



**THE OHIO STATE  
UNIVERSITY**

## Introduction

OSU SMOOTH uses demand and usage data to provide optimized scheduling and dispatching services, which not only provides passengers access to multiple choices of transportation through different automated shuttle sizes and speeds, but also an effective, dependable and green solution for individuals with limited mobility.

The system has been designed to maximize the replicability and scalability for future city-wide deployments. It conforms to the National ITS Architecture to maintain the benefits of possible cooperation with other subsystems of ITS.

This poster illustrates the general architecture of SMOOTH which includes the corresponding ITS subsystems, the knowledge enriched map that helps to alleviate the load of perception, the modules of autonomous vehicles, an agent based pedestrian/crowd motion modeling method which simulates the social force and intention to predict long-term pedestrian path.

## ACKNOWLEDGEMENTS

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Related projects can be seen at  
<http://citr.osu.edu>

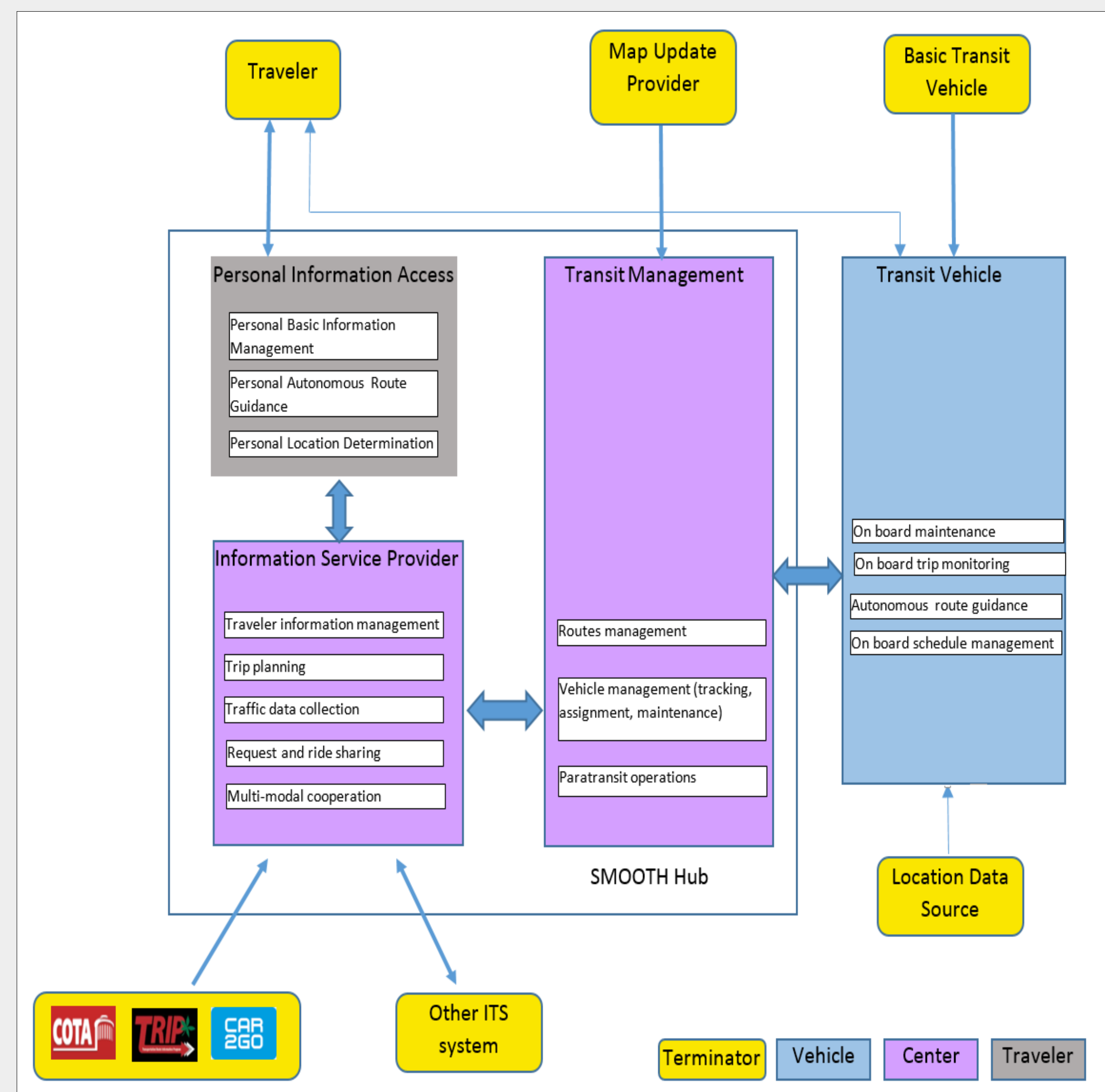
**CITR** | Control and Intelligent  
Transportation Research Lab

