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An Efficient Low Power Transmission Over Long Range in Wireless Sensor Networks for environmental studies

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Abstract

The applications of wireless sensor networks in various areas such as Military, Surveillance, Monitoring, Agriculture, Road Safety etc. has made it a supportive era for various technologies and increased the usage. These Wireless Sensor Networks contains many sensor nodes. These sensor nodes need to be deployed in the remote and dangerous areas which are difficult to reach and monitor. So it is difficult to supply the energy to these huge numbers of nodes. Many applications need both low power consumption and long distance transmission in Wireless Sensor Networks. Hence the main theme of the project is to implement a system in Wireless Sensor Networks such that the sensor node consumes low power during data transmission and also provide long distance transmission. The system also makes use of Zigbee Technology for data transmission and reception, and Raspberry PI device to provide webpage for displaying the data. The data displayed in the webpage is visible and even accessible from any place thus defining long distance transmission.

Keywords: Wireless Sensor Networks, Zigbee Technology, Raspberry PI, Sensor node.

INTRODUCTION

Wireless Sensor Networks (WSN) contain large number of tiny, low cost sensor nodes with limited energy, processing power and storage. They are used to monitor the desired environment and report the collected data to the base station/gateway. Due to their low power and wireless communication, the WSNs are widely developed and used in many applications such as habitat monitoring, military, object tracking,

agriculture, smart metering and many others. A large number of nodes need to be deployed in remote and dangerous areas that are unreachable and even in harsh environments where there is need to analyze the parameters such as temperature, humidity, fire, etc. and transmit the data to the sink for analysis, control and monitoring. Hence it is important to consider energy supply for all the nodes. The data that is to be monitored and controlled need to be visible for anyone even at distant locations. Therefore, power consumption and long-distance transmission need to be taken into consideration. Many research works have been done in order to provide low-power consumption or long-distance transmission. A few research work have been done in order to provide both in one system.

SYSTEM DESIGN AND WORKING

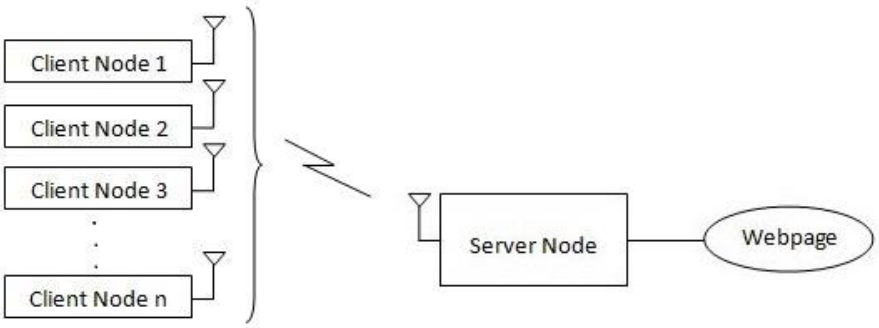

Figure 1: System Structure

The proposed system is designed for Wireless Sensor Networks to provide low power consumption as well as long distance transmission. The system consists of several number of client nodes and a server node. Each client node comprises of number of sensors to sense the environment for which they are needed, a controller in order to monitor and control the data that is received from the sensors and a transmitter to transmit the sensed and formatted data to the server node. The data transmission is done using wireless technology.

The sensors continuously monitor the environment and transmit the data to the controller. If there is a sudden change in the environment that differs from the equilibrium, then that information is sensed by the sensors and transmitted to the controller. The controller then transmits the data to the server through wireless transmission.

LOW POWER MODE

The data received from the sensors is a 16-bit data. The transmission of this data directly needs more transmission power for the client node. Hence in order to reduce the energy consumption, the 16-bit data is transformed into 8-bit data through some

encoding technique. Hence as the bit length reduces, the transmission power of the sensor node also reduces and hence the energy is efficiently used for data transmission.

LONG DISTANCE MODE

The encoded data transmitted by the client is received by the server for further analysis and display. The encoded data is transformed into original data by decoding it. This data is transmitted to the internet and displayed on a webpage. As this information could be visualized form any place anywhere in the world, thus long distance is achieved.

