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Switched Reluctance Motor Drive for Electric Vehicle Using Programmable Logic Control (PLC) Strategy

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***Abstract*—This type of Hybrid electric vehicle is a where most of the researches are taking to place. It is a variable solution to reduce the air pollution and many other pollution .The Electric vehicles (EV) with switched reluctance motor (SRM) is the one type of permanent magnetic motor. The hybridization of different energy sources can be used to driving miles of EV .And then installing a PV panel on the electrical vehicle. It will be reduce the dependence on the battery supply. This is the paper of switched reluctance motor with PV panel and battery is the main important energy source is used. Then advanced converter circuit is proposed here. Then to control the energy flow between the SRM, PV panel and battery. The programmable logic controller(PLC) is used here .This Circuit with PLC controller has to less total harmonic distortion in the SRM phase current compared to the other controller. This converter can be operated in six different modes. In which this four modes are used for driving purpose and other two modes are used for stand–still onboard charging purpose. In this driving mode of the speed control of SRM motor is obtained here .Then additionally added to the LDR(Light depending resistance) .The LDR can placed on the PV panel which helps in tracking the maximum intensity of sun light. The main purpose of LDR can use to generation maximum electrical energy. Then the charging modes battery can charging is accomplished by without use of any external hardware. Then the efficient charging of battery is maximum power point tracking of PV panel also can be done here. Then The Simulation is done on MATLAB.**

***Index Terms*—Battery, electric Vehicle (EV), LDR, converter, solar panel, and SRM.**

I. Introduction

The Electric vehicle is used for motor and due to corresponding energy sources. The vehicle has a many advantages with compared to other vehicle. It has high efficiency and less pollution due to independence of the fuel. Then the current battery source technology is not enough to provide the sufficient energy supply to the motor, it will be reduce the driving miles of the electrical vehicle. It will be overcome all type of problems in permanent magnetic motor are replaced with used for highly efficient switched reluctance motor (srm). The PV panel is used for a renewable energy source to drive the motor with continuous rotation and it will be reduce the independence on battery for energy, then the life time of the battery can be extended by many other applications. When the motor load become low or the energy generated by the PV panel is more. The PV panel can be used to charge the battery at high intensity period.

Then additionally added to the LDR(Light depending resistance).The LDR can placed on the PV panel which helps in tracking the maximum intensity of sun light. The main purpose of LDR can use to generation maximum electrical energy. The test result become that SRM has high efficiency and maximum output power similar to the permanent magnetic synchronous motor. Then the rotor of the SRM does not have any type of winding, therefore it has high efficiency and low cost and it will be used for wide range of speed controlling purpose. The Several type of converters are available for SRM drive among this modified converter is the best option for considering it's switch numbers and control of the switches. But the vehicle application high performance to charging circuit is also needed. The proposed system can be used for this type electrical vehicle. Then it is used for PLC controller.PLC stands for programmable logic controller. It will be reduce the complicated circuit connections. Then it will be reduce the number of wiring connections. And it has high efficiency with compared to other controllers. It is specially have a number of inputs and outputs. The input and output pins are mainly used for many applications. The output of the electrical

Vehicle becomes displayed for ladder diagram with using PLC controller. For the efficient charging of battery and it have low cost operation of EV with new converter for SRM is introduced here, it can effectively to co-ordinate the PV panel, SRM and battery. This converter circuit can be operated with six modes and it is achieving the energy flow control between the three ports. The programmable logic controller (PLC) is used instead of conventional controller. The PLC controller has lesser harmonic distortion in the motor current.

II. The New Proposed Controller System

The proposed controller circuit can use here. The controller can be used for many automation applications. It will be fully automation without manual operation; manual operation can be

used for starting point of the motor, after running of motor does not uses of manual control. Manual control can be used for adjusting the speed with desired application. .It will be reducing the complicated circuit connections. Then it will be reduce the number of wiring connections. And it has high efficiency with compared to other controllers. It is specially have a number of inputs and outputs. The input and output pins are mainly used for many applications. It will be shows become ladder representations.

