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Research on Node Localization in Wireless Sensor Networks

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Abstract

Wireless sensor network is a kind of distributed sensor network, which is a sensor that can detect and examine the external world. WSN sensor in the wireless communication, so the network is flexible, device location can be changed at any time, but also with the Internet wired or wireless connection. A multi hop ad hoc network formed by wireless communication. WSN is widely used in military, intelligent transportation, environmental monitoring, health care and other fields. This paper studies the node localization technology in Wireless Sensor Networks and builds IoT software for intelligent Internet of things and elaborates application of wireless sensor network node localization.

Keywords:*Node Localization,Wireless Sensor Networks,Location Calculation ,IoT Software.*

1. Introduction

Wireless Sensor Network(WSN) is composed of deployed in the monitoring area of a large number of cheap micro sensor nodes through wireless communication forming a multi hop self-organizing network system.It is the current international concern, multi-disciplinary, highly cross and highly integrated knowledge frontier research and integrated sensor technology, embedded computing technology, modern network and wireless communication technology, distributed information processing technology.Its purpose is to perceive collaboration, acquisition and processing of network information of object in the coverage area, and wirelessly transmitted through the wireless network, finally transmitted to the observer. Sensors, sensing objects and observers constitute the three elements of the sensor network. The wireless sensor network as a new technology, more and more domestic and international academic and engineering circles, in military reconnaissance, environmental monitoring, medical care, space exploration, intelligent Home Furnishing, industrial control and other commercial applications show a broad application prospect and WSN is considered one of the impacting technology in twenty-first Century.

The basic idea of WSN originated in 1970s. In 1978, the DARPA working group distributed sensor network was established in 1980, Carnegie - Mellon University; distributed sensor network project DARPA (DSN) on sensor network research precedent; 80- in twentieth Century 90s, the main research in the military field, has become the key technology of network centric warfare, opened the prelude to the research of wireless sensor network in 1990s; later, WSN attracted widespread attention in academic circles, military and industrial field, wireless sensor network technology in the modern sense. Wireless sensor network industry, the earliest can be traced back to the 1960s war. From 1980s to 90s, the wireless sensor network industry in Europe and the United States have been developed, the United States will be more used in military areas. Since twenty-first Century, it has gradually entered into the research and application of wireless sensor network in modern sense. Although the financial crisis in 2008 had the greatest impact on traditional industries, the wireless sensor network industry is a new force, entered the stage of rapid development. A survey report from the United States shows that in 2011, the world market for wireless sensor network systems and services market value of $4 billion 600 million, an increase of nearly 15%.

At present, the developed countries attach great importance to the development of wireless sensor networks. Specifically, the earliest prelude to industrial development in modern wireless sensor network of the United States in the communication protocol, hardware and chip technology and other core technologies is the leader, Japan and South Korea in the application in the forefront. The U.S. military began the first wireless sensor network

technology research, including CEC, REM, TRSS, Sensor, IT, WINS, Smart Dust, Sea Web and other research projects. The U.S. Department of Defense's vision program has invested tens of millions of dollars to help universities research and development of wireless sensor network technology. The SF (N) also has a large number of projects associated with it. NSF in 2003 to develop the W SN research program, the annual allocation of $34 million to support research projects, and set up a sensor network research center at the University of California at Los Angeles. Research on the network technology and the 2005 plan system, mainly on the next generation of high reliable and secure scalable network, programmable wireless network and sensor network characteristics, the amount of subsidy of $40 million. In addition, the U.S. Department of transportation, the Department of energy, the U.S. National Aviation Aviation has launched a large number of related research projects. Almost all the famous American colleges and universities are engaged in research in W SN related technology research group, Institute of Canada, Britain, Germany, Finland, Japan and Italy and other countries have joined the WSN study. University of California at Los Angeles, University of California at Berkeley, Massachusetts Institute of Technology, Cornell University, Harvard University, Carnegie Mellon University and other research results in the field of WSN is more prominent. In the international academic conferences, the research on W SN is increasing, and the number of retrieved papers has been increased year by year. The United States Crossbow, Dust Network, Ember, Freescale and other companies have also carried out the research work of WSN. Research institutions in Canada, Britain, Germany, Finland, Japan and Italy and other countries have joined the WSN study. The European Union's Sixth Framework Program information society technology as one of the priority areas of development. Many of them involved in the study of WSN. Launched EYES and other research projects. Japan's Ministry of general affairs in March 2004 set up a "ubiquitous sensor network, the survey will be. Business community, the European Union's Philips, Siemens, Ericsson, ZMD, France Telecom, Chipcon and other companies; Japan's NEC, OKI, Sky-leynetworks,, OMRON and other companies have carried out the study.

2. The Study on WSN Node Localization Technology

Positioning is to determine the location and positioning technology is an important support technology for wireless sensor networks. In many cases, the nodes in wireless sensor networks need to know their physical location, if the network can not provide the corresponding location information, then many of the features of the sensor is meaningless. In wireless sensor networks, the location of each node is not desirable. Moreover, because of the high cost and the limitation of the configuration conditions, it is unrealistic to configure the GPS receiver for each node. Therefore, it is very important and necessary to study the sensor positioning technology.

