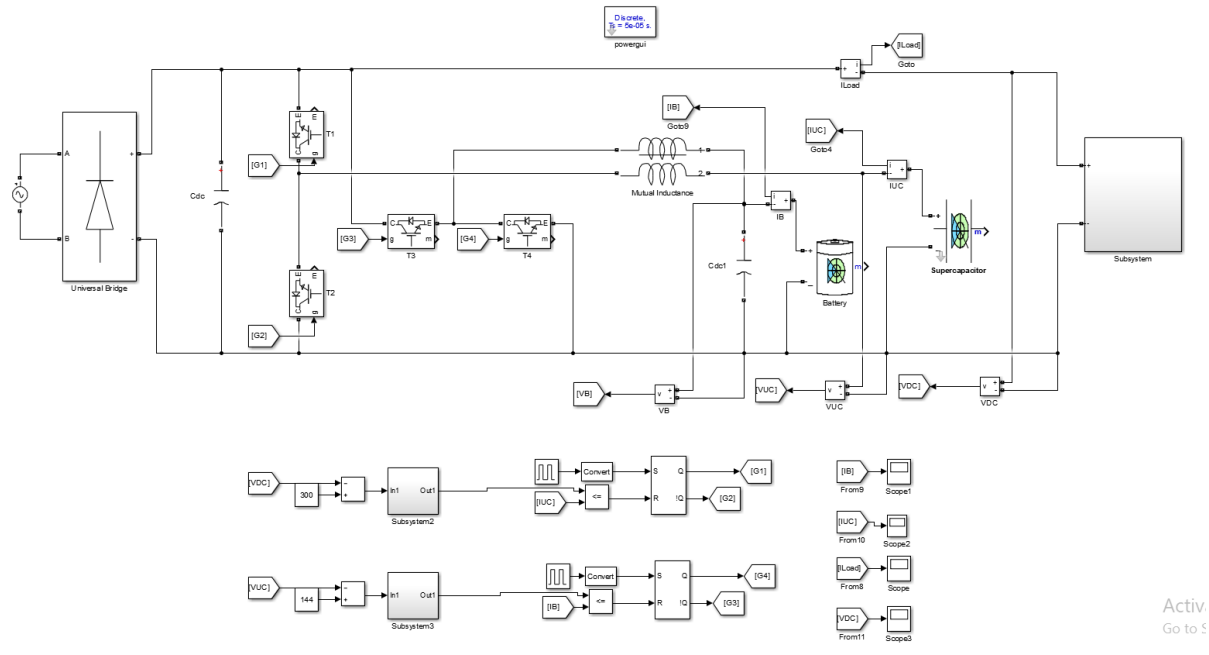

Fig.4: Proposed Hybrid energy storage system applied to electric vehicles in ANN

The above figure shows the Proposed Hybrid energy storage system applied to electric vehicles in ANN, here we are using the artificial neural network the ANN having many advantages compared to PI.

IV. RESULT

Table 1: Comparison table of THD of PI controller and Proposed ANN

S.No.	Signal Name	THD in PI techniques	THD in proposed ANN techniques
1	I_B	109.85	80.59
2	I_{UC}	76.48	66.00
3	Power Load V_{DC}	1290.27	1290.27

The table 1 shows the Comparison table of THD of PI controller and ANN. Here we can see the different parameter value in THD in PI techniques and THD in ANN techniques. And the parameters are battery current, ultra-capacitor current, power load in PI are displayed in table. The low value we have get in v compare to THD in PI techniques.

