



UNIVERSITI  
TEKNOLOGI  
MARA



# Globalising Knowledge and Information

## SCIENCE TECHNOLOGY

## NATIONAL SEMINAR ON

## SCIENCE TECHNOLOGY & SOCIAL SCIENCES

## 2006

30-31 May 2006

Swiss Garden Resort & Spa  
Kuantan, Pahang





## Temporal-Based Nurse Duty Roster System

Masita @ Masila Abd Jalil  
Noraida Hj Ali  
Amir Ngah  
Suryani Ismail

### ABSTRACT

*This paper describes the design of a temporal-based Nurse Duty Roster System which uses temporal database to keep all the data and information needed by Sisters at the Hospital. Timestamps are used to make the data available with valid time. Valid time denotes the time period during which a fact is true with respect to the real world. Arrangement of a duty roster is based on the different types of leaves, shift requests, night shifts, on call and wards or units in which the nurses work. In this system, the date is a very important attribute in order to produce a systematic duty roster. The system is developed using Visual Basic 6.0 programming, Crystal Report 8.0 and Microsoft Access 97 as its database.*

**Keywords:** *Nurse Duty Roster System, temporal database, timestamps, duty roster, and schedule.*

### Introduction

Nurse duty roster is a duty roster that displays nurses' working time and leaves in a particular wards or units. It has four working shifts which are morning, afternoon, night shifts and office hour. The roster also includes six types of leaves namely annual leave, public holiday, off day, replacement off day, sleep day and nights off. Nurses take their turns based on their shift requests or as set by the sisters. Generally, each roster is generated once every fortnightly by the Sister in charge of the ward. At least three days before each roster is out, nurses can submit their application for duty or shift requests together with their approved leaves should they wish to take any days off. This is done to assist sisters in scheduling their duties.

If compared with other work schedules, duty rosters for nurses are quite complicated. This is because each roster is arranged after taking into account several aspects. One of them is the number of nurses in the ward. This is to avoid any shortages of nurses on a particular shift. For example, if the ward has 18 nurses, two will be put on night shifts and another two will be given leaves after the night shifts. In this case, the remaining 14 nurses will be put into two working shifts which are the morning and afternoon shifts. Out of the seven nurses on duty for each shift, three would be given leaves. Therefore, this means that only four nurses will actually work for the morning and afternoon shifts.

Another aspect to consider is the shift requests as submitted by nurses. All nurses can apply but the approval is made on the *First Come First Serve* basis. The request is applicable for morning and afternoon shifts only whereas the night shifts will be arranged by the sisters. A few nurses working on morning shifts will also be assigned *on call* status which simply means that they need to stand by in case of any emergency that requires them to replace other nurses on duty.

In addition to its complexity, the manual system also suffers from a few problems. Although, the roster should be available three days before the previous roster expires, this is never been the case. This is mainly due to the fact that the roster is generated manually and a lot of referencing needs to be done before the roster can be issued. Thus, this time consuming task is very much depended on the sisters in charge and their time. Another issue is closely related to the flexibility nature of the roster itself. Nurses are allowed to swap shifts among themselves if they are not happy with them. This in turn makes it difficult to trace who works on which shifts if too many changes or swapping take place.

Thus, the system has been designed to tackle some of the problems faced by the nurses and sisters, particularly in generating a more systematic duty roster. Through the use of a temporal database, all information about the previous duty rosters can be kept for future and easy referencing. The system also takes shift requests as well as other leaves information as part of its main input. An additional security feature on the other hand ensures that confidential information is not accessible and the system is not misused by unauthorized parties. This system can also generate a report for each ward and this report can be referred by the nurses and the management.

### Temporal Database

Most of database application technologies nowadays are in the *temporal* environment. These include finance

applications such as portfolio management, accounting and banking. In repositories involving personnel information, medical records and stocks taking management, temporal type databases are gaining popularity. More and more applications involving scheduling are also adopting temporal database. Such applications include flight schedule, public transport schedule, duty roster as well as project management schedule.

