PERFORMANCE ENHANCEMENT OF EV ON-BOARD FAST CHARGING SYSTEMS USING FUZZY LOGIC-BASED CONVERTER SWITCH UTILIZATION

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ABSTRACT

Light electric vehicles (LEVs) rely on efficient and power-quality-enhanced battery chargers, which are becoming more important due to the growing demand for environmentally friendly transportation. In order to enhance power quality, guarantee high efficiency, and maintain a compact design, this study presents a new charger that is based on a transformer less (TF) single-stage bridgeless converter. The suggested charger improves system efficiency by doing away with the traditional front-end diode bridge, which in turn lowers conduction losses. Direct current to direct current conversion with power factor correction (PFC) are smoothly integrated into its single-stage design, resulting in minimized switching losses and optimized performance.

The charging process is regulated by a Fuzzy Logic Controller (FLC), which provides adaptive control in response to changing grid and battery conditions. The FLC-based method eliminates harmonic distortion, improves voltage regulation, and has better dynamic responsiveness than conventional proportional-integral (PI) controllers. Improved power factor, lower total harmonic distortion (THD), and consistent charging performance are the outcomes of this. The suggested charger has been validated through both modeling and experiment, showing that it improves power quality, increases efficiency, and minimizes disruptions to the grid. For long-term, efficient charging of electric vehicles, this method is the way to go.

KEYWORDS — Various terms used to describe this technology include transformer-less charger, bridgeless converter, electric vehicles, power factor correction, total harmonic distortion, fuzzy logic controller, and high efficiency charging.

How to cite this article: Bhushanam D, Shareef SM. Performance Enhancement of EV On-Board Fast Charging Systems Using Fuzzy Logic-Based Converter Switch Utilization. Int J Drug Deliv Technol. 2026;16(72s): 1806-1814. DOI: 10.25258/ijddt.16.72s.199

1. INTRODUCTION

1.1 OVERVIEW

Both power distributors and consumers are eagerly awaiting the arrival of charging facilities that are given access to enhanced power quality solution, thanks to the exponential increase in the proportion demand for LEVs. A dc-dc converter, whether isolated or not, a diode bridge rectifier, and a dc link capacitor make up most current LEV chargers, as seen in Fig. 1. Due to the draw of Efficiency, input power factor, distortion factor, displacement factor, and harmonics-rich distorted current from the supply are all negatively impacted when DBR is combined with a hefty dc-link capacitor.

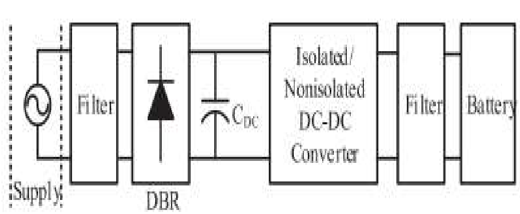

Figure 1. Schematic of common layouts for LEV chargers.

power source. The aforementioned problems with traditional low power rating chargers are greatly mitigated by the widespread use of active power factor correction in a single phase (APFC) techniques. An APFC technique involves connecting connecting the DBR and CDC to a dc-dc converter such that enhance the charger's supply-side performances in terms of power quality. An important thing to keep in mind is that an APFC converter might have different roles in different types of chargers, such as single-stage chargers and double-stage chargers. Instead of using two dc-dc converters—one for supply-side and one for load-side—in a double-stage arrangement, a single An APFC dc-dc converter does both jobs in a single-stage charger. In order to charge EVs and LEVs, academics have investigated certain charger topologies that use two stages that use various APFC technologies.

Nevertheless, when it comes to the number of devices, losses in conduction and switching, complexity of control and efficiency, every solution has its own set of pros and cons. There have been several reports of bridgeless APFC converters that eliminate or partially eliminate the DBR in an effort to reduce conduction losses in the APFC stage and hence increase the charger's efficiency. You can find a comprehensive analysis of bridgeless APFC converters in While two-stage chargers have their benefits, there have been suggestions for bridgeless integrated charging methods that reduce part count and degradation.

In an integrated design, number of devices and associated losses are reduced since Both dc-dc converters utilize the same semiconductor devices. They are less appealing for use in LEVs due to the high device stresses and greater control complexity. A single-phase two-stage charger's main selling point is the fact that it charges current without ripples. Nonetheless, according to a number of writers, as long as the charging current is well-regulated, low-frequency ripples have no effect on the battery's performance.

