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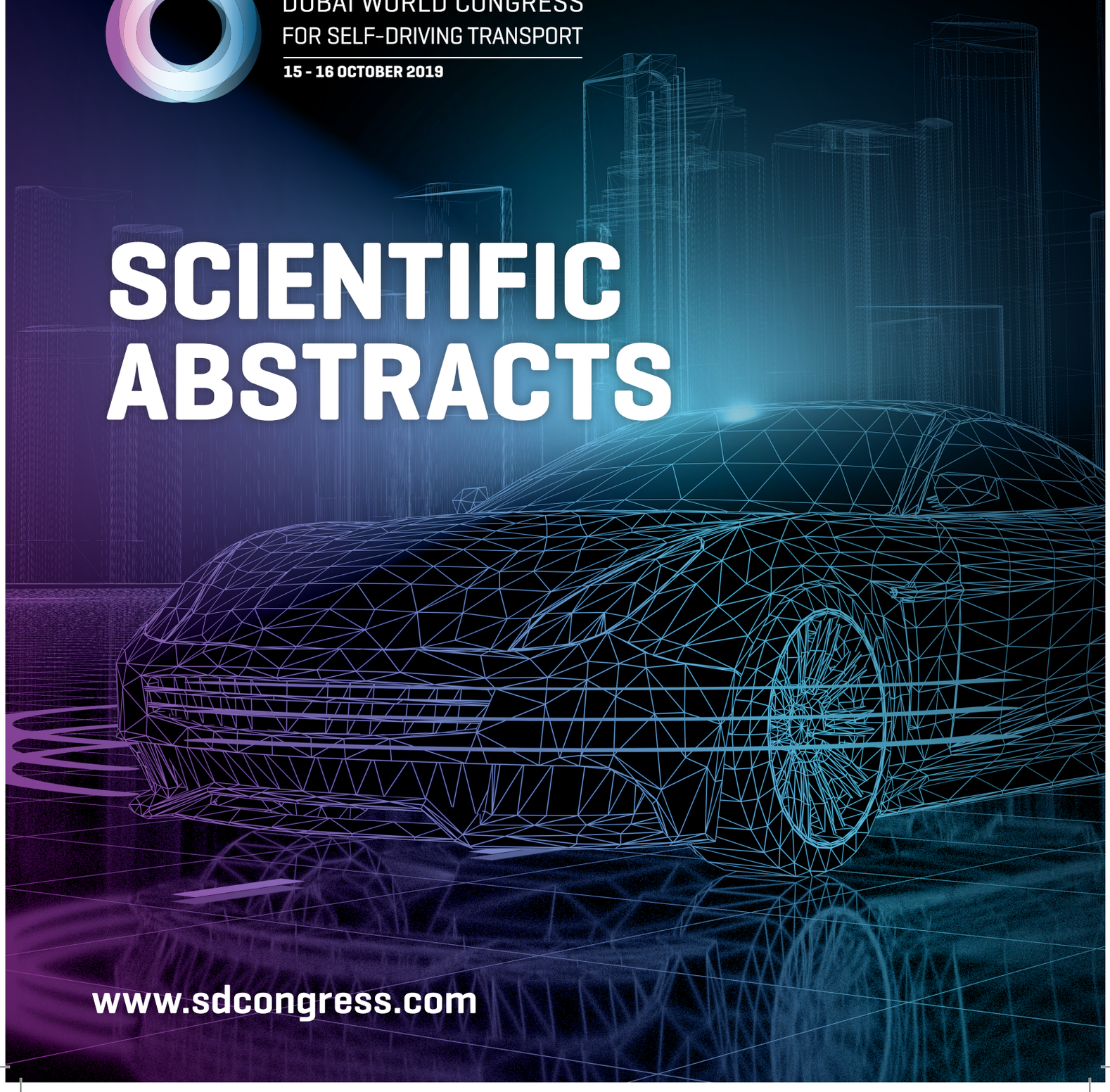
DUBAI WORLD CONGRESS
FOR SELF-DRIVING TRANSPORT

15 - 16 OCTOBER 2019

SCIENTIFIC ABSTRACTS



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Passenger-Centric Experience in Smart Mobility

