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An Example with Microsoft Kinect: City Modeling with Kinect

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***Abstract*— In this paper, we use Kinect device to detect human hand movements and we explain how we can build a city with human hand movements. Kinect is a system that can detect human movements and send them to computers. It was developed by Microsoft to play games for the Xbox game console and is being used over time for applications in other areas. Because of the new technology, there is a lack of application and the literature in this field. In this study , the user's hand movements were detected by Kinect and is done the modeling of the city by drag and drop method by accessing shapes that was designed in the WPF screen.**

Keywords—kinect; modelling; WPF screen

I. Introduction

Kinect or Project Natal is a device that allows you to play games without any controller and a line of motion sensing input devices by Microsoft for Xbox 360 and Xbox One video game consoles and Windows PCs [1]. Kinect is a camera with a depth sensor. The convenience Kinect provides here is for the human to perceive the joint points and transfer the arm movements towards the computerized environment. Depth sensing systems such as Kinect are among the current research topics in computer vision and image processing [2].

Due to the increasing importance of your visuals, it is getting harder drawing operations that performed manually in the fields as technology, construction and architecture. It has become inevitable to present drawing and Computer Aided Design (CAD) models on paper or computer applications in the form of augmented reality. Kinect is a technology that grows in this point in human - computer interaction [8].

Recently, computer vision systems using Kinect, which costs less than traditional 3D cameras, have begun to be developed [3].

In this study, it is aimed to model a city by dragging and dropping onto Windows Presentation Foundation (WPF) screen by programming previously designed 3D models in visual studio application. Here, the software provides an integrity by adding control steps to the modeling phase of a city using the data it receives from the sensors on the Kinect.

The work was arranged as follows: In Section 2, materials and methods was explained. In Section 3, evaluations of the study were described. In Section 4, conclusions were presented.

II. Material and Methods

A. Kinect Mechanism

Kinect is a special purpose camera system developed by Microsoft that has the ability to detect motion, depth and audio. The hardware structure of the device includes RGB camera, infrared projector, depth sensor camera and sound sensor microphones. The version produced for Xbox 360 game consoles is called "Kinect for Xbox 360" and the version produced for commercial use is called "Kinect for Windows". The device view of the Kinect for Windows version is shown in Fig. 1 [4].

Fig. 1. *Kinect for Windows [4]*

Kinect's optical components consist of IR Emitter, IR Depth Sensor, color sensor, tilt motor and microphone array. Kinect optical components in Fig. 2 are as shown.

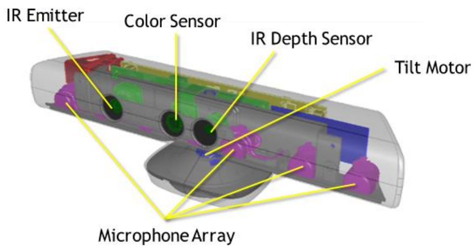

Fig. 2. *Kinect optical components [5]*

Where, IR Emitter is emits infrared light beams, IR Depth Sensor is reads the IR beams reflected back to the sensor, Color Sensor is to make capturing a color images possible. The tilt motor is the mechanism that gives the sensor the ability to move vertically, and a simple DC motor is formed. Kinect can be moved by

(+/- 27) degrees using software. The grate at the bottom portion of the Kinect 4 microphone is available. These microphones are arranged at regular intervals on the bottom of the Kinect to capture the best sound quality and the angle that the sound comes from [5].

Normal cameras collect light that jumps between objects in front. The camera turns this light into an image that resembles our own eyes. The Kinect, on the other hand, records the distance of the objects placed in front of it. Kinect uses infrared light to create a depth image that captures where things are, not what objects look like [6].

B. *The Kinect Skeletal Structure*

Kinect forms the skeleton structure from 20 joint points as shown in Fig. 3. Each joint datum belongs to a predefined body region in the Kinect coordinate space, which contains 3D coordinates and is shown as a time series. The Microsoft Kinect SDK and OpenNI libraries are available for real-time and advanced animations. Both of these libraries can track the 20 joins of the human skeleton.