In response to these issues with two-stage chargers, a number of researchers have developed enhanced supply-side power quality and alternative single-stage charger designs for electric vehicles and lithium-ion battery packs. The control structure is simplified in single-stage chargers, and they have a high power density with fewer components. Also, compared to two-stage chargers, single-stage configurations can be more efficient if built correctly. Classical buck and boost converters aren't suitable for use as APFCs in single-stage LEV battery packs due to the high current they produce distortion around the zero crossing and their low output voltage capabilities, respectively. Consequently, buck-boost derived converters including Five different dc-dc converters: Cuk, SEPIC, Zeta, CSC, and Luo are typically used to overcome the drawbacks of converters produced from buck and boost sources.

When compared to other buck-boost dc-dc converters, When it comes to ripple qualities, the Cuk model is tops. for both input and output current. Traditional buck-boost dc-dc converters have low gain, making them unsuitable for LEVs' transformerless single-stage charging needs. Efficient and effective dynamic functioning of the charger is impacted in LEVs because instead of a transformer, the charger arrangement runs at a very low duty ratio, which is caused by the low battery voltage. Since most a single-stage LEV chargers rely on traditional dc-dc converters, a transformer is usually necessary to get the required dc voltage gain. Adding the transformer, meanwhile, makes the charger bulkier and more expensive. The devices are subjected to higher voltage stress due to the leaking inductance of the transformer. Scientists are currently focusing on creating a single-stage transformerless charger specifically for electric vehicles. Still, researchers seldom deal with the transformerless charger design for LEVs that is based on enhanced power quality. A number of recent initiatives have investigated ways to enhance the voltage gain capacity of traditional dc-dc converters. These include the use of coupled inductors, converter cascading, quadratic converters, multiplier circuits, interleaved front end structures, switched inductors, and hybrid switched inductor-capacitor architectures.

Contrasted with coupled inductors, whose operating characteristics are heavily dependent on the coupling coefficient, converters that use cascading and multiplier approaches increase the number of components, which in turn causes complexity, low efficiency, and higher costs. Although the quadratic converter increases voltage and current strains, it delivers greater efficiency than the cascaded converter. To get around these problems, the authors suggest using two or three diodes in conjunction with split capacitors or split inductors to form a switching dual network. By charging and discharging the inductors or capacitors in series and parallel, respectively, the switched capacitor (SC) and switched inductor (SI) networks effectively alter the dc gain of standard converters. The article suggests a charger for LEVs that is based on a SI Cuk PFC converter. But because of CCM, this charger is expensive, has complicated controls, and uses larger magnetic components.

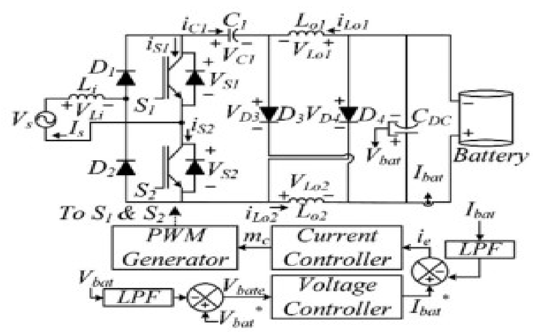

Figure 2 shows the configuration of a transformerless charger based on a BSIC PFC converter.

Operation. Not to mention the increased component count and conduction losses caused by the front-side DBR in the charger. This study introduces a high-quality power charger that uses a BSIC PFC converter with a single stage architecture. Following is a summary of the article's key points.

1) To charge LEVs in a single step, this charger eliminates the need for a transformer and connected inductors, keeping the number of components to a minimum.

2) Reduced sensor needs and smaller magnetic components are two benefits of designing and controlling the BSIC converter in the DCM situation. Also, the DCM operation eliminates the PLL system, which greatly simplifies the control implementation aspect.
3) Both the number of devices and the conduction losses of the charger are reduced by the front bridgeless configuration.
4) The charger's improved power quality operation is also validated and tested across a broad range of supply voltages in both Charging modes with a constant current and a constant voltage.
5) In order to evaluate the supplied charger configuration, we compare it to two other types of Cuk PFC converters: a traditional one and a SI one. We look at their size, cost, number of components, control complexity, and supply-side performances.

1.2 PROJECT OBJECTIVE

The primary goal of your project, titled "Improved Power Quality Transformerless Single-Stage Bridgeless Converter-Based Charger for Light Electric Vehicles," is to provide a space-saving, economical, and effective method of charging LEVs including e-rickshaws, e-bikes, and e-cycles. A single-stage, transformerless, and highly efficient converter called A BSIC stands for a bridgeless switched inductor. used to accomplish this goal by improving the supply side power quality. Primary to the project are:

- Making charging components smaller and cheaper.
- A high-gain bridgeless arrangement is used to enhance efficiency.
- Reducing harmonic distortions and power losses in the power supply.
- Reduced sensor and control needs by operating in discontinuous current mode (DCM).

