# Virtual Apartment Simulation
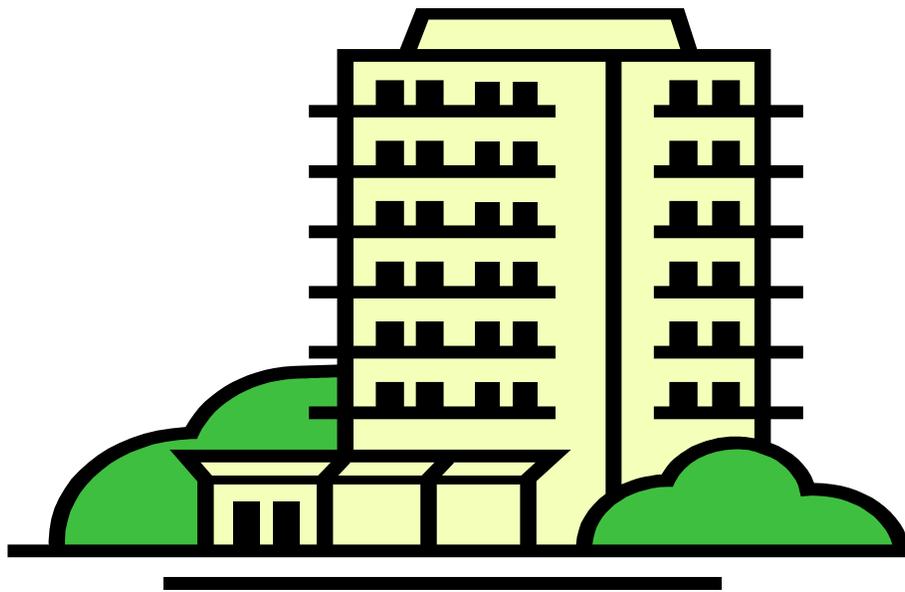
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COSC 729 Virtual Reality and its Applications

# Abstract

The goal of our project is to give a virtual tour of the 3D space of our apartment to the prospective tenants. The Project emphasizes on the need for a digital representation of the apartment in order to show benefits of creating a virtual environment prior to the physical visit by the future tenants before moving in. The probable customer can visualize the actual environment of the apartment on rental websites through this simulation. This architecture will help them to make an assessment on the outcome of this 3D prototype. While our project focuses on the idea of a virtual tour for an occupant, it also emphasizes the need for a digital representation of the apartment for the construction company.

# Introduction

Currently, apartment and condo consumers can get a good idea of the layout and physical image of a living space. One may even come across a "virtual tour". That virtual tour consists of a camera view of a given room that the user can manipulate to rotate and ultimately view the whole space. This can give a very good idea of what the potential space would be like in person, however, you are limited to a skewed view of the room given the camera lens. Also, the building must already exist, given that the tour is based on live images/video. This is why our project will be useful for consumers as well as investors/construction companies. Over the years, 3ds max, Vrml and other 3d modeling software's made simulation easier. In past years, there was only 2D simulation available in apartment searching websites like Rent.com, apartment.com etc... This project will make prospective tenants life easier by giving them a chance to visualize the apartment via 3d models before corporeal visit. This will help them to discover the advantages, loopholes, barricade of the property. At times it is really impossible to go physically and observe the place. It involves both time and money. So this project will give them an opportunity to identify the risks before planning to relocate.

# Goals and Objectives

The goal of our group project was to show case the simulation of the Apartment environment. This virtual tour will give our users the ability to explore the 3D space. This was done by creating interactive attributes within objects such as an airplane is flying around the apartment's roof, people are walking and kids are playing inside the park. Cars could be seen driving in front of the apartment. If you click on the apartment main door, it will take you to the living room and there is a video playing on the TV screen. Color interpolators are also added to the environment. Anchor nodes are added to moving back and forth in the environment. All the interaction between the objects could be improved by adding more animation to them in our future work.

We would like for our simulation to do several other things, such as have a camera view that is capable of "walking" through the entire space, including leasing office, other building amenities (fitness room, laundry room, etc…), the grounds, and of course, the actual apartment. We would like to have a model that will literally show every aspect of the space. This would mean that the user could click on a closet and the door would open, showing the storage space. One would be able to click on a refrigerator or even cabinets and see the interior. Zooming in on specific areas would also be a feature. Also, dimensions are an important part of apartment shopping, given that furniture must fit to the tenants' satisfaction. It would be extremely useful to be able to ascertain the exact coordinates of a point in the room with just another click of the mouse. Those coordinates would have to be translated from the pixels that the computer understands to a chosen metric system that the user can relate to lengths. The overall goal is to give a virtual tour which is as close as possible to physically walking by yourself.

# VRML and Modeling

a. Park: The park.max was imported to the 3DS Max environment for further implementation.
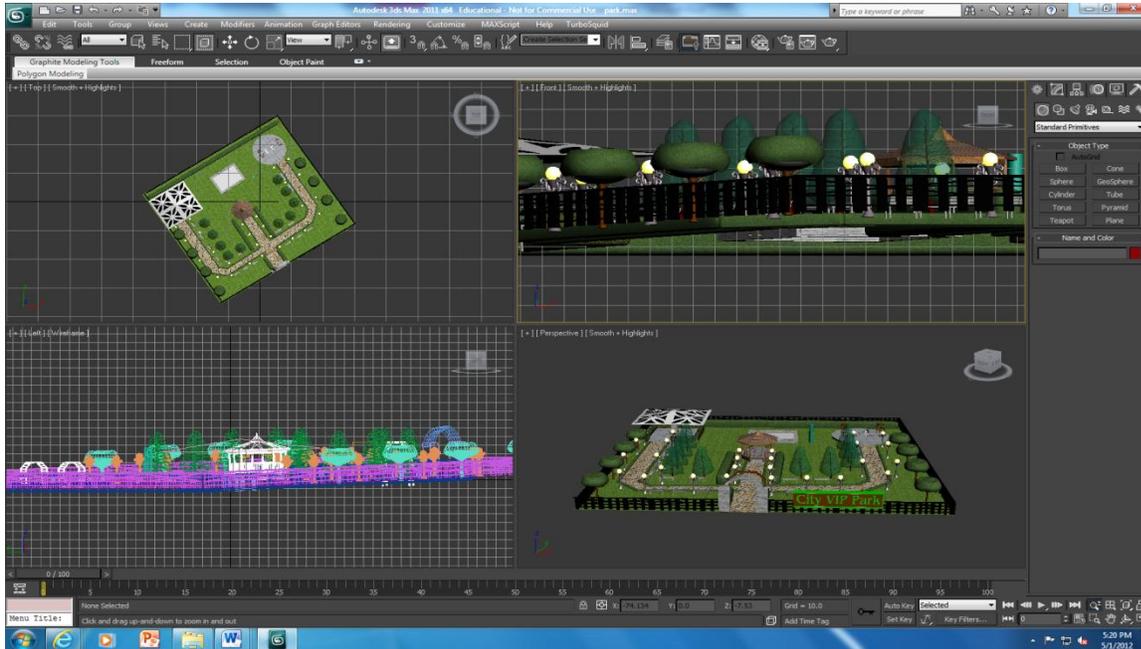