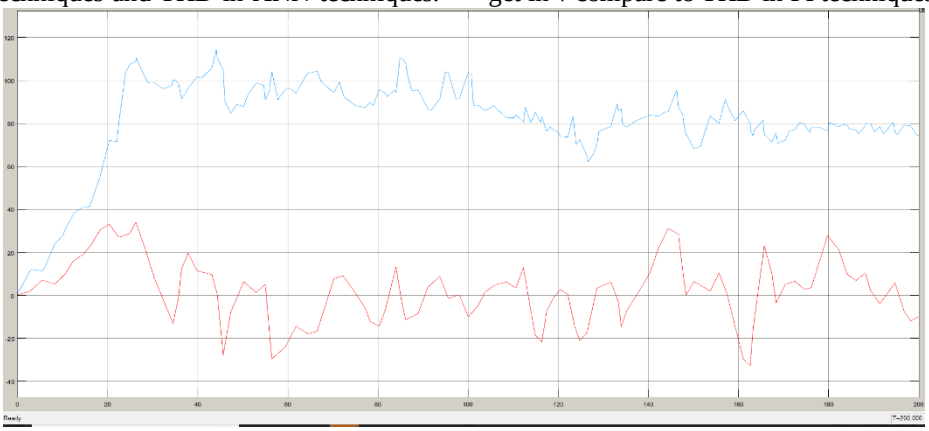

Fig.5: super-capacitor and Li-ion battery Power

The above figure 5 is the waveform of Power of the super-capacitor and Li-ion battery HESS applied on electric vehicles here comparing the power of Li-ion battery and super capacitor, the Li-ion battery having high power variation in power compared to super capacitor.

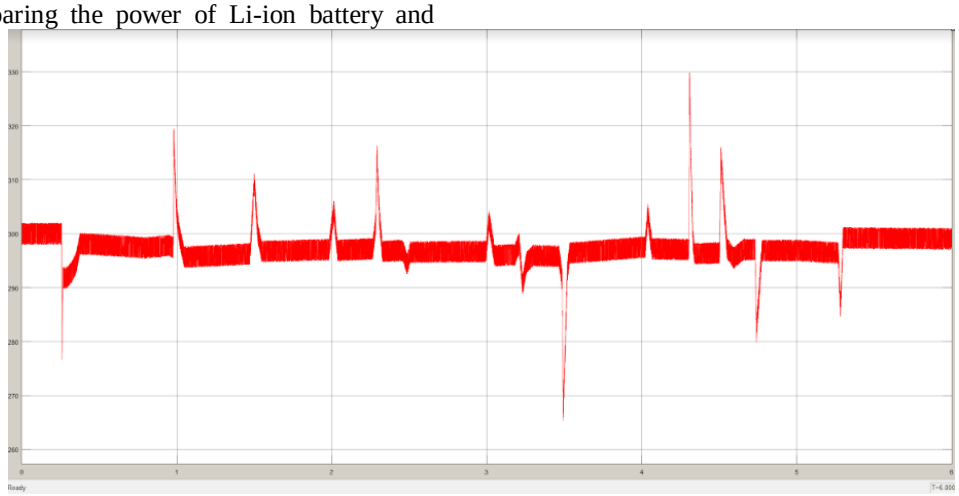

Fig.6: Graph diagram of PI V_{DC}

The above figure 6 shows the graph diagram of DC voltage in PI controller circuit.

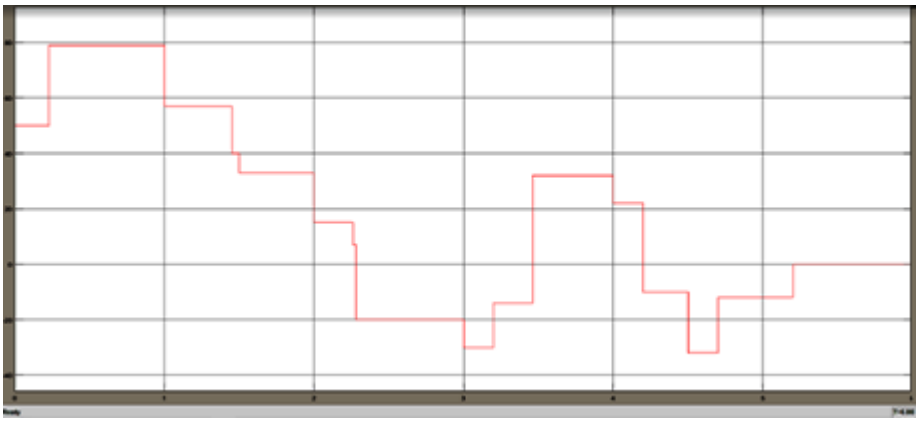

Fig.7: Graph diagram of PI Loads

The above figure 7 shows the graph diagram of loads in PI controller.

