



Implications of Using Internet of Things in Public Transport

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Abstract: With the advent of urbanization, the role of public transportation cannot be ignored. Rapid rise in urban population and car-centric urban development has led to various challenges for public transportations. Public transport systems are an essential part of safe, clean and affordable transport for development. These systems bring many benefits to individuals, communities, and the local economy. In spite of its necessity and benefits, public transport is a challenging endeavor in urban areas. The millennial commuters want the system to be highly efficient and commuter-friendly. This has led to the use of Internet of Things (IoT) in public transport. This paper focuses on the need and use of Internet of Things technology in making public transport smarter, faster, efficient, economical, and environmental friendly. This study is based on secondary data collected from various sources like research journals, internet, magazines, newspapers, and PhD theses. The objectives are to study the need of public transport in India and the use of IoT in Public transport.

Index Terms – Internet of Things, Public Transportation, Smart City, Smart Transportation.

I. INTRODUCTION

The urban population has been increasing steadily since last 10 years. It was reported at 34.47% in 2019, as per the development indicators collected by World Bank. This number is nearly equal to the total population of the US. This will require investment in the urban infrastructure and such investments will define livability of the cities.

The Smart Cities Mission was launched by the Government of India to promote the cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions. The focus is on sustainable and inclusive development and the idea is to look at compact areas, create a replicable model which will act like a light house to other aspiring cities. The main purpose of the Smart Cities Mission is to drive economic growth and improve quality of life. Existing areas, including slums, will transform into better planned ones because of the area-based development. Cities will use technology through application of Smart Solutions to improve infrastructure and services.

Smart cities cannot be built without smart public transport. Under the smart cities programme, the cities are required to build efficient urban mobility and public transportation by creating walkable localities, as well as promoting a variety of transport options. Lack of such facilities will force the public to use other modes of transport like private vehicles which will have negative impact on environment and public infrastructure.

Intelligent Transport System (ITS) holds promise for a sustainable and balanced transportation solution. ITS is essentially the application of computer and communications technologies coming in aid of the transport problems. These technologies enable gathering of data or intelligence and then providing timely feedback to traffic managers and road-users. ITS results in improved safety to drivers, better traffic efficiency, reduced traffic congestion, improved energy efficiency and environmental quality and enhanced economic productivity.

Using Internet of Things one can connect every element of public transport network operations, providing the technical tools to assemble groups of devices and sensors to connect them to IT infrastructure. This covers everything from vehicle control to location tracking applications, and from public announcement systems, passenger information systems, enhanced communications, passenger counting, fleet management and surveillance systems.

II. NEED OF PUBLIC TRANSPORT

India, one of the fastest growing economies in the world, is achieving a growth rate of 7.5% per annum. With a growing population too, the country is working hard to transform itself over the next few decades. Improving public transportation is high on the agenda. Public transportation can convey many more people in much less space than individual automobiles, which helps to keep traffic congestion lower, which in turn reduces air pollution from idling vehicles, and helps riders avoid the stress that comes from daily driving in highly congested areas.

Urbanization

Urban population (% of total population) in India was reported at 34.47% in 2019, according to the World Bank collection of development indicators. By 2030, 40.76% of the country's population is expected to reside in urban areas. While only 30% of the total population live in urban areas, approximately 63% of India's Gross Domestic Product (GDP) is contributed by those urban areas. Among the several factors that have led to the urbanization in India, two factors- population growth and migration are the major factors. The expansion of towns and cities is also seen as a huge contributor to the urbanization growth. Cities provide major opportunities for sustainable development, because they have large numbers of people living in a small area. This offers significant economies of scale which provide jobs, housing and services. The potential of Indian cities needs to be fully realized for ecological, economic and social sustainability. This urbanization can be harnessed and sustained by inclusive planning that provides affordable transportation, continuous water supply, modern sewage treatment and a good solid waste management system.

Public transport systems are an essential part of safe, clean and affordable transport for development. Without it, work opportunities would exist only within walking distance of their homes, so public transport improves livelihood opportunities. It also provides greater access to education, health care and recreation. For senior citizens, people with disabilities and children, public transport is often the only means of mobility.

Government of India is developing smart cities across the country, making them citizen friendly and sustainable. Smart Cities target to put people first in their approach. The Indian government launched a mission in 2015 called Smart Cities Mission to meet the objectives. The execution of the mission is broadly divided into 4 categories:

Physical Infrastructure involves building and developing physical infrastructures like residential and commercial buildings, transportation systems, energy systems, water supply and sewage systems, sanitation facilities, solid waste management systems, etc.

