Artificial intelligence in public transport

How intelligent is AI really?

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Artificial intelligence has become a major topic in both IT and public transport. But what are the current capabilities of this technology? Where is it used? Is artificial intelligence sufficiently advanced to offer real opportunities for operators and make a journey more pleasant for passengers? We must ask ourselves whether the implementation of an AI solution provides real advantages for public transport. Is artificial intelligence the technology of the future?

In the past few years there has been strong developments in the field of sensor technology. Today, sensors incorporate efficient and reliable processors that are sufficiently small to permit complex computational processes, such as machine learning, within a small space. Modern AI sensors acquire a much wider variety of data from the environment image than conventional sensors. They combine and process data directly into information that can be used in real time – while complying with data privacy guidelines.

As with every new technology, public transport operators must gain greater efficiency coupled with enhanced passenger comfort and safety. Otherwise it would not be acceptable. This also applies to the next generation of artificial intelligence. And the question arises: does AI offer sufficient added value in public transport to justify its use? The short answer is: yes. Because these learn capable systems were developed precisely for this purpose.

The advantages of learn capable sensors

Customer service is one of the biggest challenges in public transport. For many years the topic of travel comfort has taken first place in passenger surveys – i.e. as little crowding as possible within the vehicle. Transport operators are constantly faced with the task of finding a balance between optimum capacity utilization and best-possible customer comfort. What is more, during a pandemic it is essential to steer passenger flows, to and promote social distancing. This is only possible when a passenger guidance system is in place. It also prevents congestions at the doors. Information in real-time is required for that purpose. Where in the vehicle is space for how many passengers? In order to identify this, AI sensor technology uses visual information from different angles. Learn capable algorithms then calculate the distances between passengers. If a threshold value is reached, passengers are automatically informed.

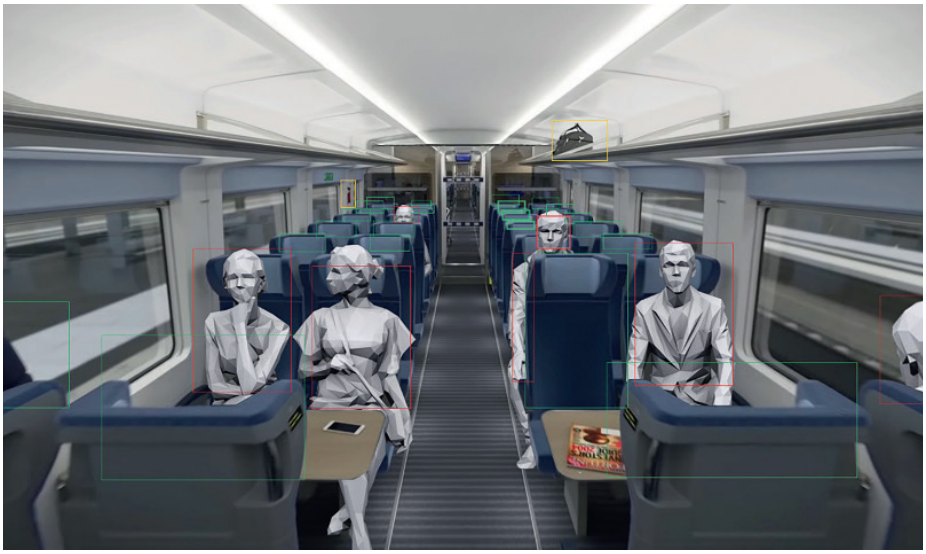

Fig. 1: Object recognition in the vehicle.

Another sensitive issue is stopping times. Efficient boarding and alighting is hampered by large passenger volumes. Announcements at the stops, e.g. *Please board at all doors*, are not very customer-friendly. Waiting passenger prefer to know in advance where free space is available, before the vehicles arrive. Dynamic information in real-time is required to determine such capacity indicators. The new generation of artificial intelligence has this capability. Adaptive sensors recognize where there is a surge of passengers towards the doors shortly before a stop. The sensors calculate how many seats are vacant and transmit this information directly to where it is needed: displays at bus/tram stops, platforms and on the doors of the vehicle. This enables passengers to see in advance where seats are free, giving them sufficient time to go to the appropriate door.

Information on seat availability in the vehicle can be transmitted to travellers in real-time, i.e. via apps. With the aid of modern AI, new products such as fast reservations are conceivable in conjunction with booking systems and various comfort classes. Long-distance transport would also benefit greatly from optimized boarding and alighting procedures – guided by real-time information from the train, as displayed on the platform and carriage.

Dynamic pattern or object recognition within the vehicle delivers a great deal of additional useful information for improving passenger comfort. The sensors learn how to detect items left behind on the luggage rack and to distinguish between vacant and occupied seats. They recognize graffiti and vandalism, and can distinguish dirt from waste and clothing garments. They can also notify passengers of vacant spaces for bicycles, strollers or wheelchairs. Adaptive sensors even detect the occurrence of a medical emergency or a danger threat. Someone may be lying unconscious on the floor, or a passenger is behaving abnormally. The system notifies the driver and control centre, in order to request medical aid or security personnel.
AI serves not only to enhance passenger comfort. It also makes life easier for the driver, supports staff in routine checks and passenger counting, and assists the cleaning crew at the terminus, while delivering critical real-time information to planners and dispatchers at the control centre.

