Design of DC Home System Using Solar Panel

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Abstract— Intention of this project is to design a system which is required for small home or office etc. so we design 12 volt DC supply system for small family requirement We have seen that the electricity is the basic needs of human life because our daily working require electricity for various purpose like mobile charging fan for cooling purpose light for night working purpose etc. We things the basic need of human without electricity was very difficult so we think how to come electricity in such area so we think about solar energy which is easily available everywhere and also our natural fuels are limited up to certain year for giving power for saving purpose of this fuels we use the ultimate source of energy such as sun energy to generate electricity so we have think to design of such project which provide electricity easily.

Key words: Solar energy, Solar Panel, Charge Controller, Battery, Energy efficient, etc

I. Introduction

The increasing demand for energy and rapid depletion of conventional is posing a grave threat to human life and their sustainability. Therefore, harnessing the renewable energy such solar and wind, which is abundant on earth to conserve the remaining fossil fuels is nowadays a governmental researchers and academicians priority. A majority of the renewable energy sources are inherently and DC in nature and therefore if they can be harnessed in their original from for the DC appliances using simple power electronics it will be a promising solution to DC micro grid concept DC micro grid concept is motivated be a number of factors such as the rapid increase in residential and commercial PV power system rapid growth in energy efficient product that utilize DC power the emergence of standards for DC voltages. DC micro grid is having several advantages over the AC grid. Several data centers are running on renewable energy source. PV energy is one of the potential candidates for fulfilling the energy for the places which remotely located and its sources is the sunlight. The focus of this work is to use this solar energy using power electronics and control to fulfill the greater percentage of energy demand. Solar energy is clean and free of emissions, since it does not produce pollutants or by-products harmful to nature. The conversion of solar energy into electrical energy has many application fields. Solar to electrical energy conversion can be done in two ways: solar thermal and solar photovoltaic. Solar thermal is similar to conventional AC electricity generation by steam turbine excepting that instead of fossil fuel; heat extracted from concentrated solar ray is used to produce steam and apart is stored in thermally insulated tanks for using during intermittency of sunshine or night time.

II. Literature review

First solar collector created by Swiss scientist named Horace-Benedict de Saussure in 1767 he take an insulated box enclosed with three layers of glass which suck up heat energy. After that Saussure's box became famous and widely known as the first solar oven, getting temperatures of 230 degrees Fahrenheit. After that in 1839 a most important landmark in the progression of solar energy occurs with the significant of the photovoltaic effect by a French scientist Edmond Becquerel. In this he used two electrodes placed in an electrolyte and then exposing it to the light and results is tremendous electricity increased a lot. In 1873, Willoughby Smith discovered photoconductivity of a material known as selenium. In 1887 there was the discovery of the ultraviolet ray capacity to cause a spark jump between two electrodes and this was done by Heinrich Hertz. In 1891 the first solar heater was created. In 1893 the first solar cell was introduced. In 1908 William J. Baileys invented a copper collector which was constructed using copper coils and boxes. In 1958, solar energy was used in space. A solar cell is a semiconductor device that absorbs sunlight and converts it into electrical energy. Today's most common cell is a mass manufactured single p-n junction Silicon cell with efficiency up to about 17% Since 1973, the word energy has been continuously in the news. There has been shortage of oil in many parts of the world and the price of this commodity has increased steeply. It is clear that the fossil fuel era of non-renewable resources is gradually coming to an end. Oil and natural gas will be depleted first, followed eventually by coal. In India the energy problem is very serious.

A. Brief Description of Existing System

1) Solar Panel

Fig. 1: Solar Panel

Solar Panel A solar panel is a packaged connected assembly of photovoltaic cells. Solar panels use light energy photon from the sun to generate electricity through the photovoltaic effect. The majority of modules use wafer based cells or thin film cells based on non-magnetic conductive transition metals, telluride or silicon. Electrical connections are made in series to achieve a desired output voltage and or in parallel to provide a desired current capability. The conducting wires that take the current off the panels may contain silver, copper or other nonmagnetic conductive transition metals. The cells must be connected electrically to one another and to the rest of the system. Each panel is rated by its DC output power under standard test conditions, and

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typically ranges from 100 to 320 watts. Depending on construction, photovoltaic panels can produce electricity from a range of light frequencies, but usually cannot cover the entire solar range (specifically, ultraviolet and low or diffused light). Hence, much of the incident sun light energy is wasted by solar panels, and they can give far higher efficiencies if illuminated with monochromatic light. The advantages of solar panels are, they are the most readily available solar technology.

