# A DESIGN AND IMPLEMENTAION OF MODIFIED COMPACT SOLAR CELL ARRAY POWER PRODUCTION SYSTEM

**V.S. Vedhika[1], E.Elakkiya[2], K.Pavithra[3], K.Akilandaeswari[4], Asst.Prof.K.S.Gowthaman[5]**

[1][2][3][4]BE Students, Dept of Electrical and Electronics Engineering, GCE, Thanjavur, Tamilnadu

[5]Asst.Professor (Int.Guide), Dept of Electrical and Electronics Engineering, GCE, Thanjavur, Tamilnadu

**Abstract**

The marketplace for electrical vehicles has been growing staggeringly over the last 2 years and may still expand exponentially. This wants an outsized domestic and industrial charging network. The work unit charging infrastructure that enables electrical vehicle adoption depends heavily on partnerships between the personal and public sectors, as well as utilities, government agencies, automakers, and then the ultimate public. Electrical vehicles square measure shifting energy paradigms for quality round the world. Several factors contribute to a thought of supplying with electricity: once to charge, wherever to charge, however briskly will the vehicle charge, and UN agency can charge have an effect on. As additional electrical vehicles pull power from the grid, utilities can should address the increasing demand drivers can place on the grid. Energy storage and supply from star PV systems provides a facile resolution to power suppliers and drivers alike.

**Keywords:** Electric vehicle (EV),solar array, LCD display, photovoltaic cell(PV), Automatic voice recognition.

## I. INTRODUCTION

The project is focused on the design of an electric driven vehicle that can regenerate power using solar energy technology. If this type of vehicle became a standard commercial vehicle, the demand for fuel would decrease substantially. Designing this vehicle for practicality is the primary difficulty. The vehicle must be lightweight to minimize the size of the motor required to withstand urban transport needs. The vehicle is being designed to house one driver; practically, there would be need for additional space for other passengers and materials. Another consideration in the use of solar energy to power a vehicle is that the solar panel must be efficient enough to generate enough power for propulsion in a reasonable amount of time.

## II. LITERATURE REVIEW

A procedure of simulation and modeling solar cells and PV modules, working partially shadowed in Pspice environment, is presented. Simulation results have been contrasted with real measured data from a commercial PV module of 209 Wp from Siliken. Some cases of study are presented as application examples of this simulation methodology, showing its potential on the design of bypass diodes configuration to include in a PV module and also on the study of PV generators working in partial shading conditions. [1]

The vehicle routing problem is to minimize the total travel distance of a number of vehicle under various constraints.This study improves the original model of vehicle routing problem by adding some strains such as time windows,volume,weight,as parameters into the model.The model is adjusted to an multilate -goals vehicle scheduling problem based on the mutilate -goals programming ,and study on how the time -windows and time-distinction affects the delivering planning.we use GAMS to simulate and solve this problem.[2]

The IEA implementing the agreement on Hybrid and Electric vehicles operates the Task 19 “Life cycle assessment of Electric vehicles -From raw material resources to waste management of vehicles with an electric drivetrain”.The goal of this are provide policy and decision makers with FACTS for decision on EV related issues,improve “END OF LIFE MANAGEMENT” by promotion of best available technologies and practices, identify DESIGN for recyclability and minimal resource consumption and establish a “RESEARCH PLATFORM for life cycle assessment including end of life management for electric vehicles”to augment the benefits and competitiveness of vehicles with an electric drivetrain.[3]

To increase the driving safety, agility and driving comfort numerous active chassis control systems and integrated vehicle dynamic control systems are applied. In combination with the electric mobility synergetic effects may be used to improve, extend or even create new functions from these both key technologies.The energy demand plays an important part especially for electric vehicles(BEV),where the decisive factor act vice versa on the characteristic feature of the vehicle.Based on the domain-specific actuating variable from the longitudinal and lateral dynamics control the distribution on the drive, brake and steering system is calculated analytically.[4]

