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Title:	EFFICIENT SCHEDULING OF WORKFLOW IN CLOUD ENVIORNMENT USING BILLING MODEL AWARE TASK CLUSTERING
Author:	D.A.PRATHIBHA , B.LATHA, G. SUMATHI
Abstract:	Cloud computing is a cost effective alternative for the scientific community to deploy large scale workflow applications.For executing large scale scientific workflow applications in a distributed heterogeneous environment ,scheduling of workflow tasks with the dynamic resources is a challenging issue.Moreover in a utility based computing like cloud which supports pay per use model of the resources ,scheduling algorithm must efficiently utilize the available time of the resource.Most of the existing scheduling heuristics does not consider the dynamic nature of the cloud and hence produce the static schedule. Public cloud environment like Amazon EC2 offers catalog of resources and the price is generally metered per hour.Here any fractional usage is rounded off to the next hour.To meet the budget and deadline of the customers proposed work focuses to incorporate a billing model aware task clustering mechanism in the workflow scheduling process . This work also presents a resource selection algorithm which can be used for choosing proper resource at each stage in the workflow. Preliminary results obtained by running two scientific applications Montage and Cybershake with different resources and task clustering mechanisms are discussed.
Keywords:	Cloud Computing,Workflow,Resource Selection,Deadline,Budget,Task Clustering
Source:	Journal of Theoretical and Applied Information Technology 31 July 2014 -- Vol. 65. No. 3 -- 2014

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Title:	CHDS: A FAST SEARCH ALGORITHM FOR MOTION ESTIMATION IN VIDEO CODING STANDARD SR. VANI, M. SANGEETHA, P. DAVIS
Author:	R. VANI, M. SANGEETHA, P. DAVIS
Abstract:	In this paper, we propose a new hybrid Cross Hexagon Diamond Search algorithm (CHDS) using cross-shaped search pattern as the initial step and asymmetric hexagon-shaped patterns and small diamond pattern as the subsequent steps for fast block motion estimation. In block motion estimation, search pattern with different shape or size and the center biased motion vector distribution characteristics has a great impact on search speed and distortion performance. The previously developed fast search algorithms focus on improvement of either coarse search or inner search. The Proposed CHDS algorithm reduces the number of search points by exploiting the distortion information in the neighbouring search points. Simulations are done using MATLAB and our experimental results indicate that the proposed CHDS algorithm reduces an average of 39.78% of time for motion estimation compared to New Hexagon Search (NHEXS), 10.86% of time for motion estimation compared to Hexagon Search (HS) and 38.64% of time for motion estimation compared to Diamond Search (DS).
Keywords:	Motion Estimation, Block Matching, Motion Vector, Search Algorithm
Source:	Journal of Theoretical and Applied Information Technology 31 July 2014 -- Vol. 65. No. 3 -- 2014

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Title:	OPTIMIZED PRIORITY ASSIGNMENT SCHEME FOR CONGESTED WIRELESS SENSOR NETWORKS
Author:	BEULAH JAYAKUMARI. R, DR. JAWAHARSENTHILKUMAR V
Abstract:	Congestion is a likely event in wireless sensor networks due to node density and traffic convergence. Congestion can decrease network lifetime and reduce information accuracy. Transferring crucial data during congestion is a challenging problem in wireless sensor network. To achieve this we have proposed a competent data delivery protocol called Optimized Priority Assignment Scheme for congested wireless sensor network (OPAS). It dynamically assigns priority to every data based on their time critical nature and drops highly correlated duplicate data by considering delivery probability and

Title:	TSAAC: THRESHOLD SENSITIVE ASSISTANT AIDED CLUSTERING PROTOCOL FOR HETEROGENEOUS WSNs USING NICHING PARTICLE SWARM OPTIMIZATION
Author:	A. KARTHIKEYAN, 2FALAK JINDAL, NEERAJ KAUR BUMRAH, SWAPNIL PAMECHA, T.SHANKAR
Abstract:	The energy efficiency and improvement in network's lifetime are some of the critical issues in wireless sensor networks (WSNs). Remote environmental monitoring and target tracking are the important applications of a wireless sensor network. In this paper, TSAAC (Threshold Sensitive Assistant Aided Clustering) a heterogeneous protocol using Niching Particle Swarm Optimization (NPSO), for wireless sensor networks is proposed. It employs three levels of heterogeneity with cluster head being selected optimally based on the fitness function of NPSO, which is an important technique for multimodal optimization. To further balance the energy dissipation and enhance the system robustness, an assistant cluster head can be selected based on the cluster state information. Being threshold sensitive, this protocol significantly improves the stability period and reduces energy consumption considerably by 14% compared to TSEP (Threshold Sensitive Stable Election Protocol). The performance of the proposed protocol is compared with the existing protocols like LEACH, AAAC-NPSO, SEP and TSEP. The simulation results show that TSAAC-NPSO can achieve better network lifetime.
Keywords:	WSNs (Wireless Sensor Networks), NPSO (Niching Particle Swarm Optimization), Heterogeneity, Assistant-Aided Clustering, Thresholding.
Source:	Journal of Theoretical and Applied Information Technology 31 July 2014 -- Vol. 65. No. 3 -- 2014

