

# Intelligent Reminder System of Having Medicine for Chronic Patients

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*Abstract:* - This research is originally creative research, and already applied patent under authority of Patent Bureau of Taiwan (applying case number: 095121418). People living in modern society are full of much pressure from all kinds of environment everyday and with the great change of dining habit people easily have many chronic diseases. In addition to causing huge damage to individual health, it also cost much society medical resource. Most chronic diseases need special care from nursing staff to remind of when to have the correct medicine. It is naturally proceeding in wards but patients usually forget to punctually have medicine once they leave the hospital and get back home, and this situation neglecting or forgetting to have medicine according to doctors' instruction often causes many un-fortunate deaths of patients resulting in offsetting-less for individual and family. Owing to the speedy development of communication technology and semiconductor, GSM communication module can be integrated and embedded into single chip and let GSM be carried into many products to increase the added-value of products. So how to combine microprocessor with communication module to construct a safe, intelligent, and full-purpose monitoring system for individual to have medicine to solve the problem mentioned above becomes an interesting issue for us. The research category of this study are including a medicine box as the main part of product which includes GSM module, speech-functional DSP, control panel displaying all information for patients, medicine detecting function, and a single chip microprocessor to operate the monitoring function. On the other hand, the interface of the commander terminal PC in nursing center, instructing all information for patients to punctually have medicine, is developed by us programming with VB language. The system function was verified completed successful and could be published for commercials for its creativity and practical purpose.

Keywords : GSM communication module, speech-functional DSP, Intelligent monitoring, Microprocessor, Interface

## 1. Study Motivation

People living in modern society are full of much pressure from all kinds of environment everyday and with the great change of dining habit people easily have many chronic diseases. In addition to causing huge damage to individual health, it also cost much society medical resource. Most chronic diseases need special care from nursing staff to remind of when to have the correct medicine. Owing to the speedy development of communication technology and semiconductor, GSM communication module can be integrated and embedded into single chip and let GSM be carried into many products to increase the added-value of products. So how to combine microprocessor with communication module to construct a safe, intelligent, and full-purpose monitoring system for individual to have medicine to solve the problem mentioned above becomes an interesting issue for us.

## 2. Study purpose

Base on the study motivation mentioned above, The research category of this study are including a medicine box as the main part of product, including GSM module, speech-functional DSP, control panel displaying all information for patients, medicine detecting function, and a single chip microprocessor to operate the monitoring function. On the other hand, the interface of the commander terminal PC in nursing center, instructing all information for patients to punctually have medicine, is developed by us programming with

VB language. The monitoring system has dynamic monitoring screens, auto-oral -notifying system, alarm system, timing & procedure management for having medicine, and auto-tracing patients system by GSM system to deal with all kinds of patients without punctually having medicine.

The whole system has superiorities such as bi-direction communication-interface being able to real-time manage all emergency, and notify close friends or family of the patients whether they having medicine according to planed schedule punctually or not so as to further protect their health.

## 3. Importance of the Research

It is wonderful to concrete the conception "implementing knowledge into real life" and try to lead automation conception into daily life; furthermore, let people feel the convenience and practical function of technology.

This system make it significant that the mission of simple but not being neglected for having medicine of patients is taken over by hospital through auto-detecting system in the medicine-box and monitoring on servo computer in nursing center and can insure patients' having medicine according doctor's prescription punctually as well as their health. This invention also provided records of chronic patients to make patients having medicine simple, informational, and systemic. Furthermore, in this system, combining computer communication function, GSM wireless system, and serial communication technique of microprocessor to becoming local communication system not only obtain a

complete communication system but also enrich the extra-value of unique system.

#### 4. Software and hardware structure

The whole system-structure of the medicine box for certain individual patient, in which an intelligent monitoring system was designed and whole circuits was PCB-layout in the box, was shown in Fig. 1. The system included GSM communication module that collected patient's information of having medicine and transmitted the information to the nursing center in hospital as well as collected the response information from center for being indicated on medicine box to correctly decoding the echo code as to control alarm-system, oral-message and LCD displayer to remind patient to have medicine punctually.