b. Human Models: Biped is imported in to the 3D model to show case human animation by using predefined .bip files.
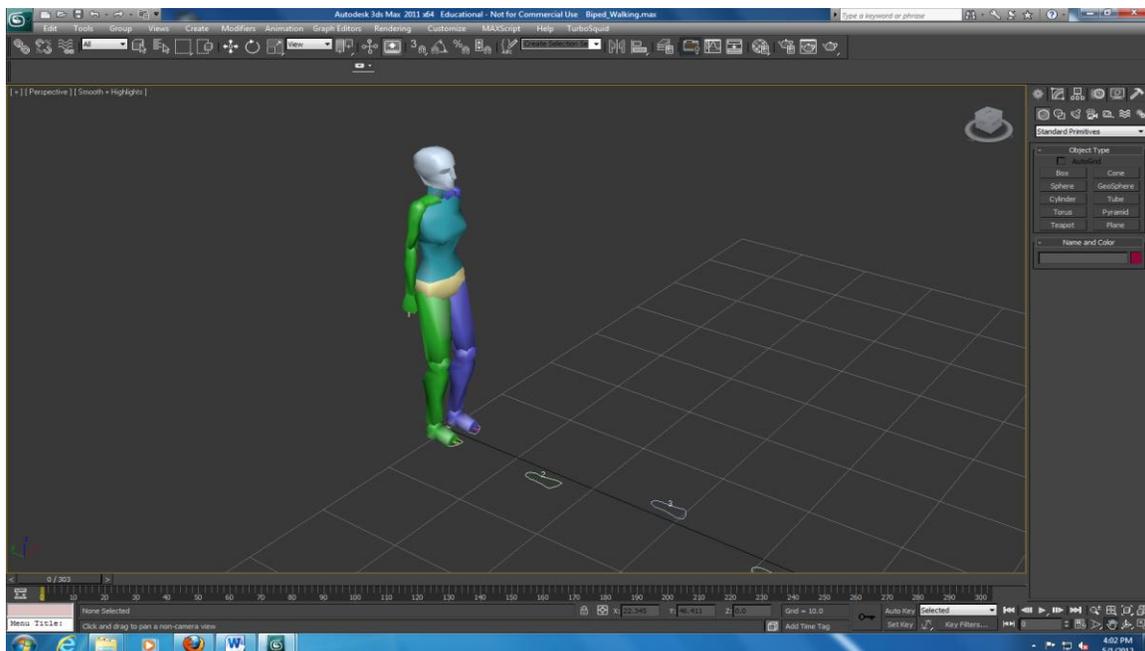
c.  Cars: Touch sensors are making the vehicles to drive in front of the apartment.
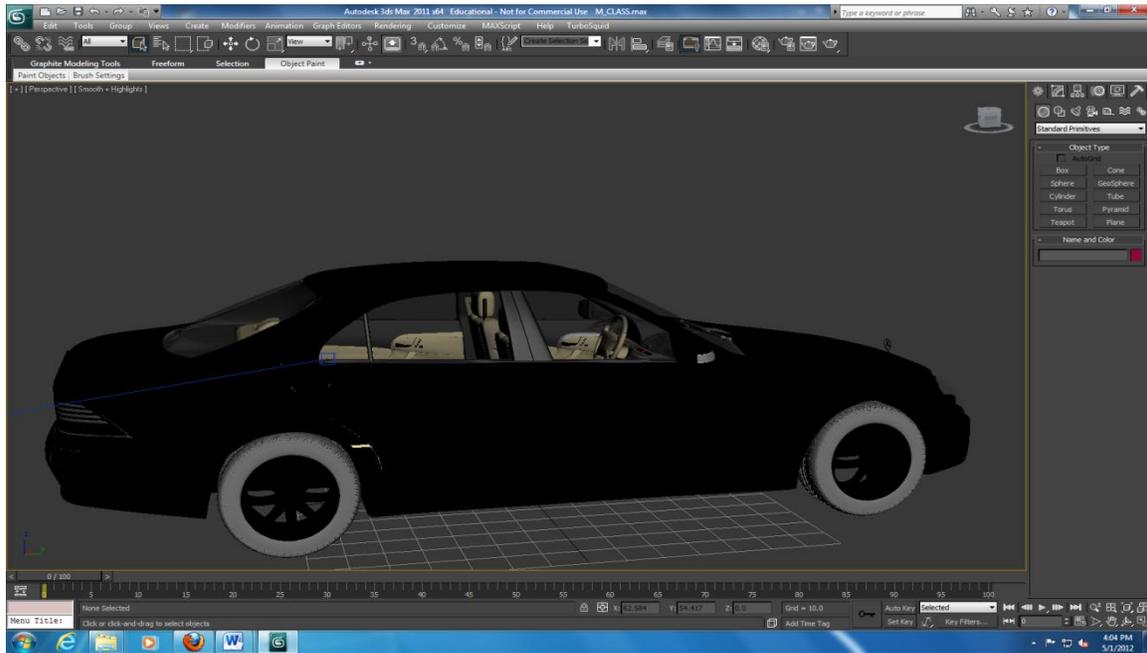


