PERFORMANCE ENHANCEMENT OF WIRELESS SENSOR NETWORK TECHNOLOGY ZIGBEE

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ABSTRACT

ZigBee is wireless communication technology which use high level communication protocols. ZigBee is one of the best cost effective wireless networks which use minimal power digital radios as well as nominal rate for per- sonal area networks. ZigBee claims to be much cheaper and less expensive because of its simpler structure than Bluetooth, WIFI and other available wireless networks. ZigBee works on radio frequency which requires low power and long-lasting availability. Another win for ZigBee is, it provides extra network security using mesh network. It offers unbelievable data transferring speed upto 250 kbps which is also defeating point to switch over the Zigbee from complicated and expensive wireless networks. It delivers high security, less expensive, hassle-free structure using low power radio frequencies. ZigBee uses standard protocol which is almost free of cost, easy to upgrade firmware and network security.

INTRODUCTION

ZigBee wireless networks are commonly being used as sensing networks for military security purposes to detect fire, blast, or any other nuclear happenings. It is much involved in environmental monitoring to measure heat, humidity and more. Several improved implementations have been done in past years approaching effective wireless networking. People use to communicate each other using standard available wireless networks like Bluetooth[1], WIFI, GSM and others and more doubt these are much famous in our daily life even though expensive as well as complicated structures. On the other hand, ZigBee wireless sensor networks didn't perform well in practical applications as a new tech-nology it should. Its best for many reasons over other networks but when we talk about large scale wireless sensor networks, ZigBee is really not an ideal choice because coordinator can't perform well to communicate with routers due to long distance. In large scale coordinator suffers because it gets an excessive amount of messages which coordinator can't handle efficiently due to its limited processing ability. That is the point which limits Zigbee to perform well in large scale wire- less networks and communication drawbacks popup in form of message delays, unexpected sensor node behavior, data lose while sending or receiving to coordinator. Researchers have done depth workout over it to fix this issue and overcome the shortcomings while coordinator communication but unfortunately all of previous work belongs to software improvements rather than concentrating on hardware support to prevail over flaws. In this paper, a processing design has been proposed to maximize the performance of ZigBee wireless sensor network. Overall network is divided in two parts for ease. first one is getting data, joining nodes and net- work building. In second part, processing data, con-servation of network information and dealing with the host computer. First part will be handled by coordinator and the else part will tackled by processor which is wired with coordinator using RS-232 interface.

LITERATURE REVIEW
FUTURE SCOPE OF ZIGBEE

Zigbee has a potentially bright future ahead. Backed up research that points toward a monumental increase in home networking, Zigbee would be a provider of game-changing and transforming statistics in the years to come that would revolutionize the world of wireless technology.

1. In the next four years, there would be a rise of an overwhelming 3400 times in Zigbee's revenues.

2. Zigbee's sales are expected to meet an incredible amount of over 700 million dollars in the year 2008.

3. Within the next two, three years, Zigbee will be a household name and there would be a minimum of 100-150 Zigbee chips in every home

4. A Zigbee chip will cost as low as 5 dollars a chip and the smaller memory size requirement of protocol stack will drop the price down to only 2 dollars a chip.

Mostly dependent on the power systems, industrial automation's requirements encompasses systems that are regulated and distance controlled. Using Zigbee for su- perior power management, the author proposed a dig- ital system by enabling remote switching devices and monitoring power related systems. This was done for wireless sensor networks based on Zigbee for supervisory control for electric systems parameters like voltage and current and the diagnosis, condition monitoring. Zigbee technology was used by researchers to create an actor network and wireless sensor. To attest and prove the efficiency and reliability of the communication network, many intelligent services based on ZigBee actor network and wireless sensor were demonstrated. With this network technology, autonomous control of devices in intelligent space such as lamp, curtain has been made possible through robot sharing of information largely and a great improvement in performance with "light-packs". The communication between the sensor node and base station for wireless data acquisition is actually done through ZigBee wireless communication protocol. The collector plate includes re-quired sensors and associated signal-conditioners and the wireless sensor node is situated on it. An application program on LabView platform was developed by researchers for acquisition of data, data processing and data analysis and it was executed in the PC of the base station. The design of the key components of the information terminal along with the wireless receiving modules wireless transmission and collection of data from network was done by researchers with the principle of ZigBee that also included the main hardware which was 51 Series of single-chip. The solution based system worked well through actual measuring and the hardware and software. It accomplished what it was set on to do and achieved the objective and goal that were expected from it and so it has been successfully implemented to the wireless vehicle system. A wireless sensor network application was designed by Routing Protocol (SHARP. Each of the three basic integrated modules in SHARP performs clearly stated tasks to allow the entire security framework to be a complete system by itself. Despite its increasing popularity, the fact that ZigBee operates in an environment which al-ready widely uses Wi-Fi, creates a newfound challenge for ZigBee technology.

APPLICATIONS OF ZIGBEE TECHNOLOGY

Being cost-effective, battery-efficient and its wireless connectivity, this Zigbee technology is utilized in every appliance and it is not bound by limitations of a particular level. It functions automatically in many devices and is programmed in a form of a chip. It even allows you to remotely control and monitor the entire factory unit while sitting in a cabin by centralizing all units in one place. Similarly, the same centralization can be done in a home by raising the security aspect [8]. These small equipment's work great and numerous of little de- vices are coming embedded with Zigbee. This ZigBee technology [7] is winning the market over by launching devices like control units for home, industry, smoke, heat sensors, wireless devices and medical. Zigbee has revolutionized the field of technology and it will soon become a major part of every aspect of our life.

