Low Cost Data Logger And Monitoring System For A Small Solar PV Energy System

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Abstract- *A data logger and monitoring system are very crucial for a smooth, efficient and robust operation of PV solar energy system. Datalogger and monitoring system enables the proper operation and contributes to identifying system malfunctioning before any major breakdown. In this thesis, a low-cost, user-friendly, reliable datalogger and monitoring system has been developed mainly for a pico solar home system in a rural area of a developing country. This ESP 32 microcontroller based datalogger stores all monitoring parameter in a micro SD card and displays that on a local webpage in HTML format. Data can be downloaded directly from the webpage to analyze and verify the system operation. The developed datalogger hardware prototype uses only three sensors for temperature, voltage, and current sensing. An Android app is also developed for cell phone to display all parameters in real time basis for an efficient monitoring which can also able to send an alert text message to maintenance personnel for any issues in battery charging. The overall cost of this prototype is only around C$ 50..*

Keywords- Solar Energy, Solar Panel,SHS

I. INTRODUCTION

Energy or electrical power plays an important role in this modern civilization and the proper development of a nation depends on the availability of energy for industries and human civilization. So, energy or power is a vital element for the socio-economic development of a country. Due to the huge urbanization and technological development, the world energy consumption is increasing very rapidly. According to the U.S Energy Information Administration (EIA) statistics, global energy consumption will increase by 28% between 2015 to 2040. It will increase from 575 quadrillion British thermal units (Btu) in 2015 to 663 quadrillion Btu by 2030 and then to 736 quadrillions Btu by 2040 [1].

This energy consumption is mainly based on fossil fuel and oil. The world total reserve of this fossil fuel will deplete within the next two or three decades. The mono dependency policy on fossil fuel must reduce for the greater sustainability of human beings. Moreover, this type of fuels is creating greenhouse gas emission and carbon footprint issues. So, for the existence of the human world, a reliable and easy affordable alternative energy needs to be found. Also, the accessibility of electricity for all people of the world must be ensured. Power or electricity is required for both economic and social development of humans all over the globe. Read already published work in the same field.

II. DEFINATION OF SOLAR ENERGY

Solar energy is radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaics, solar thermal energy, solar architecture, molten salt power plants and artificial photosynthesis. It is an essential source of renewable energy, and its technologies are broadly characterized as either passive solar or active solar depending on how they capture and distribute solar energy or convert it into solar power.

III. SOLAR PANEl IMPORTANT

Solar power systems derive clean, pure energy from the sun. Installing solar panels on your home helps combat greenhouse gas emissions and reduces our collective dependence on fossil fuel. Traditional electricity is sourced from fossil fuels such as coal and natural gas. ... Renewable energy also improves public health.

IV. LOW COST DATA LOGGER FOR SOLAR HOME SYSTEM

For future analysis & processing, Solar Home System needs real time data storage element. It allows the system to monitor the stability & accuracy of the system. With the evolution of information technology & Electronics it can be possible to store various real time data found from the system to a micro SD card without any time lag. Most of the modern system demands data to be saved for further analysis. Data is no longer to be transmitted to a remote server for all the time. Real time transmission of Data needs more power, cost & Hardware.

Software interfacing circuitry. If data for several days is saved locally, then it can be used next to estimate system's

current operating state. Where a conventional Data Logger or real time monitoring unit costs more with advanced transmission process, a Smart data recorder interfaced with Solar Home System can do all the same monitoring and data storing with less cost. a system is developed to sense these data and send to a micro SD card where a text file is created automatically for data storage. The process of system design & verification is very economical i.e. overall cost is kept as less as possible. Household applications of solar PV in developing countries are limited to the following three system.

- Small PV system consisting of one or more solar PV modules with a total peak power of 200W or less & a battery. These are used for powering household appliances such as lights, radio, television & fans.
- Solar lanterns consist of a PV-module & a portable light with battery.
- PV battery charging stations have an array of PV modules, which are used to charge batteries for individual households. These can be used for powering home systems & portable lanterns.

The Smart Data logger can be used for any of three above systems in order to estimate the operating condition.

