GREEN VEHICLE

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Abstract

With the conventional nonrenewable sources of energy nearing depletion, the world is on a lookout for alternate source of renewable energy. The problem plaguing the world is pollution and its ill effects. The automotive industry, highest guzzler of nonrenewable sources and one of the highest polluting source, needs to shift its focus towards the renewable fuels to escape the energy crisis and the perils of pollution. The green vehicle is a solution designed, having these problems in mind.

Green vehicle is powered using solar energy, wind energy, regenerative braking and external electric power supply. The energy is stored in a battery, which drives the motor through a speed controller. The battery and motor are connected by means of a regenerative braking setup, so that the energy spent can be captured again and can help in increasing the efficiency of the three wheeler.

Keywords- *Solar, Wind, Regenerative braking, Electric vehicle*

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1. INTRODUCTION

Energy keeps the world moving currently, the world relies mostly on energy of fossil fuels, a nonrenewable source of energy. From domestic to industrial applications, we need them in every walk of our life. They have become an integral and indispensable part of our life. But they are very limited in nature and they are nearing their extinction in this century [1-2] If they come to an end, world would come to a standstill. Power crisis can also lead to various political issues that can threaten the survival of mankind.

Moreover, they have also been a leading source of pollution [3-16] which is one of the most alarming problems of this century. There are lot of problems like global warming, melting of polar ice caps and ozone layer depletion among many others. So, it is high time we fall back on alternate, renewable and clean sources of energy. In the current scenario, 'three wheeler' or the 'auto rickshaw' is one of the most common mode of transport. On an average, a three wheeler consumes more than three liters of diesel per day.

With millions of auto rickshaws plying, the fuel consumption by this class of vehicles alone amounts to millions of liters of diesel per day. It is also a vehicle whose speed does not matter much, unlike cars or other vehicles. Also that a three wheeler needs only one motor in contrast to the two motors used in heavy vehicles, which means that driving a three wheeler requires less power. There are three wheelers using LPG and CNG for fuel. But again they are asource of fossil fuels, irrespective of the fact that they reduce pollution. There are electric autorickshaws plying in some parts of the world. But the problem is that they have a charging time of 6-8 hours and cannot run continuously for more than 6 hours. Taking all the above points into consideration, we have come up with an idea of green vehicle a three wheeler which runs on solar, wind, regenerative braking and external power supply.

2. ENERGY SOURCES

2.1 Solar Energy

It is one of the key energy source of the vehicle. Monocrystalline solar panels are better than polycrystalline panels, as they have better power generation [17]. The panel is mounted flat over the vehicle top. If it is placed at an inclination, the alignment has to be changed for different times, which becomes a bit tedious. A tracking system also cannot be installed as the power required for lifting the panel would be more than the extra power gained by tracking, which means a loss of energy. On having an inclined roof, the other problem is the drag caused due to the inclination. This would be an obstruction for the movement of the vehicle, which means a loss of energy to overcome this obstruction. So rods are raised from the chassis and a solar panel is mounted over it.

2.2. Wind Energy

The wind energy is a varying but a continuous source of energy on earth. During rainy season, the output of the solar panel is very less, which means there has to be an another power source, that is dominant during rainy season. For this purpose, the wind power is used. There are two types of power generating wind turbines-vertical axis wind turbine (VAWT) and horizontal axis wind turbine (HAWT).But, HAWT is

considered to be better than VAWT in terms of energy produced[18]. The generation of energy from wind power requires high torque dynamo that can produce a considerable amount of voltage for each rotation of the blades. Connecting the shaft of the fan to the dynamo, if done using a belt drive could give rise to frictional losses and slippage between the two rotating arrangements. So a gear arrangement is preferred as it is compact and can produce better effects.

