Prototype Interface for Virtual Reality Shopping with Focus on the Inspection of Products

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Abstract

Grocery shopping in a virtual reality environment is a more convenient alternative to going to a physical store, while providing customers with more confidence in the vendor's products than traditional online shopping. This is achieved via allowing the customer to visually inspect the item they want to buy through a video feed of the actual item in the physical store, which the author demonstrates through a user interface prototype where each item is associated with a particular video feed. Grocery shopping in a virtual reality environment also allows for more intuitive applications of data analytics and recommender systems to help the user in getting the items they want, which has been the direction of development for most current virtual reality shopping experiences. Combined with the item inspection interface, grocery shopping in virtual reality can become a useful alternative to traditional grocery shopping for customers without the time or means of travel, without sacrificing peace of mind and quality of products. It can also be a good method for vendors to showcase their products to potential customers.

Background

With traditional grocery shopping, the customer must physically enter a store and navigate the premises in order to gather the items they need. While this process allows the customer to carefully inspect the real product before purchasing, it is very inconvenient for customers who do not have the time or the mode of transport to physically reach the store they want. Online shopping alleviates this problem by allowing the customer to order certain products at home and have it delivered to their door, but the customer cannot inspect the actual product. All the information they have on the product is from marketing material provided by the seller, so the customer must put their trust in the seller and often become disappointed when the product they receive is not the same product they expected. By combining live video feed from a physical store with a virtual reality (VR) online shopping environment, virtual reality grocery shopping combines the best of both worlds: Through the VR environment, the user can both order the products they need from the comfort of their home while having the opportunity to visually inspect the product before purchasing.

Another advantage of VR grocery shopping is that it is much more intuitive to integrate a virtual assistant system into such a shopping environment. This is in fact the focus of many current VR shopping experiences that are being developed, as discussed in the Current Efforts section below. In general, it can be assumed that users can interact with objects in a VR environment in similar ways to how they would interact with objects in the physical world. This includes being able to rotate their vision to observe the whole 3-dimensional environment, being able to talk (through a microphone), to hear, and to interact with objects with their hands, fingers, eyes or other body

parts depending on the input methods configured. This wealth of interaction methods also means that there is more information that can be gathered from the user and shown to the user compared to traditional online shopping, where the only media that can be assumed to be available to the user are a flat screen and a selection input method, such as a mouse and keyboard combination or a touchscreen. Applications that take advantage of virtual reality's unique interaction methods are mentioned in the Current Efforts section below, but generally revolves around a recommender system, where existing data about the user is processed to inform the user on what the best items to purchase at a particular time would be. This information can include the user's own shopping history and product ratings, the shopping history and product ratings of other users in the current user's circle, the items the user currently possess, a particular list of items or recipe that the user wants to complete, among other considerations. However, the existing recommender systems used in VR shopping experiences are not truly personalized to each user. They only utilized surface-level data such as which products the user's friends rated highly or which products the user does not need to purchase more of because they already have some in their smart refrigerator, rather than analyzing the user's shopping habits in order to recommend the most relevant items to the user. A true shopping habit-based recommender system can be a good direction for further research and development of VR shopping experiences in the future.

Current Efforts

There have been multiple demonstrations of VR shopping experience, each with its unique features. For example, the Buy+ system from Alibaba, demonstrated in 2016 [1, 2], allows the user to traverse a physical store, using the actual store's panoramic photographs to create the

environment. It also maps each item the user can purchase to a visible item on the photographic environment to simulate the feeling of physically going to the store. The ShelfZone® system from Italian company inVRsion [3], also demonstrated in 2016, allows the user to identify products they can afford with their reward points, identify products their contacts bought, book a test drive, and identify all the items required to complete a cooking recipe, among other features. A VR shopping experience designed for retail chain Walmart by Texas-based company Ghost Machine and demonstrated in 2020 [3] allows the customer to identify accessories or recommended items that would pair well with the products they are purchasing. It also connects to the customer's other devices such as their smartphone or smart refrigerator to determine what the user may need or may not need, as well as to check for the status of relevant services, such as oil change.

Problem Statement

While all the aforementioned VR shopping experiences contain useful and innovative features, they did not touch on one important aspect of VR shopping: The ability for the customer to inspect the actual product. Instead, they opted to focus on providing a virtual assistant system to ease the user experience. By prototyping another interface for VR grocery shopping, the author aims to address the inspection concern through associating each item the user can purchase with a unique video feed or dynamic photo feed. The author also aims to maintain a minimal interface necessary for the user to accomplish the task of purchasing a product while pursuing this goal. For example, the shopping cart present in the Walmart VR Virtual Shopping Experience by

Ghost Machine is an artifact of physical grocery shopping and is not strictly necessary to purchase a product, so it can be removed.

Method

A menu-style user interface was developed for VR headsets, which allows the user to select an item, see the item's associated video feed, and manipulate shopping lists containing these items in VR. The prototype uses an internal mock database and can be executed locally without any network connection, except for displaying online videos.

Experimental Environment

The prototype was developed using the Unity game engine, with source control maintained via Plastic SCM. An Oculus Quest 2 headset and associated controllers were used for the VR hardware, interfaced with the developer's computer through SteamVR 2 and its Unity plugin for a vendor-neutral solution. Other software tools used for the project include 3D models library Sketchfab and its Unity plugin, as well as the Unity asset VR UIKit for certain user interface (UI) elements (not to be confused with VR UI Kit, which is a similar but unrelated asset). A Unity package to display YouTube videos, made by iBicha [5], was also used to display videos uploaded on YouTube.

Setup Tutorial

In order to recreate the experimental environment for the prototype application to execute, the reader should follow these steps:

1. Create a Unity account.
2. Install Unity Hub.

3. Inside Unity Hub, add the Unity project for the prototype application by navigating to Projects Open and select the project directory. The prototype application's source code is available upon request.
4. Create a Steam account.
5. Download and install Steam.
6. Inside Steam, download and install SteamVR.
7. To test the prototype on an Oculus Quest 2 headset, follow steps 8 to 10. For other headsets, follow their own setup processes for SteamVR.
8. Download and setup the Oculus software at https://www.oculus.com/download_app/?id=1582076955407037
9. Once the Oculus software is setup, connect the Oculus Quest 2 into the computer and set it up. Leave the Oculus software open. If the Quest 2 asks for permission for the computer to access its data, allow access.
10. If the Quest 2 prompts the user to enable Oculus Link, enable. If Oculus Link cannot be enabled, connect the Quest 2 and the computer to the same Wi-Fi network. Inside the Oculus software, go to Settings Beta and enable Air Link. Likewise, enable Air Link inside the Quest 2's environment. Connect the Quest 2 to the computer via Air Link by choosing the "Quick Settings" panel inside Quest 2 (the 4-icon, rounded square panel), choose "Oculus Air Link", then choose "Launch".
11. Inside Unity Hub, open the project for the prototype application. If the previous steps were properly followed, the SteamVR home environment (with the night sky and dark mountains) should be visible on the Quest 2 headset after the project is initialized.

12. Press the “Play” button (a right-pointing triangle) in Unity to execute the project.

Prototype Demonstration

Upon executing the prototype application, the user will be greeted with the item menu.

