Retraction

Retraction: Design of an integrated system of wireless power transfer, battery health monitoring system and automated power factor correction in electric vehicles (J. Phys.: Conf. Ser. 1916 012066)

Published 23 February 2022

This article (and all articles in the proceedings volume relating to the same conference) has been retracted by IOP Publishing following an extensive investigation in line with the COPE guidelines. This investigation has uncovered evidence of systematic manipulation of the publication process and considerable citation manipulation.

IOP Publishing respectfully requests that readers consider all work within this volume potentially unreliable, as the volume has not been through a credible peer review process.

IOP Publishing regrets that our usual quality checks did not identify these issues before publication, and have since put additional measures in place to try to prevent these issues from reoccurring. IOP Publishing wishes to credit anonymous whistleblowers and the Problematic Paper Screener [1] for bringing some of the above issues to our attention, prompting us to investigate further.

[1] Cabanac G, Labbé C and Magazinov A 2021 arXiv:2107.06751v1

Retraction published: 23 February 2022

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI.

Published under licence by IOP Publishing Ltd
Design of an integrated system of wireless power transfer, battery health monitoring system and automated power factor correction in electric vehicles.

R Senthil Kumar1, S Saravanan1, M K Raj Sivaram1, S Kishore Aravindh1, K Manoj Kiran1 and M Kavin Kumar1
1Department of Electrical and Electronics Engineering, Sri Krishna College of Technology, Coimbatore, Tamilnadu, India.
senthilkumar.r@skct.edu.in

Abstract. Since gasoline prices have risen, electric vehicles (EVs) are becoming more common. As a result of these conditions, many vehicle manufacturers are searching for alternative energy sources to petrol. Electrical energy sources could be better for the environment because they produce fewer emissions. Furthermore, electric cars have major benefits in terms of energy efficiency and environmental safety. This project aims in providing a complete solution of wireless power transfer, battery health alert system and automated power factor correction of the electrical system of electrical vehicles, thereby providing a complete integrated solution of wireless charging of rechargeable battery present in electric vehicles as well as proper utilization of the active power to the maximum in AC Electric vehicles, therefore increasing the efficiency of the power utilization. This project also discusses the battery health alert system. This project aims in providing an automated solution of reactive power compensation of electrical system in EVs to reduce the wastage of power effectively.

1. Introduction

Through the present day developments in the field of electric vehicles, the incorporation of Wireless Power Transfer System can upgrade the infrastructure of forthcoming Electrical Vehicles. If the wireless power transfer system is successfully incorporated, the EVs can be charged easily when they are parked in parking slots, reduces the use of tangled charging cables. An oscillating magnetic field is used to transfer power from the transmitter to the receiver in the wireless transfer system. WPTS generates electric fields that transfer energy between transmitters and receivers through the air gap. With the rapid growth of the electric vehicle industry, more efficient and convenient battery charging is expected. With further development, the concept of the dynamic wireless power transfer system can also be incorporated, where the cars could be charged wirelessly while driving with utmost ease, thereby reducing the cause of flat batteries. In applications where secondary batteries are used as a power source, it is desirable to know the state of charge and the health of the batteries. Thus a battery health alert system would be incorporated in order to check the status of the battery. If the voltage of the battery drops below the threshold value, a GSM alert will be sent to the driver’s contact number regarding the status of the battery. Thus determining
the state of voltage in batteries periodically helps in preventing the batteries from being flat. In recent years, power quality has become a great concern due to large advancements in the field of power electronics and electrical power system. Most of the EVs would have a large number of inductive loads. When turning on inductive loads, especially that runs on AC supply would draw reactive power. To avoid reactive power consumption, a capacitor bank may be automatically actuated when the power factor falls below the threshold value using any Microcontroller Unit, thereby improving the power quality.

2. Fundamentals

2.1. Principle of Wireless Power Transfer

Wireless Power Transfer System or WPTS is a system that provides power without using any wires or physical connection through the air gap. The transmitter device produces a time-varying or high-frequency electromagnetic field that transmits power without any physical wires to the receiver device. The receiver unit collects and supplies electrical power from the magnetic field and supplies to the battery [1-4].

2.2. Battery Health Alert System

The analog pin of the Arduino functions as a basic voltmeter where the value of the voltage is recovered. Then, by using the Analog to Digital conversion formula, we can transform the analog value into a digital voltage value. If the voltage of the battery falls below the threshold value, a GSM alert will be sent to the driver’s mobile number.

2.3. Power Factor Correction System.

This method for compensation of the lagging current by generating a leading current by connecting a capacitor across the power supply is called power factor correction. In order to change the power factor to unity, adequate capacitance should be included. The power factor correction (PFC) is to counteract the unpredictable effects of electrical load that produce a power factor that is lesser than the unity. It is done using a microcontroller. This method not only improves the power quality but also improves the lifetime of static capacitors [8-12].

