Review on Congestion Pricing using Electronic Road Pricing (ERP) system

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Abstract- **nowadays, traffic congestion has been increasing due to rapid development of vehicles. So, there is need of Intelligent Transportation Systems (ITS) or the advanced use of Information and Communication Technology (ICT) in the transportation system, it offers new tools in the continual effort to develop an accessible, safe, and sustainable transportation system. In this paper, described ITS application and technologies and especially focus is placed on Electronic road pricing (ERP) system. This paper is also discuss the benefits and role of ERP system for congestion pricing.**

Index Terms- **Electronic road pricing (ERP) system, Volume Count, Feasibility, traffic congestion.**

INTRODUCTION

Traffic congestion [1] has been increasing worldwide as a result of increased motorization, urbanization, population growth and changes in population density. Congestion reduces efficiency or transportation infrastructure and increases travel time, air pollution and fuel consumption. Now a day's development of roads has created a new havoc which lead to the increase in the accident cases all across the world, in order to over-come from such a problem.

Congestion pricing[2] is a system of surcharging users of public goods that are subject to congestion through excess demand such as higher peak charges bus services, electricity, metros, railways, telephones, and road pricing to reduce traffic congestion. Airlines and shipping companies may be charged higher fees for slots at airports and through canals at busy times. This pricing strategy regulates demand, making it possible to manage congestion without increasing supply.

In the developing world, [3] the migration from rural to urbanized habitats has progressed differently. Many areas of the developing world have urbanized without significant motorization and the formation of suburbs. A small portion of the population can afford automobiles, but the automobiles greatly increase congestion in these multimodal transportation systems. They also produce considerable air pollution, pose a significant safety risk, and exacerbate feelings of inequities in the society.

Road pricing [4] is now being advocated as an efficient means of managing traffic demand and of meeting other objectives, such as reducing the environmental impact of road traffic and improving public transport. This paper shows how a network toll pattern could be determined so as to reduce network travel demand to a desirable level. [5] The demand between each origin and destination pair is described as a function of the generalized travel cost. When there is no toll charge, higher values of potential demand might cause congestion and queuing at bottleneck links of the road network. Queuing delay at saturated links may grow to choke off enough potential demand to reduce realized demand to the capacity of the network. Thus leading to a queuing equilibrium where travel demand and travel cost match each other.

Any ERP system [6] has to be planned, implemented and used in concert with other policy measures. Ultimately, however, the success of any programme depends heavily on the ability of governments to tackle the problems efficiently and effectively.

I.I Congestion Pricing Technics [7]
1) Electronic Toll Collection
Today, most toll roads are equipped with an electronic toll-collection system, like E-Z Pass, that E-Z Pass uses a vehicle-mounted transponder that is activated by an antenna on a toll lane. Your account

information is stored in the transponder. The antenna identifies your transponder and real.

2) Cordon zones with congestion pricing

With the intelligent transportation system, cordon zones can also be enforced where mass transportation systems are available and their use encouraged. Cordon systems make it possible to collect taxes from those entering city areas with high traffic while encouraging the use of mass transit.

3) Smart Parking systems

An automated (car) parking system (APS) is a mechanical system designed to minimize the area and/or volume required for parking cars. Like a multi-story parking garage, an APS provides parking for cars on multiple levels stacked vertically to maximize the number of parking spaces while minimizing land usage.

The APS, however, utilizes a mechanical system to transport cars to and from parking spaces (rather than the driver) in order to eliminate much of the space wasted in a multi-story parking garage. While a multi-story parking garage is similar to multiple parking lots stacked vertically, an APS is more similar to an automated storage and retrieval system for cars.

4) Floating Car Data/Floating Cellular Data

- Non Real-time:
- Manual surveys
- Video recording
- Manual search.
- In-vehicle data recording.

Real-time:

- Not inductive loop
- Automatic Number Plate Recognition (ANPR).
- GPS trace + mobile communication e.g. GSM.
- Radio Signal Triangulation.
- Roadside beacon + dedicated system

5) Automatic Road Enforcement

A traffic enforcement camera system, consisting of a camera and a vehicle-monitoring device, is used to detect and identify vehicles disobeying a speed limit or some other road legal requirement and automatically ticket offenders based on the license plate number. Traffic tickets are sent by mail. Speed cameras identify speed limit. Red light cameras detect vehicles that cross a stop line. Bus lane cameras identify vehicles traveling in lanes reserved for buses.

