THE ADVANCE TECHNOLOGY OF SMART ROAD CONSTRUCTION: USING SENSIOR

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Abstract: In today world the traffic is a main problem for every people. This traffic occurs due to increasing availability of vehicle on the road as we see that every people.

Typically, there is very little technology that goes into roads. They tend to be made out of asphalt or concrete, which is compacted into a smooth, solid surface and painted upon to indicate certain restrictions, routes and information. And that’s pretty much it.

The automated highway system is defined as "a lane or set of lanes where specially equipped cars, trucks and buses could travel together under computer control. It is one aspect of intelligent transportation systems (ITS), which apply electronics, computers and control technology developed for aviation, the space program and defense to the improvement of highways, vehicles and public transportation.

This paper looks into recent developments and research trends in collision avoidance/warning systems and automation of vehicle longitudinal/lateral control tasks. It is an attempt to provide a bigger picture of the very diverse, detailed and highly multidisciplinary research in this area. Based on diversely selected research, this paper explains the initiatives for automation in different levels of transportation system with a specific emphasis on the vehicle-level automation. Human factor studies and legal issues are analyzed as well as control algorithms. Drivers' comfort and well-being, increased safety, and increased highway capacity are among the most important initiatives counted for automation. However, sometimes these are contradictory requirements. Relying on an analytical survey of the published research, we will try to provide a more clear understanding of the impact of automation/warning systems on each of the above-mentioned factors. The discussion of sensory issues requires a dedicated paper due to its broad range and is not addressed in this paper.

***Key Word* - Smart parking, Magnetic sensors, forward-looking sensors, Automatic control**

I. INTRODUCTION

Vehicle and highway automation is believed to reduce the risk of accidents, improve safety, increase capacity, reduce fuel consumption and enhance overall comfort and performance for drivers. There has been enough reason to assume that more automated automobiles relieve the driver from many undesirable routines of driving task. It has also been known that many of the car accidents are due to human errors. Therefore, the conclusion has been that with a robust automated system the chance of car accidents can be reduced. With the overwhelming increase in the number of vehicles on the road another concern has been road capacity. Some kind of automation that would help to safely increase traffic flow has been considered as one potential solution to Congested Highways a smoother cruise with an automated system can reduce fuel consumption and engine wear.

The potential of connected, smart roads is huge. Not only will they keep us safe by regulating the speed of our vehicles and implementing warning systems, but also transmit real time data and share information across the network, making it simpler and quicker to get around, to find parking, to commute effectively and communicate with each other.

TECHNOLOGY

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Automated highway systems combine magnetic sensors, computers, digital radio, forward-looking sensors, video cameras, and display technologies. Various combinations of these technologies are being applied in different pilot tests:
Magnetic sensors: Magnetic sensors could be imbedded along the highway lanes. Magnetometers under the car's bumpers would sense the magnets and automatically keep the cars in the center of the lane.
Networked Computers: The system would not rely on a central computer to direct the movement of all vehicles. Rather, networks of small computers would be installed in vehicles and along the sides of roadways to coordinate the flow of traffic.
Digital radio: Digital radio equipment in each car would allow the computer on board to Communicate with other vehicles in the vicinity and with supervisory computers monitoring the roadway.
Forward-looking sensors: Using radar or an infrared laser, these sensors would detect dangerous obstacles and other vehicles ahead.
Video cameras: Linked to computers that process images rapidly, video cameras could detect dangerous obstacles and other vehicles ahead. They could also be used along with or instead of magnets to track lane boundaries.
Visual Displays: Mounted on the dashboard or projected onto the windshield, it would give the driver information about the operation of the vehicle.

ENABLING TECHNOLOGIES

Some technical issues regarding communication between sensor nodes still have to be resolved. In the context of the Internet of Things (IoT), the communication between sensors nodes has to be wireless, as cabling costs for millions of sensors is impractical and extremely expensive. Low power communication standards, suitable for an extremely large number of devices and their heterogeneity, are necessary. In particular, depending on location and necessary coverage, there are a number of different networks in smart cities. Depending on location and coverage, these can be classified as:-

Home Area Networks: These typically use short range standards, with operating frequencies in the ISM bands. Standards include ZigBee, Dash7 and Wi-Fi (802.11 g/n), or wired standards such as Ethernet. All the monitoring and control system's components in a home are connected by the HAN.

Wide Area Networks: These provide for communication between utilities and customers' premises, which requires a much broader coverage than HANs, with infrastructure such as leased lines based on optic fiber or broadband wireless, e.g., 3G and LTE, and managed by service providers.

