A Report on Registration Problems in Augmented Reality

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***Abstract*— Registration is the accurate alignment of real and virtual objects. Without accurate registration, the illusion that the virtual objects exist in the real environment is severely compromised. Registration is a difficult problem and a topic of continuing research. The goal of this paper is to cover the recent advances in Augmented Reality registration problem (error).Registration as the base technology of augmented reality should be capable to reflect the location and orientation change quickly during the virtual information loaded in the real target scene. The Registration error has many region such as calibration error, tracker error ,system delay, misalignment of the model and optical distortion. Augmented reality (AR) is a technology which supplements the real world with the virtual image, text and other information aligned with real scenes to augment perception and experiences for the real environment.**

Keywords— Registration error; augmented reality; Registration technology;

INTRODUCTION

Augmented Reality is a variation of Virtual Environments. Augmented reality (AR) is a technology which supplements the real world with the virtual image, text and other information aligned with real scenes to augment perception and experiences for the real environment. Point set registration is a basic problem which frequently arises in medical image analysis ,computer vision, and pattern recognition.3-D point set registration mainly solves the problems of pose and correspondence estimation between two or more 3-D objects. Thereafter, it has a variety of applications in several fields such as motion tracking, object identification, and especially in medical image fusion. It uses several disciplines, such as computer vision, computer graphics, human-computer interactive, and display and so on. AR technology in the recent years has been widely used in various fields, such as industry, military, education, entertainment and medicine. The registration problem can be categorized into rigid or non-rigid registration depending on the application and the form of the data. Rigid registration, which only involves a small number of parameters, is relatively easy and has been widely studied.

Basic Idea-

A. *Registration Method*

Registration methods are divided into two categories, one is based on artificial markers, and the other is based on natural features. The existing registration methods based on natural features can be divided into three categories. The first one is using machine learning methods, such as Randomized Tree and Bayesian, to train feature points and achieve registration Achieve real time and accurate registration. The stability of this method depends on the input data for learning. The second one is tracking-by-detection method, for example, SIFT or SURF algorithm is used for feature detection and then registration is achieved by calculating the homographic matrix. This kind of methods usually with high registration precision, but the computation cost is too high to reach the real time performance.

II. CLASSIFICATION OF REGISTRATION TECHNOLOGY-

The Registration is a process which blends virtual objects generated by computer with real world image caught by camera. First of all it confirms the position between virtual objects and observer, and then projects the virtual objects into the visual field of the observer through projection transformation.

In general, the registration technology can be classified into three kinds: tracker-based registration technology, knowledge-based registration technology and computer vision-based registration technology.

A. *Tracker Based Registration Technology-*

Tracking technology of augmented reality includes: mechanical, magnetic sensing, GPS, optics ultrasonic and inertia.

Tracking Technology	Advantages
Mechanical	It is Exactness, low time delay, no vision or magnetic field disturbance , suitable for exact track for small objects.
Magnetic sensing	Low price, exactness, no vision occlusion, good noise immunity, suitable for large field track.
GPS	It is Suitable for outdoor large field track.
Optics	Easy use, large work range, high speed, no magnetic field disturbance, high precision.
Ultrasonic	Easily disturbed by ultrasonic in the environment, low precision in large range
Inertia	3 degrees of freedom, drift, not very exactly at low speed

B. Knowledge-based registration technology-

The trackers are fixed on the equipment with known structure to ensure the position and direction. Some 3D trackers are fixed on the key components to monitor the position and state of the system. The main problem of this method is that we must realize the structure of key components in advance and there are time delay and errors among trackers.

C. COMPUTER VISION-BASED REGISTRATION TECHNOLOGY-

The computer vision-based registration technology can be separated into registration based on camera calibration and registration based on affine transformation .Computer vision-based registration technology is becoming a registration technology with high potential in the application of Augmented Reality system. It has very high registration precision which can reach pixel level.

D. ERROR MODEL

III. REGISTRATION ERROR METRICS-

Registration error matrices are the three types such as linear registration error, lateral error and depth error.

a) s- Lateral
b) b-Linear
c) t-Depth Error

IV. ERROR MODEL OVERVIEW

Error Model Overview can be explain with the help of Four types of errors –

A) Alignment error

B) Display error

C) Viewing error

D) Head-tracking error

A. *Alignment error-*

This type of error in acquiring the data for the virtual object and aligning it with the real patient in the laboratory. For this type of application, the error sources are CT scanning etc.

B. *Display error-*

In display error includes optical distortion, miscalibration of the virtual images with respect to the tracker's sensor. Error made in displaying the computed image

C. *Viewing error*

This type of error is the user's eye points in the computer graphics model. Main Sources of this type of error is the calibration error, rotation of the user's eyes.

D. *Head-tracking error*

Head-tracking error sources are tracker delay, static and dynamic tracker measurement error and calibration error.

V. SOURCES OF ERROR

Registration errors are difficult to control because of the high accuracy requirements and the numerous sources of error. These sources of error can be divided into two types that is: static and dynamic.

A. Static Error

Static errors are the ones that cause registration errors even when the user's viewpoint and the objects in the environment remain completely still.

The four main sources of static errors are:

a) Optical distortion
b) Errors in the tracking system
c) Mechanical misalignments
d) Incorrect viewing parameters

B. Dynamic Error

Dynamic errors are the ones that have no effect until either the view point or the objects begin moving. Mostly Dynamic errors occur causes of system delays.

Methods used to reduce dynamic registration fall under four main categories:

a) Reduce system lag
b) Reduce apparent lag
c) Match temporal streams
d) Predict future locations

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