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1. Introduction

Economical activity of human being has been getting globally while its energy consumption has been increasing. As a consequence adverse impact is given to natural environment. Abnormal weather frequently happens anywhere in the world resulted in disasters as localized heavy rain, drought or others. It is one of the important objectives for human being to pursue environmental protection for sustainable development in 21st century. (1) Responding to the requirement, meteorological and hydrological measurement is changing from point measurement to line and then area measurement. Its measurement data is used with radar observation data and satellite observation data to get more reliable weather information. For the purpose wide area's meteorological and hydrological information should be acquired and be processed at real time. And the results should be easily accessed. Based on this understanding we have put new concept product called "Field Information Server" ® into the market with cutting edge technology. (2) This paper focused on the concept of the system and its applications.

2. Concept of the Field information server ® (Fis) system

The Field information server is the system that collects the scattered information widely spread over the vast area in a reliable way, processes them and gives the information via network to users. Moreover the information from many Fis(s) is integrated by the dedicated software called "Fis.view" in a PC on the network and offered to users. Fig. 1 shows the configuration of the system. There are a variety of sensors which are used in meteorological and hydrological observation and their combinations in observatory points are different. Visual information such as real time image in a field has become more important. The environmental condition of the observatory is usually not good that temperature varies low to high, power may fail and there are lightning strikes. The observatories locate at urban area to even mountainous area where uneasy access.

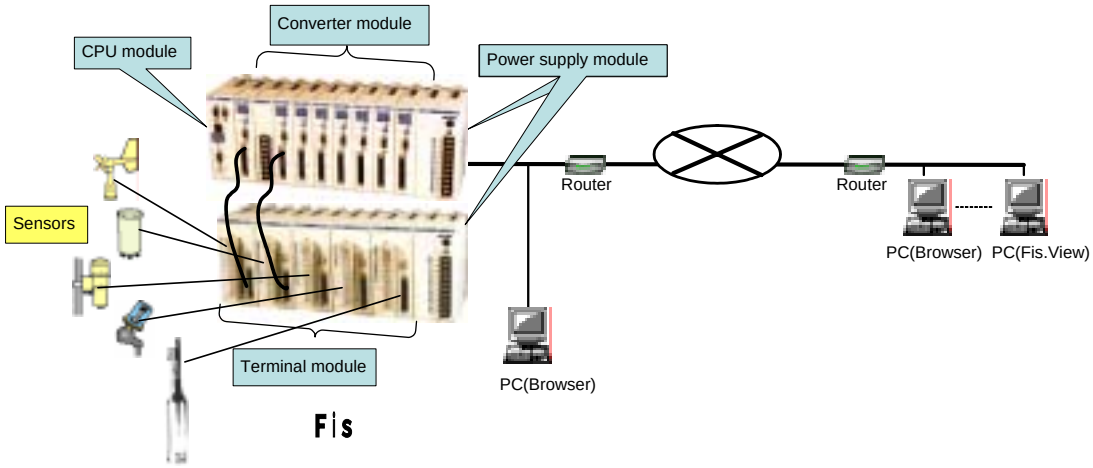

Fig. 1 Configuration of the Fis system

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Converter module	Sensor
Wind module	Anemometer
Temperature and humidity module	Thermometer, dew-point sensor, Thermo-hygrometer, hygrometer, psychrometer
Temperature module	Thermometer, ground temperature sensor, water temperature meter
Rain module	Rain gage, rain detector, rainfall intensity sensor
Sunshine and radiation module	Heliograph, actinometer, evaporation meter, net radiation sensor, heat flow sensor
Atmospheric pressure module	Barometer
Snow module	Snow depth meter
Visibility module	Visibility meter
Voltage module	Water depth meter, barometer, visibility meter
Flow module	Radio flow meter

Table 1 Sorts of converter module and corresponding sensors

Under these conditions it is necessary to have capabilities for instruments of remote failure analysis and of prompt repair to reduce measurements with data missing.

The followings are the features of the Fis

(1) Sensor interface

a. The Fis can receive signal from many kinds of sensors showed in table 1.

The Fis has converter modules correspond to sensor sorts. The combination of converter modules and number is free depending on applications. No program change is necessary for a configuration.

b. The Fis can acquire image from video camera and merge it with meteorological and hydrological data.

Necessary sensor interfaces for measurement will be developed more.

(2) Data processing

Raw data are processed into the convenient information for user.

c. The Fis can convert signal from sensors, process them statistically and output via analog, digital or serial line. The processed data file is protected at power failure.

d. The Fis can make scaling of input and output signal, Fis can assign method of data processing with a specified file.

e. The Fis system can integrate data from Fis(s) up to 20 with the Fis.View.