Authors:
Samar AbdelFattah, Omnya ElFeki, Nadia AbdelSalam, Alaa Khamis

Abstract:
Smart mobility is a disruptive mobility technology that aims at providing safer, greener, and more efficient mobility modes. This revolutionary technology is built on the following principles: flexibility, efficiency, integration, clean technology and safety. The ultimate goal of smart mobility is Zero Crashes, Zero Emission, Zero Congestion and Zero Ownership. For example, one of the main aspects of smart mobility is to promote mobility as a service (MaaS). As defined by MaaS America, MaaS is "the delivery, through an integrated digital platform and across all available modes of transport, of seamless, infinitely adaptable, personal mobility services." MaaS will eventually make the need for personal car ownership obsolete by offering better, more affordable and customer-centric shared and on-demand transportation services and experience. The human element is something that has been neglected over the past two generations, because the main focus was on technology-centered strategies. However, the shifting between ownership models and/or user ship models will require major involvement from human-centered design development that helps plan a smarter infrastructure to create a somewhat idealistic smart environment. The smart mobility systems include but are not limited to autonomous buses, self-driving cars, unmanned flying vehicles, smart bikes, Hyperloop and so many more. This is exactly where human-centered design development comes in, to ensure the feasibility of the technological advancements on complex mobility systems and their desire by the passengers.

Understanding how levels of satisfaction differ across transportation modes can be helpful in order to assess the gap between the passenger's needs/expectations and the provided service. The factors influencing the satisfaction level can be either external or internal factors such as personal preferences, mode preferences, or confined by characteristics of the travel journey such as long distance.

Keywords:
Mobility, Passenger-Centered Design, Influence Factors, Tech-Integration, Smart Mobility, Experience Anatomy, Quality of Experience, AI, IoT, VR, AR

A Cybersecurity Protection Framework to Support Dubai's Self-Driving Transport Strategy

Author:
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Abstract:
Three main elements (process, risk management, and controls) of a cybersecurity protection framework for the Dubai self-driving transport strategy are discussed. Novel threats as a result of using RF (radio frequency) and self-driving technologies such as radars that correspond to the risk management element are identified and discussed. Novel threats that arise as a result of using self-driving vehicle technologies include attacking the computing system, attacking the power sub-systems, attacking the new in-vehicle networks (e.g., automotive Ethernet based network architectures), attacking the perception system (Cameras, Lidar, Radar, IMU, GPS, etc.). The following types of RF attacks are also
discussed, jamming, replay attacks, evil-twin attack, wardriving, and sniffing. In addition, the following vulnerabilities involving the Internet of Radio (IoR) technologies are also discussed: rogue cell towers, rogue Wi-Fi hotspot, vulnerable wireless devices, eavesdropping/surveillance devices, and unapproved IoT emitters. Finally, the role of SDRs (software defined radios) for penetration testing and monitoring wireless communication systems during attacks including intrusion detection systems and incident response are analyzed. Some cybersecurity recommendations for Dubai's self-driving transport strategy
are formulated.

Key Words:
Automotive cybersecurity, self-driving vehicle cybersecurity, protection framework, threats, radio frequency threats, self-driving vehicle threats, intelligent transportation, smart city infrastructure, transport strategy

Identifying the Key Safety Benefits of Autonomous Taxi by Analysing the Human Factors that Increase the Likelihood of Traffic Collision for the Taxi Industry

Authors:
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Prof. Bassam Abu-Hijleh, Dean of Engineering & IT, The British University in Dubai

Abstract:
Autonomous Driving systems are expected to support solving various traffic concerns and reducing traffic collisions is one of the primary anticipated benefits. The United Arab Emirates is one of the leading nations in the future transport solutions and the Emirate of Dubai has announced a road map to operate 25% of the total trips without a driver by year 2030 . The first phase of the non-driver trips will be on autonomous taxi (Dubai Future Foundation, 2018). The roles and the responsibilities of a taxi driver might exposed him to stress, distraction and fatigue more than the average driver which has significant impact on the high number of accidents for taxi drivers. Those factors may affect the risk tolerance and the risk perception for a taxi driver. The study includes literatures related to social, health, demographic and external factors that could relevant to the likelihood of causing accident for taxi drivers and focuses on the additional difficulties that the taxi drivers face in comparison to other drivers. The research aim at analysing the key benefits of deploying autonomous taxi for traffic collision avoidance by studying the human factors that affect and are responsible for traffic accidents and assuming that these issues will be solved after the autonomous driving system takes over.

