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The System Design of Children's Medical Treatment and Health Care based on Mobile Internet

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Abstract

With development of medical technology, more and more population need the mobile medical service. As a vulnerable group, children need more medical treatment and health care than adult. But now there is no mobile medical service only for the children and guardian. In order to solve the phenomena, we design novel children's medical treatment and health care system based on mobile internet and cloud computing platform. This system includes emerging technologies for the sake of providing convenient and specific for the children population. From a long term, this integrate system will make a great contribution to the medical treatment and health care for the children.

Keywords*: children's medical treatment and health care, cloud computing, Android mobile platform, emerging technology, cloud push notification*

1. Introduction

Mobile medical treatment and health care is a new service mode that built on remote medical treatment system [1]. At present, because of the medical treatment resources is insufficient and mal-distribution, this will cause a majority of population in the world are not met for the need of medical treatment and health care. Meanwhile, the highly expensive medical costs and the complex medical procedure produce much more inconvenience about the patients. The process of training a right medical treatment staff need a long period of time, it cannot satisfy the rapid increase speed of the requirements for medical treatment resources. As for the children's, this group of population has the feature of disease multiple happen, so they need much more medical treatment resources.

For the above problems, the mobile internet medical system can effectively solve the problems. Doctors provide the online medical service based on the conventional internet or the mobile internet, the patients can choose a proper doctor by a professional self-assist terminals, after diagnosis the patients can uploading the diagnostic results, and interact the diagnostic messages. Patients also can give the image format of diagnostic results of disease characteristics to doctors, this can perform an across regions diagnosis and treat, it can without the limit of time and space. Medical informationalized [2] is an effective method to solve the problems of high medical cost and lack of medical resources and mil-distribution, it will become an inevitable direction in the future. Especially for children's, the children's who can use the mobile internet will have much more chance to choose a proper doctor for himself/herself, it will significant reduce the sick and death rate of children's.

According to the analysis above, in this article, we are aimed at design a novel system of children's medical treatment and health care based on the mobile internet. In this system, we can satisfy the requirements of children's population for the service of medical, accompany with the rapid development of clouding computing and intelligent technology, our built system based on the mobile internet platform and cloud computing, have a strong practical significance.

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2. Mobile Internet and Cloud Computing Platform

2.1. Android Mobile Internet Platform

Android system is based on the Linux system [3], the platform has four layers structure: Operating system, Middle component, Application software, User interface. It uses the stack way to construct the structure, in this stack structure, the function between layers are separated, so its division clear. This division way can guarantee a low coupling between layers, when we modify the lower layer, the upper layer do not need modify. The Figure 1 shows the four layers of android mobile internet platform. Because it has much more excellent characteristics, so in this article we choose the android mobile internet platform to construct our system of children's medical treatment and health care.

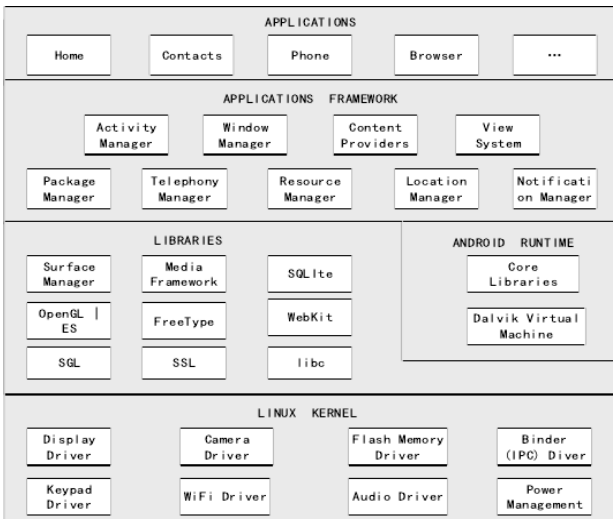


Figure 1. The Four Layers Structure of Android Mobile Internet Platform

2.2. Cloud Computing Platform

Cloud computing is a fusion product of conventional computer science and technologies[4], such as distributed computing, grid computing, parallel computing, utility computing, visualization, network storage technology and load balance. It can utilize large-scale low-cost computing units to compute in different places and via mobile internet platform to provide the computing and storage services. The computing platform has five basic characteristics:

(1)Large-scale: certain scales of nodes construct the system, and the system's scale can be expanding infinitely.

