Ultra Low Voltage Step up and Power Management to Sense Humidity and Temperature

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Abstract - One of the major challenges in monitoring the environmental conditions is living the renewable power, source capable of supplying continuous power to the monitoring sensors and the transmitting modules. using the renewable power source for the Environmental conditions Monitoring Remote Sensor. In this research the power in terms of milli watts or even in tens at milliwatt are produced using renewable source. This renewable power is utilized for the wireless sensor to measure the humidity level in the atmosphere. This research develops of Power Management System (PMS) of renewable power source to operate the low power sensor to know the environmental conditions of remote area. It also discusses the generation of low power source.

1. INTRODUCTION

Plant microbial fuel cells (PMFCs) are considered an alternative renewable power source for remote environmental monitoring. A PMFC is a device that consists of an anode and a cathode. A PMFC is a bio electrochemical system in which rhizodeposits of the plants are oxidized by electrochemically active bacteria in the anode. These rhizodeposits consist of exudates, lysates and secretions. The released electrons flows through an external circuit, harvesting electrical power, to the cathode where oxygen is reduced to water. The PMFC generates continuous electricity and is based on renewable natural processes. However, the voltage generation was smaller and faced problems for growth of the roots by the electrode materials. The electricity generation is rice by using small scale electricity application.LTC3108 Integrated circuit as 4F, 2.7V is connected through PMFC, which contains Dc-Dc converter and 4 capacitor are connected parallel. The output potentials of PMFC are limited to 648mW which can be boosted using DC–DC converters for target sensors. However, despite efforts to increase the current and potential, the average continuous power from PMFC is too low to operate remote sensors continuously. As a solution, the sensors are operated intermittently by storing microbial energy in capacitors and managing the energy using a power management system (PMS) . The generating electricity from PMFC is low, using
the converter rice to maximum 5.1V. Where the current rating is depend on load due to varied. The measured voltage regulator rated as 445 mW, was placed. That only supply capable voltage to operate a different operation like, Sensor, Microcontroller, Zigbee. The Sensor operate with 3.3V supply through voltage regulator, its sense a humidity from a atmosphere. Now microcontroller shows a measured humidity as temperature rating, that rating is received through Zigbee to transfer to distination. They used the MFCs to operate sensors requiring an average of 18mW power. The main limitation of all of these systems is that they generate power at the mW level and cannot be used to operate remote environmental sensors that require watt-level power. Our goal was to develop a power management system that can operate remote sensors requiring high power using a PMFC as a renewable power source. We designed a novel power management system that uses two DC/DC converters and a digital logic circuit to convert low-level power from a PMFC

2. MATERIALS AND METHODS

1. PLANT MICROBIALFUEL CELLS

Plant microbial fuel cells produce electricity from living plants. During photosynthesis plants produce 70 percent of organic material which is excreted through the roots, it is taken by plant microbial fuel cell for its operation. It consists of two electrode materials namely cathode and anode. Both cathode and anode are made up of graphite materials. Insulated copper materials are used for electrical connections between cathode and anode. silicon rubber is used for coating to prevent water from contacting the electrical connection.20 feet length wire from electrode to connect power management system . the custom design consists of 4 cells and each cell gives 162 microwatts.

Power output from PMFC= no. of cells *power from one cell

= 4*162

= 648 microwatts

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2. Power Management System

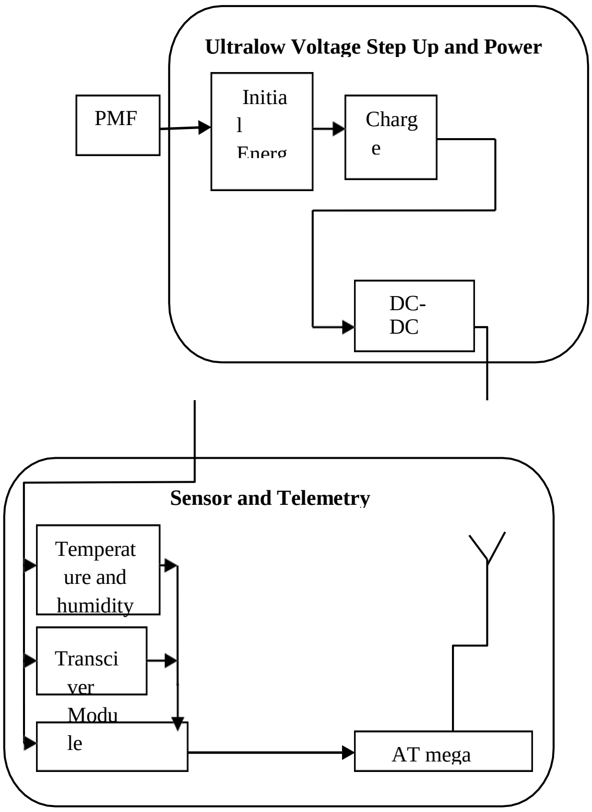
The designed power management system consists of energy storing capacitors, DC/DC converters, voltage regulators and low power sensors to store and utilize energy. The LTC3108 is used as step up converter device which is designed to create an ultralow input voltage step-up DC/DC converter and power manager. It is suited only for low power wireless sensors and other applications in which surplus energy harvesting is used to generate system power because traditional battery power is inconvenient or impractical.

