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Embedded based automatic solar energy management system for industrial applications

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ABSTRACT

This research paper portrays the automatic energy management system. Solar energy is used as alternate renewable energy and the energy obtained from solar energy can be directly utilized as dc supply for handling dc machines. The DC power is further converted to AC with the help of inverter. This process takes place automatically with the help of advanced microcontroller. The microcontroller is programmed in such a way to detect the kind of power supply needed for machines (i.e.) whether AC or DC supply. If there is no need of power supply to the machines solar energy can be directly stored in the battery for later use. This technique is applicable for both in residential and industries purpose. For the implementation of the system PIC microcontroller is used and simulation is done by Keil C µ Vision 4 software is applied for different mode of operations. In order to reduce the bus bars and wastage of power, this system provides a solution to operate efficiently into different modes. The result of our research idea will be done in Keil C software.

Introduction

Now-a-days natural resources and quantum of fossil energy are dwindling day by day and getting exhausted at a very fast rate. Hence conservation, tapping new resources of energy and harnessing of the same from the various non conventional sources, is an important aspect of energy production and energy management. Renewable energy from solar is sustainable and does not lead to increase carbon-di-oxide emissions. The research idea of the embedded system based automatic energy management system using solar energy helps to utilize the complete energy produced in the solar panel.

In home this method is used for automatic switch on/off of lights and for other electrical equipment's or else if power is not utilized it automatically stores energy in battery for future purposes. In Industries the solar power is utilized both directly and indirectly. DC supply is given to DC machines and similarly AC supply is given to AC machines, if there is no need of power supply. It automatically stored in the battery. The energy produced by solar panel is utilized completely without any wastage of energy.

The increase of the power demand combined with the modernization of the industrial plants, resulted in the proliferation of power demand according to the need and it help to operate the machine automatically in different modules of power supply(i.e.) whether dc or ac supply.

In order to achieve a better performance for the automatic process. It is important not only to choose the best hardware for a specific application. But also improve the modes of operation strategy related to the topology used. For that Keil c software provides the various simulation output. PIC microcontroller board helps us to port our ideas. After debugging we get the results in the UART window. To find out the need of operation at a particular situation is difficult and it consumes time and men power. By using this technology we can operate the industry automatically. In this context, this paper presents different modes of operation to perform a different task. In this method the overall cost per unit of energy produced is less than the cost of new coal, natural gas and its installation. So the implementation can be made easier than any other methods. Since in the concept of green building our proposed idea also implemented.

Literature Survey

Bruno Belvedere, Michele Bianchi, Aletal, [1] " A Microcontroller-Based Power management system for standalone Micro grids with hybrid power supply", The paper presents a microcontroller-based power management system (PMS) designed for the online operation of an experimental low voltage micro grid equipped with a battery storage system and two power supplies: a kilowatt (kW)-class proton exchange membrane (PEM) fuel cell (FC) and a photovoltaic (PV) module emulator, both connected to a low voltage ac node. The connections of the energy sources to the common ac bus make use of power inverters with specific functionalities. The ac node feeds electric active and reactive load emulators able to reproduce programmable profiles. The automatic PMS provides the micro grid monitoring and the FC power scheduling in both grid-connected and islanded operating conditions. The paper describes the structure and functionalities of the PMS as well as a specific experimental investigation aimed at assessing the dynamic performance of the micro grid in islanded conditions.

Mohd Tariq1, SagarBhardwaj, Mohd Rashid,[2]"Effective battery charging system by solar energy using C programming and microcontroller", In this paper a simple, reliable and effective solar panel charging system has been introduced consisting of a solar panel of desired size and shape. This solar panel is integrated with an embedded system (which contains three modules i.e. dc to ac converter, microcontroller/compiler module and charging output and a battery system).This embedded system regulates the electricity produced (after being converted to ac from dc) between the storage battery and

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Charging output with the help of microcontroller which is programmed to combat the situations in presence and in absence of input supply and able to supply stored energy at night or unavailability of solar source.

Moser, C.; Thiele, L.; Brunelli, D.; Benini, L,[3] "Adaptive Power Management for Environmentally Powered Systems". In this paper the energy consumption has become vitally important to battery operated portable and embedded systems. A dynamic voltage scaling (DVS) technique reduces the processor's dynamic power consumption quadratic ally at the expense of linearly decreasing the performance. Reducing energy using DVS in the context of real-time systems should consider this tradeoff. The usage of compiler to annotate an application's source code with path-dependent information called power management hints (PMHs). This information captures the temporal behavior of the application, which varies by executing different paths. During program execution, the OS periodically changes the processor's frequency and voltage based on the temporal information provided by the PMHs. These speed adaptation points are called power management points (PMPs). We evaluate our scheme using two embedded applications: a video decoder and an automatic target recognition application.

