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AN IOT BASED CHARGING MODULE FOR RECHARGABLE BATTERIES OF ELECTRIC VEHICLES

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Abstract: Fossil fuels are a non-renewable resource that is exhaustible in near future. An alternative for such automobiles is using electricity which can be generated by renewable resources to power up the vehicle. This paper gives an idea about charging these Electric-Vehicles (e-Vehicles) using a renewable energy source such as solar using solar panels and provide the maximum power generated. The proposed system is controlled using the Arduino UNO to view the amount of charge generated through an LCD. GSM modules give alert messages if there is an overcharge or undercharges. A rain sensor is also integrated to alert the user if there are any changes in climatic conditions that affect the charging of PV cells. The entire status of the battery along with the amount of power being transferred is uploaded to the cloud and can be seen through a webpage at any time. The main aim of this paper is in reducing the consumption of non-renewable energy sources and greenhouse gas emissions reduction.
Keywords: based; iot; charging; module; rechargeable;

I. INTRODUCTION

As the population increases, there is also an increase in the usage of automobile vehicles. Current vehicles mostly are dependent on fossil fuels such as petrol, diesel, LPG, etc. Fossil fuels are a non-renewable resource that is one-time use. To find an alternative energy resource that is renewable and easily available for daily use different types of vehicle engine development have been conducted, one such energy source is electrical energy. After successful development across years, vehicles powered by electric energy are becoming the general trend worldwide because of its many advantages. As such charging stations for electric vehicles are in need. To accommodate easy access, we have designed a solar-powered charging station. Solar energy is not only a renewable energy resource but also easy to obtain from Sun. [14] [15].

Electric vehicles withdraw the required current to power up using the rechargeable batteries that are integrated with it. Around 1832, one of the very basic electrically running motor vehicles was invented by Robert Anderson, and later time first commercially available EVs were released by General Motors Company. Many companies are investing more to develop e-vehicles extensively since their numerous uses for the customers.[5]. There are many reasons why future generations will start using EVs mainly because of their eco-friendly nature. They do not emit any smoke or toxic gases to the environment. They are very quiet in nature and use renewable sources of energy which decreases the use of fossil fuels. Overall, the advantage of using EVs is more to the environment.[7] Here we are using an Arduino controller to make the system more cost-effective and IoT is also integrated to make the system applications wider and mobile.

The main aim is to generate maximum power required to power up the battery using Photovoltaic cells that uses renewable energy such as Solar light and along with implementing IoT applications such as knowing the charge status of the battery and a close monitoring of the battery remotely.[10]

II. LITERATURE SURVEY

This paper investigates gives an idea of implementing charging ideas in a confine environment such as workplaces where people park their vehicles on outside for a very longer duration. The main objective here is to determine the maximum energy that can [6] [9] obtained during all seasons of the year along with different orientation of PV cells. The required data is gathered with the help of government environment departments. Availability of sunlight during different is analyzed and a system that can generate maximum energy is built. Since, Netherlands gets less sunlight during some seasons of the year the output of the system is 30% oversized. Hence the dependencies of the system to the grid are more and does not act independent. Hence a mechanism is brought up where they charge multiple number of EVs on single instance using EV-PV chargers and adding a local storage unit makes it grid independent. [1]

By keeping the study for the future that is extinctions of fossil fuels and using non-conventional energy sources as major source they designed a solar car that can run at 30Km/Hr per charge. The key elements they used build this solar car are Photovoltaic modules, Brushless DC motor, tube batteries powered by solar energy, steering and a miniature circuit board (MCBs). A brushless DC motor is used since the field effective losses are very and also the coupling losses. The car that is designed takes 18 long hours to charge by using local electricity and tested run distance for 100Kms. They have also designed a similar model using reluctance motor and tests are being carried out. A major drawback is using the conventional energy sources which doesn't make it cost-effective.[3]

In the paper two methods of contactless charging technologies is discussed. One being swapping the battery instead of using a conventional way of charging EVs on a charging station. By this method the vehicle owner can swap the discharged battery with the newly charged battery. By this the time consumptions in charging station can be reduced from hours to minutes. Another method is Wireless Power Transfer. This method is very advance where the EVs can be charged without even stopping the engine. Here the roads are built with induction coils at the end with the wireless magnetic coil integrated in the EV the battery charges when the vehicle moves. Although both methods are good theoretically building such advance infrastructure makes the system very costly and not consumer friendly. [8]

One of the requirements that emerging majorly in a big populated country such as India are the electric vehicles that decreases the use of petroleum products. According to a survey by Indian Government in future time due to increasing number of interests on people buying EVs more there is a need of deploying charging stations throughout the country in very fast phase and making them environmentally friendly [4]. These infrastructures need to be in smart manner which is necessary to make country a Smart Country by 2030. [13]Electrical vehicles (EV) are the major requirements in these drastic changes with degrading environment.[6] by the year 2030.