Modelling and simulation have become inseparable activities in any applied science or engineering research and development endeavour. Adding to the modelling complexity are the electric vehicles with a rich interplay of previously well demarcated disciplines of electrical and electronics engineering and mechanical automotive engineering. Topics ranging from determine the lack of expert or mature modelling and simulation tool and constantly changing landscape of electric vehicles tend to keep the electric vehicle modelling and simulations groups small, esoteric and often lacking in direction.[5]

Electric vehicles constitute a multidisciplinary subject that involves disciplines such as automotive, mechanical, electrical and control engineering. Due to this multidisciplinary technical nature, practical teaching methodologies are of special relevance. Paradoxically, in the past, the training of engineers specializing in this area has lacked the practical component represented by field tests, due to the difficulty of accessing real systems. This paper presents an educational project specifically designed for the teaching and training of engineering students with different backgrounds and experience. The teaching methodology focuses on the topology of electric traction drives and their control. [6]

The auto rickshaw is one of the important transport medium for end to end connectivity in many Asian cities. In order to reduce the pollution, the auto rickshaw with compressed natural gas (CNG) compatible kit is also available. It is a cheap transport solution in comparison to other mode of transport due to continuous increase in oil price and higher per Km travelling cost. The battery operated electric rickshaw is an alternative option to replace the auto rickshaw as it is environment friendly and the overall system cost is much less than conventional auto rickshaw. The electric rickshaw battery is charged by grid electricity, which is costlier and there is inconvenience associated with the charging and replacing of battery. [7]

This ability can be achieved by the management system in this article through the android cilent .The user can control the charge and discharging purpose ,as well as provide the timely charging reminded through the mobile phone .Further ,the mobile cilent BMS can be transplanted in the application of electric kart ,home energy resource system,and other fields that require power systems.Therefore ,designing the lithum battery monitoring system based on the android platform and ARM microcontroller is necessary.The novelty of the designed BMS in this paper is the monitoring method using android cilent.And the system has higher voltage measurement accuracy :what is more ,it is able to balance the cells and estimate SOH.The designed a low -cost intelligent li-ion BMS based on at mega 16 and used multichannel analog switch and differential amplifier to detect the voltage on each cell.[8]

This paper presents a study that aims to determine the effect of different drive modes (acceleration, deceleration, cruising) on the energy consumption (EC) of an electric auto rickshaw (e-rickshaw). The performance tests for the e-rickshaw were conducted on-road as well as on chassis dynamometer which followed a new drive cycle. Drive cycle analysis was done to analyse the EC during vehicle operation and the drive modes. The study indicated that average EC of the e-rickshaw was 31.17 Wh/km for the cycle. The percentage contribution of the drive modes to input power, torque and output power were estimated using a computer program developed for the study and results presented. [9]

This paper presents a study that aim to look at the optimization of the delivery cost of energy depending on the energy sources and time of charging. When there are a lot of electric cars the amount of charging energy(electricity) necessary at same time becomes critical factor. The charging stations need to be high powered to recharge a vehicle

rapidly:slow charging at a normal power outlet(3kw) leads to long charging times(10-16 hours), in contradiction to rapid charging station (upto150kw) which allow charring in less than half an hour.This immediately influences power density at a certain time and moment and is also a cause for high installation costs.The economic side of charging of (PH)BEV's including hardware costs, installation cost, operation costs should be carefully guarded to come to appropriate pricing.[10]

