International Journal of Engineering Research and General Science Volume 3, Issue 2, March-April, 2015
ISSN 2091-2730

Self Powered Wireless Sensor Network Using Hybrid PV-Wind System

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Absract:-A Wireless Sensor Node in a sensor network is capable of performing different processing, gathering sensory information and communicating with other connected nodes in the network. Rechargeable batteries are used to power the sensor nodes. But frequent recharging and replacement of these batteries becomes a burden in network. So mitigate this problem many energy harvesting schemes have been proposed which is to convert the energy from the environment into electricity to recharge the sensor nodes. Energy harvesting from single source have environmental limitations like if the sensor is installed inside a building solar energy is unable to used and with wind generators is that they are too big, and are expensive if the size has to be decreased. Hence proposed system is design to provide multisource and self powered power supply to wireless sensor node which could stay charged by generating power on its own.

Keywords: Energy Harvest, WSNs, MPTT, Super capacitor, Photovoltaic effect,ANSM,WEH

I. INTRODUCTION

Wireless sensor network (WSN) are utilized in a wide range of applications, including military applications and the monitoring of oceans and wildlife.WSN comprise many low cost devices called sensors, which monitor the status of the environment and send sensing data to the sink node. Wireless sensor nodes are becoming more and more popular due to the technological advancements in the field of microelectronics technology and the development of ultra-low power microcontrollers that can be used in the embedded system. Wireless sensor network (WSN) consisting of several sensor nodes are used to monitor various parameters. The wireless sensor networks are commonly deployed in civilian and military applications such as natural disaster detection, healthcare system, traffic control system, building security system etc.Because of limitations on the energy supply, available storage space and the computational capacity of the sensor nodes, the data that are transmitted between a sensor node and the sink node must be forwarded by other sensor nodes. Rechargeable batteries are used to power the sensor nodes. Frequent recharging and replacement of these batteries become a burden in WSN.So WSN nodes can gain and store energy from its surrounding environment. Harvesting of energy from single source has many limitations. Thus renewable resources based on single source may not be effective in-terms of cost, reliability and efficiency for which hybrid systems offer a better option. Solar panel usually generate maximum power during mid of day and gradually decrease during the night where windmill usually generates maximum power during the night .So reliability can be achieved to an extent to make these method more reliable a power storage system such as battery can be added to the system so that when maximum power is generated above the demand, instead of wasting that energy the power can be stored and it can be discharged during the time when power generation is below the actual need. Hence proposed system is designed to provide multisource and self powered power supply to any wireless sensor node which could stay charged by generating power on its own.

II.RELATED WORK

Energy harvesting scheme which is based on solar power works on photo-voltaic effect[1].A recharging assembly is also developed that recharges the batteries of the sensor node.Solar energy harvesting through photo-voltaic conversion technique provides the highest power density. Maximum Peak Power Tracking (MPPT) is adopted in this harvesting method. The point at which the output power is the maximum at the given level of light intensity is called Maximum Power Point (MPP) shown in fig 1.

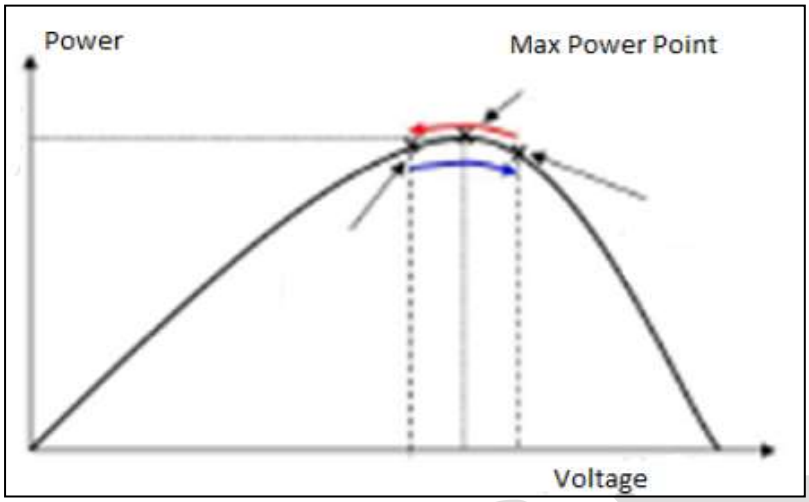

Figure 1. Maximum peak power tracking

To increase the performance of wireless sensors,adaptive node-selection based on solar power is used[2]. To solve node-selection problem, an adaptive node-selection mechanism (ANSM) scheme is proposed. This mechanism selects the least active node to reduce the overlapping of the sensor but keep constant coverage of the target area in wireless sensor networks.