III. OBJECTIVE

In this paper, a solar powered charger for electric vehicle is planned and created. Our reliance on petroleum derivatives is radically diminished by the joined utilization of sun powered energy and Electric Vehicle (EV) charging. Here the energy is created in bio friendly way by using PV cells that reduces the dependencies on the grid. By utilizing sun-based energy the framework the contamination caused is diminished too insignificant. A sunlight based controlled gadget has low asset utilization being free and effectively reachable in climate. Sun powered energy is sustainable power in this way gives a drawn-out use of framework.

IV. METHODOLOGY

To make the controller module an energy efficient and eco-friendly, the system is energized using solar PV panels. The system is controlled and automated using Arduino UNO controller.LDR sensors directs the solar panel which is being connected to servo motor. Motor rotates the PV cells to different angles depending on the sun light that falls throughout the day with the help of light dependent properties of LDRs. A voltage regulator circuit is used for regulating operating voltage for the controller. This helps to generate maximum power required for the batteries to be charged. The entire system is integrated to the cloud with the help of IoT applications ThingSpeak. Here the output from different sensors is being collected and a qualitative log is being shown. Voltage sensor will check the voltages of coming from the battery. If voltages fall out of range then the system sends the message to the registered user using a GSM module. Results are displayed physically on the system using LCD and same data is uploaded to cloud using ThingSpeak which can be seen remotely by the user.

V. PROPOSED SYSTEM

An eco-friendly system is designed for the solar power to generate the required energy for the battery to be charged. Many designs are made in order to bring optimization to the system. Different studies have showed various approaches to build a charging station that are environmentally friendly that reduces the greenhouse effect and consumption of non-renewable resources to power up the vehicles.

The main objective of the paper is to build charging station for the electric vehicles that utilizes the Solar power to charge the batteries required for EV and to make these stations smart by implementing IoT that bring added advantages such as monitoring the charging status of the battery anywhere at any time remotely. It also helps to keep the track of charging cycles updated in the cloud storage. It is built in such way that any changes in climatic conditions should notify the owner.