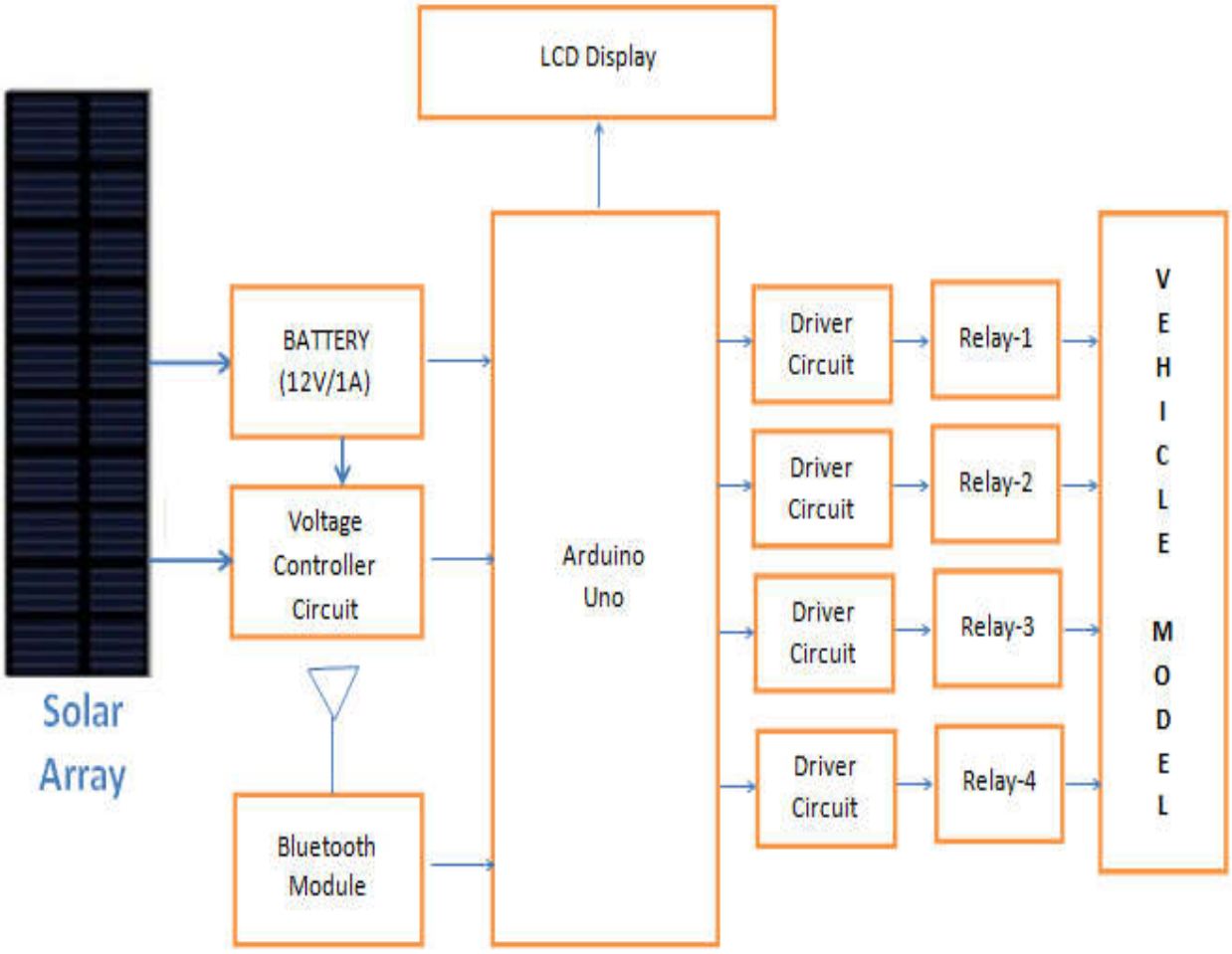
## III. EXISTING SYSTEM

In existing system ,most of the vehicles are operated with support of fuel (petrol ,diesel or gas) or battery power. If the vehicle operated with support of fuel following problems takes place. Day by Day increasing fuel cost, Atmospheric pollution, Shortage of fuel.Another hand, we have electric vehicle which was operated with support of battery. The battery is charged by wired power system.One of the major drawbacks in wired power system is the losses taking place during the transmission and distribution of electrical power. The approximated amount of power loss during distribution and transmission is 26%. The main reason for this power loss is the resistance of wires that are used for grid.