Field Area Networks: Typically used in a smart grid to connect customers' premises to substations.

- Zigbee
- Dash7
- 3G And LTE
- RFID and NEF
    - *Smart energy metering*
    - *Data acquisition and control*
    - *City touristic surfing*
    - *Smart car parks*

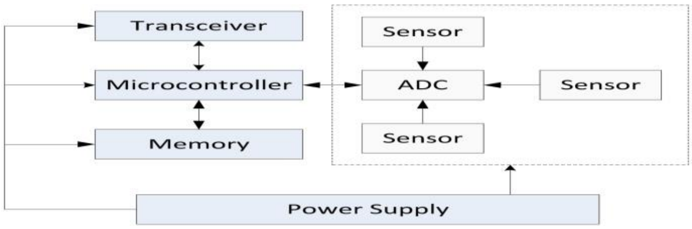
SENSING PLATFORMS

With the advent of ubiquitous sensing, various devices and platforms are currently available for this purpose. Although ideas to implement these platforms have been around for decades, only recently have these systems been feasible from a cost perspective, driven by reduced manufacturing costs as well as low-cost electronic components such as radio transceivers, microcontrollers, microprocessors and sensors. Sourcing these components in bulk becomes increasingly less expensive as technology progresses.

Sensor nodes can be interfaced to a number of sensors. The most common include humidity, light and temperatures sensors. These platforms are built in such a way that the sensed data is collected by the sensors, sometimes pre-processed, and then transmitted to a sink node via other sensor nodes; hence they are usually set up in a network, also known as a wireless sensor network (WSN).

WIRELESS SENSOR NETWORKS

Wireless sensor networks consist of wireless sensor nodes, which are devices equipped with a processor, a radio interface, an analog-to-digital converter, multiple sensors, memory and a power supply. The general architecture of a wireless sensor node is illustrated



ENERGY HARVESTING

Wireless sensor networks are characterized by severe resource constraints, one of which is the reliance on battery life. With the deployment of sensor nodes in very large numbers in smart cities, it is infeasible to replace or recharge batteries in these devices. Creating energy efficient solutions from protocol design to sophisticated power management schemes are efficient and necessary methods, but not sufficient. A popular way of supplementing power includes solar panels, but sunlight is not always available and it is not the most cost effective solution. The harvesting of energy from alternative sources in the environment is actively being researched and developed. Examples of these energy sources include thermal, light (solar), wind, mechanical (vibration) and many others. However, efficient ways of capturing this energy are vital, as the energy from these sources is usually available in extremely small quantities.

Methods of energy harvesting, in the context of smart cities include:

- Wind energy
- RF energy
- Electric field
- Vibration and movement
- Light and thermal sources
- Piezo-electric harvesters in bridge and highway

INTELLIGENT TRANSPORTATION SYSTEMS

Intelligent transportation systems usually refers to the use of information and communication technologies (rather than innovations in the construction of the roadway) in the field of road transport, including infrastructure, vehicles and users, and in traffic management and mobility management, as well as for interfaces with other modes of transport.

Despite new innovations being injected into energy-efficient cars, the same doesn't seem to apply for the roads they drive on. But this looks all set to change with smart technologies signaling the roads of our future will look very different.

From solar powered roads and law enforcement drones to glow-in-the-dark motorways; we explore the ways in which technology might change our roads in years to come.

SOLAR ROADS

The Solar Roadways Project is on a mission to replace concrete surfaces like standard asphalt roads with panels fitted with photovoltaic cells to generate and store electricity.

The panels could be mistaken for a light-up dance floor with over 300 flashing LEDs but are in fact solar-powered panels. The hexagonal-shaped panels contain tempered glass, microprocessors, snow-melting heating devices and inductive charging capability for electric vehicles when driving.

SELF-HEALING CONCRETE ROADS

Trials are being undertaken at three UK universities to create self-healing concrete technologies that allow roads to autonomously repair themselves without the need for human intervention.

The University of Bath, Cardiff University and the University of Cambridge are all testing ways to produce self-healing concrete that uses bacteria to seal cracks once damage or decay is detected.

At present, billions are being spent in the UK each year to maintain and restore concrete structures including bridges, roads and tunnels. Extending the lifetime of such structures will reduce the astronomical preservation costs and lead to a significant environmental impact.

ELECTRIC CHARGING STATIONS

Imagine not needing to make an inconvenient pit stop to charge your car on a long journey? For drivers of electric vehicles (EV), this dream might soon be recognized. The introduction of an Electric Priority Lane would use embedded magnetic fields for EV users to charge their car on the go.