3. Working

3.1. Design Wireless Power Transfer Circuit

The Wireless Power Transfer System aids in delivery of power from a source to a load without any physical connections. When the magnetic resonance is transmitted over a less distance, wireless power transfer will be used. With the help of inductive coupling between coils of wire, the magnetic field is generated and the power is transferred. The flux generated at the linear coil must have higher solidity with high frequency to transfer the energy using magnetic induction. The AC supply from the mains is converted to a constant DC supply using Voltage regulator IC 7805. Then the constant DC supply is converted into a pulsating DC Supply with the help of an oscillator circuit. The variable pulsating DC voltage is then fed to the transmitter coil. Then the receiver coil receives the pulsating dc pulses through the principle of magnetic coupling. Then the power is fed to a rechargeable battery through appropriate filter circuits. The rate of power transfer depends upon the distance from the middle of the transmitter to the receiver coil, thickness of the copper wire used, number of turns in transmitter and receiver coils and the frequency at which the power is transferred [1-4].

3.2. Design of Battery Health Alert System

For safe operation, effective battery management is needed. Battery failure can be caused by a number of causes, including battery degradation and design flaws. It is necessary to determine the output of
batteries for quality control and battery management. The Arduino-MCU has a large number of analog pins within the Arduino-MCU that connects to an analog-to-digital converter (A-D Converter).

The Arduino MCU’s A-D Converter is a 10-bit converter, which means the output value varies from 0 to 1023. By using the analogRead() function, we can obtain the digital value. In order to obtain voltage value greater than 5 V, the input voltage must be separated such that the real input voltage of the Arduino MCU is 5V or less. We are using a 100 kohm resistor and a resistor of 10kohm to build the divider of 10:1 in this experiment. It measures up to 50 V. The voltage divider section reduces the voltage measured in the range of the Arduino-MCU analog inputs. The analog sensor detects the voltage on the analog pin and converts it to a format that can be further processed by the microcontroller. If the measured voltage falls below the threshold value, a digital output is generated and fed to the GSM Module. This sends a GSM Alert to the prescribed contact number. With the help of internet of things (IoT), we can inform the manufacturer and user regarding the battery status due to advances in notification system design [5-6].

The working methodology of battery health alert system is depicted in the figure 1.

![Figure 1. Structural outline of workflow of Battery health alert system](image)

3.3 Design of Automated Power Factor Correction system

The Power factor is the ratio of the kW and the kVA drawn by the load where the kW is the actual load and the kVA is the apparent load. It is the measure of how efficiently the current is transformed into the useful output, and it is specifically useful in evaluating the load current on the efficiency of the system. In
the electrical power supply, the load’s power factor of 1.0 signifies the most effective utilization of the supply, whereas a load with a power factor of 0.5 or less results in surplus of losses [10-11].

Figure 2. Block diagram of Battery health alert system and Automated power factor correction

A low power factor is enhanced with respect to the addition of a capacitive load to an inductive load. The capacitive correction is applied to circuits which use induction loads, by means of reduction of the lagging current and thus reducing supply losses. For an instance, let us consider any inductive load as an AC Induction motor. If the motor is corrected to a power factor of 1.0 the inductive reactance and the capacitive reactance at the supply frequency also become equal and hence the frequency of the resonant and line become equal. If the motor is over corrected, the resonant frequency will fall below than the frequency of the supply voltage. If the frequency produced by the decelerating motor passes through the corrected motor, high currents and voltages around the circuit are produced, thus causing drastic damage to the capacitors and motor. Capacitors should be connected parallel to the load circuit, only in lagging power factor. The capacitance of capacitors will be added when connected in parallel only if it is operated in lagging power factor, in parallel and actuated only at lagging power factor conditions [7-11]. The block diagram of the Automated Power Factor Correction is depicted in the figure 2. Zero Crossing Detectors are used to detect zero crossings of current and voltage [6]. In comparator mode, the time lag amid the zero-voltage pulse and the zero-current pulse is properly produced by proper op-amp circuits which are fed to two Arduino interrupt pins. Then the power factor is calculated and the actuation of the capacitor bank is done depending upon the lagging power factor, thereby improving the power quality [7-11]. The working methodology of Automatic Power Factor Correction is depicted in the figure 3.
4. Experimental Conduction

The complete system is captured in the picture below as shown in the figure 4. The power is transferred wirelessly. It is observed that the rate of power transfer is depends upon the distance in the middle of transmitter and the receiver coil, thickness of the copper wire used, number of turns in transmitter and receiver coils and frequency at which the power is transferred. In our proposed design, when voltage of battery falls below 4V, experimented with the potentiometer, a GSM Message is sent to the Driver’s mobile number regarding the status of the battery as shown in the figure 5 experimental conduction.
Figure 4. The hardware setup of the proposed project.

Figure 5. A GSM Message is received at the driver’s contact number

The system is tested with an AC induction motor. When the value of lagging power factor falls below 0.78, the capacitor bank is actuated and the power factor is corrected to 0.98. Thus the system achieved its major objectives of wireless power transfer, battery health alert and automatic power factor correction.