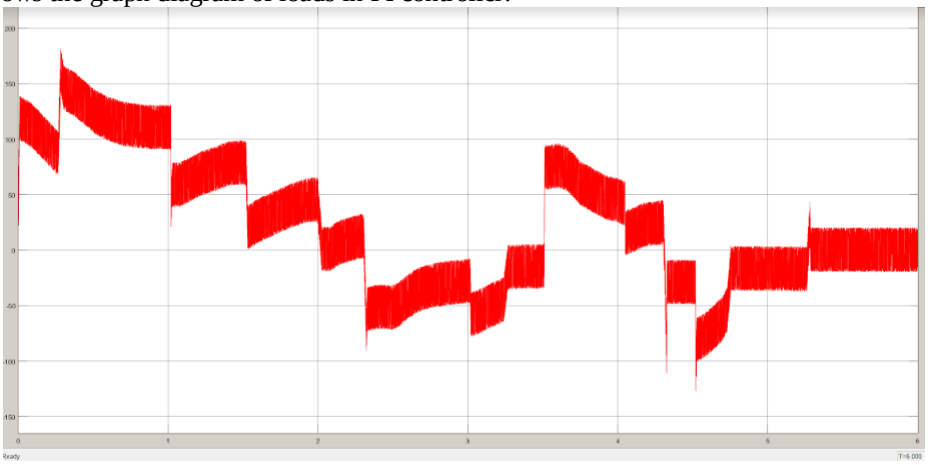

Fig.8: Graph diagram of PI I_{UC}

The above figure 8 shows the graph diagram of ultra-capacitor current (I_{UC}) in PI controller.it have hundreds of times more electrical charge quantity than a normal capacitor current.

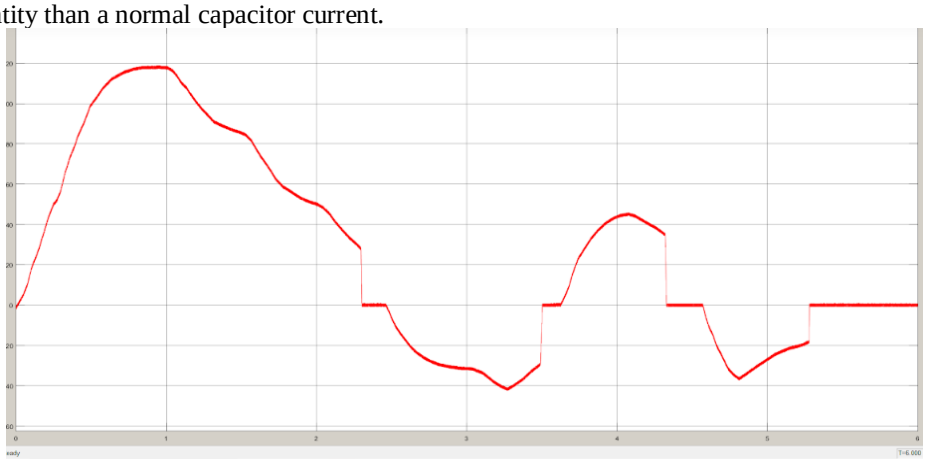

Fig.9: Graph diagram of PI I_B

The above figure 9 graph diagram shows the battery current (I_B) in PI controller.

