PATH MATRIX USING LINEAR CONGESTION TO INCREASE THE QUALITY OF SERVICE THROUGH WARSHALS ALGORITHM

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ABSTRACT :-- In this paper a practically efficient quality of service algorithm is proposed .Here we have a WARSHALS CONGESTION BASED algorithm for congestion path matrix to be retrieved .The algorithm provides the shortest congestion path matrix due to the congestion that is available in between the different vertex .The algorithm provides an alternate solution to the problem available using constant congestion constants and finding an optimal path matrix based over the congestion occurring over the graph. **

KEYWORDS :--Qos Routing, Dijkstra Algoritm ,Congestion Constant, Real Time, Optimization

INTRODUCTION :

Brief Review Of Warshall's Algorithm

Let G=(v,e) is a multigraph with n vertices $v_1,v_2,\ldots\ldots v_n$. suppose we want to find path matrix P of the graph. then to find the shortest path between the vertices in a graph warshall defined n+1,n x n matrices P_1, P_2, $P_3 \ldots$ P_n. such that

$$P_k[i][j] = \begin{cases} 1 & \text{if there is simple path from } v_i \textbf{\textit{ to }} v_j \text{ which does not use any vertices except } v_1,v_2,\ldots\ldots v_n \\ 0 & \text{otherwise} \end{cases}$$

from the above discussion it is clear that P_0 is the adjacency matrix A of graph G .since G consists of n vertices ,the last matrix P_n. becomes the path matrix of G.
here $P_{k-1}[i][j] =1$ can occur only when one of the two cases occurs:
there exists an edge between v_i and v_j which does not use any other vertice except possibily $v_1,v_2,\ldots\ldots v_{k-1}$ hence $P_k[i][j] =1$
there exists an edge between v_i and v_k and an edge between v_k and v_1 where each edge does not use any other vertex except possibly $v_1,v_2,\ldots\ldots v_{k-1}$. hence
$P_{k-1}[i][k] =1$ and $P_{k-1}[k][j] =1$
We can obtain the elements of matrix P_k with the help of the formula

$P_k[i][j]= P_{k-1}[i][k] \vee (P_{k-1}[i][k] \wedge P_{k-1}[k][j])$

Where V and $\wedge$ are and and or operations.

The path matrix can be evaluated with the formulas
$P=A \vee A^2 \vee A^3 \ldots\ldots\ldots \vee A^N$

WARSHALS ALGORITHM

Step 1: [initialization of path matrix]
    Repeat through step 2 for i=0,1,2….n-1
    Repeat through step 2 for j=0,1,2….n-1
Step 2:[test the conditions and apply the path matrix accordingly]
    If (a[i][j] = = 0)
        P[i][j] = 0
    Else
        P[i][j] = 1
Step 3:[evaluate path matrix]
    Repeat through step 4 for k=0,1,2….n-1
    Repeat through step 4 for i=0,1,2….n-1
    Repeat through step 4 for j=0,1,2….n-1
Step 4: P[i][j] = P[i][j] | (P[i][k] & P[k][j])
Step 5: Exit

PREVIOUS WORK

The quality of service could be provided with the help of several algorithms that could be drafted .

The literature below provides the major algorithms and the overview of constraint based Quality_Of_Service (QOS) for routing.

Fernando Kuipers and Piet Van Mieghem et al provided an overview of constriant based path selection algorithms for QOS routing published in IEEE 2002 communications magazine.It mainly aims at identifying a set of Quality Of Service (QOS) constraints .the problem is known to be NP – COMPLETE [1] problem and leads to proposal of several heuristic algorithms.

The paper views on multiconstraint path problem(mcp)[2]which retrievs the shortest length path among the posiible paths .this problem is known as Multiconstraint Optimal Path Problem(MCOP)[3]. The focus has been made to the special case problem as Restricted Shortest Path Problem (RSP) where the goal is to find the least cost path among those that satisfy only one constraint denoted by **D**.

A representative sample of solutions for MCP problems with more optimal solutions are discussed with different approximations .

