Solar based Electric Vehicle charging control system using Internet of things

Ravichandhiran.S[1] Dr. K.Vijayan[^2], Saravanan.K[^3], Mohamed Feyaazudeen.AM[^4] , Nithyanantham.S [^5],

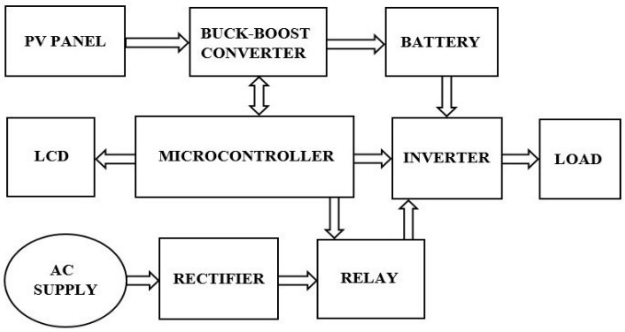
[1]*Professor, Department of Mechatronics Engineering,* [2]*HOD, Department of Mechatronics Engineering*

[3,4,5,] *U.G students, Department of Mechatronics Engineering*

Abstract- **In this paper, control strategy is to meet the load demand and reduce power interruption. The power flow from various sources is managed through the use of a Microcontroller connected with a hybrid supply using Relay. The power flow is managed by injecting excess power from the AC grid into the battery to charge it when power is not generated by the PV panel. Power from AC grid is harnessed by transformer coupled bridge converters, and power from PV is harnessed by buck-boost converters connected with battery charging / discharging control. The relay acts as an open circuit when power is generated by the solar panel, or it acts as a closed circuit when power is not produced by the solar panel. When closed circuit, the power is used by the AC grid through rectifier. The simulation results obtained by MATLAB /Simulink demonstrate the performance of this control strategy under different modes of operation and the efficacy of this proposed system.**

I. INTRODUCTION

This project is based on the development of electric car charging with a combination of solar and grid electricity to encourage the use of electric cars and reduce energy consumption. The rapid depletion of fossil fuels, the ever-increasing demand for energy and the concern about climate change encourage the production of electricity from renewable energy sources. Photovoltaic (PV) has become a popular energy source due to its environmental friendliness and cost-effectiveness. However, these sources are essentially discontinuous. Therefore, it is difficult to provide a stable and continuous power supply using these sources. This can be solved by effectively integrating energy into the storage elements. The interesting complementary behavior of the PV power separation and the network power minimum utilization model combined with the DC-DC converter led to research on their integration and the result is hybrid PV systems. To integrate multiple renewable energy sources to overcome power interruption and power demand, the conventional approach in our proposed system uses separate single-input converters for each source connected



to a common DC-DC converter for maximum output system

Fig.1. Block diagram

efficiency. However, these Buck-Boost (DC-DC) converters are not effectively used due to the intermittent nature of renewable energy sources. There are also many electrical conversion steps that reduce the efficiency system.

II. WORKING

The PV panel is connected to an MPPT that works as a Buck-Boost. When the power supply from the PV panel is not enough, the MPPT works as a Boost converter. When the PV panel supply voltage is higher than the optimum voltage, the MPPT acts as a Buck converter and supplies power to the rechargeable battery.

A microcontroller is connected to the system to control the voltage and display the values through an LCD screen. In the second part of this system, the AC power is converted to DC using a full-wave rectifier and fed to the relay module. When the battery voltage is low, the microcontroller triggers the relay module to

open the contact. The battery or rectifier input is given to the inverter to convert the DC input to AC input. The microcontroller simultaneously monitors the PV panel voltage, if it is not enough, the relay to charge the battery and then supply power to the inverter. Then the inverter produced 230v for output. We can now charge electric vehicles with a separate adapter according to the vehicle's battery capacity.

III. METHODOLOGY

MPPT (maximum power point tracking) is applied to acquire the intense electricity from sun irradiance. MPPT cooperates with DC-DC raise converter to control the duty cycle of the enhance converter with the aid of following the maximum present day and voltage of solar PV machine. Incremental Conductance (INC) primarily based MPPT algorithm for solar PV gadget is advanced here. The equation for enforcing the INC algorithm may be easily gotten from the basic energy equation. The equation for electricity is given as, differentiating the above equation with respect to voltage. So the equal load isn't always linear and because of thevarieties in available power source, load can range over a extensive scope of bends. That's why a nonlinear exam is needed for a solid operation.

