DESIGN AND IMPLEMENTATION OF FUZZIFIED DISK SCHEDULING ALGORITHM

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Abstract

Various processes can be creating requests for writing and reading disk records in multiprogramming systems. Disk scheduling is one of the major accountability of operating systems. Disk scheduling algorithms integrates seek time only, the factor rotational delay is ignored by existing algorithms. But this algorithm considers both factors; seek time as well as rotational delay. The disk scheduling algorithms are basically used to assign the services to the input and output requests on the disk. This paper introduced a new fuzzified disk scheduling algorithm by using some fuzzy rules. The scope and purpose of this paper is to improve the performance of disk scheduling. This paper considers two inputs named as seek distance and rotational delay and finds a crisp range named as priority which represents the sequence of execution. It uses nine fuzzy rules, with the help of mamdani type fuzzy inference in Mat-lab and finds single value for output priority.

Keywords:Disk Scheduling, Fuzzy Logic, Rotational Delay, Seek Distance

Introduction

Operating System (OS) is basically used to provide an interface between user and hardware. Operating System is the basic requirement to operate any system and control the execution of any type of program. Operating System is a system software which is basically used to manage the computer hardware resources and provide services for the computer programs. Functions of operating system named as memory management, device management, processor management, and file management are used to manage all the operations in a system.

The concept of disk scheduling is used to provide the multiprogramming environment for control memory. Disk scheduling algorithms are basically used to assign the Input Output Services. Since looking for disk is time taking, scheduling algorithms effort is to minimize this invisibility. If chosen disk drive or organizer is accessible, request is worked instantaneously. If demanding, new application for service will be located in the line of pending applications. When one request is finished, the Operating System has to choose which incomplete request to deal next. The OS depend on the type of algorithm it needs when dealing and selecting what specific disk request is to be handled next. The intention of expending these algorithms is charge head actions, to the amount as conceivable. If the head move merely, the seek time will be faster. To check how this mechanism work, the altered disk scheduling algorithms will be conversed and illustrations are also delivered for enhanced understanding on these altered algorithms. Disk Scheduling Algorithm is used to compute Total Head Movement (THM), Seek Distance (SD) and Rotational Delay (RD). In this paper compute SD and RD after that calculate THM with the help of Priority (P).

Terms which are generally used in Disk Scheduling are

Latency Time: The time taken for the data block to rotate from its current to just under the read-write head is called latency time.

Seek Time: The time taken to position the read-write head on the top of the track where data block is stored.

Transfer Time: The time taken to transfer a block of data from the disk to memory.

Literature Survey

An approach to grid scheduling optimization based on fuzzy association rule mining is proposed by Huang and Jin [1]. A fuzzy scheduling controller for a computer disk file track-following servo is proposed by Yen and Yung Yaw Chen [2]. Prognosis of machine health condition using neuro-fuzzy systems is proposed by Wang, Wilson Q., M. FaridGolnaraghi, and Fathy Ismail [3]. Predicting penetration rate of hard rock tunnel boring machine using fuzzy logic is proposed by Ghasemi, Ebrahim, SaffetYagiz, and Mohammad Ataei [4]. Resource allocation and scheduling theory based on distributed environment is proposed by Yue, Zhao, and QianXu [5]. A comparative study on resource allocation and energy efficient job scheduling strategies in large-scale parallel computing systems is proposed by Chandio and Aftab Ahmed [6]. Hybrid Job Scheduling Algorithm for Cloud Computing Environment proposed by Javanmardi, Saeed [7]. Analysis of the GSTF disk scheduling algorithm proposed by Bachmat, Eitan, and Ilan Elhanan [8]. A Comprehensive Review for Disk Scheduling Algorithms proposed by Celis, John Ryan [9]. Design and Performance Evaluation of an Optimized Disk Scheduling Algorithm (ODSA) proposed by Bhoi, Sourav Kumar, Sanjaya Kumar Panda, and Imran Hossain Faruk [10]. Weak Real-Time Based on Disk Storage System Scheduling Strategy proposed by Liu, Si Yuan, Lu Bai, and Yan Zhang [11]. A New Optimized Real-Time Disk Scheduling Algorithm proposed by Nidhi, Nidhi, and Dayashankar Singh [12]. A general framework for dynamic and automatic I/O scheduling in hard and solid-state drives proposed by González-Férez, Pilar, Juan Piernas, and Toni Cortes [13]. A New Approach to Disk Scheduling Using Fuzzy Logic is proposed by PriyaHoodaand SupriyaRaheja [14]. This paper consider two factor named as seek time and rotational delay for schedule the disk. Fuzzy Logic based algorithm for disk scheduling policy is proposed by Talip [15]. This paper propose a new fuzzy model for improving the performance of disk scheduling.

