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Improving the Performance of Delay-sensitive Multimedia Computation in Automotive Networks with DP-ERACOM using CloudSim Simulator

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Abstract: We propose a Dynamic Priority-based Efficient Resource Allocation and Computing (DP-ERACOM) scheme for processing delay-sensitive multimedia computation in automotive networks. The proposed scheme breaks down each multimedia task into four smaller tasks and dynamically distributes resources based on the priority of the multimedia tasks. The three main processing and computing units in the proposed scheme are the load manager, compute cluster unit, and transmission unit. We evaluate the performance of the proposed scheme using CloudSim simulator. The results show that the proposed scheme can significantly improve the performance of delay-sensitive multimedia computation in automotive networks.
Keywords: DP-ERACOM, CloudSim, DFD, Multimedia Cloud Computing (MCC), Simulation Network, Data Center

I. INTRODUCTION

Fast Internet could be a key requirement considering autonomous or driver-less vehicles, which automotive industry is now focused on globally in partnership among academia. As shown in Figure 1, these intelligent vehicles can capture high-definition photographs & videos process a spread of sensory data considering a successful & smooth drive, & benefit of a spread of multimedia services & applications considering comfort & pleasure.

Additionally, these intelligent vehicles can interact & share a range of knowledge with each other via a roadside infrastructure, including images of road maps, information about road safety, & data on traffic loads considering safe driving. Additionally, these vehicles are capable of exchanging a large range of information, including automatic parking, map location, Internet access, cooperative control, collision alerts, driver assistance, & distribution of traffic information. As a result, vehicles as a full produce a major volume of time-sensitive data that has to be processed promptly so as to ensure delivery on time & preserve customer satisfaction. However, isolated onboard devices are unable to research such an oversized volume of multimedia-related data thanks to their limited storage & computational capacity.

More over , tasks could also be made tougher through sporadic connectivity, brief radio communication, a scarcity of bandwidth, & rapid mobility. Cloud computing (CC) may be a new paradigm in computing that gives customers with quick & high-speed processing capabilities as a service without requiring them to put in any hardware. Therefore, CC may be a cost-effective method considering processing lots of data. Enhancing access to multimedia services through the mixing of CC among smart vehicles may be a practical approach towards do so. This also reveal a good range of possible research & application areas. Traditional CC is not appropriate considering such crucial & delay-sensitive multimedia applications & services. Thus, a new computing paradigm known as multimedia cloud computing is created towards manage such delay-sensitive & important multimedia applications & services (MCC). MCC focuses on how to give multimedia applications necessary quality about service (QoS). Multimedia processing of vehicular data is more crucial & difficult since it calls considering quick processing, prompt responses, & low costs. considering instance, MCC must process & distribute information about inclement weather (such as fog) or an accident that occurred on the highway because if this information is not processed & distributed towards other incoming vehicles in a timely manner, there will be additional accidents & fatalities. In this paper, we present a Dynamic Priority-based Efficient Resource Allocation & COMputing (DP-ERACOM) scheme towards process delay-sensitive multimedia computation (i.e., video & picture data) considering automotive networks at lowered cost based on multimedia tasks priority. Each multimedia task is broken down into four smaller tasks in the proposed DP-ERACOM scheme, & resources (i.e., MCC resources) are distributed dynamically.

The three primary processing & computing units in the proposed scheme: Load manager, compute cluster unit, & transmission unit are in order of importance.

Vehicle multimedia processing requests are received at the DP-ERACOM request queue & sent to the load manager (LM) considering additional processing. LM assigns incoming requests to specific computer clusters after analysing their nature (CC). Depending on the type of the request, CC processes received requests & sends them towards the following CC or towards a transmission unit (TU). The processed request is then broadcast or unicast towards a single or collection of cars through TU. Suggested the system uses work queues (JQs) to handle any processing request's priority or urgency. Each CC & TU in DP-ERACOM has a single job queue to hold all multimedia requests. Provides an illustration of this idea. Abbreviations & symbols used in our paper are listed nevertheless.

