Optimization of Power Quality Issues in EV Charging Station

P.Preedeepa[1] ,S.Sivaranjani[2] ,M.Nandhini[3], M.Swathisriranjani[4], S.Saravanan[5]
Department of Electrical and Electronics Engineering,
Muthayammal Engineering college(Autonomous),
Rasipuram,Tamilnadu,India

Abstract: Due to substantial generation and demand fluctuations in wind and solar standalone green micro grids electrical vehicle charging station, energy management strategies are becoming essential for the power sharing and voltage regulation purposes. The classical energy management strategies employ the maximum power point tracking (MPPT) algorithms and rely on batteries in case of possible excess or deficit of energy. However, to realize -constant voltage (IU) charging regime and life span of batteries, energy management strategies require is more flexible with the power curtailment feature. In this paper, a coordinated and multi variable energy management strategy is proposed that employs a wind and solar turbine and converters of a wind and solar standalone DC micro grids electrical vehicle charging station as controllable generators by adjusting the pitch angle and the switching duty cycles. The proposed strategy is developed as an online nonlinear model predictive control (NMPC) algorithm. Applying to a sample wind and solar standalone DC micro grids electrical vehicle charging station, the developed controller realizes the IU regime for charging the battery bank. The variable load demands are also shared accurately between generators in proportion to their ratings. Moreover, the DC bus voltage is regulated with in a pre defined range, as a design parameter

Keywords: Electric Vehicle, EV charging station, Distribution network, Power quality.

1.INTRODUCTION

This thesis deals with developing energy management strategies (EMSs) that dynamically optimize the operation of stand-alone DC micro grids electrical vehicle charging stations electrical vehicle charging station, consisting of wind and solar, converters (DFIG), and battery branches, to coordinately manage energy flows and regulate dc bus voltage level of micro grids electrical vehicle charging station. The proposed strategies are novel constrained and multivariable maximum power point trackers (MPPTS) that employ renewable energy systems as flexible generators which means that their generated powers are optimally curtailed, if required, in proportion to their ratings. The presented EMSs are developed using non-linear model predictive control (NMPC) technique and dynamically extract the optimal control signals with respect to the battery bank and wind and solar turbine operations. In The remainder of this chapter reviews the notion of sustainable micro grids electrical vehicle charging station and briefly describes three wind and solar, wind and solar, and battery branches. A discussion on energy management strategies is then provided which is followed by a overview of the NMPC technique to implement multivariable and non- linear optimal controllers for the constrained problems. However, with increasing installations of DFIG systems into the grid, the following issues appear if the inverters keep operation at MPPT mode even within the Rated power range:

II. EXISTING SYSTEM

The stability of a DC micro grids electrical vehicle charging station is measured in terms of the stability of its dc bus voltage level which is one of the main control objectives. The grid voltage source converters (G-VSCs) are the primary slack terminals to regulate the voltage level of grid-connected micro grids electrical vehicle charging station. Battery banks, on the other hand, are effective slack terminals for wind and solar standalone micro grids electrical vehicle charging station their energy absorbing capacities are limited regarding a number of operational constraints. The single-phase two-stage configuration is preferable for residential PV applications. The control structure of a two-stage single-phase PV system with the proposed control concept is which indicates that the hybrid control strategy is implemented in the control of the boost stage depending on the instantaneous available power of the PV panels, the actual output power of the PV panels can be expressed as where Po(t) is the output power of the PV panels (i.e., input power of the power conversion stage), PPV(t) is the available maximum power of the PV panels, and Limit is selected by taking into account the tradeoffs among the thermal performance (lifetime) of power devices, the PV inverter utilization factor, and the annual energy yield. As the available PV power is weather-dependent, the operation modes will alter accordingly with the wind and solar irradiance and ambient temperature.

Exemplifies different operation regions for a single-phase System during a day with the proposed control strategy the operation principle of the proposed hybrid MPPT-CPG control can be described as follows. When PPT (t) ≥ P limit, the system enters into CPG operation mode and the MPPT control is deactivated. The PV output power is regulated by a proportional controller (KCPG).The CPG control can be achieved by diverting the operating point from the maximum power point, if the available power of the PV panel exceeds the power limit when the wind and solar irradiance is increased from0.8 kW/m2 to 1 kW/m2, the operating point of the PV panels either moves to “L” or “H” rather than “M”. Accordingly, the Operating point of the PV inverter is changed. There are three Alternatives of the control variables for CPG control: VPV, IPV, and or PPV. The first two control options can be achieved on a basis of the existing power point tracking algorithms, e.g., Perturb and Observe (P&O) and incremental conductance methods.