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Title:	MULTI-FACTOR APPROACH FOR EFFECTIVE REGRESSION TESTING USING TEST CASE OPTIMIZATION
Author:	S RAJU, G V UMA
Abstract:	Regression testing intends to ensure that a software applications works as specified after changes have been made to it, is an important phase in software development lifecycle. Regression testing is the re-execution of some subset of test that has already been conducted. In regression testing, number of regression tests increases and it is impractical and inefficient to re execute every test for every application or function when change occurs. It is an expensive testing process used to detect regression faults. Regression testing has been used to support software-testing activities and assure acquiring an appropriate quality through several versions of a software product during its development and maintenance. Test suites can be large and conducting regression tests is tedious. Regression testing assures the quality of modified applications against unintended changes. The test case selection and prioritization is important in regression testing. Test case prioritization seeks to find an efficient ordering of test case execution for regression testing. Test case prioritization is used in regression testing, at the test suite level, with the goal of detecting faults as early as possible in the regression testing process, given a test suite inherited from previous versions of the system.
Keywords:	Regression Test, Test Case Prioritization, Priority Factors, Defect Density, Defect Removal Efficiency, Average Percentage of Fault Detected (APFD), Genetic Algorithm, Clustering.
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Title:	COOPERATIVE PACKET DELIVERY USING ENHANCED COOPERATIVE OPPORTUNISTIC ROUTING SCHEME (ECORS) IN MANET
Author:	VIJAYAKUMAR A, SELVAMANI K
Abstract:	Cooperative communication is an active area of research today. It enables the nodes to achieve spatial diversity, which leads to tremendous improvement in system capacity and delay. In this proposed system cooperative communication mechanism is used to determine a list of intermediate relay nodes that follows en-route to the destinations. Here, when data packets are broadcasted from a source node and the packets are received by a destination node along with the route. Cooperative communications which utilizes nearby terminals to relay the message transmissions also induces the non-cooperative nodes to participate in some opportunistic environments for achieving the diversity gains and to improve the efficiencies among the mobile nodes in wireless mobile ad hoc networks. The Enhanced Cooperative Opportunistic Routing Scheme (ECORS) which is based on light weight proactive source routing is used in this work to ensure the cooperation of participating mobile nodes in MANETs. This new protocol is used to easily identify the intermediate nodes and establishing the trusted routes. The comparative performance analyses among AODV versus ECORS are properly carried out and the better cooperative packet delivery ratio, increased throughput and decreased delay in packet delivery are achieved in this network simulation.

Keywords:	Cooperative communication, MANETs, Opportunistic packet forwarding, Packet delivery, Retransmission, Throughput.
Source:	Journal of Theoretical and Applied Information Technology 31 July 2014 -- Vol. 65. No. 3 -- 2014

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Title:	TERRESTRIAL-TO-SATELLITE INTERFERENCE IN THE C-BAND: TRACTABLE CALCULATION TECHNIQUE
Author:	LWAY FAISAL ABDULRAZAK, A. HAMEED
Abstract:	This paper presents a research conducted on the interference mitigation between IMT-Advanced and Fixed Satellite Services (FSS). It covers a deterministic analysis for interference to noise ratio (I/N), adjacent channel interference ratio (ACIR) and path loss propagation, in order to determine the separation distances in the co-channel interference (CCI) and adjacent channel Interference (ACI) scenarios. An analytical model has been developed based on the deterministic analysis of the propagation model. The IMT-Advanced parameters have been represented by Worldwide Interoperability for Microwave Access (WiMAX) 802.16e. The impact of different FSS channel bandwidths, guard band separations, antenna heights and different deployment areas on co-existence feasibility are considered. The results obtained in terms of minimum required separation distance in three scenarios, co-channel, zero-guard band, and adjacent channel are analyzed.
Keywords:	Interference, Separation Distance, Bandwidth, IMT-Advanced, Guard Band
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Title:	FEATURE EXTRACTION AND DIMENSIONALITY REDUCTION IN PATTERN RECOGNITION USING HANDWRITTEN ODIA NUMERALS
Author:	PRADEEPTA K. SARANGI, KIRAN K. RAVULAKOLLU
Abstract:	Feature extraction is the initial and critical stage which needs to be carried out very carefully for any recognition system that uses pattern matching. In order to reduce the feature extraction complexity, dimensionality reduction is applied. This also increases the performance and recognition accuracy. This paper proposes the concept of a new feature extraction and dimensionality reduction method based on a set of linear transformation of the character image. The verification of the method has been carried out by implementing a simple recurrent neural network (RNN) with a data set consisting of 1500 isolated handwritten Odia numerals. An accuracy of 92.41% is reported. Experimental results show that the proposed method has the potential to be used as a feature extraction method for handwritten Odia numerals.
Keywords:	Handwritten Recognition, Odia Numerals, Recurrent Neural Network, Feature Extraction
Source:	Journal of Theoretical and Applied Information Technology 31 July 2014 -- Vol. 65. No. 3 -- 2014