II. CLOUDSIM

CloudSim is an open-source frame used to simulate cloud computing structure and services. It's developed by the CLOUDS Lab association. It's used for modelling and acting in a pall computing terrain as a means for assessing a thesis previous to software development in order to reproduce tests and results. For illustration, suppose you were to emplace an operation or a website on the pall and wanted to test the services and cargo that your product can handle and also tune its performance to overcome backups before risking deployment. In that case, similar evaluations could be performed by simply rendering a simulation of that terrain with the help of colourful flexible, and scalable classes handed by the CloudSim package.

A. Why use CloudSim

1) Open source and free of cost, so it favours experimenters and inventors working in the field.
2) Easy to download and set up.
3) It's further generalised and extensible to support modelling and trial. Doesn't bear any high-spec computer to work on.
4) Provides-defined allocation programs and application models for managing resources and allows the perpetration of stoner-defined algorithms as well.
5) The attestation provides pre-coded exemplifications for new inventors to get familiar with the essential classes and functions.
6) Paraphernalia backups before deployment to reduce the threat, lower costs, increase performance, and raise profit.

CloudSim Core Simulation Engine provides interfaces for the operation of coffers similar as VM, memory, and bandwidth of Virtualised Datacenter. CloudSim subcaste as VMs, Cloudlets, Hosts, etc. It also handles network- related prosecution along with the provisioning of resources and their prosecution and operation.

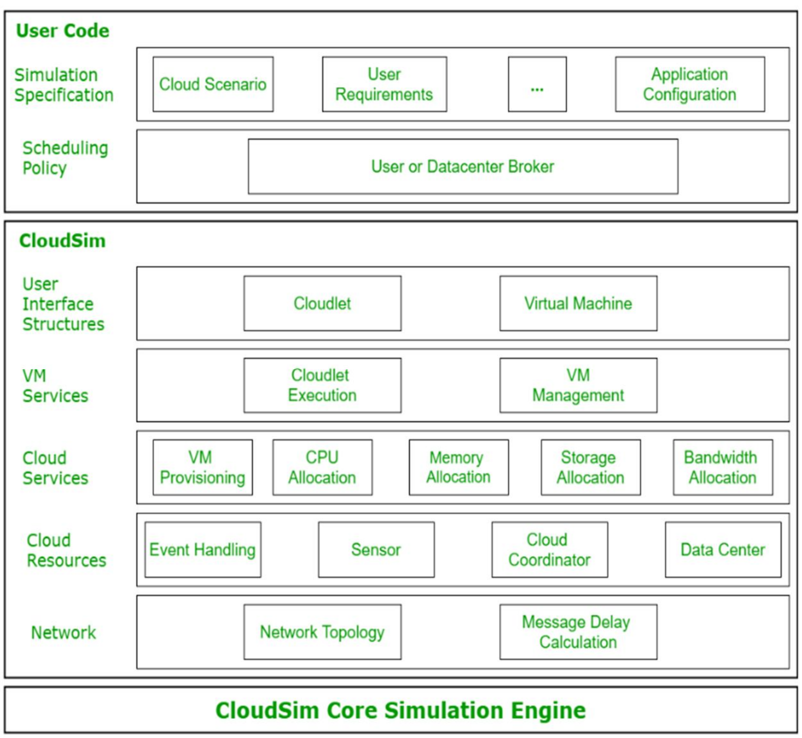

Fig.1.CloudSim Layered Architecture

III. SYSTEM ANALYSIS

A. *Existing System*

The integration of cars among cloud computing has emerged as a problematic computing paradigm in the current system. However, there are some difficulties among processing multimedia materials (such as resource costs, quick service response times, & experience quality) that have a significant impact on the effectiveness of vehicular communication. Similar to this, VCC develops an ID-based signature mechanism considering information verification. The pseudonymous revocation & batch verification approaches are used in the proposed scheme to carry out signature verification. Under conditions of heavy traffic, messages passing between vehicles in critical & emergency situations receive more attention. Therefore, it is crucial to confirm the information's source in such dire circumstances.

