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Electric Vehicle Charging System with Rectifier Load using Hybrid Fuzzy-PI Controller

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Abstract:- Development on electric vehicles is becoming an increasingly significant area of focus. It is clear that a lot of study has been done on electric cars, which is why it is essential to continue working on this line of inquiry as the cost of gasoline continues to rise and environmental issues continue to have an impact on the natural world. Within the realm of electric cars, rectifier load-based electric vehicles have earned a significant amount of relevance for wireless charging. Vehicle manufacturers across the board are devoting significant resources to the research and development of electric cars that can be powered by batteries. In most cases, the battery chargers for module electric vehicles are connected to the low-voltage system in order to facilitate the charging process. In this article, a rectifier load is added to an electric vehicle-based wireless charging system, and the fuzzy PI hybrid controller is used to improve the system's power output, efficiency, and other relevant metrics.

Keywords:- *Electric Vehicle, Fuzzy PI Controller, Rectifier Load*

I. INTRODUCTION

Discharges from vehicles have a substantial influence on the overall change in temperature throughout the earth. [1] A great number of countries have given it serious thought and are actively working on the development of alternative fuel technologies. [2] The use of battery electric force is the most promising option for propelling electric cars in the here and now as well as in the near future. [3] Automobile manufacturers from over the globe are investing a significant amount of effort into the research and development of battery-powered electric cars that are efficient. [4] Module Electric Vehicles battery chargers are typically associated with the low-voltage network for the purpose of charging; consequently, their increased infiltration combined with uneven charging may have the potential to influence the appropriation framework with regard to voltage unbalance and transformer over-burdening. [5-7]

Electric Cars, which is the most important factor in ensuring that electric vehicles can operate well. [8] As the demand for electricity continues to rise, new policies and significant initiatives are being developed to enhance the energy efficiency of a wide variety of industries, including manufacturing, commerce, transportation, and advanced communication, as well as entertainment, personal computers, and portable electronic devices. [9] The ability to store any surplus electrical energy over extended periods of time and to effectively recover the stored energy is an important development that is contributing to a reduction in the amount of energy that is being used. [10] The work described in this research has been applied using MATLAB 2016a to do a rectifier load analysis of a wireless charging system, which has resulted in an increase in both power output and efficiency. The controller that is being used is referred to as a Hybrid Fuzzy PI Controller.

II. IMPLEMENTATION

The implementation of the rectifier load analysis for the electric car is shown in this section. In this, the first step is the implementation of the basic paper [1], which is followed by the improvement of the control system via the development of FISPI (Fuzzy Inference Set with PI). The model is composed of three subcomponents and was developed using MATLAB Simulink. It is compatible with all versions of MATLAB that are newer than 2016a.

The first portion is the input model after the transistors, the second part is the Vc1p and Vc2p outputs, and the third part is the model for the efficiency and power output. These three sections make up the circuit.

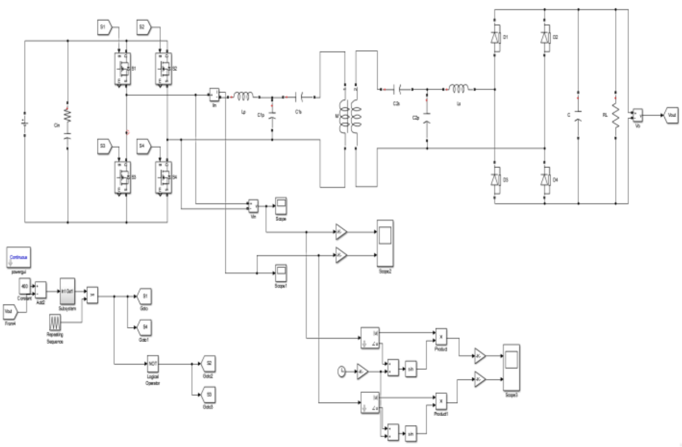

Fig 1:- Model For Rectifier Load EV

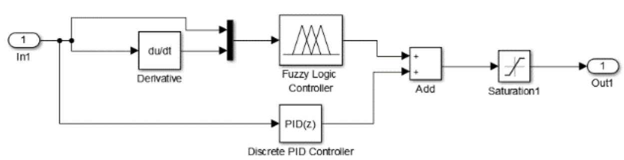

Fig 2:- FIS PI controller

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The final, suggested model with the FUZZY PI controller can be shown in Figs. 1 and 2, and a portion of the control can be seen in Fig. 3.

