FIS-BASED ENVIRONMENTAL MONITORING SYSTEMS AND THEIR CONTENTS

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Field information server "Fis" acquires various environmental data such as air temperature, wind speed and wind direction, precipitation, river water level and water quality, and then provides the data in various protocols. Users can browse the environmental data from anywhere via Internet networks, and also can remotely set and control Fis along with performing failure diagnosis.

Moreover, with "Fis.View" the information integrating dedicated software for Fis, the combination of Fis and Fis.View can increase the applicability of the Fis system for environmental measurement of various field data covering hydrological and meteorological observation.

This paper describes three typical applications including a rainfall measurement and remote transmission system for dam sites, an integrated environmental measurement system for horse tracks and a road condition forecasting system for cold regions with heavy snowfalls and freezing temperatures.

INTRODUCTION

In general, preexisting environmental measurement systems rely on on-site confirmation and setting of measurements, and to remotely monitor them requires the use of public networks which connect an observatory and observation spots on a one-to-one or one-to-N basis, and exchange data. This arrangement is capable of providing data to only a restricted number of people in restricted locations at restricted times, limiting access to information to the benefit of few people in few areas.

The IT revolution, meanwhile, has achieved remarkable progress in recent years, and has enabled anyone to transmit information anytime, anywhere over the Internet, together with on-line remote monitoring. Furthermore, as the 21st century has been called the century of the environment, global environmental issues, which are closely related to our daily lives as well as business and social development, are coming more and more into the spotlight. Under these circumstances, environmental information regarding the atmosphere and rivers has become an essential element of our lives, and thus it must be made available in real-time and on a global scale.

A "Fis" (Field Information Server) is an environmental measurement system developed to meet these demands. It can collect measurements and images from various environment sensors, while providing these data in real time through the Internet or intranets. Fis also has a remote diagnosis function, and can alert the operator to system failures or measured data alarms by Internet e-mail. With "environment measurement and related matters" as its key, this paper introduces three types of Fis applications that work with the dedicated software, Fis.View, and that have actually been delivered or are currently being developed.

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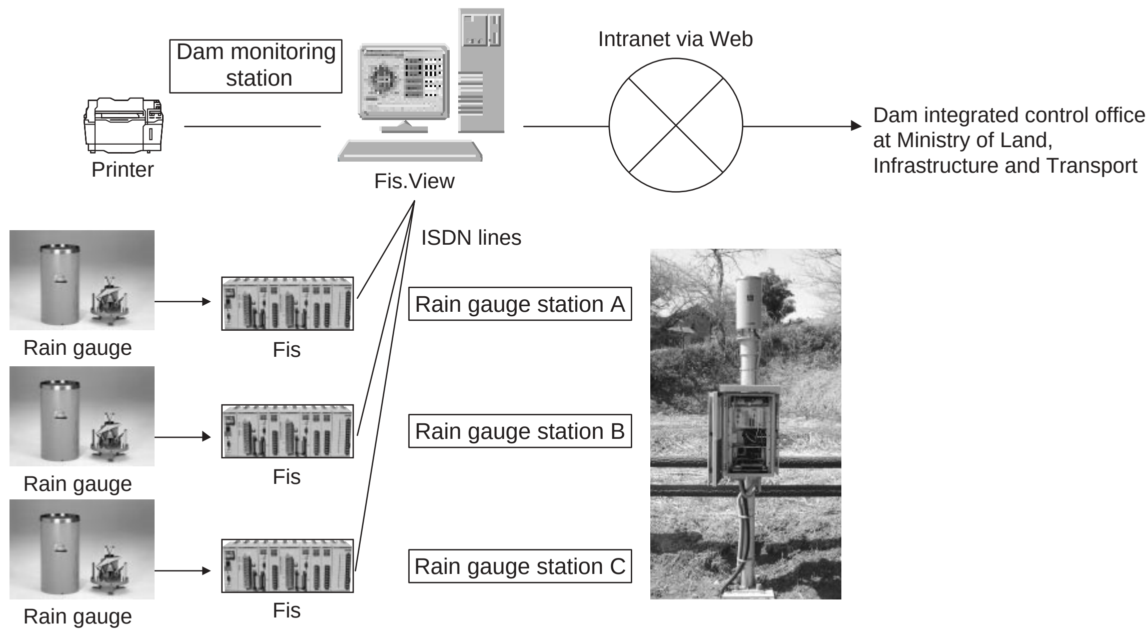

Figure 1 Rainfall Measurement and Remote Transmission System for Dam Sites

RAINFALL MEASUREMENT AND REMOTE TRANSMISSION SYSTEM FOR DAM SITES

(1) Overview

This system was developed for a dam construction office of the Ministry of Land, Infrastructure and Transport, to collectively control data from its rain gauge stations. It gathers measured rainfalls from multiple stations, and then displays them and issues alarms if necessary. The data are also transferred to a water information system in a dam integrated control office by way of the ministry's intranet, so that they can be viewed on terminals anywhere in Japan.