V. SYSTEM DESIGN & SETUP

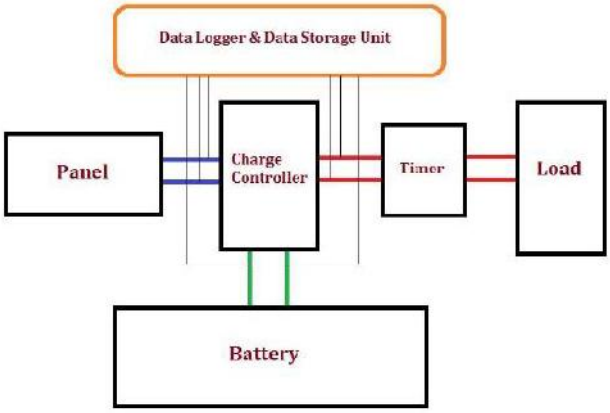

Fig- 1 Complete diagram of the system

5.1: Components of the System

The overall system is composed of some basic elements

- Solar Panel
- Real Time Clock
- SD Card Module
- TFT monitor
- Buck Regulator
- Solar Charge Controller
- Battery
- System Load
- Microcontroller (Arduino Mega)
- Analog Voltage & Current sensors

5.2: Major Parts Of System

A SHS consists of mainly three major parts. They are the following:

1) Pico-solar panel
2) Charge controller and
3) Rechargeable battery

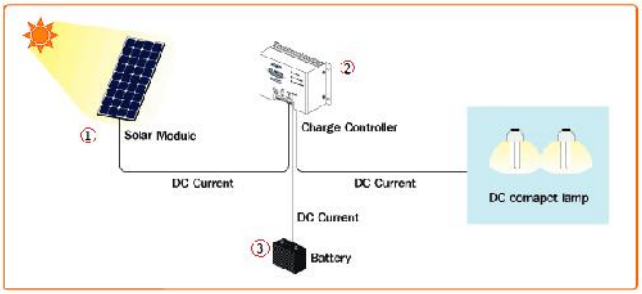

Figure 2: Different Components of Solar Home System

1) Pico-Solar Panel:

Solar home systems use photovoltaic (PV) cells and this PV cells are made from semiconductor materials such as silicon and generate DC electricity from sunlight. A different number of cells according to the size of PV are connected together and sealed in a waterproof case which called PV panel. Figure 2-4 presents a small PV panel which is called Pico-Solar panel. These pico-solar panels range from 0.1 Watt-peak to 20 Watt-peak.

Figure 3: Pico-Solar Panel Set Up on the House Roof

PV cells and panels are described by their capacity called watt-peak (Wp) rating and the generation depend on

this capacity considering standard conditions and weather. Generally, 20 Wp or 30 Wp PV systems are using for the solar home system but a system with higher capacity are also available depending on the load like 40,50,60,100 and 130 Wp.

2) Charge Controller:

The solar charge controller is a controller that is used to control the charging of the solar appliances and also battery. The function of the controller is to regulate the voltage and current from the solar PV panel to the battery in order to prevent overcharging and also over-discharging. Many technologies have been included in the design of a solar charge controller. For example, MPPT charge controller included maximum power point tracking algorithm to optimize the production of the PV cell or panel. Figure 2-5 shows a charge controller for SHS.

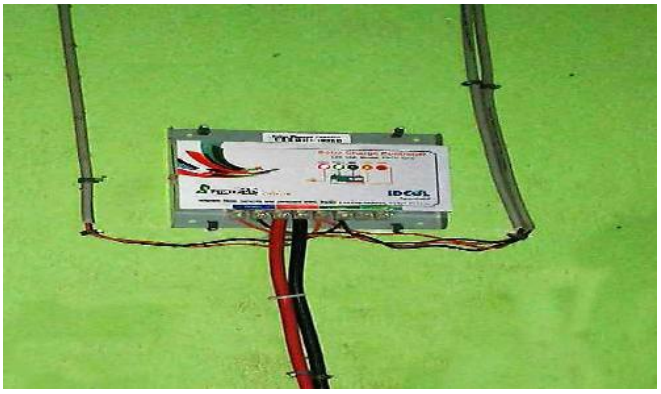

Figure 2- 5: Pico-Solar Charge Controller Setup in the House Wall

3) Rechargeable Battery:

Mainly rechargeable batteries are used to store electricity from the energy of sun using solar PV panel. The battery is used to store charge or electricity throughout the day so that it can provide the backup energy required to light up at the night or even on any cloudy day. This rechargeable battery is providing a stable voltage for the DC small appliances. Normally, a lead acid battery is used to store electricity and run small DC lights and fans. Figure 2-6 shows a rechargeable lead-acid battery for SHS. Nowadays, lithium-ion batteries are also becoming popular for this purpose due to longer lifespan and fewer maintenance issues than a lead-acid battery.

Figure 2- 6: Rechargeable Battery setup in the house of SHS

VI. CONCLUSION

For a smooth, efficient and robust operation of PV solar energy system, a data logger, and monitoring system is very foremost. Datalogger and monitoring system enables the proper operation and contributes to identifying system malfunctioning before any major failure. By having a data logger, it becomes very easy to trace any particular data on a specific time period which leads to an easily traceable scenario to find any anomalies in operation. Moreover, deploying the monitoring system in the PV solar energy system increase system reliability and ensure smooth operation. An efficient monitoring system can assist the user of this energy system to run the system trouble-free for many years.

VII. ACKNOWLEDGMENT

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