TCP/IP Request Management Using Customized MLFB Queue Scheduling Technique

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TCP/IP Request Management Using Customized MLFB Queue Scheduling Technique

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Abstract

The main goal of building a school management system is usually easy to enhance the communication between school managers, teachers and students' families. However, the increasing popularity and growing patronage of these management systems which noticeable recently, perhaps because of the increasing computer literacy and increasing internet access has no small measure led to an increasing waiting time in data retrieval. This reduces throughput, and also increasing the system vulnerability to malicious attacks and adversary penetration. In our proposed system, TCP/IP requests have been managed by applying a more time conscious scheduling algorithm in combination with others to address issues of time and throughput. To execute this multilevel feedback queue (MLFB) has been built based on a, first come, first serve (FCFS) and a modification of round robin scheduling technique by taking the variable time slice of the processes instead of fixed time slices. The implementation of the MLFB queue technique with adaptive time slice value ensured the efficient and effective handling a vast amount of various users' requests in a short time, with little waiting time. This is because the time conscious nature of the technique is more consistent with the requirements of TCP/IP based requests. Finally, to improve the security of the proposed system, three separate types of client application protocols have also been created to provide a secure access to each client.

Keywords*: MIS, ESIMS, C/S, MLFB*

1. Introduction

School Information Management System (SIMS) is a large database system which has been used to enhance the efficiency of school management by providing an interactive community portal for stakeholders (i.e. Parents, Teachers, Students and Management Administration). It allows users to save almost of their school's information electronically, including information of students, employees, properties, and teaching materials, etc. Because of the diversity of users such as teachers, families, and students, there will be many requests for data in at the same time. This leads to increasing network traffic as well as the load on the database server. An enhanced School Information Management System (ESIMS) was proposed; in this system, TCP/IP requests in a scheduled fashion will be handled to manage the system load to be responding to the nature time, the amount and the behavior of these requests more efficiently and effectively. This system deals directly with the database by the server program only and creates an automatic query in accordance with users' requests.

The front end and the back end are two parts of client server system. The latter also called database server, which uses to manage access structure, query assessment and optimization, 'concurrency control', and 'recovery' [1]. Whereas, the front end is called a client, each client provides an interface. The interface between the front end and the back end is through SQL, or through an application program. The clients use this interface to connect with a back-end server (database) to access data. Traffic congestion has always represented a main problem in the paradigm of Client / Server systems (C/S). This appears when many clients simultaneously send requests to the same server [2]. Another issue is all users working synchronously with the database. This clearly indicates that system's maintenance will likely be impossible as well as the shortage of system security.

This system is designed in an easy way to reduce network traffic by designing three types of client applications (teacher, family, and student) to classify the requests according to their type, and then use the scheduling algorithms (A priory, Round Robin, and FCFS algorithm) to simplify the communication between the school manager, teachers and students' families. This has been achieved by managing the TCP/IP requests of all users to the main system by applying scheduling algorithms to the requests. A multilevel feedback queue contains the following three levels are: 1) Priority

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scheduling technique. 2) FCFS algorithm. 3) Round robin algorithm. Distributing the requests among the queues in the database server based on parameters, such as IP addresses, port numbers, and some load information (Process sections, Priority value, pointer of request stating, Type of request, Arrival, Time and Burst time) has been applied in order to protect the database server from overloading and to differentiate the services that are competing among clients' requests for limited server resources. The round Robin algorithm has been modified to obtain fair execution for each request. In the next section an overview of the scheduling algorithms was presented and used in the system.

The rest of the paper is organized as follows: In section 2 we deal with the basic introduction about the Management information system and descried School Management System Structure with the Functionalities. Sections 3 present the basic introduction about the scheduling algorithms and detailed view of the MLFB algorithm which used in our proposed system. Sections 4 describe our proposed model and we compare the original round robin algorithm with a proposed round robin algorithm for our proposed module using variable time in terms of waiting time, turnaround time and the total number of context switches. Section 5 contains the results, and discussions on the performance of our proposed model. Finally, section 6 gives the conclusion of the paper.