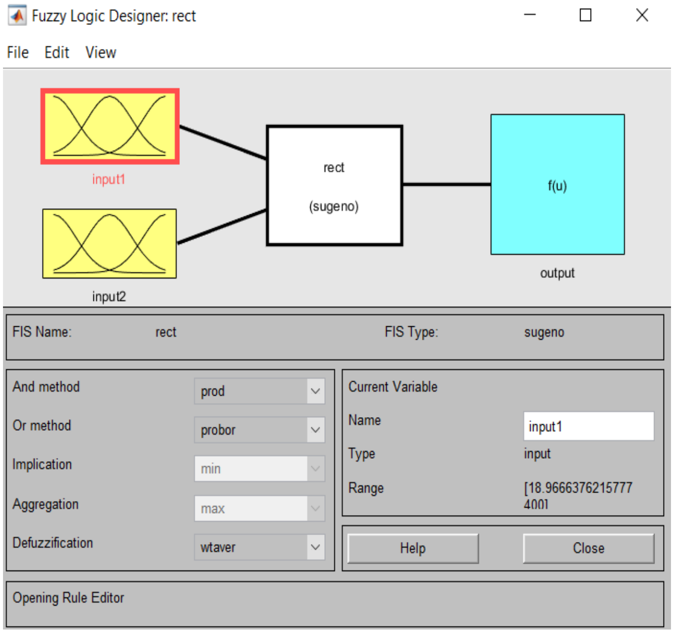

Fig 3:- FIS PI control Sugeno Rules

In Fig. 4, the FISPI rules in fuzzy logic controller are illustrated to be applied in the indicated manner.

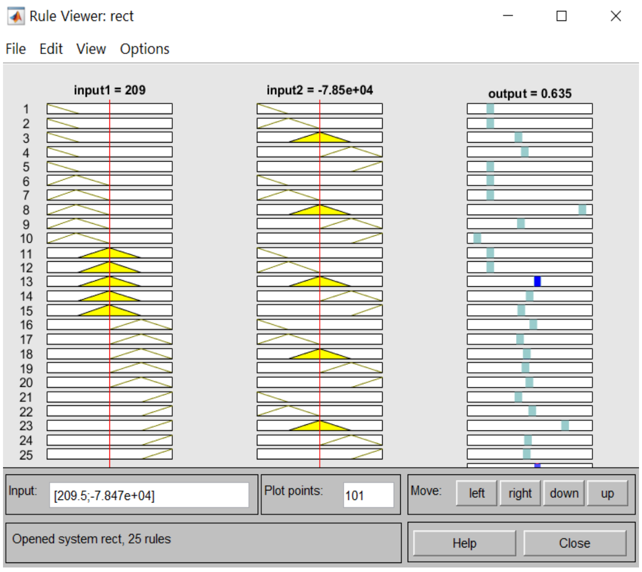

Fig. 4: Basic Rule Structure

Figure 5 depicts the control structure for the HYBRID FUZZY PI modelling that is used for rectifier load analysis.

