Development and Application of integrated monitoring platform for the Doppler Weather SA-BAND Radar

Q Zhang¹, J Sun¹, C C Zhao² and H Y Chen³

¹Meteorological Observatory of Shandong Province, Jinan, China
²Meteorological Bureau of Weifang, Shandong Province, Weifang, China
³Meteorological Bureau of Guan’nan, Jiangsu Province, Lianyungang, China

Email: *nuist_zq@126.com, 512913621@qq.com

Abstract. The doppler weather SA-band radar is an important part of modern meteorological observation methods, monitoring the running status of radar and the data transmission is important. This paper introduced the composition of radar system and classification of radar data, analysed the characteristics and laws of the radar when is normal or abnormal. Using Macromedia Dreamweaver and PHP, developed the integrated monitoring platform for the doppler weather SA-band radar which could monitor the real-time radar system running status and important performance indicators such as radar power, status parameters and others on Web page, and when the status is abnormal it will trigger the audio alarm.

1. Introduction

The doppler weather SA-band radar (abbreviation radar) is one of the most effective means for monitoring and early warning of sudden disaster weather, it plays an important role in monitoring storms, typhoons, hail, tornado and other severe weather system, and provides favorable support forecasters to analysis of changes in weather forecast and artificial influence on weather operations. Radar has achieved remarkable economic and social benefits, is one of an important symbol of the meteorological modernization of our country [1].

The doppler weather SA-band radar is a complex structure which will generate reflect radar products and the working state of the various parameters which are very important to determine radar operating status and do maintenance for the system and improve the availability of radar system and reduce the failure incidence[2].

Therefore, it is important to monitor the operation status of the system and the upload of the radar data and the operating parameters of the system.
2. BRIEF INTRODUCTION OF RADAR SYSTEM

2.1 System components. The radar system is composed of three parts:
RDA(Radar data acquisition):RDA consists of four parts: transmitter, antenna, receiver and
signal processor. Its main function is to produce and transmit radio frequency pulse, and
receive the scattering energy of these pulses, and form the basic data.
RPG(Radar products generator): radar product generation system, which is the command
center of the whole radar system which receives the basic data from the RDA, carries on the
processing to it and generates various kinds of products, and passes the products to users.
PUP(Principal user processor): the main user terminal system, which obtains, stores and
displays products [1].

2.2 Data classification
2.2.1 Radar status information. Radar status information are stored in/opt/rda/log folder.
These log files include:
Calibration.log, FC.log, Alarm.log, Operation.log, Status.log, PL.log, Rad.log, which FC.log and
Rad.log generate a new file each hour with the format of YYYYMMDDHH_filename.
Log, other documents, such as Calibration.log generate a new file every day with the format
YYYYMMDD_filename. Log, which YYYYMMDDHHmm respectively year, month, day,
hour, minute.

2.2.2 Radar base data. Stored in RPG Computer Archive2 folder format Archive
YYYYMMDDHH.mmA, such as Archive2013091011.12A, is Sept. 10, 2013 11:12 based
data,(world time).

2.2.3 Radar Product data. 39 kinds of products such as radar reflectivity factor(R), the
average radial velocity(V) stored in the PUP Computer folder named after the product and the
day time (Beijing time) [1].

3. Monitoring platform development

The doppler weather SA-band radar integrated monitoring platform could monitor the
operation status of the radar system and data generation and uploaded, determine the radar
operating status and the performance of the system with radar state information on the web.

3.1 Development tools. We choose Macromedia Dreamweaver (DW) to produce the web page,
using PHP to prepare the core program and Apache to build Web services.

3.2 Platform construction
3.2.1 Design web page framework. Designed the framework and the layout of the interface for
the new generation of weather radar monitoring platform. Using DW to build the basic
framework of the doppler weather SA-band radar monitoring platform.
3.2.2 Build server environment. The core code of the monitoring platform is written by PHP,
so it needs to build the PHP operating environment. Installed Apache (web server software)
and embedded PHP language environment, system configuration and network port settings
including PHP working environment, set the home page for the http://127.0.0.1/index.php.

3.2.3 Core programs. The core programs of the monitoring platform were written by PHP, including system operating status displaying program, the alarm sound triggering program, the status information to reading and displaying program, numerical comparison program, the alarm information displaying program and others.

3.3 Operation monitoring principle

3.3.1 Information acquisition. The monitoring platform read RDA information in the status.log, calibration.log, alarm.log, IQ62.log and other documents. To obtain information from status.log for monitoring RDA operation status, accessing power radar, clutter suppression and calibration data from calibration.log and IQ62.log, getting alarm information from alarm.log.

As shown in Figure 1, take the RDA "OPERATIONAL status" as an example, first positioning "OPERATIONAL status" in the text, using PHP we can read the the state numerical value and the recorded time of "OPERATIONAL status". We can read out the recorded time of "STATE OPERATING" state values and "PEAK POWER TRANSMITTER" numerical value in the same way[2].

