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Development of Microcontroller Based Multi Sensor Node

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ABSTARCT:
Wireless sensor network (WSN) has been developing rapidly during the latest decade. Computer science, automation technologies, radio frequency (RF) technology, electronics and other related techniques have contributed extensively to the development of WSN technology. Generally, a wireless sensor node is a device equipped with at least microprocessor, radio transceiver, memory, power source, analog-to-digital converter (ADC) and one or multiple sensors. Wireless sensor networks are wireless networks composed of sensors, which monitor surrounding condition as one system. These sensors are implemented by using microcontroller, transceiver, etc. Sensor nodes are installed in the surrounding environment to monitor specific environmental parameters and pass the collected data to the base station. Thus, WSN enables access to harsh places or environments where are impossible to set up the cables. Consequently, it is quite suitable to apply a wireless sensor system to obtain reliable data from the wireless network for the purpose of monitoring and control. Sensor nodes abilities limit depend on factors like power, processing power, storage and communication capability. Information collected by nodes are sent to the base station by unsecure means. Securing the transferred data from outside attacks is a tough task. This is due to the nature of wireless broadcasting, limited resources and remote area of deployment. Wireless security can be obtained by authentication, cryptography or key management. The goal with this paper is to is to design and build a wireless sensor network. The core objective is to design a system that enables remote control and monitoring of temperature readings from different areas through a wireless network.

Keyword: WSN, nRF24L01+, AT mega, Attiny85, Arduino.

I. INTRODUNCTION:

Wireless Sensor Network

Some applications that involves a particular type of sensing they do not facilitate high data rates in the scope of wireless networks. The wireless networks, working in this manner and supporting the low data rates do fall in the category of wireless sensor networks (WSN).Some of the applications and areas where WSN can be very useful are as follows:

- Environmental monitoring: a WSN can be employed in any desired area to get the information about any changing environmental quantity like temperature, sun light, flow of a river, seismic or volcanic activities (figure 3.1), humidity of air, air pollution, water level etc.
- Agriculture: WSN can gather information about soil moisture, sun light, rain water lever and soil composition.
- Patient monitoring system: WSN can be used to monitor a patient condition in a hospital room. WSN can be used to monitor blood rate, glucose level, and body temperature. It is also useful to store and process the gathered data from long time observation of the patients and their test results.
- Home security and automation: in smart home scheme WSN is used for ensure the security of a house. Also it can be used to automate the home electrical appliances. Motion sensors and door lock system are used for the purpose of home security. WSN are also used in remote controlling of different home appliances as television and wireless mouse and keyboards.

Following Figure shows the architecture of wireless sensor Network.

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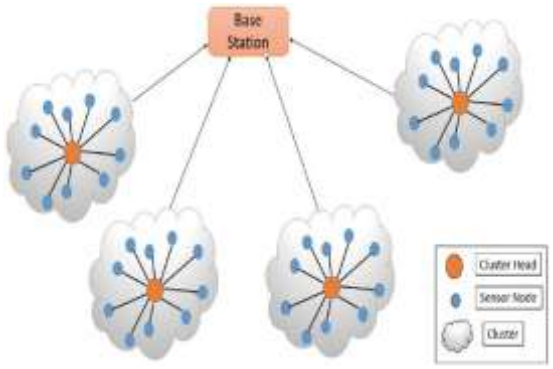
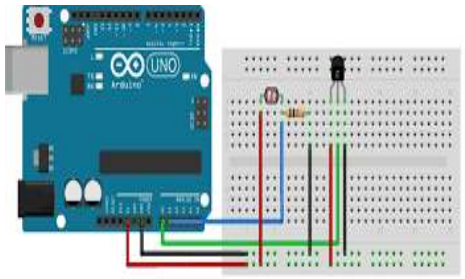
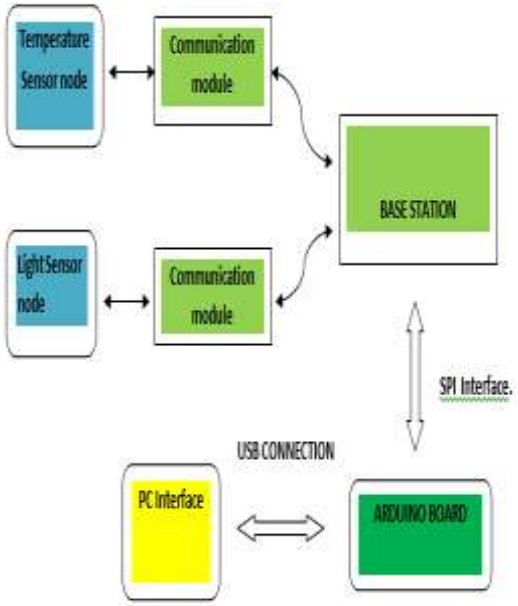




Hardware Design:

This part covers the summary of hardware design at first. Then the components that are used to construct the hardware are described in detail and their functions are also explained. The connections that are to be made in between those components are also depicted in this section with schematic diagrams.