# EAGER: A Unified Solution of Mixed Traffic Sensing, Tracking and Acceptable Active Accident Avoidance for On-Demand Automated Shuttles in a Smart City

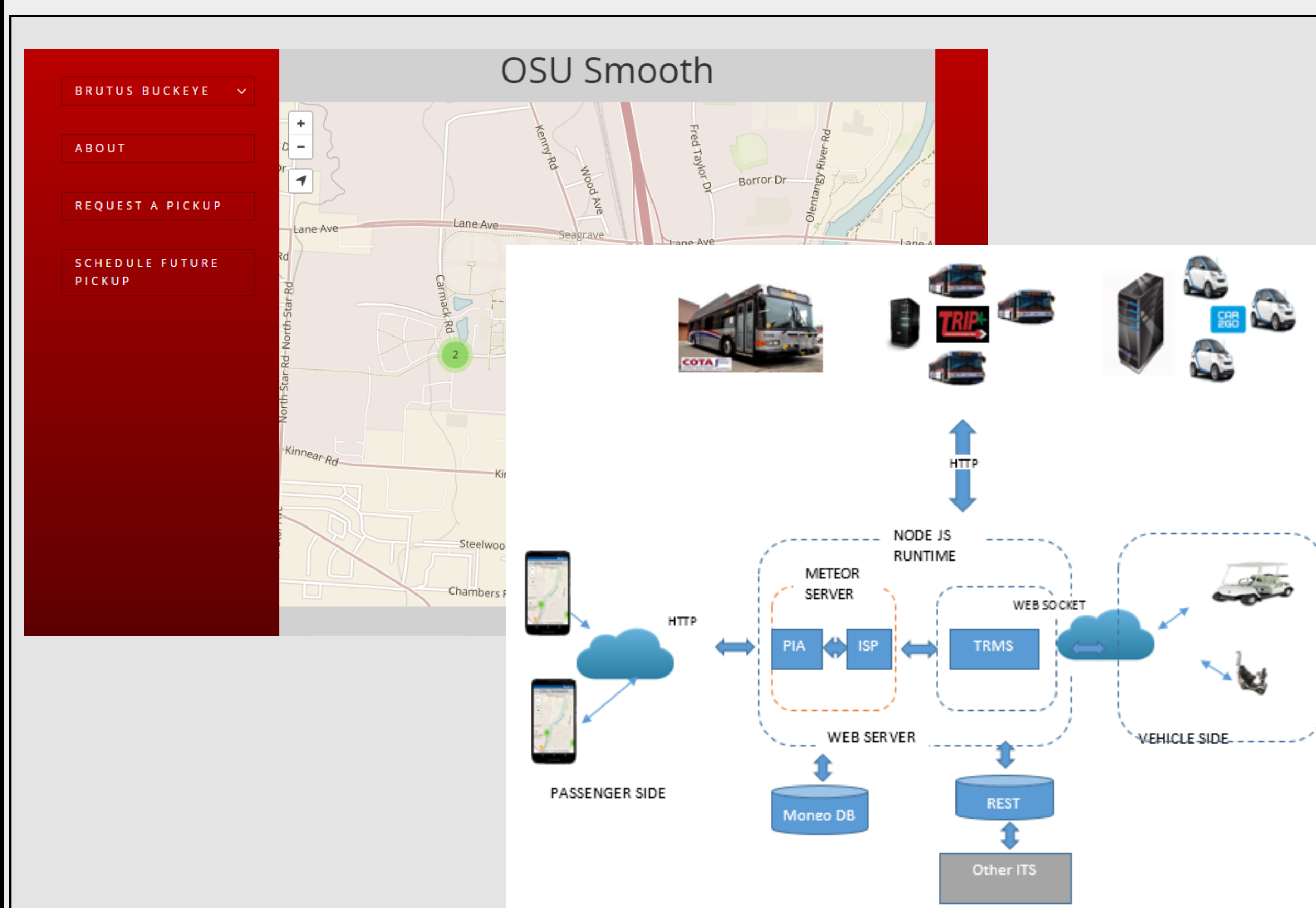
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## ITS Architecture

