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IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

A MODIFIED METHOD OF MODEL PREDICTIVE CONTROL FOR VEHICLE-TO-GRID APPLICATION

***N. Yogaraja*[1] *and Dr.M. Ramasamy*[2]**
[1]PG Student, Department of EEE, K.S.R. College of Engineering, Tiruchengode – 637302, Tamil Nadu, India
[2]Associate Professor, Department of EEE, K.S.R. College of Engineering, Tiruchengode - 637302, Tamil Nadu, India

Abstract: The projected market share of renewable energy sources poses a challenge. A contemporary, energy system on renewable energy and electric transportation is replacing one based on fossil fuels. New control methods are required because to the intermittent, stochastic, dispersed nature of the generation as well as the innovative consumption patterns. This study first proposes an adaptive model-based receding horizon control approach to solve the issues with the energy management system (EMS) in micro-grid operations. For the optimum operation of the micro-grid powered by renewable energy, the major objective of the EMS is to balance power generation and demand through energy storage. While the output of electrical energy used to be regulated to match consumer demand. This method main concern is that sustainable energy sources do not permit for, this method looks at managing the demand side of energy production using a demand response system and model predictive controller in addition to managing the generation of power. Control is implemented at the level. This approach explains both the fundamental ideas behind this so-called model predictive control (MPC). This issue is being tested using MATLAB to assess the effects of different limits and settings. The application's modular structure makes it a good platform for further model predictive control-based vehicle to grid. In this case study, a model predictive controller is used to simulate a V2G in Mat-lab for each power flow system.

Index Terms - Model predictive control (MPC); bidirectional AC-DC converter; vehicle-to-grid (V2G); electric vehicle (EV).

1. INTRODUCTION

The growing awareness of the dangers to our civilization based on fossil fuels is causing the generators of electricity to switch from the conventional sources to the renewable ones which do not degrade the natural environment. At the same time, the global technological transformation forces customers to respect electricity, offering access to production taking into account environmental conditions. Thus, the customer is technically able to cover the daily energy demand through own production. However, the potential local electricity shortages encourage customers to connect with the electricity grid, where the prosumer profile is balanced. Simultaneously, there is a slow technological retreat from the use of fossil fuels in transport. Electromobility allows customers to store up electricity from their own generation sources or from the electricity network and to shift the peak of the power system load to the night hours when the electric vehicle (EV) is charging. This concept defines the new function of an electric vehicle as a mobile energy storage, which with the support of appropriate procedures can significantly contribute to improving the energy system balance. The specificity of the use of EVs use by customers imposes significant restrictions on the amount of energy that can be transferred from the vehicle to the energy system, because it always involves limiting the maximum range of the vehicle. It is implemented through a bidirectional energy transfer using an isolated AC/DC converter and a buck-boost DC/DC converter.

Scope of the project

To utilize the Vehicle's battery storage in required place. Battery Charging and Discharging control is implemented in our system. State of Charge is maintained properly. Battery control is verified using the set values applied in Modified Predictive controller. Output Voltage balancing is done using the Feedback based on PI controller method.

2. EXISTING AND PROPOSED SYSTEM

2.1 Existing System:

To determine whether V2G is feasible, it is important to perform a cost-revenue analysis, taking into account the projected number of vehicles that will take part in V2G power, the total available storage capacity in the vehicles, and the power requirements of the grid supply. when commercial electric vehicles on the road were absolutely minimal. So, as we currently envision a world with widespread use of electric vehicles, it becomes compelling to compare the power capabilities of the total vehicle fleet and the grid.

1. Power supply to the grid.
2. Communication systems for the grid to access the vehicle's power.
3. A high precision measurement system to track the power flow.

