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Application of Driverless Electric Automated Shuttles for Public Transport in Villages: the case of Appelscha

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Executive Summary

Automated vehicles have reached the level of maturity in which their applicability to address transport needs are being assessed in pilot projects worldwide. It is of increasing importance to assess and share the experiences gained in these projects. This contribution reports about the application of automated vehicles in the city of Appelscha, The Netherlands. Appelscha is part of the municipality of Ooststellingwerf and is challenged with a predicted decline of inhabitants and an already shrinking public transport network. To preserve the regions accessibility, the municipality of Ooststellingwerf started a pilot with electric automated vehicles. The municipality of Ooststellingwerf rented two Easymile EZ10 vehicles. These vehicles drove on a separate cycle lane for six weeks in September and October 2016. This pilot has shown that a pilot is possible with little infrastructural changes. Even though the maximum speed of 15 km/h might suggest that automated vehicles are suitable to share the road with cyclists, the cycle lane in Appelscha was not sufficient due to the width of the cycle lane . Therefore cyclist had to pass the vehicles using the roadside. Extra safety measurements were taken to inform other road users and cyclists about the vehicle that they might cross paths with. Thanks to that no accidents occurred during the pilot. Apart from the non-suitable cycle lane, the idea of using the automated vehicles was positively received by the public.

1 The case

1.1 Background of the case

Appelscha is a village in the region of Ooststellingwerf, Friesland NL. Appelscha has approximately 5,000 inhabitants. One of the future challenges for the municipality of Ooststellingwerf is the predicted decline of inhabitants [2]. The decline of inhabitants will make the regular bus line, which is barely viable now, no longer viable. The public transport network is already shrinking in this area due to the lack of users. In order to preserve good accessibility in the region, especially for the disabled and elderly, the municipality looked into the possibilities of automated transport. This type of transport can be cheaper because there is no need for a driver and this type of transport can offer ‘on demand’ service. The sustainability of the automated vehicles, which are electrical, coincide with the goal of zero emission by 2030 as set by the municipality of Ooststellingwerf. A pilot with an automated electrical vehicle was conducted to find out if this type of vehicle could be the future mode of transportation without any infrastructural changes in rural regions of the Netherlands. Also, the pilot was conducted to gather some insights in how people in and outside the vehicle responded towards the vehicle [3]. The motto of the municipality was ‘learning by doing’.

Figure 1: Appelscha [1]

1.2 The vehicle

The automated electric vehicle that was used for this case was a prototype of the EZ10 from Easymile. This is a SAE-level 4 vehicle, because it is able to drive automated on certain routes, which have to be mapped in the vehicle. The vehicle is not (yet) able to drive on any road at any time . The municipality rented two vehicles for the duration of the pilot starting from the 13th of September up until the 31st of October. The supplier Easymile made sure the vehicles met the requirement set by the Dutch Vehicle Approval Authority known as RDW. Some of the adjustments Easymile made were to make sure the doors of the vehicle could always be opened while standing still, but not while driving. Also, according to the law, which regulates the requirements vehicles have to meet, the exterior of the vehicle cannot contain any sharp edges or other edges, which might cause severe injury when involved in an accident [4]. Figure 1shows the vehicle that has been used for the pilot in Appelscha.

Figure 1: The vehicle [5]

1.3 Route of the vehicle

The automated electric vehicle was set to drive from the visitor centre of the Forestry Commission (Bezoekerscentrum Staatsbosbeheer) to the roundabout, which gives entry to the village Appelscha. The distance between these destinations was approximately 2.5 kilometres. Easymile, the supplier of the vehicles, conducted a site assessment. The municipality of Ooststellingwerf and Easymile agreed that, in regards to the maximum speed of 15 km/h, the vehicle should drive on the separate cycle track next to the main road. To prepare the separate cycle track for the vehicle there were some, relatively small, adjustments. The municipality constructed some overtaking lanes where the vehicles could safely pass each other. Other adjustments were made in regards to warning other road users about the automated vehicles. There were painted signs on the bicycle lane with a picture of the vehicle to warn cyclists that they might cross paths with the vehicle. There were also warning signs next to the cycle lane. Matrix signs were placed at crossing points with the exits of expressway N381. A temporary (yellow) yield line was placed for the vehicles coming from or entering the expressway N381 to give way to the road users on the separate cycle lane. Also, an information board at the start of the route was placed to provide information about the automated vehicle driving in the area. Figure 2 shows a few of these warning signs.