Hardware Description

In this proposed method solar energy is used an alternate energy for power supply. The advanced microcontroller PIC 16F877A, which is programmed in such a way to detect the supply for machines automatically. The battery level indicators help to indicate the battery level. Relay turned on/off according to the power supply given to the machine.

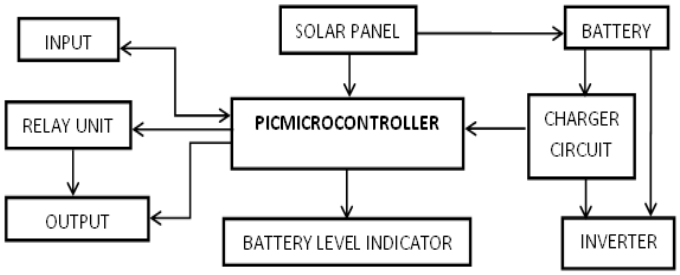


Fig. 1.Block Diagram of the Proposed System

Solar energy is the prototype of an environmentally friendly energy source. The solar panel produces the DC power. The obtained DC power is directly stored in the battery. The main function of the PIC microcontroller is, use the solar power in directly (DC power) and indirectly (AC power). The PIC microcontroller provides the various modes for the industry requirements, if the industry needs the AC power the PIC microcontroller operates in MODE 1. In this mode the solar energy is indirectly used (i.e.,.) with the help of inverter the stored DC power is converted into AC. In the MODE 2 the PIC microcontroller programmed as to directly utilize the solar power (i.e.,) the industry in need of DC power. If the industry needs both AC and DC power the microcontroller operates in MODE 3. If the industry does not requires any power the microcontroller detect the default mode and the power will be stored for future purpose. The various modes of operations (Table 1) are performed with the help of PIC microcontroller.

Table 1. Various modes of operation

Modes	Operations
MODE 1	AC supply
MODE 2	DC supply
MODE 3	Both AC & DC supply
Default	Power stored in Battery

The various functional block units are,

Table 2.Hardware summary

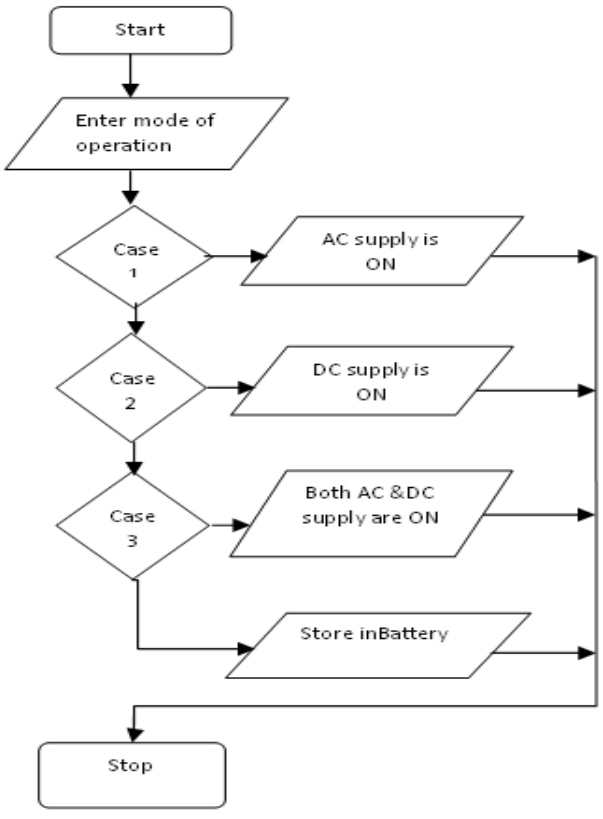
Functional Block	Functions
PIC MICROCONTROLLER	The PIC16F877A CMOS FLASH-based 8 – bit microcontroller is upward compatible device. Here we design the PIC microcontroller in such a way for the needs of different Power supply.
SOLAR PANEL	The Kyocera KD315 solar panels are mainly intended for grid-tie systems. The solar panel produces DC power to our proposed system. Generated DC power will be utilized as directly (as DC) and indirectly (as AC).
BATTERY	The generated solar power (DC) was directly stored in battery.
BATTERY LEVEL INDICATOR	LEDS play a very important role in the indication of the battery level.
INVERTER	Inverters are used to convert dc to ac supply (according to consumer needs).
RELAY	Relay is switching device. Every electronic system required some type of switching device here we used electromagnetic relay for switching on the power supply. Relay 1 for dc supply, Relay 2 for ac supply and relay 3 for battery storage.

