DAFFODIL INTERNATIONAL UNIVERSITY

DHAKA, BANGLADESH

PROJECT

ON

Construction Of A Photosensitive Solar Electricity System

BY

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APPROVAL

This Project titled **"Construction Of A Photosensitive Solar Electricity System"**, submitted by MD.SABUR KHAN to the Department of Electrical and Electronics Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Electrical and Electronics Engineering and approved as to its style and contents. The presentation was held on June, 2014

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DECLARATION

I hereby declare that, this project has been done by me under the supervision **Professor Dr. M. Shamsul Alam, Professor and Dean, Department of EEE ,Faculty of Engineering** of Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

Newly, solar system bases Automatic Streets light are used in many countries. The main advantage of this system is that it works automatic. It also saves the electricity and by those things we can use the extra electricity in other sectors. Since the system is based on solar that's why we have to face some problems in rainy season. The work is already started to solve the problem and step by step it will complete. Though The time duration of rainy season is not so long, that's why this type of system can be used in our country. Now-a-days many types of solar system base application is running and we can see those things around us. By using those types of application we can reduce some pressure from the main load. In many countries people are using many solar system base things like- **Solar Heating, Solar Thermal Electricity, Solar Cooking, Solar Water Heater, Solar dryer ETC.** Our government is taking many steps to increase the use of solar panel system. If our government is thinking seriously about the solar panel system then we can also use those solar system base applications which are using other countries.

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Chapter 1

1.1 INTRODUCTION

A most important & significant look in our modern civilization is ―energy, used in different forms. Many necessary functions can be at a stand still without energy. So energy is a part of our life. There are various form of energy consumption process such raw energy in falling water, in deposits of coal, oil and gas etc are most well known form. Energy sources which are regenerated after a regular time cycle are commonly known as renewable sources of energy like hydro power, solar energy, wind energy, tidal energy, biomass fuels etc. In a particular location available renewable energy sources are finite quantity, which depends on their respective characteristics feature. When renewable energy sources is extracted at a higher rate then its regenerative rate is becomes non renewable. Energy produced from renewable natural resources & technologies. The present energy demand is increasing day by day in Bangladesh due to various reasons such as increasing population, the aspiration for improved living standard and general economic and industrial growth. The power generation system is principally depended on imported petroleum oil and own natural gas. On the other hand, as the information about the deposits of fossil fuels in Bangladesh, if they are consumed at the present rate, the reversed natural gas and coal will be exhausted by the year 2020 to 2030. To reduce the dependency on imported fuel and the pressure on natural gas, the present power generation system must be diversified and at the same time indigenous energy resources have to be explored and developed. It may be mentioned that concern for environment is a now a universal issue and conventional energy gives rise to greenhouse gases with adverse consequences for health and climate. In these perspectives, harnessing of renewable energies and development of relative technologies is a highly important strategic option. Communities in rural areas and mainly in remote areas of Bangladesh have very little possibilities to participate on the national electricity supply. Therefore, and in the context of environment protection, renewable energies can contribute substantial to the delivery of alternative energy to the users etc. are some of the key issues that determine the need for technological inventions in solving energy problems in the rural areas

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1.2 Definition of Energy:

Energy: Energy is the measure of a physical system. It defines the quality of the changes and processes, which take place in the Universe, beginning with movement and finishing with thinking.

1.3 Renewable Energy:

Renewable energy is energy generated from natural resources such as sunlight, wind, rain, tides, and geothermal heat which are renewable (naturally replenished). In 2006, about 18% of global final energy consumption came from renewable, with 13% coming from traditional biomass, such as wood-burning. Hydroelectricity was the next largest renewable source, providing 3% of global energy consumption and 15% of global electricity generation. Wind power is growing at the rate of 30 percent annually, with a worldwide installed capacity of 121,000 megawatts (MW) in 2008, and is widely used in European countries and the United States. The annual manufacturing output of the photovoltaic industry reached 6,900 MW in 2008, and photovoltaic (PV) power stations are popular in Germany and Spain. Solar thermal power stations operate in the USA and Spain, and the largest of these is the 354 MW SEGS power plant in the Mojave Desert. The world's largest geothermal power installation is The Geysers in Californian, with a rated capacity of 750 MW. Brazil has one of the largest renewable energy programs in the world, involving production of ethanol fuel from sugar cane, and ethanol now provides 18 percent of the country's automotive fuel. Ethanol fuel is also widely available in the USA. While most renewable energy projects and production is large-scale, renewable technologies are also suited to small off-grid applications, sometimes in rural and remote areas, where energy is often crucial in human development. Kenya has the world's highest household solar ownership rate with roughly 30,000 small (20–100 watt) solar power systems sold per year. Some renewable-energy technologies are criticized for being intermittent or unsightly, yet the renewable-energy market continues to grow. Climate-change concerns, coupled with high oil prices, peak oil, and increasing government support, are driving increasing renewable-energy legislation, incentives and commercialization. New government spending, regulation and policies should help the industry weather the 2009 economic crisis better than many other sectors.

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1.4 Objectives Of Project:

Solar energy is a very useful renewable source of energy, which may be the answer to the future for power or energy needs, as global warming seems to pick up rapidly. So we can all contribute to the environment by using solar energy thus erasing or trimming down various gas emissions, which can endanger earth, in turn ,the millions of people in it. By installing solar street lights in the capital city of Bangladesh. It will help to reduce the energy crisis. The installation cost of solar street light is less than the Traditional street lights installing and maintenance cost. So , by installing solar lights , it will help to boost the economy of Bangladesh.

1.5 Project Overview:

This project paper is divided into five chapters:

In the first chapter entitled “Introduction” that discussed about the theme, intention, and the overview of the project.

In the second chapter entitled Renewable Energy Technologies Suitable For Bangladesh, Present Scenario Of Conventional And Renewable Energy Utilization In Bangladesh, Ongoing Renewable Energy Technology Projects In Bangladesh, Government Support In Renewable Energy In Bangladesh.

In the Third chapter entitled solar energy uses, solar photovoltaic, advantage of photovoltaic, solar heating in use, solar thermal electricity, solar cooking, solar water heater, solar dryer.

In Forth chapter entitled solar cells, connect cell to make modules, types of solar cells, charge controller, types of charge controller and its application, voltage setting of charge controller, battery, inverter, its applications and types.

In the Fifth chapter entitled solar home system design, site screening, batter sizing, array sizing, selections of charge controller and converter, system wiring.

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In the sixth chapter entitled details about project, system calculation of 3W solar system and system design about off-grid type auto inverter-4.5KVA,with over voltage protection input voltage 48V and output voltage 220V-240V,50Hz.

1.6 Types of Renewable Energy

Biomass
Geothermal Energy
Wind Energy
Photovoltaic (PV) Cells Hydropower

Photovoltaic (PV) Cells:

PV cells produce electricity from sunlight. Materials used in computer chips are similar to materials used in PV cells. These materials absorb sunlight, which frees the electrons from their atoms and allows them to generate electricity. PV cells are great because they don‘t require high maintenance, are very reliable, and don‘t produce pollutants.

1.7 Advantages of Renewable Energy: With the goal of reducing air pollution and advancing public health, renewable energy methods like solar and wind are being embraced around the world. Renewable energy has several environmental and economic benefits.

Environmental Benefits: Because renewable energy sources like solar and wind do not require the use of fossil fuels, they do not emit carbon dioxide. Carbon dioxide is a bi-product of burning coal and gas. By reducing the amount of fossil fuels we burn, we are decreasing the amount of pollutants and chemicals being emitted into the atmosphere.

Wind Energy: Electricity generated by wind through turbines is a fast-growing renewable energy source around the world. These turbines can be placed on land or offshore. One turbine can create enough energy to power 500 homes that use average levels of electricity.

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Solar: Solar energy is generated through the sun's heat. To put into context the immense power of the sun, the entire supply of coal, oil and natural gas is equivalent to the power put off by the sun in just 20 days. This energy can be harnessed through the use of photovoltaic solar panel that can be put on roofs, atop building and even on cars.

