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Charging Station for E-Vehicle using Solar with IOT

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***Abstract*—**This paper is about charging E-vehicle module using the Solar panel, availability of maximum power is viewed by IOT device and the maximum power generated by the solar is being tracked using the MPPT controller. The simulation model is designed using Proteus software. The whole setup is connected to the Arduino UNO R3, the battery level, generated and distributes an amount of the battery is viewed using an LCD. GSM modem is used to get an alert message for any reduction of power occurred in the system. A web page is used to check the availability status of charge, the amount of power transferred to the charging module and the available location for the charging station can be displayed. The main idea of this paper is to reduce greenhouse gas emission and fossil fuel.

***Keywords* -** Solar panel, DC-DC converter, Arduino UNO R3, Modem, Servo motor, Battery, MPPT controller.

I. INTRODUCTION

The demand for conventional energy like coal, natural gas, and oil is raised, so that the researchers forced towards the development of renewable resources or non-conventional energy resources. In the last couple of years, there has been a lot of discussion around the prices of fuel apart from the deregulation of petrol and fossil fuel prices. Moreover, these threats of disruption of supplies have brought the focus on to alternate drive train technologies. In 1800s electric vehicle had led on the road. While Robert Anderson, a British inventor introduces first crude electric carriage. The potential for alternative technologies in automobiles such as electric vehicle, which is first successfully discovered by William Morrison, a chemist in the US. His six-passenger electric vehicle is capable of top speed of 14 miles per hour more than that of the electric wage. The upcoming year will come more and more solar electric vehicle due to these reasons : (1)Reduction of emission of fossil fuel for extracting

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power from renewable resources (2)intelligent compliance to electronic requirements that facilitate the monitoring the availability of used power using IOT, and(3)tracking of sun's radiation throughout a time. Electric vehicle confines the outlook of passenger a vehicle that draws current from the rechargeable battery. There are three types of electric vehicle: hybrid electric vehicle(HEV), plug-in hybrid(PHEV), battery electric vehicle(BEV) and extended range electric vehicle(EREV). The main objective of the paper is to provide power from solar PV cell to the charging station in which the vehicle can be charged through the rechargeable battery and also with the help of IOT, the availability status of the charging station can be monitored frequently at any moment.

II. LITERATURE SURVEY

A. Modelling for tracking position. PV cell is a semiconductor device which absorbs energy whenever the solar radiation hits the device. The angular position of the sun varied changes according to the climate, day and night. A Solar cell is made up of monocrystalline silicon. Solar cells are very thin and fragile. Aluminium frame is fitted around the module so that it can be fixed easily and it also supports the structure. Solar array or PV array is the connection of a number of solar cells. PV module is formed by the interconnection of solar cells(i.e. 36 cells connected in series) A PV array is multiple solar panels which is electrically wired together wired together to form a large PV installation called an array. The effects of PV array are (i) losses will occur due to the interconnection of mismatched solar cells. (ii)A temperature of the module, (iii) failure of modes in the PV module. LDR (Light Dependent Resistor) is used to sense the light and a servo motor which automatically rotates the solar panel in the directional path of the sunlight. LDR sensor faces the path where the sunlight radiation is maximum. LDR is also known as a photoresistor, light sensitive device. LDR sensors are placed at the left and right side of the solar panel. The solar panel is rotated by the servomotor. The servomotor places a major role in tilting the solar panel with the help of the LDR sensor. LDR's electrical resistance depends on the intensity of the light falling.

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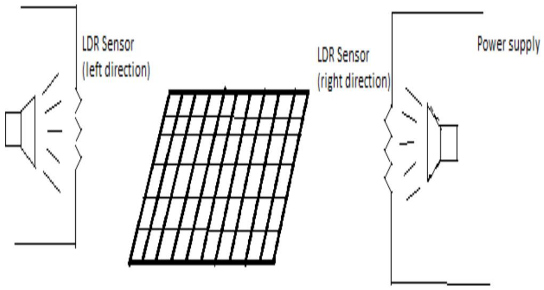

Figure1: Solar tracking sensor

B. Modelling of Arduino UNO R3 Arduino UNO R3 is a microcontroller board which is based on the ATmega328 (datasheet). It has 14 digital input/output pins it consists of 16 MHZ crystal oscillator. It has a power jack and an ICSP header and a reset button. The UNO means one in Italian. UNO and version 1.0 will be the reference version of Arduino which will be moving forward. Uno is the latest in the series of USB Arduino boards. The operating voltage is 5volt but the recommended input voltage is 7-12 volts. If it supplies less than 7v, the Arduino board may be unstable, and If it supplies more than 12volt, the voltage regulator may overheat and damage the board. The current usage of Arduino models is an ATmega328. The flash memory of Arduino UNO R3 is 32KB but in the system RAM is about 2KB, wherein EEPROM is 1KB and the clock speed is 16MHZ.

