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3D User Interface and Augmented Reality COMS W4172
Assignment 3 Documentation
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In this assignment, I implemented a GoblinXNA application – tracking camera – to track markers, select object and manipulate objects. All interactions in my assignment are accomplished through the use of tracked markers and triggers specified using buttons on the keyboard and mouse.

My project contains four selectable virtual objects, including a humvee car, a gear, a cup and a g36c gun. These four selectable virtual objects are child of the ground marker array, and the ground marker is added to the scene of the application. These four objects reside within a coordinate system determined by the position and orientation of the ground array. Once the ground marker array is detected, these four objects will be displayed on the screen, as show in figure 1.

Figure 1: Ground marker objects.

All these four objects are downloaded from TurboSquid.com/XNA. The website is a platform for graphic users to share and sell 3D models. The website offers a number of free objects.
The humvee car model is published on 23 July 2008. The URL link to download the model is: http://www.turbosquid.com/3d-models/free-humvees-3d-model/413510
The gear model is published on 10 Dec 2011. The URL link to download the model is: http://www.turbosquid.com/FullPreview/Index.cfm/ID/643650
The cup model is published on 28 Jan 2012. The URL link to download the model is: http://www.turbosquid.com/FullPreview/Index.cfm/ID/651726
The g36c gun model is published on 9 Mar 2012. The URL link to download the model is: http://www.turbosquid.com/FullPreview/Index.cfm/ID/659740

SELECTION

My project also has a cone object attached to the toolbar marker array. This object is the selector of the four selectable virtual objects. Initially, this object is invisible and transferred to (-400, -400, -400). After both ground marker and the toolbar marker are detected, this cone object will be visible and move along with the tool bar marker, as shown in figure 2.

All objects in GoblinXNA will initially load to a location close to each other. That might cause unexpected selection if the cone collides with one of the four ground marker objects. Transferring the cone to (-400, -400, -400) is able to effectively avoid unexpected selection before detecting the toolbar. If I do not initially hide the cone and set it invisible, users might get confused about it functions and location. In order to make objects in the system appear in a natural and logical order, I make the cone invisible by setting its diffuse value to 0. Once the toolbar marker is detected, the system will reset the diffuse value of the cone back to 0.6. As a result, users are able to see the purple cone. The cone resides within a coordinate system determined by the position and orientation of the toolbar marker.

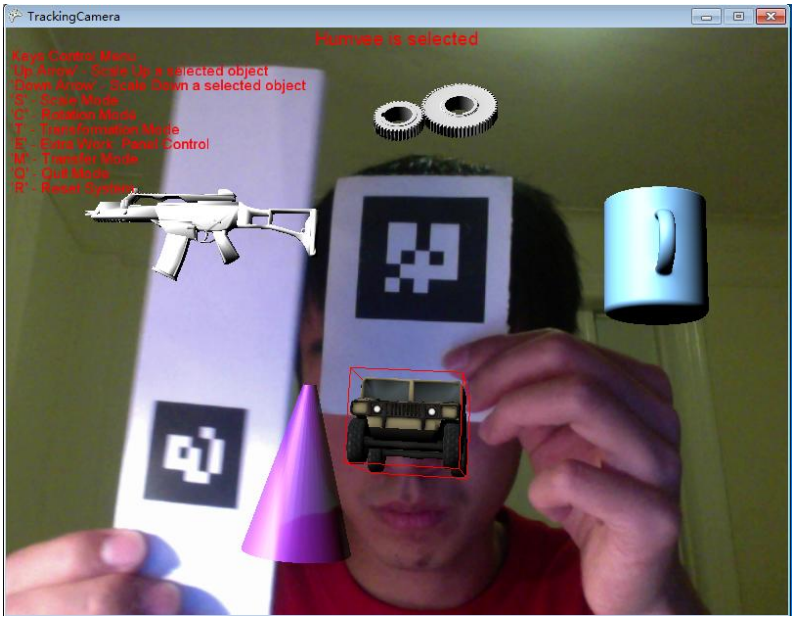

Figure 2: Objects on ground marker and tool bar marker.

Users are able to select an object from the four ground marker objects using the toolbar marker object. Once a ground marker object colludes with the cone object, it becomes selected. A bounding box will be displayed around the selected object, as shown in figure 2. This visual effect allows users to visualize the selected objects instead of guessing from limited information displayed on the screen or on the console. After making a selection, a selection notification will be displayed on top of the screen, as shown in figure 2. My design of the user interface keeps users informed about the system status. According to the ten heuristics, the notification screen keeps users informed about what is going on, through appropriate feedback within reasonable time [1]. These feedbacks are significant for building a user-friendly user interface.