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Title:	RESOURCE MEDIAN MULTICAST ROUTING PROTOCOL FOR ENERGY CONTROLLED MULTIPATH COMMUNICATION IN WIRELESS AD-HOC NETWORK
Author:	SHANMUGASUNDARAM, CHANDRASEKAR
Abstract:	Many applications in network consisting of scattered interactive method, software improvements and replica model for distributed database envisages optimized routing, scheduling and data dispersal schemes. A large wireless ad-hoc network broadcast messages from the source to all the elements in a multicast group. Certain research works based on the leader election model (DSLE) focus on the incentives in the form of reputations ensuring security to participate in the election process. With the application of DSLE, the consumption of resources was balanced during the detection of intrusion whereas the detection service through routing was not effective. In order to discover the path the method Channel-Aware Ad hoc On-Demand Multipath Distance Vector (CA-AOMDV) chooses the stable links and also predicts the path failure for improving the routing decisions. To improve the routing decision, CA-AOMDV uses the channel average non-fading period as a routing metric but maximal energy was consumed for obtaining the channel state information in wireless ad-hoc network. To handle the communication using multi-path routing path effectively, Resource Median Multicast Routing (RMMR) Protocol is designed. The protocol RMMR adapt to any form of wireless ad-hoc network with median multicast tree for effective routing service. The initial connection between the wireless nodes is counted and computation effort is minimized using the median multicast trees. Median Multicast employs Energy Controlled Active Multicast (ECAM) algorithm which constructs a multicast tree with minimal energy consumption while transferring the information. ECAM algorithm uses the idling concept to reduce the

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Title:	ANALYSIS OF OPTIMIZATION TECHNIQUES IN CHI-SQUARED AUTOMATIC INTERACTION DETECTION
Author:	SWARNALATHA S.R, G.M. KADHAR NAWAZ
Abstract:	In the context of pattern classification, one of the major issues discussed by most of researchers is \diamond curse of dimensionality \diamond problem which occurs in data classification because the data processed in most of the application is high-dimensional feature space. So, the essential consideration here is that irrelevant features should be identified which causes less classification accuracy and the main motto is to find a minimum set of attributes from the initial set of data helping to make the patterns easier to understand along with improved classification accuracy and reduced learning time. Therefore, the selection of feature set is the process to search for an optimal feature subset from the initial data set without compromising the classification performance and efficiency in generating classification model. In this paper, we develop a hybrid classifier by combining CHAID and genetic algorithm. Initially, the genetic algorithm with ABC operator will extract the best attributes and based on the extracted attributes the CHAID will generate the decision tree. We analyze the performance with different datasets and compare the analysis with the existing technique.
Keywords:	Optimization, Chi-Square, Automatic Interaction, Detection
Source:	Journal of Theoretical and Applied Information Technology 31 July 2014 -- Vol. 65. No. 3 -- 2014
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Title:	POWER SYSTEM LOADABILITY IMPROVEMENT BY OPTIMAL ALLOCATION OF FACTS DEVICES USING REAL CODED GENETIC ALGORITHM
Author:	R.MEDESWARAN, N.KAMARAJ
Abstract:	FACTS devices can effectively control the load flow distribution, improve the usage of existing system installations by increasing transmission capability, compensate reactive power, improve power quality, and improve stabilities of the power network. However, the location and settings of these devices in the system plays a significant role to achieve such benefits. This work presents the application of Real Coded Genetic Algorithm (RGA) for finding out the optimal locations, and the optimal parameter settings of single type and multi type FACTS devices to achieve maximum system loadability (MSL) in the power system. The FACTS devices used are Thyristor Controlled Series Capacitor (TCSC) and Unified Power Flow Controller (UPFC). The reactance model for TCSC and the decoupled model for UPFC are considered for this work. The thermal limits of the line and voltage limits of the buses are taken as constraints during the optimization. Simulated Binary Crossover (SBX) and Non-uniform polynomial mutation are employed to improve the performance of the Genetic Algorithm used. Simulations are performed on IEEE 6 bus and 30 bus power systems. The obtained results are encouraging and show the effectiveness of RGA.
Keywords:	Loadability, FACTS, TCSC, UPFC, and Real Coded Genetic Algorithm
Source:	Journal of Theoretical and Applied Information Technology 31 July 2014 -- Vol. 65. No. 3 -- 2014
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Title:	DOCUMENT CLUSTERING USING CO-WORD ANALYSIS AND FORMATION OF KEYWORD AGAINST DOCUMENT MATRIX
Author:	Document Clustering, Text Mining, Keyword Extraction, Co-word Analysis, HTML Tags.
Abstract:	A complexity of the retrieval of relevant document from a large corpus of documents is the most common challenging problem in the areas of web mining and search engines. In addition, the growth of unlabelled and unsupervised documents also increases this complexity. Document clustering algorithms plays a vital role to reduce this problem. In this paper, an algorithm was proposed to cluster the documents based on their concepts. The proposed algorithm in its first part identifies the vital keywords of the document, those helps to find out the concept of the document, using our new statistical text mining algorithm. In the second part, based on the results derived, the given documents are clustered using
Keywords:	Vs Documents matrix analysis. This proposed Document Clustering algorithm gives more than 90 % accuracy.
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Title:	A NOVEL APPROACH OF FIC FOR COMPRESSION OF LARGE SCALE REMOTE SENSING COLOR IMAGES
Author:	D.SOPHIN SEELI, DR.M.K.JEYAKUMAR
Abstract:	Image compression has become an important issue in the storage and the transmission of images including satellite and aerial photographs. A new approach was used for compressing satellite images is to construct compression algorithms by using the fractal theory. This paper is based on a novel image structure, Spiral Architecture, which has hexagonal instead of square pixels as the basic element. In the proposed work, we use only two codebooks for all images. Open and private code book is generated for the remote sensing image gallery, instead of using separate codebook for each during the process; hence high compression ratio can be achieved. Introducing Spiral Architecture into fractal image compression for remote sensing images will improve the compression performance in compression ratio, reduction of memory and bandwidth cost of large-scale remote sensing images.
Keywords:	Fractal Image Compression; Compression Ratio; Large-Scale Remote Sensing Image; Hexagonal Structure; Spiral Architecture; Codebook.
Source:	Journal of Theoretical and Applied Information Technology 31 July 2014 -- Vol. 65. No. 3 -- 2014