Public Health:

Pollution coming from power plants taints our air supply and causes asthma. Through the use of renewable energy, we could eliminate these harmful substances in the air, leading to a healthier population.

Cost and Supply: Once the solar panels are installed and the windmills are put up, renewable energy is essentially free. It costs nothing to use the suns rays, and taking advantage of a windy day is free. Furthermore, the supply of wind is not going to diminish. The sun's rays are also prevalent and will exist for millions of years.

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CHAPTER 2

2.1 Renewable Energy Technologies Suitable for Bangladesh:

Different types of renewable energy technologies (RET) applications suitable for Bangladesh are described in the subsequent headings.

- Solar Thermal
- Solar photovoltaic (SPV)
- Biomass
- Small Hydro
- Waste Energy

2.2 Present Scenario of Conventional and renewable energy

(Electric power) Utilization in Bangladesh:

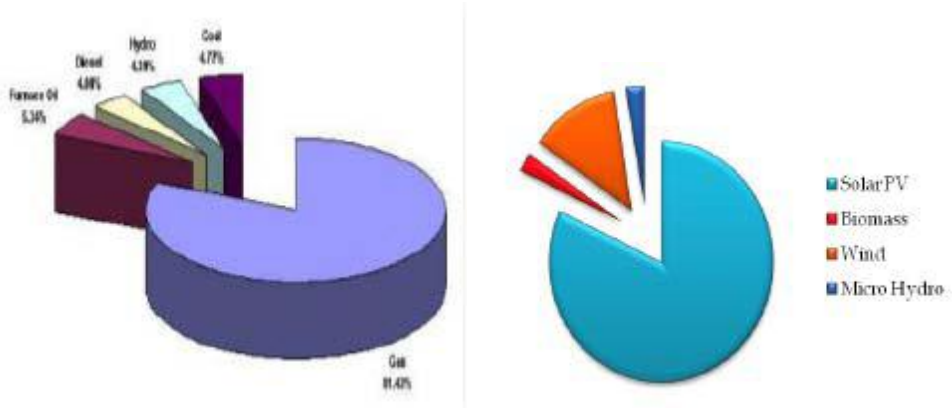

Fig 1:Electrical Power

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Bangladesh Total insulated power in grid electricity is 5254 MW

Hydro	230MW
Coal	250MW
Diesel	200MW
Gas	4285MW

Total insulated power off grid electricity is 22.55 MW	
Micro Hydro	0.1MW
Biomass	0.5MW
Wind	2.5MW
Solar	18.55MW

2.3 Ongoing Renewable Energy Technology (RET) Projects in Bangladesh:

Renewable energy development project- REB/IDCON.

Sustainable rural energy- LGED Solar & Wind resource assessment project- RERC, DU SHS project- Grameen Sakti.

PREGA- REB/BPDB GTZ funded project – REB.

Biogas pilot project – LGED.

RET in Asia- CMES/KUET SHS project- BRAC.

CHT SHS project- BPDB.

RET feasibility study- BCSIR.

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SHS project-TMSS.

Solar home lighting system- Centre for mass education in science (CMES) Solar home system- Integrated Development Foundation (IDF)

Wind power generation- BPDB

Hybrid system- Grameen Sakti, BRAC.

2.4 Government Support in Renewable Energy Sector in Bangladesh:

Sector	**Opportunity**
Government policy	Government setup a target that at least 5% electricity by 2015 and 10% by 2020 will be generated from RE
Duty & VAT	Government wipe out all sort of duty from renewable energy commodities
Tax Holiday(According to RE P0licy)	According to declared RE policy, Renewable energy company will enjoy 5 years tax holiday from its inception however current budget doesn't support it
Manufacturing plant for PV module	Duty of capital machinery for assembling of PV module is exempted.

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CHAPTER 3

3.1 Solar energy uses:

- Solar energy uses in various respects. Such as-
- Generate electricity using photovoltaic solar cells.
- Generate electricity using concentrated solar power.
- Generate electricity by heating trapped air, which rotates turbines in a solar updraft tower.
- Heat buildings, directly, through passive solar building design.
- Heat foodstuffs, through solar ovens.
- Heat water or air for domestic hot water and space heating needs using solar- thermal panels.
- Heat and cool air through use of solar chimneys.
- Generate electricity in geosynchronous orbit using solar power satellite.
- Solar air conditioning.

3.2 Photovoltaic:

Becquerel first discovered that sunlight could be converted directly into electricity in 1839, when he observed the photo galvanic effect. But the first solar cell, developed by Chapin, Fuller and Pearson, revealed in 1954. It had an efficiency of 6% only. In 1956, the invention of 10% efficient silicon solar cell was reported. Only two years later, the first solar cells were used on the Vanguard I orbiting satellite. Since then, the use of solar electricity (also known as photovoltaic) is going on increasing year by year and some have been in continuous outdoor operation on Earth or in space for over 30 years.

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3.3 Advantages of Photovoltaic:

Photovoltaic has shown, since the 1970s, that the human race can get a substantial portion of its electrical power without burning fossil fuels (coal, oil or natural gas) or creating nuclear fission reactions. Photovoltaic helps us avoid most of the threats associated with our present techniques of electricity production and also has many other benefits. Photovoltaic has shown that it can generate electricity for the human race for a wide range of applications, scales, climates, and geographic locations. It can provide electricity to remote transmitter stations in the mountains allowing better communication without building a road to deliver diesel fuel for its generator. It can supply electricity to the community in an island, which is very far from utility grid, or can supply electricity to the people of poor countries like African countries, where people are scattered and grid electricity is not feasible. Fossil-fuel plants have many disadvantages: a wide range of environmentally hazardous emissions, parts which wear out, steadily increasing fuel costs, they are not modular (deployable in small increments), and they suffer low public opinion (no one wants a coal burning power plant in their neighborhood). Photovoltaic suffers none of these problems. Some other advantages of photovoltaic are given below- Fuel source of photovoltaic is vast and essentially infinite. No emissions, no combustion or radioactive fuel for disposal. Low operating cost. No moving parts. No high temperature corrosion or safety issue. High reliability in modules (>20 years). Completely modular (small or large increment is possible). Quick installation. Can be integrated into new or existing building structures. Can be installed at nearly any point-of-use. Daily output peak may match local demand. High public acceptance. Excellent safety record.

3.4 Various Uses Of Solar:

There are many types of solar which are using in many ways. They are-

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3.4.1 Solar Heating:

Fig2: The family living in this house enjoys hot water heated by the sun with a solar thermal system

Solar heating harnesses the power of the sun to provide solar thermal energy for solar hot water, solar space heating, and solar pool heaters. A solar heating system saves energy, reduces utility costs, and produces clean energy. The efficiency and reliability The family living in this house enjoys hot water heated by the sun with a solar thermal system

of solar heating systems have increased dramatically, making them attractive options in the home or business. But there is still room for improvement.

3.4.2 Solar Thermal Electricity:

Solar energy can also be used to make electricity. Some solar power plants, like the one in the picture to the right in California's Mojave Desert, use a highly curved mirror called a parabolic trough to focus the sunlight on a pipe running down a central point above the curve of the mirror. The mirror focuses the sunlight to strike the pipe, and it gets so hot that it can boil water into steam. That steam can then be used to turn a turbine to make electricity. In California's Mojave Desert, there are huge rows of solar mirrors arranged in what's called "solar thermal power plants" that use this idea to make electricity for more than 350,000 homes. The problem with solar energy is that it works only when the sun is shining. So, on cloudy days and at night, the power plants can't create energy. Some solar plants are a

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"hybrid" technology. During the daytime they use the sun. At night and on cloudy days they burn natural gas to boil the water so they can continue to make electricity.

3.4.3 Solar Cooking:

Solar cookers use sunlight for cooking, drying and pasteurization. Solar cooking offsets fuel costs, reduces demand for fuel or firewood, and improves air quality by reducing or removing a source of smoke. Concentrating solar cookers use reflectors to concentrate light on a cooking container. The most common reflector geometries are flat plate, disc and parabolic trough type. These designs cook faster and at higher temperatures (up to 350 °C) but require direct light to function properly.