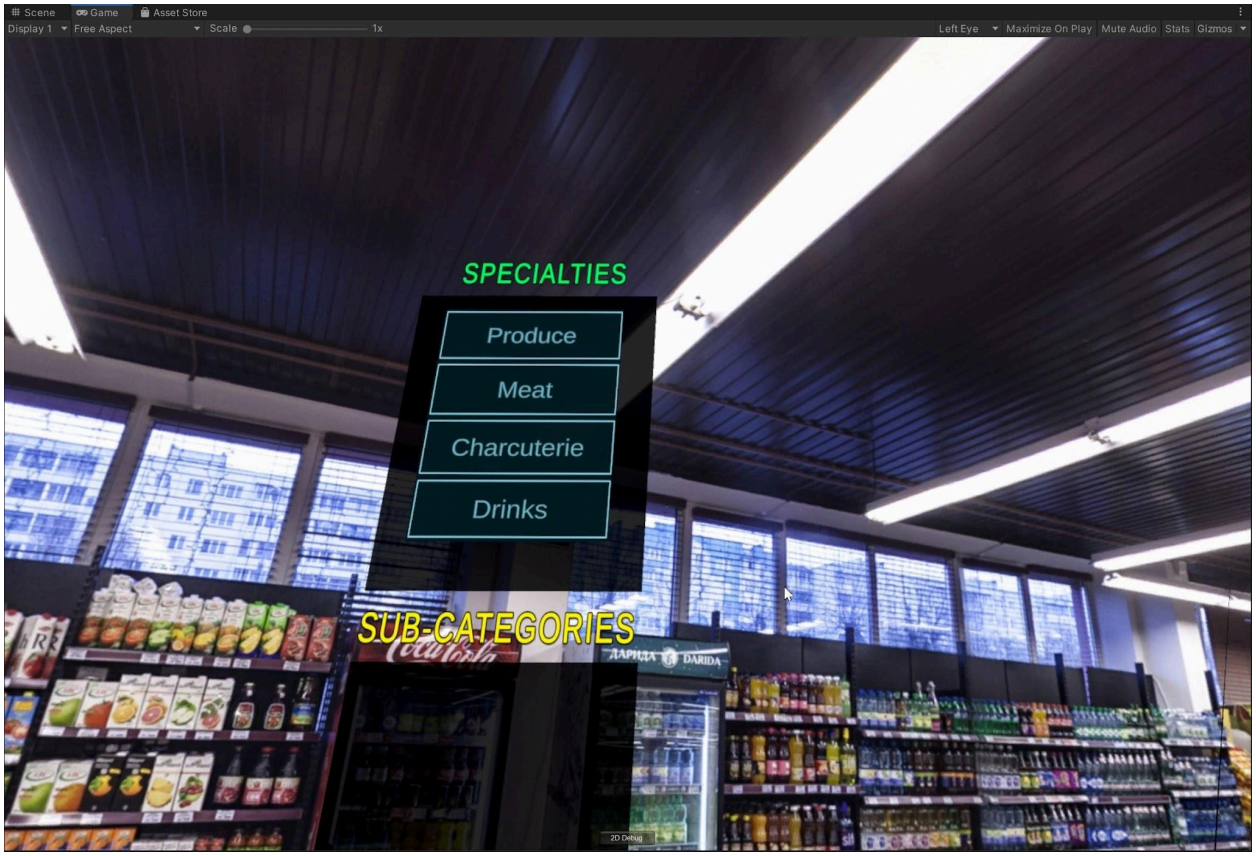


Figure 1. Screenshot of top-level categories in the item menu

The item menu is laid out in the following manner: The player first chooses a top-level category (hereafter referred to as a “specialty”) using a laser pointer from their handheld VR controller. These specialties are automatically read from the database and buttons for them are generated accordingly. Upon selecting a specialty, the application will read the sub-categories (“category”) under said specialty and generate buttons for these categories in a sub-menu.

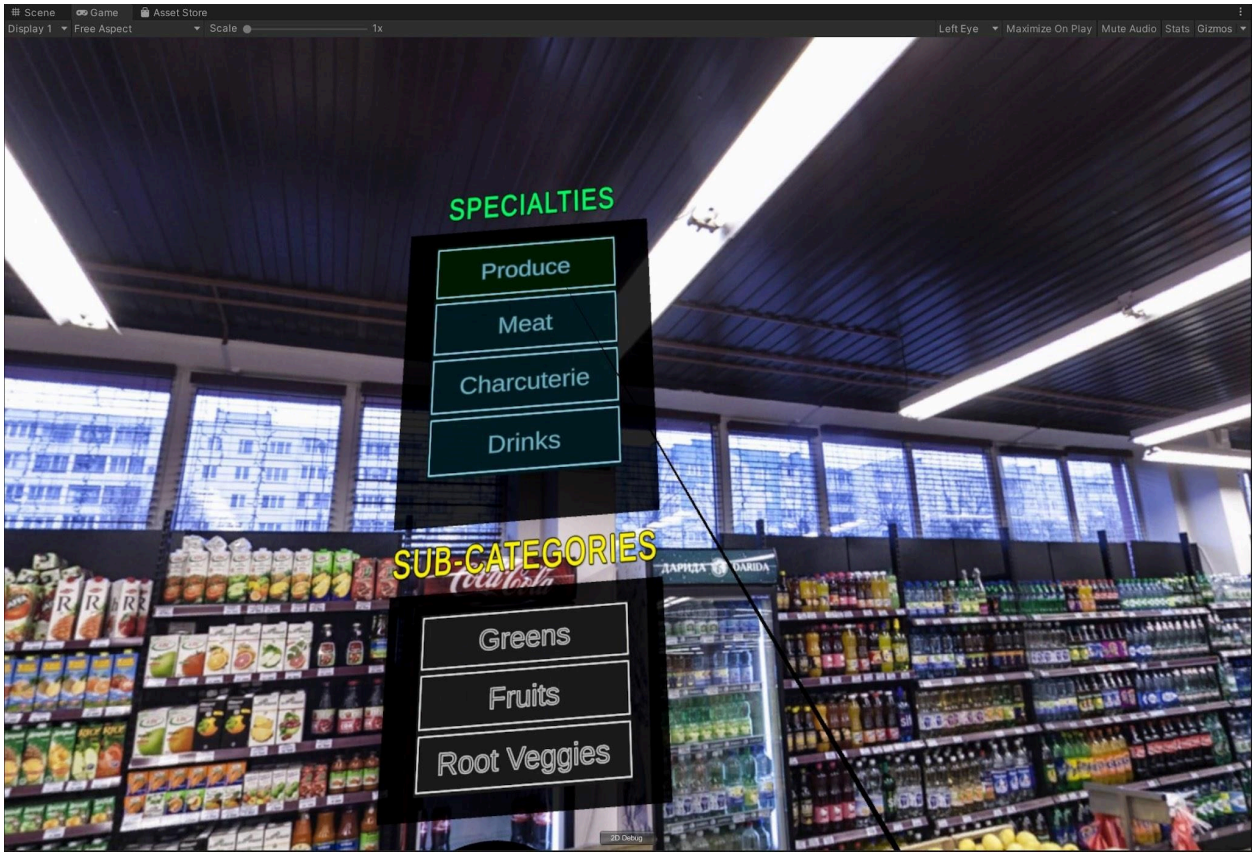


Figure 2. Screenshot of the item menu with buttons representing sub-categories

Upon picking a category, the models representing each item in the category (also read from the database and automatically generated) will be displayed on top of the item menu. The user selects a particular item using the handheld controller, which will trigger the application to display the item's information in the item information area.