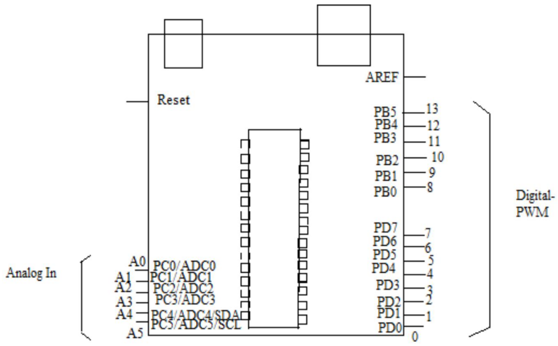

Figure 2: Arduino UNO R3

C. Modelling of DC-DC Converter A dc-dc converter is an electronic circuit or electromechanical device that converts the source of direct current (DC) from one voltage level to another. It is a type of electric power converter. Power level ranges from very low to very high that is from small batteries to high voltage power transmission. Closed feedback loop maintains constant voltage output even when changing input voltage and output current. Four common topologies are (i) Buck converter, (ii) Boost converter, (iii) Buck-Boost converter and (iv) SEPIC Converter.

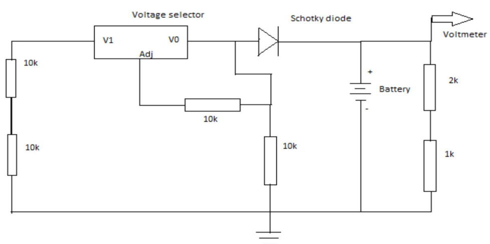

Figure 3: DC-DC converter.

Applying Kirchhoff's law,

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$$L\,(di_L/dt) + V_C = 0 \quad ,$$
$$i_0 + i_L = i_L \quad ,$$
$$V_0 = V_C \quad ,$$
$$i_0 = V_0/R \quad ,$$
and
$$i_C = C\,(dV_0/dt)$$
$$X_1 = -X_2/L \quad ,$$
$$i_L = C\,(dV_C/dt) + V_0/R,$$
$$X_2 = (X_2/C) - (X_2/RC)$$

The state equations are,

$$X = Ax + BV_s$$
$$V_0 = Cx$$

Transfer function,

$$V_0(s)/d(s) = (V_s/LC) / (s^2 + (1/RC)s + 1/LC)$$

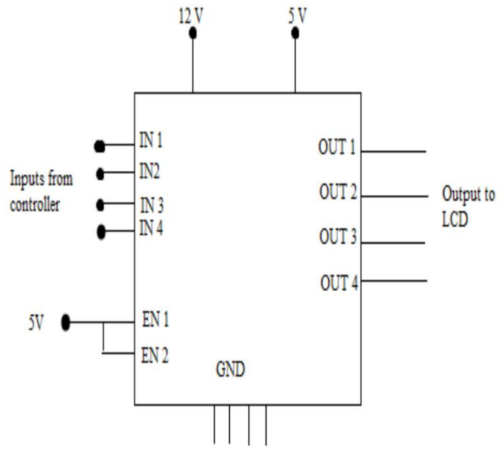

Figure 4:Motor drive-L293D

D. Modelling of Motor Drives A motor drive is an amplifier which drives the function of the motor in either direction. The motor drives operation depends upon the tracking position of the solar panel in either left or right direction. It also converts the low current signal from the circuit (solar panel) into a high current signal. Based on the angular position of the sun's radiation (or) maximum radiation absorbed from the solar panel. The motor drive initiates the speed of rotation. In addition to the functions, the overall output voltage can be controlled from maximum to minimum or vice versa with the help of potentiometer in order to satisfy the required charging capability. The function of the circuit is to convert the low current signal to the high current signal.