d.  Airplane: The airplane animation is imported in to the 3D max environment to add prosperity to the scene.
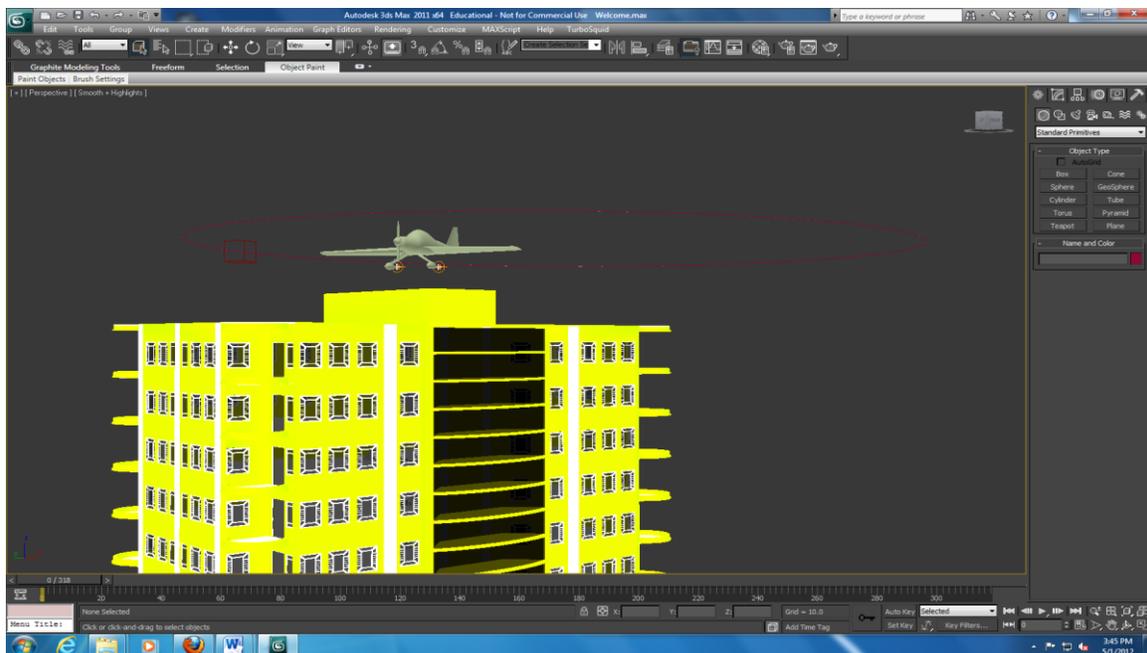
e. Living room area: The .avi file has been added to provide the user a real time experience of watching television.

```
#==============================================================================
# TV Screen
Transform {
    #translation 0 7 0.07
    translation 151 -23.4 -48
    rotation 0 1 0 1.571
    children Shape {
        geometry Box { size 14 10 0.05 }
        appearance Appearance {
            material DEF Screen Material {diffuseColor 0.5 0.6 0.7}

            texture MovieTexture {
            loop                TRUE    # exposedField SFBool
            speed               1.0      # exposedField SFFloat
            startTime           0        # exposedField SFTime
            stopTime            0        # exposedField SFTime
            url                 ["Madden_NFL.avi"]
            repeatS             TRUE    # SFBool
            repeatT             TRUE    # SFBool
            }
        }
    }
}
#------------------------------------------------------------------------------
```

f. Living room area: A color interpolator has been added to the hanging light to add lushness to the scene.

```
DEF CI ColorInterpolator { #isik renk degistiriyor
  key [ 0, .25, .5, .75, 1 ]
  keyValue [ 1 0 0, 0 1 0,
             0 0 1, 0 1 0,
             1 0 0
           ]
}

DEF TIME_2 TimeSensor {
  loop TRUE
  cycleInterval 5
}

ROUTE TIME_2.fraction_changed TO CI.set_fraction
ROUTE CI.value_changed        TO MAT.set_diffuseColor
```

# Advantages and Barriers to VR apartment

**The advantages of developing the virtual apartment model are:**

- Easy to explore different aspects of the virtual space of the apartment.
- Portability
- trouble-free to  implement new changes
- Freedom of movement
- straightforward to visualize the unknown or the unpredictable
- Ability to attach qualitative data to the models
- Saves money
- Increases chance of completed projects being fully functional.

**The obstructions:**
- Technical issues
- Frequent changes
- Ownership of the models
- Privacy and security

# Design Environment and Implementation

The residential apartment building House.max was downloaded from Turbosqid.com for development and implementation. The apartment model contained only the exterior part of the scene. The airplane animation and the 3D models for Park, living room , bedroom ,Kitchen were also downloaded from the Turbosqid .com and imported into the 3DS max environment for further addition  to the apartment building.

The development started from the apartment building by adding a plane to the building. Airplane animation on the roof of the building has added richness to the scene. An anchor node was established on the apartment door for navigation to the Living room. There was lighting issues

with the living room. It was highly dependent on lights and shadows. The problem was overcome by adjusting the lighting settings. User can see a video on the TV inside living room. We added a kitchen to the model. Model for the bedroom and bathroom was eventually added to the scene. While exporting in to .wrl file, the textures went missing. So the texture issues was fixed using Vrml pad. The Anchors and touch sensors are added to the scene using 3DS Max to make the development easier. We put an anchor node on the wall of the Living room to navigate to the Kitchen. In the kitchen we also have another animation of kitchen cupboard door closing using a touch sensor. Once you click on the wall of the kitchen using anchor node, it will steer the user to the bathroom. There is another anchor node on the wall of the bathroom to go to the bedroom. We have also implemented anchor nodes on the floor to go back to the previous panorama. A color interpolator has been added to the hanging light of the living room. Finally when the user will click on the bedroom wall, it will take him to the park. Inside the park we have used bipeds to show human interactions like walking people, playing kids. Background music has been playing throughout project. Previously there were no textures on the sight. On the final stage of the program we have added textures and interpolators to the scene to make it move dynamic.