Figure 2: Warning signs [6]

The width of the separate cycle lane was between 2.70 metres and 3.10 metres. The width of the vehicle was 1.99 metres. This means that the space remaining for the cyclists varies from 0.71 metres to 1.11 metres. The average space a cyclist needs to overtake is 1.50 metres, taking into account .50 metres distance to any obstacle in general plus the width of the cyclist themselves [7]. When the vehicle started driving to study the route, the sensors picked up objects on the side of the cycle lane. Garden fences, low branches and high grass made the vehicle slow down or triggered the emergency brake. During the pilot the municipality made sure the grass on both sides of the cycle lane was cut so the vehicle would not detect the grass as an object. Branches from trees and bushes on both sides of the cycle lane were cut back for the same reason. Also, the position of the vehicle on the cycle lane had to be adjusted. Therefore the vehicle maintained 20 cm distance to the side of the cycle lane, the so-called ‘virtual space’. This virtual space meant less space for the cyclist to pass or overtake the vehicle. The evaluation report (not publicly available) from RDW and the municipality stated that the cycle lane in this situation was in retrospect not suitable to facilitate both the vehicles and the cyclists. The questionnaires filled in by the users of the vehicle and other road users conclude the same; the vehicle should not be on the cycle lane in this situation. Apart from the non-suitable cycle lane, the idea of using the automated vehicles was positively received by the public. Figure 3 shows the position of the vehicle on the cycle lane.

Figure 3: Position of the vehicle[8]

1.4 Legal

To be able to drive with an automated vehicle on the Dutch roads, a permit from RDW is mandatory. Without a permit from RDW driving is illegal. In this case two permits were given; one permit to drive on the separate cycle lane and one permit to be allowed to transport people in the vehicle. Because this vehicle is a level 4 vehicle, it needs to learn the route. The first permit allows the vehicle to drive and explore the route. In order to transport people in the vehicle, RDW has to make sure that the vehicle is well adjusted to its route. The aforementioned virtual space slowed the progress towards the second permit. Extra safety precautions were needed to be allowed to transport people. This demanded flexibility, creativity and an analytical way of thinking from the municipality. The municipality hired traffic controllers and placed extra warning signs to inform cyclists and other road users that they could come in contact with this automated vehicle. They explicitly added the fact that the vehicle will not swerve around cyclists and requested cyclists to keep one metre distant from the vehicle while passing or overtaking it. The municipality had noticed that cyclists found it sometimes confusing when they approached the vehicle if it was going to make space for the cyclists, which it didn’t. More information about the way the vehicle reacts was spread on local media and the extra warning sign stating that the vehicle will not swerve around cyclists took away some of that confusion. Also the traffic controllers outside the vehicle and the steward inside the vehicle provided information about the vehicle. This increased the goodwill of the inhabitants of Appelscha and the other road users. After providing extra information towards the public, hiring traffic controllers to inform other road users and placing extra warning signs, the municipality received permission to transport people in the vehicle.

1.5 Conclusion

This pilot has provided insights into the requirements which have to be met to let automated electrical vehicles drive on cycle lanes. The cycle lane in the situation at Appelscha was too narrow to facilitate both vehicles and cyclists and therefore the cyclists had to move to the roadside to overtake the vehicles or to let the vehicles pass. The results from the questionnaire show that other road users and cyclists believe that the vehicles should not have been on the cycle lane, but the results also show that the public does believe in a future for automated electrical vehicles. The municipality had to be flexible and had to deal with sudden problems. The 'can do' attitude from the municipality made this pilot happen. No accidents occurred during the pilot.

Project context

This abstract is a result of the case study, which has been conducted for the Spatial and Transport Impacts of Automated Driving, or STAD, project. The STAD project performs joint research about the implications of the future of accessibility and spatial development of mobility with respect to autonomous driving technologies. This project brings academic and governmental institutions together with private companies to collaborate on research to fill the knowledge gap about the longer term, indirect and larger scale impacts of automated driving [9]. The project has been divided into subprojects. This case study is a result from work package 7 'Case studies and demonstrators'. One of the objectives of this work package is to define the lessons learned from previous projects and pilots regarding automated driving. This particular case study is about the pilot with two Easymile automated electric vehicles at Appelscha, the Netherlands.

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References

[1] Search: *Appelscha*, maps.google.com accessed on 2017-02-17

[2] *Bevolkingskrimp – Krimpgebieden en anticipeergebieden*, https://www.rijksoverheid.nl/onderwerpen/bevolkingskrimp/inhoud/krimpgebieden-en-anticipeergebieden, accessed on 2017-02-10

[3] *Pilot zelfrijdend vervoer in Appelscha* [video], https://www.youtube.com/watch?v=GwdL38hTmWY, accessed on 2017-02-10

[4] Article 5.2.48 Regeling voertuigen

[5] *Noorden maakt werk van zelfrijdend vervoer*, https://www.provinciegroningen.nl/actueel/nieuws/nieuwsbericht/_nieuws/toon/Item/noorden-maakt-werk-van-zelfrijdend-vervoer/, accessed on 2017-02-10

[6] *Pilot zelfrijdend voertuig van start in Appelscha*, http://www.compactmedia.nl/2016/09/17/pilot-zelf-rijdend-voertuig-van-start-in-appelscha/, accessed on 2017-02-10

[7] T. Zeegers, *Over breedtes van fietspaden*, CROW – Fietsberaad, 2004

[8] *Zelfrijdende busjes maken proefritjes in Appelscha*, https://www.dekrantvanmiddendrenthe.nl/nieuws/regio/459874/zelfrijdende-busjes-maken-proefritjes-in-appelscha.html, accessed on 2017-02-10

[9] *Spatial and Transport impacts of Automated Driving*, http://stad.tudelft.nl/wordpress/, accessed on 2017-02-08

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