Random Forest-based Handheld Operation and Maintenance of Hospital Information Systems via WeChat MiniProgram

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Abstract—**In view of the current situation of various old hospital information systems (HISs), namely, most of them are PC terminal-based applications, this paper addressed the detailed design and implement processes of a handheld HIS (HhHIS) based on the WeChat MiniProgram. The realization principle of the Operation and maintenance decision engine based on random forest algorithm is explained detailedly firstly, followed by the key realization steps of HhHIS. A prototype HhHIS was developed and successfully applied to a 3-Grade A-Class hospital in Hunan province, Hunan children's hospital. Experimental results indicated that the developed HhHIS can solve the cross-platform problem of different mobile phone terminals and have the merits of easy-to-use and registration-free as well as download-free. In addition, practical application effects demonstrated that the HhHIS can carry out agile and low-cost upgrade and transformation of existing hospital operation and maintenance systems, so that the operation and maintenance personnel can grasp the operation and maintenance information of various on-site HISs anytime and anywhere.**

Keywords—WeChat MiniProgram; Handheld Operation and Maintenance; **Operation and maintenance decision engine**；*Random forest*

I. INTRODUCTION

Along with the continuous deepening of China's medical and health system reform，as an important part of medical reform, Hospital information construction has been rapidly developed. With the continuous deepening of information technology, the IT system of the hospital is increasingly complex. On the one hand, the hospital business is more and more dependent on the IT system. IT system has become the key to many business processes, and even the base of some businesses. On the other hand, IT system operation, maintenance, and management is increasingly difficult, especially to ensure the stable and reliable operation of the hospital key business system all the time, can grasp the operation status of the relevant system for the first time, IT is very important.

At present, China has more mobile Internet users than any other country, with about 850 million people using smartphones to access the Internet, with the development of modern mobile communication technology with each passing day, mobile office raised eyebrows brings great benefits to the hospital, through smart phones and tabletsto access email, documents, and the application of the user has formed the scale, in order to adapt to this change, the hospital IT system management control and the security policy should also be extended to the corresponding mobile devices, applications and mobile terminal docking status of potential has emerged.

In this paper, Operation and maintenance decision engine is designed and implemented based on random forest algorithm, using the popular WeChat MiniProgram technology combined with Java language to receive the running status messages of different IT systems and advice. At the same time, WeChat MiniProgram is used as the display and response platform of operation and maintenance, which can not only guarantee privacy, but also enable IT operation and maintenance personnel to monitor and respond anytime and anywhere, providing strong system support for improving operation and maintenance efficiency and quickly responding to failures.

II. WECHAT MINIPROGRAM INTRODUCTION

WeChat, in China, is one of the major applications that Chinese people use in daily life. WeChat MiniProgram is an application that can be used without download and installation [1]. WeChat MiniPrograms are a new way of connecting users and services. They are easy to access and share on WeChat, delivering excellent user experience. It realizes the dream of application at your fingertips. User scan or search to open the application. When you're done, you can quit, do not need to close uninstall; It will not disturb users, nor push messages, generate subscription relations, and share with the circle of friends.

Choose WeChat MiniProgram to do IT handheld operation and maintenance transformation, mainly based on the following considerations:

1.Cross-platform.No matter mobile operating system is android or IOS, as long as it can run WeChat, it can run small programs to avoid developing two apps based on android and IOS[2];

2. Low development difficulty. The secondary development based on WeChat MiniProgram framework can enable users to spend more money, manpower, and energy on how to operate a good product and do a good job in the content itself;

3. Easy to use. For users, compared with various apps, The UI and operation process of WeChat MiniProgram will be more unified, which will also reduce the difficulty for users to use.

