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Application of Queuing Theory in Traffic Management System

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Abstract

The issues of traffic management are the process of increased disturbance in the movement of traffic. In India the traffic congestion is rapidly increased due to increasing vehicles on the road which produces many problems. In the current paper more has been review about the queuing theory and its important applications. This paper analyzes the importance of queuing theory in the field of traffic management system for this Bhopal, Indore, Ujjain city which were located in the India is chosen. This paper review the range of queuing theory results in the area of waiting time, utilization analysis and design of system the traffic crowd follows a repeatable pattern during the day and the proper people accepts it as a daily routine.

Keywords:*Waiting time, System design, Repeatable, Congestion, Queuing theory.*

INTRODUCTION:

Due to continuous rising of vehicles newly applying techniques in the production system of those vehicles, also increased flexibility of working people etc. the transportation demand increased continuously and in second case the supply which means for transportation system including like road. Any transport system of public. They doesn't follow this trend with time which forms more and more traffic on the roads results in the increased in congestion due to congestion the travelling time increase, decreases the flow. Maximize the fuel consumption which show negative effect on the environment which arises the problems of traffic congestion. It is a situation on road network which slower speed. Longer trip time and rises the Vehicular queuing to overcome this traffic management problem the queuing theory along with its applications are used. It is a mathematical technique which reduces waiting time of particular queuing theory have been studies for this traffic service which was helpful for managing traffic flow system. Generally queuing theory works in three steps which include

1) Statistical interference.
2) The Inertia of the system
3) The system optimising problem

(a) Statistical Interference In this step, the mathematical models are used for settling the data which was useful for solving the problems of traffic management system based on Queuing theory and provide the rationalisation of queuing system.

(b) The Inectia of System:

Namely the probability of regularity of quality of the waiting time of customer, buying period distribution steady state under statistical equilibrium and second is the instantaneous state.

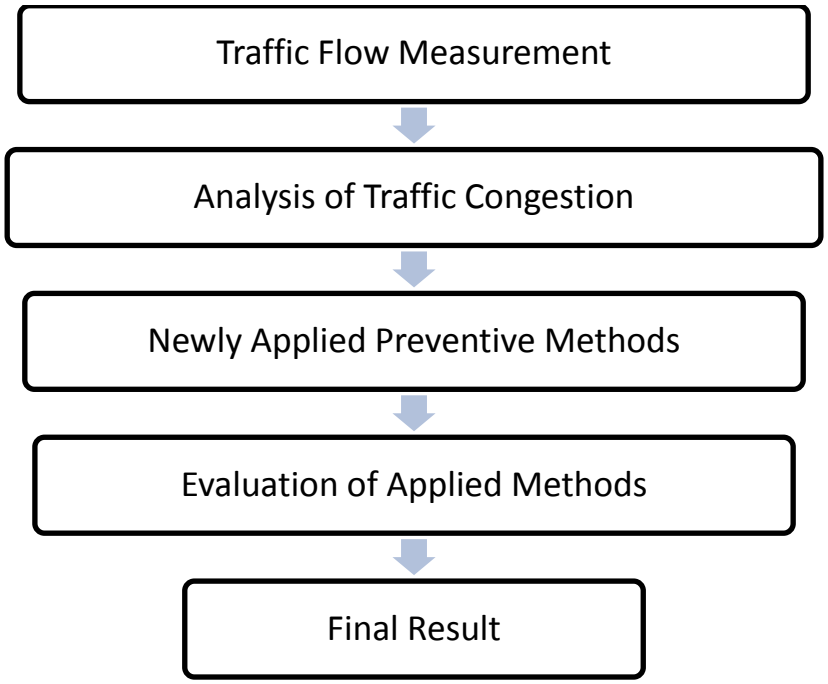
(c) The System Optimization Problems :

Its purpose is to make all system produce best result two groups containing the system design optimization and the system control optimization. The former is known as static optimization problem which have aim to make the system achieve maximum benefit or under a newly system applied as called dynamic optimization problem.

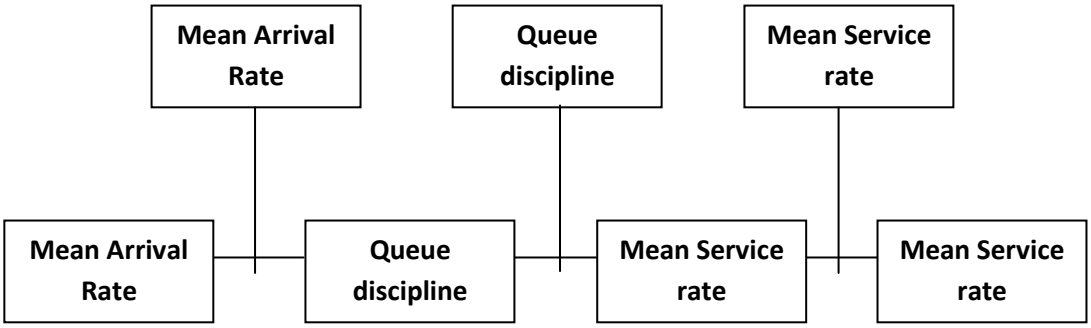
SOME ADVERSE EFFECT OF TRAFFIC CONGESTION:

- Due to traffic congestion there was much wastage of time of drivers and passengers who blocked in traffic which directly affected on economic health of the nations.
- It also increases the wastage of fuel which increases the air pollution and carbon dioxide emission.
- Because of traffic congestion the emergency vehicle may delay in reaching to their destination where they are urgently reached.
- And because of delays they was late arrival their employment meetings and education which results in loss of business disciplinary actions and other personal losses.

