ISSN: 0975-766X
CODEN: IJPTFI
Available Online through *Research Article*
www.ijptonline.com

RELIABILITY ENHANCEMENT OF RENEWABLE ENERGY USING PROGRAMMABLE SYSTEM ON CHIP MODEL

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Received on: 03-02-2017 *Accepted on: 12-03-2017*

Abstract.

The global demand for and availability of renewable energy being enhanced by the knowledge of reliability importance of each and every redundant hardware defined software components in the programmable System on Chip(PSoC) model. In the reliability enhancement of hydropower with other sources like solar and wind which fulfills energy crises Generally reliability of these renewable energy are uncertainty in nature which makes reliable with any mixed system will be a useful origin so that the reliability can also be predicted in a preventive maintenance style by using either wind or solar power when hydro power fails for essential loads. This leads the energy supply continuity is an essential factor of energy with embedded system design achieved by modeling and simulating. This is being achieved a novel concept of designing with Embedded System for Renewable Energy Sources (ESRES) and Peak Power Point tracking (PPPT) concept.

Keywords: PSoC, Reliability, ESRES and PPPT

1 Introduction

The renewable energy targets protecting biodiversity presents both challenges and opportplant unities at national, regional and local levels based on the area and location. Some of the countries are already making good progress in meeting goals, including wind and solar energy [1]. The Meanwhile, other countries are making less progress in developing renewable energy infrastructure. For instance, investment in solar development is not currently considered profitable in Poland due to a lack of economic incentives [2,3].Methods for modeling the power requirement for many years process do not provide more elaborately to accesses above all [4]. The crude measure of the potential

habitat impacts of energy generation is given by overall estimating the land area required to generate a given amount of electricity generation. Maximum mixed system called hybrid energy system and other techniques nave been discussed [5, 6]. Fault tolerant systems are built at high cost and are limited to life critical applications such as avionics and nuclear power plants. Redundancy techniques have been widely accepted as a means to enhance the reliability of computing systems in which both hardware and software redundancies are employed to provide fault tolerance. Hardware redundancy involves the use of many possible processors while software redundancy involves the use of several independently developed versions of a program module. The reliability enhancement of a hardware system can be done either by reducing the complexity of the system to a minimum that is required for the given functionality or by increasing the reliability of individual components to improve the overall system reliability. The parallel redundancy is one in which one or more hot spares operate in parallel so that even if one fails, others still function. The standby redundancy where a spare is switched on to take over the function of the failed component or subsystem that has failed can also be used to improve the system reliability. The reliability of a series-parallel system with and without simultaneous failures was considered in a 3 energy state redundant system in works [7].

A further challenge is the upgrading the existing system and expansion of national power grids to cope up with renewable energy development system. This adds to the land 'footprint' of renewable energy production and its impact on the ecosystems – which is also a consideration with conventional energy production. As is the case with energy plants themselves, engaging early on in the planning process with local complaint unities, transparent decision-making and managing expectations will be key to the success for the future of these projects [8].

2. Implementation of PSoc with ESRES

The proposed design of a system for electrical power utilization how the PSoc and ESRES integrated work. Solar energy using PV system, wind energy and the hydro electric energy these three are integrated. The load may be segregated into two types one is completely full load and other one is mostly essential or emergency load so that when there is requirement of full load then there by the hydro electric power station will supply the full load. In case of any failure like electrical or mechanical in hydro electric power station then either solar or wind power can be utilized through PSoc controller which will provide continuous supply to the emergency or essential load. The integrated reliable source of three power can be utilized effectively as per availability of the individual reliable source that can be done by hardware as well as software alternations with coordination with the control devices SEPIC and CUCK. In case of solar one of the inputs is connected to the output of the PV array and the other input connected to

the output of a generator. Combined of the two converters is achieved by reconfiguring the two diodes from each converter and the shared utilizes the Cuk output inductor by the SEPIC converter. This model allows each converter to operate normal individual in the event that any one reliable sources unavailable. Using PSoc which makes reliable power supply to the required load as it segregated according to the requirement. This requires less power consumption as compared with other controllers the driver required also connected to the output pin of PSoc[11].The design improved based on the previous technical implementation of fault tolerant system[9.10]. The performance of each block is depends on the response of previous block. But if any block has any error thereby it recovers or isolates based on the fault tolerant system. So the failure or error block recovers and continuous its operation as usual. The block diagram of the Embedded System with Renewable Energy Sources (ESRES) fault tolerant PSoC controller based system is shown in the Figure 1.