PV panel is hooked up to the MPPT, which act as buck-boost. when the strength deliver from PV panel isn't always sufficient then MPPT act as an increase converter, when the electricity deliver from PV panel is extra than the most advantageous voltage then the MPPT act as greenback converter and fed to rechargeable battery. The microcontroller is hooked up to the device to display the voltage score and show the values with the help of lcd show. some other part of this device has AC supply transformed to DC supply with the help of the total wave rectifier and given to the relay module. when the voltage from the battery is low the microcontroller triggers the relay module to open touch.

The deliver from battery or from the rectifier is given to the inverter to transform DC supply to AC supply. Microcontroller simultaneously screen the voltage from the PV panel when it is not sufficient then it on relay to fee battery and then give the supply to inverter. Then the inverter produced 230v as output. we are able to now fee the electric vehicles using separate adapter concerning to the potential of the motors battery. The EV charging schedules are calculated in step with EV proprietor necessities and charging traits: energy requirements, connection duration, EV battery performance, charger's electricity rating and charger's performance. In an remoted gadget, excessive energy is typically stored in batteries for the duration of the day and the batteries are used to strength the home equipment in instances whilst PV panels do not absorb enough energy. Bidirectional DC-DC converter (additionally known as digital price controller) performs an important component in an isolated sun device. The purpose is to make sure the battery charging cycle is working at most fulfilling conditions, specially to prevent overcharging and deep disc.

IV. SIMULATION

The above is the simulation model of our proposed system which helps to design and implement our proposed model. The simulation model has all the components that are connected to give the proposed model of our system.

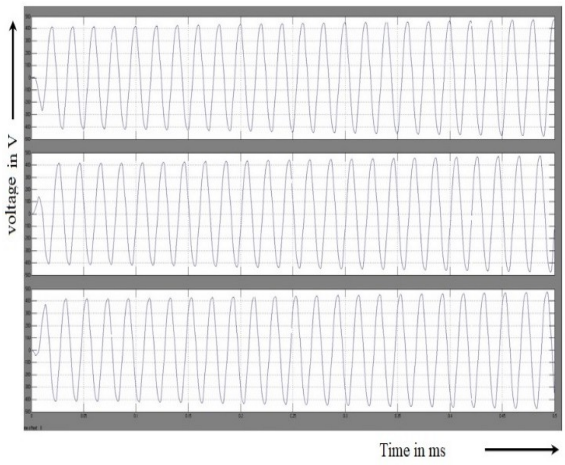


Fig.3. Output Waveform

The output waveform from the Simulation results obtained using MATLAB/Simulink show the performance of the proposed system under various modes of operation. The simulation model and efficacy of the proposed system are verified through detailed experimental studies, to demonstrate the capability of the system operation in different modes with the help of MATLAB/Simulink and hardware model

V. EXISTING SYSYTEM

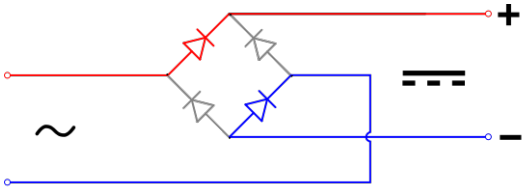
There are some power stations for charging the electrical vehicle but not much more because there is heavy power demand for electricity and due to the usage of electrical vehicle is also lesser. The existing system use only grid supply that is main disadvantage because to manage the power demand it is quite difficult. The existing system does not contain hybrid source of energy to manage the power demand.

VI. PROPOSED SYSTEM

In an isolated system, immoderate strength is generally saved in batteries all through the day and the batteries are used to strength the home equipment in instances while PV panels do no longer soak up sufficient electricity. The

VII. IMPLEMENTTION

The power supply stage is composed of a rectifying circuitry in which 220V AC is rectified to a regulated and filtered DC using a full-wave bridge network. The charge controller circuit comprises of electronic components such as capacitors, resistors, op- amps, diodes, transistors and light emitting diodes. The charge controller circuit in conjunction with the microcontroller is manipulated such that it can detect presence or absence of battery at the charging terminal, wrong battery polarity connection at the charging terminals, charging status of the battery, full charge status of the battery and float charge.



