

Dynamic Barrier System For Traffic Control

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Introduction

Situation

- The traffic issues of Dubai cost the city and its population millions in wasted time and fuel.
- Although major projects have been undertaken to ease traffic congestion in Dubai such as the Dubai Metro projected in 2009 and the recently completed Dubai Tram project and various road widening projects
- This study is to evaluate the traffic congestion on major Dubai highways and evaluate viable solutions so as to select the most feasible solution
- For this purpose the Sheikh Mohammed bin Zayed road is subjected to study in order to represent it as a sample of Dubai's peak hour traffic woes
- The Sheikh Mohammed bin Zayed road is a major highway which connects Dubai to the emirates of Sharjah, Ajman, Fujairah and Ras Al Khaimah



Fig 1. Traffic Congestion in Sheikh Mohammed bin Zayed Road [1]

Identification of problems:

- Peak hour traffic is one of the major problems for congestion in the Sheikh Mohammad Bin Zayed road since it is one of the easiest and fastest ways to travel from Dubai to Sharjah.
- Major construction works lead to closure of lanes which exponentially decreases traffic flow. Whether it be constructing new roads or bridges, the need to close the lanes causes major delays and problems.
- The nonlinear growth of vehicles is cited as the primary reason for ever increasing traffic congestion issues.



Fig 2. Construction In Sheikh Mohammed Bin Zayed Road [2]

Solutions

Traditional solution

The traditional solution to traffic problems on highways is building extra lanes. The main step in this type of solution is the decision making whether to go with the project or not. This is done based on a demand model which is created by extensive public outreach. The city officials, engineers and planners meet up and use this model to estimate the capacity improvements required for the specific roadway.

Issues

- Cost: Example in USA it takes about \$2 to \$10 million per lane mile.
- Space limitation
- Time frame of completion: on average it takes 1 year per lane
- Confliction of ideas between city officials.



Fig 3. Graph comparing Road Growth and Mobility Level [4]

Automated highway system

- Automated Highway System, Platoon system, is used describe two or more vehicles operated under automatic control as a unit and are travelling at the same speed with relatively small inter-vehicle spacing.^[10]
- String stability used for safety and stability of vehicles
- Spacing 2-4 meters
- Reduces Consumption of fuel
- Autonomous vehicle preferred
- SARTRE AND PATH conducted successful experiment

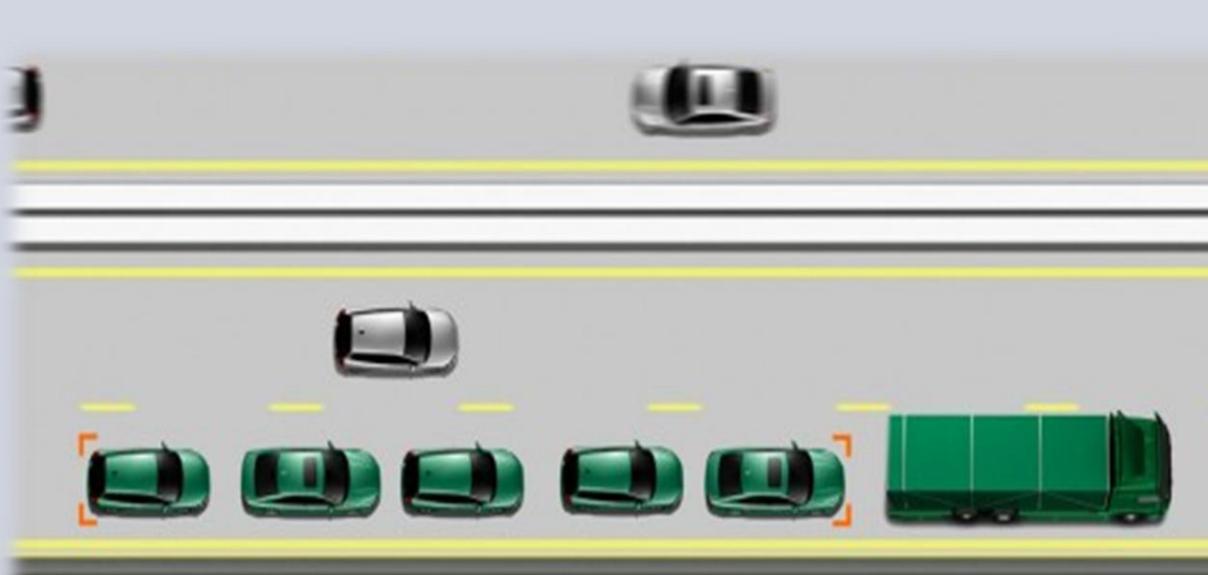


Fig 4. Automated Highway System [10]

Issues

- Complexity of the project
- Lack of Control of driving
- Reliability

Straddling bus

- Straddling bus was roused by a Chinese innovation in 2010.
- A subway design 2 meters above the ground.
- It uses electricity and solar panels as a power source.
- It runs at an average speed of 40km/h and a maximum speed of 60km/h.
- Will straddling Bus solve the traffic congestion problem?
 - ❖ Capacity of 1200 passengers.
 - ❖ Reduces the number of public transport vehicles.
 - ❖ 20-30% reduction of traffic congestion.



