A ROSTER SYSTEM FOR NURSES

A Thesis

By

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DECLARATION

I hereby certify that this project report is my own work and it has never been submitted for any degree programme.

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ABSTRACT

Nurse roster is the process of creating a plan, showing working hours for the employees in the plan over a given planning horizon. Making rosters is an important activity in healthcare. Today, highly qualified heath personnel spend a lot of their time making and updating rosters manually.

Hospitals in Sri Lanka use manual system to create two categories of nurse rosters namely two-shift system and three-shift system. In our work, we mainly focused on the 3-shift system to create feasible and optimal high quality monthly schedule for nurses of the hospitals in Sri Lanka.

Constrain analysis is important in solving problems such as Nurse Scheduling Problem (NSP). Several constraints were identified during the requirements analysis. Identified constraints were then divided into two groups as hard and soft depending on their effects on the final solution. **Hard constraints** must be satisfied to obtain feasible solutions but **soft constraints** are typically time related constraints, desirable but not compulsory, and thus can be ignored if necessary.

This study was carried out in two stages. First, division of nurses into shift groups using graph theory and graph coloring was done. Subsequently an algorithm was implemented to create the nurse roster at the second stage, we were forced to use heuristic methods based on graph coloring techniques. In this research, modified Greedy Algorithm for solving NSP was applied to get a feasible solution. In graph theory two adjacent vertices cannot be colored using the same colour. Nurses must be in the same group to be present in the same shift, and this prevented the constraint violation. Bench members namely those who are having the freedom to work in any shift or any group of nurses were considered as a special group.

Several real world cases from Sri Lankan hospitals were used to test the algorithm. Solutions to these cases were generated by using the method described above. The solutions were examined by nurses who are highly experienced in manual roster creating. The nurses' assessments of the generated rosters were all positive. Within approximately one second the constructed algorithm creates a feasible solution for 20 employees for a period of 4 weeks. System was implemented using server side scripting language PHP, and MYSQL was used as backend. In this study some of the soft constraints were not considered. As a further study, an algorithm can be developed without violating any soft constraints to increase the quality of the schedule. We concluded that a high quality feasible monthly schedule for nurses can be developed combining graph colouring method and other existing algorithms.

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LIST OF ABBRIVIATIONS

NSP **Nurse Scheduling Problem**

NR **Nurse Roster**

CSP **Constrain Satisfaction Problem**

M **Morning Shift**

E **Evening Shift**

N **Night Shift**

OT **Over Time**

CHAPTER 01

Introduction

1.1 Overview

Nurse scheduling process is very crucial task for managing nurse duty schedules in hospital system. It is a responsible activity in health care services. Currently, highly qualified nurses and administrative officers spend a lot of time to make and update rosters. By using appropriate automated tools for this work, we can find fair and better solutions.

In our Literature Survey and proposed work, we mainly focused to find out possible solutions to real-world personal scheduling problems in work places such as hospitals and other medical centers. It is obvious that personal scheduling problems, especially in hospital systems are very complex due to the low number of legal restrictions on the problem defined.

Roster of nursing staff is one of the most important but complex problem for the hospital management. Nursing skills affect patient care, health budget and the welfare of the staff, hence the preparation of well balanced roster is considered as to be crucial in nursing practice. The activity of roster extends beyond matching names to shifts. It requires critical thinking and good decision making skills to develop a roster that effectively balances patient care, employee and other needs in the organization.

In the nurses roster problem , the characteristics of the constraints are different Some constraints refer to particular duties of the nurses while other constraints restrict consecutive shifts, days, weekends, etc. hence very hard to find good quality solutions.

The health system of Sri Lanka offers a diversity of services based on indigenous and western medicine. The government and private health services are delivered through a comprehensive network of primary triangulation level community centers, hospitals, and dispensaries.

However, scheduling of nurses has always been difficult. So nurse scheduling is one major problem that are facing by many good hospitals all over the world. Normally nurses work for three shifts, because patients need nursing care throughout the day. The hospital management is facing a difficult task to assign nurses in a ward to the shifts according to their requirement.