III. DESIGNED AND IMPLEMENTED OF THE HANDHELD OPERATION AND MAINTENANCE SYSTEM

A. architecture

According to functions, the handheld operation and maintenance system designed can be divided into three parts: o

operation and maintenance decision engine, message processor, and WeChat MiniProgram to display and response. The architecture diagram is shown in figure 1:

Operation and maintenance decision engine: different message receivers that receive the running status messages from different IT systems and store them in the database for use by message processor. According to the received IT system alarm information, based on the historical data and machine learning, a series of emergency operation scripts including application restart, host restart and two-machine switch are listed to the small program users according to the probability, and one-click execution function is provided.

Message processor: according to different application scenarios of users, process the received message data to satisfy the interaction with WeChat MiniProgram framework[3].

WeChat MiniProgram display response part: based on the API and components provided by WeChat MiniProgram and using html5 and javascript technology to build a mobile operation and maintenance system across the operating system platform, to ensure that users can understand the operation and maintenance information anytime and anywhere[4].
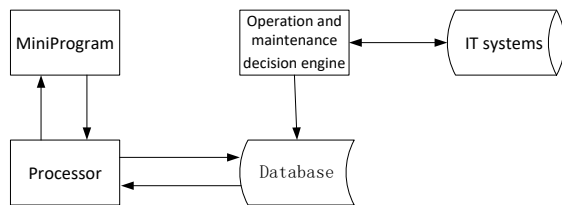

Fig. 1. Handheld operation system architecture diagram.

B. Design and implementation of operation and maintenance decision engine

The operation and maintenance decision engine includes message receiving module and intelligent operation and maintenance module.

1) The design and implementation of message receiver

In order to better represent the design and implementation of message receiver, we take the operation of receiving network circuit as an example to detail the implementation steps.The operation of network circuit includes normal, lost packet and interrupted three states. To fully understand the real-time operation of network lines, we need to regularly update the line name, on/off state, lost packet rate, latest update time, last state change time, operator and other information. The key steps are as follows:

```
String source = request.getParameter("source");// Label
information source
String content = request.getParameter("content").trim();//Get
information content
XljkService xs = new XljkService();
xs.delAllXljk();
```

```
String[] arrs = content.split("#");
ArrayList< Xljk > xljks = new ArrayList< Xljk >();
for(int i=0;i<arrs.length;i++){// The information content is
processed and stored in the database according to the
standard
        String[] arrs_xljk = arrs[i].split("~");
        Xljk x = new Xljk();
        x.setGuid(arrs_xljk[0]);
        x.setName(arrs_xljk[1]);
        x.setP1a(arrs_xljk[2]);
        x.setP1aloss(arrs_xljk[3]);
        x.setNewUpdateTime(arrs_xljk[4]);
        x.setChangeTime(arrs_xljk[5]);
        x.setYys(arrs_xljk[6]);
xljks.add(x);
}
xs.addTiquXljkAll(xljks);
```

As you can see from the above code, different sources of information need to write different message receivers to meet specific business requirements.

2) Design and implementation of intelligent operation and maintenance engine based on random forest

The so-called intelligent operation and maintenance refers to the addition of a brain based on machine learning on the basis of automatic operation and maintenance, which directs the monitoring system to collect the data needed for brain decision-making, make analysis and decisions, and command the automated scripts to execute the decisions of the brain, so as to achieve the overall goal of the operation and maintenance system.

In machine learning, a random forest is a classifier that contains multiple decision trees, and its output category is determined by the mode of the categories output by individual trees[5].

In intelligent operation and maintenance, features are used as input variables, including host IP address, unique machine, alarm information keywords, etc.The label is the operation and maintenance action to be taken, including application restart, host shutdown, host restart, switch between two machines and other operations.We use equipment manufacturers, application system common fault processing documents, according to the rich experience of operation and maintenance engineers guidance, generated a label sample, and conduct model training.On the basis of the above training set, we use the random forest algorithm to predict the emergency operation and maintenance actions to be taken according to the characteristics, with the following examples:

Operation and maintenance action:
Action 1: restart the application
Action 2: close the device,
Action 3: restart the host
Action 4: switch between two machines
Each tree in the random forest can be regarded as a CART (classification regression tree). Let's assume that there are 3 CART trees in the forest, and the total number of features is N=3, and let's take m=1 (let's assume that each CART tree corresponds to a different feature).

