Needs and expectations of older passengers in using autonomous public transport

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Abstract

AVENUE is a H2020 EC project, aiming to design and carry out full scale demonstrations of urban transport automation by deploying fleets of autonomous mini-buses in low to medium demand areas of 4 European demonstrator cities. The target group of AVENUE is passengers, including people with reduced mobility, disabilities, elderly and in general potentially vulnerable users. User experience and accessibility are of key importance when designing and developing innovative and disruptive urban public transport services. Thus, user surveys were realized in six countries, one of which was Greece. In this paper, the users' feedback gathered in the Greek survey with 15 older travelers (> 60 years old) is presented. Overall, the survey showed that about half of the respondents are willing to use driverless /autonomous public busses, but with several pre-requisites. The safety level, reliability and trust issues are crucial factors for the elder passengers and the autonomous busses acceptance level.

Keywords: *Autonomous public transport, older passengers needs, passenger surveys.*

1. Introduction

The mobility environment is evolving fast, due to the increased automation, connectivity, digitization, commodisation and electrification, as well as the new business models that affect various markets sectors, but mainly the automated transport. The RethinkX report (Arbib & Seba, 2017) states that "*by 2030, 95% of passenger miles traveled will be served by on-demand autonomous electric vehicles owned by fleets, not individuals, in a new business model "transport-as-a-service*". Also, according to ResearchandMarkets (2017), "*the global autonomous vehicles market revenue is expected to grow at a CAGR of 39.6% during the forecast period 2017-2027 reaching $126.8 billion by 2027*". Consequently, the public transport system is expected to be also greatly affected and change completely from the introduction of autonomous vehicles into the traffic. In Europe there are several pilots or closed-loop efforts already in various cities, where autonomous mini-buses have been put in the traffic, with new passengers using and familiarising with them every day.

Users acceptance of autonomous public transport is nowadays a key concern in the research and automotive communities. This concern is even more profound in the vulnerable population, especially since they are more in need of the public transport for their daily transport and mobility within cities. The World Health Organisation (WHO; 2016), more than 1 billion people (that accounts for 15% of the world population) live with some form of

disability. This percentage raises even more due to the aging of the population, with a related increase of chronic health conditions, amongst other. One in six people in the EU has a disability (from mild to severe), translating into approximately 80 million citizens. Very often, due to physical and/or attitudinal barriers, these people are excluded from participating fully in society and in the economy (EC, 2014).

AVENUE is a H2020 EC project that aims to design and perform full scale demonstrations in the area of urban transport automation. Fleets of autonomous mini-buses will be deployed in low to medium demand areas of 4 European demonstrator cities: Geneva, Lyon, Copenhagen and Luxembourg, and three replicator cities. AVENUE reconsiders the existing public transportation system, focusing on the main objective that is to enable passengers to move from one place to another. Instead of trying to accommodate autonomous vehicles to the existing solutions of pre-scheduled bus itineraries, the project takes into account the passenger's special needs and time constrains and integrates them on door2door services, setting up a new model of public transportation. Communications solutions to be used support I2V, V2I & V2V that will allow a twofold increase of the average vehicle speed and a tenfold increase in the range served by autonomous vehicles. Additionally, a set of corresponding in- and out- of vehicle services that substantially enhance road safety, the overall quality of the service and the value added to the passenger will be introduced, targeting also elderly people, people with disabilities and vulnerable users.

