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Solar and Wind Powered Electric Vehicle

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Abstract: *Energy crisis and pollution caused by vehicle emissions are one of the most important issues in the present society. Due to the charging time of battery of electric vehicle, requirement of charging on board is explored as option. This paper deals with the design of a hybrid model of a solar and wind, which uses the battery as its storage system. This system allows the two sources to supply the load separately or simultaneously depending on the availability of the energy sources. The power generated from the wind and solar is fluctuating in nature. The system obtains maximum solar energy during day time and maximum wind energy during the night because the wind blows more at night compared to day time. Therefore, battery of the vehicle can be charged by using hybrid energy system.*

Keywords *—electric vehicle; hybrid solar and wind;*

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I. INTRODUCTION

Due to depleting fossil fuel and its detrimental effect on the environment alternative energy source is a mandate. The wind and solar energy resources are prospective options. As conventional sources are insufficient in meeting the load demands, the other forms of energy sources can compensate for the difference. The air quality of cities is mainly affected by vehicle emissions. Among the renewable energy sources harnessing wind energy with wind turbines appears to be the most promising source of renewable energy. Wind energy conversion systems are used to capture the energy available in the wind to convert into electrical energy. The solar photovoltaic system and wind systems have been promoted around the world on a comparatively larger scale. These independent systems cannot provide a continuous source of energy, as they are seasonal. For example, a solar photovoltaic energy system cannot provide reliable power during non-sunny days. The wind system cannot satisfy constant load demands due to significant fluctuations in the magnitude of wind speeds from hour to hour throughout the year. Therefore, energy storage systems will be required for each of these systems in order to satisfy the power demands. Usually, the storage system is expensive and the size has to be reduced to a minimum possible for the renewable energy system to be cost effective. The power generated from both wind and solar components is stored in a battery bank. A hybrid renewable energy system utilizes two or more energy production methods, usually solar and wind power. The other advantage of solar/wind hybrid system is that when solar and wind power production is used together, the reliability of the system is enhanced. Additionally, the size of battery storage can be reduced slightly as there is less reliance on one method of power production. Often, when there is no sun, there is plenty of wind. The conventional electric car finds the difficulty of charging it after few kilometers but the wind and solar powered car help to eliminate this drawback as this car has the facility to be charged on board due to the wind and solar energy. Here power is generated from wind turbines and the solar panels and is directed to the battery for the charging. The battery is recharged on board and the vehicle doesn't need to be standby for charging.

II. BLOCK DIAGRAM OF PROPOSED SYSTEM

The wind and solar powered car have high efficiencyand is a vehicle with least maintenance.

Block diagram of the proposed system is shown in Figure

1. The car works on the concept of charging and discharging of the battery on board. When the vehicle runs, the motor consumes power from the battery and after certain kilometers, it needs to be recharged. In this car, power is generated from wind turbines and the solar modules are directed to the battery for the charging. The battery is recharged on board and the car doesn't need to be standby for charging. To conserve the energy and to utilize it at best a vehicle is designed which will run on the battery and which will get charged by free energy sources. Then as per the requirement, the solar panel and wind energy generator motor is connected. Energy generated from a wind turbine is shown by using LED in the project for demo purpose. But in actual, this energy

will be as per the battery voltage ratings and used to charge the battery which will be then used to drive a vehicle. For building a robot which is driven by remote, a Bluetooth module HC-05 is selected as a remote which works by using a Bluetooth controller application and checked its functioning. The data signal coming from the Bluetooth module is given bit by bit to the controller. Then Controller is programmed for receiving the bits from the application and as per the signal gives some respective output. The controller receives the bits sent from remote and checks whether it is from required signal or not. If bits match with the required data then as per the condition, Controller will drive robot either forward, reverse, left, right or stop. For driving motors of the vehicle, Driver IC L293D which receives the signal from the controller is used and as per the signal, it gives 12V or 0V to the motor terminals. And as per the voltages on motor terminals motor rotates in either forward or reverse or stop. For moving the vehicle in forwarding direction signal is sent in such a way that driver IC gives 12 and 0V to both the motors to run in the same direction i.e. forward. For moving reverse 12 and 0V are given to the motors by driver IC L293D exactly in opposite way as of forward so both motors rotate in reverse direction. For moving in left direction left motor will remain stopped and the right motor will move in forward direction while for moving in right direction right motor will remain stopped and left will be moved in the forward direction. In this way the vehicle is drivenby remote wirelessly by using the battery as a supply source.