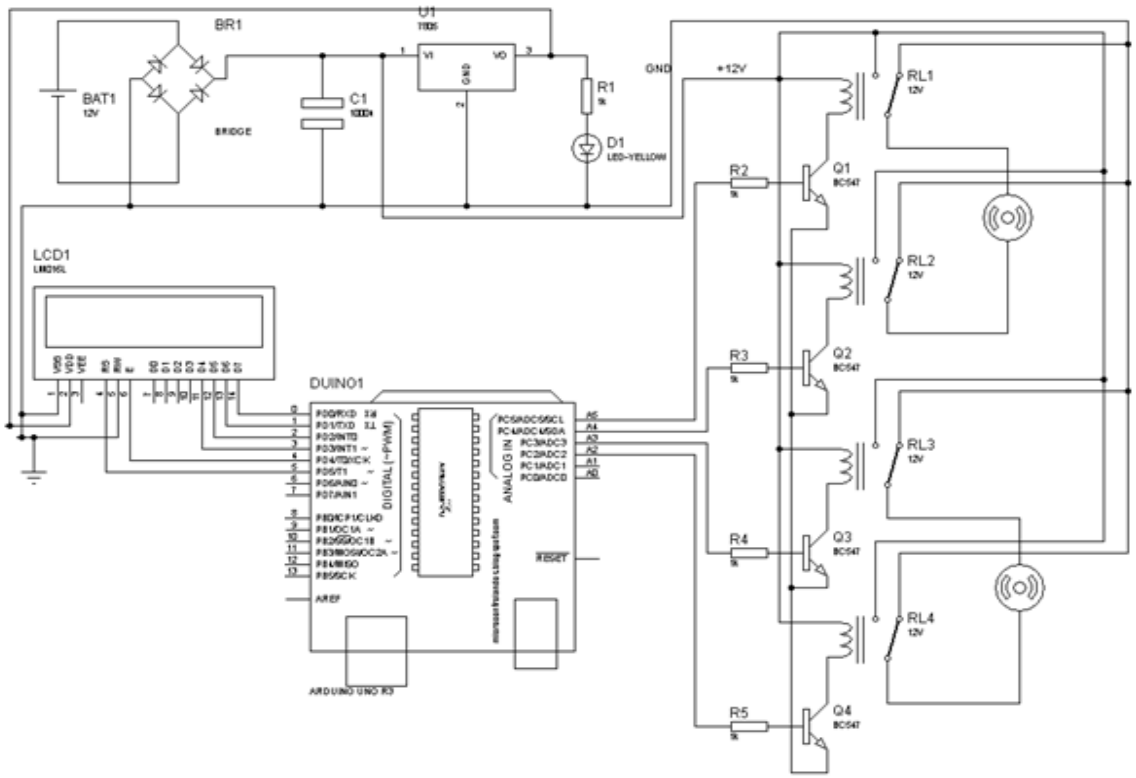
## IV. PROPOSED SYSTEM

The adaption of solar power is rising as a trusted renewable energy source. Photovoltaic cells are used in conversion of solar energy into useful electrical energy. Here, we used solar cell array to drive the vehicle with lot of advantages. The charge generated by an array of solar panels is received and its flow in and out of a battery pack is to be controlled in such a way that to ensure efficient operation of electric vehicle. The stored energy would be transferred to a Geared DC motor which would run the vehicle. The vehicle should be controlled by Google voice assistance.

### 4.1 Block Diagram



### 4.2Circuit Diagram




## V. COMPONENTS DESCRIPTION

### 5.1 Arduino uno microcontroller

It is a microcontroller board developed by Arduino.cc and based on Atmega328.Electronic devices are becoming compact, flexible and cheap that are capable of doing more function as compared to their predecessors that happened to cover more space, turned out costly with the ability to perform fewer functions. Experts always strive to introduce innovation in automation that requires minimum effort and gives maximum output. The microcontroller was introduced in the electronics industry with the purpose of making our tasks easy that come with even a remote connection with automation in any way. Microcontrollers are widely used in embedded systems and make devices work according to our needs and requirements. We have already discussed the controllers like 8051, Atmega16, Atmega328 and PIC16F877. Arduino Uno is a very valuable addition in the electronics that consists of USB interface, 14 digital I/O pins, 6 analog pins, and Atmega328 microcontroller. It also supports serial communication using Tx and Rx pins.

### 5.2 LED:

Arduino Uno comes with built-in LED which is connected through pin 13. Providing HIGH value to the pin will turn it ON and LOW will turn it OFF.

