

# Research on Data Synchronization Technology of Mobile Database Based on Real-time Embedded System

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**Keywords:** Embedded, Data transmission, HTTP, caching

**Abstract.** Design the technologies for data acquisition of embedded mobile terminal, data transmission and synchronization of embedded mobile terminal and the server and establishment and maintenance of the server database. Solve the shortcomings as difficulty in data acquisition of data synchronization, complicated operation of equipment, large amount of data, data error and lost in the process of transmission. Information could be acquired whenever and wherever by using the embedded portable device. Simplify the user operation by preparing the Android mobile terminal application software, reduce data error and increase data security and reliability by HTTP, caching and synchronization technology.

## Preface

At present, the mobile terminal devices like mobile phone, notebook computer, PDA has been widely used in our daily life and the rapid development of wireless communication technology and satellite communication technology also provide a ready access to information. The groundbreaking computing mode - mobile computing mode has been spawned through the coordination of the development of computing technology and wireless communication technology. Nowadays, a new exploration space for the database technology has been expanded by the needs for the database on the server system in the past by the rapid update of the mobile computing technology. The requirements for the function of mobile database system cannot meet the existing demand any more.

At present, the database system has become an essential component based on UNIX or the embedded control module of Android operating system. Because these SCM devices has been all over the automation control field, the application of the embedded database has been basically popularized in civil or military facilities, academic and engineering circles and industry or construction industry or agriculture. The foreign research of embedded mobile database technology has the following results:

Rutgers University is in a leading position in mobile computing field. It comprehensively studied the key technology related to the embedded mobile database. For example, mobile data management, mobile Internet, mobile data replication and data synchronization technology. And, the university has made many valuable research results.

Purdue University has studied the technologies for mobile data processing and replication of embedded mobile data and provided the effective practical scheme for the two kinds of technology. For example, data processing scheme for embedded mobile database and locking scheme.

## System Framework Design

### System Frame Diagram

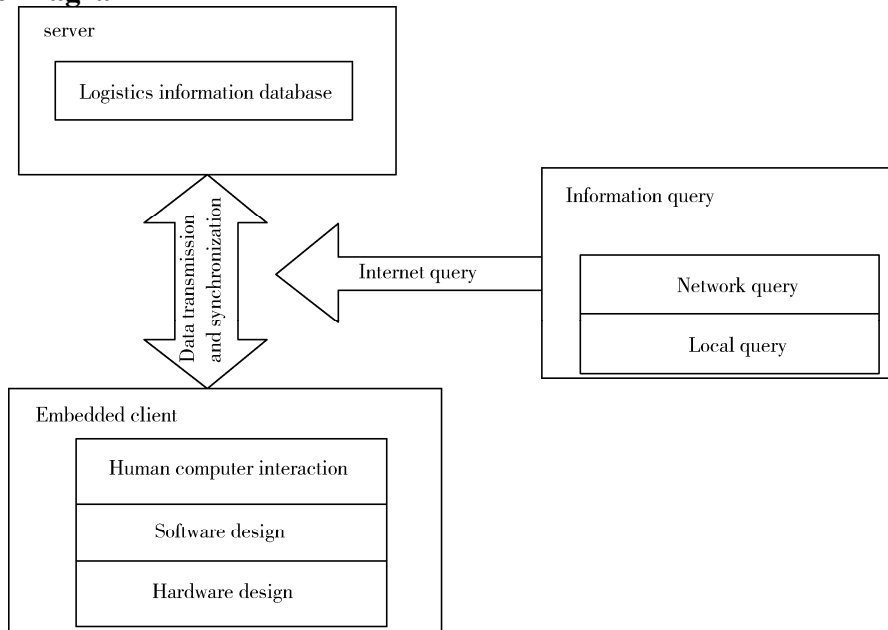


Figure 1. General Design Frame

### Description of System Functions

#### (1) Data Information Acquisition

In this system, we mainly use the GPS sensor to collect location information and check the ascribed provinces and cities through database query algorithm of the location information (latitude and longitude) and the information of which will be directly indicated on the map. In addition, the system also use photoelectric sensor to scan the barcode of order information and to acquire the two-dimensional code information. The two-dimensional code information will be synchronized to the server through the network and the server query database sends the order information to the embedded mobile terminal equipment for display.

#### (2) Data synchronization

To avoid occurring the error, we introduced the data synchronization function in design of this system. Through the data synchronization technology, data information could be shared between the server of the system and the embedded mobile terminal equipment without duplication of data information. No matter when and where, once information is changed, the system will automatically change the server data to achieve real-time data synchronization.