2. Management Information System with Server/ Client Area

The Management Information System (MIS) has more than one definition, eras, and dimensions. MIS is defined as "a system based on the database of the organization evolved for the purpose of providing information to people in the organization" or it is a "Computer based Information System" [12]. In order to develop the school or college management, many organizations use a variety of hardware, software and network resources, and continued to develop a variety of management for staff, students, parents, and teachers, which formed a certain range of building information system [13]. With respect to MIS eras, Kenneth and Laudon identify many periods of MIS evolution corresponding to the five phases in the development of computing technology: 1) mainframe and minicomputer computing, 2) personal computers, 3) client/server networks, 4) enterprise computing, and 5) cloud computing [11]. Information system represents an incorporation of many dimensions which are *management*, *organization*, and *technology*. The management dimension includes leadership, strategy, and management behavior. The second dimension involves computer hardware, software, data management technology, and networking technology. The last dimension consists of the organization's hierarchy, functional specialties, business processes, culture, and political interest groups [11].

Many researchers have used the terms Management Information System (MIS), information system, Enterprise Resource Planning (ERP), and information technology management interchangeably. However, the most important difference between them is that ERP refers to one category which is classified under Information systems and MIS. In other words, IS and MIS represents a broader umbrella which includes other categories. The specialization of most management information systems is in particular commercial and industrial sectors, aspects of the enterprise, or management substructure. A management information system gives the business managers information that they need to make decisions. One of a vital application of such systems is a School Information Management System (SIMS) which uses to enhance school management performance.

School Information Management Systems (SIMS) cover school administration, and allows users to store almost all information about schools electronically, including information of students, staff, property, and teaching materials, etc. The most important aspect in such systems is the ease of information sharing with authorized users; searching in records, and reports generating. Figure1. Shows the general structure of the SIMS system with its Functionalities. SIMS uses client/ server as a communication technique in order to share the available data on a server between thousands or even millions of users simultaneously.

Communication between two applications is generally called as IPC (Inter-Process Communication). The TCP/IP protocol is one type of IPC, which represents the leader of network communication with scalable, client/ server architecture [6]. It can be used to establish connections between different types of computers and servers. The client program and the server program interact with each other by sending messages over the network. The data sources may use different transfer protocols; it plays an important role in forming the typical data patterns measured on the high speed links [4]. A client program is a program running on one end system that requests and receives a service from a server

program running on another end system [3]. Two end systems have been used under Ethernet technology because of its robust features.

Ethernet technology has obtained fast development because of its low price and high degree of flexibility. It is not only widely used in the business office area, but it also has been applied in a dominant position of the upper network communication market in commercial computer network communications and industrial control systems. Using it in embedded devices is becoming wider and wider and its market share is getting higher and Higher [5].

This research configured the MIS to meet the most individual school's needs. It is a multi-user system and can be used by hundreds or even thousands of users at the same time by helping scheduling algorithms. At a particular point of view, it is a platform which can be run on a Local Area Network (LAN) or public server with a static IP. Wherever the user is, once he/ she has intranet connection and SMS client installed, users can log on to the ESIMS server easily just by entering the user name, password, and IP address for the server and send request.