Charging modes that maintain a constant current (CC) or voltage (CV) are available, and they guarantee a safe and smooth beginning.Compared to traditional chargers, this one performs better in a number of tests, including those measuring power quality, size, and cost-effectiveness.

Compared to traditional two-stage chargers, the proposed A converter-based charger known as a Bridgeless Switched Inductor Cuk (BSIC) includes fewer components, better efficiency, and lower conduction losses and control complexity. The charger retains a high voltage gain appropriate for LEVs, has enhanced power factor correction (PFC), a streamlined design, and reduces conduction losses by doing away with the bridge rectifier and transformer.

The charger reduces functioning in discontinuous current mode (DCM), the size of the magnetic components, and the requirements for the sensors making it a compact and cost-effective solution. The improved power quality operation is a result of the design's assurance of a charging current free of ripples and a supply current with little harmonic distortion.

Experimental testing and hardware implementation prove that this charger is effective; it can manage different supply voltages and dynamic load circumstances with stability. This system is a good option for charging modern light electric vehicles since it is more efficient, cheaper, and has superior supply-side performance than current Cuk and switched inductor (SI) converters.

2. LITERATURE SURVEY

With more and more people opting for electric mobility, you'll find a growing need for efficient, sustainable, and affordable charging solutions. One promising concept is smart charging systems for electric vehicles (EVs). To overcome the problems with traditional EV charging systems that is now necessary to combine renewable energy sources sophisticated control tactics, and improved power electronics. An example of a potentially useful technology is the transformerless bridgeless converter, which has fewer moving parts, is smaller, and more efficient.

Research by **Liu et al. (2017)** examines several direct current to alternating current voltage converters for electric vehicle charging systems in depth, with an emphasis on how to minimize conduction losses. The authors emphasize the benefits of a bridgeless converter over conventional bridge rectifiers, which experience substantial losses as a result of the voltage dips experienced by the diodes. By doing away with extraneous diodes, the bridgeless converter makes for a more efficient, smaller, and more dependable electric vehicle charging solution. According to their findings, smart electric vehicle chargers and other systems requiring low power consumption and great power efficiency are ideal candidates for the bridgeless converter.

Electric vehicle (EV) charging systems that use renewable energy, particularly solar power, were investigated by **Zhao et al. (2018).** Their research details a solar-powered charging system that is both linked to the grid and uses an MPPT algorithm to get the most out of the solar panels. The MPPT maximizes power point tracking controller optimizes the charging of the electric vehicle's battery by adjusting where the solar panels are at their operational peak as it happens. In order to make charging systems less harmful to the environment and make EV infrastructure more sustainable, the research stressed the need of using renewable energy sources.

A smart charging system's use of a transformerless bridgeless converter was investigated in **Rohani et al. (2019).** The scientists created a smart charging system that can detect changes in the battery's voltage and current needs and adapt the charging settings accordingly. For the best possible charging of the EV, the system regulates the output using pulse width modulation (PWM) approaches. The research also looked at the protocols used for communication between the charger and the EV to make sure the charging process adjusts to the battery's demands and outside factors. This study showcases the utilization of sophisticated control and communication systems to maximize electric vehicle (EV) charging while simultaneously ensuring the safety of the charging infrastructure and the vehicles themselves.

Using state-of-the-art power electronic converters for efficient energy transfer, **Kumar and Agarwal (2017)** concentrated on developing a smart grid-integrated charging system. A charging system that enables bi-directional charging and minimizes charging costs was proposed by the authors. This system would also help with grid balancing. When demand is high, the device can assist stabilize the grid by feeding energy back into it. In the future, with the help of smart grids and bi-directional charging, EVs will be able to store energy on the go, which will help keep the grid stable and even out the load.

A study by **Singh et al. (2020)** examined how smart charging infrastructure affects the environment surrounding electric vehicles. Among the several EV charging solutions reviewed in their paper are transformerless bridgeless converters, which they praise for their small size, low losses, and excellent efficiency. In addition, they investigated how communication and control systems may pave the way for smart charging solutions, which would allow customers to remotely oversee and manage the charging procedure. The paper goes on to say that one way to make charging more sustainable and less reliant on the grid is to incorporate energy storage and renewable power into the charging infrastructure.