Disk Scheduling Algorithms

1. **FCFS (First Come, First Served):**It is the modestmethod of disk scheduling algorithms. The I/O requirements are processes or served as per to their appearance. The request touches first will be retrieved and served first. Subsequently, it monitors the order of start; it causes the remote swings from the innermost to the outermost pathways of the disk and so on [32].

2. **SSTF (Shortest Seek Time First):**This algorithm is based on the knowledge that R/W head should proceed to the path which is adjacent to its current position [32]. The technique would remain same until all the path requests are attended.

3. **SCAN**: This algorithm is prepared by affecting the R/W head rear and onward to the innermost and outermost pathway. As it scans the pathways from end to end, it process each the requests found in the direction it is controlled[32]. This algorithm is also known as the Elevator algorithm.

4. **LOOK**: This algorithm is alike to SCAN algorithm excluding for the end-to-end stretch of each curve. The R/W head is individual tasked to go the furthermost location in need of examining [32].

5. **C-SCAN (Circular Scan):** This algorithm is an upgradedform of the SCAN algorithm. C-SCAN curves the disk from one end to-end, but as soon it touches one of the end pathways it then transfers to the other end pathway without examining any requesting location [32].

6. **C-LOOK:** Circular LOOK is justsimilarto C-SCAN which uses a return curve before handling a set of disk requests [32]. It does not derive to the end of the pathways unless there is a request, moreover read or write on such disk location similar with the LOOK algorithm.

Fuzzy Logic Control System

Fuzzy Logic deals with reasoning that is estimated rather than accurately gathered from classical predicate logic.LotfiZadeh, a professor of computer science at the University of California founded the theory of fuzzy logic [16]. Fuzzy Logic is a problem-solving controller system methodology that delivers itself to implementation in systems ranging from small, simple, multi-channel PC, networked, or workstation-based data achievement and control systems. It needs some numerical constraints in order to operate such as what is measured significant error and significant rate-of-change-of-error, but particular values of these numbers are generally not critical unless very approachable performance is required in which case empirical tuning would determine them.

Innumerable applications of fuzzy logic have piercing a method for an operational exploitation of fuzzy logic in the framework of challenging processes. Fuzzy logic is a modeling method well suited for the control of complex and non-linear systems [17]. Control design of an ankle foot orthosis with the application of fuzzy logic is proposed by M. Kanthi, V. I. George and H. S. Mruthyunjaya [18]. Type-2 Fuzzy Logic in Decision Support Systems is proposed by Comas and Diego S [19]. Fuzzy Logic Applications in Flanges Manufacturing proposed by Turc, Cristian Gheorghe and George Belgiu[21]. Combining boolean consistent fuzzy logic and ahp illustrated on the web service selection problem proposed by Dragovic and Ivana [22]. Application of the L-fuzzy concept analysis in the morphological image and signal processing proposed by Alcalde, Cristina, Ana Burusco, and Ramón Fuentes-González [20]. Intelligent maximum power point trackers for photovoltaic applications using FPGA chip were proposed by Chekired [23]. Interval type-2 fuzzy weight adjustment for backpropagation neural networks with application in time series prediction were proposed by Gaxiola and Fernando [24]. Fuzzy Logic Applications in Control Theory and Systems Biology proposed by Xu and Sendren Sheng-Dong[25] . New Applications of Soft Computing, Artificial Intelligence, Fuzzy Logic & Genetic Algorithm in Bioinformatics proposed by A. T. Hiwarkar, and R. Sridhar Iyer [26]. Application of a model based on fuzzy logic for evaluating nursing diagnostic accuracy of students proposed by MHBM Lopes [27]. Fuzzy logic control in air conditioning system [28], ducting system [29], CPU scheduling [30] and Job shop scheduling [31] proposed by R. Kumari, V. K. Sharma and S. Kumar.