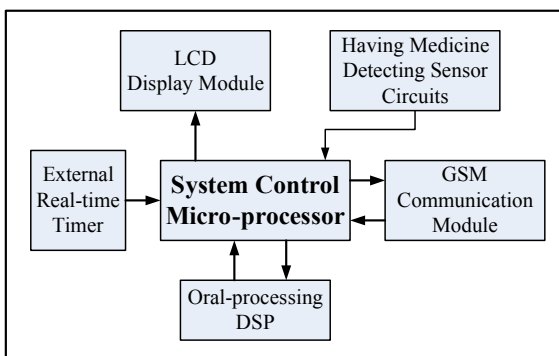


Fig 1. Patient's medicine-box system structure

System control microprocessor [1],[2],[3] in patient's medicine-box was responsible for scanning the condition of sensors that detected the status whether the medicine was had by patient on time or not and coded those statuses before transmitting the information to GSM module which would send back to nursing center in hospital in time to proceed proper response. Meantime the alarm-light on every unit collecting medicine and built on medicine-box would flash to notify the patient to have the medicine. The LCD module would display the information including whether punctually having medicine, the message receiving from main console in nursing center in hospital far away, the patient's coding No., present time, the name of the medicine, and what meal of medicine the patient should have. Chinese characters coding database [4],[5] was used to transfer information into Chinese to display on LCD displayer. External real-time provide the real time base for system as reference time on slave device---medicine-box.

#### 5. Project Design

The whole system of Intelligent Reminder System of Having Medicine for Chronic Patients could be designed with five sub-systems as following:

- (1) System circuits of scanning status of having medicine.
- (2) Full-multiplexer local communication system

- between GSM module in medicine-box and main console in nursing center in hospital far away.
- (3) Point-matrix TFT-LCD displayer system.[10]
- (4) Sensors to detect status of having medicine.[1]
- (5) Oral-processing DSP system.

The description of all sub-system explained as following.

#### 5.1 System Communication Structure

As shown in Fig. 2, The whole structure of reminder of having medicine was constructed with one medicine-box which was detecting condition of patients having medicine by some special sensors circuit controlled by a microprocessor in it and sent the status of those condition to Main control console by GSM communication module (the main console could be located in hospital nursing center far away from or in PC of patients' houses) which could access time of having medicine according to every meal and sleep time of patients through designed graphic interface with Visual Basic language. Every time when patient ought to have medicine, the main console would transmit message to SMS module through Com port. The Slave device called medicine box would receive the message and the microprocessor in medicine box would decode control code from main console and correctly response what action should be taken.

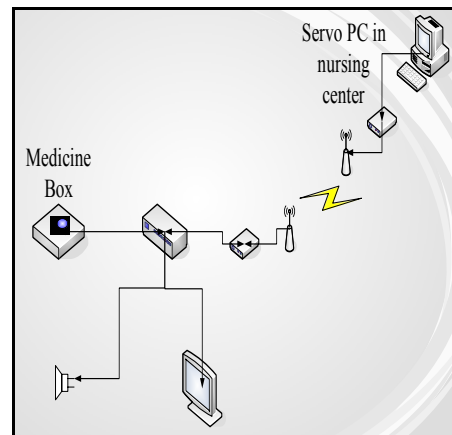


Fig 2 Conception of system communication structure

The main tasks of Slave device (medicine-box of patient) are

- (1) Receiving SMS message transmitting through GSM from servo PC (main console) in nursing center in hospital far away including schedule of having medicine, password, patient's name, time for having medicine, name of medicine.
- (2) Scanning the real statuses of having medicine indicated on the medicine-box. When receiving command message from system processor on medicine-box, the detected circuit would scan every medicine collecting unit whether the medicine was had by patient punctually or not through sensors circuits, and then response the status code to servo PC in nursing center to take proper action.

- (3) Alarm device, which would send out related information onto LCD displayer as well as oral message and flash led to warn the patient not having medicine in time and even automatically call out to the patient if he or she was outdoors. But if the medicine was had in time then the message would be ignored.

The planned software flow-chart of operating procedures for medicine-box was shown in Fig. 3.