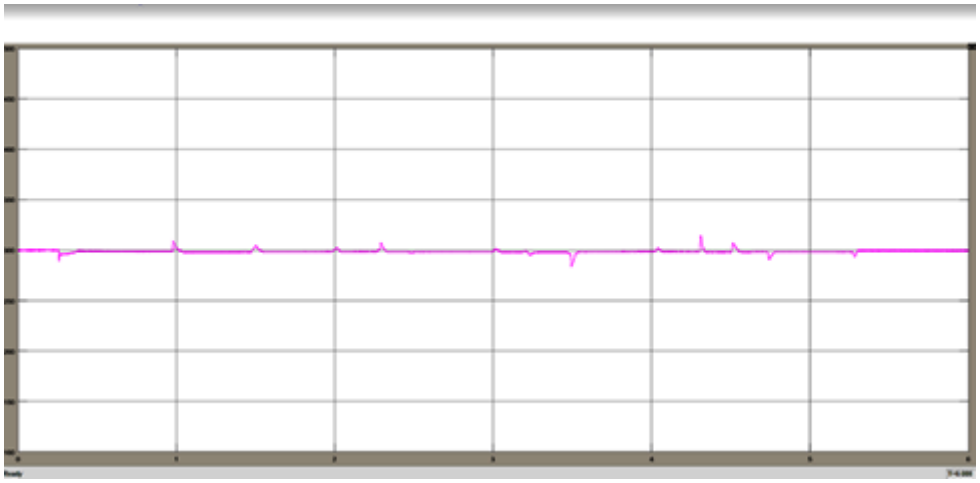

Fig.10: Graph diagram of THD ANN V_{DC}

The above figure 10 shows the graph diagram of THD ANN V_{DC}.Here have the DC voltage in artificial neural network-based circuit. Here we can see the total harmonic distortion (THD).

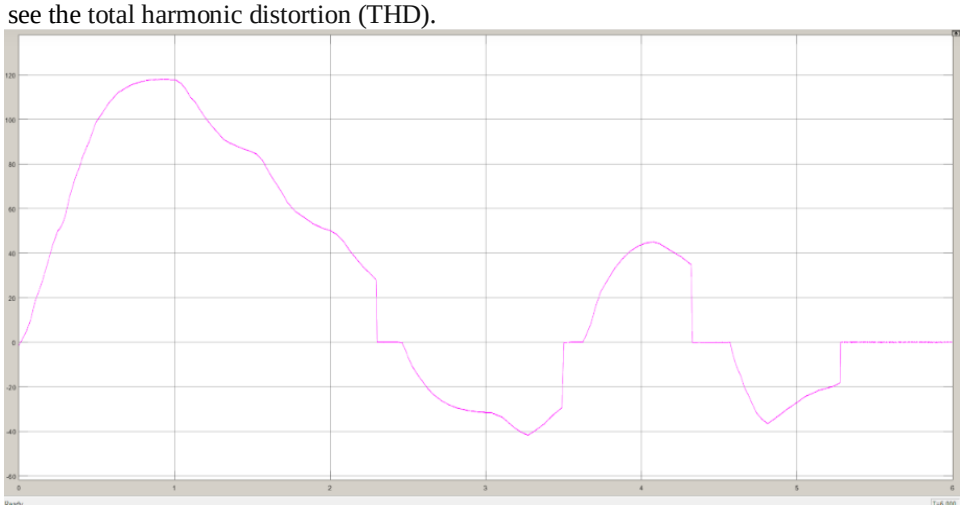

Fig.11: Graph diagram of THD ANN I_B

The above figure 11 shows the graph diagram of THD ANN I_B. here we can see the battery current in ANN based circuits.