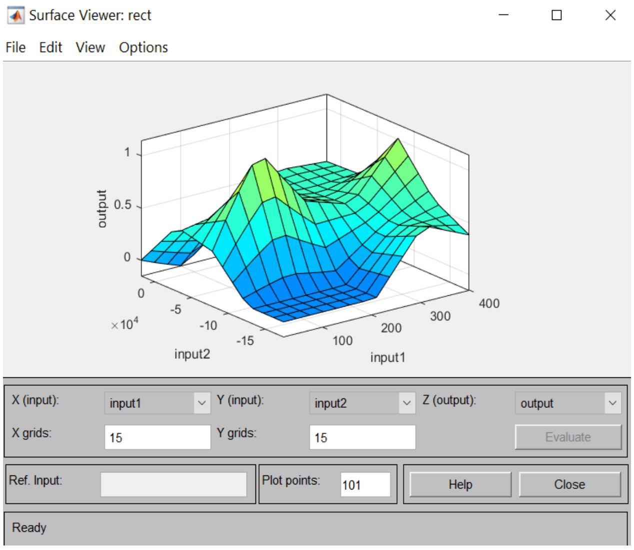

Fig. 5:- HYBRID FUZZY PI Control Surface View

In Fig. 6, the surface view of the rule set is shown.

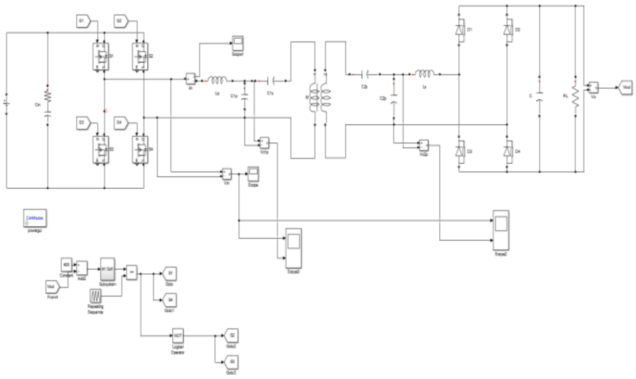

Fig. 6:- model with vc1p and vc2p output in HYBRID FUZZY PI

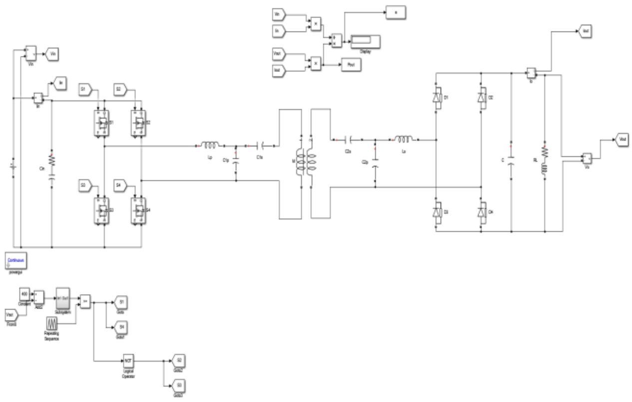

Fig. 7:- Final Proposed model with Efficiency and power output

In Fig. 6 and 7 final proposed model with HYBRID FUZZY PI implementation are shown.

III. RESULTS

This section shows the results of the last section implementations.

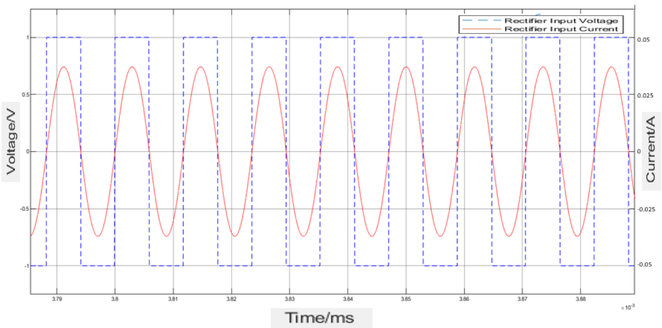

Fig. 8:- Rectifier Input Voltage and Current for Proposed Model

Fig. 8 and Fig. 9 shows the inputs of the HYBRID FUZZY PI model.

