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The Possibility of Operating Electric Cars in the Weather Conditions of Chad

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Abstract- Numerous studies have been conducted on electric motor driven vehicles powered by different energy sources. Solar energy, fuel cells and super capacitors are a few alternative energy sources that can be used to power the motors of an electric vehicle. Several obstacles still remain in the way of popularizing electric vehicles, namely their range, and the time needed to recharge. In this research it is attempted to bring the electric car to a wider audience, by physically converting used automobiles to electric power and researching its potential as a fully electric automobile. A compact car was converted into a battery powered electrically driven automobile with minimum modifications to the original car. The engine of the car was removed but the original gear box was kept unchanged for more versatility.

Keywords- *Electric Vehicles; Recharge Timing, Photovoltaic, Solar Radiation.*

I. INTRODUCTION

From the beginning of the industrial revolution in Europe until today, the world has relied on fossil fuels for energy production [1]. Fossil fuels are an ever-diminishing resource, and their prices continue to rise and fall in a way that has a major impact on the economies of their producing and importing countries as well [2]. In recent years, after the spread of climate change and the impact of the glass house on the ground, much attention has been focused on the environmental impact of fossil fuels [3, 4]. Researchers have begun to find alternatives; including changing fuel from diesel and gasoline to environmentally friendly fuels such as biodiesel and hydrogen [5-10]. As these alternatives work to reduce the exhaust pollutants of compounds significantly, but does not help to reduce the damage and has a significant impact on agricultural production and the environment [11].

The trend towards renewable energy is a goal and a road map for researchers to reduce the effects of environmental damage caused by fossil fuel [12]. Solar energy is free, clean, and potentially powerful. Its applications have varied over the past years. They are used for heating water for household purposes [13], heating the air for comfort [14], and heating the houses with a Trombe wall [15, 16]. It is also used to produce electric power using solar chimney [17, 18], concentrating stations [19], and photovoltaic cells [20]. Photovoltaic technology is an advanced and flexible technology that can be used in populated and remote areas and can be used in the plain and mountain attached to the national grid or standing alone [21, 22]. It has also been used in the past two decades in generating electricity for medical clinics [23], running water pumps [24, 25], street lighting [26, 27], and power processing for communications towers [28, 29]. Solar cells, like other solar-related applications, are affected by air and weather conditions. They are strongly influenced by solar radiation [30], temperature [31], relative humidity [32], and wind speed [33]. The rise in cell temperature resulting from the transformation of most of the solar radiation falling on the solar panel into heat, which causes low productivity and solar cell efficiency, can be considered the biggest dilemma until recently [34, 35]. The researchers found an innovative way to reduce the heat of the photovoltaic cell and take advantage of the heat emitted from it in other applications [36, 37].

The transport sector accounts for 33% of all global CO2 emissions [38]. Local air pollution is a major issue in cities of both developed and developing countries [39, 40]. Fossil fuel is a finite resource. The peak of fossil fuel production has been predicted by many researchers and is estimated to reach its peak in the first half of the 21st century [41-45]. According to the regulations issued by the US Environmental Protection Agency (EPA), there are limits on the amount of CO, NO and S hydrocarbons and non-burning hydrocarbons that can be emitted per mile [46]. So, manufacturers are forced to manufacture vehicles with low carbon emissions [47]. Cars and heavy vehicles are the second largest source of air pollution because of pollutant emissions [48]. The trend to produce cars with zero pollution was the idea of researchers since the seventies of the last century [49]. Perhaps the most important result of this idea is the operation of internal combustion engines with hydrogen [50]. Several models of fuel-cell cars have also been sold to markets [51]. Finally there are electric cars and hybrids that combine two types of electric and fuel (fossil or alternative) [52]. Electric cars are completely silent during operation, show rapid acceleration and require less maintenance, but the distance traveled for each full charge of the battery is limited [53-55]. The time required to recharge the batteries was long compared to the refilling of a gasoline car or a diesel car in a few minutes [56]. This negative of this option is the need for a car with an internal combustion engine used for long journeys 57]. This is a major deterrent to middle-class buyers interested in the economy who cannot afford to buy two cars.