CART1：IP address

	Action	action 1	action 2	action 3	action 4
IP address	192.168.1.1	90%	10%	0	0
	192.168.1.2	20%	30%	40%	10%
	192.168.1.3	50%	0	50%	0

CART2：Unique machine

	Action	action 1	action 2	action 3	action 4
Unique machine	YES	5%	30%	5%	60%
	NO	50%	0	50%	0

CART3：Warning information keyword

	Action	action 1	action 2	action 3	action 4
Warning information keyword	Hardware alarm	0	40%	30%	30%
	Application alarm	85%	5%	5%	5%

According to the classification results of the three CART trees, if we receive the application warning information of one 192.168.1.1 host in the two-machine system, we can get the possibility of performing relevant emergency operations:：

CART		action 1	action 2	action 3	action 4
IP address	192.168.1.1	90%	10%	0	0
Unique machine	Yes	5%	30%	5%	60%
Warning information keyword	Application alarm	85%	5%	5%	5%
Final possibility		60%	15%	3.3%	21.7%

In the end, we concluded that the most likely emergency action we would take upon receiving this alert would be to restart the application, then switch between the two machines, shut down the device, and restart the host, respectively.

C. Implementation of The handheld operation and maintenance system Based on WeChat MiniProgram

As shown in figure 2, The technical architecture of WeChat MiniProgram is very clear, which is divided into three parts: view layer, logic layer, and system layer. JS is responsible for the implementation of the business logic, while the view layer is implemented by WXML , which is actually a template language defined by WeChat, and WXSS, which is similar to CSS.In the system layer, the applet implements the call to the underlying API interface with the help of JSBridge. Therefore, developers should not think too much about the implementation difference of IOS and android when developing in the applet. Instead, they should focus on developing in the upper view layer and logic layer.
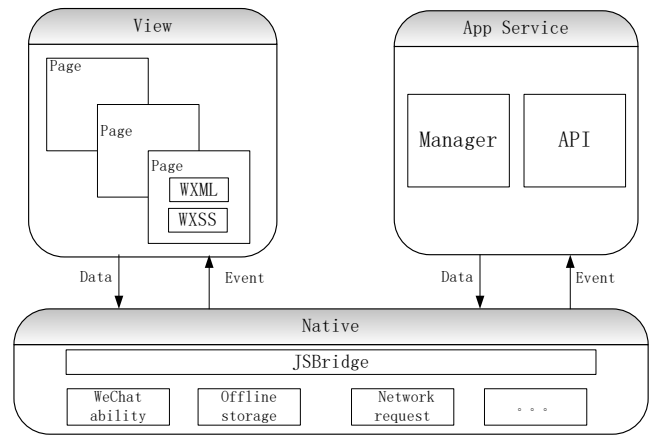

Fig. 2. WeChat MiniProgram technical architecture diagram.

IV. MINIPROGRAM INTERACT WITH MESSAGE PROCESSOR

MiniProgram must interact with the background, and the following code shows how the network circuit performance page interacts with the message processor.

```
receiveXljk: function () {
  var that = this
  wx.request({  // The MiniProgram requests the data to the background, after obtaining the success will return the data to the memory and display
    url: 'https://weixin.hnccb.top/jxhyw/servlet/FrontShowXljkServlet',
    data: {
      guid: that.data.guid,
      roleid:that.data.roleid,
      unit:that.data.unit
    },
    header: {
      'content-type': 'application/json'
    },
    success: function (res) {
      that.setData({ arr: res.data[0].xjs })
    },
  })
},
```

