DATA TRANSMISSION USING JUXTAPOSE PROJECT WITH WIRELESS SENSOR NETWORK

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This work is dedicated to my beloved wife

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ABSTRACT

Wireless sensor networks (WSNs) have been used to develop solutions for a wide range of problems, ranging from military applications to environmental and habitat monitoring. Actually, these applications require low cost, low power and low data sensor nodes that communicating over multiple hop to cover a large geographical area. One type of WSNs is Telosb, which is the latest in a line of nodes developed by University California Berkeley to enable wireless sensor network research. It is a new mote design built from scratch based on experiences with previous mote generations. Telos' new design consists of three major goals to enable experimentation, minimal power consumption, easy to use, and increased software and hardware robustness. The main objective of this research is to embed nesC code in four WSNs and to distribute them to collect data environment (temperature and humidity) the data will collected in a PC through a base station sensor connected to the PC. This network of sensors and PC will be interfaced to the Internet and by using JXTA project which is a kind of peer to peer technology, the collected data can be implemented in a creating file by writing a java code to create a file each our in the PC. The created file will transfer to another place to other peer using JXTA shell through its commands. In our project the embedded operating system used in WSNs is TinyOS 2.1.0, and the wireless sensor is TelosB which is consist of low power transceiver based on CC2420 ChipCon chips that employ IEEE 802.15.4.

ABSTRAK

Rangkaian sensor tanpa wayar (WSNs) telah digunakan untuk mengembangkan solusi untuk pelbagai masalah, mulai dari aplikasi ketenteraan untuk persekitaran dan habitat pemantauan. Sebenarnya, aplikasi ini memerlukan kos rendah, daya rendah dan rendah nod sensor data bahawa berkomunikasi selama beberapa hop untuk merangkumi kawasan geografi yang besar. Satu jenis WSNs adalah Telosb, yang terbaru dalam garis nod yang dibangunkan oleh Universiti California, Berkeley untuk mengaktifkan rangkaian sensor wayarles WSNs kajian. Ini adalah desain lebih baru yang dibina dari awal berdasarkan pengalaman dengan lebih generasi sebelumnya. Telos desain baru terdiri daripada tiga tujuan utama untuk membolehkan eksperimentasi, konsumsi daya minimal, mudah digunakan, dan peningkatan ketahanan perisian dan perkakasan. Tujuan utama dari kajian ini adalah untuk menanamkan kod nesc dalam empat WSNs dan untuk mengedar mereka untuk mengumpul data persekitaran (suhu dan kelembapan) data akan dikumpul dalam sebuah PC melalui stesen pengkalan sensor disambungkan ke PC. Jaringan ini sensor dan PC akan dihubungkan ke Internet dan dengan menggunakan projek JXTA yang merupakan jenis teknologi rakan rakan, data yang dikumpul dapat dilaksanakan dalam mencipta fail dengan menulis kod java untuk membuat sebuah file setiap kita di PC. Gambar yang dibuat akan memindahkan ke tempat lain untuk rakan lain yang menggunakan shell JXTA melalui arahan. Dalam projek kami tertanam sistem operasi yang digunakan dalam WSNs adalah TinyOS 2.1.0, dan tanpa wayar sensor TelosB yang terdiri daripada pemancar kuasa rendah berdasarkan CC2420 cip yang menggajikan ChipCon IEEE 802.15.4.

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LIST OF ABBREVIATIONS

ADC	-	Analogue to Digital Converter
DARPA	-	Defense Advanced Research Project Agency
ISM	-	Industrial Scientific Medical
IEEE	-	Institute of Electrical and Electronics Engineers
J2SE	-	Java 2 Standard Edition
LAN	-	Local Area Network
NAT	-	Network Allocation Table
nesC		Network Embedded System C
P2P		Peer 2 Peer
PRR	-	Packet Reception Rate
PC	-	Personal Computer
QoS	-	Quality of Service
RF		Radio Frequency
SensIT	-	Sensor Information Technology
TinyOS	-	Tiny operating system

TOSSIM	-	Tiny Operating System Simulator
UCLA	-	University California Los Angeles
USB	-	Universal Serial Bus
WAN	-	Wide Area Network
WSNs	-	Wireless Sensor Networks
XML	-	Extensible Markup Language

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CHAPTER 1

INTRODUCTION

1.1 Background

In recent years, much interest has been involved in the design of Wireless Sensor Networks (WSNs) technologies. WSN technologies are driving many of the significant advances currently being made in the field of data communications. End-users of WSN technologies want their sensed data to be available in a timely, accurate and secure fashion. Interfacing WSN technologies with the Internet is a key requirement for making sensor data globally available.

