Estimated Position Based on the Camera by a Fingerprint Method for Optimizing 3D Effects

Sung-muk Kang, Jin-hoon Park, Yun-su Choi, Jin-won Park and Jun-dong Cho
College of information and Communication Engineering, Sungkyunkwan University
Suwon, Korea
smkang@vada.skku.ac.kr, jdcho@skku.edu

Abstract: We present a method for users to effectively watch 3D. There is disparity in the 3D image. The disparity is varied based on the user's location, the method that we have proposed is possible to change the user's viewing environment. As a method to know the user's location, first, it must detect the user's face in haar-like. Place the area to find detect the user's face to the region of interest. The region of interest distinguishes the color of the glasses in the HSV color model. Then, we obtain the numbers of pixels glasses. In comparison with the data that has been previously saved, you can keep track of the user's location..

1. Introduction

Recent developments in IT technology and demand for smart devices exploding services, LBS (Location Based Service) are becoming more important. The location information is needed in order to provide a position estimate in accordance with the user's location, appropriate security information, SNS, weather.

Outdoor location estimation methods include GPS (Global Positioning System) based on the satellite communication [1] and Network system based on the mobile communication [2]. Indoor location estimation methods include RF (Radio Frequency) [3], MF (Magnetic Field) [4] and Fingerprint-based [5] etc. However, it is a problem that the signal does not reach and it interferes signal processing of the signal disturbance. Method for calibration is necessary. These techniques have been widely studied method using a camera to compensate for the problem. The camera is able to separate the location information because of the different image for each location to obtain information. Position estimation using the camera [6-9], you can use the Stereo camera [7], use the recognition is possible Marker, such as a QR code [8], use the SfM (Structure-form-Motion) technology [9], SLAM (Simultaneous Localization And Mapping) [6].

In this paper, by using a single camera, we propose a method to determine the user's location. It should have the location information and pre-acquired image information configure the database. Estimate the location of the user by comparing the information to obtain from the device and the database. The proposed method use Fingerprint techniques that utilize a database and using the image information instead of the intensity of the signal. It uses a Haar-like algorithm to find the user's face in order to estimate the location of the user from the monitor camera device used by a user. Use the effects of the light receiving less HSV color model to distinguish the color of the 3D glasses. If you distinguish the color of the glasses, calculates the number of pixels of the glasses. And estimate the position of user by comparing the database and it. Since estimates the location of the user, converting the 3D viewing with the user desired (stereoscopic effect and decrease fatigue) video image according to the user's position may be watching.

The rest of paper is organized as follows. We will present conventional location estimation techniques in Section 2. In Section 3, we will present proposed method. Experimental result will be given in Section 4, and finally, we shall draw the conclusion in Section 5.

2. Related Work

Currently, the location estimation technique for providing LBS technology in a variety of smart devices and various devices have been widely used in our daily life. the position estimation method is divided largely into two types. First, Using the satellite signals(GPS, Network, etc.) to the position estimation method in an outdoor environment have developed a method. Secondly, to provide a variety of services, using the RF, MF in an indoor environment have developed method. Also, location estimation using a camera or using a sensor to visually provide information about the user's location has been studied.

2.1 Location Estimation Using the Camera

2.1.1 SLAM [6]

SLAM is a technique that only the sensor which is attached to the robot creates a map of the environment of the unknown. By combining the sensors (camera, ultrasonic, LIDAR, radar etc.) for identification in the surrounding and the sensors (gyro, IMU, etc.) to record the motion direction information are configured the system. Measuring the observation information obtained by the robot, create a map of their surroundings estimate the absolute position at the same time.

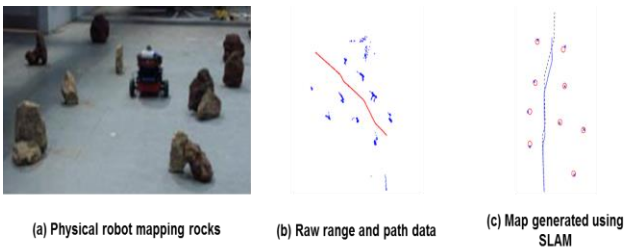

Figure 1 SLAM(Simultaneous Localization And Mapping)

2.1.2 Stereo Vision [7]

Stereo Vision performe a process to acquire an image through the two image sensors, unlike the ordinary camera. According to the distance(Baseline) between the two image sensors, it is to acquire images from the difference of each other angle. Through the process of matching of images calculate the depth of the object and the camera, it is possible to distance calculation .

Figure 2 Stereo Vision

2. 2 Fingerprint-based estimate of the user's location

Fingerprint-based position estimation is saved the information obtained for each point of each location in the database, a position Estimation Methods according to the probabilistic model to estimate the location information and through a comparison input by the user.

