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SOLUTION FOR USING SMART TECHNOLOGIES IN PUBLIC TRANSPORTATION "CASE OF COMPANY TRANSTU IN TUNISIA"

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Summary

As we know the transports very import in our dairy life and special a public transport which give us facilitates movements and hence increases opportunities and increases land value. also reduce air pollution, and creates employment opportunities to millions of people, so actually all the word tries to improve the public transpiration system. So, in this article we discuss the situation of public transport in Tunisia, specifically, we chose bus transport and then we try to propose smart solutions to help this wired, and finally we make a survey to figure out the best solution adapted with Tunisia infrastructure and budget.

Keywords: public transportation, smart technologies.

Introduction

New public transportation technologies are causing an unprecedented change in the transportation systems, which is an exciting inflection point. The increasing use of connected and smart transportation has the potential to drastically alter how users interact, experience, and use mass transit systems.

Emerging technologies in public transportation could provide relief for the congested city and metro traffic systems while also improving and securing the user experience.

The development of smart-technology usage in public transport is one of the key aspects of the formation of smart cities focused on attracting residents with substantial innovative and entrepreneurial potential. In the current demographic conditions, to attract and retain young people, the future of the "creative class", is a necessary factor in the development of a city like Tunis to use public transport to reduce pollution and traffic problems. So, we propose in this article to work about how we can use smart technology in public transport, and we will also propose solutions to improve the service in one of the biggest and most important public transportation company in Tunisia, "Transtu".

Research aim: To suggest possible solutions for using smart technologies in Public transportation in Tunisia.

The following **objectives** have been set to achieve the aim:
1. To evaluate which kind of smart technology is already used in Transtu.
2. To analyse the actual situation of public transport in Tunisia.
3. To present a possible solution for using smart technology in Public transportation.
4. To figure out the best solution that can used in Tunisia.

Research object and methods

The object of the research is to find solutions for the use of smart technology in Tunisia's transportation systems.

We will use different methods to help us figure out the problem of public transportation in Tunisia and find a way to introduce smart technology in public transport, so this research task was approached in multiple stages as highlighted below:

o   Quantitative methods: this method allows us to discover the exact statistics of all the information we need. In our research we will use a survey, and the results will help us choose the best solution adapted to the infrastructure and technology of Tunisia.

o   Qualitative research is the method for collecting data. We will use text analysis; it is a very important step in this article because without previous data, we cannot conduct our research (Kuo, Y. H., Leung, J. M. Y., & Yan, Y. 2023).

The method of investigation to choose the best smart solution we can use in public transportation in Tunisia

This study aims to figure out the age category of how using public transportation and choosing the best solution can match our infrastructure and technology in Tunisia.

The study has been conducted using the online survey in March 2023. A total of 52 respondents have been interviewed. The question has been divided into two blocks:
✓   Socio-demographic profiles of the respondent.
✓   Choose smart technology adapted to public transportation in Tunisia.

The results of subsequent studies are based on valid observations. But in this study it is specific with a general sample. Firstly, the judgmental sampling method has not been used because it was a very large sample, but another way the study has been conducted simultaneously, and the area under study is very dynamic, in particular, innovative solutions in the field of public transport, based on smart technology.

The study used the following socio-demographic indicators and their categories: gender, current situation, age, and country.

Initial analysis of the data showed the following: Among the respondents, there are 67% women, and 35% men (52 observations).

Respondents related age as follows: the majority (62%) is between the ages of 25 and 34, while the minority (28%) is between the ages of 24 and 35. 56% of workers and 39% of students are more concerned with the original region of Africa than with 18% of Europe and 17% of Asia.

The majority of the analysis of the question related to the choice of smart technology used in public transport in Tunisia:
1. Are you using public transportation?
2. How often do you use public transportation per day?
3. How many types of public transportation do you use?
4. Do you have information about smart technology?
5. Have you ever heard about the use of smart technology in transportation?
6. What do you think about the quality of public transport in Tunisia?
7. What is the best public transportation like in Tunisia?
8. Which smart technology do you think is appropriate for the Tunis system?

