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USING TECHNOLOGY OF .NET WEB SERVICES IN THE AREA OF AUTOMATION

VYUŽITÍ TECHNOLOGIE .NET WEBOVÝCH SLUŽEB V PROSTŘEDÍ AUTOMATIZACE

**Abstract**

This work deals with a technology for data exchange XML Web Services and its application to specific tasks. One of the applications created allows you to monitor and control the real thermal process through a number of client devices, independent of the operating system, the type or their location. The thermal process can be controlled, for example, by another process, a website or a mobile phone. The system is designed from its base and contains three main parts. The hardware part consists from a measuring card, actuators and temperature sensors. The core application is a server that is running the XML Web Service, Windows Service and SQL Server. Client software for mobile phones and web sites was also created.

**Abstrakt**

Tato práce se zabývá technologií pro výměnu dat XML Web Services a jejím uplatnění na konkrétních úlohách. Jedna z vytvořených aplikací umožňuje monitorovat a ovládat reálný tepelný proces pomocí mnoha klientských zařízení nezávislých na použitém operačním systému, druhu nebo např. poloze. Tepelný proces tak může být ovládán např. jiným procesem, webovou stránkou nebo mobilním telefonem. Systém je vytvořen od základu a obsahuje tři hlavní části. Hardwarová část je realizovaná pomocí měřicí karty, akčních členů a teplotních senzorů. Jádrem aplikace je server, na kterém běží XML Web Service, Windows Service a SQL Server. Byl vytvořen také klientský software pro mobilní telefony a webové stránky.

## 1 INTRODUCTION

A Web service is a tool for communication and exchange of information in the Internet environment. This tool is open to a wide range of different applications communicating with each other. Web service clients may not know the detailed description of the service, but they can find it out at any time. A binary form of data transmission may not be identical for all various operating systems. On the other hand, the Web services using XML allows uniform data transition, regardless of the client operating system. [Kačmář, 2001]. If we want to communicate with a Web service, it is just a matter of a simple sending the appropriate XML message via HTTP protocol. Since each device that is designed to support Internet HTTP protocol, and because many of the programming languages allow you to access XML parser, the restrictions on the types of applications that can use Web services is reduced. In fact, most programming environments contain a set of tools of high levels that make communication with the Web service as easy as calling a local function [MacDonald and others 2006].

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## 2 PRINCIPLE OF A WEB SERVICES AND ITS STANDARDS

With the help of Web services it can be relatively easy to apply business logic of someone else. This methodology is similar to the methodologies used by programmers in the case of API libraries, classes and components. The main difference is that Web services can be located on a remote server and administrated by another company [MacDonald and others 2006]. The key to the success of Web services is that they are based on open standards, and that these standards are accepted by large companies as Microsoft, IBM, Sun and others. When building web services several specifications are used:

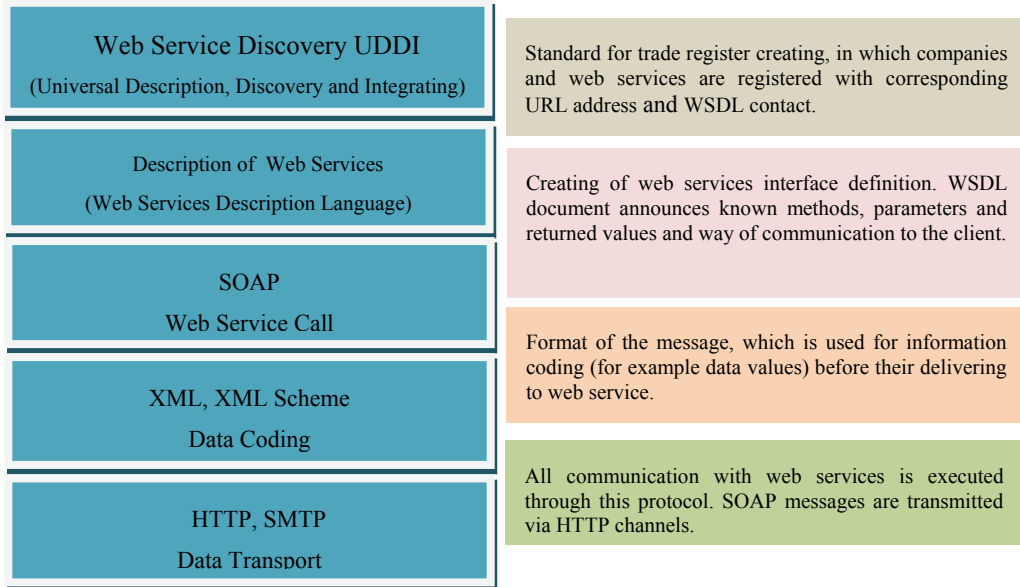
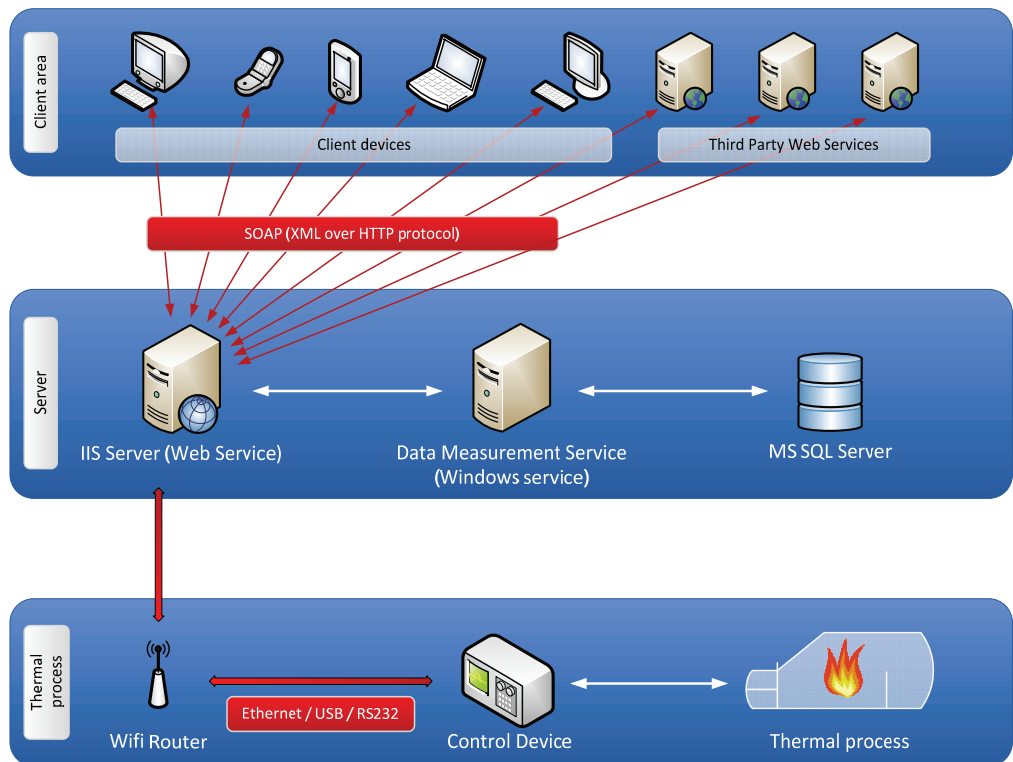


