Project Synopsis

on

(SOLAR BICYCLE)

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by

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Introduction to Solar Bicycle

A method of upgrades a conventional electric powered bicycle over to Solar-Powered Electrical Bicycle that is powered by an electric motor which gets its supply from photovoltaic (PV) panels. The PV panels must be mounted and installed at the bicycle without compromising riding comfortability. The method employs a small electric motor that are easily connected and separated for ease of transport. A solar collector is connected to the rechargeable batteries for collecting solar energy and converting such energy to electrical power that is delivered to the rechargeable batteries for recharging thereof. A rechargeable battery is operable connected to DC motor for providing electrical power to drive the motor.

Fig: Solar Bicycle

The solar assisted bicycle dev eloped is driven by DC motor fitted in front or rear axle housing & operated by solar energy. The solar panels mounted on the carriage will charge the battery & which in turn drive the hub motor. When the bicycle is idle, the solar panel will charge the battery. This arrangement will replace the petrol engine, the gear box & the fuel tank in case of a two wheeler or a chain sprocket, chain & gear shifting arrangement of a conventional bicycle being used by most common man. As a part of dissertation work, the solar assisted bicycle is fitted with a dc hub motor on front axle of a bicycle with power rating of 250W and with a travelling speed of around25-30 kmph. It is provided with a pair of lead acid batteries of 35mAh each, a photovoltaic solar panel with capacity of 20 watt, a voltage regulator of 24v 10 Amp, accelerator and motor controller of 24v 25Amp. There is also a provision for charging of the battery with 220-240V, AC wall outlet supply, in case of poor solar supply due to cloudy weather.

1. Classes of the solar Bicycle:

E-bikes are classed according to the power that their electric motor can deliver and the control system, i.e., when and how the power from the motor is applied. Also the classification of e-bikes is complicated as much of the definition is due to legal reasons of what constitutes a bicycle and what constitutes a moped or motorcycle. As such, the classification of these e-bikes varies greatly across countries and local jurisdictions. Despite these legal complications, the classification of e-bikes is mainly decided by whether the e-bike's motor assists the rider using a ***pedal-assist*** system or by a ***power-on-demand*** one.

Definitions of these are as follows:

- With **pedal-assist** the electric motor is regulated by pedalling. The pedal-assist augments the efforts of the rider when they are pedalling. These e-bikes – called pedicels – have a sensor to detect the pedalling speed, the pedalling force, or both. Brake activation is sensed to disable the motor as well.
- With **power-on-demand** the motor is activated by a throttle, usually handlebar-mounted just like on most motorcycles or scooters.

Therefore, very broadly, e-bikes can be classed as:

- *E-bikes with pedal-assist only*: either *pedelecs* (legally classed as bicycles) or *S-Pedelecs* (often legally classed as mopeds)
    - *Pedelecs*: have pedal-assist only, motor assists only up to a decent but not excessive speed (usually 25 km/h), motor power up to 250 watts, often legally classed as bicycles

- *S-Pedelecs*: have pedal-assist only, motor power can be greater than 250 watts, can attain a higher speed (e.g., 45 km/h) before motor stops assisting, legally classed as a moped or motorcycle (**not** a bicycle)

E-bikes with power-on-demand and *pedal-assist*

E-bikes with power-on-demand only: often have more powerful motors than pedelecs but not always, the more powerful of these are legally classed as mopeds or motorcycles

Pedal-assist only

E-bikes with pedal-assist only are usually called *pedelecs* but can be broadly classified into pedelecs proper and the more powerful S-Pedelecs.

Pedelecs:

The term "pedelec" (from **ped**al **ele**ctric **c**ycle) refers to an e-bike where the *pedal-assist* electric drive system is limited to a decent but not excessive top speed, and where its motor is relatively low-powered. Pedelecs are legally classed as bicycles rather than low-powered motorcycles or mopeds.

The most influential definition which distinguishes which e-bikes are pedelecs and which are not, comes from the EU. From the EU directive (EN15194 standard) for motor vehicles, a bicycle is considered a pedelec if:

1. the *pedal-assist*, i.e. the motorised assistance that only engages when the rider is pedalling, cuts out once 25 km/h is reached, and
2. when the motor produces *maximum continuous rated power* of not more than 250 watts (n.b. the motor can produce more power for short periods, such as when the rider is struggling to get up a steep hill).

An e-bike conforming to these conditions is considered to be a pedelec in the EU and is legally classed as a bicycle. The EN15194 standard is valid across the whole of the EU and has also been adopted by some non-EU European nations and also some jurisdictions outside of Europe (such as the state of Victoria in Australia).[13]

Pedelecs are much like conventional bicycles in use and function — the electric motor only provides assistance, most notably when the rider would otherwise struggle against a headwind or be going uphill. Pedelecs are therefore especially useful for people living in hilly areas where riding a bike would prove too strenuous for many to consider taking up cycling as a daily means of transport. They are also useful when it would be helpful for the riders who more generally need some assistance, e.g. for elderly people.