B. *Proposed System*

Substantially impair vehicular multimedia. In order to meet difficulties about quick reaction time, guaranteed the quality of experience, & minimal computing cost, we suggested an efficient dynamic priority-based resource allocation & computing architecture considering cars in this work. Multimedia jobs are broken down into four smaller tasks in our suggested method & assigned towards proper dedicated computing cluster considering processing .To guarantee timely delivery of responses towards various vehicular multimedia jobs among various priorities, a priority non-preemptive queue is employed. Additionally, our suggested approach dynamically updates computational resources supported demand data. Using cloudsim simulator & a baseline single cluster-based ADPS, the performance of the proposed method is assessed in terms of quality of experience, resource cost, & reaction time.

IV. SYSTEM DESIGN

A. *System Architecture*

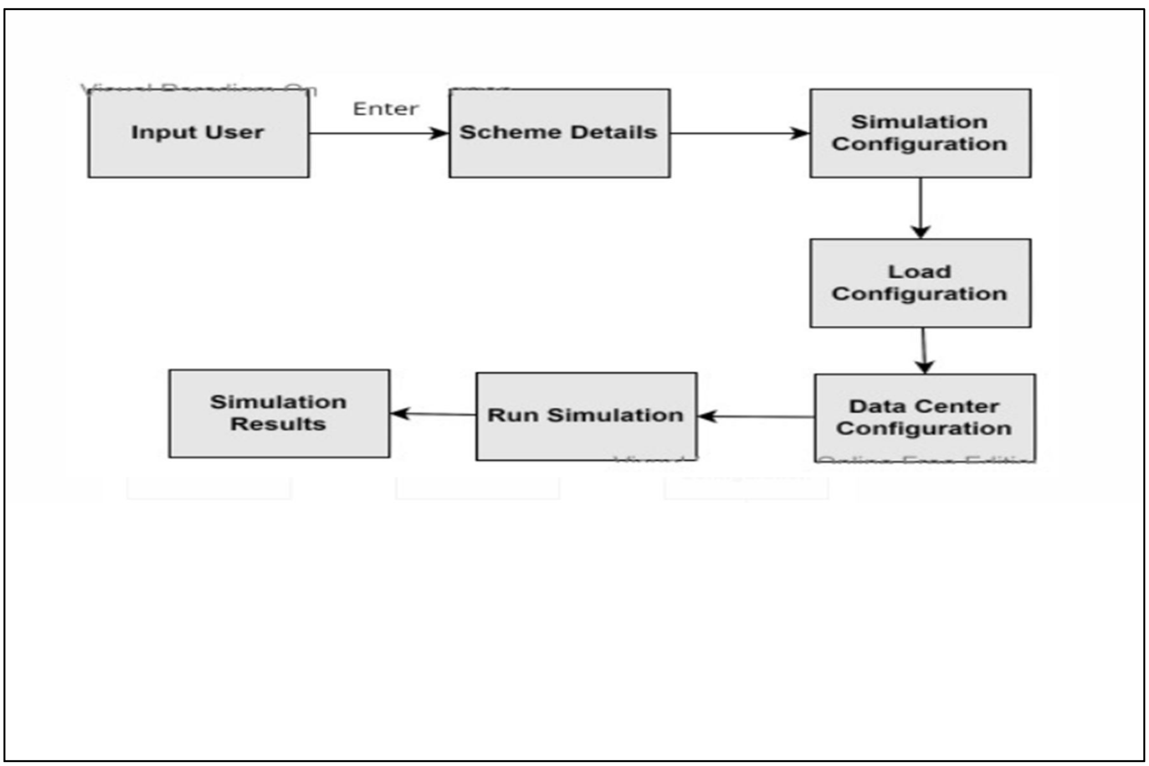

Fig. 2.System Architecture

B. *Data Flow Diagram*

A DFD frame another name pondering a DFD. It is an essential graphical formalism certain can traverse used through implies about depict a system in phrasing about data it gets, taking care about it performs on specific data, in addition towards data it produces as a result. It's used through the address system's a gigantic number.

