

# Arduino Based Battery Operated Vehicle

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*Abstract:* Solar-powered cars run on clean energy produced when sunlight strikes a solar panel which is mounted on the car. These cars blend engineering from the automotive, aerospace, bicycle, and alternative energy sectors. The energy input determines the solar car's design, with some being created for general usage and others for racing. Photovoltaic (PV) cells are used in solar vehicles to convert sunlight directly into electrical energy. PV cells have an efficiency rate of 15-20% and are made of semiconductor materials including silicon and alloys of indium, gallium, and nitrogen. The propulsion system in this technique is powered by a battery that is recharged by a solar array. The solar panel, battery, control system, and dc motors make up the drive system. Arduino, Motor Shield, and Bluetooth make up the controlling system unit.

**Keywords:** Arduino, DC Motor, Solar Panel, Battery, Solar vehicle

## I. INTRODUCTION

### 1.1 IMPORTANCE OF RENEWABLE ENERGY

A number of remedies, such as reforestation and restrictions on automobile usage, have been suggested to reduce air pollution. Since the 1990s, Japan has adopted extensive recycling and solar power, similar to China and Germany. Japan has the third-largest installed capacity and is the world's top producer of photovoltaics. After Fukushima in 2011, the nation's policy began to shift towards renewable energy sources, and solar power has become a significant national initiative in Japan. Vehicles are responsible for 22% of Beijing's overall pollution, whereas road dust and automobiles are a major source of pollution in Delhi's capital city.

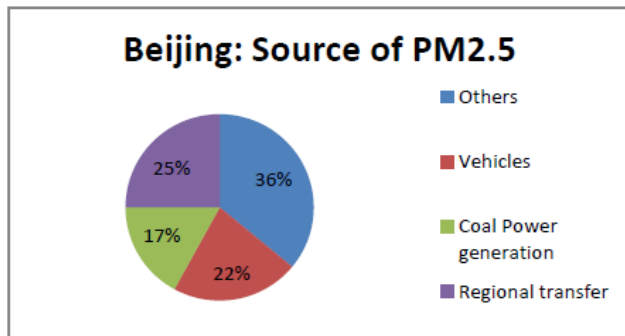


Figure 1: Beijing source

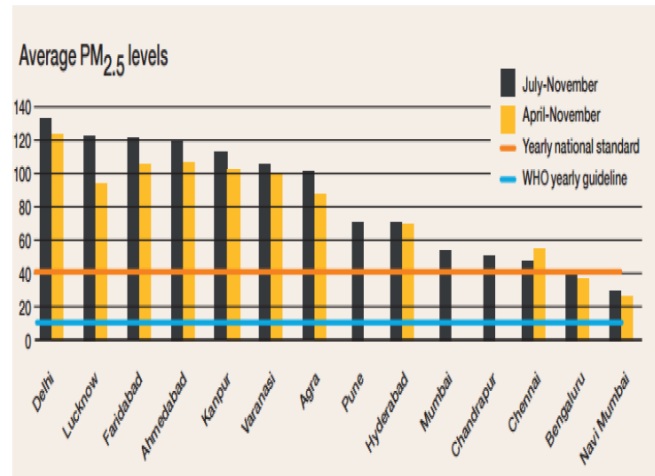


Figure 2: Pollution survey

### 1.2 SOLAR POWER

Solar power is the conversion of energy from sunlight into electricity, either directly using photovoltaic (PV), or indirectly using concentrated solar power. Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaic cells convert light into an electric current using the photovoltaic effect. The International Energy Agency projected in 2014 that under its "high renewables" scenario, by 2050, solar photovoltaics and concentrated solar power would contribute about 16 and 11 percent, respectively, of the worldwide electricity consumption, and solar would be the world's largest source of electricity. Most solar installations would be in China and India. Photovoltaics were initially solely used as a source of electricity for small and medium-sized applications, from the calculator powered by a single solar cell to remote homes powered by an off-grid rooftop PV system. As the cost of solar electricity has fallen, the number of grid-connected solar PV systems has grown into the millions and utility-scale solar power stations with hundreds of megawatts are being built.

Solar PV is rapidly becoming an inexpensive, low-carbon technology to harness renewable energy from the Sun.

### 1.3 SOLAR POWERED CAR

A car powered by solar energy is a vehicle that uses a type of renewable resource that can be obtained when sunlight incident on the solar panel placed on the surface of the vehicle. Solar cars combine technology typical aerospace, bicycle, alternative energy and automotive industries. The design of a solar vehicle is severely limited by the amount of energy input into the car. Most solar cars have been built for the purpose of solar car races. Some solar cars are designed also for public use.