III. PROPOSED SYSTEM

Construction of wind and solar farms are increasing every day. But in the Mean time, the transmission networks are getting overloaded and their efficiency is being reduced. For carrying out renewable energy transmission on a transmission grid, it is essential to study environmental conditions and load variations. Because it is a fact that load and environmental conditions are changing all the time. Therefore, it is very complicated to keep the constant stability for renewable energy transmission. The main reasons of instability issues due to renewable energy transmission are environmental conditions, synchronization and overloading. The efficiency of the network is also reduced as a result of overloading and related types of variations. There is the need for a separate type of network which should be able to transmit the power appropriately by accommodating constraints associated with these renewable resources. The power network should be able to deal with instability problems (due to changing climate conditions and load changes within the network) by maintaining stability at every point in the network. Instability can create massive damage to the network, equipment’s and eventually the economy.

Smart micro grid design is still unattainable for renewable energy transmission. Therefore, it is necessary to carry out research on the smart micro grid to solve the problems of power flow. The micro grid is beneficial to the power industry because generated energy is being transmitted in this grid; instead of the distribution grid. The author is contributing and proposing a new model for transmitting renewable energy. The research is contributed to improve renewable energy efficiency and reducing the power flow issues at the National grid. It connected electric cars directly to the micro grid where electric cars are capable of receiving and sending power. The research is also useful for transmitting renewable energy in rural areas and on the Islands. Power flow control and stability have to be achieved automatically by means of closed loop control principles.). The smart grid uses the control, protection, computer technology and communications to transmit the energy with high reliability. The smart grid incorporates the renewable energy generations and storage options and enabling new services such as vehicle - grid energy flow. It is categorized to increase reliability of power applications such as voltage regulations, power efficiency etc. The energy storage system is one of major component of the smart grid. Transmitting renewable energy effectively into grid requires energy storage system that stores large amount of energy. Lithium ion and sodium sulphate type batteries are most suitable for these types of applications. It supports the energy demands during the peak times and charge up in the off-peak times.

The power conversion system with AC/DC and DC/DC components used to stabilize the voltage and to control the frequency of insulated gate bipolar transistor (IGBT) switches. It senses the voltage and current and applies the correct duty cycle to IGBT switches in order to regulate the voltage flow at the micro grid. Buck converters are implemented at the EV charging station to reduce the voltage. Boost converters are used to step up the voltage from the solar panels while buck-boost converters are used to regulate the voltage at the micro grid monitoring and control center.

The input is used to create a variability of 0.001 in the duty cycle. The switching frequencies of high power IGBT switches are very low and they produce voltage spikes in the voltage. To solve this problem, a PWM control strategy is applied to reduce the harmonics and smooth the output waveforms. The output voltage of the power converters is decided by the PWM switching by applying the eight ON and OFF states of the three phase PWM pulses. The duty cycle applied to the power converter switches is between 0 and 1. The duty cycle controls the speed of the IGBT switches at the converter station. It is observed that by increasing the PWM pulse frequency, voltage and spikes are reduced. Transients and voltage spike waveforms are analyzed and reduced by using power electronic filters.