Social Infrastructure involves working for the redevelopment of the human and social capital, such as the educational, healthcare, and entertainment sectors, etc.

Economic Infrastructure Smart cities need to identify their core competence, advantages, and potential to generate economic activities to create employment opportunities and economic infrastructure.

Institutional Infrastructure refers to the governance of the city. Today cities need high-quality governance, especially e-governance and citizen participation. It will gear up the activities related to planning and management systems.

Congestion

A century of car-centric urban development has left our cities polluted and congested. The density of private cars soared by 18 per cent in just two years in Mumbai. With 510 cars per km, the car density in the city is almost five times that of Delhi, which has 108 cars per km. The reason for Mumbai's high car density can be attributed to lack of road space with just 2,000 km of roads as compared with 28,999 km in Delhi, although the city's private car population is less than a third of Delhi's. The other cities that followed suit are Pune at the second spot with 359 cars per km, Kolkata at third position with 319 cars per km, Chennai with 297 cars per km and Bengaluru a distant last with 149 cars per km, according to the statistics from the respective state transport departments.

It took 60 years (1951 to 2008) for India to cross the mark of 105 million registered vehicles. But thereafter, the same number was added in a mere six years (2009-15). The number of vehicles in India has increased 700 times -- from 0.3 million in 1951 to 210 million in 2015 as per the study by the Centre for Science and Environment (CSE) titled 'At The Crossroads'. According to the study, the number of cars registered in India between 1951 and 2005 stood at 10.3 million and cars almost twice that number were registered in just ten years -- 20 million from 2006 to 2015.

Public transport is far more efficient than personal motor vehicles in terms of road space it uses. A bus carrying 40 passengers uses 2.5 times more road space than a car carrying only 1 or 2 people. Public transport is thus important for improving sustainable mobility in urban areas.

Pollution

Exposure to toxic vehicular pollution has worsened in India due to staggering pace of motorisation, with the number of registered vehicles going up 700 times from 0.3 million in 1951 to 210 million in 2015, a study has said. The study by the Centre for Science and Environment (CSE) titled 'At The Crossroads' -- has revealed that the growing number of private vehicles without adequate public transport in cities will lock in enormous amounts of pollution and carbon.

A report submitted by the Environment Pollution (Prevention and Control) Authority to the Supreme Court had said that there is an enormous shortfall in the current level of public transport services. It had called for massive augmentation of public transport so that people do not use their cars.

Public transport is far more efficient than personal motor vehicles in terms of energy consumption also. A bus carries about 20 times more passengers than a car and consumes only 3 times as much fuel as a car. This leads to less air pollution and encourage low-carbon growth in cities.

III. BENEFITS OF PUBLIC TRANSPORTATION

Public transportation systems bring many benefits to individuals, communities, and the local economy.

Reduces Pollution

By moving people more efficiently, public transit produces significantly less air pollution per passenger mile than a standard car carrying a single driver. Buses emit 20% less carbon monoxide, 10% as much hydrocarbons, and 75% as much nitrogen oxides per passenger mile than an automobile with a single occupant.

Fuel Efficiency

Public transportation is also more fuel efficient per passenger mile, which contributes to an overall decrease in the amount of energy necessary for transportation.

Increased Mobility

For those who don't, or can't, drive, public transportation allows them to get to work, to school, to the grocery store or doctor's clinic, or just to visit friends, without having to engage a friend or relative to do the driving.

Frees up time

Taking public transportation can free up a significant amount of time and attention, as someone else is doing the driving, which allows riders to spend their transit time reading, working, studying, or being entertained instead of having to watch the road.

Encourage healthier habits:

Public transportation is linked to healthier lifestyles, as people who use public transportation are said to get more than three times the amount of physical activity per day than those who don't, just from walking to and from their transit stops and their final destination.

IV. CHALLENGES OF PUBLIC TRANSPORTATION

Public transport is a challenging endeavor in urban areas. As certain city populations grow, and as their economic bases shift and evolve and their housing sector adjusts, even more vehicles are entering the roads each day. Various challenges are faced by public transportation.

Frequent Breakdowns

This causes a temporary stoppage of services and leaves passengers stranded in the midst of their commutes. This causes a lot of frustration for the passengers and also causes the disruption of the entire transportation network, delaying the journeys of a larger number of people. This had a cumulative effect on the overall functioning of a city or a region that is dependent on the transportation system.