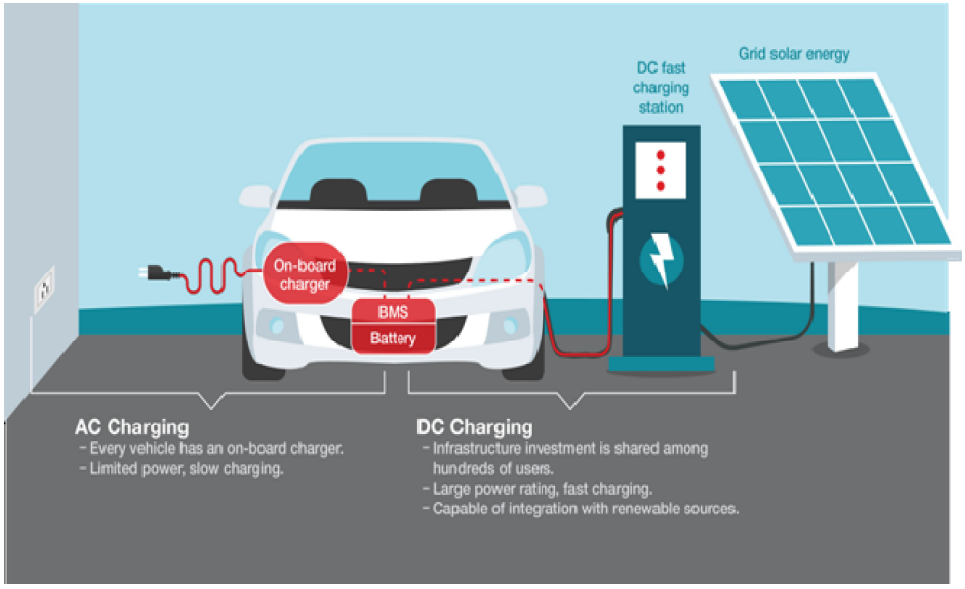


Figure 1: Proposed System

VI. IMPLEMENTATION OF PROPOSED SYSTEM

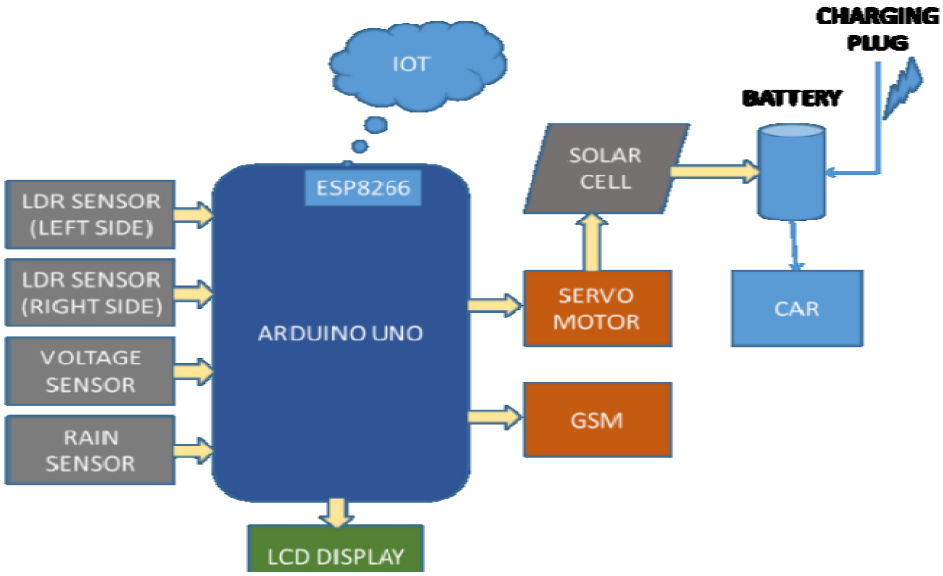


Figure 2. Proposed System block diagram

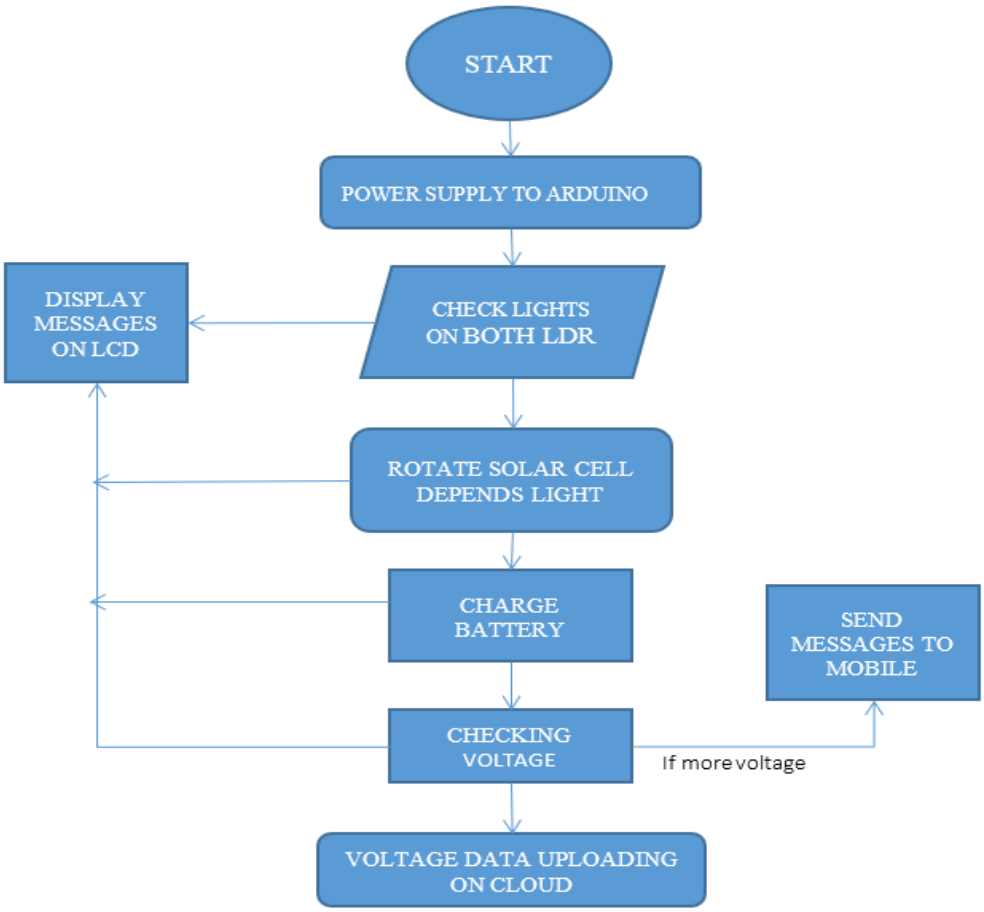
The Arduino UNO acts as major controller to monitor the repetitive task of charging the battery. Using Photovoltaic cells to generate power makes the system eco-friendly. A voltage regulator circuit is built along with a voltage regulator sensor to regulate the input and output voltage for the operating range. A servo motor is used to rotate the solar panel from 0° to 180° angles with the help of LDRs to gather information about the sun position throughout the day so that maximum utilization of sun energy is achieved. Two LDRs indicates the change in direction of the sun to rotate the solar panel. Now the controller calculates the voltage that is being generated and stabilize the output from regulatory circuit. In IoT part we will upload the voltage data to the ThingSpeak an open-source cloud server using the Internet provided by the ESP8266 Wi-Fi module. Here, many sensors are used to collect data for various parameters. An FC-37 rain sensor is used to detect the weather changes in the location during rain fall which in turn sends the alert messages on the climatic changes in the location. The output can also be viewed using LCD display.

