BIM-GIS Oriented Inteligente Knowledge Discovery

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Propose an Geo-Spatial Smart Dashboard for multi buildings or campus to deliver an Intelligent Insights into different types of 2D and 3D data correspond to BIM, GIS and IoT.
Why 3D Space is complicated…

- How Store and Deal with
  - Structured,
  - Semi Structured, &
  - Unstructured Data
Why 3D Space is complicated...

- And different types of
  - 2D and 3D geometry,
  - Semantic,
  - Level of details,
  - Live stream sensor data,
  - Historical data,
  - Blob files.
Why 3D Space is complicated...

And also

- Inconsistency,
- Redundancy,
- Discrete & Continuous data in the data sets.

All these...confuse Data Analytics and Decision Making.
Why Knowledge Discovery in 3D Space

• David, as a building Manager has to prepare well log report for owners about energy efficiency of building, controlling any crime in campus, lighting Management ... . He has only few data from bills or reports and so on.

• Expectations: More Insights, and better decision to finalize report.

• The lake of a union framework and methodology in one place to have more insight and help decision maker in the realm of multi building.
Proposed Solution

Data Model
- Geo-Spatial Data Model
- BIM Data Model
- IOT Stream Data
- Semantic Data
- Historical Data

Smart Dashboard
- Descriptive Analysis: What Happened
- Statistical analysis
- Diagnostic: Why it Happened
- Knowledge Extraction
- Predictive: What will Happen
- Supervised/Un-supervised Machine Learning
- Prescriptive: What Action to Take
- Ontology Based Reasoning
Proposed Solution

Spatial Smart Dashboard

Unified Rules Extraction and Decision Engine From Data Lake

Smart Citizens
Decision Makers
Evacuation Plan
Energy Efficiency
Emergency Response
Data Architecture Model

- Blob Files
- Sensor Data
- Environmental Data
- 3D Database
- CityGML
- Historical Data
- BIM
- Spatial Analysis
- Machine Learning
- Prescription Analytics
- Statistics Visualization
<table>
<thead>
<tr>
<th>Object</th>
<th>Age</th>
<th>Distance to Exit (m)</th>
<th>Floor (3D Information)</th>
<th>Age of Building</th>
<th>Disability</th>
<th>Decision</th>
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</table>
How do it better…
Fuzzy Rough set Feature Selection

The decision class is Rough since the boundary region is not empty.
How do it better…
Proposed Fuzzy Granular Decision Tree

- FGDT plays the role of global Optimization rather local optimization

- FGDT supports discrete and continuous attributes in 2D/3D geometry dataset and semantic data.
Rule 1 (2D & 3D) : Age = 50 AND Floor = 3 AND Disability = NO AND Distance to Exit Door = 8 m

Rule 2 (2D & 3D) : Age = 35 AND Floor = 1 AND Disability = NO AND Distance to Exit Door = 5 m

Aggregated Function
The input for the defuzzification process is the aggregate output fuzzy set and the output is a single number.

Centroid defuzzification method finds a point representing the center of gravity of the aggregated fuzzy set $A$, on the interval $[a, b]$.
Stay Tune for next...

- Manage different types of data (2D/3D Geo-DB, Semiotics, Blob Files, sensor Data, ...) in the term of Storing and Analytics in a Data Lake (Azure Data Lake)

- The Proposed Unified Rule Extraction and Decision Engine from 3D Geo-DB and BIM data Enhance proper Performance of different Applications.
Design a Spatial Smart Dashboard (SSD) with four major types of analytics like **Descriptive** analytics to answer the question of what happened, **Diagnostic** analytics to determine why happened, **Predictive** analytics to predict the phenomena in a period of time and **Prescriptive** to what take action.
Thank you ...