Proposed Fuzzified Disk Scheduling Algorithm (FDSA)

This paper introduced an innovative expert system for design and implementation of new disk scheduling algorithm with the help of some fuzzy rules. These rules are basically used to examine the optimal solution for disk scheduling. This paper deals with some fuzzy rules and these rules are based on seek distance and rotational delay. This work is proposed to compute a new priority for execute sectors in CPU with the help of Mamdani type inference.

This paper uses some suitable linguistic variables as input and output. These variables are basically used for compute a crisp value for priority. In this paper, two input variables named as Seek Distance (SD) and Rotational Delay (RD) and one output variable named as Priority (P). Seek Distance (SD), Rotational Delay (RD) and Priority (P) measured as Low, Medium and High. These linguistic fuzzy rules have described the relationship between defined input variables (SD and PD) and output (P). This algorithm used 9 rules which are based on IF THEN statement such as: - IF SD is low and RD is low THEN P is low. These rules are outlined in table 1.

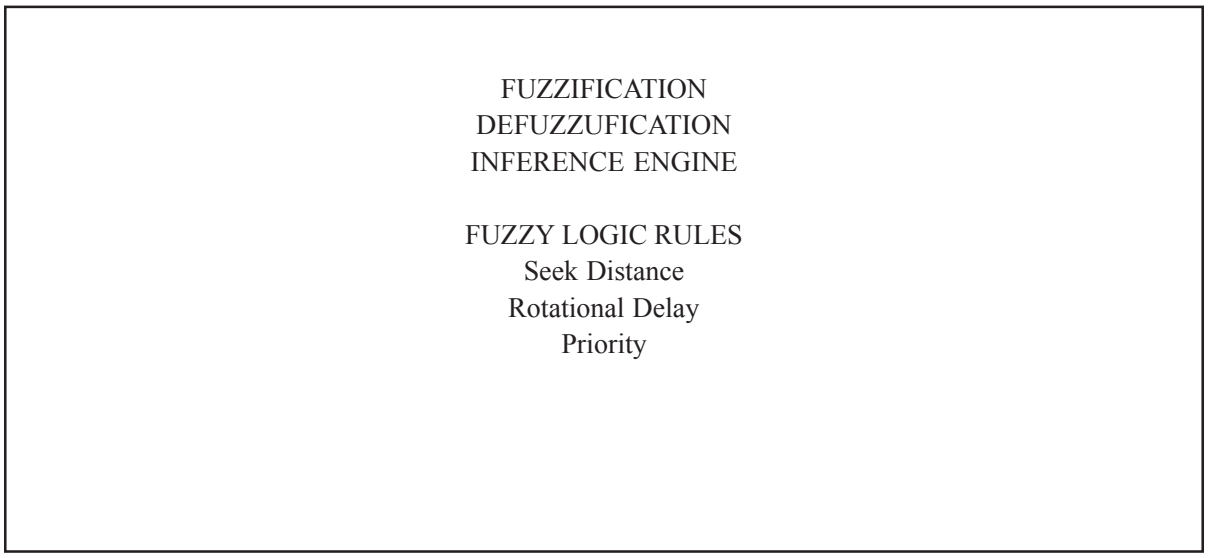

Figure 1: Architecture of Proposed System

Figure 1 shows the architecture of proposed system. Figure 2 shows the Mamdani type inference system named as "Disk Scheduling". Figure 3 shows the membership function of input variable named as Seek Distance. Figure 4 shows the membership function of another input variable named as Rotational Delay. Figure 5 shows the membership function of output variable named as Priority. Figure 6 outlines the rules of disk scheduling. Figure 7 outlines the surface viewer of disk scheduling.

