Introduction to Intelligent Transportation Systems

Basic Knowledge
What is ITS

• Application of well-established technologies of communication, control, electronics, computer hardware and computer software in order to increase the safety and efficiency parameters of the actual transportation system.
Intelligent Transportation System

Collection of entities that collaborate in the movement of freight and passengers, and that have the ability to learn, adapt to new situations, and use information/knowledge to enhance operational efficiency

Collection of entities that perform tasks according to internal regulations and a given common objective
# Class Syllabus (Topics)

<table>
<thead>
<tr>
<th>Block</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to ITS: definition, roles and involvement.</td>
</tr>
<tr>
<td>2</td>
<td>Advanced Traveler Information Systems (ATIS)</td>
</tr>
<tr>
<td>3</td>
<td>Advanced Transportation Management Systems (ATMS)</td>
</tr>
<tr>
<td>4</td>
<td>ITS services: Advanced Public Transportation Systems (APTS), Commercial Vehicle Operation (CVO), etc</td>
</tr>
<tr>
<td>5</td>
<td>ITS and technologies: Automated highway systems (AHS), Autonomous Vehicles, Intelligent Infrastructures, etc</td>
</tr>
<tr>
<td>6</td>
<td>Critical ITS issues: ITS and security, ITS and safety, human factors, privacy, sustainability, etc</td>
</tr>
<tr>
<td>7</td>
<td>The future of ITS</td>
</tr>
</tbody>
</table>
Course Instructors

• Lecturer: Amnir Hadachi
  – Lectures: Tue. 14.15 - 16.00
  – Labs: Thur. 12.15 - 14.00

  – Room: Ülikooli 17, room 220
  – Email: amnir.hadachi@ut.ee
Student Requirements

• Attendance and participation (15%)
• Midterm exam (20%)
• Final exam (20%)
• Projects and presentations: (25%) (two choices)
  – Research paper (individual)
    • Critical review of selected ITS literature
    • Analysis on some topic of interest to you related to ITS
  – Creating a small application (individual or group)
    • Possible application will be discussed during the lab sessions
Student Requirements

- Labs: (20%)
  - First part is related to image processing and computer vision in ITS
  - Second part is concerned about traffic simulation and V2V communication
Why is ITS important?

- **Travel:**
  - Time Savings
  - Reduced Crashes and Fatalities
  - Improved security and safety
  - Cost Avoidance
  - Increased reliability
  - Improved trip planning
  - Improved emergency response
Why is ITS important?

- **Economic:**
  - Increased Customer Satisfaction
  - Improved productivity
  - On-time delivery

- **Environmental:**
  - Fuel saving
  - Reduced air pollution
ITS elements

ITS Objectives

• Manage Congestion on arterial and freeways
• Improve safety
• Increased and higher quality mobility
• Reduce energy use and negative environmental impact
• Increase efficiency
• Increase coordination
• Improved public-private partnerships
• Improved Economic Productivity
ITS Structure

- **Technology**
  - Sensing
  - Communications
  - Computing
  - Algorithms

- **Institutions**
  - Vehicle
  - Transport infrastructure
  - Cameras
  - Magnetic loops
  - Sensors

- **Systems**

**ITS benefits public and private sectors**
ITS Driving Factors

- Technology
- Resources

Issues:
- Economic Development
- Quality of Life
- Sustainability
- Social Equity

Institutional and organizational realities

Environmental Issues
ITS Scale

ORGANIZATIONAL SCALE

Integrated Supply Chain
Intermodal
Modal

GEOGRAPHIC SCALE

Urban
Regional
National
Global

TIME SCALE

Real Time
Tactical Planning
Strategic Planning
Impact of ITS

• Provide traffic information to road users during and before a trip through communication technologies.

• Provide Information about public transportation in real time.
  – Scheduling systems
  – Vehicle location systems

• Goods delivery operators can optimize in an efficient way their business.