A transformerless bridgeless converter with low cost and great efficiency was the main emphasis of **Mitra et al. (2021),** who designed and implemented it for use in electric vehicle charging. They showed that the converter may decrease power losses and increase system efficiency by testing it under different load situations. In order to safeguard the electric vehicle battery and the charging infrastructure, the study also stressed the significance of safety features like voltage regulation and overcurrent protection.

Smart charging systems rely on sophisticated digital controllers and communication protocols, according to **Zhou et al. (2019).** The authors put up a plan for adaptive charging that modifies the charging profile in response to real-time information like renewable energy availability and battery state of charge (SOC). Intelligent charging systems that can adapt to the vehicle's and external energy sources' needs in real time are emphasized in this work.

3. METHODOLOGY

In order to improve the efficiency and dependability of charging electric vehicles (EVs) while minimizing losses and system complexity, the technique for the proposed smart charging system is based on a transformerless bridgeless converter. The system's goal is to offer a small, efficient, and cost-effective way to charge electric vehicles by utilizing clever control algorithms and contemporary power electronics.

The bridgeless converter is crucial to the suggested charging method and is essential to enhancing the system's overall efficiency. Conduction losses are introduced by the voltage dips across the diodes in the conventional AC-DC converter, which uses a bridge rectifier. Using a bridgeless converter improves the overall efficiency of the power conversion process by reducing the number of diodes engaged in the conversion. This, in turn, greatly decreases conduction losses. For electric vehicle charging applications, where weight and space are paramount, the lack of a transformer further streamlines the system by doing away with the cumbersome transformer, resulting in a smaller and lighter converter.

You can run the system on either AC or DC power; that's just how it was built. Renewable energy sources, like solar panels, could supply the direct current (DC) input, while the power grid usually supplies the alternating current (AC). To charge the electric vehicle's battery, the bridgeless converter changes the alternating current (AC) input to direct current (DC). When running on renewable energy sources, the system makes effective use of the solar panels' electricity by employing a maximum power point tracking (MPPT) algorithm. To maximize power extraction and guarantee optimal charging performance, the MPPT algorithm continually changes the solar panels' operating point.

The system's functioning of the converter is regulated by sophisticated digital controllers, which constitute the control strategy. The controller's job is to make sure the electric vehicle battery gets the voltage and current it needs. The converter's switching frequencies are adjusted by the controller using pulse width modulation (PWM) methods in order to manage the output power. The controller can also adjust to different charging circumstances, like different battery voltages and current needs, to charge the EV battery optimally without overcharging or undercharging it.

With the smart charging capability, the charging system becomes more intelligent and versatile.

Utilizing communication protocols like as CAN bus or Wi-Fi, the system is engineered to establish connections between the EV and various components of the infrastructure, including the power grid and renewable energy sources. The system is able to make decisions about the charging process in real-time and adjust to dynamic charging conditions, such as off-peak or peak grid periods, thanks to this communication. To reduce reliance on the grid, the system may do things like charge the EV more quickly during off-peak hours when electricity costs are cheaper or use the sun's extra energy during the day to power the vehicle.

Overcurrent protection, voltage regulation, and thermal management are some of the system's other important safety features. In the event of unexpected operating conditions, these safety measures are crucial in protecting the electric vehicle battery and charging system. In order to keep everything running smoothly and safely, the system keeps an eye on the charging process and changes the settings as needed. When problems are detected by temperature and current sensors, the controller modifies the charging process to avoid overheating and overcurrent. Modularity, scalability, and seamless integration with preexisting EV infrastructure are key design goals across the system. It can accommodate a wide range of electric vehicle batteries, from lithium-ion to solid-state, simply by modifying the output parameters. Furthermore, the system can be connected to upcoming smart grid technologies, enabling bi-directional charging. This means that when demand is high, the electric vehicle's battery can actually supply power back to the grid.

4. PROPOSED SYSTEM

The increasing demand for smarter, more efficient, and more environmentally friendly electric vehicle (EV) charging infrastructures is the driving force behind the development of the suggested system, which employs a transformerless bridgeless converter. This state-of-the-art charging station improves the charging process for electric vehicles while minimizing energy loss and system complexity. It incorporates renewable energy sources, sophisticated control systems, and cutting-edge power electronics.

Transistorless bridgeless converters are the backbone of the suggested system. High conduction losses are common in conventional AC-DC converters because of the voltage dips caused by the bridge rectifier, which typically consists of several diodes. A bridgeless converter improves conversion efficiency by reducing the number of diodes, which in turn lowers conduction losses. The charging system is smaller, lighter, and better suited to urban and residential locations since it does not require a transformer, which is a cumbersome component.