Title:	DETERMINING MAXIMUM/MINIMUM VALUES FOR TWO-DIMENTIONAL MATHMATICLE FUNCTIONS USING RANDOM CREOSSOVER TECHNIQUES
Author:	SHIHADEH ALQRAINY
Abstract:	This paper presents a solution to determining the maximum/minimum values for two-dimensional mathematical functions using the three most popular crossover techniques (Single point, Two point and cut and splice) randomly in genetic algorithm. A set of experiments were ran over 20 complex functions, the obtained results show that using random crossover techniques tends to be worst compared with traditional genetic algorithm that uses specific crossover method such as single point crossover.
Keywords:	Genetic Algorithm, Machine Learning, Heuristic Search. Crossover Methods
Source:	Journal of Theoretical and Applied Information Technology 31 July 2014 -- Vol. 65. No. 3 -- 2014

Title:	TWO-WAYS DATABASE SYNCHRONIZATION IN HOMOGENEOUS DBMS USING AUDIT LOG APPROACH
Author:	RAI GUDAKESA, I MADE SUKARSA, I GUSTI MADE ARYA SASMITA
Abstract:	Data integration is the most important part in applying distributed database, in which data from various data source can be united by implementing integration. Data replication is one of the data integration forms which is very popular nowadays, since it is convenient or it can do backup towards data in various different sites. The practice absolutely has shortcomings in data integration, as there is no control over the integration from replicated data, therefore it is necessary to do synchronization towards data. Data synchronization is a part of replication, it is a process to ensure each copy of database contains similar object and data. Data synchronization can be applied in numerous methods, one of them is utilizing Audit Log that is recorded every activities occur at database. Audit Log can be applied to almost any Database Management System (DBMS). This research utilized TCP Socket and client-server architecture to distribute data from Audit Log. The final result concludes that Audit Log can be utilized in synchronization with client-server implementation, yet it has limitation in recording data. This paper also showing how Audit Log created and managed to be used as replication and synchronization procedure.
Keywords:	Distributed Database, Data Integration, Data Replication, Data Synchronization, Audit Log
Source:	Journal of Theoretical and Applied Information Technology 31 July 2014 -- Vol. 65. No. 3 -- 2014

Title:	A FUZZY AHP PROCESS IN GIS ENVIRONMENT FOR LANDFILL SITE SELECTION
Author:	BENNIS Kaoutar, BAH I Lahcen
Abstract:	The purpose of this paper is to present a hybrid methodology combining Geographic Information Systems (GIS), Fuzzy Analytic Hierarchical Process (FAHP) and stakeholder's judgment. This multi-level decision-making tool captures the ambiguity and impreciseness in decision making judgments, and

	<p>results in a final priority ranking to site a new waste disposal area for the city of Tangier in the north of Morocco.</p> <p>The criteria at hand are spatial by nature and contribute differently to the choice-making process, the GIS-FAHP integration allows to deal with geospatial data while accounting for the tradeoffs of the criteria with regard to the main objective.</p> <p>In fact, the FAHP acts in a first time as a method of extracting the weights of each criteria/layer from a pair-wise comparison matrix, then, in a second time, FAHP acts as a method in selecting the best site from a set of most viable sites; the pair-wise comparison matrices are the result of stakeholders evaluation of all criteria, sub-criteria and sites.</p> <p>The set of most viable sites is obtained with the GIS tool in which we conducted the data preparation, each criterion is represented by a layer which is either extracted from remote sensing imagery or digitalization of local maps, a weighted linear combination (WLC) processes the layers and results in a map of suitability for landfill siting.</p>
Keywords:	Fuzzy Analysis, Analytic Hierarchical Process (AHP), Geographic Information System (GIS) , Weighted Linear Combination (WLC), Suitability.
Source:	Journal of Theoretical and Applied Information Technology 31 July 2014 -- Vol. 65. No. 3 -- 2014

