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Traffic Control Problem at Junctions

R. Kabila[1], T. Ramesh[2]
[1]M.Phil scholar, Department of Mathematics, Dr.SNS. Rajalaksmi college of arts and science, Coimbatore, Tamilnadu, India
[2]Asst.Professor, Department of Mathematics, Dr.SNS. Rajalaksmi college of arts and science, Coimbatore, Tamilnadu, India

ABSTRACT

In this paper, we are tried to solve the traffic difficulty in a city, the graph theory concept has been applied. The traffic control at the crossroads is difficult for traffic police. At the meeting point, a set of vehicles has to wait for longer time. This situation is modelled as a graph with vertices and edges. The vertices are represents the traffic intersection and edges represents the flow of vehicles that move towards the traffic intersection. The plan of this paper is to reduce the waiting time of traffic participants at three road, four road and five road junctions.

Keywords : Traffic stream, Traffic flow, Directed graph, Optimization.

I. INTRODUCTION

Traffic jam is a critical incident faced by the traffic users who travel on city roads. Due to traffic jamming, traffic users spoil precious time and petroleum. Traffic jam on city roads can be moderate by producing extra road and rail network; yet, it is sometimes not possible or achievable to create additional roads because of some reasons, such as lack of essential fund, permanent structure. Still, the obtainable roads may be somewhat customized to reduce the jamming on city roads.

For an example, formation of a bypass over an urban may reduce the number of motor vehicles go through in the city, and consequently minimizing traffic on urban roads. Overcrowding sometimes happens by reason of unorganized movement of vehicles on city roads and an ordered traffic stream may direct to minimization of blocking. Wireless sensors, Mobile phone networks, GPS and GIS systems some examples which are combined with ICT to control the traffic on urban roads. The traffic system is considered as a directed graph with limited number of nodes and edges. Once the situation is modelled as a graph, we can find the singular paths for the graph as well for the traffic network. An optimized distribution of paths is essential to diminish the traffic collapse. A traffic stream is a cluster of vehicles they are moving towards a road throughout an intersection. The vehicles move through at an intersection the flow can be classified as free flow, complex flow and a crossing.

A free flow means the number of vehicles moving without disruption, it is usually available at the left hand directions at the junctions from one road to another road. A complex flow means, combination of two or more road vehicles meet at an intersection, which are many streams together to become a single stream towards further road. Though, a crossing may be a stream of vehicles which has to wait for another road vehicle which is flowing through the intersection.

There is a crossing; it constantly has to be controlled by traffic lights, traffic sensors or traffic police. When the traffic police or light stops a vehicle flow, it increases the travel time. Further all the three classifications, free flow has zero waiting time and the crossing having maximum waiting time. The complex flow gain extra time to regulate the flow and merge it with other roads. The time for free flow is fewer than the time for complex flow and time necessary for complex flow is less than the time necessary for crossing.

The ambition of the system is to avoid the crossing of vehicles and thus permitting only complex flow and free flow throughout the intersection. So the system acceptable only free flow and complex flow at the intersections without troubling the whole traffic system. At a four road intersection has always crossings, so there may be traffic jam at the morning and evening time while huge number of vehicles enters and exits to and from the city roads.

II. METHODOLOGY

Traffic congestion commonly happens at the intersection and traffic intersections are mostly three types (i) Three road intersection (ii) Four road intersection (iii) Five road intersection. But the five road intersections are more also exist in metropolitan areas; here the solution is for the problem with four road and five road intersection.

Suppose there are two or more roads meets together, the vehicles will not move continuously because it will come mutually. So there is a chance to collapse and accidents. The vehicles should not allow moving freely. They have to wait for others. There are four incoming stream and four outgoing streams are considered. Four crossing are formed at the four road intersection.

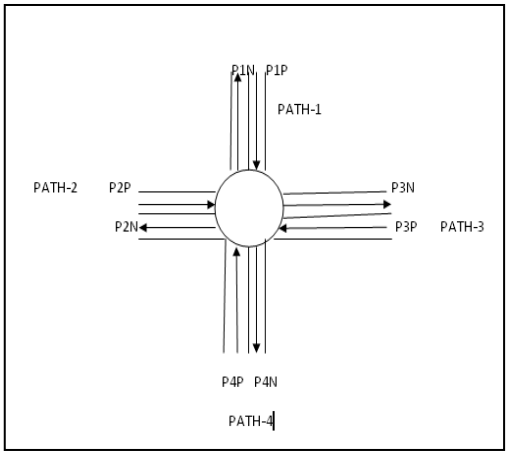

Figure 1. Traffic flows at four road intersection

In the above figure, Path-1 has two vehicle flows 'P1P' and 'P1N'. Where 'P1N' indicates the traffic stream leave from the meeting point to the path-1 and 'P1P' means the stream which come into the meeting point from the path-1. 'P2P', 'P2N' for path-2, 'P3P', 'P3N' for path-3 and 'P4P', 'P4N' for path-4 also has the same denotation as for 'P1P', 'P1N'.

