VR and AR models are developed to suit the requirements of mobile Location-Based Computing for Infrastructure field tasks (LBC-Infra).
LBC-Infra's User Interface Components

- Visualization and feedback
  - Displaying graphical details
  - Displaying non-graphical information and instructions
- Control
- Access
- Navigation
- Manipulation
- Collaboration
Real-time Navigation Guidance

- $P_1$, $P_2$, etc. are locations of the user extracted from tracking devices
- $P_0$ is the location of the target point of interest based on the task
Data Exchange and Integration Model

- GIS layers (Building, image, block, object layers)
- Façade Images (JPEG, PNG, GIF formats)
- CAD 3D files (e.g. DWG format)
- Information from other applications (e.g. cost estimation, scheduling)
- External Building Model (VRML format)
- Internal Building Model (VRML format)
- Objects (VRML format)
- DEM model (BT format)
- IFC model
- Database
- 3D Model (VRML format)
- Location data
- On-site data input/retrieval

Data exchange → Data integration
Data Integration

- CAD drawings of the buildings
- Small VRML object library of objects embedded in the 3D model
- Orthogonal digital images of the facades of the buildings
- GIS maps of Montreal
- Digital Elevation Model (DEM)
- Tracking (RTK GPS, video tracking...)
Prototype System Development

- Development in Java and Java 3D
- MapObjects Java Edition to integrate GIS
- Integrates 4D model of the campus
- Has a GUI for Tablet PC
- Developing databases for construction, inspection and maintenance
Case Study: Concordia University Downtown Campus
Floor Plans Used for Creating the Model

1st floor plan
(for extrusion from 1st to 4th floor)

5th floor Plan
(for extrusion from 5th floor to the top of building)
GIS Layers Used in Creating the 3D Model

- Building Layer (polygons)
- Image Layer (lines)
- Object Layer (points)
- Block Layer (polygons)
Examples of Objects Around Buildings
Virtual Model of the Library Building
3D Model of a Floor in the New Building
Tracking Methods

Indoor Video-Based Tracking
- Marker
- Artificial damage added for testing
- Digital Camera
- Electronic stylus
- Tablet PC

Outdoor GPS-Based Tracking
- GPS and RD antennas
AR Application in Building Construction

• Example of construction site

• Graphical Augmentation

Marker

Column

Workspace

Column ID
Augmentation of a Column

- Marker
- Column ID
- Workspace
- Video camera
- Head Mounted Display
Non Immersive Virtual Reality

- 3D Browser
- Tree Structure of Facilities
- 2D GIS Browser
- Locations Obtained from GPS

Locations Obtained from GPS

Tree Structure of Facilities

3D Browser
Conclusions and Future Work

- The proposed approach facilitates accessing and collecting inspection data by allowing field workers to interact with geo-referenced infrastructure models.
- Retrieving information is done automatically in real time based on tracking the location and orientation of the user.
- The method would improve the efficiency and safety of field workers by allowing them to concentrate on their job.
- Further development and testing of the prototype system.
- Study of the system in practical situations and investigating collaboration scenarios among a team of on-site workers.