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APPLICATION FOR MEASUREMENT IN WIRELESS SENSOR NETWORKS

APLIKACE PRO MĚŘENÍ V BEZDRÁTOVÝCH SENZOROVÝCH SÍTÍCH

Abstract

This paper deals with wireless sensor networks, which are based on IEEE 802.15.4 standard. The development kit from Jennic company was used for wireless measuring of values and for creation of sensor network. For this purposes the sensor boards with wireless modules with marking JN5139 were used. These boards provide sensors (sensor of temperature, relative humidity and light sensor) but also another interface, which helps to develop applications. Modules are programmed in Integrated Development Environment (IDE), which integrates C function library and C++ compiler and linker.

The visualization application was created for monitoring of wireless sensor network. There is the possibility of local and wireless measurement. For creation of this application the SCADA/HMI system, Control Web 5 was used. This SCADA/HMI system enables to communicate with all wireless modules through base station (network's coordinator). The application also enables initialisation and network setting the any wireless module communicating with the base station. The advantage is the remote configuration and control of network. The application also enables the gathering, converting, viewing and archiving of incoming data from particular modules.

Abstrakt

Příspěvek se zabývá bezdrátovými senzorovými sítěmi, založenými na standardu IEEE 802.15.4. Pro bezdrátové měření veličin a tvorbu senzorové sítě byl použit vývojový kit od společnosti Jennic, který nabízí senzorové desky s bezdrátovými moduly s označením JN5139. Senzorové desky jsou osazeny nejen snímači, ale také dalším rozhraním, které dovoluje snadnější vývoj aplikací. Moduly jsou programovány v prostředí IDE - Integrated Development Environment, které integruje Jennic C knihovny obsahující C++ compiler a linker.

Pro monitorování navržené senzorové bezdrátové sítě byla vytvořena vizualizační aplikace v prostředí kategorie SCADA/HMI, v prostředí Control Web 5. SCADA systém umožňuje komunikovat skrz základnovou stanici s celou bezdrátovou sítí. Vytvořená aplikace umožňuje příchozí data z jednotlivých bezdrátových stanic shromažďovat, zpracovávat, prohlížet a archivovat. K dispozici je možnost lokálního i bezdrátového měření. Výhodou je vzdálená konfigurace a řízení sítě. Aplikace také umožňuje inicializovat a síťově nastavit libovolný bezdrátový modul komunikující se základnovou stanicí (koordinátorem sítě). Koordinátor komunikuje s vytvořenou aplikací pomocí sériové linky a ovladače ASCII v.5.14.0.0.

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1 INTRODUCTION

Wireless technologies become trends in communication area and their usage we can find in different applications. Flexibility and then free of cable distribution are their big advantages. Hence it is possible to use wireless standards in different applications, e.g. for measurement of value, monitoring of equipment state, remote operating and control, in alarm systems, etc. A bigger emphasis on total reliability of whole wireless system is given and also on work in real time which is not quite simple. Every wireless standard does not use for time-consuming applications.

2 HARDWARE FOR CREATION OF THE WIRELESS JENIE NET. APPLICATION

This paper is focused on wireless sensor networks, which are based on 802.15.4 standard. This standard forms the base for ZigBee technology. It is concerned kind of networks, which are possible in term of their signal range to class to PAN (Personal Area Network) networks and which are characterized by very low power consumption (using battery power supply is typical for their power supply), less range and low baud rate which is defined about 250 kbps.

These networks are typical for measurement, processing and data transfer on 2,4 GHz frequency. For these purposes JN5139 – EK010 evaluation kit from Jennic company was used.

Evaluation kit is composed from controller board, sensor boards and from individual wireless modules, which create the base of these boards. Boards dispose of the hardware resources helping easier development of applications. Is concerned LED diodes, LCD display, buttons, temperature and relative humidity Sensirion SHT11 sensor, light level TSL2550 sensor, expansion ports for other sensors connection, UART interface for communication and loading programs from computer to the module, etc.

It is possible very effectively test the primary programmable proposal up to final applications on these hardware.