E. Battery voltage sensor A voltage sensor is basically used to sense the actual requirement of voltage from the charging station and also complements to recharge a battery. Here, it can sense DC voltage level as well as AC voltage level. The voltage sensed can be adjustable by the variable resistor connected to the motor which can frequently increase or decrease the output voltage within the capacity of the battery. The sensors are easily reacting to the electrical or optical signals. Some voltage sensors can provide sign or pulse trains as output and others can produce amplitude modulation, pulse width modulation or frequency modulation outputs.

Measurement Value = (Accuracy)

Current = 1mA ~ 1500A(+or- 1%)

Voltage = 6V ~ 18V(+or- 0.2%)

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Temperature = -400C ~ 1050C

F. Modelling of LCD LCD stands for Liquid Crystal Display, works on the principle of blocking light rather than emitting. It has a unique advantage of having low power consumption than LED (Light Emitting Diode). It is composed of several layers which include two polarized panel filters and electrodes and light is projected from a lens on a layer of liquid crystal. The combination of colored light with the grayscale image of the crystal (framed as electric current flows the crystal) forms the colored image. The image displayed in the screen and LCD should be controlled by the applied current. Polarized light must be used. Liquid crystal should able to control both of the operations to transmit or can also be able to change the polarized light. Thus, in the Liquid crystal screen, the Sensed signal and the battery voltage is displayed.

G. Description of the regulator The MCP1612 is a 1A, 1.4MHZ, fully integrated, current mode control synchronous buck regulator. The MCP1612 is packed in the 8-pin MSOP and space saving, 3X3 DFN packages. The DFN package also provides a low thermal resistance package option for high-power, high ambient temperature application. The output voltage of the MCP1612 is easily set over the range of 0.8v-5.0v by using an external resistive divider. They can be used with ceramic, tantalum or aluminium electrolytic output capacitors. Ceramic capacitors with values as low as 4.7uF can be used to keep the output ripple voltage low. For applications that required better load step performance, the value of the output capacitor can be increased to 47uF. Additional features integrated into the MCP1612 include sudden capability, soft-start, UVLO, over current and over temperature protection.

H. Modelling of IoT device IOT has become advantageous in every field, interrelated electronic devices with computer devices. It has the capability to communicate or transfer the data over a network without any interfaces. In present, IOT serves as a resource for upgrading a real-life usage by wireless communication. It provides an optimized result and engages the user with real-time experience which improves on timespace contact. IoT provides the effective user -interface program to avoid the flaw and blind spot which may affect the accuracy of the system. The recent technology improves and sharpens the customer engagement and also improves the working of product and aid in robust development to automation technology. It provides reliable data of demanding functionality where the different users can participate and use it at the same time. The current data analytics presents an external insight but IoT gives the real information which leads the safe and perfect environment for collecting resources.

III. PROPOSED SYSTEM

A. Working of module: As a solar PV array plays a vital role in a project, the model simply uses torches with LDR sensor to track the position for generating power from the source which helps the continuous flow of energy. Since the tilting angle of the sun varies from 0 o to 180o , two sensors should be built for either direction i.e., one in the left and other in the right. Then, the collected electric source from the PV cell is transferred to the converter together with the buck regulator which stabilizes the power. The entire DC-DC converter setup maintains the reliability of output from the cell and it should unbiased output when it exceeds the expected result in order to avoid a hysteresis loss. Initially, DC-DC converter accepts the DC input voltage and also provide s output as DC voltage in next level whether lower or higher depends on the requirement such that converter output voltage matches the power supply required to the module. Connection and disconnection from the supply to the load can be controlled using the switch in the simple DC-DC converter circuit. It provides DC regulated power supply to the battery. MCP1612 is a 1A synchronous buck regulator provides fast response to sudden load changes as well as overcurrent protection in the event of a short load as before passing to the converter. Input voltage range is 2.7 to 5.5V while the output is adjustable by properly setting an external resistor divider and ran a range from 0.8V to VIN. 1.4 MHz is set as a switching clock frequency. The regulated constant voltage is delivered to an analog input of Arduino to avoid the complexity of the operation. The meter should help to monitor the constant voltage. Arduino UNO R3 is a microcontroller board with 20 digital input and six can be used as an analog input. Program for tracking, delivering and displaying the required power output supply can be loaded on it as follows from the easy-to-use Arduino computer program. It has an extensive support community, which makes it a very easy way to get started with electronic equipment and also R3 is the latest version