User experience and accessibility are of key importance when designing and developing innovative and disruptive urban public transport services. To ensure that a system is not only usable but also optimally accepted by the intended target groups, users need to be involved and their opinion and needs have to be taken into account as early and thoroughly as possible. Within the project, all relevant stakeholders (including younger and older persons, their family and healthcare professionals) opinion play an important role in the requirement phase and throughout the various development phases in the project. Emphasis is also given to the cultural and organisational differences within the user group and member countries. This includes explorative and qualitative studies that have started early in the project, as well as detailed personas to establish a common understanding about the scope and key issues behind the user requests and expectations. This constitutes an important step for the definition of the appropriate use cases of each demonstrator, the scenarios for each implementation phase, and the value added services required for the success of the demonstrators. Thus, within AVENUE a human-centred design approach for the design of the use cases is being followed. To this end, state of the art analysis on transport and services' technologies for autonomous vehicle solutions was realised, in conjunction with a benchmarking of best practices, using background experience coming from existing deployments and pilots. In parallel, an analysis of both the relevant stakeholders' expectations and needs was performed (for the demonstrator cities) and of the traveller's needs and requirements.

For the later, user surveys were realized in six countries, one of which was Greece. In this paper, the users' feedback that was recorded in the Greek survey with 15 older travelers (> 60 years old) is presented. Issues to be discussed and analysed are the requirements (need of assistance, information needs, etc.), their habits (usual travel distance, interaction with the driver, comfort-related, pre-trip preparation, etc.), and demands in relation to public transport,

the evaluation of experience with autonomous buses (if existent), especially in comparison to conventional public transport and the wishes and expectations for future autonomous buses in order to improve public transport.

2. Scope and methodology

The scope of the survey in Greece is to understand the needs and expectations of the elderly passengers in relation to the current and future-autonomous public transport system and services. Since problems and requirements might vary between local areas and between nationalities, the results were used in the project in comparison with four more countries (Denmark, France, Luxembourg and Germany) where relevant interviews were conducted, based on which outcomes on the cultural difference will be achieved. Detailed presentation of the survey outcomes from each country are available in Dubielzig et. al (2018).

Prior to the engagement of each user with the interview, he/she was ensured on the data confidentially and anonymity. Participation in the interviews was voluntary. The interviewees were informed that they are able to withdraw at any time and without any given reason. Also, all participants were informed that after the survey, the data will be only considered in aggregated form, i.e. together with all other users data and will be used by the project partners only (this was explicitly explained to the participants). The participants reside in Thessaloniki city and frequently use public transport. The participants are parents or family members of CERTH employees. They were asked in advance by their family members if they consent to participate in the interview and if they accept to be contacted by a CERTH employee. Interviews were pre-scheduled with the participants and took place on the phone.

In order to insure the homogeneity of the data collection process, and to obtain the same level of information for all countries, common interviews templates have been designed and used, composed of 60 questions. After a brief introduction and collection of demographic data, the interview is divided into three parts:

1. requirements for public transport based on the current use of “classic” public transport: the aim of this part was to identify the status-quo and current issues;
2. evaluation of experience with autonomous buses (if existent), especially in comparison to conventional public transport (preference among the two): this part of the questionnaire aimed at finding out the experience passengers already have with autonomous public transport;
3. wishes and expectations for future autonomous buses: in this part all passengers were asked to imagine how future autonomous busses could change and improve public transport.

The results are presented in Section 3.

3. Survey results

3.1 Demographic data

All the participating users were above 60 years of age, of which 9 were male and 6 female. Three users have visual problems, another three hearing problems and one faces mobility limitations (walking stick user), due to aging. All users reported that they use public transport several times a week. The most popular reason for using public transport is for leisure, as shown in Figure 1 below.