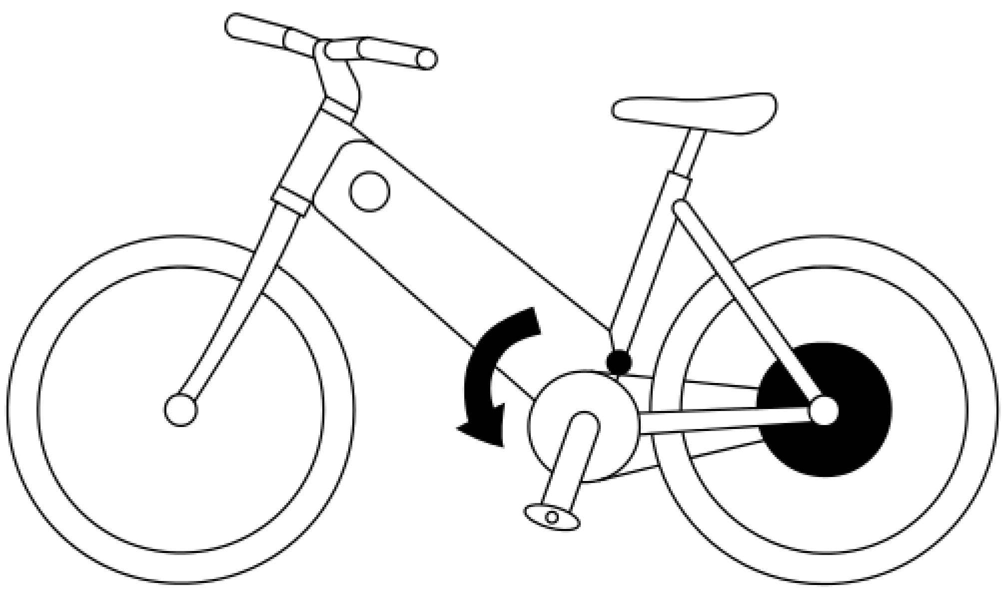

Fig: Pedelecs

S-Pedelecs

More powerful pedelecs which are not legally classed as bicycles are dubbed **S-Pedelecs** (short for *Schnell-Pedelecs,* i.e. Speedy-Pedelecs) in Germany. These have a motor more powerful than 250 watts and less limited, or unlimited, pedal-assist, i.e. the motor does not stop assisting the rider once 25 km/h has been reached. S-Pedelec class e-bikes are therefore usually classified as mopeds or motorcycles rather than as bicycles and therefore may (depending on the jurisdiction) need to be registered and insured, the rider may need some sort of driver's license (either car or motorcycle) and motorcycle helmets may have to be worn.[14]

Power-on-demand and pedal-assist

Some e-bikes combine both pedal-assist sensors as well as a throttle. An example of these is the *eZee Torq*[15] and Adventure 24+ by BMEBIKES.[16]

Power-on-demand only

Some e-bikes have an electric motor that operates on a **power-on-demand** basis only. In this case, the electric motor is engaged and operated manually using a throttle, which is usually on the handgrip just like the ones on a motorbike or scooter. These sorts of e-bikes often, but not always, have more powerful motors than pedelecs do.

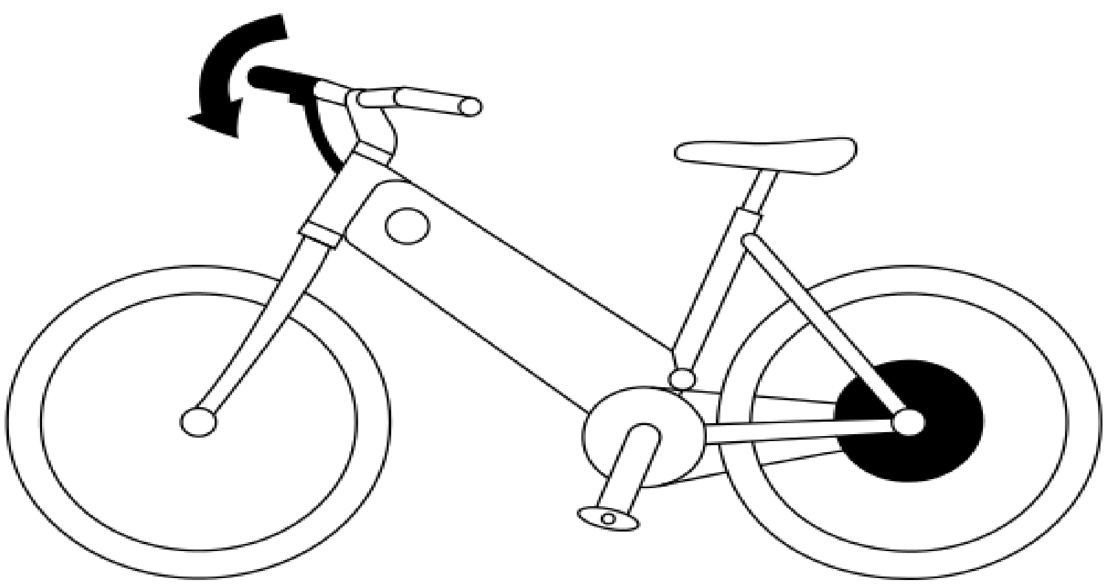

Fig: S- Pedelecs

With *power-on-demand only* e-bikes the rider can:

1. ride by pedal power alone, i.e. fully human-powered.
2. ride by electric motor alone by operating the throttle manually.
3. ride using both together at the same time.