# Results and Conclusion

## How is the Application Used?

The Simulated apartment was created using 3ds Max and VRML97. The demo file can be loaded to the Cortona/Cosmo player by simple drag and drop. The viewer can interact with the virtual display by panning to different camera views built-in to the environment and by clicking on the touch sensors. User can also move around between different camera views by simply choosing one from the camera dropdown. VRML has another feature called world creator while lets the user experience a special view of the virtual world. The complete application runs as movie .Different cameras give the prospect to the user to look at different positions/aspects of the application. The entire application gives the user a real time feeling.

# Why is the application useful?

The application has a few uses.  A potential tenant can use this system to gain a really good idea of how the lifestyle of living would be at this particular apartment community.  Also, they could plan their furniture buying and/or moving given the exact dimensions provided for each space during the actual tour (future work).  The investors would find this application useful because they could develop an exact model of their vision to construction companies.  From that stage, they can choose the company who is most confident and cost efficient.  Lastly, the chosen construction company can use the application to come up with the soundest plan of action before the ground breaking commences.

## Why is virtual reality the appropriate technology?

Virtual Reality is a way of interaction between the real and virtual world. In past years only 2D models are being used in apartment rentals website. It is difficult to get a real time sense about the available apartment. Hence this project gives user a feeling of being "in" the environment. Virtual reality composes the whole experience as realistic as possible which makes easier for the tenants to decide on the right apartment for relocation. This is exactly the kind of affect that we were looking to have in our project with the apartment tour; therefore virtual reality was the obvious technology to use.

## Problems encountered

We encountered problems such as texture exporting, making the background to the entire project more realistic, some of the biped animations, and initially connecting multiple outside environments (building and park).  The addition of the code was not a problem; however figuring out the correct coordinates to use for the environments to match up visually took a lot of time.

## Remaining shortcomings?

Add skin meshes to the bipeds. Include activities using bipeds inside the apartment like sitting on the sofa, walking around the living room.  In order for the project to be more marketable and useful in our generation, many (if not all) of the features mentioned earlier should be

implemented. For example, we would like to make the tour feel more as if you are actually walking through the environment, including hallways.

## Recommendations for further improvements?

Add more rooms to the present environment. Append more texture, lights and bipeds to the environment. Apply animation and objects to each room to give the apartment more well-designed and pragmatic feel. Also, we would like to add more of the other amenities offered, such as fitness room, laundry room, business center, etc. More of the realistic animations that we have already implemented would definitely add to the realism as well.

# VRML and 3Ds Max Figures

- **Cam01**. This shot is the front view of the Apartment building. The user can either go inside the building and or get inside the park.
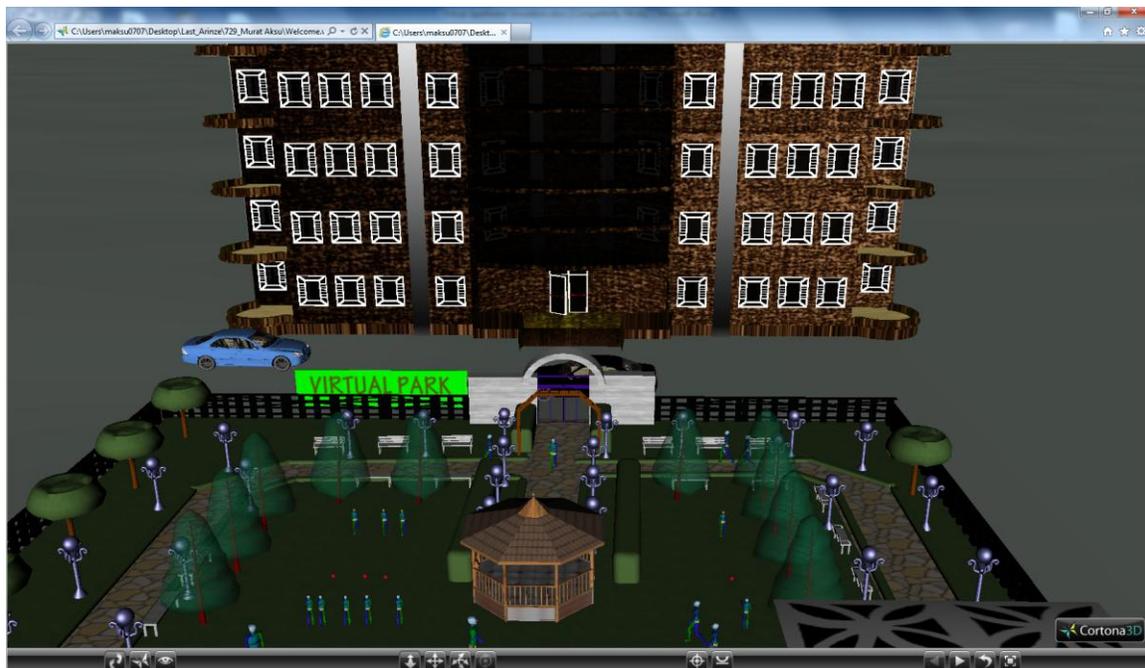
- **Cam02**. Touch sensor is applied on the cars. Viewers will be able to use the touch sensors to make the car drive in front of the building.



- **Cam 03**: Anchor node on the building door enables the user to enter inside the building.

- **Cam 04**: View of an airplane flying around the roof of the building.