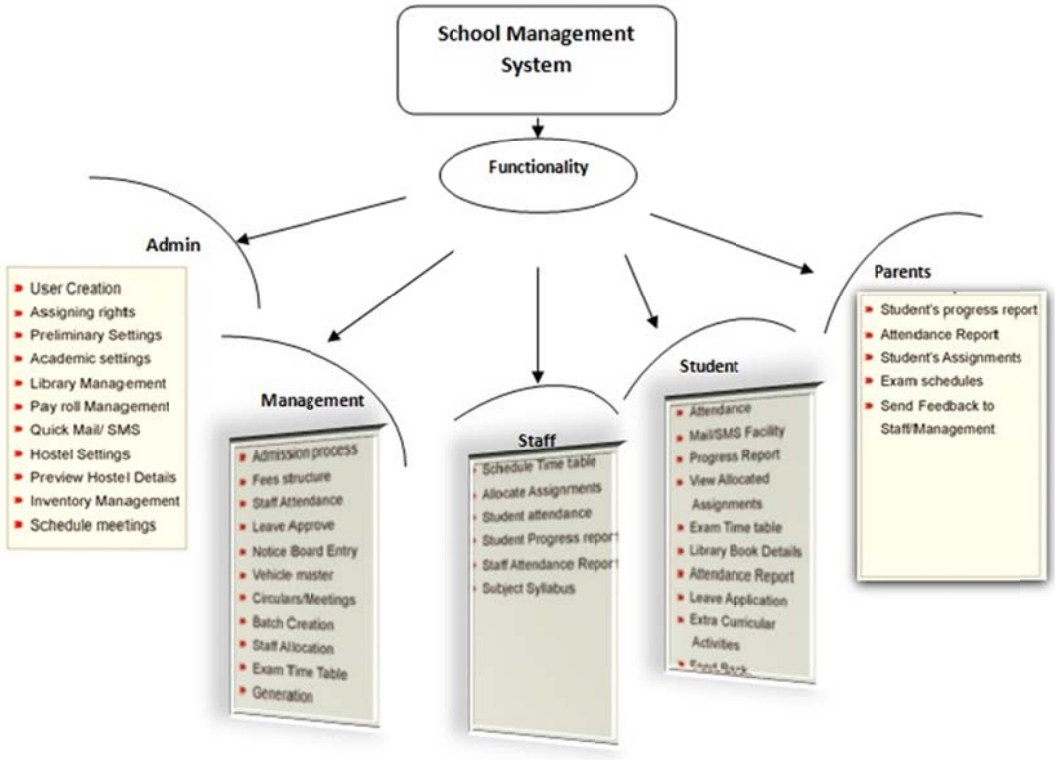


Figure1. School Management System Structure with the Functionalities

3. Scheduling algorithms

This section explains the scheduling algorithms which are used in this system. The main objective of scheduling algorithms which have been adapted in this system is to reduce the response network traffic, waiting time, and to increase the throughput. Many metrics can be measured in order to assess high efficiency of scheduling in such algorithms. Throughput metric is the number of processes completed per unit time. Turnaround time represents the interval from the time of submission of a process to the time of completion. As such, waiting time defines as the time spends by the process in the ready queue). The last metric is response time, which refers to the time interval between the submission of job unit the first response is produced [7]. Three scheduling algorithms have been combined to build a multilevel feedback queue as follows:

Level 1: Priority scheduling technique divides requests in accordance with the importance of user. For instance, a teacher with high importance and family with low importance with respect to Priority value that comes through arrived IP packets from the clients' application. The output of this algorithm is two queues, one for teachers' requests (high priority) and the latter for family requests (low priority).

Level 2: First Come First Serve (FCFS) algorithm selects the family requests queue that has same order; requests will be served according to the arrival time. This algorithm is easily managed with a FIFO queue. New process enters the queue through the tail of the queue and leaves through the head of the queue [8].

Level 3: It represents a round robin algorithm, a priori algorithm is just used to create two queues, one for teachers (high priority) and another for family (low priority) which does not contain any order in the database, and FCFS processes a limited amount of data which only display the results from the database. A RR time sliced technique will be applied to manipulate huge data of requests in order to update existing information or add new records to the database.

The RR algorithm is designed especially for time-sharing systems and is similar to the FCFS algorithm, but the preemption is added to switch between processes [8]. The RR algorithm will allow the first process in the queue (circular queue) to run depending on the duration of a small unit of time, which is called a time quantum or time slice, and run the next process in the queue for the duration of the same time slice. The RR approach allows for many devices on the network to get a free time for sharing the network resources [10]. The system's requests are scheduled according to the given burst time, arrival time, and priority value.

