

# Design and Realization of Multifunctional Medical Self-Service Terminal

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**Abstract**—According to the problem of long time waiting for registration, paying and inspection and short time for diagnosis and treatment in hospital which revealed in the traditional outpatient service process and based on hospital-bank cooperation mode and the existing medical information system in a hospital, with the conception of integration, a multifunctional medical self-service system fitting for hospital has been designed and implemented. A series of self service functions such as starting card, registration, report fetching and payment have been designed which has achieved data seamless transformation between HIS, LIS, Unionpay, Medical insurance and Citizen card, so the patient's medical information has integrated and has provided basic information for building electronic health document.

**Keywords**—Hospital-bank cooperation, Multifunctional, Medical care self-service, Design, Realization.

## I. INTRODUCTION

The concept of self-service first appeared in the banking and telecom industry. In recent years, due to its portable, flexible and unattended operation characteristic, it has found applications in the medical care industry, which has drawn wide attention of the hygiene administration department and hospital institutions of all levels. Currently, banks are actively seeking their cooperation with medical care institutions and promote the bank-hospital cooperation projects relying on their advantages in terms of self-service operation and payment. Owing to the bank-hospital cooperation mode, the popularity of self-service devices in hospitals has been accelerated. However, the utilization rate of the medical care self-service devices is extremely low. The main reason is that self-service devices in hospitals dominated by banks pay more attention to economic profits rather than the demands of hospital services and the user experience of patients. Thus the user experience of self-service devices in hospitals is not favourable. The incomplete device functions also result in the inconvenience of patients, who are thus reluctant to get help from them [1].

Considering the above problems existing in the bank-hospital cooperation projects dominated by banks, the First Affiliated Hospital of Wenzhou Medical University (hereinafter referred to the "First Affiliated Hospital") has formed a hospital-bank cooperation mode with the R&D dominated by the hospital and the bank providing fund and human resources support. Under the cooperation mode, the first affiliated hospital has carefully reformed our medical treatment procedures and studied users' demands according to

years of experiences and the practical situation of the First Affiliated Hospital. Based on that, a multi-functional self-service terminal for outpatient and hospitalization services has been designed and developed [2]-[3].

## II. HOSPITAL-BANK COOPERATION.

The hospital-bank cooperation mode of the First Affiliated Hospital means the development process of medical care self-service terminal to be jointly completed by the hospital and the bank. The cooperation mode is that the bank gives the fund support during the project development and the personnel support after the launch of the self-service terminal. In terms of fund support, all the expenses of the project are undertaken by six banks; in terms of personnel support, after the launch of the self-help devices, banks should send personnel to guide users to use the self-help devices to handle some formalities without occupying human resources of the First Affiliated Hospital. At the same time, banks can absorb funds through the self-help terminal in the hospital. In this way, a win-win pattern among banks, the hospital and patients, is taken shape. The characteristics of the hospital-bank cooperation mode of the Frist Affiliated Hospital: 1) The hospital-bank cooperation can reduce the cost of the hospital and the introduction of multiple banks can form a competitive mechanism to maximize the interests of patients and the hospital; 2) The hospital is always in a dominant role. The dominant role of the hospital can curb the excessive commercialization of self-help services and guarantee the interests of hospitals and patients.

## III. HARDWARE CONSTITUTIONS

The system consists of the IPC, ID card reader, touch screen systems, magnetic card reader, card control system, system management software, paper currency acceptor system, printing system, monitoring system (monitoring operation of the user) and POS terminal. The system architecture of multifunctional medical self-service terminal is shown in Fig. 1. The following part will give a brief introduction of its hardware composition:

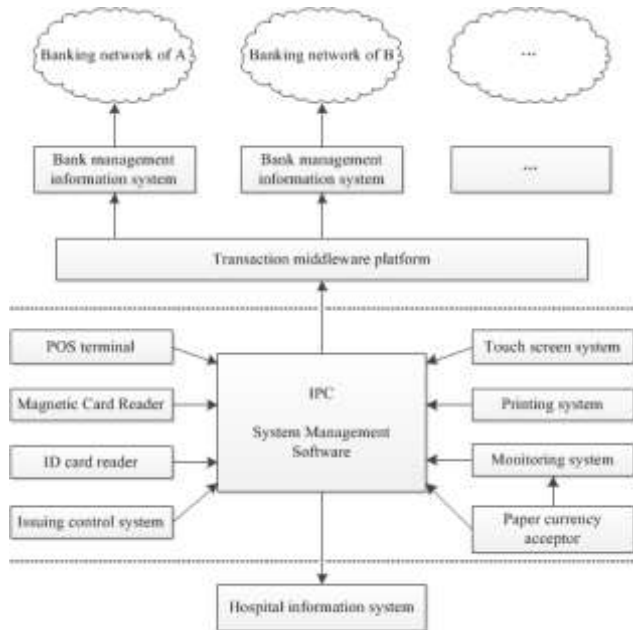


Fig. 1 The system architecture of multifunctional medical self-service terminal

A. IPC

IPC or industrial personal computer is based on PC bus. Its major parts include the industrial crate, the passive backplane and various board cards which can be inserted into the IPC, including CPU card, I/O card and so on. Designs like the all-steel machine shell, machine mound bar filter and double positive pressure fan as well as the electromagnetic compatibility (EMC) technique solve the problems of electromagnetic interference, vibration, dust and high/low temperature.