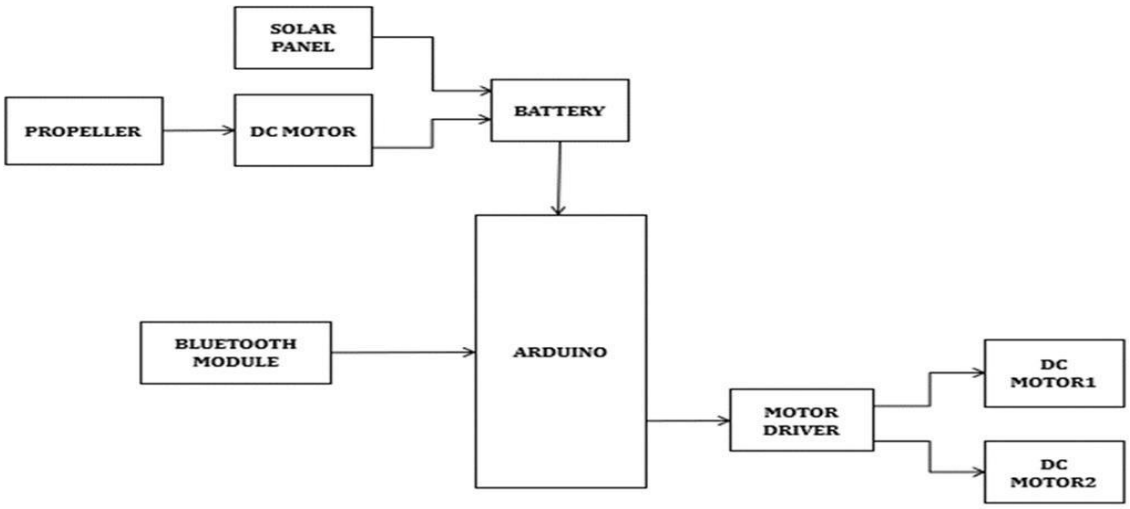

Fig: 1: Block Diagram of Solar and Wind Powered EV

III. SYSTEM COMPONENTS

ARDUINO UNO:

BLUETOOTH MODULE:

The Bluetooth module HC-05 is a MASTER/SLAVE module. By default the factory setting is SLAVE. The Role of the module (Master or Slave) can be configured only by AT COMMANDS. The slave modules cannot initiate a connection to another Bluetooth device but can accept connections. HC-05 embedded Bluetooth serial communication module has two work modes:

- Order-response work mode: In this mode, we can configure the different control parameters which finally determine working of the module. In this mode, we can't communicate with other devices.
- Automatic connection work mode: In this mode, the device works as per the settings previously defined by the user in AT commandmode and can communicate with other devices.

There are three work roles (Master, Slave, andLoopback) at the automatic connection work mode.

- Master – Slave work mode: The master establishes a connection with slave devices found within its range that is called as access points and there is nothing to do with slave until the communication channel is created by the master.
- Loop Back: It functions in the same loop until it gets an interrupt signal or any other command.

CHARGE CONTROLLER:

A charge controller is basically a current or a voltage controller to charge the battery and to protect the cells from overcharging. It directs the current and voltage coming from the solar panels and wind turbine to chargethe battery.

Working:

The microcontroller is powered up with 5V regulated DC supply from the battery. Ones the microcontroller is powered ON, it continuously monitors the battery voltage with the help of ADC. A potential divider connected at the pin 2 of the ADC with resistor arrangement, scale down the voltage from 0V-20V to 0V-05V. This circuit is implemented with a parallel regulation technique which allows the charging current to flow into the battery and once the battery is fully charged it stops charging. By making this charging as pulsed, wasting of current as heat is reduced to keep the battery topped-up. Once the battery is fully charged, then microcontroller interrupts the charging by energizing the relay through the MOSFET. Whenever the solar panel voltage falls below the Zener diode voltage the charging of the battery is interrupted by the MOSFET. By this way, solar charging system charges the battery as well as protects the battery and loads from over and under voltages.

MOTOR DRIVER CIRCUIT (L293D):

L293D is a typical Motor driver circuit which is a 16 pin IC that can control a set of two DC motors simultaneously in any direction. It works on the concept of H-bridge. H-bridge is a circuit which allows the voltage to be flown in either direction. The voltage needs to change its direction for being able to rotate the motor in clockwise or anticlockwise direction. In a single L293D chip there is two H-Bridge circuit inside the IC which can rotate two dc motors independently. Left input pins will regulate the rotation of motor connected across left side and right input for the motor on the right-hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1 i.e., High or Low.