FLOW CHART OF PREVENTING TRAFFIC CONGESTION



DIFFERENT PARAMETERS OF QUEUING SYSTEMS



(a) Mean arrival rate (λ)

It is the rate at which customer arrive at service facility. It is expressed in flow or a progress in arrival time. If the inter arrival time that is time progression is known then the arrival rate can be found out from the equation which is started below.

$$\lambda = \frac{3600}{h}$$

It can be specified as a deterministic distribution or a probabilistic distribution and sometime demand or inputs are substituted for arrival.

(b) Mean Service Rate (μ)

It is the rate at which customer depart from a transportation facility it is also expressed in flow or reaching time progression if the inter service time which is service time progression is know then the service rate can be found out from the given below equation.

$$\mu = \frac{3600}{h}$$

(c) Number of Servers:

The number of Servers that are being utilize should be specified and in the manner. They work that is they work as parallel servers or a series server has to be specified.

(d) Queue discipline:

It is the parameter of queuing theory which explains how the customers arrived at a service facility. There are different types of queue discipline they are as follows.

1) First in first out (FIFO).
2) First in last out (FILO)
3) Served in random order (SIRO)
4) Priority Scheduling
5) Processor Sharing

(1) First in First out (FIFO)-

If the Customers are served in the order of their arrival, then this is known as the First come, first served (FCFS) service discipline prepaid taxi queue at airports

where the tax is engaged on a first come, first served basis is an example of this discipline.

(2) First in Last out (FILO)-

Sometimes the customers are serviced in the reverse order of their entry so that the ones who join the last are served first for example let that letters to be typed or order forms to be processed accumulate in a pile typist or the clerk might process there letters or order by taking each new task the top of the pile.

Thus a just arriving task would be the next to be serviced provided that no fresh task arrived for therefore it is picked up similarly the people who join an elevator first are the last ones to leave it.

(3) Served in Random Order (SIRO)-

Under this rule customers are selected for service at random, irrespective of their arrivals in the service system. In this every customer in the queue is equally likely to be selected the time of arrival of the customers is therefore of no relevance in such a case.

(4) Priority Service-

Under this service the customers are grouped in priority classes on the basis of some attributes such as service time or any urgency or according to some identifiable Characteristics in this service FIFO rule is used within each class to provide service treatment of VIPs in preference to other patients in the hospital is an example of priority service.

(5) Processor Sharing-

In this system the server is switched between all the queues for a predefined slice of time in a round robin manner. Each queue head is served for that specific time. It doesn't matter. If the service is complete for a customer or not, if not then it will be served in its next turn. This is wed to avoid the server time killed by customer for the external activities.

Different Measures of System applied by queuing theory for traffic measurement the measures of systems are given below.

(1) Utilization factor It is measured in ρ

$$P=\frac{\lambda}{\mu}$$

(2) Probability of exactly different customers in queuing system which contain waiting along with service. It is denoted by Pn

(3) Average number of customers in queuing systems which is denoted by $\underline{L}$ or $\underline{Ls}$

$$\boldsymbol{Ls} = \frac{\lambda}{(\mu - \lambda)}$$

(4) Average queue length or number of customers for this Lq notation is used

$$Lq = \frac{\lambda^2}{(\mu - \lambda)}$$

(5) Expected waiting time in system for each customer.

It is denoted by W or Ws $Ws \frac{1}{(\mu - \lambda)}$

(6) Waiting time in queue for each customer. It is denoted by Wq.