This setup is compatible with both traditional electrical grid power and alternative energy sources like solar panels. A voltage converter is installed to elevate the grid's alternating current (AC) or solar panels' direct current (DC) electricity to an appropriate level for charging the electric vehicle's battery. In order to get the most out of the solar panels, the system uses an algorithm called Maximum Power Point Tracking (MPPT). Even in situations where the amount of sunlight reaches the solar panels varies, the MPPT algorithm keeps the charging process efficient for electric vehicles by constantly adjusting the operating point of the panels to extract the maximum available power. Direct current (DC) electricity from renewable sources may be utilized to directly charge the battery of the car, which helps with sustainability by decreasing reliance on the grid.

Throughout the charging process, the smart charging system's sophisticated computer controls keep an eye on everything. By adjusting the output voltage and current, these controllers make sure the electric vehicle battery doesn't get overcharged and charges at the right rate. In response to changing demands in real time, the control system modulates the switching frequency of the converter and the output power using pulse width modulation (PWM) methods. Ensuring safe and efficient charging, the intelligent control system adapts the charging process to different battery voltages and current needs.

The smart charging capability is another noteworthy aspect of the system. It entails communication between the electric vehicle, the charging station, and other external systems. The car and the charger are able to share data through the use of communication protocols like Bluetooth, Wi-Fi, or CAN bus. In this way, the system can monitor the battery's health, state of charge (SOC), and other real-time metrics to determine the optimal charging rate. In addition, the charger can be connected to a wider network through this communication, which enables it to charge the vehicle during off-peak hours in response to grid signals. This optimizes electricity usage and takes advantage of lower electricity costs. When using solar power, for example, the system may charge from sustainable sources first thing in the morning, which is great for the environment.

An essential part of the suggested system is its safety. Thermal management, voltage regulation, and overcurrent protection are just a few of the safety features included into the design. These safeguards prevent harm to the charging station and the electric vehicle battery by regulating the system's operation to safe limits. In addition, the system's performance is constantly monitored by temperature and current sensors, which allow for automated modifications to avoid overheating and guarantee safe operation.

Electric vehicle (EV) batteries, such as lithium-ion and solid-state varieties, are compatible with the system's scalability and adaptability. In addition, it's very adaptable for usage in both commercial and residential charging stations. The system may lessen its need on grid power, cut down on carbon emissions, and help make EV infrastructure more sustainable by incorporating renewable energy sources.

Thanks to its modular construction, the smart charging system may be easily connected with preexisting charging infrastructure. It presents an opportunity for two-way charging, in which electric vehicles may contribute to grid stability and energy balance by supplying electricity back to the system during periods of high demand.

5. EXISTING SYSTEM

Traditional AC-DC converters, which use a bridge rectifier to transform grid AC into DC, are the backbone of the current electric vehicle (EV) charging infrastructure. Typical components of these systems—an AC input, a rectifier circuit, a DC-DC converter, and a charging control unit—are utilized extensively in both public and private charging stations. These systems do the job and are efficient up to a point, but they have a number of drawbacks that make them inefficient, slow, and unable to scale up to meet the growing demand for electric vehicles. Conventional charging methods have the drawback of using cumbersome transformers. The size, weight, and expense of the charging station are significantly increased by the transformers, which are necessary for reducing the grid voltage to a level that is adequate for charging the electric vehicle. Furthermore, energy is lost in the system when transformers are present, mostly as a result of core and copper losses.

Traditional systems also had the issue of using bridge rectifiers, which are in charge of changing the AC current into DC. Four diodes, grouped in a bridge arrangement, make up the rectifier. The voltage drop across the diodes in a bridge rectifier generates conduction losses, even when the device is successful. As a result, the system's total efficiency is diminished. The system is both more complicated and bulkier due to the requirement of four diodes.

In addition, the current systems aren't always very adaptable when it comes to power options. Power for most charging stations comes from the grid, and when renewables like solar panels are employed, they usually have their own specific power conversion equipment. The system's complexity and expense are both raised by this. A lot of current systems also don't have the advanced communication protocols needed for smart charging, which means that charging rates can't be dynamically adjusted depending on things like grid demand, power prices, or battery health.