This research studied the significance of the human factor on the traffic accidents of taxi drivers in the emirate of Dubai by examining the impact of different variables on accidents. The research analyzed the variables that are related to the human factors that increases the probability of traffic collision. The outcome of the statistical analysis indicated that the human factor is causing many taxi traffic accidents due to factors such as drivers age, experience and drive duration. Out of 10 reasons for causing the traffic collisions, the traffic collisions occurred due to not keeping, not keeping in line and careless driving behavior accounted for 76% of traffic accidents and these reasons could be linked to human factor.

Keywords:
Human Factor, Autonomous Cars, Taxi Drivers, Safety, Traffic Collision, Statistical Analysis

Intelligent Systems Lab Automated Electric Vehicle

Authors:
Ahmed Hussein, Pablo Marin, Abdulla Al-Kaff, Fernando Garcia

Abstract:
The technological advances in the Intelligent Transportation Systems (ITS) are exponentially improving over the last century. The objective is to provide intelligent and innovative services for the different modes of transportation, towards a better, safer, coordinated and smarter transport networks. The Intelligent Transportation Systems (ITS) focus is divided into two main categories;
the first is to improve existing components of the transport networks, while the second is to develop intelligent vehicles which facilitate the transportation process. Different research efforts have been exerted to tackle various aspects in the fields of the automated vehicles. Accordingly, this article is addressing the problem of multiple automated vehicles cooperation and coordination.

The proposed solution is focused on the development of the iCab platforms, which is an abbreviation for "Intelligent Campus Automobile". The platforms are two electric golf-carts that were modified mechanically, electronically and electrically towards the goal of automated driving. Each iCab was equipped with several on-board embedded computers, perception sensors and auxiliary devices, in order to execute the necessary actions for self-driving. Moreover, the platforms are capable of several Vehicle-to-Everything (V2X) communication schemes, applying three layers of control, utilizing cooperation architecture for platooning, executing localization systems, mapping systems, perception systems, and finally several planning systems. Hundreds of experiments were carried-out for the validation of each system in the iCab platform. Results proved the functionality of the platform to self-drive from one point to another with minimal human intervention.

Keywords:
Automated Vehicle, ROS-based, Software Architecture, Planning; Localization, Mapping, Sensor Fusion

Quo Vadis: Policy Governance and Infrastructure Investment in the Era of Multimodal Self-driving Transport

Author:
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Abstract:
Infrastructure investment is a common scheme to boost economic productivity and carrying it out involves a multilateral decision. In the realm of infrastructure investment, what are the critical roles the policy-makers and legislative-enablers should take? What scale and magnitude of investment are enough to ensure the intended outcome? Is there an interrelation or a contradiction between investing in different asset classes? What are the corresponding measures to avoid the likelihood of investment offset? How could policy governance, legislative structure, and managerial strategy maximize the synergistic value among investment returns and positive spillovers to further empower a nation's long-term competitiveness? Cities around the globe are either in the transition stage of repositioning their long-term competitiveness or in the development stage of large-scale metropolitan planning. Within the governmental leadership, decisions have been found in these two settings: the outstanding commitments on the modernization of efficient infrastructure systems and the transformative mindset to recapitalize city's assets: both developable and underutilized lands. This article presents a surgical diagnosis of investment decision-making in the scope of multimodal self-driving transport (SDT) and examines the economic growth driven by the process of policy formation and managerial strategy toward city development. First, prior to the fund allocation, the prerequisite is to decide what kind of city do people want? Cities built around transit, as an example, would look and operate drastically different from cities built around cars. The interrelation between self-driving transit and cars and the corresponding investment activities is well articulated. Second, investment decisions need to differentiate between the intended outcomes generated by investing in value-creating vs. value-destroying projects. Third, the review of cities' transformational experiences offers common mistakes and meaningful lessons to shape a better future outcome.