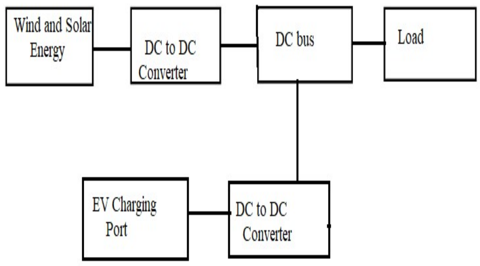

Fig.1.Block diagram of proposed system

The wind and solar standalone DC micro grids electrical vehicle charging station in above figure is a small-scale micro grid for remote applications. The wind and solar turbine operate at variable speeds and is connected to the electrical generator directly, that is, the direct-drive coupling. The variable speed operation is more flexible for the power management and MPPT applications. Furthermore, direct-drive coupling is more efficient and reliable and is more popular for small- scale wind and solar turbines. In spite of high cost, permanent magnet synchronous generators (PMSGs) are the most dominant type of direct- drive generators in the market, chiefly due to higher efficiency. Permanent magnet synchronous generators (PMSG) wind and solar energy conversion system (WECS) using variable speed operation is being used more frequently in low power wind and solar turbine application. Variable speed systems have several advantages over the traditional method of operating wind and solar turbines, such as the reduction of mechanical stress and an increase in energy capture. To fully exploit the last-mentioned advantage, many efforts have been made to develop maximum power point tracking (MPPT) control schemes.

To allow the variable speed operation of the PMSG WECS a conventional three-phase bridge rectifier with a bulky capacitor associated with voltage source current controlled inverter (VS-CCI) is used. This simple scheme introduces a high intensity low frequency current harmonic content into the PMSG and consequently increases the total loses in it. Subsequently, decreases the power capability of the system. This paper presents a comparative simulation study between three different approaches applied to harmonic mitigation on PMSG WECS. The amount of energy captured from a WECS depends not only on the wind and solar at the site, but depends on the control strategy used for the WECS and also depends on the conversion efficiency. Permanent magnet synchronous generators wind and solar energy converters system with variable speed operation is being used more frequently in low power wind and solar turbine applications. Variable speed systems have several advantages such as the reduction of mechanical stress and an increase in energy capture. In order to achieve optimum wind and solar energy extraction at low power fixed pitch WECS, the wind and solar turbine generator operating in variable-speed.

The rotor speed is allowed to vary with the wind and solar speed, by maintaining the tip speed ratio to the value that maximizes aerodynamic efficiency. The PMSG load line should be matched very closely to the maximum power line of the WTG. This paper has the main focus in the first energy conversion stage the AC-DC converter, which is responsible by an injection of a high harmonic current content into the PMSG

IV. RESULT AND DISCUSSION

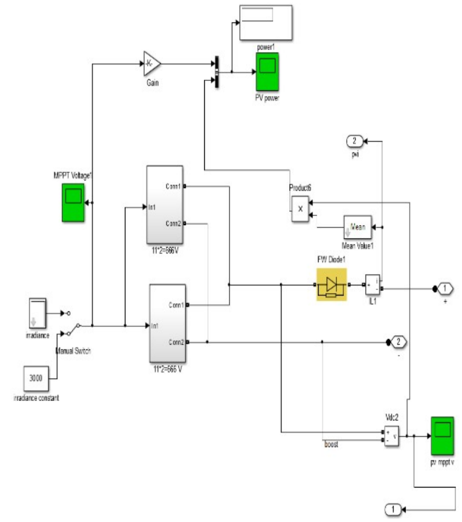

Fig.2. Simulation Diagram

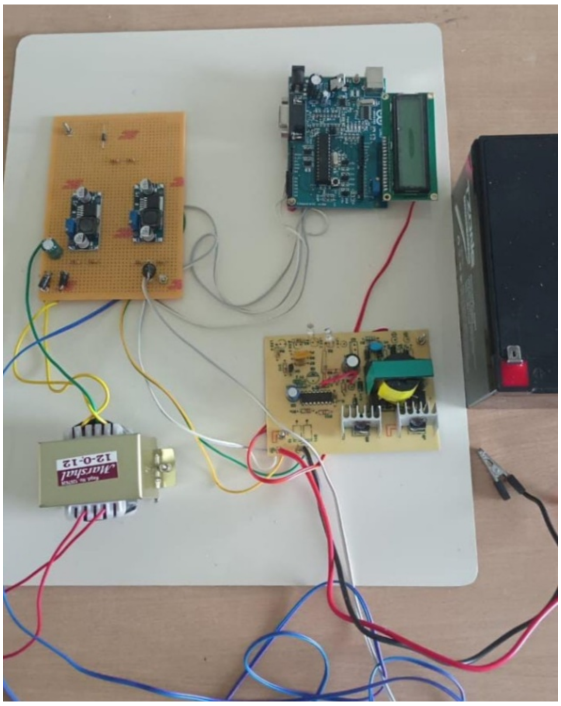

Fig.3.Hardware kit

In this system, we developed a novel optimal EMS that manages the energy flows across a wind and solar standalone green DC micro grids electrical vehicle charging station, consisting of the wind and solar, wind and solar, and battery branches. A coordinated and multivariable online NMPC strategy has been developed to address, as the optimal EMS, three main control objectives of wind and solar standalone DC micro grids electrical vehicle charging stations electrical vehicle charging station. These objectives are the voltage level regulation, proportional power sharing, and battery management.