The vital strength points in the proposed RR scheduling algorithm are reducing the waiting time and the number of context switches as well as raising the throughput by putting some variation in the time slice instead of assigning the fixed time slice.

A multilevel feedback queue has some properties that define the system and these properties vary according to the system's specifications and they are as follows:

- The number of levels used in the system
- The scheduling algorithm for each level
- The method used for promoting the process to a higher priority queue
- The method used for demoting a process to a lower priority queue
- The method used for selecting the process from each queue

4. Description of Proposed Model

This section provides a general idea about the structure of the proposed system as illustrated in Figure 2. ESIMS can be applied in many environments of educational institutions such as schools and universities due to the robust characteristics of the system. For instance, it offers an easy way of interaction between system-user, manages all student activities by teachers, simplifies the monitoring of student status by their families, and sends direct email to students' families in order to inform them about different activities of the student in his / her institution. In general, the proposed model can be split into two major parts SIMS and TCP/IP request management scheduling algorithm fashion.

The SIMS is considered as a first part of the model which contains all functions of the system in the main graphical user interface (GUI) such as add, delete, make queries, and print reports. By using other interface, administrators can create special users with different authentications in order to manage the database. Other types of users such as students, teachers and families can send their requests through network directly by using the interface of the client application.

Handling TCP/IP requests in a scheduled fashion is the second major part in the model which has many tasks to perform simultaneously. As discussed previously in section 3 scheduling algorithm will be invoked when there are many requests from clients. The requests of users are managed by applying a Multilevel Feedback-Queue Scheduling (MLFB). MLFB partitions the ready queue into several separate queues based on some property of the request, such as request priority or process type. This algorithm also allows to process to move between queues according to the features of request burst time. As a consequence, a process which uses too much time will be moved to lower priority queue. This scheme leaves network bound and interactive processes in the higher-priority queues and processes with computational bound in a lower priority queue. In addition, a process that waits too long in lower-priority queue may be moved to a higher-priority queue as they are served accordingly.

Figure 2 shows the structure of the clients' request which include the following contents: 1) Process sections contain a number of operations with the data necessary for updating, adding or displaying data from the database. 2) The priority value represents the priorities of request execution. 3) Counter value represents the state of the request during the execution and indicates the address of the next part of the process which will be executed.4) Arrival Time of the request to the server. 5) Burst time for the request.6) Type value determines the operations which will be executed such as add attendances, add score, display attendances, display score, add course, and update course.

With respect to system security, the existing TCP/IP routing protocol will be used for routing purposes only, the data field (variable size) will contain the security and data elements of the ESIMS. This leads to designing three types of clients' applications which are teacher client, family client, and student client. This clearly provides an additional security to the system when each client has a particular application, for example, teachers use different application from students' families.