(2) Basic Configuration and Functions

Figure 1 shows the basic configuration of this system. It is comprised of one dam monitoring station equipped with Fis.View and three rain gauge stations each of which has a Fis installed and is connected with the station's Fis.View through ISDN lines. The gauge stations regularly measure precipitation in 10 minute, one hour, and daily intervals, along with accumulated precipitation and other relevant data, for example, dates and times when the rainfalls started. Meanwhile, the monitoring station acquires these data from the gauge stations every hour, then displays them in real time, and tabulates, graphs, or prints them. All the data obtained at the monitoring station are also sent to the dam integrated control office through the ministry's intranet.

(3) Features

With this system, data from three rain gauge stations can be simultaneously displayed on a single display, and two days worth of data, that of the current day and the day before, can be listed simultaneously. Figure 2 shows a rainfall monitoring screen. This screen was specifically designed in response to customers' requests. It can record rainfall data while alarms are being issued, by showing rainfalls and alarms at the three gauge stations at a glance, and allowing the displayed data to be printed arbitrarily.

If per hour precipitation at any one of the three rain gauge stations exceeds a threshold value, the system automatically changes the data-collecting interval from the standard one hour to 30 minutes and continues to measure rainfall. The interval will be automatically reset to one hour when the system concludes from hourly precipitation checks that rain has stopped. Various threshold values used in issuing alarms for precipitation can be set or changed accordingly. These alarm functions automatically notify customers that precipitation has reached a danger level, and enables more accurate measurement of rainfalls afterward, allowing the whole system to effectively support advanced dam control.

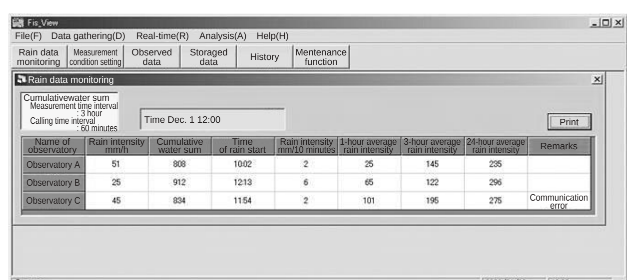

Figure 2 Rainfall Monitoring Screen

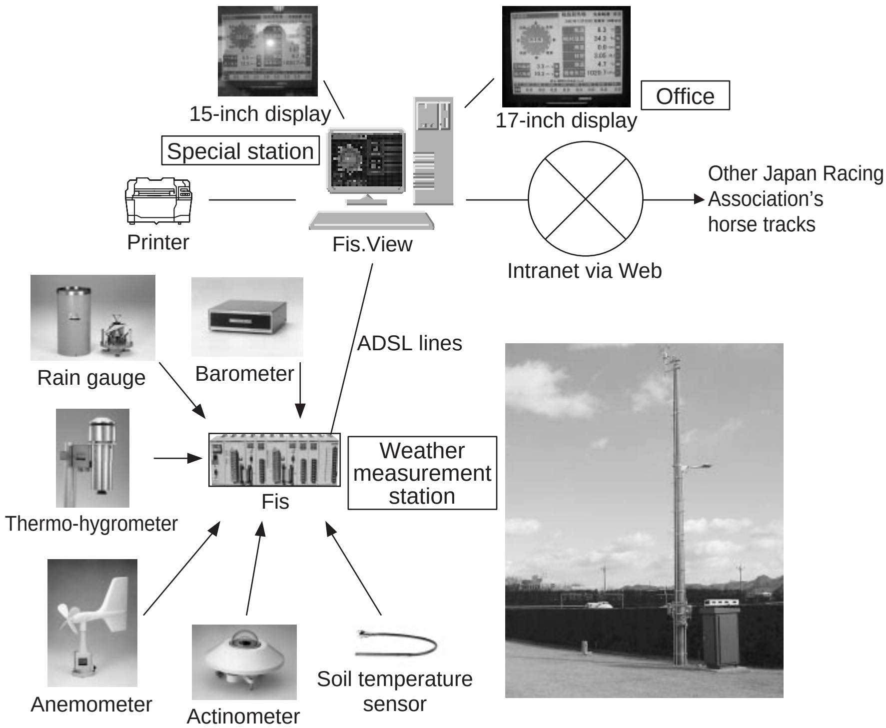

Figure 3 Integrated Environmental Measurement System for Horse Tracks

Moreover, all the data acquired by this system on an hourly or half-hourly basis are transmitted to a water information system in a dam integrated control office, and then along with precipitation data obtained at other construction offices in the Kanto region, realizes the unified management of dam-related data.