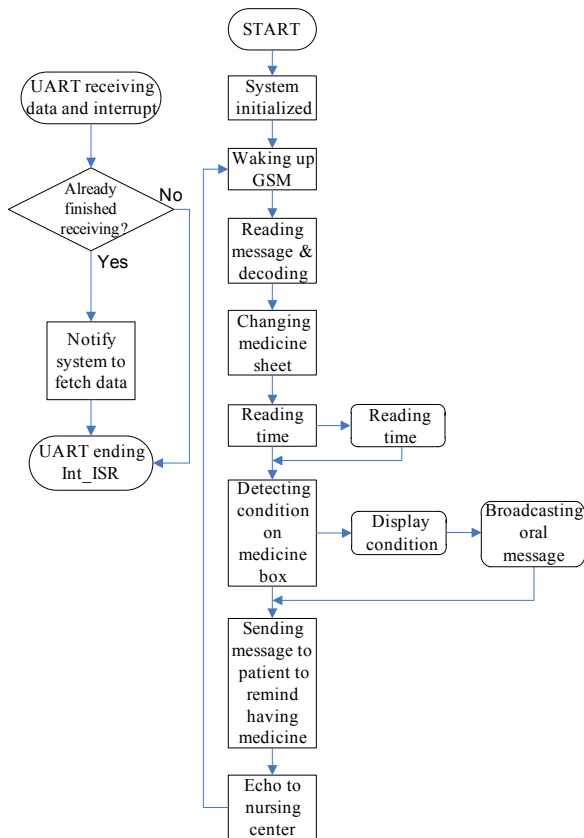


Fig. 3 Control flow-chart of medicine-box

### 5.2 Communication interface design of medicine-box

In this project, we used GSM cell-phone to develop the system communication platform was main based on the mechanism with cell-phone to send all information and short message to remind patient to have medicine in time and attached some controlled codes at the end of SMS message in order to provide correct having medicine through internet.

### 5.3 Protocols of communication

#### (A) Nursing center to medicine box

Table1 Communication protocol of nursing center

Command bit (3)	Patient's number (8)	Medicine sheet No. (8)	Time (6)	The first having (2)	No. of tablets (28)
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Command bit : CTB --> center to box

Patient No. : 0 0 0 0 0 0  
 Medicine Sheet No. : 0 0 0 0 0 1  
 Time : 0 6 0 8 1 4 (Year/Month/Date)  
 First Having Time : The first Checked Having Time  
 Coding Number : Coding Number of Having Medicine according to the matched No. in Table 2.

Table 2 Coding No. of having medicine

Time	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Morning	1	5	9	13	17	21	25
Noon	2	6	10	14	18	22	26
Evening	3	7	11	15	19	23	27
Night	4	8	12	16	20	24	28

#### (B) Medicine-box To Hospital Nursing Center

Table 3 Communication Protocols of Medicine-box

Command bit (3)	No. of Medicine Sheet(8)	Time of Having Medicine (2)	Status of Having Medicine (1)
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Command Bit : BTC --> Medicine-box to Nursing center  
 No. of Medicine Sheet : 0 0 0 0 0 1  
 Time of Having Medicine : Echo Status of Time of Having Medicine  
 Status of Having Medicine :  
 1 : Not Having Medicine  
 2 : Delaying Having Medicine

### 5.4 The software flowchart of operating procedures in nursing center with VB

There were four flow-charts of graph interface system (GIS) which was designed by ourselves with Visual Basic Language as shown in Fig 4, 5, 6, and 7[6]. The description of those flow-charts were explained as follow:

In Fig. 4, the operating procedure after receiving the coming message of having medicine of patient's far away, the system would initialize the parameters first, and then checked whether it was over the set time-limitation of receiving data, if no, then the system would wait until the time was over. Next, the system would wake up the GSM module and check whether there was any message received on GSM module, if no, then the system would wait until it certainly received message transmitted from medicine-box far away then stopped the timer and read the message. Finally, the system would check whether the protocol format was correct, if yes, the it would fetch the information of having medicine and stored it into the database [7], and then reset the timer so as to receive next coming message.

