

## Solar Powered Autonomous Vehicle for Green Campus Drive

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### Abstract

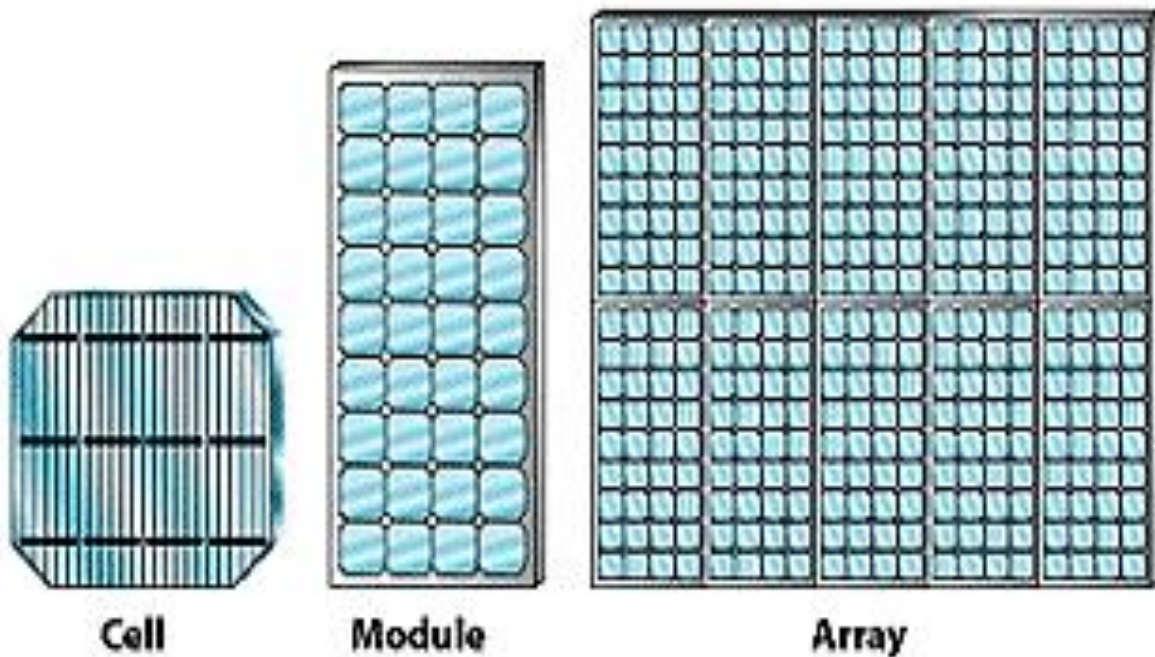
*In major cities, the pollution level is so high, due to vehicle emission, which contains the carbon monoxide responsible for the global warming as well as the diseases. This leads to a situation that the humans cannot live in those places. In major institutions with huge sprawling lands and buildings with various departments, people frequently uses vehicle for their movements which in turn increase the pollution. To overcome these issues, this work is aimed to design a solar powered autonomous vehicle which navigates in the presence of obstacles. Obstacle identification and evasion plays a vital role in the presentation of an independent vehicle. The vehicle is programmed to run on continuous scheduled trips and on demand trips. A mobile app has been developed to schedule on demand. The vehicle navigates itself by predefined routes and follows the path. IR and ultrasonic tracking and obstacle detection technology makes the vehicle to stay on their path and avoiding collision. The sensor in the vehicle detects the presence of an obstacle. Aluminum is preferred for the main body of the vehicle. This study presents the design and fabrication of the vehicle which comprises of both mechanical and electrical components. The entire unit consists of a microcontroller, sensors, motors solar panels, batteries, power supply and wheels. The overall outcome of this work will be reduction in pollution and easy navigation for all the stakeholders. This pilot project shall increase the use of autonomous solar vehicle for institutions, hospitals and industries where the predefined movements of human and goods are largely encouraged. The designed vehicle is capable to navigate on the basis of decisions taken autonomously.*