The advantages of implementing this system are:

- Since we are using Solar energy to generate electricity it is truly a renewable source of energy which can be harnessed in any parts of the world.

- It reduces the electricity bill for owners of the charging stations making them more profitable even though the initial investment is more.
- IoT makes the things much easier as it gives timely updates for the owner even in their absence.
- Using of GSM module is an added advantage during no internet connections with the owner.

VII. FLOW DIAGRAM



IX. IMPLEMENTATION OF CHARGING MODULE

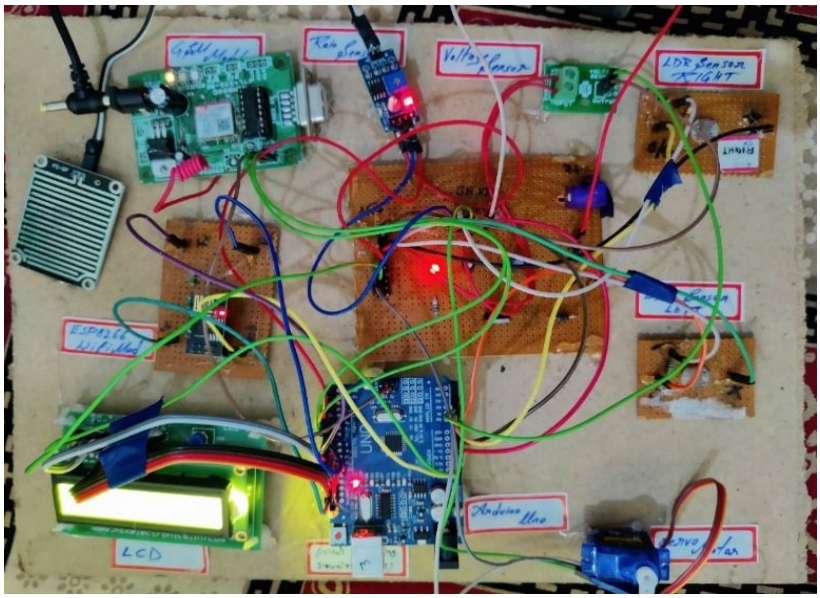


Figure 11: E-Vehicle Charging Module Prototype Model

X. RESULTS AND DISCUSSIONS

The output of the system can be seen in the system as well as remotely using IoT. Using LCD in the system displays the maximum voltage that is generated by charging the battery. Figure gives the outcomes of the LCD display.