The truth table representing the functionality of thismotor driver is shown in the table:

Enable	Input 1	Input 2	Function
HIGH	LOW	LOW	STOP
HIGH	LOW	HIGH	CLOCKWISE
HIGH	HIGH	LOW	ANTI-CLOCKWISE
HIGH	HIGH	HIGH	STOP
LOW	X	X	STOP

Table.1: Truth Table of L293D Motor Driver

DC MOTOR:

A DC motor is any of a class of rotary electrical machines that converts direct current electrical energy into mechanical energy. The principle of working of a DC motor is that "Whenever a current carrying conductor is placed in a magnetic field, it experiences a mechanical force". The direction of this force is given by Fleming's left-hand rule and its magnitude is given by:

$$F = BIL$$

Where, B = magnetic flux density.
I = current.
L = length of the conductor within the magneticfield.

When armature windings are connected to a DC supply, the current sets up in the winding. The magnetic field may be provided by field winding (electromagnetism) or by using permanent magnets. In this case, current carrying armature conductors experience force due to themagnetic field

LEAD ACID BATTERY:

A battery is where electrical energy can be stored as chemical energy and this chemical energy is then converted to electrical energy as when required. The conversion of electrical energy into chemical energy by applying external electrical source is known as charging of the battery. Whereas conversion of chemical energy into electrical energy for supplying the external load is known as discharging of the battery.

Materials used for Lead Acid Storage Battery Cells
The main active materials required to construct a leadacid battery are

1. Lead peroxide (PbO_2).
2. Sponge lead (Pb)
3. Dilute sulfuric acid (H_2SO_4).

IV. CONCLUSION AND FUTURE WORK

It is shown in Figure 2, that the solar energy through solar panel and wind energy through fan powers the system. There is huge potential for producing electricity from renewable sources. This project gives a clear idea that vehicle-powered with the help of solar energy and wind energy is more effective than fuel vehicle. By combining the two intermittent sources of the wind and solar energy to charge battery of electric vehicle. The system's power transfer efficiency and reliability can be improved significantly. Here it is tried to find key features for improving solar energy conversion that is distance, angle, wavelength, and temperature. By the use of hybrid vehicles, it is possible to eliminate the usage of fossil fuels. It has higher efficiency than using individual solar and wind system.

As there is synchronization between the electric motor and Bluetooth module, it is found that charging cycle of batteries are less. The durability and convenience to the consumer can be improved by using this type of vehicle. Charging of Lead acid batteries can be done through solar charging scheme and wind turbine. This methodology of design can be relevantly adopted and verified for three-wheeler and four-wheeler vehicles in future.

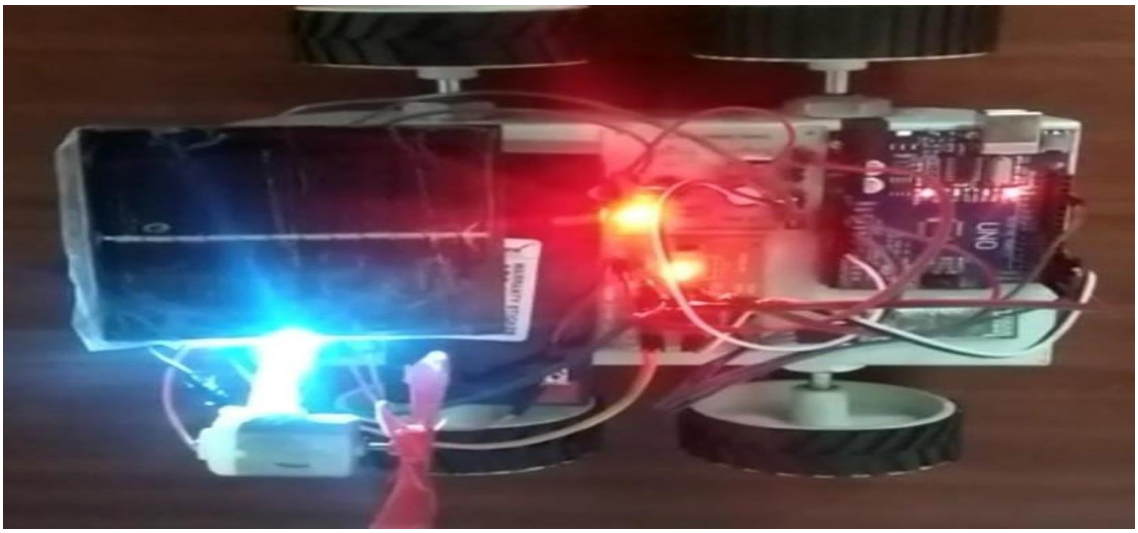

Fig 2: Developed Model of Solar and Wind Powered EV

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