Software Description

Algorithm

Step 1	:	Start the program.
Step 2	:	Enter the mode of operation.
Step 3	:	Evaluate mode of operation with switch case.
Step 4	:	Case=1, Print AC supply is ON.
Step 5	:	Case=2, Print DC supply ON.
Step 6	:	Case=3, Print AC & DC supply ON.
Step 7	:	Entered case option is invalid then, Print Store in battery.
Step 8	:	Stop the program

Flowchart



KEIL C µ vision 4

The Keil C development tools for the 8051 microcontroller family support every level of developer from the professional applications engineer to the student just learning about embedded software development. The industry-standard Keil C Compilers, Macro Assemblers, Debuggers, Real-time Kernels, and Single-board Computers support ALL 8051-compatible derivatives and help you get your projects completed on schedule. With the Keil tools, we can generate embedded applications for virtually every 8051 derivative. The Keil Software 8051 development tools are designed for the professional software developer; any level of programmer can use them to get the most out of the 8051 microcontroller architecture. Keil C µ Vision 4 help provides the various simulation output.

PROGRAM FOR MICROCONTROLLER USING KEIL C µVISION 4

```
#include<REG51.h>
#include<stdio.h>
char_getkey(void);
void main(void)
  {
char i;
SCON=0x50;
TMOD=0x20;
TH1=221;
TR1=1;
TI=1;
while(1)
{
        printf("\n Enter the mode of Operation
\n MODE 1 - AC supply
\n MODE 2 - DC supply
\n MODE 3 - for both AC & DC Supply \n");
        i=_getkey();
        switch(i)
        {
case '1':
        printf("\n AC SUPPLY  IS ON\n");
        break;
        case '2':
        printf("\n DC SUPPLY  IS ON\n");
        break;
        case '3':
        printf("\n Both AC & DC SUPPLY  ARE ON\n");
        break;
        default :
        printf("\n WRONG  OPTION  \n
STORED  IN BATTERY  \n");
        break;
        }
        }
        }
```

Simulation Results

In our research we use the PIC microcontroller board for porting our ideas. Since after the debugging, we get the results in UART window.

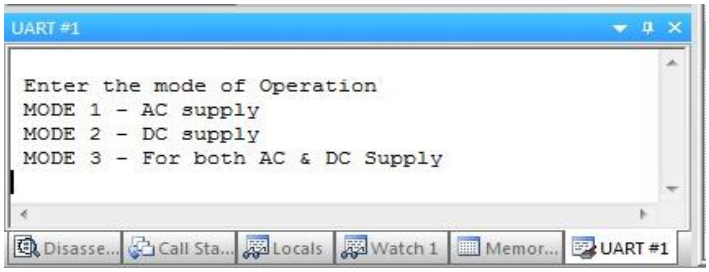


Fig. 2. Output in UART

The UART show the microcontroller was displays the mode of operation and waits for input.

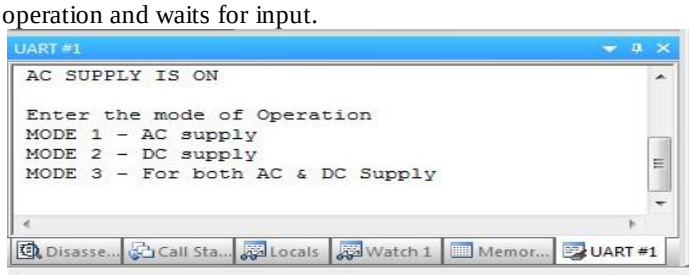


Fig. 3.Output of Mode 1

Now MODE 1 is selected, UART display for AC supply is ON (Figure 3). The Solar panel delivers the DC power, by using the inverter we convert it into DC to AC for our application.

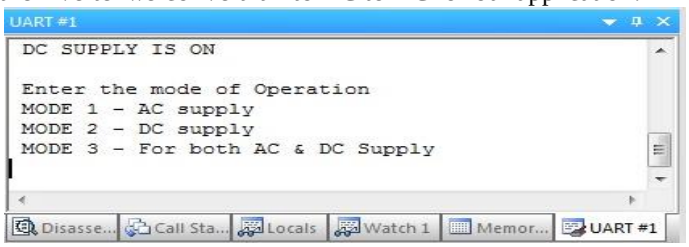


Fig. 4. Output of Mode 2

MODE 2 was operated for DC supply, UART display the output as DC supply is ON (Figure 4). Solar energy is directly utilized in this operation.

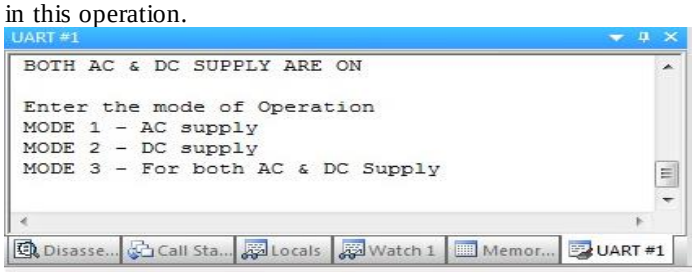


Fig. 5. Output of Mode 3

Due to in need of AC & DC Supply, the MODE 3 (Figure 5) can act as the multifunction operation. If we need the AC & DC supply we can operates this operation.