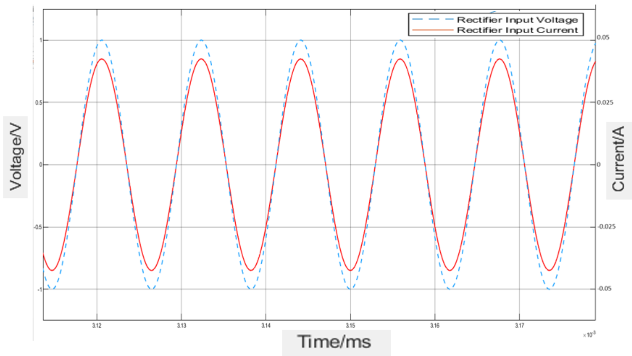

Fig. 9:- Fundamental Input Voltage and Current of Rectifier for Proposed Model

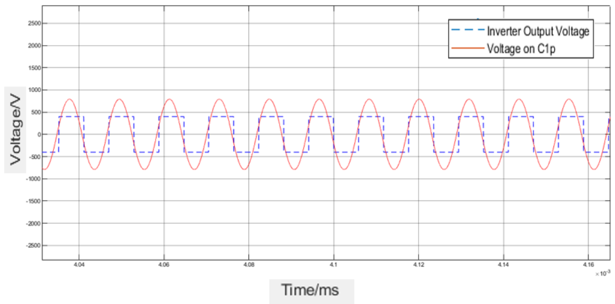

Fig. 10:- Inverter Output Voltage and Voltage on C1p

Fig. 10 and Fig. 11 shows voltages Vc1p and Vc2p outputs.