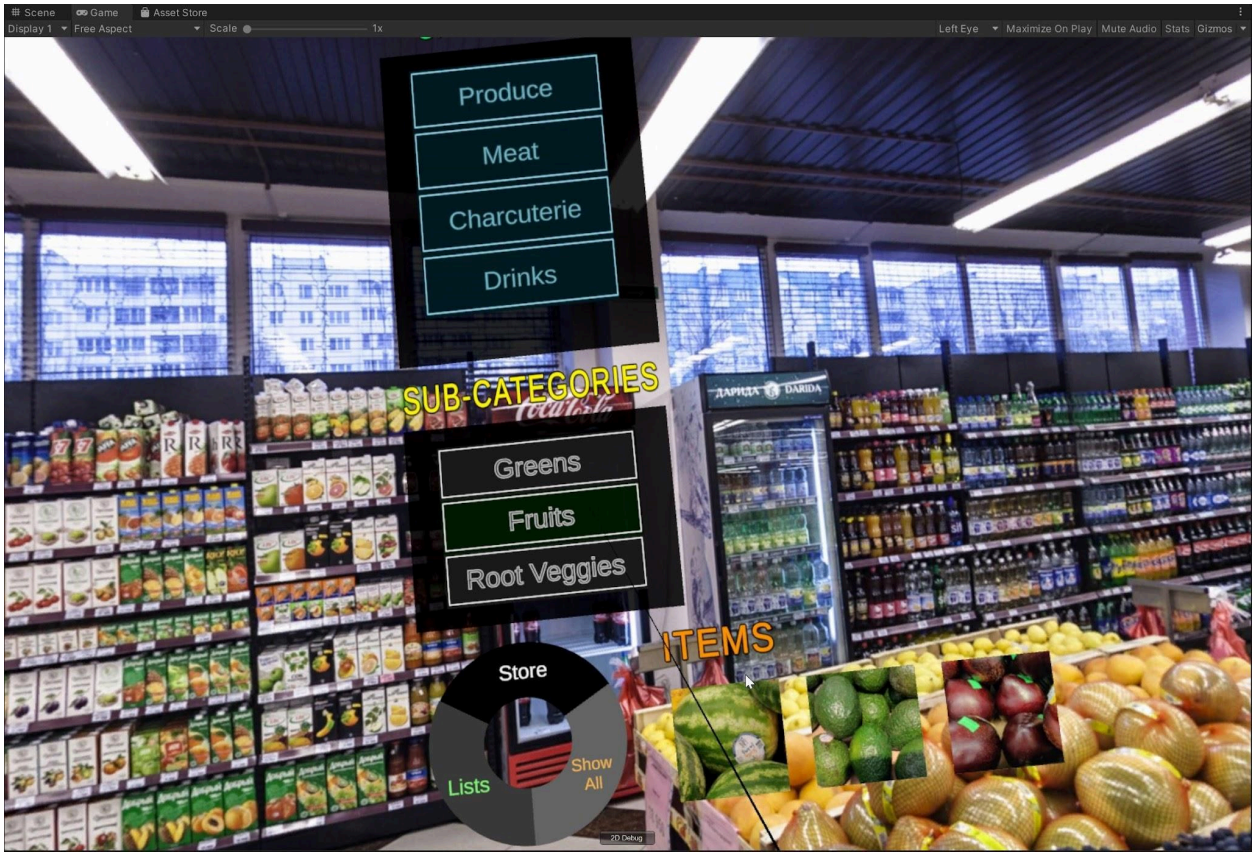


Figure 3. Screenshot of items in the item menu

The item information area consists of three sections: A frame for the video feed of the item, a text area for information pertaining to the item and a buttons area to specify how many units of the item to add to the user's shopping list. To save disk space, each item was associated with a YouTube link in the database. The video frame will automatically connect to this YouTube link and displays the video being referred to by the link to the user. However, the prototype can be easily modified to display a locally stored video for each item or grab the video from another site. If a video feed for the item cannot be found, the frame will be blank, and an error message will be shown to the user accordingly. All the videos currently used in the prototype were taken

from items in a local Fresh Thyme grocery market. If video information is unavailable or otherwise not desired, functionality to display a specific image of the item or cycle through images of the item at a specific rate (“dynamic photo feed”) is also implemented inside the prototype system. This information can also be automatically retrieved from the database using the item’s name if the item’s images are stored in a folder sharing the item’s name in the “Images” directory.