A. Proposed Converter Topology with Different Modes of Operations

The proposed converter is used to containing the three energy terminal, SRM, battery, PV panel. The converter has four switches (S0~S3), four diodes (D0~D3) and two relay. The converter can be operated in various different operating modes by the relay switches. The relay can be denoted by j1, j2.

In mode1.The PV panel will act as the source to drive the motor with desired speed. In this mode the energy supplied by the PV to the motor. The excess of energy in the PV is used to charge the battery in high speed application. In mode 2 when the electrical vehicle is running at under heavy load condition, then the both battery and PV will be supply the motor. In mode 3, the PV panel will be driving the motor and battery is inactive at this condition. In mode4, the battery will be driving the motor. Then the last two modes are used for battery charging mode.

The four modes are used for driving purpose. And other two modes are used for charging purpose. The driving and charging mode can be applicable with using PLC controller.

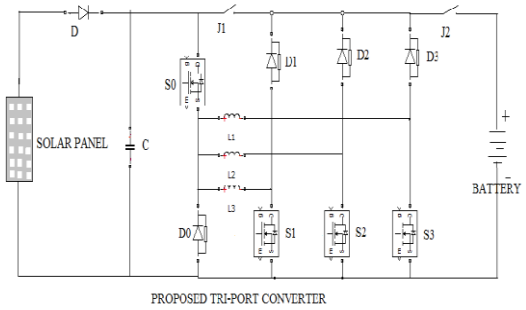

Fig. 1. Proposed converter circuit

1) Mode-1: Driving Mode

The vehicle is running at under low load condition and there is enough solar energy to supply by the PV panel will be driving the motor. In this condition the system will be operate on mode1.The equivalent operation circuit can proposed here. The switch J1 turn off and switch J2 turn on at this condition. The solar energy produced from the PV panel with depends on the LDR intensity. And it is used to drive the motor as well as to charge the battery at same period. This mode is called as driving (or) charging mode because of the battery will be charged when the motor is in under operating condition without any external power.

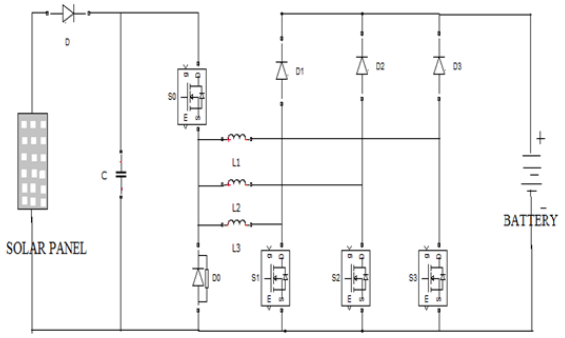

Fig. 2. Mode 1: Driving Mode

2) Mode-2

In this system also called other modes of converter circuit at drive the motor. The system will operated become when the load is heavy condition and the solar energy produced by the PV panel is not enough to drive the motor at heavy load condition. The Both the PV panel and battery will delivered the power to drive the vehicle. Then the modes become the both switches are turned on. The switches denoted become j1and j2.

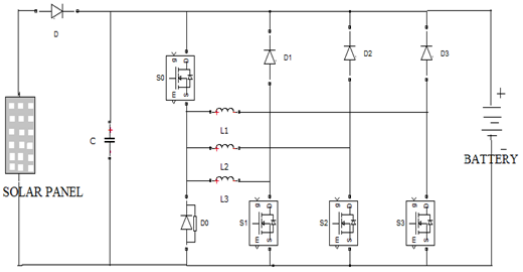

Fig. 3. Mode-2

3) Mode-3

The Vehicle will be operating in this mode when the battery is unable to supply the power for meet load, then PV panel will drive the motor. The relay switch J1 is turned on and other switch J2 will be turned off. In this mode become to drive the vehicle with sufficient solar irradiation.