The Arduino microcontroller was used in the work to monitor the battery charge status and to further drive the liquid crystal display to enable the user have a deep knowledge of the system functionalities. The design uses a combination of constant current and constant voltage to charge batteries connected across its terminals for 12V batteries. It is a common problem to always overcharge batteries thereby shortening the life span of the batteries and increasing the Mean Time to Failure of such battery. The charge controller circuit in conjunction with the microcontroller is manipulated such that it can detect presence or absence of battery at the charging terminal. The battery charger is used to put energy into a secondary cell by forcing electric current through it. An efficient battery charger requires a charge controller whose main function is to keep the batteries properly charged and safe for the long term and prevent it from deep discharging.The simple inverter circuit consists of Arduino, step up transformer 12-230v and two MOSFET. A voltage regulator, which give constant voltage to Arduino board regardless of battery voltage (Battery voltage must not drop below 11.90V). The two capacitors connected to voltage regulator gives stability which act as filter to convert DC to pure AC. The input capacitor 1000uF helps the inverter to start softly and provide immunity against sudden input voltage fluctuations.Two MOSFETs are employed which can handle around 300 Watt power with heat sink mounted. By turn off and on each MOSFET alternatively we can develop alternating flux to produce alternating current. The transformer is a step down one, which is used in reverse to step-up the voltage and it its center tapped. The transformer's voltage and current parameter also decides maximum output power.

VIII. HARDWARE

As the demand for solar electric systems grows, progressive builders are adding Solar Photo Voltaic (PV) as an option for their customer's emphasis will be placed on information that will be useful in including a grid-connected. PV system in a bid for a residential or small commercial building. We will also cover those details of the technology and installation that may be helpful in selecting subcontractors to perform the work, working with a designer, and directing work as it proceeds.

Arrays are most commonly mounted on roofs or on steel poles set in concrete. In certain applications, they

may be mounted at ground level or on building walls. Solar modules can also be mounted to serve as part or all of a shade structure such as a patio cover. On roof-mounted systems, the PV array is typically mounted on fixed racks, parallel to the roof for aesthetic reasons and stood off several inches above the roof surface to allow airflow that will keep them as cool as practical.

POWER SUPPLY

The power supply is provided inverter and microcontroller. The DC power supply with both positive and negative output voltages, a step-up transformer is used and Arduino operates at low power. A relay is an electrically operated switch. Where many relays are used to an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid state relays. Relays are used where it is necessary to control a circuit by a low-power signal where several circuits must be controlled by one signal. The first relays were used in long distance telegraph circuits as amplifiers they repeated the signal coming from one circuit and retransmitted it on another circuit. It is a common problem to always overcharge batteries thereby shortening the life span of the batteries and increasing the Mean Time to Failure of such batteries.

IX. BATTERY

The EV battery charging schedules set by the EV Parking Manager (EVPM) are followed by the EV`s chargers. A two way communication between the EV`s chargers and the EVPM is assumed. The EV Parking Manager has the kW loading capacity limits of the distribution network to which the parking facility's charging infrastructure is connected to (according to the distribution network technical constraints). The loading capacity limits are assumed to be made available by the DSO. The EV batteries are considered as purely resistive loads that charge at a constant power rating. The EV battery charging schedules set by the EV Parking Manager (EVPM) are followed by the EV`s chargers. A two way communication between the EVs' chargers and the EVPM is assumed. The EV Parking Manager has the kW loading capacitylimits of the distribution network to which the parking facility's
charging infrastructure is connected to (according to the distribution network technical constraints).The EV charging schedules are calculated according to EV owner requirements and charging characteristics: Energy requirements, connection duration, EV battery efficiency

Fig.7. Solar panel

MPPT

MPPT (Maximum Power Point Tracking) is utilized to obtain the extreme power from sun irradiance. MPPT cooperates with DC-DC boost converter to control the duty cycle of the boost converter by following the maximum current and voltage of solar PV system. Incremental Conductance (INC) based MPPT algorithm for solar PV system is developed here. The equation forimplementing the INC algorithm can be easily gotten from the basic power equation. The equation for power is given as, differentiating the above equation with respect to voltage. So the equivalent load is not linear and because of the varieties in accessible energy source, load can fluctuate over a wide scope of bends. That's why a nonlinear examination is required for a stable operation.