2) Charge Controller

A charge controller, charge regulator or battery regulator limits the rate at which electric currents added to or drawn from electric batteries. It prevents overcharging and may protect against overvoltage which can reduce battery performance or lifespan, and may pose a safety risk. It may also prevent completely draining ("deep discharging") a battery, or perform controlled discharges, depending on the battery technology, to protect battery life. The terms "charge controller" or "charge regulator" may refer to either a stand-alone device, or to control circuitry integrated within a battery pack, battery-powered device, or battery charger A charge controller, charge regulator or battery regulator limits the rate at which electric currents added to or drawn from electric batteries It prevents overcharging and may protect against overvoltage which can reduce battery performance or lifespan, and may pose a safety risk. Simple charge controllers stop charging a battery when they exceed a set high voltage level, and re-enable charging when battery voltage drops back below that level. Pulse width modulation (PWM) and maximum power point tracker (MPPT) technologies are more electronically sophisticated, adjusting charging rates depending on the battery's level, to allow charging closer to its maximum capacity.

3) Battery

Fig. 2: Battery

Battery In stand-alone photovoltaic system, the electrical energy produced by the PV array cannot always be used when it is produced because the demand for energy does not always coincide with its production. Electrical storage batteries are commonly used in PV system. The primary functions of a storage battery in a PV system are:

1) Energy Storage Capacity and Autonomy: to store electrical energy when it is produced by the PV array and to supply energy to electrical loads as needed or on demand.
2) Voltage and Current Stabilization: to supply power to electrical loads at stable voltages and currents, by suppressing or smoothing out transients that may occur in PV system.
3) Supply Surge Currents: to supply surge or high peak operating currents to electrical loads or appliance.

B. DC load equipment

1) Fan

Fig. 3: DC load equipment

Solar fan DC 12V with bloc technology and ac not charger included solar panel not included battery not included. We are pleased to offer you SOLAR DC CEILING FAN, manufactured using latest Brush Less DC Motor Technology. This technology enables us to use solar power for applications like Fans, Pumps, and Blowers etc. Features of this fan are high efficiency, compact design, easy & maintenance free operations. This fan saves 100% electrical power as it works on solar power. So by doing one time investment one can enjoy life time of cool breeze. Tech Specs : Fan Type: DC Ceiling Fan Low Power Operating Voltage : 12 Volts DC and Direct on Solar Panel Casing : Aluminum Current rating : 2.5 Amps @ 12V on-load voltage Fan Height:5.5 Blade size:18.7 Fan Depth:8 Fan Weight:3kg Wattage : 30watts RPM: 350 DC Motor Type: Permanent magnet type Sweep: 1200mm Regulator: Optional

C. LED Light

Fig. 4: LED Light

12V DC LED Light Bulb. Known for their maximum energy efficiency, these bulbs offered by us are widely used in industrial lighting and home lighting and offer this product as per client requirements and this product made by our expert with great quality.

Benefits:

1) Energy efficient
2) Eco-friendly
3) Long life
4) Reduces energy consumption

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III. METHODOLOGY OF PROJECT

A. Requirement Analysis

This chapter categorizes requirements for creating applications in smart homes. The list of requirements provides guidance for tool developers from an industry perspective. A composition tool should either fulfill these requirements inherently or provide means to solution developers (e.g., installers, home owners) to cover relevant aspects with little effort. The requirements are clustered in seven categories, each of which consists of three to five requirements.

B. Simplicity

Simplicity describes the complexity of application development. It involves the interaction between the system and the application developer. Learning: Targeting usually untrained home end-users the composition tool must be easy to learn and simple to use. Building/Changing: Experienced or trained users should be able to quickly develop or modify even complex applications. Levels of abstraction: Providing multiple layers of abstraction allows to hide implementation details to end users and to expose them to more advanced developers.

C. Modeling

This category deals with requirements that affect the way the smart home applications can be modeled. Venting: Applications in smart homes are highly event-driven. This is due to domain characteristics as well as resource and energy constraints of devices. Thus it should be possible to model finegrainedevent management (e.g., subscribe, unsubscribe) and event delivery. It should further be possible to model event management, to deal with both synchronous and asynchronous events, and to handle events with defined and undefined order. Expressiveness: Smart home applications combine information from multiple domains (e.g., health care, security). To make creation of such applications efficient, application developers should be limited in their capabilities to some extent. However, the challenge is to still provide the expressiveness that is needed to develop powerful domain-specific and cross-domain applications.