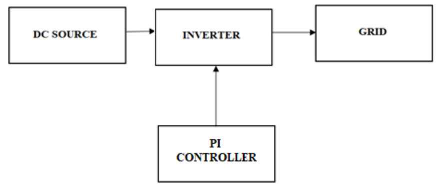


Fig 1: Block Diagram of Existing System

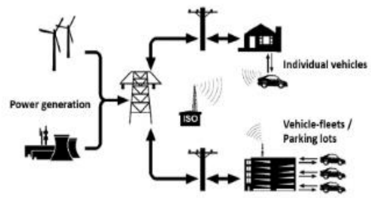


Fig 2: A schematic illustrating a model implementation of vehicle to grid technology.

2.2 Disadvantages:

1. PI controller is used, grid stability and response is slow.
2. Power storage is not possible.
3. The proposed system overcome this difficulty.

2.3 Proposed System:

The V2G process with the predictive model The starting point for the conducted research is to develop a proposal for the process of relationship in the V2G service between the V2G Operator and the EV user. The new process idea includes an element supporting the matching of the EV user needs and the needs of the energy system. This element is a module for predicting the energy consumption of the described EV vehicle before starting the service (predictive model). This is a first step to describe a mechanism for predicting the energy consumption in the V2G service provision process. It can be assumed that the calculation engine for predicting the EV demand (future energy consumption by EV) can be implemented on both sides of the service however, it seems rational to locate it with the V2G service provider because: – the customer will not incur additional costs for the on-board EV equipment.

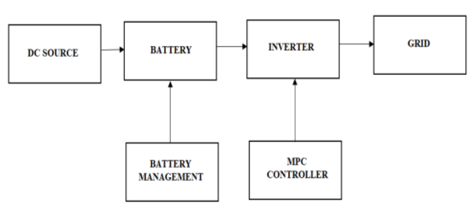


Fig 3: Block Diagram of Proposed System

2.4 Advantages:

- Fast responding model predictive control method (MPC) is used.
- Continuous power flow and grid stability is maintained properly.
- Reduced power loss and easily movable.

2.5 Predictive Model:

General structure of MPC. For nonlinear systems, independent of the chosen performance criterion, the optimization becomes a nonlinear programming problem which is non-convex in the majority of cases. Only u (k I k), the first control move of the sequence, is implemented on the real plant from time step k to k+l. At time step k+l the measurement y(k+l) is used together with u(klk) by the observer to compute the new estimate x(k + 1), the horizons M and P are shifted ahead by one step and a new optimization problem is solved at time step k + 1 with the new initial condition x(k + 1).

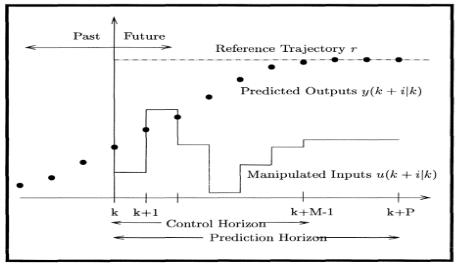


Fig 4: Optimization problem

3. Software requirement

MATLAB Software is used in this Simulation. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages. Identifying System Components, Three types of components define a system:

- Parameters — System values that remain constant unless you change them.
- States — Variables in the system that change over time.
- Signals — Input and output values that change dynamically during a simulation.