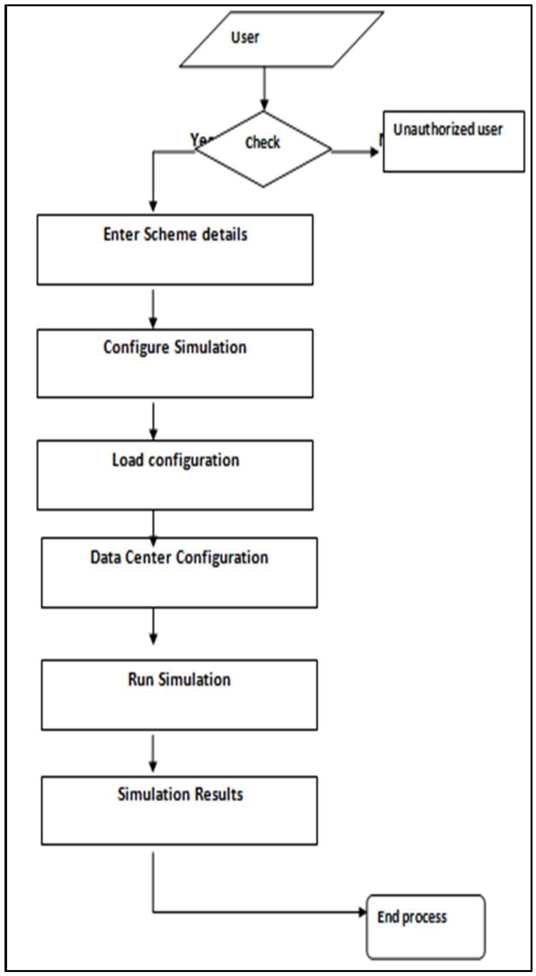

Fig. 3.Data Flow Diagram

V. IMPLEMENTATION

A. Model Design

1) *Virtual Memory:* It creates individual server for User request.
2) *Virtual Machine Manager:* It Allocates memory for one user to one data center.
3) *Data Center:* It gives the information to data user based on the location.
4) *Data User:* User is connected to data center.

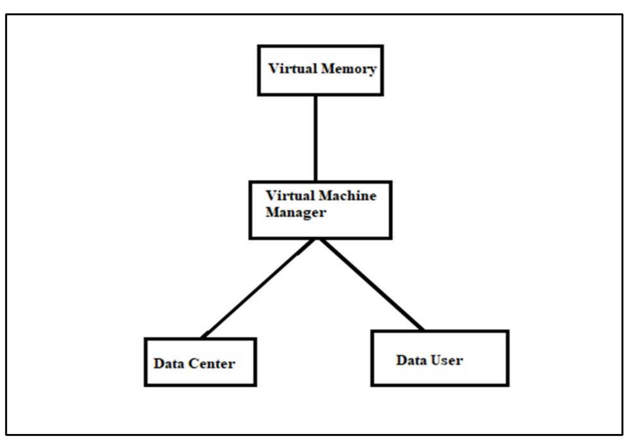

Fig.4. Model Design

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B. DP-ERACOM the DP-ERACOM Scheme has Three Main Components

1) VMCC Architecture:

In this section, the VMCC structure will be discussed for processing multimedia-related jobs. The processing of multimedia is divided into four-way Conversion ,Extraction, Matching, Reconstruction. In the DP- ERACOM scheme, all these four calculations are performed independently by 4 devoted computing clusters (DCC). Each devoted computing cluster is allocated computing resources stoutly as per need or loading and consists of a precedence line to maintain the precedence of multimedia requests.