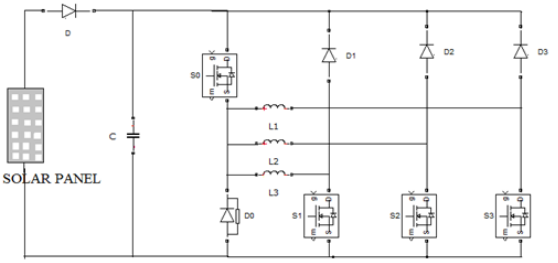

Fig. 4. Mode-3

4) Mode-4

The vehicle will operate in this mode when there have no sufficient solar irradiation and PV panel become out of power, the battery will supply the power. In this mode both the relays j1 and j2 are conducting.

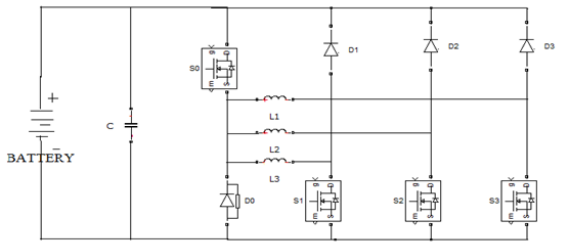

Fig. 5. Mode-4

5) Charging mode

The mode five and mode six are called battery charging mode. With help of using external source. The external source also called solar power. The energy is a one of the renewable energy. Doesn't create any environmental pollution.

6) Mode-5 and Mode-6

In this mode become when the vehicle is parked below the sun. The PV panel will convert light energy into electrical energy. Then the PV panel will charge the battery. When the switches become are j1 will be turn off and j2 will be turn on. The conditions of charging the battery with using converter circuit. The condition below is j1 will be

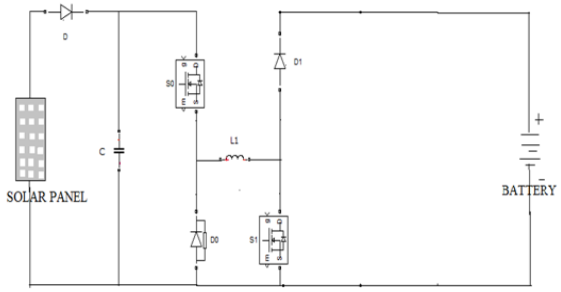

Fig. 6. Mode-5 and Mode-6

B. Graphical Representation

The output of the electrical vehicle is represented by using graphical format. The normal speed or normal running condition or less speed doesn't need for battery supply. When the vehicle reaches the maximum speed, that period additionally need for external battery sources.

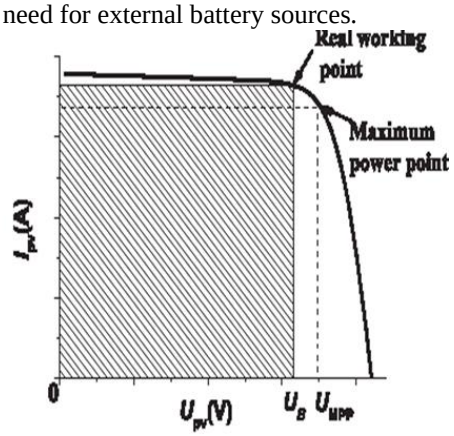

Fig. 7. Output waveform

III. Proposed Controller (PLC) System

The proposed control system can be used for PLC. The programmable logic controller can be proposed here. The controller has a high control efficiency and there is no need any external device. It is fully automated control system. Without using any external wiring connection. The PLC controller has many input and output. The input and output pins are commonly used for various applications. The controller has a many advantages .It is high control efficiency with compared to other controller device.

A programmable logic controller (PLC) or programmable controller is an industrial digital computer which has been ruggedized and adapted for the control of manufacturing processes and automation control system or robotic devices, or any activity that requires high reliability control and ease of programming and process fault diagnosis.

TABLE I
Conditions of Operation

Modes	Relay J1	Relay J2
Mode 1	Off	On
Mode 2	On	On
Mode 3	On	Off
Mode 4	On	On
Mode 5	Off	On
Mode 6	Off	On

A. Basic Functions of PLC

The most basic function of a programmable controller is to emulate the functions of electro-mechanical relays. The Discrete inputs are given a unique address, and a PLC instruction can test if the input state is on or off.

