Work in Progress: Context Aware Maps

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Abstract

We look at how analog and digital maps can be augmented with context related information. In the analog case we use Augmented Reality to superimpose virtual objects onto the view of a printed map. For user friendliness we use standard mobile phone for Augmented Reality. To do this we have ported the ARToolkit to Symbian. We have implemented two case studies where printed maps are augmented with traffic-data by attaching markers to them.

1 Introduction

The importance and usage of printed map through history needs no further introduction. Maps can be found almost everywhere to help us orient in our environment. In their analog e.g. printed form they provide us static geospatial information. In recent years we have also seen the introduction of digital maps in applications such as car navigation, services on the web that let you search for a particular address and so on. Digital maps are more dynamic but also more expensive to employ and are overwhelmingly outnumbered by analog ones.

Ordinary 2D maps can be extended into several dimensions using Augmented Reality (AR) as shown in [Bobrich and Otto 2002]. AR is about enhancing a users view of the real world by projecting computer generated graphical information onto it. Another way to see it is that the visualization domain is projected onto the problem domain. To do this the position and orientation of the uses head must be tracked by the system. Tracking can be done with ultra sound, GPS, magnetic sensors, video etc. We are working with the ARToolkit [ARToolkit], which is based on video tracking of markers. A marker consists of a square with a pattern. The pattern is known and is used to identify the marker while the square is used for calculating the camera position and orientation relative to the reference coordinate system centered at the marker. These extrinsic parameters are used as the modelview matrix in a 3D graphics pipeline while the intrinsic parameters obtained during calibration of the camera are used for the projection matrix. The overlaid graphics can thus be rendered with the correct perspective.

In our research we are looking at Ubiquitous Mobile Augmented Reality [Henrysson and Ollila 2004]. We want the platform to be mobile and ubiquitous. We have chosen to work with Smartphones, which have the necessary capabilities for AR i.e. camera, CPU, storage and display. We have ported the ARToolkit to Symbian, which is one of the dominating Smartphone platforms. The purpose of our research is to visualize context related information where AR is one of the visualization modes. The idea is to retrieve information based on personalization and context awareness data and present this information using appropriate visualization mode considering the spatial relationship between information and environment.

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2 Context Aware Maps

The idea behind context aware maps is to augment analog and digital maps with context related information. Context Awareness is an area where sensor data such as position, time, temperature etc. is used to optimize configurations and services. We have focused on time and position. To augment the maps, markers with known sizes and patterns have to be added. We must know the scale of the map and the position of the markers for the superimposed graphics to have the correct scale and position.

3 Implementation

We have implemented two case studies; a tram station map augmented with an animation showing the current tram positions and a map of the Nordic region augmented with air traffic data. The hardware setup consists of a Nokia 6600 running Symbian and Series 60. It has a 0.3 megapixel camera with a QQVGA viewfinder resolution and 106 MHz ARM9 CPU.

The tram stop application is driven by timetable data and shows the current positions of the trams trafficking the area shown on the map. Since this map was originally in bitmap format the implementation was straightforward. First we obtained the positions of the tram stops in pixels relative to the composited marker and then we translated the distance in pixel space to distance in coordinate space. The rendering is done in 2D with sprites representing the trams (see Figure 1).

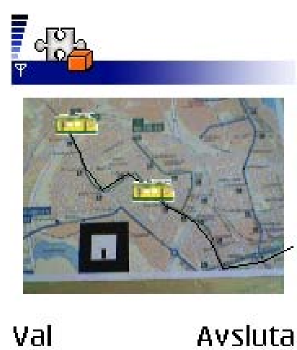

Figure 1: Map with marker and screenshot from mobile device.

The flight data application uses authentic flight data from the Air Traffic Control (ATC) [Lange et al. 2003] project at NVIS. In ATC flight trajectories are visualized together with weather information. The trajectories can be manipulated interactively to avoid collisions and bad weather conditions. As a first step we have augmented a printed map of the Nordic region with a 3D flight trajectory between Arlanda and Kastrup (see Figure 2). The plane is represented with a simple polygon to reduce complexity since we are using pure OpenGL ES. The flight information is given in longitude and latitude, which are also the coordinates of the map. We have approximated with Cartesian coordinated to avoid spherical to planar mapping.

Figure 2: Flight data

We have so far only used one marker, which limits our field of view, but more markers can be used to enlarge the trackable area.

4 Discussion and Future Work

We have shown how to tie context-related computer generated information to printed maps using AR on such a ubiquitous device as a Smartphone. This can be applied to any printed map provided its coordinate system and the relative positions of the markers are known. A drawback of our current solution is that markers have to be known in advance, but there exist solutions [Spotcode] where the pattern consists of a sequence similar to a bar code that can be translated to a number and used to fetch information from a server. Such networking solutions are essential for context aware maps that require up-to-date information.

The current plan for future work is to speed up the software using fixed-point math. After that we will look at how to extend the tracking to be more independent of markers. One technique that will be useful for augmented maps is texture tracking [Kato et al. 2003] where texture features can be used to track the camera. Other methods that will be studied are GPS, optical flow and inertia sensors.

We would also like to study the interaction capabilities of the Smartphone and compare it to using a wand in front of an immersive workbench, which is the case with the current ATC implementation.

References

ARTOOLKIT. www.hitl.washington.edu/artoolkit/.

BOBRICH, J., AND OTTO, S. 2002. Augmanted maps. In *Symposium on Geospatial Theory, Processing and Applications*, Ottawa, Canada.

HENRYSSON, A., AND OLLILA, M. 2004. Umar - ubiquitous mobile aygmanted reality. In *3rd International Conference on Mobile and Ubiquitous Multimedia*, Washington, USA.

KATO, H., TACHIBANA, K., BILLINGHURST, M., , AND GRAFE., M. 2003. A registration method based on texture tracking using artoolkit. In *2nd IEEE International Augmented Reality Toolkit Workshop*, Waseda Univ., Tokyo, Japan.

LANGE, M., HJALMARSSON, J., COOPER, M., YNNERMAN, A., AND DUONG, V. 2003. 3d visualization and 3d and voice interaction in air traffic management. In *SIGRAD2003, The Annual SIGRAD Conference.*, Ume, Sweden.

SPOTCODE. www.highenergymagic.com/spotcode/.