Research results

The first railway in Tunisia, connecting Tunis and La Goulette, was opened in 1872. The first trolley, which was initially drawn by horses, was inaugurated in 1885; tram electrification began in 1902. In 1903, a commuter train between Tunis, Bab Saadoun, and La Manouba was inaugurated. Bus service began in 1930. Trolleybuses took the place of trolleys by 1944. Tunis's transportation networks were nationalized after the country attained independence. In 1964, the Société Nationale des Transports (SNT) was given responsibility for overseeing transit in the greater Tunis region. To provide a modern transit system without incurring the expense of establishing a subterranean metro, the Metroleger was subsequently developed. Between Tunis and Ben Arous, the first trains on Line 1 started running in 1985 (Wolkowitsch, M. 1964).

In 2003, the SNT and the company Metro in Tunis were combined:

- The current state of public transportation technology.

- Over the previous 20 years, public transportation appeared to be developing more slowly than other areas of the transportation industry. The electronic transformation of their current IT infrastructure is frequently what inhibits public transportation services from incorporating innovative technology.

For this reason, solutions to issues with public transportation must have three crucial elements:

- Provide the option to cut expenses, for instance, by combining various technologies.

- Provide a strong case for return on investment, such as by lowering implementation and management expenses.

- Securing the future by making sure that the investments made today will endure.

It can be challenging to replace, integrate with new solutions, or upgrade existing technology used in public transportation, whether it is due to vendor lock-in or the use of a complicated range of hardware. Because of this, Digi's transportation solutions are made to be extremely quick to deploy, provide system-wide monitoring and management with Digi Remote Manager®, and help transit authorities make the switch to 5G, the upcoming network technology. Digi's transportation solutions are also made to meet the many and complex demands of mass transit systems.

Incentives to improve public transport using technology. Generally, public transportation is expected to carry out several crucial tasks that the current, overworked systems are occasionally unable to complete. Public transportation that is useful and accessible should:

- Give those with no other practical or cheap options basic mobility, this will democratize access to jobs, healthcare, and neighborhood resources.

- Increase the job prospects in public transportation networks and provide secure, comfortable, and practical solutions for city dwellers to get to work

- By reducing traffic congestion, pollution, and the likelihood of accidents, you can increase public safety.
- Reduce a community's overall carbon footprint.

Failure to invest in updating public transportation infrastructure "may lead to a loss of $340 billion in total commercial sales between 2017 and 2023," according to a report commissioned by the American Public Transportation Association (APTA). This is a compelling reason for public officials to give infrastructure modernization projects top priority and adopt cutting-edge public transportation systems (García-Ortiz, A., Amin, S. M., & Wootton, J. R. 1995).

On a more upbeat note, these are some of the encouraging issues brought up in the APTA piece:
- Public transportation expenditures return $5 in economic gains for every dollar spent.

- Every billion dollars spent on public transportation sustains and generates about 50,000 jobs.
- Every $10 million invested in public transportation increases economic output by $30 million.
- Operating expenditures of $10 million result in $32 million more in improved revenue for the company.
- The private sector receives an estimated $39 billion in public transportation spending.
- The challenges of adopting new public transportation technologies

Even though IOT and 5G technology present a potential path for enhancing public transportation and its IT infrastructure, city planners and IT operations teams will still confront some difficulties. Optimizing intelligent traffic management and other public transport systems can be difficult due to the range of hardware and software solutions that many of these systems use.

The usage of a variety of apps for tasks including capacity management, security, fare collection, and vehicle movement assessment is probably widespread among transportation authorities and agencies. It can be expensive and time-consuming to combine controls or end-user access to multiple services in a single interface.

Due in large part to the following issues: restricted funding for modernization efforts, it is frequently not viable to replace outdated IT infrastructure and applications. Transit systems, on the other hand, can use 5G to constantly monitor, integrate, and control data-driven activities across numerous platforms and applications by installing IOT Coherent devices, such as Digi TX64 5G and Digi TX64 5G Rail.