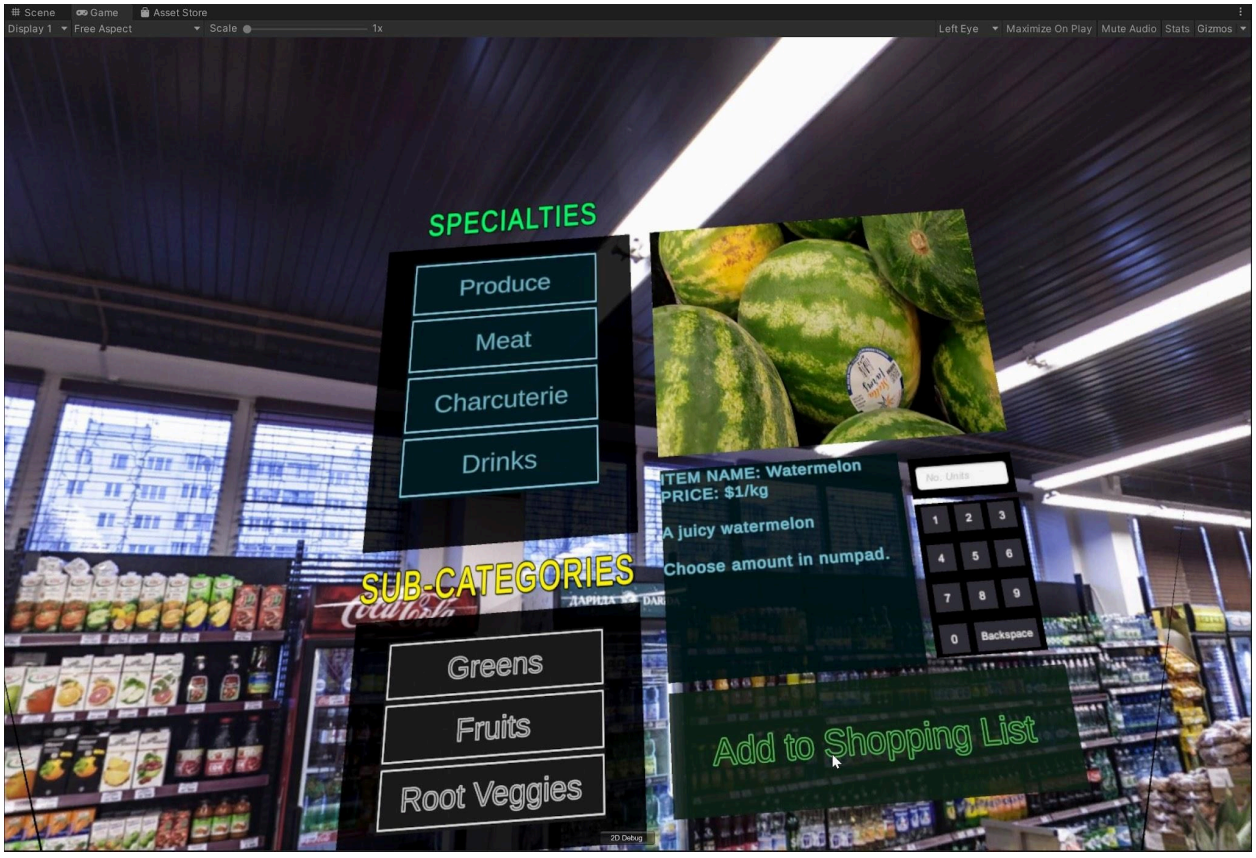


Figure 4. Screenshot of item information area with video

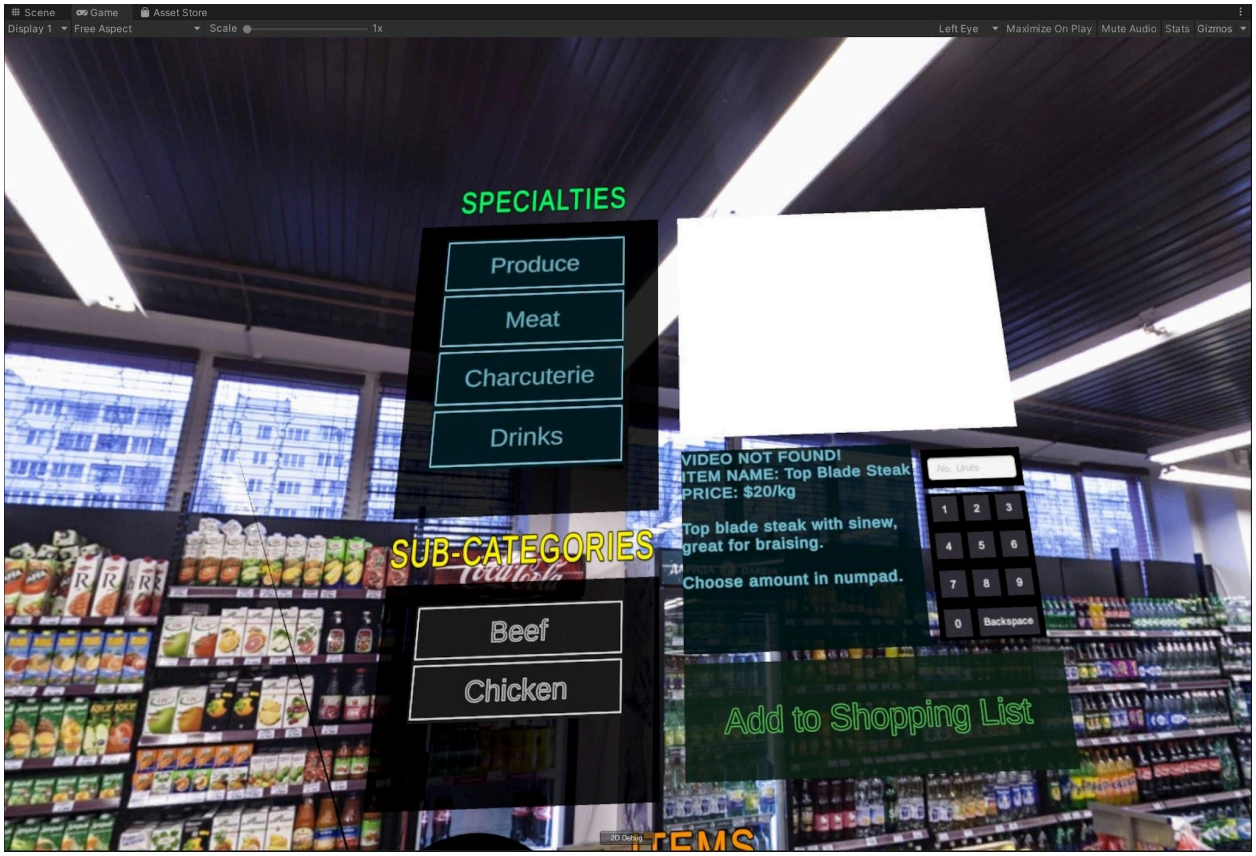


Figure 5. Screenshot of item information area where a video feed for the item cannot be found

The item's information itself consists of an item description, the unit of interest for the item (for example, 1 package, 1 kg, 1m, or other viable units), and the unit price of the item. All of which is stored in the database and displayed to the user accordingly.



Figure 6. Screenshot of item information area with focus on the item's information

The user can also add an item to the current shopping list by specifying how many units they want to add, before pressing the "Add to Shopping List" button. If no specific amount is input by the user, the "Add to Shopping List" button will automatically add 1 unit of the item into the shopping list.

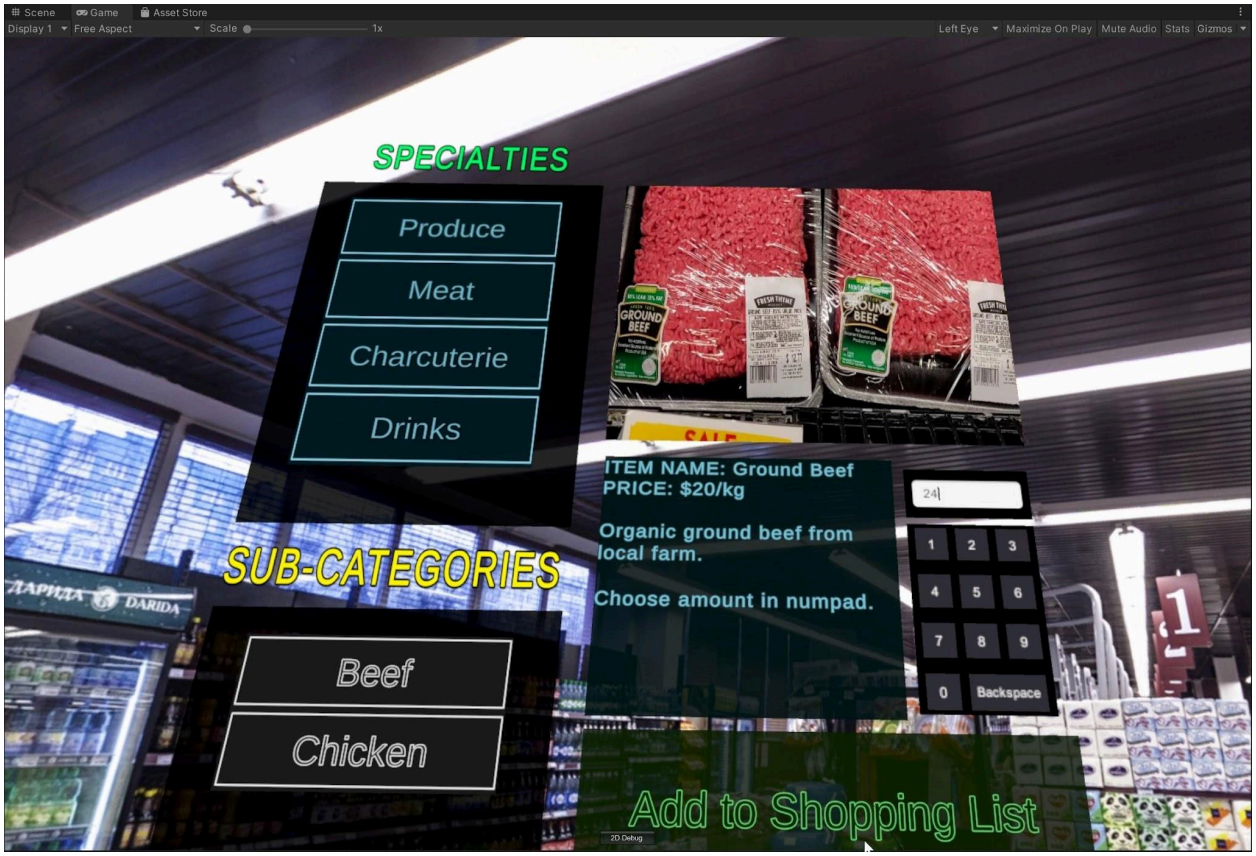


Figure 7. Specifying units of item to add into the shopping list

The shopping list is a system that allows the user to easily manage which items they want to buy. It was added into the prototype system to demonstrate how the user can easily inspect a specific item that they want to view, without having to search for the item in the menu or the VR store. Each item in the shopping list is displayed through a line of text with the item's name and the number of units that were added into the list. Each shopping list is currently identified by the time and date it was created.