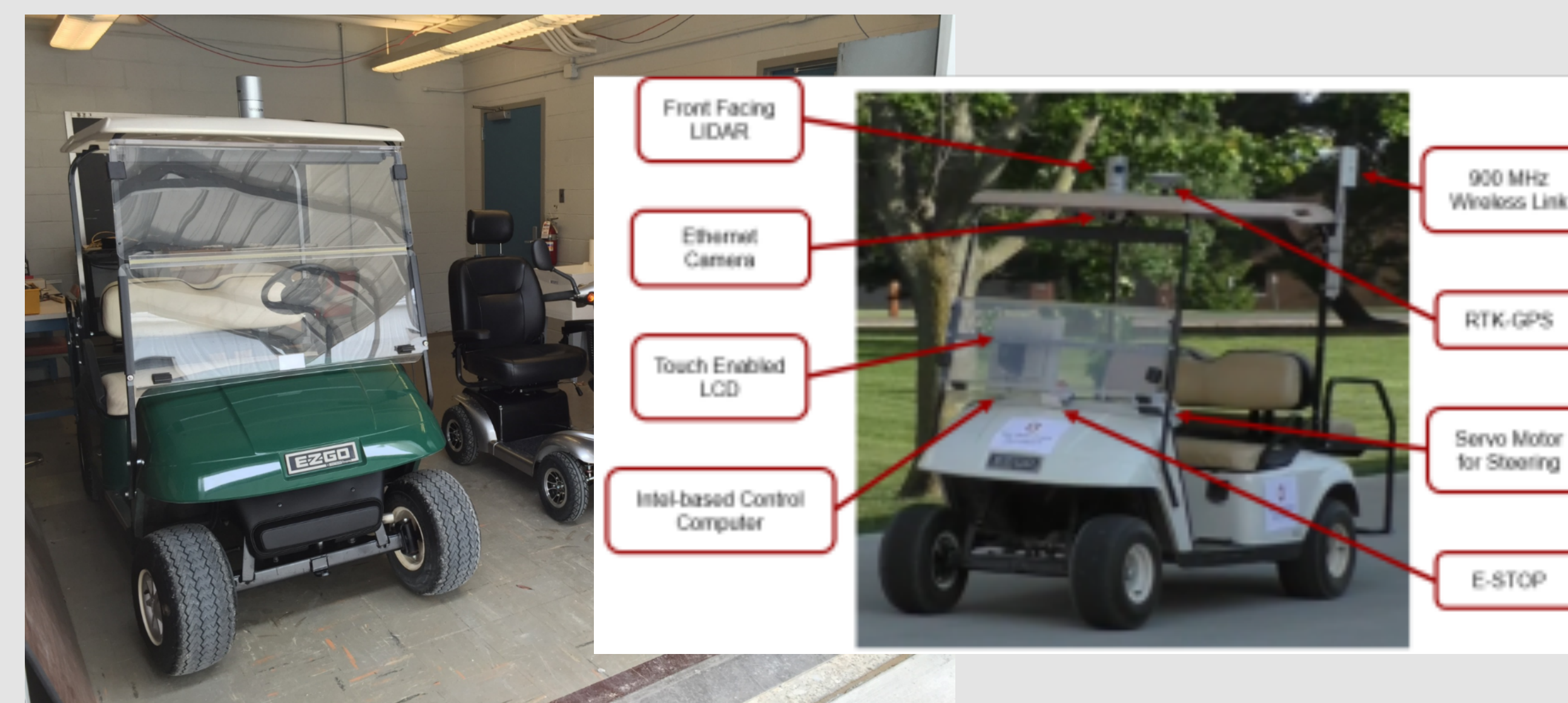


## Web-Based Architecture



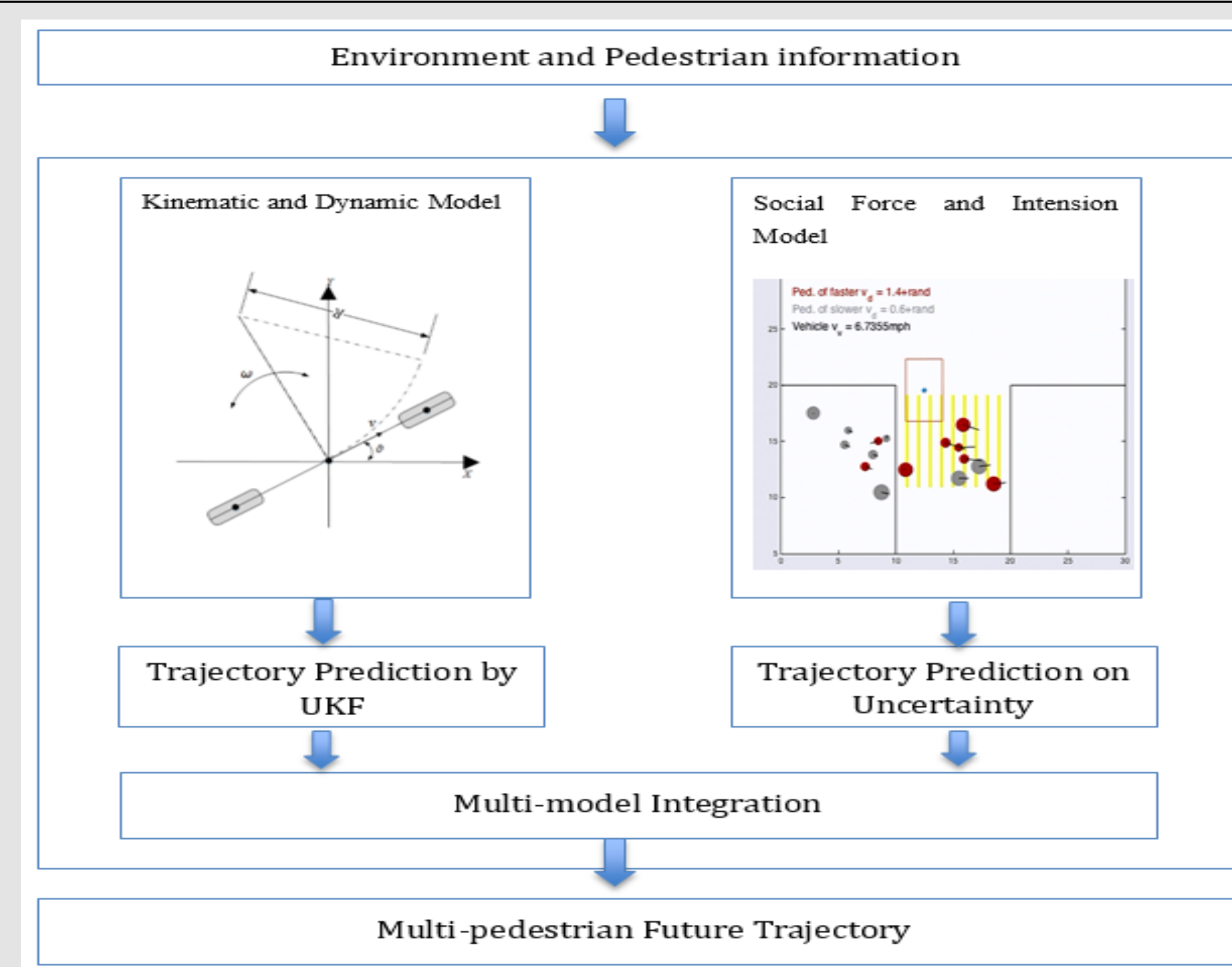
- Designed as a web architecture, utilizing a cloud-based application platform called Meteor, which can be accessed from desktops and mobile devices.
- Deployed as a multi-tier web system. ISP is the web server in charge of responding to requests. TRMS implements transit logic which communicate with vehicles through web sockets.
- Cooperates with other transit modes by integrating its services to make a multi modal transit plan.

## Autonomous Vehicles



- Two types of pilot vehicles have been constructed, two single passenger mobility scooters and two four passenger golf carts.
- Different configurations of sensors for different use cases. For the complex use cases, the vehicles are equipped with LIDAR, camera, IMU and RTK GPS. But for the simpler use cases, the vehicles are equipped with only low-cost sensors: web cameras, odometer, general IMU and GPS.
- Fusing sensors, map, traffic rules and contextual cues: a knowledge based approach for pedestrian, vehicle and traffic light detection.

