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Smart Queue Management System Using GSM Technology

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Abstract

The paper discusses efficient time management in various applications, through a queue management system. The system presented here uses GSM technology, a personal computer serving as the main server and a microcontroller, making it embedded in nature. The entire system is controlled by a master controller VB program, and the access to the PC is achieved through standard RS232 protocol (Serial Communication). Though designed for clinical application i.e. doctor –patient interaction, the system can be suitably modified and extended further to serve many such applications. The design depends extensively on the perfect synchronization between the three major elements of the system – GSM, Personal Computer and microcontroller. The system has been evaluated successfully and the results obtained are promising.

Keywords: Queue management, Clinical management, GSM, Token, Data Access Object, Data logging.

1. Introduction

Time is a quantity that is non-renewable and continuous. Any process that saves time and space is considered vital in many applications. Time is an important quantity, which has to be efficiently managed. Wastage of time in a queue is always non-negotiable and it is in this, that the present queue management system finds its importance. The idea of the system starts with a simple question – "How could time be smartly utilized?" This smart queue management system will take out the burden of waiting in a long queue until one gets attended.

The system presented here considers the long wait of a patient in a queue for the doctor's appointment & examination.

It comprises of three major elements:

1.) A GSM (Global System for Mobile) modem [1, 3, 7]

2.) A personal computer, which will act as a server, controlling the complete operation flow.

3.) A microcontroller (Atmel 89C51) for display and automatic room powering system [8].

The GSM modem acts as an interfacing element between the server machine (Doctor) and the User (Patient). The communication is done through SMS (Short Message Service) technology [2,5]. The system accepts SMS's from the various end users and alerts the patient by SMS's. The synchronization between the two communications is of high priority in this queue management system. The software is designed in Visual Basic (VB6) and controls the total system flow.

The smart queue management system presented here has the following advantages:

1. Eliminates the long waiting time wasted in a queue.
2. Efficient method of token distribution
3. A completely digitized and error free token system
4. Remote registration and on the move token distribution system.
5. Reduction of the physical strain involved.

2. Plan of Work

The system flow occurs on three platforms, GSM modem, Server PC and the Microcontroller. The GSM modem is the hardware link in the entire system. The overall working is controlled by a specially designed VB6 code. An embedded C code compiled with Keil compiler controls the functioning of the microcontroller.The microcontroller takes care of the display unit at the server end and the room power automation.

The working of the entire system is based on specially designed VB6 based software, titled as 'Token Manager'.It receives messages from the GSM modem through RS232 port, decodes it, sends back an acknowledgment through the GSM modem and performs various tasks based on the message received[9,10]. The software also sets up and maintains a database (using Data Access Object, a database provision available in VB itself) for data logging of the patients.

The working of the system can be divided into the following steps:

1. Receiving messages from users
2. Decoding it and updating the queue database
3. Sending acknowledgment to the user.
4. Displaying tokens and sending messages to users in advance of 30 minutes of their turn.
5. Flushing the queue.

In order to register for an appointment, the User (patient) has to send a message to the server number (GSM modem at the server side) in a fixed format. If one sends a message in the agreed format he/she will be appended to the queue (i.e. added to the database) and an acknowledgment message with the token number will be send to him. If the format of the message does not match with the predefined format then the user will be acknowledged with an error message.

The next step is to send messages to the registered users for the appointment. A patient will receive two messages before his turn comes. First message will inform the time of the doctor's arrival. For this to happen, the doctor will have to send a message about his arrival time to the server machine (his/her clinic) and that message format is unique to the doctor and it should reach the server at least 45 minutes before his/ her arrival. As soon as the server receives the time of doctor's arrival, it will initially alerts the first three patients in the database by sending an SMS. A display system, showing the token number will guide the patients to cross check their token number again and then proceed for consultation.

The server PC in the doctor's room is provided with a GUI (designed in VB6), which will act as the front end interface. It will show all the details of the patient as per the message received from the patient earlier (during registration). The doctor can also use a digital prescription pad and give a print out of the same to the user. The same prescription will be saved in the server PC as a file in the corresponding patient's folder which will be created automatically during the patient's consultation with the doctor. The GUI is also equipped with a search option, thus helping the doctor to skip all those usual routine of checking the prescription again.

