combination with satellite tracking technology to determine the position more correctly in outdoor spaces. In our work we propose a rich description of the geographic object. Beyond the location, this description inform about the thematic and the related services to a geographic object. So in addition to problems related to the location, we offer an analysis and solutions to other problems related to interactions with the geographical environment such as updating and filtering data.

In the third work a GIS / RIFD integration is proposed. This integration allows extracting information about the spatial objects from the GIS by mobile users on the train. However, a break in the connection with the remote GIS causes a cessation on the functioning. This demonstrates the advantage of the ambient storage of information we propose; an ambient storage that enables data allocation and filtering by proximity. On the other hand, our automatic data update approach can provide an optimization to this work; instead of receiving inspection data exclusively from staff's smartphones, the road infrastructure can be equipped with sensor networks and each change in this infrastructure state trigger a repair notification to avoid random inspections and to perform well-localized instructions.

The fourth work introduced a system that collects data from the geographical environment through a sensors network. This joins our approach on the richness of instrumentation of the geographical environment as well as the richness of information to extract. This work also joined our approach on the instant data update; because the data collected by the sensors are sent automatically to the servers. However, the proposed system is limited to desktop data visualization and ignores the aspect of mobility and ubiquity of information that are the core concepts of the ubiquitous computing. On the other hand, the system restricts the integration with GIS to data visualization. GIS is actually used to access visually to locations through a 3D digital map.

From the analysis and evaluation of previous related work, we believe that our work involves:

- A rich and open theoretical framework to implement ambient computing in the geographic domain. This theoretical framework is based on the concept of the spatial object and the concept of communicating object and their fusion.
- A technologic independent and open conceptualization.
- A support for communication and updating various geometric and thematic information and services related to a spatial object.

7. Prospects and future work

We presented in this work, the concept of Smart Geographic Object. This concept came through a theoretical study to position GIS technology in ubiquitous computing era. We also presented the added value of SGO and illustrated how this concept can responds to some crucial GIS limitations. However, the current work rise a set of challenges that will be explored in the future works. First, the descriptions of the geographic objects constitute a real issue due to the complexity of the geographic environment. Since we are working on geographic object in urban area, we are currently investigating some geographic data model for the storage and the exchange of virtual 3D city models. The majority of these models have an XML-based format, which will make the extension of the meta-models possible to describe the geographic object our way. Second, our proposition is build on making the geographic environment a part of the GIS technology functioning. This means that the geographic environment will move from a state to a dynamic state. And will offer various functionalities. In ubiquitous environments the functionalities are more and more modeled and published as services. This leads us to think about a service oriented architecture that enables the discovery and the composition of the services offered by the Smart Geographic Object one side; and to manage the heterogeneity of these services on the other side. In this context several ubiquitous middleware are proposed, especially in Smart city projects.

Our current work open the way to many promising implementations - based on ubiquitous computing core concepts - especially in the context-aware mobile geographic systems. It also extends the functioning of GIS technology out side the system it self to make the environment an integral part of this functioning.

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