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Title:	SEARCH IN TEXT DOCUMENTS BASED ON N-GRAMS AND FOURIER WINDOW TRANSFORMATION
Author:	K.YA KUDRYAVTSEV
Abstract:	This paper is of theoretical nature and is devoted to the development and theoretical justification of the new Full Text Search method in documents. The idea of the method is to partition the text into N-grams, to construct "spectrograms" of a text document using the windowed Fourier transform. Then a fast Fourier transform algorithm is used and "spectrogram" of the text of the document is compared to the "spectrogram" of the search line in special "control" points. This paper provides a rigorous mathematical justification of the proposed method, the possibility of forming conclusions on the presence of the search line in the document is proven. A generalized algorithm of a new method of full-text search is presented.
Keywords:	Full-text search in databases, Window Fourier transform, Fast Fourier Transform, Spectrogram text, N-Grams.
Source:	Journal of Theoretical and Applied Information Technology 31 July 2014 -- Vol. 65. No. 3 -- 2014

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Title:	GA BASED FEATURE RANKING MECHANISM TO DETECT NEW BORN INFANTS JAUNDICE WITH AN ENSEMBLE TREE STRATEGY
Author:	A. ARULMOZHI, DR.M. EZHILARASI
Abstract:	Jaundice is a yellow discoloration of the skin and whites of the eyes that is often seen in newborns. Newborn jaundice can be analyzed by scrutinizing the infant and examining blood levels of bilirubin. Infants with high blood levels of bilirubin called hyperbilirubinaemia, evolve the yellow color when bilirubin acquires in the skin. The major symptom of jaundice is yellow coloring of the skin and conjunctiva of the eyes. A Genetic Algorithm (GA) is used to enhance or optimize the overall behavior by evolving the population. Genetic Algorithms (GAs) are a virtually new criterion for a search, based on the precept on instinctive selection. Ensemble methods are learning algorithms that design a set of classifiers. An ensemble of classifiers is a predetermined classifier whose individual decisions are combined in some way to classify new examples. In this analysis, an ensemble of fitness evaluations would produce an ensemble of fitness values for each individual. The experimental results reveal that the proposed method can act as a supplement to support earlier detection and more effective treatment due to improved jaundice detection.
Keywords:	Fitness Evaluation, Jaundice, Hyperbilirubinaemia, Maximal Information Compression Index (MICI), Machine Learning, Kernel Support Vector Machine (SVM), Gray Level Co-occurrence Matrix (GLCM), Genetic Algorithm (GA).
Source:	Journal of Theoretical and Applied Information Technology 31 July 2014 -- Vol. 65. No. 3 -- 2014

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Title:	REDUCED ORDER LINEAR QUADRATIC REGULATOR PLUS PROPORTIONAL DOUBLE INTEGRAL BASED CONTROLLER FOR A POSITIVE OUTPUT ELEMENTARY SUPER LIFT LUO-CONVERTER
Author:	N.ARUNKUMAR, T.S. SIVAKUMARAN, K.RAMASH KUMAR, S.SARANYA

Abstract:	The design and analysis of reduced-order linear quadratic regulator (ROLQR) plus proportional double integral controller (PDIC) for enhancing the dynamic performance of the positive output elementary super lift Luo-converter (POESLLC) worked in continuous conduction mode (CCM) is carried out, The ultimate aim is designing the PDIC is to obtain the efficient output voltage regulation with zero steady state error. The ROLQR is mainly designed to regulate inductor current which in turn enhances the dynamic performance of the converter. The POESLLC is modeled using state space average technique. Extensive simulation is carried under both line and load variations and the controller platform are evaluated using well as in the experimental model (digital dsPIC30F4011controller). The simulation and experimental results are illustrated that the POESLLC with ROLQR plus PDIC tracks reference voltage, regulate the inductor current and robust in spite of line and load variation.
Keywords:	DC-DC Power Conversion, Positive Output Elementary Super Lift Luo-Converter, Linear Quadratic Regulator, Proportional Double Integral Controller And State-Space Average Model.
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TWO-WAYS DATABASE SYNCHRONIZATION IN HOMOGENEOUS DBMS USING AUDIT LOG APPROACH

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ABSTRACT

Data integration is the most important part in applying distributed database, in which data from various data source can be united by implementing integration. Data replication is one of the data integration forms which is very popular nowadays, since it is convenient or it can do backup towards data in various different sites. The practice absolutely has shortcomings in data integration, as there is no control over the integration from replicated data, therefore it is necessary to do synchronization towards data. Data synchronization is a part of replication, it is a process to ensure each copy of database contains similar object and data. Data synchronization can be applied in numerous methods, one of them is utilizing Audit Log that is recorded every activities occur at database. Audit Log can be applied to almost any Database Management System (DBMS). This research utilized TCP Socket and client-server architecture to distribute data from Audit Log. The final result concludes that Audit Log can be utilized in synchronization with client-server implementation, yet it has limitation in recording data. This paper also showing how Audit Log created and managed to be used as replication and synchronization procedure.