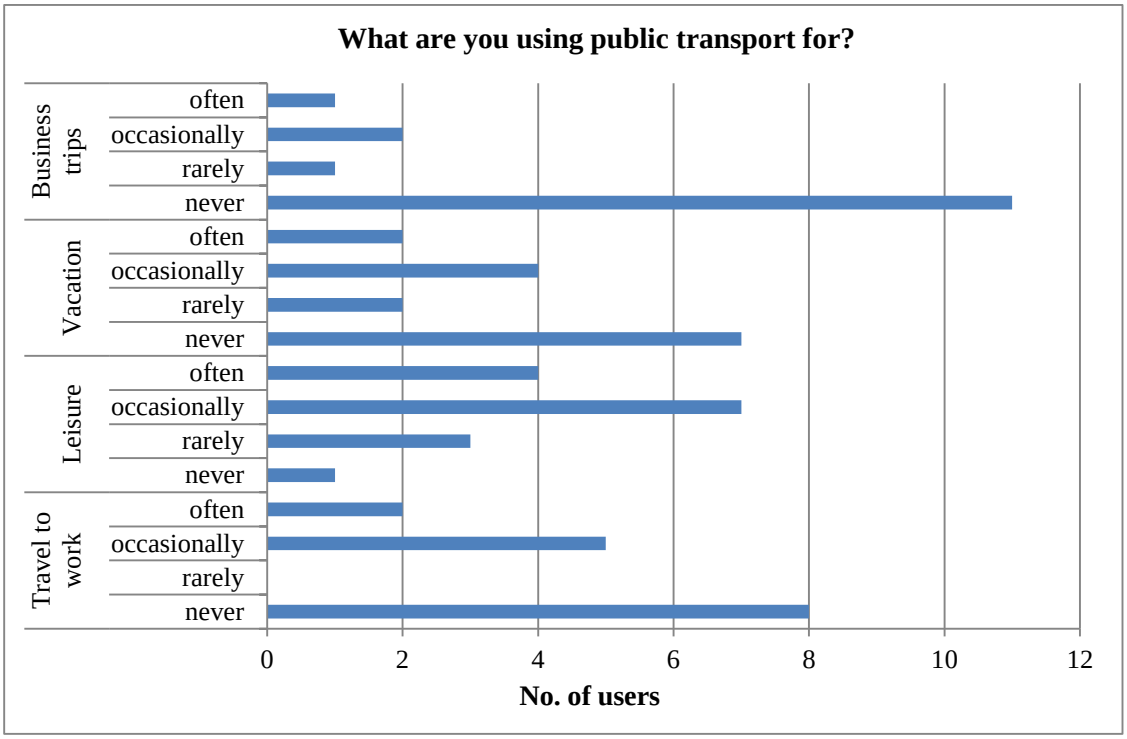

Figure 1: *Reason and frequency for using public transport*

3.2 Results on the requirements for the current public transport services

A series of questions were asked to the participants that affect the design and operation of autonomous buses and related services. These relate to the reason for travelling, the use of smartphones and the need of information on-board, the need for human assistance while on the bus, comfort-related issues.

The mean reason for using public transport is bad weather condition, followed by low visibility (night), increased traffic and major events/trade fairs due to the limited parking available. Five participants stated that they use their mobile phone in order to be updated for timetable and connection information, while all users replied that this information is important to be delivered in the bus primarily visually, followed by acoustic messages. The departure and arrival times are considered important when using PT. Also, the majority reported that they speak to the driver in case they want to ask information in relation to their

trip (bus connections, bus stop). All users responded that they usually look for a seat when getting on the bus, based on the following criteria, as presented in Figure 2:

