

Security with Evidence Using Zigbee

Mahesh Raj Urs
Software Engineer , Philips Pvt Ltd , Banglore, Email : maheshrajurs85@gmail.com

Badrinath K
Assistant Professor , Department of Information Science, SJCIT Chickballapur 562101
Email : badrik86@gmail.com

Sharath P V
Assistant Professor , Department of Information Science, SJCIT Chickballapur 562101
Email : sharathpvs@gmail.com

Abstract:

The ZigBee standard is designed to enable the deployment of low-cost, low-power and self-forming wireless sensor and control networks based on the IEEE 802.15.4 physical radio standard. Despite the low data rates of ZigBee, its use for transmission of image has been proven to be feasible. The current researches of ZigBee wireless sensor network on industrial automation, electronic products, smart buildings and medical care were presented and, as an explorative application of ZigBee wireless sensor network in providing security using motion sensor and image capturing device is appreciable. This paper presents the idea of providing security with evidence in the frame work of ZigBee-cam project which targeted the development of a low-cost, ultra-low-power, long-range, ergonomic wireless cam using ZigBee technology to transmit high quality image.
Keywords : ZigBee Cam, ZigBee Coordinator, ZigBee Massage, ZigBee IP gateway

1. Introduction

ZigBee is a wireless standard-based technology that addresses the needs of sensor network applications, enabling broad-based deployment of complex wireless networks with low-cost and low power solutions that run for years on inexpensive primary batteries. The maximum data rate of this technology is 250 kb/s[1], which is low compared to other technologies, but sufficient to transmit high quality image using available bandwidth.

Several approaches can be found in the literature that examine the possibility of 802.15.4/ZigBee networks supporting multimedia data transmission. The general conclusion drawn from previous work is that multimedia data like text, voice and control signals can be carried over ZigBee[2]. However there are several restrictions in terms of available bandwidth and network topology.

The Z-cam project goal is to develop a low-cost, ultra-low-power ergonomic wireless end device using ZigBee technology to capture image as an evidence of intrusion at forbidden area by the use of motion sensor, and transmit the captured image to the ZigBee coordinator for further processing and for taking decision. The selection of Zig-Bee protocol for image transmission results in lower power consumption and higher network range than Bluetooth technology, which is widely used in similar devices. Other technologies such as DECT and Wi-Fi consume much more power than Bluetooth and cannot be integrated into small devices. The decreased power consumption also has an impact on the lifetime of the rechargeable battery, and consequently on the lifetime of the end node, since batteries in wireless end nodes are not replaceable.

Due to the limited available bandwidth, image must be compressed before being transmitted, keeping the impact on image quality as low as possible. The selection and implementation of the most suitable image codec for high-quality image transmission over constrained networks, using constrained devices is challenging and also it depends on the application requirement.

This paper's aim is to present in detail the above procedure using Z-Cam's requirement as follows. section 2, we present a brief overview of Z-Cam architecture and data flow in the network. Then section 3 we discuss the architecture of ZigBee-IP gateway. Finally section 4 we discuss about voice codec selection, required image quality and power management

2. Z-cam architecture:

The software/firmware architecture of Z-cam used with a PC is illustrated in Figure. 1. It consists of a wireless end device and a USB dongle providing ZigBee connectivity to the PC. The end device consists of a motion sensor 's' to detect intrusion at the forbidden area for this many sensors are available in the market like PIR sensor, and a high definition camera 'cam' to take a set of picture when an alarm signal is triggered from the sensor. The captured image must be processed and compressed using suitable compression technology like jpeg gif etc., by the Digital Image Processing (DIP) module at the end node. For that a microcontroller is required which operates at low power supply. Many such microcontrollers available and supports such image codec's.

After processing the image must be transferred to the control station either through the ZigBee-IP gateway or through the dongle which is connected to the PC. If the ZigBee network is too far from control station the its better to use ZigBee-IP gateway explained in next section[3, 4]. The dongle consist of ZigBee Coordinator to communicate with ZigBee network and received data is transferred to pc for further processing and monitoring through USB interface.

