A sensor platform based on PowerPC

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Abstract

WSN (Wireless Sensor Networks) are considered the sensing technology of the future. Many experimental systems have been designed to create a WSN to collect environment data and accessed via a web-interface. But almost WSN are build on the special technology including the software and hardware. In order to extend the application of WSN, we design a sensor platform based on PowerPC, on which the genral embedded Linux runs.Then the abundant free-software and open-source is introduced into WSN's study.We also present a prototype for data collecting and data publishing for this platform. Especially, we utilize the SVG to release the data dynamically.

1 Introduction

As the development of micro-electronic technology and so on. It is possible to develop the low-cost, low power and multifuction sensor nodes with small size. These small sensor nodes consist of sensing, data processing and communicating components and represent a significant improvement over traditional sensors. A sensor network is composed of a large number of sensor nodes and the position of sensor nodes need not be engineered. Sensor networks may consist of many different types of sensors such as seismic, low sampling rate magnetic, thermal, visual, infrared, acoustic and radar, which are able to monitor a wide variety of ambient conditions. Sensor nodes can be used for continuous sensing, event detection, event ID, location sensing, and local control of actuators. The concept of micro-sensing and wireless connection of these nodes promise many new applications into military, environment, health, home and other commercial areas. It is possible to expand and this classification with more categories such as space exploration, chemical processing and disaster relief.

In this paper we build a wireless sensor networks to monitor the environment. In our project we make use of the sensors of Crossbow Technology Inc. The Wireless Sensor Networks will be connected with PC or Internet through serial port. Due to limitation of low-speed serial communication and the Mote-microprocessor low-performance, the Wireless Sensor Network consisted of pure Crossbow's products is small scale. But in the factual application it is too small to monitor a large scale region. Usually the sensor data is published through the non-smart PC with large volume and high power consumption. It is not easy to be configured and moved anywhere, while in some situation easy configuration and movement of the device is very important. So we decide to adopt the PowerPC as the sensor data processing center and publishing center.

PowerPC is a high-integrated, small volume and optimized for communication and it has a CPM (communication processing module) . As a CPU of RISC architecture PowrPC has high performance and it is the processors of many types of embedded systems such as PS3, many Switchers and Routers. In our project it only has a power of 4W and it is suitable for wireless sensor networks.

We use the SVG as the data publishing format. SVG is a shortcut of Scalable Vector Graphics and it is the extension of XML language. As an open technology it is a good choice as the data format.

2 The Usage of system

In Chinese Western Region the environment gets worse and worse year by year. Many researches have done in order to find the reasons and try to resolve it. Becuase of lack of enough data it is impossible to study the changes of environment in the larger

scale. At present many institutes including Chinese Academic Institute spend lots of money in the manual monitoring. It is very expensive to build the solid monitoring stations in those places unfit to live in. So it is a good solution to use a automatic and portable monitoring system which is easy to be configured and to be moved. It will be very convenient to the researches and enhance the development of environment studying of Western China.

3 the hardware and software of System

The system consists of two parts which are wireless sensor networks and embedded Linux system based on PowerPC.

We use Crossbow MOTE-KIT5040 wireless sensor network toolkit to build the WSN . The products of Crossbow are different from others' and they split the functions of sensor into two : the one named Sensor is responsible for environmental data collecting and another named Mote is to data receiving or data sending or both receiving and sending. Because of the Mote with the data switching function it will expand the monitoring scale very rapidly. The Mote is programmable and according to different programs it will have different functions. The program of Mote is compiled and written into Mote through an Open-Source embedded Operating System named TinyOS, which was invented UC Berkely and is used for some Wireless Sensor Networks development. In our project we use three sensors of MTS310, four motes of MPR400 and one sensor board of MIB510.

We use Octobus with 405EP as our sensor data processing center. In the PowerPC we could recompile the Linux kernel and make a file system with BusyBox 1.0. xlisten is an free-software program which could transform the serial port data from the mote into the readable format. We could import it from X86 platform to PowerPC.