Fig. 1 Web services standards

## 3 APPLICATION OF WEB SERVICES IN AUTOMATION

The power of Web services is primarily in their universality and independence from the terminal device. Speed of a Web service response is directly proportional to the speed of a response between a terminal client and a transfer rate of a XML document, thus the volume of transmitted data. Since the XML format is designed in a similar way as a text format, more data is transmitted than for the binary format file transfer. Disadvantage may then be when compared to the other solutions the transferring larger volume of data. Thanks to the advances in data transfer rates is this disadvantage becoming less significant. This technology finds an application in technological processes and measurements, which do not require the system response in milliseconds, but the response is sufficient in seconds or even tens of seconds. The XML format also allows storing binary files and therefore the picture. A typical example of using it may be a system for data acquisition from the production line, monitoring lines using a webcam, the measurement of temperature in operation, the control of incineration of biomass, etc. An example of a simple scheme of a Web services application can be as following:



**Fig. 2** Application of thermal process monitoring

## 4 SYSTEM APPLICATION FOR TEMPERATURE MONITORING

As a result of a temperature system monitoring task is the application that measures data, evaluates them and saves them in a database and using Web services provides the data to the client applications. Using Web services this application will ensure seamless communication among all possible types of clients. A part of the task is also a design of individual thermometers for measured values acquisition and a client for mobile devices.

### 4.1 A measured process

The task of this layer is to capture analog values of variables. In this case it is a task of temperature monitoring using four analog thermometers LM35D. With the thermometer a linear characteristic of measured temperature is obtained depending on the output voltage. This system is powered by a data acquisition card. A data acquisition card LABJACK UE9 also records the output voltage. The card can communicate with the server in several ways through a USB port or using Ethernet. A cheaper option for this system is to use Ethernet, mainly due to the possibility of having significantly greater distance between the measuring card and the server.

### 4.2 The server

The processing, storing and providing data to clients is on the server using Web services. For these purposes a process solution was developed called WebM (see Chapter 5), including an application for communicating with SQL Server, a Window system service application for easy management of Windows services, the installation package and a Web service. The advantage of having only one system solution is easy scalability of the system. This is because different applications share common parts among themselves and each of them exist in this system solution only once. If the system needs to be modified, for example, for another data acquisition card, it is possible to change only one class within the entire system solution and the other parts will not be

affected by this change. An application on the server side (WebM) is created using Microsoft. Net Framework in C # language.

### 4.3 Client

In this layer the system has been running for just displaying the measured data, or further processing by other Web services. Clients can communicate with the server using a Web service by HTTP or SMTP protocol. A part of the system is an example client for mobile and portable devices (see a client application for mobile devices).

## 5 APPLICATION IMPLEMENTATION

The solution on a server side was designed as the part of a system for temperature measurement and has several important tasks:

- Communication with a data acquisition card LabJack UE9,
- Processing measured values,
- Conversion of measured voltage into degrees of Celsius,
- Storing values into SQL database,
- Providing data to clients, etc.