D. Time

The ability to impose timing constraints on the system is crucial for two reasons. First, smart home applications affect the real world. Second, applications interact with resource-constrained devices which exhibit limited availability and varying delays. This distinction between real world data timing and communication timing may significantly impact fulfilling the requirements in complex scenarios. For example, the age of a sensor reading may include the real world time of the measurement as well as the time of transporting the data from the source to the sink. Hard real-time: A system which supports hard real-time guarantees that a certain action is performed within a given time frame. Smart home developers can specify this time frame in application development.

E. Mobility

Mobility includes both mobile devices and changes in the system (e.g., devices and services leave or join the system). Discovery enables detection and integration of devices statically during design time or dynamically during runtime. In case of a repository, devices are located based on a match between their capabilities and the user's preferences. Location Awareness some applications require location-aware devices and services. Thus application developers should be able to a) find out the location of specific devices and b) find devices with respect to a given location in order to use services of these particular devices.

F. Technical ability and varying delays

This distinction between real. This section describes technical requirements to a com-world data timing and communication timing may signify position solution .icantly impact fulfilling the requirements in complex Interaction with Heterogeneous Services Intercon-narios.

G. Security, Safety and Privacy

Process Safety Unsafe applications negatively in-switched on at the same time or avoiding all devices pact devices or the environment in a way which is to be switched on at the same time to prevent from not foreseen by the developer and must be predicted peaks in the power supply system). This requirement to ensure process safety mostly addresses quality (acceptance) of the system

***1)** Requirement of Specification for Solar Household System*

1) 50 Watt Solar Panel
2) Battery 12 Volt (65) Ah
3) Controller (10)Ah(12V-24V)
4) Cable (6mm & 1mm)
5) LED 2 Light 5 watts
6) 25 Watt Fan

IV. DESIGN

A. Design and Development

we have design a system which is required for small home or office etc. so we design 12 volt dc supply system for small family requirement We have seen that the electricity is the basic needs of human life because our daily working require electricity for various purpose like mobile charging fan for cooling purpose light for night working purpose etc.

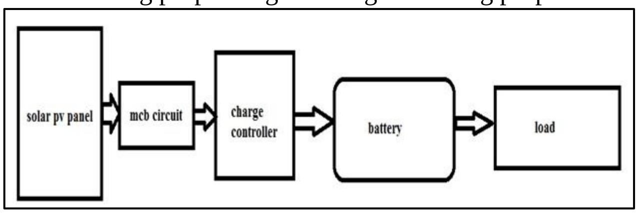

Fig. 5: Design of Load Flow Diagrams

B. Architectural Design

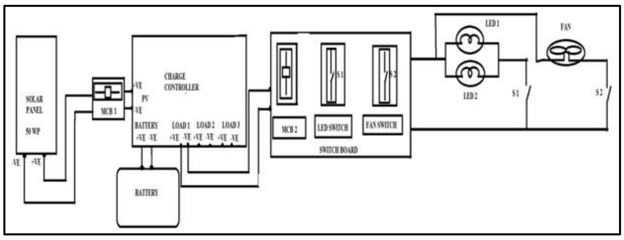

Fig. 6: Circuit Diagram of Solar DC Home System

components of system

– Solar panel
– MCB1

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- Charge controller
- Battery
- Switch board
- MCB2 , led switch S1and fan switch S2

C. Working and Construction of System

It consist of solar panel of 50peak watt value and have 12 voltage supply and 2.5amp current capacity which is place at an inclination of 22.5 degree at southern side for better collection of solar energy. And which is connected to the incoming mcb1 for protection purpose. This is then connected to the charge controller which is required for protection from voltage fluctuation, over voltage, and for charge control purpose .The charge controller having capacity of handling three loads at a time. And then connected to battery for charging.

D. Interference Design of System

Sr.No.	Equipment	Specification
01	Solar panel	P=50watt I=2.5amp V=12volt
02	Charge controller	Std.
03	battery	V=12volt I=2amp Charging capacity=6hr Discharge cap=8hr Ratting =48Ahr
04	Wire	Poly cap Thickness=6mm Length=20m Conductor=cu(high strength)
05	DC celling fan	V=12volt DC I=2.08amp W=25watt Cooling area = 10*10sq m
06	DC led light	W= 5 watt each V=12volt I=0.833amp
07	Switch board	Two MCB ,two switch one dc fan regulator

Table 1: The Functional Details Of The Equipment Which Is Shown In Below

V. IMPLEMENTATION AND TESTING

A. Principle of Testing

1) Solar Panel

Fig. 6: polycrystalline solar panel

Maximum power (P max)	50W
Open circuit voltage (Voc)	21.37V
Short circuit current (Isc)	2.50 A
Maximum power voltage (Vmp)	17.18 V
Maximum power current (Imp)	2.33A
Maximum system voltage	1000V

Table IihTechnical Specification

2) Solar Panel Working

The sun actually gives off radiation energy in the form of light. Solar panels convert photons into electrical energy, which can also be stored in battery for use later. These panels contain semiconductor made of silicon and when the radiation comes in contact with silicon and atoms, the photons are absorbed, but electrons are separated from the rest of the atoms. These freed electrons create electrical current. However, to use the current, the must first be run through the power inverter to change the direct current (DC) into alternating current (AC). The electricity is stored in batteries so it can be used at any time, even at night.