(2)Extend smoothing: the system has highly extendibility and elasticity, it supports the plug and play technology, increase and reduce resources convenient.

(3)Resource sharing: providing one or more forms of computing and storage sources pools, the resource sharing can be provided by abstract method.

(4)Dynamic allocation: Implement the resources automatic allocation management, including resources real-time monitoring and automatic dispatch, and providing monitoring and management.

(5)Across regions: Integrated the resources that distributed many physical nodes, and providing a unified resources sharing, and implement the load balance between nodes.

Because of the cloud computing technology has a best computing and storage capability, and the cloud computing platform can be compatible for various platforms, such as mobile internet platform, it can be seen in the Figure 2. In practical, the medical

treatment and health care system based on mobile internet platform need much more computing complexity and storage complexity, it must process the data between the different physical nodes, and these requirements can be handled by a cloud computing system. So, in order to build a new medical treatment and health care system on an android mobile internet platform, we need using the cloud computing platform to complete the computing and storage for us. In a word, we build the novel medical treatment and health care system based on Android mobile internet platform and Cloud computing platform.

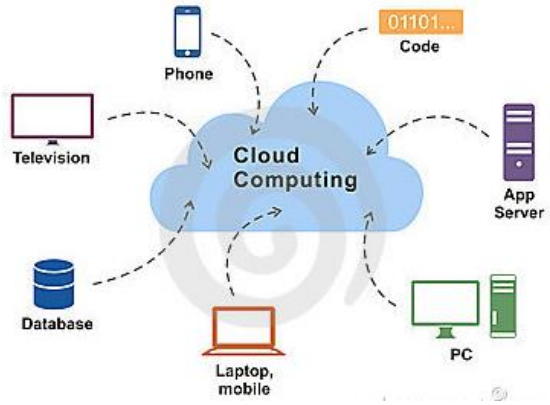


Figure 2. The Cloud Computing Platform and the Various Compatible Platforms

3. Children's Medical Treatment and Health Care System

The system of children's medical treatment and health care are designed as described in the Figure 3. We design two roles in whole system called user portal and management portal. In the user portal module, we design various medical service for children users, such as diagnosis and treat service, health care consult and bailout. In the other management portal module, we design back-office support service for users, such as system configuration management, hospital management and so on.