V. CONCULSION

The issue of considering the discharging mode of the battery operation, which shifts the problem to the class of hybrid dynamical systems, is currently being investigated. In this work environmental impact is reduced because of using renewable resources, such as solar or winds power to power EV. It improves resilience and reliability. Batteries can be provided backup power in case of power outages or fluctuations. So, it helps to reduce the operational costs of EV charging stations. Instead of using power from grid we are using renewable energy of free electricity.

REFERENCES

[1] V.Dhinesh, T.Premkumar, S.Saravanan and G.Vijayakumar," Online Grid Integrated Photovoltaic System with New Level Inverter System" International Research Journal of Engineering and Technology (IRJET), Vol.5, Issue 12, pp.1544-1547, 2018.

[2] J.Vinoth, T.Muthukumar, M.Murugagndam and S.Saravanan," Efficiency Improvement of Partially Shaded PV System, International Journal of Innovative Research in Science, Engineering and Technology, Vol.4, Special issue 6, pp.1502-1510, 2015.

[3] M.B.Malayandi, Dr.S.Saravanan, Dr. M.Muruganandam, "A Single Phase Bridgeless Boost Converter for Power Factor Correction on Three State Switching Cells", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4, Special Issue 6, pp. 1560-1566, May 2015.

[4] A.Sasipriya, T.Malathi, and S.Saravanan, "Analysis of Peak to Average Power Ratio Reduction Techniques in SFBC OFDM System" IOSR Journal of Electronics and Communication Engineering (IOSR-JECE), Vol. 7, No.5, 2013.

[5] P.Ranjitha, V.Dhinesh, M.Muruganandam, S.Saravanan, "Implementation of Soft Switching with Cascaded Transformers to drive the PMDC Motor", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4, Special Issue 6, pp. 1411-1418, May 2015.

[6] C.Sowmiya, N.Mohanandhini, S.Saravanan and M.Ranjitha,"Inverter Power Control Based On DC-Link Voltage Regulation for IPMSM Drives using ANN" International Research Journal of Engineering and Technology (IRJET), Vol.5, Issue 11, pp.1442-1448, 2018.

[7] N.Yuvaraj, B.Deepan, M.Muruganandam, S.Saravanan, "STATCOM Based of Adaptive Control Technique to Enhance Voltage Stability on Power Grid", International Journal of Innovative Research in Science, Engineering and Technology, Vol. 4, Special Issue 6, pp. 1454-1461, May 2015.

[8] P.Manikandan, S.Karthick, S.Saravanan and T.Divya," Role of Solar Powered Automatic Traffic Light Controller for Energy Conservation" International Research Journal of Engineering and Technology (IRJET), Vol.5, Issue 12, pp.989-992, 2018.

[9] R.Satheesh Kumar, D. Kanimozhi, S. Saravanan, "An Efficient Control Scheme for Wind Farm Using Back to Back Converter," International Journal of Engineering Research & Technology (IJERT), Vol. 2, No.9, pp.3282-3289, 2013.

[10] K.Prakashraj, G.Vijayakumar, S.Saravanan and S.Saranraj, "IoT Based Energy Monitoring and Management System for Smart Home Using Renewable Energy Resources," International Research Journal of Engineering and Technology, Vol.7, Issue 2, pp.1790-1797, 2020.

[11] J Mohammed siddi, A. Senthil kumar, S.Saravanan, M. Swathisriranjani, "Hybrid Renewable Energy Sources for Power Quality Improvement with Intelligent Controller," International Research Journal of Engineering and Technology, Vol.7, Issue 2, pp.1782-1789, 2020.