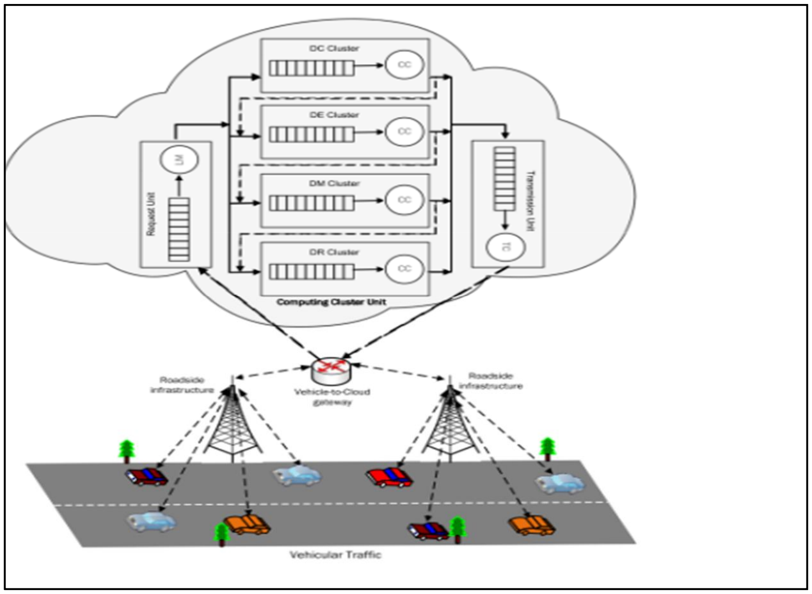

Fig.5. Multimedia oriented cloud computing architecture for vehicles

The vehicle submits its request to RU, which further forwards it to LM. The CCU has four sub-divisions:

a) Dynamic Conversion Cluster (DCC)
b) Dynamic Extraction Cluster (DEC)
c) Dynamic Matching Cluster (DMC)
d) Dynamic Reconstruction Cluster (DRC)

2) VMCC Queuing Model

There are 3 types of job queues:

a) Requests line in which the vehicle submits its media job
b) Computing or job file which stores vehicular media job for pall processing
c) Transmission line which store and hold the media jobs before encouraging them to their destination.

3) Resource Allocation for VMCC

Computing resources are allocated stoutly to the devoted computing clusters (DCC) on the base of the loading of vehicular tasks. This ensures minimizing the computing cost. If there are more vehicular requests than calculating coffers, also further computing coffers are allocated to DCCs. also, if the number of vehicular requests is less than the allocated coffers, also calculating coffers are removed. This ensures minimization of cost and a better QoE(Quality of Experience).

In the below Algorithm 1, between lines 1- 4, original assignments and analyzations are made to incoming vehicular requests in time span αt. In lines 5- 7, vehicular multimedia requests are deconstructed and sorted on the base of precedence. In lines 8- 12, Calculating clusters are assigned coffers on the base of workload entered in time αt. In lines 13- 15, each multimedia task is assigned an applicable CC and is also put into its job line for processing. In lines 16- 22, CC processes the multimedia task and forwards it to the coming computing unit or TU depending upon the nature of the task.

Eventually, in lines 23- 25, the reused multimedia tasks are encouraged to the vehicular druggies concurrently to enhance the QoE and to meet the delayed deadline of the task.

Algorithm 1 Priority-Based Task Scheduling and Processing Procedure

input : Global channel set N
output: Sorted Set of available channel K

Initialize request queue with $R_Q \leftarrow$ null
Assign collection time C_t with initial value α_t;
$C_t \leftarrow \alpha_t$
Collect requests from vehicles till the expiry of α_t
LM analyzes the R_Q to estimate the total workload N
for $n_i \leftarrow 1$ **to** N **do**
  /* Sort n_i based on priority value */
LM assigns computing resource χ_{α_t} to each computing cluster CC based on the value of total workload N
$DCC \leftarrow \chi_{\alpha_t}$
$DEC \leftarrow \chi_{\alpha_t}$
$DMC \leftarrow \chi_{\alpha_t}$
$DRC \leftarrow \chi_{\alpha_t}$
for $I \leftarrow 1$ **to** N **do**
  /* LM sends multimedia task I into the priority queue P_Q of its appropriate CC */
for $J \leftarrow 1$ **to** N **do**
  /* CC processes the multimedia task J */
  if J *wants further processing step* **then**
    Add J into the P_Q of next CC
  else
    Add J into the P_Q^T of TU
for $K \leftarrow 1$ **to** P_Q^T **do**
  /* TU transmits processed multimedia task K to its intended vehicle(s) */