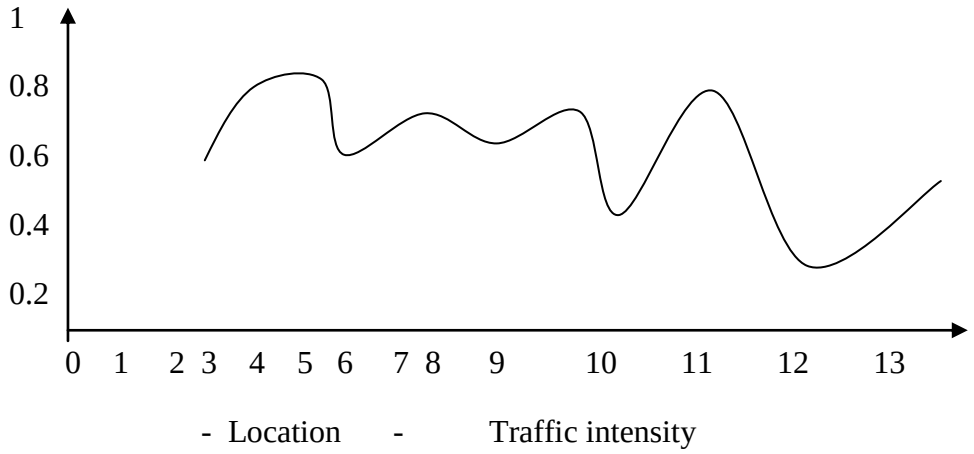
$$Wq = \frac{\lambda}{\mu(\mu - \lambda)}$$

Result & Discussion:

By using the different parameters stated in this paper on the basis of queuing theory we represent the traffic flow of traffic in the cities of Bhopal, Ujjain and Indore.

Location	Timing	Arrival		Service		Arrival rate	Service rate	Traffic Intensity
		Vehicle	Min	Vehicle	Min			
Bhopal	Morning	24	1.18	31	1.02	22	31	0.6534
	Afternoon	23	2.48	18	1.05	10	19	0.5340
	Evening	32	1.16	28	1.04	28	29	0.9249
Ujjain	Morning	27	2.34	16	1.42	12	11	0.9349
	Afternoon	20	1.38	25	1.01	17	23	0.6465
	Evening	19	1.32	20	1.00	14	21	0.6097
Indore	Morning	18	2.01	15	1.03	8	15	0.5385
	Afternoon	28	1.58	26	1.05	19	25	0.6509
	Evening	48	8.05	43	1.42	7	30	0.2716

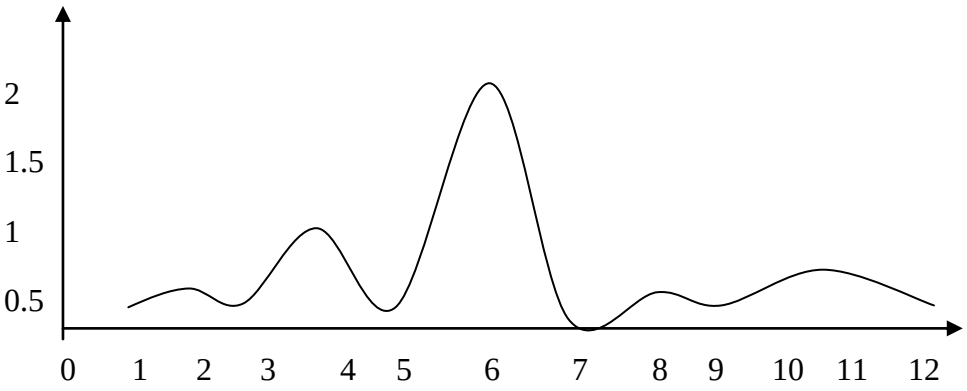
Graphical Representation of traffic intensity of Bhopal, Ujjain & Indore.



Representation of View of traffic situation of Bhopal, Indore and Ujjain

Location	Session	Arrival rate	Service rate	Traffic intensity	Mean no. Of vehicle waiting in the system	Mean no. Of vehicle waiting in queue	Mean time Spent in the system	Mean of Sport in the queue
		Λ	μ	P	Ls	Lq	Ws	Wq
Bhopal	Morning	22	31	0.6532	1	1	0.0927	0.0612
	Afternoon	8	17	0.5340	1	1	0.1372	0.0943
	Evening	28	29	0.9249	18	1	0.6892	0.6362
Ujjain	Morning	12	13	0.9342	19	17	1.6407	1.5387
	Afternoon	14	23	0.6594	2	18	0.1245	0.0683
	Evening	13	20	0.6709	1	1	0.1359	0.1052
Indore	Morning	8	16	0.5385	1	2	0.1653	0.0962
	Afternoon	16	24	0.6095	2	1	0.1232	0.0832
	Evening	7	28	0.2167	0	0	0.0414	0.0092

Graphical Representation of traffic situation



- Location - Traffic intensity

Conclusion :

The queuing theory is an effective mathematical technique for solving various traffic problems of any system as queuing theory focussed on representation of traffic situation by using various mathematical terms and formulas its application cover a wide range of present situation including the traffic congestion. City planning and urban design practices can have a huge impact on level of future traffic congestion. The present work is based on the actual survey of traffic flow at various times at different locations of Bhopal, Ujjain and Indore city. The application of the queuing theory is exploited to minimized the traffic congestion at a particular time.

By this work we find out different steps to avoid the congestion.

(1) The traffic can be reduced by increasing road capacity.

(2) We can provide separate lane for specific user group.

(3) Variable massage sign can be installed along the roadway to avoid road users.

(4) By increasing width of channel of congested route.

(5) Applying parking restrictions for the motor vehicle.

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