### 5.3 BATTERY

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smartphones, and electric cars. When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that will flow through an external electric circuit to the positive terminal. When a battery is connected to an external electric load, a redox reaction converts high-energy reactants to lower-energy products, and the free-energy difference is delivered to the external circuit as electrical energy. Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved to include devices composed of a single cell. Batteries convert chemical energy directly to electrical energy. In many cases, the electrical energy released is the difference in the cohesive or bond energies of the metals, oxides, or molecules undergoing the electrochemical reaction. For instance, energy can be stored in Zn or Li, which are high-energy metals because they are not stabilized by d-electron bonding, unlike transition metals. Batteries are designed such that the energetically favorable redox reaction can occur only if electrons move through the external part of the circuit.

A battery consists of some number of voltaic cells. Each cell consists of two half-cells connected in series by a conductive electrolyte containing metal cations. One half-cell includes electrolyte and the negative electrode, the electrode to which anions (negatively charged ions) migrate; the other half-cell includes electrolyte and the positive electrode, to which cations (positively charged ions) migrate. Cations are reduced (electrons are added) at the cathode, while metal atoms are oxidized (electrons are removed) at the anode. Some cells use different electrolytes for each half-cell; then a separator is used to prevent mixing of the electrolytes while allowing ions to flow between half-cells to complete the electrical circuit.

### 5.4 TRANSFORMER:

A transformer is a static (or stationary) piece of which electric power in one circuit is transformed into electric power of the same frequency in another circuit. It can raise or lower the voltage in a circuit but with a corresponding decrease or increase in current. It works with the principle of mutual induction. In our project we are using step down transformer for providing a necessary supply for the electronic circuits. In our project we are using a 15-0-15 center tapped transformer.

### 5.5 RECTIFIER:

The DC level obtained from a sinusoidal input can be improved 100% using a process called full-wave rectification. It uses 4 diodes in a bridge configuration. From the basic bridge configuration we see that two diodes (say D2 & D3) are conducting while the other two diodes (D1 & D4) are in "off" state during the period t =0 to T/2. Accordingly for he negative of the input the conducting diodes are D1 & D4. Thus the polarity across the load is the same.

### 5.6 FILTER:

The filter circuit used here is the capacitor filter circuit where a capacitor is connected at the rectifier output, and a DC is obtained across it. The filtered waveform is essentially a DC voltage with negligible ripples, which is ultimately fed to the load.

### 5.7 REGULATOR:

The output voltage from the capacitor is more filtered and finally regulated. The voltage regulator is a device, which maintains the output voltage constant irrespective of the change in supply variations, load variation and temperature changes. Here we use two fixed voltage regulators namely LM 812, LM 7805 and LM7912. The IC 7812 is a +12V regulator IC 7912 is a -12V regulator and IC 7805 is a +5V regulator.

This project uses +5V, +12V power supply for the operations of the IC's and relay driver circuit

### 5.8 BLUETOOTH MODULE HC-05

It is used for many applications like wireless headset, game controllers, wireless mouse, wireless keyboard and many more consumer applications. It has range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions. It is IEEE 802.15.1 standardized protocol, through which one can build wireless Personal Area Network (PAN). It uses frequency-hopping spread spectrum (FHSS) radio technology to send data over air. It uses serial communication to communicate with devices. It communicates with microcontroller using serial port (USART).HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration.

### 5.9 RESISTOR:

Resistors are the most commonly used component in electronics and their purpose is to create specified values of current and voltage in a circuit. A number of different resistors are shown in the photos. (The resistors are on millimeter paper, with 1cm spacing togive some idea of the dimensions). The left photo shows some low-power resistors, while the right shows some higher-power resistors. Resistors with power dissipation below 5 watt (most commonly used types) are cylindrical in shape, with a wire protruding from each end for connecting to a circuit.

### 5.10 CAPACITORS

Capacitors are common components of electronic circuits, used almost as frequently as resistors. Basic difference between the two is the fact that capacitor resistance (called reactance) depends on voltage frequency, not only on capacitors' features .Capacitors are used in circuits for filtering signals of specified frequency. They are common components of electrical filters, oscillator circuits, etc. Capacitors come in various shapes and sizes, depending on their capacity, working voltage, insulator type, temperature coefficient and other factors. All capacitors can divided in two groups: those with changeable capacity values and those with fixed capacity values.