Fig3 : Solar cooking dish

3.4.4 Solar Water Heater:

Where heat from the Sun is used to heat water in glass panels in our roof. This means we don't need to use so much gas or electricity to heat our water at home. Water is pumped through pipes in the panel. The pipes are painted black, so they get hot when the Sun shines on them. Many homes used solar water heaters.

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Fig4: Solar water heating mechanism

Today, solar water heaters are making a comeback. They heat water for use inside homes and businesses. They also heat swimming pools like in the picture. Panels on the roof of a building, like this one on the right, contain water pipes. When the sun hits the panels and the pipes, the sunlight warms them.

3.4.5 Solar dryer:

Agricultural and other products have been dried by the sun and wind in the open air for thousands of years. The purpose is either to preserve them for later use, as is the case with food; or as an integral part of the production process, as with timber, tobacco and laundering. In industrialized regions and sectors, open air-drying has now been largely replaced by mechanized dryers, with boilers to heat incoming air, and fans to force it through at a high rate. Mechanized drying is faster than open-air drying, uses much less land and usually gives a better quality product. But the equipment is expensive and requires substantial quantities of fuel or electricity to operate.

Solar dryer Application:

For centuries people of various nations have been preserving dates, figs, apricots, grapes, bananas, pineapples, other fruits, herbs, cassava, yams, potatoes, corn, peas, onions, garlic, carrots, peppers, milk, coffee, meat, and fish by drying.

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But drying is also beneficial for hay, copra (kernel of the coconut), tea and other income producing non-food crops. It is worth noting that until around the end of the 18th century when canning was developed, drying was virtually the only method of food preservation.

Solar Drying Can Improve Agricultural Products:

Dehydration of vegetables and other food crops by traditional methods of open-air sun drying is not satisfactory, because the products deteriorate rapidly. Furthermore, traditional methods do not protect the products from contamination by dirt, debris, insects, or germs. A study by Akwasi Ayensu from the Dept. of Physics at the University of Cape Coast, Cape Coast, Ghana demonstrates that food items dried in a solar dryer were superior to those which were sun dried when evaluated in terms of taste, color, and mould counts. He asserts, and many others agree that solar drying systems must be developed to utilize this energy resource to improve food preservation. This translates into quality products that can be stored for extended periods, easily transported at less cost while still providing excellent nutritive value.

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CHAPTER 4

4.1 Solar cells:

Photovoltaic (PV) or solar cells are PN junction Semiconductor devices. It converts sun light into direct current electricity. Groups of solar cells are electrically connected into PV modules, arrays. PV modules or arrays can be used to charge batteries .This system can be used to power any number of Electrical loads. PV systems can produce alternating currents or Inverter. Compatible with any conventional appliances and operate in parallel with and interconnected to the Utility grid. Solar cells often are distinguished by their type of semiconductor junction-

(A)Homojunction (n + p layer is of the same material)

(B)Heterojunction (n + p layer is of different material)

(C)MIS (Metal / Isolator / Semiconductor

(D)SIS (Semiconductor / Isolator / Semiconductor).

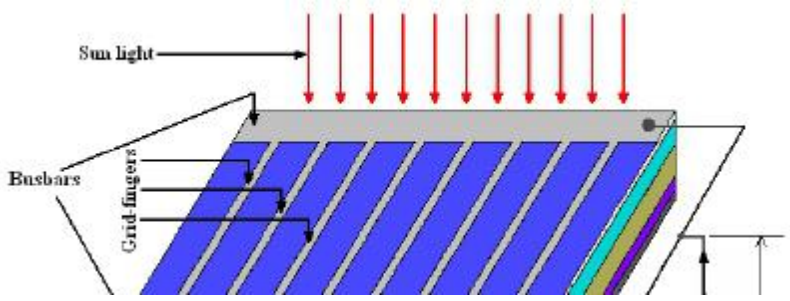

Fig5:Solar Cell

4.2 Connect cell to make modules:

- One silicon solar cell produces 0.5V to 0.6V

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- Usually 36 cells are connected together to make a Module
- Such one module has enough voltage to charge 12 volt batteries and Run pumps and motors
- PV Module is basic building block of a PV power system
- Modules can be connected to produce more power

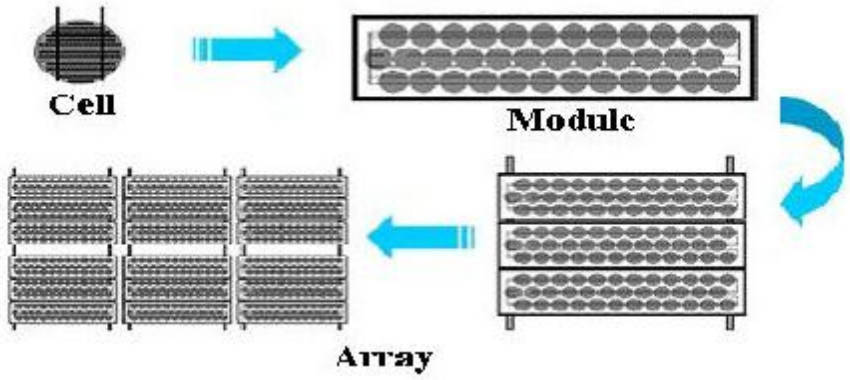

Fig 6 : Cells, Modules, Panels and Arrays

4.3 Types of Solar Cells:

Solar cells can be classified according to semiconductor materials of the cell, according to the crystalline structure of the material, and according to the number of junctions of the cell. According to the crystalline structure of the material there are three types of solar cells.

1. Single-crystalline or mono crystalline cells
2. Multi-crystalline or polycrystalline cells and
3. Amorphous cells

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Fig7 : Amorphous solar Polycrystalline Single Crystal

4.4 Monocrystalline Cells

Monocrystalline cells are the most important type, because they have the highest conversion efficiency (25%), and the base material, which is extremely pure silicon, is already well established in the field of semiconductor production. Currently, the methods of producing silicon single-crystals are primarily either the Czochralsky process or the floating zone technique. In the Czochralsky process, monocrystalline silicon grows on a seed, which is pulled slowly out of the silicon melt. With both methods, silicon rods are produced, which are cut into slices of 0.2 to 0.4 mm thickness. The discs (wafers) produced in this way, then, undergo several further production steps. These are, for instance:

a. Grinding and cleaning
b. Doping
c. Metallization
d. Antireflection coating

Fig8: Monocrystalline Cells

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4.5 Polycrystalline Cells:

The manufacturing process for monocrystalline silicon is highly energy-intensive and therefore very expensive. For this reason, in many cases polycrystalline silicon (Poly- Si) is preferred. Poly-Si develops, when a silicon melt is cooled down slowly and controlled. The yielded silicon ingot is sliced and further processed, as described before. The pulling of the single-crystal can be omitted this way. Inside the Poly-Si crystal, there are crystalline regions, which are separated by grain boundaries. The losses occurring at these grain boundaries cause the lower efficiency (less than 20%) of polycrystalline cells compared with monocrystalline ones. Despite this disadvantage, the importance of polycrystalline cells is growing, because of the lower production costs.

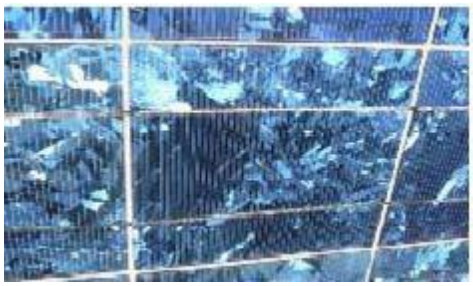

Fig9: Polycrystalline Cells

4.6 Amorphous Cells:

In order to avoid the energy-intensive production process mentioned above, and to avoid the cutting loss of the slicing process, a vapor-phase technique has been developed in which a thin film of silicon is deposited from a reactive gas such as silane (SiH4) on a carrier material like glass and doped in a further step. The semi conducting material grown in this way is called amorphous silicon. This technology has two disadvantages: first, the conversion efficiency is considerably low, i.e., less than 10%; second, the cells are affected by a degradation process during the initial months of operation, which reduces the efficiency furthermore.