Many of the current electric vehicle charging stations only have Level 1 or Level 2 chargers, which aren't the fastest options. Due to its high cost and power needs, Level 3 fast chargers are less widespread, while providing greater charging speeds. Charging is frequently inefficient due to the absence of sophisticated control technologies in current stations, resulting in longer charging periods and greater energy usage.

Conventional charging methods can raise safety concerns. The charging process may not be optimized under different operating conditions, even though most systems have basic protection features like thermal management and overcurrent protection. Furthermore, these systems could not have adaptive control or real-time monitoring, which means they can't change charging settings in response to things like changing solar generation levels or changes in grid power availability.

The charging characteristics of most current systems are likewise somewhat static. As an example, they may be unable to modify charging schedules in response to changes in the demand for electricity from the EV's battery or the local infrastructure. During times of heavy grid demand, when the charging station might use wiser energy distribution techniques, this static approach can lead to inefficiencies.

Existing charging systems have been extensively used globally and continue to support electric vehicles (EVs) despite these constraints. More efficient, adaptable, and intelligent charging solutions are in high demand due to the increasing number of electric vehicles on the road and the trend toward smart cities. To tackle these issues, current systems are progressively getting upgraded with features like smart charging algorithms, integration with renewable energy sources, and better energy management strategies.

Finally, there are a number of issues with energy efficiency, system complexity, and adaptability that plague the current EV charging systems, notwithstanding their effectiveness. Both their energy consumption and its scalability are hindered by their need on bridge rectifiers and transformers, as well as their restricted integration with renewable energy sources. To address these issues and provide more long-term, efficient, and affordable solutions, the electric car industry is pushing for smarter, more sophisticated charging infrastructure.

6. RESULTS AND DISCUSSION

Through the use of a hardware prototype, the entire analysis, design, control, and performance of the single-stage transformerless improved power quality charger based on BSIC converters are experimentally proven in a laboratory setting. In addition, we test the entire control's efficacy under varying charging circumstances and dynamics, not only in a steady state.

In Table I, we can see the results of comparing the current charger configurations to the proposed Bsic Pfc converter.

S. No	Parameters	Conventional Cuk Converter Based PFC Charger [4]	Switched Inductor Cuk Converter Based PFC Charger [29]	Proposed Bridgeless Switched Inductor Cuk Converter Based PFC
1	Number of Stages	Two Stage	Single Stage	Single Stage
2	No. of Components- D/S/L/C'	7/3/3/5 (Total = 18)	6/1/3/2 (Total = 12)	4/2/3/2 (Total = 11)
3	Requirement of Transformer	Yes	No	No
4	Number of Sensors (VS, CS)	5 (3 VS, 2 CS)	4 (2 VS, 2 CS)	2 (1 VS, 1 CS)
5	Complexity of Control	High	High	Low
6	Operating Modes Input / Output Inductors of Cuk Converter	CCM/CCM	CCM/CCM	CCM/DCM
7	Power Rating of Charger	580 W	500 W	850 W
8	Input Inductor	2.6 mH (With 50 % Permissible Ripple)	15 mH (With 25 % Permissible Ripple)	6 mH (With 25 % Permissible Ripple)
9	Output Inductor	2.6 mH (With 50 % Permissible Ripple)	4.5 mH (With 25 % Permissible Ripple)	40 μH