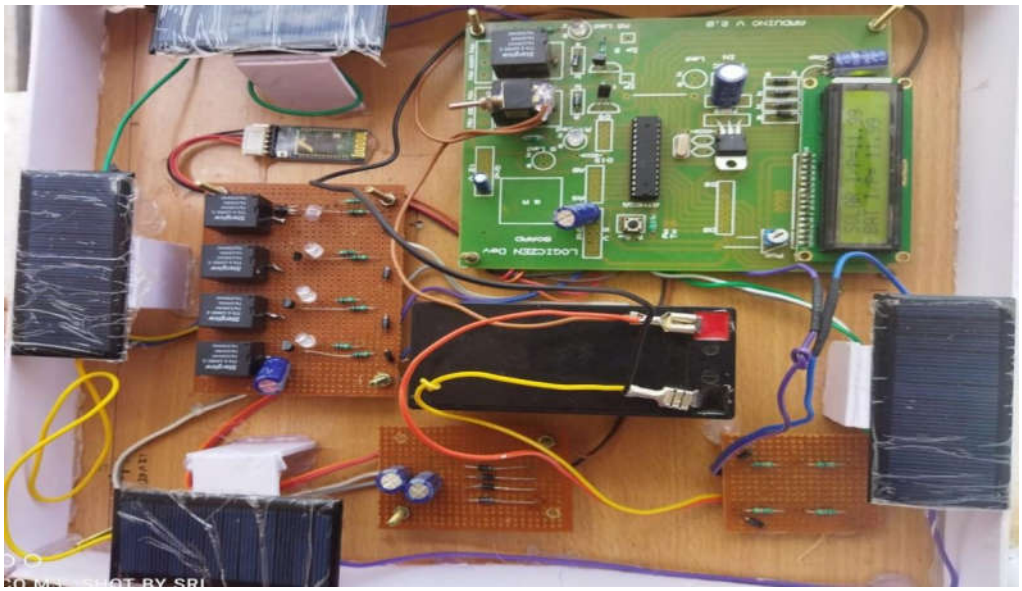
### 5.11 RELAY OPERATION

A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are doublethrow (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical. A relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts. The coil current can be on or off so relays have two switch positions and they are doublethrow (changeover) switches. Relays allow one circuit to switch a second circuit which can be completely separate from the first. For example a low voltage battery circuit can use a relay to switch a 230V AC mains circuit. There is no electrical connection inside the relay between the two circuits; the link is magnetic and mechanical.

### 5.12 DC motor

A DC motor is any of a class of rotary electrical motors that converts direct current (DC) electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor.DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings. Small DC motors are used in tools, toys, and appliances. The universal motor can operate on direct current but is a lightweight brushed motor used for portable power tools and appliances. Larger DC motors are currently used in propulsion of electric vehicles, elevator and hoists, and in drives for steel rolling mills. The advent of power electronics has made replacement of DC motors with AC motors possible in many applications.

## VI. EXPERIMENTAL PROTOTYPE



In this experimental prototype ,the solar cells are connected in series connection,the energy of solar cell stores in lead acid battery ,power supply unitare connected across arduino uno board. The arduino uno board consists of microcontroller atmega328, LCD display(2*16), rheostat miniature, on\off control and bluetooth module.