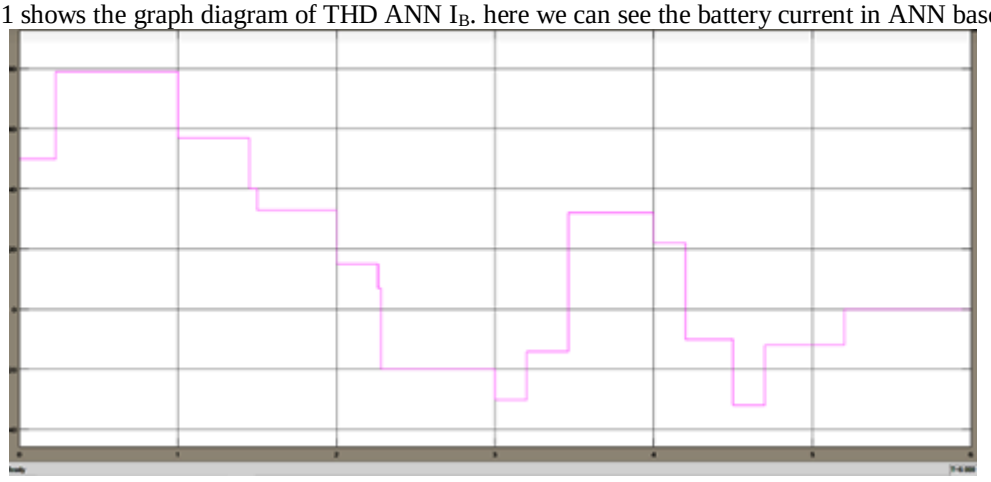

Fig.12: Graph diagram of THD ANN LOAD

The above figure 12 shows thegraphdiagram of THD ANN LOAD. Here graph shows the load current in ANN based circuit.

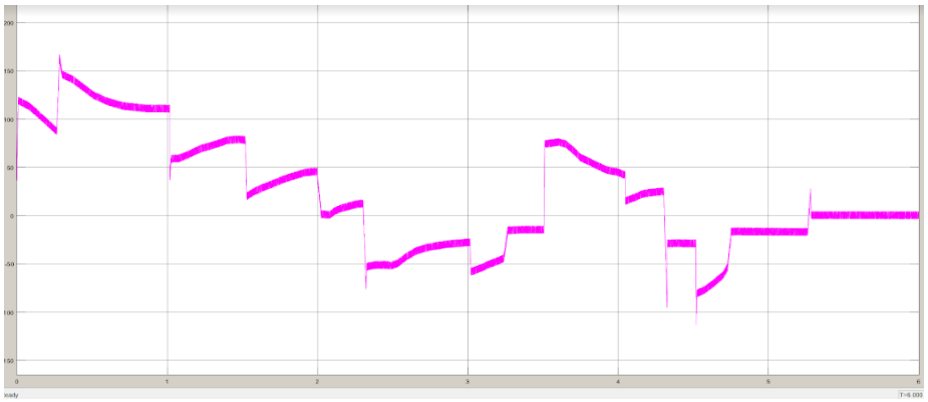

Fig.13: Graph diagram of THD ANN I_{UC}

The above figure 13 is the graph diagram of THD ANN I_{UC}.in this graph diagram shows the ultra-capacitor current in ANN based circuit.