Keywords: *Distributed Database, Data Integration, Data Replication, Data Synchronization, Audit Log*

1. INTRODUCTION

Distributed database system has some advantages, for instance, the ability to handle expansion (enhancement or widening) data and data availability, also the ability to manage where to distribute the data. Replication in distributed database is one useful way to distribute that data. To create fully consistent data while distribution process, it is not adequate by only utilizing replication process. To overcome that problem, it then uses data synchronization procedure. Data synchronization is a part of replication, it is a process to ensure each copy of database contains similar object and data [1]. Synchronization process enables a data at certain database updated in real-time or periodic at the other database [2].

The other fundamental thing in applying synchronization is by understanding how data of the replication final result can be accessed and utilized before moving to synchronization phase. Some DBMS, for example MySQL, replication can be done by manipulating existing replication feature and reading binary log file. Meanwhile, not every DBMS has similar feature in applying replication. To satisfy that condition, the utilization of *Audit*

Log and *Audit Trail* can be used. *Audit Log* can be utilized to identify who accessed database, what kind of activities, and what data has been changed [3]. General category of auditing database includes monitoring user who attempts to access the database, Data Control Language (DCL) activity, Data Definition Language (DDL) activity, and Data Manipulation Language (DML) activity [4].

In this scenario, an audit table will be made in every configured database and data in audit table will be distributed through network to targeted database which also has been configured. Transferring the data will be done through Socket with client-server model.

2. SYNCHRONIZATION METHOD

According to the explanation previously, one possible method in applying synchronization is utilizing data produced by audit log. Each DBMS has different way to make audit log. The easy way to create audit log is by using Trigger in DBMS, in order to produce an audit table in every database.

2.1 Creating Audit Log Table

Creating audit log with trigger needs all types of trigger action, such as INSERT, UPDATE and DELETE trigger. Trigger auditing has one weakness, which is not all activities of a database could be recorded, just as Data Definition Language (DDL) activity and user activities. Besides, trigger auditing also has virtues in applying at almost all DBMS.

Every synchronized configured database with this method will have one new table with auditlog_ prefix, and then followed by database name. Table 1 will show the field of the audit table.

Table 1: Field of Audit Log Table

Field	Explanation
execution_id	This <i>Field</i> is used to save log id
timestamp	This <i>Field</i> is used to save time of input data to <i>audit</i> table
table_name	This <i>Field</i> is used to record table name which has been changed
action	This <i>Field</i> is used to record type of alteration (Insert, Update or Delete)
field	This <i>Field</i> is used to record any columns in that current table.
field_pk	This <i>Field</i> is used to record <i>primary key</i> owned by current table
field_type	This <i>Field</i> is used to record data types of field owned by current table
old_data	This <i>Field</i> is used to save data before the alteration of current table. The record is valid for <i>query</i> Update and Delete, while the rest will result NULL
new_data	This <i>Field</i> is used to save new input data to current table. Recording DELETE statement will result NULL value

Every table on database will be divided into 3 triggers, each consists of AFTER INSERT, AFTER UPDATE, and AFTER DELETE, thus if there are 3 tables on database, there will be 9 triggers on that database. The utilization of AFTER aims to prevent data unsuccessfully gets into audit table. Data input which gets into audit table is data produced by recorded activities of trigger. Figure 1 shows how audit trigger is created.

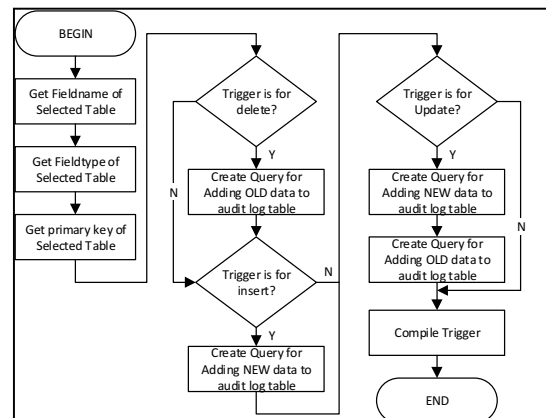


Figure 1: How Audit Log Trigger Created

Figure 1 explains how trigger loads to create audit table. It takes some data, such as field, data type and primary key, those will be a variable in trigger. Each type of trigger has different contents. Delete trigger merely has old data, since it is only old data needed in data deletion process. Insert trigger also merely uses new data, because it is only capable to obtain new data when there is new data input. Update trigger is able to record old and new data. Old data has function to search data that is going to be updated, while NEW is new data to replace old data. Data input passing through those every trigger will be marked with I code (for insert), U (for update), and D (for delete).

2.2 Synchronization Process

Before synchronization process, synchronized database in early initial state at each site must be similar. This is done to ensure synchronized data is still consistent [5]. If this condition has been satisfied, then synchronization process could be started.

To start synchronization by using data of audit log, id and last timestamp from audit table is necessary to record. Using timestamp is a very important thing and its utilization is very qualified in comparing [6], therefore timestamp is used to check whether there is new data, changed data, or deleted data from table at synchronized database according to id record and timestamp, also to make sure if there is overhaul towards the entire data in audit table which certainly will take long time.

execution_id	timestamp	table_name	action	
1	2014-02-18 06:48:50	tb_coba	I	Last sync data
				Compared
1	2014-02-18 06:48:50	tb_coba	I	
2	2014-02-18 06:49:24	tb_coba	D	
3	2014-02-18 06:53:48	tb_coba	I	
4	2014-02-18 06:53:56	tb_coba	I	
5	2014-02-18 06:54:01	tb_coba	I	
				Logged
				New data

Figure 2: How audit table data logged and compared

Figure 2 points out how the reading process of data in audit table. The id and timestamp of last data that has been read will be saved and then used to investigate whether the newer data of that id and timestamp has been into audit table. If there is new data, data delivering process can be directly started and sent to all synchronized sites.