- **Cam 05**: This shot represents the entrance to the park. The Observers could be able to enter in side by the park by enabling the touch sensor applied on the door.
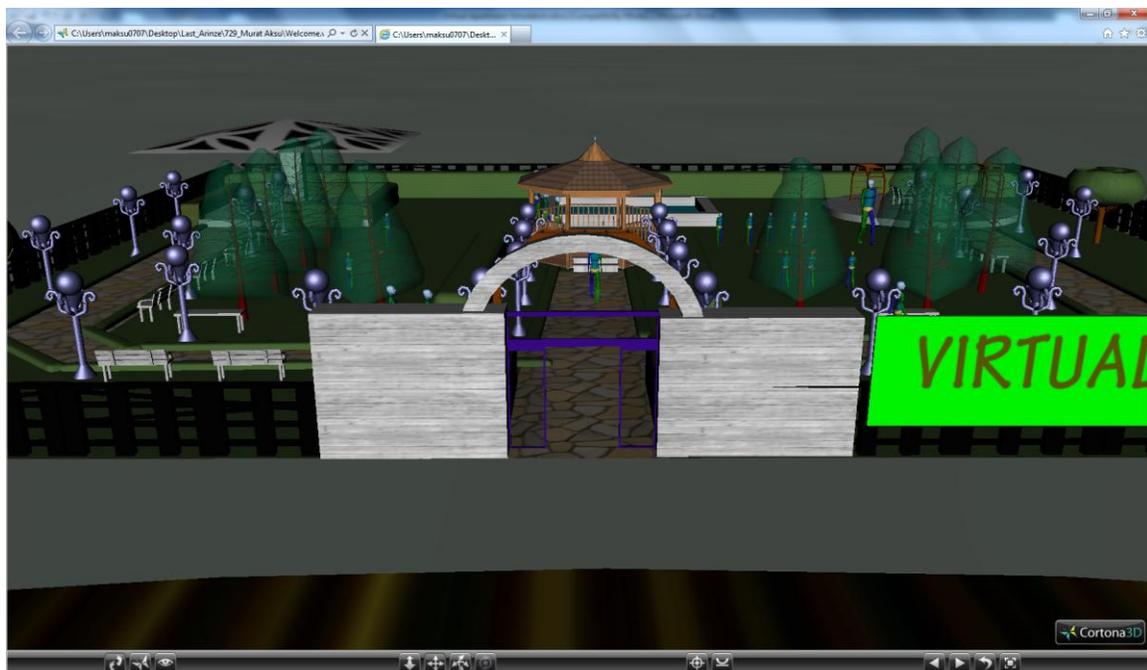
- **Cam06**: The top view of the park.



- **Cam07**: Shot to show human interaction using bipeds inside the park.
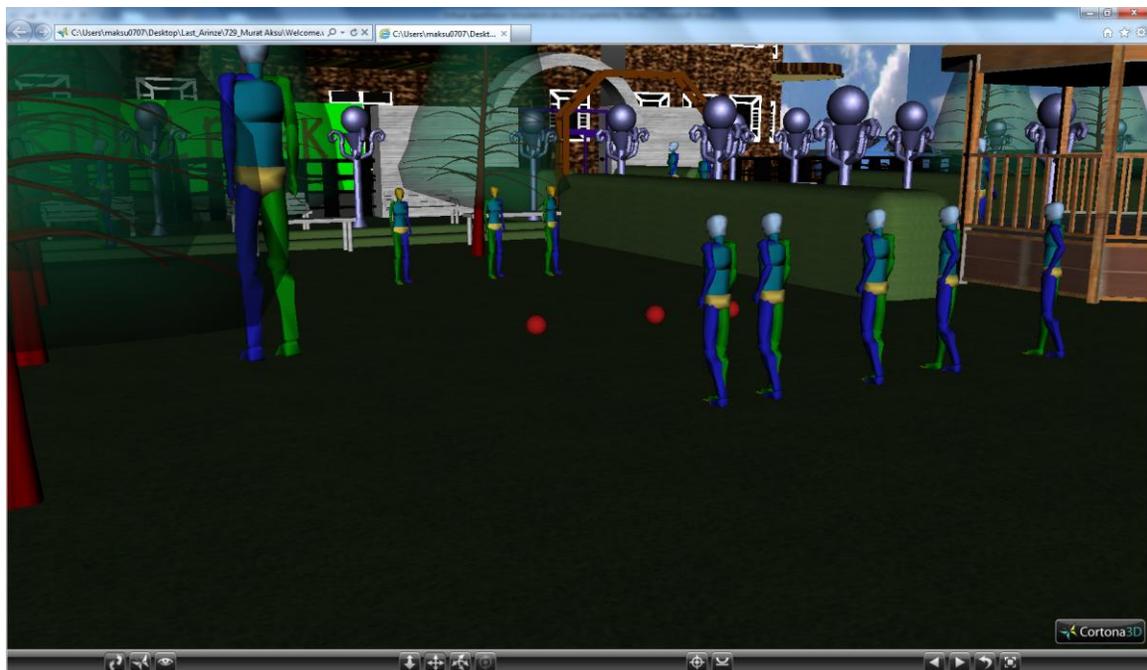
- **Cam 08**: Another shot of kids playing inside the park.
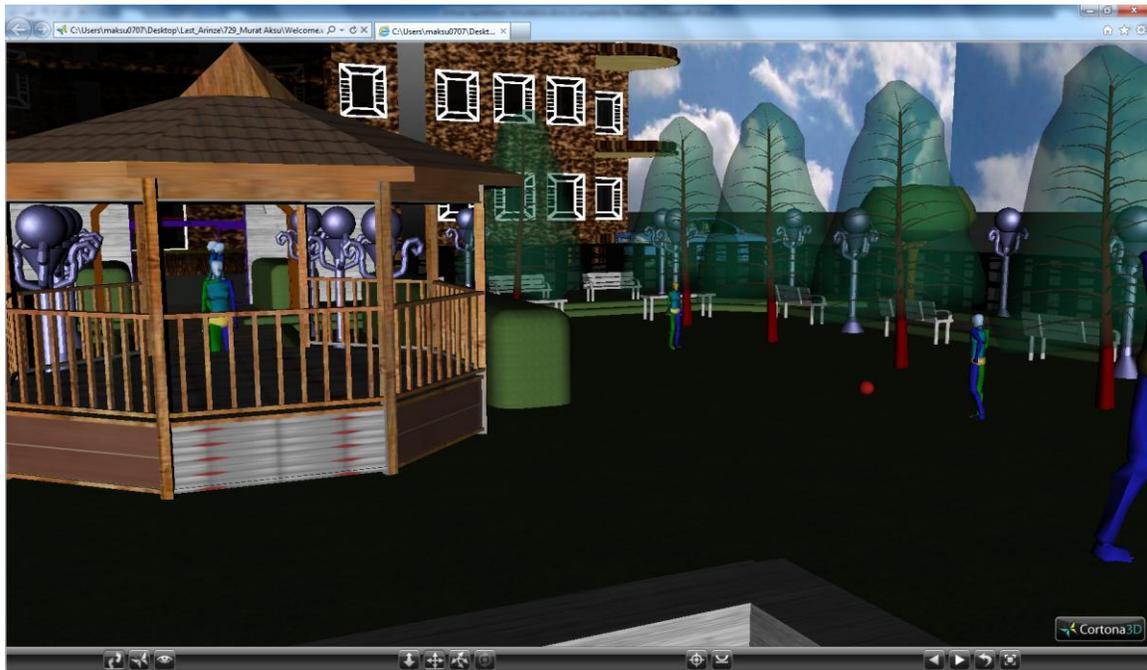