About the Author

Dipl.-Ing. (TH) Andreas Friedrichsen is employed as Product Manager at the Luminator Technology Group and responsible for the development of intelligent system solutions. Following his studies in electrical engineering he held various positions in industrial markets, utilizing cross-market synergies and promoting new technologies as “CEO of the Product”.

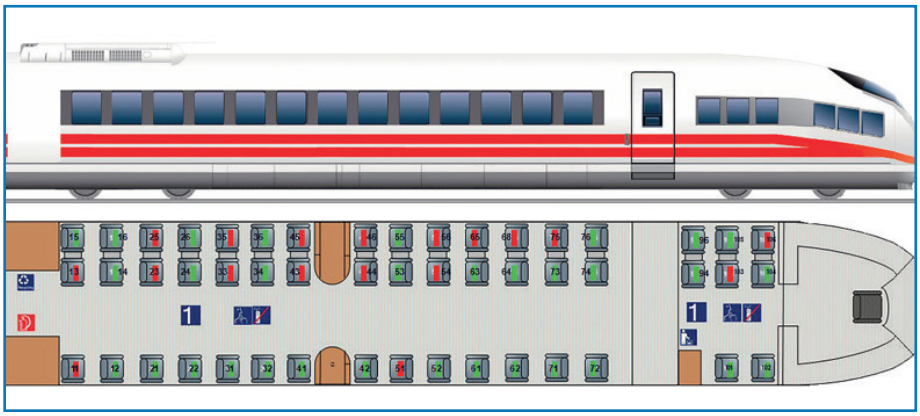

Fig. 2: Seat occupancy in real-time in the booking system

Fig. 3: Real-time seat indicator, outside.

Fig. 4: App display of seat utilization in real time.

Mode of functioning, operational safety, data protection

Learn capable sensors, installed within the vehicles, form the heart of the AI systems. The AI sensors utilize onboard cameras and have access to up-to-the-minute images, of the situation. The images are broken down into various layers and analyzed. Individual image data, such as shapes and colours, are filtered out layer by layer, patterns recognized and passenger movements calculated. Personalized data is not collected. Detailed information such as hair colour, gender, age, clothing or weight has little to no value for the optimization of operations. Extracting this data from images requires considerable processing capacity and memory. The main purpose is not the recognition of persons, but rather objects. Passengers are essentially objects that come and go, sit down or move around.
The sensors themselves are closed units, without outside access.
The AI processor, located within the vehicles, directly process the images. No pictures or images are obtained from the vehicle, only encrypted metadata, used on displays and other terminal devices. This ensures that those using the information are in possession of up to date operational informations. It can also trigger automatic loudspeaker announcements, e.g. wearing of mouth & nose protection or observance of distancing rules – when the sensors have recognized a current need for such. Planning tools in the control centre can be extended or supplemented with the data from the AI sensors. Capacity evaluations can be undertaken, response times to vehicle breakdowns reduced and databases updated.
A further use for camera-supported AI is the visual monitoring in the driving direction. The sensors monitor the zone in front of the vehicle in order to identify possible sources of danger. This technology is used primarily in trains, to which animals, low-hanging branches or objects on the tracks can represent a serious hazard. The warnings are immediately passed on to the following train.
Parts of modern AI
Artificial intelligence have been used in vehicles for some time – for example as APCs (auto-

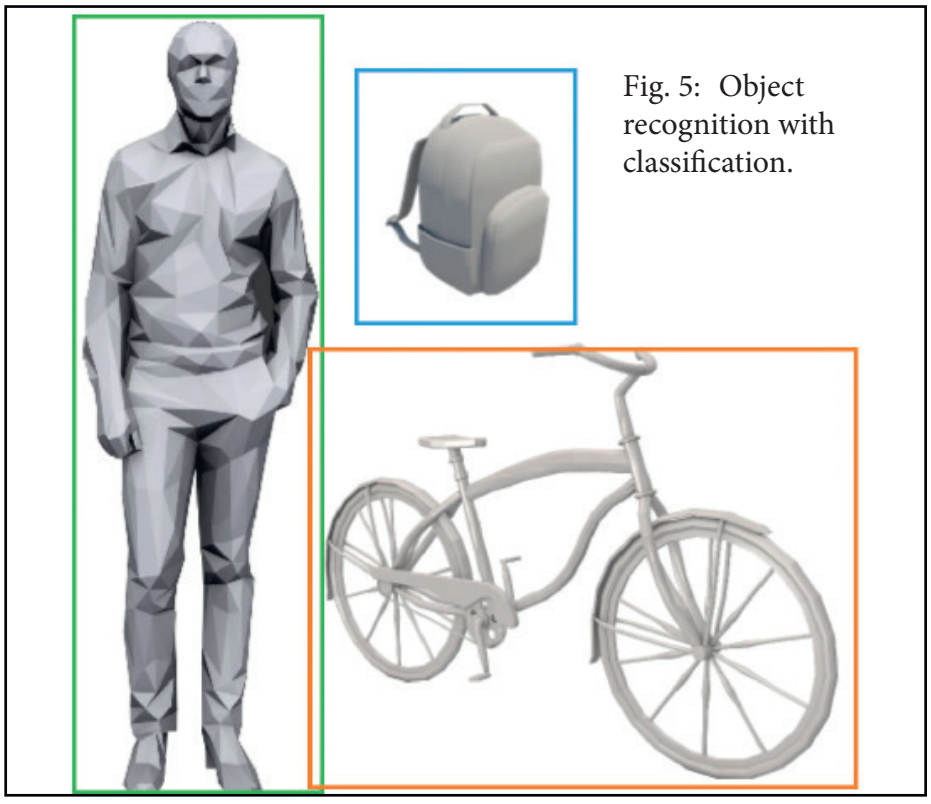
Fig. 5: Object recognition with classification.

