Smart Public Transport for Accessibility

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Contents

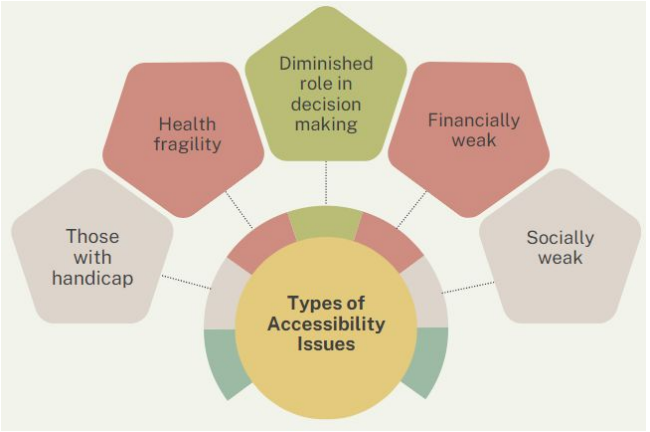
Note: all citations in this presentation are synchronized with the references in our paper

What is Accessibility, and why do we need it?

Accessibility has always been a challenge when it comes to public transport, the want for it to be financially and physically inclusive is the need of the hour. Especially when it comes to addressing the needs of **Persons with Disabilities (PwD), aged populations as well children**- accessibility is the door to independence.

Five key barriers to accessing services include [2]:

- Availability and physical accessibility of transport
- Cost
- Services and activities located in inaccessible places
- Safety and security
- Travel horizons (unwilling to travel or do not know about services)



What is Smart Transport?

CPS integrates computational and physical system, facilitating real-time interaction between human, machine, and the environment.

This integration of computational capabilities with physical components is revolutionizing traditional urban transportation systems, transforming them into intelligent networks that are more efficient, responsive, and accessible.

What challenges can CPS solve?

- obstacles to **flexibility**, such as inadequate infrastructure, a
- dearth of **real-time information**, and
- difficulties in regulating **urban** areas.

Currently available solutions

Technology/Study	Limitations
Accessibility practices (Policy, Infrastructure)	- Transfer of solutions from developed to developing countries is sensitive and challenging. - Accessibility is often not included in early stages of transit system planning.
Low-cost technologies (2005, Mashirietal.)	- Risk of vandalism. - Literacy of users may limit effectiveness. - Operational reliability and compatibility issues.
GIS for Public Transport (2014)	- Requires high-quality, standardized geographic data. - Needs coordination between multiple administrative agencies.
Public Transport in Ludhiana (2015)	- Limited time and geographical area of study. - Limited validation of scoring systems used for assessing transport facilities.
Public Transport for Cerebral Palsy (Mumbai)	- Focused only on physical and social accessibility; broader systemic changes are needed. - Policy-level improvements are slow and not universally implemented.

Currently available solutions

EzyMov Taxi Service (India)	- Limited reach to users in need due to operational scale. - High dependency on specialized technology (e.g., hydraulic lifts).
Smart Transport Solutions (CPS)	- Dependent on real-time data contribution from users. - Privacy and security concerns. - Difficult to integrate CPS with existing infrastructure. - Vulnerable to cyber-attacks.
TCPS for Smart Cities (2022)	- Does not provide solutions for accessibility issues specific to People with Disabilities. - Data security, privacy, and integration challenges with current systems.
Real-Time Distributed Feedback System (2024)	- High cost of equipment and infrastructure. - Reliance on network and sensor functioning. - Limited to detecting obstacles in specific areas (e.g., wheelchair ramps).