Trials conducted in the UK fitted electric cables under the road surface to generate electromagnetic fields picked up by a coil inside the device, which later converts into electricity. It is hoped this will increase the variety of electric vehicles taking to the roads.

ROAD POLICE DRONES

Cornwall and Devon police force – who cover the largest geographical zone of any force in England - announced the recruitment of a ‘drone manager’ to lead a dedicated unit fighting crime with airborne devices.

The move from Cornwall and Devon’s police force marks a radical shift in how Britain is opting to police its streets. While privacy and police cuts are a concerning by-product, using drones as a policing tool helps officers to combat crime and improve road safety much faster.

Offering a cheaper alternative to helicopters, there’s a high chance other police departments will exploit drones for tasks like searching for missing people, hunting down suspects and responding to road accidents.

WEATHER AND TRAFFIC DETECTION

Fast forward ten years, intelligent highways are expected to significantly reduce road deaths and make driving more energy efficient. In a way, these smart roads act as an alternative energy source to decrease unnecessary fuel waste caused by traffic delays.

But what exactly is an intelligent highway? Essentially, it’s a world where roadside ‘listening stations’ link up with vehicles’ GPS receivers to monitor any traffic issues. Drivers can then use this data to avoid congested areas and road accidents.

Another Smart Highway Project curated by Construction Company Heymans and design firm Studio Roosegaarde pilots glow-in-the-dark road markings. Trialed in the Netherlands, illuminated paint is charged by solar energy during the day and glows up for ten hours in the dark. Interactive technology of this kind would aid better visibility and safety for night-time drivers.

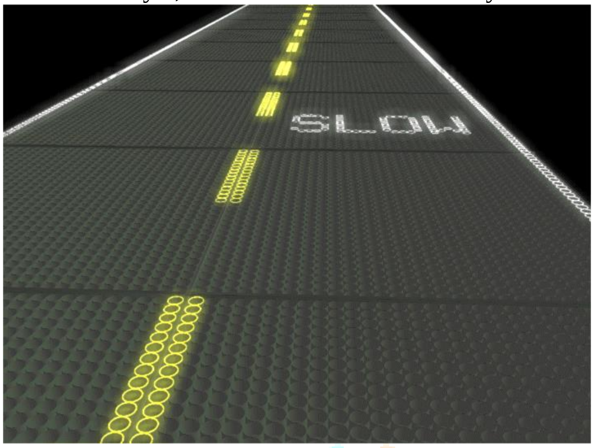
Opportunities, problems and prospects

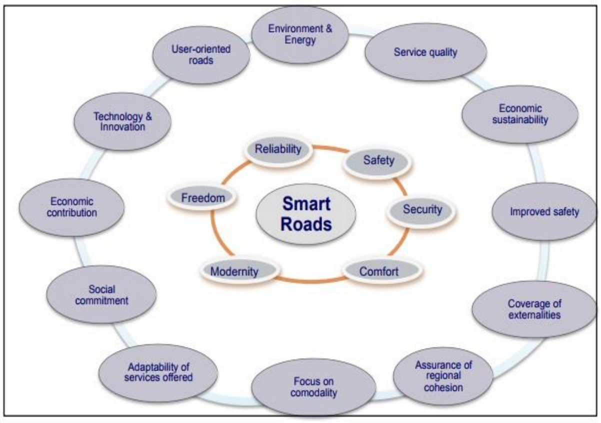
Human error accounts for 90% of traffic accidents. Automated highway systems may make our roads safer by substituting for or complementing human judgment. It could also cut down on congestion and reduce commuting times.

Yet this system also brings with it potential problems, including the fear of drivers at having to give up their individual freedom. Another criticism is could have the unintended consequence of placing more single-occupancy vehicles on the road, and thus increasing pollution Finally, it raises questions about liability and whether it would shift from the individual driver to the auto company, traffic-control center, or another entity as responsibilities for accidents might become blurred.

SMART PAVEMENT

The Missouri Department of Transportation (MoDOT) began testing out “smart pavement” at a rest stop outside of Conway, Missouri along historic Route 66 late in 2016. The pilot program currently covers about 200 square feet of sidewalk at the visitor center and cost $100,000 (Landers), largely subsidized by the Federal Highway Administration. It's all part of Missouri's Road to Tomorrow initiative to find new innovations in their transportation infrastructure. Missouri wants to take advantage of these roadways to implement other, related technologies. The panels will heat the road and keep snow and ice from accumulating. They will also feature LED diodes that will increase the visibility of road lines. The LEDs would also double in helping prevent paint from inhibiting solar power generation. The panels have not had enough time to determine durability, energy efficiency, or cost effectiveness in a real world sense yet, so MoDOT has not reach any conclusions about feasibility and future application yet.





