Driving the future of autonomous vehicles

Anton Potapov, CTO at VIST Group (subsidiary of ZYFRA Group).

With the rapid development in various industries and increasing industrialization, numerous vehicles are being designed to meet the need of the new mode of production. According to a recent reports the global industrial vehicles market is about to expand at a significant rate in a 5 year period (MRF https://www.marketwatch.com/press-release/industrial-vehicles-market-2018-global-trends-share-industry-size-growth-opportunities-and-industry-forecast-to-2022-2018-10-04). Industrial vehicles market is forecasted to reach USD 29.77 billion by 2021. And autonomous vehicles are expected to contribute significantly.

Intelligence and connectivity

We usually expect the AI to have full control over the vehicle, but it could also be, for example, an operator assistance system, which provides precise information about the operation process for best performance. The AI would be a software system that is able to perceive the vehicle state and the environment and make reliable predictions.

The main purpose of applying the AI to industry is the idea to make the production process completely autonomous. You want the truck to start moving immediately after the loading was finished, and you want the traffic lights go green just when you arrived at the intersection. In order to achieve that, you need the whole infrastructure to communicate, know its role and perform reliably. With the schedule and dispatcher removed, we can dramatically optimize the process, making the machines dance together in synergy. In other words, automation (AI) and connectivity (IoT) are complementary and will reinforce each other in the medium to long term. Without making every element of the infrastructure interconnected, that would be impossible to make any “smart” vehicle act properly: AI running the vehicle is supposed to analyze information that it receives from other vehicles, people and machines as well as its own sensors. Furthermore, if, for some reason (bed weather or mechanical crash) sensors of the autonomous vehicle would be damaged, or the sequence of actions at the enterprise due to some emergency would be broken, interconnected infrastructure would give AI a guide. That’s why connecting machines, vehicles and every single thing of certain enterprise is crucial wherever it’s implemented. IoT systems revenues for industrial Internet applications are expected to grow 17.7% in 2018 to $35.9 billion. The strongest growth in 2018 is still expected in the IoT-connected vehicle category, which is forecasted to rise 21.6% by the end of the year to $4.5 billion.

The taxi (uberization) example shows that only removing one link makes a difference, and the world's industries are rushing to change the vision of production.

What is the difference between the types of self-driving vehicles for industrial use and for daily use? Two things, basically: hardware and risk management.

Environment is very different between the two cases. In industry, you remove all personnel from autonomous operating zone and leave robots to themselves. If you need a person or vehicle in there, you equip them with trackers, and every autonomous truck watches them carefully. Should the robot see something it didn't expect, that's an emergency and a reason for operator to intervene. On the contrary, in urban environment you better expect everyone to make mistakes and behave unexpectedly.

We can use high precision navigation and sensors to obtain reliable positioning and detailed environment model. On the other hand, an autonomous vehicles need to operate 24/7 in extreme weather conditions with temperatures from -40 to +50 C, no matter how rainy it is. Every single piece of high precision equipment must operate reliably, and the most critical ones must be doubled for safe operation in case of emergency. However, the high initial cost and maintenance

cost of industrial vehicles are likely to act as restraints for the growth of the global industrial vehicles market during the short term period. If a 130-ton dump truck costs about $1 million, the cost of making it automated adds about 10-12 percent to that price tag. The price of "self-driving" set of equipment should be comparable to the vehicle, and it plays for the industry.

From the warehouse to the mine pit

There are six levels of automation as defined by SAE association, from 0 for a conventional automobile to 5 for a completely autonomous one. They vary in the amount of control the system has, its ability to monitor the environment, to operate without human driver intervention.

When the main priority is to remove the driver from the production area, we can start with semi-autonomous mode. This way the system has full control over the vehicle, but only performs some operations autonomously, while others require a remote operator's attention. As an example from mining industry, haul trucks can already work completely autonomously; bulldozers can drive themselves to the work area but require remote operator for other actions.

The first autonomous haul trucks have been launched for trial operation 10 years ago in Australia. Nowadays there are about 15 open mine pits with autonomous fleet operating around the world. The technology is growing and expanding very fast while people are getting used to the idea of self-driving vehicle being reliable and efficient.