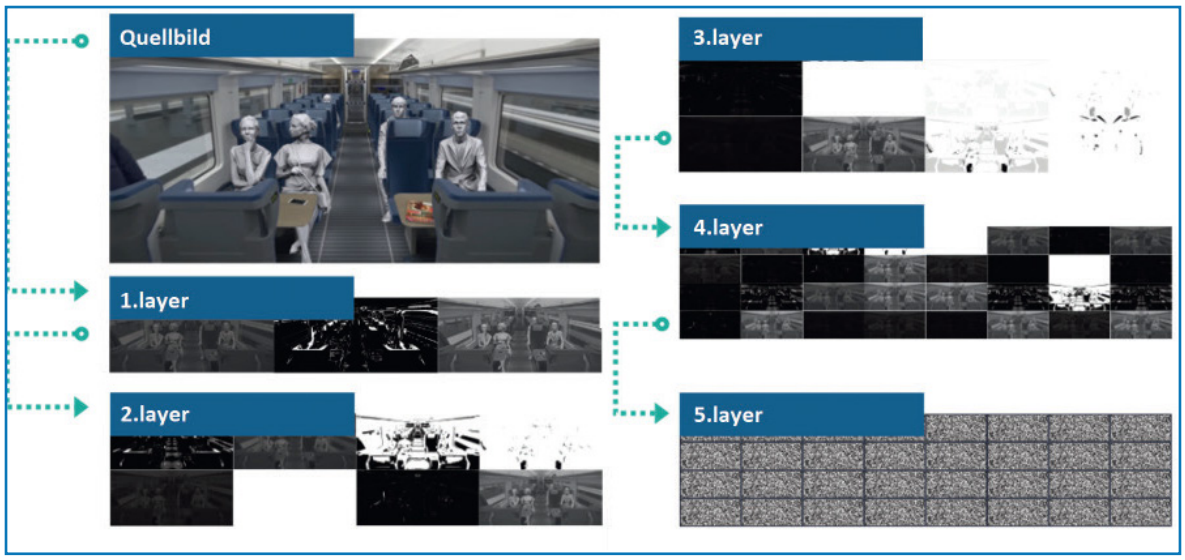

Fig. 6: Various layers for the extraction of image data. No information is contained in the last layer.

matic passenger counting) sensors installed above the doors to determine the number of persons boarding and exiting. They learn to distinguish between a ball, a dog and a human being with a cap. This AI can only count, providing two-dimensional data such as the number of persons within a certain time span. It is not able to record the dynamics in the passenger compartment during a journey.

The current generation of AI already goes a step further. It can detect the movement of objects, such as people, in relation to other objects, e.g. seats, or whether a fire extinguisher is missing. This artificial intelligence thinks three-dimensionally. It is expected that the next generation of artificial intelligence will be able to make predictions, i.e. announcements based on the current situation. Such a four-dimensional sensor system detects, e.g. that a certain area, in a fully loaded bus, is being avoided. This may be due to an unpleasant spillage or soiling. The information is important for the driver and cleaning staff. Predictability is also a decisive factor for planning – intelligent sensors deliver real-time information.

Conclusion

For public transport, artificial intelligence is not only a technology of the future, but already the present. It delivers real-time information and solutions that facilitate operations for all involved, and significantly improve the comfort and the safety of passengers. Today, AI in public transport not only stands for **artificial intelligence,** but also for **integrated customer service.**

Summary:

Artificial intelligence in public transport

Artificial intelligence in public transport offers numerous optimizations for operators, while enhancing passenger comfort and safety. At the heart of AI systems installed in the vehicle are learn capable sensors that deliver the necessary (visual) information. Today, the processors integrated into the sensors are so small, powerful and reliable that even complex calculations are possible within the most confined space. Thanks to AI, cameras become sensors.