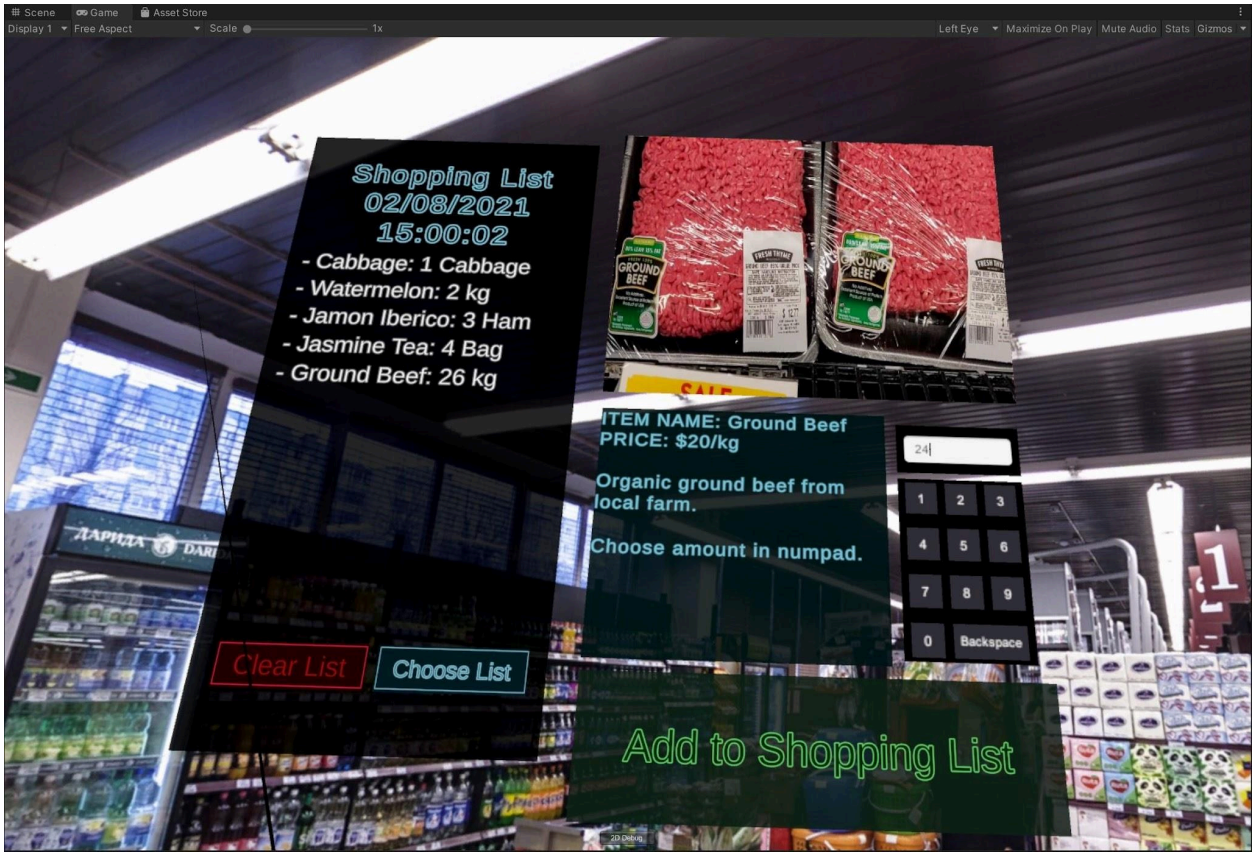


Figure 8. The shopping list

By selecting an item in the shopping list with the laser pointer, said item's information will also be displayed in the item information area, similar to when it is called from the item menu.

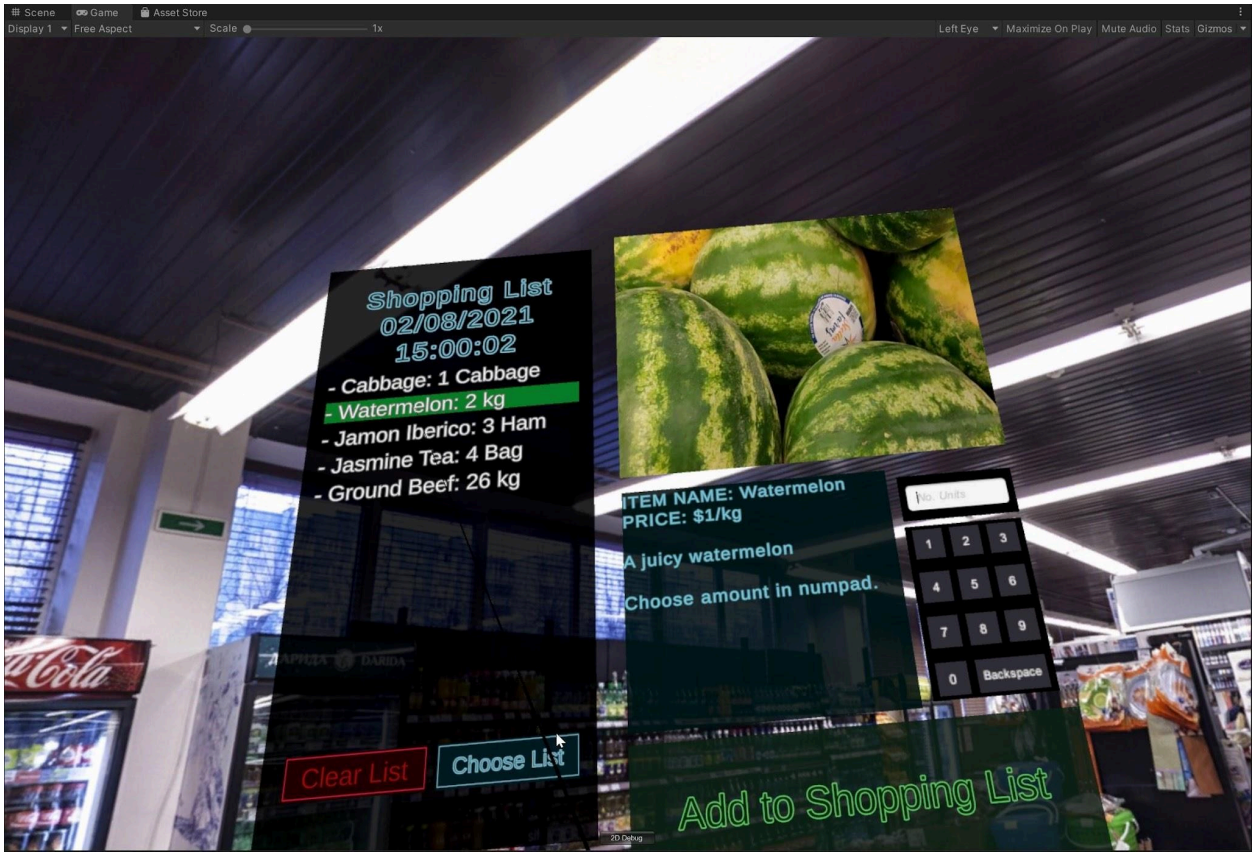


Figure 9. Picking an item in the shopping list with the laser pointer to display the item's information

The user can also clear the shopping list via the "Clear List" button.