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These disadvantages are compensated by the -

Relatively simple and inexpensive manufacturing process

The possibility of producing cells with a larger area

The lower energy consumption and

Easy to use in small electronic equipment.

Fig10 : Amorphous Cells

4.7 Charge Controller:

Older charge controllers used a mechanical relay to open or close the circuit, stopping or starting power going to the batteries. Modern charge controllers use pulse width modulation (PWM) to slowly lower the amount of power applied to the batteries as the batteries get closer and closer to fully charged. This type of controller allows the batteries to be more fully charged with less stress on the battery, extending battery life. It can also keep batteries in a fully charged state (called ―float‖) indefinitely. PWM is more complex, but doesn‘t have any mechanical connections to break. The electricity produced in the solar panel is stored in the battery. The electricity stored in the battery is used at night. This whole process is monitored by the charge controller.

A typical charge controller (Phocos) is shown in the figure bellow-

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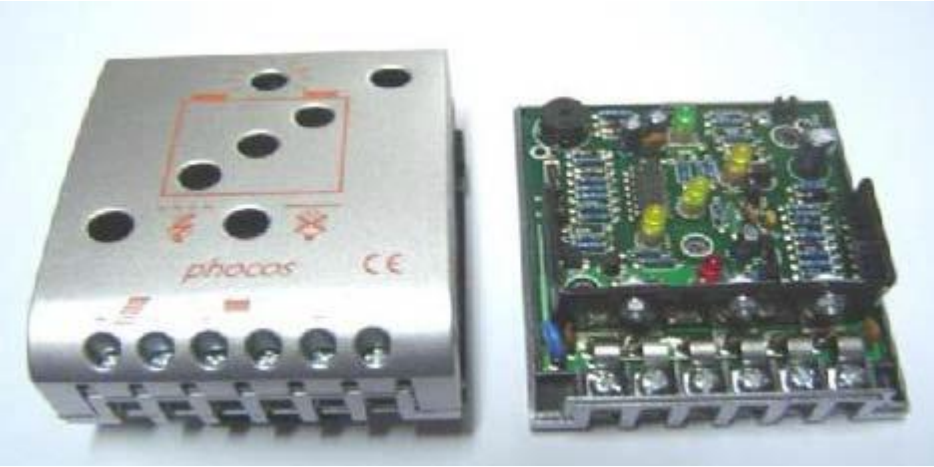

Fig11: Charge controller

4.8 Function of charge controller:

The main function of a charge controller or regulator is to fully charge a battery without permitting overcharge while preventing reverse current flow at night. Other functions are-

• Stop the process of the battery when it is fully charged.
• Disconnect the load during low voltage.
• Disconnect the load during high voltage.
• Monitor the battery voltage, state of charge, SOC etc.
• To give alarm during fault condition.
• Current measurement.

Detect when no energy is coming from the solar panels and open the circuit, disconnecting the solar panels from the batteries and stopping reverse current flow.

Charge controller is used for co-ordination and control among the battery, load and solar panel. Charge controller stores the electricity in the battery during day time and supplies the same to the load (mainly lamp) at night. On the other hand, if battery is fully charged, Then charge controller can directly supply electricity to the load (Fan, mobile charger etc) from the

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solar panel during day time. A charge controller or charge regulator is mainly worked as a voltage regulator. Generally it controls the voltage and current of the solar panel to save in battery. Solar panel mainly produces 16 volts to 21 volt and 14 volt to 14.4 volt is required to keep the battery in full charged state. The charge controller woks as a ―Buck converter‖ to minimize this voltage level. Charge controller is mainly a ―Chopper‖ or ―DC-DC converter‖. Buck converter is usually used in the solar panel which converts the high level DC voltage to the low level DC voltage.

4.9 Types of Charge controller:

Charge controller connection mainly two types-

1. Parallel or shunt controller
2. Series controller

4.10 Parallel Controller:

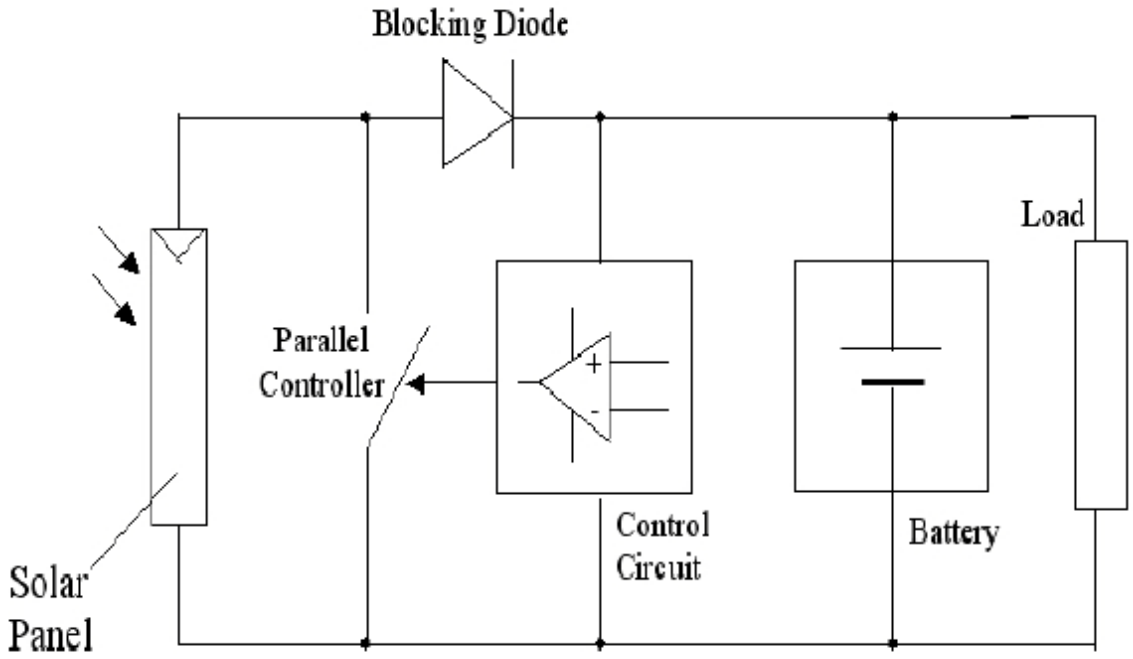

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Fig12 : Use of Shunt controller in solar home system

In this system, charge controller is in parallel with the battery and load. When the battery is fully charged, then the solar panel is short circuited by the controller.

In this system, a ―Blocking diode‖ is needed. So that reverse current would not flow from battery to the panel. When the battery is charged through this blocking diode, it gets hot.

Disadvantages of shunt controller:

• Lose of electricity
• When the panel is short circuited, huge amount of short circuit current (Isc) flows through the switch (FET).
• Shunt controller gets hotter compared to series controller.
• There is a chance of hot spot on the panel.