The most progressive application is autonomous warehouses. Restricted access, stable predictable environment, indoor navigation and perception systems – these factors reduce the uncertainty, thus optimizing efficiency and safety.

Visible achievements

Today you can watch videos from Amazon warehouse on YouTube, it's impressive. There are many companies developing autonomous control systems for different applications, and the car manufacturers are usually going one step ahead. There are already leaders with their niche expertise emerged: Komatsu is number one with their two-sided dump truck presented in 2016. Caterpillar is also doing a great job having multiple autonomous mine pits; Hitachi and Autonomous Solutions testing their own technologies. Others mostly focus on remote operation, like RCT, and they are also quite setting the trend.

There are a number of successful projects implemented. One example is an operating system for large mining trucks from Caterpillar. No human operator, in the truck or located remotely, is required to control the truck. Truck scheduling and assignment is also fully automated. Their solution for hauling has achieved a 30% production improvement compared with standard trucks with operators onboard.

Another example is Zyfra's Intelligent Mine project, a system of using digital technologies to manage production processes at open mines, built around driverless transport, robotics, the Internet of Things, artificial intelligence and predictive analytics. The company says the technology will make it possible to increase productivity by 15 to 20 percent and enable the mines to work around the clock: while mines can be hostile places for human workers, due to the presence of gases, dust and so on, these are no obstacles to autonomous technology.

Speaking of autonomous industrial vehicles, due to a narrow supply the competition is high. The demand is growing fast, but as an industrial unit management is complex, you would need to purchase a new set of autonomous-ready trucks and the infrastructure and then wait until the integration and testing is finished, and then use the system for a few years until the experiment finally pays off and proves to be efficient. The industry does not want to innovate, it wants to increase and expand, and we compete for those customers who are ready to try. As for today, the most influenced industry is autonomous warehousing while mining is among the most complex ones.

The number of companies deploying systems like these is growing. As autonomous technology matures and further demonstrates its reliability, it will be deployed in sites less controlled in the near future. Although there are narrow field leaders, the market still lacks one clear global leader, which leaves the doors wide open for the up and coming challengers.

Between efficiency and security

Automation gives you optimization, production efficiency, lesser maintenance costs. In mining, for example, removing people from the pit allows to change the process entirely: you don't need to stop the production and evacuate people for another blast anymore; you can calculate risks instead of just keeping to human safety standards.

Obviously, safety is going to be the biggest concern about vehicles automation for the nearest future. While the progress of self-driving taxis has all the attention, the public wonders whether we will trust a car to bring our children from school anytime soon. The technology is getting further proving its reliability, and our mentality needs to keep up.

At some point the new technology will take over the world as a new industrial revolution, and this is when we face some real side effects. As digitally controlled vehicles spread and become more accessible, communicate intensively with each other and with infrastructure, security becomes an issue. Cyber security problem is going to be very challenging.

As for now, autonomous and remotely controlled vehicles are rare and we can control the connection on both sides. Connecting process is closed and not autonomous. Although there is a chance of hacker attacks, it’s not a hot topic among the professionals at the moment. Scalability is a number one issue. But when using autonomous vehicles will become more common, the third parties will be engaged in the process, then we should expect the probability of hacking into the system on every single level, and the possible consequences could be disastrous. Hopefully, there will be appropriate cyber security tools implemented (it is another greater topic).

The wheels of tomorrow

Autonomous vehicles provide a new level of intercommunication and predictability, which are essential for internal logistics of any industry.

Automation leads to a significant cost reduction, and humanity has to respond. It’s easy to imagine a global decrease in prices for goods all around the world, or the marketing departments taking advantage of it. Either way it is another step for the digital era, and isn’t it exciting to watch how it is developing?

More specifically, we can put the forecast this way:

- In 5 years most warehouses and similar "simple" industries will plan towards logistics automation;
- in 10 years most mining companies will give automation a try;
- in 20 years self-driving cars will handle transportation in large cities around the world;
- In 30 years most mine pits around the world will be automated.

With automation, the gap between developed and developing countries can become unreachable, and it doesn't sound good. We shall hope this would bring us to the need of unity and cooperation rather than ultimately split the world community. It requires the ability to listen, to feel, to forgive, and it is something the technology does not provide.