Some power-on-demand only e-bikes can hardly be confused with, let alone categorised as, bicycles. For example, the *Noped* is a term used by the Ministry of Transportation of Ontario for e-bikes which do not have pedals or in which the pedals have been removed from their motorised bicycle. These are better categorised as electric mopeds or electric motorcycles.

2. Basic terminology of Solar Bicycle:

I. **Direct Current (DC)** - Electric current in which the flow of electrons is in one direction only. Opposite of Alternating Current (AC).

II. **Array (Solar)** - Any number of solar photovoltaic modules or panels connected together to provide a single electrical output.

III. **Cell (battery)** - The basic unit of an electrochemical battery. A lead acid cell produces about 2.12 volts and a 12 volt battery uses 6 of these cells and fully charged measures about 12.72 volts.

IV. **Cell (solar)** - The basic unit of a photovoltaic solar panel. A 12 volt solar panel typically has 36 individual cells, a 24 volt solar panel uses 72 cells.

V. **Charge Controller** - An electronic device that regulates the voltage from the solar panel array to ensure maximum transfer of energy and prevent overcharging the battery bank.

VI. **Circuit Breaker** - A safety device used to stop the flow of electricity in an electric device or circuit to prevent damage or fire when an overload condition occurs.

VII. **Crystalline Silicon Photovoltaic Cell** - A type of photovoltaic cell made from a single crystal or a polycrystalline slice of silicon. Individual cells are then joined together to form a solar module.

VIII. **voltage regulator** -is an electronic circuit that provides a stable dc voltage independent of the load current, temperature and ac line voltage variations. A voltage regulator may use a simple feed-forward design or may include negative feedback. It may use an electromechanical mechanism, or electronic components. Depending on the design, it may be used to regulate one or more AC or DC voltages.

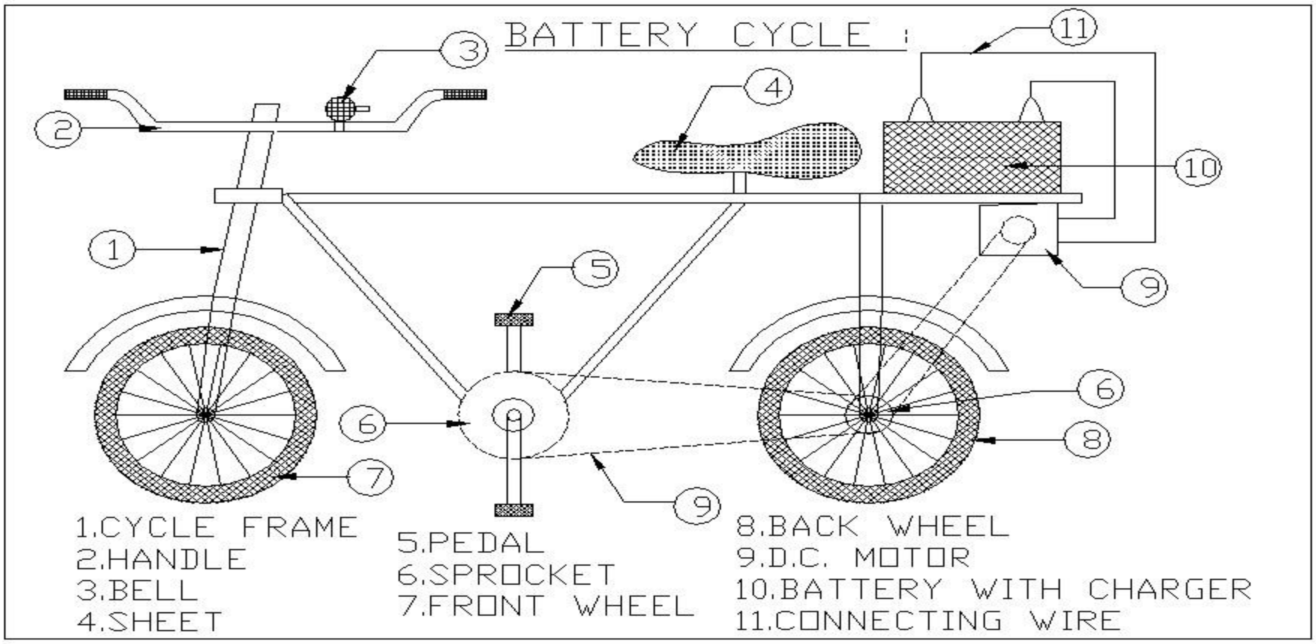

Fig: Basic Parts of solar bicycle

3. Classification of Solar Bicycle:

An "electric bicycle" is a bicycle equipped with fully operable pedals and an electric motor of less than 750 watts.