HARDWARE DESIGN AND WORKING

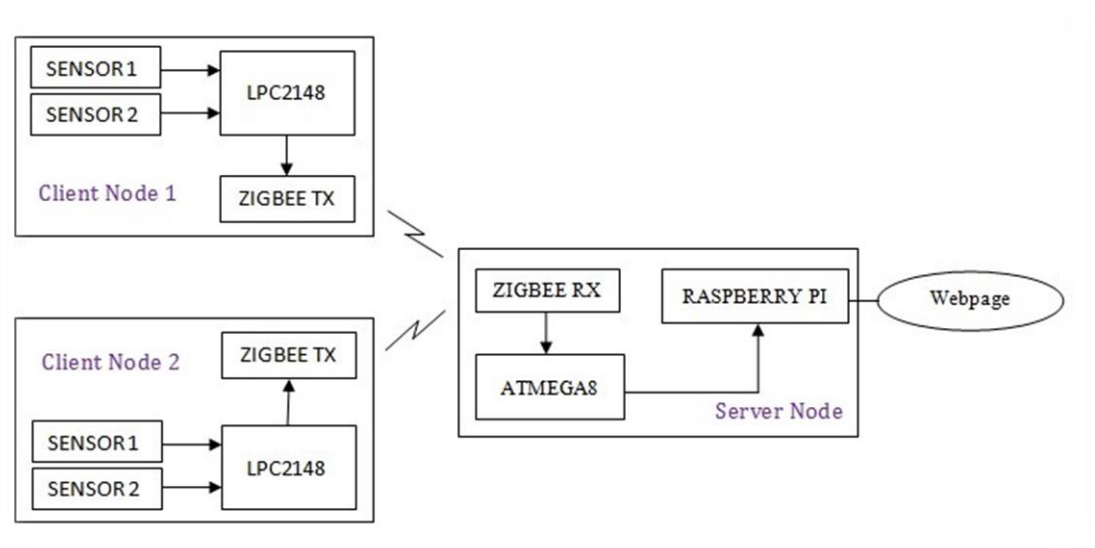

Figure 2: Hardware Structure

The client node considered in this system consists of two sensors: Temperature Sensor LM35 and a Fire sensor. The sensors sense the data and transmit the data to the LPC2148 microcontroller. This data is then transformed into 8-bit using ASCII coding technique. The encoding process is explained with an example:
Let us consider the data received from the sensor is 27^0 degree which is in unpacked form. This form is represented in unpacked mode i. e., 16-bit data. The packed format of the data 27^0 is represented as 00000010 00000111. Hence

Unpacked mode:	2	7
Packed mode:	00000010	00000111

The 4 MSB bits (upper nibble) form the above are discarded and hence the data is

Unpacked mode:	2	7
Packed mode:	00000010	00000111
	0010	0111

This 8-bit data is now encoded using ASCII coding by adding 48 to each digit of the number. This encoded 8-bit data is now transmitted to the server through Zigbee Technology. Zigbee is used such that it provides low power long distance transmission within the given range of Zigbee.
The server node consists of Zigbee receiver that receives the encoded data, and it is transmitted to ATMEGA8 microcontroller where the data is decoded into 8-bit data. This data is sent and displayed on the webpage that is provided using the Raspberry PI device which is a mini-sized computer displaying the webpage. Hence the data can be visualized from any place by achieving long distance.