(3) Output

Necessary format and necessary physical signal interface are provided.

f. The Fis can make analog and digital signal programmable.

g. The Fis provides rich transmission (TCP/IP, PPP, FTP, Socket) (Ethernet, RS232C)

h. The Fis can provide web environment so that data watch is capable with a browser.

(4) Reliability, easy maintenance

Reduction of data measurement missing

i. The Fis can download software and can do failure diagnosis remotely.

j. The Fis can make hot-swap at module failure.

k. The Fis can send alarm mail to the assigned address.

(5) System expandability

Easy system change and expansion

l. The Fis can automatically make time adjustment by SNTP or radio-clock.

m. The Fis system provides data integration and display software (Fis.View) runs on a PC.

3. Configuration of the Fis

(1) Hardware and software configuration of data acquisition members

Fig. 2 shows the hardware configuration and the signal processing of a Fis. A signal from each sensor comes into a terminal module which noise including surge is rejected in. And then the signal is led to a converter module which the signal is converted to the digital one according to the signal characteristics in. The converted data is used to make a data file for day statistic like day mean,

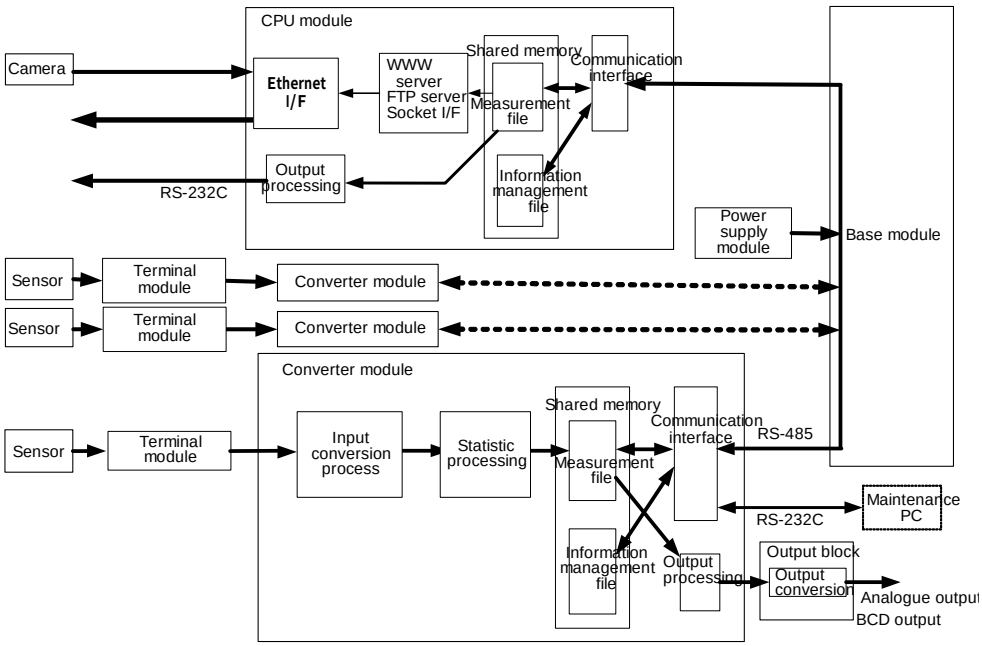

Fig. 2 Fis equipment composition and signal processing system

maximum and minimum. A specific terminal module and a converter module provide each sensor with a specific signal processing and data processing. Accordingly a base module is equipped to deploy necessary terminal modules and converter modules in parallel. Each measurement file in converter modules determines input-output data processing. The file can be down-loaded from external.

The base module has a signal bus and a power supply bus. Each module is powered through this bus by a power module. A CPU module collects data files in converter modules routinely every three seconds and further makes higher level data processing than in the converter modules. It can protect data against power failure. The processed data is transmitted to external networks with Ethernet or RS232C. Furthermore analogue or BCD signal outputs are available for local purposes. According to this configuration mentioned above, user can change the number and sort of converters