VISUALISING THE SMART ROADS

LIQUID PRESENCE OVER PAVEMENT

Snow and ice control material rate guideline are presented. These application rates are based upon results of their minters of field testing various strategy/tactic combinations by 24 highways agencies. The recommended rates apply to both state and streets. Appropriate engaged in snow and ice control operations on highways.

Use in a smart security and liquid presence sensor.

- Smart agriculture
- Smart ambient
- Smart security

Include humidity and temperature
Sensors which can used for ice
Generation prediction

Fig. flooding point monitoring

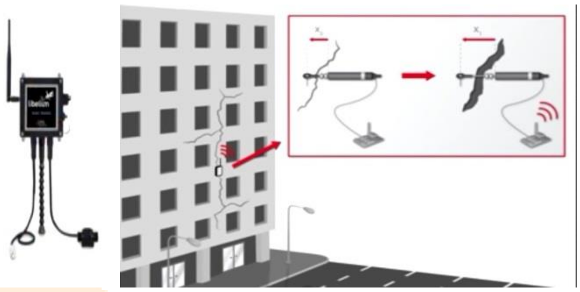
WEATHER MONITORING AT RISKY POINTS

- Smart Agriculture
  - Include a low-cost weather station:
    - Pluviometer
    - Vane sensor
    - Anemometer
    - Temperature + Humidity

- Weather station:
  - Rainfall
  - Temperature + Humidity
  - Wind speed and direction

STRUCTURAL CRACK MONITORING

- ➢ Smart cities
    - Linear displacement sensor to control structural cracks.

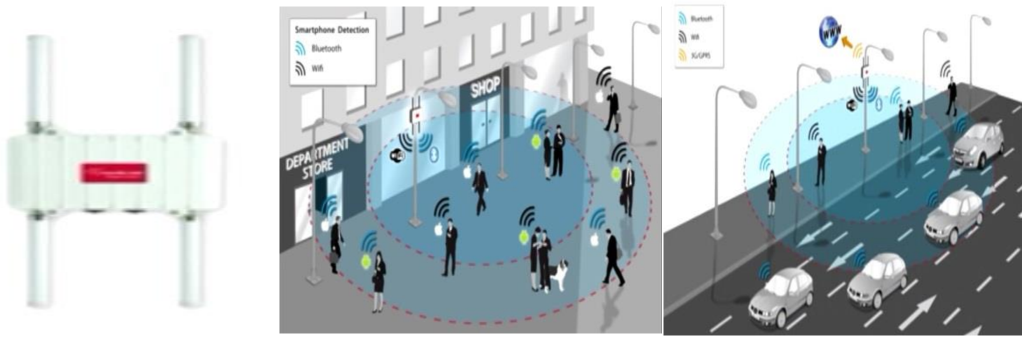


VEHICLE DETECTION

- ➢ Smart parking
    - o Magnetic field sensor
    - o Vehicle detection for parking slots
    - o Traffic jam detection
    - o Robust enclosure: IK10, IP-67
    - o PVC material so as not to cause interferences

VEHICLES AND PEDESTRAIN DETCTION

- ➢ Meshlium scanner
    - o Used for real-time traffic and pedestrian estimation



CONCLUSION

His role of advanced sensing in smart road was discussed. Arrays of applications in smart road which can benefit from advanced sensing were described. These include infrastructure health monitoring, electricity and water distribution systems, transportation systems and surveillance, amongst others. The state of the art in each of the considered applications is reviewed and inherent challenges are highlighted. In a world where carbon emissions have to be reduced for greener living and sustainability is promoted, there are a still many challenges to be resolved.

It is evident that the evolution of technology will play a major role in advanced sensing, as the evolution of hardware required for sensing applications will certainly be driven by these technological advances. Even though there are pilot projects for smart road, there are various challenges. These challenges require a holistic approach for solving, which will involve multi-disciplinary collaborations. For instance, standardization efforts should consider all involved parties, such as municipalities, utilities and other services providers so that unified solutions in terms of sensing and communication infrastructures are put in place. It will be inefficient to have separate infrastructures (in terms of sensing platforms), but it will also be challenging to unify these services under a single infrastructure

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