![Figure 1 location, read the value of the parameter](image-url)

3.3.2 Monitoring principle of RDA. All the radar system operating status information of each scan will be recorded in status.log, the recording time accurate to the millisecond, including the operation status, scanning mode, transmitter power etc.[1]. In the state information, according to the RDA "OPERATIONAL status" and "operating state" and "transmitter peak power" to judge the running status of the RDA. RDA "OPERATIONAL status" has five status: shutdown(SHTDN), not operation(INOP), must maintain(MNT man), need to maintain(MNT REQ) and online(on line), "operating state" has six status: startup (stup), stand by (STBY), restart(RSTUP), operate(OPER) and playback (PLYBK) and off-line operate(LOPER).

When the radar system is in normal operation state, the "transmitter peak power" should be greater than 750kW and less than 900kW, "OPERATIONAL status" is "online", the "operating state" is "OPER". When the radar is in abnormal operation and performance in general for two cases: first, the radar system is running, but the transmitter power abnormal either below 750kW or higher than 900kW, second, the radar antenna switch stop running,
RDA "OPERATIONAL status" and "operating state" are no longer "on line" and "OPER".
Using PHP to read the value of the last recorded transmitter peak power in status.log, if the
peak power is not between the 750-900KW, that means RDA is abnormal operation, if peak
power is between the 750-900kW, then by judging state of the last recorded value of
"OPERATIONAL status" and "operationg state", if the states are "on line" and "OPER"
respectively, we identified radar system is in normal operation, otherwise it is in abnormal
operation.

3.3.3. Monitoring principle of RPG. When PRG is in normal operation, radar will produce the
base data stored in the RPG host Archive2 folder, one base data for one scan time. At present,
the wide application of scan mode is VCP21, an individual sweep time is about 6 minutes. We
could get the running state of RPG by judging the latest base data generation time. If the
difference between the current time and the latest data recorded time is about 6 minutes, we
judged RPG is normal, otherwise abnormal.
The monitoring principle of PUP is as the same as RPG and do not introduce.

4. FUNCTIONS

4.1 Monitoring platform display. The overall framework of the monitoring platform is build
by Macromedia Dreamweaver. Figure 2 for the monitoring platform interface.

![Fig. 2 interface of monitoring platform](image)

Platform interface is divided into the name area and functional area, the functional area
included of the link area, the monitoring area and alarm information displaying area.

4.2 Monitoring platform functions
4.2.1 URL link function. The monitoring platform links the common business platforms such
as the China Meteorological Administration Integrated Meteorological System Operation
Monitoring Platform (ASOM) and others.
4.2.2 Status diagnosis function. According to the radar status information, the base data and
the products, the monitoring platform judges the radar system operation status. If any
monitoring status is abnormal, the monitoring platform will trigger the audio alarm, as shown
in Figure 3 below. Take RDA as example, when the operation of the RDA is normal, shows
RDA ●, if abnormal shows RDA ○ and audio alarm starts.

Figure 3 state monitoring of radar systems: (a) normal  (b) abnormal

4.2.3 Parameter monitoring function. The monitoring platform makes real-time monitoring of the system parameters of the radar operation, including system parameters and radar transmitter power, noise temperature, syscal value, and show numerical values. To continuous wave (CW), velocity and spectrum width (phase and velocity) and other parameters, the monitoring platform not only shows the expected value and the measured value, and laso compared and made judgments. The difference of the measured value and the expected value set a threshold of 0.5 and 1.0, if the difference absolute value less than 0.5, shows ●, between 0.5 and 1.0, judge as warning state, shows ○, greater than 1.0 for the abnormal state, shows ●, else shows "null" and ○. The following figure 4, take monitoring parameter "CW" for example.

| CW | CW | CW | CW |
|----|----|----|----|
| MEASURED=41.50 | MEASURED=41.50 | MEASURED=41.50 | MEASURED=null |
| EXPECTED=41.79 | EXPECTED=42.10 | EXPECTED=42.60 | EXPECTED=null |

Fig. 4 monitoring parameter "CW" of radar system

4.2.4 Alarm information display function. When radar system has alarm information, in the alarm information displaying area will show them,else shows "no alarm".

5. Conclusion

The doppler weather SA-band radar integrated monitoring platform is in the form of web page display, for the first-line technical staff of radar judgment on radar system operating state and have a guiding role for maintenance. The monitoring platform can monitor various operating parameters of the radar system in real time, and the response time of the audio alarm is less than 60 seconds when the operation state is abnormal.

The monitoring platform is a stand-alone version of the platform currently, could only monitor one radar, if you want to control the other radar only need to change the corresponding parameters in the platform. And affected by the factors such as network circuit and transmission software instability, the monitoring platform will have a short time delay occasionally.
References

[1] Yu X D, Yao X P and Xiong T N 2006 The principle and applications of Doppler weather radar. *China Meteorological Press*, 5-10

[2] Wang Z W, Zhong T, Wang Z W and Lin Z N 2008 Calibration Method of Echo Intensity for China Doppler weather SA-band radar-S. *Modern radar*, 30 30-33

[3] Huang X, Zhang P Y and Xiong Y 2005 Transmitter Phase Noise of Doppler Weather Radar Measurement. *Modern radar*, 07 62-66.