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A PRECISION MEASUREMENT FOR ARTOOLKIT'S OPTICAL TRACKING USING FIDUCIAL MARKERS

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ABSTRACT

Augmented reality (AR) systems frequently make use of optical tracking devices that are fitted with fiducial markers. When it comes to augmented reality systems, the well-known ARToolkit serves as an example. There are a number of applications for the tracking subsystem in augmented reality, one of which is the calculation of the precise orientation and location of virtual objects. In order to facilitate the reporting and practical use of the findings acquired from comprehensive accuracy experiments that make use of specified markers, the implementation of an accuracy function definition is necessary.

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According to the findings, the precision of tracking is determined by the combinations of the distance between the camera and the marker as well as the angle at which the camera is turned in reference to the marker. In order to optimize the setup of augmented reality apps that are dependent on optical tracking, the insights that were described before can be applied.

Keywords: Augmented reality (AR) systems, ARToolkit, Accuracy Function, Precise Orientation, Optical Tracking.

INTRODUCTION

We were able to construct a system that is capable of identifying building facades and showing multimedia representations of their past or future appearance by utilizing our concept for an all-encompassing augmented reality platform utilized for spatial exploration. Our technique relies heavily on the Android application known as ARToolkit, which makes use of the inherent characteristics of buildings in order to precisely identify them. When using augmented reality apps outside, the effects of lighting conditions, surfaces that reflect light, and items that conceal the markers are all potential aspects that might potentially have an impact on the overall user experience. When experiencing the same environment, it is necessary to make adjustments to the settings of the application, the parameters of the markers, the methods for producing, and other aspects in order to ensure the best possible experience. Using ARToolkit 5.3, we constructed an extra application that can automatically monitor the rate at which several markers emerge in a single photograph of the same item. This was done in order to address the problem that we were experiencing.

EXPERIMENTAL CONFIGURATION

In the course of our project, we made use of ARToolkit to track the movement of a single cardboard marker. The flexible shape made it easier to move along the y-axis, and the marker, which measured 55 millimetres in side length and was patterned after the ARToolkit

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pattern "sample1," was connected to it in a stable manner. The camera was positioned on a mechanical jig in such a way that the centre of the marker and the focus point of the lens were aligned at the same elevation during the process of taking the photograph. For the purpose of this investigation, a regular camera that is available for purchase in the market was utilized, namely the Philips PCVC750K. The refresh rate of the display was 15 hertz, and the resolution of the display was 640 pixels per inch (PPI).

The experiment is made up of a collection of different test sequences. Every single episode was comprised of a cumulative total of 250 measurements that were taken in that order. We changed the distance between the camera and the marker, as well as the rotation of the marker along the y-axis, during the short intervals that occurred between the test sequences respectively. We were able to effectively establish the alignment of the marker at the centre of the video picture by carrying out the necessary alterations to the setup. There was no change in any other aspect. We made use of artificial ways of illumination in order to guarantee that this consistency would be maintained. Over the course of nine separate rounds, we made a methodical adjustment of the distance between the marker and the camera by increments of ten centimeters, beginning at twenty centimeters and going all the way up to one hundred centimeters. At the same time as the angle of the marker around the x and z axes was maintained at 0 degrees, the angle of the y-axis was altered in increments of 2.5 degrees (35 variants), ranging from 0 degrees to 85 degrees. As a consequence of this, our experiment resulted in the production of a total of 78,750 distinct datasets. These datasets were comprised of 315 test sequences, each of which had 250 measurements.

RESULTS

The outcomes of this research are presented with fig. 1 to 4.