VI. RESULTS AND TESTING

To run code double click on 'run.bat' file towards get below screen

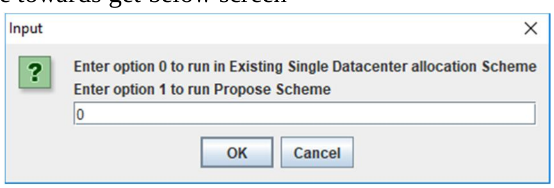

Fig.6. Existing System Simulation Option

In above screen enter option 0 towards run simulation among single data center & then click OK button towards get below screen.

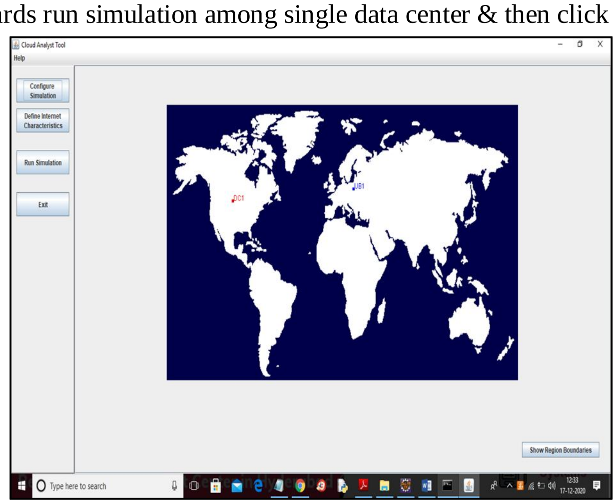

Fig.7. Configuration Simulation

In above screen there is only one RED COLOUR data center & one blue colour user or vehicle is there & towards create multiple data center & users or vehicles then click on 'Configure Simulation' button from left side about screen towards get below screen.

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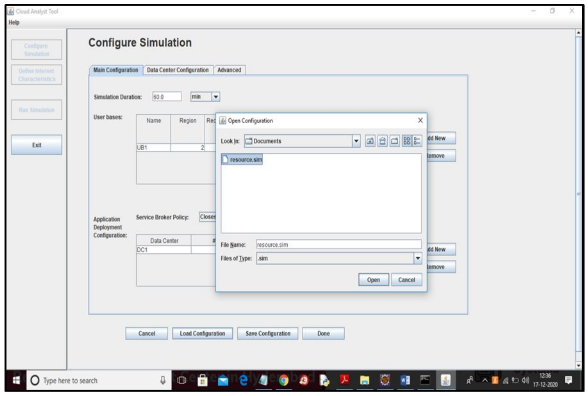

Fig.8. Load Configuration

In above screen after clicking on 'Load Configuration' button then select 'resource.sim' file & then click on 'Open' button towards load all resources & towards get below screen. This resource.sim file u can see inside code folder.

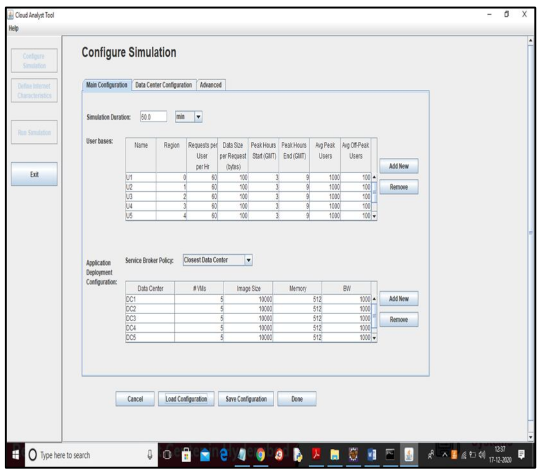

Fig.9.Data Center Configuration

In above screen we can see multiple users & DC are created & considering each user we have his required resources details & among DC we can see available resources & towards see many other details then click on 'Data Center Configuration' tab & now click on 'Done' button towards get below screen.

