

Marker Based Augmented Reality Browser

Mrs. Mayura Kinikar Jinesh Patel Rucha Dalvi Amit Narwal Rashmi Thorat

Department Of Computer Engineering
Maharashtra Academy Of Engineering
Pune, India.

Abstract-This paper gives the overview of augmented reality and augmented reality browser. It also describes the various approaches of augmented reality browser. This paper mainly proposes an algorithm for marker detection.

Keywords- Augmented Reality, Augmented reality browser, Binarization, Marker detection and Marker parsing.

I. INTRODUCTION

A. Augmented Reality

Augmented reality is the combination of real scene viewed by the user and a virtual scene generated by the computer. The real world scene is augmented by the virtual scene which is any additional information such as graphics, sound, video, textual data, photos or animation. Augmented reality enhances the current perception of the real world around the user and makes the information about the surrounding real world of the user more interactive. Augmented reality blurs the line between what's real and what's computer-generated by enhancing what we see, hear, feel and smell. Augmented reality differs from virtual reality as it is very close to the real world. Through augmented reality user experiences a whole new dimension of visualizing the world around him. Augmented reality is a very fast growing technology with a great future.

With augmented reality one can create their own world.

B. Augmented Reality Browser

Augmented reality browser is a new class of outdoor AR application intended for smartphones. The core function of an AR-browser is to simply display mostly textual annotations that are registered to places or objects in the real world. It enhances the real world objects by augmenting it with digital information. There are two approaches for augmented reality browser-

- 1) Location based augmented reality browser
- 2) Marker based augmented reality browser

Location based augmented reality browser are mostly used for getting information of or locating nearby cafes, shops, historical monuments and other businesses, whereas Marker based augmented reality browser are used for detecting and scanning a marker or image.

C. Marker Based Augmented Reality Browser

Marker based augmented reality browser uses a camera and fiducial which is a virtual marker to determine the center, orientation and range of its spherical coordinate system. In this, a marker is detected and a 3D model is overlaid on the marker's position.

II. MARKER DETECTION ALGORITHM

A. Algorithm overview

The algorithm has three stages: Binarization, Marker detection and Marker parsing.

In binarization stage, a binarized image which is a two-level image containing the marker is obtained.

In marker detection stage, template matching is used between binarized image and a binary template to locate all the probable marker location(s).

The approximate orientation of the marker is also found and a convex hull is created about that. In marker parsing stage, each convex hull is considered and bits representing the marker are identified.

ADAPTIVE
BINARIZATION

LOG-BASED
BINARIZATION

COLOR
SEGMENTATION

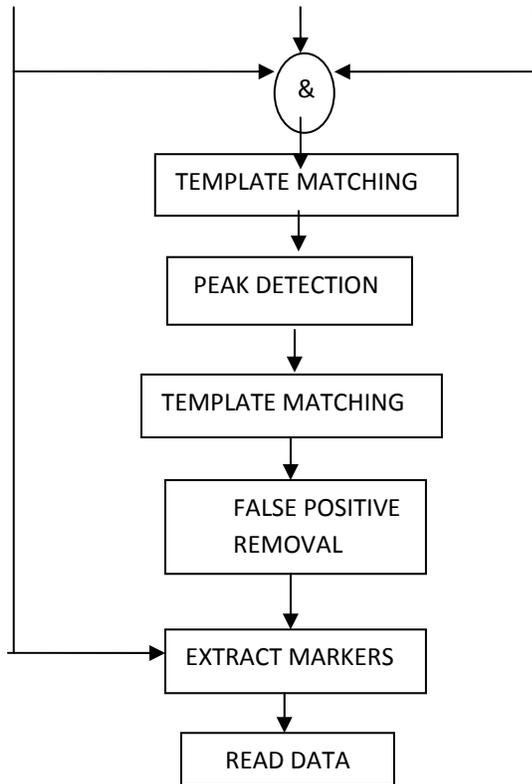


Figure 1: Algorithm stages

B. Binarization

This stage contains three types of binarization techniques. This is the most critical part of the algorithm. All possible marker regions are detected in this stage. The output of these three binarization techniques are ANDed together in this stage.

1) Adaptive binarization

The image is subdivided into blocks and the per block black-or-white decision is taken relative to the previous blocks. This technique is efficient in binarizing non-even lit sources, however, it does not utilize all spatial correlations.