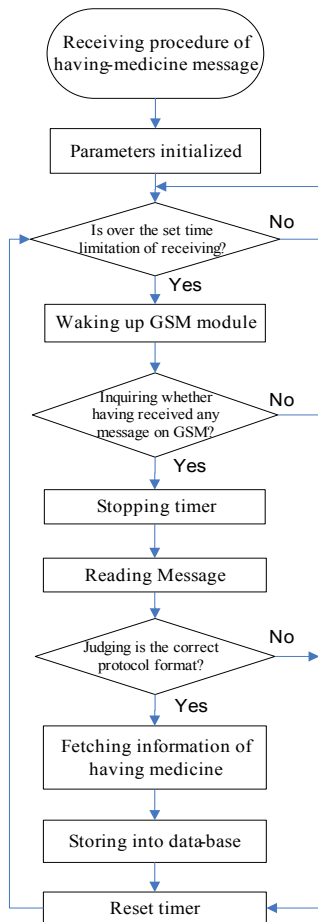


Fig. 4 Control software flow-chart of monitoring screen in nursing center in hospital (1)

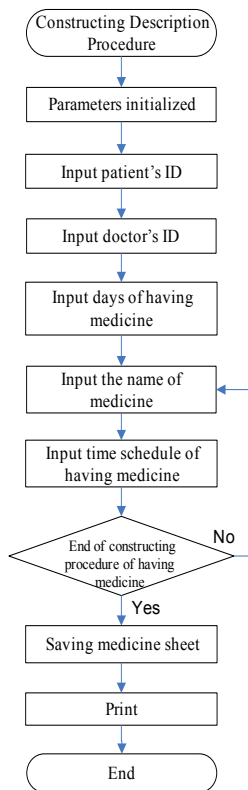


Fig. 5 Control software flow-chart of monitoring screen in nursing center in hospital (2)

This was the flow-chart of the function which the doctor made the prescription for patients in Fig. 5, and the procedure must begin with inputting the coding No. of patient's and doctor's to make sure that the medicine sheet was really made by doctor. The next we must input total days having medicine, first, input the name of medicine and then what day and what time (meal) the medicine should be had by patient. All pills must be input step by step. Finally, the system would save such information about the medicine after checking whether there was any missing data of every related input item. After all data was saved in the database, we could print the medicine sheet or prescription out as reference for patients to have correct medicine in time.

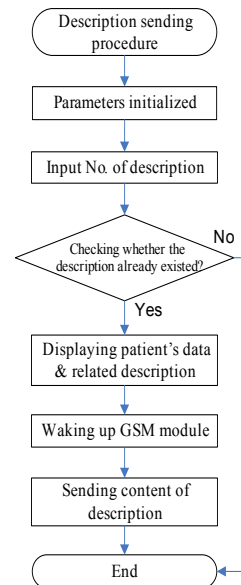


Fig. 6 Control software flow-chart of monitoring screen in nursing center in hospital (3)

The medicine sheet (prescription) would be sent to medicine-box through GSM communication module. But before sending, we must input the coding No. of medicine sheet and check whether there was the medicine prescription in the database. If there really were, then the system would show out the coding No. of the patient and the content of the medicine to let the doctor to check. When there was no any error, the system would link all the information about patient's having medicine and coding by program so as to transmit the message to medicine-box in patient's house through GSM module. The software flow-chart of this procedure was shown in Fig. 6.

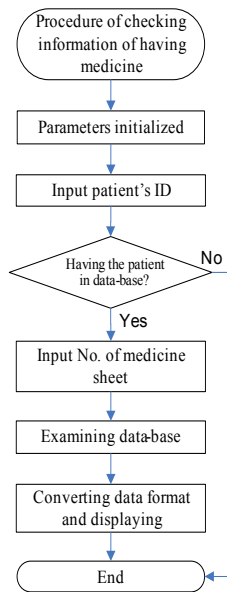


Fig. 7 Control software flow-chart of monitoring screen in nursing center in hospital (4)

In order to make sure patients' having medicine according to doctor's prescription, especially for those chronic ones, in this monitoring system a function designed for doctors' checking the patient's status of having medicine was that first doctor need to input the coding No. of the patient, and then the system would list out all prescription of the patient. The doctor could select one of them and the system would show out the status of having medicine, which was offered with graph after data transferring. and the software flow-chart was shown in Fig. 7.