In Jaffe's approximation [4] the MCP problem is defined with two constraints (M=2) .the algorithm first determines two positive multipliers D1 and D2.It then uses these multipliers to assign composite weight W(U,V)to every link (U,V)that belongs to E by linearly combining the original weights.

An other is Fallback Algorithm which deals with computing the shortest path one at a time with respect to a given QOS measure which is repeated until a solution is found with the same or alternative constraint.

Chen and Nahrstedt [5] provides an algorithm that transforms the MCP algorithm by scalling down M-1 link weights into bounded integer weights .to solve the problem they proposed two algorithms based on Dynamic

Programming The Extended Dijkstra Shortest Path Algorithm (EDSP) And Extended Bellman Ford Algorithm(BFS).

Korman and Krunz [6] proposed a randomised algorithm for mcp problem where in initialization phase the algorithms computes the shortest path from every node U TO D w.r.t. Each link weights and linear combination of all weights ,after which the Randomised Breadth First Search Algorithm is computed from S TO D.

Kruntz and Krunz [7] an other heuristic algorithm H_COP.here the shortest path is determined using a number of constraints while minimizing a path length function.

Yuan [8] presented two heuristics for the mcp problem :the limited granularity heuristic And Limited Path Heuristic (LPH). LPH is mainly based on Bellman Ford Algorithm [BFS] and uses two fundamental concepts in TAMCRA.

Liu and Ramakrishnan [9] considered to find out not one but multiple shortest paths that are within constraints .the linear length function used is the same as of Jaffes Algorithm they proposed an algorithm A* PRUNE .It calculates the shortest paths from S TO D TO ALL I that belong to N .The weights of these paths will be used to evaluate whether a certain path can be a feasible path(similar look ahead features were also used in H_COP. After this initialization the algorithm proceeds in Dijkstra fashion .the node with the shortest predicted end to end length is extracted from the heap then all of its neighbors are examined .the neighbors that cause a loop or lead to a violation are pruned.

An exact solution to the rsp problem can be found out by systematically examining every path between s and d in Brute Force manner that is using depth first search with Backtracking but due to size of networks this seems to be unuseful in practice.

An alternative solution known as Constrained Bellman Ford (CBF) Algorithm [10] is proposed that maintains a list of paths from s to every other node with increasing cost and decreasing delay.it selects a node whose list contains a path that satisfies d and has minimum cost .cbf then explores all neighbouring nodes (if required) adds new path to the list of each neighbor.

RSP Algorithms could also be solved using Pseudo – Polynomial Time Algorithms [11] depending on actual input data and size of the network.this incurs long execution time and can happen if granularity/density of link weights is very small.

Another solution is backward Forward Heuristics Algorithms [12] that are actually concatenation of two segments .the first part is so far explored path from s to AN intermediate node u.the second is the delay or least cost path from node u to d.the approach is for centralized and distributed networks where Least Delay Path (LDP) is determined then Least Cost Path (Lcp) from every node U to D .The BFH then starts from s and explores every node as in Dijkstra’s algorithms but the performance results to three times faster than Dijkstra’s algorithms.

In Langrangian based Linear Composition Algorithms search is based on linearly combining two multipliers for delay and cost to obtain different combinations.the approximate values for the multipliers can be generated by systematically iterating the shortest path with respect to the linear combinations and adjusting the multipliers value in direction of the optimal solution.

Liang Guo and Ibraihim Matta [13] published their paper in ieee 1999 named ”*Search Space Reduction In QOS ROUTING* ”.here hybrid algorithms is also posiible to device efficient heuristics for the rsp problems combining the above algorithms .according to this heuristic the cost of Least Delay Path (LDP) is selected as the cost constraint ,the problem is then solved by minimizing non linear length function analogous to TAMCRA. The final algorrithm is known as SSR+DCCR.

An other other approach is the Bi-Directional Search In Qos Routing PROPOSED BY F.A Kuipers And P Van Meighem [14] .It is used for unicast routing where an exact hybrid algorithm HAMCRA that is purely based on bidirection search is proposed .it uses the speed of heuristic when the constraints are loose and effectively maintains exactness where the heuristics fail.