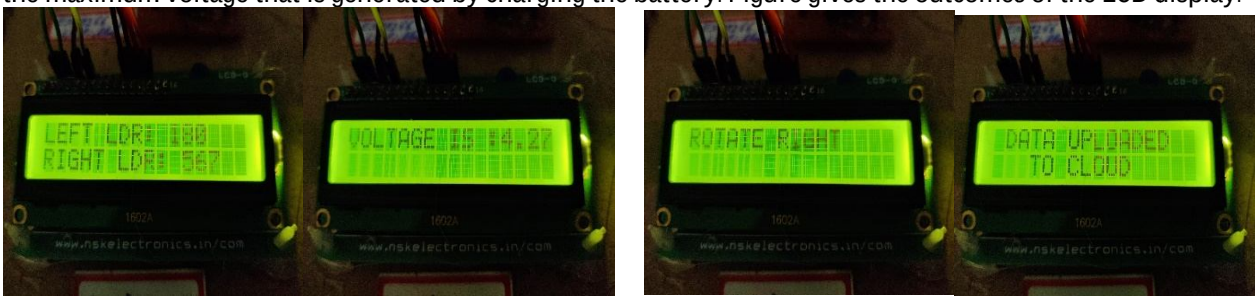


Figure 12. Different Outputs on LCD display

In the above figures, an example of output scenario is taken that is displayed on LCD

(1) It shows the resistance values of the LDRs that generates when solar light falls on the sensors. It rotates the solar panel depending on the direction of light which falls more.
(2) Voltage is calculated, Voltage = Vout / (R2/(R1+R2)) where R1 and R2 are the values of LDR sensors.
(3) Since the value of right LDR is more, the servo motor rotates the solar panel towards right where more sunlight falls.
(4) Once all the voltage is measured the final voltage data is uploaded to the cloud which helps the owner to get information of charging remotely.

Using IoT the entire charging data can be accessible remotely by using an open-source cloud storage server ThingSpeak. It gives the exact charge of the battery with various time constraints.

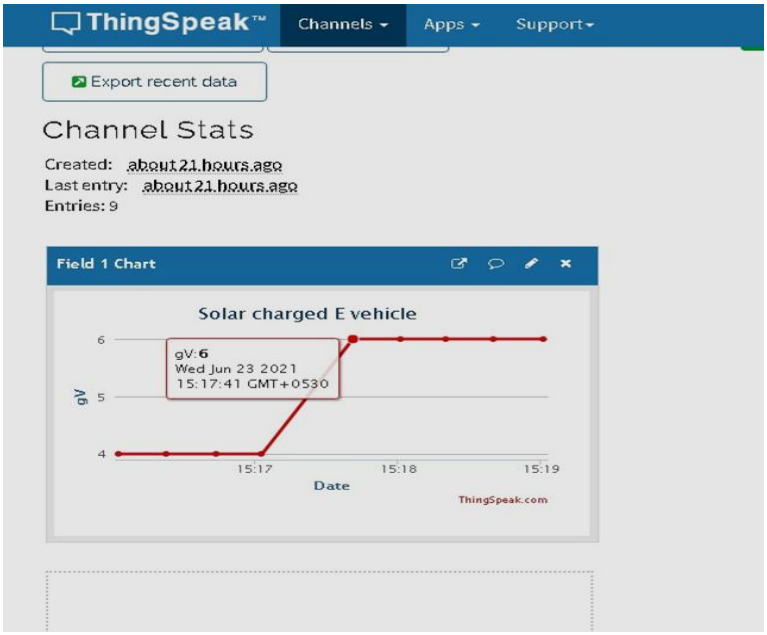


Figure 13. ThingSpeak Output

With the presence of GSM module, it can alert the user when the climatic conditions change like raining.

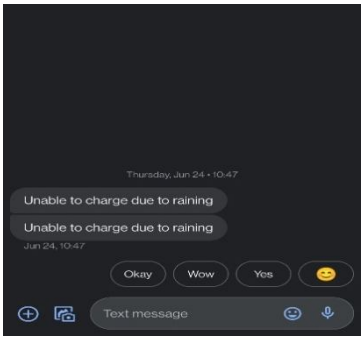


Figure 15. Alert messages on owner mobile

XI. CONCLUSIONS AND FUTURE WORK

Internet of Things (IoT) based charging module/ station monitors status of the rechargeable battery in real-time along with remotely keeping a record of charging cycles on different time constraints. The usage of cloud platform makes it more feature rich system. A centralized management mechanism is built. It keeps the owners of charging stations updated regarding the battery status even during their absence. Using a microcontroller such as Arduino makes the system more effective as there is a repetitive monitoring that needed to be carried out making it easy. Since the entire system is built using a renewable energy source such as Solar light to generate power required for batteries it makes the system eco-friendly and reduces the use of non-renewable resources. All these parameters and advantages makes system a cost effective and a reliable system.

Since this is a prototype it can be implemented in a larger scale to check the accuracy of the system and make it more reliable. The data storage system can be improved to register multiple vehicle users to that data base of the station and get their access to the battery status of the station remotely utilize to charge their vehicles when they pass by.

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