Figure 10. Clearing the shopping list

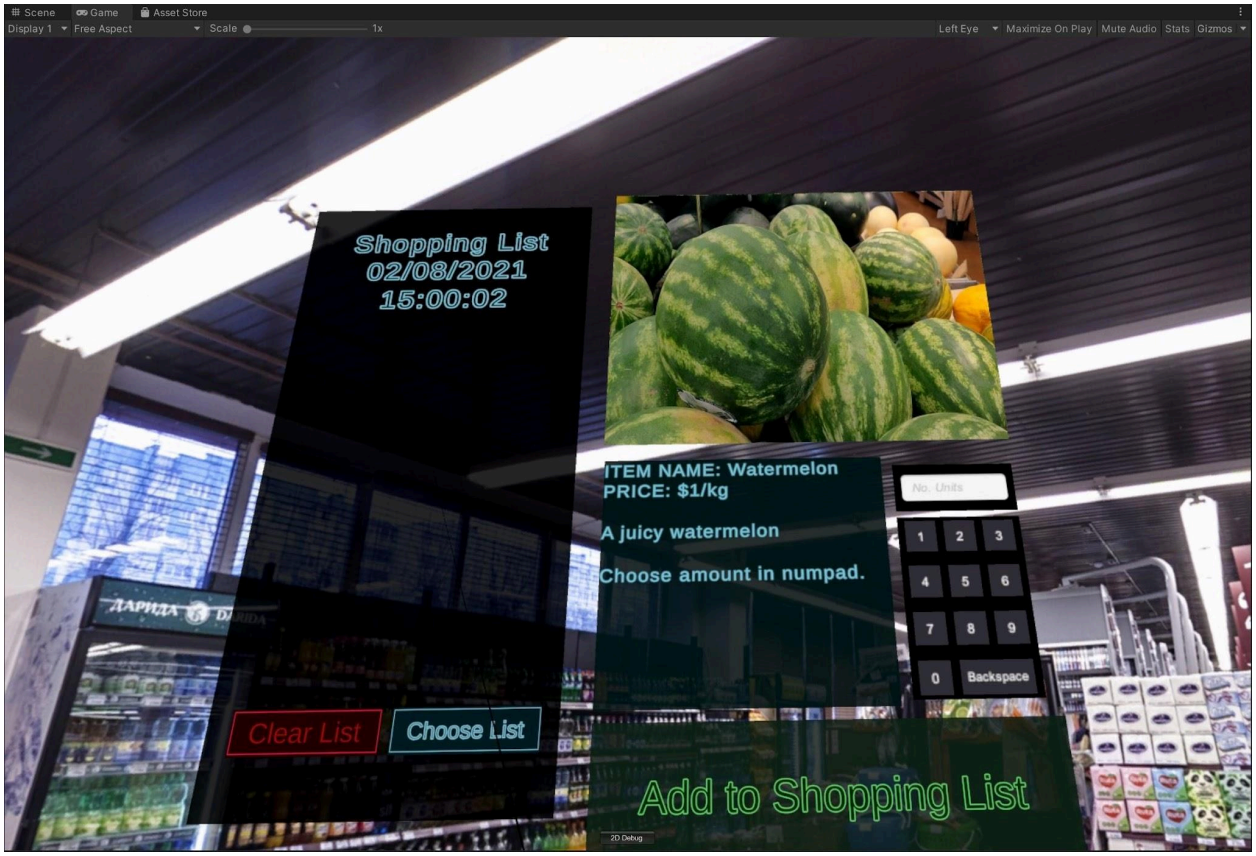


Figure 11. The shopping list is cleared

The user can also choose a specific shopping list to view using the “Choose List” button.



Figure 12. The “Choose List” button

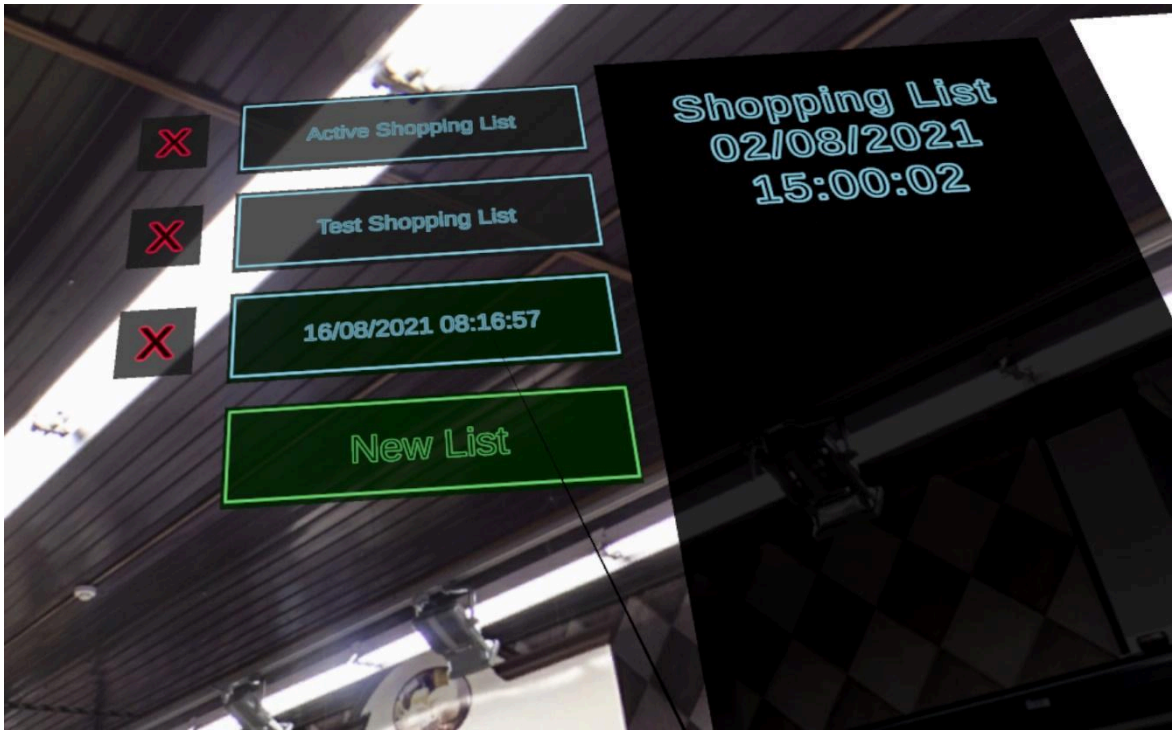


Figure 13. The list of shopping lists. The new list to be viewed is hovered upon

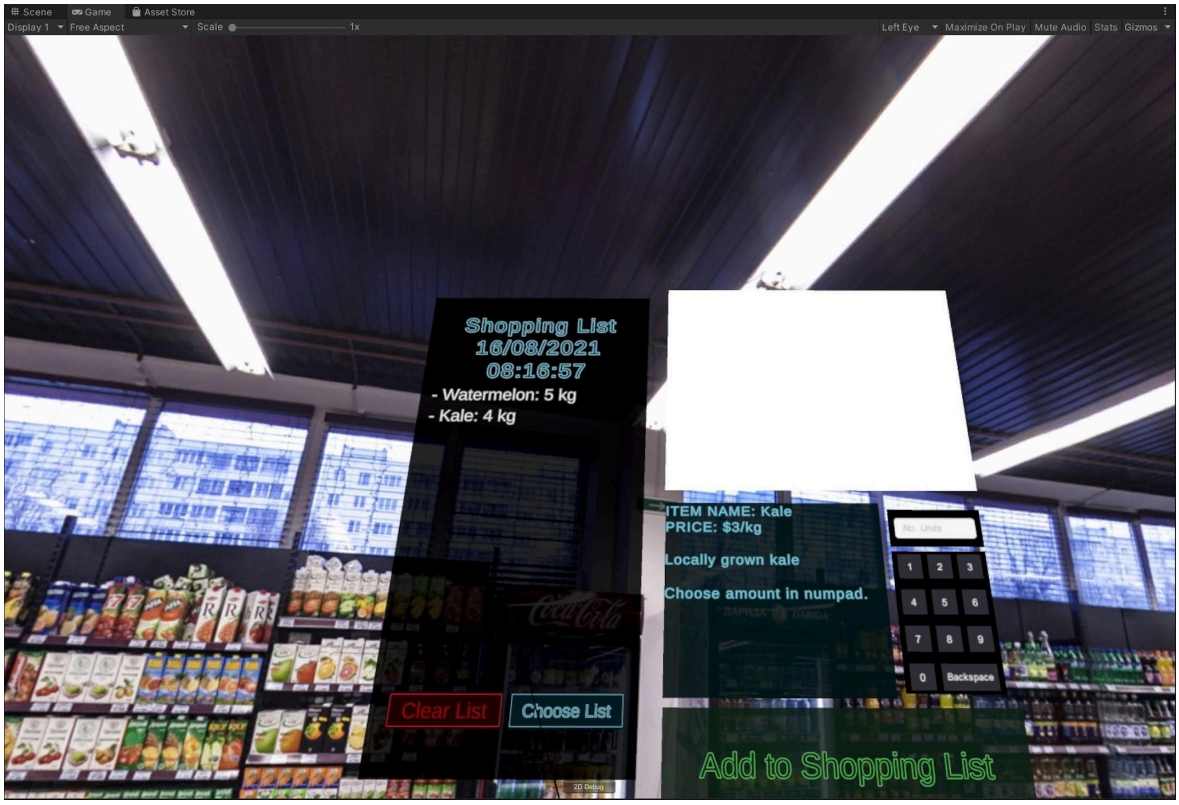


Figure 14. The new list is displayed

By triggering the red “X” besides a button representing a specific shopping list with the laser pointer, the user can also remove that shopping list from the database. If the list being removed is also the list being viewed, the newest remaining shopping list (based on recorded time and date of creation) will be automatically displayed instead.