Table 1: Set of Proposed Rules

Seek Distance (SD)	Rotational Delay (RD)	Priority (P)
Low	Low	Low
Low	Medium	Low
Low	High	Medium
Medium	Low	Low
Medium	Medium	Medium
Medium	High	High
High	Low	Medium
High	Medium	High
High	High	High

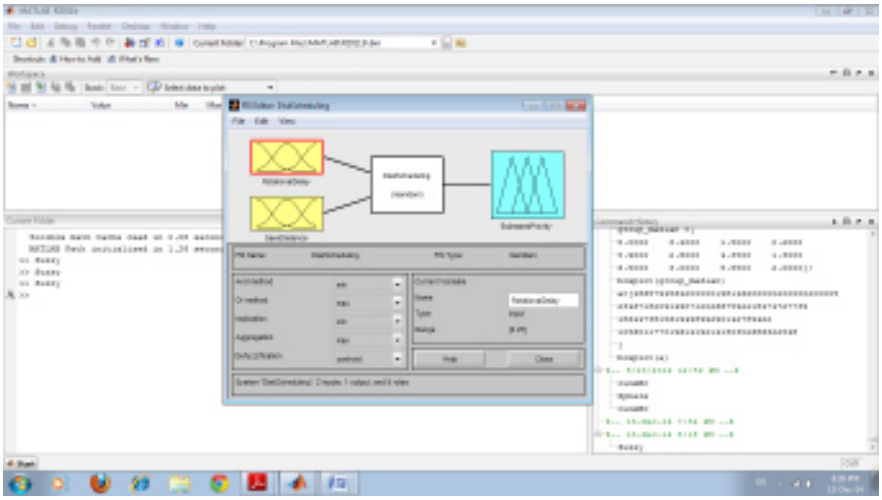

Figure 2: Mamdani Type Inference System Disk Scheduling

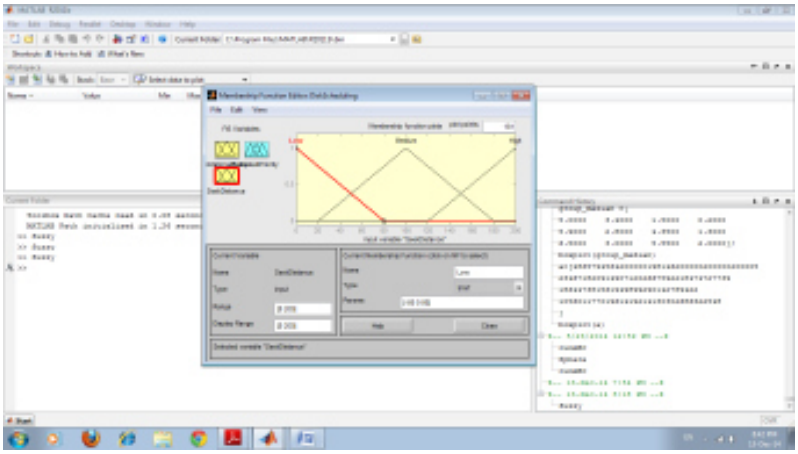

Figure 3: Membership Function of Input Variable Seek Distance