3) Charge Controller

A charge controller, charge regulator or battery regulator limits the rate at which electric current is added to or drawn from electric batteries. It prevents overcharging and may protect against overvoltage, which can reduce battery performance or lifespan, and may pose a safety risk. It may also prevent completely draining ("deep discharging") a battery, or perform controlled discharges, depending on the battery technology, to protect battery life. The terms "charge controller" or "charge regulator" may refer to either a stand-alone device, or to control circuitry integrated within a battery pack, battery-powered device, or battery charger A charge controller, charge regulator or battery regulator limits the rate at which electric current is added to or drawn from electric batteries. It prevents overcharging and may protect against overvoltage, which can reduce battery performance or lifespan, and may pose a safety risk. It may also prevent completely draining. A series charge controller or series regulator disables further current flow into batteries when they are full. A shunt charge controller or shunt regulator diverts excess electricity to an auxiliary or "shunt" load, such as an electric water heater, when batteries are full. Simple charge controllers stop charging a battery when they exceed a set high voltage level, and re-enable charging when battery voltage drops back below that level. Pulse width modulation (PWM) and maximum power point tracker (MPPT) technologies are more electronically sophisticated, adjusting charging rates depending on the battery's level, to allow charging closer to its maximum capacity.

4) Features

1) Automatic selection of 12v/24v battery
2) Aesthetic & compact design
3) 98% efficiency
4) Fuse-less electronic & software controlled protections
5) USB port
6) Option of SMF and lead acid battery selection
7) Load controller with LVD & dusk to dawn feature

5) Technical specifications

- PWM based technology.
- Automatic battery voltage selection of 12/24Volt (Available in 10amp & 20 Amp).

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- In built low voltage disconnect (LVD) & 20% extra power than rated capacity.
- 125 Watt panels in 12 system in 6Amps ; 200Watt & 400Watt panels in 12/24Volt system in 10Amps.
- 400Watt & 800Watt panels in 12/24Volt system in 20Amps.

6) Battery

An electric battery is a device consisting of one or more electrochemical cells with external connections provided to power electrical devices such as flashlights, smartphones, and electric cars When a battery is supplying electric power, its positive terminal is the cathode and its negative terminal is the anode. The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device. When a battery is connected to an external circuit, electrolytes are able to move as ions within, allowing the chemical reactions to be completed at the separate terminals and so deliver energy to the external circuit. It is the movement of those ions within the battery which allows current to flow out of the battery to perform work. Historically the term "battery" specifically referred to a device composed of multiple cells, however the usage has evolved to additionally include devices composed of a single cell. Primary (single-use or "disposable") batteries are used once and discarded; the electrode materials are irreversibly changed during discharge. Common examples are the alkaline battery used for flashlights and a multitude of portable electronic devices. Secondary (rechargeable) batteries can be discharged and recharged multiple times using mains power from a wall socket; the original composition of the electrodes can be restored by reverse current. Examples include the lead-acid batteries used in vehicles and lithium-ion batteries used for portable electronics such as laptops and smartphones. Batteries come in many shapes and sizes, from miniature cells used to power hearing aids and wristwatches to small, thin cells used in smartphones, to large lead acid batteries used in cars and trucks, and at the largest extreme, huge battery banks the size of rooms that provide standby or emergency power for telephone exchanges and computer data centers.

7) Charging Method

a) Constant Current Charging

Constant current charging is a method that is commonly uses for charging lead acid battery. The advantage of using this method is it easy to determine the amount of capacity (amp hrs) supplied during charging process. Besides that, there is no need for temperature compensation which is required in constant voltage systems. Usually, at high-rate of charging, the battery voltage rises excessively and the water decomposes, causing heat generation at the final stage of the charge, thus, damaging the battery. However, the constant current method relatively kept a low rate of charging process and charging time is not critical. The constant current methods may be used as refreshing charge when many batteries is being charge at one time, as this method easily determine the amount of charge returned to the battery. It is not recommended to use constant current charging as refreshing the battery because it will shorten the battery life.

