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Future of Feeder Service - Automated Transport System

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Abstract — *Transportation systems are currently being transformed by advances in information and communication technologies. The development of autonomous transportation holds the promise of providing revolutionary improvements in speed, efficiency, safety and reliability. Automated systems are ideally suited to supplement the existing mass public transport system with collective, semi-collective and personal on-demand and shuttle services. When demand is low or pick-up points are far apart, they are much more effective than conventional public mass transport systems. . A wider take-up of automated transport systems within cites or city-like environments has yet to happen. Studies have shown new transport systems based on automation to have significant potential in areas of low to medium public transport demand and/or as a feeder service to the main public transport network. Further research is necessary in order to exploit the potential benefits of automation in road transport in a manner that is safe. This paper identifies key advantages of automated transport system as feeder service.*

Keywords-*Automation, Connectivity, Feeder Service, Interiors, Urban Impact*

I. INTRODUCTION

India, the second most populous country in the world, and a fast growing economy, is seeing terrible road congestion problems in its cities. The problem is often felt in almost all major cities. This is primarily because infrastructure growth is slow compared to growth in number of vehicles, due to space and cost constraints. Traffic in India is chaotic and largely different from the western traffic. Building infrastructure, levying proper taxes to curb private vehicle growth and improving public transport facilities are long-term solutions to this problem. These permanent solution approaches need government intervention.

During recent years the development of automated traffic systems has received increased attention, and substantial effort has been invested in trying to find a solution to the problem. Automation in road transport has the potential to reduce the negative impact of several societal challenges such as number of road accidents and subsequent injuries and fatalities, the impact of road transport on the environment, and the flow of traffic and mobility of people in urban areas with exploding population levels. Automation in collective public transport has been a reality for several years by now in the case of guided systems with fully segregated right-of-way. The key advantage of ARTS (Automated Road Transport System) is identified in the potential for offering a higher frequency of service in the off-peaks, provided the operating costs are lower than a conventional bus. Also, there is a potential for higher flexibility in adapting the supply to demand because of the lack of drivers' scheduling constraints.

Automated systems are ideally suited to supplement the existing mass public transport system with collective, semi-collective and personal on-demand and shuttle services. When demand is low or pick-up points are far apart, they are much more effective than conventional public mass transport systems. Cyber cars are operated automatically with state-of-the-art obstacle-avoidance technology in order to run on existing infrastructure among pedestrians, cyclists and road vehicles in low-density areas.

Fig1. Cyber cars

II. NEED OF STUDY

The traditional mass public transportation systems have reached a level of saturation in current scenario. This leads to more usage of private vehicles and thereby increasing traffic in already congested roads. During peak hours the situation is even worse. The main reason is inaccessibility of public transport system in interiors of the city. Urban population is increasing drastically. This means in future more vehicles will be there on road. It is necessary to curb increase in usage of private vehicles. For this the public mass transport needs to be revamped so as to attract passengers. If various modes of transport are interconnected then it can increase usage of public transport.

It is necessary to introduce a medium capacity feeder service for existing public transport system. Automation can eliminate human related errors and prove to be more efficient and convenient for commuters. In fact the infrastructure needed for such a feeder service is very limited and keeping aside initial cost of instalment, the system is cheap compared to conventional transit systems.

III. LITERATURE REVIEW

Daniel Lee, Sebastian Pokutta "TOWARD A SCIENCE OF AUTONOMY FOR PHYSICAL SYSTEMS: TRANSPORTATION (2015)"

Daniel Lee, Sebastian Pokutta, The coming implementation of autonomy and related technologies will have a major impact in the future of transportation systems. It is critical that we better understand how advances in sensors, mapping, navigation, data analytics, security and other technologies will influence safety and efficiency of transportation. A renewed commitment to studying and preparing for the upcoming changes is needed, encompassing the federal level to corporations as well as the general public.

Todd Litman Victoria "AUTONOMOUS VEHICLE IMPLEMENTATION PREDICTIONS IMPLICATIONS FOR TRANSPORT PLANNING - TRANSPORT POLICY INSTITUTE (2015)"

Todd Litman Victoria, This report explores the impacts that autonomous vehicles are likely to have on travel demands and transportation planning. It discusses autonomous vehicle benefits and costs, predicts their likely development and implementation based on experience with previous vehicle technologies, and explores how they will affect planning decisions such as optimal road, parking and public transit supply. The analysis indicates that some benefits, such as independent mobility for affluent non-drivers, may begin in the 2020s or 2030s, but most impacts, including reduced traffic and parking congestion, independent mobility for low-income people, increased safety, energy conservation and pollution reductions, will only be significant when autonomous vehicles become common and affordable, probably in the 2040s to 2060s, and some benefits may require prohibiting human-driven vehicles on certain roadways, which could take longer.