ARCHITECTURE

Network Reference Model

Wireless or wired network devices are popularly defined by the Open Systems Interconnection (OSI) reference model which was developed by the ISO in compliance with the 1980 definition of communication-related protocols and services. This generic 7 layered model is applicable to all media types and networks. The version of ISO-OSI network reference model [2] for ZigBee use, intents and purposes is demonstrated in the ZigBee network model does not use 3 layers that are session, presentation or transport layer. Moreover, there is a direct link between the user application and application layer (APL).

IEEE 802.15.4 Standard

The IEEE standard [3] does not state specifications out- side of routing schemes or network growth, peer-to-peer communications link, repair mechanisms and a network topology. However, it specifies the ability to uniquely identify every radio along with the format of communications and the methods between these radios in the network. The ZigBee Alliance has selected the IEEE 802.15.4 standard which was launched in May 2003 that specifies three frequency bands to use a standard worldwide, as the controls and framework that ZigBee will follow when creating its networking and applications. IEEE 802.15.4.

ZIGBEE DEVICE TYPES

Zigbee devices are of three types:

1. ZigBee coordinator (ZC): This is the most competent device that allows the coordinator to form the foundation (root) of the network tree that may connect to other networks. Since the network was started by this device, there is only one ZigBee coordinator in every single network. It not only stores network related information but also acts as arepository and trust center for security keys.

2. ZigBee Router (ZR): This not only runs as application function but also acts as an intermediary that passes on data from other devices.

3. ZigBee End Device (ZED): It cannot transmit data from other devices. However, it contains enough functionality to communicate with the parent node which will either be a router or the coordinator. This relationship facilitates a long battery life since it allows the

node to sleep a considerable amount of time. It can be less expensive to manufacture in comparison with a ZR or ZC because it requires the least memory.

The coordinator is responsible to starting of the ZigBee network [6]. Mentioned below are the steps for network initialization:

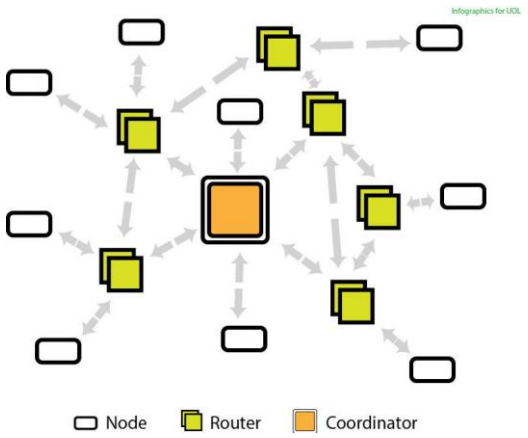

Figure 1: ZIGBEE Network Structure

1. Search for a Radio Channel – The coordinator searches for an appropriate radio channel that has the least activity. This search can only include usable channels e.g. avoiding wireless LAN operating frequencies.

2. Assign a PAN ID - A Personal Area Network identifier assigned when the coordinator starts the net- work. The PAN ID can either be pre-decided or it can be one that does not conflict with other frequencies in the network in the same channel. The coordinator assigns a short network address to it- self at this phase like 0x0000.

3. Start the Network - The coordinator initiates itself in coordinator mode after finishing its configuration. Now, it is all set to handle the response to queries from other devices that want to join the network.

Evaluation

System Design and Methodology

Zigbee's new and improved wireless sensor network comprises of many other sensors, host computer, a processor and ZigBee nodes. The senor facilitates the collection of information and uploads it to the ZigBee node in the network which is then sent to the coordinator via the ZigBee node. The sensor information is immediately sent by the coordinator to the processor through a wired connection. The processor is responsible for the handling and conservation of that information and providing it to the host computer whenever it queries the ZigBee wireless sensor network. However, in the improved version, there is no direct contact and relationship between the ZigBee wireless sensor net- work and the host computer. The processor is the main difference between the improved ZigBee wireless sensor network. The traditional one in which one of the two interfaces is connected to the host computer while the second one is connected to the coordinator. The hard- ware resource is what determines the interface design. The interfacing design greatly employs the use of the serial port, the USB interface and parallel port. We have made use of the serial port in this

paper that acts as the interface between the processor and the coordinator. It also allows us to choose various communication protocols between the host computer and processor and in this paper, we have chosen the Modbus protocol [5] between these two. Distributed Processing

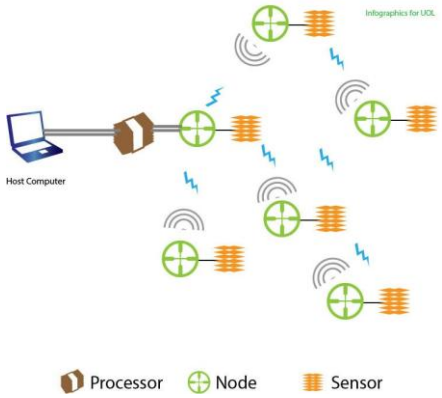

Figure 2: Improved Performance Design

Design: A distributed processing design is needed, to support WSN at large scale. Design and Implementation of coordinator: Improves the coordinators processing ability [4] to response for every message. Processing and Performance Challenge: Processing design should facilitate large-scale WSN ZigBee. Should be efficient without any loopholes.

CONCLUSION

Proposed a solution to improve performance of ZigBee wireless sensor networks at large scale areas by developing a distributed processing design technique. Existing wireless network have certain shortcomings in scalability and coordinator's processing. But our processing design approach can come up with much improved re- sults. Concluding above, proposed solution to initiate ZigBee WSN to perform well in large scale areas.

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