Solar cars depend on a solar array that uses photovoltaic cells (PV cells) to convert sunlight into electricity. Unlike solar thermal energy which converts solar energy to heat for either household purposes, industrial purposes or to be converted to electricity, PV cells directly convert sunlight into electricity. When sunlight (photons) strikes PV cells, they excite electrons and allow them to flow, creating an electric current. PV cells are made of semiconductor materials such as silicon and alloys of indium, gallium and nitrogen. Crystalline silicon is the most common material used and has an efficiency rate of 15-20%. The first solar family car was built in 2013.

### 1.4 PROPOSED MODEL

This method consists of drive system powered by a battery which is charged through a solar array as per the diagram in Figure 3. The drive system consists of solar panel, battery, controlling system and dc motors. The controlling system unit consists of Arduino, Motor shield and Bluetooth. While considering this model, less importance is given towards the safety of the driver and monitoring the performance of the vehicle. The conventional solar vehicle is designed merely a simple mode of transport. It ensures limited safety and comfort to the driver.

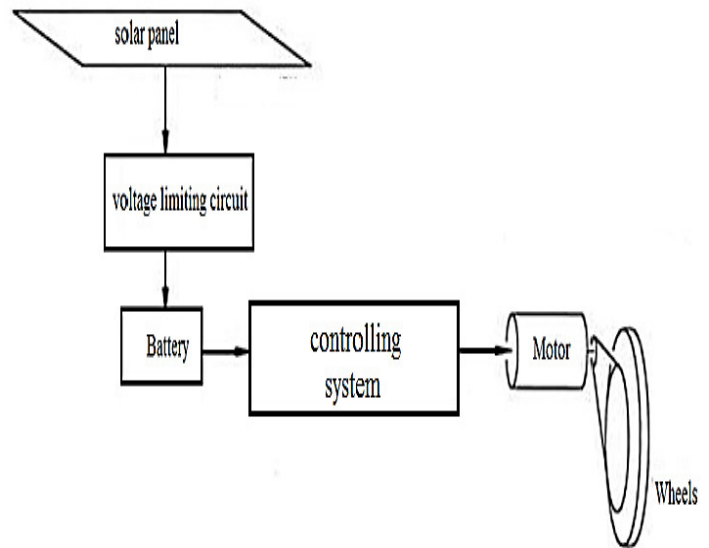


Figure 3: Diagram of proposed model  
The proposed model is designed in such a way that it achieves all the mentioned objectives by adding various features to the conventional solar vehicle design. The additional features are mentioned below.

1. Safety features
2. Emergency shutdown system
3. Driver vital monitoring

The above-mentioned parameters are monitored using sensors and a microcontroller with built in Bluetooth module and data is uploaded to the cloud.

### 1.5 OBJECTIVE

This Project gives a design of more sophisticated safety features and means of monitoring the vehicles performance and drivers vitals. This design also adds remote monitoring facility to monitor the vehicle and the driver via cloud.

### 1.6 TECHNOLOGY USED

ARDUINO which is an open source hardware and software used for the code computing & monitoring application in the design. The controller i.e. Arduino which has inbuilt Bluetooth module and facility to be programmed via cloud is registered to this cloud. The program which is included in the device for communication purpose. An android app of the same cloud is used to monitor the data via Smart phones.

## 2. BACKGROUND

In [1] “AbhinyaChaturvedi, KirtiKushwaha, ParulKashyap, Dr.J.P.Navni of Electrical & Electronics Department, Raj Kumar Goel Institute of Technology for Women, Ghaziabad, India”. Year: April 2017 Paper is about solar powered vehicle. This survey aims at reducing fuel cost and to use hybrid technologies including the possibilities of hydrogen fuel. The paper also explains about the history of solar vehicles and development of a telemetry system where solar power cars can serve for better understanding of energy usage in vehicles and the aspects applicable to electric vehicle as a whole. The review work is the study of all previous works related to the electric and solar cars have been done. Solar powered vehicle is a three-wheel drive and has been used for shorter distances. The main concentration was made on improving the design and making them cost effective. Energy from Sun is captured by the solar panels and is converted to electrical energy. The electrical energy thus obtained is being fed to the batteries that get charged and is used to run 24 V DC high torques DC series motor. The shaft of the motor is connected to the rear wheel of the vehicle through chain sprocket. The batteries are initially fully charged and thereafter they are charged by panels. They are used for charging the batteries. The batteries which we are using are lead acid batteries which are of 48V rating each of 12V. The motor’s rating is of 48V which gets charged through the four 12V batteries. The belt used in our project is a timing belt which has teeth that fit into a matching toothed pulley. When correctly tensioned, they have no slippage, run at constant speed, and are often used to transfer direct motion for indexing or timing purposes. They are often used in lieu of chains or gears, so there is less noise and a lubrication bath is not necessary. Timing belts need the least tension of all belts, and are among the most efficient. We have laid emphasis on the economical part so that it can be used to cover short distances without consuming energy from external sources and at the same time keep the environment pollution free.

