DYNAMIC RESOURCE ALLOCATION IN ROAD TRANSPORT SECTOR USING MOBILE CLOUD COMPUTING TECHNIQUES

*G. Sadasiva prasad1, Dr. K. Rajagopal2, Dr.K. Prahlada rao3

1Associate Professor, Dept. of Mech. Engg., MITS, Madanapalle
2Professor & Head, Dept. of Mech. Engg., KSRM, Kadapa
3Professor, Dept. of Mech. Engg. JNTU, Anantapur

ABSTRACT

Literature review revealed application of various techniques for efficient use of existing resources in road transport sector vehicles, operators and related facilities. This issue assumes bigger dimensions in situations where there are multiple routes and the demand in the routes is highly fluctuating over the day. The application of the existing techniques as reported in literature addresses above issues to a considerable extent. However the main draw back in existing techniques is lack of proper uninterrupted information about vehicles and demand available at a central place for allocation of vehicles in different roads and huge computational times required for processing. Cloud computing is a recently developed processing tool that is used in effective utilization of resources in transport sector under dynamic resource allocation. Since the demand fluctuates at different times in different routes, mobile cloud computing techniques are being used to address the issues related to effective resource allocation. This paper attempts at, making a detailed study of application of mobile cloud computing techniques in transport sector for dynamic resource allocation and to identify the limitations there in, with a view to address the limitations. Creating identical clouds at various strategic points and mobile feeding of information to each cloud, creation of a central processing place called as traffic manager, releasing vehicle / driver allocation orders of the traffic manager etc, are some of the essential features of the proposed mobile cloud computing. Simulation studies are made by considering case studies and the results are compared with real time values. The proposed mobile cloud computing makes use of JRE processing. The required algorithms along with coding, flow diagram and the output are presented. It has been observed that the proposed mobile cloud computing processing offers uninterrupted service with minimum preprocessing, processing and post processing time. Further the proposed method can be used for handling large number of vehicles / routes with case and hence is more efficient than the existing methods of dynamic resource allocation.
allocation. The major contribution of present work is developing of a mobile cloud computing processor offering uninterrupted services with minimum processing time capable of handling large vehicles / driver facilities under severe demand fluctuating conditions.

**Keywords:** Dynamic Resource Allocation (DRA), Transport, Mobile, Cloud, Planning, Route, Vehicles.

1.0 INTRODUCTION

With the enormous exponential growth of population all over the world in general and India in particular, people have to heavily depend on public and private transport systems for their day to day life [1]. A public transport system is normally maintained by government and is supposed to provide regular and continuous transport services to the public. The major public transport is road transport in countries like India. As the government could not provide adequate transport facilities meeting the public demand, private transport undertakings have slowly come up providing transport facilities [8]. Though the transport undertakings are supposed to provide high quality of service at reasonably economic fares, due to improper planning of transport systems the above goal could not be achieved and transport sectors are running under loss. This limitation can be mainly attributed to the un organized scientific planning of transport system causing huge investments, vehicles count not be used to fullest extent, high operating costs etc. This has resulted in high transport fares which forced public to go in for unorganized transport means, which normally violate rules and regulation resulting in unsafe [5] and uncomfortable travel by the public[1]. This situation arises when there are heavy fluctuations in the demand for vehicles at different times in different routes over different periods of time and lack of communication to a central point which distributes the fleet at hand suitng the demand [6]. In this situation, there are no fixed vehicles or fixed routes and the vehicles assignment over routes continuously changes based on the demand. The central point is the allocation manager. This system can operate on manual basis [7]. However if we consider a heavy fluctuation in demand over the day over multiple routes, especially in metro cities at peak hours, manual operation by the manager at central point may not be practically feasible. In such cases it is recommended that a computer programming may be used [2] which computes instantly and displays the vehicle – route allocation details and consequent orders [3]. In this paper an attempt is made to consider a real time problem, and to develop a computer programme and study the output. For this, simulations models will be proposed and the results of the simulation will be evaluated against above real time situations. To make the concepts and applications of dynamic resource planning clear [2] a few cases are analyzed. Conventional computing for dynamic resource allocation may not be feasible in cases of high density of vehicles, routes and traffic. Hence is this paper an attempt is also made to use mobile cloud computing techniques for dynamic resource allocation using mobile devices for communicating data to a central resource allocation point. Cloud computing consists of feeding heavy data to a high capacity server, which has multi operating facilities to generate end user information instantly. The principle of working of mobile cloud consists of installing mobile communicating devices at different convenient places with the facility of communicating vehicle Vs route requirement data to different cloud stations situated at different convenient points and also to a central point called as allocation manager. The manager will select the nearest available cloud and process the data instantly and compute the same to generate vehicle – route allocation orders and communicate back, the same to respective mobile devices for execution [9]. Laboratory simulation models will be developed for this case and algorithms and coding are written with flow diagrams. Upto five convenient roots are considered with fluctuation in demand over the day. The simulation results are compared with available real time situation values to assess [4] the validity of the proposed method. Exhaustive literature survey on dynamic resource allocation in general and using
mobile cloud computing in particular with limitations there in, especially dealing with very high density vehicle – route situations are presented. The major contribution of the present work will be to propose a computer based dynamic resource planning in transport sector for high density fluctuation requirements using mobile cloud computing techniques, and to address the limitation in existing methods. Attempt will also be made to develop laboratory simulation models to validate the proposed method.