• Provide information for urban planning and support them in their decision making.
ITS: Simplified Architecture

- Data Collection
- Planning Analysis
- Traffic Control
- Traveler Management
Data Collection

• Source of data:
  – Cameras
  – Magnetic loops or induction loops
  – GPS
  – Smartphones
  – Mobile phones network
  – Surveys
  – etc
Traffic Control

Incident Management

Network Control

Network Operations Response

Traffic lights

VMS

Lane signal
Traveler Management

Traveler Information Services
- SMS
- Portal
- Mobile
- Radio or TV

Demand Management/Payment Methods
- Licensing
- eTicket
- Parking
- Road Pricing or Toll
Dynamic Traffic Management Process

1. Traffic Management Center
2. Surveillance
3. Control
4. Supply
5. Traffic Conditions
6. Information Loop
7. Control Loop
8. Travel Demand
9. Information

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ITS: Subsystems

• Major areas of ITS:
  – Advanced Traffic Management System (ATMS)
  – Advanced Traveller Information Systems (ATIS)
  – Advanced Public Transportation Systems (APTS)
  – Advanced Vehicle Control Systems (AVCS)
  – Commercial Vehicle Operations (CVO)
  – Advanced Rural Transportation systems (ARTS)
ITS: Subsystems

- Advanced Traffic Management System (ATMS)
  - Network management, including incident management, traffic light control, electronic toll collection, congestion prediction and congestion-ameliorating strategies.
ITS: Subsystems

- Advanced Traveller Information Systems (ATIS)
  - Information provided to drivers pre-trip and during the trip in the vehicle. ATMS helps provide real-time network information.
ITS: Subsystems

- Advanced Public Transportation Systems (APTS)
  - Passenger information and technologies to enhance system operations, including fare collection, intermodal transfers, scheduling.
ITS: Subsystems

• Advanced Vehicle Control Systems (AVCS)
  – A set of technologies designed to enhance driver control and vehicle safety.
ITS: Subsystems

- Commercial Vehicle Operations (CVO)
  - Technologies to enhance commercial fleet productivity, including weigh-in-motion (WIM), pre-clearance procedures, interstate coordination.
ITS: Subsystems

• Advanced Rural Transportation systems (ARTS)
  – Mostly safety and security technologies for travel in rural areas.
  
  – NB: Rural Areas are defined as areas with less infrastructure resources access compared to metropolitan areas
ITS global vision

An Intelligent Multi-modal Transportation Vision for Lagos

- Traveler Management
  - Mobile
  - Portal
  - SMS
  - Radio / TV
  - Traveler Information Service

- Traffic Control
  - Incident Management (Traffic)
    - Police/Medical / Fire
    - Breakdown/LASMA

- Transport Planning/Analysis
  - Planning

- Analytics + Data Integration
  - Traffic Mgt Information System

- Performance Mgmt
  - Internal KPI
  - 3rd Party SLA
  - Asset Mgt

- Data Collection (of Traffic)
  - Smart app
  - Cellular
  - Planned Maintenance
  - Call Centre
  - Camera
  - Manual Survey
  - GPS
  - Social Media
  - Citizen Portal

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ITS Services

- Traveler information;
- Traffic management and operations;
- Vehicle services;
- Freight transport;
- Public transport;
- Emergency;
- Transport-related electronic payment;
- Road transport related personal safety;
- Weather and environmental conditions monitoring;
- Disaster response management and coordination;
ITS Services

- Traveler Information:
  - Pretrip information;
  - On-trip information;
  - Route guidance and navigation pretrip;
  - Route guidance and navigation on-trip;
  - Trip planning support;
  - Travel services information.
ITS Services

- Traffic Management and Operations:
  - Traffic management and control;
  - Transport related incident management;
  - Demand management;
  - Transport infrastructure maintenance management;
  - Policing/enforcing traffic regulations.
ITS Services

- Vehicle Services:
  - Transport-related vision enhancement;
  - Automated vehicle operation;
  - Collision avoidance;
  - Safety readiness;
  - Precrash restraint deployment.
ITS Services

• Freight Transport and Logistics:
  – Administrative functions:
    • Commercial vehicle preclearance;
    • Commercial vehicle administrative processes;
    • Automated roadside safety inspection;
    • Commercial vehicle on-board safety monitoring;
  – Commercial functions:
    • Freight transport fleet management;
    • Intermodal information management;
    • Management and control of intermodal centers;
    • Management of dangerous freight.
ITS Services

• Public Transport:
  – Public transport management;
  – Demand responsive and shared transport.
ITS Services

• Emergency:
  – Transport-related emergency notification and personal security;
  – After theft vehicle recovery;
  – Emergency vehicle management;
  – Emergency vehicle preemption;
  – Emergency vehicle data;
  – Hazardous materials and incident notification.
ITS Services

- Transport-Related Electronic Payment:
  - Transport-related electronic financial transactions;
  - Integration of transport-related electronic payment services.