## Pedestrian Safety



### Problem:

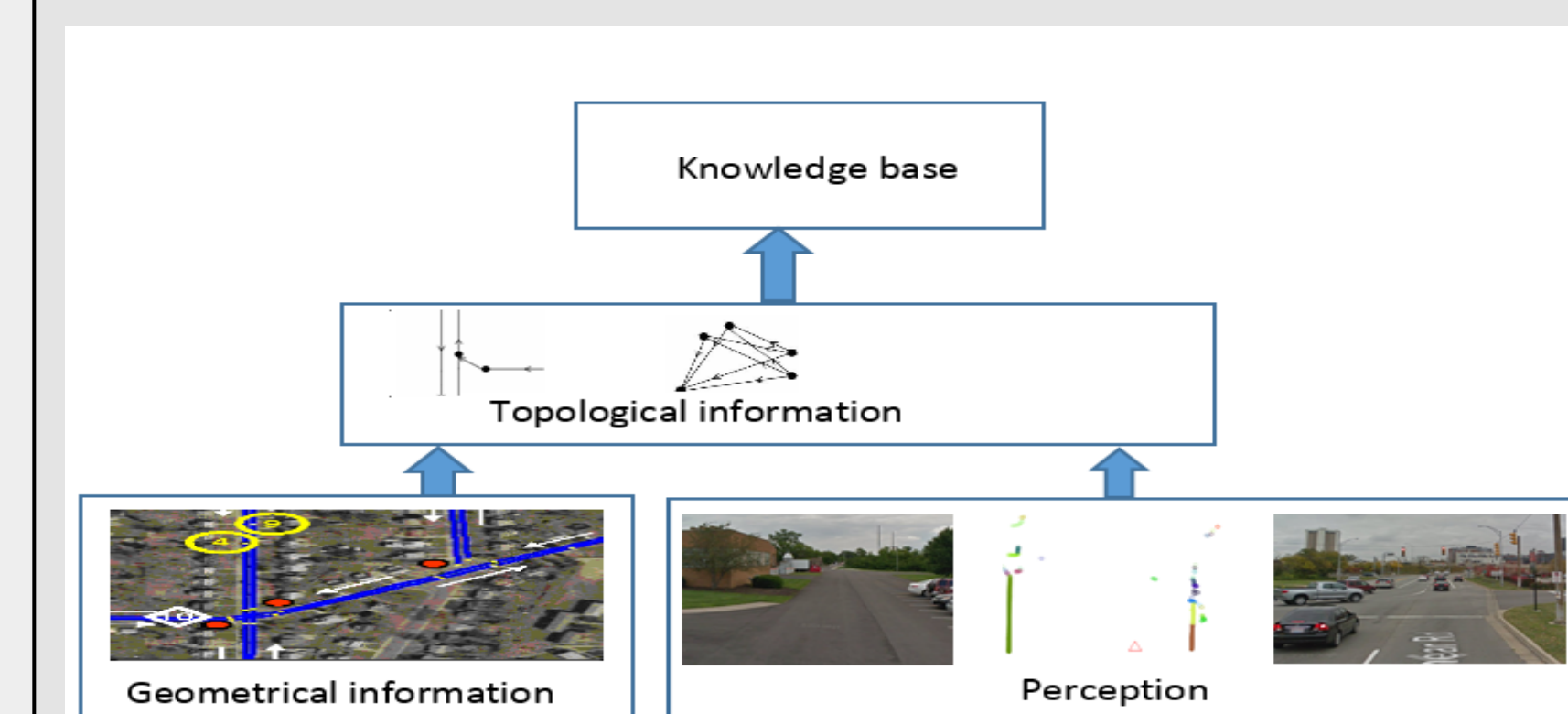
- It is difficult to predict trajectories of pedestrians, due to highly dynamical movement of pedestrians and crowd traffic: sidewalks, pedestrian crossing
- "Collision imminent" (pedestrian in front of vehicle) check is not sufficient.

