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Zero Power Wireless Sensors Using Energy Processing

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Abstract – In this paper we have implemented wireless sensors using Arduino (AVR 328) microcontroller. It is a single microcontroller solution which senses various environmental parameters such as temperature, humidity, and light intensity. Based on zigbee wireless technology, the temperature, humidity and light sensor network is composed of three parts: the transmitter, receiver and display system. The sensor network is powered by using solar energy. The current consumption of this wireless sensor network is 45 mA only. So the power consumption is very less. We can use this sensor to sense environmental monitoring condition in agricultural sector.

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I. INTRODUCTION

In this 21st century, weather monitoring holds great importance and have uses in several areas ranging from keeping track of agricultural field weather conditions to industrial conditions monitoring. Weather monitoring would help in keeping track of different climatic behaviors including temperature, humidity and light intensity. Weather Monitoring System can be either wired or wireless one.

In case of wireless communication, the connectivity will be more convenient and user friendly. Weather monitoring would not require physical presence of the person at the location. Wireless communication is the transfer of information over a distance without the use of wires. The distances involved may be short (a few meters as in television remote control).

ZigBee technology is the cheapest and the most convenient technology now being used for wireless communication. The Zero Power Wireless Sensor Network basically requires few basic modules such as ZigBee interfacing module, display module, various sensors, microcontroller module and a solar panel.

The primary motivation behind taking up this project is the large utility of the wireless weather monitoring in varied areas ranging from agricultural growth and development to industrial development. The weather conditions of a field can be monitored from a distant place by farmers and won't require them to be physically present there in order to know the climatic behavior at the location by using wireless communication. It will be of great use in the war affected regions as it would be risky for farmers to visit their farm regularly, instead now they could monitor their farm from their home.

II. IMPLEMENTATION

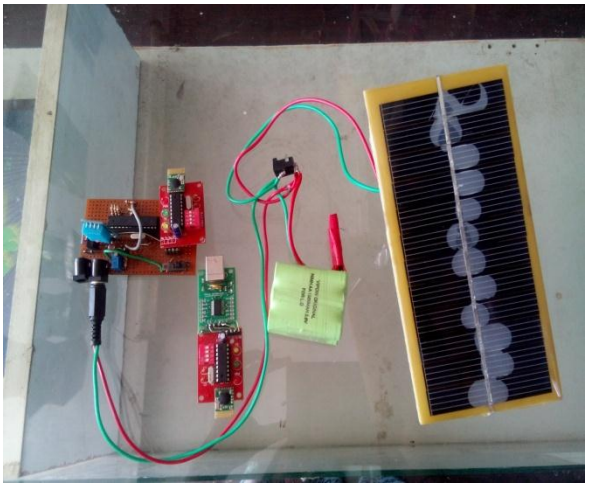


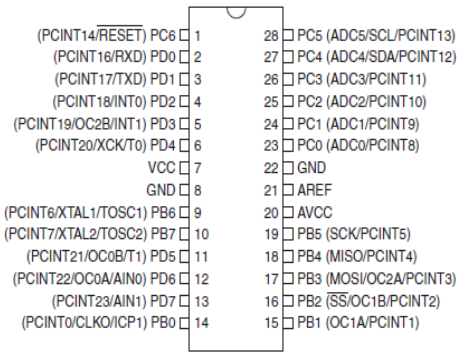
Fig.1 Solar powered wireless sensor

The Zero Power Wireless Sensor Network basically consists following basic modules:

1. Arduino
2. Sensors
3. Zigbee
4. Interfacing

1. Arduino-

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.



2. Sensors

*DHT 11 (temperature + humidity)

The DHT11 is a basic, ultra low-cost digital temperature and humidity sensor. It uses a capacitive humidity sensor and a thermistor to measure the surrounding air, and spits out a digital signal on the data pin (no analog input pins needed). It's fairly simple to use, but requires careful timing to grab data. The only real downside of this sensor is you can only get new data from it once every 2 seconds, so when using our library, sensor readings can be up to 2 seconds old.

*LDR

Light Dependent Resistor (Photo Resistor):-

When light falls i.e. when the photons fall on the device, the electrons in the valence band of the semiconductor material are excited to the conduction band. These photons in the incident light should have energy greater than the band gap of the semiconductor material to make the electrons jump from the valence band to the conduction band.

Hence when light having enough energy is incident on the device more & more electrons are excited to the conduction band which results in large number of charge carriers. The result of this process is more and more current starts flowing and hence it is said that the resistance of the device has decreased. This is the most common **working principle of LDR**

3. Zigbee-

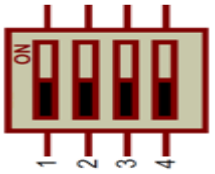
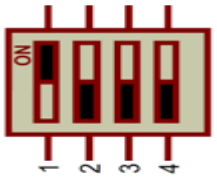
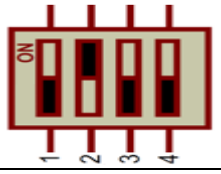
CC2500 is a FSK /MSK Transceiver module. It provide extensive hardware support for packet handling ,data buffering ,burst transmissions ,clear channel assessment, link quality indication and wake on radio . Its data stream can be Manchester coded by the modulator and decoded by the demodulator .It has a high performance and easily to design your product. It can be used in 2400-2483.5MHz ISM/SRD band systems, Consumer Electronics, Active RFID, Wireless game controllers, wireless KB/Mouse and others wireless systems.

