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Enhancement of Battery Life by using Efficient Energy Monitoring System

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Abstract-Now a days, every sector is facing challenges regarding deficiency of getting uninterrupted power supply. To satisfy the need of electrical energy of every individual is a challenge for the power engineers. They must think over the alternative energy sources such as solar, wind, hybrid system, tidal etc. Till now, we primarily relied upon Fossil fuels to meet the requirement of our energy needs. In coming years, due to increasing demand, there will be a significant need for implementation of renewable energy as a primary source of energy. Productive use of electrical energy is the basis for long-term sustainable economic development. As we know Solar energy is the ultimate renewable source of energy. Harnessing its energy holds great promise for the world energy crises, and it will be heavily called upon as fossil fuels are being depleted. Here the comparison of traditional and renewable energy sources on the basis of observed and calculated circuit parameters with the help of an energy monitoring system. The hardware system used in this study comprises of several technologies like PLC (Programmable logic controller), SCADA (Supervisory Control and Data Acquisition) along with the sources to be compared.

Keywords: *solar energy, monitoring system, battery life enhancement, relay.*

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I. INTRODUCTION

Among renewable sources, solar is the most abundant and developed to be a promising source of energy. The use of solar cells began in the 19th century when it was observed that the sunlight is capable of generating usable electrical energy. Solar energy is being used in many applications like water heating, cooking, producing electricity for past few decades. They have been used in different sectors where electrical power from grid was unobtainable. During the last decade, there has been an exponential increase, both in unit power ratings and efficiency. Large scale solar farms, can meet the power requirement over both, a large and densely populated area, while small scale solar power projects are being used to provide electricity to isolated locations. Collectively, solar power system is the easiest and efficient source for the generation of electricity for domestic as well as industrial objectives.

An effective use of renewable energy attracts a great deal of attention globally to cope up with the environmental problems such as reducing CO_2 emission and also to compete with the continuous degradation of non-renewable resources. Presently, thermal is one of the most used and prominent resource. But the gradient content of coal is not high enough due to which excess amount of coal is being used for power generation. There are also other non-renewable resources available in nature such as wind and hydro, but the low efficiency, high installation cost and seasonal working of plant affects the generation.

Here the monitoring system involves- data collection and review, plant surveys and system measurements, observation and review of operating practices, data analysis through PLC and SCADA for maximum utilization of solar energy is presented.

The objectives of this analysis are-

- To compare parameters of renewable and non-renewable sources.
- Battery life enhancement.

II. SOLAR ENERGY

In 21st century, the use of Solar technology to provide electricity, heating and cooling, as well as transportation is now spread across the globe, and recent trends suggest sustained growth worldwide. Solar power is the energy directly obtained from solar irradiance and effectively utilized in the residential and commercial applications.

Solar panel is a solar array of a photovoltaic system designed to absorb the sunrays as a source of energy for generating electricity. The solar panel consists of mono-crystalline silicon solar cells which are most efficient among its classifieds types. It is easily available as well as has a market share of over 90%.

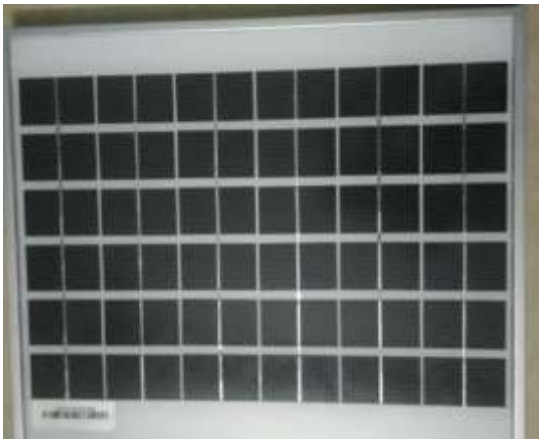

Fig 1: solar panel

Specifically in this study, the solar power is referred as the solar energy converted in the form of electrical energy. The solar energy, in addition to its environmental benefits, is also an economic driver.

III. PROGRAMMABLE LOGIC CONTROLLER

PLC is a specialized digital computer used for automation of machinery or electrical equipment. Unlike generally used computers, the PLC is designed in systematic manner for multiple inputs and output arrangements and also for extended temperature ranges, resistance to vibration and impact. It is an example of real time system, since output results obtained must be in response to input conditions in a limited time, otherwise the results obtained will be inadvertent. Until the start of present decade, these operations were successfully completed by using relays, circuit breakers etc.