- **Cam 09**: View of people walking and going inside the porch.
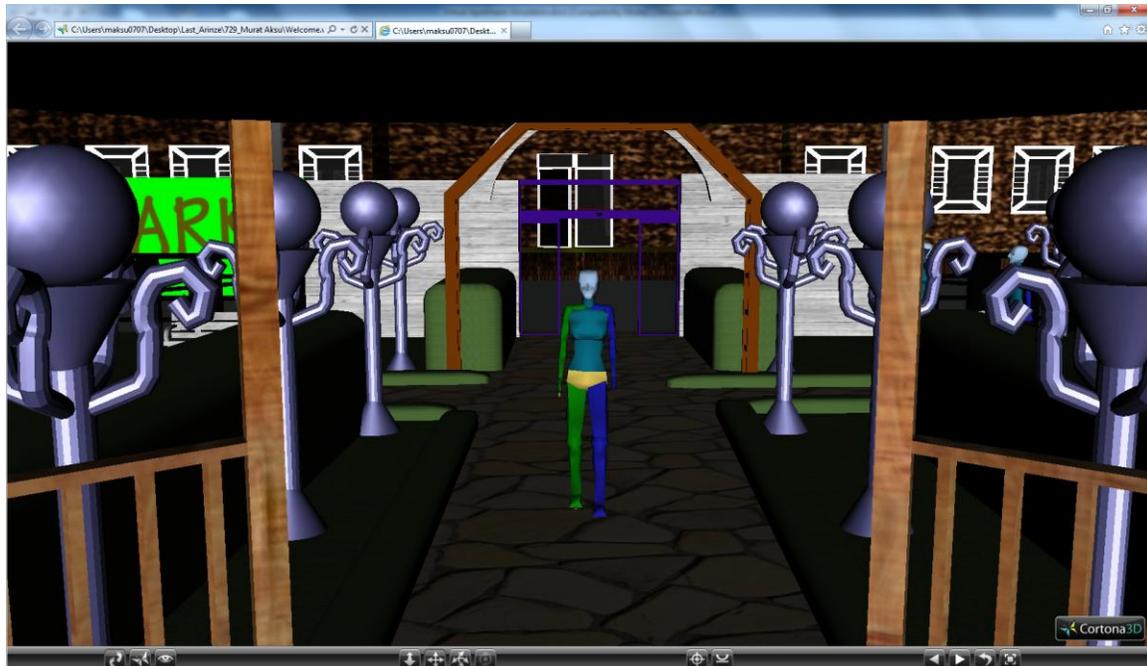
- **Cam10**: The shot represents the inside view of the living room.  An anchor node has added on the wall to go to the Kitchen. Another anchor node also added on the floor of the room to go back to the living room.
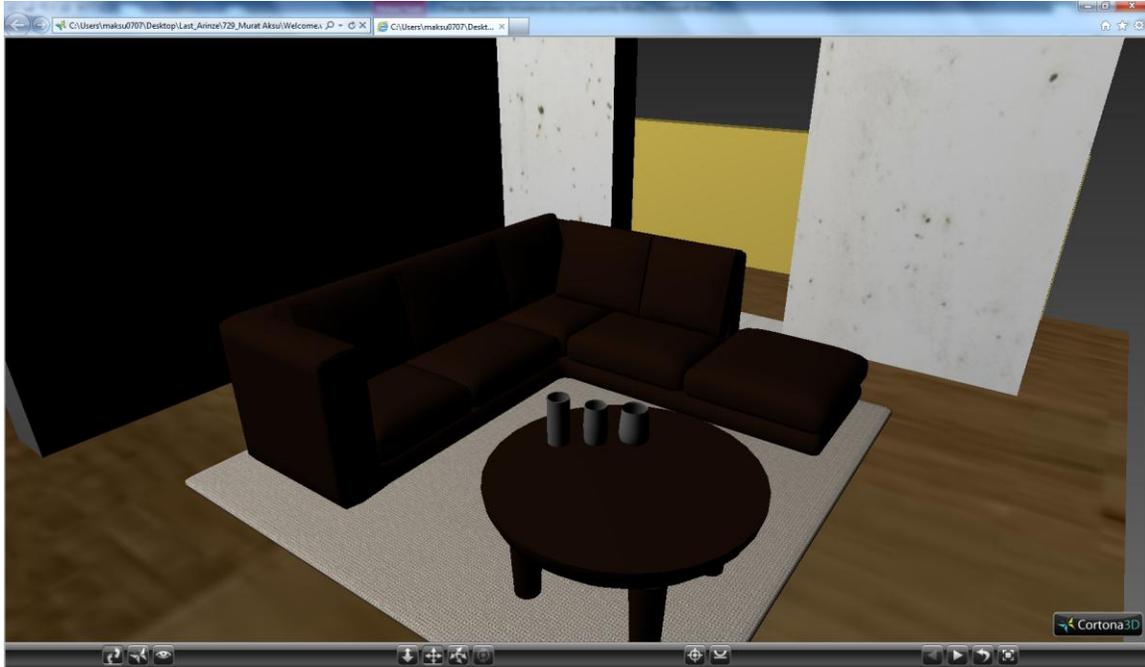