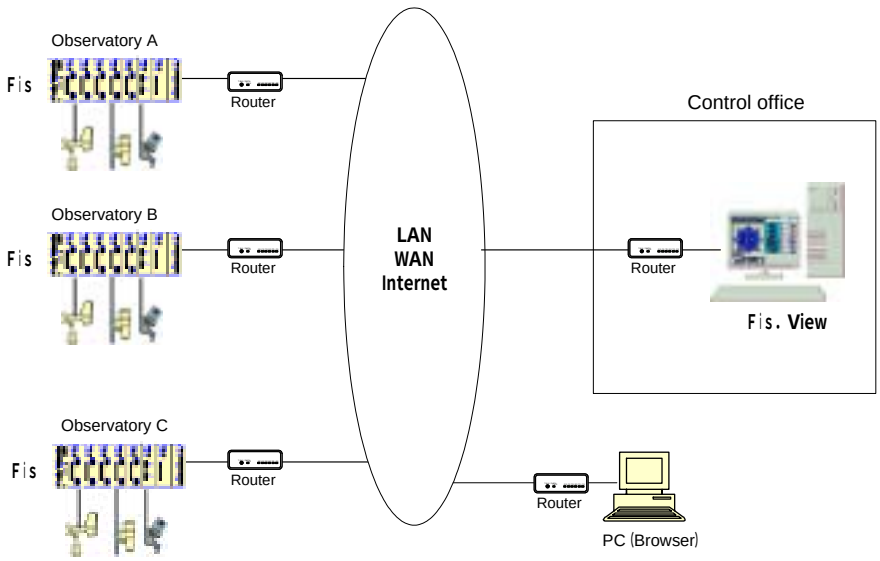

Fig. 3 Fis system configration

to meet their specific applications. It is unnecessary to change the software in the CPU module even when the number of converter changed. When new converter module is added to the base module, the CPU module automatically starts data collection from the new converter module. The converter modules have hot swap capability.

(2) Total system configuration

The system provide user with a Fis.View ”information integration package software” for data integration , data comparison and highly statistic data processing from plural Fis(s).

Fig. 3 shows the configuration of Fis and Fis.View. (hereafter Fis system)

The Fis.View runs on a PC and collects data files from plural Fis(s) on network. It has features of database construction, statistic processing like monthly or yearly, correlation analysis among observatories and integral display of those data. The Fis.View reads firstly converter module information in the assigned Fis at data collection. And then it automatically recognizes configuration of converter modules with the information. A browser like Internet explorer can read each Fis’s data but integral data from plural Fis(s) is only available with the Fis.View.

(3) Network function and data flow

A Fis.View connects with Fis(s) on the network and reads setting information, measurement information and recording information. Fig. 4 shows major data flow and data processing between the Fis and the Fis.Vew.

The Fis has two sorts of files, management files and data measurement files.

The management file is categorized into two types. One is a total management file which manages all files in the Fis. The other is a management file for data measurement files like assigned time data and daily processing data.

① Fis data processing

At the new installation of Fis or adding the converter module, user can describe a system configuration by simply putting parameters into the Fis management file such as observatory name, its number, data recording interval, measurement element number, element code, addresses of converter module. Those set of management information is filed with the specific management number. The management number is renewed when any management information is changed and is kept up to the latest 10.