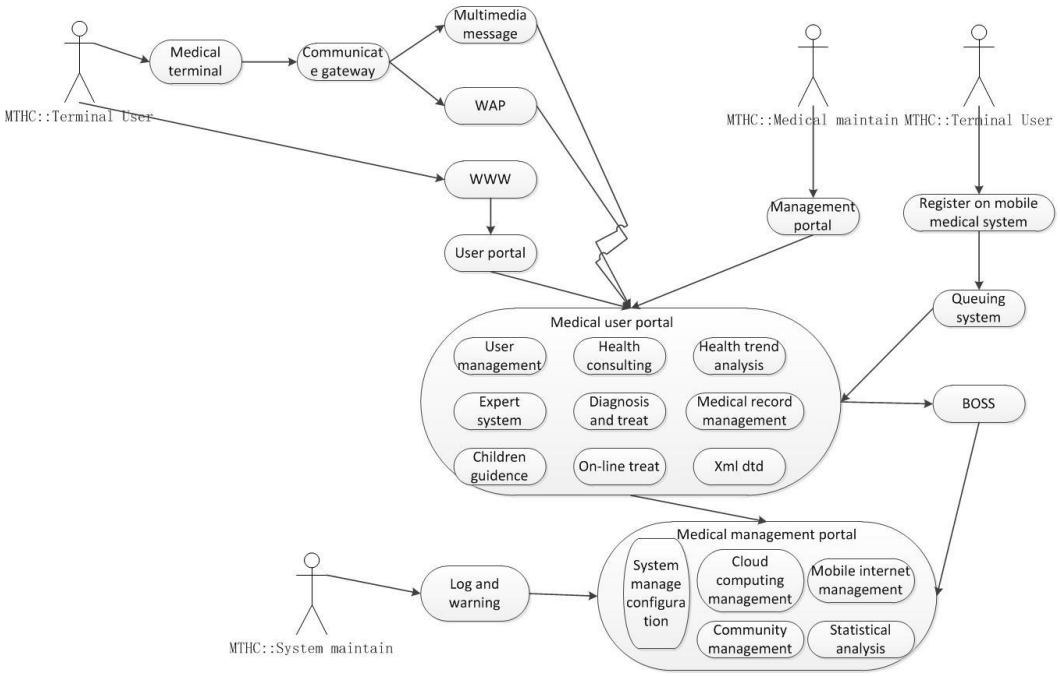


Figure 3. The System of Children's Medical Treatment and Health Care

First, we give the application scene graph (Figure 3) to form a frame of our system, our system have two main portals for children's medical treatment and health care. After giving the main structure of our system, we will give the detail design as follow.

3.1. Database Design

The database is a core technology of a mobile cloud computing system, it can define the basic characteristic of the system. A good database design will lead better system design. In the article, we use the SQL Server database software to build the database of our system [5]. We design all of eight tables, such as User(children) table, Hospital information table, Doctor information table, Department dictionary table, Disease information table, Push consulting table, Disease consulting table and Doctor's advice table. None of them can be dispensed with. As an example, we give the User table and Hospital information table in the database, as described in Table 1 and 2.

Table 1. The User table

Field name	Description	Data type	NULL or NOT	Index
ID	ID number	Int	Not	Primary
Cn	Children name	Varchar(20)	NULL	
Sex	Sex	Int	NOT	
Mh	Medical history	Varchar(20)	NULL	
Gua	Guardian	Varchar(20)	NOT	
Gua tele	Guardian telephone	Int	NULL	
Addr	Address	Varchar(20)	NULL	

Table 2. The Hospital Information Table

Field name	Description	Data type	NULL or NOT	Index
ID	ID number	Int	Not	Primary
Hn	Hospital name	Varchar(20)	NULL	
Addr	Address	Varchar(20)	NOT	
Lmtel	Linkman telephone	Varchar(20)	NOT	

Email	Email	Varchar(20)	NOT	
Ad	Attending doctor	Varchar(20)	NULL	
Pc	Postcode	Int	NULL	

3.2. System Business Process

After building the database for the Children's Medical treatment and health care system (CMTHC), we can construct the business process of the system. The CMTHC system aim at providing a novel and convenient way to implement the medical treatment and health care. This system especially design for the children, and provide the individual medical information storage function and doctors, experts communication function, the children's guardian can use this platform complete seek a medical treat, and do a medical treat on the mobile internet, it will reduce the distance of space, and share the resources among all hospitals and doctors, that will bring a novel way to treat the disease that children suffered.

The clients are two individual modules, children and guardian user module and doctor module. The user module provide register account, and login the application, besides, we implement the remote consultation, daily remind, health record management, peripheral service, first aid position, life tips important functions in the user client. The doctor client, we implement answer user consult problem, inquire sick children health record and the push messages functions. The CMTHC system's clients are installed on the Android mobile phone of users and doctors, respectively. As shown in Figure 4, we give the CMTHC system's business process.