Hospital management has to consider many different constraints when making scheduling for a ward. Hence preparing a duty roster of nurses can be taken as a constraint satisfaction problem. However it is often difficult to create schedules that satisfy all the constraints or requirements. Normally timetabling problems considering the constraints provided by nurses, hospital management as well as by the patients.

The objectives in this problem are complicated. By using good automatic tool for this work, a considerable amount of time can spend for working with patients. Fair and better solutions for the employees with their preferences are other benefits. Not only fair and better solutions but also develop a regular procedure for allocating nurses to work shifts. All this things influence to satisfying organizational scheduling policies, such as specific work requirements while minimum staffing to avoid a waste of man power.

Different demands of patients, different qualifications and specializations of nursing personals in various clinical and administration requirements, unpredictable absenteeism, and different work patterns and other factors make the problem more complicated.

Considering the numerous complaints made by the nurses, we describe a flexible automated system and solution approach for the roster of nurse problem. Both general and individual preferences are taken into consideration in addition to satisfying the working environment and system of agreements.

1.2 Problem Description – A roster of Nurse Problem

In organizations that operate continuously, daily work is divided into shifts. In such a context, the scheduling problem consists of assigning a schedule to each worker, which involves building a timetable for a specified period. The timetable should comply with staffing requirements, the rules laid down by the administration and the contract clauses.

The terms *schedule* and *roster* are different. They are defined as follows.

- Scheduling is the apportionment, subject to constraints, of resources to objects placed in space – time, in such a way as minimize the total cost of the resources used[2].

- Roster is the placing, subject to constraints, of resources into slots in a Patten[2].

However, scheduling nurses is a difficult and important personal scheduling problem that is faced by many hospitals across the world. The main reason which lies on that is patients need nursing care throughout 24 hours over seven days a week.

Normally the nurse in-charge of each ward or the head nurse prepares this roster. The head nurse has the responsibility to construct the nurse roster monthly and it should be published before the next month.

After that, the Head nurse announces the due nights assigned for other nurses at the eighteenth day of the month and asks to notice the leave of each individual as soon as possible. Because of inanimate and time-consuming and for various other reasons, the Nurse Scheduling Problem (NSP) has caused much research attention.

The hospital system in Sri Lanka is of two categories:

1. Government Hospitals
2. Private Hospitals

Hospitals in Sri Lanka use manual system to create two categories of nurse rosters namely two-shift system and three-shift system. Currently most of the Government and private hospitals use 3-shift time frame system.

However, in our work, we mainly focused on the 3-shift system to create feasible, high quality monthly schedule for nurses of the hospitals in Sri Lanka.

Shift Type	Time	
	Staring Time	End Time
Morning	7.00 A.M	1.00 P.M
Evening	1.00 P.M	7.00 P.M
Night	7.00 P.M	7.00 A.M

Table 1.1: Shift Types

Under the rules of 3- shifts system, nurses have to be assigned to these shifts or give the days-off. One nurse can have only one shift for one day. The scheduling period is usually one or two weeks or one month. It depends on hospitals and wards requirements.

The responsible person whom we considered as the Head nurse will fill the table with duty nights for each and every nurse. This is normally filled by identifying a pattern among the number of nurses and the required number of nurses.

For an example, in the surgery unit in Matara General Hospital has sixteen nurses where two nurses are needed for each night shift and other nurses are needed for each morning and evening shifts. The head nurse of this unit gives a night shift for each individual once every seven days. After the night shift, the following day is the awaiting days-off. This night is taken as the first to calculate the next night shifts. Allocation of the first due night in a month has a connection with the previous month. In the process of creating a new schedule, the head nurse constantly gets help from the previous one. These comparisons make the process easy.

The head nurse initiates the nurse roster for the next month by the fifteenth day of the current month. Each nurse is requesting leave by considering the off-days, they have obtained and also their own needs. Other than these off- days the numbers of Sundays in a month are also given as leave for each nurse. For an example, for each individual nurse, the total number of Sundays in a particular month is given as off-days. All these allocations will be done to fill up the roster without destructing the constraints.