2.3 Regenerative Braking

It is a technology used in hybrid cars and electric vehicles. It uses the energy of the wheels to charge the battery. This energy is otherwise lost in the form of heat. It captures from10% to 25% of the energy which is lost in friction [19]. It is beneficial to be used in high torque vehicles with frequent start, stop operations. It needs a considerable speed and load, so that a fair amount of energy can be generated from this method. Considering the above mentioned points, an auto rickshaw is an ideal choice to have regenerative braking installed in it.

2.4. External Power Source

The power source in the present day scenario would be 220V,50 Hz AC supply. But this supply leads to a lot of conversion losses from AC to DC, thereby not getting the maximum output. There can be a provision of DC power outlets for charging the vehicles, once these vehicles become popular[20]. The fuel stations can integrate solar power and wind power as a part of their setup and can charge vehicles, which would mean charging using clean fuel. But for this to happen the rate of charging of batteries has to increase. Fast charging batteries are the need of the day in order for these vehicles to be a success.

3. BASIC BLOCK DIAGRAM

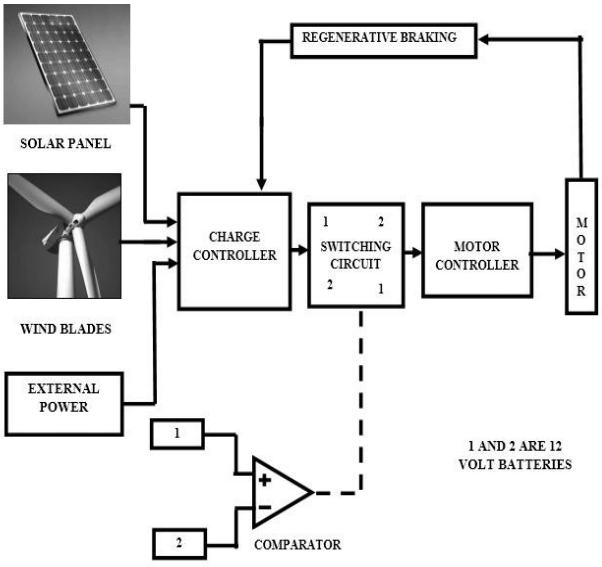

Fig. 1: Basic block diagram of green vehicle

The block diagram of the green vehicle is shown in Fig.1. The sources- solar, wind and external electric power are given to the charge controller. The charge controller charges the battery, which drives the motor. The motor speed is controlled by means of a motor controller. The motor is connected in such a way that energy lost in braking is captured in another battery by regenerative braking. There is a comparator and a switching circuit between the two batteries. It is the work of the comparator and the switching circuit to select the battery to run the motor. The two batteries have an indicator each to display the amount of charge. Initially the motor is driven by battery1 and the power from regenerative braking is stored in battery2.When the voltage in battery2 exceeds the voltage in battery1, then the battery2 starts running the motor and battery1 gets charged. There is a need for a motor controller to interface the battery with the motor so that the speed of the vehicle can be varied. The motor controller is a rheostat whose resistance can be varied thereby varying the current to the motor and thus the speed. It acts as a gear box in a conventional automobile.

4. DESIGN OF PROTOTYPE

Having in view of all the above points and information, we have designed a prototype of the green vehicle, the main consideration being that of the motor. We found that a DC motor with 12V, 500rpm and 10 kg-cm torque would suffice our application. Based on the motor, we obtained a battery which can run the motor at rated speed. The specification of the battery is 12V, 1.2AH. Now the battery asks for sources so that it can drive the motor. It has a 12V, 10W flat-mounted solar panel on its top. The wind fan is placed just below the solar panel. A three bladed fan is used for this purpose. The problem with the conventional wind energy producing setup is the energy loss caused due to the drag of the blades. But in this case, the fan is mounted in such a way that no loss is caused due to the drag force[21]. The blade angle is kept at 15 degrees [22]. The fan is then mounted on a stand and is attached to a dynamo rated 12V, 1A through a gear mechanism. The gear ratio selected is 4:1, so that the output is maximized .The output of the wind energy is given to the controller whose output is 12V. Both these power sources are connected to the battery. There is an auxiliary battery which can act as the load when the primary battery acts as a source. As mentioned above, we have used a comparator that can switch between the batteries running the prototype. The regenerative mechanism is also used in this. Apart from these, there is also a provision to charge it through an external 220VAC, 50Hz to 12V DC supply converter.