Reliability of Bus Timings

The reliability of bus timings is affected by various factors such as driver not reporting on time, getting stuck in a traffic jam, and breakdown of a bus on road.

Traffic Congestion

Traffic congestion during office timings is a major challenge for Public Transport. Dedicated bus lane and use of technology can be used to avoid traffic jams.

Customer Experience

Not only do customers want public transport to be more convenient and accessible, they also want their experience to be comfortable, memorable and personalised. In other words, customer expectations have changed. The better experiences that customers have on public transport, the more likely they are to use it and encourage their friends, family, and colleagues to do the same.

V. BENEFITS OF USING IOTs IN PUBLIC TRANSPORT

Public Transport is typically cheaper and greener than travelling by a private vehicle. But it may not be as comfortable, convenient, or as quick as a private vehicle. Planning of schedules around the Public Transport timetables must be made by the passengers and sometimes unforeseen circumstances may disrupt the public transport operations.

However, with the use of IoTs, many drawbacks of public transportation are slowly being eliminated. Smart connected public transportation systems will offer many benefits to passengers. This technology will further improve the passenger's experience on public transit by offering real-time vehicle tracking, notifications in case of an unexpected event, and personalized travel news to passengers.

Real-Time Vehicle Tracking

One of the main complaints by the public transport users is their inability to get real-time information about where the vehicle is or when it will arrive at a particular stop. Use of IoT technology enables easy tracking of the location of the buses. The buses can be fitted with Global Positioning System (GPS) that are connected to the internet. The GPS data is transmitted back to a central command center. After receiving the GPS data, the information can be relayed to the passengers mobile device or to an electronic sign at transit stops. Passengers can then know the exact time the vehicle will arrive at a particular stop.

Additionally, commuters can also know if buses are filled or empty. They can also know the number of people waiting at the bus stop. This way, they can know when they can find the most convenient time to start their commute. Thus, commuters can know the exact Estimated Time of Arrival (ETA) for their buses and leave their homes just in time to get the next empty bus. They won't need to spend their time just waiting for the next empty bus.

Unexpected Events

Unforeseen circumstances can sometimes disrupt public transportation such as breakdowns, road closures, or inclement weather. Internet of Things will enable in easily re-routing of vehicles, notifying passengers, and helping them in making alternate arrangements. It will also enable the public transport administration to develop a contingency plan in such event of an unforeseen circumstance.

Personalised Travel Information

People love to feel special. Personalized information will make passengers of public transport feel as if they are being taken care of. Internet of Things technology will enable the administrators to easily send out personalized travel information to passengers. For example, they can track a particular person's travel habits and determine which station and/or route that person frequently uses. In the event of a scheduled station closure or the re-routing of a particular route, the administration would be able to notify the person ahead of time.

Maintaining Vehicles & equipment

A major cause of passengers' dissatisfaction with most public transport systems, is the frequent breakdown of vehicles or infrastructure. Using IoT systems to constantly monitor the different health parameters of vehicles and infrastructure can help identify potential problems in advance. These parameters may include engine temperatures, tire pressure, fuel and battery levels, and other similar factors that are indicative of system health. IoT sensors can continually monitor these parameters to spot any anomalies and notify the concerned personnel to initiate maintenance activities. This will lead to high uptime of services, minimal disruptions, and greater safety for passengers.

Optimizing transport routes

Using IoT sensors at bus stops, transportation authorities can have a clear assessment of the footfall at these places. They can know how many people need to be picked up from which stop. They can use this information to allocate the appropriate number of vehicles to different routes. They can also use the traffic information gathered through the sensors planted along the roads, at signals, and on street lights to plan the fastest routes. The shortest route between two points can be constantly relayed to the bus drivers, who can use this information to get their passengers to their destinations in the fastest way possible.

Minimizing traffic and pollution

Using IoT in long term will benefit the public transportation by making it highly efficient and commuter-friendly transportation system. This will lead in the increasing preference for public transport over private vehicles. People will prefer using it more not just for economic reasons but for overall convenience. This will reduce the number of private vehicles on roads and in the process, make public transport even faster and safer. A city that is predominantly dependent on public transport also cuts down significantly on its carbon footprint, leading to benefits on the environmental front.

VI. CONCLUSION

The Internet of Things technology will continue to improve the passenger experience for public transportation by offering real-time vehicle tracking, improved responses in the event of an unexpected event, and personalized travel information. As cities become more congested and as more people look for ways to go green, public transit will become a very attractive option for people looking to forgo using their personal vehicles. IoT technology will only improve public transit and as public transit improves, there will be converts left and right.

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