Proposal Project: Smart Navigation in Transport Interchanges: A Mobile App Case Study of Príncipe Pío

App: A DÓNDE VAS?!

Autors: Allison Fernández, Federico Gulisano, Elena Hernández-Pacheco, María Eugenia Hernández, Ana Racero

Objective: Wayfinding, Signposting, and Information.

Focus: User centric. Solutions description:

What solve? How? Tools, equipment? Cost? How it will be integrate in the Platform?

Problem statement

The current navigation experience within the transport hub is inadequate, particularly for users unfamiliar with the intermodal urban mobility system. Poor signage limited real-time information on bus departures and arrivals, and unreliable QR code boards exacerbate the problem, leading to confusion and inefficiency for users. It could generate overcrowding in some places due to the misinformation and the need to have more staff to attend to users' questions and doubts.

Proposed solution

Our main aim is to improve the user experience inside the interchange in order to make easy the movements and encourage its usability and accessibility. Then we propose developing a Digital Twin (DT) of the transport hub to serve as the foundation for a mobile application that enhances user navigation and experience. The app would provide:

Dynamic wayfinding

- An interactive map (like Google Maps) guides users from their current location (e.g., shopping mall or other hub areas) to their destination within the hub. Using specific, easy-to-understand and easy-to-remember **nomenclature** to identify each space and location within the interchange.
- Estimated time to reach the desired platform or bus bay or move from point A to B (origin – destination) based on real-time pedestrian flow (congestion or pressence) within the hub.

Real-time information

- Bus, metro, and train schedules, including delays or incidents.
- Environmental variables status.

Also, we proposed using the screen devices available in the hub to connect with the database app and show the same or more specific real time and reliable information relevant for the users in a specific location inside the hub.

Core features and data sources

The solution would rely on the following data streams:

- Transport schedules: Arrival and departure times for buses, trains, and metro services.
- User geolocation: Real-time location tracking to guide users.
- Pedestrian flow monitoring: Sensors or cameras to estimate crowd levels (not necessarily counting individuals but detecting congestion levels).
- Incident alerts: Updates on delays or disruptions in transport services.
- Environmental variables data: Temperature, air, noise, humidity.
- Cybersecurity resilience: Implement tokens and algorithms to avoid cyber-attacks or data corruption.

Benefits

The solution aims to:

- Enhance the user experience by minimizing confusion and frustration.
- Improve the usability of the interchange and reduce the penalty to the transfer action inside it.
- Increase user independence, making navigation less reliant on physical signage or narrow corridors that cannot be easily altered.
- Encourage users to utilize amenities such as shopping areas, knowing they have sufficient time to reach their transport connections.

Scalability

The concept is highly scalable and can be adapted to other transport hubs, as the essential data requirements remain consistent across locations and depend exclusively on the hub and transport mode services available in this.

Stakeholders

The primary stakeholders who could benefit from or support the implementation include:

Public Administration: A public service initiative enhancing the citizen experience at a minimal implementation cost.

Transport hub operators/Concessionaires: A means to improve the hub's reputation and user satisfaction. Potential to increase revenue from shopping areas as users can confidently spend time there without worrying about missing their connections.

Future works

Use historical data related to occupancy within the interchange to predict using specific parameters (time of day, day of the week, whether there are events or not, etc.) how congested it will be and estimate the actual time the user could spend to move within the interchange, reach their destination (different bus and metro modes of transport in this case) and the waiting times according to the arrival/departure times of each.

On a large scale this estimation could also be extended to additional modes or services (using other sources of information) such as the number of available spaces in the park-and-ride car park or the availability of bicycles in the nearest BiciMad stations.

Budget proposal

Name	Description	Tools
1. Development costs		
1.1 Mobile application development	Development of a mobile application featuring real-time information, dynamic wayfinding, and an interactive map.	Frameworks, APIs for transport schedules, integration with geolocation and sensor systems.
1.2 Digital twin implementation	Development of a digital twin for the transport hub to simulate real-time pedestrian flows and operational insights.	Monitoring cameras, 3D modeling software, cloud-based simulation platforms.
2. Equipment costs		
2.1 Monitoring equipment	Cameras for pedestrian flow monitoring.	Includes installation and setup costs.
3. Implementation costs		
3.1.System integration	Integration of the app and digital twin system into the existing transport platform.	Platform integration and API development.
4. Maintenance and operational costs		
4.1 Maintenance of mobile application	Updates, bug fixes, and feature improvements.	
4.2 Digital twin maintenance	Regular updates to reflect structural or operational changes in the transport hub.	
4.3 Equipment maintenance	Regular calibration and repair/replacement of cameras	