5. CIRCUITS:

5.1 Regenerative Braking

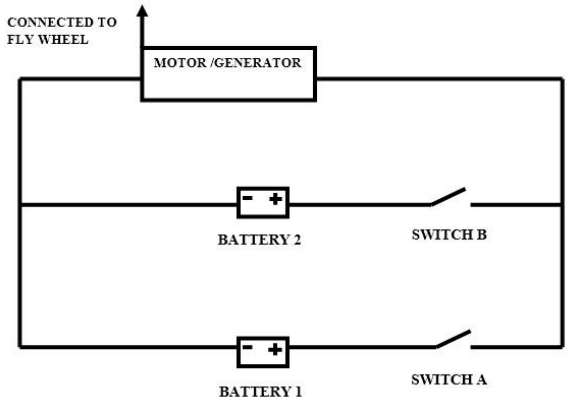

Fig. 2: Circuit diagram of regenerative braking

Regenerative braking is a technology to capture the energy lost in the form of friction when the vehicle stops. As illustrated in Fig 2, when the vehicle is in running condition, the switch A is closed and switch B is in open condition. This means that the vehicle runs in battery1.When the vehicle brakes, the switch A is opened and switch B is closed, thereby disconnecting the battery1 from the circuit and storing the energy obtained from the stopping of vehicle in battery2.If the motor runs in battery2 (energy previously stored from regenerative braking), then on decelerating, the energy is stored in battery1.The regenerative braking is to be controlled by means of a mechanical switch by the driver[23].

5.2 Speed Controller

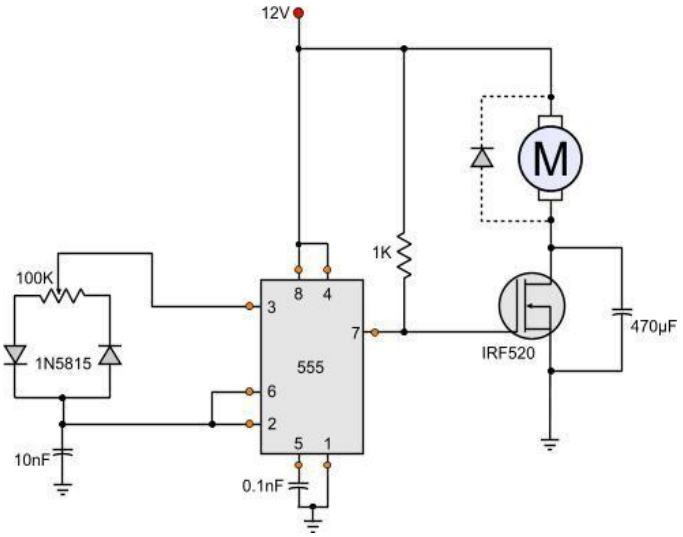

Fig. 3: Circuit diagram of speed control circuit

The speed controller is shown in Fig. 3[24] .It involves 555 timer used in astable mode. It acts as the gear box that can vary the speed in vehicles. The output of the controller is given to the motor. The input to the controller circuit is 12V.