Temporal data stored in temporal database is different from data stored in a non-temporal database. Unlike a non-temporal database, a temporal database has a time period attached to its data. This time period is used to indicate when data is valid or being stored in the database (Baniegbal, Barringer & Pnueli 1987). Since data stored will always changes over time, the data must be capable of showing such changes (Touzovich 1991). Conventional databases on the other hand only consider stored data to be valid at current time and do not keep track of past or future database states (Sean Wang, Betini, Broodsky and Jojodia 1997). By attaching a time period to the data, it becomes possible to store different database states. In the case of the Nurse Duty Roster System, this is important to ensure that old data is not deleted or got overridden when new data is stored. For example, a nurse working on a morning shift from 13 to 15 January 2005 later starts her afternoon shift from 16 to 18 January and so on. In this case, temporal database needs to be applied so that old data representing dates of the morning shifts would not be deleted. All of these dates are important and required by the Sisters in generating new rosters.

Two approaches have been introduced to visualize the temporal data attribute; the first approach focuses on status and the second approach is based on events (Knight & Ma Jixin 1994). The later event-oriented temporal database is found to be more flexible as compared to the first approach in that only the primary keys and the related fields that would change need to be rerecorded. The rest of the data remain intact.

(Noraida 1999) focuses on the use of temporal concepts in news archiving. In the Temporal Based News Archiving and Retrieval System, data is represented using 'timestamp' technique and information is retrieved using indexing technique. The model comprises of the formation of historical news data and temporal engine that will manage historical data. Another system in (Mohd Ramaeh Paul 2003) on the other hand focuses primarily on how to use risk management in temporal database and how it would be possible to fully exploit the advantages of using temporal type database.

### System Specification

The System Development Life Cycle (SDLC) has been chosen as the approach to develop this system. Only three out of the six SDLC phases are employed namely the Requirements Analysis and Definition, System and Software Design and Implementation and Testing. Visual Basic 6.0 is used as the main programming language for developing this system with Crystal Report 8.0 as its report generator. Operating on Microsoft Windows XP platform, the system uses Microsoft Access 97 as its database.

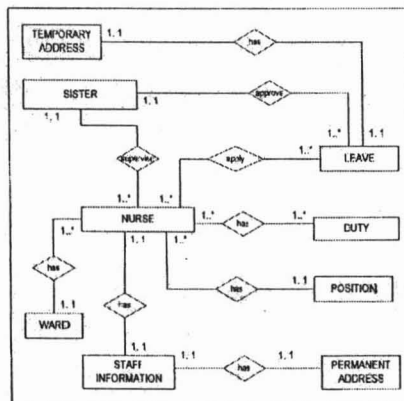


Fig. 1: Entity Relationship Diagram (ERD)

Figure 1 shows the Entity Relationship Diagram (ERD) for the system. An ERD is a tool that represents the entities that exist in a database and their relationships (Connolly, T., Begg, C. & Strachan, A. 1998). These relationships can be used to design the input and output of the system. Context diagram of the system as depicted in Figure 2 provides the graphical view of the whole system. As shown in the diagram, there are two main entities in this system, which are sisters and nurses.