[12] S. Raveendar, P.M. Manikandan, S. Saravanan, V. Dhinesh, M. Swathisriranjani, "Flyback Converter Based BLDC Motor Drives for Power Device Applications," International Research Journal of Engineering and Technology, Vol.7, Issue 2, pp.1632-1637, 2020.

[13] K. Manikanth, P. Manikandan, V. Dhinesh, Dr. N. Mohananthini, Dr. S. Saravanan, "Optimal Scheduling of Solar Wind Bio-Mass Systems and Evaluating the Demand Response Impacts on Effective Load Carrying Capability," International Research Journal of Engineering and Technology, Vol.7, Issue 2, pp.1632-1637, 2020.

[14] T.R. Vignesh, M.Swathisriranjani, R.Sundar, S.Saravanan, T.Thenmozhi," Controller for Charging Electric Vehicles Using Solar Energy", Journal of Engineering Research and Application, vol.10, Issue.01,pp.49-53, 2020.

[15] V.Dhinesh, Dr.G.Vijayakumar, Dr.S.Saravanan," A Photovoltaic Modeling module with different Converters for Grid Operations", International Journal of Innovative Research in Technology, vol.6, Issue 8, pp.89-95, 2020.

[16] V. Dhinesh, R. Raja, S. Karthick, Dr. S. Saravanan," A Dual Stage Flyback Converter using VC Method", International Research Journal of Engineering and Technology, Vol.7, Issue 1, pp.1057-1062, 2020.

[17] G. Poovarasan, S. Susikumar, S. Naveen, N. Mohananthini, S. Saravanan," Study of Poultry Fodder Passing Through Trolley in Feeder Box," International Journal of Engineering Technology Research & Management, vol.4, Issue.1, pp.76-83, 2020.

[18] C. Sowmya, N. Mohananthini, S. Saravanan, and A. Senthil kumar," Using artificial intelligence inverter power control which is based on DC link voltage regulation for IPMSM drives with electrolytic capacitor," AIP Conference Proceedings 2207, 050001 (2020); https://doi.org/10.1063/5.0000390, Published Online: 28 February 2020.

[19] M.Revathi, S.Saravanan, R.Raja, P.Manikandan," A Multiport System for A Battery Storage System Based on Modified Converter with MANFIS Algorithm," International Journal of Engineering Technology Research & Management, vol.4, issue 2, pp.217-222, 2020.

[20] D Boopathi, S Saravanan, Kaliannan Jagatheesan, B Anand, "Performance estimation of frequency regulation for a micro-grid power system using PSO-PID controller", International Journal of Applied Evolutionary Computation (IJAEC), Vol.12, Issue.4, pp.36-49, 2021.

[21] V Deepika, S Saravanan, N Mohananthini, G Dineshkumar, S Saranraj, M Swathisriranjan, "Design and Implementation of Battery Management System for Electric Vehicle Charging Station", Annals of the Romanian Society for Cell Biology, Vol.25, Issue.6, 17769-17774, 2021.

[22] A Senthilkumar, S Saravanan, N Mohananthini, M Pushparaj, "Investigation on Mitigation of Power Quality Problems in Utility and Customer side Using Unified Power Quality Conditioner", Journal of Electrical Systems, Vol.18, Issue.4, pp.434-445, 2022.

[23] V Kumarakrishnan, G Vijayakumar, D Boopathi, K Jagatheesan, S Saravanan, B Anand," Frequency regulation of interconnected power generating system using ant colony optimization technique tuned PID controller", Control and Measurement Applications for Smart Grid: Select Proceedings of SGESC 2021, pp..129-141.

[24] C Nagarajan, B Tharani, S Saravanan, R Prakash," Performance estimation and control analysis of AC-DC/DC-DC hybrid multi-port intelligent controllers based power flow optimizing using STEM strategy and RPFC technique", International Journal of Robotics and Control Systems", Vol.2, Issue.1, pp.124-139, 2022.

[25] G Vijayakumar, M Sujith, S Saravanan, Dipesh B Pardeshi, MA Inayathullaa," An optimized MPPT method for PV system with fast convergence under rapidly changing of irradiation", 2022 International Virtual Conference on Power Engineering Computing and Control: Developments in Electric Vehicles and Energy Sector for Sustainable Future (PECCON), pp.1-4.

