IMPACT OF AUTOMATED HIGHWAY SYSTEMS ON INTELLIGENT TRANSPORTATION SYSTEMS RESEARCH.

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AUTOMATED HIGHWAY SYSTEMS – TIMELINE.


- late 1960’s – invention of Computers – boost for research.

AUTOMATED HIGHWAY SYSTEMS – TIMELINE.

- 1980’s – advances in computers, microelectronics & sensors – impetus on AHS research – California PATH program – significant contribution to AHS research.


AUTOMATED HIGHWAY SYSTEMS

- a new relationship between driver and highway infrastructure.

- designated lanes along limited access roadway – specially equipped vehicles – operated – completely automatic control.

- Uses vehicle and highway control technologies – shift driving functions from driver/operator to vehicle.
**MAJOR AHS GOALS**

- **Improve safety** – *reducing* fatality, personal injury, pain & suffering, driving stress.
- **Save money and optimize investment** – *max* efficiency, integration of services -> *smoother* flow, *reduction* of costs, public – private partnerships.
- **Improving accessibility & mobility** – *smoother* traffic flow, *better* access & outreach to everyone, *more* just-in-time deliveries.
- **Improve environmental efficiencies** – *reducing* emissions, solid base for reliable & lower cost transit, alternate powered vehicles.
- **Create Jobs** – *stronger* national economy, *increased* research on ITS development, technology transfer.
Automated Highway System
HOW IT WORKS??

- driver using AHS -> validation lane – checking for suitability – function properly in AHS.

- destination determined, tolls deducted – driver steers into automated lane.

- Improper working vehicles – directed to manual lanes, rest driven to a merging area

- Automatic Control System – takes control of vehicle till it moves outside – driver relaxed state.
HOW IT WORKS??

- At the exit point, system checks on driver – conscious/able to take control/sick/dead etc.

- Control TRANSFERRED – vehicle moves out of the lane.
AUTOMATION SYSTEMS

Two types
- Partially Automated Systems
- Fully Automated Systems

Partial Automation – rely on the driver for most driving functions – limited control of the vehicle during an emergency.

Full Automation – drivers totally disengaged from driving tasks – SAFER.
CONCEPT FAMILIES

- **Independent Vehicle Concept** – In-vehicle technology, no coordination between vehicles also & no infrastructural assistance.

- **Cooperative Concept** – Vehicles on the road communicate through radars and sensors deployed - > COORDINATION & SAFETY.

- **Infrastructure Supported Concept** – Automated vehicles in dedicated lanes using global information & smart infrastructure to assist vehicle operations.
Concept Families

- **Infrastructure Assisted Concept** – automated roadside system – assistance & coordination during entry, exit, merging & emergencies.

- **Adaptable Concept** – adapting to the conditions prevailing in the locality. Wide range of comparable standards that leave decisions & solutions to be taken by the stakeholder.
CURRENT TECHNOLOGIES

- Modern day use of technology in vehicles – driver safety.
- Eg: air bags, anti lock brakes, adaptive cruise control, power steering.

- AHS – requires much greater technology for use – vehicle locators, collision control devices, travel information systems, navigation systems etc.

- These are nowadays available in luxury brands – an indicator of openness to AHS.
The Control Design of AHS

- 5 layers

- **Physical Layer** – onboard vehicle controllers.

- **Regulation Layer** – responsible for the longitudinal and lateral guidance of the control, execution of manoeuvres ordered by the coordination layer.

- **Coordination Layer** – responsible for selecting the vehicle activities – in consultation with other coordination layers of neighbouring vehicles + link layer (updation of activity plan)
**THE SYSTEM CONCEPT**

- **Link Layer** – Roadside Control System – every 0.5-1.0 km – control traffic link within to attain max capacity & min travel time.

- Link receives traffic flow from neighbouring links, measures vehicle densities at each link junctions, taking along many considerations and devises on a activity plan for the vehicle or the platoon as a whole.

- **Network Layer** – control entering traffic and route them to links that constitute AHS in order to optimize capacity & travel time, minimize congestion.
SOCIAL AND INSTITUTIONAL CHALLENGES FOR AHS

- Land Use

- Environmental Impact

- Effect on people’s mobility on their inability to use new technology.

- Effects on government owned transport systems.

- Financial Impacts
**UNCLEAR SOCIAL AND ENVIRONMENTAL IMPACTS**

- **Congestion at entry and exit:** more number of vehicles using the AHS could congest the entry and exit sectors.

- **Unclear Social and Environmental Impacts:** AHS might trigger urban sprawl, thus increasing the dependence on vehicles -> HIGHER emissions.

- **Safety:** brake failure -> chain reaction of accidents. Safety at a realistic cost??

- **Equity:** federal and state government funding possibilities. Proper utilization of public worth...??
TRANSITION FROM CONVENTIONAL HIGHWAYS TO AHS

- **Evolutionary Approach** – IMPOSSIBLE – not all people would favour CHANGE.

- **Solution**: Gradual Implementation – one lane to be converted to AHS – initial users benefit – government vehicles convert to AHS vehicles.

- Market Penetration of automated vehicle technology imminent—>COMMERCIALIZATION.
PUBLIC ACCEPTANCE

- For acceptance - design with complex human factors and operational reliability considerations to be considered.

- Analysis of user responses viz. fully automated control, narrower lanes, higher speeds etc should be done.

- User fears, inertia and distrust in new technologies – eliminated only be systematic and gradual implementation.
INSTITUTIONAL ISSUES

- **Finance**: Who pays for the AHS??
  - covering the cost of AHS
  - Priority in investment v/s National Highways
  - Rights and privileges of the operating entity.
  - **Inventory**: new funds to cover the factors or a result based investment.

- **Organizational Issues**: Is the State Government capable enough to manage such systems??

- **Liability Issues**: “Who” is responsible for accidents??
VEHICLE PLATOONING

- The 8-vehicle platoon demonstration – San Diego, CA (Aug. 97) – California PATH program.

- “Buick LeSabres” operated under precise automatic control & highway speeds – feasibility study for the public.

- Increased highway output, closer distances of separation, twice as much traffic capacity, reduced congestion, safer, stress free ride.

- Closer Spacing – reduced aerodynamic drag – reduced fuel consumption.
PATH Engineer Jurgen Guldner reads the newspaper at nearly 40 mph.
CONCLUSION

- **AHS** - State of the art technology with major transportation benefit in many respects.

- Integration of various control systems, each with predefined role.

- Due to technological advances of the current day, no more showstoppers.

- Institutional & societal challenges remain – consensus expected -> Successful Implementation.
REFERENCE(S)

- Cheon, Sanghyun, “An Overview of Automated Highway systems (AHS) and the social and the institutional challenges that they face.” Link: http://www.uctc.net/papers/624.pdf


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