

# Augmenting Physical Maps: an AR Platform for Geographical Information Visualization

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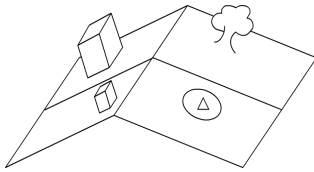
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## Abstract

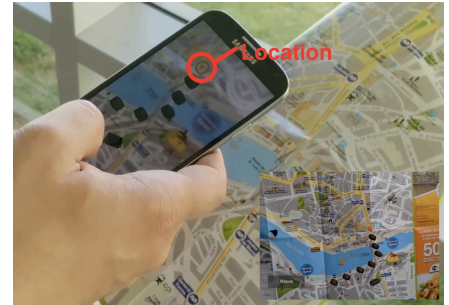
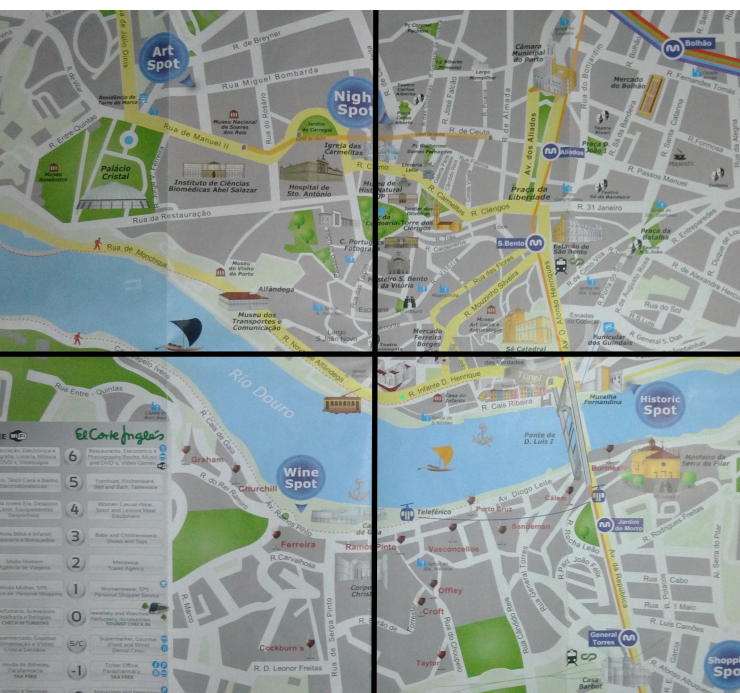
Physical maps of a city or region are important pieces of geographical information for tourists and local citizens. Unfortunately the amount of information that can be presented on a piece of paper is limited. In order to extend the map information we propose an augmented reality (AR) system, ARTourMap, for additional information visualization and interaction. This system provides an abstraction layer to develop applications based on the concept of separated logic map tiles taking advantage of a multi-target system where several regions of the map trigger different superimposed graphics. This allows the map to be folded, to be partially occluded, and to have dematerialized information. To demonstrate the proposed system ARTourMap, three layers were developed: a location-based game with points of interest (POIs), a 3D building visualization and an historical map layer.

## AR TourMap

The ARTourMap system is an AR graphical layer that enables the creation of location-based applications superimposed into physical maps. In the example below the tourist map is divided into four map tiles. The augmented reality content will follow the physical paper when rendered in the mobile device.  
(More information at: [http://mat.inescporto.pt/?page\\_id=169#wp3](http://mat.inescporto.pt/?page_id=169#wp3))



$$\text{MapTile}_{ij} = \{\text{ARMarker}_{ij}, \text{Geometry}_{ij}, \text{geocoord}_{ij}\}$$



## Location-based Game Layer

In this mode, the application explores the GPS position from the device [JC11] indicating the position of the user in the physical map and suggesting the exploration of touristic paths and stories [GFLT11].



## 3D Layer

Through the usage of the GeoStream library [GJR+15], this layer downloads building information from OpenStreetMaps and extrapolates possible heights for the retrieved building footprints. It then performs an extrusion of each footprint in order to create an approximate 3D mesh. Each MapTile now has several 3D buildings placed in their real positions, giving the user a better vision of the dimension and content of the city [GJR+15].



## Historical and Cultural Heritage Layer

This layer explores the connection between the current map and its 19th century counterpart allowing for an historical voyage through time. The tourist will be able to identify new streets that now exist and older streets that are no more. A slider that gently fades the old map over the current physical one allows for the tourist to better spot the cultural heritage [Hal11] points of interest and how to get there.