B. Card reader

The card reader of the system can be divided into two cards, namely the magnetic card reader and the ID card reader. Both kinds of the card reader are connected with the host computer through the USB interface. The former is used to read the information on users' health card and the latter is used to read users' ID card information based on the products certified by the Ministry of Public Security of the PRC.

C. Printer

The system integrates four kinds of printers, namely the laser printer, the thermal printer, the stylus printer and the film printer. They all feature USB interface. The laser printer is used to print the payment list, medical records and test reports; the thermal printer is used to print the medical treatment guidance and vouchers; the stylus printer is used to print the receipts; the film printer is used to print the image film of patients.

D. Paper currency acceptor

The paper currency acceptor aims to achieve the cash pre-deposit function. Adopting MEI CASHFLOW® BNF, the paper currency acceptor can identify paper money with the face value of 5RMB, 10RMB, 20RMB and 100RMB. It can handle more than 30 pieces each time and 500 pieces at most. The paper currency acceptor is shown in figure 2.



Fig. 2 The paper currency acceptor

E. POS terminal

The bank's POS machine is connected with the system through RS-232C serial port. For the sake of safety, this system specially designs the push-pull rod system for the POS machine. When the bank transaction is conducted, the system will start the POS machine automatically. When the transaction is done, the POS machine is pulled back and hidden. The electric push-pull rod system is shown in figure 3.



Fig. 3 The electric push-pull rod

IV. DESIGN OF SOFTWARE

The system covers more than 20 functional modules of outpatient and hospitalization services. The C/S architecture is adopted and Oracle 11g serves as the backstage database. PowerBuilder 11.5 is used for the development [4]-[5]. The connection with the Hospital Information System (HIS) of the hospital terminal realizes the self-support of HIS. The connection with the core business system of the bank terminal realizes the pre-deposit function of the diagnosis and treatment card. The backstage management platform in the system realizes the account checking, statement management and other relevant functions between the bank and the hospital's HIS. The following part will introduces the major functions of the system:

A. Self-help medical care card handling

Users choose "Handle he medical care card" on the main interface of the self-help device. Then the screen will remind the user to insert the second-generation ID card. The system uses the interface function provided by the second-generation ID card information collector. The ID card information read by the system will be displayed on the screen. Then the user is required to type in the contact number and deposit certain amount with cash or bank card in advance. After that, the system uses the card-issuing system to write the health number of the patient generated by the system into the card, and the name and health number of the patient will be printed on the card surface. In this way, the self-support card issuance is realized. The ID card information collector is connected with the self-help terminal device through the RS-232C serial communication method, and provides the interface function, which is packaged in cardapi2.dll. The function to read the ID card information is GetPersonMsgA (ref PERSONINFOA

pInfo, string pszImageFile. The input parameter is the file name and storage path of the information collected by the collector. The output parameter is the ID card information analysed by the collector. The partly code of reading ID card information is shown in figure 4.

```

String ls_path
IF ib_initok = False Or Not FileExists("c:\license.dat") THEN
    RETURN False
END IF
IF as_pszimagefile = " Or IsNull(as_pszimagefile) THEN
    ls_path = "c:\wyyy_szf.bmp"
ELSE
    ls_path = as_pszimagefile
END IF
of_reset()
PERSONINFOW PERSONINFO
IF GetPersonMsgA(PERSONINFO, ls_path) = 0 THEN
    of_save(ls_path)
    RETURN True
ELSE
    RETURN False
END IF
    
```

Fig. 4 The code of reading ID card information

**B. Cash pre-deposit**

Users choose “Cash pre-deposit” on the main interface of the self-help machine. The screen will display the user’s pre-deposit account information and the operation procedures. At the same time, the system uses the interface function to initialize the paper money machine and the video monitoring system. Press “Star the cash pre-deposit,” and the user can start inserting coins or insert the paper money which is 60% new one by one into the paper money inlet. The system uses the corresponding interface function to finish paper money checking, collecting and pressing. The operation will be ended by countdown or that the user presses “End the cash pre-deposit.” The system will obtain the total amount deposited by the user and save the data to the user’s pre-deposit account. The interface functions of the paper money machine are packaged in the library file, “MEIAPP.dll,” such as startPayout(), stopPayout() and getAllMoney().