The loading capacity limits are assumed to be made available by the DSO. The EV batteries are considered as purely resistive loads that charge at a constant power rating. The EV Parking Manager calculates and assigns battery charging schedules to EV`s on a first-come first-served basis. The EV charging schedules are calculated according to EV owner requirements and charging characteristics: Energy requirements, connection duration, EV battery efficiency, charger's power rating and charger's efficiency. In an isolated system, excessive electricity is usually stored in batteries during the day and the batteries are used to power the appliances in times when PV panels do not absorb enough energy. The DC-DC buck-boost converter plays an important part in an isolated solar system. The goal is to ensure the battery charging cycle is working at optimal conditions, mainly to prevent overcharging and deep discharge.

X. CONCLUSION

The PV-powered EV battery-buffered EV charging station with smart electricity control has been validated for greater than a 12 months on a administrative center charging station at UC Davis West Village. The operation results display that the machine manage, PV electricity estimation, EV charging load projection, and battery SOC optimization are completed as predicted. A PV integrated EV charging station geared up with a buffer battery and with wise power control can nearly eliminate the station's top power call for and reduce the energy alternate with the software grid with the aid of a factor of 2. The anticipated PV power based totally at the extracted weather information displays the actual PV strength era. extra complex PV strength forecasting models with more accurate hour-by way of-hour weather records may want to improve the accuracy of the anticipated PV electricity. The linear healthy of the ancient EV charging load facts for each day of the week for the contemporary six-week length seems appropriate for extracting the charging sample of a place of work EV charging station. since the cutting-edge charging station has most effective one outlet, the uncertainty and contingency will have an effect on the end result of the burden call for projection. The shrewd electricity control strategy is excellent ideal for charging station structures having one big electricity storage battery and multiple charging stores.

REFERENCES

[1] Alexandru A.M., De MauroA., Fiasché M., Sisca F.G., Taisch M., Fasanotti L., Grasseni P., A smart web-based maintenance system for a smart manufacturing environment, IEEE 1st International Forum on Research and Technologies forSociety and Industry Leveraging a better tomorrow (2015), 579-584.

[2] Bojun X.C.W.X.X., Textile Production Management System Based on Client/Server, Cotton Textile Technology 6 (2002).

[3] Deyi Dong, Zhenquan Shi, The Loom monitoring system design with high reliability and easy maintainability, International conference on Control, Automation and System Engineering.

[4] Dorian Schneider Yves-Simon Gloy, DoritMerhof, Vision-Based On-Loom Measurement of Yar Densities in Woven Fabrics, IEEE transactions on instrumentation and measurement 64(4) (2015).

[5] Gerkey B.P., Vaughan R.T., Stoy K., Howard A., Sukhatme G.S., Mataric M.J., Most valuable player: A robot device server for distributed control, IEEE/RSJ International Conference on Intelligent Robots and Systems 3 (2001), 1226-1231.

[6] Vladimir G., Dmitriy B., Win T.N., Evgen I., The vision system in the weaving loom industry, IEEE Conference of Russian Young Researchers in Electrical and Electronic Engineering (2017), 669-671.

[7] C.Nagarajan and M.Madheswaran - 'Experimental verification and stability state space analysis of CLL-T Series Parallel Resonant Converter' - Journal of ELECTRICAL ENGINEERING, Vol.63 (6), pp.365-372, Dec.2012.

[8] C.Nagarajan and M.Madheswaran - 'Performance Analysis of LCL-T Resonant Converter with Fuzzy/PID Using State Space Analysis'- Springer, Electrical Engineering, Vol.93 (3), pp.167-178, September 2011.

[9] C.Nagarajan and M.Madheswaran - 'Stability Analysis of Series Parallel Resonant Converter with Fuzzy Logic Controller Using State Space Techniques'- Taylor & Francis, Electric Power Components and Systems, Vol.39 (8), pp.780-793, May 2011.

[10] C.Nagarajan and M.Madheswaran - 'Experimental Study and steady state stability analysis of CLL-T Series Parallel Resonant Converter with Fuzzy controller using State Space Analysis'- Iranian Journal of Electrical & Electronic Engineering, Vol.8 (3), pp.259-267, September 2012.

[11] Nagarajan C., Neelakrishnan G., Akila P., Fathima U., Sneha S. "Performance Analysis and Implementation of 89C51 Controller Based Solar Tracking System with Boost Converter" Journal of VLSI Design Tools & Technology. 2022; 12(2): 34–41p.

[12] C. Nagarajan, G.Neelakrishnan, R. Janani, S.Maithili, G. Ramya "Investigation on Fault Analysis for Power Transformers Using Adaptive Differential Relay" Asian Journal of Electrical Science, Vol.11 No.1, pp: 1-8, 2022.