[26] C Nagarajan, K Umadevi, S Saravanan, M Muruganandam, "Performance Analysis of PSO DFFP Based DC-DC Converter with Non Isolated CI using PV Panel", International Journal of Robotics and Control Systems' Vol.2, Issue.2, pp.408-423, 2022.

[27] VM Geetha, S Saravanan, M Swathisriranjani, CS Satheesh, S Saranraj, "Partial Power Processing Based Bidirectional Converter for Electric Vehicle Fast Charging Stations", Journal of Physics: Conference Series, Vol.2325, Issue.1, pp.012028, 2022.

[28] M Santhosh Kumar, G Dineshkumar, S Saravanan, M Swathisriranjani, M Selvakumari, "Converter Design and Control of Grid Connected Hybrid Renewable Energy System Using Neuro Fuzzy Logic Model", 2022 Second International Conference on Computer Science, Engineering and Applications (ICCSEA), pp.1-6, 2022.

[29] C Gnanavel, A Johny Renoald, S Saravanan, K Vanchinathan, P Sathishkhanna, "An Experimental Investigation of Fuzzy-Based Voltage-Lift Multilevel Inverter Using Solar Photovoltaic Application", Smart Grids and Green Energy Systems, pp.59-74, 2022.

[30] C Nagarajan, K Umadevi, S Saravanan, M Muruganandam, "Performance investigation of ANFIS and PSO DFFP based boost converter with NICI using solar panel", International Journal of Engineering, Science and Technology, Vol.14, Issue.2, pp.11-21,2022.

[31] K Priyanka, N Mohananthini, S Saravanan, S Saranraj, R Manikandan, "Renewable operated electrical vehicle battery charging based on fuzzy logic control system", AIP Conference Proceedings, Vol.2452, Issue.1, pp.030007, 2022.

[32] V Kumarakrishnan, G Vijayakumar, D Boopathi, K Jagatheesan, S Saravanan, B Anand, "Optimized PSO technique based PID controller for load frequency control of single area power system", Solid State Technology, Vol.63. Issue.5, pp.7979-7990, 2020.

[33] G. Poovarasan, S. Susikumar, S. Naveen, N. Mohananthini, S. Saravanan, "Implementation of IoT Based Poultry Feeder Box", International Journal of Innovative Research In Technology, Vol.6, Issue.2, pp.33-38, 2020.

[34] N.Gokulnath, B.Jasim Khan, S.Kumaravel, Dr.A.Senthil Kumar and Dr.S.Saravanan, "Soldier Health and Position Tracking System", International Journal of Innovative Research In Technology (IJIRT)), Vol-6 Issues 12, pp.39-45, 2020.

[35] P.Navaneetha, R.Ramiya Devi, S.Vennila, P.Manikandan and Dr.S.Saravanan , " IOT Based Crop Protection System against Birds and Wild Animal Attacks", International Journal of Innovative Research In Technology (IJIRT)), Vol-6 Issues 11, pp.133-143, 2020.

[36] V. Dhinesh, D. Prasad, G. Jeevitha, V. Silambarasan, Dr. S. Saravanan, " A Zero Voltage Switching Pulse Width Modulated Multilevel Buck Converter", International Research Journal of Engineering and Technology (IRJET), Vol 7 Issue 3, pp.1764,2020.

[37] K. Punitha, M. Rajkumar, S. Karthick and Dr. S. Saravanan, " Impact of Solar And Wind Integration on Frequency Control System", International Research Journal of Engineering and Technology (IRJET), Vol 7 Issue 3, pp.1357-1362,2020.

[38] A.Arulkumar, S.Balaji, M.Balakrishnan, G.Dineshkumar and S.Saravanan, "Design And Implementation of Low Cost Automatic Wall Painting Machine" International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 03, pp.170-176, 2020.

[39] V.Periyasamy, S.Surya, K. Vasanth, Dr.G.Vijayakumar and Dr.S.Saravanan, "Design And Implementation of Iot Based Modern Weaving Loom Monitoring System" International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 04, pp.11-18, 2020.

[40] M.Yogheshwaran, D.Praveenkumar,S.Pravin,P.M.Manikandan and Dr.S.Saravanan, "IoT Based Intelligent Traffic Control System" International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 04, pp.59-63, 2020.