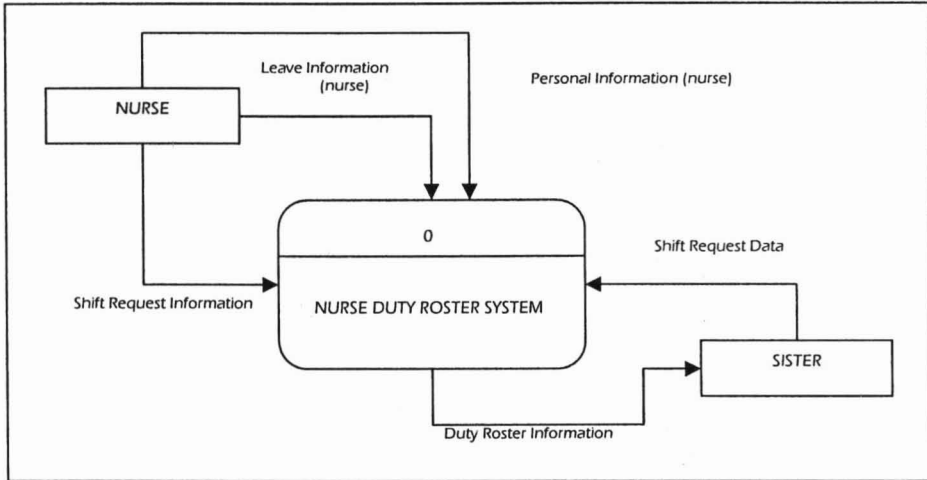


Fig. 2: Context Diagram

The data for the system is structured into ten tables. These tables are used to record all the information especially on staff personal particulars, the duty roster and the list of wards or units at the Hospital.

### System Implementation

The Temporal Based Nurse Duty Roster System comprises of two modules; a module for nurses and another for use by the sisters. The menu hierarchy of the system is shown in Figure 3 below. It illustrates the menus, submenus and the sequence of the screen displays. Figure 4 to 10 display some of the interfaces that have been designed for both of the modules.