Table1 Specification table of solar PV panel

Specifications	Ratings
Type of solar cells	Thin film solar cell
Size	344 * 289 * 22 mm
Rated voltage (Vmax)	18V
Open circuit voltage	21.96V
Rated Power	10W
No. of solar cells	6*6
Tolerance	±3%

But due to errors and decreased efficiency, relays and allied systems were drawn out, replacing them with PLC. The machine controlled operations performed by relays and allied systems are

Fig 2: Micro-Logix 1100 Series B

performed by PLC with more ease and efficiency. In monitoring system, PLC and PCs are used for performing its operation. The PLC programming is done by basic ladder logic which has various advantages amongst them reusability is the chief advantage.

PLC is used as an intermediate between source and the load whose data is then sent to SCADA for monitoring and analysing the given parameters. The details of the PLC used for this system are as follows:

Table2 Specification table of PLC

Specifications	Ratings
Rated input voltage	24V DC
Rated output voltage	24V DC
No of Analog Inputs/outputs	2
Manufacturer	Allen Bradley Pvt. Ltd
Series	Micro-Logix 1100 Series-B

IV. SCADA (Supervisory Control and Data Acquisition)

SCADA is an industrial automation control system at the core of many modern industries. It works well in many different types of enterprises because it can range from simple configuration to large, complex projects. In today's world, there is some type of SCADA system running behind the scenes, at almost everywhere like at local supermarket, refinery, waste water treatment plant, or even your own home. In basic SCADA architectures, information from sensors or manual inputs are sent to PLCs (programmable logic controllers) or RTUs (remote terminal units), which then send that information to computers with SCADA software. Modern SCADA systems allow real-time data from the plant floor to be accessed from anywhere in the world. SCADA monitors, controls and alarms the plant from a centralized location. It includes the communication of information between a SCADA central host computer, many scattered units and/or Programmable Logic Controllers. SCADA offers the ease of monitoring of sensors placed at distances, from one central location.

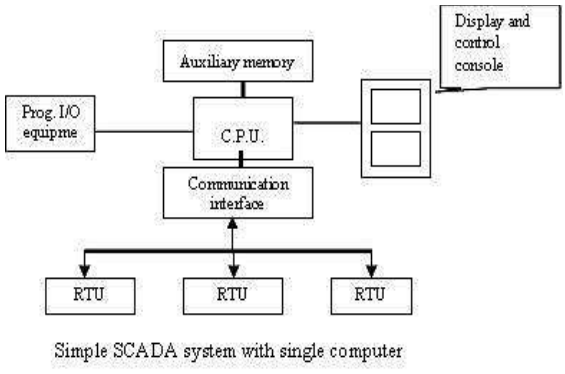

Fig 3: SCADA system

V. INDUSTRIAL RELAY

- A relay is usually an electromechanical device that is actuated by an electrical current. The current flowing in one circuit causes the opening or closing of another circuit.
- Relays are like remote control switches and are used in many applications because of their relative simplicity, long life, and proven high reliability.

- To reduce human errors and time delay an automated circuitry was required and this is achieved by using a relay.
- The relay used in this paper is an 8 pin RS8E industrial relay, which operates for maximum voltage levels of 24V DC.
- When solar light intensity is reduced to a certain value the PLC send a command signal to the relay, which results in toggling of sources by the relay, for optimum functionality the control switches to a backup source.

Table 3 Specification table of Relay

Specifications	Ratings
Rated Max voltage	24V DC
Rated Current	1 Amp
Max coil Resistance	500 KΩ
Operate time	0.020 sec. max
Release time	0.010 sec. max
Manufacturer	PLA components Pvt. Ltd
Series	8 pin RS8E

VI. METHODOLOGY

The main focus is that the comparison of energy obtained from renewable and non-renewable sources based on electrical parameters. For PLC to operate, current and voltage signal in the range of 0-20 mA and 0-20V DC are required respectively. In order to provide PLC these signals, the electrical power from the source should be unaltered, for this purpose a hardware circuit is fabricated. This circuit is then connected to PLC. The RS logix 500 software is used for ladder logic programming.

