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**WIRELESS RIVER WATER LEVEL MEASURING SYSTEM**

**BEZDRÁTOVÝ MĚŘÍCÍ SYSTÉM ÚROVNĚ HLADINY VODNÍCH TOKŮ**

**Abstrakt**

Príspevok popisuje realizaci systému bezdrátového monitorování a „hlídání“ úrovně hladiny vodních toků pro potřeby hasičského sboru. Systém umožňuje sledování, kontrolu a archivaci monitorovaných údajů.

**Abstract**

This article describes realization of the water level measurement and visualization application for flood-protection system. This system is used the fire brigade to check river water levels and flood prevention. The control and alarm system situated in the control room watches, checks, processes and archives current measured level values. The included alarm system in the application works as prevention to possible high flood. The system measures river water levels on three different geographical places. There is used the wireless communication to transfer data between measuring points on the river and the visualization and alarm system situated in control room in this application.

**Keywords**

Water level measuring system, wireless communications, control system, data acquisition and presentation, software for industrial visualization applications

**1 Application hardware**

**Microcomputer UCT520-S**

The UCT520-S is a general-purpose microprocessor control terminal very useful device for monitoring, control and data acquisition applications. The UCT520-S microcomputer has an 8-bit microprocessor. The internal memory is for data storage and the flash memory provides system and application programming storage. The memory management is sophisticated and assures memory switching, according to programming needs. The device utilizes serial and IrDA (Infrared Data Association) ports. The microcomputer communications interfaces are serial asynchronous channels complying with the RS-232 and RS-422/485 standards. The maximum transmission data speed is 115.2 kbps. The microcomputer has an internal accumulator power supply. The external power supply for the device requires stabilized energy source. The microcomputer has numerous programming possibilities. It supports the programming environment of BASIC UCT520 interpretive language or the MON520 debugging environment. The debugging environment is used for various types of applications, which are created using machine-like programming languages. The platform for programming tools is any personal computer, which is connected to UCT520-S device through RS-232 serial asynchronous transmission link.

**Radiomodem MC12F**

The MC12F is multi-purpose device intended for radio data transmission and paging signaling transmission in radio networks. The device allows combination of different data sources in one radio network. The device utilizes the standard RS-232 serial channel. The modem implements several protocols for communications. It is possible to use one technology to transmit data in different protocols,

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e.g. fire sensors, alarms and lot of other information all in one network. The radiomodem is possible to use for various type of data transfer applications. The MC12F RDI (Radio Data Interface) connects to data radio station and data source/receiver. The DMB (DCom Master Bus) protocol was created for the optimal communication between RDI and the main station. The radiomodem software makes possibilities to variable number of retractions in the network, remote configuration of the device parameters from dispatching, wide possibilities of configuration and functions at the same time in more protocols, e.g. data transmission, configuration or paging. The data transfer process is secured by DMB protocol and additional data coding by GMSK (Gaussian Minimum Shift Keying) modulation scrambler. The software supports the programmable function of drivers for local control and data acquisition too. The system is easily expandable by modules for distributed control by serial line RS-232/RS-485 protocols. The device uses the POCSAG (Post Office Code Standardization Advisory Group) protocol for sending data messages to pagers. The POCSAG code is a synchronous paging format that allows pages to be transmitted in a single-batch structure. The POCSAG code provides improved battery saving capability and an increased code capacity.

## **2 Application software**

### **Development tool Control Web**

The Control Web development software is an all-purpose tool for developing and running of visualization and control applications, applications for data acquisition, storage and evaluation and human-machine interfaces. It is a tool for creation of large-scale enterprise distributed application capable to communicate over tenths of thousands of input/output points, containing hundreds of operator panels, working on number of distributed computers within a network. The development tool works in the operating systems environment using the Win32 application program interface and supports a number of industrial standards. The object-oriented component architecture ensures for the developed applications the widest range of employment, beginning from simple applications not consuming too much time up to real-time control applications. It makes possible to use any existing standards for programs, user's interfaces, data exchange and databases access, computer network communication and collaboration with data acquisition and control hardware are respected. The Control Web can also act as software-bridge among SQL database, Internet network browsers and GSM (Global System for Mobile communications) mobile phone network. The software is used in various types of industrial applications, e.g. visualization systems or machine control systems.

### **Programming environment BASIC UCT520**

The BASIC UCT520 is the programming environment to technical applications development for the microcomputer UCT520 series. The interpreter BASIC UCT520 enables the translation of the user's application programs and functions. The speed of the user's program execution is dependent upon the administration of the microprocessor in the microcomputer UCT520. The programming language BASIC UCT520 enables the user to enter his own binary programs too. A binary program is any program written in the assembler programming machine language for the microprocessor 8032 series or compatible types.

## **3 Application description**

The realized measuring and visualization system makes as river flood-protection system. It is used the fire brigade to high flood prevention. The system is responsible for correct river water levels measurement and presents on the operator station situated in the control room. The integrated alarm protection in this system is highlighting the river water level increasing possibility. The metering system conception uses separate measuring stations located on selected different flood dangerous places. These are places with the increased river water flood probability and with possibility of accurate water level measurement, e.g. load-bearing bridge structure and so on.

The metering system consists of three separated measured stations and main operator station for dispatchers. There is wireless data transfer between stations. The main operation station integrates

personal computer with control and visualization application running on MS Windows NT4.0 platform and cooperated communication modem unit MC12F type. Relevant modem device communicates with control application via serial RS-232 channel. The each of the measured station is based on UTC 520S microcomputer and wireless transmitter station. Data transfer process between microcomputer and corresponding transmitter station is realized by help of serial RS-232 transmit protocol. There is supersound probe for measuring current water levels at each of the measuring system. Analog measured signal from probe is subsequently processed by the microcomputer's control system. The microcomputer's interface for measured signal from particular probe is A/D (Analog/Digital) converter module M520AD1 type. The basic conception of the measuring and operator station shows Figure1.