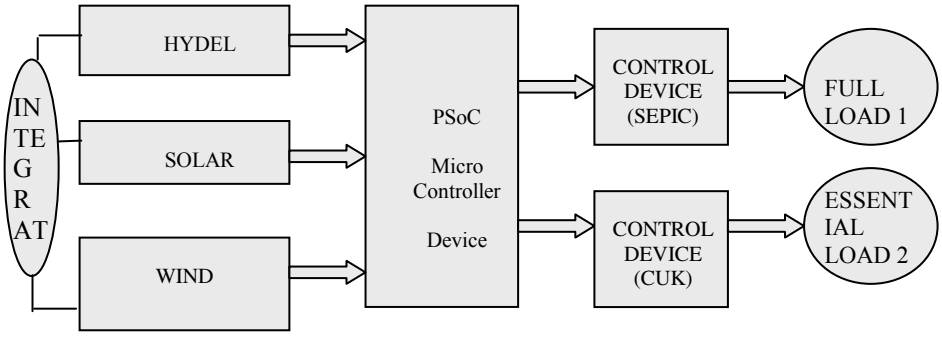

Fig. 1 ESRES Hybrid energy model.

Maximizing power for the required load being achieved with the peak power point tracking (PPPT), this is being modeled and discussed in further section with verification. With this the power required for two different loads can be provided which gives the better advanced power management system. The mathematical relationship between different integrated energy being elaborately explained below.

3. Reliability with Mathematical Modeling

The above ESRS hybrid energy model proposed with PSoc has five energy states. The energy state E_0 stands for plant operating condition or standby condition. For Energy state E_1, Let us consider in the plant unit (X_1) is in failed status, then reliable source activation standby plant unit (X_2) will take over and the plant unit is in standby condition. In the energy state E_2, when plant unit is in failed condition, First plant unit (X_3) will take over and another plant unit is in operable condition due to immediate repair. In energy state E_3, further plant unit is in failed condition, the plant unit will take over and the current plant unit is in operable condition. In energy state E_4, all activation plant units are down under repair and the overall system is in the failure energy state and their repairs are to be done separately. In this

case, the energy state's E_2 and E_3 are not treated as absorbing energy states since transition from E_2 to E_1 and E_3 to E_2 are immediately possible similarly up to E_n that depends on the renewable energy reliable source available. The five energy states considered are represented as

$$E_0 = x_1.x_2.x_3 \quad (1)$$

$$E_1 = \bar{x}_1.x_2.x_3 + x_1.x_2.x_3 \quad (2)$$

$$E_2 = x_1.\bar{x}_2.x_3 + x_1.x_2.x_3 \quad (3)$$

$$E_3 = x_1.x_2.\bar{x}_3 + x_1.x_2.x_3 \quad (4)$$

$$E_4 = \bar{x}_1.\bar{x}_2.\bar{x}_3 \quad (5)$$

The model for the 5 energy state –Triple Modular Redundant Hybrid energy System for an controller with failure and repair rates and the Mean Time Failure (MTF) is calculated for the above system using the equations from (1) to (5). The reliability of the overall fault tolerant PSoC-system is achieved in terms of the hardware defined software components, input and output devices, PSoC core and its interconnections and the voltage reliable source used. The hybrid energy fault tolerant system has been operated during the entire testing period and the results of its error detection capability and the reliability of the PSoC based energy system expressed in MTF when one or two are subjected to fail is tabulated in the Table 1.

Table 1. Reliability of the PSoC system with Hardware and software.

Hardware and Software connected to Input source		Failure of one Source	Maintenance of components (Corrective & Preventive Distributions)		MTF (20000) hours
Reliable source1	Inter connection		Timer1	Inter connection	
Success	Success	Nil	Nil	Nil	15E6
Failed	Success	Normal operation	Nil	Nil	991
Failed	Failed	Normal operation	Nil	Nil	787
Failed	Failed	Normal operation	Nil	Nil	323
Failed	Failed	Exponential	Nil	Nil	6273
Failed	Failed	Exponential	Exponential	Nil	6346
Failed	Failed	Exponential	Exponential	Exponential	6126

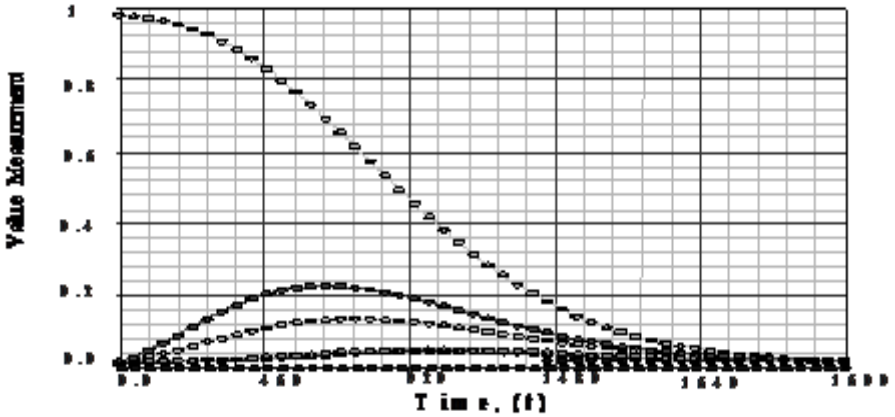

Fig. 2 Reliability of the reliable source importance.