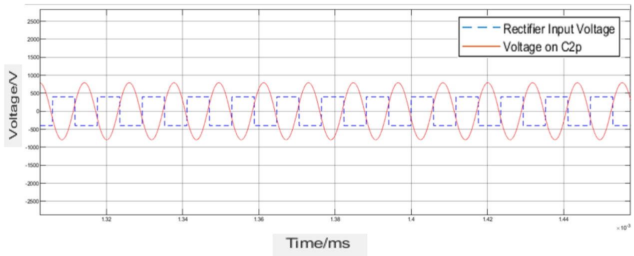

Fig. 11:- Rectifier Input Voltage and Voltage across C2p

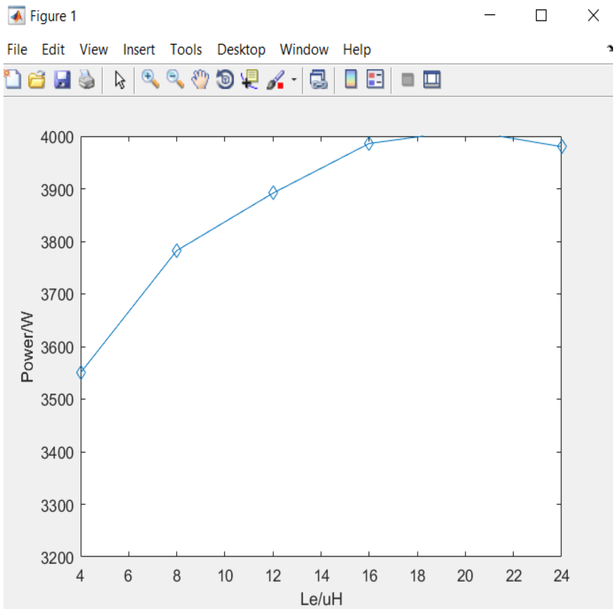

Fig. 12:- Power Output

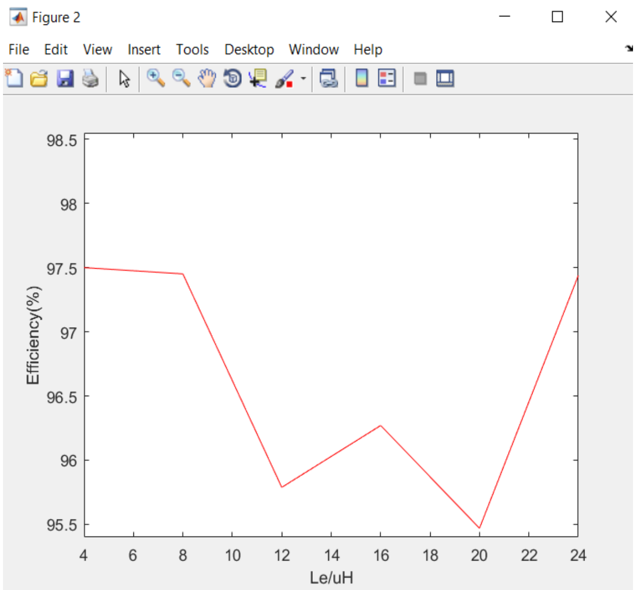

Fig. 13:- Efficiency Output

The graphs of the power output and the efficiency output are displayed in Figures 12 and 13, respectively. A comparison between the current results with the planned outcomes is presented in table 1.

	Existing	Proposed Fuzzy PI
Pout Max(W)	3950	4000
Efficiency(%)	95.44	97.5

Table 1:- Comparison of Existing and Proposed model

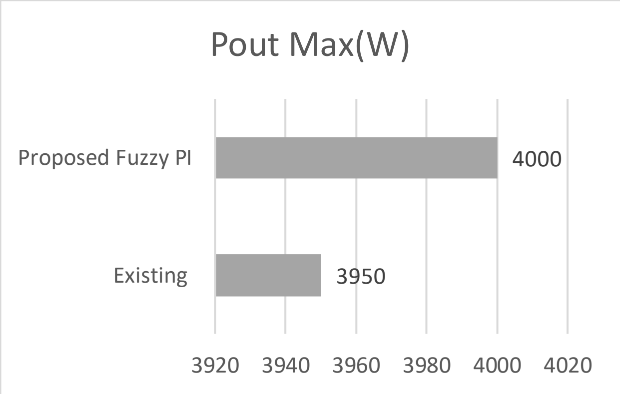

Fig. 14:- Power max Comparison

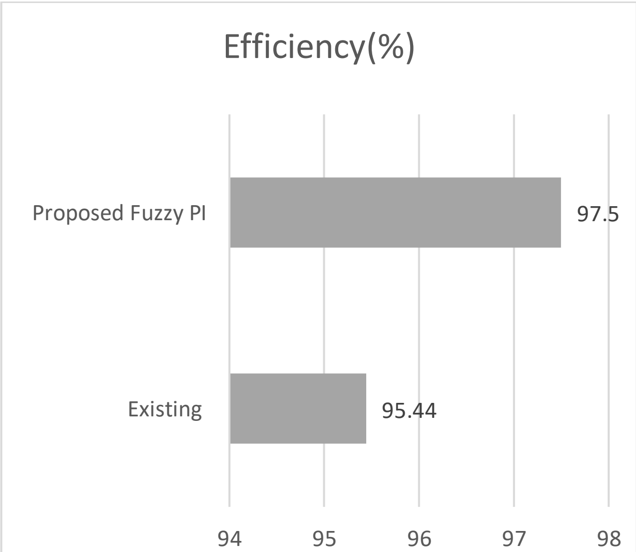

Fig. 15:- Efficiency Comparison

The maximum power production and efficiency of the present system are compared to those of the proposed system in Figures 14 and 15. The HYBRID FUZZY PI model that was developed demonstrates significantly improved results for rectifier load analysis in the charging of electric vehicles.

IV. CONCLUSION

The increased expense of petroleum will be somewhat offset by the increased usage of electric vehicles, which will also help reduce emissions of greenhouse gases. In order to assist the choosing process, electric transportation necessitates the preparation of a broad variety of charging systems in a state that is simple to operate. It is possible that in the future, optional technologies such as remote electric car charging systems will be developed to charge electric vehicles (EVs) without causing any module-related problems. As a result, the implementation of a rectifier load analysis of an electric vehicle is carried out in this research work. A novel approach that makes use of the Hybrid Fuzzy PI control system is provided. This approach is utilised to regulate the output voltage, and the regulated voltage is then supplied to gate pulses for accurate result verification. It can be inferred that the advantage of the control system is a greater level of efficiency than is now present, as well as a higher level of maximum power generation that also performs better.

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