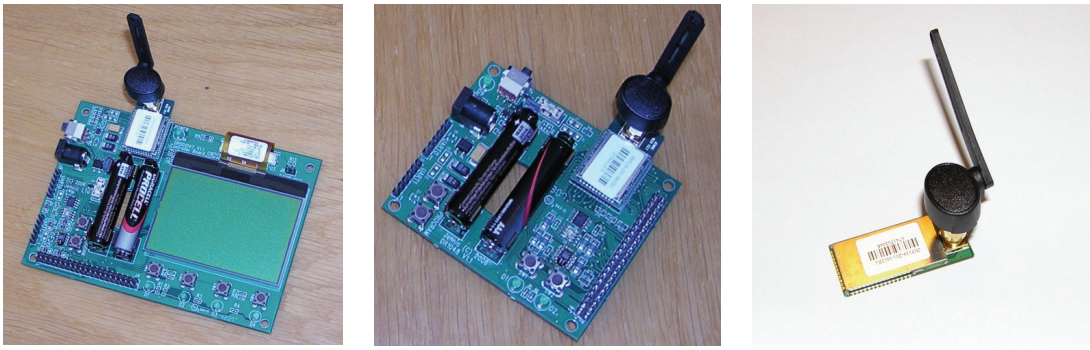

Fig. 1 Controller board, sensor board and wireless module

For individual wireless module is also requirement to create interface, which allow the access on its hardware and possibility of programming as well. The simply programmer and printed-circuit board were created for these needs, which enable to use of ADC, DAC converters, GPIO (General Purpose Input/Output) – pins for configuration of digital inputs and outputs specified for I2C bus line, comparators, application counters and timers, etc. Wireless module was soldered on created interface by SMD technology, where it was needed to ensure 3,3V power supply with the help of stabilizer and possibility of access on reset and programming buttons. The board of programmer including extension interface we can see in the figure 2.

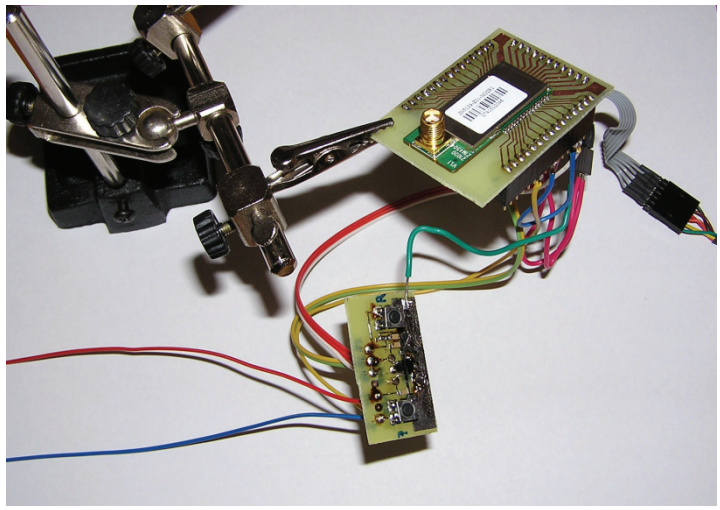

Fig. 2 Wireless module soldered on created interface and connected to the programming board

3 DEVELOPMENT OF APPLICATIONS FOR WIRELESS MODULES

It is possible to use two kind of environment for development of applications. Interface of command line (CLI – Command Line Interface) and integrated development environment (IDE – Integrated Development Environment). The first makes it possible to development of applications with the help of command line in Cygwin environment, which is the Linux emulator for Windows. The second environment makes it possible to development of applications in graphical user environment to integrating Jennic C libraries, see [Jennic User Guides, 2009-03-10].