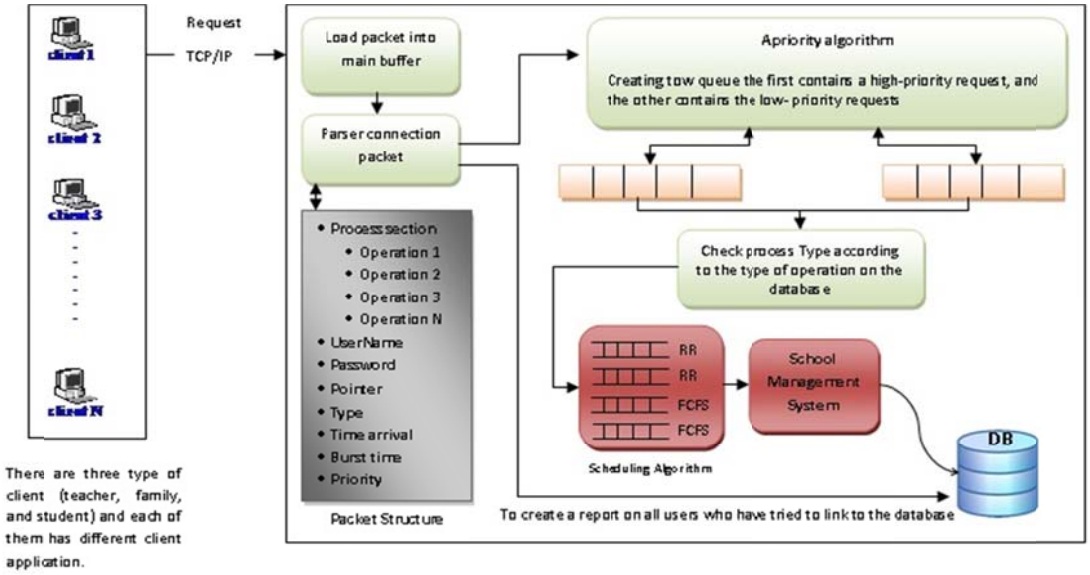
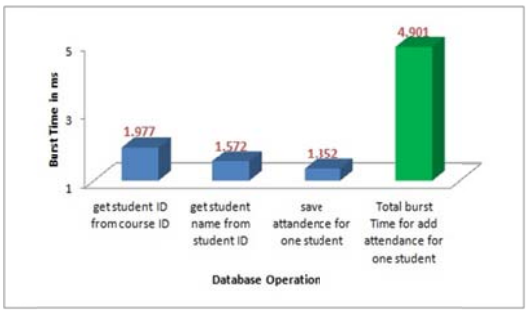


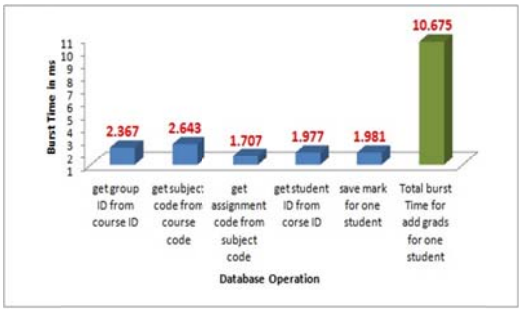
Figure 2. Proposed and Enhanced Model of ESIMS with integration of MLFB algorithm to manage TCP/IP request

4.1. Proposed Algorithm Evaluation

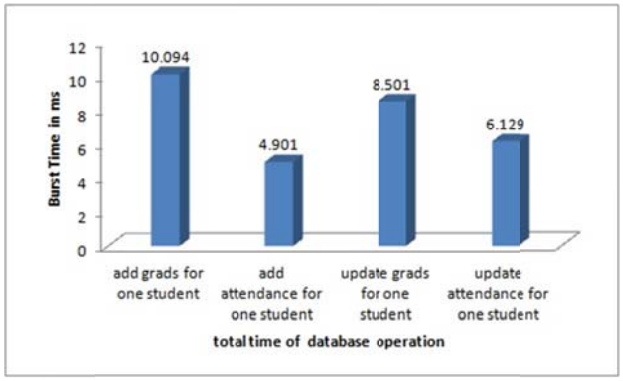
In this section the Proposed Round Robin Scheduling Algorithm was evaluated by considering a real example, during obtained the actual value of the burst time for each database process which are needed in this system by building codes to calculate the actual burst time of these processes (using ThinkPad computer Intel® Core™ i7 CPU 2.67GHz, RAM 4.00GB, WIN 7 32-bit Operating System). The time slice calculated according to the process burst time, if the number of processes is odd in queue the time slice will be the mid process burst time, else the number of processes is even in queue the time slice is an average of all processes burst time is assigned to the processes. Figures. 3(a), (b), and (c) shows the burst time details for processes, adding attendance, adding grades for a one of student, and total Burst time to four important operations in the database. This example compares with the classic Round Robin Scheduling Algorithm and with the modified Round Robin Scheduling Algorithm in waiting time. Two processes have been taken, the algorithm works effectively even if it used with a very large number of processes, as seen in the next section when display the result of 100 request come from client application to update the grades and attendance for students in the existing database on a server.



