UNIVERSITÉ DE PAU ET DES PAYS DE L'ADOUR | COLLÈGE STEE SCIENCES ET TECHNOLOGIES POUR L'ÉNERGIE ET L'ENVIRONNEMENT

M2 Computer Science Industry 4.0

Title : The Role of Digital Twin to Advance Urban Smart Mobility Solutions

Author : Zain RAMZAN

WHY ?

- Cities face increasing urbanization challenges: congestion, pollution, inefficient public transport.
- IoT and AI offer solutions, but scalability, data integration, and real-time decision-making remain major hurdles.
- Digital Twins (DTs): A promising technology to create virtual representations of real-world mobility systems for enhanced decision-making.

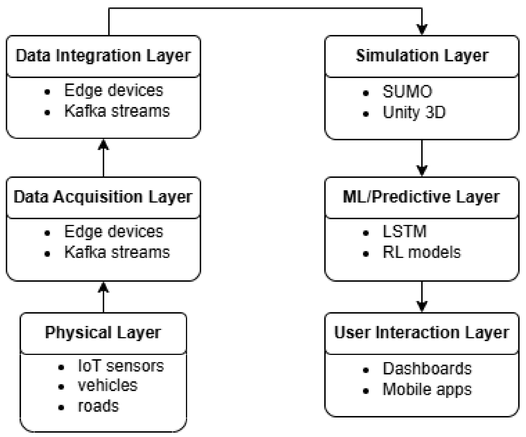
STATE OF THE ART

- IoT, AI, and Intelligent Transport Systems (ITS) enable traffic management but suffer from data inconsistency and privacy concerns.
- Various Digital Twin applications in urban mobility exist, but many face high computational costs, interoperability issues, and limited real-time adaptability.
- Need for a scalable, adaptive, and interoperable system that integrates real-time traffic data with predictive analytics.

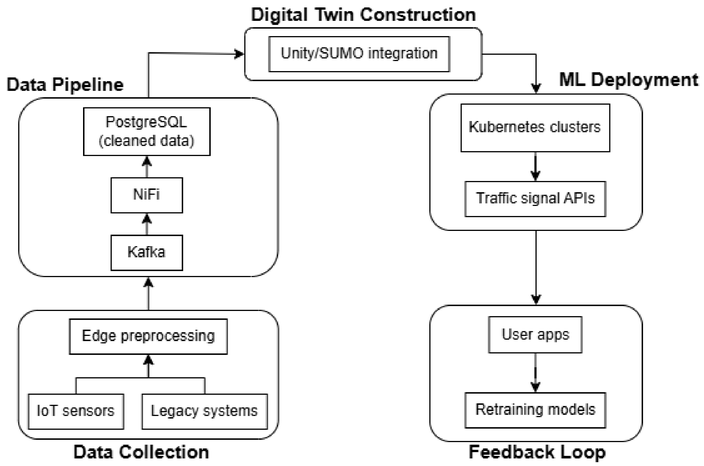
RELATED WORKS (COMPARISON TABLE)

Solution	*Advantage*	*Limitation*
TAQ & GBMMM	*Multi-modal transport optimization*	*High computational complexity*
METACITIES	*Optimized traffic & environmental benefits*	*Scalability challenges*
Scalable DT Framework	*Traffic prediction & efficiency*	*High computational needs*
Risk-aware DT System	*Real-time traffic & safety analysis*	*Deployment challenges*
DUMDTS (Proposed Solution)	*Real-time adaptability, scalability, interoperability*	*Initial setup costs, privacy concerns*

THE SOLUTION (DUMDTS: DYNAMIC URBAN MOBILITY DIGITAL TWIN SYSTEM)



System Architecture



DUMDTS Implementation

RESULTS, CONCLUSION, PERSPECTIVES

KEY INNOVATIONS

- Real-time, self-adaptive urban mobility framework.
- Standardized interoperability with traffic systems.
- Scalability for different urban environments.

IMPACT

Enhanced sustainability, efficiency, and urban mobility planning.

FUTURE WORKS

Integrating 5G & Edge AI, improving cybersecurity, expanding smart city applications.