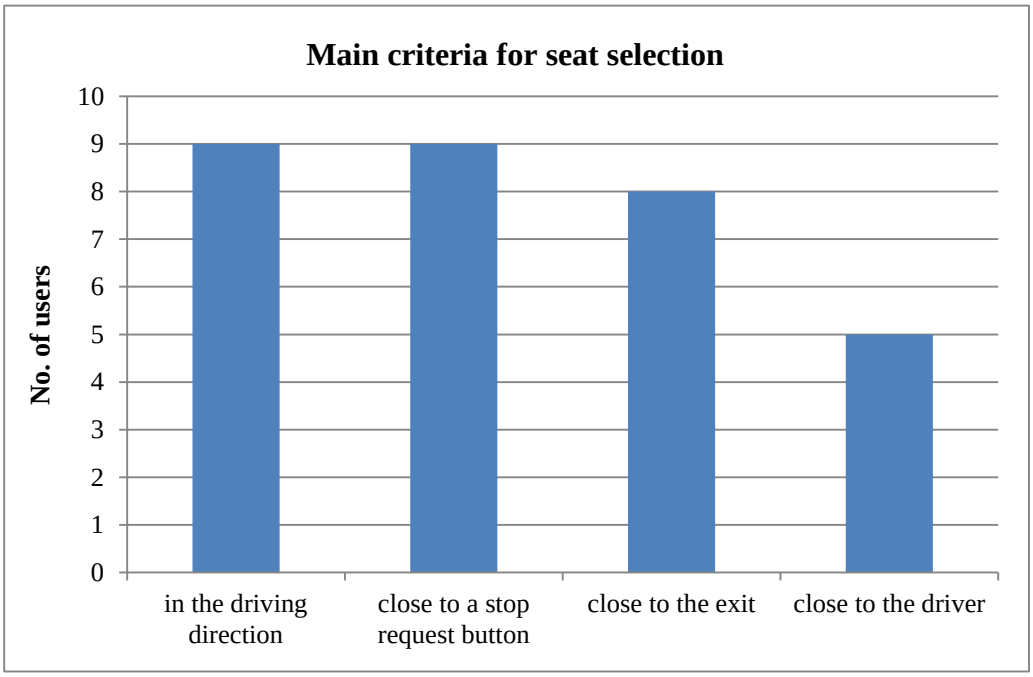

Figure 2: *Main criteria for seat selection*

Finally, 10 out of 15 participants stated that they use PT when travelling in a less familiar city and they consult a map before getting on the bus.

3.3 Results on the wishes and expectations for future autonomous buses

The respondents replied hypothetically in questions relating to autonomous buses, as only two have travelled with an autonomous vehicle subway. However, half of them have heard that there are buses that drive independently and 8 replied that they are willing to ride with such a bus, provided that it fulfills the following pre-requisites:

- it is safe and in service for a long time (many years) without accidents,
- it is free of charge,
- the infrastructure and the roads are adapted accordingly,
- it has a low speed,
- an employee is present.

Regarding the later pre-requisite, it does make a difference to many of the participants whether a driver/employee of the transport company is in the vehicle; below, the main reasons and expectations from the driver/employee are listed:

- Passengers would feel comfortable enough to take such a bus.

- To assist older passengers and help them if they cannot get off the bus.
- To control the bus in case of an emergency (accident, for safety reasons), as a human can react better.

The most important concerns that the users have when autonomous buses will be used regularly in the traffic are shown in Figure 3. Clearly, most participants (9 users) worry that employees will lose their jobs and that there will be more accidents (8 users). Also, 5 users are concerned that the ticket cost will increase.

