## Aurama: Local Knowledge Discovery with Augmented Reality

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Introduction: The proliferation of Augmented Reality (AR) mobile applications in terms of user adoption is driven by the emergence and maturity of a host of technologies. These include the development of high in resolution and crisp in interactivity mobile displays, the advancement of indoor and outdoor localization systems and AI-powered computer vision systems. All are glued together through software services running on handheld or wearable devices. Besides the tech allowing for AR to become functional, for an application to become successful in user popularity terms, the availability of rich and engaging content is a prerequisite. Here, we propose Wikipedia as a source of content for a class of AR applications that target local search and knowledge discovery in physical space. The motivation lies on the features that have made Wikipedia popular online: knowledge describing facts and the real world at an unprecedented scale, becoming accessible in hundreds of languages through a sustainable crowdsourcing system. In addition, more that 40% of Wikipedia's articles are geo-tagged, meaning they can be embedded in physical spaces using computer systems and become context to user experience as they navigate the world. In this setting we develop Aurama, an AR mobile application leveraging Wikipedia content aiming to assist tourists with guidance and foster local knowledge exploration in cities. We describe the challenges, best design and engineering practices for developing such an application in terms of deploying a mobile system that can identify buildings and objects in the physical world that have a Wikipedia page entry. We discuss the lessons learned in our effort to effectively train a computer vision system in this setting and how mobile context described through sensor retrieved information can assist the image recognition task significantly improving user experience. We also discuss a general system architecture for over-the-air model updates as user navigate a city as well as enlist a set of key visual design design principles that allow for swift interactions between users and discovered content.

## Wikipedia as Content Source in AR

Wikipedia, in addition to offering a large set of notable geo-tagged items that can be used to bootstrap an AR system for local knowledge exploration, it offers relevant knowledge content that can be presented to a user's device once site recognition has taken place.



Fig. 1: Screenshots corresponding to the user facing mobile application. Upon recognition of a site, an active icon appears. The user can click it to access information related to the detected site.

## An end-to-end Mobile AR System for Local Knowledge Discovery

From data collection to mobile development and deployment, we design a develop an AR mobile system that enables the discovery of historic and notable information in cities. We use a Convolution Neural Network architecture to train deep site recognition models which are specialised at identifying sites at particular geographic regions. When a user navigates to a particular area, the corresponding region-specific model is off-loaded to the user's device.

## Exploiting new Sources of Image Data

We develop a Google Street View based system that can automatically generate image data at scale to train image classification models used by Aurama to recognize sites of interest. We highlight the importance of sourcing high quality training data as well as the use of mobile context awareness to build a system that offers satisfactory user experience in an outdoor setting.