I.II Electronic Road Pricing (ERP) system

The Electronic Road Pricing (ERP) system [8] is an electronic toll collection scheme adopted in Singapore to manage traffic by way of road pricing and as a usage-based taxation mechanism to complement the purchase-based Certificate of Entitlement system. Singapore was the first city in the world to implement an electronic road toll collection system for purposes of congestion pricing. The system uses open road tolling. Vehicles do not stop or slow down to pay tolls. This system is currently successfully working in many countries Singapore, London, England, Stockholm, Sweden, Jakarta etc.

I.II.I Benefits of ERP [9]:

Minimises traffic volume in heavily used roads in the CBD and Orchard areas, as well as major expressways.

Optimises usage of the road network by encouraging motorists to consider alternatives.

Provides a fair price for motorists. Charges are based on usage those who use the roads pay more; while those who use the roads less frequently or who travel during non-ERP hours pay less or don't need to pay at all.

No more monthly/daily licences. Motorists no longer need to buy paper licences to drive through high traffic areas in the CBD.

No human error. ERP's reliable and fully automated system operates 24 hours. Its central computer system ensures gantries are always working properly.

Traffic congestion [10] is costly to the individual and society. It results in the loss of productive hours, environmental pollution, wasted fuel and adverse health effects. To keep traffic moving, ERP is a holistic and integrated approach using all the tools available, including building more roads, regulating vehicle growth, implementing traffic engineering solutions and promoting the use of public transport. In addition to the various measures, we also need to manage traffic demand through ERP.

With more vehicles on the road, ERP [11] remains effective in addressing current and future traffic conditions and ensuring motorists continue to have a smooth journey. Traffic Survey [12] counts may provide some precise information about numbers of vehicles and their types.

Figure 1 ERP Gantry in Singapore [12]

II. LITERATURE SURVEY

Road pricing [13] is now being advocated as an efficient means of managing traffic demand and of meeting other objectives, such as reducing the environmental impact of road traffic and improving public transport. This paper shows how a network toll pattern could be determined so as to reduce network travel demand to a desirable level. The demand between each origin destination pair is described as a function of the generalized travel cost. When there is no toll charge, higher values of potential demand might cause congestion and queuing at bottleneck links of the road network.

Queuing delay [14] at saturated links may grow to choke off enough potential demand to reduce realized demand to the capacity of the network. Thus leading to a queuing equilibrium where travel demand and travel cost match each other. We also show that the link toll pattern that could hold the traffic demand to a desirable level is not unique, a bi-level programming method is developed to select the best

toll pattern among the feasible solutions based on pre-specified criteria.

When there is no control on road use [15], the urban road network may become congested, and vehicle queues may occur at bottlenecks, causing waste of time and/or producing unacceptable environmental damage. This paper has examined the problem of using road pricing to restrain traffic demand to within a desirable level.

Any ERP system [16] has to be planned, implemented and used in concert with other policy measures. Ultimately, however, the success of any programme depends heavily on the ability of governments to tackle the problems efficiently and effectively.

III. CONCLUSIONS AND FUTURE SCOPE

1. ERP is useful to reduce the traffic at busiest area's like central business districts or urban areas.
2. From the ERP Gantries, it will also give the important information like real time traffic, Emergency situations, and the behavior of users can recorded, guide the user for shortest path etc.
3. After the implementation of ERP, people should more conscious about traffic rules & regulations. Also, public transport user getting increased. Because, there is no charges for public transport in ERP System.

In this paper a review of different congestion pricing applications in transportation has been discussed. First, different Congestion pricing technics and the role of congestion pricing in transportation is described. Then Literature reviewed on electronic road pricing (ERP) system is described.

ERP system is successfully working in many countries. Future work for ERP system is, that, to check the feasibility of ERP system in India. Especially for smart cities or CBD (central business district) areas.

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