Fingerprint technique is classified as an off-line phase and an on-line phase. Offline step is building a database. Stores the data obtained at each position point and the position information in the database. Online step is substantially estimating the location of the user. Compare the input data from the current position of the user and the similarity of the constructed database of data, and estimates the position to find the most similar data.[5]

3. Proposed Method

The proposed system is described. It describes the fingerprint technique in phases of the off-line and on-line.

3. 1 The proposed system

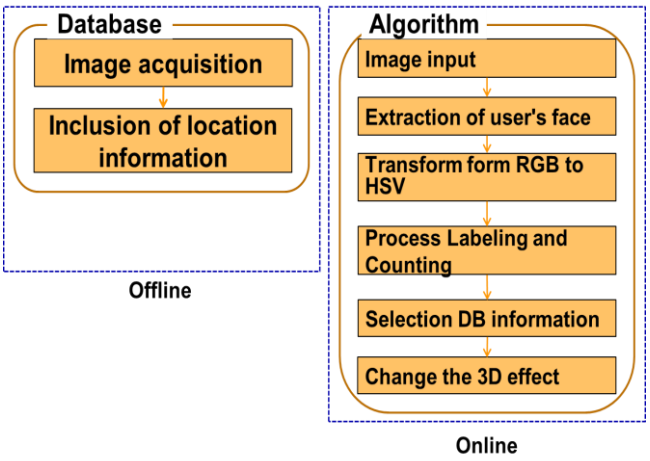

Figure 3 Proposed method system diagram

3. 2 Build a database (Off-line phase)

Off-line step for the database building step is configured to include pixel information from the image obtained at each position within the experimental range. In this paper, off-line phase proceeds in two setting process pixel information in accordance with the user distance and image acquisition. Image acquisition as shown in Figure 4 is obtained in the direction of the viewing device.

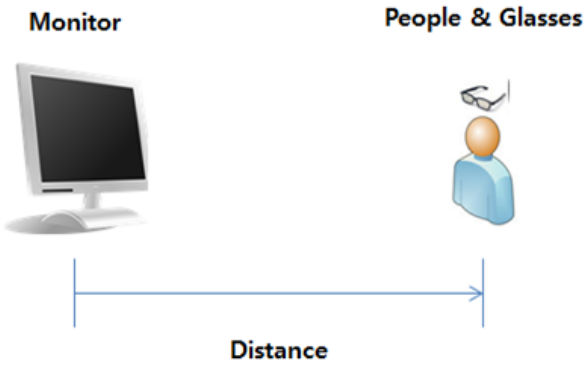

Figure 4 Distance between the user and the monitor

As shown from the Table 1, it can be seen that the average value.

Table 1 Database values (mean values and distance values)

distance	Average(pixels)
50cm	1268
60cm	1092
70cm	757

3. 3 The location estimation algorithms (On-line phase)

In the on-line phase, Compares the obtained image data in the user's location with a database. The input image to obtain information about the number of pixels of the glasses. Check the database most similar pixel information. The location of the user estimate. In this paper, it is determined that the input image from the device and the database information that has been built due to the use of images by resource of information Fingerprint Technique.

The first process step find the face by using the Haar-like algorithm. Normally, when shooting the picture, the background is taken with other things around. If it separately extract only the face area in the image eliminating the need to process the entire image from the feature extraction process. Reduces the throughput by ROI (Region of Interest) setting through the face recognition, and by removing the background image can increase the reliability in advance by reducing unnecessary information to the feature extraction, as shown in Figure 5.

Figure 5 Haar-like algorithm to recognize user's face

The second step is converted to HSV color model. In general, files that are stored on the computer are represented by RGB model. The eyes of people who are sensitive to red, blue and green are easy to express. The image recognition disadvantages include the intensity of each component light. Each value is greatly changed by the change of the light. Typically, the input images are often unevenly distributed in the light of uniform state. It also frequently occurs when a shadow caused by the illumination to the target object. In this case, The use of HSV model may be free to some extent from the effects of the influence of strong light or shadow. Therefore, find the face in order to find the color of the glasses by HSV model as shown Figure 6.

Figure 6 Transform form RGB to HSV color model

The third step is the Labeling. After conversion to HSV color model, only part of glasses and the Labeling by the binary. The reason for labeling is to get the number of pixels of the glasses in the labeling process. When converted to the HSV model, there may be other parts similar to the color glasses. Because of the proportion of the glasses from the face area occupied by the high, find a the number of pixel by processing labeling as shown Figure 7.