2.0 LITERATURE REVIEW

Sadasiva Prasad et al [1], identified the issues and challenges related dynamic resource allocation polices in road transport sectors. They have suggested the various steps to be taken for improving the efficiency of functioning of road transport sector and suggested methods of road transport sector and suffested methods for the same. They reached upon mobile cloud computing application for addressing above issues. B.Sai et al [2], applied cloud computing techniques in dynamic resources allocation for solving scheduling problems on virtual machines. Their method compared well with existing methods. Cobo et al [3], worked on the conceptual structures of intelligent transport systems (ITS). They developed an automatic method for detecting hidden themes and their effect over a period of time. This method combined performance analysis and science mapping. Litman, T. et al [4], did extensive work on evaluating accessibility for transportation planning and submitted his conclusions. Safe et al [5], worked on clean, and affordable transport for development, with special reference to safety of the transport systems. ESCAP et al [6], analysis emerging issues in transport sector and suggested transport and millennium development goals. Keller, G. et al [7], worked on low volume roads engineering leading to best management practices in transport sector. Yanfeng et al [8], developed a smart parking system based on dynamic resource allocation. Their work was based on mixed integer linear program at each destination in a time driven sequence. They conducted that this approach reduced traffic congestion in urban areas and exploited technologies for searching parking space availability, resulting in performance improvement over existing parking behavior. Sarkar, A et al [9], developed a sustainable rural roads maintenance system in India.

3.0 ISSUES AND CHALLENGES IN DRA

The main challenges in transport sector are:

a. Providing scientifically organized planning for transport using mobile cloud computing,

b. Providing good quality of services,

c. Planning for new strategies,

d. Optimizing the fleet size, and

4.0 SCOPE AND OBJECTIVES OF PRESENT WORK

The main objectives of the present work are

a. Addressing various drawbacks of transport system,

b. Providing consistently high quality of service,

c. Strategic planning for transport sector using mobile cloud computing techniques,

d. Reshaping transport activities,

e. Matching the vehicles with service demand and

f. Targeting travel time variability.
5.0 FORMULATION OF PROBLEM

In view of the enormous increase in demand for transport, a scientifically organized and planned transport system has become a must. Hence the present work is undertaken to study the existing limitations in transport sector planning and to proposed dynamic resource allocation in transport sector using mobile cloud computing techniques.

6.0 METHODOLOGY OF PRESENT WORK

The methodology of present work consists of the following steps.

6.1 Development of appropriate application software under mobile cloud computing,
6.2 Fixing the vehicle roots, number of vehicle in each route for normal vehicle demand, anticipated fluctuation in demand in each root etc.
6.3 Fixing a simulation model and writing the required algorithm along with the flow diagram and coding.
6.4 Running the programme for output.
6.5 Analyzing the output of the simulation model and comparing with real time values for validation of the software used for simulation model.
6.6 Generalization of the proposed method, for large number of roots and vehicles with fluctuations in demand.