1) **Class 1 Electric Bicycle:**

A “class 1 electric bicycle,” or “low-speed pedal-assisted electric bicycle,” is a bicycle equipped with a motor that provides assistance only when the rider is pedaling, and that ceases to provide assistance when the bicycle reaches the speed of 20 miles per hour.

2) **Class 2 Electric Bicycle:**

A “class 2 electric bicycle,” or “low-speed throttle-assisted electric bicycle,” is a bicycle equipped with a motor that may be used exclusively to propel the bicycle, and that is not capable of providing assistance when the bicycle reaches the speed of 20 miles per hour.

3) **Class 3 Electric Bicycle:**

A “class 3 electric bicycle,” or “speed pedal-assisted electric bicycle,” is a bicycle equipped with a motor that provides assistance only when the rider is pedaling, and that ceases to provide assistance when the bicycle reaches the speed of 28 miles per hour, and equipped with a speedometer.

Various component Used in Solar Bicycle:

a. Bicycle
b. Lead Acid Battery
c. Solar Panel/cells
d. Hub motor
e. Speed Controller
f. Battery Charger
g. Wires
h. Throttle

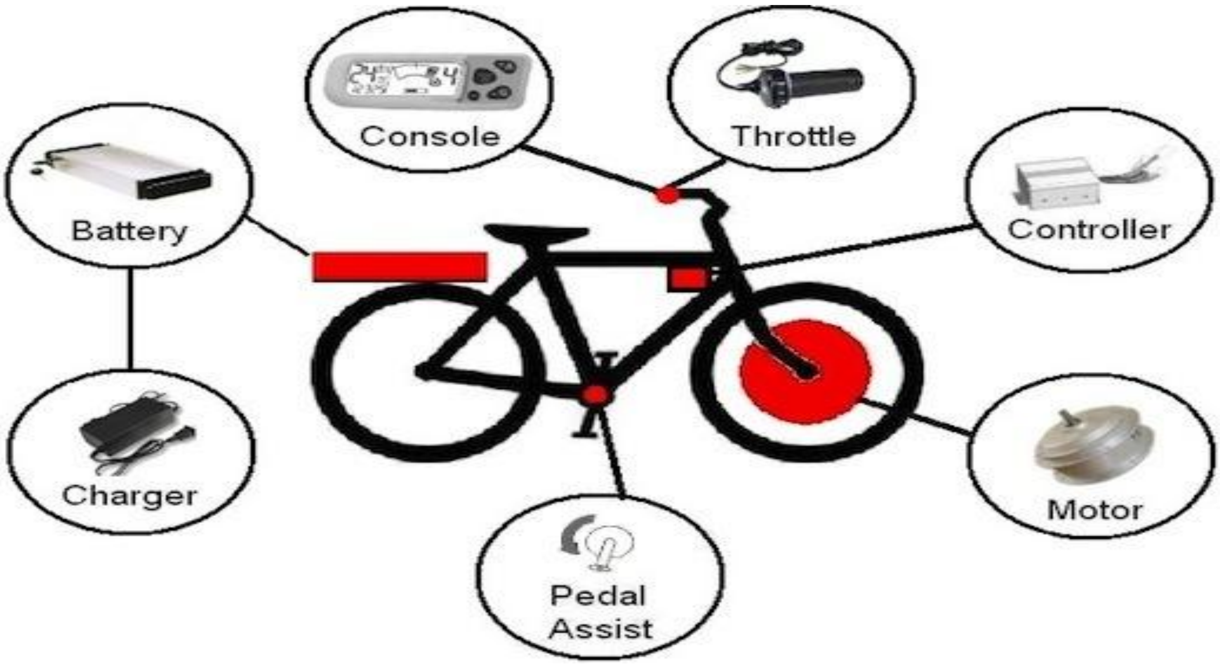

Fig: Various components of Solar Bicycle

1. Bicycle:

A **bicycle**, also called a **cycle** or **bike**, is a human-powered, pedal-driven, single-track vehicle, having two wheels attached to a frame, one behind the other. A bicycle rider is called a cyclist, or bicyclist. Bicycles were introduced in the late 19th century in Europe, and by the early 21st century, more than 1 billion have been produced worldwide.[1][2][3] These numbers far exceed the number of cars, both in total and ranked by the number of individual models produced.[4][5][6]

Fig: Bicycle

They are the principal means of transportation in many regions. They also provide a popular form of recreation, and have been adapted for use as children's toys, general fitness, military and police applications, courier services, bicycle racing and bicycle stunts. The basic shape and configuration of a typical upright or "safety bicycle", has changed little since the first chain-driven model was developed around 1885.[7][8][9] But many details have been improved, especially since the advent of modern materials and computer-aided design. These have allowed for a proliferation of specialized designs for many types of cycling.The bicycle's invention has had an enormous effect on society, both in terms of culture and of advancing modern industrial methods. Several components that eventually played a key role in the development of the automobile were initially invented for use in the bicycle, including ball bearings, pneumatic tires, chain-driven sprockets and tension-spoked wheels