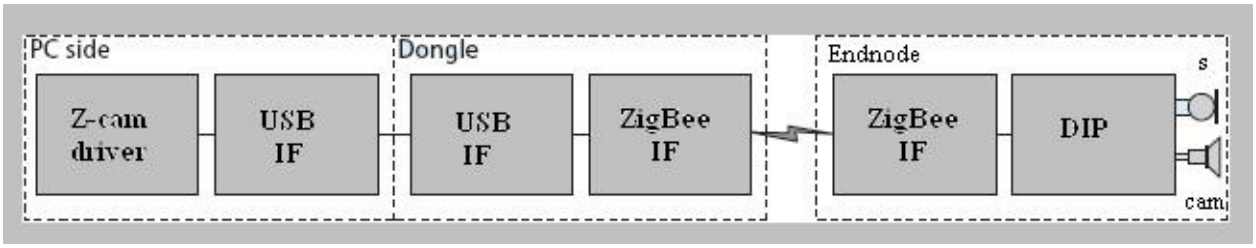

Figure 1: ZigBee-Cam architecture

3. ZigBe-IP Gateway architecture

The gateway establishes interoperability between ZigBee network and IP network so the message containing image from the end node while travelling towards remote control center it is received by gateway. Gateway consists of a ZigBee coordinator module to communicate with ZigBee network by exchanging zigbee message. GSM/GPRS module in the gateway module is to establishes GPRS connection to the server at the control station and sends the captured image. GPRS module works on AT commands. So finally the microcontroller is to give proper command and to control both ZigBee coordinator and GPRS module to establish interoperability between both IP and zigbee network[5].

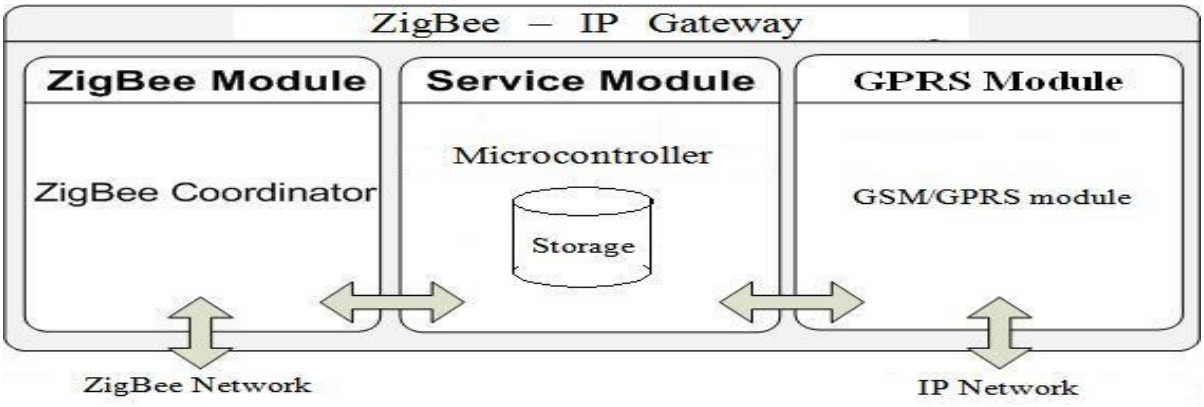

Figure 2: ZigBee – IP gateway

Before sending the image through the GPRS communication it is stored locally as backup to overcome transmission errors. So this Gateway module is cost effective to use when the ZigBee network and control station are too far otherwise can use dongle as shown in Figure 1.

4. Codec Selection, image quality and Processing power

Codec selection depends on the application requirement and also several limitations are there, it must not consume too much power for processing as the end node is battery powered and it only decides the lifespan of the end node. The compressed image must not take too much storage space. Also image quality and resolution must be acceptable. So some lossless compression technology is preferred like JPEG, BMP, TGA, GIF, TIFF etc these technologies can produce a picture of acceptable quality, resolution and which takes less memory for storage, as a result it takes less processing power and transmission time without any error [6].

5. Conclusion

This paper presented and discussed various aspects of the selection process for a image codec for high quality image transmission over ZigBee. It also discussed the difficulties of processing image on an ultra low power Digital Image Processing platform with performance and memory constraints. The conclusion drawn from this work can be useful for any application that requires high-quality image transmission over constrained networks and using constrained devices.

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