Key Words:
Infrastructure Investment, Policy Governance, Legislative Consistency, Managerial Strategy and Growth on Value Creation, Liveable Cities

An Inside Look into the Purchasing Cycle of Electric Vehicles in the GCC

Author:
Jorge Bialade, General Manager, YallaMotor

Abstract:
With the introduction of electric vehicles and new technologies, the automotive industry is going through tremendous changes globally. Historically, and due to the affordable price of petrol, the Middle East's automotive industry is well known as a gasoline driven one. That being said, over the last couple of years and with the introduction of EVs in the region, there have been initiatives from private and public sectors to catch up with the international trend towards building a more sustainable future by reducing carbon emissions from vehicles.

Altering the status quo is never an easy task and requires the support of every stakeholder to have a better understanding of the situation. From our perspective, we understand Electric Vehicles have different selling points as compared to internal combustion engine (ICE) vehicles, hence the car buyer purchase phases are different too. With the United Arab Emirates leading this change in the Middle East, the region aims to promote and generate more awareness on this front. However, car buyers are facing different challenges that must be tackled in order to accelerate the adoption of electric vehicles.

YallaMotor survey aimed to throw more light on the pain points that potential buyers are faced with when purchasing an Electric Vehicle . The following results have the purpose of validating current assumptions but also finding new areas to tackle in order to facilitate the promotion of EVs on the road .

At this stage and with more electric vehicles set to make their way onto streets by the end of 2019, we aim to make this information accessible to everyone. As the largest automotive platform in the region, we firmly believe that we have the responsibility to share this information with all stakeholders in order to build and open more discussions that effectively will help the automotive industry to overcome challenges towards building a more sustainable future with more electric vehicles on the roads of the GCC.

Testing and Validating Autonomous Vehicles using PTV Vissim Traffic Simulator with a Case Study on Dubai's Road Network

Authors:
Dr. Jochen Lohmiller, Manager Microscopic Simulation, PTV Group
Hussein Falih, Transport Modeller, Project Management & Services, PTV Group

Abstract:
One public test area for self-driving vehicles in Germany is in the city of Karlsruhe (https://taf-bw.de/en/). But before testing self-driving vehicles in real world, virtual testing of those test areas accelerates the development. For such virtual tests, dedicated simulation tools are required for the different stages of development and validation. Up to today, the simulations mostly addresses the internal systems of a vehicle plus sensor simulations to detect the environment. The simulation often does not take traffic situations into account. This can be overcome by using traffic simulation. Advanced traffic simulation models simulate all modes of transport, such as individual human drivers, cyclists, pedestrians and different other connected and autonomous (CAV) behavior, which allows testing under different vehicle/driver populations.

The case study shows an impact of CAV on a section of Dubai road network. Vissim model were built for the base scenario where only conventional cars are used. Then, applying various penetration rates of AV/CAV to observe the impact on the average network delay. Two scenarios were used during the simulation. The first one uses only AVs, where the second scenarios uses the same percentages of AVs but with active platooning.

Keywords:
Co-Simulation, Autonomous Vehicles (AVs), Connected Autonomous Vehicles (CAV), PTV Vissim, CoEXist, Driving Behavior

Connected Services and User Experience in Premium Vehicles

Author:
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Abstract:
The role of technology has considerably broadened how cars of today are conceptualised, designed and manufactured. The role of the engineer in these processes has evolved too.

The most visible advancement in recent times, arguably, for drivers and users of mobility has been in the area of sensing – be it interior occupant comfort or exterior environment tracking, control devices – be it high performance Systems-on-Chips or redundant resilient systems, and graphical displays – be it screens for advanced driver assistance or entertainment and productivity enhancement. These technologies help cars on their journey to be more modern, more efficient, safer and more user-friendly.

One of the advancements that has not been visible in plain sight is connectivity. Connectivity in a car is now considered table stakes. High performance and premium vehicles and their users have a different set of requirements from connected services compared to a shared mobility vehicle or a commuter friendly car. Use cases are oriented more towards enhancement and optimisation of performance and comfort features rather than cost and utility. Priorities are oriented more towards privacy and security than availability and cross-compatibility.