# VII . OUTPUT

## BATTERY OUTPUT

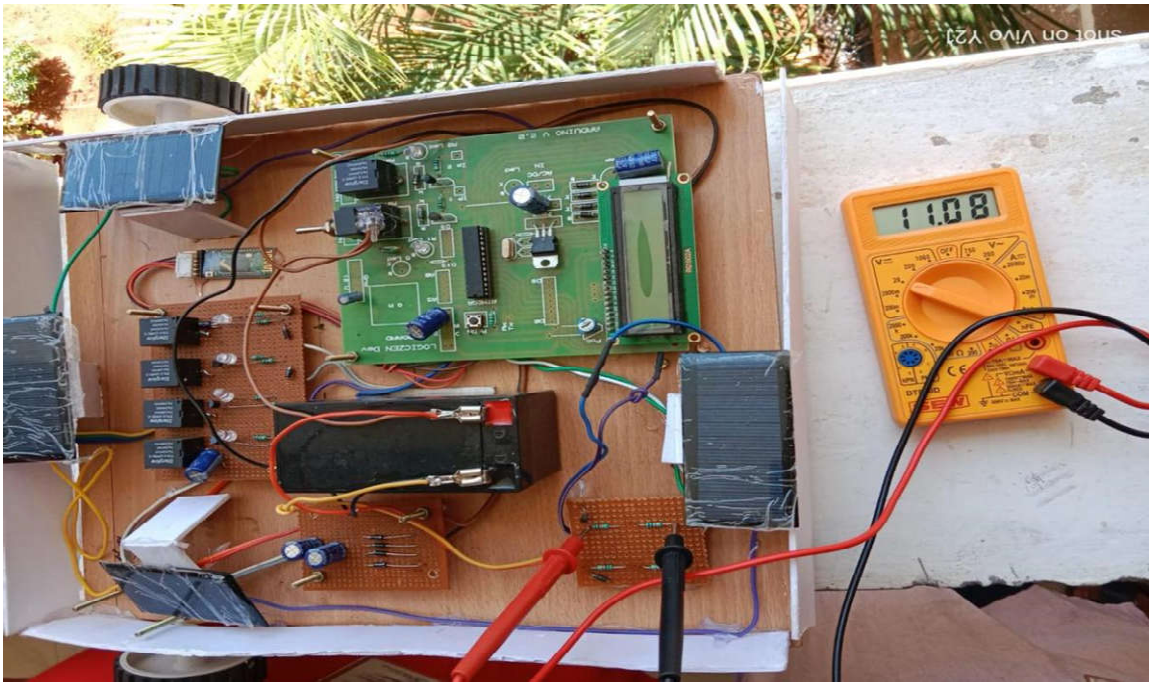



Fig 7.1

This figure (7.1) refers to the battery output of this project ,In our project we are not segregated in both battery and solar cells power .we are inbuilted a program for both battery and solar cells in a microcontroller and the output will be shows in the single LCD display .Incase if you want to know about the battery and solar cell volatges separately by using multimeter we can see it separately .This multimeter shows the battery voltage and this battery capacity is 12 v .

**SOLAR CELL OUTPUT**

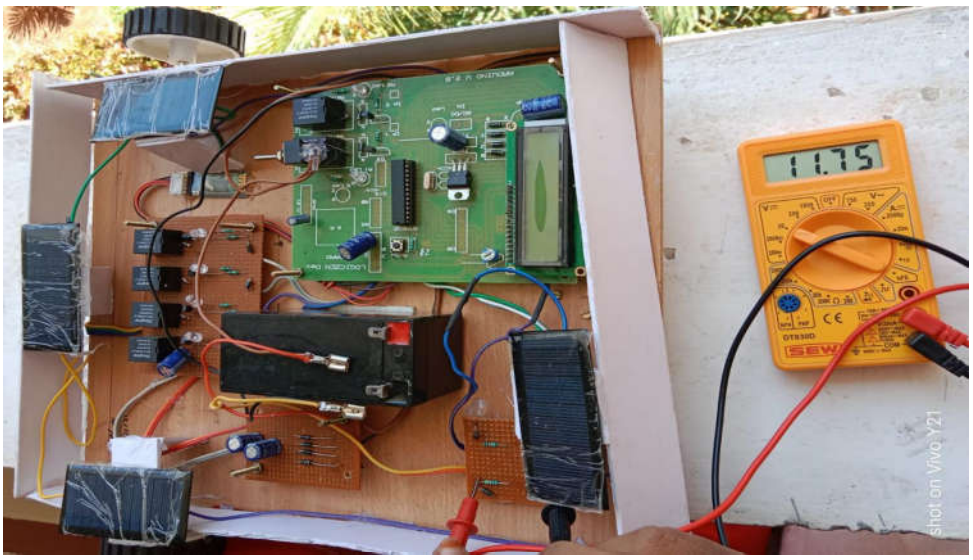



Fig 7.2

This fig(7.2) refers to the solar cells are generated the voltage through sunlight and each solar cell consist of 1.5 to 3 v . without any supply or battery and we can measured the separate voltage by using multi meter .we can measured it separately by using voltage divider circuit.