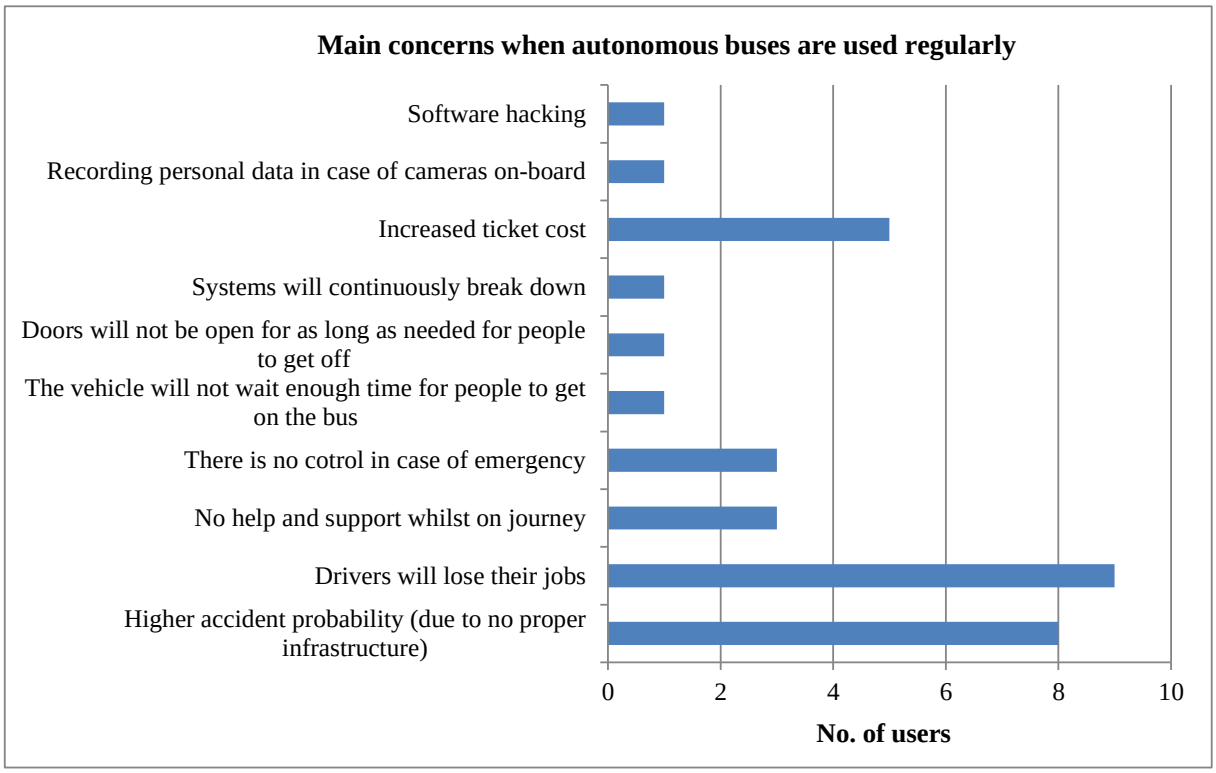

Figure 3: *Users' concerns for autonomous buses integration in the traffic*

Finally, the participants were asked to express their wishes and expectations concerning autonomous buses of the future. A number of different replies were provided, some of which are supported by several users, such as the need for the autonomous buses to be reliable, comfortable and environmental friendly (as stated by 6 users) and be fast and frequent (4 users). The users' feedback is depicted in Figure 4.