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of Arduino. Simultaneously, on the other side as an input, battery voltage sensor and motor drives to perform the efficient working to get rid of the faults of overload or supply interruption. Battery voltage sensor consists of the potentiometer with two points of an electric circuit into a physical signal proportional to the voltage which is been received as a digital input to the Arduino later. These battery management components measure the charge or discharge current flowing through the battery, the voltage across the battery is posted as the reference value to the sensor. When the sensor assumes to lower output in the result, the potentiometer is set to increase as the expected output and it also can be minimized based on the rise in that output. The motor indicates the flow of charges through the circuit and also the direction of the motor alters in accordance with the Switching position of the torches toward the LDR sensor. If the torch holds in the left direction, the motor seems to rotate in the anticlockwise direction and vice versa. The L293 driver which simultaneously drives two motors so that it is easy to maintain the either directions of the LDR sensor. It is easy to maintain the two directions of the LDR sensor. It has an automatic thermal shutdown which means the chip will stop working if it gets too hot. LCD shows the actual output from Arduino as a result of every operation of the electrical circuit. LM016L is the LCD used as common, their interfacing with various microcontrollers (8-bit or 16-bit). Some stuff in the Arduino program help to clear and frequent result with the new look of battery voltage. The screen should display tilting position (right or left), the actual battery voltage and also whether the motor is on or off. Before using the LCD for display purpose, LCD is initialized sending
a set of commands to initialize the LCD and also by internal

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Figure 5: Block diagram of charging module

