Voice Communication Over Zigbee Protocol: A Literature Review

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Abstract— ZigBee is an IEEE 802.15.4 standard for data communications with business and consumer devices. It employs a suite of technologies to enable scalable, self-organizing, self-healing networks that can manage various data traffic patterns. ZigBee is a low-cost, low-power, wireless mesh networking standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries. This paper proposes an integrated approach towards Transmission of High Quality of Voice Data using 8-bit Microcontroller through Zigbee. Here Zigbee technology is used since it provides seamless addressable connectivity, simple and low cost wireless communication and networking solution for low data rate and low power consumption applications. Generally, Voice over Zigbee networks uses 32- bit Micro Controllers. These prototypes have complex circuitry and thus very expensive. Here, in this project we have made a prototype that uses low power 8- bit Micro Controller and Off the Shelf components, which makes it cost effective and easy for production. Because of its low cost and easy availability of components, it can be easily deployed in circuit that uses voice communication. This work is quite helpful in applications such as home monitoring and automation, environmental monitoring, green telecommunication, industry control, controlling multiple embedded devices with voice signal and emerging low rate wireless sensor applications.

Keywords— Zigbee, Voice communication, IEEE 80215.4, Data traffic, networking, wireless control, monitoring application.

INTRODUCTION

(1)The Zigbee Technology

The ZigBee was built on top of IEEE 802.15.4 standard. The IEEE 802.15.4 standard defines the characteristics of the physical and Medium Access Control (MAC) layers for Wireless Personal Area Network (WPAN)(1).

The name refers to the waggle dance of honey bees after their return to the beehive. ZigBee is named for erratic zigzagging patterns of bees between flowers which symbolizes communication between nodes in a mesh network. Network components of ZigBee are analogous to queen bee, drones and worker bees. This communication dance (The ZigBee Principle) is what engineers are trying to emulate with this protocol a bunch of separate and simple organisms that join together to tackle complex tasks. [8] ZigBee is a low-cost, low-power, wireless mesh network standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications. Low power-usage allows longer life with smaller batteries. Mesh networking provides high reliability and more extensive range. ZigBee chip vendors typically sell integrated radios and microcontrollers with between 60 KB and 256 KB flash memory(3). ZigBee provides specifications for devices that have low data rates, consume very low power and are thus characterized by long battery life. ZigBee makes possible completely networked homes where all devices are able to communicate and be controlled by a single unit (2).

A. *Need for ZIGBEE*

1) There are a multitude of standards that address mid to high data rates for voice, PC LANs, video, etc. However, up till now there hasn't been a wireless network standard that meets the unique needs of sensors and control devices. Sensors and controls don't need high bandwidth but they do need low latency and very low energy consumption for long battery lives and for large device arrays .

2) There are a multitude of proprietary wireless systems manufactured today to solve a multitude of problems that also don't require high data rates but do require low cost and very low current drain.

3) These proprietary systems were designed because there were no standards that met their requirements. These legacy systems are creating significant interoperability problems with each other and with newer technologies.(3)

(2)Zigbee device types

Zigbee devices are of three types:

1) ZigBee coordinator (ZC): The most capable device, the coordinator forms the root of the network tree and might bridge to other networks. There is exactly one ZigBee coordinator in each network since it is the device that started the network originally. It stores information about the network, including acting as the Trust Center & repository for security key[6].

2) *ZigBee Router (ZR)*: used to route the messages between the coordinator and the end device. It also boots the signal coming from the end device[6].

3) *ZigBee End Device (ZED)*: Contains just enough functionality to talk to the parent node (either the coordinator or a router); it cannot relay data from other devices. This relationship allows the node to be asleep a significant amount of the time thereby giving long battery life. A ZED requires the least amount of memory, and therefore can be less expensive to manufacture than ZR or ZC[6].

Advantages of Zigbee [5]**:**

1. Low power consumption
2. Low cost
3. High quality of voice data
4. High density of nodes per network
5. Easy installation
6. Reliable data transfer
7. Short range operation
8. Global implementation and Simple protocol

RELATED WORK

The researches have developed several voice communication protocols for voice transmission. Authors developed a real-time emergency rescue communication system for mine tunnel over Zigbee networks. They use embedded system named Atmel ATmega32 to implement on-board audio sampling, ADPCM encoding and packet transmission [2]. However, voice packet due to the stochastic transmissions of voice packets, a burst of voice packets may cause micro-controller unable to afford encoding and to handle packet transmission simultaneously. Their study did not provide any flow control mechanism, to reduce the significant packet error rate due to the burst voice packets[2]. The research from Brunelli et al. has investigated and analyzed the performance of Zigbee network for voice transmission. They adjusted the sensor network deployment to maximize transmission performance. Their simulation and experimental results have demonstrated that by adjusting the input and output queue size properly, WSN is capable of providing most common voice streaming applications[1]. On the other hand, the usage of Bluetooth as the direct access of voice transmission has been prevalent. Therefore, transmitting voice data via Bluetooth and then over limited Zigbee bandwidth is very attractive for many applications. The bandwidth difference between these two wireless transmissions may require an effective flow control mechanism. Accordingly, designing a flow control and traffic management to maintain a balanced traffic flow between Bluetooth and Zigbee would be an important research issue[2].

 Later the researches evolved, tried to resolve some problems addressed above. They modified and improved previous implementation for voice communication over Zigbee. They adopted non-acknowledgement mode and G.729. A codec to transmit 127B voice data every 100ms[1][2]. They achieved higher bandwidth utilization. Nevertheless, the flow control mechanism for burst traffic was not taken into account. When the communication range increases, the packet loss rate may increase. The research in presented a hybrid Zigbee/Bluetooth grid infrastructure. The authors proposed a packet format conversion mechanism for heterogeneous wireless network which equipped wireless nodes with both wireless interfaces. Their system allowed a widespread diffusion between 2 Mbps Bluetooth data rate to inter-transfer with 250 kbps Zigbee data rate[6]

PROPOSED WORK

(1) Our main aim is to design and development of a zigbee based voice communication protocol for multi device voice communication.

(2) We are going for employment of IEEE 802.15.4 Zigbee technology which is based on WLAN (Wireless Local Area Network or WiFi) or DSSS(Direct Sequence Spread Spectrum), CSMA-CA(Carrier Sense Multiple Access-Collision Avoidance) protocols enable multiple devices employing zigbee technology to communicate to independent devices seamlessly even in same vincity.

(3)   In it we are going to use of low cost 8 bit microcontroller with inbuilt ADC(Analog to Digital converter) enables low hardware count and extremely simple circuitry as compared to other author complex 32 bit microcontroller or DSP based system and employment of PWM (Pulse Width Modulation) technology for DAC (Digital to Analog converter) reduces the component count further.

(4) We will use off the shelf component .The use of off the shelf component and low cost 8 bit microcontroller enables easy indigenous

(5) The use of embedded C platform and MATLAB enables easy integration off our technology into existing wireless products.

(6) Also we can introduce a R2R (report-to-record) DAC (digital to analog converter) technique for further increasing the DAC (Digital to Analog converter) resolution and thus the achieved output voice quality.

(7) It aims to development of a voice compression algorithm also comparable to ADPCM (Adaptive Differential Pulse Code Modulation), but less mathematically expensive to fit in low memory profile 8 bit microcontroller to achieve moderate voice quality.

(8) It also aims to development of a bit swapping protocol to efficiency communicate 8 bit to 16 bit resolution voice data over 8 bit ASCII (American standard code for information interchange) serial communication channel without compromising the sapling frequency and thus voice quality.

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