**SOLAR CELL AND BATTERY OUTPUT**

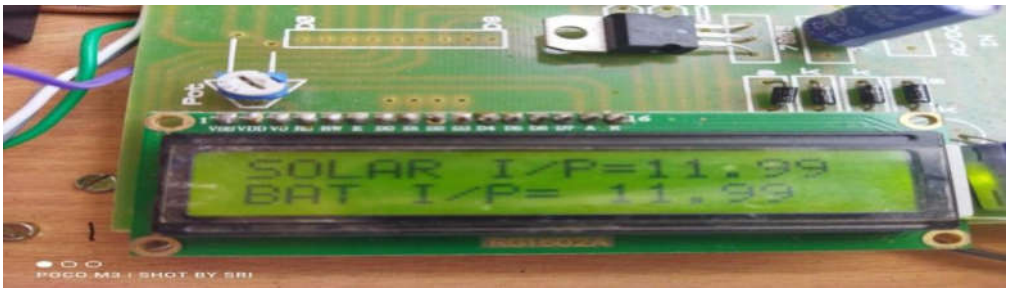



Fig 7.3

The output of the modified compact solar cell array production system .The input of the solar is 11.99 v and battery contains 11.99 v charging capacity.

## VIII. CONCLUSION

SPEV provides a pollution less transportation and utilization of non conventional energy. The SPEV would benefited by the end users like Industries, university campus, amusment parks. Physically challenged people would be benefited with automated driving mode concept.The technology used in SPEV contribute its supports to Green transportation.

## REFERENCES

[1] S.Silvestre, A.Boronat, A.Chouder,"Study of bypass diode configuration on pv modules", Applied Energy, Elsevier, vol.86(9), pages 1632-1640, September 2009.

[2] H.Li, J.Wu and Y.Zhang, "Research on modified optimization model for vehicle routing problem in E-commerce Logistics Distribution," IEEE 2010 International conference on E-business and E-government, pp.3411-3415

[3] Gerfried Jungmeier, Jennifer B. Dunn, Amgad Elgowainy, Enver Doruk Ozdemir,Simone Ehrenberger, Hans Jorg Althaus, Rolf Widmer, " Key issues in life cycle assessment of elecytic vehicles- findings in the international energy agency on hybrid and electric vehicles" 2013 world electric vehicle symposium and exhibition(EVS27), pp.1-7.

[4]R. Buchta, X.Liu-henke, "Energetic aspects for an integrated vehicle dynamics control for e-vehicles with decentral drives and all wheel steering",, IEEE Mechatronics system. 2013 International symposium on electrodynamics and mechatronics system (SELM), pp.35-36.

[5] Vinten D. Diwakar, Syrus R. Nedumthaly, R.Prakash "Objective based modeling and simukation within a context of an electric vehicle development program", 2013 world electric vehicle symposium and exhibition (EVS27) 17-20, November. 2013.

[6] Pablo Moreno-Torres, Marcos Blanco, Marcos Lafoz, and Jaime R.Arribas, "Educational project for a teaching of control of electric traction drives", January 2015.

[7] M.Sameeullah and S.Chandel, "Design and analysis of solar electric rickshaw: A green transport model, 2016 International conference on energy efficient technologies for sustainability (ICEETS), pp.206-211

[8] Chuanxue Song, Yulong Shao, Shixin Song, Silun Peng, and Feng Xiao " A novel electric Bicycle battery monitoring system based on android client", 8 August 2017 Journal of engineering, Vol. 2017.

[9]Robindro Lairenlakpam, Gananath Doulat Thakre, Poonam Gupta and Yograj Singh, "Effect of different drive modes on energy consumption of an electric auto rickshaw", IEEE Trans.electrification conference (ITEC-India), 9th April 2018.

[10] P.Arras, G.Tabunshchyk,S.Korotunkov and V. Okhmak, " Cost optimization simulation for electric vehicle charging infrastructure," 2020 IEEE European technology and engineering management summit(E-TEMS),2020 Date of conference 5-7 March 2020