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Figure 15. Removing the current shopping list

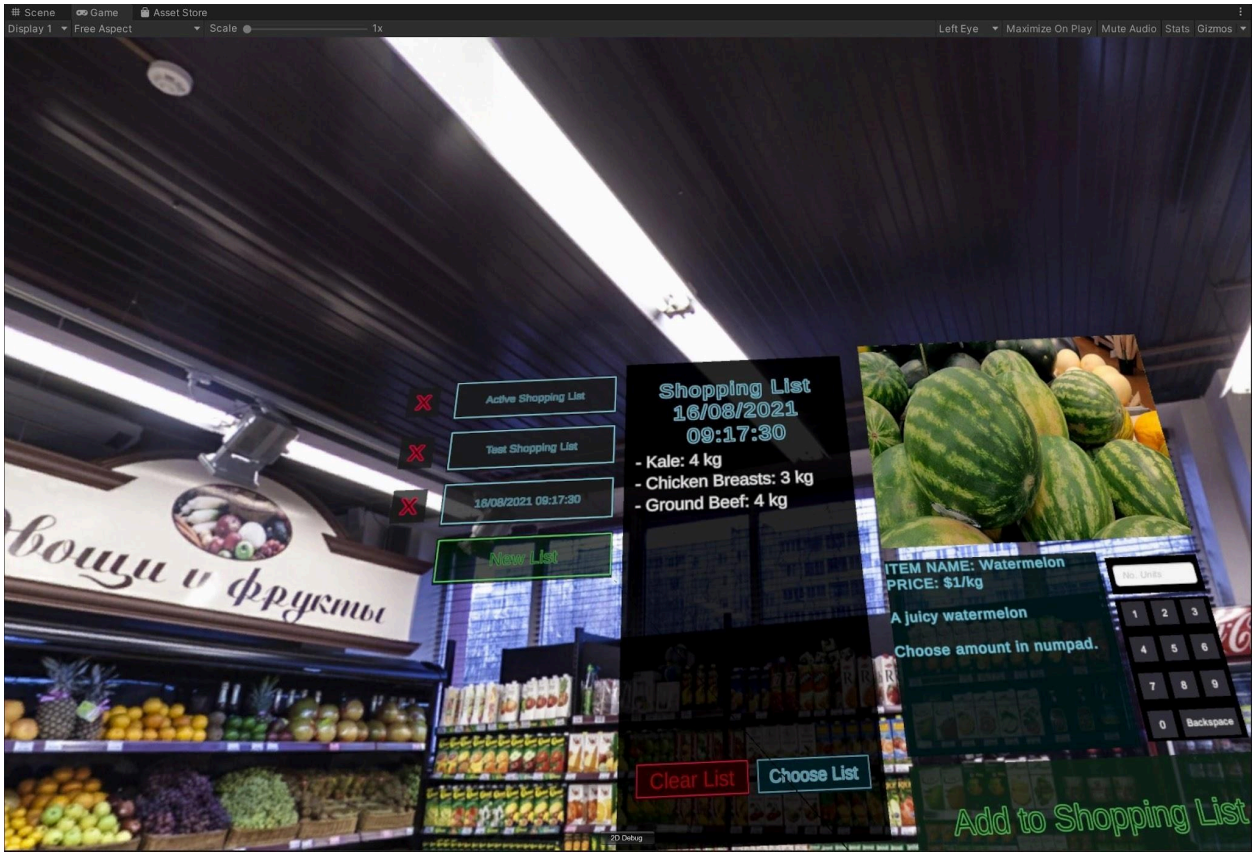


Figure 16. The list is removed, and the newest list is displayed instead

A radial menu is implemented to allow the user to easily switch between the item menu and the shopping list menu, without cluttering the user interface. By rolling the joystick on the handheld controller, the user can navigate through the radial menu. The radial menu currently has 3 positions: The upper position leads the user to the item menu, the lower-left position leads the user to the shopping list menu and the lower-right position shows both menus. The user activates the radial menu by pressing the joystick. That is, if the user pushes the joystick up and presses it, the item menu will be displayed. If the user pushes the joystick down and to the left and presses it, the shopping list menu will be displayed instead. If the user pushes the joystick down and to

the right, both menus will be displayed, with the shopping list on the left and the item menu on the right of the item information area.