### Solution:

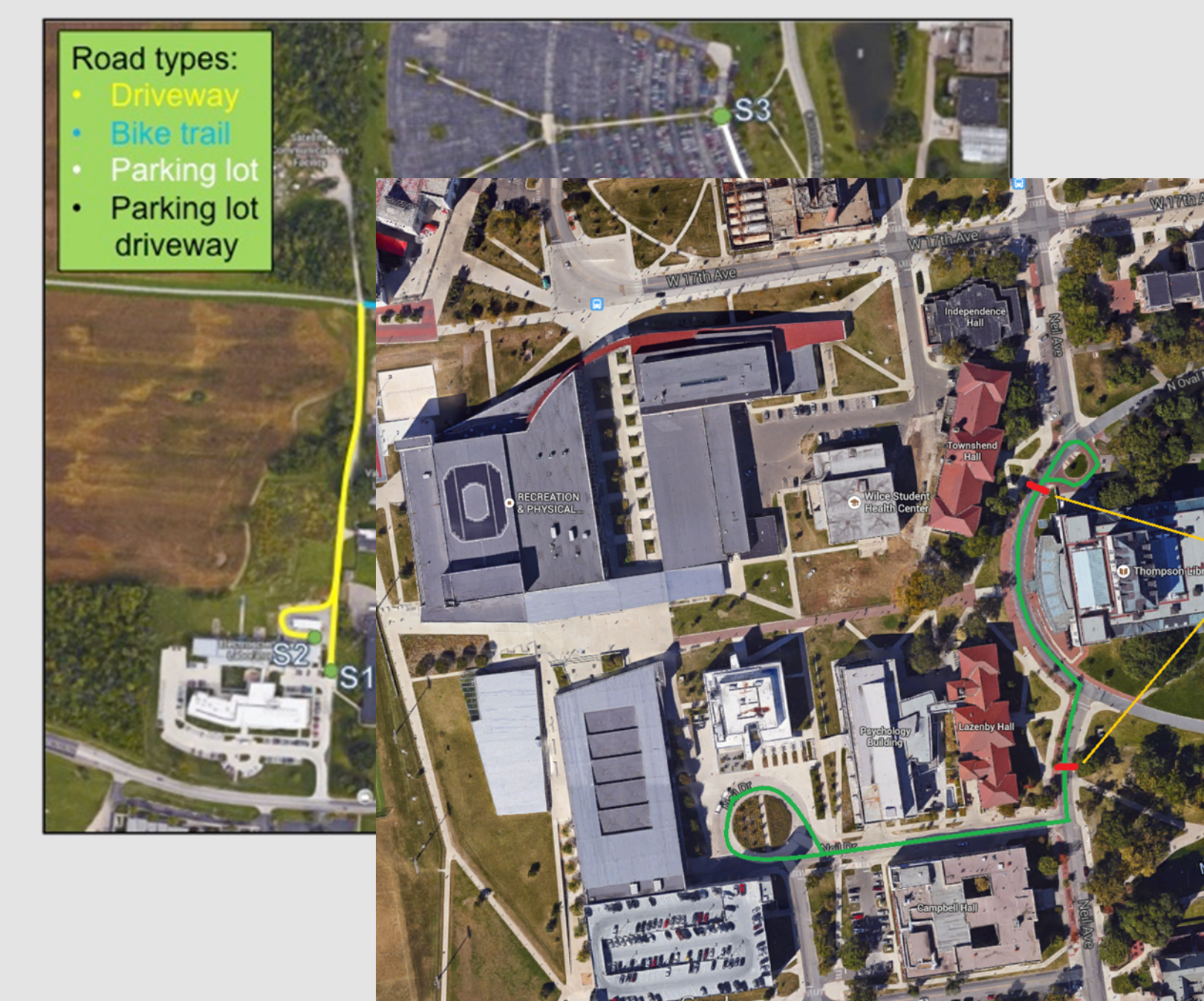
- An agent based Pedestrian/Crowd Motion Modeling method to simulate the social forces and intensions to predict long-term pedestrian paths
- An integrated pedestrian trajectory prediction approach is designed. It combines kinematic and dynamic aspects of the model, the agent based social force interactions and Intention-aware models.

## Knowledge-Enriched Map

- Extend the definition of checkpoints in route network definition file (RNDF) with the related perception model and the knowledge base.



## Test Phases



- The first two testing phases will be completed on The Ohio State University campus.
- The vast facilities in place on OSU's main campus with the preset knowledge enriched map will make it an ideal test-bed.

## Next Steps

- Easy to deploy and effective maintenance system:
  - Autonomous charging
  - Autonomous parking and management
- Lower cost solution: mobile device drive driven Smooth.
- Vehicle to vehicle cooperation within the scope of Smooth capabilities to:
  - balance the load of requests
  - share parking and charging stations

