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CHARGING OF ELECRIC VEHICLE BATTERY USING BIDIRECTIONAL CONVERTER

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ABSTRACT

Despite the fact that hybrid electric cars offer many of the same benefits as hybrid automobiles, the primary difference is that the vehicles use an electric motor powered by an energy storage system that draws its energy from a secondary energy source such as batteries or a power grid to supplement the primary energy supply. The electric motor may also function as a generator, turning regenerative braking energy into electricity that is stored in the vehicle's energy storage unit, if one is available. It is common practise to incorporate a hybrid control method in an energy conservation analysis of a vehicle, which distributes the load across different operating modes, such as driving the vehicle. It is the purpose of this thesis to examine the introduction of an electric vehicle (EV) framework and the applications of this framework in combination with a hybrid energy storage system. This study presents a contemporary hybrid energy storage system for electric cars, which will enable for long-distance endurance and cost minimization while also allowing for cost reduction. Based on the state of charge of the supercapacitor, this thesis proposes an optimal control method for a hybrid energy storage device constructed on a Lithium-ion battery capacity dynamic constraint rule-based control based on the capacity of the Li-ion battery. The use of an ANFIS controller results in better outputs with less distortion for hybrid energy storage systems.

I.INTRODUCTION

The country's petroleum reserves do not have adequate reserves to satisfy the country's requirements. The price of crude oil and natural gas imported from other countries fluctuates, and this has a significant impact on the price of crude oil and natural gas. The United States and China are both ahead of India

In terms of total oil imports, India has dropped to the third position globally.Current estimates indicate that india relies on crude oil for 82.8% of its total petroleum needs, while natural gas imports make up 45.3% of the overall energy basket. To combat air pollution, which is closely linked to the consumption of petroleum products, there have been concerted efforts to reduce the use of these fules. Aside from that, because of the massive amount of crude oil imported, it places a tremendous economic burden on the people of India who live there. In order to reach these goals, we would need to increase our use of green renewable energies and nuclear energy while concurrently decreasing our dependence on fossil fuels, as previously

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indicated. In terms of petroleum products, it is projected that motorised vehicles account for more than half of total petroleum product use. As a result, the use of these automobiles contributes to considerable air pollution, which has a negative impact on our natural environment. India's high dependence on petroleum products in the transportation industry is a key contributing factor to this situation. A direct outcome of this is that new innovations in the field of transportation such as battery-powered Plug-in Electric Vehicles (PEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) are gaining ground in the battle against greenhouse gas emissions and air pollution. Plug-in hybrid cars are electric vehicles that are recharged by utilising an external energy source, such as the electrical grid, to fuel their batteries. Plug-in hybrid vehicles are also known as plug-in electric vehicles (PEV). [5] Many causes have contributed to the recent electrification of transportation, including the need for more electricity, the need for greater economic development, and a range of other considerations. Additionally, for a period of time, the railroads were fortunate in that they were able to operate a great variety of various types of electric locomotives. 6 Trains are scheduled to proceed on a preset route; they are travelling from point A to point B. Receiving electric power from a conductor rail is made much more easy with the aid of pantograph slider slides, which may be found here. The definition's scope has been expanded. As a result of the wide variety of utility alternatives (UTOPIA) that they provide, it is more difficult for electric vehicles (EVs) to acquire power in a comparable fashion. An electric car battery pack (usually of high power and large capacity) is also used as an energy storage device, allowing the vehicle to travel a reasonable distance between charging sessions. [7] Up until now, electric cars (EVs) have remained out of reach for the vast majority of purchasers, despite a slew of government incentives. Currently, government incentives and tax credits are vitally important in order to increase the market share of electric cars in the short term. [8] Make exaggerated claims Obtaining enough storage capacity for electric vehicle electricity, which is mostly provided by a battery, is the most challenging problem an electric vehicle must solve. Batteries, on the other hand, have become prohibitively costly as a result of their short life cycle, high cost, and poor capacity for storing energy. There are numerous requirements that must be met when developing a battery for an electric vehicle, which makes it very challenging.

