

Augmented Reality on the Web: Development using Computer Vision; Problems & Proposed Solutions with the present AR

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Summary

The IRSEEM research institute of ESIGELEC, France wish to contribute its research findings to this W3C workshop from the ongoing research in field of development of augmented reality with the help of computer vision based methods for merging the virtual world as close and as accurate as possible to the real environment .

Abstract

The paper presents how can structure from motion methods of computer vision viz. epipolar geometry, homography and fundamental matrix estimation can be used to rebuild the gap between Augmented Reality (AR) and the web. Also we present some of the potential problems with AR techniques developed on web and mobile and thought provoking solutions.

Introduction

Augmented Reality has come a long distance now with many of the mobile AR applications being a part of everyday life for many of the geeks and social human beings as well. But still, it has not reached far enough where the world can said to be saturated with "real augmentation" at last.

The successful integration of AR on the web and developing user interfaces for the unhindered run of applications, calls for the methods with strong fundamentals which are compatible enough to link the two fields. We have been involved in developing the algorithms for the implementation of AR in a larger sense. The augmented mobile applications which work on iPhone, Android, and Symbian software platforms such as *Wikitude World Browser* [1] and *Augmented Geo Travel* [2] serve as travel guides and personal navigation devices and tracks the points of interest and eventually these applications overlay the virtual 3-dimensional (3D) image and its information on real-time view.

Our augmented reality research dealing with the web interface focuses on tracking and augmenting the area of interest (AOI) which is chosen/ selected in an abstract manner by the

user. This is different in comparison with point tracking methods and marker based AR approaches for real time tracking to deal with such situations.

The approach actually consists of using "Google Street View "database (basically images) as a reference to user images to produce AR world with the virtual information. This is an alternative method for markerless AR application development which can serve as real time interfacing of user data with the online available databases for AR on the web.

Methodology

The current optical or video technology methods which are being used for AR do not employ the provision of the real time access and usage of online available databases.

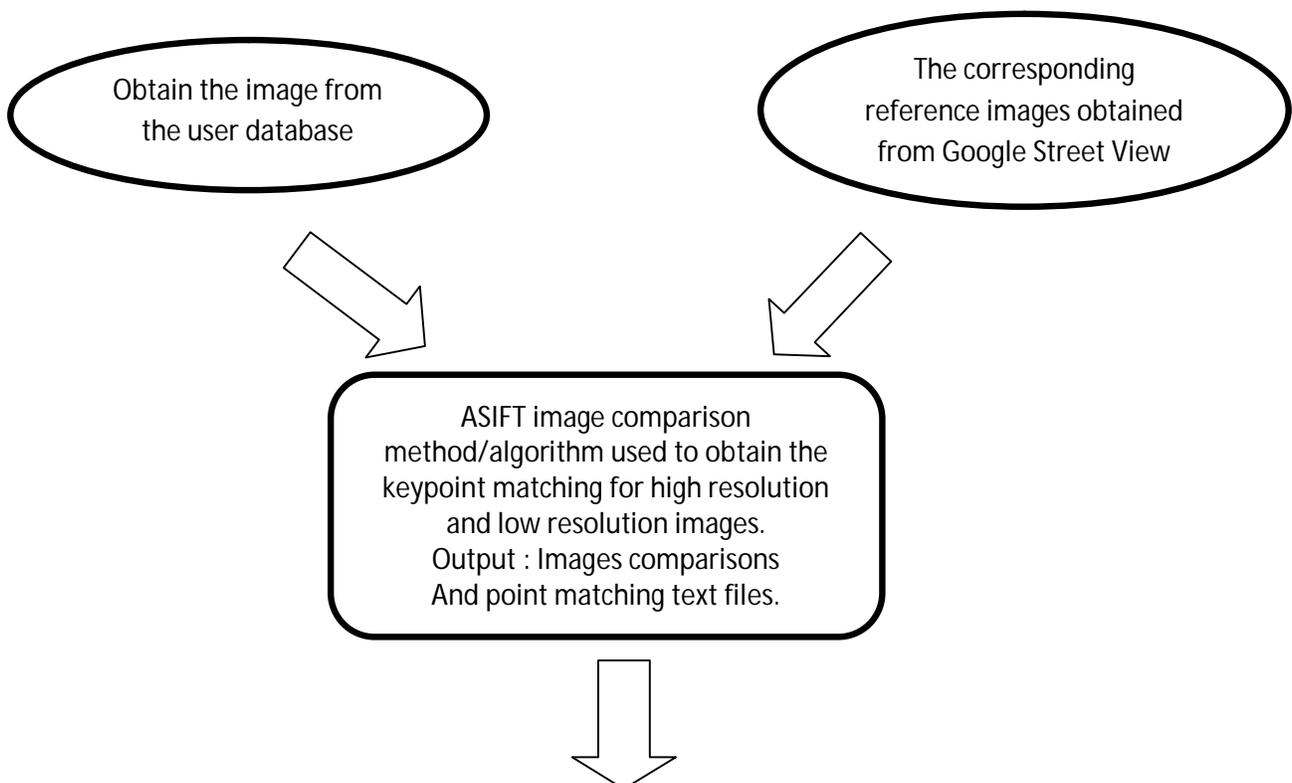
The following section lists the approach that we use in developing our system:

Block Diagram

Phase I: All the key points are detected in the camera images and Google Street View Images. This stage uses a fully affine invariant image comparison method, Affine-SIFT [3] (ASIFT) which extract the corresponding pair of points which leads to computation of Fundamental Matrix [4] .

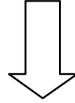
Eventually, the epipolar lines are plotted and the epipole is computed in the user image.

The following diagram lists the steps in detail:



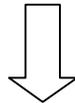
Computation of Fundamental Matrix (F)

It is calculated and tested by various methods viz 8 point algorithm, RANSAC , LMEDS to obtain the precise F .



Epipolar lines:

The corresponding keypoint matching are used to plot the epipolar lines between the 2 images, which pass through exactly the same position of the matches in the respective images.



Computation of the epipole:

The images not being rectified, contain the epipole within them, which is determined and plotted in the user image.

Phase II: Initially in this phase, a mouse based user interaction is developed so that the user can select his Area of interest in the real time interface.

Later, using the projective (epipolar) geometry, the following different methods are explored to obtain the exact Area of Interest in the images.

- The homography method.
- Matching of the exact descriptors in the image points along the epipolar lines using the masking of some area in SURF [5] algorithm.
- Finally the AOI obtained is augmented with the required information or the object in the real world images.

Some of the Challenges and Proposed solutions

We think that there are various challenges still in AR field which need to be solved before it can be successfully utilized at all platforms of the web/mobile and also for developing user interfaces . These can form a useful part of the discussion at the W3C workshop this year. Some of them are listed below:

- **Interoperability:** It may not be obvious and it may not even be true that users have a right to view any layer of Augmented Reality through any Augmented Reality browser. Logically then, a lack of interoperability between AR environments would be a tragedy of the same type as if the web had remained defined by only some of the players for some time at least.

Solution: Interoperability, standards and openness have been what has let the Web scale and flourish beyond the suffocating walled gardens of its early days. The same is true of telephones, railroads and countless other networked technologies and of course AR now! So there is growing demand for these kinds of standards to be set up in AR .

- **Single person oriented AR:** This is one of the weakest aspects of the existing interaction patterns for augmented reality. Most of the AR techniques rely on single-person or socially disconnected user experiences.

Solution – Multiple person AR: The interaction patterns for augmented experience should become proficient at creating valuable experiences for both individuals in social groups and people participating in mixed-reality experiences together. Condensed projectors can lead to group interactions and experiences without using multiple hardware devices. There is a need to project mixed realities into public, common, or social spaces which makes them social by default.

- **Secured Web AR :**

The security and spam are one of the major issues with AR in the upcoming years. There remains a high possibility of a view of augmented reality being hacked by ill-intentioned people to show what they want you to see.

- **Incognito Environment /Privacy concerns:**

The environmentally aware AR device, service, or application has the potential to recognize one's identity locally or globally when the person wants to remain undercover!

Solution:

- Individual Augmented ID need to develop.
- The initiation of effective privacy management solutions including hardware, software, standards, and legal frameworks.

- **AR for the “human”**

It's quite essential now for mixed-reality experiences to offer some sort of broad, long-term value in the creative and information-driven economies of the future for developing interaction patterns that address the everyday activities of the humans. Otherwise, augmented reality will remain a specialized form of experience that will be suited only to some particular type of applications.

- **Open AR on Web:** User experiences – personal and social, information delivery in real time and added value are the problems of the web! So too goes the development of Augmented Reality: the web of everywhere.

AR should not be a closed, proprietary lens through which we view the world - unable to change the way we view that world or see it as others do because our accumulated knowledge is trapped inside one platform and inaccessible from others.

Solution: The need to build the platforms for exciting AR programs that encourage other people to develop layers of content that they can display and use . A complete neutral AR development is the goal with the grant of right to everyone to augment his/her reality with whatever information he/she wants.

Acknowledgment

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References

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