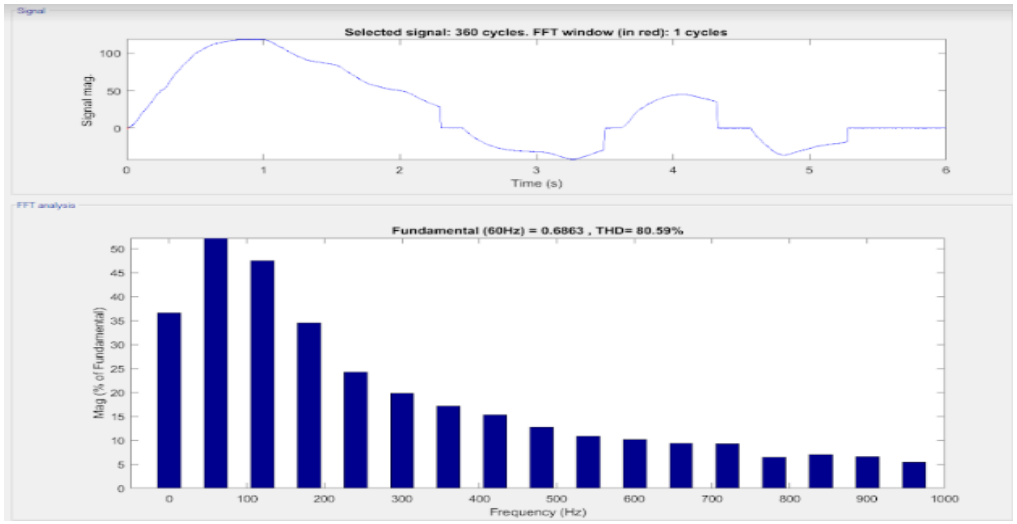

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Fig.14: Graph diagram of IB in ANN

The above figure 14 shows the graph diagram of IB in ANN. here we can see the total harmonic distortion of ANN circuits. Here we can see the 80.59% of THD that means total harmonic distortion.

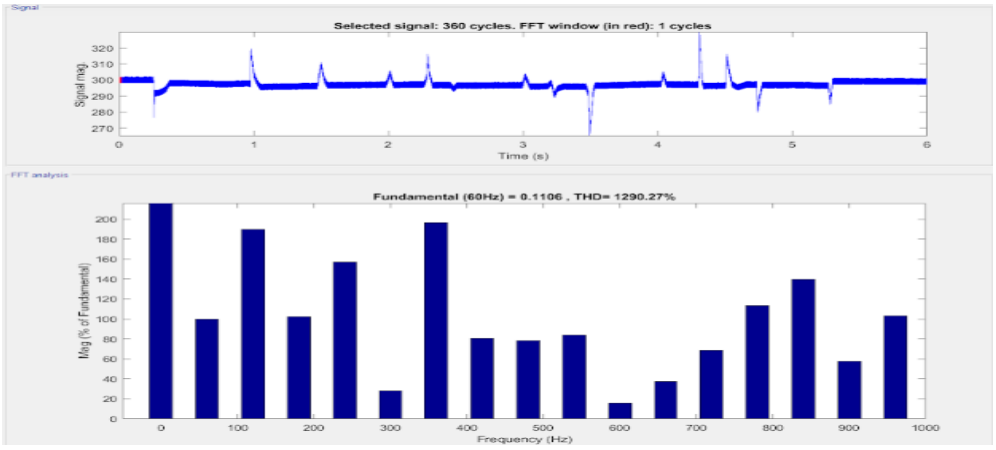

Fig.15: Graph diagram of ANN V_{DC}

The above figure 15 shows the graph diagram of V_{DC}. The diagram shows the total harmonic distortion in ANN circuit (display from MATLAB). here we can see the total harmonic distortion 1290% is in this graph.

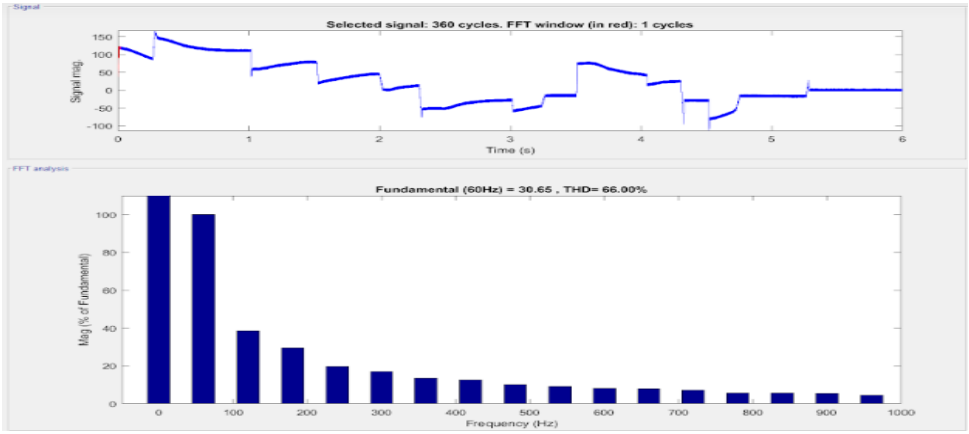

Fig.16: Graph diagram of I_{UC} in ANN.