The technological advances in the areas of integrated circuits and device fabrication will yield tiny, low cost, low power sensors, as shown in Figure 1. Tiny is important because they can be scattered around to measure just about everything that you can imagine. Low power because they won't need to carry a large battery and may even be solar-powered. Low-cost because the numbers required will be enormous. A wireless sensor network in its simplest form can be defined as a network of (possibly low size and low complex) devices denoted as nodes that can

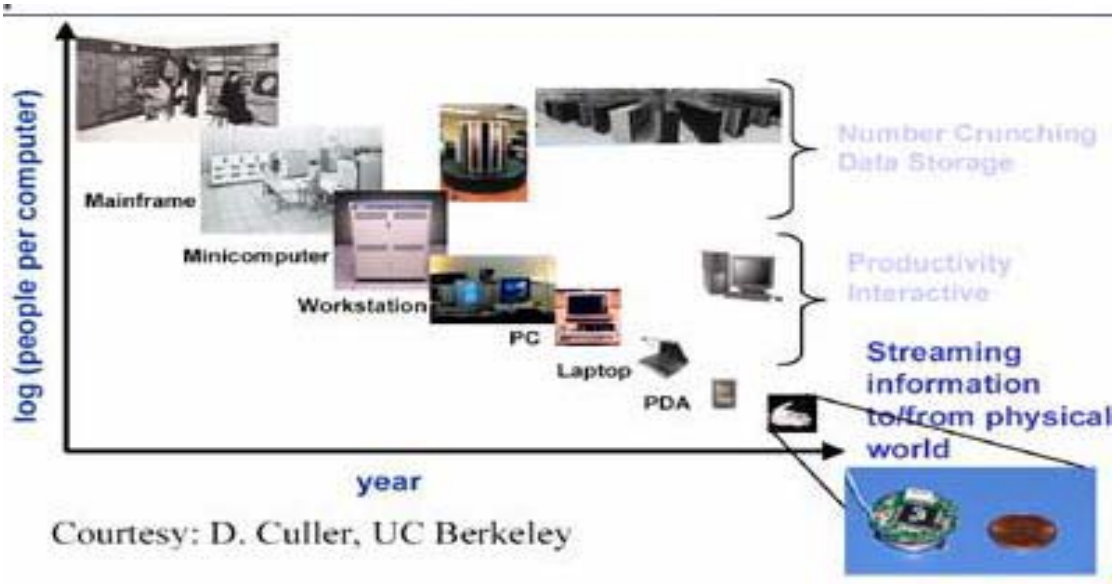

Figure 1.1: Technological advances in the area of computing devices from mainframeto wireless sensor networks.

sense the environment and communicate the information gathered from the monitored field (e.g., an area or volume) through wireless links; the data is forwarded, possibly via multiple hops relaying, to a sink (sometimes denoted as controller or monitor) that can use it locally, or is connected to other networks (e.g., the Internet) through a gateway. The nodes can be stationary or moving. They can be aware of their location or not. They can be homogeneous or not [1].

These tiny sensor nodes, which consist of sensing, data processing, and communicating components, leverage the idea of sensor networks. Sensor networks represent a significant improvement over traditional sensors. Researchers see WSNs as an ‘‘exciting emerging domain of deeply networked systems of low-power wireless motes with a tiny amount of CPU and memory, and large federated networks for high-resolution sensing of the environment’’ [2].

The use of WSN has been on the increase. More and more application are based on WSN today, many people think that wireless sensor networks can become

as important as the Internet. Just as the Internet allows access to digital information anywhere, sensor networks will provide remote interaction with the physical world.

For many applications, the sensor networks cannot operate in complete isolation; there must be a way for a monitoring entity to gain access to the data produced by the sensor network. By connecting the sensor network to an existing network infrastructure such as the global Internet, a local-area network, or a private intran et, gaining remote access to the sensor network is straightforward.

1.1.1 Application of WSN

WSN has very wide applications for areas including health care remote monitoring, military and national security application. Environmental data collection application is one where a research scientist wants to collect several sensor readings from a set of points in an environment over a period of time in order to detect trends and interdependencies. This scientist would want to collect data from hundreds of points spread throughout the area and then analyze the data offline [3].

There are many related applications using WSN as their fundamental communication platform, such as traffic control, industrial security, animal monitoring, and military information integration. WSN also used in embedded applications, such as environmental monitoring to improve agricultural yields, structural monitoring to track building and bridge integrity, and industrial control to provide more sense points and control points at lower cost [4].