**C. Pre-deposit through the bank card**

Users choose “Pre-deposit through the bank card.” Then the screen will display the patient’s account information and the operation procedures. The user enters the pre-deposit amount. The user enters the pre-deposit amount. Then the system will push forward the POS machine through activating the POS machine push rod with the serial port. At the same time, the POS machine will be driven. The user can directly use the bank’s POS machine to swipe the bank card or transfer money. The operation of the bank card is fully realized through the bank service. After the operation ends, the bank will show the transaction message. If the transaction is successful, the transaction message is “0000.” Then the system will deposit the transaction amount to the patient’s personal account. The bank transaction process is shown in figure 5.

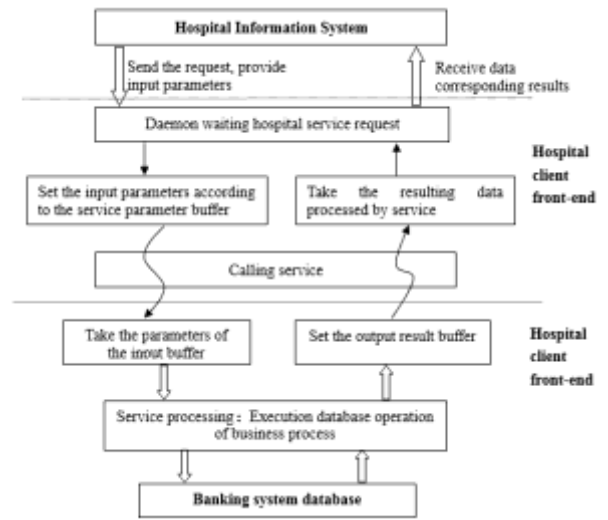


Fig.5 The bank transaction process

**D. Payment**

Users can check the doctor’s advice on the medicine intake, inspection result and treatment with their account information. If without dissent, the patient can choose to pay the full amount or part of the amount. The payment operation is conducted through the pre-deposit withholding module of the financial system. The workflow chart of payment is shown in figure 6.

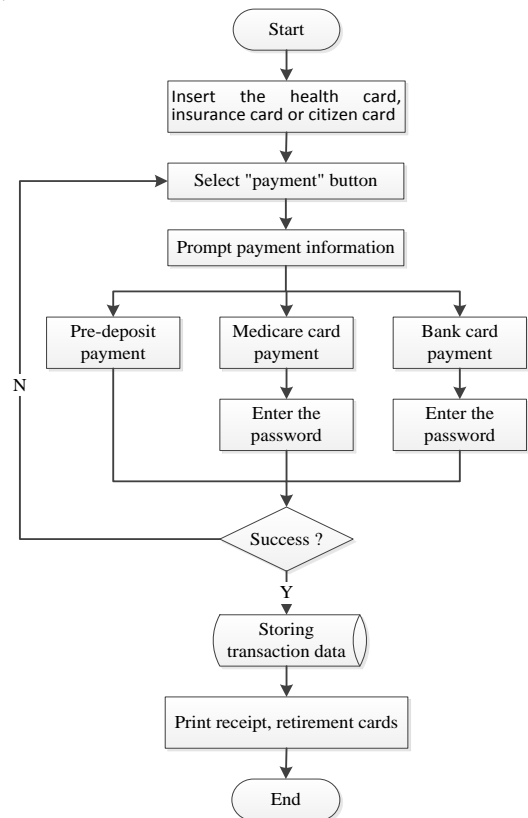


Fig. 6 The workflow chart of payment

**E. Account check**

The hospital and banks should check the account. The hospital chooses the account checking date (the chosen date should be smaller than the current date) and sends the account check request data package to banks. The account check time

should be within the transaction time of banks (00:00:00~23:59:59). Banks can check the transactions and the transaction amount of the account checking date and send the account checking feedback data package as well as the transaction list of the account checking date to the hospital. The system automatically checks the account based on the data of the hospital and banks.

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#### V. CONCLUSIONS

Focusing on the problem of long time waiting for registration, paying and inspection and short time for diagnosis and treatment in hospital which revealed in the traditional outpatient service process, with the existing medical information system, for the convenience of patients and improve efficiency, a multifunctional medical self-service terminal has been designed and implemented, which laid the foundation for self-service outpatient and emergency mode. First, the use of ID card for applying a health card avoids the manual entry of basic information about the patients, and more convenient than manual handling. Second, the self-service terminals is unlimited by time, so that it can be used any time in 24 hours a day. With understandable explanation in user interface of the system for operating easily, the patients can transact the relevant business quickly. Third, the self-service terminal without manual operation, avoids manual transaction process, and reduces artificial service window so that reduces the human cost of hospital. Since the system has been applied, it is running stable, and achieved good effect. With the development of the internet and the mobile smart devices, the medical care self-service will get rid of the shackles of time and space to be more and more popular. With the increasing number of people recognizing the medical care self-service, the research focus should be on how to provide the quality medical care self-service.

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#### VI. AUTHOR DETAILS



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