The microcontroller (Atmel 89C51) controls the display section and power automation of the doctor's cabin. It receives a token number from the server PC and displays it. Here, both the GSM modem and the microcontroller use the same transmission line of the server PC. The switching between the two is done with the help of a demultiplexer, which in turn is controlled by the server PC, so as to select one channel out of two, since one channel of the demultiplexer is connected to the GSM modem and the other to the microcontroller. This is achieved by the DTR line of RS232 and this line is again controlled by the VB code.

The power automation deals with powering the light and the cooling system of the cabin. As soon as the "Doctor In' button in the GUI is clicked the microcontroller will activate the lights and cooling system through relays, which are connected in the appropriate ports. Also, a day's consultation files are closed by clicking 'Doctor Out' button. This will also sends signals to microcontroller so as to switch off the lights and cooling system of the cabin. Thus a complete power management is also possible.

KeilMicroVision 4.0' is used to develop the program for the microcontroller.

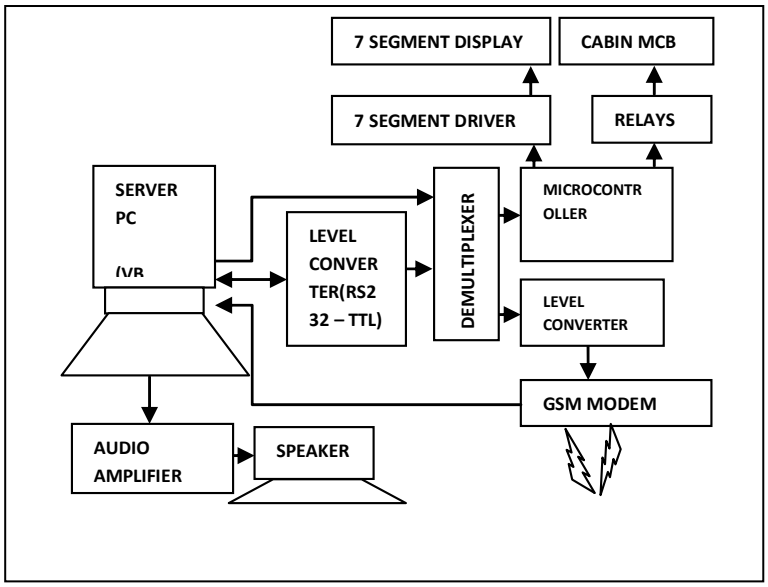

Fig. 1: Block diagram of the complete system.

3. Design Methodology

Since the system consists of three separate elements, the testing of individual parts is highly necessary and this is carried out by testing them separately. Initially the connection between the server PC and the GSM modem were achieved[6]. AT commands were used in order to establish the communication between them. Then a test message from another mobile was sent to the GSM modem and made sure that the particular message is logged on to a database created using 'Data access object' and eventually a file and a folder is created for the same in the server disk.

The microcontroller part is tested separately without connecting the GSM modem. After that stage the integration of all the three elements – server PC, GSM modem and the microcontroller was tested. For proper routing of the signals from server PC to GSM modem and sever PC to microcontroller, a demultiplexer is employed. Thus, a final integration is done after programming the microcontroller for power management. The data logging was tested and the complete communication flow was established in the laboratory environment. The design steps could beeasily read from the two flow charts, mentioned in Figure 2 and Figure 3:

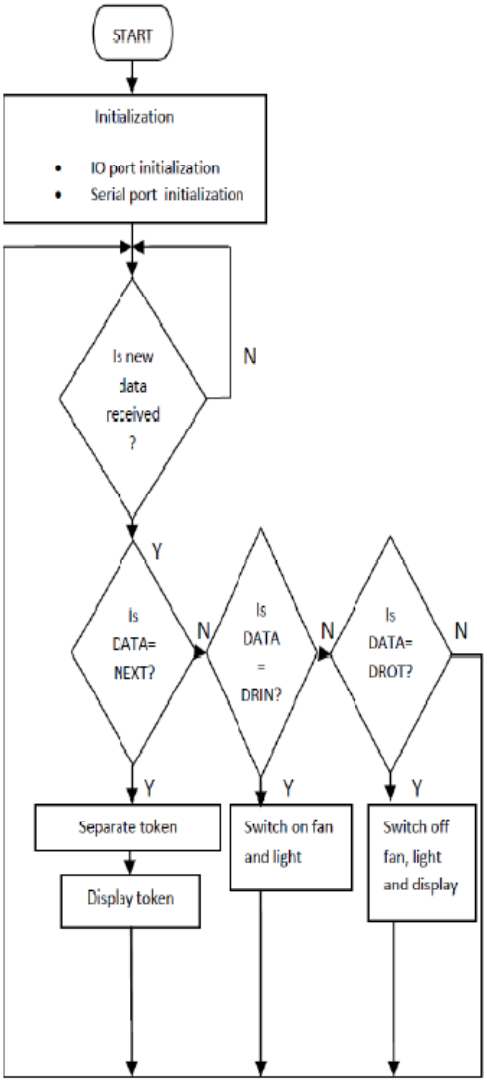

Fig.2 Flowchart for Microcontroller program

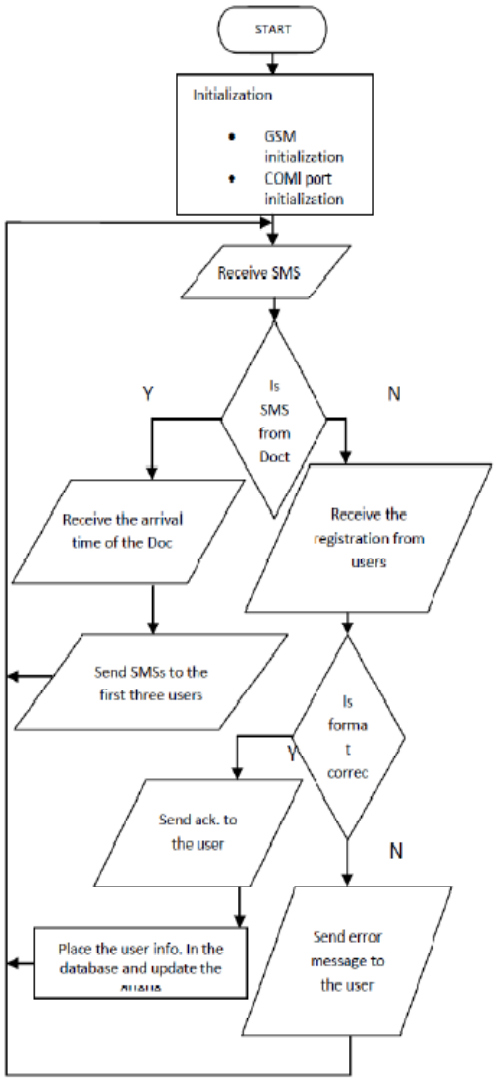

Fig.3 Flowchart for Visual Basic program

4. Results and Discussion

By feeding in the appointment requests from various mobile phones, the validation of the system is ensured. The message reception and transmission link was established as designed. A file being created for each applicant in the desired folder and the appending and flushing of the database is found to be correct. The Visual Basics front end GUI is shown in the figures below.

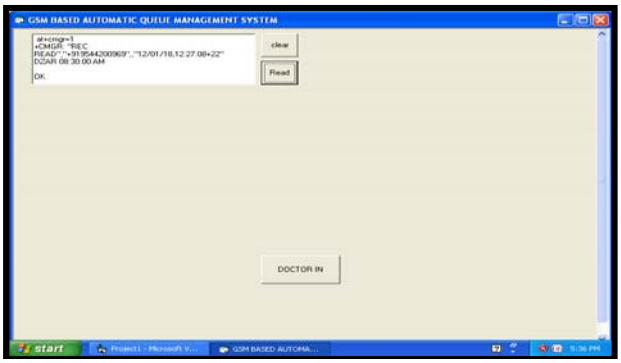

Fig. 4: Initial GUI.

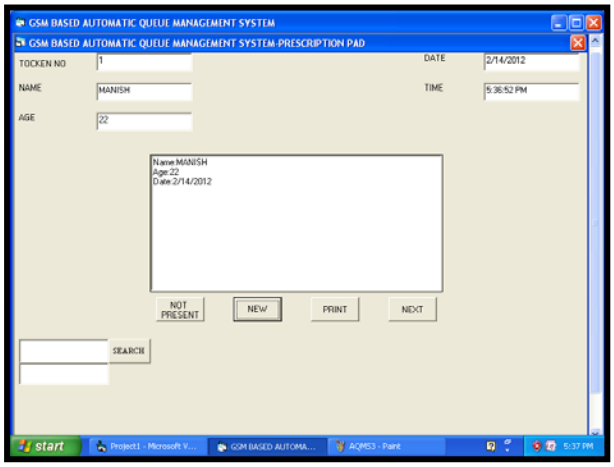

Fig. 5: Patient's information through the GUI.