**Keywords:** Autonomous solar vehicle, mechanical design, solar panel

### INTRODUCTION

The electric vehicle was popular in the early twentieth century and declined in the market after World War I due to massive discoveries of crude oil and cheap gasoline. After 100 years, the electric vehicle is emerging into the market. Today's world is facing depletion of crude oil supplies and increasing carbon dioxide in the atmosphere by fossil fuel burning. Total carbon dioxide emission from fossil fuel burning reached 28 billion metric tons in 2005 and the emission has resulted in the increase of carbon dioxide concentration from 280 to 396ppm in the atmosphere. World is looking an alternate energy for the transportation, which is pollution free, reduction of price and

environment friendly. It can be achieved with electric vehicle where the energy is supplied by solar. For a smooth run, wireless telemetry is used. Solar array as shown in Fig. 1 uses photo voltaic cells which convert sunlight into electricity [8]. Crystalline silicon is used due to high efficiency rate of 15–20%. The maximum power output from the arrays is around 2 kilowatts (2.6hp). The arrays are fixed on the vehicle body. The wireless telemetry incorporated monitors the energy consumption and all other relevant parameters. The parameters vary with respect to sunlight. The solar panel of each having the power of 10 KW is connected in parallel.



*Figure 1: Solar cell, module and array structure.*

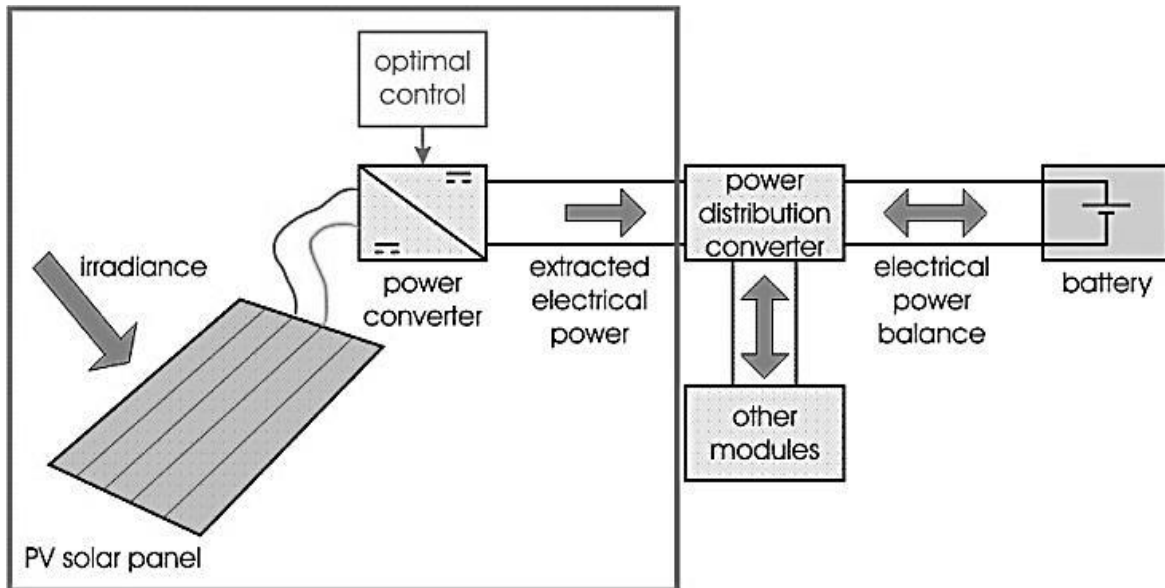
### LITERATURE SURVEY

Solar energy is one of the renewable sources of energy which can be exploited in order to meet the power demands, but the solar energy is not utilized fully. So, there is a need for developing a system which can utilize solar energy to the maximum level. The solar powered autonomous vehicle uses solar panels which converts the solar energy into electrical energy. The converted energy is then stored in batteries. The vehicle is run by the energy that is stored in the batteries [1]. In existing solar vehicle, it is either one seater or double seater, no pre-defined paths are available in the existing vehicle [4]. The issue in the vehicle is the safety and will not be able to hold up safety in the event of an accident [2]. There is no solar vehicle that absorbs the solar radiation 100% till now, all vehicle companies are concentrating on developing the autonomous solar vehicles because it will make a big revolution in the automobile industry and companies believe that the future will depend on electric vehicles. In [3], Permanent Magnet