Stavroula Siachalou and Leonidas Georgialdis [15] in their joint publication in IEEE INFOCOMM 2003 under the are efficient QOS routing proposed the direct application of dynamic programming equations and can also be used in the conjunction with known Polynomial Time Approximation Algorithm .it enhanced the average case behavior in addition to polynomial worst case running time .

Alex Dubrovsky Mario Gerla,Scott Seongwook Lee Dirceu Cavendish [16] in their paper published at NSF(ANI-9805436) as mentoioned " *Internet Qos Routing With Ip Telephony And Tcp Traffic* " Proposed Open Shortest Path First (Ospf) Routing Protocol where a diffserv model is used for added control and processing overhead that is manageable over large networks. Here they had showed significant delay and throughput improvement over ip telephony and strategy currently used in internet.

Hans De Neve and Piet Van Meighem in their paper published at IEEE ATM WORKSHOP PG 324-328 under the topic "*A Multiple Quality Of Service Routing Algorithm For Pnni* ,"[17] proposed an algorithm Tunable Accuracy Multiple Constraint Routing Algorithm (TAMCRA) [18] .It possess tunable accuracy via one parameter k which reflects a number of shortest paths taken into account during computation .

Alpar Jutner ,Balas Szviatovski,Iidiko Mecs ,Zsolt Rajko [19] in their paper langrange relaxation based mehtod for the QOS ROUTING problem proposed a solution to Delay Constrained Least Cost Routing Problem (DCLC).The LARAC algorithm provides polynomial heuristics solution to the DCLC problem instead of using the heuristics to manipulate the different methods an langrange relaxation this method also gives lower bound on optimal solution along with the result.

Peggy Kam ,Chris Nasser And Xiao Yi Cao in 2002 published a paper named THE Shortest Weight Constrained (Swcpp) [20] problem which mainly dealt with finding the least cost path between two specified vertices such that the total weight is less than a specifeid value.the algorithm presented used dynamic programming by Saigal and correctness by Rossel Saigals Algorithm solves the problem of finding the shortest walk with exactly Q edges and but here the costs were to be non negative.

Fernando Kuipers And Piet Van Mieghem [21] published their paper in Computer Communications in 2001 named AS "*Mamcra: A Constrained Based Multicast Routing Algorithm*". Here MAMCRA operates on the set of S shortest paths from S to all P multicast members is calculated . Then m is optimised without violating the constraints.

Iwata 'S Algorithm [22] proposed on polynomial time algorithm to solve the MCP problem .The algorithm first computes one of the shortest path algorithm based on the qos measures and then checks if the constraints are met. In this case the procedure is repeated untill another measures are examined.

Zhongchao Yu published a paper named "An Initial Study Of The Multi Constraint Routing Problem Genetic Algorithm And Proposed SA_MCP [23] Algorithm .it is a genetic based algorithm .he showed it internally parallel and combined with SA_MCP and had a potential to tackle togher problems.

Dong-Wong Shin , Ekp Chong And Hj Siegel [24] in their joint paper named as *"Multiconstraint Qos Routing Scheme Using A Modified Dijkstra's Algorithm* "published in WORLD SCIENTIFIC 2002 proposed MPMP (Multi Prepaths Multi Post Paths) That Achieve Low EDR and polynomial worst case time complexity using modified Dijkstra algorithm with a metric called the minimum normalised margin .

COMPARISION OF ALREADY EXISTING COMPLEXITY AVAILABLE

ALGORITHM	COMPLEXITY
JAFFES ALGORITHM	O(NLOGN+Me)

IWATTA'S ALGORITHM	O(Mnlogn+ME)
SAMCRA,TAMCRA	O(Knlog(Kn)+k^2Me)
RANDOMISED ALGORITHM	O(Mnlogn+ME)
H_COP	O(NLOGN+Me)
LPH	O(K^2NE)
A*PRUNE	O(QN(m+N+logh))

PROBLEM FORMULATION

The basic **Warshals Algorithm** provides the path matrix for a given graph if at all it exists. The problem is to find the path matrix with the existing congestion that occurs and which is taken as a congestion array named as congestion matrix .The congestion path marrix algorithm Is a cross algorithm of the **Warshals Algorithm** where the graph G(v,e) has one more parameter added as the congestion matrix with the adjacency matrix which is generated by the edges of each vertex in the **Warshals Algorithm** . The algorithm is carried over the linear time computations.