FLOW CHART FOR PROCESS FLOW IN CLIENT AND SERVER NODES

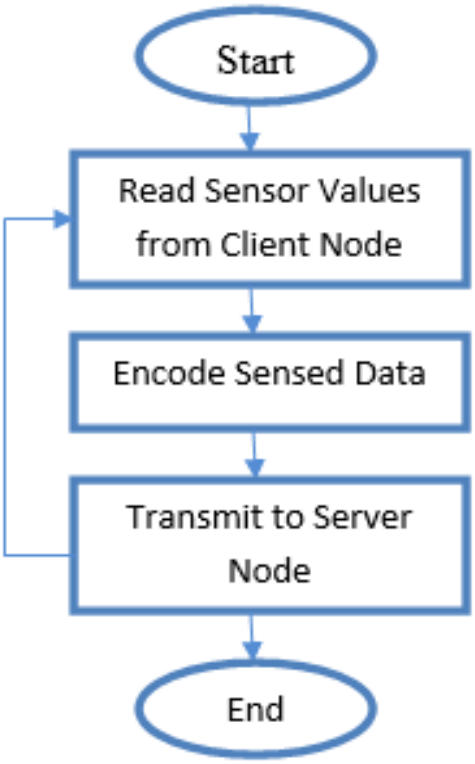

Figure 3: Process Flow in Client Node

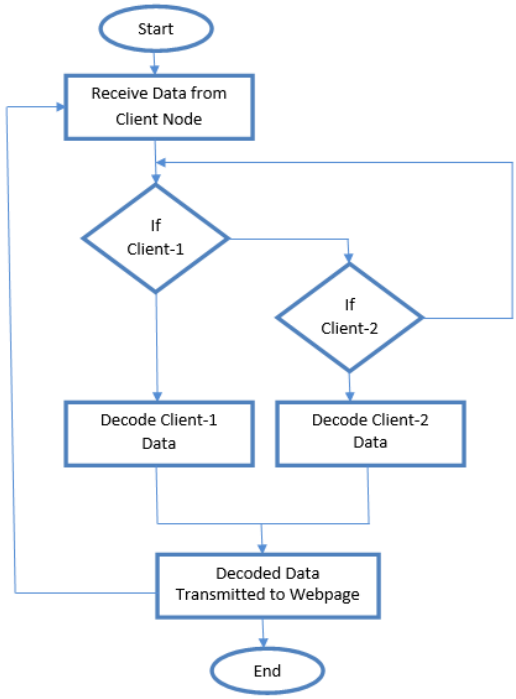

Figure 4: Process Flow in Server Node

LITERATURE SURVEY

A low power and long distance system based on Wireless Sensor Networks [1] that reduces the energy consumption and increase the transmission distance by the combined application of hardware and software. The working frequency band of the whole system can be set from 470MHz to 485MHz.

System Design

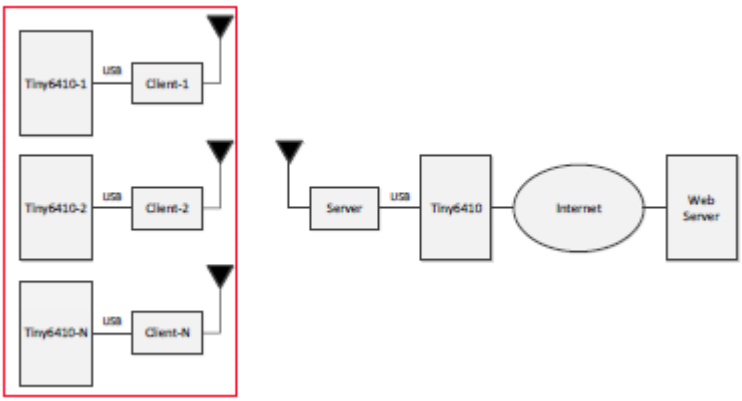

Figure 5: Structure of the system

The communication mechanism in this system between client nodes and server node is TDMA that relates to MAC protocol. The message transmitted is made of synchronization word and data packet. The principle that the transmission rate of synchronization word is greater than that of data packet is proposed in order to increase transmission distance of the system. The client is set into sleep mode when it does not need to communicate with the server thus achieving low power consumption. The battery consumption in 802. 15. 4/Zigbee motes which are the promising technologies for wireless sensor networks is presented [2]. It integrates the current consumption characteristics under various operations and analytical models. The main theme of the paper[2] is to provide a model that predicts the current consumption at maximum, average and minimum levels under various considerations such as traffic load, data rate etc.