#### (3) Data Information Caching

After the data information acquisition, if the network connection is normal, the mobile terminal equipment can directly communicate with the server and achieve data synchronization. However, if the network is abnormal and even being disconnected, caching technology is used to temporarily save data information to prevent the loss of information, and the data will be synchronized to the server. Data could be acquired through the embedded terminal equipment. Repeated scanning operation is not available due to abnormal network.

#### (4) HTTP

HTTP is to artificially divide the upload or download task (a file or a compressed package) into several parts. Each part could separately upload or download. If network is abnormal, the previous transmission will be interrupted. When network connection is normal for a second time, it could continue to upload or download the part which is not uploaded or downloaded from the part which has been uploaded and downloaded. The user can save time and improve the speed.

## Function Modules Design

**Hardware Design for Embedded Mobile Portable Terminal Equipment:** Embedded hardware design for the system includes power supply, the smallest system, information acquisition module, display module, button, network transmission and the positioning module. As shown in Figure 2.

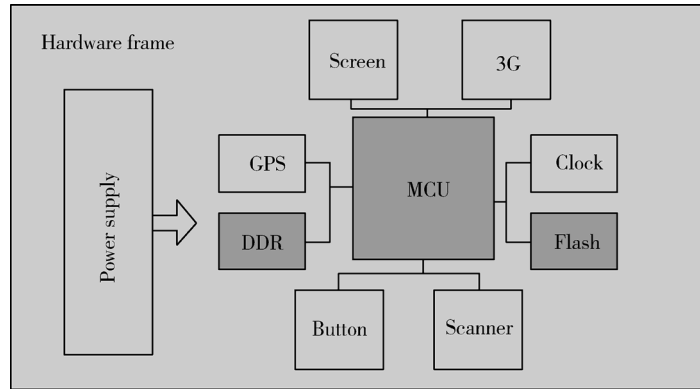


Figure 2. Hardware Design Frame

### (1) Power Supply Design

The common power supply adapter is to transfer the 220VAC to low voltage DC - AC-DC power supply. As the first stage conversion of power supply for the embedded system, AC-DC is also the most important conversion. Control the post-class output voltage through the different duty cycle of PWM signal. The chip is widely used in switching power supply. As shown in Figure 3

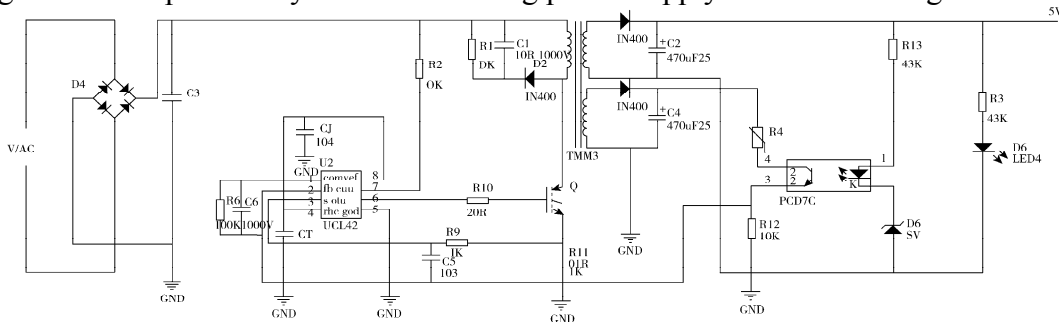


Figure 3. AC-DC Power Supply Design

### (2) Information acquisition module

Information acquisition is the most important part in whole logistics data management. It transfers the items or order information into computer binary language. Add the GPS position sensors, scanners and network card based on the minimum system. And, build the hardware circuit for the peripheral module of the MCU processor controls. As shown in figure 4.