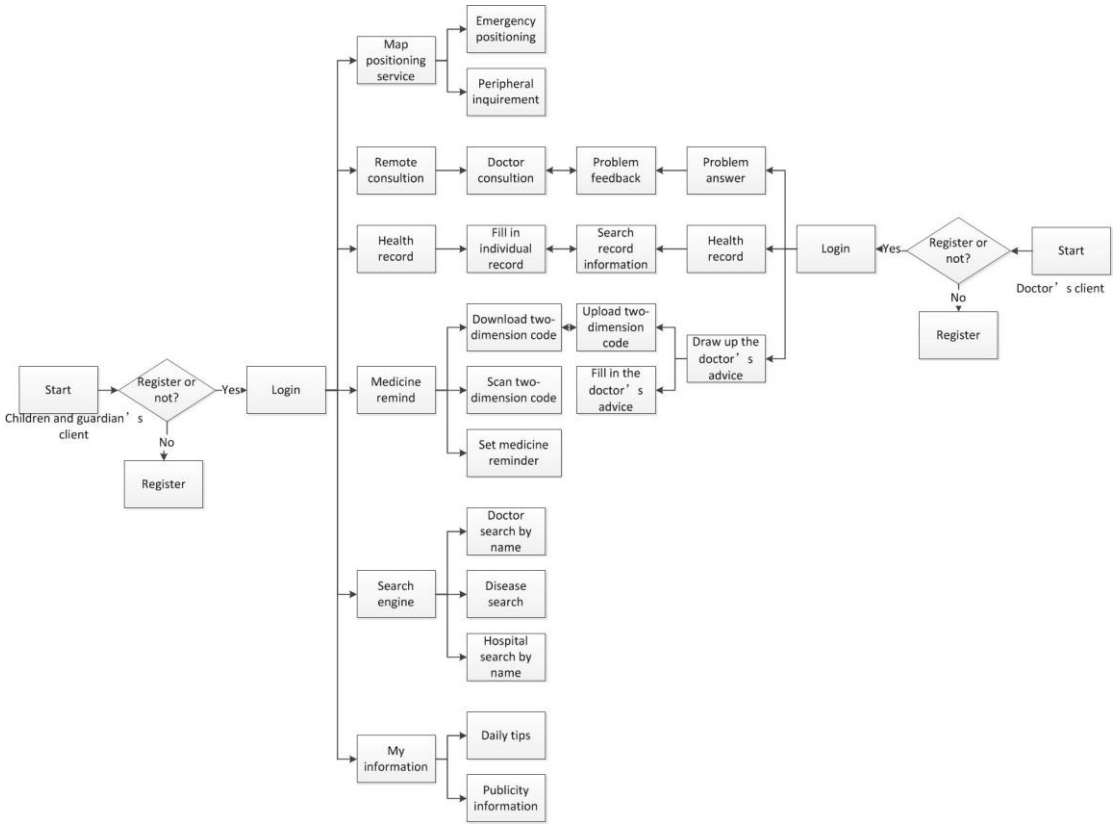


Figure 4. The CMTHC System's Business Process

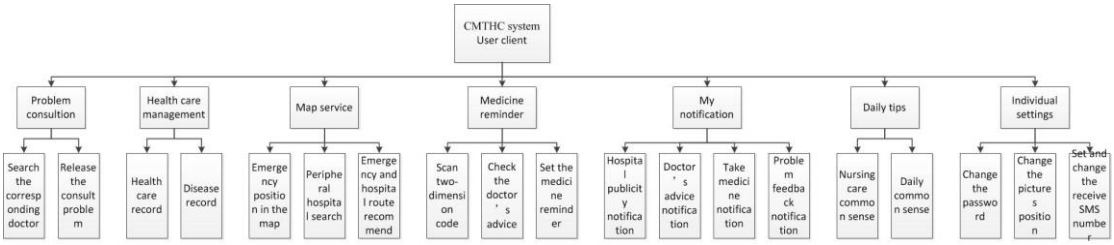
When the children have been ill, the guardian use the client to consult the problems, and the system will choose the specified doctor. Then the guardians upload his/her problem, and system pushes the problem to the corresponding doctor's client. The doctor then check the problem, and examine the disease of the children, and check the user's

health record, according to the comprehensive information, give the doctor's advice on the client, and feedback the advice in time.