2. **Lead Acid Battery:**

A battery is rated in voltage and amp-hours. Voltage times amps times hours equals watt-hours and this is the total energy available from the battery. So my battery pack has 2 x 12V x 16Ah = 384 watt hours. In other words it will give 384 watts for an hour. But actually, it won't. The "16 Ah" is a rating to be taken with a very large grain of salt. An essential thing to know about batteries is that *they give a lesser amount of total energy when discharged at a high rate*. Read that last sentence again and absorb it, it's important. A battery's electrical power is not like a glass of water. If you drain that glass quickly or slowly, it contains the same amount of water. Batteries, not so. Draw high amperage, and your total amount of energy is less! Because of this, batteries are often rated nominally at a slow 10-hour discharge rate, in which case they will give more total energy and thus seem like a better battery. Bikes and all electric vehicles use energy at a very high rate. A bike can easily draw enough current to discharge a battery pack fully in under half an hour, so batteries will not give their rated output under these conditions.

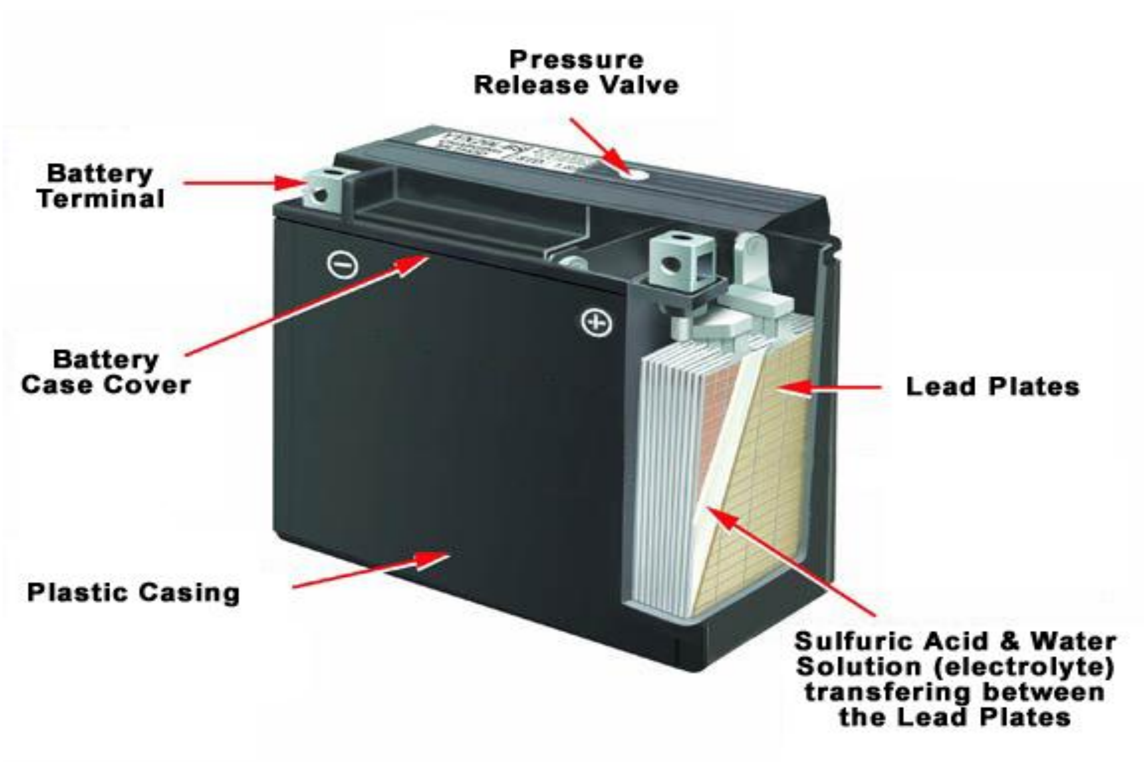

Fig: Lead Acid Battery

Another tempting choice for cheap batteries might be Panasonic or Powersonic or Sonnenschein gel-cell /lead acid batteries. Gel cells are the typical batteries that come with most stock electric bicycles and kits. They are not AGM. Longevity is not as good, though the stated juice per weight ratio seems better, and they are available in a variety of smaller sizes if weight were more of an issue than range. Hawker makes slightly larger AGM batteries such as the G16EP like my B&B which have a little more juice but are also heavier. The Hawkers are very well made. Another great thing about AGM type batteries is that they can be charged quickly at much higher amps than other kinds of lead acid batteries. Likewise they have the ability to give high current with no problems. AGM batteries are also unique among almost all battery types in that they retain a full charge for months with no 'charge leakage.' One of the big drawbacks of of NiMH batteries is that they discharge about 1% to 2% per day. Regular lead acid batteries will just go dead in a few months as well. Because of this, AGM batteries are also marketed to people with antique cars and snow plows - vehicles that aren't used very often and are likely to have a dead battery when you finally want to start it up.

All lead acid batteries have two big drawbacks. They are quite heavy for the total amount of power they deliver. And even these so called "deep cycle" batteries really should not be deep-cycled too often, as repeated deep discharging dramatically shortens their useful lifespan. This is where NiCads have lead acid beat, as they are more power dense and can be run down pretty much all the way without much damage. Of course large NiCads are much more expensive and must be recycled carefully due to the toxic cadmium.

