Design and Implementation of the Inner Mongolia Meteorological Service Intranet APP

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Abstract. The new media platform based on internet, like WeChat and other mobile phone applications (APPs), can provide meteorological information to users more conveniently and efficiently than the traditional platforms, such as TV, telephone, short message, etc. Therefore, an intranet APP is developed in Inner Mongolia Meteorological Information Center to realize the rapid acquisition of meteorological information in the 70th anniversary celebration of the Inner Mongolia Autonomous Region. Based on user experience and user demands, the APP offers multiple meteorological service products covering meteorological observations and forecasts. It quickly displays the data from the critical regional automatic stations and mobile meteorological stations for relevant users. In this way, it provides seamless, all-round, refined and targeted meteorological services throughout the celebration.

Keywords: APP, observation, forecast.

1. Background and demand analysis

1.1. Background
In the context of information globalization, the Internet, the information technology and the communication equipment have achieved innovation and development, and the mobile phone application (APP) has become an important way to obtain information in people's daily life[1]. As a tools system, the APP can help people complete an action or a series of actions more conveniently and efficiently. According to the characteristics of APP and based on user experience and user demands, the Inner Mongolia meteorological service intranet APP is designed in this paper. It aims to obtain the meteorological information fast and provide the information of observation, forecast and meteorological decision-making service to users as soon as possible, and thus to serve the 70th anniversary celebration of the Inner Mongolia Autonomous Region.

1.2. Demand analysis
The Inner Mongolia meteorological service intranet APP is designed to mainly provide the decision-making service and realize the usability. First, the technicians find out the expectations of the users in obtaining meteorological information, understand the interaction between the users and the APP, and take the users' demands and expectations as the focus in the interaction design of this APP. Then, the
modules of data display and statistical function and the interface layout are designed after the communication with the staff in Inner Mongolia Meteorological Bureau[2]. Finally, the APP is developed based on user experience, operation processes, feasibility and practicability.

2. Technical route

2.1. System architecture
The system includes the display layer, the application layer, basic components, support services and the data layer. The specific framework is shown in Fig. 1.

As shown in Fig. 1, in the display layer, users can access the system through the APP, and administrators can manage and maintain it through the mobile service management site. The middle layer is the mobile service platform, which mainly implements the business logic of the APP. It includes the following four parts.
First, support services. It adopts the general mature technology to provide support services for the system, including component loading service, data buffer service, document extraction service, data interface service, data encryption service, region of interest service, map scaling service and data conversion service.

Second, basic components. It contains basic functional components of the APP, mainly including display configuration, uniform user authentication, data access configuration, application module loading, security authentication, auto-update, real-time data synchronization, positioning information processing, logging configuration, etc.

Third, application layer. According to the needs of the applications, the corresponding application modules are integrated and implemented through dynamic loading.

The data resource layer and the accessed application systems are on the bottom. The data resource layer includes database and file system directory (buffer file, static file, log file, configuration file, etc.). The application systems are accessed following the interface access specification according to the operation needs.

2.2. System features
First, the system is suitable for different terminal devices. It can be applied in the two major operating systems of Android and iOS on both mobile phones and tablets, mainly with the form of APP.

Second, it can well adapt to the network. It is compatible with WiFi, 3G, 4G, etc., and displays high-quality pictures and videos in WiFi. Its inquiries users whether to display pictures and videos in 3G and 4G to reduce the mobile data usage.

Third, it has good operability. The user's operation can be responded within 3 seconds in a good network, and it will give a warning when the network doesn't work.

Fourth, it is reliable with stable operation and easy maintenance and expansion. It has good expansibilities of data type and function, and well adapts to the accessed systems. The operation is simple and convenient, which conforms to the users’ habits for mobile devices [3].

Fifth, it has good security mechanism. It can ensure the data security and reliability through the ways of user access control, information transmission encryption and identity authentication, realizing the maximum resistance to external attacks.

Finally, it supports offline accesses. The system can be operated without network. When the network is available, the data can be synchronized to the server to ensure the data consistency.

