ROAD WEB MARKUP LANGUAGE AND ITS APPLICATION EXAMPLES

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Abstract

The Civil Engineering Research Institute of Hokkaido (CERI) and its joint research group have been developing an XML-based Road Web Markup Language (RWML) since late 1997. Recently, we made RWML Version 1.0, which is compatible with the XML Schema. The specification was made open to the public for its diffusion.

RWML employs XML, a next-generation language for the Internet, to describe road-related information including condition of road surface, weather, and regional tourist information, according to time and location along the road.

This paper explains the specification of RWML Version 1.0 and the effects brought by use of RMWL, and reports its application through examples of RMWL use.

Introduction

Road-related information on Internet is described by Hyper Text Markup Language (HTML), a language used for describing Internet websites. Authors have been developing RWML, aiming to provide value-added information by combining information from multiple sources. This paper explains the specification of RWML Version 1.0 and the use of RMWL, and reports its application through examples of RMWL use.

Development of RWML Version 1.0

RWML, by complying with XML, was developed to make road-related information freely distributable and usable on the Internet. The process of development is as explained below.

Specification development through joint research by public and private organizations

Development of RWML was initially started at the end of 1997 by the Civil Engineering Research Institute of the Hokkaido Development Bureau (formerly CERI). RWML was examined in Research on Development of Internet-based Road Information

System, which was conducted from fiscal 1996 through 1998. Participants in this research project were widely recruited from the private sector by open invitation[1].

In preliminary experiments, the usability of roadside weather sensors and road monitoring camera images was examined. In June 1998, a working group was established to develop a working specification of RWML. In July 1999, RWML Version 0.7 was made and released on the Internet[2]. After text editing and other corrections, Version 0.71 was published in October 1999[2].

Revisions of the specification based on field experiments

From fiscal 2000 through 2002, CERI conducted the Research on Application of Advanced Information/Communication Technologies for Mobile Terminal Devices, for which public advertisement was made to recruit participants. As part of this research project, four field experiments were performed. The E-Route Experiment[3], conducted in 2001 and 2002, aimed to identify the potential of information provision to drivers during the summer travel season in Hokkaido. The "Smart Sapporo Snow Information Experiment[4], conducted in 2002 and 2003, aimed to smoothen urban winter traffic in Hokkaido.

For these experiments, monitors were recruited from the public. Information was supplied to their cellular phones and personal computers via Internet, in order to evaluate the effects of information provision on transportation behavior. These were large-scale experiments with many monitors: 2,000 for the E-Route Experiment in 2002, and 615 for the Smart Sapporo Snow Information Experiment in 2003.

In October 2001, we released RWML Version 0.8, whose specification incorporates additions and changes made to the information items based on the results of the E-Route Experiment of the same year[2]. Version 0.81 integrated changes made after the Smart Sapporo Snow Information Experiment in 2002. Version 0.82 combined changes made after the E-Route Experiment in 2002.

Formulation of RWML Version 1.0

After a series of corrections and changes, information items of RWML were fixed. We specified the following items for road, weather, disaster, and regional information:

Road information	•Road weather, •Road surface condition, •Monitored image, •Congestion, •Road control/closure, •Traffic flow, •Travel time, •Site-specific information, •Road administrator
Weather information	•Current weather, •Forecast, •Warnings and cautions
Disaster-prevention information	•Hypocenter, •Seismic intensity, •Tsunami, Road damage, •Danger-prone sites, •Tsunami-prone sites, •Refuge sites, •Contacts during disaster, •Detours, •Emergency transportation routes, •Disaster-prevention centers, •Recovery
Regional information	•"Country Message," or messages from locals, •Events, •Tourism, •Scenic information

Table 1. Information items defined in RWML

During experimental system construction, difficulties were pointed out in the development of applications to process RWML. This problem was recognized to be an obstacle for widespread use of RWML. To simplify the structure of the RWML specification, we decided to overhaul the structure of RWML. Based on Version 0.82, development of Version 1.0 was launched.