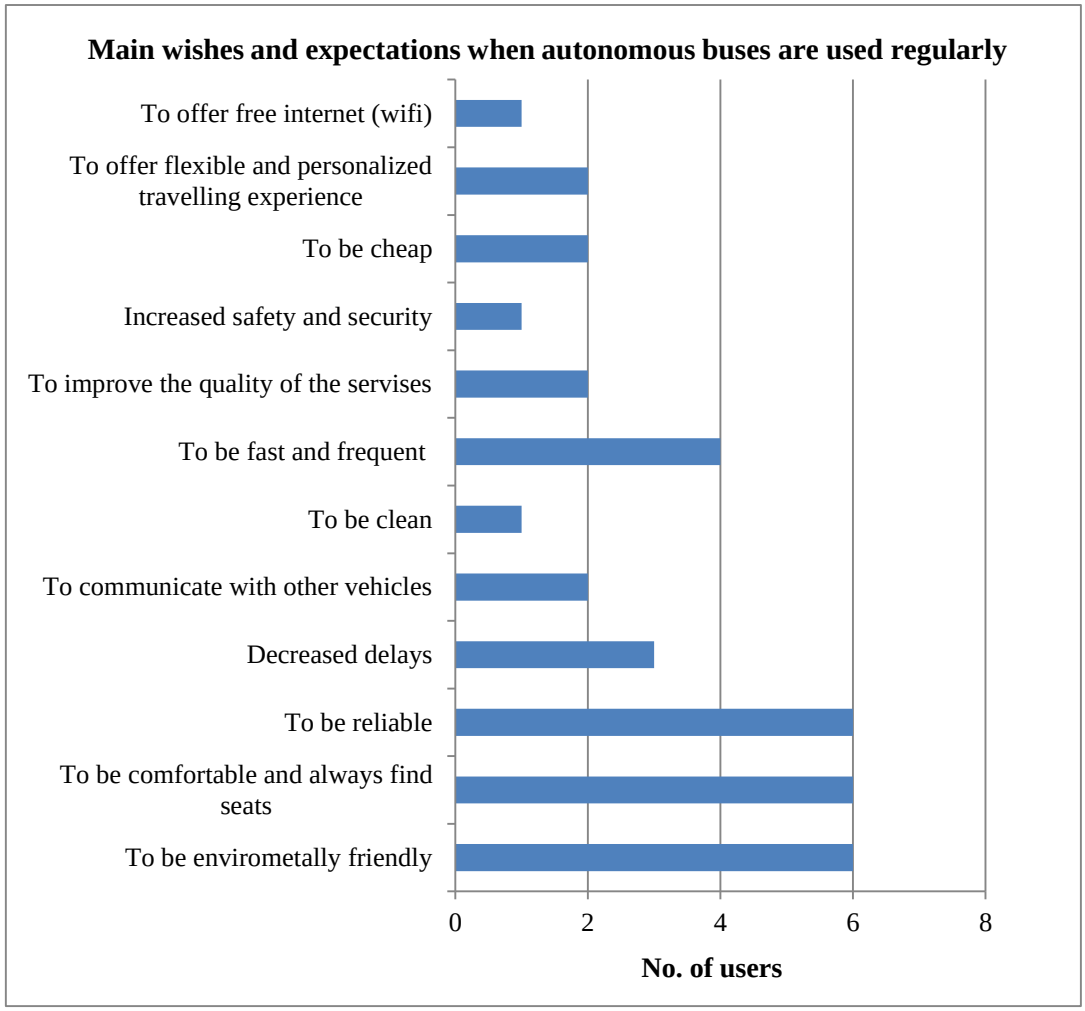

Figure 3: *Users' wishes and expectations for autonomous buses integration in the traffic*

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4. Conclusions

AVENUE project sets up a new model of public transportation. This model enables safe, efficient, on demand and emission free public transportation, available anytime and anywhere, mixing conventional public transport with novel service models such as these of the sharing economy. To ensure an actual, positive user experience for all, users are involved in all relevant phases of the project (conception of services, security option, operation validation,

etc.) as needed to guarantee that their opinion and needs are taken into account. This is of great importance, especially since the target group of AVENUE is all passengers, including people with reduced mobility, disabilities, elderly and in general potentially vulnerable users. Thus, passenger's special needs and time constrains are to be integrated in door2door services.

For this reason interviews with passengers were realised in 5 countries, in order to capture their needs and expectations when using PT and driverless PT. The results described in the paper concern the survey that was realised in Greece with 15 elder persons (>60 years of age). Overall, the survey showed that about half of the respondents are willing to use driverless /autonomous public busses, but with several pre-requisites. First of all, they will feel safer if an employee is always on board or the service runs for many years and they trust it. Other important issues relate to the proven safety of operation (for some years), its cost, speed and infrastructure readiness that are crucial factors for the elder passengers and the autonomous busses acceptance level. The respondents replied hypothetically about the autonomous buses, as they have never used an autonomous vehicle so far (but about half of them are aware of their existence), apart from 2 people that have used an autonomous metro.

In summary, based on the analysis throughout all the participating countries in the survey, it can be said that the requirements, identified in the survey are similar across Europe. Fortunately, most requirements can already be found in the relevant regulations and standards. However, measures to enhance users trust is considered as a key step for the ideal acceptance of autonomous vehicles, including buses, by all types of passengers. Of course, once the AVENUE services are developed, the pilots will provide valuable feedback on their final acceptance by the target group.

5. References-Bibliography

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