II.LITERATURE SURVEY

C. Lai, Y. Cheng, M. Hsieh and Y. Lin, "Development of a Bidirectional DC/DC Converter With Dual-Battery Energy Storage for Hybrid Electric Vehicle System," in IEEE Transactions on Vehicular Technology,

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Electric vehicles (EV) are promising alternate fuel technologies to curtail vehicular emissions. A modeling framework in a hybrid electric vehicle system with a joint analysis of EV in powering and regenerative braking mode is introduced. Bidirectional DC–DC converters (BDC) are important for widespread voltage matching and effective for recovery of feedback energy. BDC connects the first voltage source (FVS) and second voltage source (SVS), and a DC-bus voltage at various levels is implemented. The main objectives of this work are coordinated control of the DC energy sources of various voltage levels, independent power flow between both the energy sources, and regulation of current flow from the DC-bus to the voltage sources. Optimization of the feedback control in the converter circuit of HEV is designed using an artificial neural network (ANN). Applicability of the EV in bidirectional power flow management is demonstrated. Furthermore, the dual-source low-voltage buck/boost mode enables independent power flow management between the two sources—FVS and SVS. In both modes of operation of the converter, drive performance with an ANN is compared with a conventional proportional–integral control. Simulations executed in MATLAB/Simulink demonstrate low steady-state error, peak overshoot, and settling time with the ANN controller. Nowadays, transportation systems play a crucial role in the entire world. The majority are automobiles with internal combustion engines (ICE). Using ICEs has resulted in acute issues including air pollution, global warming, and rapid depletion of the world's petroleum resources [1]. The three types of vehicles suggested to replace conventional cars with ICE are fuel cell vehicles (FCV) [2], electric vehicles (EV) [3] and hybrid electric vehicles (HEV). The performance of fuel cell and electric vehicles falls well short of what is required. As a result, the focus of advanced vehicle technology development has shifted to HEVs [4]. A hybrid vehicle has two or more forms of energy stored on board: one is a specific type of gasoline is used as fuel in a conventional hybrid electric car. The other is an electrical storage device that can be used in both directions. There are various methods to minimize fuel consumption in hybrid electric vehicles [5]. By utilizing an energy storage system, hybrid electric vehicles can reduce fuel consumption in a variety of

ways, including collecting energy during braking, downsizing the engine, operating the engine more effectively, and turning off the engine when it is not in use [6]. Regenerative braking is used in advanced HEVs to convert the vehicle's kinetic energy into electric energy rather than dissipating it as heat energy as per standard brakes [7]. A few HEVs [8] produce energy by spinning an electrical generator (also called a motor–generator), which is then used to charge their batteries or directly power the electric drive motors. A hybrid electric car produces fewer emissions from its ICE than a gasoline car of comparable size, further improving fuel economy. Moreover, it contains a component with a high energy density, such as a super capacitor (SC), which avoids peak energy transience during acceleration and regenerative braking systems [9]. SCs may store and release regenerative energy during deceleration and acceleration, producing extra power. Figure 1 shows a basic block diagram for a hybrid electric vehicle (HEV) power system.

m, Vinay & Raju, Isaac. (2017). Hybrid Electric Vehicles. International Journal of Engineering Trends and Technology. 50. 93-95. 10.14445/22315381/IJETT-V50P215.