This talk focuses on the confluence of state-of-the-art car interiors with cockpit control systems and connected services that the vehicle and its users demand. Various technologies onboard the vehicle and online in the cloud enable their presence and this paper and talk will attempt to provide an overview.

Key Words:
Infotainment System, Cockpit Control System, Domain Control System, UX, User Experience, UI, User Interface, HMI, Human Machine Interface, Sports car, Premium vehicle, Connected Services, Connected Car, Virtual Car, Vehicle Shadow, Privacy, Security, IoT, Internet of Things, AI, Artificial Intelligence, ML, Machine Learning, Data Analytics, Back-end Services, App, API Integration

Measuring Vehicle Intelligence in Human Transport: What Is Your Car's IQ?

Authors:
Dan Baxter, PE, ITS Roads & Vehicles Practice Lead, Stantec Consulting Services
Samaneh Khazraeian, PhD, PE, ITS Analyst, Stantec Consulting Services

Abstract:
A method of measuring and comparing vehicle intelligence of connected automated vehicles (CAV) technology in a proving ground setting will provide an expedient and effective path toward safe operation of CAV on public highways. As software interfaces with the engine control unit, and the ECU can communicate to other vehicles, the cloud, and the infrastructure, how much can the human occupant trust the car to make good decisions, operate safely and exhibit resilient behavior during challenges? Resilience engineering applied to CAV seeks to establish a measurable safe response of a CAV to an operational challenge, detection of the challenge, avoidance of a potential crash or operational failure, and recovery of safe operation. A highly resilient CAV will respond to challenges and return to normal operation elegantly. The resilience testing paradigm applied within a public sector (government) established proving ground will provide a supporting methodology for voluntary or regulatory testing of CAV capabilities. In the United States, regulation is routinely the role of local, state and federal government agencies. This paper is not a synthesis of CAV regulation, it assumes that safety regulations will exist as a patchwork across multiple agencies across many political boundaries, and that some countries will regulate CAV operation and others will not. This paper, as a part of a project sponsored by Stantec, proposes a Multi-Criteria Decision Analysis (MCDA) along with an "oppositional resilience strategy" to develop an "automotive intelligence quotient" or "Automotive IQ (AIQ)." The AIQ number on the consumer facing window sticker will provide consumers with a comparative quantified indicator of the degree to which the vehicle can drive itself. Different alternatives (vehicle) are compared against some criteria defined as a part of this paper and a numeric value is assigned to their intelligence using the MCDA method through an oppositional strategy. In the oppositional strategy, a technology application is brought to the proving ground by a private sector "for profit" entity. The proving ground owner designs tests to determine the point at which the technology application becomes unsafe. The technology owner performs the tests, with the proving ground owner as an observer. Operational resilience of the technology application will be observed and rated numerically, not unlike the safety ratings applied today to crash testing.

Key Words:
Connected Automated Vehicles, Testing, Intelligence Quotient (IQ), Ranking, MCDA

Autonomous Robot Guide based on the Loomo Mini Personal Transporter

Authors:
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Abstract:
This paper presents recent work done at the American University of Sharjah in collaboration with the Road Transport Authority of Dubai on the development of personal autonomous modes of transport that could address various transportation related issues such as availability, traffic, pollution, energy, and climate. We have built a robot guide prototype based on the Loomo platform, which can either be operated manually by the user or autonomously navigate to a user's location, a designated destination, or its home base. Built-in robot capabilities were extended with mapping, localization, and routing services. The map of the environment and the location of the robot are updated dynamically based on readings from on-board ultrasonic sensors and signals received from BLE beacons placed within its surroundings. Suitable routes are computed in real-time while obstacles are actively detected and avoided. Users are provided with a mobile application that allows calling a robot for assistance, specifying a destination, taking control of the robot for personal ride mode, and dismissing it afterward. Users can also interact with the robot, through the speech recognition module, and conversely the robot can provide oral feedback about its location and status. A scalable system architecture was designed using server and broker to serve many users and employ multiple robots, as may be required depending on the usage scenario. The current prototype has been demonstrated to guide visitors within the AUS engineering building. This is a work in progress as many issues remain to be addressed, such as achieving simultaneous localization and mapping and better obstacle avoidance. Also, limitations inherent to the Loomo robot currently prevent outdoor use or computer-controlled ride mode. Nevertheless, the modular system architecture as well as the localization and navigation services currently developed could be extended to a full personal taxi robot, by using a different robot platform.