5.3 Charge Controller

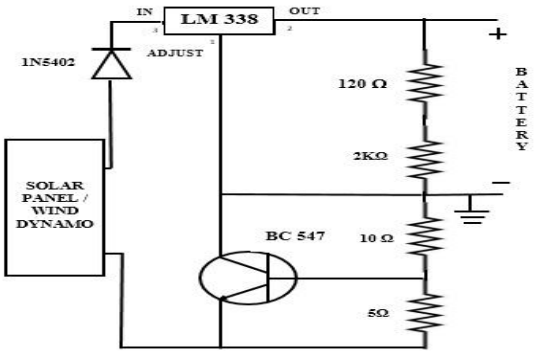

Fig 4: Charge controller circuit

The main purpose of this controller circuit, shown in Fig3, is to make the flow of current in a single direction. If this circuit is not used, back flow of current can take place driving the solar panel and dynamo from the battery as load. It also maximizes the maximum power input into the battery. The solar panel output is 12V which is given to the battery through a charge controller circuit. The wind has a very varying output. The output of wind is also connected to a charge controller of 12V. These two sources along with the external power source with input 220V/50HzAC and output 12V DC is connected in parallel to the battery which charge it. The external power source has an in built charge controller circuit in it.

6. PROTOTYPE

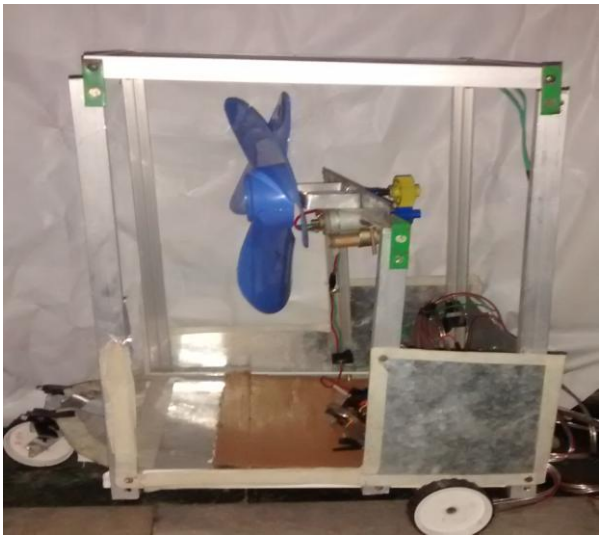

Fig 4: Side view of prototype

Fig 5: Front view of prototype

7. RESULTS

The vehicle was tested under various conditions and following are the results obtained from them:

7.1 Power Requirement

Input voltage for the motor	: 12V
Input current for each motor to carry load	: 0.3A
Total power consumed for one motor	: 3.6W
Number of motors used	: 2
Total power required	: 3.6 X 2=**7.2W**

7.2 Energy from Sources

Voltage from solar panel	: 19.5V
Current from solar panel	: 0.45A
Peak hours of solar input	: 6 hour
Average energy from solar panel /day	: 60Wh
Average energy from wind turbine/day	: 20Wh
Total energy input	: 80Wh

Runtime of the vehicle (theoretical)
Practical runtime : 10.5 hours

The results of the project were satisfactory which indicate the feasibility of the project. The output voltage from the solar panel was measured by placing the prototype under the sun and ensuring that no shading effects fall on the solar panel. Shading effect reduces the solar panel output. The output from wind was tested in such a way that it had some clearance before and behind it, in order to ensure flow of wind without disruption. The current output was measured in a no load condition by having zero load. This runtime of the vehicle is same as the average runtime of a three-wheeler. The output of the regenerative set up increases with load. For the small prototype, power produced is 0.2W and would be more efficient in case of a bigger model and could be stored in a battery for further use.

8. ADVANTAGES

These vehicles are the ones mankind would depend on for the future. They are clean, nonpolluting vehicles. They have very less maintenance cost involved. The prices of the fuels will no longer be a concern. The vehicular fares will come down by a great deal. It helps us to conserve the nonrenewable sources of energy. The problems involved with pollution will be completely eliminated. The sources, being abundant will serve as a perfect substitute to the fossil fuels in use today.

9. CONCLUSIONS

We believe this design is just a primitive step involved in designing and fabricating the automobiles of the future. Though it can be argued that the amount of energy generated is less, further improvements can be brought about by carrying out research in this field. If this vehicle becomes commercialized, it will be a one stop solution for all the problems that the world is worried of currently.

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