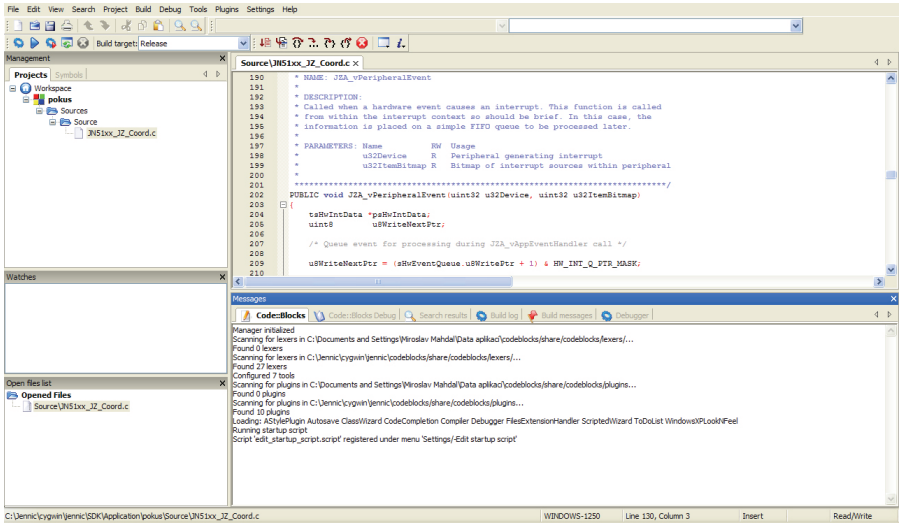

Fig. 3 Integrated Development Environment - IDE

4 JENIE NET. APPLICATION

It is concerned in created application which serves for monitoring, measurement and operating in wireless network. This application uses sensors on controller and sensor boards and so serves for temperature, relative humidity and light level measurement and also enables voltage measurement on supply batteries of wireless boards or individual wireless modules. In addition it enables to control the other hardware as LED diodes, LCD display, to check of button state, etc. For creation of this

application the SCADA/HMI system, Control Web 5 was used. The whole wireless network is composed of three end devices, router and network's coordinator. Coordinator communicates with computer alias with Jenie Net. application with the help of serial line and ASCII v.5.14.0.0 driver. The whole network topology we can see in the figure 4.

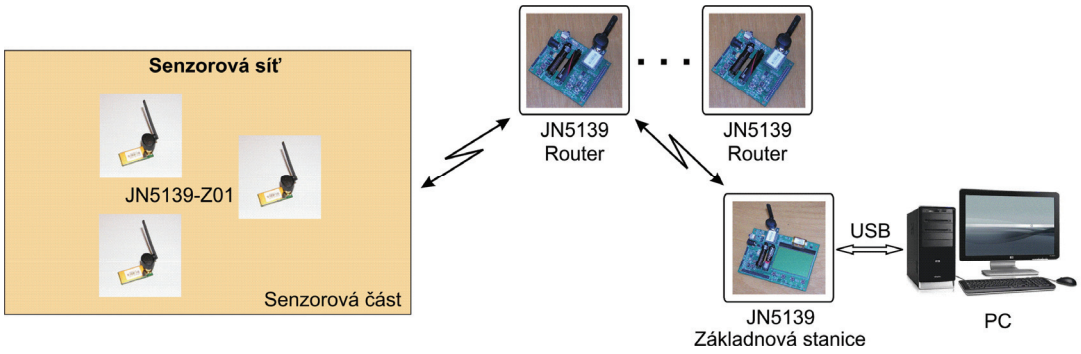

Fig. 4 Designed network's topology for sensor network

Jenie Net. allows the initialization of wireless modules as coordinator, router or end device whereas there is the setting of network's parameters of module. It means the setting of communication channel, PAN ID, network's application ID, setting of routing, count of connected station to the module, poll period of end device to their parent (coordinator or routers), etc. This set is saved in the module memory every time in order to at reset function or shutdown and repeatedly turning-on the module did not have to be initialized again.

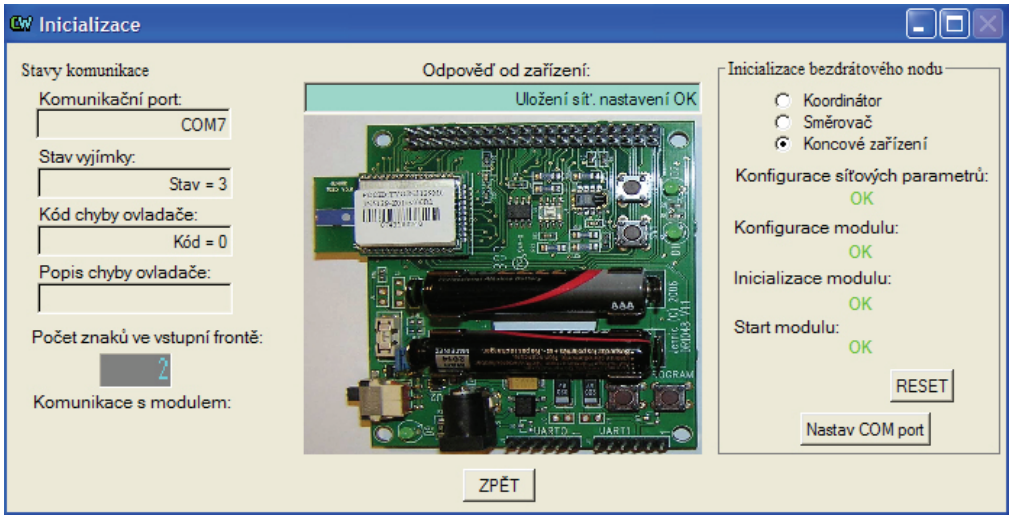

Fig. 5 The window of Jenie Net. application – initialization of wireless module

There is also the possibility of COM port selection, which can be changed in running of application. At initialization of coordinator is established the wireless network and end devices can identify automatically in range of central gathering station or through appropriate router. Module is identified through MAC address or can be applied so-called bit identification.