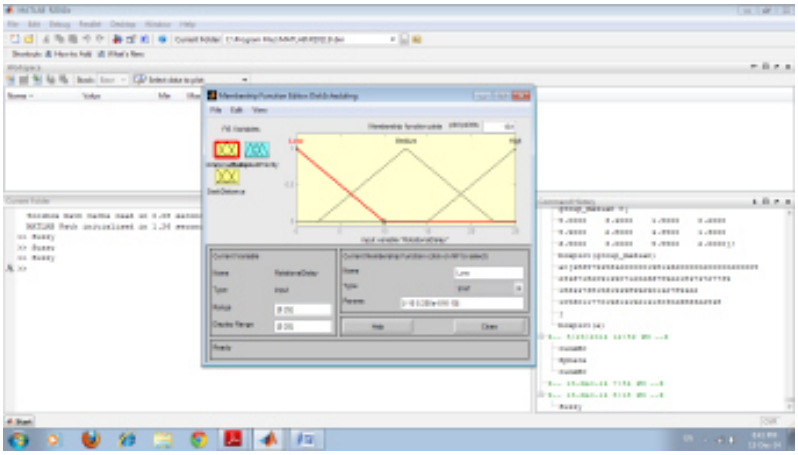

Figure 4: Membership Function of Input Variable Rotational Delay

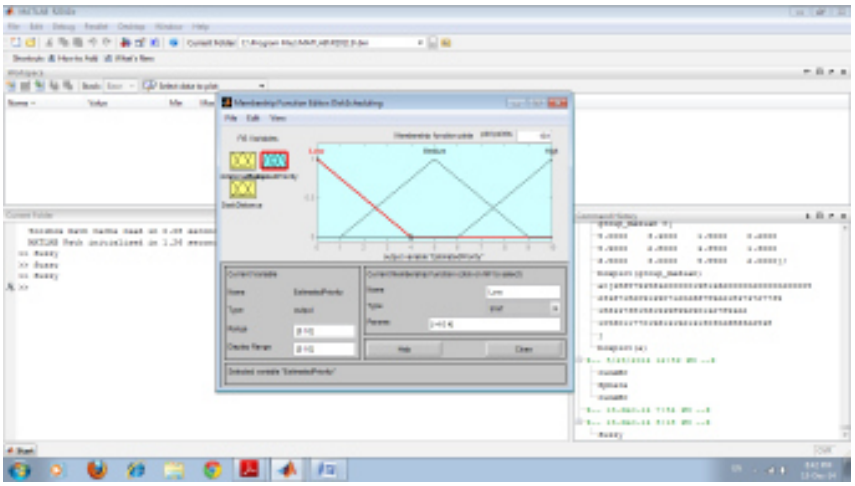

Figure 5: Membership Function of Output Variable Priority

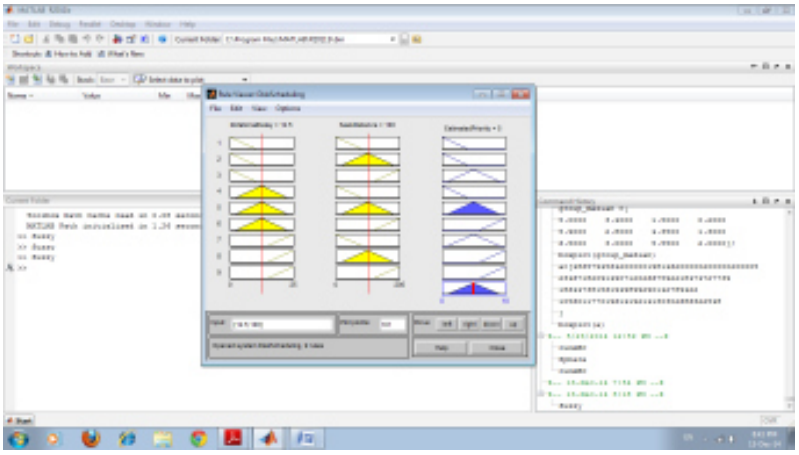

Figure 6 : Rules of Disk Scheduling

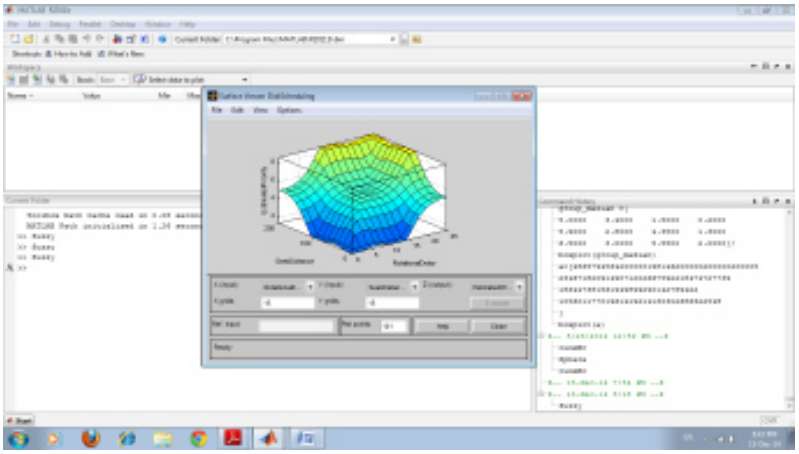

Figure 7 : Surface Viewer of Disk Scheduling

Proposed Algorithm: Fuzzified Disk Scheduling Algorithm (FDSA)