2.1. Initial storage and Transmitter capacitor

The energy produced by PMFC is stored in a capacitor called initial energy storing capacitor. This capacitor is directly connected to the PMFC. A 1F capacitor is capable of storing enough energy for further sensor operation. The Transmitter capacitor is used to store the energy which is required for the transmitter operation .This capacitor is directly connected to the Transmitter.

2.2. Charge pump

A charge pump is a kind of DC to DC converter device that uses capacitors for energetic charge storage to increase or decrease voltage.



DC/DC converter is the electronic device which converts the low voltage into higher voltage by consuming current. However, a DC/DC converter has a limited ability to raise a low potential to a high potential at

It is added to the PMS circuit for automatic starting and repowering. after the initial storage capacitor completely charged , the charge pump automatically starts the DC/DC converter. charge pump is disabled after starting the converter to obtained higher power efficiency. it remains disabled until repowering is necessary in power management system.

2.3. DC/DC Converter

ratio of the input and output potentials. This ensures that DC/DC converters will provide the required 445mW power. The maximum boost ratio (MBR) is defined as the theoretical highest boost ratio at which a DC/DC converter can operate without the output voltage collapsing.

2.4. Calculating the power efficiency of the PMS

The efficiency of the PMS is determined by measuring the power efficiency of the DC/DC converters, assuming that the power consumption by the other components can be ignored. it only operates during short periods (typically 12 s) when the system is being repowered, so its power consumption is negligible. The power efficiency of a DC/DC converter can be expressed as

efficiency = Pout / Pin*100

3. SENSOR

The Si7021 inter integrated circuit Humidity and Temperature Sensor is a monolithic CMOS IC integrating humidity and temperature sensor elements, signal processing, an analog-to- digital converter, an I2C Interface and calibration data. The patented use of industry-standard, low-K polymeric dielectrics for sensing humidity enables the construction of low-power, low drift and hysteresis monolithic CMOS Sensor ICs , and very good long term stability. The humidity and temperature sensors are factory-calibrated and the data of calibration is stored in the non-volatile ,on chip memory. This gives that the sensors are completely interchangeable, with software changes required or no recalibration. The Si7021 is reflow solderable and is available in a 3x3 mm DFN package. It can be used as both software- and hardware-compatible drop-in upgrading temperature sensor , low power consumption and featuring precision sensing over a wider range. The Si7021
which it can operate stably . The boost ratio for a DC/DC converter is defined by the gives an accurate ,humidity measurement for factory-calibrated digital solution , low-power, dew- point, and temperature.

4 TRANSCEIVER(IEEE802.15.4)

Besides highlighting the overall characteristics of the physical and MAC layers of the IEEE 802.15.4 standard, and the network, security and application layers of the ZigBee wireless technology, this article focuses on

efficient implementation of IEEE 802.15.4-compliant radio-on-a-chip by identifying potential low-power features in the standard, suitable transceiver architectures and considering standard CMOS design issues. In addition, it also presents system-level considerations and implementation choices for a commercially available low-cost, low-power Zigbee- ready CMOS RF transceiver compliant to the IEEE
802.15.4 standard.

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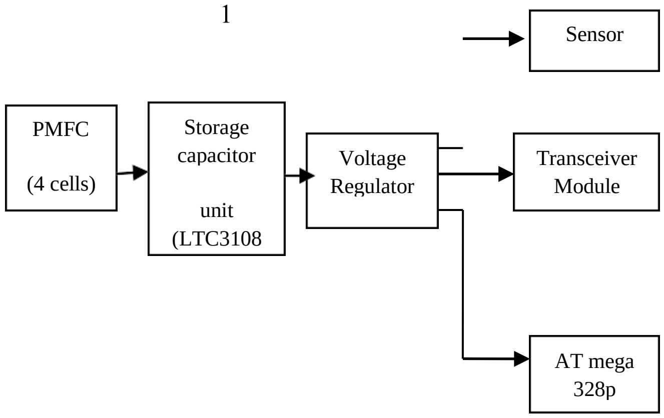

PMS for Stable state Operation

4. BLOCK DIAGRAM

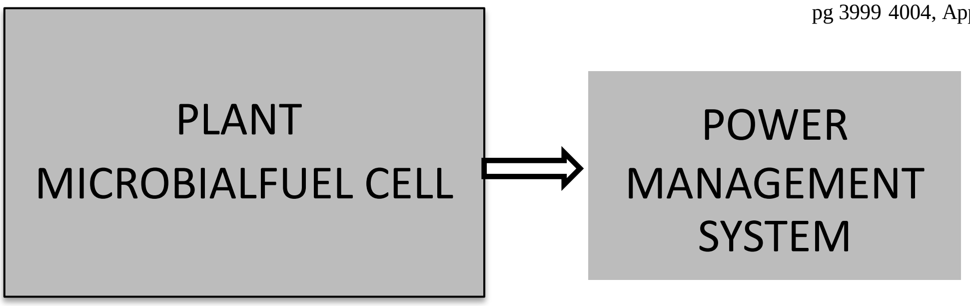

Fig5. Block diagram of the proposed method

4. CONCLUSION

A PMFC producing 3.4mW average continuous power . Produce 2.5W power intermittently, and this power can be used to operate a wireless sensor. A SMFC can be used as a renewable alternative power source for remote sensors requiring high power.

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