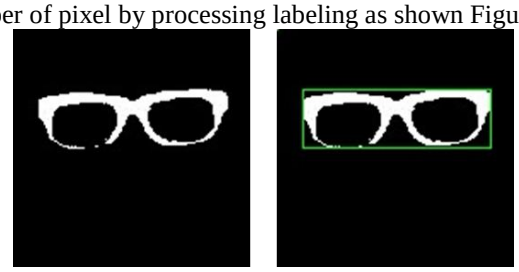

Figure 7 Process Labeling

As final step, the comparison image has been processed and the database The comparison has been processed with the database. Estimate the location of the user by comparing the pixel number information and the distance information stored in the database.

4. Experimental Result

In this paper, it is defined with respect to the method of the experiment conducted for the evaluation of the proposed algorithm. Acquire data from real environment and analyze the results to the experiment for the position estimation at any position point.

4.1 Environmental experiment

Equipment used for the verification of the experiment is as shown in Table 2. We process to convert the resolution of the image acquired as 640x480 at the position of the user and building of the database. Installing a webcam above the height of the monitor camera has acquired all of the images. The proposed experiment was performed using the visual studio 2010, it was processed through the image OpenCV with C.

Table 2 Experimental equipment Overview

Camera	Webcam
Image quality	640 x 480
OS	Windows 7
CPU	Intel i7-3770
Tool	Visual Studio 2010
Program	Open CV, C

4.2 Algorithm performance analysis

In this paper, build a database by specifying the three spaces in the experiment, and the experiment in an indoor environment the three spaces. To the comparison between the image data and the database data, select the best available information on the location of the user to estimate the location of the user to estimate the accuracy. The Table 3 shows the accuracy in measuring the distance to the user of using the algorithm suggested in the experimental environment. We measured by preparing a 10 sheets of images for each distance.

Table 3 Analyze user location estimation accuracy

Experiment environment	Accuracy
Lab	90%
Room	93.3%
Living room	90%

5. Conclusion

In this paper, we propose a user-oriented 3D image processing method by determining the user's location. Using our methods, fatigue level and stereoscopic effect 3D images will be optimized. The proposed method by a single camera can be measured. It is also possible to use a camera that is attached to a computer monitor, TV. And building a database based on the image data to a Fingerprint technique used in an existing position estimation. It can easily make the viewing experience for users who want to watch 3D stereoscopic images or reducing fatigue.

Acknowlegment

This research was supported by Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education(NRF-2013R1A1A2058942)
This work was supported by the Technological Innovation R&D Program funded by the Small and Medium Business Administration(SMBA, Korea)" [S2343584 , Development of automated manufacturing robot system technology integrating with the 6 DOF robot mechanism and the S/W platform for assembling mobile IT products]

References

[1] E. Kaplan, C. Hegarty. “Understanding GPS: Principles and Applications”, Artect House, Norwood, May. 2005.
[2] Hui Liu, Houshang Darabi, Pat Banerjee, Jing Liu, “Survey of wireless indoor positioning techniques and systems”, IEEE Transactions on System, Man, and Cybernetics-Part C:Applications and reviews, vol. 37, NO.6, November. 2007.
[3] D.G. Kim, Y.H. Kim, J.W. Han, K.H. Song, and H.N. Kim, “Emitter geolocation based on TDOA/FDOA measurements and its analysis,” J.KICS, vol. 38C, no. 9, Sept. 2013.
[4] S. Hur, J. Song and Y. Park, “Indoor position technology in Geo-Megnetic field,” J.KICS, vol. 38C, no. 1, pp. 131-140, Jan. 2013.
[5] K. Kaemarungsi, “Efficient design of indoor positioning systems based on position fingerprint” International conference on wireless networks, communication and mobile computing, vol. 1, pp. 181-186 June 2005
[6] N. Karlsson, E.D. Bernardo, J. Ostrowski, L. Goncalves, P. Pirjanian, M.E. Munich, “The vSLAM Algorithm for Robust Localization and Mapping,” Proc. IEEE Int’I Conference Robotics and Automation. pp.24-29, Apr. 2005
[7] S.I. Kim, J.S. Lee, Y.W. Shon, “Distance Measurement of the Multi Moving Objects using Parallel Stereo Camera in the Video Monitoring System” Journal of the korean institute of Illuminationg and Electrical installation Engineers. vol. 18, No.1, pp.137-145. 2004
[8] J.S. Song, S.J. Hur, Y.W. Park, J.H. Choi, “User Positioning Method Based on Image Similarity Comparison Using Single Camera”, The Journal of Korean Institue of Communications and Information Sciences, vol.40, No.8, 08. 2015
[9] J.B. Kim, “ Indoor Location Positioning System for Image Recognition based LBS”, Jouranl of Korea Spatial Information Society, vol.10, No.2, 2008
[10] H.J. Kim, D.H. Lee, T.J. Oh, H. Myung, "Localization of a Monocular Camera using a Feature-based Probabilistic Map", Journal of Institute of Control, Robotics and System, vol.21, No.4, pp.367-371, 2015