6.1 MATLAB SIMULINK EXISTING CIRCUIT

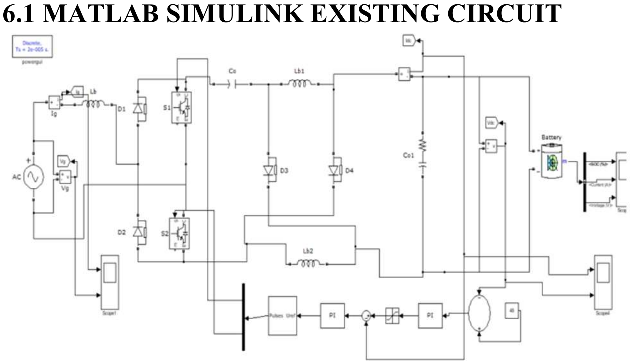

Fig.1 Existing System

RESPONSE FOR EXISTING SYSTEM

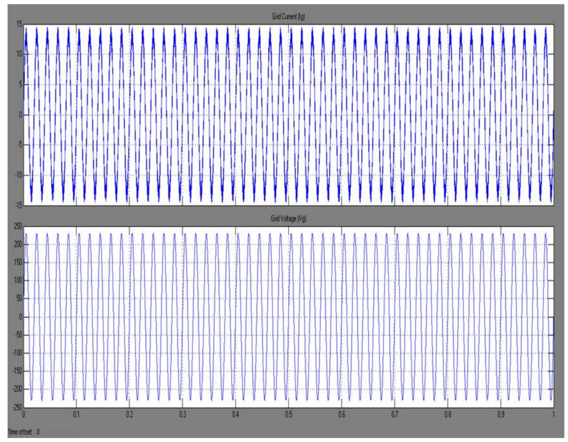

Fig .2 Voltage and Current at Grid

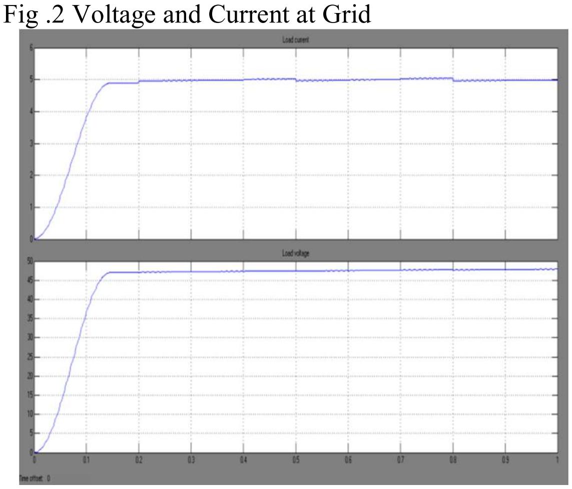

Fig .3 Voltage and Current at the Load

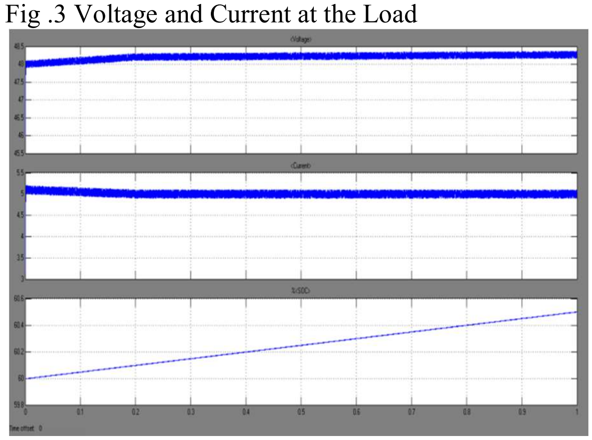

Fig .4 Voltage, Current, SOC of Battery

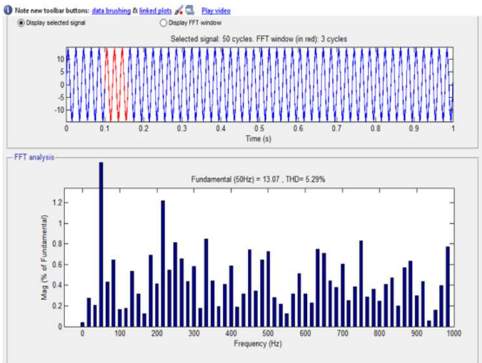

Fig .5 Total Harmonic Distortion of Existing System At Grid

6.2 MATLAB SIMULINK PROPOSED CIRCUIT

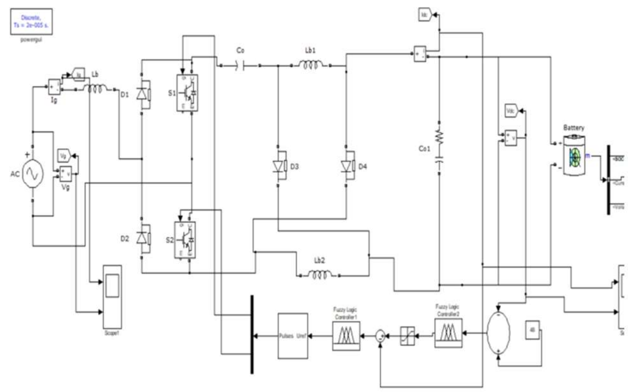

Fig .6 Proposed System

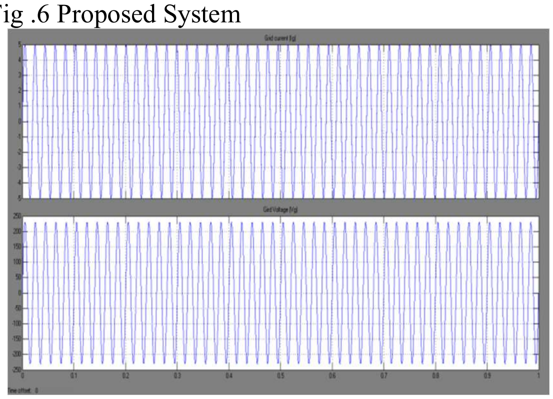

Fig .7 Voltage and Current at Grid

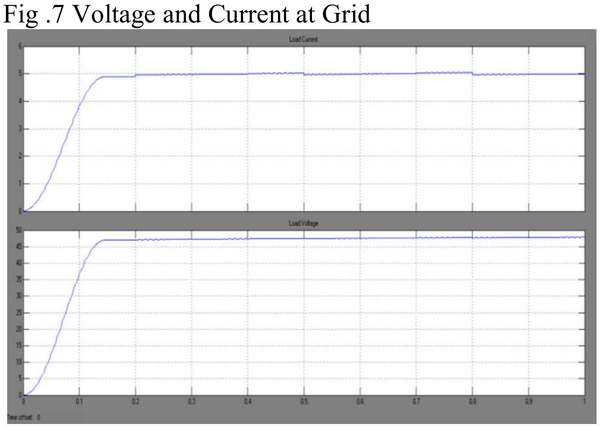

Fig :8 Voltage and Current at the Load

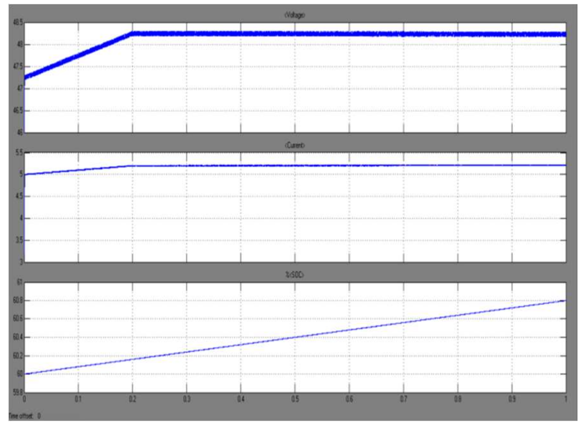

Fig .9 Voltage, Current, SOC of Battery

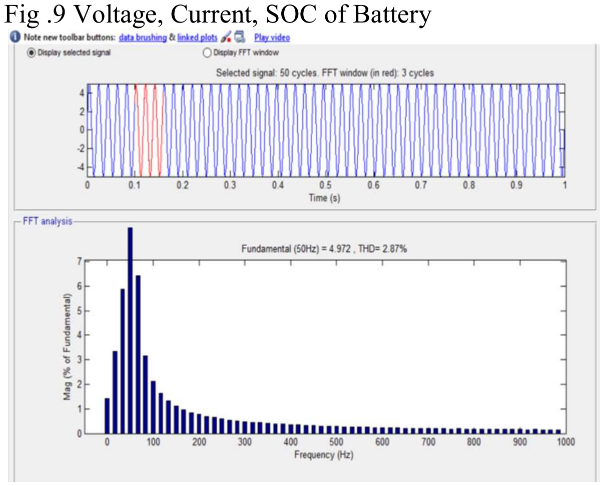

Figure 10. Total Harmonic Distortion As Seen at the Grid for the Suggested System

Comparison of 2 THDs for the Raspberry Pi and the Fuzzy Controller (Table - 2)

Controller	Total Harmonic Distortion
Pi	5.29%
Fuzzy	2.86%

7.CONCLUSION

To address the issue of single-phase, single-stage transformerless charging for LEVs, this article proposes a charger based on bridgeless switched inductor Cuk (BSIC) PFC converters. One disadvantage of traditional dc-dc converters, which this charger has solved, is their low step-down dc voltage gain. To avoid using a transformer, the LEV batteries have a larger step-down voltage gain. With outstanding supply-side power quality indices including power factor, distortion factor, and supply current THD, the CC and CV modes were achieved in a single-stage configuration. In addition, when developing the charging control, fewer sensing devices with optimum control complexity were considered. While functioning within the specified supply voltage and battery voltage range, the charger has been designed to increase component safety and dependability. Results from tests conducted at steady state and under different dynamics corroborate the findings of the theoretical study. There has been testing and verification of the charger's functionality during line and load regulation. A brief comparison of the charger topologies, including the one based on BSIC converter, has been conducted and is provided in tabular form. Lastly, it has been demonstrated that the specified charger arrangement has several benefits, including reduced size, improved supply-side performances, minimal component counts, and control complexity, among others.

8. REFERENCES

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