5. Conclusion
Owing to the rapid growth in the field of Electrical vehicles due to increased fuel prices, any advancement in the field of Electrical Vehicles would be a great asset [12]. The idea and the experimental conduction of the integrated system of wireless power transfer, battery health alert system and automatic power factor correction using Arduino MCU Unit is discussed in this paper with a systematic flow of architecture and the description of the outcomes of this design. The transmission distance of the power through wireless mode with minimal losses is one of the concerns of this design. Improving the efficiency with minimal loss of power through maximum coupling effect is our next prime objective.
Designing a battery health alert system to an electric vehicle would be an ideal feature, which would add a further asset to the field of Electric Vehicles. A GSM Alert regarding the status of the battery would remind the drivers before the batteries get flattened.

An automated power factor correction in electric vehicles would definitely improve the efficiency as well as the vehicle’s infrastructure. The automated power factor correction device is a very effective design for enhancing productive utilization of active power, especially in large EVs where there are more number of inductive loads. The overall efficiency of the system as well as its architecture improves significantly.

This design accomplishes its objective by providing an integrated solution that comprises wireless power transfer, battery health alert system and automatic Power Factor Correction of inductive loads in Electric vehicles.

References

[1] Z. Zhang, H. Pang, A. Georgiadis and C. Cecati, Wireless Power Transfer—An Overview, in IEEE Transactions on Industrial Electronics, vol. 66, no. 2, pp. 1044-1058, Feb. 2019, doi: 10.1109/TIE.2018.2835378.

[2] Pickelsimer, Michael Christopher, Wireless Power Transfer System with Power Factor Correction for Electric Vehicles. Master's Thesis, University of Tennessee, 2012.

[3] S. Li and C. C. Mi, Wireless Power Transfer for Electric Vehicle Applications, in IEEE Journal of Emerging and Selected Topics in Power Electronics, vol. 3, no. 1, pp. 4-17, March 2015, doi: 10.1109/JESTPE.2014.2319453.

[4] Mohammad Shidujaman, Hooman Samani, Mohammad Arif, Wireless Power Transmission Trends, 3rd International Conference On Informatics, Electronics & Vision 2014.

[5] Mohammad Yunus, et.al. Arduino Based Smart AC-DC Voltmeter for Electronic Circuit Analysis."IOSR Journal of Electrical and Electronics Engineering (IOSR-JEEE), 15(1), (2020): pp.10-15S. Round. An adaptive battery monitoring system for an electric vehicle", 1998 International Conference on Power Electronic Drives and Energy Systems for Industrial Growth 1998 Proceedings PEDES.98, 1998.

[6] T. S. Gunawan, M. H. Anwar, M. Kartiwi and Z. Janin, Development of Power Factor Meter using Arduino 2018 IEEE 5th International Conference on Smart Instrumentation, Measurement and Application (ICSIMA), Songkhla, Thailand, 2018, pp. 1-4, doi: 10.1109/ICSIMA.2018.8688750.

[7] W. Ali, H. Farooq, M. Jamil, A. U. Rehman, R. Taimoor and M. Ahmad, Automatic Power Factor Correction for Single Phase Domestic Loads by Means of Arduino Based TRIAC Control of Capacitor Banks, 2018 2nd International Conference on Energy Conservation and Efficiency (ICECE), Lahore, Pakistan, 2018, pp. 72-76, doi: 10.1109/ECE.2018.8554986.

[8] S. B. Jadav, V. D. Lohar, S. P. Choukate and S. D. Mangate, Automatic Optimization and Control of Power Factor, Reactive Power and Reduction of THD for Linear and Nonlinear Load by Using Arduino UNO, 2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT), Coimbatore, India, 2018, pp. 1128-1132, doi: 10.1109/ICICCT.2018.8473191.

[9] S. Mane, R. Sapat, P. Kor, J. Shelar, R. D. Kulkarni and J. Mundkar, Microcontroller based Automatic Power Factor Correction System for Power Quality Improvement, 2020 International Conference for Emerging Technology (INCET), Belgaum, India, 2020, pp. 1-6, doi: 10.1109/INCET49848.2020.9154008.
[10] Shobha R. Mane, Ashwini A. Kolekar, Maithili M. Molaj, Sadhana V. Patil, Mazharhussain N. Mestri, *Arduino Based Power Factor Correction*, International Journal Of Electrical, Electronics And Data Communication, ISSN: 2320-2084 Volume-4, Issue-4, Apr.-2016

[11] Prakash Duraisamy, Xiaohui Yuan, El Saba, A. and Sumithra Palanisamy, Contrast enhancement and assessment of OCT images, Proceedings of International Conference on Informatics, Electronics & Vision (ICIEV), 2012 Date: 18-19 May 2012 pp.91-95 Location: Dhaka, Print ISBN: 978-1-4673-1153-3, INSPEC Accession Number: 13058449 Digital Object Identifier: 10.1109/ICIEV.2012.6317381)

[12] Sumithra M. G., Thanushkodi, K. and Helan Jenifer Archana, A. A New Speaker Recognition System with Combined Feature Extraction Techniques, Journal of Computer Science, Vol. 7, Issue 4, pp.459-465, 2011. (With impact factor SNIP of 0.162 and SJR of 0.034).