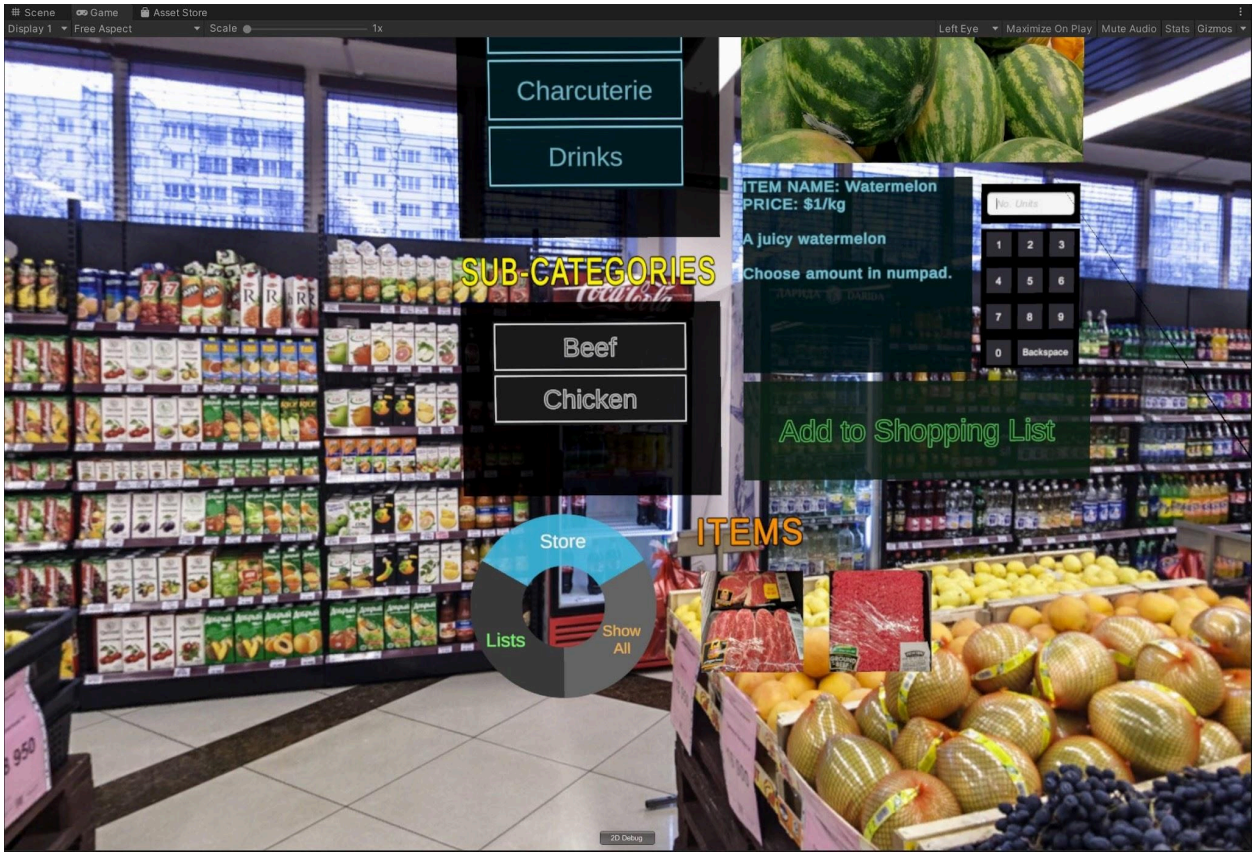


Figure 17. Calling the item menu using the joystick

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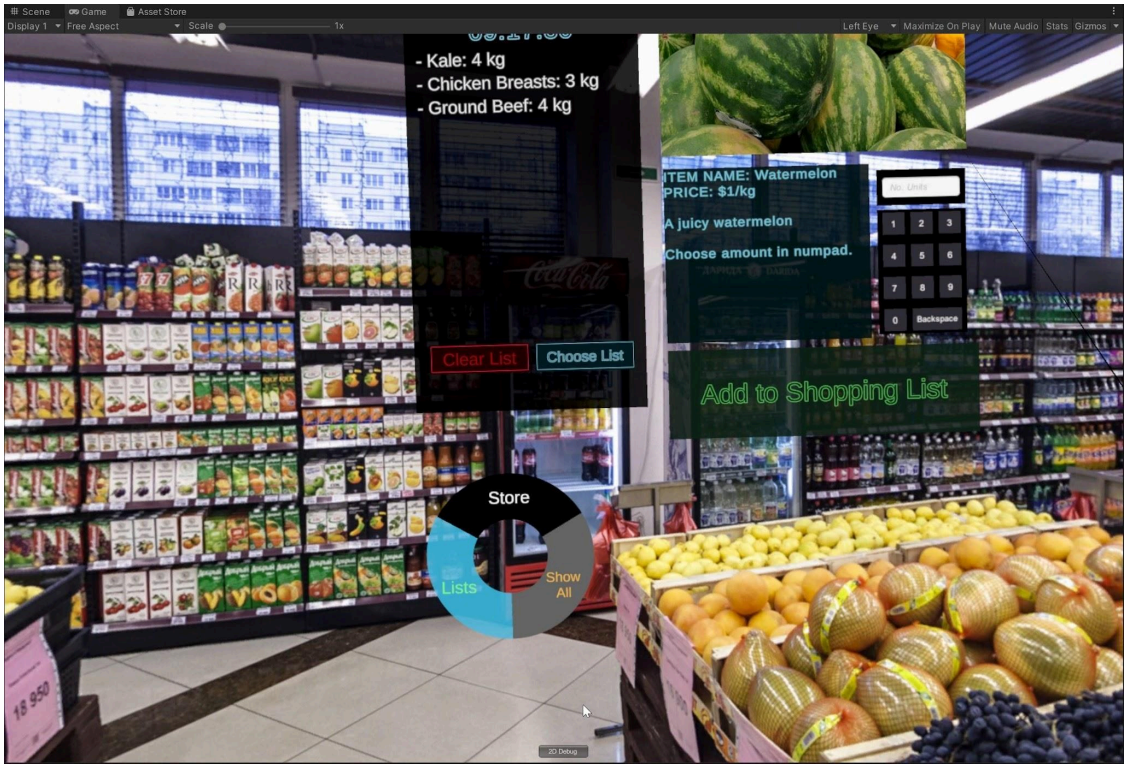


Figure 18. Calling the shopping list menu using the joystick

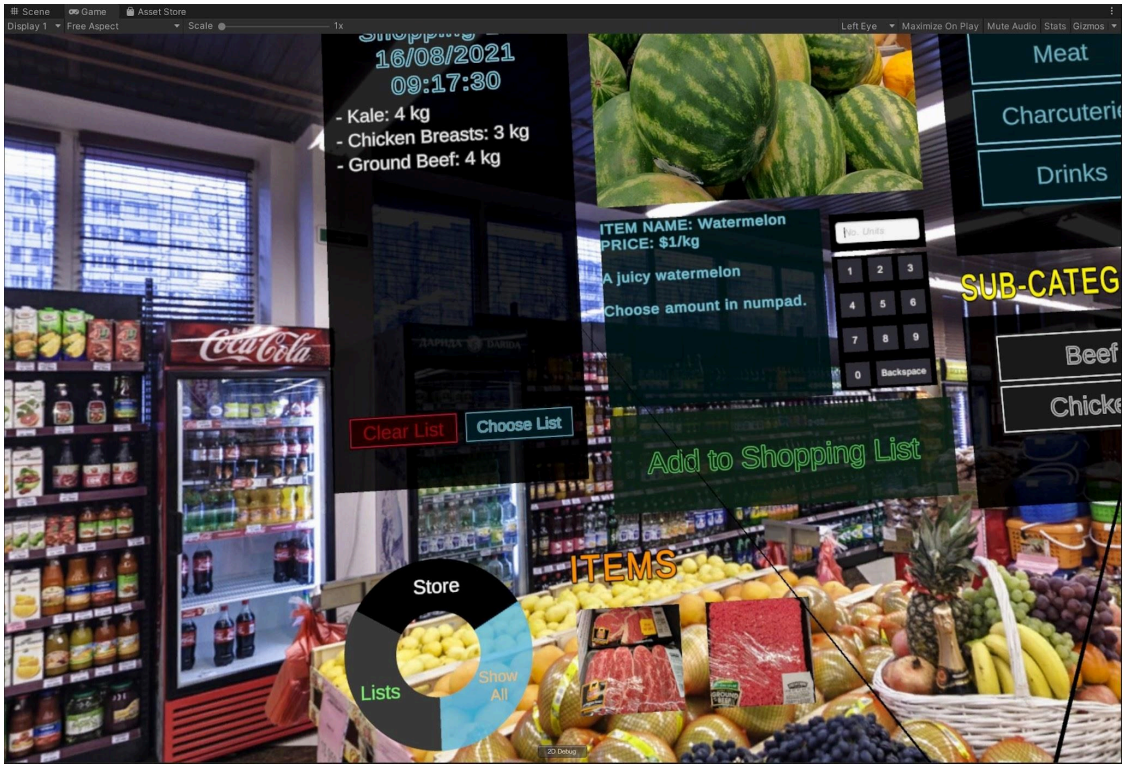


Figure 19. Calling both menus using the joystick

Discussion

Through the prototype user interface, the ability for the user to visually inspect items in a VR grocery shopping environment via video feeds was demonstrated. The user can also manage their shopping lists in the same menu system with minimal physical interaction. The entire prototype can be repackaged as a module to integrate into bigger existing VR shopping experiences, adding item inspection and shopping list management capabilities to more fully-fledged products.

Future Works

While the basic premise of inspecting a physical item in the store in a VR grocery shopping environment was demonstrated, there is much work to be done before the system can be considered viable. Some directions for future development and application of the prototype user interface include:

- Connecting the application to an actual store or warehouse's database, where applicable, to gather and display real-time video or photo feed of actual products.
- Adding a purchasing system to simulate an item or a list of items being purchased.
- Integrating the prototype into an existing VR shopping environment to add item inspection capabilities.
- Implementing benchmark capabilities into the system to determine user response time to various shopping tasks and user interface interactions.
- Setting up the prototype system to allow multiple users to use the system simultaneously.

- Implementing a recommender system to recommend the user relevant items in the database, using the user's shopping lists and shopping history as inputs. Newly added items considered relevant to the user can also be recommended.
- A secure authentication system to make sure each user is reliably granted access to the system while ensuring that each user's data (such as shopping lists and shopping history, as well as recommended items) is only accessible to that user.
- Allowing the user to search for a specific system and be teleported to said item in a VR store environment where each item is represented by a 3D model.
- Further user experience (UX) testing to develop more intuitive interaction methods and better user interface design. For example, there might be faster and more intuitive ways to purchase an item than to grab it using your hands in the VR environment or to select it from a list using a laser pointer.
- Applying Metaverse principles to the VR shopping environment: Each VR shopping environment can double as a social network where users can share their shopping lists or recipes, or users can define their own VR shopping environment suitable for the products that they want to trade. For example, a VR shopping environment for a car vendor can allow the buyer to test-drive a car using a realistic driving simulation.
- Quality-of-life improvements to the prototype system such as: Allowing the user to remove an item from the shopping list, allowing the user to change the number of units of an item in the shopping list without adding items, allowing the user to create shopping lists for a specific time and date, user experience or user interface improvements.

Conclusion

By developing a user interface for VR grocery shopping that associated each item with a unique video feed, the author concluded that developing a VR shopping system that allows the user to inspect the actual product, manage their shopping lists, and perform the basic task of purchasing a product is not difficult and can be readily pursued by parties with sufficient interest. Such a system would also be simple enough to integrate into existing VR shopping experiences, where the user can be led to a particular item in a physical store or have a virtual assistant guide them through the shopping process. However, much development needs to be done before such an integrated VR grocery shopping system is ready for widespread use. In particular, setting up a physical store to provide real-time video or photo feed of specific items remains a major issue.

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