Jenie Net. allows the access to local or wireless measurement in sensor network after initialization of wireless modules. When the local measurement is selected, then the measurement proceeds on network's coordinator. The coordinator is connected directly to the computer through USB. When we select the wireless measurement, we have the possibility of connection to the selected module or to receive and to transmit data for all modules (broadcast messages). When the wireless module (initialized as end device) is not asked for data, it is automatically stated to the „sleep“ mode

after set period. The current drain is reduced about to 2μA. In this way it is possible markedly to extend the battery life of wireless modules.

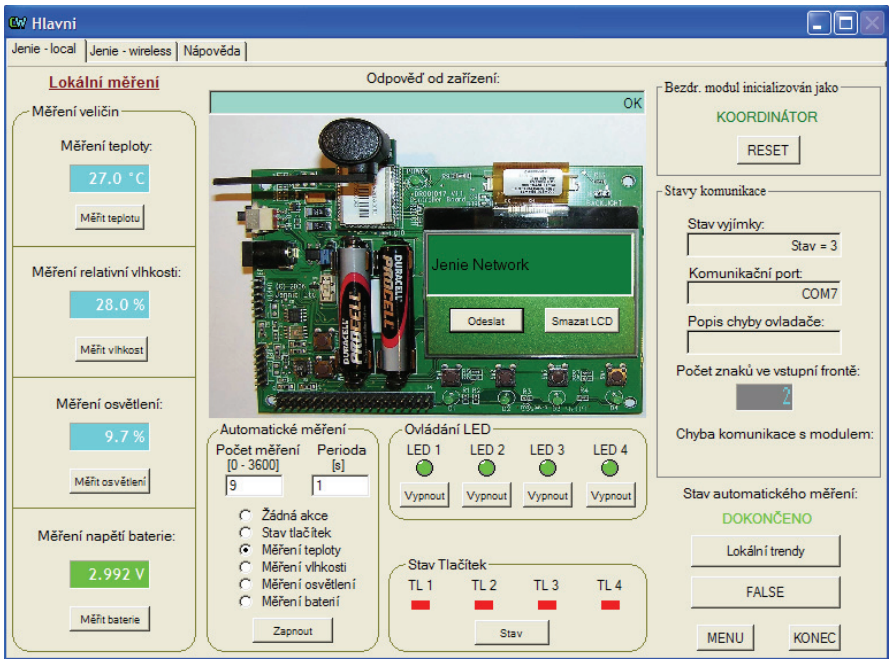

Fig. 6 The window for local measurement of value

For measurement of value we can select the measurement on query where the module will be sent values from one's measurement or we can use automatic measurement and enter the count and period of measurement. The modules send data to the gathering station (coordinator) through wireless network and this station sends data in required format to the Jenie Net. application. In application the data are decoded. In window „Zpracování dat“ it is possible to send the request to wireless module on average value calculation, dispersion, range or minimum and maximum value for certain measurement.

Application can also monitor the trends of measured value for local and wireless measurement including of possibilities to save data to the *. MDB and *. DBF database files. DBF files we can view directly from application with the help of dBase browser or the table in InCalc environment. The help with application describe is also not missing for creation application.

5 CONCLUSIONS

The paper deals with measurement and visualization in wireless sensor networks, where the hardware resources of 802.15.4 platform are described, which are used for this proposal. The big advantage of used modules, outgoing from standard definition is very low energy consumption and so the possibilities of battery power supply. It brings advantages in applications where the possibility of connection to the line power supply is not. It increases the mobility of these devices.

The board for the total using of individual JN5139 wireless modules was created, which enables the access to the hardware interface including the programmer. In the next part the created Jenie Net. application is described, which serves for initialization and operating of wireless module’s hardware resources and also for measurement of selected value in wireless network. The application also enables the gathering, converting, viewing and archiving of incoming data from particular modules.

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