As a database server the Microsoft SQL Server 2008 was selected, on which a database is located. The database server is configured for remote connections. The server must handle client requests coming from the Internet. Requirement processing is controlled by Microsoft IIS (Internet Information Server). It was necessary to configure it and maintain its security.

The application was created as a solution built on the Microsoft. Net Framework version 3.5. As a common programming language for all applications the C # language was selected and the solution was developed using Microsoft Visual Studio 2008. The application is located in the namespace called WebM and individual applications share among themselves their components and classes. The different parts of the application are shown in the following diagram:

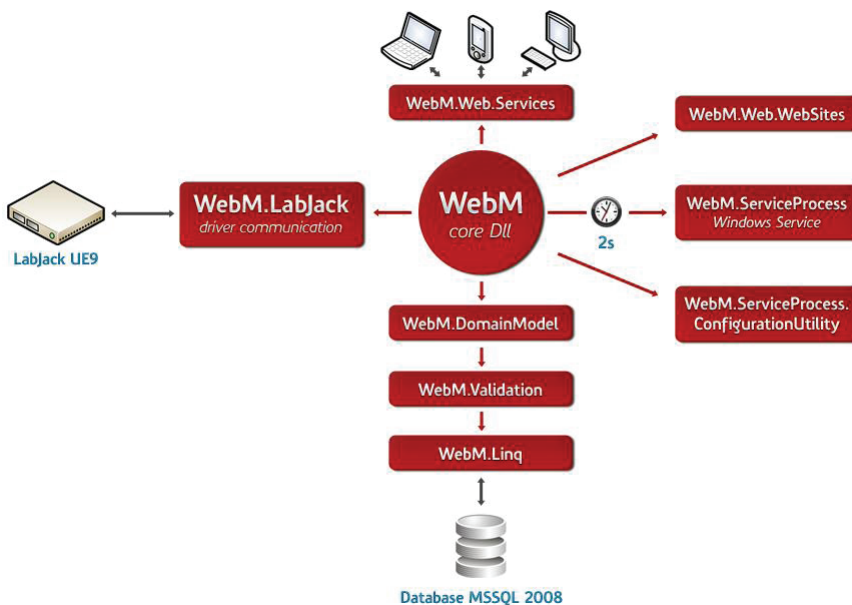
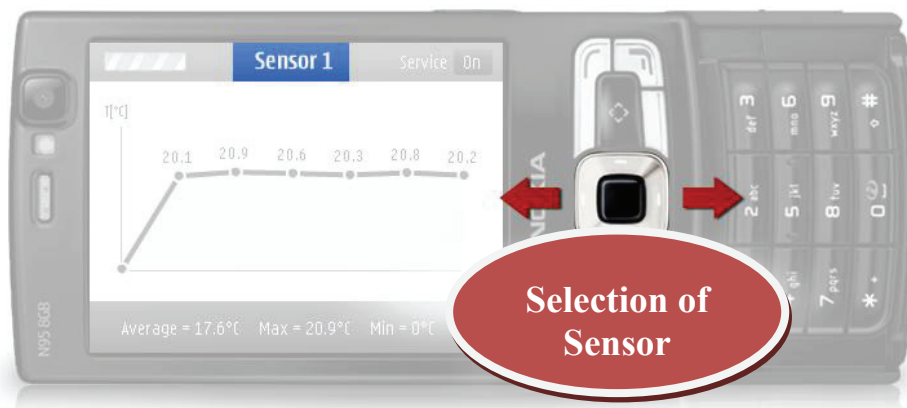


Fig. 3 Architecture of Monitoring Application

A client application for mobile devices, such as an example of a client consuming a Web service, was prepared for an application for mobile devices. The application is built on technology, Adobe Flash Lite 2.0. This was chosen primarily for its versatility. The new component is completely rewritten from the previous version and uses the new improved algorithms for drawing; it has a smaller size and is processing with a multiple-higher speed. The application allows running in two modes XML Web Service and the so-called quick mode.

Control functions are enabled using a mobile phone keypad. The left and right arrows the program toggles the selected sensor, keys 1 to 4 select the sensor directly. The user interface software for mobile devices is shown in the following Figure.



**Fig. 4** Mobile Client consuming web services

## 6 CONCLUSION

This contribution described a method of resolving temperature monitoring application using the latest IT technologies. The application is divided into three main parts. The first one named as the hardware layer had the task of selecting and constructing an appropriate set of thermometers. The resulting connection of LM35DZ thermometers is suitable for measurements at greater distances and for stabilizing time of thermometer about 8s.

Another layer of this system is a solution on the server side. For this purpose a complete solution called WebM is implemented in C # shared by all the other parts of the system. This solution is advanced using the latest developer component WebM of Microsoft technology. A result of this WebM component application is an effective work in a code and easy extension of a system. The last part of the application is a creation of a client for mobile devices. The result is a functional application for mobile phones, which plots a current course of the measured data and allows you to switch between the 4 heat sensors.

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**Fig. 5** Remote temperature monitoring