3. **Solar Panels/ Cells:**

Solar panels absorb the sunlight as a source of energy to generate electricity or heat. 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 (W). The efficiency of a module determines the area of a module given the same rated output – an 8% efficient 230 W module will have twice the area of a 16% efficient 230 W module. There are a few commercially available solar modules that exceed efficiency of 22%[1] and reportedly also exceeding 24%.[2][3] 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.

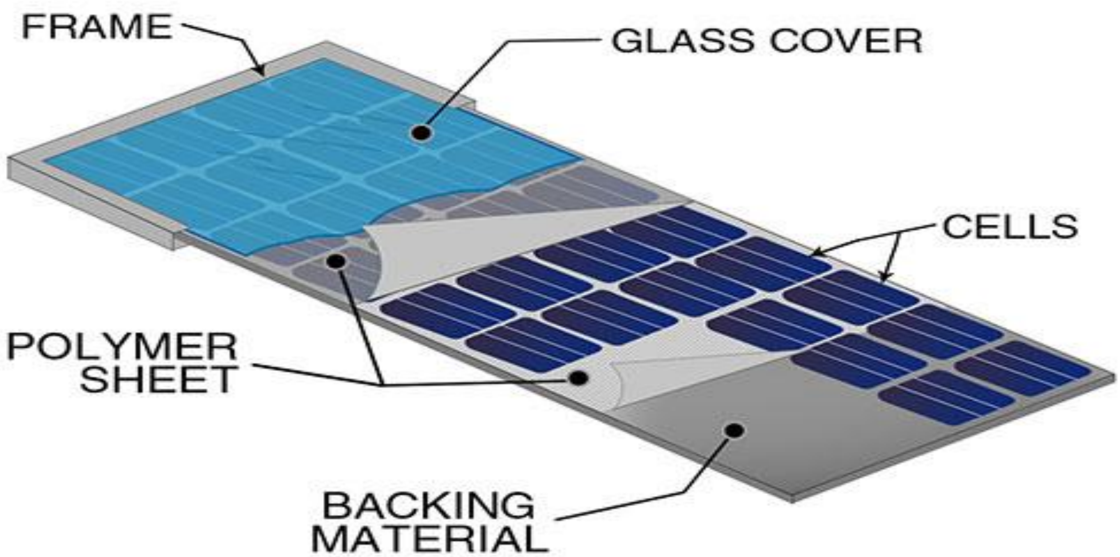

Fig: Solar panel/cells

The most common application of solar panels is solar water heating systems. Photovoltaic modules use light energy (photons) from the Sun to generate electricity through the photovoltaic effect. The majority of modules use wafer-based crystalline silicon cells or thin-film cells. The structural (load carrying) member of a module can either be the top layer or the back layer. Cells must also be protected from mechanical damage and moisture.

Specification of Solar panel

Maximum Power (Watt)	20
Charging Current (Amp)	2
Open Circuit Voltage (V)	21.6
Max Power Voltage (V)	17
Short Circuit Current	1.316
Power Measured at Standard Test Condition	1000W per m2 at 25^0C
Lifespan	25 years
Size	500mm × 338mm × 35mm

Most modules are rigid, but semi-flexible ones are available, based on thin-film cells. The cells must be connected electrically in series, one to another. Externally, most of photovoltaic modules use MC4 connectors type to facilitate easy weatherproof connections to the rest of the system. Modules electrical connections are made in series to achieve a desired output voltage or in parallel to provide a desired current capability. The conducting wires that take the current off the modules may contain silver, copper or other non-magnetic conductive transition metals. Bypass diodes may be incorporated or used externally, in case of partial module shading, to maximize the output of module sections still illuminated. Some special solar PV modules include concentrators in which light is focused by lenses or mirrors onto smaller cells.

4. **Hub DC Motor:**

The permanent magnet DC hub motor is a conventional Dc motor. The stator is inside the rotor with the permanent magnets placed inside. The stator is fixed on the axle and the hub will be made to rotate by AC supplied by the batteries. It generates high torque at low speed, which is highly efficient and which doesn’t need sprockets, brackets and drive chains. Thus they are very reliable and have a long life. The main feature of the Brushless DC Machines is that they can be controlled to give wide constant power speed ranges. Hub motor electromagnetic fields are supplied to the stationary windings of the motor. The outer part of the motor follows, or tries to follow, those fields, turning the attached wheel. In a brushed motor, energy is transferred by brushes contacting the rotating shaft of the motor. Energy is transferred in a brushless motor electronically, eliminating physical contact between stationary and moving parts. Although brushless motor technology is more expensive, most are more efficient and longer-lasting than brushed motor systems. A hub motor typically is designed in one of three configurations.