7.0 PRESENT WORK

Before developing the dynamic resource allocation programme using the said mobile cloud computing techniques, the following steps as listed below are identified.

7.1 Assumptions
a) For a given situation, the number of roots (R1,R2…Rn) is constant.
b) Let the demand (no. of passengers) in roots R1, R2...Rn be d1, d2….dn under normal conditions without fluctuations is (c).
c) The total no. of passengers in all the roots over the day is constant meaning thereby an increase in demand in a particular route results in a corresponding decrease in another route.
d) Based on the speed of the vehicles and distance to be covered in each route, the number of vehicles moving at a given time under normal demand in the said route may be assumed suitably.
e) Let there be N number of clouds (C1, C2…..Cn).
f) The office of the traffic manager is located at a place equidistant from all the clouds.
g) Important busy places in each route are provided with a mobile communication device connecting all the clouds and traffic manager.
h) All the vehicles in all the routes have the same seating capacity (c) including over loading of 10%.
i) The total time of travel in each route is one hour.
j) At any given point of time in any route the demand can vary from 0 to 2c.
k) A spare vehicle with capacity (c) is provides in each route.

7.2 Creation of a mathematical Simulation model based on select case studies
Consider the case of a traffic situation, where there are five routes (R1,……..R5). The no of vehicles in each route is 2 and the capacity of each vehicle in all the roots is 50 (c=50). Let there be 4 clouds in each route with a total of 4X5=20 clouds (C1,C2….C20), the demand in route R1 is expressed as DR1 which can be less than c=50 or equal to c=50 or greater than C=50, Similarily in
other routes the demands are DR2, DR3, DR4 and DR5. A fluctuation in demand means the values of DR1,….DR5 are either more than or less than c.

7.3 Algorithm, flow diagram and coding for dynamic resource allocation using mobile cloud computing techniques

7.3.1 Algorithm

a) Choose the routes (R1, or R2….R5)

b) Based on the mobile communication information the demand DR1 or DR2….DR5 in each root is noted down.

c) If the demand is normal, let the vehicles move normally.

d) The central traffic manager selects the nearest cloud and processes the vehicles allocation based on the demand and releases the orders to the respective mobile stations.

e) If a particular cloud fails, the traffic manager shifts to another nearest cloud for information. The orders may be in the form shown in next step.

f) If the demand in a route is more than normal, divert a vehicle from the less demand root to above route etc.

7.3.2 Flow diagram

```
Start – choose the routes (R1…R5)

Obtain demand DR1….DR5

Normal demand (c) - vehicles run normally

Processing by central traffic manager

Shift to another cloud if required

Releasing of vehicle allocation orders

End
```

7.3.3 Coding

Sample coding based on java language is given below.

```java
import java.awt.*;
import java.applet.*;
import java.awt.event.*;
```
import java.util.*;
import java.awt.geom.*;
import java.awt.Graphics.*;
<br>\</applet code=s4 width=780 height=500></applet>
public class s4 extends Applet
{
int bbb=0,aaa=0,ddd,op=0,as=0;
Button bb1=new Button("click");
Button bb2=new Button("DR1=");
Button bb3=new Button("DR2=");
Button bb4=new Button("DR3=");
Button bb5=new Button("DR4=");
Button bb6=new Button("DR5=");
Button bb7=new Button("\c=");
TextField t1=new TextField("65");
TextField t2=new TextField("70");
TextField t3=new TextField("80");
TextField t4=new TextField("85");
TextField t5=new TextField("30");
TextField t6=new TextField("50");
public void init()
{
add(bb1);
add(bb2);add(t1);
add(bb3);add(t2);
add(bb4);add(t3);
add(bb5);add(t4);
add(bb6);add(t5);
add(bb7);add(t6);
add(bb8);add(t7);
}
if ((DR1<=c) && (DR2>c) && (DR2<=2*c) && (DR3<=c))
{
bbb=0;
}
else if ((DR1>c) && (DR1<=2*c) && (DR2<c) && (DR3==c) && (DR4==c))
{
bbb=1;
}
else if ((DR1>c) && (DR1<=2*c) && (DR2>c) && (DR2<=2*c) && (DR3>c) && (DR3<=2*c) && (DR4>c) && (DR4<=2*c) && (DR5<c))
{
bbb=2;
}
op=1;
aaa=0;
repaint();
}
if (bbb==0)
{
g.setColor(Color.red);
g.drawString ("Release one vehicle from route R1 and divert to route R2",50,100);
}
else if (bbb==1)
{
    g.setColor(Color.red);
    g.drawString ("Release one vehicle from route R2 and divert to route R1",50,100);
}
else if (bbb==2) {
    g.setColor(Color.red);
    g.drawString ("Release one vehicle from route R5 and divert to route R1.",50,100);
    g.drawString ("Further borrow 3 vehicles from near by traffic network",50,120);
    g.drawString ("and divert one each for routes R2, R3 and R4",50,140);
}