Self organizing network provides the location information of nodes by a certain method, so as to realize the localization of wireless sensor networks. This self-organizing network can be divided into node localization and target localization. In sensor networks, there is no uniform optimal location algorithm, only suitable for the specific environment of the positioning algorithm. In certain environments, some algorithms may perform better than others. Therefore, different environments have different localization algorithms. In recent years, with the rapid development of cellular network communication technology, the demand for mobile location is becoming more and more urgent. In cellular networks, mobile location information based services, such as vehicle and traffic management, public security services, network planning and design, resource management, etc., need to accurately locate the mobile station. According to the positioning of the main body and the use of equipment can be different to the wireless location of the mobile station is divided into mobile station (terminal) positioning, network-based positioning and GPS assisted positioning three types.

For different wireless positioning systems, the parameters are different, the positioning methods and techniques are also different, but in principle, the wireless positioning mechanism is generally composed of the following three steps:

Step 1 The radio signal to one or several electrical parameters (amplitude, frequency, phase, propagation time) were measured according to the propagation

characteristics of the wave measurement of electrical parameters into the distance, distance or angle of arrival, used to express the position.
Step 2 Using a variety of algorithms or techniques to achieve spatial location estimation.
Step 2 Estimate the value.

Localization in wireless sensor networks is the known information solution of unknown point coordinates, the theory and implementation way and the traditional positioning technology has a certain similarity, only discrete distributed collaborative network endows the sensor network localization technology unique connotation.The sensor node structure and the energy supply of the mobile / sensor nodes and dynamic voltage conversion and WSN process graph are shown in the following figure,

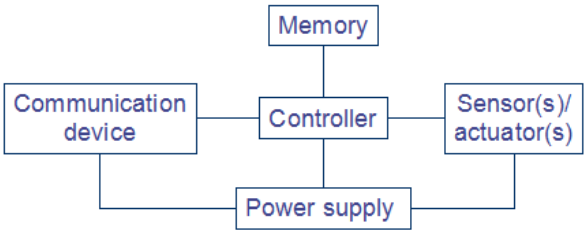

Figure 1 Sensor node structure

Primary batteries			
Chemistry	Zinc-air	Lithium	Alkaline
Energy (J/cm 3)	3780	2880	1200
Secondary batteries			
Chemistry	Lithium	NiMHd	NiCd
Energy (J/cm 3)	1080	860	650

Figure 2 Energy per unit volume (per cubic centimeter)

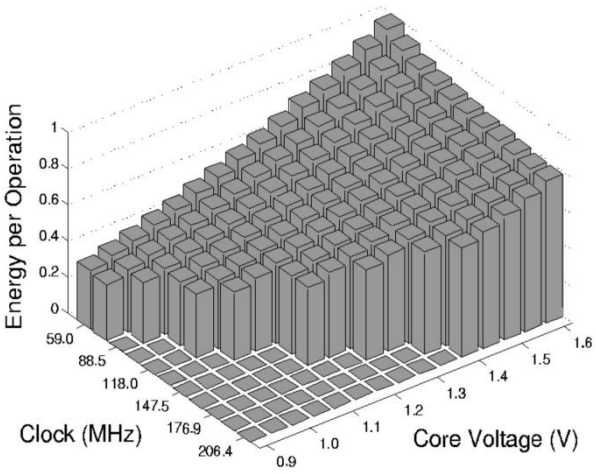

Figure 3 Dynamic voltage conversion

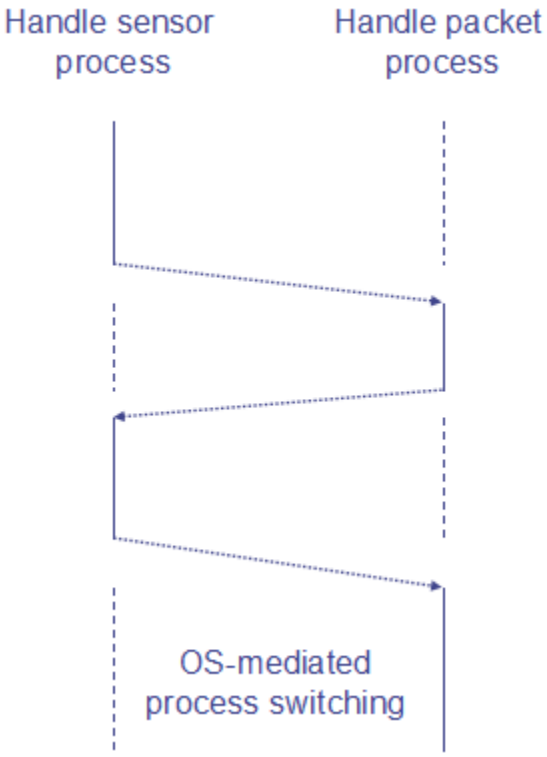

Figure 4 WSN Process graph

Location calculation can be divided into two types: centralized and distributed. The centralized positioning technology means that the sensor nodes transmit the data to a central location, where the computation is performed to determine the location of each node. Doherty Piste: and Ghaoui propose a centralized positioning technique using convex

optimization algorithm to estimate location. Due to the high communication cost and the inherent delay, the centralized computing is not suitable for the mobile application environment. Distributed positioning technology does not require centralized computing, each node can only rely on the limited communication with neighboring nodes can determine their location. According to the difference of the location estimation mechanism, we divide the distributed location technology into two categories: based (Range-) and free (Range-). Range- based positioning mechanism to estimate the position according to the absolute distance or angle point, ranging technology adopted, mostly depends on the clock source, precise multiple communication and communication equipment of the angles between the derivation, which require complex hardware to achieve. As for the sensor nodes into high power consumption structure, too much.