INTEGRATED ENVIRONMENTAL MEASUREMENT SYSTEM FOR HORSE TRACKS

(1) Overview

It is very important for horse tracks to monitor variables such as weather and racetrack conditions to maintain their racetracks, judge whether races can take place, and manage actual races. Therefore horse tracks can benefit by having advanced maintenance owing to information gained by accessing the latest accurate weather data, information about weather changes, and an accumulated weather database.

This system gathers weather data measured at horse tracks—such as rainfalls, wind directions and speeds, temperatures and humidities, and atmospheric pressures—then displays them in real time or in trend graphs, and issues alarms if necessary. The data are transferred to other horse tracks in Japan via an intranet network, so that they can be viewed on terminals anywhere in the country.

(2) Basic Configuration and Functions

Figure 3 shows the basic configuration of this system. It is comprised of a monitoring station, an office, and a weather measurement station. The special station has a Fis.View-equipped personal computer and a 15-inch display, the office with a 17-inch display, and the weather measurement station with a Fis, and all of them are connected through dedicated NTT ADSL lines. The measurement station regularly measures daily precipitation, wind directions and speeds, atmospheric pressures, temperatures and humidities, soil temperatures, and solar radiation data. Meanwhile, the special station acquires these data from the measurement station every five minutes. These data are displayed at the special station and the office in real time, and can be compared with the most recently measured data. Weekly compilations of these data are also compiled and graphically represented, then sent to other horse tracks through an intranet.

(3) Features

With this system, real-time, comparative, and weekly data are not only simultaneously displayed on the display screen, but can also be monitored with their graphics forms, realizing the understanding of weather transitions at a glance. Figure 4 shows a weather monitor screen of the displays. The screen consists of up to four frames, the readout of each of which may be turned on or off, with the items to be displayed and the sizes thereof able to be freely specified. Character colors and sizes, data updating intervals, and permissible deviation ranges (dead bands) within which the latest data are regarded