b) Constant voltage charging

Constant voltage charging is a methods use to restore the battery to a fully charge condition in short period of time. This type of charging must has a very stable output voltage and high current capacity, as extremely large currents are allowed to flow in the initial stage of charge, where the battery voltage is low. However, this type of charging method is not practical because the requirement of a high current capacity, results in high cost. The heat generation in the battery is also high because of the high current flow in the battery causing the battery life to be short. Generally, constant voltage charger has a device to limit initial current. This can be accomplished by a constant current regulator, or by designing the overall impedance of the circuit. Constant voltage charger is effectively to charge the battery at short period of time, as during the final stage charge, the current automatically decreases and the water decomposition will be minimized. A combination charging uses two types of charging. It‛s called a Two-rate‖ or Two-step‖ charging. A variety of couples can be made, such as constant current/constant current, constant-voltage/constant-current and so on. In general the first step uses a quick or fast charge mode, and the second uses a low charge current. The switching from the first step to the second can be carried out by many different methods such as battery voltage sensing, a time control, charge current sensing and many more.

VI. EXPERIMENTAL RESULT

A. DC Load Calculation

Sr. No.	1st	2nd	Total
Equipment	Dc Fan	Dc LED Light	-
Power (W)	25W	5W+5W	35W
Voltage (V)	12V	12V	-
Current (I)	2.08A	0.833A	2.917A

Table 3: Observation Chart

1) DC Fan

Power = Voltage * Current

P = V*I

I = P/V

I = 25/12 = 2.08A

2) DC LED Light

P = V*I

I = P/V

I = 5/12 = 0.4167

Two Led Light Current is = 0.833A

3) Total

Total Power = 35W

Total Current = 2.913A

4) Solar Plate Rating Calculation

Solar Plate Power = 50W

Solar Plate Voltage = 19.84V

Solar Plate Current = 2.520A

Normal Operating Temp. = 45.5^0 C

5) Battery Capacity

For 12 Hours

Q = I*t (AH) = 2.520*12 = Q = 30.24AH

6) Practically Part Solar Panel

Solar panel voltage across two terminal is 19.84v at no-load. (Load is connected to the direct solar panel through charge controller)

Sr. No.	Fan Speed Increase	Current (I)	Voltage (V)	Power (W) P = V*I
1	No-Load	-	19.84V	-

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2	Step 1	2.15A	17.70V	38.055
3	Step 2	2.29A	17.50V	40.533
4	Step 3	2.40A	17.25V	41.4
5	Step 4	2.46A	16.97V	41.746
6	Step 5	2.57A	16.72V	42.97

Table 4: Observation Chart (For Dc Fan Only)

7) Calculation

Load is increase step by step.

Step 1 :-

Power (W) = V*I
= 17.70*2.15
= 38.055W

Step 2 :-

Power (W) = V*I
= 17.50*2.29
= 40.533W

Step 3 :-

Power (W) = V*I
= 17.25*2.40
= 41.4W

Step 4 :-

Power (W) = V*I
= 16.97*2.46
= 41.746W

Step 5 :-

Power (W) = V*I
= 16.72*2.57
= 42.97W

a) Load is connected to the battery

(Load is connected to the direct solar panel through without charge controller)

Sr. No.	Fan Speed Increase	Current (I)	Voltage (V)	Power (W) P = V*I
1	No-Load	-	12V	-
2	Step 1	1.20A	11.85V	14.22W
3	Step 2	1.36A	11.83V	16.08W
4	Step 3	1.43A	11.81V	16.89W
5	Step 4	1.59A	11.79V	18.75W
6	Step 5	1.69A	11.77V	19.89W

Table 5: Observation Chart

b) Calculation

Load is increase step by step.

Step 1 :-

Power (W) = V*I
= 11.85*1.20
= 14.22W

Step 2:-

Power (W) = V*I
= 11.83*1.36
= 16.08W

Step 3:-

Power (W) = V*I
= 11.81*1.43
= 16.89W

Step 4:-

Power (W) = V*I
= 11.79*1.59
= 18.75W

Step 5:-

Power (W) = V*I
= 11.77*1.69
= 19.89W

From dc home project we conclude that mainly saving of electricity in low cost because we know that solar energy is freely available in nature, with low maintenance and also nonpolluting. Due to other fuel plants surrounding climate polluted with limitation of fossil fuel they are available also certain year to overcome this problem we required maximum renewable energy sources. The system was also built to conserve energy with the use of light emitting diode lamp (LED lamp) to replace other lamps such as fluorescent lamp which might reduce the efficiency of the battery .the main improvement of this project has been elimination of a dc to ac inverter unit.

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