In [2] “Intelligent automatic car based on voice recognition system” by WindaAstuti; E. ByanWahyuRiyandwita in 2017 IEEE Student Conference on Research and Development (SCOReD) Year: 2017 A vehicle key provides the main functions for accessing the vehicle, accessing the ignition mechanism, and the ability to actually start the car. Voice based starting engine access control system potentially replaces these main functions by replacing the key with the specific user voice. In the proposed system, the access may be authorized simply by means of an enrolled user speaking into a microphone attached to the system.

In [3] “Performance enhancement of Solar Vehicle by integration of supercapacitors in the energy storage system” by ZinebCabrane; Mohammed Ouassaid; Mohamed Maaroufi 2016 International Renewable and Sustainable Energy Conference (IRSEC) Year: 2016 To improve the performance of Solar Vehicle (SV), supercapacitor has been used as an auxiliary energy storage system. Indeed, SCs are used as an energy storage device during fast power changes and recovers the braking energy to enhance the SV autonomy. In other hand, the batteries are used to meet the energy requirements for a relatively long duration and to store the excess of energy.

In [4] “Design of an arduino-based smart car” by Zhao Wang; Eng Gee Lim; Weiwei Wang; Mark Leach; KaLok Man, 2016 International SoC Design Conference (ISOCC). Year: 2016 Remote-controlled cars are one of the most popular toy products currently on the mass market. Each series of car has a specific remote-control unit. This presents the consumer with a critical problem; obtaining a substitution controller where the original control unit has broken down. In this work a robot based on an external Arduino microcontroller, controllable by an Android application via Bluetooth, which can be recommended as a prototype for the combination of embedded systems with Android mobile devices is investigated.

## 3. DESIGN SPECIFICATIONS

### 3.1 ANDROID APPLICATION

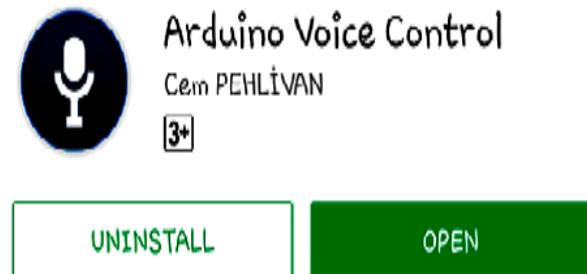


Figure.4 Android application

Android studio isn't really required here, since I will provide you with the Android application that I made. You can install the given .apk file to use the application. There are three main parts to this project. An Android smartphone, a Bluetooth transceiver, and an Arduino. HC 05 works on serial communication. The Android app is designed to send serial data to the Arduino Bluetooth module when a button is pressed on the app. The Arduino Bluetooth module at the other end receives the data and sends it to the Arduino through the TX pin of the Bluetooth module (connected to RX pin of Arduino). The

code uploaded to the Arduino checks the received data and compares it. You can open the serial monitor and watch the received data while connecting.

### 3.2 BRUSHLESS DC (BLDC) MOTOR

DC motor: A DC motor is an electric motor that runs on direct current (DC) electricity. DC Motor Connections: Figure shows schematically the different methods of connecting the field and armature circuits in a DC Motor. The direction of the arrows indicates the direction of the magnetic fields.

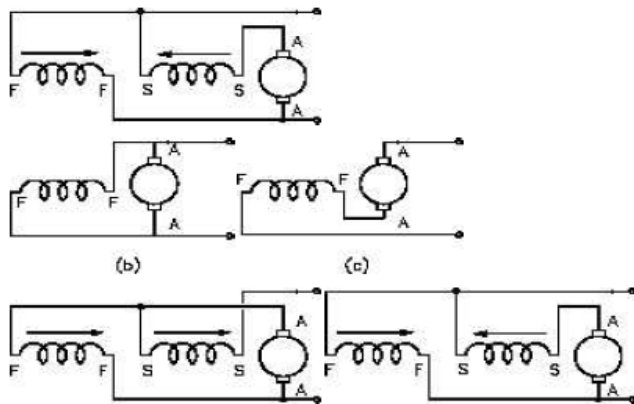


Figure 5 DC motor connections

### 3.3 SOLAR PANEL

Solar panel as represented in Figure 4.4 refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating. A photovoltaic (PV) module is a packaged; connect assembly of typically 6x10 photovoltaic solar cells. Photovoltaic modules constitute the photovoltaic array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions (STC), and typically ranges from 100 to 365 watts. The efficiency of a module determines the area of a module given the same rated output – an 8% efficient 230 watt module will have twice the area of a 16% efficient 230 watt module. There are a few commercially available solar modules that exceed 22% efficiency and reportedly also exceeding 24%. A single solar module can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes an array of photovoltaic modules, an inverter, a battery pack for storage, interconnection wiring, and optionally a solar tracking mechanism.