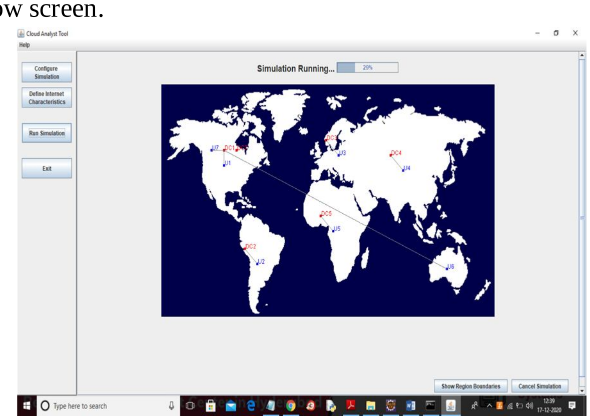

Fig.8.Simulation Running

In above screen we can see each blue colour user is sending request towards its single DC & after simulation will get below processing details.

In below screen we can see among existing technique overall response time is 71.51 milli seconds & total power consume is 1.92 joules & scroll down above screen towards get cloud cost.In above screen propose cloud cost is $4.06 which is lesser than existing scheme

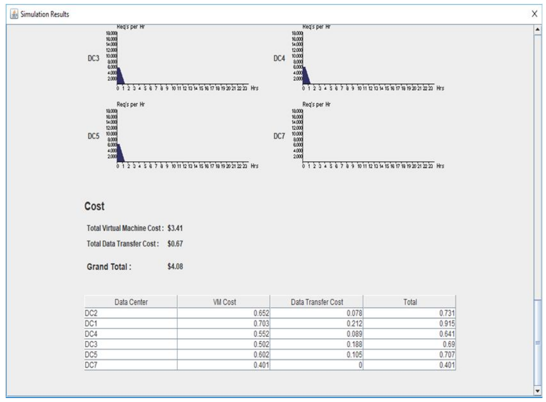

Fig.9. Simulation Results Summary

If there are multiple Data Center in the Existing System then the below table depicts the overall response time summary:

	Average (ms)	Minimum (ms)	Maximum (ms)
Overall Response Time	69.56	38.73	246.11
DC Processing Time	0.34	0.00	1.17
Power Consumption	1.38	0.00	4.75

Table 1. Existing System with Data Centers

VII. CONCLUSION AND FUTURE WORK

In intelligent transportation systems, vehicles are outfitted with a variety of sensors, cameras, & other intelligent devices that generate a large volume of multimedia-related content considering processing. However, on-board standalone computing devices are unable to handle this workload due to their constrained storage, battery life, & processing power. As a result, it is imperative that automobiles be integrated among multimedia cloud computing (MCC), as it offers a potent computing tool that enables quick & effective computation about multimedia applications & services considering vehicles. In order to address issues about quick reaction time, guaranteed quality of experience, & minimal computing cost, we suggested a dynamic priority-based efficient resource allocation & computing architecture considering cars.

Multimedia jobs are broken down into four smaller tasks in our suggested method & assigned to a proper dedicated computing cluster considering processing. To guarantee timely delivery of responses towards various vehicular multimedia jobs among various priorities, a priority non-preemptive queue is used. In addition, our suggested approach dynamically updates computational resources based on demand data. Using cloudsim simulator & a baseline single cluster-based computing scheme, the performance of the proposed scheme is assessed in terms of quality of the experience (QoE), resource cost, & reaction time. According to simulation findings, the proposed plan performs better than the standard single cluster-based computing & static resource allocation plan.

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