DC (PMDC) motor, rheostat control, batteries, solar panel, throttle, motor controller are used. PMDC motor is attached to the wheels and the speed of the bike is controlled by controlling the speed of the motor using a control unit and the throttle arrangements [4, 5]. The disadvantage of this solar electric bike is that the speed and the efficiency is less and also the motor seater is only on where the movement of the vehicle is manual.

### Proposed hardware design and implementation

In this proposed work, the vehicle is designed to use solar energy for its movement. Also, it has a facility to detect the objects and obstacle in the running path [9]. The vehicle design to operate automatically for running on pre-defined path which is stored in the processor. The schedule of trip can also be intimated by the mobile app called "CAB". The solar powered autonomous vehicle is designed for large campus such as industry, institute and hospitals. The prototype is designed and tested.



**Figure 2:** Block diagram of the hardware design.

A reduced scale of the proposed vehicle consists of an aluminum frame holding the solar panel, batteries, two independently driven wheels and four printed circuit boards (PCBs) housing the power electronic circuits and control software. The design consideration as shown in Fig 2 is done with the weight of the materials or humans and the motor has to be selected as per requirement. The prototype vehicle designed consists of components like solar panel, battery; 60 RPM geared motor, programmable interface controller (PIC) microcontroller, relay, and IR sensor circuit with transmitter and receiver for obstacle detection, LCD display. The designed vehicle shall be attached with the Arduino UNO and some electronic components for the purpose of vehicle to run in pre-defined autonomous path. GPS helps the vehicle to follow the correct route that to be travelled by the vehicle. The mobile application called 'CAB' will be useful for the persons for booking the cab to reach the destination point. The solar panels are mounted on top of the vehicle which converts solar energy into electrical energy.

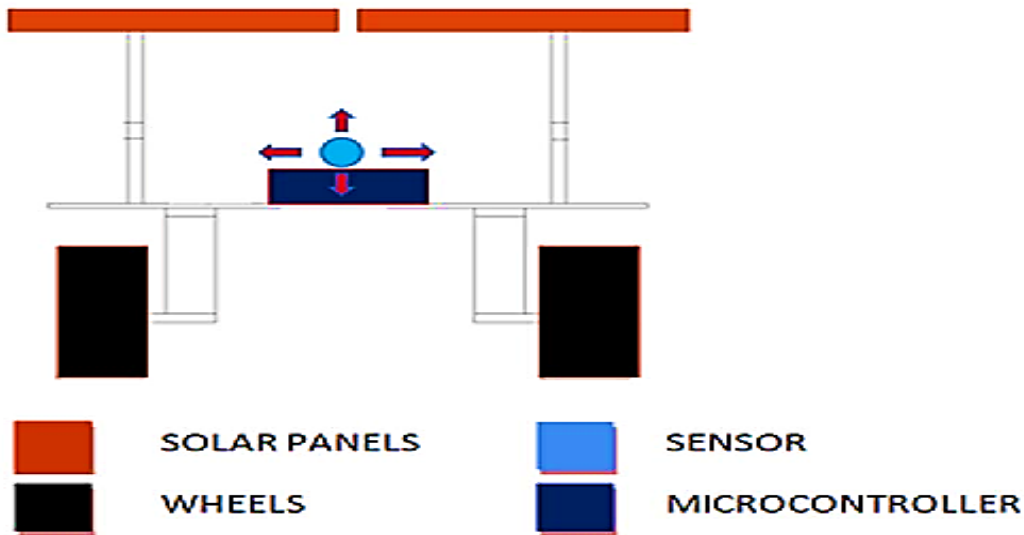
This obtained electrical energy is passed to the 12V rechargeable lead acid batteries.