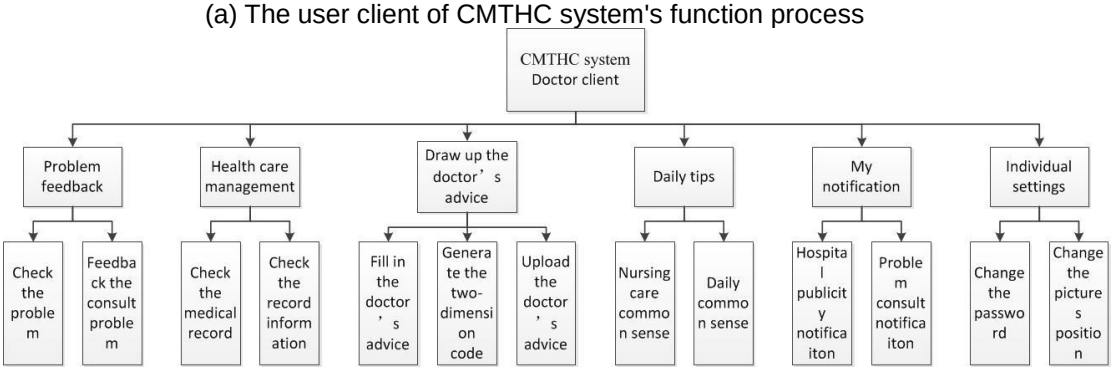
The doctor fill in the answer for the disease of the children, and system will save the answer into the database, and using a novel technology to generate a QR code for the answer. Then the user client can download and scan the QR code to seek the doctor's answer for the problem, check the medicine information, and set the medicine reminder. The other functions for the users, is also very useful, children will get medical treatment in time, and get the protection of health care all-weather.

3.3. System Function Process

In the CMTHC system, there are two roles of client, the children and guardian's user client and the doctor client. In the user client, we implement the functions of problem consult, health record management, map service, medicine reminder, and information alert, daily tips and settings management. In the doctor client, we implement the functions of problem feedback, health record management, and doctor’s advice fill in, information reminder, daily tips and settings management. From Figure 5 we can see the system's function process of whole user client and doctor client.



(a) The user client of CMTHC system's function process



(b) The doctor client of CMTHC system's function process

Figure 5. The System's Function Process

4. Main Modules for Children Medical Treatment and Health Care System

We have built the system on the Android mobile internet platform based on the cloud computing platform. Differ from the conventional medical and health platform; we implement four particular functions based on the cloud computing platform. These functions are the characteristic of our system.

4.1. Push Notification Service Module

The conventional Medical treatment system based on B/S architecture, the customer's client can require the information from server, and the server then send information to the client. Without requirement, the server cannot send information to the customer. Besides, the customer's client need to dynamic listen to the WEB server to connect to the server all the time, this way will lead to the client's Mobile equipment frequently opened the wireless communication module. The persistence of opening services on a Mobile phone will waste a low of battery. In order to solve this problem of conventional B/S architecture, we use the cloud push notification service(CPNS) instead of the conventional dynamic requirement in the CMTHC system[6], this push service include reminding the user to get the newest medical information and problem feedback at the first time.

The CPNS is a cloud server agent, the server do not send information to the client directly, but send information to the cloud server agent. And the client gets information from cloud server agent. Figure 6 give the technological process of CPNS, from the figure, we can see that the cloud server agent is the intermediary of the B/S architecture. The server need only send information to the cloud server agent and the client need to check the cloud push notification. Other things are completed by the cloud server agent.

