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RESEARCH ARTICLE

Intelligent Transportation Systems along with the COVID-19 Pandemic will Significantly Change the Transportation Market

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Abstract:

Background:

Reducing human presence in vehicles and transportation infrastructure is a common concept of Intelligent Transportation Systems and COVID-19 guidelines. However, the motivation for the reduced human presence is different. Intelligent Transportation Systems aim to improve transportation services with innovative technologies that can replace human handling and supervision. In contrast, COVID-19 guidelines aim to make the transportation means less busy, because a busy bus or a busy train means more opportunities for potential infection of passengers.

Objective:

The study aims to explain how the transportation market will be changed and why these changes are going to take place.

Methods:

The paper analyzes the current situation with its pros and cons and evaluates the ways in which the Intelligent Transportation Systems and the COVID-19 pandemic will affect this situation. A case study is also considered.

Results:

Intelligent Transportation Systems and the COVID-19 pandemic are two major factors in the transportation market that will significantly change the transportation means we know.

Conclusion:

It seems that the influence of the intense Intelligent Transportation Systems development and the impact of the COVID-19 outbreak is still underestimated by many governments; hence they continue to invest in traditional transportation instead of moving forward for a new generation of transportation.

Keywords: Intelligent transportation systems, COVID-19, Public transportation, Passengers, Pandemic, Infection.

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1. INTRODUCTION

Astoundingly, Intelligent Transportation Systems and COVID-19 guidelines have a common central theme – both set sights on taking out human presence. However, their reasons for taking out human presence are different. Intelligent Transportation Systems aims at shifting the burden of managing vehicles and transportation infrastructure from humans to automatic technologies, so as a result, there will be fewer humans in vehicles and transportation infrastructure [1]. On the other hand, COVID-19 guidelines aim at keeping peo-

ple away from each other, so they will not spread the pandemic, and because of this aim, fewer humans in vehicles and transportation infrastructure is clearly advantageous [2].

Freight transportation is significantly affected by these aims [3]. While many people work in the freight transportation industry, Intelligent Transportation Systems can reduce the number of people needed to operate many freight transportation supply lines [4]. This is aligned with the restrictions stipulated by the COVID-19 regulations, which endeavor to reduce the number of deaths and illnesses by the presence of fewer people in any thinkable location. However, it should be noted that while COVID-19 regulations encourage both drivers and passengers to stay away from transportation

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means, Intelligent Transportation Systems encourage only drivers to stay away from transportation means. Therefore, in freight transportation where there are no passengers, COVID-19 and Intelligent Transportation Systems encourage the same group of people to avoid being present in transportation means. In contrast, in passenger transportation, there are also the passengers who are not discouraged from being present in transportation means by the Intelligent Transportation Systems.

Public transportation will also be significantly affected by the Intelligent Transportation Systems penetration and the COVID-19 pandemic. In a paper written before COVID-19 emerged, the authors explained [5] why public buses could remain cost-effective in a world with intelligent private vehicles only in large and dense zones. Nowadays the public buses have a much smaller demand, and as a result, the public buses' cost-effectiveness is even poorer.

Even when a vaccine for COVID-19 is available, a significant percentage of the population will still be afraid to travel in crowded buses. Some will be afraid that the vaccine is not effective enough, and some will be afraid of other viruses [6]. Moreover, in a poll in the US, about thirty percent of the respondents answered that they are unlikely to take any vaccine for COVID-19 and about fifty percent of the respondents answered that they are unlikely to take any vaccine for COVID-19 that has been made outside the US [7]. So, crowded public transportation means will still be fear-provoking for a significant portion of the population even when a COVID-19 vaccine is available [8].

Another issue is the way of driving. While each human driver drives in their way, vehicles operated by Intelligent Transportation Systems take similar turns. Such vehicles also accelerate or apply the brakes similarly. Many researches have shown that the different way of human driving is one the key reasons for traffic jams or traffic congestions [9, 10]; therefore, vehicles equipped with Intelligent Transportation Systems will significantly reduce traffic jams [11, 12]. Since traffic jams are one of the chief reasons to favor public transportation, Intelligent Transportation Systems will reduce the motivation for public transportation.

Due to other reasons, COVID-19 will also reduce the motivation for public transportation. In public transport, the passengers are not surrounded by metallic barriers like in private vehicles. Therefore, the passengers will be much less protected from the COVID-19 virus. The separated vehicles can protect their passengers from the unwelcome virus much more than a simple cloth mask.

In addition, tourists were an important part of the public transportation users [13]. The eagerness of people to travel for tourism purposes was significantly reduced since the COVID-19 pandemic broke out.

Another concern regarding the COVID-19 guidelines is the conflict with the concept of High Occupancy Vehicle (HOV) lanes that give priority to more occupied vehicles. The COVID-19 guidelines aim at reducing the number of people in each vehicle; whereas the HOV lanes aim at exactly the opposite – increasing the number of people in each vehicle

with the purpose of eliminating traffic congestions [14].

However, the success of HOV lanes in eliminating traffic congestion is doubtful because HOV accomplishes the task of avoiding traffic congestion only if there are traffic congestions in the first place. That is to say, it is essential to have ongoing congestion in the general-purpose lanes in order to motivate the drivers to shift to the HOV lane; otherwise, the drivers will continue to use the general-purpose lanes [15].

Table 1 summarizes the influences of both COVID-19 and autonomous vehicles. It can be seen that the influences are very similar.