7.4 Output and orders of the traffic manager
The following refers to outputs for different cases.

7.4.1 Case :1
3 routes with DR1 < c and DR2 > c and DR3 = c.
No. of routes 3 (R1, R2, and R3)
No. of vehicles in each route (normal) = 2.
Normal capacity of vehicle = c =50 (including overloading).
Actual demand in route 1 = DR1 = 35 (< c)
Actual demand in route 2 = DR2 = 65 (> c)
Actual demand in route 3 = DR3 = 50 (= c)

Output:

7.4.2 Case :2
4 routes with DR1 > c, DR2 <c, DR3 =c and DR4 = c.
No. of routes 4 (R1, R2, R3 and R4)
No. of vehicles in each route (normal) = 2.
Normal capacity of vehicle = c =50 (including overloading).
Actual demand in route 1 = DR1 = 65 (> c)
Actual demand in route 2 = DR2 = 35 (< c)
Actual demand in route 3 = DR3 = 50 (= c)
Actual demand in route 4 = DR4 = 50 (= c)
7.4.3 Case: 3
5 routes with DR1 > c, DR2 > c, DR3 > c, DR4 > c and DR5 < c.
No. of routes 5 (R1, R2, R3, R4 and R5)
No. of vehicles in each route (normal) = 2.
Normal capacity of vehicle = c = 50 (including overloading).
Actual demand in route 1 = DR1 = 70 (> c)
Actual demand in route 2 = DR2 = 75 (> c)
Actual demand in route 3 = DR3 = 65 (> c)
Actual demand in route 4 = DR4 = 60 (> c)
Actual demand in route 5 = DR5 = 30 (< c)

Output:

7.5 Validation of simulation results with real time actual values
The mathematical simulation models with 5 routes is considered and different combination of demands (more than 500) in different routes are tried and the outputs are compared with the corresponding requirements of real time situations. It has been observed that the results of simulation in totality agree with the actual real time values. Hence by suitable modifications in assumptions as shown in section 7.1, the developed algorithms and coding can be extended for any desired real time situations.

8.0 RESULTS AND DISCUSSIONS

1. Since the traffic manager chooses the nearest cloud from among the identical clouds simulated at different strategic places, the time of computation is reduced to a considerable extent compared to existing methods.
2. If a particular cloud breaks down, the traffic manager can immediately choose another nearest cloud, thereby rendering uninterrupted resource allocation service, which is not the case with existing cloud computing methods.

3. It has been established that the results of the mathematical simulation model very well agree with real time solutions, paving way for application of the proposed application software with suitable modifications for any real time dynamic resource allocation problems.

4. Considering above, it has been established that the proposed mobile cloud computing technique for dynamic resource allocations in road transport sector is reliable, fault free and quick compared to existing mobile cloud computing techniques.

9.0 CONCLUSIONS

The major contribution of present work is developing of a mobile cloud computing processor offering uninterrupted services with minimum processing time capable of handling large vehicles driver facilities under severe demand fluctuating conditions.

REFERENCES