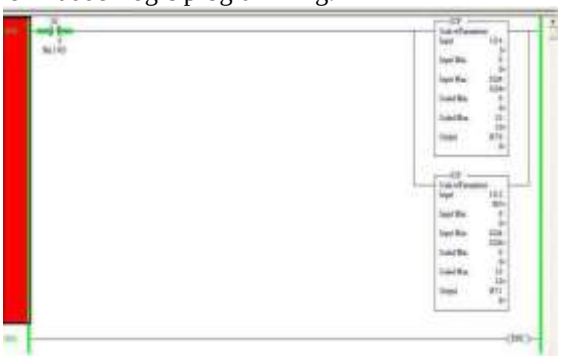

Fig 4: Ladder Programming

Monitoring of current and voltage signal is done on SCADA. The parameters from solar PV panel and battery are taken into consideration for a specific period. Firstly the solar panel is connected and the values are analysed through PLC and SCADA. Then battery is connected and its values are obtained for same specific period. Based on these values the electrical parameters of both the solar PV panel and battery are compared.

VII. RUN-TIME ANALYSIS

During test run following observations were made:-

(a) We studied the output obtained from solar panel for specific time period. The generated output voltage and current tends to vary with the light intensity. The following graph shows the monitored output voltage and current of solar panel.

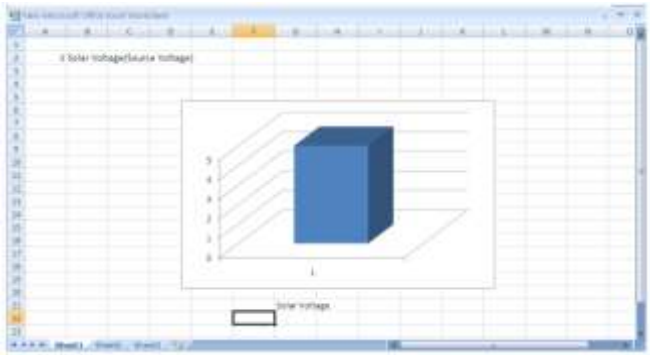

Fig 5: Graph of output voltage (solar panel)

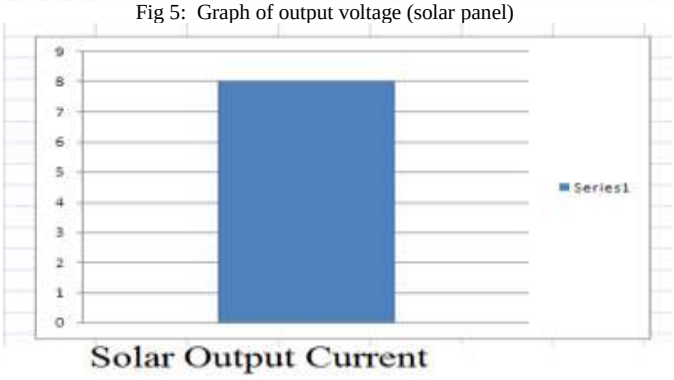

Fig 6: Solar output current

(b) The output obtained from battery for its specific time period is graphically shown as follows:

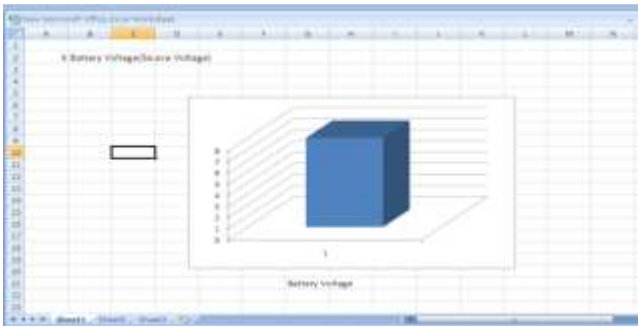

Fig 7: Graph of output voltage (battery)

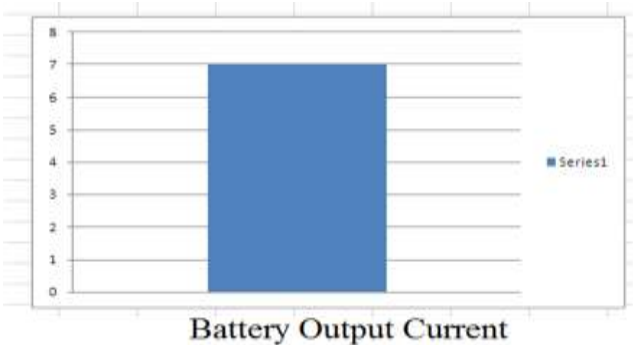

Fig 8: Graph of battery output current

VIII. BATTERY

There are different types of batteries like lead acid battery, Ni-cadmium battery, Ni-iron battery, dry cell battery etc. Dry cell battery is a type of chemical cell, commonly used today, in the form of batteries, for many electrical appliances. Here we have used a dry cell battery as the back-up energy source due to its cost effectiveness and capability of producing high currents. Dry cell batteries are still being used in 99% of solar and backup power system. The operating hours of the battery used in our hardware is 1.3 Ah/20 and battery life is approximately 10,000 hours. The cyclic use range is 14.50 to 14.80 V and in standby mode its range is 13 to 13.80 V.