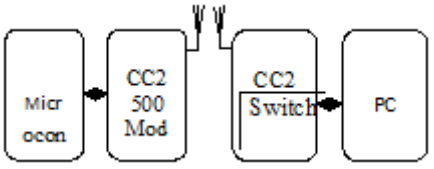
4. Interfacing-

Baud Rate Setting

Baud rate has to be set when module is OFF, as the switch positions are read only during power up. Modifying this setting during operation will have no effect on operation of module.

Baud rate settings mentioned in table given below are for Channel 0.

Switch	Baud Rate Setting
	9600 bps
	38400 bps
	19200 bps



Interfacing of Arduino Board with ATK CC2500

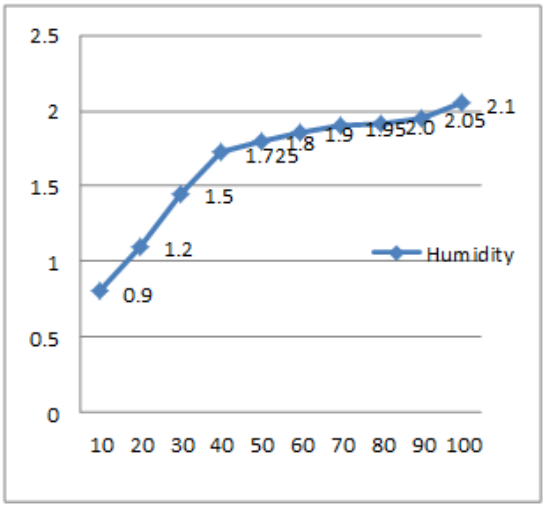
Result:

Power Consumption: 0.2 Watt

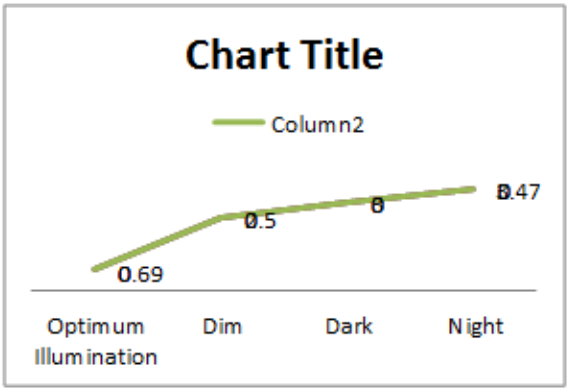
Current Consumption: 45 mA

Power Backup: 48 hrs using 2200 mA power backup

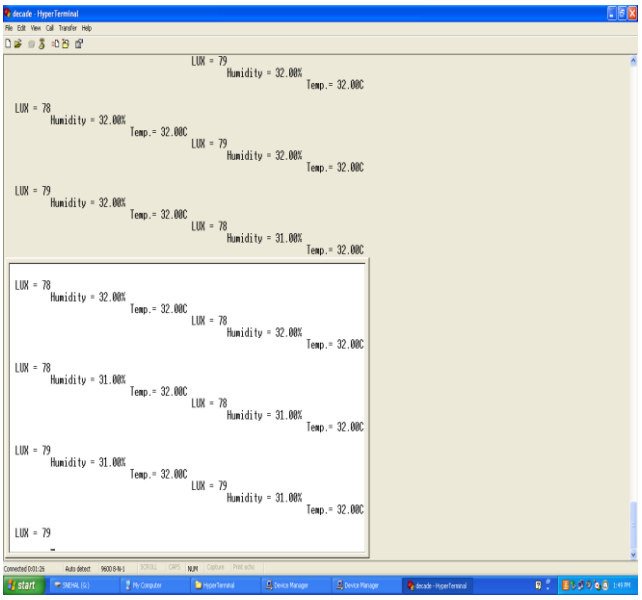
Humidity Sensor Reading



Light Sensor Reading:



Output on PC



V. CONCLUSION

The project deals with designing a simple and low cost zero power wireless sensors which are handled by using solar energy. It consist DHT 11, LDR, Zigbee module and AVR Atmega-328 microcontroller unit to monitor weather conditions of the desired location and transmit it to a computer at distant location. The designed product module is at prelim stage and designed for temperature, humidity and light intensity monitoring but can be enhanced for monitoring other different type of environmental and climatic behavior of a location, which also can be cost effective.

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