Case of Tunisian four Solutions of smart technology to improve the public transportation. In the case of Tunisia, the choice of smart technology that we can introduce in Transtu Company is difficult because we already don't have a good infrastructure, we don't have a big budget, and it is not easy for the population to make everything online. Not all the families have internet, so we will propose simple solutions that are efficient at the same time.

Application Tunistrans. I propose creating a simple telephone application named Tunistrans, where we can put for each bus number the times of arrival at point A and the times of arrival at point B, mention the delay if there is one, how much the transport costs, and another transport alternative where we can also pay for tickets by bank card and receive an electronic tick in our email box. Also, to encourage the Tunisian population to download the application and use it, we can offer a 30% reduction for the first 10 tickets purchased and also offer free tickets on the first day of school holidays and public holidays. So if we can attract 40% of the population to using this technology, we have already received the introduction of new technology within our public transport and a reduction in the use of the paper ticket, so we have gained agents at the impression level, saved time, and protected our plant from pollution because near all the bus or metro stations there are huge quantities of old tickets in the street.

Traffic video surveillance. This is a compelling reason for public officials to give infrastructure modernization projects top priority and adopt cutting-edge public transportation systems.

The Intel processors used by professional video to create its Intelligent Traffic Management System (ITMS) combine a CPU and GPU into a single semiconductor component. To monitor, control, and examine vehicle movement, the ITMS analyzes unprocessed visual input. For the protection of motorists and pedestrians, this makes it simple to enforce traffic laws.

This solution is very helpful in Tunisia because usually we have traffic problems and bus delays. The driver never has information about the situation along the way. Maybe with this technology we can find alternatives at the moment and avoid all these problems.

Self-check. Self-check is automatic control; in Tunisia, unfortunately, we need a controller who arrives and controls the passenger ticket one by one, so this technology consists of installing a small screen at the port level of each bus when the ticket can pass and allowing us to open the entrance bar to the bus. In this case, we managed to implement new technology and other time savings better than waiting for a single person to arrive and control more than 50 passengers. Also organize wired transport in Tunisia, and specifically the most disorganized is bus and metro transportation, which also ensures that all passengers are paid for their transport.

5G supports new public transport technology. City planners and IT operations teams will encounter several difficulties even if 5G and IoT technology offer a promising way to enhance public transportation and its IT infrastructure. Optimizing intelligent traffic management and other public transport systems can be difficult because many of them use a mix of hardware and software solutions. The usage of a variety of apps for tasks including capacity management, security, fare collection, and vehicle movement assessment is probably widespread among transportation authorities and agencies. It can be expensive and time-consuming to combine controls or end-user access to multiple services in a single interface. Due in large part to the following issues: limited budgets for modernization efforts, it is frequently not possible to completely replace existing IT infrastructure and applications. Transit systems, on the other hand, can use 5G to consistently monitor, integrate, and manage data-driven functions across numerous platforms and applications by deploying IOT coherent devices, such as Digi TX64 5G and Digi TX64 5G Rail.(Sutar, S. H., Koul, R., & Suryavanshi, R. 2016).

Survey results. The survey aimed to explore public transport usage, attitudes towards public transport quality, and knowledge and preferences for smart transportation technologies in Tunisia. The survey was conducted on a sample of 53 individuals, including 67.9% females and 32.1% males, of various ages, employment statuses, and geographical origins. Gender representation in the survey was slightly skewed towards females, with 67.9% of respondents being female. Respondents' ages varied from under 24 to 44 years old, with the majority falling between 25 and 34 years old. Regarding employment status, 56.6% of respondents identified themselves as workers, 39.6% as students, and 3.8% as "others." Additionally, most respondents were from Africa, with 18.9% of respondents from Europe, 17% from Asia, and 11.3% from "other" regions.

In terms of the quality of public transport in Tunisia, 58.2% of respondents considered it to be a low-quality service, while 34% described it as normal, and 11.3% labeled it a good-quality service. No respondent found public transport in Tunisia to be excellent. However, when asked about the best public transport mode in Tunisia, most respondents preferred trains, followed by buses and metros.