There have been many studies of electric motors powered by different power sources. Solar, fuel cells and superconductors are a few alternative energy sources and energy storage systems that can be used to operate electric motor vehicles [58-60]. Electric vehicles have the ability to be completely emission-free, because the source of energy from which electricity is generated can be renewable [61]. Electric vehicles are an excellent alternative to existing fossil fuel vehicles for several reasons. Electric vehicles do not produce exhaust emissions, and therefore do not cause local air pollution [62-65]. In addition, there is the possibility of imposing an electric vehicle using electricity produced by renewable energy sources [66]. The main engine of the electric vehicle is more efficient than the internal combustion engine, especially when the number of cycles per minute is reduced, moreover, the electric motors eliminates engine deceleration and facilitates the breaking of repetition [67].

Transforming an existing vehicle with an internal combustion engine into electrical power brings new possibilities and challenges. There is large proportion of vehicles in daily use,

particularly in developing countries for several decades. These compounds lack modern emission control systems and emit more pollutants into the atmosphere. However, a huge amount of energy has already been invested in the manufacture of these vehicles. Converting them to electric vehicles will save the energy required to manufacture the entire electric vehicles from scratch.

The Republic of Chad is located in Central Africa, southern Libya, is the fifth largest country in Africa in terms of area. Chad can be divided into several regions, such as the desert region in the north, the arid Sahel belt in the center and the most fertile Sudanese savannah in the south. Chad has the largest lake in Chad and the second largest wetland in Africa. The capital is N'Djamena, the largest city in country. Chad is a poor country because of its limited economic potential and the country generally depends on agriculture and grazing. Therefore, reducing dependence on oil and its derivatives will provide the state with great liquidity, which is in dire need for industrial and urban development and improvement of infrastructure [68-70].

In short, this project seeks to reduce the cost of the initial purchase of an electric vehicle by converting a used vehicle into electric power and improving the distance that can be moved under a single charge. Traditional cars have been converted into an electric powered vehicle. This was done while maintaining the structural integrity of the vehicle and recommended total car weight. This vehicle is currently being used to implement the different routes of the domain extensions that the search comes from.

II. EXPERIMENTAL SETUP

A. System principle of operation

Batteries are the leading concept on which the solar powered cars work. These batteries operate all the power, which enters and exit the system. This in return makes the car move. The patrol tank (gasoline tank) of a conventional car is also a battery pack of the solar powered car. Lead acid battery, nickel metal hybrid battery, nickel cadmium battery, lithium ion battery, and lithium polymer battery are the most common batteries used in the cars. The battery pack produces the needed system voltage that includes various singular cells and modules. The motor controller/balancer, peak power trackers, and a data acquisition system are power electronic systems. These power electronics are components that are needed in the working of the solar powered cars. The main functions are to control and monitor the electricity inside the system [10].

B. Description of the system

We used 60x59 PV Cell which provide 4.5 volts:

Rechargeable AA batteries which provide a supply of nearly 4.5 volts:

Figure 3: A Rechargeable batteries

Toy RC-Car to mount the PV and connect the charging circuit as main power source for the car:

Figure 4: RC-car

Two dc motors one for differential drive and one for steering the car with capacitor between each motor terminals to reduce noise:

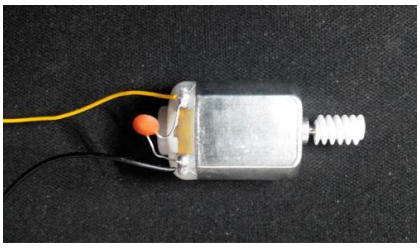


Figure 5: Toy small voltage DC motor

C. Control strategy of the system

The control process is as following:

1. The batteries supply voltage to car and works as a fuel.
2. Control circuit in the car operates when actuating signal is sent from remote control.
3. Over time the voltage drops in the batteries.
4. The solar PV compensates the voltage via charging circuit and maintains the voltage constant at the batteries.