Fig: Hub DC Motor

Considered least practical is an axial-flux motor, where the stator windings are typically sandwiched between sets of magnets. The other two configurations are both radial designs with the motor magnets bonded to the rotor; in one, the inner rotation motor, the rotor sits inside the stator, as in a conventional motor. In the other, the outer-rotation motor, the rotor sits outside the stator and rotates around it. The application of hub motors in vehicular uses is still evolving, and neither configuration has become standard. Electric motors have their greatest torque at startup, making them ideal for vehicles as they need the most torque at startup too. The idea of "revving up" so common with internal combustion engines is unnecessary with electric motors. Their greatest torque occurs as the rotor first begins to turn, which is why electric motors do not require a transmission. A gear-down arrangement may be needed, but unlike in a transmission normally paired with a combustion engine, no shifting is needed for electric motors

5. Motor Controller:

A **motor controller** is a device or group of devices that serves to govern in some predetermined manner the performance of an electric motor.[1] A motor controller might include a manual or automatic means for starting and stopping the motor, selecting forward or reverse rotation, selecting and regulating the speed, regulating or limiting the torque, and protecting against overloads and faults

Fig: Motor Controller

The simplest case is a switch to connect a motor to a power source, such as in small appliances or power tools. The switch may be manually operated or may be a relay or contactor connected to some form of sensor to automatically start and stop the motor. The switch may have several positions to select different connections of the motor. This may allow reduced-voltage starting of the motor, reversing control or selection of multiple speeds. Overload and over current protection may be omitted in very small motor controllers, which rely on the supplying circuit to have over current protection. Small motors may have built-in overload devices to automatically open the circuit on overload. Larger motors have a protective overload relay or temperature sensing relay included in the controller and fuses or circuit breakers for over current protection. An automatic motor controller may also include limit switches or other devices to protect the driven machinery.

More complex motor controllers may be used to accurately control the speed and torque of the connected motor (or motors) and may be part of closed loop control systems for precise positioning of a driven machine. For example, a numerically controlled lathe will accurately position the cutting tool according to a preprogrammed profile and compensate for varying load conditions and perturbing forces to maintain tool position.

6. Battery Charger:

A **battery charger**, or **recharger**, is a device used to put energy into a secondary cell or rechargeable battery by forcing an electric current through it. The charging protocol (how much voltage or current for how long, and what to do when charging is complete, for instance) depends on the size and type of the battery being charged. Some battery types have high tolerance for overcharging (i.e., continued charging after the battery has been fully charged) and can be recharged by connection to a constant voltage source or a constant current source, depending on battery type. Simple chargers of this type must be manually disconnected at the end of the charge cycle, and some battery types absolutely require, or may use a timer, to cut off charging current at some fixed time, approximately when charging is complete. Other battery types cannot withstand over-charging, being damaged (reduced capacity, reduced lifetime) or overheating or even exploding. The charger may have temperature or voltage sensing circuits and a microprocessor controller to safely adjust the charging current and voltage, determine the state of charge, and cut off at the end of charge.

Fig: Battery Charger

A trickle charger provides a relatively small amount of current, only enough to counteract self-discharge of a battery that is idle for a long time. Slow battery chargers may take several hours to complete a charge. High-rate chargers may restore most capacity much faster, but high rate chargers can be more than some battery types can tolerate. Such batteries require active monitoring of the battery to protect it from overcharging. Electric vehicles ideally need high-rate chargers. For public access, installation of such chargers and the distribution support for them is an issue in the proposed adoption of electric cars.

Throttle:

The thumb throttle, no surprise here, is designed to be operated by the thumb. It consists of just a small lever that protrudes from the handlebar towards the rider. Thumb throttles are the least obtrusive of the three types of ebike throttles. One thing I love about the thumb throttle is that it almost never interferes with brake levers or twist shifters. It only occasionally interferes with lever shifters, but this can usually be fixed by slightly rotating the thumb throttle's own lever up or down to avoid the path of the shifter lever.Thumb throttles allow the greatest freedom of handle bar accessories, like lights and mirrors, since they take up so little room. They also allow you to use any aftermarket handle bar grips you'd like, since they don't

Fig: Thumb Throttle

reach to the end of the handlebar. Another unexpected advantage of thumb throttles is a slight increase in safety. As we'll soon see, other throttles have a higher chance of accidental engagement, either by bumping into a wall, doorway or other object – or simply through an inattentive rider.

The main complaint against thumb throttles is thumb exhaustion. It doesn't sound like such a serious problem, but after long stretches of riding at full throttle many people complain that their thumb simply gets sore and tired from holding the throttle's lever down the entire time. Unlike other throttle types that spread the load out to the whole hand, thumb throttles focus the entire force of the return spring solely on the thumb. Another disadvantage of thumb throttles is that they require you to constantly keep one fewer finger on the handlebars. The better grip on the handlebar you have, the better you can handle the ebike, especially in an emergency situation where you may have just milliseconds to think and take evasive action. This situation, while rare, isn't the best time to have your strongest digit off hanging out by himself. I personally discovered another unexpected downside of thumb throttles while commuting in the *very* cold winters of Pittsburgh. While your four fingers are wrapped around the handlebar and help keep each other warm, your lonely thumb protrudes far below the handlebar, hanging out in no man's land and bearing the full brunt of the chilly air racing by.