1. Read order of all requested sectors which are received by the scheduler.
2. Read currently located head position.
3. Calculate the Seek Distance (SD) with the help of requested sectors.
   SD = |Current head position – next requested sector|
4. Calculate the Rotational Delay (RD) with the help of sectors values.
   RD = (8.33* sectors value)/63
5. Use Seek Distance (SD) and Rotational Delay (RD) as an input.
6. Calculate Priority (P) with the help of given inputs through FIS Disk Scheduling.
7. Arrange all the Priority values in ascending order.
8. Now serve the entire request in order.
9. Update head position.
10. Repeat step 1 to 9 until the queue is empty.

Result

The proposed algorithm FDSA is compared with already existing conventional algorithm named as FCFS, SSTF, LOOK, C-LOOK and SCAN. The proposed algorithm FDSA provides better result as compare to conventional algorithm.

Verified this algorithm with the help of a simple example. The order of requested sectors in the disk queue is 95, 180, 34, 119, 11, 123, 62, 64 and the current read/write head position is 50. Now compute the Total Head Movement (THM) for the entire disk scheduling algorithm and compare all of them. Figure 8 outlines the comparison between all the used disk scheduling algorithms. This comparison shows that FDSA is gives the better result as compare to other algorithms

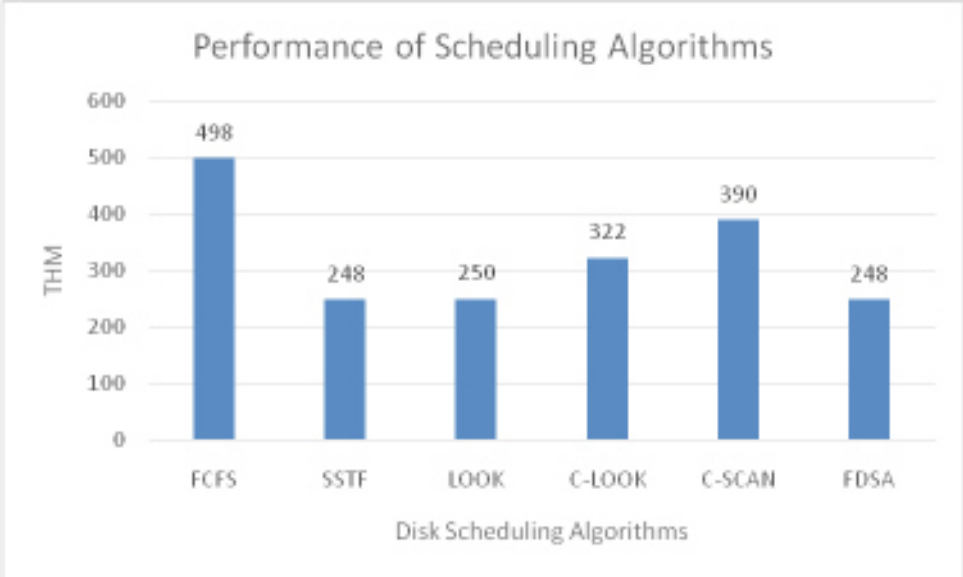

Figure 8 : Comparison of Total Head Movements

Conclusion

This paper presents a novel approach for Disk Scheduling. The proposed approach is based on some fuzzy logic rules. These rules are basically used to calculate a priority of the new sequence of sectors. Fuzzy Inference System used two inputs named as Seek Distance and Rotational Delay and one output named as Priority. As per calculated priority, all the sectors executed and found the THM (Total Head Movement). Results prove that the proposed algorithm is better than some existing algorithm in term of performance.

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