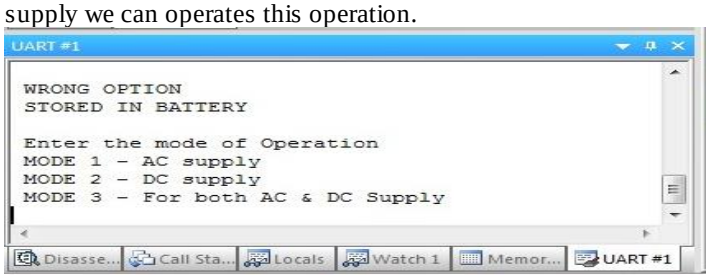


Fig. 6.Output of Default cases

The input mode will be the wrong the option microcontroller will go for the ideal condition to store the DC power directly (Figure 6) & also it waits for next operation.

Conclusion

The proposed system embedded system based on energy management system using solar energy is found to be more

compact and less complex. It can readily be used to perform tedious and repetitive tasks. The energy obtained from solar energy can be utilized as dc supply directly for handling dc machines. In another way, it can further be converted as dc to ac with the help of inverter. The embedded controller is detect the kind of power supply needed for machines (i.e.) whether dc or ac supply. The previous results which shows the different operation performed by the embedded microcontroller as the safest way of our needs.

This research greatly reduces man power, saves energy, safety and operates efficiently without any human interference. The future makes this system is the base for the future energy management system. The principle of the development of science is that "nothing is impossible". So we shell look forward to a bright and sophisticated world.

References

[1]. Bruno belvedere, Michele Bianchi, Alberto Borghetti, "A Microcontroller-Based Power management system for standalone Micro grids with hybrid power supply", IEEE Transactions on sustainable energy, Vol.3, pp. 422-431, July 2012.

[2]. Mohd Tariq1, SagarBhardwaj, MohdRashid, "Effective battery charging system by solar energy using C programming and microcontroller", American Journal of Electrical Power and Energy Systems. Vol. 2, No. 2, 2013, pp. 41-43, March 2013.

[3]. Moser, C. ; Thiele, L. ; Brunelli, D. ; Benini, L., "Adap A Hajizadeh and MA Golkar. Intelligent power management strategy of hybrid distributed generation system. International journal of Electrical Power and Energy System, 29(10), 2007. "Adaptive Power Management for Environmentally Powered Systems", IEEE Transaction on computers. Vol. 59, Issue: 4, pp. 478-491. 2010.

[4]. Antonio Mancina, Gaetano F. Anastasi, Giuseppe Lipari, TommasoCucinotta, *Member, IEEE*, Leonardo Mangeruca, Roberto Checcozzo, and FulvioRusinà "A Real-Time Service-Oriented Architecture for Industrial Automation" IEEE Transactions on Industrial Informatics, Vol. 5, No. 3, pp. 267-277, Aug 2009

[5]. J. B. Cardell and T. Chin Yen, "Distributed energy resources in electricity markets: The price droop mechanism," in Proc. 48th Ann. Allerton Conf., Monticello, IL, Sep. 29–Oct. 1 2010.

[6]. F. Katiraei, M. R. Iravani, and P. W. Lehn, "Micro-grid autonomous operation during and subsequent to islanding process," IEEE Trans. Power Del., vol. 20, no. 1, pp. 248–257, Jan. 2005.

[7]. N. Jenkins, R. Allan, P. Crossley, D. Kirschen, and G. Strbac, Embedded Generation. London, U.K.: IEE, 2000.

[8]. S.D.J McArthur, E.M. Davidson, V.M. Catterson, A.L. Dimeas, N.D. Hatziargyriou, F. Ponci, and T. Funabashi. Multi-agent systems for power engineering application - part I: Concepts, approaches, and technical challenges. IEEE Transactions on Power Systems, 22(4), 2007.

[9]. C Abbey and G Joos. Energy management strategies for optimization of energy storage in wind power hybrid system. In PESC record IEEE annual power electronics specialists conference, 2005.

[10]. F. Kienzle, P. Ahč in and G. Andersson "Valuing investments in multi-energy conversion, storage, and demand-side management systems under uncertainty", IEEE Trans. Sustain. Energy, vol. 2, no. 2, pp.194 -202 2011.

[11]. J Kwi-Seong, L Wong-Yong, and K Chang-Soo. Energy management strategies based on fuzzy logic for a fuel cell hybrid bus. Journal of Power Sources, 2(145), 2005.

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