Table 1. Influences of COVID-19 and autonomous vehicles.

| COVID-19 Influences | Autonomous Vehicles Influences |
|---|---|
| Both drivers and passengers should stay away | Only drivers should stay away |
| Freight transportation should be completely automatic | Freight transportation should be completely automatic |
| Reduces desirability of public transportation | Reduces desirability of public transportation |
| Reduces traffic jams | Reduces traffic jams |

2. METHODS

When it comes to fully autonomous vehicles, which is the top level of Intelligent Transportation Systems, these vehicles will be able to travel in platoons [16]. Platoons are a formation of a long train of autonomous vehicles where each vehicle keeps an equal distance from the vehicle ahead, and all the vehicles go at the same speed [17]. Such platoons will be put into operation both in freight transportation, where autonomous trucks will be platooned, and in autonomous passenger cars. Such a platoon is shown in Fig. (1).



Fig (1). Platoon of autonomous vehicles.

In the early 19th century, there was a group of English textile workers named Luddites that protested against the changes brought about by the Industrial Revolution. They occasionally demolished the innovative machines because they saw them as a threat to their livelihoods [18]. Nowadays, there are people who think that their jobs can be threatened by autonomous vehicles; however, as the Luddites had only short term and limited success, the protest against the autonomous car is expected to have the same short term and limited success.

Autonomous vehicle platoons will provide much better service because a traditional train can only take a large group

of passengers from one central station to another central station. Often a connection to another transportation means is necessitated [19]. In contrast, a platoon of autonomous vehicles can be easily split and combined, so the vehicles will be able to take passengers from various locations and give each of them a ride anywhere the road is present [20]. Therefore, even though COVID-19 discourages people from traveling, the Intelligent Transportation Systems may encourage people to travel more even though the travelling will be in much smaller groups.

The concept of platoons is suitable for the COVID-19 regulations that require distancing and separation. A separate vehicle for each passenger is ideal for avoiding infection of COVID-19.

Currently, fully autonomous vehicles without the necessity of a safety driver are approved only in a few states in the US - Arizona, California, Michigan, and Ohio [21]. However, autonomous vehicles are about to be approved in many other locations [22], and platoons of autonomous vehicles are on the horizon.

It is unsure when the COVID-19 pandemic and its consequences will leave off. The COVID-19 itself can be with us even up to 2025 [23]. At any rate, COVID-19 will not vanish in one day, and worldwide vaccination is a long-time task. In addition, fears and worries of the general public regarding COVID-19 will take time to stop. These concerns may dissuade people from entering crowded transportation means even when the COVID-19 itself comes to an end. Currently, we cannot entirely predict the long-term effects of COVID-19 on our societies [24].

The US Secretary of Transportation also commented on the year 2025. He foresaw that autonomous cars would be prevalent all over the world by 2025 [25]. Yet again, this transportation market alteration will not come about suddenly; rather, this alteration will be gradually adopted by additional authorities and passengers.

3. RESULTS AND DISCUSSION

Since before the COVID-19 outbreak, the trains in Israel run at a massive loss on a regular basis, and therefore, Israel Railways is subsidized by an enormous ratio of 85% [26]. While there are occasionally overloaded trains, most of the routes are commonly unfilled. On average, they are 70% empty [27]. Even with these openhanded conditions, the trains in Israel serve only 5% of the travels [22]. Fig. (2) shows an empty travelling railroad car.

In a few years, autonomous vehicles will be prevalent all over the world, including Israel. The competition between the traditional trains and the new trains of autonomous vehicles platoons will be hopeless for the traditional trains. Autonomous vehicles platoons will have several substantial competitive advantages:

- Better service. No need for connections with other means of transportation.
- No need for massive subsidies.
- Good response to the public panic that the COVID-19 has generated.



Fig (2). Empty railroad car of Israel Railways.

In Israel, the expansion of road no. 1 to Jerusalem from 2 to 3 lanes has been carried out concurrently with the construction of the adjacent new railroad to Jerusalem. The expansion cost of the road no. 1 was NIS 2.35 billion [28], and 133,000 vehicles averagely travel on this road every day. In contrast, the construction cost of the adjacent railroad is estimated between NIS 6.9 billion to NIS 9 billion [29], and 9,300 passengers averagely travel on this train every day [30]. The rate of car occupancy in Israel is 1.24 to 1.34 of private cars only [31]. 133,000 of all kinds of vehicles, including buses, are about 200,000 people, which give an unreasonable relative amount. The 9,300 train passengers are a small portion of the passengers and the investment in railroad is out of all proportion.

With the outbreak of the COVID-19 pandemic, all the passenger trains traffic in Israel has been stopped [32]. However, this is not an indication for a permanent close, because the Israel ministry of transportation uses this temporal stoppage for electrifying parts of the railways throughout the country.

CONCLUSION

It seems that the influence of the intense Intelligent Transportation Systems development and the impact of the COVID-19 outbreak is still underestimated by many governments; hence they continue to invest in traditional transportation instead of moving forward for a new generation of transportation [33].

New transportation technologies that provide a private space or space for very few people are the future transportation technologies. There are such emerging transportation technologies like SkyTran, which is a transportation means with private compact carriages that go on dedicated tracks installed at the height of several feet. It employs magnetic levitation in order to move these private compact carriages without contacting its tracks or the ground [34]. Also, platoons of private autonomous cars provide a space for very few people in each car.

Such transportation technologies can offer a better service without any need for connections and better protection from viruses.

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