2.3. Operation logic
The data are stored with Memcached on the home page by, and they are regularly maintained in the backstage for the front-end use. The observation data such as temperature, air pressure and relative humidity at the nearest stations can be displayed on the home page according to the user's location. According to the preset rules, it can update the cache and display the regional products. Produce is shown in Tab 1.

| Name                     | Time horizon         | Update strategy                        |
|--------------------------|----------------------|----------------------------------------|
| Operation product        | Latest product       | Automatically updating the cache every 10 minutes |
| Decision-making product  | Latest 5 pieces      | Real-time accessing                     |
| Disaster data            | Latest 2 days        | Real-time accessing                     |
| SWAN data                | Latest 24 hours      | Real-time processing and real-time accessing |
| Disaster data            | Latest 2 days        | Real-time accessing                     |
| Satellite data           | Latest 5 hours       | Real-time accessing                     |
| Radar image product      | Latest 30 minutes    | 5-minutely processing and real-time accessing |
| Precipitation forecast   | Latest time point    | 10-minutely processing and real-time accessing |
| Temperature forecast     | Latest time point    | 10-minutely processing and real-time accessing |
| Comprehensive observation| Latest 5 pieces      | Real-time accessing                     |
| RMAPS product            | Latest time point    | 10-minutely processing and real-time accessing |
3. **Operation logic and display of the APP**

Based on the unified data environment, an integrated platform displaying the meteorological products and sharing the operation management information over the region is built. The platform covers 14 operation products, including comprehensive observations, weather products, climate products, weather modification products, public meteorological service products, data service products and operation management products. It realizes the display of more than 60 kinds of operation products in the Inner Mongolia Autonomous Region and the secondary regions [3].

| Product type                           | Number | Product type                  | Number |
|----------------------------------------|--------|-------------------------------|--------|
| Observation product                    | 2      | Basic data product            | 5      |
| Weather product                        | 10     | Forecast product              | 1      |
| Climate product                        | 4      | Disaster warning              | 2      |
| Ecological and agricultural product    | 6      | Image product                 | 2      |
| Weather modification product           | 6      | Specification                 | 1      |
| Decision-making service                | 4      | Real-time product             | 8      |
| Professional meteorological service    | 6      | Radar                         | 6      |

### 3.1. Weather observation

The data comes from China Integrated Meteorological Information Sharing System (CIMISS), including the hourly data from the national stations and the minutely data from the automatic stations. The visibility and weather phenomenon are from the latest hourly data of national station, which is updated and cached every 10 minutes. The temperature, air pressure, relative humidity, wind speed, wind direction and precipitation are from the latest minutely data of automatic station, which is updated and cached every 2 minutes. The weather phenomenon data are obtained from the nearest automatic weather stations. If precipitation is observed, the weather phenomenon is identified as rainfall, otherwise, the weather phenomenon is identified according to the cloud cover. Based on the user's location, the hourly data of the nearest national station within 80 km and the minutely data of the nearest automatic station within 20 km are obtained from the cache. If the data is absent, the CIMISS is accessed.

### 3.2. Weather forecast

The APP gets the nearest national station number. According to the station number, the latest revised forecast is obtained from CIMISS and updated on the page every 10 minutes. The weather forecast is released at 08:00 a.m. and 20:00 p.m. every day. It is revised at 05:00, 06:00, 10:00, 15:00 and 16:00 every day in the Inner Mongolia Autonomous Region Meteorological Observatory. Before 8 a.m. when the new weather forecast is unavailable and the old weather forecasts are available for less than seven days, the data of six days are displayed.

### 3.3. User login

The user of the operation version logs in to the APP with the username and password, which are consistent with those in the integrated information system. The user of the decision-making version can log in by inputting the mobile phone number which is configured in the backstage.

### 3.4. Special services and others

Other operation products are customized based on the operation version. The modules of early warning information, disaster information, public opinion reference and information bulletin can be displayed through the customization. Figure 2 shows the special service page for the 70th anniversary celebration of the Inner Mongolia Autonomous Region.
Figure 2. The special service page for the 70th anniversary celebration.

4. Summary
The Inner Mongolia meteorological service intranet APP developed in Inner Mongolia Meteorological Information Center is the first mobile phone APP to display meteorological observations, weather forecasts, meteorological service products and integrate the ground, radar and satellite data based on the Geographic Information System map. Meanwhile, with the unique advantages of portability, intelligence and good interactivity, the APP has been a vital support for users to quickly obtain meteorological information during the 70th anniversary celebration. It rapidly shows the data from the critical regional automatic stations and mobile meteorological stations for users, providing seamless, all-round, refined and targeted meteorological services throughout the celebration.

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