V. ACHIEVEMENT EXHIBITION

As shown in figure 3, the authority management function is used to ensure that specific users can log in and access the system and ensure information security.Figure 4 shows the navigation interface of the handle operation and maintenance platform.Figure 5 shows the monitoring situation of relevant indicators of one system, which is updated once in 60 seconds.Figure 6 is the on-off situation of the local network circuit, which is updated once every 300 seconds.It can be seen that through the WeChat-MiniProgram, this handle operation and maintenance system will show the system transaction, application port state, network circuit state, alarm information to the user, so that the operation and maintenance personnel can grasp the operation and maintenance information anytime and anywhere.
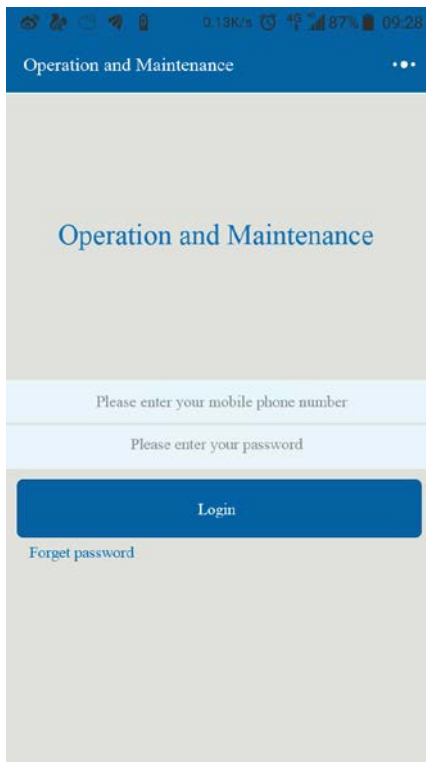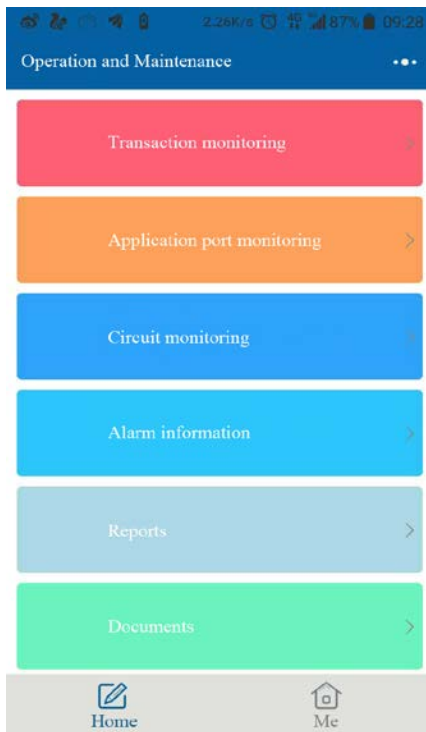
Fig. 3. User log-in.

Fig. 4. Navigation interface of Handheld operation and maintenance platform.

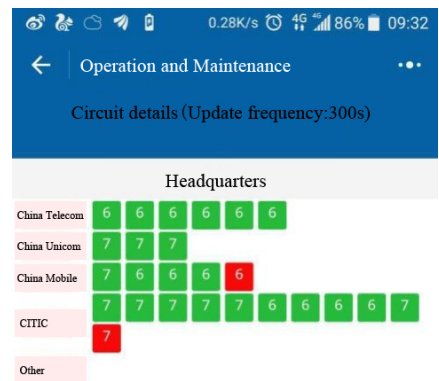Fig. 5. Monitoring of relevant indicators of one system.

Fig. 6. On and off of the headquarters network circuit.

VI. CONCLUSIONS AND FUTURE WORK

In this paper, the handheld operation and Maintenance system based on WeChat MiniProgram through the message receiver real-time receiving host, network, application of port operation condition information, such as through the message processing and processing the data, and use the

WeChat-MiniProgram framework integrated development display to the user, convenient operational information rapidly and has been successfully applied to the Hunan children's hospital, has obtained the good effect.

Our system is currently more concerned with the presentation of operational information than interactive actions. When the network goes wrong, how to quickly and conveniently report the fault to the operator, when the system is wrong, whether the emergency script can be executed quickly is worth further consideration.

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