The battery is used for the purpose of storing the electrical energy. This stored electrical energy is used to run the wheels attached with the 60 RPM geared DC motor which changes electrical energy kept on mechanical energy. Due to the mechanical force the motor gets rotated. As the DC motor is connected with the wheels, the vehicle will move automatically when the main switch is in 'ON' position. The LCD display connected with the PIC microcontroller shows that the vehicle is moving in the forward direction.

The mechanical design is shown in Fig. 3 for the purpose of obstacle detection IR sensor is used. The IR sensor is attached with the PIC microcontroller. Once the obstacle is detected, the vehicle gets stopped and, the signal from the IR sensor goes to the PIC microcontroller and then relay starts get operated. On detecting the obstacle, the vehicle first moves to the right direction of the obstacle for some distance and then goes in the forward path, then moves to the left side of the obstacle for some distance and follows the designed path. It moves away from the obstacle by certain distance and follows the line path as coded in the PIC microcontroller. As it

is travelling in a closed path inside the campus and when it finds any pre-defined stop, the vehicle will be stopped for particular time mentioned in the program and then the vehicle starts and follows the pre-defined path. A rechargeable lead acid battery of 12V is used in this project.

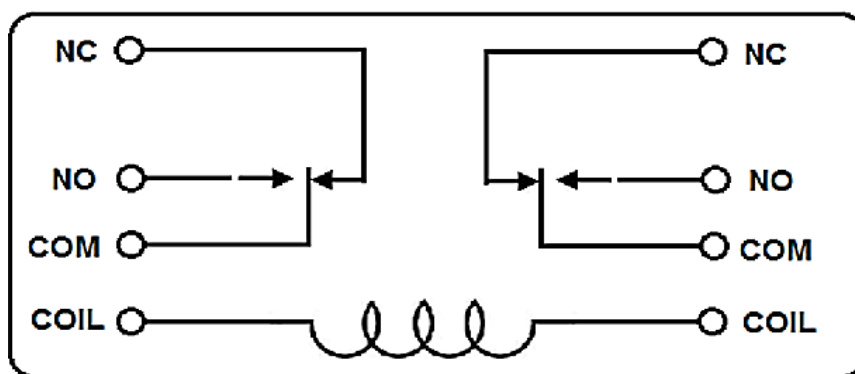
Motor used is 12V 60 RPM geared DC motor which is of high quality and low cost. Motor shaft is connected to wheel for the movement of the vehicle. At the backside of the vehicle, 2 wheel connected with motor is used and in the front side one ball wheel is connected.



*Figure 3: Mechanical design of the proposed system.*

PIC microcontroller is a processor with built in memory and RAM and used to control the project [6, 7]. So it protects in building a circuit that has distinct outside RAM, ROM and peripheral chips. IR

sensors detect obstacles with reference to the wavelengths ranging from 0.7 to 1000 microns. This emits radiation temperatures detected by IR sensors. Relay configuration is shown in Fig. 4.



○ represents the terminals of the relay

*Figure 4: Relay circuit.*

An LCD which is a flat panel display that consists of two glass panels, with the liquid crystal material sandwiched in between them produces a visual image.

## RESULTS AND CONCLUSION

The solar powered electric vehicle runs on a solar power which helps the campus to make a pollution free green campus. The 20W panel helps the vehicle to run and the

energy is stored in the battery for later use. The battery gets fully charged in 10 hours and gets discharged in 8 hours. The vehicle will run at a speed of 10kmph. The battery will be continuously charging when the vehicle is at rest. There is no direction-finding wheel or physical device, basically a start key and a stop key. This autonomous vehicle will be used to reduce the pollution and helps in avoiding the accidents.

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