When the cloud server agents get the information, it will choose a proper time to send push notification to the client. After sent the push notification, cloud server agent will return a receipt to the server, this receipt expresses the information was received by the CPNS, and it will find a proper time sent the information to the client. If the information cannot be sent to the client, CPNS will return an error code to the server. When the servers get the error code, it will resend the information to CPNS.

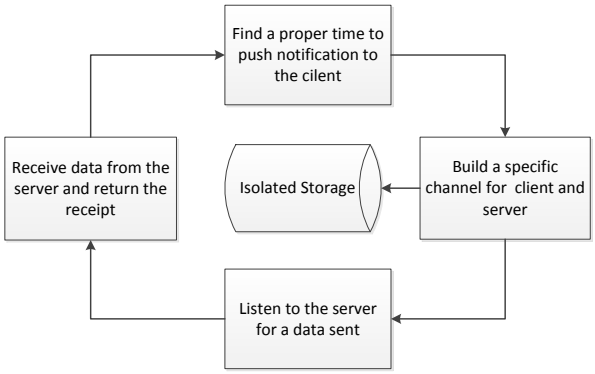


Figure 6. The Information Communication by Cloud Platform in the CMTHC System

4.2. QR Code Generation and Analysis Module

In the module of medicine remind, the doctor using doctor client to fill in the doctor's advice, this information will push to the corresponding children and guardian user client by CPNS. When user client get the doctor's advice, he/she can extract the time and dose for the medicine, and set the medicine reminder. On the basis of this process, our system research a new convenient way for the service. Our system's function will code the doctor's advice to a QR code image [7], and then upload the code image to CPNS, or store in the local to print on the medical record. The user client can use camera on the Android mobile phone to scan the QR code or download the code image from CPNS, this way will save a lot of operations, make it more convenient.

The doctor's advice QR code generation and analysis process include two main steps; we described them in the Figure 7.

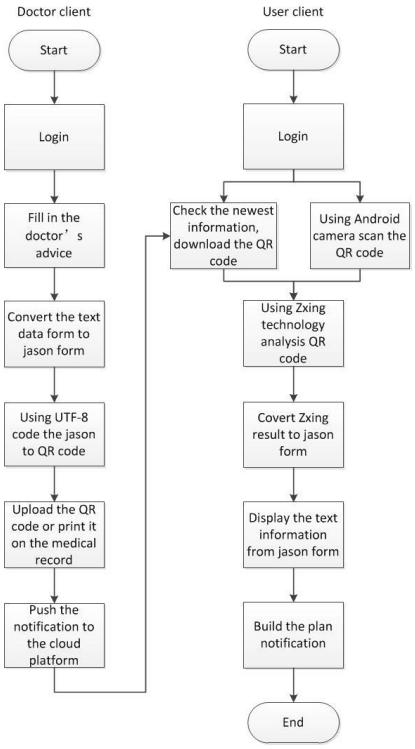


Figure 7. The Process of Doctor's Advice QR Code Generation and Analysis

In the process, the doctor take charge of fill in the doctor's advice, and the user need only scan the QR code or download the QR code to get the doctor's advice; this is a simplified process for information transmission. In the system, we will use ZXing open-source project's function "encode" to convert jason information form to a QR code, and then using "decode" to convert QR code to jason information form. The jason information form will increase the information transmission speed in a mobile internet platform, so we choose convert the text information to jason information form to get a rapid transmission.

4.3. Remote Health Consulted Module

Remote health consulted module is a significant function in the CMTHC system for children. Differ from adult, the children have more fragile body and easy to be ill, so this population needs more health consulted. Children and guardian user can search a proper expert in remote region on the CMTHC system, and fill in the disease condition and problems that need to consult; this information will be sent to the cloud platform. The doctor can check the problems that patients asked about their illness and health condition from the doctor's client, and combine the patient's health record to complete diagnosis whenever and wherever possible. This way will implement the patient and doctor communication remote, that balance the resources of medical.