We introduced the basic tags and compatibility with the XML Schema in Version 1.0. They contributed to easier application development and to enhanced extensibility of the specification. The following section discusses the introduction of basic tags and compatibility with the XML Schema.

The feature of RWML Version 1.0

Introduction of basic tags

In RWML Version 1.0, the framework for description of all road-related information items is defined as "basic tags" as shown in Figure 1. Such description allows latitude, longitude, address or name of route to be used as keywords for a search. Also, by analyzing “point” factors, it becomes possible to understand the information on point locations because the description of “point” factors is common. In addition, the basic tags include routes, areas, dates and time, which could be used for searching. This makes it easy to install applications and unnecessary to correct software for searching point locations even if information is added in future.

Employment of such a method has made it easier to define newly added information items. The structure of the specification itself is simple and extensible.

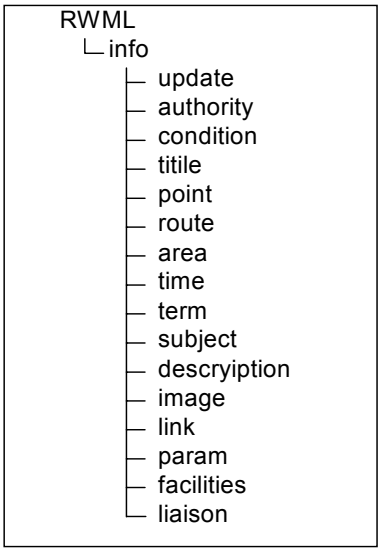

Figure 1. Basic structure of RWML Version 1.0

Compatibility with the XML Schema

Version 1.0 of RWML is compatible with the XML Schema. It can select data of numerical values and dates, in addition to text, which streamlines data digitization and application development. Version 1.0 employed methods that simplify the application development process. For example, it defines the data type for values of attributes for each element. This is clearly defined in the specification if data are those that are automatically interpreted by an application or that will be displayed for users.

The XML Schema can define a higher-level data structure than DTD. It can better describe the structure of the basic tags of Version 1.0, according to the specification.

Also, the XML Schema supports namespaces, so it can handle different document files in an integrated manner. This feature allows extension of the application by combination of XML with Simple Object Access Protocol (SOAP), for use as an XML Web Service. This would be very useful.

Furthermore, the XML Schema describes its own structure by XML itself. Software package applications compatible with the XML Schema can be used with RWML Version 1.0 (Figure 2).

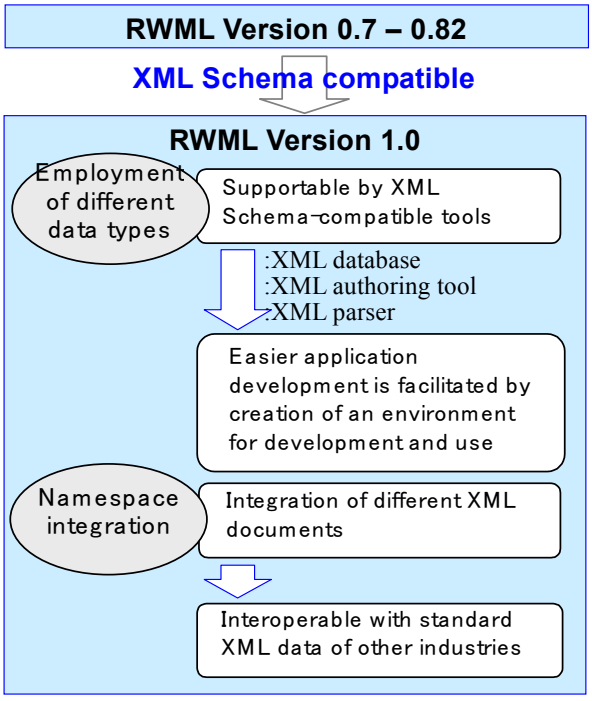

Figure 2. Advantages of compatibility with the XML Schema

Effects of RMWL

Employment of RMWL dramatically enhances the distributability and usability of road-related information across the Internet. In this section, an RMWL-based system is compared with a traditional system, and the effects of RWML on distributability and usability of information are described.