- Cam 11 (a): Another shot of the living room. User can be able to navigate from Living room to kitchen by using the anchor node attached on the wall. User can also go back to the previous scene by clicking on the floor.
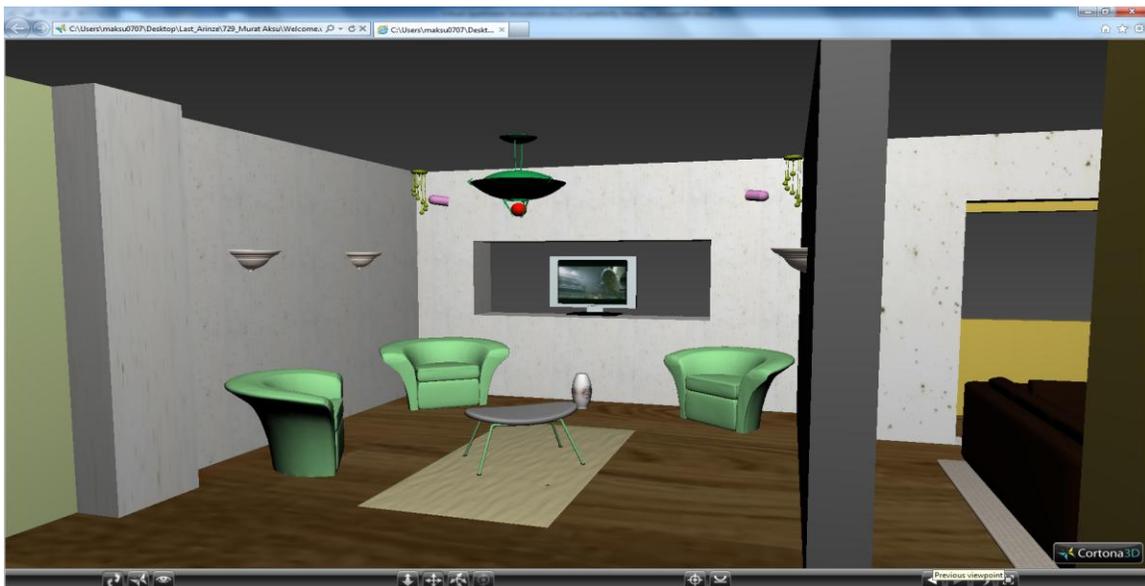
(b) A color interpolator is added to the hanging light. The color of the light changes from red to green in the below image.



- **(C)**: A dog is added the living room environment.

(D) User can be able to watch TV in the living room.



- **Cam08**. The shot for the kitchen.
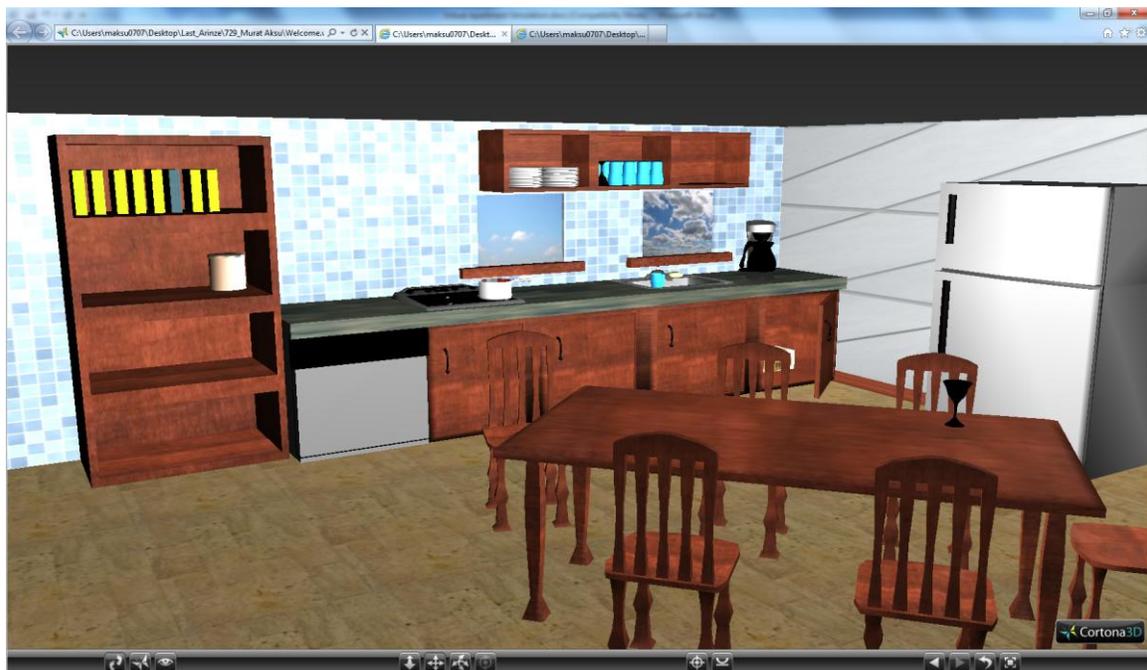
- **Cam 09**: Another shot of the kitchen.
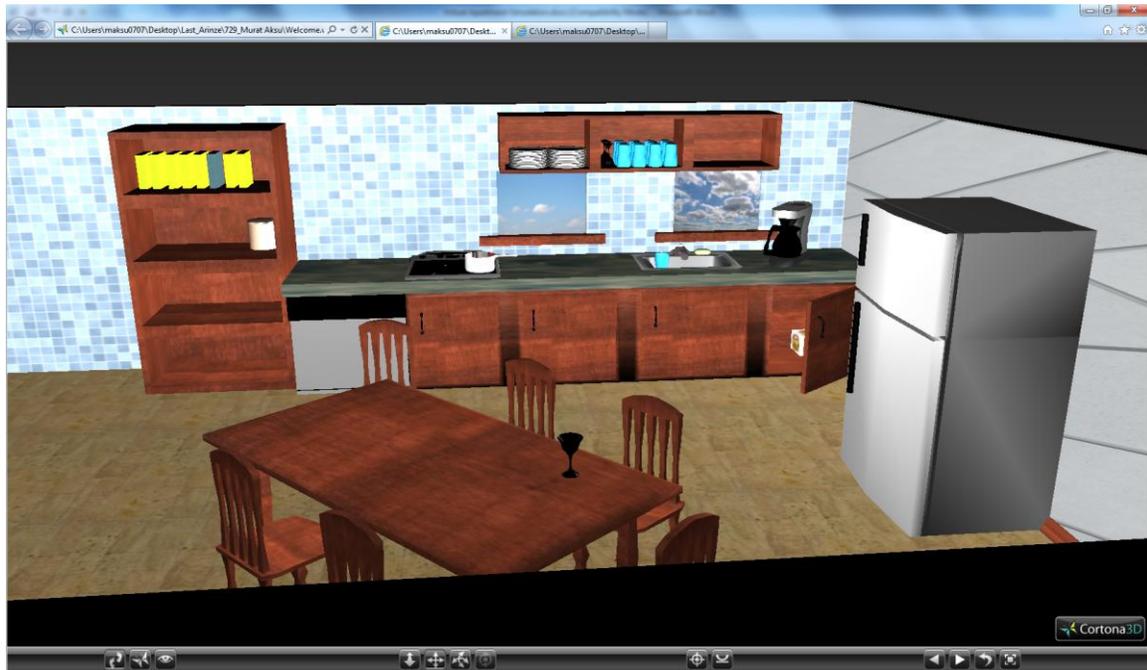