Figure 6 Solar panel

### 3.4 CIRCUIT CONNECTION

The connections are made as per the above shown figure 7. Arduino board has total 28 pins. The Bluetooth has total 6 pins, two pins are not connected to any parts and these pins are released to the air for the communication purpose. The remaining four pins are connected to the Arduino. Motor shield is placed directly on the top of the Arduino. All the pins of the Arduino are connected to the Motor shield.

As shown in the figure 7 the motors are connected to the shield m1, m2 or m3, m4 pins respectively. As we know that Vcc and Gnd of the module goes to Vcc and Gnd of Arduino. The TXD pin goes to RXD pin of Arduino and RXD pin goes to TXD pin of Arduino i.e. (digital pin 0 and 1). as shown below.

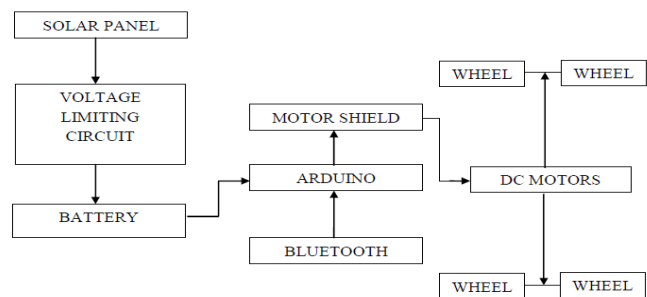


Figure.7 Block Diagram of Arduino Based Solar Vehicle

Solar panel is a device that converts solar energy into electrical energy which is the main power source for our the system, in order to store the power the lead acid battery is connected which is the backup for the whole system. We know that if sudden increase in the power supply, there would be a chance of

occurring the fault which can damage the system to avoid and maintain we are providing a voltage limiting circuit which can limit the voltage and provide the necessary voltage. The battery is connected to the Arduino, which is the essential part of the system which will be controlling the whole system accordingly, it will be controlling the motors and provide the direction to the motors, As Arduino cannot provide the required amount of the supply to run the to the motors to provide necessary supply Motor shield is used which is connected between the Arduino and motors.

The Bluetooth is the source for connecting to the system in order to give the voice command which is nothing but the monitoring of vehicle. Bluetooth is connected to the Arduino. While installing the program into the Arduino RX and TX pins are removed. The Bluetooth is paired to the android phone and through that we are controlling the system. From the motor shield the supply is directly given to the dc motors and the four wheels are connected to the respective motors.

The Arduino UNO is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The UNO differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

#### 4. CONCLUSION

Integrating features of all the hardware components used have been developed in it and using solar as a main source for the vehicle to run though voice command successfully. Presence of every module has been reasoned out and placed carefully, thus contributing to the best working of the unit. Secondly, using highly advanced IC's with the help of growing technology, the project has been successfully implemented. Thus the project has been successfully designed and tested.

Arduino platform has done is to take what was once a fragmented and expensive market for robotics and microprocessors and become the major platform, largely by virtue of much lower cost and ease of use, leading to higher volume and popularity, and community support behind it.

Arduino has made it simple to program their boards with any computer via USB and simple to integrate with a wide array of sensors and devices. In future much more parameters can be

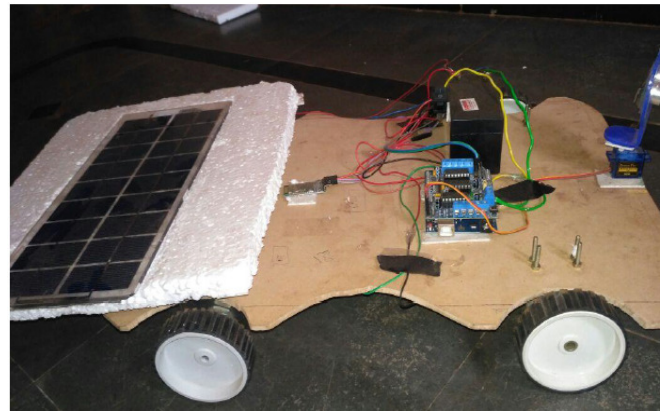


Figure.8 Prototype of the system

added to this project like accelerometers, sensors, in order to reduce cost and more economical. At this point in time many businesses haven't heard of and aren't using the Arduino, but we believe that will change pretty quickly as businesses eventually hire people familiar with Arduino.

#### REFERENCES

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