Comparison with a traditional system

Conventional information-provision systems are designed to perform centralized management of various types of data to meet the diverse needs of users. Such a system requires a great deal of work for coordination among organizations, and the cost and time for system construction and operation are substantial.

In addition, to provide information via various media, the system needs to be compatible with each medium. Not only is such a system redundant and inefficient, but also it is too large. It cannot meet changing user needs and provide information satisfactorily.

Employment of RMWL allows construction of a distributed system with a high degree of freedom and extensibility. Table 2 compares a distributed system based on RMWL with a traditional central-server-dependent system.

	Traditional central-server- dependent system	Proposed RWML-based decentralized system
Coupling	Tight	Loose
Connectability	A method needs to be determined for connection between the central server and information providers.	Information is obtained and disseminated from WWW and RWML.
Usability	Upon authorization by the central server, information can be acquired according to the specified method.	Information can be acquired from WWW servers of each information provider.
Extensibility	For every extension, the system of the central server needs to be modified.	All information providers can provide information in whatever ways available.
Responsibility	The responsibility is centered on the central server.	The responsibility is on each information provider.
Diversity	Fairness and neutrality of the central server is demanded. Degree of information provision is limited.	Each information provider can provide information on its own responsibility. Users can choose information as they need it.

Table 2. Central-server-dependent system and RWML-based decentralized system

Enhancement of distributability and usability of information

For their travel, road users need various types of information, including that on tourism, shortest route, weather, and disaster prevention. Most of such information is all over the Internet. However, the volume of information on the Internet is tremendous. Users need to spend a great deal of time to find what they need.

If RWML is employed, information on the Internet can be used as a single database. Efficient use of a large volume of information becomes possible. Another problem is that the information on the Internet is not always linked in a way users want. Therefore, information is underused.

To improve usability of information, it is important to provide information that meets the needs of users.

If RWML is employed, road-related information across the Internet can be selected and compiled according to user needs using the software application before the information is offered to users. Information can be selected, discarded, and combined according to user location, information needs, and preferences.

Applications of RWML

Employment models of RWML

Employment of RWML offers several benefits. 1) A large volume of data on the Internet becomes usable. 2) Distribution of data is made possible on the Web, the core system of the Internet. 3) Due to the scalability achieved, the service coverage ranges from local to global.

A more significant benefit of RWML is that a website that satisfies user needs can be constructed extremely easily. To construct an RWML-based website, existing website information must be converted into RWML data in compliance with the specification of RWML Version 1.0. Then an application that fulfills user needs (display of information according to user location and time) can be developed.