4.11 Series Controller:

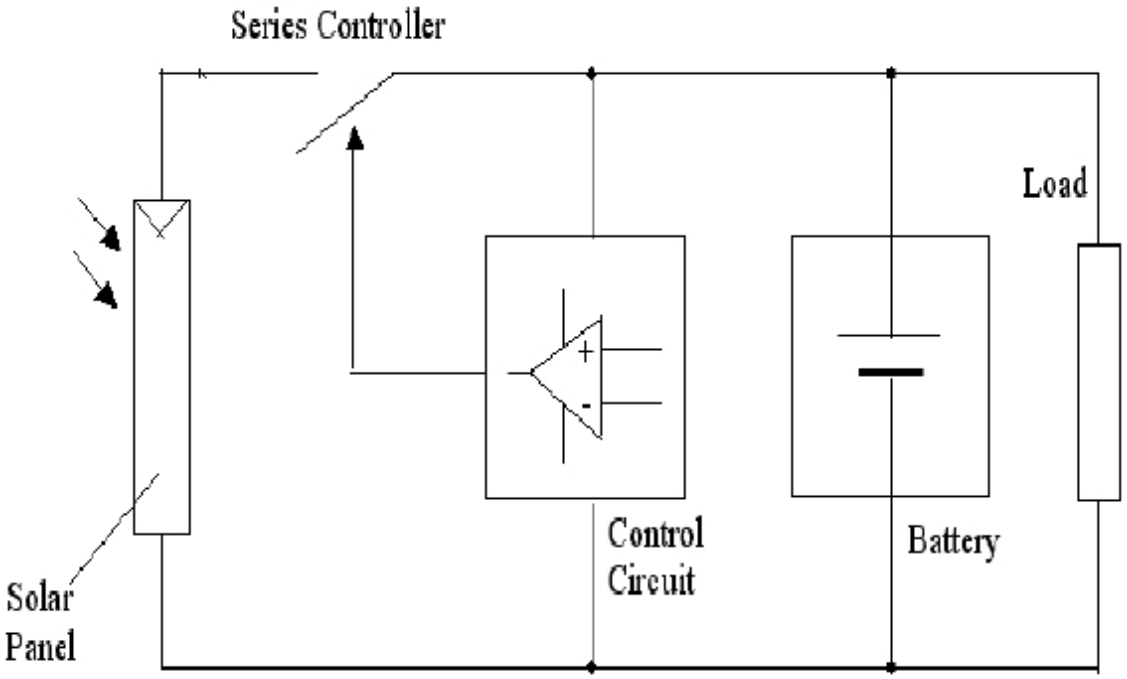

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Fig13: Use of Shunt controller in solar home system

In this system, charge controller is connected in between with the solar panel and battery. In order to terminate the flow of electricity to the battery, the series controller must be removed from the battery. There‘s no need of blocking diode in this system, but in many reasons it is used to terminate the process of discharging at night. The resistance should be maintained as low as possible in order to minimize lose of the electricity.

Advantages of series controller:

• Blocking diode is not required.
• Series controller switch is handled with low voltage compared to shunt controller.
• Low switching noise.
• It is possible of precision charge and PWM of the battery.
• No chance of hot spot like the shunt controller.

4.12 Selection of charge controller:

Solid state series controller is suitable for small system (4 ampere). Solid state shunt controller is suitable for the system of 4 to 30 ampere. A good controller must have following features-

- Low voltage disconnection.
- Battery charging current indicator (LED or meter).
- Battery voltage indicator (LED or meter).
- Sense lead.
- Adjustable set point
- Ability of Communication (for large system).
- Data logger
- Computer interface

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4.13 Voltage setting of controller:

The following factors are responsible for the voltage setting of controller-

- Types of battery
- Charging characteristics of charge controller

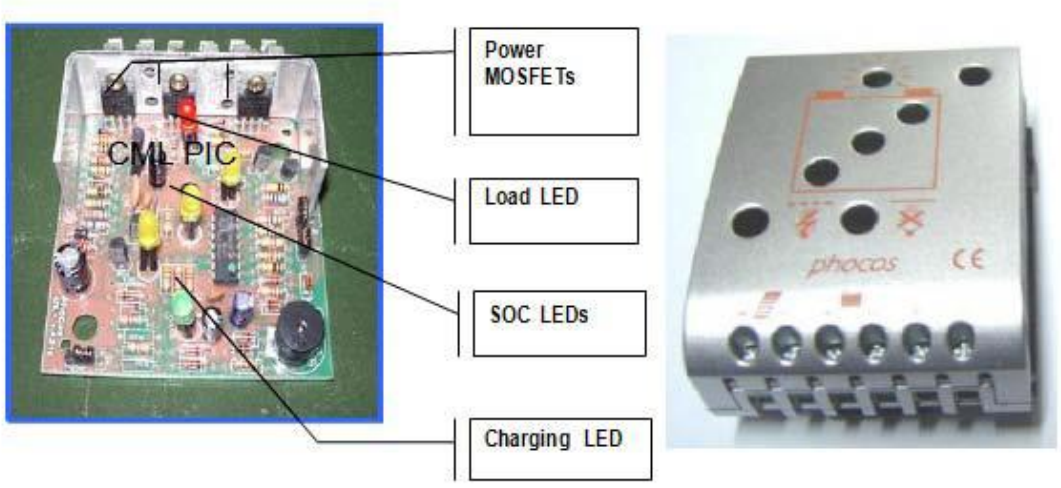

Fig14 : A solid state series controller and its various parts

Size of the battery

- Maximum panel current
- Depth of last charge

4.14 MPPT Charge controller:

MPPT charge controller is a maximum power point tracker which is an electronic DC to DC converter which takes the DC input from the solar panels, changes it to high frequency AC and converts it back to a different DC current to match with the batteries. This is a solely electronic tracking system and not concerned with the panel system at all.

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Fig15 : Phocos MPPT 100/20(20amp)

4.15 Battery:

Battery Storage:

Batteries are often used in PV systems for the purpose of storing energy produced by the PV array during the day, and to supply it to electrical loads as needed (during the night and periods of cloudy weather). Other reasons batteries are used in PV systems are to operate the PV array near its maximum power point, to power electrical loads at stable voltages, and to supply surge currents to electrical loads and inverters. In most cases, a battery charge controller is used in these systems to protect the battery from overcharge and over discharge.

Fig16: volt, 100 Ah solar battery Industrial; 2 volt, 200 Ah battery

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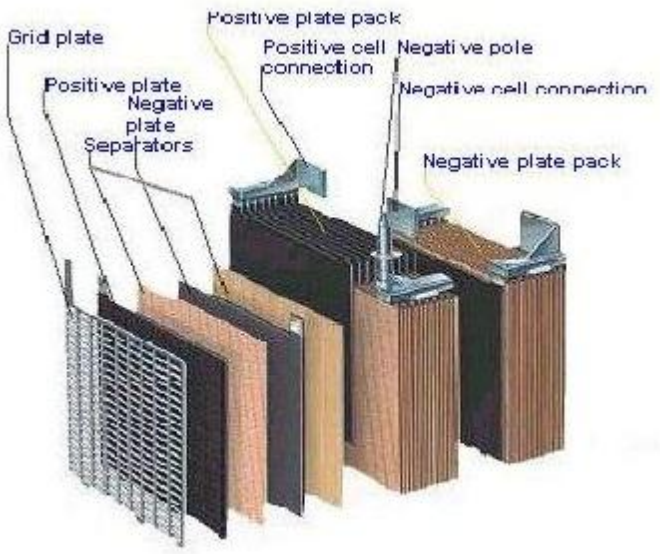

Fig17: Battery

4.16 Inverter:

An inverter is an electrical device that converts direct current (DC) to alternating current(AC); the resulting AC can be at any required voltage and frequency with the use of appropriate transformers, switching, and control circuits. Inverters are commonly used to supply AC power from DC sources such as solar panels or batteries. The electrical inverter is a high-power electronic oscillator. It is so named because early mechanical AC to DC converters was made to work in reverse, and thus was "inverted", to convert DC to AC.

Applications:

An inverter converts the DC electricity from sources such as batteries, solar panels, or fuel cells to AC electricity. The electricity can be at any required voltage; in particular it can operate AC equipment designed for mains operation, or rectified to produce DC at any desired voltage. Designed to provide 115 VAC from the 12 VDC source provided in an

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automobile. The unit shown provides up to 1.2 Amps of alternating current, or just enough to power two sixty watt light bulbs.

Fig18 : Inverter

String inverter:

Fig19:Inverter

- Good look
- Available in small- and medium-sized
- PV power station
- User-friendly Interface
- Power level 1.5KW to 6KW.