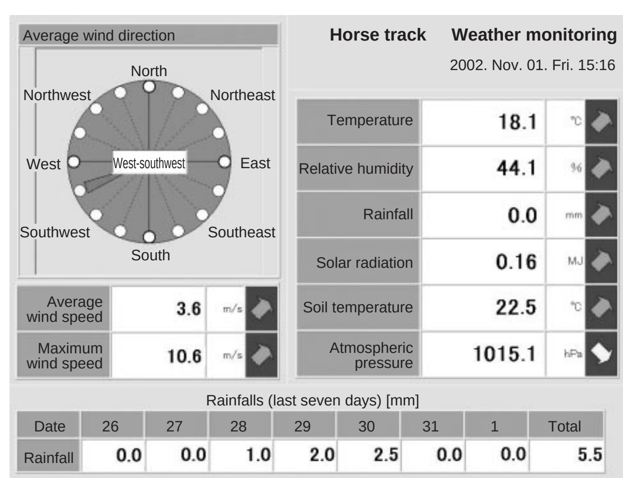

Figure 4 Weather Monitor Screen

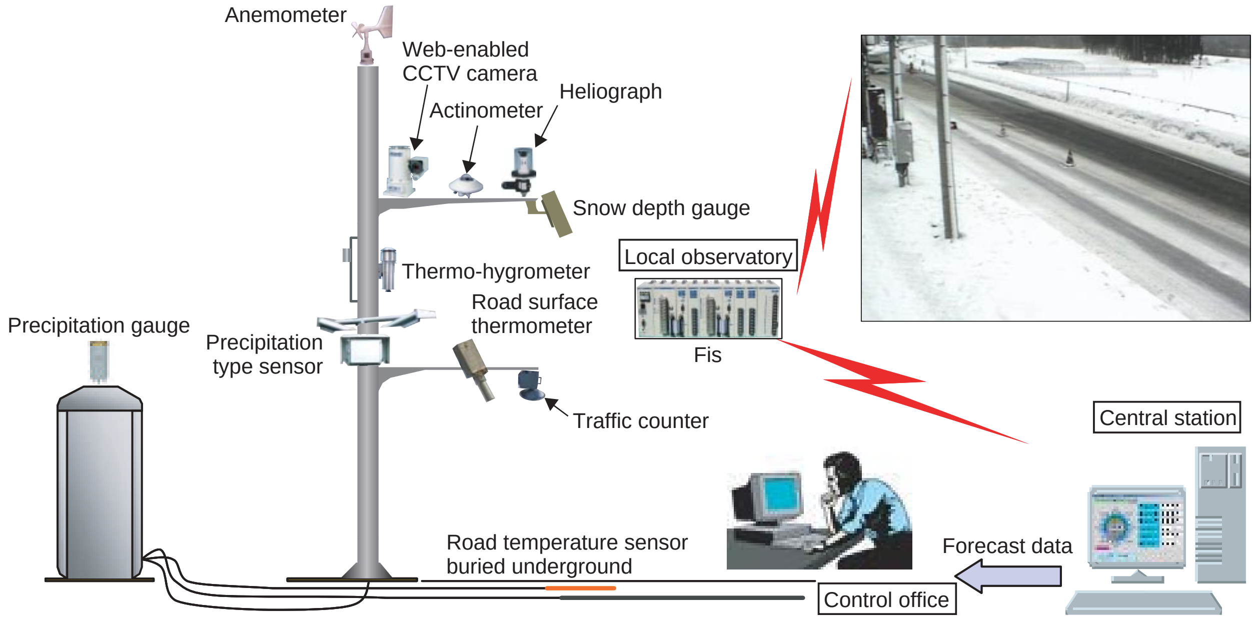

Figure 5 Road Condition Forecast System for Cold Regions with Heavy Snowfalls

as the same as the previous data can also be specified, facilitating configuration of screens tailored to applications or users at either of the screen installations.

Furthermore, all the weather data acquired on this system are stored to a database. This facilitates making graphic displays for grasping weather transitions, and record keeping by generating reports or printing data, thus making the whole system effectively supportive for the advanced maintenance of horse tracks.

ROAD CONDITION FORECAST SYSTEM FOR COLD REGIONS WITH HEAVY SNOWFALLS

(1) Overview

It is very essential in cold regions with heavy snowfalls to reduce costs for securing road safety or maintaining road conditions by clearing snow or other measures, and to address environmental issues concerning antifreeze. This proposed system represents an example of special road systems that will make the most of a road condition forecast mechanism being developed by our company. The system aims at advanced road maintenance by providing accurate road condition forecasts. Specifically, this system forecasts road conditions in more than one region based on weather and road data from the local observatories, and transmits the information over the Internet.

(2) Basic Configuration and Functions

Figure 5 shows a conceptual illustration of this system. It is comprised of a central station and multiple local weather observatories that have been situated so that there is only one common observatory in several regions that closely interrelate with each other in terms of the weather. These weather observatories are equipped with weather sensors—for measuring rainfalls, wind directions and wind speeds, temperatures, and visibility, as well as road-related sensors—including road temperature sensors, traffic counters, and Web-enabled CCTV cameras. A Fis is used to monitor data from the equipment. The local observatories and the central station are connected through dedicated NTT lines or optic-fiber networks of the Ministry of Land, Infrastructure and Transport. A Fis.View installation at the central station gathers data hourly from the local observatories and stores them to a database. It then forecasts short-range road conditions for the next three hours using both the latest and previous data in the database, and transmits the forecasts together with real-time weather data, road data, and camera images via the Internet or by e-mail.

(3) Applications

Since studless tires have become much more popular than studded ones, there have been many incidents of slippery road conditions causing traffic jams or accidents in winter in cold regions with heavy snowfalls. This is why a national project has been launched to study this problem and develop appropriate measures, and we believe that this system can be very useful in various ways in establishing advanced road maintenance. The following gives main examples of possible applications.

a. Integrated Snowplow Control System

By combining the road condition forecast system with our GPS-enabled, contactless mobile communications card, and vehicle positioning equipment using a card reader/writer, it is possible to build an integrated snowplow control system that can quickly remove snow and be effectively operated. With this control system, the positions of two or more snowplows can be monitored, and a road monitor screen can be displayed by inputting weather, road information and road condition forecasts, thereby achieving more effective operation of snowplows.

b. Antifreeze Sprinkler Control System
It is becoming common knowledge that repeatedly sprinkling a high concentration of antifreeze can significantly affect the environment, including vegetation. This antifreeze sprinkler control system can be used to avoid sprinkling an excessive amount of antifreeze and to assist in sprinkling it in a timely manner, which ultimately makes an automatic sprinkler system possible.

CONCLUSION

Fis can provide a wide variety of services by integrating its wealth of functions with application-specific added value, such as a forecast mechanism, operation control, and monitoring and display. In addition to the dam sites, horse tracks, and roads systems which this paper outlined, Fis can be applied to various fields—agricultural production, frost forecasting, disaster prevention through water level and rainfall measurement, river condition monitoring, sluiceway monitoring, fire alarm generation, and many others.

We anticipate the provision of more advanced Fis-based systems for these fields, leveraging the abundantly versatile weather sensors and Fis functions. ◆

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