Machine learning in the transport sector

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Part of the Tranzinfo Hot Topics series, this Hot Topic presents a brief overview of an emerging area of artificial intelligence that has important applications in the transport sector: machine learning.

What is it?

You may have heard a lot recently about artificial intelligence, or AI. Artificial intelligence is a fast-developing area of computer science that aims to provide machines with the ability to mimic human decision-making and to seem like they have human intelligence. The field of AI covers a wide range of concepts and technologies, including robotics, automation, natural language applications, biometrics, and machine learning.

The term machine learning refers to the algorithms and methodologies used to enable software to improve and adapt, or 'learn', over time when exposed to new data without being explicitly programmed. Computers are 'trained' using large amounts of sample data ('big data') to make decisions based on probabilities and pattern recognition. For example, machine learning should allow automated vehicles to become more capable with exposure to larger sets of data, and to improve in tasks such as piloting and natural language processing. Deep learning is a subset of machine learning utilising artificial neural networks and multiple layers of data.

Who is using it?

Many sectors of the economy are already using or developing machine learning applications. You may have heard of robo financial advice; job-seeking algorithms; digital diagnosis in healthcare; 'chatbots' used in customer service; customer-targeted marketing (which even has applications in online dating!); voice-activated household assistants such as Google Home and Amazon Echo; driver telematics in the auto industry; and, of course, driverless vehicles.

What is happening in transport?

Transport networks are constantly producing large amounts of data, such as vehicle and passenger movements and network conditions, with new sources of data constantly appearing and datasets growing in size. This makes them an ideal subject for machine learning applications to improve planning, management, and safety. Machine learning has potential for many uses in areas such as ITS, traffic management, public transport operation, freight logistics, pedestrian movement, crowd simulation modelling, pre-trip guidance for travellers, and road safety.

In the field of traffic management, projects involving machine learning are being applied to traffic operations in Melbourne and Sydney. Machine learning techniques enable patterns and models to be derived from large volumes of real-time traffic data. Uses include predicting traffic jams and congestion; incident duration prediction; mobility modelling; and smart motorways management.

In Singapore researchers have developed a machine-learning program to accurately recreate and predict public transport use, or 'ridership', based on data from the public transport smartcard system and information on the distribution of land-use and amenities. Such modelling assists transport and urban planners. Similar ideas are being investigated for the implementation and assessment of new bike share systems. Machine learning can be applied to predict when certain docking stations will be full or close to empty, and the likely destination of the riders. Such data would help planners to implement new services and schedule maintenance.

In the field of customer service, Transport for London (TfL) recently entered the world of chatbots with the launch of a 'travelbot' to answer customer queries about service disruptions and travel information.

Telematics tools - apps and hardware sensors that measure driving behaviour, miles travelled and even the condition of the vehicle – are being used increasingly to improve driver habits, while insurance companies use the data to offer rewards and discounts to safe drivers. Telematics tools are able to amass large amounts of data, from vehicle miles travelled to drivers' braking patterns, speeding, sharp cornering or over-acceleration. Machine learning analytical tools, when applied to this data, can produce patterns and models of driving behaviour more quickly and efficiently than other methods. Machine learning techniques are also being investigated by fleet managers for predicting when vehicles will require maintenance.

Machine learning is at the forefront of automated vehicle development as it enables vehicles to grow more reliable with exposure to large amounts of data collected from sensors on and in the car, as well as data from external sources such as test vehicles and infrastructure.

A number of technology giants such as IBM, Google, and Nvidia, as well as Uber, are adapting and developing their AI platforms for use in driverless vehicles and forming partnerships with car companies. Areas of focus include pedestrian avoidance systems, navigation, intelligent assistant functions, driver monitoring, and natural language interactions.

In vehicle automation, a major area using machine learning is sensors and pedestrian detection systems. The latest development in sensors are vision-based cameras rather than range-based technology such as lasers and radar. Vision-based sensors can tell what an object is, based on data collected and interpreted over time, rather than simply how far away it is. They can also interpret road signs. Tech company Nvidia is developing virtual environments in which driverless cars can gain experience, rather than gathering real-world data. The challenge in this field is to get driverless cars to communicate with pedestrians as well as other cars. Tech company Drive.ai is working on ways in which driverless cars can make their intentions clear to people on or near the road, who would otherwise communicate with the human driver of a car.

Software companies are working towards developing intuitive driver support systems that are capable of learning the preferences and driving habits of the driver, and can use this data to improve driver comfort and safety. Natural language interaction and a conversational interface between driver and car is the aim here. For example, a digital co-pilot capable of taking control of the car if the driver is tired. The software could also function as entertainment and personal services – booking a restaurant or organising schedules and making suggestions based on the preferences of driver. It will also be able to advise on travel times and conditions. An early example of this technology is Apple's Siri, which is already integrated in many new cars through the use of iPhone handsets. BMW and Nissan are working to incorporate Microsoft's Cortana assistant into their vehicles.

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