Further improvements can be made by making the PV cell track the sunlight via LDR sensors to have the best efficacy for long distance trips in real world car.

D. Design of system parts

This part is mainly about the solar PV specifications and circuits which is the main supply of the car circuit:

PV Cell: Table 1 lists the specifications of the used PV module

Table 1: solar PV cell specifications

Peak Power Watt	0.4
Open circuit voltage (Voc)	6.0V
Peak voltage (Vmp)	4.5V
Short Circuit current (Isc)	100mA

Peak Current (Imp)	90mA
Output Tolerance	±10%
Operating Temperature	-20 C° to +85
Storage temperature	-5 C° to +45

Charging circuit

A rechargeable battery provides a fairly consistent output voltage. We use the solar panel to charge up a NiMH rechargeable battery.

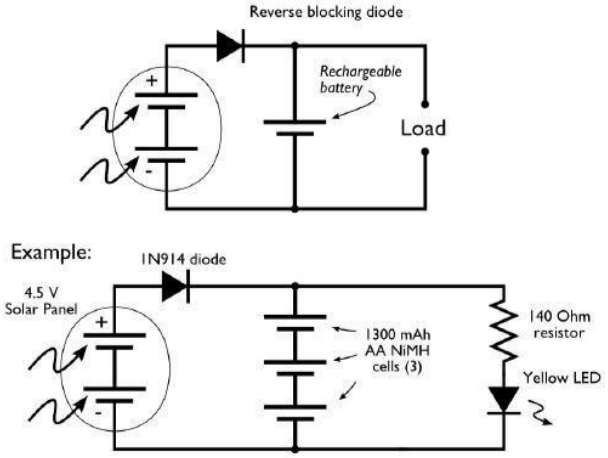
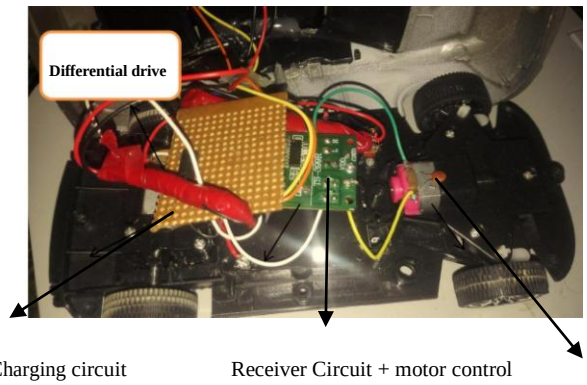


Figure 6: charging circuit schematic

Project Prototype



Charging circuit Receiver Circuit + motor control Steering motor

Figure 7: final look of inside circuit

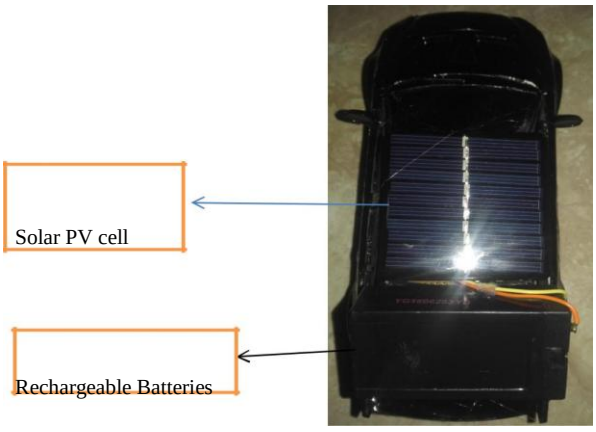


Figure 8: Outside look of the car

CONCLUSION

It can be concluded that the conversion of a conventional gasoline powered automobile into battery powered electrical vehicle can be done with minimum modifications to the original vehicle. The conversion should be done to match the performance of either the original vehicle or a desired driving cycle. In this project we implement this concept in small RC Car which shows this small modification to become environmental friendly.

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