IX. COMPARISON

The parameters obtained from both sources are shown on SCADA. These parameters are compared as shown in following table.

Table 4: Solar Source

Parameters	Design Values	Measured Values
Voltage (unit)	4.5	4.5
Current (unit)	8	8
Power (Watts)	3.6	3.6

Table 5: Battery

Parameters	Design Values	Measured Values
Voltage (unit)	7	7
Current (unit)	7	7
Power (Watts)	4.9	4.9

Scale: voltage-1unit=1 volt, current-1unit=0.1 amp

The number of operating hours of battery as mentioned above is 10,000. Using solar PV panel as backup source, operating hours of battery are saved. During daytime if solar source is in operation for specific time period i.e. 8 hours, then these equals the same number of hours saved from operating life of battery. According to this calculation, for a year, considering holidays and maintenance break, operating hours of solar source will be 320×8=2560 hrs. Therefore, 2560 operating hours of battery will be saved in a year i.e. battery operated for only 10,000-2560=7440 hours. Therefore life of battery is enhanced by 2560 hours.

Therefore we can calculate the enhanced life of battery by using formula,

Enhanced life = Operating hours + Operating of battery of solar source hours of
(Hours) Battery

Results can be tabulated as follows:

Table 6

Time	Operation of battery	Operation of solar panel	Total savings	Enhanced life of battery
Hours	10000	2560	2560	12560
Days	417	107	107	524

From above comparison tables, it is analysed that by using solar PV panel as a primary source the overall life of the battery is increased.

X. CONCLUSION

It concludes that, after implementing this project, the battery life is enhanced by 2560 hrs i.e. 107 days (operating hours= 16 hrs per day) using solar PV panel as a primary source was successful. This system can be useful in domestic as well as industrial sectors where batteries are used for supply purpose. As the solar light intensity decreases below certain value, automatic toggling will take place between the sources. From table 6, we can conclude that the overall battery life enhancement is 2560 hours i.e. 107 days.

REFERENCES

[1] Kamaldeep Kaur, and Prof. Ravinder Kaur "Energy Management System using PLC and SCADA", International Journal of Engineering Research & Technology (IJERT) vol. 3, Issue 11, Nov. 2014.
[2] P.Thamarai and R.Amudhevalli, "Energy Monitoring System USING PLC & SCADAS", International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering , Vol. 3, Issue 2, Feb. 2014.
[3] Sagar P. Jain and Sanjay L. Haridas , "Energy Efficient Automized Public Utility Building", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 4, Issue 5, May 2014.
[4] Pranay Shete, Nirajkumar Maurya, Prashant Meshram and Subina Khan, "Efficiency Enhancement by Live Sun Tracking for Solar PV System", International Journal on Recent and Innovation Trends in Computing and Communication, Volume: 2 Issue: 12, Dec. 2014.
[5] Sandip Sarkar, Edward Tiedemann, "cdma2000: Battery Life Improvement Techniques ", Qualcomm Incorporated, San Diego, CA 92121, USA.
[6] Chol-Ho Kim, Moon-Young Kim and Gun-Woo Moon, "A Modularized Charge Equalizer Using a Battery Monitoring IC for Series-Connected Li-Ion Battery Strings in Electric Vehicles", IEEE Transactions on Power Electronics, volume: 28, Issue: 8, August 2013
[7] M. Bradgard, N. Soltau, S. Thomas, and R. W. De Doncker, "The balance of renewable sources and user demands in grids: power electronics for modular battery energy storage system," *IEEE Trans. Power Electron.*, vol. 25, no. 12, pp. 3049–3056, Dec. 2010.
[8] D. Linden and T. B. Reddy, *Handbook of Batteries*. McGrew-Hill Professional, 2001.
[9] M. Pedram, N. Chang, Y. Kim, and Y. Wang, "Hybrid electrical energy storage systems," in *ISLPED*, 2010.