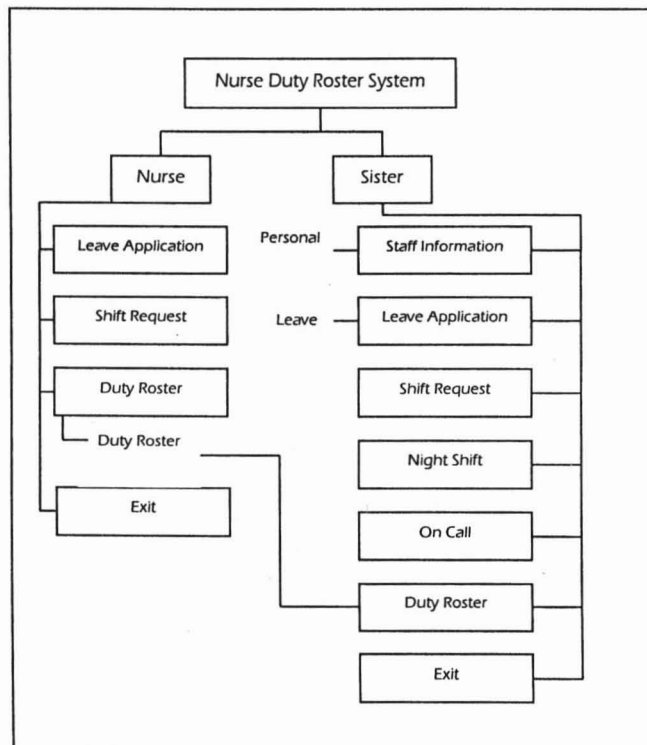


Fig. 3: Menu Hierarchy

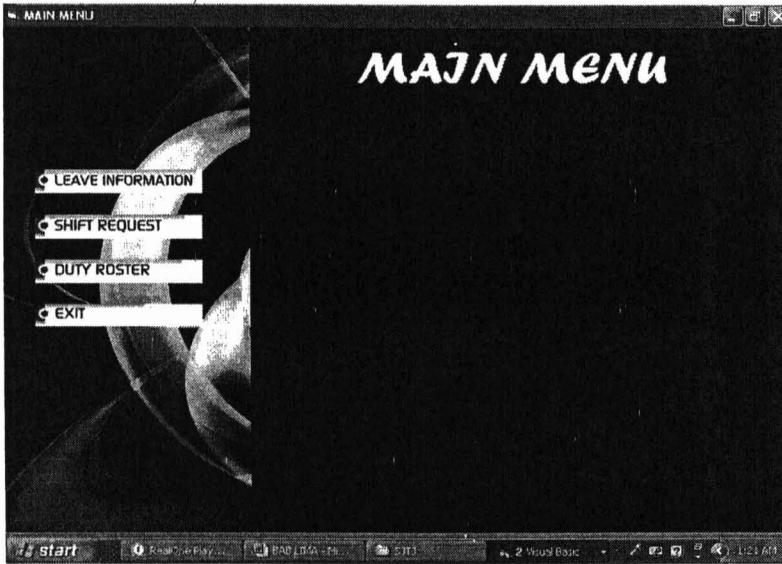


Fig. 4: The Module for Nurses

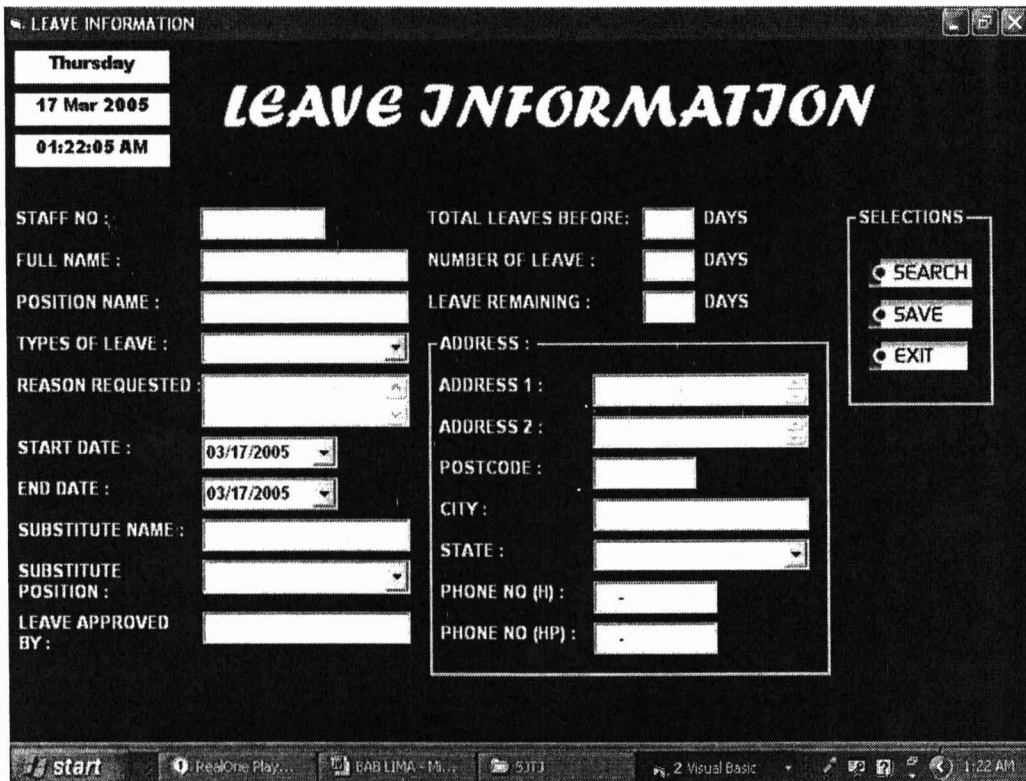


Fig. 5: Leave Information Interface

### Module Implementation for Nurses

There are three menus in the module for nurses which are *Leave Information*, *Shift Request* and *Duty Roster*. All of these menus can be viewed or filled up by the nurses. *Leave Information* menu can be filled up when the sister has

approved their leave applications. Nurses can use the *Shift Request* menu as shown in Figure 6 to apply for their morning and afternoon shifts. Through the *Duty Roster* menu, nurses can view the duty roster report according to their requested dates and their respective wards as shown in Figure 8.