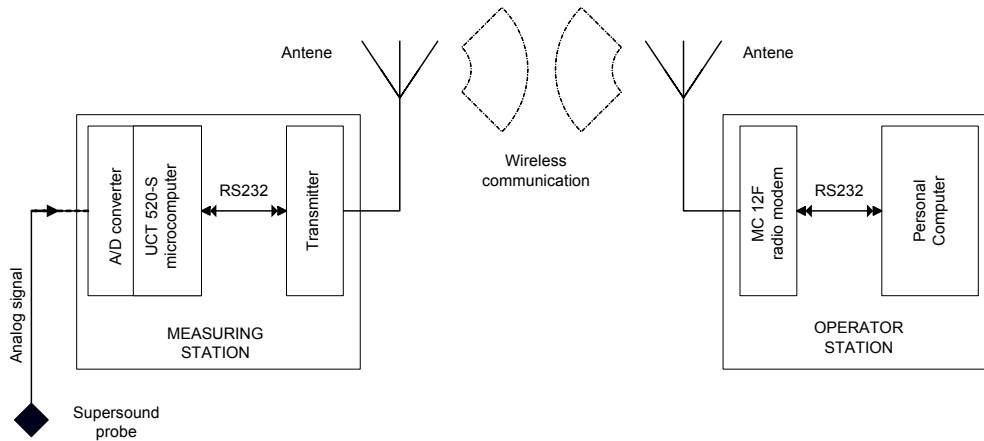


Figure1: Measuring and operator stations basic conception.

The current river water level values from supersound probe are measured in periodical time intervals, processed and saved into the microcomputer memory. There are archives of measured values in the microcomputer memory. Oldest measured values are permanently erased from memory and replaced by new data records. It makes the operator station possibility to send the requirement and obtain measured data in past time periods.

The user's control and measuring application for microcomputer was developed in the debugging environment MON520 using the personal computer. This environment enables the downloading and the debugging of user's applications and programs for the microcomputer from the personal computer and subsequently the operation of application programs. The personal computer initiates a translation of source programs into the reserved independent memory. There is space of 64 KB in the SRAM memory with battery backup available for the application programs in the microcomputer. Portion of the memory space is used by the MON520 environment. Data transmission uses the device Motorola GM350 type. It is suitable device for cooperation with all parameters and functions serial line programmable, giving enhanced communication effectiveness. There is serial line RS-232 transmit protocol in the communication between devices at the measuring station. The operator station uses for wireless communication radiom modem MC12F type. Radio modem cooperates the personal computer via serial line RS-232 too. The MC12F RDI (Radio Data Interface) is universal device intended for radio data transmission and paging signaling transmission in radio networks and converts radio signals (HF/VHF/UHF) into digital communications devices especially well suited for packet radio communications. The device allows combination of different data sources in one radio network. It is possible to use one technology to transmit telemetry, paging and data in different protocols, sensors and lot of other information all in one network. The radio modem extracts digital data from the analog received radio signal. The digital data is then processed and passed on to the personal computer. The personal computer communicates via serial RS-232 port using the special MC12F transmit protocol. User's control and visualization application process and analyses the received data. The

application makes possible to display data digestedly in the table or graphs. The alarm system watches limit values of the water level and operates the hooter. There are configurable limit values in the alarm system. The device makes it possible to easy connect to all types of handie-talkie apparatus and communications systems. The device also encodes and packetizes transferred data. Encoded packets are then sent to the radio for transmission with the modem enabling the radio transmit mode. The DMB (DCom Master Bus) protocol makes communication between RDI and main station optimal. The transfer rate in the radio canal between radio stations is 1200 Bd using FSK (Frequency Shift Key) modulation type according to BELL 202 norm specification. The MC12F device is able to easy modify parameters as well as to implement several protocols. Thanks to that it is possible to use the modem for different type of applications.

#### 4 Conclusion

This article illustrates how to realize the measuring, visualization but especially supervisory system for the river water levels. This practical application shows advantages using of the modern communication technology in the industrial measuring and visualization application. The all system conception was selected with reference to concrete requirements of the customer. The selection of the hardware, software, communication protocols and radio net were implemented in the appropriate manner conformable with application requirements. This way designed measurement and visualization system is optimal for this type of measuring and visualization industrial applications. The radio modem MC12F series and the microcomputer UCT520-S type are compact instruments that can be used in a variety of automation industrial applications. The selected wireless transmit technology is modern, dependable and low-cost way to transmit a smaller data volumes for long transmission distances. The wireless communication technology makes possible to data acquisition from remote and inaccessible places.

**Opponent:** Ing. Petr Orság, Ph.D.

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#### References

- [1.] Dcom: *Radiomodem MC12F*. User's manual, Edition 2001.
- [2.] MITE: *Microcomputer and Terminal UCT520-S*. Technical manual, Edition 2000.
- [3.] MITE: *Data acquisition unit JSD520*. Technical manual, Edition 2001.
- [4.] MITE: *A/D converters module M520AD*. Technical manual, Edition 2001.
- [5.] MITE: *Programming environment BASIC UCT520*. Programming manual, 2002.
- [6.] URL: <<http://www.mite.cz/>>
- [7.] URL: <<http://www.dcom.cz/>>