In the case of one way synchronization, the implementation of that model still produces merely replication mode, it is because when there is data deletion at slave site, thus that data will never be fetched and produce not synchronized database. It differs from two ways synchronization, where alteration at master or slave site will influence each other. To solve problems in that one way synchronization, it needs a third party application to control alteration at slave site in real-time, therefore rollback data can be conducted.

3. IMPLEMENTATION

Previous discussion of synchronization design will be implemented by using client-server architecture in exchanging data process and DBMS. This research used DBMS MySQL.

Regarding to Figure 3, synchronization process works by using client-server architecture and data deliverance is done by using *socket stream*. Client is a software that installed to every sites where the database that will be synchronized are used. Connection config on client is file containing connection configuration to DBMS where it has database existing which will be synchronized and connection configuration such as ip address, port and authentication user needed to do communication by using socket [7]. Client application uses one database, it consists of some configuration tables, they are table to save data received from the other clients, table to save data which will be sent to the other clients, also master and slave synchronization configuration table.

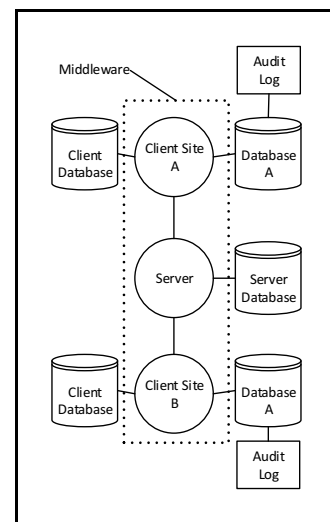


Figure 3: Scheme of Synchronization Architecture Implementation.

Sending and executing data uses traditional sort algorithm, it means first data input will be processed firstly (FIFO) [8]. Generally, client and server application has main function as data sender and receiver. In term of sending data, the application will determine what and where to send. In term of receiving data, the application will work more at waiting data to arrange what process should be conducted towards that data [9].

Moreover, each client can synchronize more than one database at one local site. There are two types of configuration can be conducted, those are configuration as master and as slave. When it is configuration as master, then the connection setting of database and synchronized table must be determined. For configuration as slave, the client has to register the other clients which control database as master at configuration database, and then do requesting data from master client in the form of database and table list which is necessary to be selected and synchronized. When slave assures to accomplish selecting database and table, client master will register slave into configuration database, this further will be used to know where to sent audit table. Figure 4 shows any components owned by client

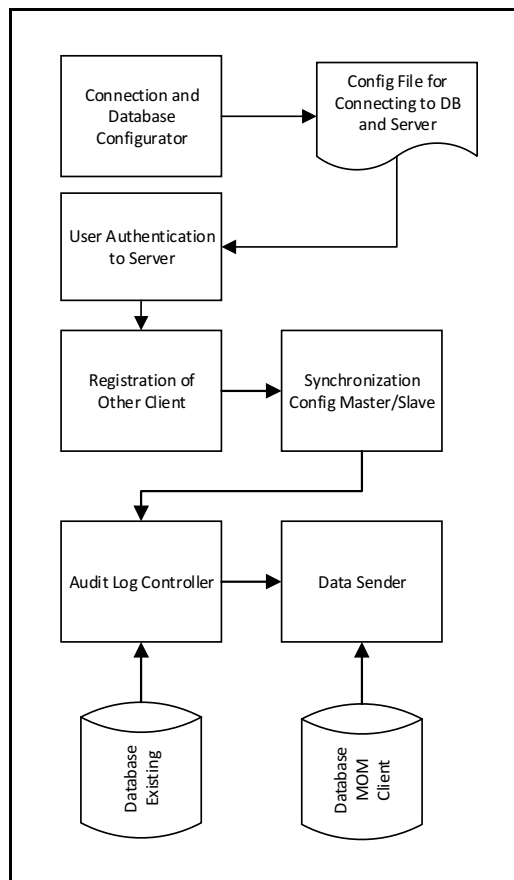


Figure 4: Components of Synchronization Client

Server synchronization has more moderate function than client. Server has duties to receive data from one client and send to directed client. Moreover, client also has function to supply service utilizing authority, therefore only client who inputs authentication correctly will be permitted to send data through server. Although it seems simple, server's duties are hardly difficult since it enables many clients connected at once and many inputs-outputs through the server to and fro. Therefore, server application is supposed to be installed in the computer with excellent hardware and network specification. Figure 5 illustrates any components owned by server synchronization.