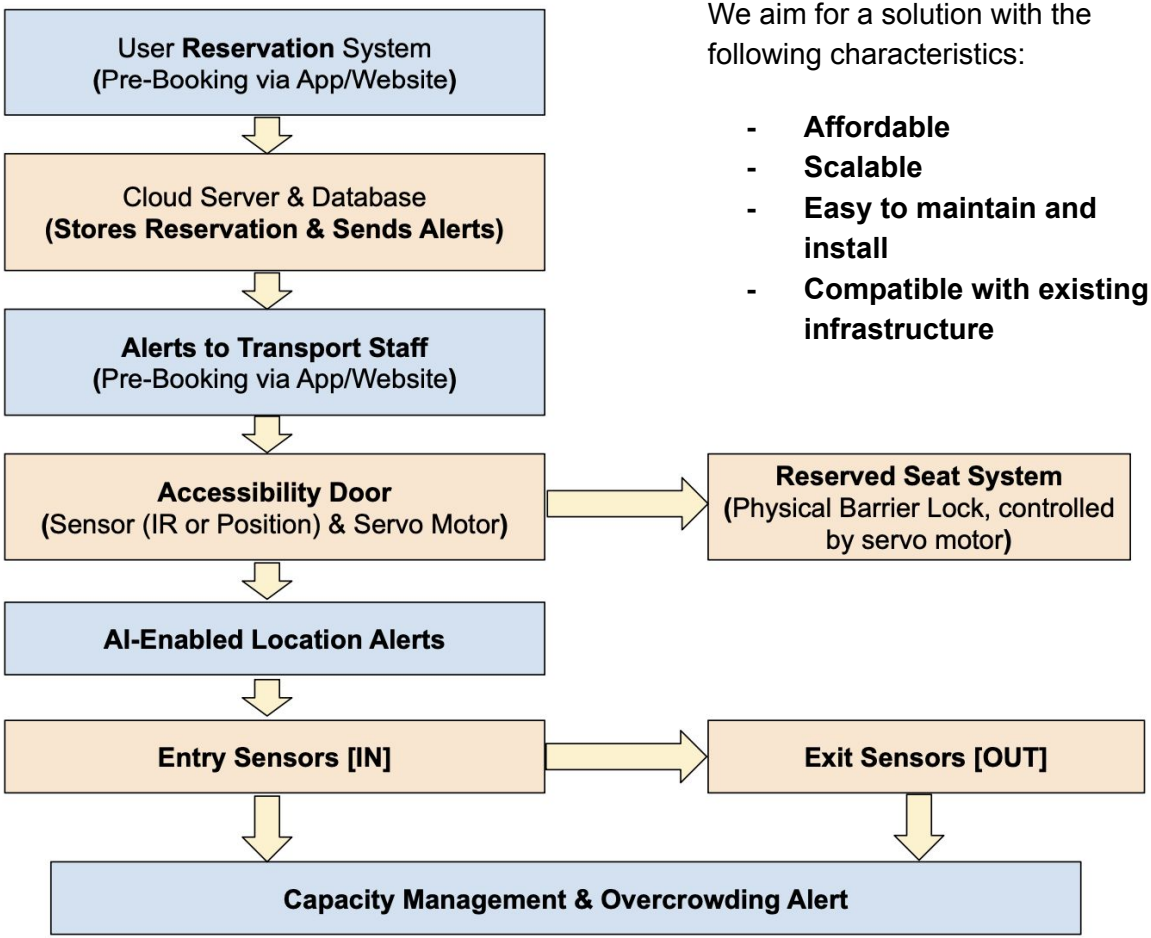
Sensor-Based Capacity Management System

Objective:

- Address **overcrowding and seat reservation** in public transport to ensure comfortable and accessible travel for all passengers.

Solution Components:

- **Sensors or cameras** at entry points to track the number of passengers boarding.
- Sensors at exit points to monitor passengers leaving the bus.
- **Real-time computation** to ensure total passengers remain within the maximum allowed capacity.
- Transport staff aware of when and where someone with special needs might board the bus, and can prepare accordingly.

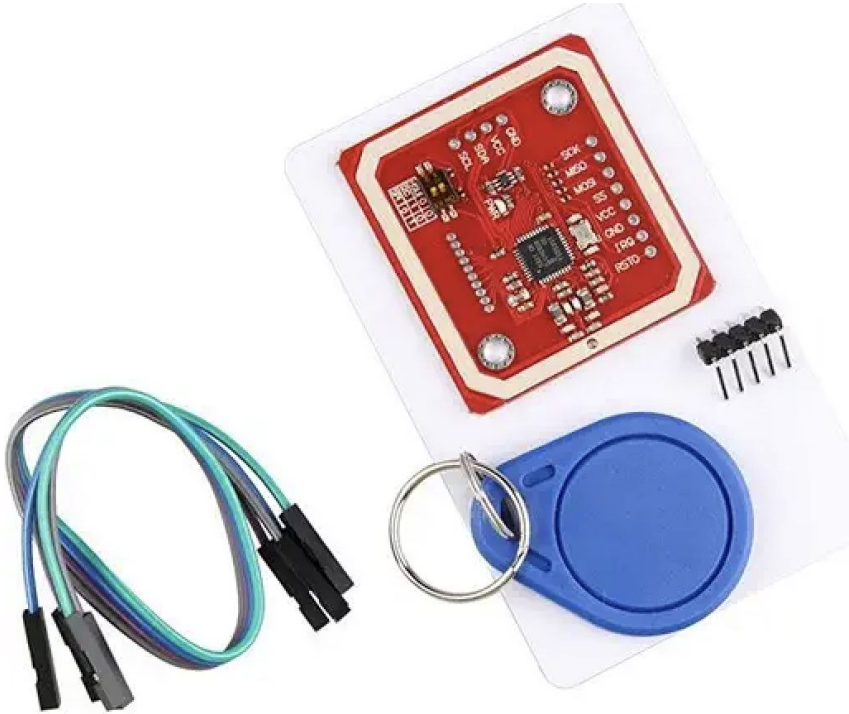


We aim for a solution with the following characteristics:

- **Affordable**
- **Scalable**
- **Easy to maintain and install**
- **Compatible with existing infrastructure**

Sensors

IR Proximity Sensor:
Sharp GP2Y0A21YK0F



RFID sensor:
PN532 NFC/RFID Module

Primary: MG996R Servo Motor

A popular high-torque digital servo for robotics, remote-controlled automobiles, and other applications needing exact angular position control is the MG996R servo motor. It is simple to interface with an Arduino, and by **sending a PWM (Pulse Width Modulation) signal from an Arduino pin, you may adjust its tilt.**

Required Parts: Arduino (such as the Arduino Uno)

Power supply for the MG996R Servo Motor (servo motors frequently need external power)

Key MG996R specifications:

Voltage range for operation: 4.8V to 7.2V

About 10–12 kg/cm of torque at 6V

PWM control signal, usually at 50 Hz

Angle range: 0° to 180°

Challenges

Table 2: Pros and Cons of Proposed Solutions

Solution	Pros	Cons
Reservation System	- Ensures accessibility by reserving seats and reduces conflict over occupying seats. - Alerts staff in advance to accommodate passengers.	- May cause inconvenience to regular passengers when there is a shortage of seats. - Risk of misuse or vandalism of the physical barrier system.
AI-Enabled Alerts	- Provides and analyzes real-time information, optimizing boarding processes by anticipating demand.	- Requires location-specific data. - Raises privacy concerns and demands data accuracy and driver compliance.
Capacity Monitoring	- Prevents overcrowding and supports efficient load management and safety compliance.	- High cost of installing and maintaining sensors/cameras. - Risk of technical failures affecting monitoring accuracy.

References:

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