(a). Burst time for adding audience



(b). Burst for adding grades



(c) . Total Burst time to the four important operations in database

Figure 3. Burst Time for Database operation

four processes are assumed arriving at time=0, with actual burst time, process 1 is "add grades for one student=10.094", process 2 "add attendance for one student=4.901", process 3 "update grades for one student=8.001", and process 4 "update attendance for one student=6.129" (rounded of real numbers to integers only in this example for ease of understanding example 10.675=11, 4.901=5, 8.001=8, 6.129=6) with time quantum= 5 for using to classic round robin algorithm as show in Table 1, and time quantum=Average Burst Time for all process which equal 7.5 with rounded to integer number equal 8 to modify the Round Robin algorithm. The Table 2 shows the output using a classic RR algorithm and proposed RR algorithm. Figure 4 and Figure 5 shows a Gantt chart for both the classic RR algorithm and modify the RR algorithm.

Table 1. Arrival Time and Burst Time for Process 1 and Process 2

Process	*Arrival Time in millisecond*	*Burst Time in millisecond*
P1	0	11
P2	0	5
P3	0	8
P4	0	6

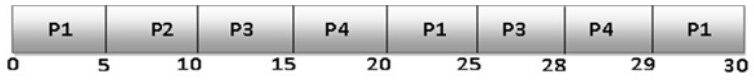


Figure 4. Gantt chart for Classic Round Robin

Figure 5. Gantt chart for Modify Round Robin

Table 2. Arrival Time and Burst Time for Process 1 and Process 2

Algorithm	*Average Waiting Time*	*CS*	*Throughput*
Classic Round Robin	16.75 ms	7	Low
Modify Round Robin	15.21 ms	4	High

Algorithm 1: Modification of Round Robin Pseudo code

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5. Result and Discussion

Our system model has two applications, the first is a server application, which is an integrated management system containing all the tasks such as add, delete, make reports and so on. The manager has full control privileges in dealing with the database through the main interface; this interface also contains essential part that shows information on how the database is linked to client applications. Also the server application has a function that allows automated interactions with client application across the network by keeping track request, that have been implemented and those that are under implementation and sending messages of request, that have been rejected to keep clients fully informed of the fate of their issued requests.

The second is a client application which is further segregated into three types of client applications, namely the teacher application, family application and student application. Figure 6 shows the teacher client application. A visual basic (VB) interface is used for selection of the process required, such as: Attendance Marks and so on, the selection of the type of operation such as: Display, Add, and so on and the selection of IP server. After pressing the submit button the client program generates Burst Time and priority value for a request and sends it to the server, when the request reaches the server application the arrival time value for the request is recorded and added making the request ready to enter one of the scheduling algorithms.

Input data to the scheduling algorithm which is the request sent from clients is shown in Figure 7. Server classifies requests according to the type of operation (Add or Display) to determine the type of scheduling algorithm that will work on the implementation of requests. The Round Robin algorithm which is the most important part of the program which is responsible for the implementation of all adding and update requests in the database. In this paper Modified Round Robin Algorithm was used to implement huge amounts of data in short time with little waiting time. Figure 8 shows the results of Modified Round Robin algorithms for update of a group of students' attendance. And Figure 9 shows the waiting time with the implementation of 100 requests at one time in the Round Robin algorithm.