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4.17 Power plant inverter:

- Professional design for large-sized PV power station
- Transformer type and transformer less type
- Satisfy different requirement, predigest design of power station

Fig20:Power plant inverter

4.18 Grid tie inverter:

A grid-tie inverter or a (GTI) is a special type of Inverter (electrical) that is used in a renewable energy power system to convert direct current into alternating current and feed it into the utility grid. The technical name for a grid-tie inverter is "grid- interactive inverter". They may also be called synchronous inverters. Grid-interactive inverters typically cannot be used in standalone applications where utility power is not available.

Fig21: Inverter for grid connected PV

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CHAPTER 5

5.1 Solar home system design:

Basic Components:

1.Module

2.Battery

3.Charge Controller

4.Load

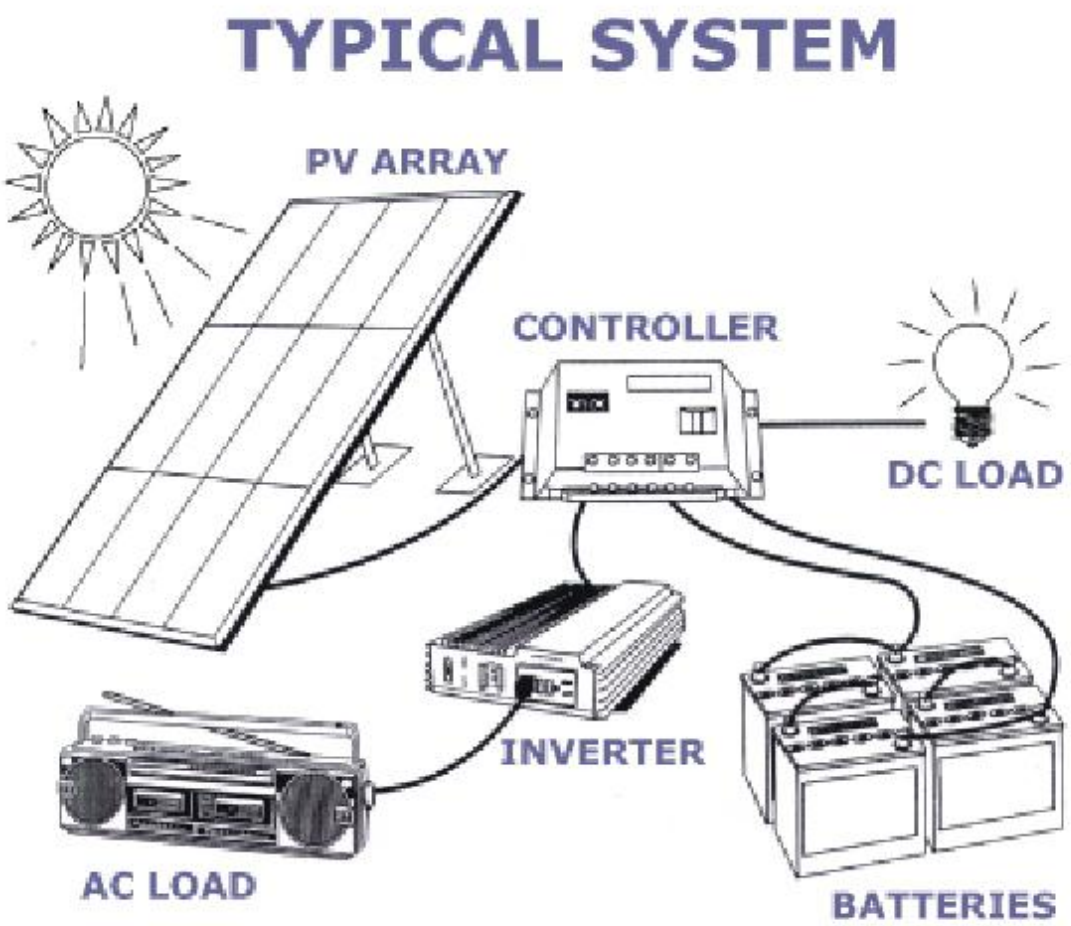

Fig22 : A typical solar home system design

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5.2 Site screening:

In this part of the design, we will first analysis the location of the installation of the solar system where there is available sunshine. As we know sunshine isn‘t equal in all places so this part very important. Because the price of the whole system depends on it.

5.3 Battery sizing:

The following characteristics are needed for a solar home system battery:

1. For deep cycle, long lifetime
2. Low maintenance
3. High charging capacity
4. The ability of completely discharge
5. Low internal discharging rate
6. Reliability
7. Minimum change under excessive temperature

5.4 Selection of charge controller:

Functional parameter of solar home system charge controller

1. Maximum current receive from PV panel
2. Ability of maximum power supply on the load
3. Mark it low voltage level
4. Mark it high voltage level
5. Electric protection from thunder
6. Good regulation
7. Protection from reverse polarity
8. Adjust with system voltage

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5.5 Selection of converter:

A solar home system use for appliance needs ac and dc voltage. As Solar module output voltage is dc, so this system dc-dc converter or dc-ac converter needed. Some of the load is connected necessary converter.

5.6 System wiring:

From PV module up to system component electric wiring is needed. Voltage drop occurs in internal resistance of the wire. Solar home system this voltage drop should keep under a limit. Wire cost is very important and wire length must be small size. Connection the solar component under dement must be fulfill:

- System must be safe
- These wire are not make defect for system components performance
- Each components works according their maximum performance
- If possible use centralized 12volt dc system
- If possible use centralized 24volt dc system

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CHAPTER 6

10W SOLAR PANEL SYSTEM

The sun is a renewable energy source that's free and plentiful. If we try to use this things, we can save extra load from the power grid.

The objective of this project is thinking about the street light power. If we implement this system, we can save extra power from the grid line. Here, it's explained below the detail procedure to build a 10-watt solar power system just using 3W.

6.1 MATERIALS

1. 10W Panel	1 piece
2. Charge Controller	1 piece
3. Battery(12V,7Ah)	1 piece
4. light(12V DC)	1 piece
5. Cable	1 meter
6. Box	1 piece

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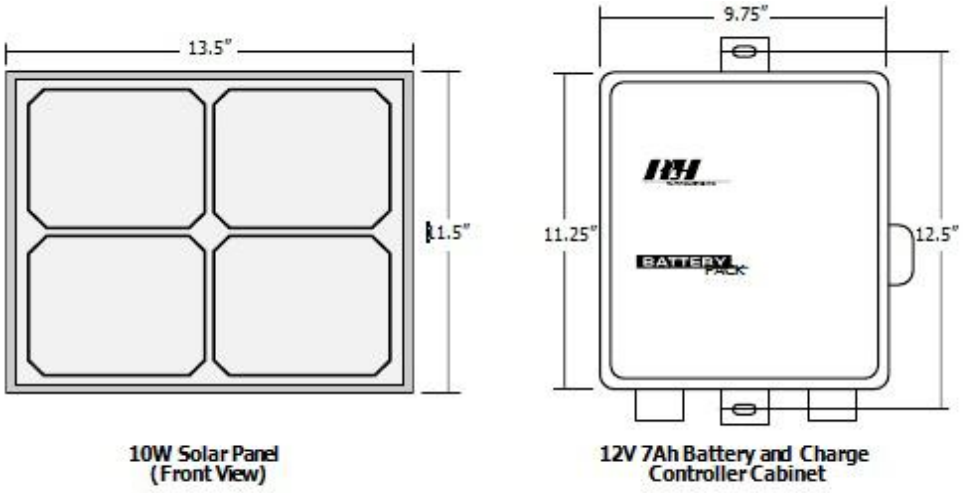
6.2 DIMENSIONAL INFORMATION:



10W Solar Panel (Front View)