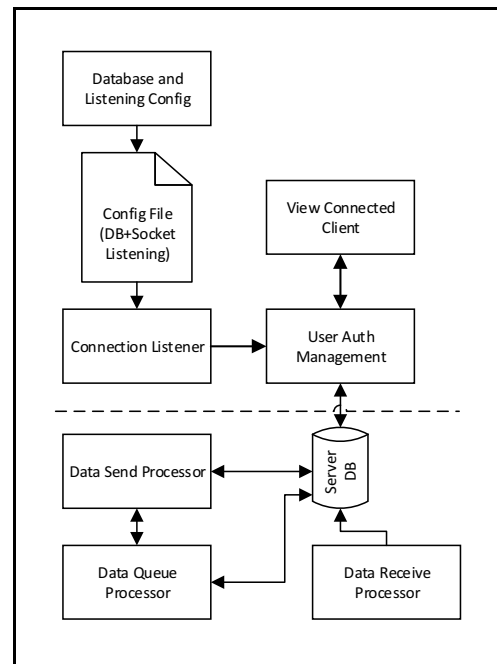


Figure 5: Components of Synchronization Server.

4. SYNCHRONIZATION ISSUES

When synchronization process is running, there are many possibilities occur toward the processed data. The emergence of the problems has to contribute the appropriate solution, so that, it can guarantee integration of data that has been synchronized. Some potential problems in implementing synchronization with client-server will be discussed below.

4.1 Client Fails Connecting to Server

Utilizing client-server model implementation obviously has a certain condition when client are not able connecting to server, particularly because of problem in network connectivity. That causes problems when a data must be sent and that data is not successfully sent. This problem can be solved by implementing deliverance status analysis process of data on the client application level. The message that is failed to send will be saved into a table and sent it back when client is fully connected to server.

4.2 Client at Destination Site is Offline

When data is already in server and will be forwarded to targeted client, there is possible problem, such as targeted client is offline, therefore server will fail to forward the data. This issue can be solved by saving data temporarily to server into

a message queue table. Server will periodically attempt sending data to targeted client according data in queue table and it will give flag if data has been successfully sent.

4.3 There are Many Stacks of Log in One Audit Table

Log in audit table will be incessantly accumulating when there is constantly an increase, changing and deletion toward a table in a database. This circumstance will really influence the performance of synchronization process done by the application, since it searches numerous data by using query. To solve this problem, data in audit table will be deleted when the synchronization is successfully done, and then truncate at table will be executed when all data is considered synchronized to all sites successfully. It does not influence the new site to do synchronization configuration, because initial state at database will help to overcome possible problems in the stage of reading audit table.

4.4 The Possibility of Endless Loop when There is Two Ways Synchronizations

In applying two ways synchronization model, both database at master and slave site will have an active audit table. It will be used in synchronization process. The issue appears when data from audit table at master site is executed to slave site, and that data is recorded again in audit table at slave site. This could cause delivering data repeatedly and become an enormous problem if it is not rightly solved. To solve that problem, it is specifically regarded to audit table. It is necessary to make a jumper table that contains which data at audit table must be jumped when data is going to be sent to targeted client has similar identity with jumper table.

4.5 Data Reconciliation

The biggest problem in implementing database synchronization is when data that is going to be synchronized experiences a conflict in execution process. That conflict emerges when data with similar primary id, however it has another column with different data. In the case of adding data, this conflict can be possibly solved. Meanwhile, in the case of updating and deleting data, it may make this problem more complex. The solution in this implementation is making a data reconciliation model, so when there is a conflict on data, the user of client application will manually decide which data is correct. Data reconciliation needs

confirmation of data selection from whole clients located in the two ways surroundings.

4.6 Data Security at Delivery Process

Data integrity can be assured through its accuracy, completeness, wholeness, health and conformity of data compared to source data [10]. Exchanged data through a communication network always has risk in its integrity problem. Changing and hijacking data by outsiders could happen when data passes through communication network. Utilizing AES encryption on data is one solution to overcome it. AES offers the combination of security, performance, efficiency, implementability and flexibility [11]. The security level could be gained based on how encryption implementation is conducted [12].

5. NEXT WORKS

Unfortunately, this does not mean that database Synchronization implementation has been fully accomplished. There are still many features need to apply in distributed database, thus it needs more effort to develop preceding implementation on previous model. Optimization in security, network and efficiency to process numerous data will certainly be another important issue to appear. The implementation of multi-server is also needed to be able to do load-balancing data which may pile up from the client.

Another aspect must be settled is implementing synchronization model in the form of multi-master. Therefore, one site does not merely use 1 master site, yet it can process similar database synchronization from the other master site. Synchronization model at fragmentation is also an extra work to add to this synchronization implementation. It is considering that fragmentation on column or row is very useful when that data is only used at some sites. Besides, it certainly will help increasing the reading performance toward data from database.

6. CONCLUSION

Synchronization implementation by utilizing this audit log method can be used to process replication and synchronization towards DML. Meanwhile, it has weakness in recording DDL activity although some DBMS like oracle could perform log to DDL.

Utilizing client-server model will absolutely encounter many problems when it is applied, for example problems in network, endless loop process, data conflict and data security. Problems

can be solved through correct solution just as previously elaborated. Even though, there are still many probabilities to solve it by applying better solution.

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