4. Electrical load for Peak Power Point Tracking

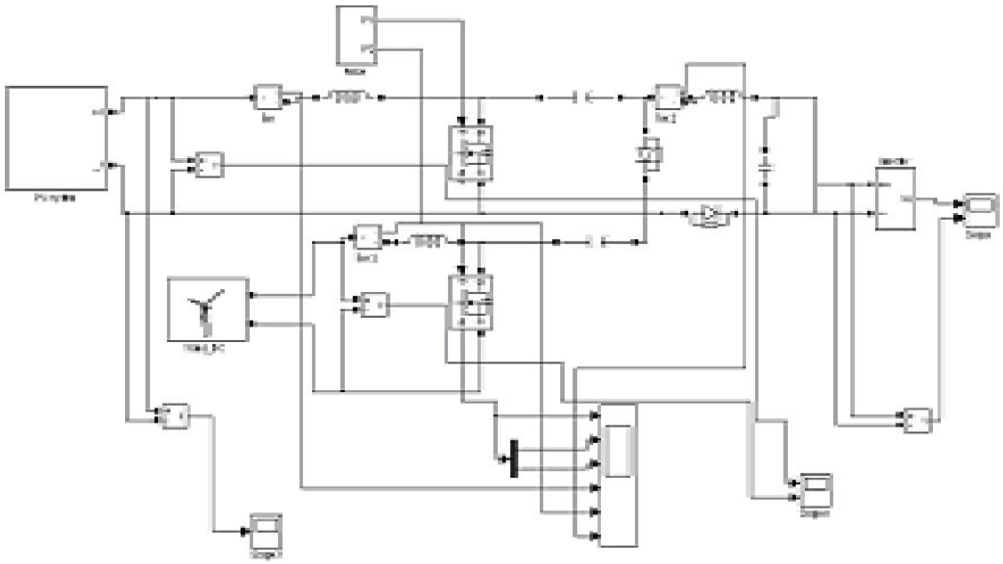

Fig. 3 Main simulation circuit for solar and wind energy.

To perform the Peak Power Point tracking (PPPT) concept controls for hydroelectric and each of the renewable energy power sources. The multiple input source structures have been suggested that integrated sources from the DC-end still achieving PPPT for each renewable reliable energy source for wind and solar energy.

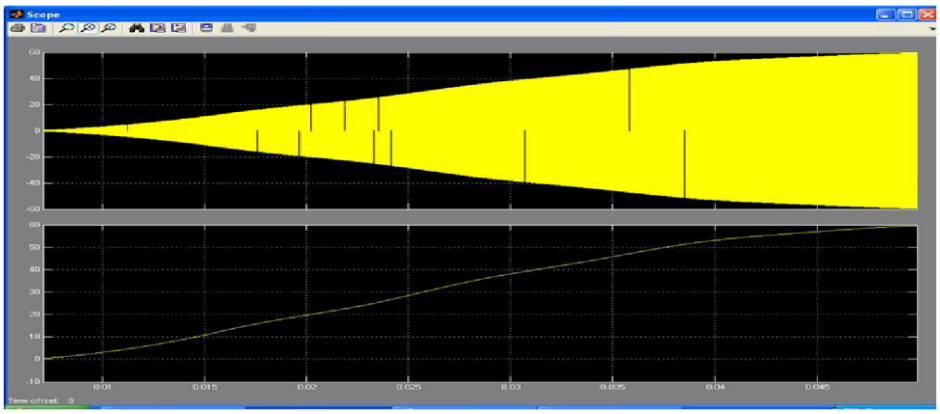

Fig. 4. Output voltages of Inverter/Converter

The mat lab circuits drawn for simulation are given below. Figure 3 illustrates the main circuit. The main circuit consists of wind and PV arrangement. The pulse generation plant unit generates pulses for Cuk and SEPIC converter. Inverter circuit converts the dc signal to ac, which can be used for the load. The simulation results show in figure 4, that The Cuk and SEPIC are very useful converters based on the requirement and availability effective in the Peak Power Point tracking (PPPT) of the wind and photovoltaic sources. Moreover additional input filter circuit are not necessary to filter out available high frequency harmonics, with both wind power and photovoltaic solar power system operating at their rated operating capacity, the integrated system can generate power as high as 35 KW. Both renewable sources like wind and solar can be stepped up or stepped down which is compatible with wide ranges of PV and wind input in case when the hydroelectric totally fails.

5. Conclusion

The knowledge of reliability importance of each and every redundant hardware defined software components in the PSoC model in the reliability enhancement of mixed system will be a useful origin so that the reliability can also be predicted in a preventive maintenance style. The overhead in increasing the reliability for providing good continuity power supply for the essential is the need for providing fast switching mechanisms or quick replacement time and service time**.** Integrating these three sources with PSoc and controlled devices like SEPIC and CUCK configurations model discussed. This is a novel concept of designing of effective embedded system with Renewable Energy (ESRES) and Peak Power Point tracking (PPPT) concept. The amount of reliability enhancement in hardware systems also depends on the quantitative specifications and the aging of the associated physical devices by tracking maximum power utilization being achieved, without which a system cannot be put to into operational condition in that environment assuming the control error free. By this approach the uninterrupted supply being achieved for essential or emergency loads. In future other energy sources can be integrated to enhance more reliability in power system domain.

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