Key Words:
Robot Guide, Personal Transportation Robot, Autonomous Navigation, Obstacle Avoidance, Mapping, Indoor Localization, BLE Beacons

Re-Imagining Dubai Downtown Architecture in the Autonomous Vehicles Era

Author:
Dr. Dalia Hafiz, Assistant Professor, Al-Ghurair University

Abstract:
The adoption of self-driving technology will likely birth new cities typologies with unique buildings and needs. Starting from centralized hubs where the cars park themselves to less congestions and empty parking lots and Autonomous Vehicles (AVs) repair shops. Although such technology can be a great tool and facilitate the passengers movement and minimize travel time, careful implementation to city configuration and urban planning is needed when applied. Priority should be given to people and places to minimize all possible undesirable effects such technologies might cause. Consideration should be given to pedestrians, cyclist and walkability in the city.

Dubai is committed to implementing smart and self-driving transport through the Vision of His Highness Sheikh Mohammed bin Rashid Al Maktoum, Vice President and Prime Minister of the UAE and Ruler of Dubai, as well as the Strategy of Dubai's Roads and Transport Authority (RTA). This paper aims at examining possible design configurations in the new and smart cities with Autonomous and connected vehicles to maintain safety, sustainability and walkability in the city while implementing such technologies.

Key Words:
Self-Driving Vehicles, Autonomous Vehicles, Smart Cities, New Cities

Self-Driving Technology is Ready Now, But How Do People and Communities Prepare?

Authors:
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Abstract:
Autonomous technologies will be transformative in their power to change the daily life of billions of people, especially the organization, form and costs of mobility. To date, attention has focused on perfecting the technology of autonomous mobility, yet the success of these technologies also depends on adoption, diffusion and social attitudes. Our experience with new technologies is that the social context is a complex domain with many conflicting interests and goals. As self-driving vehicles are introduced their success will depend on the response from individuals, communities and institutions.

It is essential that we start now to address the future social context of autonomous technologies. Engineering advances rely on fast moving intensive teams working across universities and corporations. The teams advancing AVs have deep professional knowledge and experience, as do the specialized government agencies funding, monitoring and developing guidelines for AV introduction. In contrast, the social environment into which AVs appear comprise a wide range of experience and interest in the new technology.

Our communities do not have the experience held by AV development teams and are now only seeing AVs for the first time. Social awareness and acceptance depend on experience and familiarity over many years, as well as a planning, legal and political environment that recognizes and manages change. The development of safe and reliable autonomous vehicles is just one part of the partnership necessary for adoption and use. The second part of the formula is the public domain of transport regulation and management, along with social acceptance.

In order to facilitate planning for cities and communities around autonomous vehicles we seek knowledge about how communities will greet autonomous mobilities when they arrive. As part of this process, we have surveyed residents of the US state of Michigan to learn about their interests and expectations. This paper will first address the social context of disruptive technologies, then discuss public attitudes to AVs, and conclude with analysis of the potential urban implications.

Preparing Dubai and the UAE's Road Infrastructure for Autonomous and Self Driving Transport

Author:
Scott Fennelly, Director of ITS and Transportation, Surface Mobility Consultants

Abstract:

The role of infrastructure within a city's readiness for Autonomous Vehicles is one of the main criteria that needs to be addressed to ensure that Dubai and the UAE becomes a world leader in Autonomous and Self Driving Transport.

Autonomous driving infrastructure is all about connectivity, and the changes required will need cities to examine the readiness of their current and proposed fibre optic and sensor networks, IoT devices, and facilities for Wi-Fi, as well as emerging communications technologies such as 5G. This paper provides an overview of the infrastructure changes that will need to take place to ensure the viability of operating AVs on the entire UAE road network. The paper focuses on road side sensor requirements and future design requirements to allow vehicles to detect dangerous or unexpected situations, the future of machine readable road signage, the future of road markings and requirements for AVs, and establishment of electric vehicle infrastructure to support an increase in autonomous transport on our road network, as well as the requirements for the incorporation of traffic signal information and optimisation (including the possibility of their removal in the future), and smart parking within the AV environment.