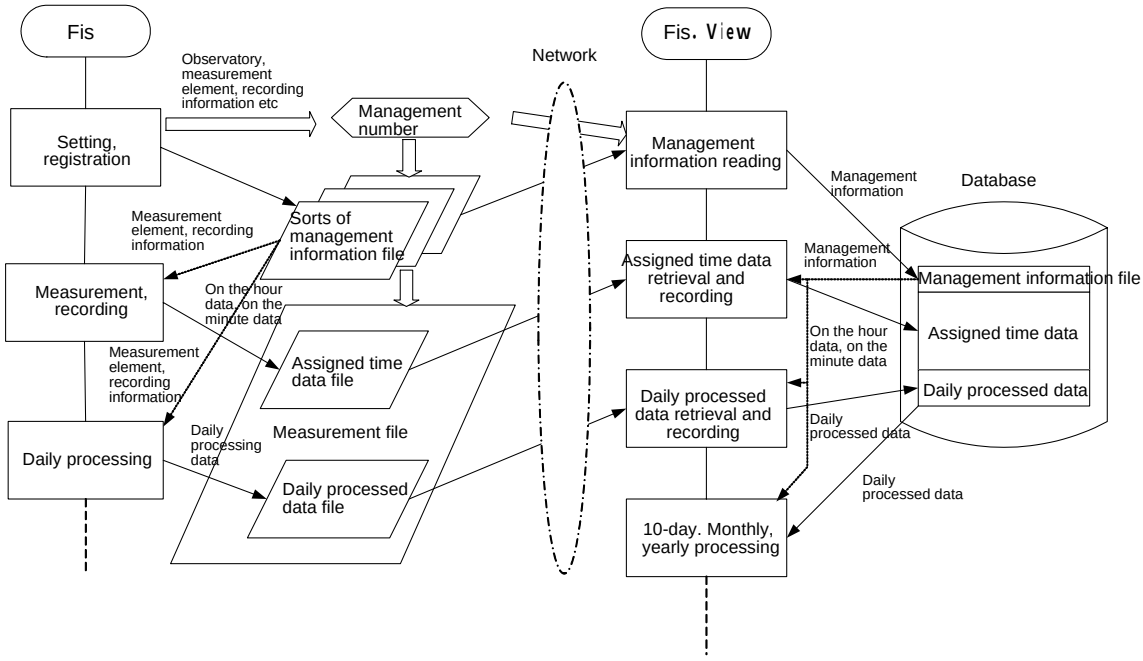

Fig. 4 Flow of processing and data of Fis system

A converter module inputs, converts and transforms signal from a sensor according to the management file. The CPU module records these data according to the same management information.

②Fis.View data processing

The Fis.View retrieves data from the assigned Fis at the assigned interval. The retrieved data are Fis management number, corresponding newest management information and assigned time data.

Additional daily processed data is retrieved at the date change. If the management number is different from former retrieval, then the management information is considered to be changed. The Fis data base can keep consistency as the Fis.View reads the management number at each retrieval time even if the Fis configuration changed. The Fis.View stores the retrieved data according to the newest management information in the database. It is possible to refer to the recording data in the database with the recording time and the observatory.

4. Application

It is easy to make up system with Fis to meet specific fields such as road, river, agriculture and so on thanks to Fis's freedom on sensor sorts choice and sensor number choice. The combination system of the Fis and the Fis.View offers not only data but also highly processed information which meets to each application. It helps user as an intelligent assistant more than data measurement.

A road weather observation system is emerging technology to reduce traffic jams or accidents in road management. The key factor is to make strong tie among man, road and car with a cutting edge information communication network. Fig. 5 shows an overview for a road weather information system. This system is installed at representative place for weather of the road to observe road circumstance. It employs many sensors such as rain gauge, anemometer, temperature, heliograph, actinometer, visibility, snow depth, road temperature and traffic counter. The Fis.View is installed in a control center. An optical fiver network connects Fis(s) on roads with the FIs.View in office. The Fis.View provides user with a database which retrieved data stored in. User can not only refer to the database with time stamp, weather condition and road condition but also make comparison between observatories and between times.

By introduction of the system into cold regions with heavy snowfalls, user can recognize road circumstances with this system using data of weather, road traffic and road surface condition from the measurement data and the camera image. Furthermore a comparison among observatories makes weather prediction and road surface prediction much easier and precise. Finally effective snowplows control management can be achieved.

5. The effect of Fis introduction

The configuration of Fis brings many merits to user. The followings are the typical examples that the Fis introduction to road application is very effective.

(1) It is easy to make any system from small to large

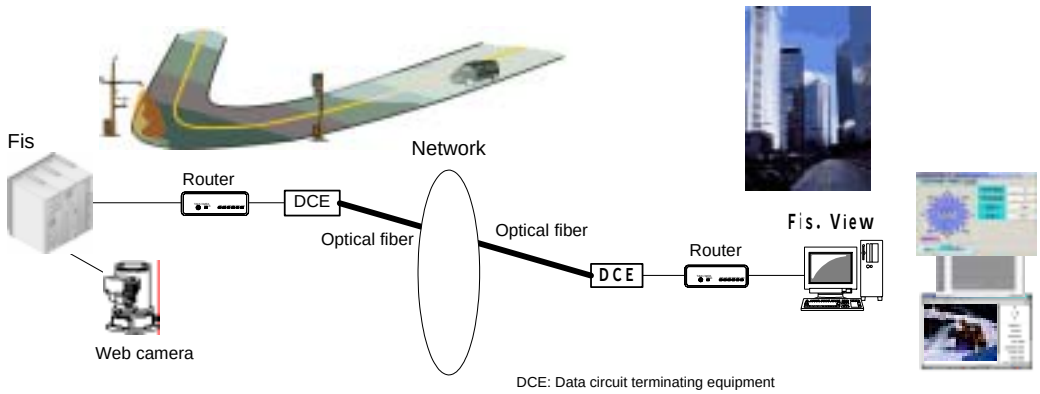

Fig. 5 Configuration of Fis road weather system

because converter modules are independent each other as all processing in converters are sensor specific.

(2) It is easy to add additional sensors such as visibility meter, road temperature and others to basic meteorological sensors such as rain gauge, anemometer and temperature sensor depending on the road circumstances like severity of weather or traffic. As a consequence integrated data of meteorological and traffic one is easily available on a web.