There is a difficulty of utilizing extra energy when the battery is fully charged. It is utilized to adaptively adjust the redundancy level of erasure codes so that the reliability of communication is improved while the network lifetime is remain constant [3]. In reality, a fully charged battery cannot harvest more energy; there is a possibility to utilize that energy so that node can harvest more energy. As a result, the extra spending has no effect on the node lifetime since this energy otherwise would be wasted. By exploiting its inherent properties, an effective solution called Solar Code is proposed.

Wind energy harvesting is very much attractive because of the large availability of wind power and its power density is also high.The design of a wireless sensor node which is powered by a micro wind turbine generator accept power management to make the node working neutrally which will never dies out of energy[4].To determine whether wind energy is active for supplying power to WSN, wind energy harvester (WEH) was designed, and built[5].The WEH consisted of a wind generator and a unit of power management to store and provide the generated energy. The wind generator consist of aero – elastic flutter to convert wind energy into electrical energy.

Renewable resources based on single source may not be effective in-terms of cost, reliability and efficiency. So to mitigate this problem hybrid systems of multiple sources is designed. There is an unique way of using the hybrid solar and wind energy effectively for pumping solution in rural parts of India. A hybrid generation system consist photo voltaic, wind turbine and battery to supply stable power [6].Maximum Power Point Tracker (MPPT) is used for extraction of maximum power from the solar and wind generator and to compensate power difference of renewable energy. When PV and WT generate power is lower than demanding power, the battery is discharged power to overcome the difference of supply and demanding power. If PV and WT generated power is higher than demand power, the battery is charged.

III. PROPOSED WORK

Wireless sensor network (WSN) is a solution that consists of spatially distributed autonomous devices. These devices consist of sensor that monitor temperature, sound, vibration motion or pollutants from different locations. Proposed system is designed to provide multisource and self powered power supply to any wireless sensor node which could stay charged by generating power on its own. Main goal of the system is to design a power generator which can work in maximum possible weather situation and to take the advantage from sun and wind both.

Block diagram of proposed work:

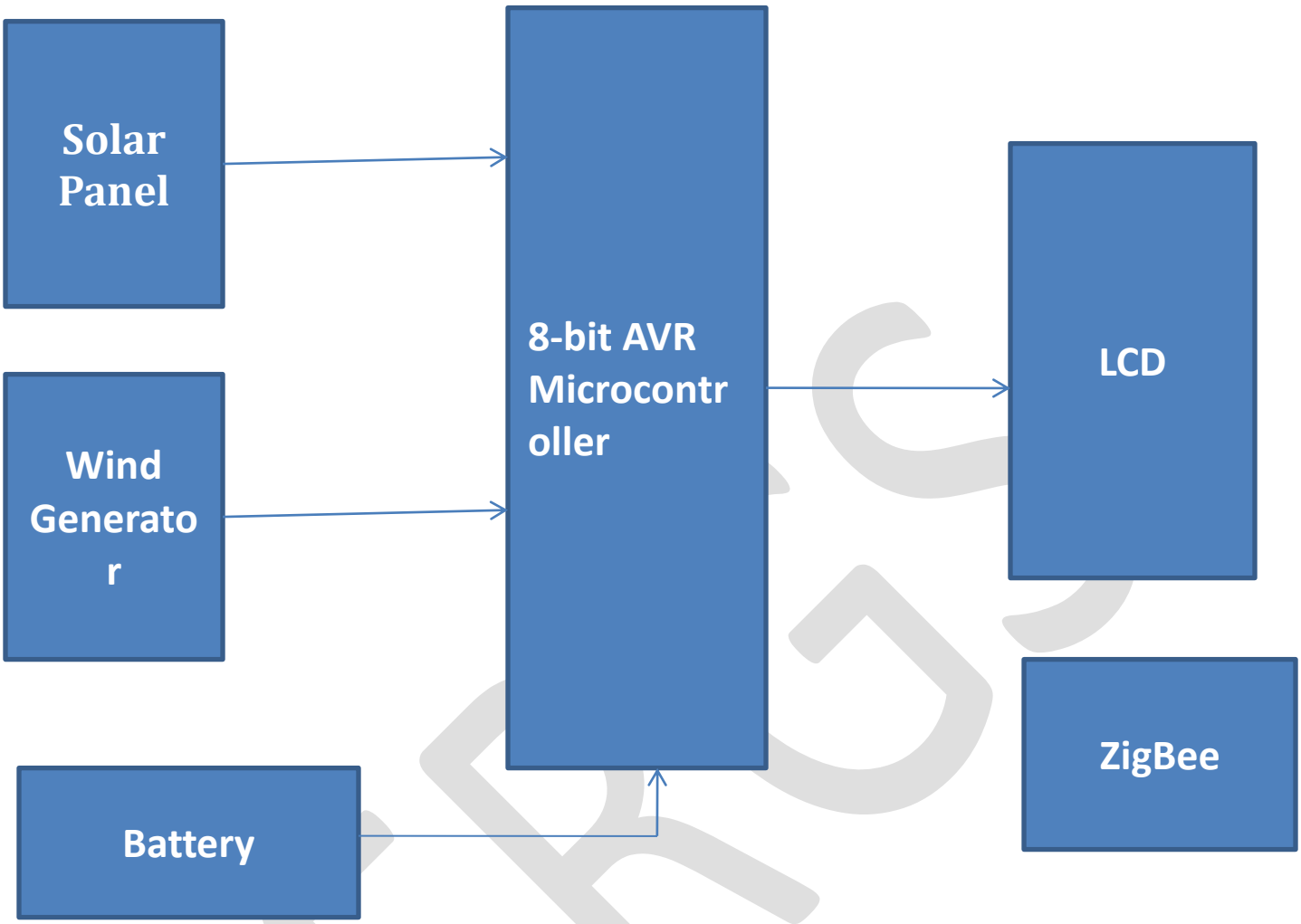

Fig 2 : Block diagram of proposed work:

Fig.2 shows the block diagram for the proposed system. Here Solar panel and wind turbine generator act as a voltage source for the entire component used in the circuit. The regulator circuit regulates the input voltage drown from solar panel to about 5 volt. In case where there is no solar power, wind turbine generator is used to recharge the circuit. DC-DC convertor which in series with the generator, step up or step down the input voltage. Power management unit is also designed to increase the reliability of network. It stored the generated energy for future use in case where there is no solar or wind energy Super capacitor or battery is used as an energy storing element for both the sources.

3.1 Principle of Solar Panel:

Solar radiations contain photons, when hit the solar panel and are absorbed by semiconducting materials, such as silicon. Due to impact of photons electrons in silicon are energized and flow through the material to produce electricity. Due to the special composition of solar cells, the electrons are only allowed to flow in a single direction. The positive charged holes are also created flow in the opposite direction of the electrons in a silicon solar panel.

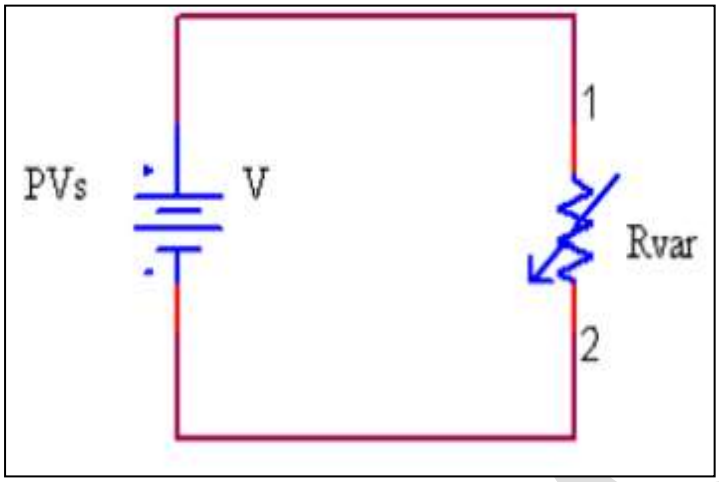

Figure 3: Photovoltaic-super capacitor energy system.