- **Cam 10**: The view of the bathroom. Texture images are applied on the floor and wall.
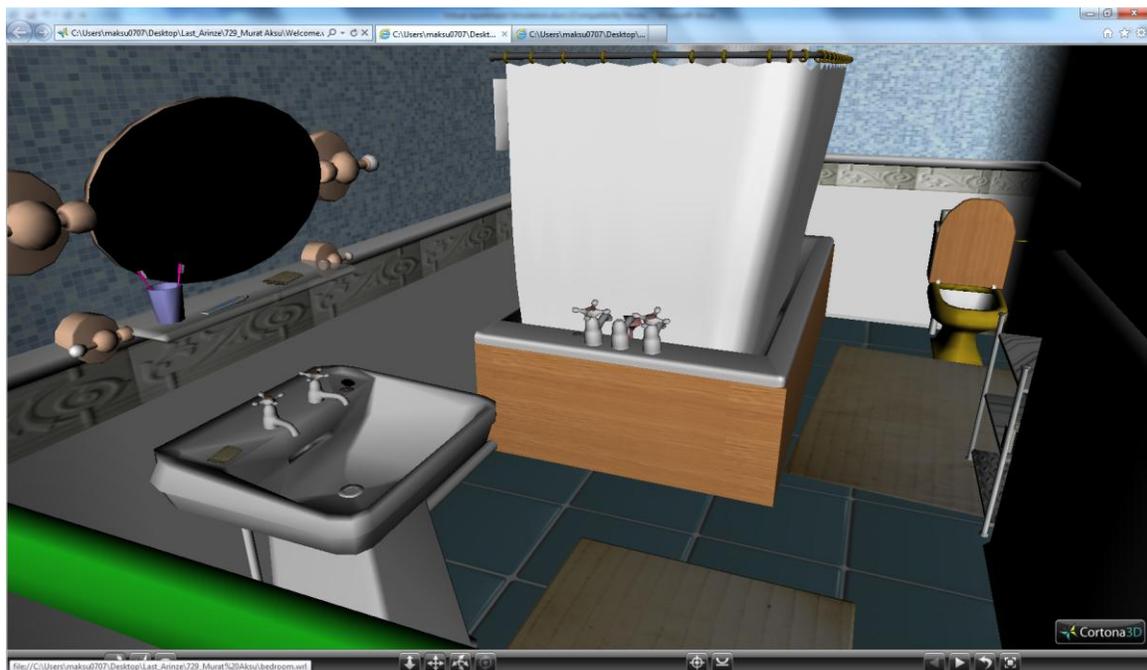
- **Cam 11**: Alternative view of the bathroom. Anchor nodes are applied on the wall and floor to move forward to the bedroom and to go back to kitchenectively.



- **Cam 13**: Shot of the bedroom. Texture images are added to room.

- Cam 14: An additional shot of the bedroom from a different camera. Day lights are added to the window area.
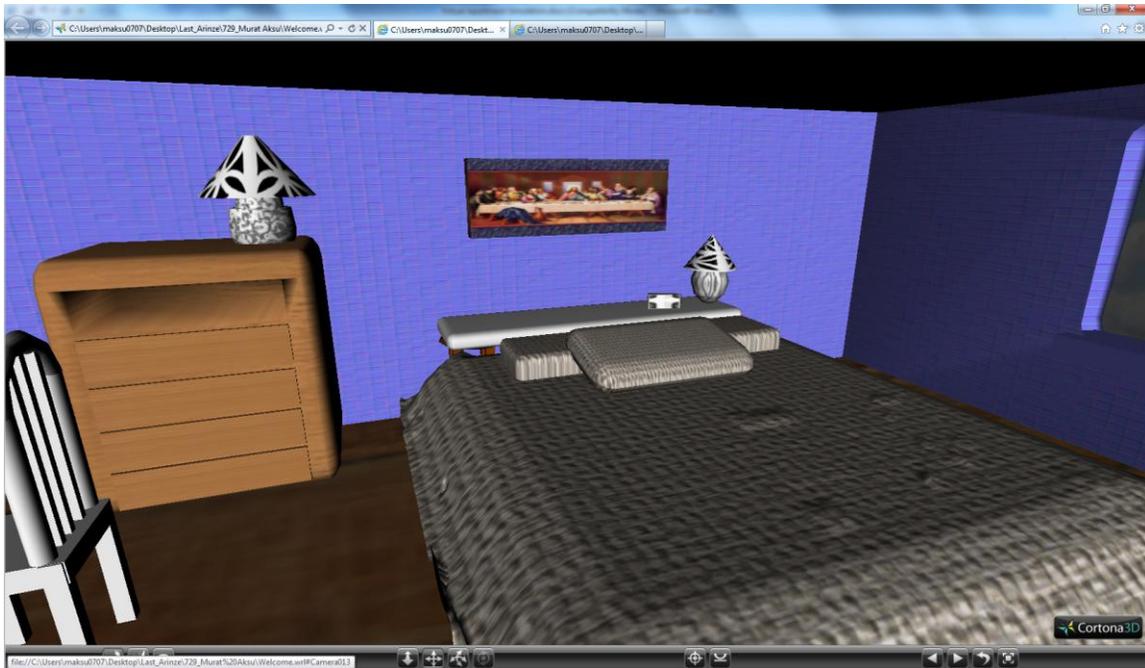


- We have implemented textures to the bedroom window. When the user will use the anchor node established on the bedroom wall, it will take him to the park.