School of Computing and Communications

LANCASTER UNIVERSITY

Utilizing Sensor Fusion for Markerless Mobile Augmented Reality

Klen Čopič Pucihar, Paul Coulton and Dan Hutchinson

Supported by

Nokia Research Center

1.Abstract

One of the key challenges of markerless Augmented Reality (AR) systems when no apriori information of the environment is available are map and scale initialization. Implementing scale is vital for ensuring that augmented objects are contextually sensitive to the environment they are projected upon. In this paper we demonstrate a sensor and vision fusion approach to provide a robust user-friendly system initialization technique. The map is initialized using the phones inbuilt accelerometers to obtain an initial orietation of the scene whilst scale is initialized using the camera auto-focusing capability. The demonstration illustrates the ease of use and benefits of such a system running on a Nokia N900.

2. Defing scale using autofocusing

Digital cameras are generally auto-focused by searching for the lens position that gives the 'best' focused image, thus the lens position is dependent on the distance to the object. If the focused lens position and the focal distance of the lens are known, the thin Gaussian lens equation can be used to calculate the distance to the object . This method known as Depth From Focus (DFF) and has until now been limited to high precision camera systems. By knowing the distance to the plane it is a matter of simple trigonometry to derive the scale of the map.

3.Sensor fusion map initialization

An alternative approach to requiring a front parallel view for initialization is to use the phone accelerometers, a common feature of current smart phones, to obtain the orientation of the phone relative to the plane allowing the system to synthetically un-project the initial frame in order to remove perspective distortions. This initialization has two advantages, namely, there is no user cooperation required in order to initialize the map and is computationally much less complex and easier to implement compared to move matching techniques. As the angle is measured by effectively utilizing the gravity, it only works for vertical and horizontal surfaces, although this is likely to represent the most common use cases.

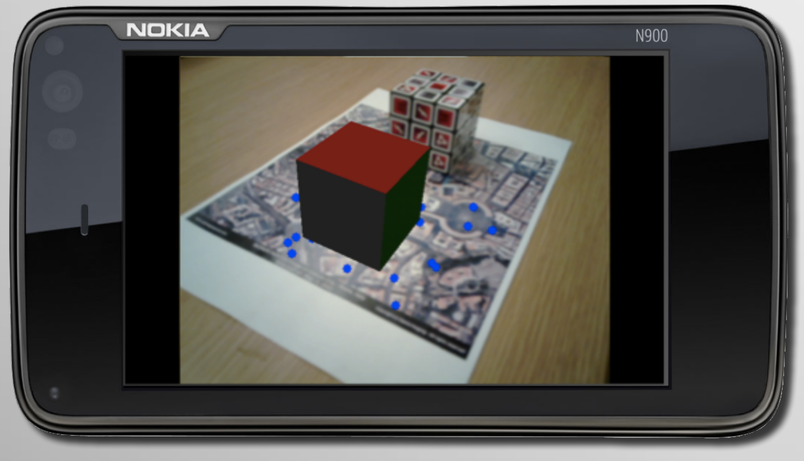

Image 1: SID-MAR Library running on Nokia N900

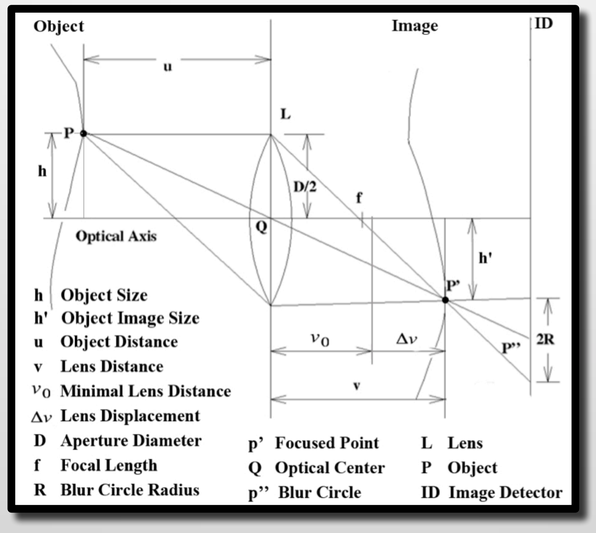

Image 2: Image Formation in a Convex Lens

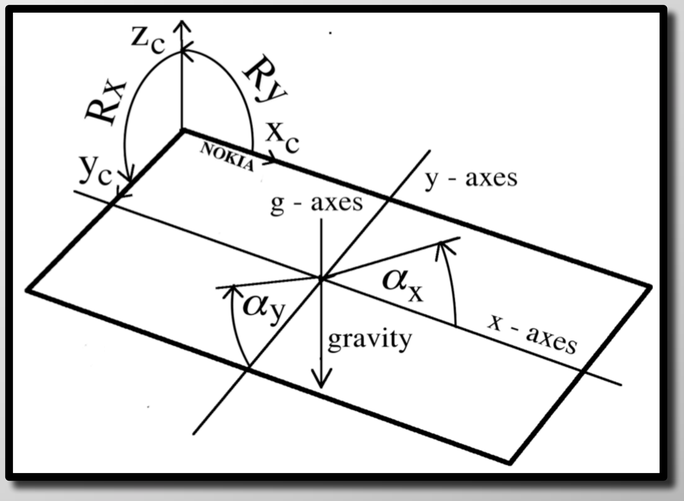

Image 3: Detecting Phone Orientation