PROPOSED ALGORITHM

A. Here we propose the adjacency matrix to be LINEARLY intersected with the constant congestion parameter that is taken as constant congestion matrix. The overall result is further calculated with the constant congestion adjacency matrix which finally provides the constant congestion path matrix and the algorithm for which is proposed as the **CONSTANT LINEAR TIME CONGETION PATH MATRIX ALGORITHM**

Claim 1

The result of these algorithms provides the congestion path matrix for the graph from each vertex to the other vertex. This reduces the time taken for a particular packet to reach to the destination vertex from the source vertex in lieu of the actual path matrix.

Claim 2

The a. algorithm provides an alternate path to the existing path matrix that can be generated with the help of the **Warshals Algorithm** ,the algorithm introduces another constant the congestion constant which reduces the time of delay that occurs due to the un-controlled congestion that effectively generates time delay and increased path length.

D. DESCRIPTION OF THE ALGORITHM : CONSTANT LINEAR TIME PATH MATRIX ALGORITHM BASED ON WARSHALS ALGORITHM

The algorithm takes the adjacency matrix and find the congestion matrix in the network to find out the real status of the path .the paths can be hawked and congested and actual real status of their path could be revisited only after intersecting with parameters as congestion. Here we have combined the adjacency matrix with the congestion matrix that describes the new matrix as congestion generated adjacency matrix .the further path matrix is calculated with changes in objects to warshals algorithm .

ALGORITHM FOR THE CONSTANT LINEAR TIME PATH MATRIX ALGORITHM BASED ON WARSHALS ALGORITHM

Step 1 : [enter adjacency matrix a1[i][j]and congestion matrixc[i][j]]

Step 2: [linearly add adjacency matrix a1[i][j]and congestion matrixc[i][j]]
for i=0 ,1,2,3, …….n-1

for j=0 ,1,2,3, …….n-1
a[i][j]=ai[i][j]+c[i][j]
Step 3: [initialization of path matrix]
Repeat through step 2 for i=0,1,2….n-1
Repeat through step 2 for j=0,1,2….n-1
Step 4:[test the conditions and apply the path matrix accordingly]
If (a[i][j] = = 0)
P[i][j] = 0
Else
P[i][j] = 1
Step 5:[evaluate path matrix]
Repeat through step 4 for k=0,1,2….n-1
Repeat through step 4 for i=0,1,2….n-1
Repeat through step 4 for j=0,1,2….n-1
Step 6: P[i][j] = P[i][j] | (P[i][k] & P[k][j])
Step 7: Exit

IMPROVEMENTS OVER THE CONSTANT CONGESTION PATH MATRIX ALGORITHM

The algorithm can be mixed with other algorithm for better performance. The mathematical operator used with the adjacency matrix can be tested as per better optimality the literature. Better congestion status can be provided as per on going research activities that may be statistical in nature or time variating. The numerical computations could be verified for small networks as real status of the full network can't be generated as data provided is insufficient and testing is possible over only simulated environments or small networks**.**

CONCLUSIONS AND FUTURE WORKS

The algorithm is an basic idea to be turned not only for networks but for other branches where congestion is a problem as in fluid dynamics where a pipe gets blocked due to larger material parts and flow drastically reduces**.** Traffic controllers can use a ground principle to introduce congestion due to certain parameters on roads air etc where time delay could be saved over compensating of an other parameter such as larger but un congested path which takes less time delay. Similarly using the same concept the traffic lights can be automatically adjusted with sensors to average out total time spent .Even upcoming braches of medicine Nano technology can utilize to find shortest path for the Nano medicine to reduce time delay and medicate faster.

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