Fig. 3. *Joint points of the Kinect skeleton [7]*

The joint data representing the human limbs are updated with the depth image frames captured at specific time intervals without deteriorating the integrity of the Kinect skeletal structure. In order to adapt the 3D model to the motion capture data obtained by Kinect, the orientation information about the joints is needed in addition to the 3D coordinate information of the joint points [8].

III. Evaluation of the Study

In this study, the Kinect SDK application is loaded onto the computer and Kinect is connected to the computer via the USB cable. Kinect skeleton detection libraries are added to the project software. Once all the necessary configurations have been completed, Kinect will calculate the distance between the joints and detect the joint points on the human skeleton.

Control parameters of the mouse operations that correspond to human hand movements are added to the application. In this study, human skeleton is detected by Kinect. Using the mouse movements corresponding to human hand movements, the models are moved onto the WPF screen by drag and drop. The operation steps of working are shown in Fig. 4.

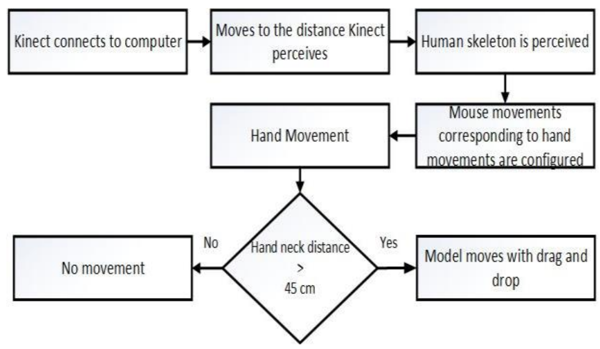

Fig. 4. *Process steps of the application*

Kinect actually seems to have three eyes. Two of them are in the middle, the third side is the side. This "third eye" determines how Kinect works. However, Kinect's third eye is actually an infrared projector. Kinect's infrared beam shines the rays of the form of infrared spots on the person in front of the projector. We can't see these points normally, but we can see using an IR camera.

In this study, we first identified the joint points on the human skeleton with Kinect. Using the program code we wrote, we combined these joint points with a line so that the human body would form. In this way we have created the human skeleton structure of Kinect corresponding to the human skeletal structure. Kinect's depth information acts like a 3D scanner to detect human movements.

The model shown in Fig. 5 was designed in the WPF screen, and the model was given motion characteristics in the XY plane. We have acquired this drag-drop motion feature that we have designed using sensor data from Kinect. In Fig. 5, the city model are shown on WPF screen.

Fig. 5. *Our city modeling designed*

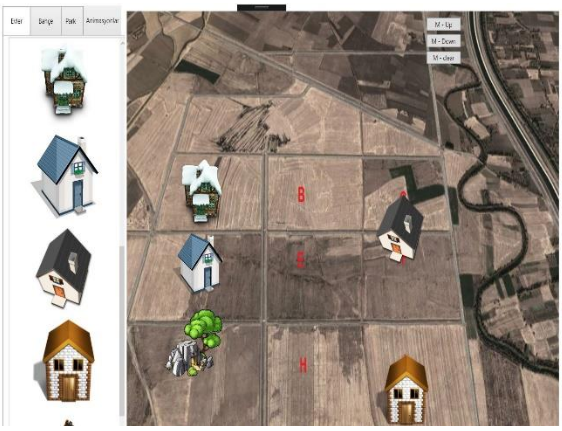

Fig. 6. *Our city modeling application with Kinect*

In Fig. 6. , is shown the application interface we use to model the city using Kinect. The hand and arm movements of the user correspond to the mouse movement defined if it has a value less than 45 cm according to the value of the angle made by the shoulder sense. The user's hand and arm movements correspond to a double click in the mouse operation when the angle of the shoulder is greater than 45 cm.

IV. Conclusion

In this study, human skeletal data detected by Kinect to correspond to mouse movement has been configured and a city modeling was carried out using hand movements. With this work, a new application on Kinect has been realized. We have provided a road map for us to try Kinect on different platforms. We have seen that this new technology can be successfully used in different disciplines.

In this study, we have found that city planning, park-garden planning, interior and exterior architectural design can be done easily with Kinect at low cost. Using this work, we can make an analysis and calculations easier by preparing an interactive prototype in the planning of a city. The problems that will arise afterwards from traditional design problems are determined in advance by this application, and we can save time and cost in the project.

Acknowledgment

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