Literature Survey

The fuel prices like the petrol is rising steadily day by day. The pollution due to vehicles in heavy traffic cities and urban areas is increasing steadily. To overcome these troubles, an effort regarding thisis made to search some other alternative sources of energy for the vehicles. It is not possible to purchase costly vehicles by poor peoples. Keeping this in mind, a search for some way to provide these economically poor people and also to provide a solution for the environmental pollution was in progress. The solar assisted bicycle is driven by DC hub motor mounted in front or rear axle housing & operated by battery charged using solar energy. The solar panels placed on the carriage will charge the battery & which in turn drives the hub motor. When the bicycle is idle, the solar panel charges the battery. This arrangement is used to replace the arrangement of petrol engine, the gear box & the fuel tank in case of two wheeler or a chain sprocket mechanism generally used by common people. Pedal assisted solar hybrid bicycle is a modification of conventional bicycle thus improving its speed as well as it gives the essential comfort to the driver while driving. During their testing they considered a hub motor of 250W 24V capacity. Their study was related to a multi-wheeled vehicle not limited to a bicycle. The preferred arrangement consists of a standard conventional bicycle with multi-speed transmission, plus an electrical generating system and a solar charging arrangement. This preferred arrangement is normally powered by a combination of motor and pedaling, coupled such that either or both may provide power at any instance. The electrical system consists of: a DC Hub motor, lead acid batteries, a hand lever operating a throttle means, a throttle means which is used to control the battery switching circuit. This vehicle it further includes a rear portion consisting of a pair of forwardly open air duct having a wind driven generator. It also includes pair of rechargeable batteries are further supported within the rear body portion and array of are supported by vertical collar support in a generally horizontal panel support.The panels are provided with the energy intensifying lens which intensifies the solar rays received from sun.

Solar bicycle is anmodification of conventional bicycle and driven by electrical energy. It can run on any type of either cemented or asphalt road or it can also run on muddy road. Solar bicycle is having very less initial and maintenance cost hence can be used for short distance travel by students, office people

PROBLEM FORMULATION

- To design the electronic circuit to connect with other hardware
- Placement of the throttle.
- Position of the solar panel.
- Position of the battery
- To reducing the total weight of the solar bicycle.
- To maintain the charging power of the lead acid battery.
- To maintain the input power of the hub motor.

DESIGN ALGORITHM

Power calculations

1) Normal reaction (N) on each tyre= W/2= 110/2= 55kg= 55*9.81=539.55 N
2) Friction Force (F) acting on each tyre:

For Static Friction, u= 0.03

F= u*N= 0.03*539.55= 16.1865 N

For Dynamic friction u=0.004

F= u*N= 0.004*539.55= 2.1582 N

Torque requirement (t)

For static Friction, T= F*R= 16.1865*0.305=

4.9368~5Nm

For Dynamic Friction, T=F*R= 2.1582*0.305= 0.658

Nm

Speed calculations

w= V/R= 15000/(0.305*3600) = 13.67 rad/sec

Power requirement (p)

A) On plain ground, For Dynamic Friction, P= T* w= = 9 watt

For Static Friction, P= T* w= = 68.35 watt

Overall power requirement= 68.35*2= 136.7 watt

B) On Inclined Surface, a=2'total force required to move vehicle

F= u*mg*cos(a) + mg sin(a)

F= 70.013N

Therefor power required= F* V = 291.72 W extra

power required = 291.72 – 136.7 = 155.02 W

B] Considering dynamic friction

F= 0.004*110*9.81*cos(2) + 110 * 9.81*sin (2)

F= 41.97 N

Power (P)= F*V= 174.611 W

Battery selection Since motor selected is of 24V hence battery voltage
rating should also be 24. Therefore we select two
batteries of 12V and 7.5 Ah in series combination of we
get 24 V and 7.5 Ah.

Charging time

Time required to charge the battery by adapter 12 V
12Ah
P= 12* 12= 144 W
T= (24*12) / 144
= 2 hrs.
By using solar panel
T= (24*7.5) /50
= 3.6 hrs
Panel selection
we use two panels of 25 W each having dimension
350mm* 550 mm

Motor selection

Hub motor of 250 W 24V is selected

Expected results using pedal arrangement Using pedal arrangement for charging battery:

Voltage rating for motor = 12-24 V
Rated speed = 1800 – 3900 rpm
Current rating = 14 Amps
Power rating = 16 – 33 HP
Lead acid battery = 12 V battery
Bike wheel to pulley turn ratio is 26’’ diameter to 2’’

COST REPORT

	Material	Cost
1.	Bicycle	Rs 1500
2.	Lead Acid Battery	Rs 900
3.	Hub DC motor	Rs 1000
4.	Solar Panel	Rs 5000
5.	Throttle	Rs 300
6.	Battery charger	Rs 1000
7.	Motor Controller	Rs 1100
8.	Wire	Rs 300
	Total	**Rs 11,100**

Action plan for completion of the project

To make Solar Bicycle, we formulate the team to accomplish the project successfully. We study about solar panel efficiency and torque of the motor on the internet.