MENU

The top left corner of the screen displays a key control menu. Users are able to learn how to use the system from the menu. All key triggers are displayed in the key control menu, as shown in figure 3. Instead of storing instructions in documentation, the interface displays a list of concrete steps on the screen. By having this design, instructions for use of the system become visible and easily retrievable [1]. As a result, users do not have to study or remember the control of the system. This design minimizes the user's memory load by making objects, actions, and options visible.

Figure 3: Key control menu and information screen.

Key Control Menu:
"Up Arrow" – Scale up a selected object.
"Down Arrow" – Scale down a selected object.
"S" – Scale Mode.
"C" – Rotation Mode.
"T" – Transformation Mode.
"E" – Extra Work: Panel Control.
"M" – Transfer Mode.
"Q" – Quit Mode.
"R" – Reset System.

The top middle screen displays selection status. Users are able to learn which object is being selected, as shown in figure 3. This information screen is able to keep users informed about the selection result within reasonable time. According to the ten heuristics, this is another example for user interface to keep users visible of system status.

ROTATION CONTROL

Users must first select an object. By pressing "C" button on the keyboard, users are able to enter the Rotation Mode. If no object is being selected, the upper right screen will notify user to make a selection before pressing the button. This notification is able to give users appropriate feedback within reasonable time.

In the rotation mode, users are able to rotate the selected object by moving the toolbar (left, right, up, down, in and out), as shown in figure 4.
Moving the toolbar left and right – Rotate the object along z-axis.
Moving the toolbar up and down – Rotate the object along y-axis.
Moving the toolbar in and out – Rotate the object along x-axis.

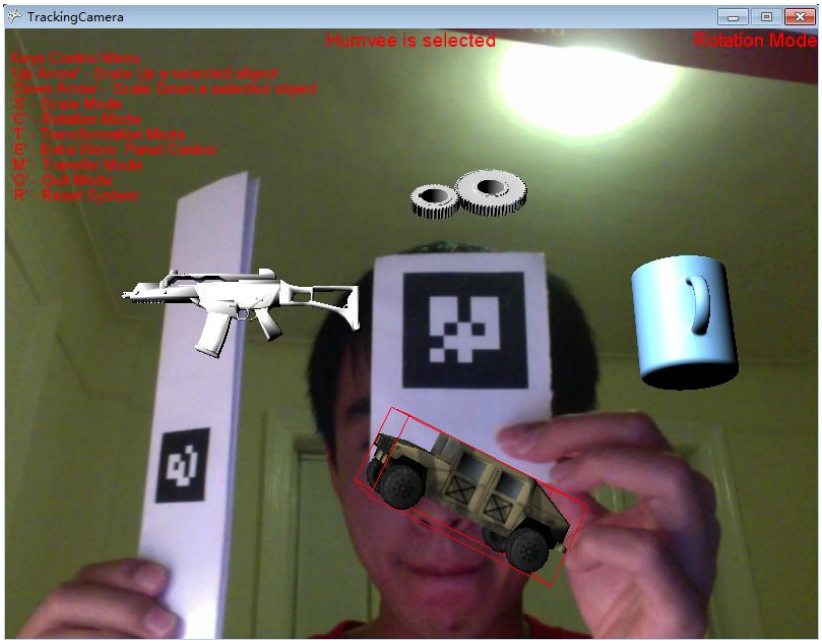

Figure 4: Rotation a selected object.

Users are able to rotate a selected object along three axes. After flipping the toolbar marker or pressing "Q" button on the keyboard (to quit the current mode), the model will stop rotating and preserve its current rotation. Users have options to reset the system by pressing "R" button on the keyboard. This function gives users freedom to control the model. They can always initialize the models back to the initial position and size.

SCALING

Users must first select an object. By pressing "S" button on the keyboard, users are able to enter the Scale Mode. If no object is being selected, the upper right screen will notify user to make a selection before pressing the button. This notification is able to give users appropriate feedback within reasonable time.

Users are able to scale the selected object up or down using the toolbar marker, as shown in figure 5 and figure 6.

Moving toolbar up – the selected object will be scaled up.

Moving toolbar down – the selected object will be scaled down.

I also implement additional scaling control using keyboard (extra work). By clicking "Up Arrow" button on the keyboard, the selected object will be scaled up by a certain unit. By clicking "Down Arrow" button on the keyboard, the selected object will be scaled down by a certain unit. Users are able to continually scale the object up or down by pressing these two buttons. The keyboard control of scaling gives user more freedom to control the selected object. It speeds up the interaction for the expert user. According to the ten heuristics, this implementation caters to both inexperienced and experienced users.