12V 7Ah Battery and Charge Controller Cabinet

6.3 CONNECTION DIAGRAM

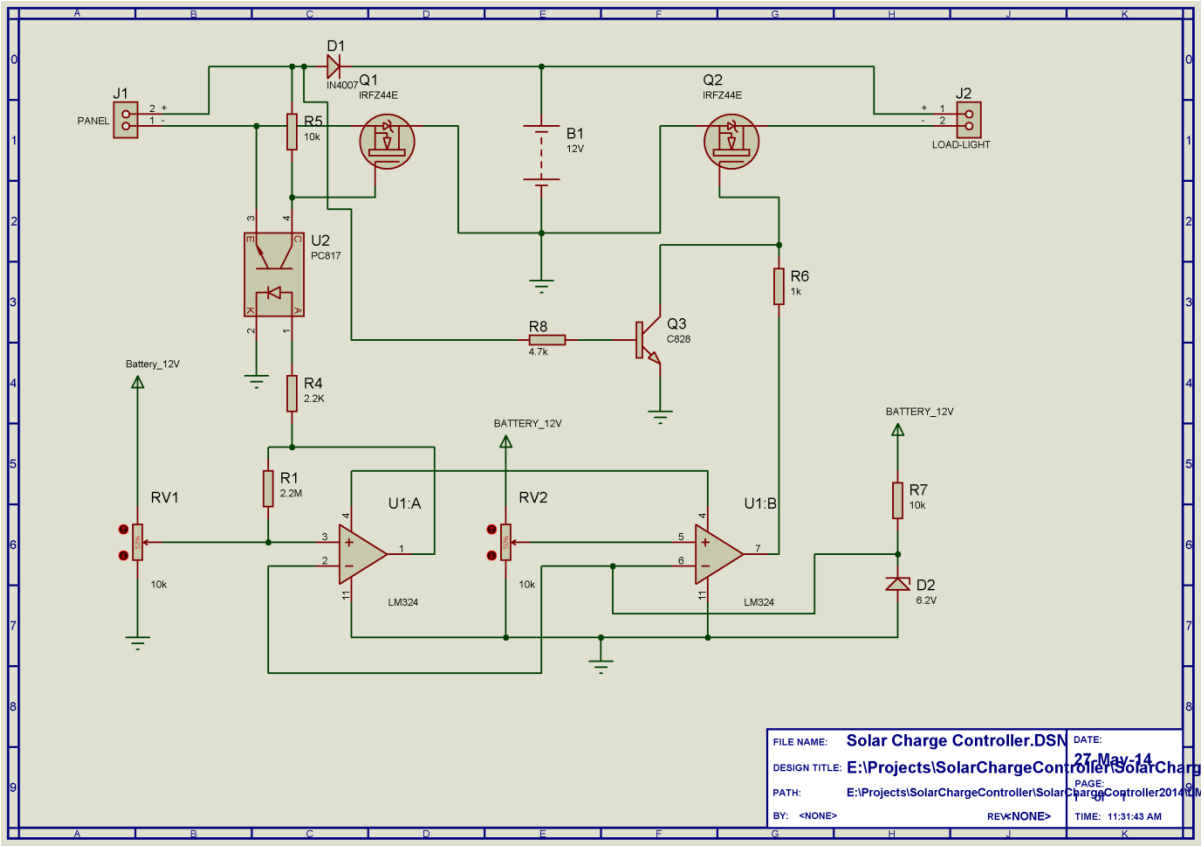


Fig23: Solar System Charge Controller

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6.4 SPECIFICATION:

MODEL TYPE			**SLPV-10W**		
Pm	Vmp	Imp	Voc	Isc	
10W	17.5V	0.58A	21.5V	0.65A	
Maximum System Voltage			1000V(IEC)		
Maximum Series Fuse Rating			10A		
Dimension			290*360*20mm		
Frame			Aluminum		
Weight			2KG		
Output Tolerance			0~+3%		
Date			November,2013		
Standard Test Condition			1000W/m2,AM 1.5,25^0C		
Operating Temperate			-40^0C to 85^0C		

6.5 Work Procedure:

At first design the circuit diagram and made a charge controller. Connect 12V battery with charge controller and also in the solar panel. The working procedure is divided into two parts. The first one is connected between the solar panel , a charge controller and a battery. The other one is battery to load. There is a fix voltage regulator which rating is 14.4V.The system is implement in high and low cut-up. The high is 14.4V and the low is above 6.3V.When the panel voltage is trying to go above 14.4V ,it will disconnect the battery from panel in a system, where used a OP-AMP ,a optocoupler and a MOSFET. Here OP-AMP is used as a switch where the negative voltage is 6.2V fixed. When the high current is flowing into the OP-AMP it will pass the voltage into the optocoupler. Then it will open the MOSFET. As a result the connection is open between the panel and battery. In other part, there is a ziner Diode which is fixed 6.2V and connected with the second OP-AMP negative terminal. When the battery is discharging and the value is above 6.2V, the load will active. If the voltage below 6.2V the connection will open between the battery and the load. In the system there is a transistor which is used for working in the day and night mode.

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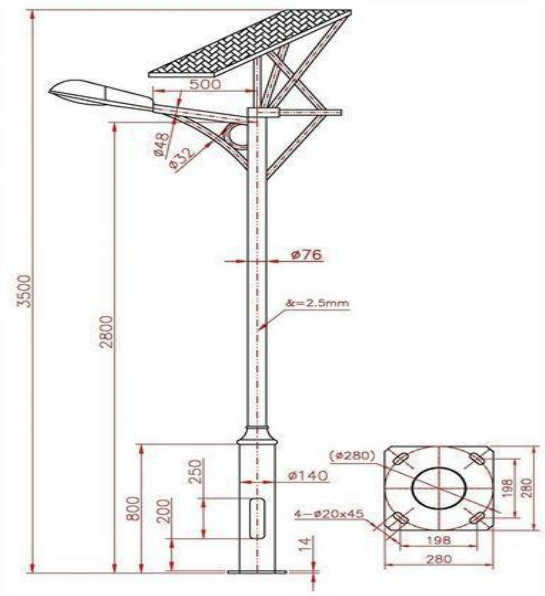

Fig24: Street Light Model

Real Picture Of Project:

Fig25:Top View

Front View

Night View

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6.6 SYSTEM CALCULATION:

Full charge cut-up=14.4V(fixed)
Zener diode=6.2V(fixed)
Load=3W
Battery Voltage=12V,7Ah
Load current=3W/12V
=0.25A per hour

Total Hour =7A/0.25Ah
=28A/hour
Panel Current =10W/17.5V
=0.5714A
Battery current =10W/12V
=0.833A
Charging time =7Ah/0.833A
=8.40h(12V battery full charge)

Project COST ESTIMATE:

EQUIPMENT	PRICE(TAKA)
PANEL-10w	1100
Battery-12V	1200
Charge Controller	800
Bulb-3W	350
Frame	2500
Box+ Others	250
TOTAL	BDT.6200 Tk

6.7 SYSTEM DETAILS:

Project Location	**Sukrabad**
System Size	7500Wp,off-grid
Project Type	Turnkey
System Voltage	48V

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6.8 Production Specification:

S/N	ITEM NAME	QUANTITY (PC)
1	200watt solar PV modules 1580mm*808mm*35mm	36
2	150watt solar PV modules 1297mm*808mm*35mm	02
3	Off-grid type auto inverter-4.5kVA,with over load protection Input volt=48V,output volt=220-240V,50Hz.	2
4	48V 120A charge controller(Built ion with auto inverter)	2
5	Panel structure,Battery Carrier,Juntion Cable,Connectors,Structure,Materials as required for the installation.	1 Lot

6.9 System Requirement:

1. A 7500Wp system will be used for lighting purposes in the load-shed time.
2. The system will provide a total backup of 4 Hours for maximum 75% AC Load.
3. It required 1000SFT(Approximately) space required at the roof for mounting at solar PV panels.

The system will accommodate the following parts:

a. An array of 7500Wp solar PV panels mounted on the roof top of the building.
b. Off-grid,4.5KVA capacity auto inverters with over load and over current protection.
c. Charge controllers,48V 120A built in with inverter.

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d. 12V 200A deep cycle batteries to provide power in night time.
e. Mounting structure for PV modules.
f. Solar cables, accessories and consumables.