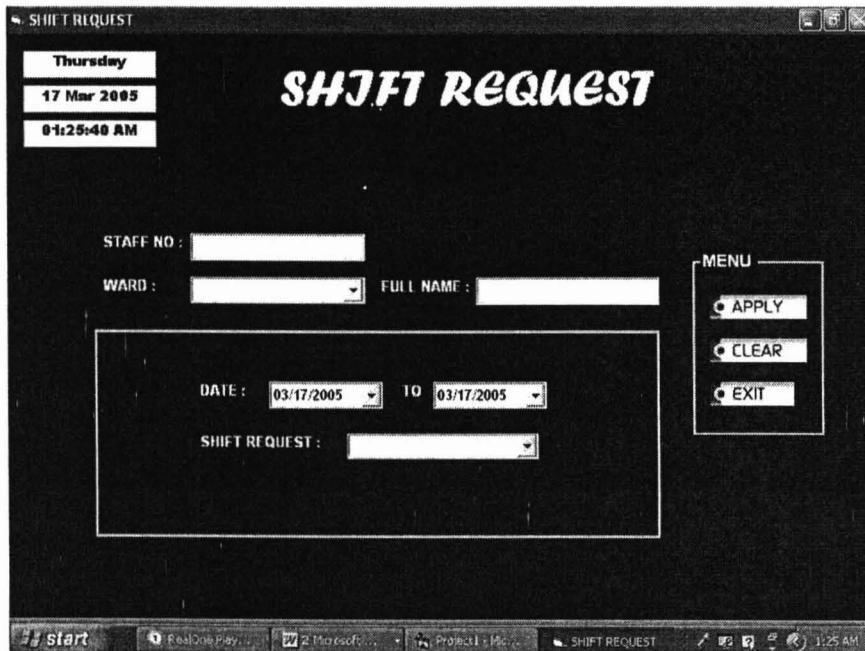


Fig. 6: Shift Request Interface

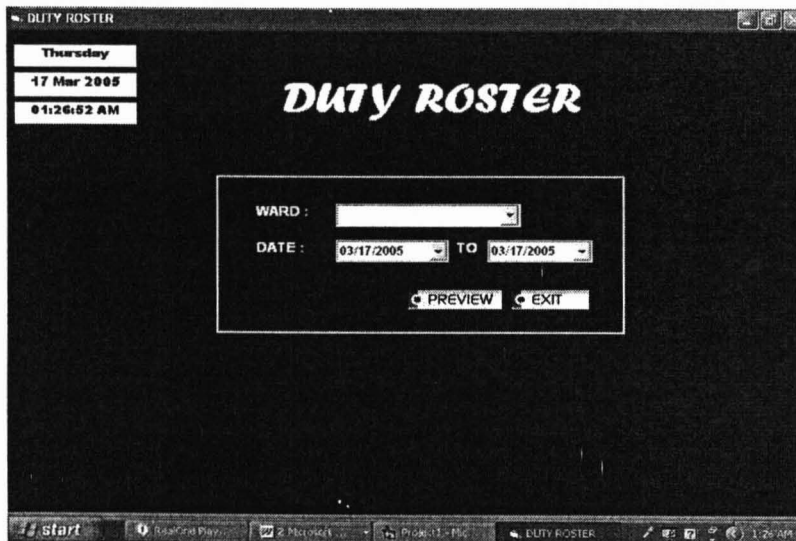


Fig. 7: Duty Roster Interface

**DUTY ROSTER WARD OPERATION THEATER**  
**01/04/2005 TO 14/04/2005**

	04/01	04/02	04/03	04/04	04/05	04/06	04/07	04/08	04/09	04/10	04/11	04/12	04/13	04/14
AMINAH JAMIL	M	M	M	HT	KM	HK	PG [C]		PG [C]	M	M	M	HT	KM
C.W.TEH C.W.HITAM	M	M	M	HT	KM	HK		PG [C]		M	M	M	HT	KM
FAIRUZ IBRAHIM	PG [C]			M	M	M	HT	KM	HK	PG [C]		PG [C]	M	M
NOR RAHIMAH OSMAN			PG [C]		PG [C]		M	M	M	HT	KM	HK	PG [C]	
NORIN ABD. RAHMAN		PG [C]		M	M	M	HT	KM	HK		PG [C]		M	M
ROHAYA HASHIM				PG [C]		PG [C]	M	M	M	HT	KM	HK		PG [C]

PG - Morning Shift      C - On Call      CTO - Owing Leave  
 FT - Afternoon Shift      HKA - Public Holiday      CTR - Unrecorded Leave

Fig. 8: Duty Roster Detail Report

### Module Implementation for Sisters

In this password-protected module, sisters have access to an additional four menus. Altogether there are seven menus which are:

- i) Staff Information
- ii) Leave Information
- iii) Ward Information
- iv) Shift Request
- v) Night Shift
- vi) On Call
- vii) Duty Roster

These menus can only be viewed or filled up by sisters. The *Staff Information* is filled up for future references while the *Leave Information* is filled up upon leaves approval. Sisters can review and validate all the shift request applications using *Shift Request* menu. Before assigning nurses for the morning and afternoon shifts, sisters need to firstly generate the Night and On Call Shift. The arrangement of Night Shift is particularly important to avoid any shortages of nurses working on that shift. In addition, it also provides *sleep days* pattern to assist the system in generating the roster. Once the duty roster is complete, the *Duty Roster* report as illustrated in Figure 8 can be generated and made available to nurses.