4 Implementation of the system

4.1 system description

system is composed of three parts

Data collection module: data of surrounding gathered by Wireless Sensor Network , then transmitted to data process module. Data process and release module: this module builds on PowerPC host. xlisten application receives the data from base station and transform the data to readable format. Mini web service is setup on host .data is release in the style of SVG. Data display module: data is shown by graphic from web page 1 .

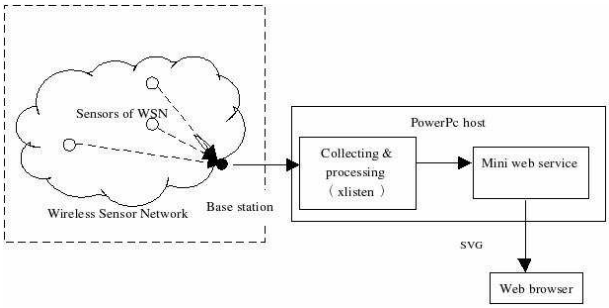

FIGURE 1: *System Structure*

4.2 detail of module implementation

- Data collection module:
  The node charging gathering data is composed of sensor (MTS310) and mote (MPR400) in which XSensorMTS300 is written; the base station is composed of gateway (MIB510) and mote in which TOSBase is written.Sensor can gather the following parameters: node id, battery, temperature, light, mic, AccelX, AccelY, MagX, MagY. sensor transmits data to the base station node by mote in way of wireless signal.The base station node of the wireless sensor network links to embedded hardware system directly through serial line , then send these data to the systematic control end through serial line .

- Data process and release module:
  This module includes the whole embedded Linux software and hardware system that this project uses. The hardware part of this project has adopted Octobus HPPC405BA Board with IBM25PPC405EP Processor, the part of the software is customized small-scale embedded Linux system according to the needs of this project function .Mini web service we use includes in busybox. Data process function is implemented by xlisten application which includes in TinyOS. We write some SVG script to release the data in graphic.

- Data display module:
  Web browser of client end need install the according plugs to display the graphic implemented by SVG, such as Adobe SVG Viewer

5 Conclusion and Future Work

At present, there should be some efforts to keep the stability of xlisten running on PowerPC. After that,

the current network architecture will be successfully applied in real environment monitoring.

According to software and hardware resources we used, on one hand, the embedded developing platform based on IBM PowerPC and Linux have all already been used widely in the development of embedded system. On the other hand, the wireless sensor network hardware of Crossbow is very expensive at present, and need the support of some proprietary software such as TinyOS. It's obviously not helpful for the widespread application of wireless sensor network. Therefore, it seems a meaningful attempt to realize port a non-Linux or non-Power application onto Linux on Power platform from the wireless sensor network. We hope to make the whole system much more general than current wireless sensor network and reduce the cost. We plan to take the place of expensive Crossbow products with more general and traditional sensors, and connect the sensors with embedded hardware directly.

We'll make use of embedded hardware system to construct the basic framework of the network, and make the network prototype realize the function of wireless sensor networks. With these generally used hardware, we can build larger scale wireless sensor network much more convenient than present.

Though TinyOS is an open-source operating and Unix/Linux-like system designed for wireless embedded sensor networks, it's obviously less general than normal Linux. So if Linux can be directly used to manipulate wireless sensor networks, it'll be helpful to make the development and using of wireless sensor networks easier, and drive more Linux users attention to wireless sensor networks. It seems the combination of Linux and wireless sensor network is a good way to promote the research of the both areas. In the future, the embedded clusters and distributed systems with the features of wireless sensor networks will be built by these hardware. This will be invoke the new development of embedded systems, wireless sensor network, clusters and distributed systems, etc.

6 List of Acronyms

`CPM` - Communication Processor Module
`FDL` - Free Documentation License
`FSF` - Free Software Foundation
`GNU` - GNU Not UNIX (recursive acronym)
`GPL` - General Public License
`RISC` - Reduced Instruction Set
`SVG` - Scalable Vector Graphic
`WSN` - Wireless Sensor Network
`X86` - Intel 8X86 Processor Family

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