CIRCUITS

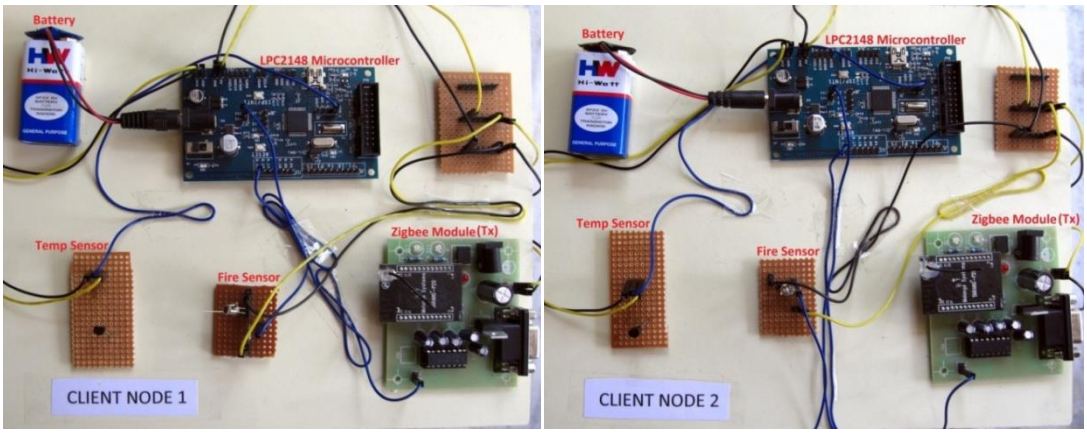

Figure 6: Client Nodes

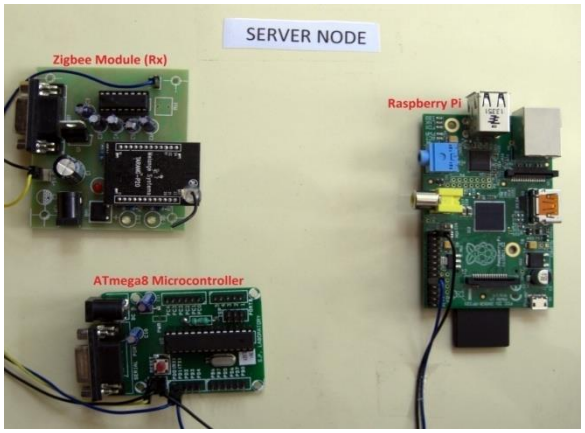

Figure 7: Server Node

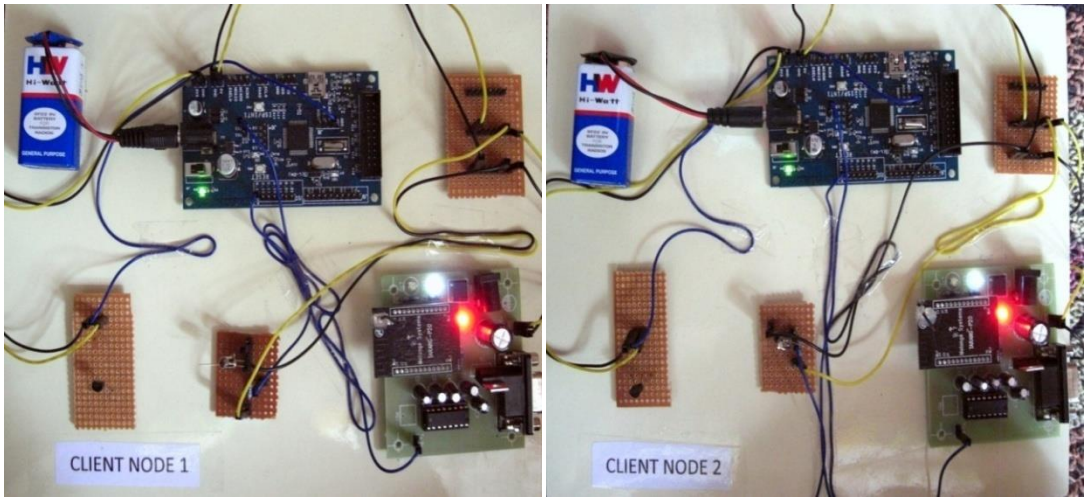

Figure 8: Client Nodes in transmitting mode

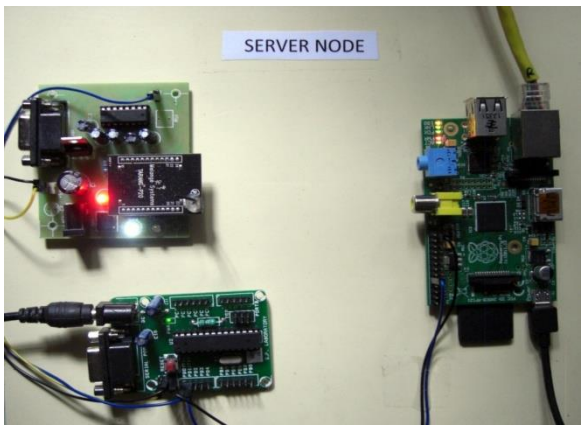

Figure 9: Server Node receiving data from client nodes

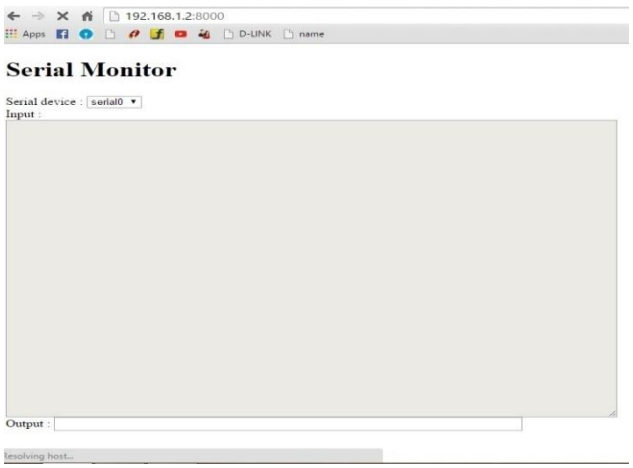

Figure 10: Webpage

OUTPUT

The data received from sensors is encoded, transmitted, decoded and displayed in the webpage. Here the message of fire occurrence is displayed when there is a fire in the room/environment considered.

CONCLUSION

A communication system is developed in wireless sensor networks to achieve low power consumption for sensor using encoding of data at client nodes and decoding at the server node. The system uses Raspberry PI device to provide webpage and transfer the data onto the webpage in order to visualize the data from any location thus achieving long distance transmission. The programming is done using MicroVision Keil (IDE) and AVR studio platforms. The resulted data is visualized in the web page.

FUTURE SCOPE

The low power consumption is achieved in the system based on encoding the data. Hence in order to further achieve low power consumption, the nodes energy analysis in terms of sleep mode, active mode etc can be considered.

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