3.2 D.C Geared Motor for harvesting wind energy

The wind generator consisted of d.c motor whose geared ratio is 1:100,so that for one rotation, rotor rotates motor turns hundred times to convert wind energy into electricity as electromagnetic flux flow through it.

3.3 Energy storage technologies

Perhaps the most complex (and crucial) design involves the energy storage mechanism. The two choices available for energy storage are batteries and electrochemical double layer capacitors,also known as ultra capacitors.Batteries are a relatively mature technology and have a higher energy density than ultra capacitors.

3.3.1 Super Capacitor:

The power efficiency becomes difficult when the power comes from a renewable source such a solar cell or a windmill.The output voltage and power of these sources are highly variable depending on the current draw. Moreover, the current that maximizes the power also changes with the environmental conditions (solar irradiation or wind intensity). In general, the output impedance of the renewable energy sources changes based on the surrounding environment. The maximum power point tracking (MPPT) method dynamically adjust the output current to match the output impedance so that the maximum amount of power can be drawn from the power generating device.

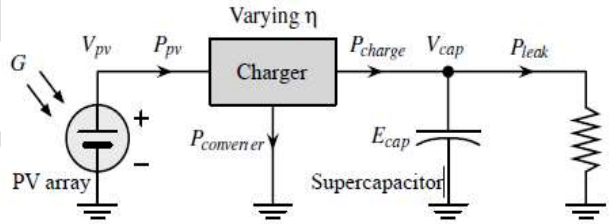

Figure 4: Photovoltaic-supercapacitor energysystem.

Figure 4 illustrates a simplified schematic diagram from energy generation to storage. The total system efficiency enhancement seeks to maximize the power that is transferred into the supercapacitor, Pcharge.

IV. CONCLUSION

Hence proposed system is designed to provide multisource and self powered power supply to any wireless sensor node which could stay charged by generating power on its own. Main goal of the system is to designed a power generator which can work in maximum possible weather situation and to take the advantage from sun and wind both.

REFERENCES :

1)P.T.V.Bhuvaneswari1,R.Balakumar1,V.Vaidehi1,P.Balamuralidhar "SolarEnergy Harvesting For Wireless Sensor Networks", 2009 First International Conference on Computational Intelligence, Communication Systems and Networks.

2)Gwo-Jiun Horng1, Tun-Yu Chang "The Adaptive Node-Selection Mechanism Scheme in Solar-Powered Wireless Sensor Networks", 2009 First International Conference on Computational Intelligence, Communication Systems and Networks.

3) Yong Yang, Lu Su, Yan Gao and Tarek F. Abdelzaher "SolarCode: Utilizing Erasure Codes for Reliable Data Deliveryin Solar-powered Wireless Sensor Networks" Mini-Conference at IEEE INFOCOM 2010

4) Yin Wu, Wenbo Liu and Yongjun Zhu,"Design of a Wind Energy Harvesting Wireless Sensor Node", Third International Conference on Information Science and Technology March 23-25, 2013.

5) D. Ramasur, G.P. Hancke, "A wind energy harvester for low power Wireless Sensor Networ".

6) R.Karthikeyan, "Wireless Sensor Networks For Efficient Irrigation System Using Hybrid Pv -Wind System".

7)Eric M. Yeatman, "Energy Scavenging for Wireless Sensor Nodes," International conference on wireless sensor networks, London, 2010.Jiang Jian,

8)Chulsung Park and Pai H. Chou, "AmbiMax: Autonomous Energy Harvesting", IEEE transactions on mobile computing, Switzerland, September 2007, Vol. 6, No. 9 pp. 1060-1074.

9)Steven Portscheller, Pavlina Akritas, Gunjan Tejani,"Solar Power Source for Sensors", Tamkang Journal of Science and Engineering,2010, vol. 8

10)Weimer, M. A., Paing T. S., &. Zane, R. A. Remote area "wind energy harvesting for low-power autonomous sensors", Department of Electrical and Computer Engineering.

10)Vijay Raghunathan, Aman Kansal, Jason Hsu, Jonathan Friedman, andMani Srivastava, "Design considerations for Solar Energy Harvesting Wireless Embeded System," 457-462, IEEE 2005.

11)J. Yick, B. Mukherje, D. Ghosal. "Wireless Sensor Network Survey,"IEEE Journal of Computer Network, 52, pp.719-724, 2008