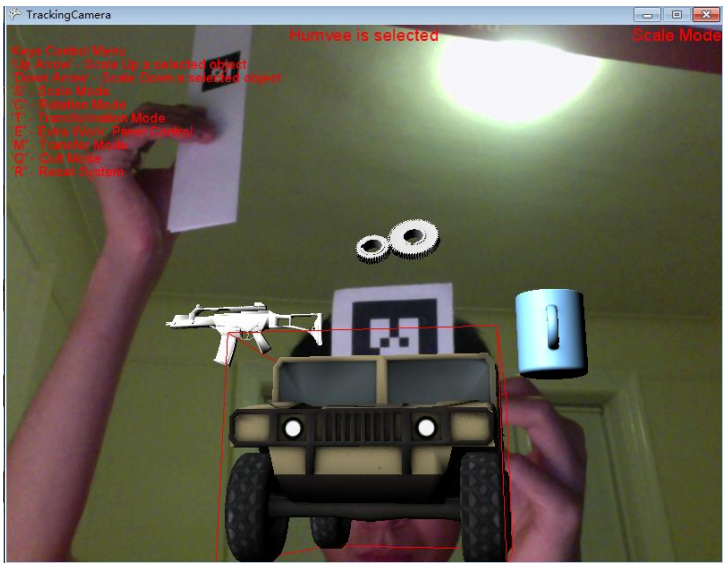

Figure 5: Scaling a selected object up using the toolbar marker.

Figure 6: Scaling a selected object down using the toolbar marker

After flipping the toolbar or pressing "Q" button on the keyboard (to quit the current mode), the model will stop scaling and preserve its current size. Users have options to reset the system by pressing "R" button on the keyboard. This function gives users freedom to control the model. They can always set models back to the initial position and size.

TRANSLATION

Users must first select an object. By pressing "T" button on the keyboard, users are able to enter the Translation Mode. If no object is being selected, the upper right screen will notify user to make a selection before pressing the button. This notification is able to give users appropriate feedback within reasonable time.

After activating the translation mode, users are able to move the object to any location on the screen using the toolbar marker, as shown in figure 7. The transformation process must have the ground marker visible for all the time. The

selected object is able to move with the toolbar marker in any desired location that is visible to the camera.

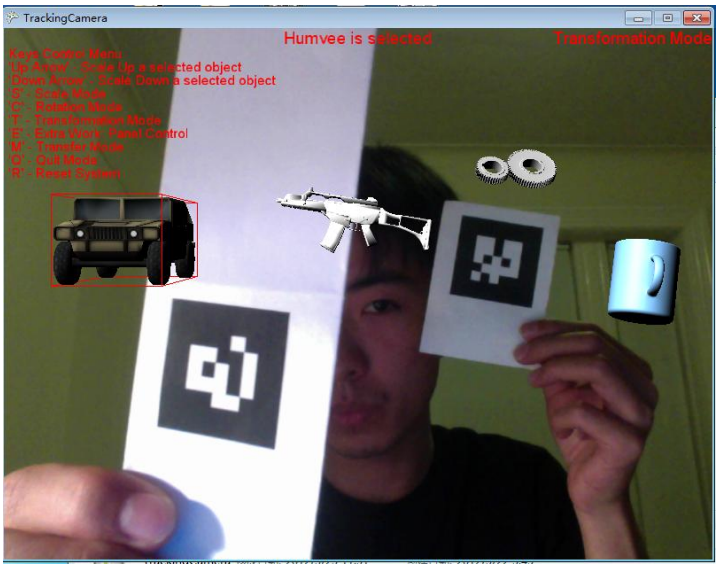

Figure 7: Transformation a selected object using the toolbar marker.

Again, by flipping the toolbar, users are able to stop the transformation. Users can quit the transformation mode by pressing "Q" button on the keyboard. The system will preserve the new location of the selected object. Users can also press "R" button on the keyboard to reset the system. All models will be initialized to the original location with default size and rotation.

TRANSFER BETWEEN MARKERS

Users must first select an object. By pressing "M" button on the keyboard, users are able to enter the Transfer Mode, as shown in figure 8. If no object is being selected, the upper right screen will notify user to make a selection before pressing the button. This notification is able to give users appropriate feedback within reasonable time.