[13] G.Neelakrishnan, K.Anandhakumar, A.Prathap, S.Prakash "Performance Estimation of cascaded h-bridge MLI for HEV using SVPWM" Suraj Punj Journal for Multidisciplinary Research, 2021, Volume 11, Issue 4, pp:750-756

[14] G.Neelakrishnan, S.N.Pruthika, P.T.Shalini, S.Soniya, "Perfromance Investigation of T-Source Inverter fed with Solar Cell" Suraj Punj Journal for Multidisciplinary Research, 2021, Volume 11, Issue 4, pp:744-749

[15] C.Nagarajan and M.Madheswaran, "Analysis and Simulation of LCL Series Resonant Full Bridge Converter Using PWM Technique with Load Independent Operation" has been presented in ICTES'08, a IEEE / IET International Conference organized by M.G.R.University, Chennai.Vol.no.1, pp.190-195, Dec.2007

[16] M Suganthi, N Ramesh, "Treatment of water using natural zeolite as membrane filter", Journal of Environmental Protection and Ecology, Volume 23, Issue 2, pp: 520-530,2022

[17] M Suganthi, N Ramesh, CT Sivakumar, K Vidhya, "Physiochemical Analysis of Ground Water used for Domestic needs in the Area of Perundurai in Erode District", International Research Journal of Multidisciplinary Technovation, pp: 630-635, 2019

[18] Renewable energy interfaced shunt active filter using a pi controller based ant colony and swarm optimization algorithmsG Vijayakumar, R Anita Australian Journal of Basic and Applied Sciences 7 (8) (2014), 110-119.

[19] Particle swarm optimization based MPPT for PV system under partial shading conditions P Selvapriyanka, G Vijayakumar IJIRSET Inter. Conf. on Eng. Tech. and Science 3, (2013),856-861.

[20] 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, Vol.5, Issue 12, pp.1544-1547, 2018.

[21] 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.

[22] 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.
[23] 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.
[24] 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.
[25] 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.
[26] 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.
[27] 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.
[28] 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.
[29] 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.
[30] 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.
[31] 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.
[32] 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.
[33] 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.
[34] Dr.S.Saravanan, S.Karthick, K.Rajeshkumar,S.Sriramachandran, P.Surjeethkumar," Fishermen Border Alert System," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol.9, Issue, 03, pp.236-241, 2020.
[35] A.Yuvaraj, S.Vijay, M.Saran, V.Dhinesh, S.Saravanan," Agriculture Fire Monitoring Robot Using IOT," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, Vol.9, Issue, 03, pp.257-262, 2020.
[36] A.Ananthan, A.M.Dhanesh, J.Gowtham, R.Dhinesh, G.Jeevitha, Dr.S.Saravanan," IoT Based Clean Water Supply", International Journal of Engineering Technology Research & Management, Vol.4, Issue.3, pp.154-162, 2020.
[37] S.Karthikeyan, A.Krishnaraj, P.Magendran, T.Divya, Dr.S.Saravanan," The Dairy Data Acquisition System", International Journal of Engineering Technology Research & Management, Vol.4, Issue.3, pp.163-169, 2020.
[38] A.Arulkumar, S.Balaji, M.Balakrishnan, G.Dineshkumar, S.Saravanan," Design and Implementation of Low Cost Automatic Wall Painting Machine", International Journal of Engineering Technology Research & Management, Vol.4, Issue.3, pp.170-176, 2020.
[39] N.Harish, R.Jayakumar, P.Kalaiyarasan, G.Vijayakumar, S.Saravanan," IoT Based Smart Home Energy Meter", International Journal of Engineering Technology Research & Management, Vol.4, Issue.3, pp.177-183, 2020.
[40] M.Amaran, S.Mannar Mannan, M.Madhu, Dr.R.Sagayaraj, Dr.S.Saravanan," Design and Implementation of Low Cost Solar Based Meat Cutting Machine", International Journal of Engineering Technology Research & Management, Vol.4, Issue.3, pp.184-190, 2020.
[41] R.Anbarsan, A.Arsathparvez, K.S.Arunachalam, M.Swathisriranjani, Dr.S.Saravanan," Automatic Class Room Light Controlling Using Arduino", International Journal of Engineering Technology Research & Management, Vol.4, Issue.3, pp.192-201, 2020.