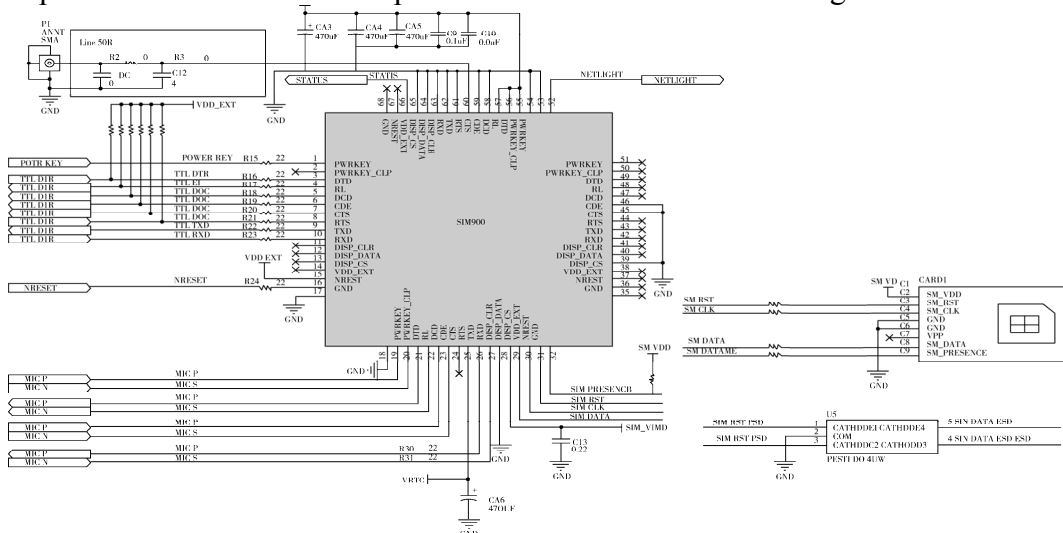


Figure 4. GPS Module

(3) Network Transmission

For the mobile logistics database data synchronization technology, it must synchronize the embedded mobile terminal equipment data to the server database and the function of data synchronization must be achieved at any time and any place. Therefore, we must adopt the wireless transmission technology. However, the current mainstream wireless transmission technology is the 3G network - WCDMA. Database synchronization function could be achieved by connecting the embedded mobile terminal equipment to the internet through the wireless internet technology and to communicate with the server.

(4) Display and Button

We add the LCD display and key control function while achieving synchronization of related data in designing. LCD display shows the scanning information and state tips. And, the auxiliary embedded mobile terminal equipment enables the user to operate the equipment smoothly. Control the embedded mobile terminal equipment by the button and touching screen to provide a convenient and visualized human-computer interaction interface.

**Design of embedded mobile database based on Android system:** Data in the three tables is involved by taking the embedded database of logistics industry as example.

First, the logistics manager table is used to maintain the logistics information table data and user information data table. Administrators with different permissions manage different data information and information of administrators could be synchronized to the corresponding embedded client database to facilitate the mobile data terminal to carry out maintenance for data. Second, the logistics information table is used to record the corresponding logistics information. User and logistics administrator can acquire the logistics information flow through the mobile terminal in real-time and achieve real-time scheduling arrangement. After completion of the whole process, user could view the corresponding recording information through the corresponding user name to facilitate the further tracing. The user information table is used for the server management and it is associated with a logistics information table. And, corresponding logistics information could be acquired through the users. According to the project requirements, the server could establish the database Logistics DB– logistics database through the SQL Server, and design the following database as shown in table 1:

Table 1. Logistics User

Field name	Data type	Data length	Blank (Yes/No)	Chinese description of field	Note
Userld	Int		No	Administrator id	Automatic generation of primary key
User Name	Varchar	50	No	Administrator name	S.N
User PWD	Varchar	50	No	Administrator password	Blank (No)
User Level	Varchar	50	No	Administrator level	Blank (No)

In addition, the client could use the WebService which synchronize the data in the server database to the mobile terminal database. It could achieve the corresponding synchronous transmission through the data which is transferred into Xml in the server so that the data base is updated.

**Database and XML optimization design**

In the procedure of calling WebService, response time may be increased correspondingly due to server or network transmission problems. At that time, the thread will be affected or even being blocked and the client is waiting or collapsing caused by the program. Then, method of asynchronous call WebService is used.

For the conventional Web method, it takes a long time to finish the corresponding request during returning the value. At that time, the thread will be a occupied all the times and it is kept in the state

of waiting. Then, a large number of server resources are consumed. Therefore, for the asynchronous call, it submits the Webservice method to the thread pool and it is implemented in it.

Second-time search optimization, when the retrieved data is static, the normal optimization scheme is to dynamically add new constraints under the existing search conditions. If the data retrieval conditions are rebuilt, the server shall carry out two times of interaction or download. Generally, a second-time retrieval method for data collection greatly reduces the burden of Web server and database server.

## Conclusion

In this paper, the data of the corresponding mobile terminal users in the server database will be automatically synchronized to the mobile terminal through the login software of the mobile end. Take the logistics software as example, it not only achieves that the user could check the corresponding data in real-time but also achieves that the administrator data and information of logistics vehicle could be synchronized to the mobile terminal of logistics administrator and achieves manage the server data and vehicle information in real-time. Synchronize the information to the corresponding server database through real-time management of logistics information and vehicle management, and data could be mutually synchronized in the database of each server.

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