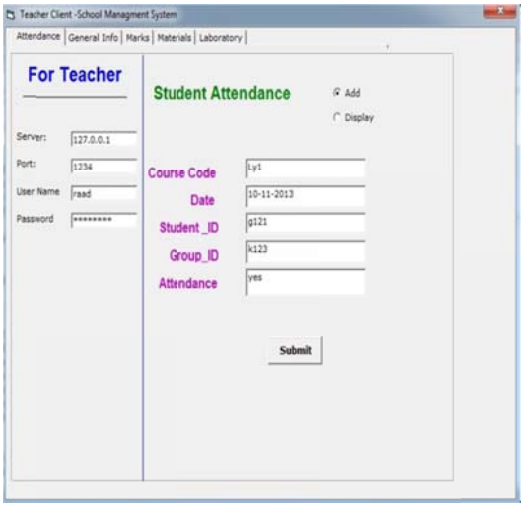

Figure 6. Main Interface for Teacher Client Application

id	op0	op1	op2	op3	op4	at	bt	pri	cot	opt	username
39	ly1	11-11-2013	g120	txt7	yes	2	2	2	1	DSP	kreem
40	ly1	11-11-2013	g120	txt7	yes	2	2	2	1	DSP	rhman
41	ly1	11-11-2013	g120	txt7	yes	1	1	1	1	DSP	rkeem
42	ly1	11-11-2013	g120	txt7	yes	2	2	2	1	DSP	staar
43	ly1	11-11-2012	g120	txt7	yes	1	1	1	1	DSP	alhak
44	ly1	11-11-2013	g120	txt7	yes	2	2	2	1	DSP	ali
45	ly1	1-11-2013	g120	1	yes	2	2	2	1	DSP	kerar
3	ly1	11-11-2013	g120	txt7	no	1	1	1	0	Add	saad
4	ly1	11-11-2013	g121	txt7	yes	1	1	1	0	Add	raad
5	ly1	11-11-2013	g120	txt7	yes	1	1	1	0	Add	saad
6	ly1	11-11-2013	g12000	222	yes	1	1	1	0	Add	ahmeed
7	ly1	11-11-2013	g120	222	yes	1	1	1	0	Add	ahmeed
8	ly1	11-11-2013	g120	222	yes	1	1	1	0	Add	ahmeed
9	ly1	11-11-2013	g120	222	yes	1	1	1	0	Add	ahmeed
10	ly1	11-11-2013	g120	222	yes	1	1	1	0	Add	ahmeed
11	ly1	11-11-2013	g120	txt7	yes	1	1	1	1	Add	raad
12	ly1	11-11-2013	g120	txt7	yes	1	1	1	1	Add	raad
13	ly1	11-11-2013	g120	txt7	yes	1	1	1	1	Add	raad
14	ly1	13-10-2013	g120	txt7	no	1	1	1	1	Add	jon
15	ly1	13-10-2013	g120	txt7	no	1	1	1	1	Add	jon
16	ly1	13-10-2013	g120	txt7	no	1	1	1	1	Add	jon
17	ly1	13-10-2013	g120	txt7	no	1	1	1	1	Add	jon
18	ly1	13-10-2013	g120	txt7	yes	5	5	5	1	Add	zaid
19	ly1	14-10-2013	g121	txt7	yes	5	5	5	1	Add	mohamed
20	ly1	14-10-2013	g120	txt7	no	5	5	5	1	Add	rehman
21	ly1	14-10-2013	g121	txt7	no	5	5	5	1	Add	rehman
22	ly1	11-11-2013	g120	txt7	yes	4	4	4	1	DSP	krar
23	ly1	11-11-2013	g121	txt7	yes	4	4	4	1	DSP	krar
24	ly1	11-11-2013	g121	txt7	yes	4	4	4	1	DSP	krar
25	ly1	17-10-2013	g120	txt7	yes	3	3	3	1	DSP	yeing