The figure 16 shows the graph diagram of ultra-capacitor current in proposed system. Here we can see the total harmonic distortion of ANN based proposed system. In the graph shows the total harmonic distortion 66%.

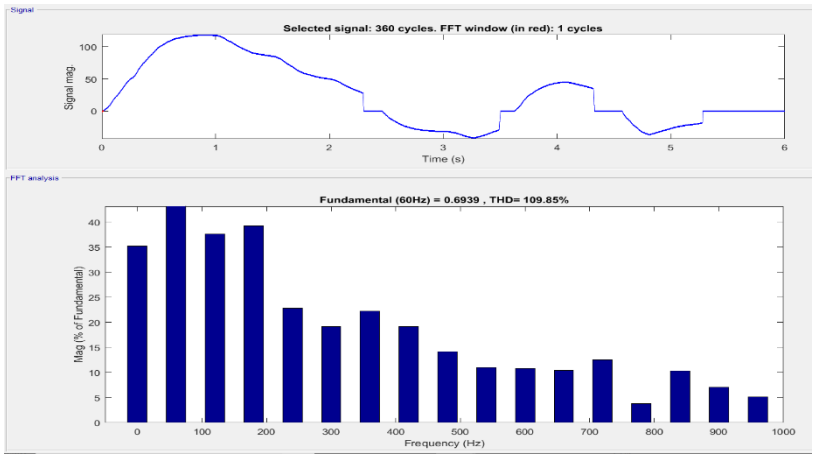

Fig.17: PI THD Battery Current

The above figure 17 shows the graph diagram of Battery Current PI controller. The total harmonic distortion is 109.85%.

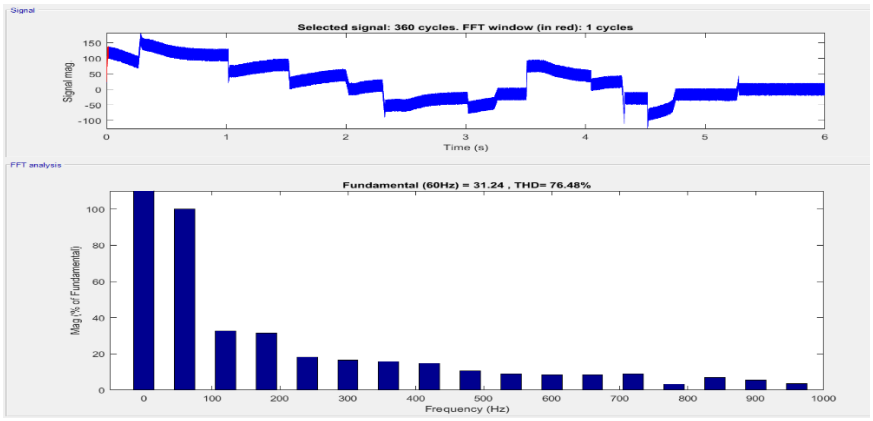

Fig.18: PI THD Super capacitor current

The above figure 18 shows the graph diagram of PI THD Supercapacitor current.