The remote health consulted module adopt the fuzzy query technology [8], users can get a synthetic search result by using doctor name, disease name and hospital name. When the input key-words are matched by the "three" fuzzy search words, the module will give the search results that include key-words.

When a user submits a query problem, the CPNS will push the notification to the doctor that user specified, and tell the doctor that there are some problems need to be handled. The information communicate mode adopt database push mode, it have four concrete steps:

(1) Add a monitor information table with the name of "Watch", and set a trigger for it.
(2) When the database searched that the table has been updated, the trigger will insert a new record in the table of "Watch".
(3) The database pushes the added information in the table of "Watch" to the server. Server will search the database to get the newest information.
(4) According to the results of query returned, if the record's solution and time is NULL, then the server will turn to search the doctor name field, and search the corresponding account by "User" table that we described above, after get the searching result, server will push information to the CPNS. Else if the record's solution and time is not NULL, then search the corresponding user name field, and send problem feedback information to the user's client.

4.4. Map Service Module

In order to implement the significant function for the children that have emergency disease, and provide the convenient and rapid search for the nearest hospital, our system implement the map service module. This module uses "Baidu maps" platform to set up the development environment [9]. And utilize the "Android system Api" built-in functions, which implement positioning related functions and position awareness flexibility.

Combing the characteristic of various positioning method, the module can choose different positioning method by means of detecting the user's scenario, we provide the WiFi and GPS positioning method and the fusion method [10]. This dynamic method will effectively balance the relationship between battery consumption and positional accuracy. Besides, we deploy the positioning database on the cloud platform, the Android mobile platform using "Web Service method" to communicate with cloud platform, and return the query results.

We use the positioning database that providing by "Baidu maps", the database records the specific mobile phone base station and WiFi access point position, the recorded information include base station identification code, the MAC address of WiFi access point, the relationship between coordinates and positions. Users can use mobile phone detecting the WiFi access point and get the base station information, then compare the information with the database, then the system can using the following two information to calculate the approximate position of the user's Android mobile phone. We can see the process of positioning in the Figure 8.

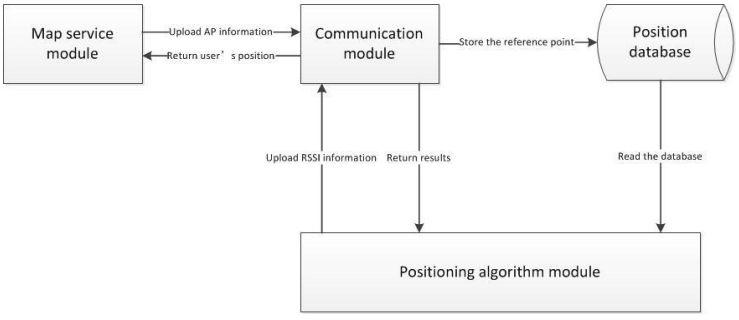


Figure 8. The Process of Map Service Module in CMTHC System

5. Conclusion

In this article, we create a new system for the need of Children's medical treatment and health care. We call it CMTHC system, and the system was built on the Android mobile internet platform and the Cloud computing platform. In the requirement analysis, we give the use-case diagram to describe the system's functional requirement and performance

requirement. After the description of requirement analysis, we give the database design and the design of system's business process and function process. In order to meet the need of Children and guardian, we bring out four novel modules for the user client and the doctor client. They are push notification service module, QR code generation and analysis module, remote health consulted module, map service module. These services are based on the emerging technology, such as cloud push notification service, QR code, fuzzy query, GPS positioning technologies. These new technologies are based on the Android and Cloud computing platform. From the system's architecture, we can see that our system can meet the need for the burgeoning population, especially for the children. This system includes emerging technologies for the sake of providing convenient and specific for the children population. From a long term, this integrate system will make a great contribution to the medical treatment and health care for the children.

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