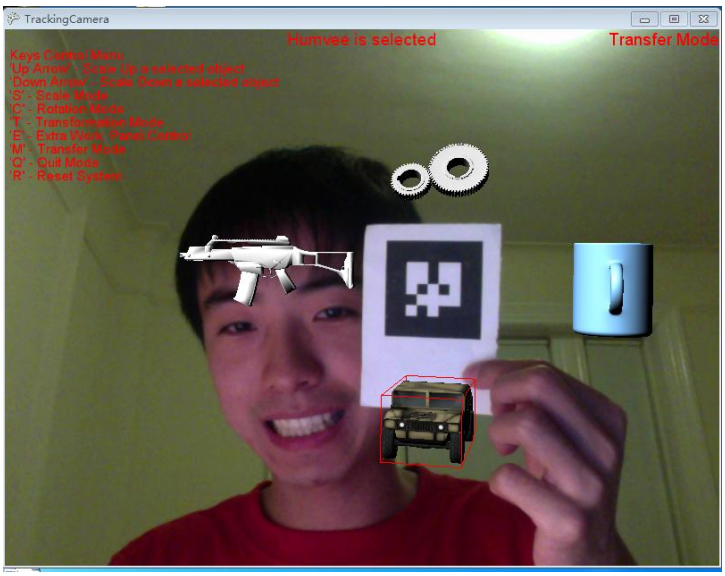

Figure 8: Transfer mode (Transfer a model from toolbar marker back to the ground marker).

After activating the transfer mode, users are able to transfer the selected model from the ground marker to the toolbar marker, as shown in figure 9. By removing the ground marker, the selected object will stay on the toolbar marker, as shown in figure 10.

Figure 9: Transferring an object to the toolbar marker.

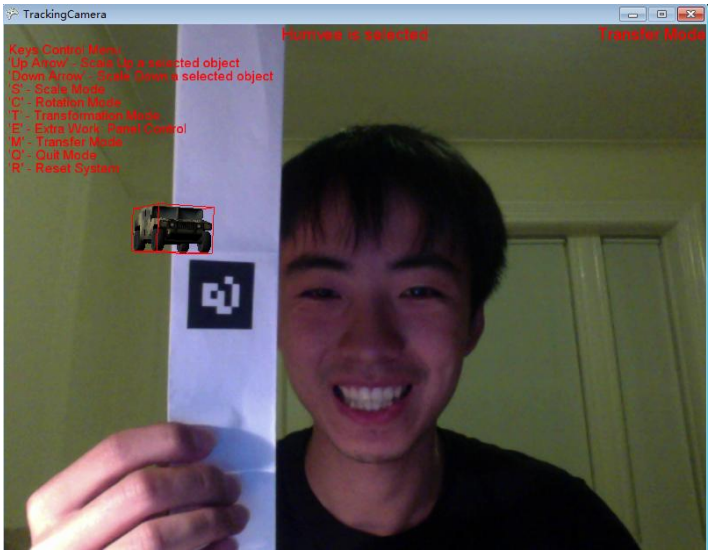

Figure 10: Transfer an object to the toolbar marker.

After bringing the ground marker back and removing the toolbar marker, the object will be transferred back to the ground marker, as shown in figure 8. This process is not single-direction and can be practiced for multiple times. The object is able to transfer between these two markers many times. Again, users are able to quit the mode by pressing "Q" button on the keyboard.

EXTRA WORK – ROTATION CONTROL PANEL

Users must first select an object. By pressing "E" button on the keyboard, users are able to activate the panel control for super rotation, as shown in figure 11. If no object is being selected, the upper right screen will notify user to make a selection

before pressing the button. This notification is able to give users appropriate feedback within reasonable time.

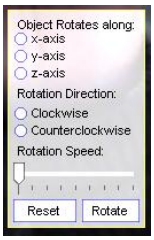

Figure 11: User control panel for object rotation.

Using this control panel, users are able to rotate the selected object clockwise or anticlockwise. The control panel allows users to select an axis and set a speed for the rotation, as shown in figure 12. After clicking the "Rotate" button, the selected object will start to rotate. This panel gives users more freedom in rotating the object. Users have more ways to rotate the selected objects. It speeds up the interaction for both the novice user and the expert user.

Figure 12: Rotate objects using control panel.

Users can click the "Reset" button to stop the rotation and initialize the rotation control panel. By clicking "Q" button on the keyboard, users are able to quit the selection mode and deselected the object. The rotation of the previous selected object will be preserved. By clicking "R" button on the keyboard, users are able to initialize the position of all objects and deselect previously selected object. Users are able to reselect an object and apply rotations to the new selected object.

REFERENCE

[1] Nielsen, Jakob. useit.com: Jakob Nielsen's Website, "Ten Usability Heuristics." Accessed February 23, 2012. http://www.useit.com/papers/heuristic/heuristic_list.html.