The survey found that 66% of respondents use public transport, with 58.5% using it one to two times per day. Most respondents who use public transport rely on one mode of transportation bus, train, or other transportation. On the other hand, 20.8% of respondents use more than two types of public transport (bus and train). It was also revealed that the majority of respondents have heard of smart technology (71.7%) and are aware of its use in transportation (62.3%).

Regarding appropriate smart technologies for the Tunisian transportation system, most respondents (46.2%) preferred Tunistrans, a mobile application that provides information about bus schedules and offers an online ticketing service. Other smart technologies mentioned included self-check machines, traffic video surveillance, and 5G technology. Respondents generally preferred smart technologies that improve transportation information provision and ticketing services, even if there was some variation in their preferences.

In conclusion, the survey results showed that there are differences in public transport usage and attitudes based on factors such as gender, age, and employment status. For instance, more females than males participated in the survey, and most respondents were aged 25–34 years old. Additionally, students were more likely to use public transport than workers, and workers were more likely to be dissatisfied with the quality of public transport than students. The survey found that 52.8% of respondents who use public transport are dissatisfied with its quality. The main reasons for dissatisfaction might be related to overcrowding, delays, and inadequate infrastructure. A potential solution to improving public transport in Tunisia could be to promote the use of smart technologies. Respondents showed significant interest in smart technologies that provide information about transportation and offer online ticketing services. Investing in these technologies could improve the overall public transport experience, making it more convenient and attractive for users in Tunisia. However, promoting the use of smart technologies could face challenges, such as the need for significant investment in new technologies and infrastructure, as well as potential privacy concerns related to the use of surveillance technologies.

These challenges should be carefully considered before implementing any new smart transportation technology. These differences should be taken into account when designing policies and solutions to improve public transport in Tunisia. Tailoring solutions to specific groups' needs and preferences could increase the likelihood of their success and acceptance.

Discussion and implications

Smart technology use in transportation is very important to day, as we know all the world works to get better transportation systems and also makes it easy, so we need to make it mandatory to introduce smart technology in our public transportation, but the same county is very reluctant to do it because they already have a good infrastructure. But in the case of Tunisia, it is not as easy as we think, which is why we need to figure out what kind of smart technology we can use to solve our problems. The most important one is the mess in the station, which can be organized, and the access to transport and accessibility of information can also have all the details of your transport or your trip, which you can book online and pay for. All of this can help the country evolve, so why not start working on smart cities?

As we see in the survey results, the best solution is to make an application that can organize all the systems (bus transport and metro) and give them the name Tunistrans. I recommend this solution because it is adapted to our system and also possible to do, first of all, because it is not expensive to do, and secondly, because with this application, we will encourage the teenagers to use smart technology and organize public transport systems.

Conclusions

1. In this study, we analyze the actual situation of public transport in Tunisia and then propose four smart solutions adapted to the infrastructure and the problem of the system, of which one can help and make it better wired. So, we are using different research methods to, first of all, understand the real and actual situation of public transport in Tunisia, specifically the bus and metro situations, and also the point of view of the population. We used qualitative and quantitative research, and especially we chose survey as the best method to give us answers to all the questions written in the research objectives.

2. The solutions we can used for using smart technologies in public transportation in Tunisia it can be:
   - As a result of the findings, smart technology has never been used in public transportation in Tunisia.
   - The actual situation of public transportation in Tunisia was evaluated as "not good" in 52% of cases.
   - The best smart solution was choosing 46% the application of Tunistrans; it is the good solution for our problems.

3. So these results show how much our public transportation is in need of help in Tunisia. We have all the necessary equipment, but unfortunately we don't give attention to this field despite the fact that public transportation is the most important thing in any country in the world. So we try to make this application, TUNISTRANS 4 True," to help my country get better, and we hope that in 2023 we can use this application, which will be the start of introducing smart technology into our system of public transportation.

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