Rasmus Lindholm "ERTICO – ITS EUROPE THEMATIC PAPER -AUTOMATION IN ROAD TRANSPORT (2013)"

Rasmus Lindholm, This paper outlines the benefits of Automation in road transport and main areas for further research and development in the field, as well as the most pressing challenges which must be addressed in order to achieve real deployment of automated applications and functions. Recommendations from the ERTICO Partnership are addressed to policy makers. Automation in road transport has the potential to reduce the negative impact of several societal challenges such as number of road accidents and subsequent injuries and fatalities, the impact of road transport on the environment, and the flow of traffic and mobility of people in urban areas with exploding population levels. Although automation in Road Transport is advancing, suitable and sustainable funding for projects and pilots, which bring stakeholders together to further develop or refine Automation functions and applications, should be continued. The end-to-end value chain and the unusually wide variety of stakeholders implicated in the field must be of particular focus for European and international projects. A level of trust should be built among Users and technology in order to achieve a sustainable implementation.

IV. CONCEPT OF AUTOMATION IN TRANSPORT

A. Towards fully automated vehicles (Self-Operating)

Highly, partial or full automation will contribute to the enhancement of traffic safety by reducing the driver‘s workload, in terms of driving, and minimizing human errors and incidents due to driver distraction or reduced vigilance. The driver has an important impact on safety and efficiency. 95% of the road accidents are human error related. Automated driving at different levels has the potential to reduce such accidents by eliminating the human factor. On the efficiency side there is up to 20% difference between the worst driver behaviour and an optimal one.

B. Safe & efficient cooperative driving

With cooperative systems, vehicle efficiency and safety can be improved both in urban driving situations. Platoons present an opportunity to both improve traffic efficiency and safety of vehicles. Cooperative highly automated driving offers significant potential benefits if combined with traffic management, especially within urban environments. Traffic management can then intervene cooperatively at different levels of the driving task, such as navigation or vehicle guidance, its intervention can range from purely informative systems to direct influence on the vehicle motion, and it could influence the availability and selection of a certain automation level within the vehicle.

C. *Definitions-Levels of Automation*

The definitions below cover the complete range of vehicle automation, ranging from vehicles that do not have any of their control systems automated (level 0) through fully automated vehicles (level 4). [2]

- *Level 0 – No Automation*: The driver is in complete and sole control of the primary vehicle controls (brake, steering, throttle, and motive power) at all times.
- *Level 1 – Function-specific Automation*: Automation at this level involves one or more specific control functions; if multiple functions are automated, they operate independently from each other.
- *Level 2 - Combined Function Automation*: This level involves automation of at least two primary control functions designed to work in unison to relieve the driver of control of those functions. The driver is still responsible for monitoring the roadway and safe operation and is expected to be available for control at any time.
- *Level 3 - Limited Self-Driving Automation*: Vehicles at this level of automation enable the driver to cede full control of all safety-critical functions under certain traffic or environmental conditions and in those conditions to rely heavily on the vehicle to monitor for changes in those conditions requiring transition back to driver control.
- *Level 4 - Full Self-Driving Automation*: The vehicle is designed to perform all safety-critical driving functions and monitor roadway conditions for an entire trip. This includes both occupied and unoccupied vehicles. By design, safe operation rests solely on the automated vehicle system.

D. Initial Applications of Automation

The ARTS application that could be built with existing technology would be small, perhaps 0.8 - 6.4 km of two-way roadway. While various circulations are possible best application considered are connection and extension. Hence ARTS can extend an existing mode of transportation by connecting it to a trip generator of some sort. [5]

Fig 2. ParkShuttle Automated Peoples Mover System

E. Characteristics of Automated Road Vehicles that determine suitable applications are:

- Low top speed - about 32-40 km/hr. This means that the trips served must be short, although they could be part of longer trips taken mostly on another mode.
- Low Operations and Maintenance cost per vehicle mile. There are no drivers, and most ARVs are built from electric vehicles which are efficient and low maintenance. This means high frequency service can be run in the off peak as well as the peak.
- Moderate fixed costs for the exclusive roadway and a central control facility. ARV system generally has a higher capital cost than a bus alternative. This means that an ARV system needs a certain minimum fleet size to keep fixed costs from becoming excessive on a per vehicle basis.
- Land requirements. Because of the need for an exclusive roadway, ARV systems will generally be built in the suburbs not the CBD. Some systems will be built at locations such as airports where there is a special need and

land is available. If a small fraction of potential applications are feasible, the number of ARV systems could be considerable.

F. Impacts of Automation

- *Impact on Traffic*: Highly or fully automated road transport will improve traffic safety, reduce congestion.
- *Impact on Humans*: Vehicle automation will reduce driver's workload, reduce accidents, increase vehicle density and minimise speed variation in urban areas.
- *Impact on Environment*: System is Environmental friendly as Automated Vehicles works on electricity and battery.

V. CONCLUSION

Over the next few decades, Public Automated Road Vehicles (small driverless buses) can help create a more compact and energy-efficient urban form. In contrast, automation of private cars would make it easier to commute long distances, and could increase total energy use. ARVs will eventually be able to operate at moderate speeds on public streets. But some exclusive ARV lanes would still be desirable, since these can be much narrower than conventional lanes, and can be routed where conventional streets are not acceptable because of noise, pollution, or overhead clearance issues. Thus automated feeder service system can change overall attitude towards public transportation and ease out existing traffic problems. Though further research is required regarding overall cost of implementation but one cannot deny benefits of such a system.

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