### 5.5 Shown screens of Graphic human-machine interface in nursing center

This is the main and initialized scanning screen as shown in Fig.8, and the main scanning screen is the entrance point for entering all sub-functions and indicating the echo information of having medicine of patient from medicine-box. This screen would wake up the GSM module every 3 seconds and check whether there was any echo message of having medicine from patient's medicine-box. If there were messages came in, the system would first judge whether the message content was strings led by CTB. And if it were, then next step was fetching medicine prescription NO., meal coding of having medicine, and all information related having medicine of patient from short message. After fetching, then writing data into database. Finally, the system deleted the message and back to initial condition.

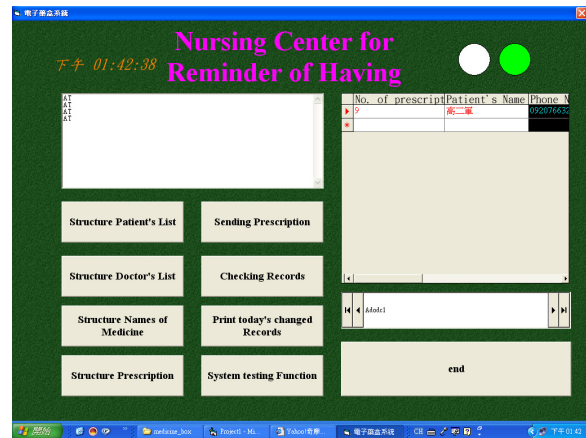


Fig. 8 Executed monitoring screen of nursing center ---Initialization Scanning Screen

Fig. 9 is another operating screen among all GIS screens [8] [9], and in this screen we could easily see there were blank spaces for inputting by nursing staffs the patient's coding No. and medicine prescription coding No. (Medicine sheet No.). If the nursing staffs pushed the "inquiring" button, then the condition of patients' having medicine would show out in the table (red sign meant haven't had medicine according the scheduled time, yellow sign meant delaying having medicine and blank space meant having had medicine punctually)

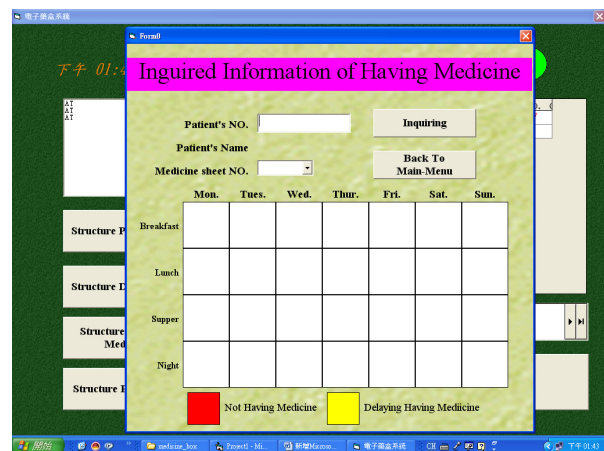


Fig. 9 Executed monitoring screen of nursing center ---Screen of response information of having medicine condition on medicine-box

## 6. Conclusion

This research tried to combine local communication system with automation conception to implement into an intelligent system which was strongly prompted by the Taiwan National Science Council as well as important development for high level education system by Taiwan Education Minister so as to create the next competition power of Taiwan's industry. In this study project we adapted an intelligent system applied in our daily life space and combined local web-net,

voice-DSP, TFT-LCD displayer control, GSM communication, and special sensors techniques to produce a medicine-box and its related monitoring mechanism suitable for both in patient's house and hospital. The originality creativity was appreciated by many manufactories and the final products has achieved the patent.

## **Acknowledgement**

This research project was sponsored by The Education Minister Department of Taiwan Government under the "Creating superiority in Teaching Strategies in Colleges Of Taiwan." And this project has won the third prize of "The Contest of Students' Creativity in Practical Works" in addition to achieving the Taiwan' Patent.

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