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The price of crude oil and natural gas imported from other countries fluctuates, and this has a significant impact on the price of crude oil and natural gas. The United States and China are both ahead of India when it comes to total oil imports, despite the fact that India has slid to third position in the globe. On the basis of current estimates, India imports crude oil for 82.8 percent of the total petroleum basket, with natural gas imports accounting for 45.3 percent of the whole basket. It has been made a concerted effort to minimise the use of petroleum products in order to address the issue of air pollution, which has been compounded by the direct correlation between petroleum product consumption and air pollution. [3] Aside from that, because of the massive amount of crude oil imported, it places a tremendous economic burden on the people of India who live there. In order to reach these goals, we would need to increase our use of green renewable energies and nuclear energy while concurrently decreasing our dependence on fossil fuels, as previously indicated. In terms of petroleum products, it is projected that motorised vehicles account for more than half of total petroleum product use. As a result, the use of these automobiles contributes to considerable air pollution, which has a negative impact on our natural environment. India's high dependence on petroleum products in the transportation industry is a key contributing factor to this situation. A direct outcome of this is that new innovations in the field of transportation such as battery-powered Plug-in Electric Vehicles (PEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) are gaining ground in the battle against greenhouse gas emissions and air pollution. Plug-in hybrid cars are electric vehicles that are recharged by utilising an external energy source, such as the electrical grid, to fuel their batteries. Plug-in hybrid vehicles are also known as plug-in electric vehicles (PEV). [5] Many causes have contributed to the recent electrification of transportation, including the need for more electricity, the need for greater economic development, and a range of other considerations. Additionally, for a period of time, the railroads were fortunate in that they were able to operate a great variety of various types of electric locomotives. 6 Trains are scheduled to proceed on a preset route; they are travelling from point A to point B. Receiving electric power from a conductor rail is made much more easy with the aid of pantograph slider slides, which may be found here. The definition's scope has been expanded. As a result of the wide variety of utility alternatives (UTOPIA) that they provide, it is more difficult for electric vehicles (EVs) to acquire power in a comparable fashion. An electric car battery pack (usually of high power and large capacity) is also used as an energy storage device, allowing the vehicle to travel a reasonable distance between charging sessions. [7] Up until now,

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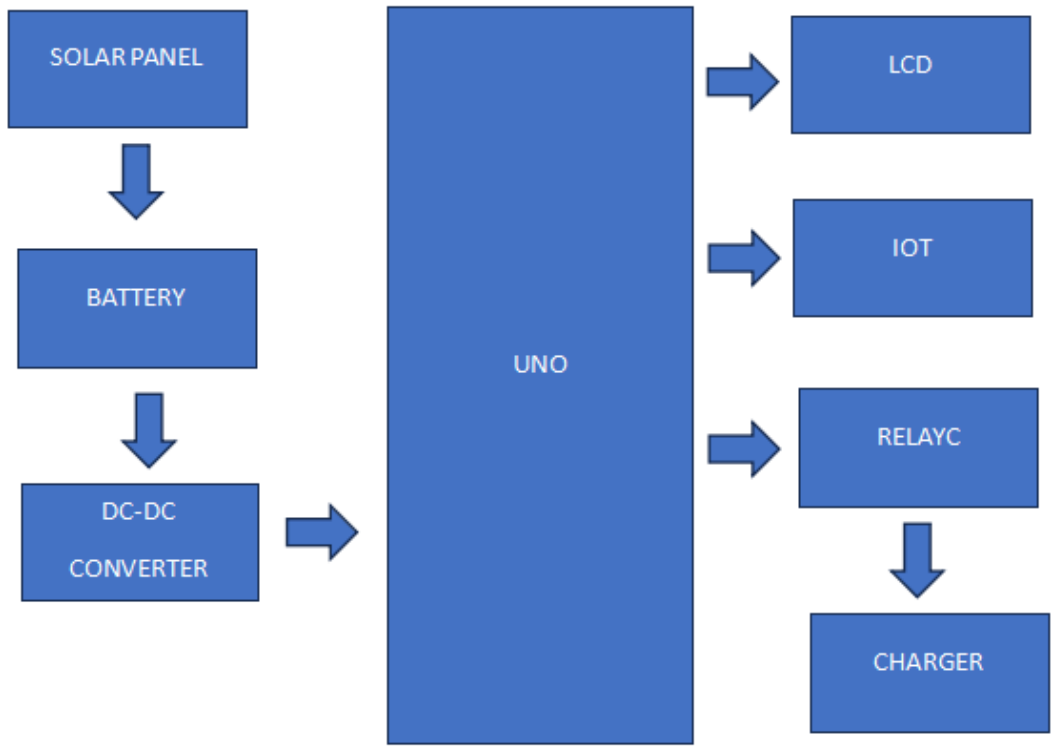
Block diagram