Table 1. Traffic flow of a four crossroad

Path	'P1N'	'P2N'	'P3N'	'P4N'
'P1P'	Right Turn	Free Flow	Crossing	Crossing
'P2P'	Crossing	Right Turn	Free Flow	Crossing
'P3P'	Crossing	Crossing	Right Turn	Free Flow
'P4P'	Free Flow	Crossing	Crossing	Right Turn

Table 1 illustrates that a stream of vehicle 'P1P', 'P2P', 'P3P' and 'P4P' are received traffic streams. It can flow to the leaving streams 'P1N', 'P2N', 'P3N' and 'P4N'.

It is obvious that all the traffic streams incoming or coming out of the crossroads can create total sixteen types of appropriate roads as showing in table 01.

The five road intersection is a crossing of five roads. The five road junction has ten different types of traffic streams exposed in figure 2.

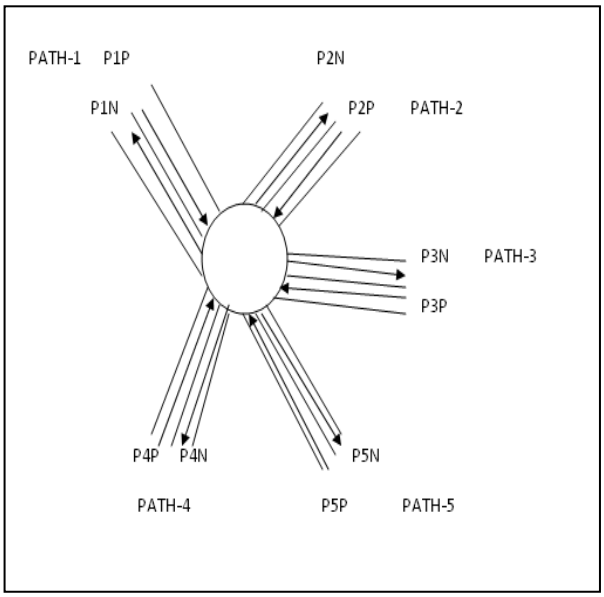

Figure 2. Traffic flow at the five road junction

It is clear from the figure that all the traffic flows can incident and coming out of the crossroads can make total twenty five types of appropriate traffics streams as exposed in table 2.

Table 2. Flow of five crossroads

Paths	**'P1N'**	**'P2N'**	**'P3N'**	**'P4N'**	**'P5N'**
'P1P'	Right Turn	Free flow	Cross	Cross	Cross
'P2P'	Cross	Right Turn	Free flow	Cross	Cross
'P3P'	Cross	Cross	Right Turn	Free flow	Cross
'P4P'	Cross	Cross	Cross	Right Turn	Free flow
'P5P'	Free flow	Cross	Cross	Cross	Right Turn

The table 2 demonstrates that a traffic torrent of vehicle 'P1P', 'P2P', 'P3P', 'P4P' and 'P5P' can flow to 'P1N', 'P2N', 'P3N', 'P4N' and 'P5N'. These two collections of pours are prearranged in strips and column to find all the alliance of flows those may be feasible for a five road crossroads.

III. ROAD INTERSECTIONS AND OPTIMIZATION

A. Four road intersection

The four road intersection has four roads incident on the junction and hence there are four arriving streams 'P1P', 'P2P', 'P3P', 'P4P' and four departing traffic streams are 'P1N', 'P2N', 'P3N, and 'P4N' as shown in fig01. All the four arriving streams may flow towards the outgoing flows with the option exposed in table-01. The circumstances can be modelled as a graph as exposed in figure 3. It shows the crossings 'CR1', 'CR2', 'CR3', and 'CR4'.

It is observable from figure 3 that the four crossing 'CR1', 'CR2', 'CR3' and 'CR4' are produced due to the edges 'P1P → P3N', 'P2P→P4N', 'P3P→P1N' and 'P4P→P2N'. Suppose two edges are eliminated there is a free flow through the intersection. Though, in doing so some streams of vehicles cannot flow towards few other roads. In figure 3 the elimination of the edge 'P1P →P3N' and 'P3P→ P1N' will cut the flow from 'P1P' to 'P3N' and 'P3P' to 'P1N'.

