

# Augmented Reality for Printed School Atlases

## Introduction and goals

As more and more students in secondary schools in Switzerland will be equipped with tablets, also because of the new school subject "Media and Computer Science", the use of Augmented Reality (AR) in classes is worth investigating. With AR, it is possible to place digital content into the real world allowing the user to interact with this digital content in real time using such a device. AR techniques can therefore be used in combination with a printed school atlas to enrich such atlas maps by additional learning materials as well as interactive functionalities. Using tablets may also increase the students' motivation to explore geographic patterns and processes depicted in the maps.

The goal of our Interdisciplinary Project Work is to create an AR Android application with Unity and Vuforia for the Swiss World Atlas. A prototypical application should be implemented, which visualizes georeferenced augmented 2D and 3D elements on exemplary printed maps from the Swiss World Atlas.

## Methods and procedure

After a literature research and a market analysis, the content of the planned application has been determined: Three printed 2D maps have been chosen from the Swiss World Atlas and an adequate connection to three digital 3D maps from the Atlas of Switzerland has been established. In total, six visualizations were realized for the final application.

Swiss World Atlas	Augmented visualization 1	Augmented visualization 2
Switzerland, Overview Bernina area (p. 31)	Glacier extent of different years - Extruded polygons, Surfaces	Volume of selected glaciers of the measurement network - Stacked cuboids
Europe, Overview Population density (p. 68)	Population density - Point cloud	Electricity: end use by consumer group - Pie charts
World, Overview, Tourism (p. 202)	Most popular holiday destinations of the Swiss - 3D bars	Charter flights: passengers on international flight routes - 3D trajectories

Table 1: Chosen maps and visualizations

While augmented visualization 1 represents the thematic information from the printed Swiss World Atlas, augmented visualization 2 is composed of thematic information from the Atlas of Switzerland - online. All the 3D augmented objects complementary overlie the printed maps of the Swiss World Atlas.

From a widerange of possible interactive functionalities, the following four have been chosen for the planned application:

- Feature query
- Time slider
- Legend
- Save/share/print screenshot

For instance, displaying a legend in combination with feature query makes it possible to show specific information about the augmented objects. Furthermore, sharing a screenshot might serve as a helpful tool to cope with a demanded task in the class (e.g. find place with highest population density). All these functionalities enrich the usability of an application and are enhanced by a simple and user-friendly graphical user interface.

## Implementation

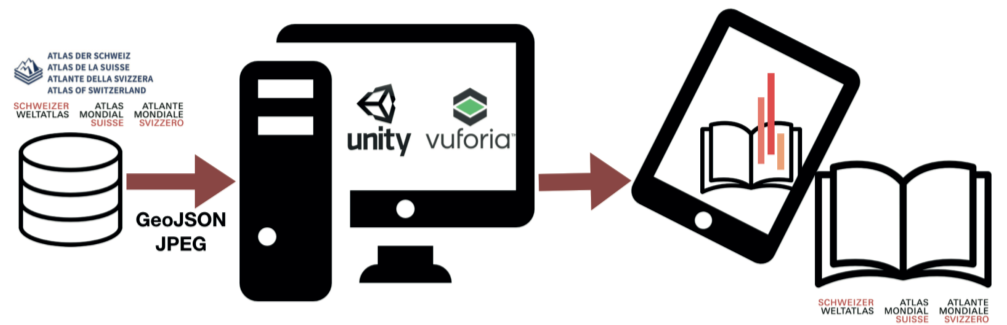


Figure 1: The workflow

With the help of the cross-platform game engine Unity and the augmented reality software development kit Vuforia, the datasets are transformed into georeferenced 2D or 3D objects on top of the maps. Animations and functionalities are developed by scripts in C#.

During the implementation, we solved successfully the challenges of importing and displaying the datasets in unity as well as adding functionalities and interactivity to the newly created objects.

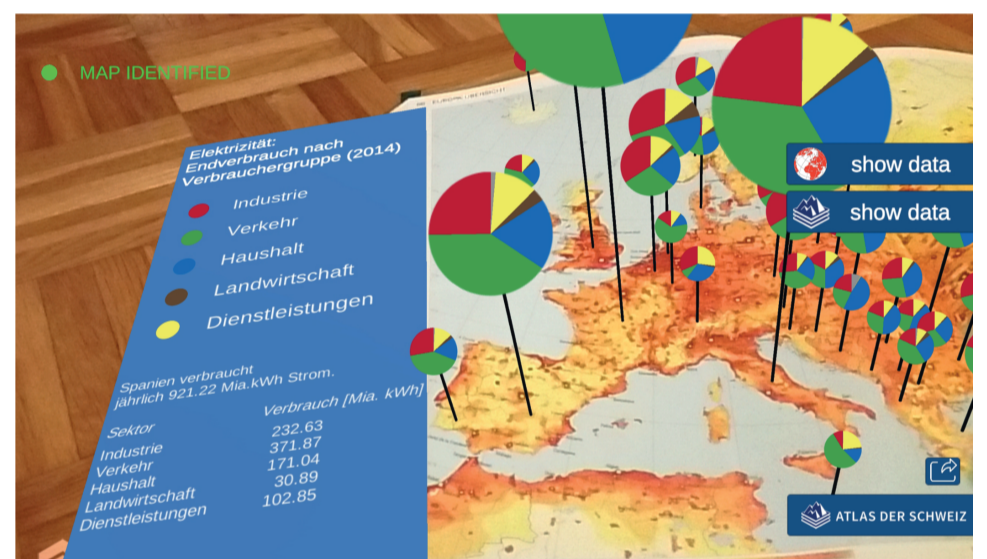


Figure 2: The augmented pie charts show the electricity end use by consumer group

By simply holding the device over the map, the implemented AR application identifies the map and displays the augmented objects on top of it. With the implemented graphical user interface, it is possible to interact with those objects.

## Conclusion and future work

In this Interdisciplinary Project Work, the implemented AR application shows that it is feasible to display augmented thematic objects on top of maps and that such use of applications should be considered more often in the future school environment. A follow-up study may examine which didactic concepts are most suitable for the developed visualizations and functions.



Figure 3: Displaying the glacier extent of the different years in the Bernina area