

Laporan Penelitian



Mobile augmented reality for furniture visualization using Simultaneous Localization and Mapping (SLAM)

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2020

Abstract

The purpose of this research is to visualize furniture objects from a catalogue using a markerless augmented reality tracking. Augmented reality is applied to help customers to envision an augmented object for learning the product knowledge of the furniture chosen. The markerless tracking method used in this research is a Simultaneous Localization and Mapping (SLAM), where a targeted surface of the floor for an augmented object can be determined in certain areas in the real world without using a marker. Testing was performed with parameters such as with a minimum of lighting intensity from without lighting, low lighting and bright lighting, a minimum of distance from 50 cm, 100 cm, and 150 cm, a minimum of height from 60 cm, 120 cm, 160 cm, and a minimum of angle from 30, 50 and 70 degree of detection from the surface of the floor. The result of this research is the Simultaneous Localization and Mapping method is confirmed to be adequate for visualizing the 3D furniture model on targeted the surface of the floor without markers.

1. Introduction

Augmented reality technology is an integration of digital information which creates interaction with users in real-time environment. In contrast to virtual reality technology which creates an immersive virtual environment, augmented reality technology uses the real world and enhance information [1,2]. Augmented reality is used to improve user perception in the real world and help users to perform certain tasks. Previous research on augmented reality is performed in the field of education as a teaching aid for teachers and in businesses to promote interior design products [3,4], and other field studies in the area of promotional advertising products [5]. Further research is the application of augmented reality to visualize furniture in furniture stores where the surface of the floor has been successfully tracked will be used as a marker, and 3D models that the user wants will appear. From each of the studies mentioned previously, there is no measurement of the effectiveness of parameters such as lighting intensity, distance, height, and angle. measurements are needed to identify the accuracy of the plane indicator used. Based on previous research, this study aims to implement mobile augmented reality using the Simultaneous Localization And Mapping method to measure the effectiveness of tracking to the floor to bring up 3d furniture models [6]. The furniture chosen for this research is a furniture catalog from Lucky Vista which has 17 furniture. However, only 5 pieces of furniture was chosen to be made in 3D models and tested in this study. Helmina Furniture is the research sample location and is located in Depok. The Helmina Furniture store has a problem when customers look at furniture catalogs and want to see the furniture directly, but the furniture stock is not available in the store. Simultaneous Localization and Mapping (SLAM) is used as a method for surface of the floor and giving successive points for triangulation. SLAM is an approach to recognize the structure of the real world by mapping in each image by comparing the position of line patterns, dot patterns, color patterns, and other readable patterns [7]. Sensors on Smartphone's will collect visual data from the real world for tracking conditions on the surface of the floor. Points will help the system to distinguish between floors, walls or obstructions. The purpose of this system is to map unidentified environments to bring up 3d models at these locations. Then simultaneously use this information to estimate the camera pose. Testing is performed by calculating the results of the analysis of the

score indicators then compared. Based on these results, usability testing will be carried out to users for the use of mobile augmented reality furniture visualization from the user's perspective.

2. Methods

The Simultaneous Localization and Mapping (SLAM) method is one of the approaches used in producing a markerless augmented reality. This method focuses on the exact distance, height, and angle when scanned with a camera that tracks the surface of the floor. According to previous research, augmented reality testing using the SLAM method does not currently work well outdoors [8]. Therefore testing will be done indoors. Tracking without the mark chosen in this study is because it is more efficient in its use and can bring up 3d furniture objects without having to use markers in catalog form [9].

The feature extraction process starts by tracking the surface. The image captured by the camera is the result of exploration from the Agent, then tracked by the system and given several Feature Points (dots) based on unique elements of high-contrast spots, curves, and edges.

Furthermore, the extracted feature points can then be used to expand the map as the agent explores the environment. The image captured in the frame that is the reference image is only processed once when looking for feature points to serve as anchors and become the first feature set. The feature extraction process will be generated in the same way and match the second set of feature points with the first extraction, then the system will store a collection of relative positions of all feature points obtained and perform triangulation to unite them into something resembling constellations so that the feature points do not change significantly when the camera is pointing them from different angles.

The propagation phase is used to generate new positions and integrate the Inertial Measurement Unit (IMU) data points in the form of device position data. From the device side, tracking using IMU sensor data is useful for estimating poses [10]. Inertial Measurement Unit or IMU is a sensor used to measure the 3d motion of an object. IMU has a Six Degree of Freedom (6DOF), namely three gyroscope axes (pitch, roll, and yaw axis) to detect tilt angles and measure changes in tilt angle axes and three accelerometer axes (x, y, and z axes) to measure and identify the accuracy of direction a device [11]. An update is performed to correct the drift introduced by propagation and will update the map with newly detected feature points. Then enter the registration stage which uses a tracking mechanism to register or synchronize virtual content with the real world.

3. Result and discussion

3.1. Requirement analysis

In this study, the SLAM testing is performed to validate whether furniture visualization can be visualized or not. Tests are carried out using lighting intensity and distance results with furniture model. Testing was performed with parameters such as with a minimum of lighting intensity from without lighting, low lighting and bright lighting, a minimum of distance from 50 cm, 100 cm, and 150 cm, a minimum of height from 60 cm, 120 cm, 160 cm, and a minimum of angle from 30, 50 and 70 degrees of detection from the surface of the floor.

3.2 Implementation of SLAM with furniture object

Some appearances of the augmentable object using SLAM Method able to bring up the 3d object furniture, the user is asked to press one of the furniture buttons. Then point the camera on the surface of the floor by moving right and left so that the surrounding surface of the floor can be tracked perfectly. Then after the tracking process is complete, the system will display a plane indicator to bring up the 3d object furniture selected.

3.3 Lighting intensity and distance testing

The analysis scores are summed according to the distance parameters. The distance scores obtained from the five furniture and tested with three different lighting intensity which are without intensity, low intensity and bright intensity. The distance value will be processed by adding the distance value from the three lighting intensity parameters based on each distance parameter (50, 100, 150).

4. Conclusion

Implementing simultaneous localization and mapping (SLAM) on an augmented reality environment is successful where each detection test is carried out at excellent lighting intensity, distance, height, and angle. an approach using augmented reality to obtain lighting and distance based on the slam test was also successful where the score was 387 for bright lighting and a score of 359 for the distance of 100 cm. Applying augmented reality can be considered to promote interior design products.

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