Fig. 9: Night Shift Interface

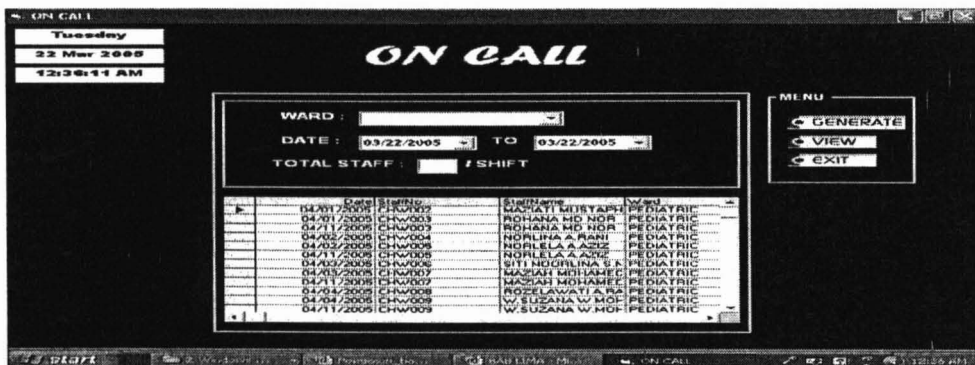


Fig. 10: On Call Interface

**Conclusion**

The Temporal Based Nurse Duty Roster System has been built to cater for the needs to produce nurses' work schedules in a more efficient and systematic way. Access to past data and other related information such as leaves and personal particulars is made easy with the application of temporal database. In addition, the system is also capable of generating duty rosters based on a range of dates as specified by users. A different type of detailed reports can also be generated for all levels of management. In conclusion, it is hoped that the system is capable of adding and delivering a quality information service to the healthcare community.

**References**

Baniegbal, B., Barringer, H. & Pnueli, A. (1987). *Temporal Logic in Specification*. Berlin: Springer-Verlag.

Connolly, T., Begg, C. & Strachan, A. (1998). *Database Systems: A Practical Approach to Design, Implementation, and Management*. 2<sup>nd</sup> ed. England: Pearson Education Limited: pp 151.

Knight, B. & Ma Jixin. (1994). A Temporal Database Model Supporting Relative and Absolute Time. *The Computer Journal*, 37(7): pp 558-596.

Mohd Ramaeh Paul, M.Y. (2003). *Temporal Risk Management*. B. Sc. Thesis (in Malay). Kolej Universiti Sains dan Teknologi Malaysia, Terengganu, Malaysia, pp 16.

Noraida, A. (1999). *Capaian Maklumat Bertemporal: Kajian Pengarkiban Berita*. M. Sc. Thesis (in Malay). Universiti Kebangsaan Malaysia, Bangi, Malaysia, pp. 19.



Sean Wang, X., Betini, C. Broodsky, A. & Jojodia, S. (1997). *Logical Design for Temporal Databases with Multiple Temporal Types*. ACM Transactions on Database Systems, 22(2): pp. 115-170.

Tauzovich, B. (1991). *Towards Temporal Extensions to the Entity Relationship Model*. Proc. 10<sup>th</sup> International Conf. On Entity Relationship Approach. San Mateo, CA: T.J Teorey (Ed.): pp 163-179.

---

MASITA @ MASILA ABD. JALIL, NORAIIDA HJ ALI, AMIR NGAH & SURYANI ISMAIL, Department of Computer Science, Faculty of Science and Technology, Kolej Universiti Sains dan Teknologi Malaysia (KUSTEM).  
masita@kustem.edu.my