To develop High Speed, Low Power Switched Reluctance Motor Converter Drive system for Electric Vehicle

Institution Details

Province	Sindh	**City**	Nawabshah
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Project Group/Team Details

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Project Details

Project Title	To develop High Speed, Low Power Switched Reluctance Motor Converter Drive system for Electric Vehicle		
Project Area of Specialization	Advance Machines Design & Drives		
Project Start Date	2021-04-01	**Project End Date**	2022-04-01
Project Summary (less than 2500 characters)	The high torque density and high rotational speed with maximum efficiency requirement is actual challenge for the motor design, as by the use of permanent magnet material motors it yields a great torque on the other hand due to availability issues, supply chain problem, high price, increased annual demand and the motor arrangement deviates to hybrid reluctance structure which is actually not robust and simple and also causes to increase the cost of motor. The recent trends in manufacturing industries, engineers and researchers there is much more interest in rare-earth material free motors, the switched reluctance motors have gained a great attention in aerospace and automotive applications as currently, Switched Reluctance Motor (SRM) shows a unique characteristics due to durability, reliability, good starting torque, fault tolerant capability, and constant extended power range, therefore it gives promising solution for the application in hybrid electric and pure electric vehicles. Now a days there is an issue globally which is power consumption, out of which witnessed i-e Switched Reluctance Machine (SRM) having concentrated winding on the stator side and no winding on the rotor switched reluctance motor is widely used in industry because of its low cost, wide range of speed and torque and less complex control structure.		
Project Objectives (less than 2500 characters)	**Main objectives of the research would be as under;** 1 To design Switched Reluctance motor (SRM) converter drive system. 2 Simulation Modelling and simulation of SR Motor converter drive. 3 To Design a new converter hardware for SR motor having low cost and low losses. 4 To compare SR Motor and its converter drive with other converter topologies. E.g. in terms of Cost, Efficiency, acoustic noise, and other switching losses.		

Project Implementation Method (less than 2500 characters)	The above procedure can be summarized in following 5 stages as; Stage 1: To design of different switched reluctance motor drive configuration in terms of losses efficiency and performance. Stage 2: Selection of new converter and to design a converter for SR motor and its experimental setup. Stage 3: Getting results of various experiments with efficiency analysis. Stage 4: Testing of SR converter and data collection. Stage 5: Comparative Analysis of Data based on result obtained.
Benefits of the Project (less than 2500 characters)	Literature reveals that no paper has been published which could have analysed the effective efficiency and harmonic generation, back emf voltage while varying the switching pattern, and excitation phase voltage of 12/8 switched reluctance motor. The design and analysis of switched reluctance machine and its hardware configuration plays a pivotal role in overall machine's performance and this project would be intensively beneficial for the machine design and drive techniques for the industrial applications. Mainly this project is intended to analyse all the above-mentioned characteristics as the proposed results and analysis would be beneficial for achieving the SR motor design and drive configuration for the application of Electric Vehicles.
Technical Details of Final Deliverable (less than 2500 characters)	Currently air contamination is a serious issue, particularly in vigorously populated urban areas, for example, London, Paris, Beijing, and Tokyo. Roughly 25% of worldwide CO2 emanations are because of transportation and traveling by air, and the vehicle of food products. Notwithstanding CO2, SOx, and NOx are additionally produced. The vitality utilized as a part of transport could twofold by 2050 subsequently, CO2 emanations should be cut by around half. It is essential to investigate advancements and practices that are the most practicable. E-drive frameworks have the ability to empower this, in this way achieving a transformation in low CO2 emanation technology. In this manner to develop zero emanation, electric vehicles have turned into the key legitimate and logical research around the globe in the 21st century. The most widely used electric motor for the traction application is the Permanent Magnet Synchronous Motor (PMSM). This is because of the reality that permanent magnet enables these motors to achieve high torque densities which actually makes this machine very small. On the other hand, the inclusion of uncommon rare-earth material in permanent magnets which is very costly and whose extraction and refining are related to non-immaterial ozone depleting substance outflows. In this manner, electric machines without rare earth materials exhibit an expanding interest to reach and accomplish comparable execution of different machines. Among the distinctive existing magnet free machines, there is much interest in switched reluctance motor for the propulsion of electric and hybrid electric vehicle due to rugged construction and simple design with the capability to operate in hazard free environment at very high speed. A concept has been released recently by Jaguar in which SRM is proposed for hybrid electric vehicle. Jingwei Zhu designed an advanced in-wheel topology of SRM for direct drive. An evaluation of comparative study of SRM with 8/6 and 10/6 configuration has been performed by Bilgin in the dynamic 12/8 SRM simulation model with vehicle dynamics equations have been analysed. Further modular stator hybrid excitation SRM presented in paper. According to the literature and as statement given in which 12/8 SRM has been optimized, the average torque is directly proportional to the square of rotor diameter. In this project initially, the SRM converter will be designed in the AutoCAD and will be imported into infolytica magnet software and the characteristics of back emf, flux linkages will be calculated by finite element method through the infolytica magnet software, then harmonics will be analysed through FFT analysis Matlab software. The suitable converter topology will be design and tested in the hardware setup.

Final Deliverable of the Project	Hardware and software of Switched reluctance motor drive configuration.
Core Industry	Advance Machine Drives and Manufacturing
Other Industries	Others
Core Technology	Automotive, Electric vehicle
Other Technologies	Others
Sustainable Development Goals	Industry, Innovation, and Infrastructure

Item Name	Type	No. of Units	Per Unit Cost (in Rs)	Total (in Rs)

			Total in (Rs)	**69200**

Project Key Milestones

Elapsed time in (days or weeks or month or quarter) since start of the project	**Milestone**	**Deliverable**
Month 1	Selection of SR machine drive configuration	Numerical Designing
Month 2	Performance comparison of suitable converter topology	Numerical Designing
Month 3	Optimization and checking of specifications with different number of sample generation	Numerical designing
Month 4	Optimization of best machine drive topology	Algorithm
Month 5	Simulation design of SR converter	Circuit design
Month 6	Hardware Design of SR converter	Integrated System
Month 7	Assembling of SR converter	Integrated System
Month 8	Optimized SR Machine converter testing	Testing
Month 9	Optimized SR Machine converter testing	Testing

Project Equipment Details

Item Name	Type	No. of Units	Per Unit Cost (in Rs)	Total (in Rs)
Switched reluctance motor drive kit	Equipment	1	30000	30000
Switching devices	Equipment	12	1000	12000
Duty cycle assembly	Equipment	1	5000	5000
Multi meters	Equipment	2	2000	4000
Oscilloscope Probs	Equipment	4	500	2000
Power Supplies	Equipment	2	2000	4000
Power Diodes	Equipment	16	200	3200
Connecting Power Leads	Wires	10	200	2000
Power Load Resistor	Equipment	4	500	2000
Miscellaneous	Miscellaneous	1	5000	5000
			Total in (Rs)	**69200**

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