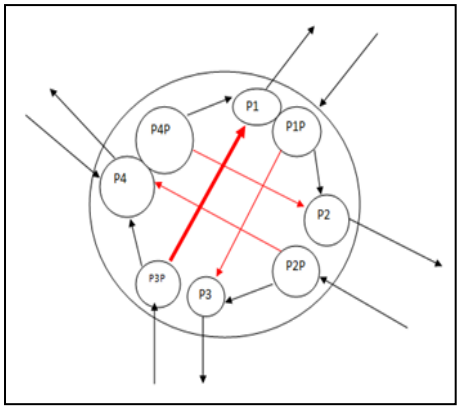

Figure 3. Four road intersection in a graph

B. Five road intersection

The five road intersection has five roads occurrence on the junction and hence there are five arriving streams 'P1P', 'P2P', 'P3P', 'P4P', 'P5P' and four departing streams 'P1N', 'P2N', 'P3N', 'P4N' and 'P5N' as shown in the figure 4. Hence all the five arriving streams may flow towards the departing flows with the option shown in table 2. The circumstances can be represented as a graph as exposed in figure 4. It shows the crossings 'CR1', 'CR2', 'CR3', 'CR4', and 'CR5'.

It is obvious from figure 4 that five crossing 'CR1', 'CR2', 'CR3', 'CR4' and 'CR5' is formed due to the edges 'P1P→P4N', 'P2P→P5N', 'P3P→P1N', 'P4P→P2N' and 'P5P→P3N', if at least three edges are take out, then we can get free flow towards through the intersection. The elimination of the edge 'P1P→P4N', 'P3P→P1N', 'P5P→P3N' will cut the flow from 'P1P→P4N', 'P3P→P1N', 'P5P→P3N'.

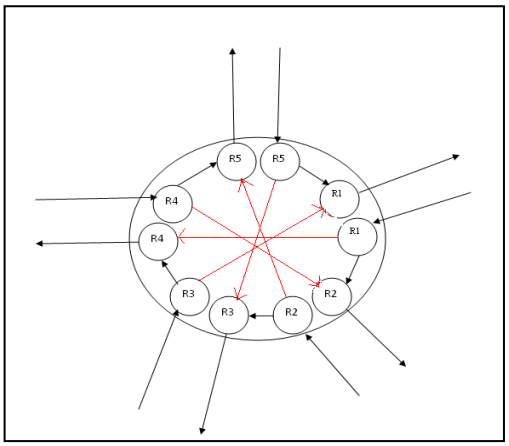

Figure 4. Five road crossing in a graph

IV. PROCEDURE

1. Identify the intersection groups with cycles.
2. Connect internal vertices to form a cycle for internal and external connectivity which shows continual flow.
3. Recognize other intersection which is not still included in the groups.
4. Connect them with the adjacent groups which were already formed for interrupted flow system.
5. Repeat all the steps as we get the free traffic flow in the system.

There are five intersections are intersection 01, intersection 02, intersection 03, intersection 04 and intersection 05 involved in the arrangement and it has been formed a free flow as multiple flow at all the junction for every stream of vehicles. The increasing flow of the system can be developed for a collection of three roads, four road and five road intersections without any trouble and a different model for assembly of road intersection has been showing in figure 5.

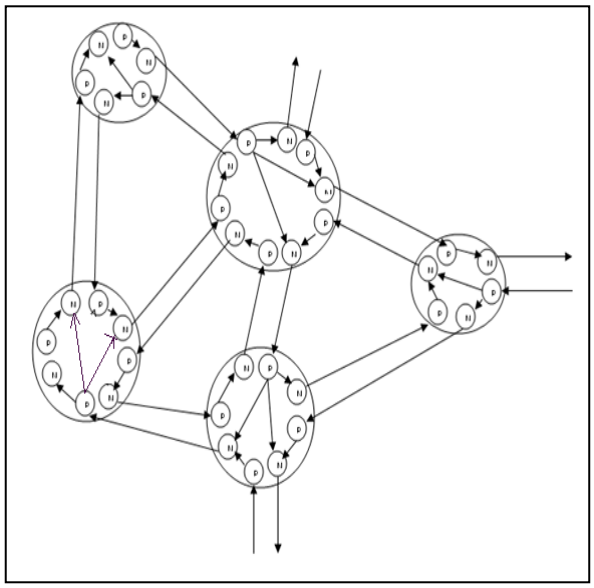

Figure 5. Five road intersection without difficult

The above system produces a free flow at all the intersection for every traffic flow of vehicles. This system can be urbanized for meeting of five road intersections without any trouble.

V. CONCLUSION

This continual flow system will make easy for a nonstop flow of vehicles at an intersection. The vehicles will move concurrently without stopping.

The difficulty of traffic jam is solved at a crossroads. The arriving and departing time at the cross roads of the traffic contributors is minimized at intersections. We are tried to solve the traffic problem at an intersection without traffic police or stoplights. But they have to travel long distance. They are never crossing at the intersection point. The traffic users move without any disturbance.

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