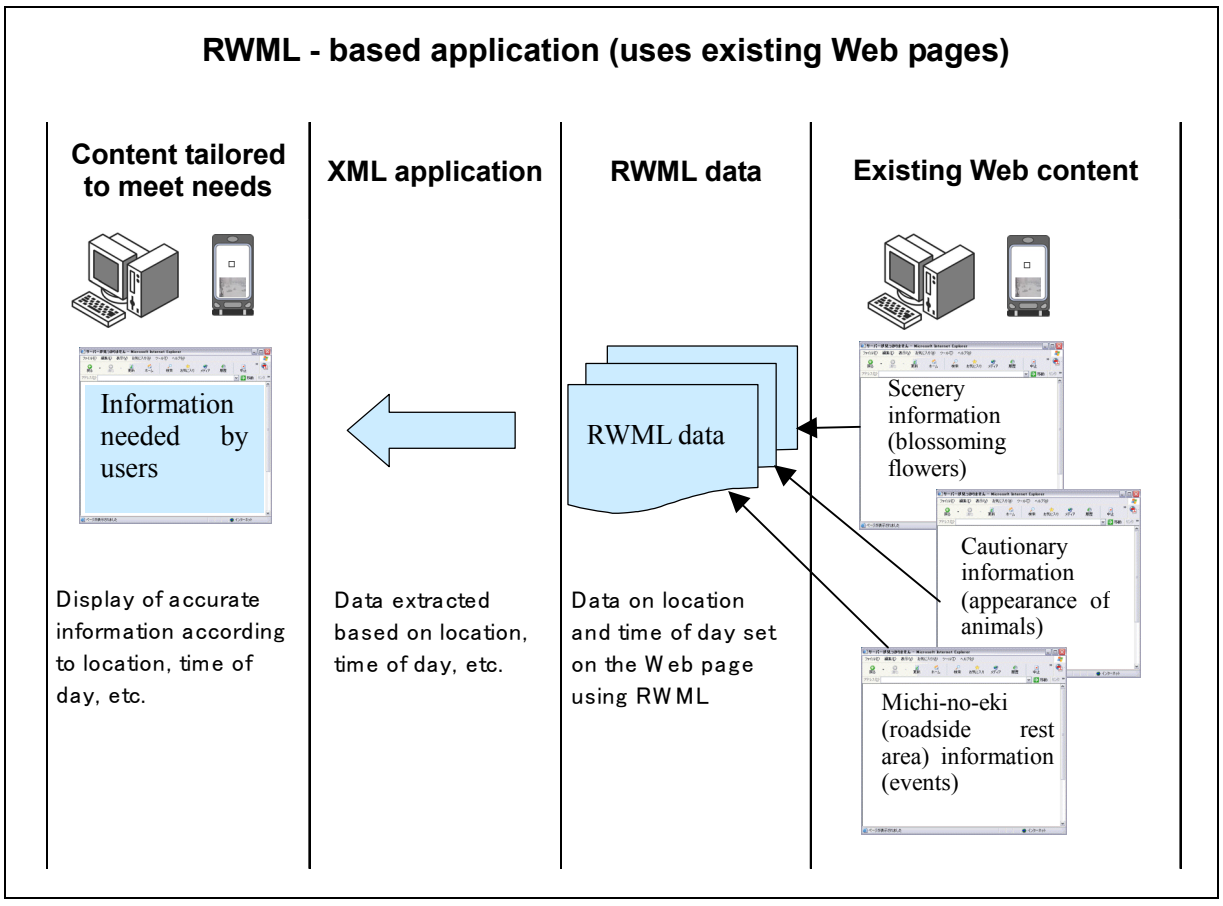

Figure 3. Procedure to develop an RWML-based application

Publication of applications

We posted applications of RWML on the RWML website (http://rwml.its-win.gr.jp), so that visitors could envisage employment of RWML. Recently posted examples of use are the provision of information on the closest Michi-no-eki (roadside rest area) and on beautiful roadside scenery.

These two applications automatically acquire location information from mobile devices equipped with a GPS function. Users who have such devices can easily obtain information they need.

If these applications are advanced, it will be possible to easily construct websites that offer…

- Information on ongoing or upcoming events and sightseeing in the vicinity
- Cautionary information on accidents and disaster along the road
- Information on road surface conditions at certain times of the day at certain locations.

Websites offering such information will greatly enhance the distributability and usability of road-related information.

Also, since RWML data are applicable for many purposes and are easy to use, they can be used in value-added information provision services. Good ideas for making use of RWML data may have the potential to foster the development of new industries.

Conclusions

The Civil Engineering Research Institute and its joint research group have been developing RWML since late 1997[1)]. In November 2003, we developed Version 1.0 of RWML in compliance with the XML Schema and published its specification.

Version 1.0 of RWML uses basic tags to make the specification simple and easy-to-read, and complies with the XML Schema to enhance usability. These new features will facilitate the development of software applications and enhance extensibility of the specification.We will improve the RWML website to promote development of the environment for introduction of RWML (for use of RWML, see the licensing conditions on the RWML website[2)]).

Finally, we would like to extend our thanks to organizations that made efforts in development of RWML of Version 1.0. We hope RWML will be used more to advance distribution and use of road-related information.

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