B. Acronyms and Abbreviations

IoT - Internet of Thing

DC - Direct current

AC - Alternating current

MPPT - Maximum Power Point Tracking

LCD - Liquid Crystal Display

LDR - Light Dependent Resistance

PV - Photovoltaic

L - Inductance

i_L - current through inductor

t - time

V_C - voltage across capacitor

I_0 - initial current

V_0 - initial voltage

R – Resistance

C - Capacitance

X_1 - reactance 1

X_2 - reactance

SIMULINK MODEL FOR THE PROPOSED CHARGING STATION SYSTEM FOR EVs OR CHARGING MODULE

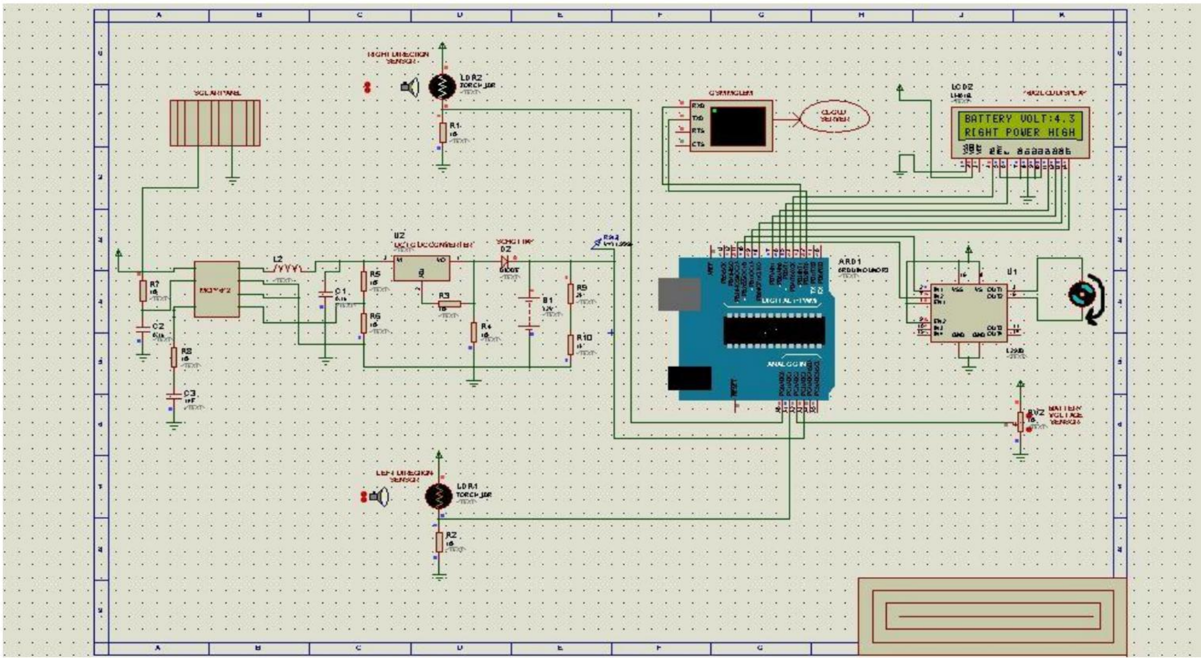

Figure 6: Proteus Model of charging module

BATTERY VOLTAGE GRAPH

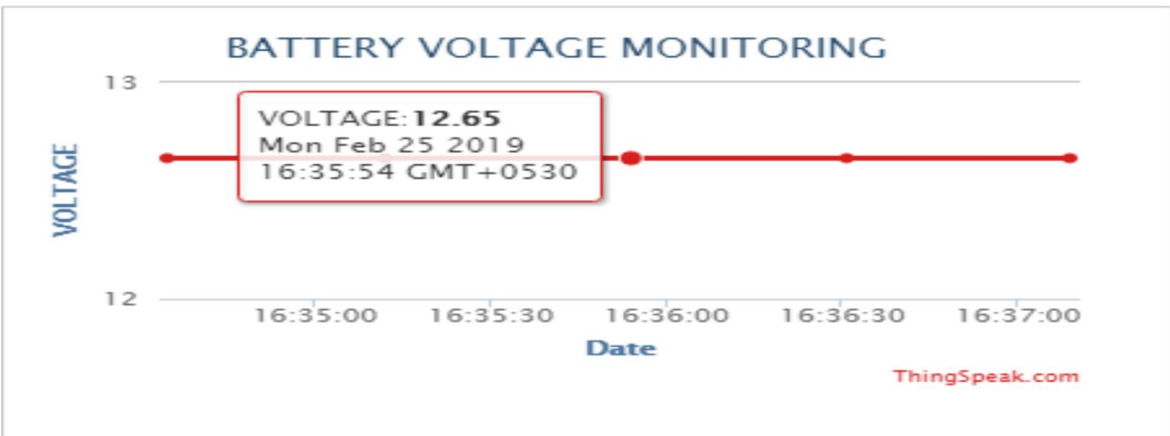

Figure 7 : Capacity of battery with time in the webpage

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V. RESULTS This paper focuses on IoT to engage information of charge station availability to the vehicle user through the webpage. The webpage is designed using normal HTML method for the clear and easy usage of information provided. The webpage may consider the graph of battery voltage and time and also the location tracked for charging station as similar to the Google map. With webpage IoT designed user can able to collect the appropriate data of battery charge details. It simply requires a 24/7 network and browser to load data using a URL address. The information such as the capacity of battery voltage, time of charging, related location is updated regularly. These are open source data and anyone can view the status of this webpage using link address with secured internet availability.

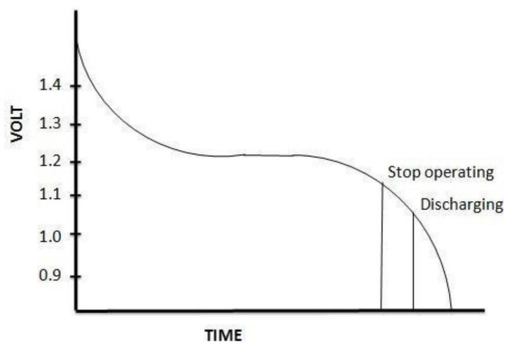

Figure 8: Continuous operation

Internet of Things (IoT) based battery sensor monitors the real-time status of the battery as an energy storage management system. The IoT developed here uses a cloud platform for management purpose. The vehicle user can easily check to the destination to reach the charging station and can view the withdrawal of battery voltage from the system. The data stored in the Arduino can withstand until battery fails to charge. For the future use, multiple user for the e-vehicle who settles the station are stored and upgraded in the database so that the distribution to the different user can be monitored.

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