2) LOG-based binarization

A simple edge detection technique is used because of the fact that markers are black and white patterns. Log (Laplacian of Gaussian) filtering followed by median filtering is used in order to obtain smoother image. The edge detected and filtered image is then thresholded.

3) Color segmentation

R, G and B values of each pixel are considered and pixel wise operations on every color component are performed. A pixel is assumed to be colored if the value of the color component is greater than the gray level (scaled) value.

Normally, a pixel is considered colored if the grayscale value Y of the pixel lies between 30-180 and at least one of the following conditions are true:

$$R > 1.05Y$$

$$G > 1.25Y$$

$$B > 1.45Y$$

The resulting black and white image is labeled. The objects within a given range are left in the image and all other objects from the image are removed.

C. Detection of location of marker

This stage contains two techniques: Template matching and False positive removal.

1) Template matching

This technique is used to identify a marker. The final binarized image from the previous stage is matched with a circular template of radius 9.5. After this, the cross-correlation pseudo-image is thresholded to a binary image by considering gray scale values above 15% of the maximum value obtained by cross-correlation. This ensures that the entire marker region is highlighted, and also that the marker does not merge with surrounding regions. This technique does not eliminate noise and irrelevant detail (false positives) from the image.

2) False positive removal

This technique is used for eliminating false positives. False positive regions are the one which satisfy any of the following condition:

a) Skewed aspect ratio is beyond 1.4 or 1/1.4

b) Area is greater than 10K pixels

D. Marker parsing

Marker parsing consists of two parts: Selecting the region of interest and Reading data bits.

1) Selecting region of interest

The approximate rotation of the marker is determined by taking a bounding box about the marker and calculating its area. This area is calculated for every

rotation (the angle of rotation is incremented by 10o in the range of 0o-90o).The minimum area corresponds to the approximate angle of rotation. The result of this step is creation of a bounding box corresponding to the actual size of the marker. It can be further rotated by the approximate rotation angle so that only the marker elements are detected for reading the data, and in identifying the origin of the marker. Bounding boxes are used as masks for extracting the relevant marker areas from the adaptively binarized image

2) Reading data bits

First the angle of rotation of the marker is determined using the Radon transform (only angles between 0- 45 and 135 -180 are considered for obtaining the origin co-ordinates).The image is then rotated by the same angle to correct this. The shear correction approach used can be described as follows - First obtain the four extreme co-ordinates of the marker, and use a method akin to bilinear interpolation to resample to a 121x121 grid Data can be now read by considering each 11x11 block as representation of a single bit. The entire block is summed; the data is considered a 0 if the normalized sum is below a threshold (50%) and a 1 otherwise. The guide bars are now located, and the 11x11 matrix is rotated yet again so that the guide bars are along the bottom right in the marker array. Additional rotation required to align the guide bars together determine the origin co-ordinates. Data is read on a bit-by-bit basis once the 11x11 aligned grid is obtain.

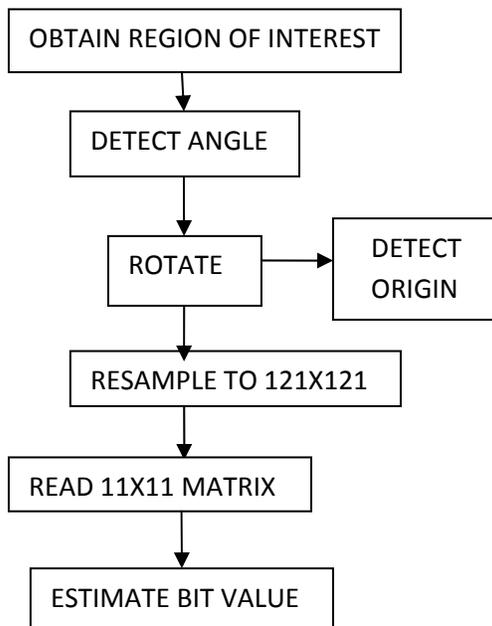


Figure 2: Parsing stages

III. FUTURE WORK

Currently this algorithm works only for limited size markers which are about 15%-20% of the image.

The algorithm can be extended and improved for arbitrarily-sized markers, as well as sparse ones.

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