Security monitoring networks are composed of nodes that are placed at fixed locations throughout an environment that continually monitor one or more sensors to

detect an anomaly. A key difference between security monitoring and environmental monitoring is that security networks are not actually collecting any data. This has a significant impact on the optimal network architecture. Each node has to frequently check the status of its sensors but it only has to transmit a data report when there is a security violation. The immediate and reliable communication of alarm messages is the primary system requirement. These are “report by exception” networks.

1.1.2 Main features of WSNs

The main features of WSNs are: scalability with respect to the number of nodes in the network, self-organization, self-healing, energy efficiency, a sufficient degree of connectivity among nodes, low-complexity, low cost and size of nodes are all very relevant features of WSNs; those protocol architectures and technical solutions providing such features can be considered as a potential framework for the creation of networks able to implement several types of applications. Unfortunately, the definition of such a protocol architecture and technical solution is not simple, and the research still needs to work on it. The massive research on WSNs started after the year 2000. however, it took advantage of the outcome of the research on wireless networks performed since the second half of the previous century. And some researchers tried to report their skills acquired in the field of ad hoc networks to the study of WSNs.

1.2 Problem Statement

Wireless sensor networks (WSNs) have been used to develop solutions for a wide range of problems, ranging from military applications to environmental and

habitat monitoring [5]. WSNs are suitable for problems with harsh environmental conditions that need unattended operation. Although they are mostly used to collect fine grained environmental or ambient information (i.e., humidity, pressure, temperature, etc.), they can also be used to actuate on their surrounding environment (e.g., by controlling mechanical actuators).

However, for WSNs to become truly ubiquitous, a number of challenges and hurdles must be overcome. One of the challenges on sensor nodes its small coverage area due to its low link quality. WSN is based on IEEE 802.15.4 that has very limited bandwidth and low transmits power. This will cause link quality can influenced by environmental factors. Recent empirical results obtained on the Berkeley mote platform indicate that wireless links are highly probabilistic, asymmetric, and the link quality (i.e, Packet Reception Rate (PRR)) depends on the transmission power and the distance traveled by a packet. As the result, communication delays in such system are highly unpredictable. Consequently, the link quality between sensor nodes in WSN should be considered while designing multi-hop routing in order to achieve high throughput for WSNs[6].

Integrating the WSNs with the internet, the information transfer and network management can be done anywhere, this integration in this project is by using JXTA P-2-P technology, which is a kind of Java technology, JXTA with instant messaging, grid computing, collaboration, or even file sharing, because JXTA is all of these things -- and more. JXTA is a set of protocols and APIs for general-purpose, computer-to-computer communication. Using JXTA, will be very useful to take the data from one place to the place and to share information, especially that JXTA project are use peer groups, which can be make a group for each special data taken from the sensor, like temperature, humidity, and so on.

1.3 Objectives

The main objectives of this proposed research are:

a) To use embedded programming code in WSNs for environmental data collection.
b) To integrate the WSNs with the Internet.
c) To use JXTA project as a tool to share the information using peer to peer communication.

1.4 Scope of Work

The scope of this work can be divided into several scopes. The first scope will use Telosb as a sensor device to collect environmental data (temperature and humidity), this will be done by writing a nesC codes and embedded it in four WSNs. Then, implement JXTA P2P technology for the integration of WSN and the Internet. The collected data will be transferred using JXTA shell from one peer to another peer.

1.5 Significance of Research Work

JXTA project are used as P2P method to take advantage of the physical parameters of WSN nodes and the environment to carry out the environmental data from one place to other place without need of using many sensors and by using just one hop to the base station WSN. This connection method of four sensors to make

one hop to the base station and then to the PC can be used to share the environment information between many places, and can be used as supervision system

1.6 Thesis Organization

The thesis is arranged into five chapters. The first chapter introduces the project work by discussing the background of WSNs and its ability to collect environmental data. Besides that, it also discusses the project objectives, scope of project, significance of the research work, and the thesis organizations. Literature review shall be discussed in the ensuing chapter. Previous researches related to the WSN and its application and brief discussion on JXTA project have been presented in the chapter two. The methodology and the nesC codes, java code and JXTA methods, analysis, JXTA project installation and JXTA shell instructions have been existing in chapter three. Chapter 4 demonstrated the methods of P-2-P technology and the reason to choose JXTA protocols to transfer the collected data from WSN. The final chapter, chapter 6 summarizes the research finding and suggested potential future work

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