[41] R.Pradhap, R.Radhakrishnan, P.Vijayakumar, R.Raja and Dr.S.Saravanan, "Solar Powered Hybrid Charging Station For Electrical Vehicle" International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 04, pp.19-27, 2020

[42] S.Shenbagavalli, T.Priyadharshini, S.Sowntharya, P.Manikandan and Dr.S.Saravanan, "Design and Implementation of Smart Traffic Controlling System" International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 04, pp.28-36, 2020.

[43] M.Pavithra, S.Pavithra, R.Rama Priya, M.Vaishnavee, M.Ranjitha and S.Saravanan, "Fingerprint Based Medical Information System Using IoT" International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 04, pp.45-51, 2020.

[44] A.Ananthan, A.M.Dhanesh, J.Gowtham, R.Dhinesh, G.Jeevitha and Dr.S.Saravanan, "IoT Based Clean Water Supply" International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 03, pp.154-162, 2020.

[45] R.Anbarsan, A.Arsathparvez, K.S.Arunachalam, M.Swathisriranjani and Dr.S.Saravanan, "Automatic Class Room Light Controlling Using Arduino" International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 03, pp.192-201, 2020.

[46] S.Karthikeyan, A.Krishnaraj, P.Magendran, T.Divya and Dr.S.Saravanan , "The Dairy Data Acquisition System" International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 03, pp.163-169, 2020.

[47] M.Amaran, S.Mannar Mannan, M.Madhu, Dr.R.Sagayaraj and Dr. S.Saravanan, "Design And Implementation of Low Cost Solar Based Meat Cutting Machine" International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 03, pp.202-208, 2020.

[48] N.Harish, R.Jayakumar, P.Kalaiyarasan, G.Vijayakumar and S. Saravanan, "IoT Based Smart Home Energy Meter" International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 03, pp.177-183, 2020.

[49] K.Subashchandrabose, G.Moulieshwaran, M.Raghul, V.Dhinesh and S.Saravanan, "Design of Portable Sanitary Napkin Vending Machine", International Journal of Engineering Technology Research & Management (IJETRM), Vol-4 Issues 03, pp.52-58, 2020.

[50] R.Gopi, K.Gowdhaman, M.Ashok, S.Divith, S.Saravanan and G.Dineshkumar, "An Online Method of Estimating State of Health of A Li-Ion Battery", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.31-36, 2023.

[51] S.Azhaganandham, P.Elangovan, M.S.Kayalkanan, M.Dineshkumar and S.Saravanan, "Automatic Direct Torque Control System For 3 Phase Induction Motor", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.1-3, 2023.

[52] K. Ranjith Kumar, A.Naveen, R.Ragupathi, S. Savitha and S. Saravanan, "Automatic Industrial-Based Air Pollution Avoidance System Using Iot", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.100-105, 2023.

[53] G.T.Nandhini, V.Megasri, T.Jeevitha, S.Sandhiya and S. Saravanan, "Automatic Pick And Drop Helping Robot", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.72-76, 2023.

[54] K.Deepika, S.Divya, A.Hema, R.Meena, V.Deepika and S.Saravanan, "Automatic Solar Panel Cleaning System", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.62-66, 2023.

[55] A.Balaji, K.Harikiruthik, A.Mohamed Hassan, S.Saravanan and S.Saranraj, "Design and Implementation of A Single Stage Multi-Pulse Flexible Topology Thyristor Rectifier for Battery Charging in Electric Vehicles", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.37-42, 2023.

[56] D.Hemalatha, S.Indhumathi, V.Myvizhi and S.Saravanan, "Design and Implementation of Intelligent Controller for Domestic Applications", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.4-7, 2023.

[57] N.Priyadharshini, S.Saraswathi, T.Swetha, K.Sivaranjani, K.Umadevi and S.Saravanan, "Fuel Monitoring System using IoT", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.126-130, 2023.

[58] S. Divyasri, E. Indhu, M. P. Keerthana, M. Selvakumari and S. Saravanan, "Gas Cylinder Monitoring System using IoT", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.67-71, 2023.

[59] J.Arul, R.Balaji, S.Jeyamoorthy, M.Manipathra, R.Sundar and S.Saravanan, "IoT based Air Conditioner Control using ESP32", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.48-52, 2023.