(3) It is easy to increase observatory and to change sensors at site because system making up is easy without program change.

(4) It is easy to displace failed modules or replace them in few steps because the Fis always watch sensors and modules to detect failure.

(5) The Fis.View offers integrated information of observatories up to 20 and makes it possible to compare data among observatories and between times. It is easy to make total management of road in area by using this function.
Fig. 6 shows an integrated data images.

Fig. 6 The integrated data image of Fis.View

6. Expanding of application

The important objective in river management is to prevent disaster like flooding and debris-avalanche. And then water resource management and prevention of water area environment come next. It is very important for the purpose to acquire and analyze hydrological data such as precipitation in area, river flow and water quality. A Fis system for river with optical fiver network can provide user with real time information overwhelming current telemeter system with 10 minutes interval information. An example is following.
The first screen of the Fis.view asks observatory which user wants to observe. Next screen shows

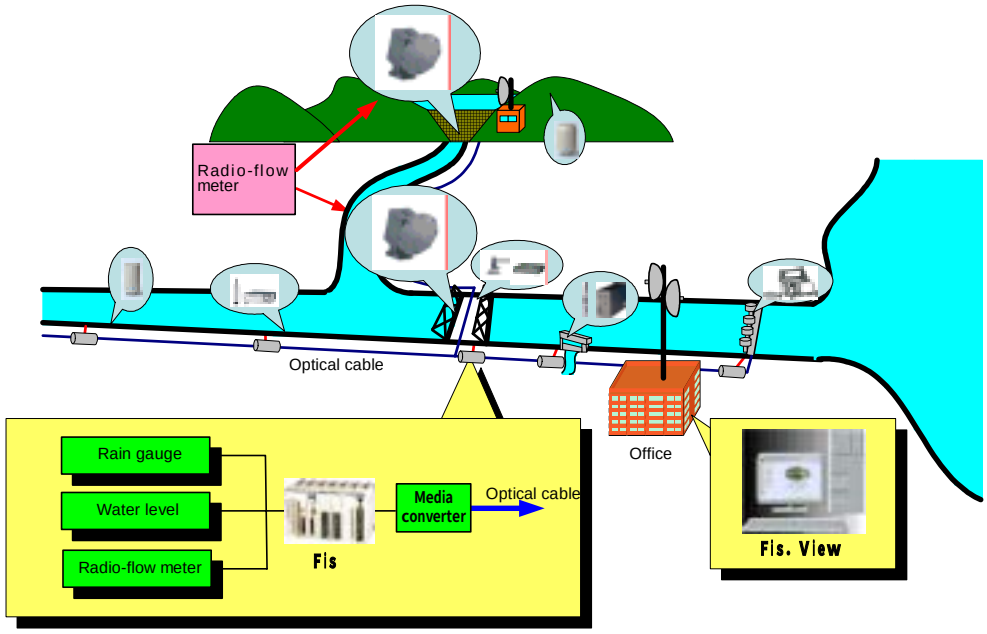

Fig. 7 Fis river information system

current water level, flow speed, flow, cumulative water sum, average wind direction and average wind speed at the observatory. A trend graph of water level in a month and a bar graph of rain intensity in a day will appear if graph is requested. A water level graph also shows an alarming level and a danger level. This feature gives user useful tool to judge circumstance with rain intensity trend. User can record data with video image from camera in disaster or in alarming condition. A mailing function gives user another convenience to know observatory point information at anytime anywhere he is. Fig. 7 shows a river information system with radio-flow meter.

The radio-flow meters are installed at least 2 places at upper stream and lower stream. The data at flooding should be stored and analyzed. This configuration gives information of current flow at two points and prediction of flow at lower stream with the cumulated data and the real time data. Furthermore stream analysis gives information of river condition if it flows smoothly or not.

This system is very useful to prevent disaster because it gives necessary real time information on web to citizen for evacuation. The further correlation analysis on the cumulated data may make clear relation among geological causes.

7. Conclusion

We have experienced over 80 systems using Fis so far. Those system are dam and river site, horse race track, heliport, railway, road, farm and so on. All system could be constructed with standard Fis and they are successfully satisfying the variety of customer’s requirements. The remote maintenance functions showed convenience and service efficiency. It is our pleasure and desire that our instruments are contributing to those wide application area. We would like to keep our effort to strengthen Fis capability to meet the increasing needs from the society such as environmental protection, disaster prevention .

8. References

(1) WMO annual report 2002 No.946

(2) Tashiro T. et al, 2003:
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