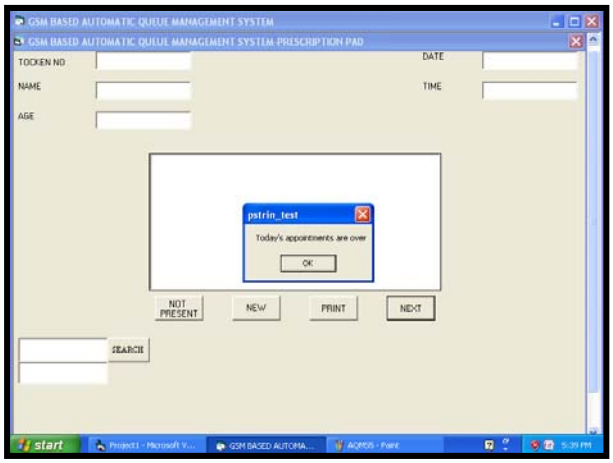

Fig. 6: Marking the end of the appointment.

The only drawback that was noticed is the time delay between the messages. Once the doctor clicks the “Doctor IN” button in the GUI, a small delay in message initiation is noticed.

The complete system is shown in the pictures below:

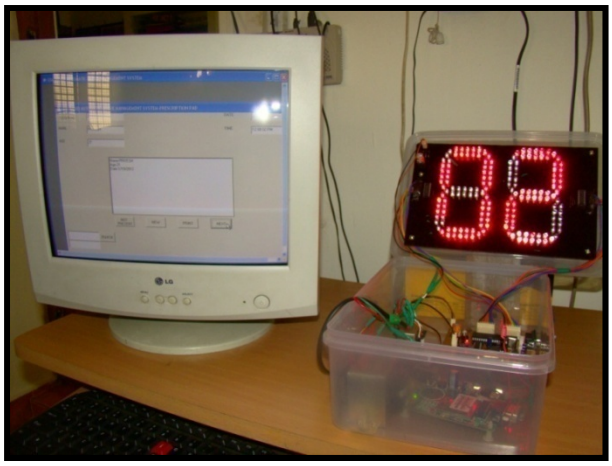

Fig. 7: Complete queue management system with display section.

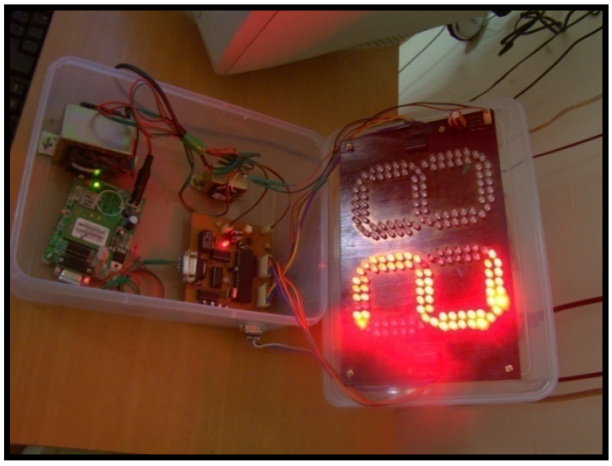

Fig. 8: Complete interfacing circuit with display section.

5. Conclusion

This project is a small step towards easing out the life. The whole head ache of waiting for ones turn to come in a long queue could be easily overcome by this project. Mobile phones gave a new dimension to the remote access mode of communication system. This project exploits the full facilities of Short Message Service (SMS). Therefore

establishing a strong reliable communication link between the server and the user. This project, hence guarantees an efficient synchronization between man and machine and a step much clearer than the existing technology, ensuring the freedom of life. Mentioning the future scope of the system, a GPRS could be attached to the system, so that the exact location of the user (patient) could be traced and thus calculating the distance between the server and the user, the system can roughly coin up the time of consultation of a patient and alert them accordingly, thus making the system more efficient and smart[4].

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