Fig 5. Straddling Bus Technology [6]

Issues

- High costs: Example \$74.5 million in building the straddling bus and 40km railways
- Cars higher than 2 meters cannot pass under the bus.
- Unavailability of the technology (Development stage).

Barrier Transfer machine (BTM)

Barrier transfer machines, are heavy vehicles that are used to exchange lanes from one side to another in order to relieve the traffic congestion during rush hour by creating a dynamic extra lane. Moveable barriers are in permanent use in cities such as Auckland; Montreal, Canada; Philadelphia, Pennsylvania;

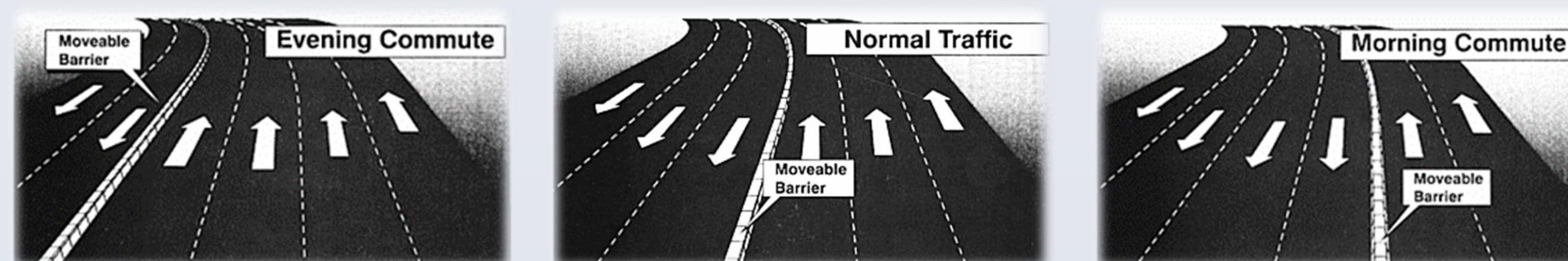


Fig 6. Mechanism of BTM [9]

Types of Application used by BTM:

- Temporary Application :
 - ❖ Temporary application is used generally for maintenance, repair or construction.
 - ❖ The Barrier Transfer machine makes the construction safer and secure.
- Permanent Application : In this application used for creating a dynamic lane where there is traffic. It reduces the traffic congestion when there is traffic on the peak time.



Fig 8. Concrete Barrier [8]

Design and Working

S-shaped conveyor in the undercarriage of the vehicle. The vehicle starts by going around the concrete lane barriers and taking over one lane while it finishes its job. The barriers(T-shaped) are lifted off the ground and onto the conveyor belt under the machine.



Fig 9 Mechanism Of BTM [9]

Traffic monitoring

The BTM system makes use of a centralized control system which utilizes the information obtained from CCTV cameras with thermal sensors. The system takes the video information and sends it to the video detection board. According to FLIR, with the help of thermal and responsive command and control software. We can collect the data of ongoing traffic. This helps the barrier transfer machine to recognize when it should replace the barriers and by how many lanes.



Cost

The Cost of building a Barrier Transfer vehicle ranges from \$250,000 to \$450,000. The barrier cost around \$500 for a 1-meter block, which would give a total of approximately \$800,000/mile

Evaluation

Recyclability:

Barrier Transfer Machine compared to the traditional solution in terms of usage of resources is more efficient since the usage of resources to build the road can be avoided.

Availability of technology:

This technology existed since the 1980's and the development of this technology has reached to a high extent so the availability of information for this technology will not be an issue compared to the Automated highway system and the straddling bus. Even the implementation will be easier and faster if done by professionals unlike the traditional solution. According to Barrier Systems Inc. there is an already available detailed specification for the BTM.

Cost

Compared to the straddling bus and the traditional solution Barrier Transfer machine has the least cost of implementation on an already existing roadway. The total cost for the machine and the specially designed barriers is about \$1.25 million.

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