Development of a Plug-and-Play Middleware for Integrating Robot Sensor Data with GIS Tools in a Cloud Environment (GIS4IoRT)

The convergence of robotic technologies and sensor networks (IoRT) has generated vast amounts of data with potential applications in several domains like agriculture and urban planning. However, the lack of interoperability between this data and Geographic Information System (GIS) tools poses a challenge. The objective of the GIS4IoRT project is the development of a "plug and play" and cloud-based middleware to bridge this gap, enabling seamless integration and visualization of heterogeneous, multi-modal, and multi-dimensional datasets within GIS environments. A GIS client (QGIS plugin) will also be developed as a user-friendly interface to browse available data and perform spatio-temporal queries within the middleware.

Key components of GIS4IoRT include: (1) middleware architecture (between the IoRT machinery and GIS software), (2) cloud-based infrastructure, (3) real-time interrogation of robots, (3) AI-based approaches to ensure data reliability and completeness, (4) spatio-temporal query support in the cloud, (4) GIS integration with the IoRT machinery, and (5) the development of standards for data storage, description of IoRT data sources, and processing in a cloud-based GIS-IoRT architecture. The middleware will support diverse data types such as: record-like, Lidar and other multi-modal images, trajectories, spatio-temporal data. The middleware will be validated in an agriculture case study. Overall expected research and technological outcomes include advancements in GIS capabilities for several decision-making contexts, based on spatio-temporal data delivered from the IoRT machinery.

In summary, the long-term vision of the GIS4IoRT project represents a paradigm shift in the integration of robotic technologies, sensor networks, and GIS tools. By addressing challenges related to: interoperability of the IoRT machinery, data wrangling, data reliability, complexity of spatio-temporal data, spatio-temporal data dynamics (pattern evolution in time), complex correlations between spatio-temporal data, interpretability and visualization of analytical results, the project challenges existing research and technological paradigms. As a consequence, we expect the development of more comprehensive and effective methods of spatio-temporal data analysis and their application in decision-making across various domains.