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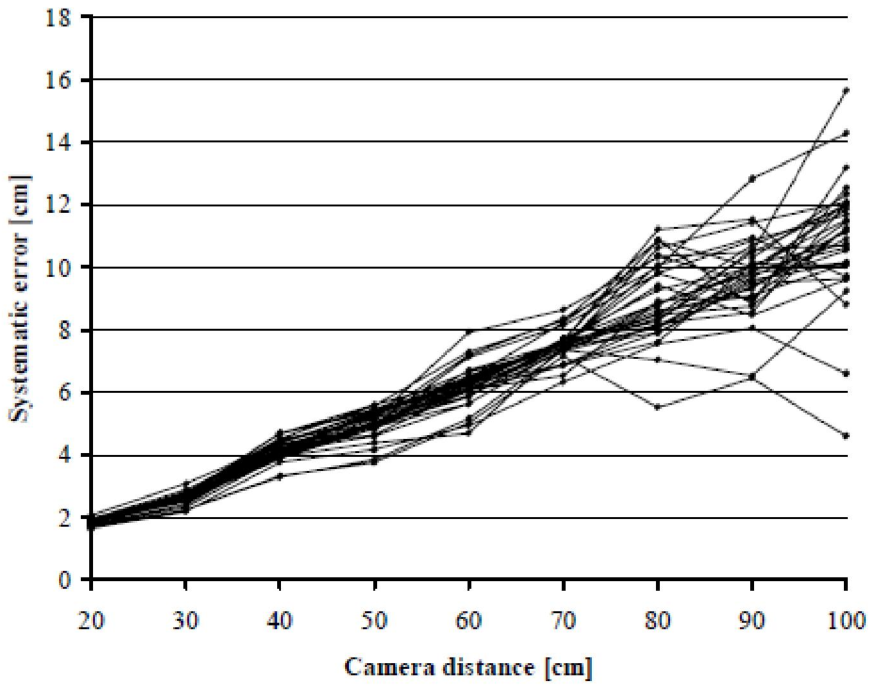

Figure 1: Errors of Distance for Various angles

STATISTICAL ACCURACY FUNCTION

Our purpose is to translate the results of the experiments into an "accuracy function" that may be utilized in real-world situations. It is not possible to utilize this accuracy function as a replacement for the confidence value that exists within ARToolkit. Both of these endeavours are aimed at evaluating distinct qualities on their own. You are able to evaluate the algorithm's capability of successfully matching each detected marker to a certain pattern by utilizing ARToolkit. Additionally, you can determine the confidence grade that corresponds to this capacity.

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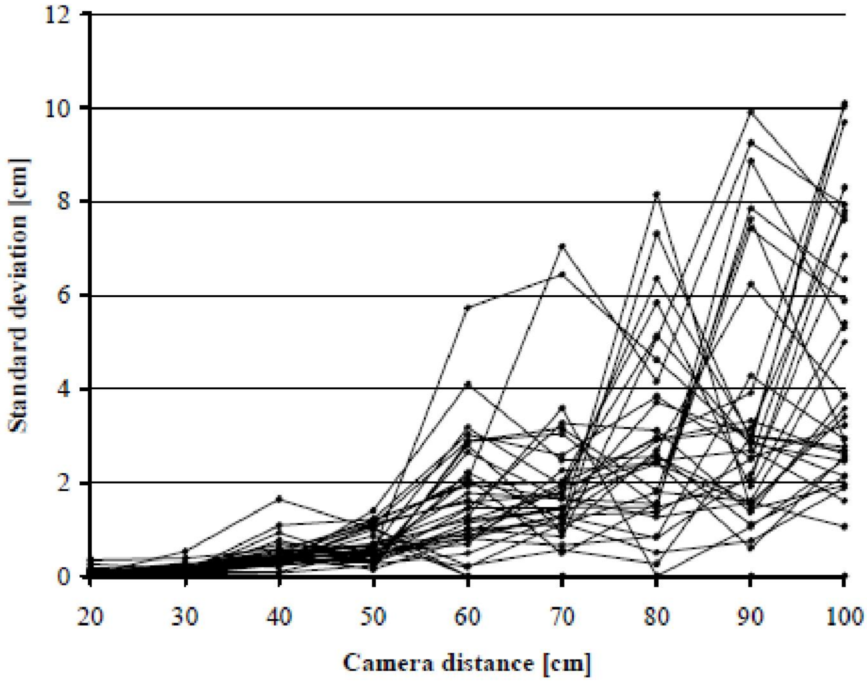