3.1 Simulation

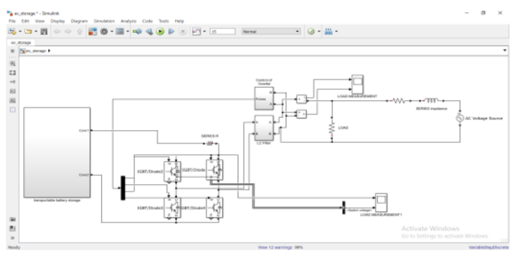


Fig 5: Overview

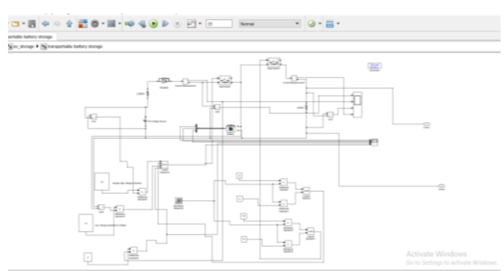


Fig 6: Conn-1 and Conn-2

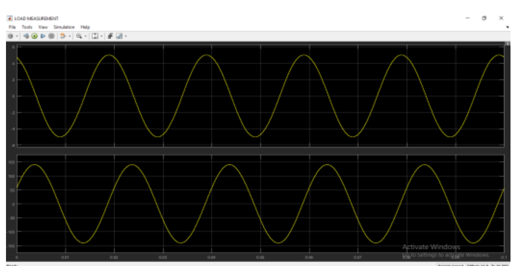
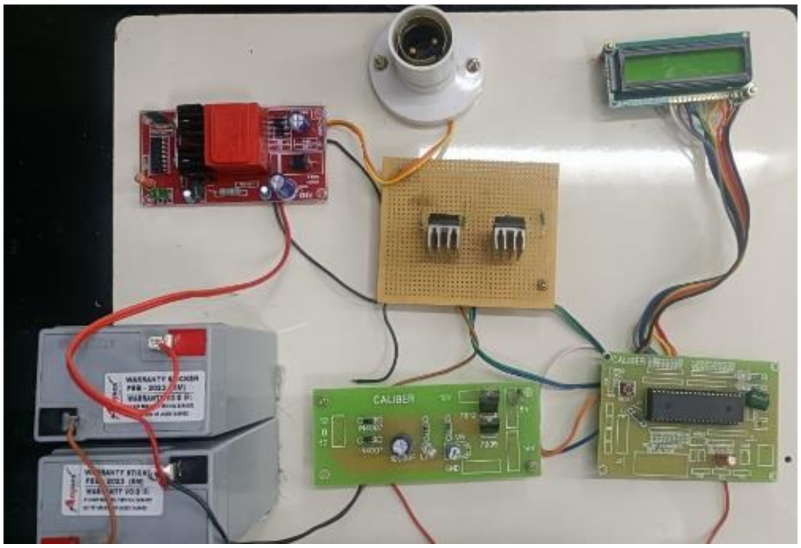


Fig 7: Current & Voltage Waveform

SL.NO	EXISTING SYSTEM	PROPOSED SYSTEM
1	Model predictive controller is used	Model predictive control is used
2	Power storage system is there	Battery storage is used.
3	, Efficiency is low	Use fuzzy logic, Efficiency is high
4	Grid stability is not proper	Grid stability is high.

Tabulation of Existing System and Proposed System Diffrentiate [Table-I]

3.2 HARDWARE



CONCLUSION

The effectiveness and popularity among the EV users of the V2G service will depend on the correct definition of the demand for EV electricity after implementation. Regarding the way of simulating the calculations and energy consumption measurements in real urban traffic, it can be stated that the electric vehicle model developed reflects well the energy phenomena occurring in it while driving under various environmental conditions.. This makes it necessary to use such a tool when calculating the parameters of the V2G process. Relieving the user from the necessity to define the abstract energy value that can be given away from theirs simplifies the use of the V2G technique, contributing to its popularisation and consequently to improving the balance of the power grid. In this study the value of d was less than 0.5%, confirmed on the three scenarios. The case-by-case studies indicate the need to conduct further research using other EV vehicles and other additional external factors that may be relevant in a different environment than the one being studied.

ACKNOWLEDGMENT

We would like to express our profound gratitude and respect to the Internal Guide and External Guide. For their thoughtful consideration and leadership, which have helped the Project succeed. Being taught by a faculty with such depth of knowledge and expertise in analysing and resolving contemporary issues is something to be proud of. Along with technical proficiency, students also learnt about the need of "accuracy in documentation." For seminar preparation, external and internal guides also provided us with current project subjects, which I used to better prepare my presentation for the project review. In order to fully use the lab facilities to complete our dissertation work, we would like to offer our sincere thanks to Prof. Dr.S.Ramesh, M.E., Ph.D., (HOD of civil department).

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