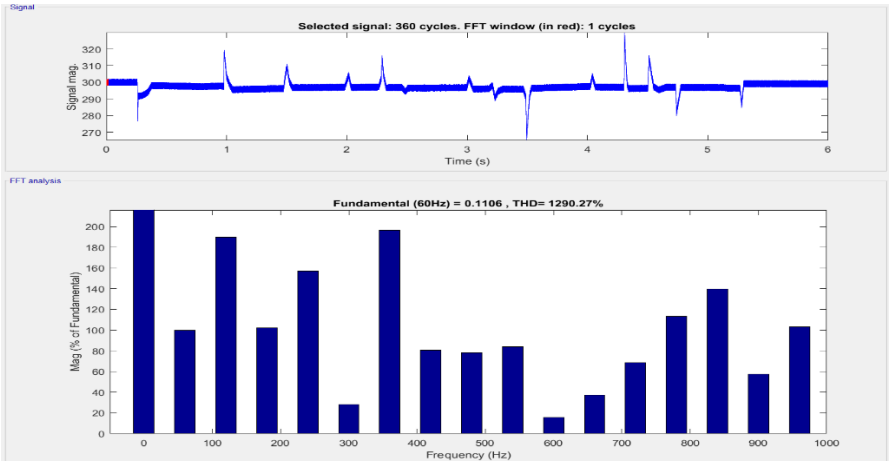

Fig.19: PI THD load voltage

The above figure 19 shows the graph diagram of PI THD load voltage

V. CONCLUSION

Hence, we are studied and implemented on simulation for hybrid energy storage system in electrical vehicle using artificial neural network in MATLAB software.A supervisor based on an artificial neural network model is also created to regulate the system and meet the power demanded by AC grid, handle the energy transfer between the hybrid system and AC grid, optimize the use of wind energy and decrease diesel generator fuel. This is for designing the efficient neural controller for maximum power point tracking of PVgenerator. Here,using ANN the hybrid storage system having less source THD at current and THD at load current and the power factor is high. The entire system is modeled using MATLAB and the output is simulated.

VI. REFERENCES

[1]. S.R. Bhatikar and R.L. Mahajan" Neural Network Based Energy Storage System Modeling for Hybrid Electric Vehicles" IEEE, Institute of Electrical and Electronics Engineers13 June 2014.

[2]. LamineThiaw, Gustave Sow, Salif Fall "Application of Neural Networks Technique in Renewable Energy Systems" IEEE, Institute of Electrical and Electronics Engineers2014

[3]. ChengchenSun'Yue Yuan "Sizing Of Hybrid Energy Storage System In Independent Microgrid Based On Bp Neural Network "IEEE, Institute of Electrical and Electronics Engineers 2013

[4]. JianjunHu "Energy Management Strategy for the Hybrid Energy Storage System of Pure Electric Vehicle Considering Traffic Information" 8 July 2018; Accepted: 28 July 2018; Published: 31 July 2018.

[5]. Mr.N. NixenPrabu "Hybrid Energy Storage System Using Four-Leg Three-Level NPC Inverter and Second Order Sliding Mode Control" IEEE Transactions on Industrial Electronics. 2010;57(12):3917-3926

[6]. Kusum Lata Tharani et al., "Choice of battery energy storage for a hybrid renewable energy system" Received: 27.07.2017, Accepted/Published Online: 18.12.2017, Final Version: 30.03.2018

[7]. Amir Mosavi, Mohsen Salimi,SinaFaizollahzadehArdabili , TimonRabczuk , ShahaboddinShamshir band and Annamaria R. Varkonyi-Koczy "State of the Art of Machine Learning Models in Energy Systems, a Systematic Review" 12 February 2019; Accepted: 28 March 2019; Published: 4 April 2019

[8]. S. Rameshwar "Automatic Control of Hybrid Renewable Energy System Using Artificial Neural Network "December 2018 | IJIRT | Volume 5 Issue 7 | ISSN: 2349-6002

[9]. Harsh Kukreja "An Introduction to Artificial Neural Network" IEEE Vol-1 Issue-5 2016

[10]. Juan Sebastián Guzmán Feria "Sizing a hybrid energy storage system in a power system" IEEE, vol.100, no.2, pp.311,316, Feb. 2012