In an electro-mechanical relay wiring diagram, a group of contacts controlling one coil is called a "rung" of a "ladder diagram ", and this concept is also used to describe PLC logic. Some models of PLC limit the number of series and parallel instructions in one "rung" of logic. The output of each rung sets or clears a storage bit, which may be associated with a physical output address or which may be an "internal coil" with no physical connection. Such internal coils can be used, for example, as a common element in multiple separate rungs. Unlike physical relays, there is usually no limit to the number of times and input.

Fig. 8. Output

B. Functions of Ladder Diagram

The ladder diagram consists of various input and various output. The diagram represented by easy to operate with

electrical vehicle without any wiring connections.

The X0 will be turned on .The solar panel (Y0) will supply to the motor (Y1) and to charging the battery at the same time. The motor running at normal speed with using solar radiation only. At the same time does not use without any battery supply, only need for solar energy. The input and output are show in below Table-2.

TABLE II
INPUT AND OUTPUT

Input/Output	Purpose
X0(Input)	Switch
D0	Comparision
Y0	Solar Energy
Y1	Motor
Y2	Battery
M0	Battery Charging

When suddenly reach the maximum speed to electrical vehicle, that the time to use additional battery power. Then additionally added to the comparison port. It is mainly used for to set desired speed. It is denoted by D0.

IV. CONCLUSION

The electrical vehicle is one of the good solutions to increasing the energy demand. Now days we are meet many problems due to some economical wise and other satiations. Main problem of the economical wise called fuel demand in our country. So this main suitable solution of all this problems.

The renewable energy source along with the battery power we can increase the driving miles of vehicle. Then the proposed tri port converter have three terminal, it can be used effectively coordinate the battery, solar panel, and switched reluctance motor (SRM). The converter circuit can be operating at various modes of operations. The various modes can be depends on the load demand of motor. Then proposed automation technique can be used here. The automation technique is called PLC controller.

REFERENCES

[1] H. Kim, M. Y. Kim, and G. W. Moon, “A modularized charge equalizer using a battery monitoring IC for series-connected Li-ion battery strings in electric vehicles,” IEEE Trans. Power Electron., vol. 28, no. 8, pp. 3779–3787, May 2013.

[2] S. M. Yang and J. Y. Chen, “Controlled dynamic braking for switched reluctance motor drives with a rectifier front end,” IEEE Trans. Ind. Electron., vol. 60, no. 11, pp. 4913–4919, Nov. 2013.

[3] A. Chiba, M. Takeno, M. Takeout M. A. Rahman, “Consideration of number of series turns 48, no.6, pp.2333-2340, Nov./Dec.2012.

[4] Y. J. Lee, A. Khaligh, and A. Emadi, “Advanced integrated bidirectional AC/DC and DC/DC converter for plug-in hybrid electric vehicles,” IEEE Trans. Veh. Technol., vol. 58, no. 8, pp. 3970–3980, Oct. 2009.

[5] A. Khaligh and S. Dusmez, “Comprehensive topological analysis of conductive and inductive charging solutions for plug-in electric vehicles,” IEEE Trans. Veh. Technol., vol. 61, no. 8, pp. 3475–3489, Oct. 2012

[6] H. C. Chang and C. M. Liaw, “Development of a compact switched reluctance motor drive for EV propulsion with voltage-boosting and PFC charging capabilities,” IEEE Trans. Veh. Technol., vol. 58, no. 7, pp. 3198–3215, Sep. 2009.

[7] I. Boldea, L. N. Tutelea, L. Parsa, and D. Dorrell, “Automotive electric propulsion systems with reduced or no permanent magnets.

[8] X. D. Xue, K. W. E. Cheng, T. W. Ng, and N. C. Cheung, “Multi-objective optimization design of in-wheel switched reluctance motors in electric vehicles,” IEEE Trans. Ind. Electron., vol. 57, no. 9, pp.2980–2987, Sep. 2010.

[9] M. Takeno, A. Chiba, N. Hoshi, S. Ogasawara, M. Takemoto, and M. A. Rahman, “Test results and torque improvement of the 50-kW switched reluctance motor designed for hybrid electric vehicles,” IEEE Trans. Ind. Appl., vol. 48, no. 4, pp. 1327–1334, Jul./Aug. 2012.