Figure 2: Distance for Standard Deviation from Various Angles

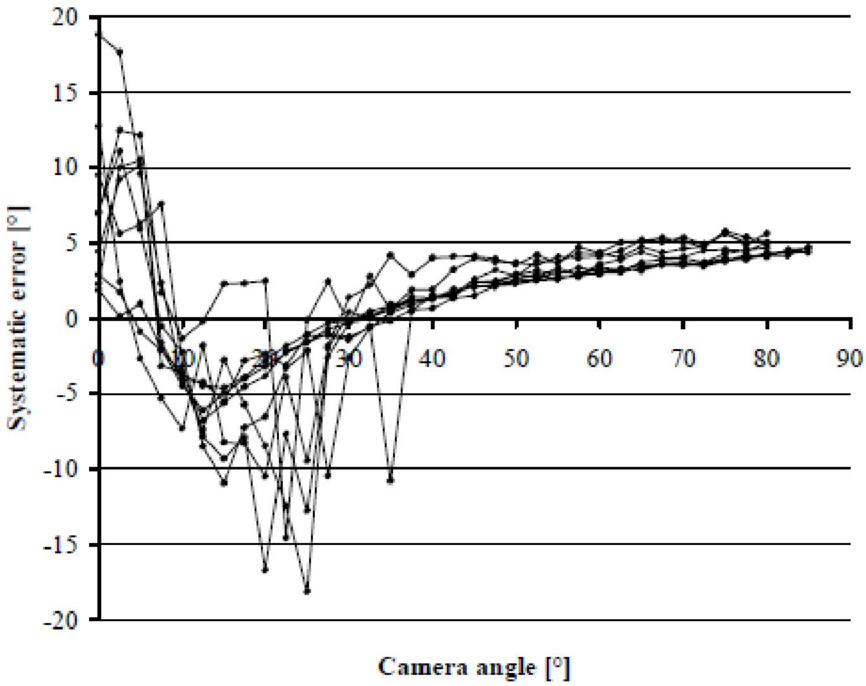

Figure 3: Errors of Angles from Various positions

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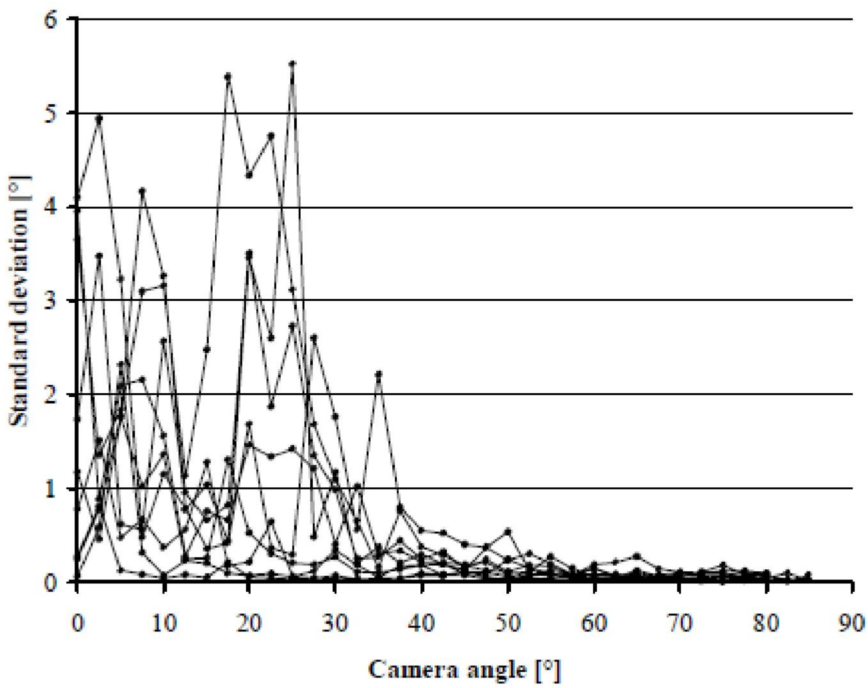

Figure 4: Camera Angles for Standard Deviation from Various Angles

When the marker is correctly identified, our accuracy function evaluates the amount of precision with which ARToolkit creates tracking parameters on the precise distance and angle to the marker. This evaluation is performed after accurately identifying the marker. We were able to effectively identify the parameter intervals that demonstrated the lowest levels of systematic error and standard deviation by doing an analysis of the data that was received from our studies.

