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A REVIEW: ENVIRONMENTAL MONITORING APPLICATIONS USING WIRELESS SENSOR TECHNOLOGY

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ABSTRACT
With a broad research on wireless sensor technology, the sensor network has proven its significance in today's modernizing world. In this paper a wireless sensor network system is proposed with open source hardware and software platform i.e Raspberry pi microcomputer which act as a base station, zigbee and a graphical user interface for user friendly application. This system is highly effective both in terms of number of sensors and the type of the sensors. This system provides low cost and feasible solution in the area of environmental monitoring application. A detail review of how actually this system will work and the expected outcome based on theoretical basis are presented in this paper. Raspberry pi is cheap, small, hackable computer linux board. Comparative analysis shows that the performances with wireless sensor nodes using raspberry pi has more successful usage in sensor network domain and remains inexpensive throughout.

INDEX TERMS – Wireless sensor network(WSN), Zigbee, Environmental Monitoring, Raspberry Pi, Sensor node, Graphical User Interface(GUI).

INTRODUCTION

Wireless sensor networks(WSNs) has emerged as an popular field for the development of environmental monitoring and other applications at different location [1].Wireless sensor network consist of sensor nodes which are used to detect or sense the data. With the combination of various hardware platforms i.e Raspberry Pi which has been presented in this paper, an efficient and cost effective monitoring system can be implemented [2]. Wireless sensor network based monitoring system can be used for from simple information mining to the collection of the complex internet based system. An open source hardware and software based linux board i.e Raspberry Pi is used as an base station with the sensor nodes [3]. The main goal of this research is to design an environmental monitoring system which can measure the physical parameters using sensor nodes. Some of the parameter which could be monitored

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by this system is pressure, temperature, luminous intensity, humidity. According to the brief survey such monitoring system has its advantages in different fields such as industrial, agriculture, home automation [2]. The sensor node in this proposed system act as a end tag device which are small, Low powered and are used for wireless communication. The sensor node will collect the data and transfer it to the base station using multihop [4]. It will process and pack the data and send it to the zigbee for further communication. The received data can be viewed at an user end using raspberry Pi or microcontroller board or GUI. Raspberry pi is a microcomputer which has a system on chip(SOC) named BCM2835. The raspberry Pi is a cheap, powerful and it does not consume a lot of power [5]-[6]. Zigbee is an IEEE 802.15.4 standard which is used as communication protocol in wireless technology [7]. Zigbee has its strength over the other communication module in terms of industrial aspect. It employs a wide variety of real industrial needs. Zigbee is a simple, low power, reliable module and operates in personal space of distance 10-100m [8]. Zigbee is well suited for monitoring applications and due to mesh networking it provides reliability and larger range.

Overall System Architecture

Implementing a wireless sensor network requires development and integration of various hardware and software components [9]. Figure 1 represents the overall system architecture of an environmental monitoring wireless sensor network system that has been presented in this paper. This system includes Raspberry Pi as a base station and a network of distributed wireless sensor nodes.

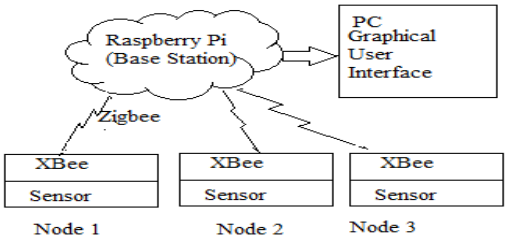

Figure 1 : System Monitoring Architecture

Each sensor node consists of microcontroller (µc), sensors and a XBee module. The Xbee module can act as a router, coordinator and end device. The XBee module which is with sensor node act as router and the XBee module on the base station will perform the function of coordinator as discussed in the Zigbee sub section [7] . The XBee modules form a mesh network topology among themselves using Zigbee networking protocol [8]. A gateway application has been implemented in the base station to support graphical user interface GUI. It is used to monitor the statistics of data that has been collected by the sensor nodes. The base station also stores the data that has been sent by the XBee module from the sensor node to the raspberry pi memory. As compared to the large scale system environmental system, the system presented in this paper is well suited for small scale environmental monitoring and data collection [1].

RASPBERRY PI

Raspberry Pi is a low cost, low powered, hack able and education oriented computer board introduced in 2012 [5]. The small microcomputer linux os board is shown in the figure 2.

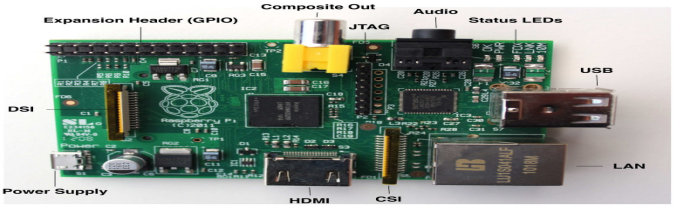

Figure 2 : Front side of Raspberry Pi

The Raspberry Pi consists of a processor and graphics chip, program memory (RAM) and various interfaces with connectors for external devices. The raspberry pi operates in the same way as pc but requiring a keyboard, a display unit, storage, power supply externally. The raspberry pi uses an operating system the "stock" os is a flavour of linux called Raspbian [3]. The raspberry pi board is mostly popular with the sensors wherte it reads the sensors inputs and store their values in a database for further records. The processor of raspberry Pi is a 32-bit, 700 MHz system on chip (SoC), which is built on the ARM11 network architecture. Arm architecture comes in a variety of core configured to provide different capacity and different ranges.

ZIGBEE

Zigbee is an IEEE 802.15.4 standard protocol for wireless communication which normally operates in the WPAN area [8]. Zigbee can be configured in three ways : coordinator, router and end device. In the presented paper the Zigbee has been configured in all three ways. At the base station side the XBee module operates as an coordinator. The main function of the coordinator is to monitor and initiate the network. The end tag device has the capability to send the data packet to the coordinator. If used more than one sensor node along with XBee module then it can be configured as an router. The zigbee has an normal range of upto 10-100m. It provides mesh and star networking topology and the mesh network topology has been preferred in this paper. The zigbee module is a low power and low complexity communication protocol. The data protection provided by the zigbee is 16 bit CRC and a data rate upto 250 kbps[8]. Its channel bandwidth is 2 MHZ. It operates in the frequency band of 2.4 GHz.

PROPOSED SYSTEM

In this paper a wireless sensor network system has been designed using Raspberry pi, XBee, GUI and a number of open source software packages. The system possess a number of significant feature, including low cost, compact, easy to maintain and a more organized data visualization using GUI. The proposed work in this paper also aims to reduce cost and more data management using GUI interface. The main advantages of these system design lies in the gateway node of wireless sensor network. A number of sensors has been included to this wireless sensor network so as to get more information about the environmental parameters.

CONCLUSION

In this paper a wireless sensor network system is presented using Raspberry Pi, XBee module along with GUI for better data visualization at the user end. A number of different sensors (Temperature, Pressure, Humidity, Altitude, Light) can be been added to this system to

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achieve/monitor the data management for environmental applications. The compatible size of the sensor node results in the reduction of complexity and size of the hardware, which in turn provides a cost effective monitoring system. An integration of both WSN and GUI results in a new architecture which will provide real-time visualization and analytics of data. Raspberry Pi provides a multipurpose usage (USB) due to its design and with memory, connectivity, processing power as the pros of this system. With the number of input and output peripherals and due to network communication, Raspberry Pi proves to be advantageous for interfacing with many different devices and hence is effective in the environmental monitoring applications.

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