In order to overcome the problem of the Range-based positioning mechanism, the Range-free positioning mechanism is proposed in recent years. The goal is to provide the position estimation with sufficient accuracy without the need of complex positioning hardware. It is the use of proximity information and connectivity information to achieve positioning. This technique is more suitable for sensor networks. The researchers put forward a variety of solutions for different environmental requirements, and can achieve better results in the relative conditions, but the real application is still rare. Therefore, more and more people to study in the field, in order to design a better positioning algorithm, so that the sensor network positioning in real life has been widely used.

In order to adapt to the current level of devices, wireless sensor networks also need lower energy consumption, more efficient node localization technology. At present, the research in this field is mainly focused on several aspects, such as low cost, high energy efficiency and high precision distance or angle measurement technology. In order to prolong the network lifetime, low complexity, low cost and low energy consumption. Low cost node localization technology for large or super large scale wireless sensor networks. In addition, node localization algorithm research has been proposed mostly based on static network, research on mobile node positioning technology is relatively small, apply the technology to the network topology node in the dynamic change of the remains to be studied.

3. Built in IoT Software for Intelligent Internet of Things

Based on the ARM mbed or RTOS, the operating system for embedded microprocessors supports the construction of all the necessary software stacks of networked sensor devices. By supporting a variety of IoT communication protocols, including LWM2M, CoAP and MQTT, you can easily access data, and through WISE-PaaS or other cloud services to convert it into different formats for communication. As shown in figure 5.

Figure 5 MCU integrated software

WISE-PaaS / RMM is the Internet of things software platform for networking equipment remote monitoring and management. With more than and 150 RESTful API, WISE-PaaS / RMM not only provides for account management, equipment management, equipment control, event management, system management and database management tools, but also highly enhanced pre integrated software and hardware preverified building block connectivity, realized from the sensor to the security data stream seamless cloud.As shown in figure 6.

Figure 6 WISE-PaaS

Through the development package, the user can easily access the WISE-PaaS / RMM compact dashboard and understand the data collected on the WISE-DB1500 carrier temperature / humidity sensor. In addition, the user can download the WISE-PaaS / RMM to create compliance with the requirements of the dashboard for analysis and event handling.As shown in figure 7.

Figure 7 WISE-PaaS Dashboard

4.Wireless Sensor Network Node Localization Application

In recent years, with the decline of computational cost and the small volume of microprocessors, a large number of wireless sensor networks have been put into use.

In the monitoring and protect the environment, with people more concerned with environmental problems and environmental data collection, need more and more, wireless sensor network provides the convenience for the study of random access data, and can also avoid invasive to the environment from traditional data collection failure. Intel has 32 small sensors in the Internet, to read "Maine duck island" on the climate, a sea was used to examine the information. Wireless sensor networks can track the migration of birds and insects, study the impact of environmental changes on crops, and monitor the composition of the oceans, atmosphere and soil. In addition, it can also be used in precision agriculture, to monitor crop pests, soil pH and fertilization status, etc.

In medical care, British scientists use wireless sensor to create an intelligent medical room, to measure blood pressure, pulse, respiration, the occupants of the sleeping posture and 24 hours a day using the status of dust. Intel also launched the family nursing technology of wireless sensor network, through the shoes, furniture and household appliances with embedded semiconductor sensor furniture and equipment, to help older people, with special disease and the daily life of the disabled, can reduce the burden of nursing staff.

In addition to civilian areas, wireless sensor networks are widely used in the field of Western defense. The West has wireless sensor deployment to the forest, mountain, sea, construction of remote information defense system; deployment in biological fuel display, bionic micro display, when the unmanned reconnaissance aircraft on mobile sensor for defense data link system to provide real-time, great depth and angle of reconnaissance and intelligence; it can also be used in important places the sniper, reconnaissance personnel, investigation and control of network equipment. According to U.S. media reports, the U.S. Department of defense has invested tens of millions of dollars, with research institutions to carry out smart dust sensor technology research and development, product sales are expected to reach billions of dollars.

In more areas, some dangerous industrial environments such as mine, nuclear power plant, the staff can use it to implement safety monitoring;

vehicle monitoring in the field of transportation; in the industrial automatic production line for real-time monitoring and control. Intel is the production of a wireless network in the factory test, the network consists of 210 sensors on 40 machines, so that the composition of the monitoring system can greatly improve the plant operation conditions, due to the timely detection of problems, can greatly reduce the cost of inspection equipment, shorten the down time, improve efficiency. And long service time.

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