Figure 7. Input data to the scheduling algorithm

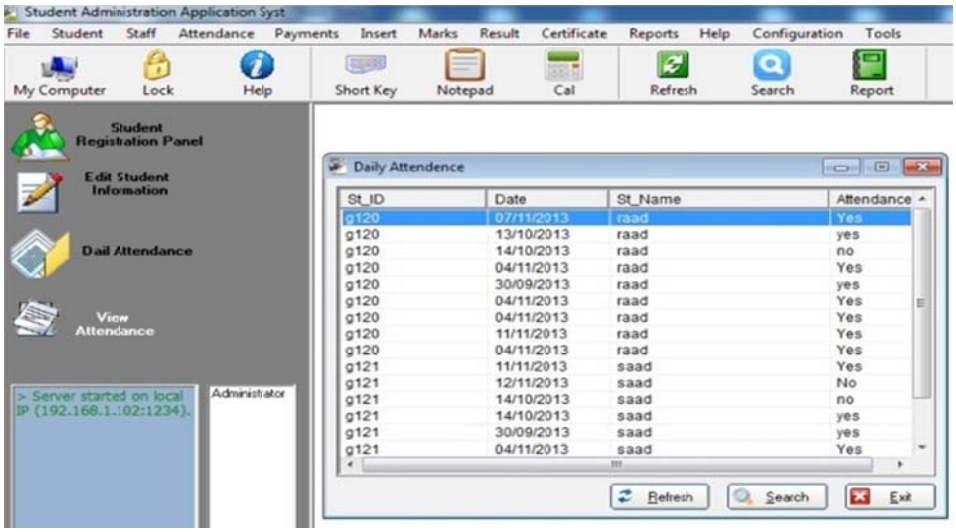

Figure 8. results of Modify Round Robin algorithm for update of a group of students' attendance

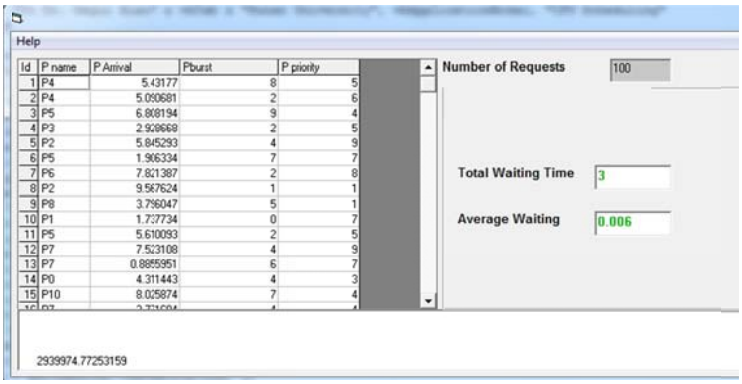

Figure 9. Execute 100 requests by Modify Round Robin Algorithm

6. Conclusion

The use of computer based management systems by institutions and organizations to facilitate data management operations is no longer new these days. This has undoubted brought a lot of success and easy in the administration and service delivery of these institutions and organizations. However, the tremendous influx users from all of kinds sending request and trying to access the system resources simultaneously has resulted in certain challenges including network traffic congestion and insecurity.

Hence, in this paper, we have proposed a new approach of dealing with these issues by integrating a modified version of Round Robin Algorithm and other scheduling algorithms like FCFS on a single platform to successfully address these setbacks. To implement our proposed approach we used a case-study of school management system (SMS), in the SMS we modified the classic round robin architecture by introducing intelligent time slice component which is more consistent with the real life applications and implemented it on a real time database system. The experimental results indicate that our proposed approach significantly improves network traffic congestion by reducing the waiting time. Besides, it is also important to mention that, our approach does not only improve the network traffic but also improve the security situation of the system. From table 1 and 2 we found that the proposed algorithm regarding the scheduling technique has a higher performance in term of speed and response time for handling the requests of the users, it had also shown that using multilevel feedback queue scheduling algorithm has produced a superior results over other scheduling techniques, knowing that the MLFBQ is the most general scheduling algorithm yet being the most complex.

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