[60] Vundel Munireddy, J.Prahathesvaran, C.R.Thirunavukarasu, M.Santhosh Kumar and S.Saravanan, "IoT Based Charge Controller for Direct Fast Charging of Electric Vehicles Using Solar Panel", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.77-81, 2023.

[61] D.Monish Kumaar, K.Akash, S.Aswinkumar, S.Saravanan and R. Sagayaraj, "IoT based Industry Surveillance and Air Pollution Monitoring using Drones", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.14-18, 2023.

[62] T.Silambarasan, R.Surya, J.Pravinkumar, R.Sundar and S Saravanan, "IoT based Monitoring System For Sewage Sweeper", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.88-93, 2023.

[63] R.Aravinthan, Alwin.Augustin, P.Divagaran, S.Saravanan and P.Manikandan, "IoT Based Power Consumption and Monitoring System", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.43-47, 2023.
[64] S.Partheeban, S.Sundaravel, S.Umapathi, R.Sagayaraj and S.Saravanan, "IoT based Safety Helmet for Mining Workers", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.116-120, 2023.
[65] D.K.Vignesh, K.Sabarishwaran, S.Yuvaraj, P.Manikandan and S Saravanan, "IoT based Smart Dustbin", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.82-87, 2023.
[66] P Muthukrishnan, P Poovarasan, S Vasanth, R Raja and S Saravanan, "Smart Borewell Child Rescue System", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.121-125, 2023.
[67] S. Gokul, B. Gokulnath, P. Manikandan, S.Saravanan and N. Mohananthini, "Smart Crop Protection From Animals And Birds Using Arduino", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.19-25, 2023.
[68] M.Abinesan, S.Jawahar, S.A.Gopi, A.Gokulraj and S.Saravanan, "Smart EV Charging Hub Integrated with Renewable Energy for Highway Utility", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.58-61, 2023.
[69] K.Eswaramoorthi, R.Manikandan, R.Balamurugan, C.Ramkumar and S.Saravanan, "Smart Parking System using IoT", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.53-57, 2023.
[70] S.Nirmalraj, C.Pranavan, M.Prem and S.Saravanan, "Smart Trolley With IoT Based Billing System", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.111-115, 2023.
[71] S. NithyaSri, S.S.Sabitha, M.Thilagavathi, S.Umamageshwari, C.Nithya and S.Saravanan, "Smart Wireless Notice Board using IoT", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.106-110, 2023.
[72] V.Gunasekaran, M.Gowtham , S. Anbubalaji, S.Saravanan and R.Prakash, "Solar based Electric Wheel Chair", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.8-13, 2023.
[73] S.Naveenkumar, S.Prakash, A.P.Shrikirishnaa, C.Ramkumar and S.Saravanan, "Two to Three Phase 5HP Digital Panel", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.94-99, 2023.
[74] Harivignesh K, Jaisankar.A, Chandru.J, Saravanan.S and Raja.R, "Voice Controlled Automatic Writer", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.26-30, 2023.
[75] N.Sakthiselvam, S.Srinivasan,S.Raajkumar, M.Selvakumari, S.Saravanan, "An Integrated Fault Isolation and Prognosis Method for Electric Drive Systems of Battery Electric Vehicles", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.166-171, 2023.
[76] P Thava Prakash, P.Venketesan, D.Vignesh, S.Prakash, S.Saravanan, "Design of Low Cost E-Bicycle using Brushless DC Motor with Speed Regulator", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.148-153, 2023.
[77] D.Tamilarasan, V.S.Vairamuthu, Y.Vasanth, K.Umadevi, S.Saravanan, "GSM based Agricultural Motor Control", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.172-177, 2023.
[78] P. Vimal, S.Veerasigamani, R.Srihari, C.S.Satheesh, S.Saravanan, "IoT Based Optimal Power Management System For Smart Grid", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.160-165, 2023.
[79] S.Abimanyu, P.Jagadheeswaran, S.Jaganath, K.Sanjay, R.Sivapranesh, K.Velmurugan, N.Mohananthini, C.S.Satheesh, S.Saravanan, "Portable Solar Tree", International Journal of New Innovations in Engineering and Technology, Vol.22, Issue.3, pp.154-159, 2023.