6.10 SYSTEM PRICES:

Supply of solar panel modules	36*200Wp 2*150Wp	Electro Solar Power Bangladesh
Supply of off-grid type auto inverter-4KVA,with overload protection	2	Made in Bangladesh Brand: Grameen ALO
Charge Controller 48V 120A built in with auto in with auto inverter	2	Made in Bangladesh Brand:Grameen ALO
Supply of Deep Cycle Lead Acid Batteries-12V 200Ah	16	Brand: jCo
1.Junction cables,connectors, structure. 2.Materials as required for the installation.	1 Lot	Local
Total Price(Including 2.5%)	**BDT.2150000.00**	
In words: Twenty One Lac and Fifty Thousand Only.		

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6.11 Types of solar panel:

1.Off-Grid solar panel

2.On-Grid solar panel

Off-Grid:

Off Grid systems are independent from the utility grid. Electricity from off grid systems is used on site. Power that is generated can also be stored in batteries and used on no sunny or cloudy days, a generator may also be used for back-up.The off grid inverter is a three-in-one system integrating the controlling of battery charging/discharging, inverting and load dumping.

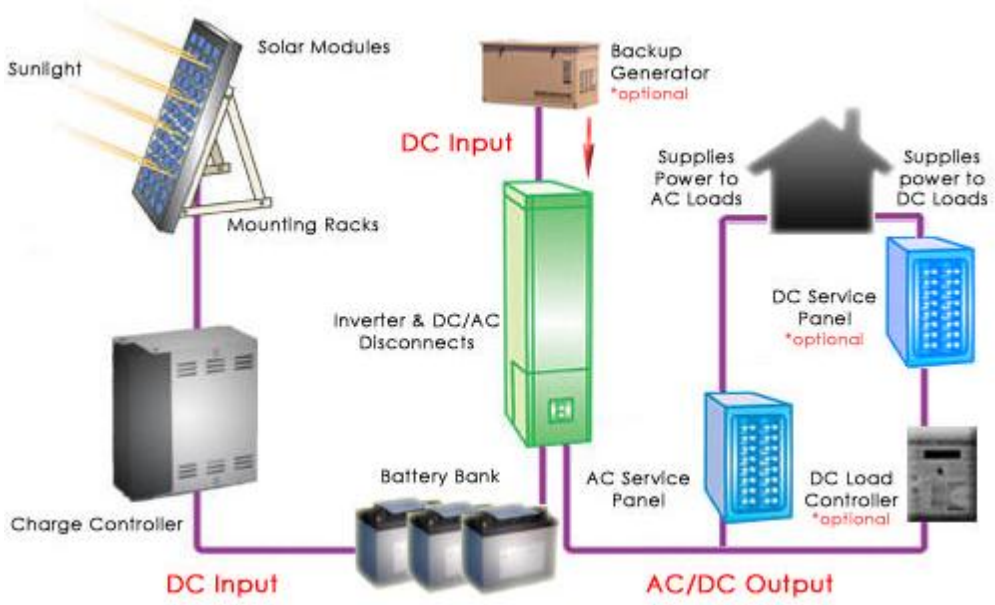

Fig26:Off-Grid system

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Control Function:

The controller regulates AC & DC output of generator to charge the batteries. The controller will charge the battery until it becomes full; when the battery is full, the controller will be in floating charge state. To protect the batteries, the controller will buzz and cut off the batteries' out-put circuit if they are over discharged or battery voltage reach the controller set point.

Batteries Bank:

Batteries are used to store energy for use at a later time, like night time or on cloudy days. The batteries used in a Solar System re deep cycle batteries, similar to those that power electric golf carts. The number of batteries used in a system varies on the type of battery and anticipated storage needs.

Inverting Function:

The off grid inverter is mainly applied for isolated solar power systems. For example system can supply power for running a separate heating system, refrigerator, pump, etc.

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On-Grid:

On Grid systems are not independent from the utility grid. It is related or connected with the grid line. The main advantage of this system is that it is giving 95% efficiency. The system is designed in a nice way. Though it is combined with the main line that's why it will work in a system. At first the supply load will come from the solar panel then the lack of load will come from the main line. The system is designed by that way.

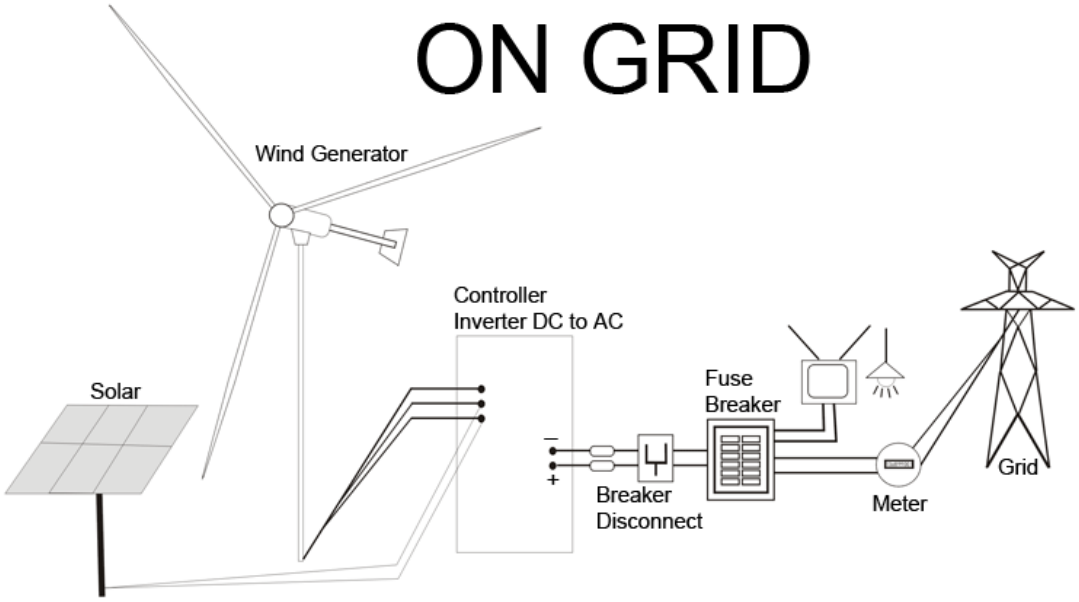

Fig27:On-Grid System

This type of system is used only for to reduce the pressure from the grid. We can use the power in the produced time.

Estimate of load:

System=2
Battery=16*12V=192V
Per System=192/2=96V

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Due to the system problem we can get some load from the solar panel.

Instrument	Amount	Watt	Total Watt
Energy Saving Bulb	46	25	1150
Fan	4	80	320

Calculation:

Total Watt=1150W+320W

=1470W

=1.47kW

=1.47kW*4hour

=5.88kWh

P=VI

I=P/V

=1.47kW/220V

=6.68A

Still one system is running. The amount of battery is 8.It is giving 4 hours backup.

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Target of Bangladesh Government:

Time	Amount
Present	400MW(Maximum)
2020	2000MW
2030	3780MW

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CHAPTER 7

Conclusions

Solar energy technologies generate electricity without producing air or water pollution. Solar thermal energy technologies may require cooling water, but most of this water can be recycled. Only small amounts of hazardous materials are produced in the manufacture of photovoltaic cells and CSP equipment and essentially none in other solar thermal applications. According to the U.S. Environmental Protection Agency (EPA), CSP plants do not damage the land, but merely take it out of use for other applications such as agriculture. Wildlife habitat may be displaced from land used for such systems, however.

Solar electricity can reduce carbon emissions by offsetting the need for carbon-producing fuels. For example, Applied Materials has installed solar panels at its manufacturing plant in Austin that will generate about 33.7 MWh annually and eliminate about 54,000 pounds of carbon emissions each year. Solar PV represents a true zero carbon emission generation option. Solar PV technology offers significantly lower capital and operating costs than Diesel power technology. Higher solar radiation levels such as at Blochistan would lower electricity cost..The nature solar energy source makes it more preferred, practical energy solution.

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