SENSOR NODE:

The sensor nodes contains a sensor and microcontroller. Sensors acquire the data and send it to microcontroller. All these sensor (temperature, light) send the analog data to microcontroller. To make the data understandable to microcontroller it needs to be converted into digital form. It is done with the help of an ADC convertor which is integrated in the microcontroller.

COMMUNICATION MODULE:

These modules sends the data to the microcontroller after receiving. Also microcontroller sends those commands as well as data which is processed and ready to be transmitted. Microcontroller is responsible to put these modules in different modes of operation. NRF24s use GFSK modulation scheme to modulate the baseband data. They are operated with the power supply of 1.9 - 3.3 volts. Very less power is consumed in standby mode.

SPI INTERFACE:

The serial peripheral interface (SPI) is a synchronous data link. It is invented by Motorola. Its operation is in full duplex mode. Single master and short distance communication link uses this interface. In this link the device communicates in master- slave configuration. The master always initialize the data frame Although multiple slaves can be there and only single master device but in this project/system we are implementing only single mater and single slave configuration. SPI is often called as a 4 wire serial bus. Serial peripheral interface (SPI) is also called as Synchronous Serial Interface.

II. RESULT:

A base station (base node) and two sensor nodes were experimented in this work. Depending on the software, you can restrict the number of sensor nodes needed in your network. The software developed in this project provided needs for identification of a maximum of four sensor nodes. This limit was just for experimental purposes. Theoretically, the network can support up to 65,536 possible nodes, which is only limited by the 16-bit nodes network ID. An assigned sensor node network ID must be recognized by the Base receiver node in order to synchronize and process its data. The base station is considered node 0 is department of communication engineering, a 16-bit

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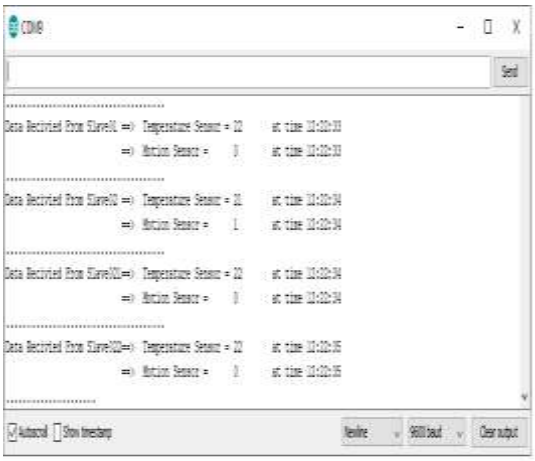
network example, sensor node 01 is department of oil and gas engineering, sensor node 02 department of control engineering, sensor node 21 department of IT engineering and sensor node 22 training center. The experimental setup of this experiment and some results are as depicted.In the first experiment we build two sensor motes and test our NRF24L01 wireless modules radio signal ranges for data transmission. One of these modules work in a sender and the other one works in receiver mode. Radio signal test are done in two different scenarios. In the first scenario range test are done in open area without any obstacles. Two sensor nodes are used for this test. One of the sensor nodes work as a sender and the other one is in receiver node.

The NRF24L01 modules can transmit data up to 75 meters in open area tests. In the second scenario we test the RF modules in a closed place, its range is highly reducing and the data cannot be transmitted far than 25 meters behind 50 cm concrete wall. The signal strength reduction is too much which means you cannot place sensor nodes far than 25 meters between them that makes our sensor network coverage in a 50m diameter circular area. This range is not enough for wide area environment monitoring applications. In order to widen our RF signal coverage area of our network we need to implement multi hopping wireless sensor networks. In the second part of our experiment a multi-hop wireless sensor network is implemented to cover wide areas. In order to achieve this issue, the radio transceiver plus antenna is added into sensor base station network. For wireless communication the 2.4GHz nRF24L01(+) radio transceiver IC, that operates within the ISM band.



The experimental results are shown in the above Serial monitor window, It is Monitor window of Arduino IDE, Where two slave nodes are transmitted data. Each slave is identified by its unique Id.

III. CONCLUSION:

The Arduino platform. It utilized the Arduino open-source software. Three nodes (the base node and two sensor nodes) were deployed with a possibility for more nodes, each used the nRF24L01+ for its radio. The project focused on using the 1-Wire sensor types. For this purpose, we used two Temperature sensor to take different temperature readings and four PIR Motion Sensor to detect any motion, we designed in addition, a voltage sensor circuit which worked accurately for the purpose of monitoring the battery level, and providing information when to recharge or change the battery. Data sent from the sensor nodes were successfully received at the base station, reported to the LCD display and serial monitor, and retrieved from Arduino Web server to a Web browser, thus makes the system scalable and flexible. Overall, a low-cost dynamic wireless sensor network system was in effect.

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