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III.PROPOSED SYSTEM

The project **Electric Vehicle Charging using a Bidirectional DC-DC Converter and an ANFIS Controller** aims to provide an efficient and intelligent charging system for electric vehicles (EVs) by incorporating advanced control techniques. The system uses a bidirectional DC-DC converter to manage the power flow between the vehicle's battery and the grid, while an Adaptive Neuro-Fuzzy Inference System (ANFIS) controller is employed to optimize the charging and discharging process, improving efficiency and stability.The proposed system consists of a **bidirectional DC-DC converter** and an **ANFIS controller** for managing electric vehicle charging and discharging processes.

Bidirectional DC-DC Converter:

1. The converter allows power flow in two directions: from the grid to the battery during charging and from the battery to the grid during discharging (vehicle-to-grid or V2G operation).
2. The bidirectional capability ensures energy can be efficiently stored in the vehicle's battery and also supplied back to the grid when needed, enhancing grid stability and supporting energy
3. management in renewable energy-based systems.

ANFIS Controller:

1. The Adaptive Neuro-Fuzzy Inference System (ANFIS) controller is used to optimize the charging process by learning from the system's behavior and adjusting the power flow dynamically.
2. The ANFIS controller combines the benefits of neural networks and fuzzy logic to handle the uncertainties and nonlinearities of the system, ensuring optimal performance under various conditions.
3. It regulates the charging current, ensuring the battery is charged efficiently while maintaining a balance between the grid and the vehicle's energy requirements. During discharging, it ensures smooth power delivery back to the grid without overloading the system.

Charging and Discharging Modes:

1. **Charging Mode**: In this mode, the EV draws power from the grid, and the bidirectional converter regulates the voltage and current to ensure efficient and safe charging. The ANFIS controller monitors the state of charge (SOC) of the battery and adjusts the charging rate accordingly.
2. **Discharging Mode (V2G)**: In this mode, when the grid requires additional power, the EV's battery can supply energy back to the grid. The converter facilitates the reverse flow of energy, and the ANFIS controller ensures the discharge is controlled to avoid battery degradation and grid instability.

Energy Management:

1. The system provides an intelligent energy management framework, enabling efficient utilization of EV batteries as distributed energy storage units. The ANFIS controller dynamically adjusts the power flow based on grid demand and the vehicle's SOC, ensuring optimal performance.

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IV.CONCLUSION

Electric autos have piqued the public's curiosity due to its promise to significantly cut energy usage as well as emissions of hazardous pollutants into the environment. In spite of the fact that governments and car manufacturers continue to agree on new electric vehicle market goals, the cost of producing electric vehicles continues to decline, making them more competitive with internal combustion vehicles. Advances in lithium-ion battery technology have played a critical role in the increasing popularity of electric vehicles, and a further shift to electric driving will need a significant increase in battery capacity. In the early phases of research, efforts are being made to get a better understanding of the precise environmental consequences of electric cars. The impacts of battery output on the total pollution created by electric vehicles are particularly complex to understand. Several recent studies have looked at the greenhouse gas emissions associated with battery manufacture, and the results have shown a wide variety of conclusions and consequences for battery manufacturing. For this reason, the energy storage device (ESS) is referred to as the "brains" of electric vehicles due to the fact that it is responsible for the performance, strength, and driving range of these vehicles. Growing demand for new electric vehicles often results in the need for a high energy density, as well as a high peak capacity, which necessitates the use of the ESS for its operation. Batteries and supercapacitors, which are capable of storing large amounts of energy and power, are often used as the energy storage system (ESS) in industrial applications these days, particularly in the automotive industry. An alternating current bidirectional DC-DC converter is created for use in hybrid electric autos, and dual battery energy sources are used in this thesis. The lifetime of a system with a PI controller is lowered as a result of the changes generated by the employment of a PI controller. In the proposed research, the smoother transitions and less distortion are achieved by combining an ANFIS controller with SPWM. This results in a longer lifetime and improved accuracy for such storage systems.

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