The current and future infrastructure requirements necessary to ensure the entire road network is viable for autonomous vehicles calls for the attention of all transportation authorities, planning disciplines (urban planners, city planners, transport planners), engineers from a wide range of disciplines, OEM's and policy makers. All must understand how the shift to autonomous transport will affect current infrastructure and how it should be reflected in our infrastructure designs now and in the future.

Keywords:
Autonomous Vehicles, Self-Driving Transport, V2X, V2I, Smart Infrastructure, Connected Vehicles, Preparing Dubai's Road Infrastructure for Autonomous and Self Driving Transport

Traffic in Co-Simulation as a Standard Toolchain for Automotive Development

Authors:
Marilo Martin-Gasulla, Thomas Benz, Dr. Dario Menichetti

Abstract:
Advanced vehicle functions need to handle more scenarios on a public road the more advanced they are. This involves extensive testing and complex validation of such systems consisting of an array of different sensors, a chain of controllers and actuators. Therefore, dedicated simulation tools are required for the different domains and stages of development and validation. Ideally, such simulation tools are combined into co-simulations.

Up to now simulations mostly recreate the internal systems of a vehicle. The environment, like streets, traffic signs and other traffic participants are combined to form a specific scenario for testing. Such combinations are innumerable and the set-up for the simulation is left to the user's fantasy. This can now be overcome by using a dedicated tool for generating realistic traffic input: traffic flow simulation. Such a traffic flow simulation creates a multitude of scenarios by generating the movements of other traffic participants.

This presentation will introduce the methodology and present implemented co-simulations.

Keywords
Co-simulation, Traffic Simulation, PTV Vissim, validation

Integrating and Validating Vehicle-to-Vehicle Communication for Safety Applications

Authors:
Ali, Mahdi Mahmud, Syed Javaid, Bilal

Abstract:
One of the latest developments in the connected vehicle technologies is vehicle-to-vehicle (V2V) communication using Dedicated Short Range Communication (DSRC) protocol, which operates in the 5.9GHz wireless band. In the V2V communication, each vehicle continually transmits Basic Safety Messages (BSM). In this paper, the performance of V2V safety applications such as Forward Collision Warning (FCW) Emergency Electronic Brake Lights (EEBL), Left Turn Assist (LTA), and Intersection Movement Assist (IMA) are demonstrated based on a prototype V2V systems that were integrated into 2 HMG vehicles . Displays, based on Android operating system, have been built in both vehicles to display warnings to inform drivers of potential threats. Test results show that the V2V safety applications have been demonstrated successfully in real-world environment.

Key Words:
Vehicle to Vehicle Communication, Basic Safety Messages, Safety Applications, DSRC

Connected Car Requires Agile Connectivity to Spur Innovation and Flexibility

Author:
Krish Inbarajan

Abstract:
Until 1995, cars were not connected to the wireless world for several reasons. But advent of lower cost of cellular connectivity, antennas, Network Access Device, IT infrastructure, and other technology developments due to the networked economy benefits, automotive OEMs saw customer, product , business and societal benefits from connecting the cars after they were manufactured and sold.

The traditional path to most new car technologies start in the aftermarket – in the case of connected car that was the situation as well. Qualcomm, the technology leader in wireless chipsets, funded most of its R&D through an aftermarket Connected Truck solution. Several other companies introduced aftermarket connected car solutions, given that there was the opportunity to innovate and create value and innovation. Then it was left to GM, through its OnStar innovation to show the industry the art of the possible and bring several industries together to make connected car credible.

In the last 20 years several innovations around technology and business models have kept the connected car industry going, but the needs of customers, automobile OEMs, the transportation co-system at the current time point towards several hard trends that make Agile Connectivity a key requirement to spur more innovation and flexibility.

This paper looks at the Connected Car industry challenges and how one key part of the solution – Connectivity can assist in more innovation and flexibility. Agile Connectivity needs to be simple and ubiquitous. The flexibility is for operations, business models, customers type, vehicle type and all aspects of transportation. A car is a form of transportation for goods and people, and connectivity will allow innovation to keep up with the needs of the world.

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