- When it comes to measuring the distance between the marker and the camera, ARToolkit displays a minimal systematic error ranging from 20 to 70 centimeters (see Figure 1 for more information).
- The ARToolkit distance estimation has a relatively low standard deviation (refer to Figure 2) when the range of the distance is between 20 and 50 centimeters.
- The estimation of the angle displays a moderate level of consistent error throughout the range of 30–40 degrees (Fig. 3).

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- The standard deviation of the angle estimation that ARToolkit creates is rather low, with a range that goes from 40 degrees to 85 degrees (refer to Figure 4).

CONCLUSION

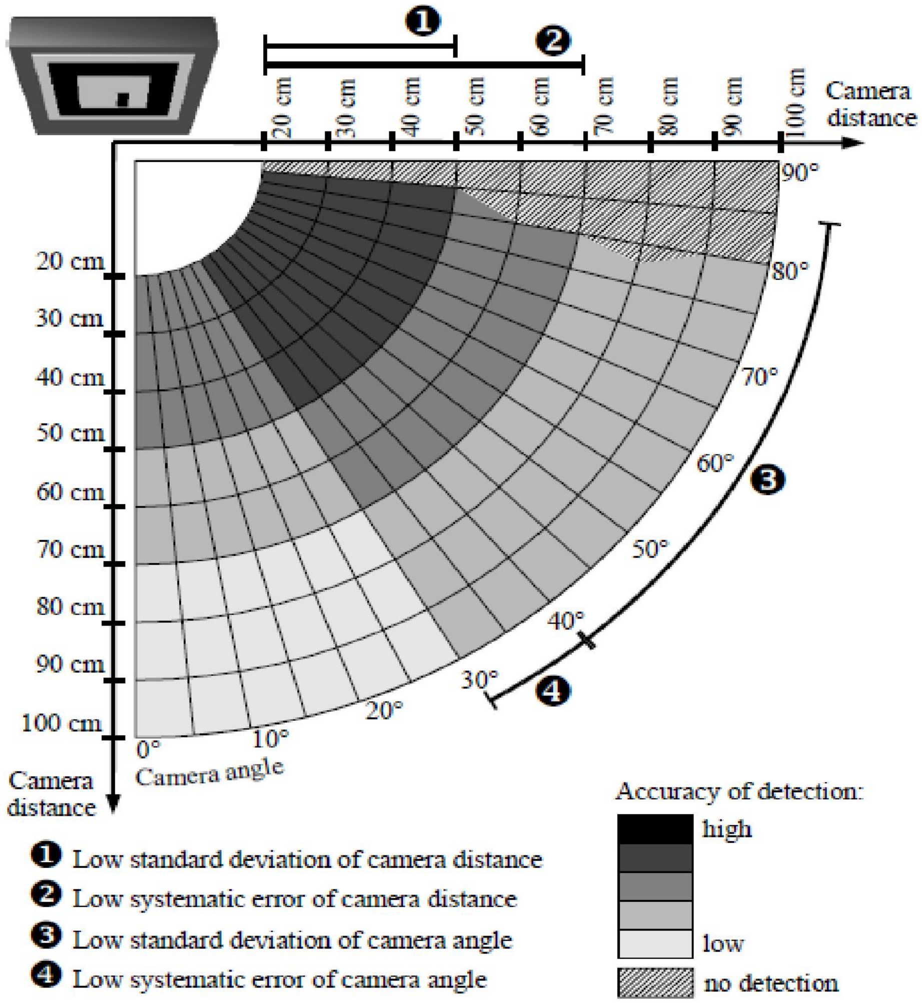

Figure 5: Function Accuracy of Camera Distance from various Angles

On display in Figure 5 are the four different time periods. Figure 5 illustrates the accuracy function of ARToolkit, which may be summarized as follows: the more darkly coloured the region in which the four intervals are represented, the more accurate the final estimation will be. Furthermore, Figure 5 illustrates the regions in which the ARToolkit marker identification did not exhibit an enough capacity to uncover patterns that are worthy of attention.

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