ARtisan Bistro: A Cooking Task Environment to Conduct Studies in Augmented Reality

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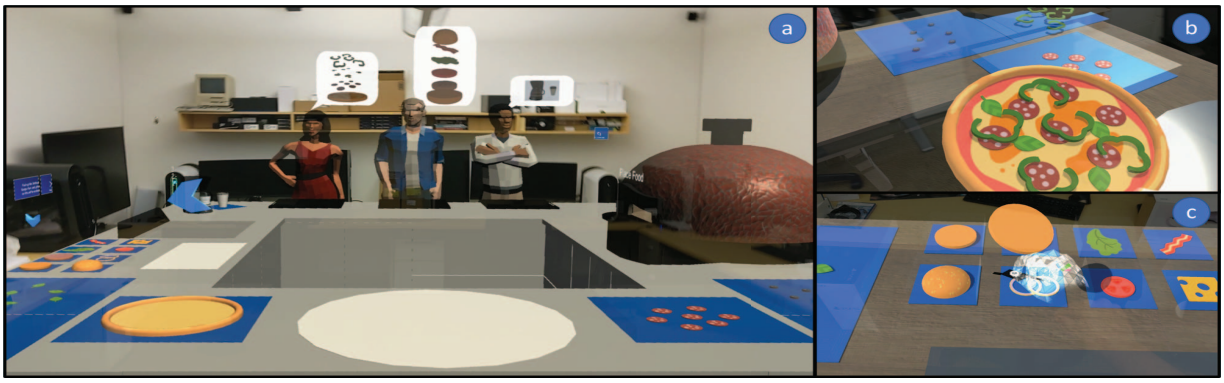

Figure 1: (a) Complete Setup of ARtisan Bistro; (b) Perfectly Cooked Pizza Taken out of the Oven; (c) Making Burger, Picking up Bottom Bun by Hand

Abstract

With the increasing popularity of Augmented Reality (AR) and newer emerging technologies for normal consumers there is an increasing need to research AR applications in more general everyday settings. ARtisan Bistro is an attempt to create a base layer environment that other researchers can build on. Our effort is to save researchers the time of developing an environment from scratch and focus more on the core part of their research.

Index Terms: Human-centered computing—Human computer interaction (HCI)—Interaction paradigms —Mixed / augmented reality; Human-centered computing—Visualization—Visualization design and evaluation methods

1 Introduction

Augmented Reality (AR) has experienced a big surge in public interest in the last few years, with AR-based mobile game Pokemon GO revenue hitting almost one billion dollars [3]. While mobile-based AR is still leading research efforts, AR head-mounted-display (HMD) research is close behind, with medicine and industry being the top areas in that field [4]. Some leading some scientists in the discipline of AR predict that AR-headsets will reach the same level of ubiquity as smartphones in the near future [1]. But there are still major obstacles limiting the wider use of AR [2], one of which is user interface limitations. To research these limitations and accelerate the growth of AR-HMDs with a mainstream audience, researchers have to come up with experiments set in more generic day-to-day scenarios, to reflect potential real-world usage.

We propose **ARtisan Bistro**, an AR-HMD environment that researchers can use to conduct experiments to test various user interfaces. If researchers do not have to design and implement a testing environment, a lot of time can be saved, and more time can be spent on research. While many experiments use specialized environments for very specific use cases, our environment can be used by researchers who do not need a specific task but rather a setting in which they can test their interfaces. Our environment is the first AR-testing environment that will be made available for all researchers to use in their experiments in 2023. ARtisan Bistro was designed with adaptability in mind, acting like a sandbox environment for experiments in AR. Also, by using a virtual environment in comparison to a real testing environment, performing the experiment is easier, as there is no setup needed.

Cooking is a relatable task for most people and as such needs little to no explanation, which makes it easy for the participants to perform. Every object in the environment can be interacted with just like if they were real physical objects, circumventing the need to learn new interaction techniques. Having the task be virtual also has the benefit that it minimizes the potential for injury.

While cooking is a simple and relatable task, it can also be used as a metaphor for more complex tasks, for example in the medical field. Working in a stressful restaurant where time matters and several things are happening at once can be compared to working in an operating room during surgery. But simulating a medical procedure with laymen is nearly impossible, due to their lack of knowledge. Using the cooking task, the stressful conditions of a surgery room can be transferred to a more generally understood and relatable environment for experiment participants.

2 ARtisan Bistro

ARtisan Bistro is an AR environment built using Unity engine v2022.1.10f1 utilizing Mixed Reality Toolkit(MRTK) that simulates a fast food restaurant where users can make burgers, pizza, and coffee at the request of customers.

2.1 Features

Burger Station: The burger station consists of 2 main parts. (1) Ingredients: There are 8 primary ingredients for the users to choose from (bottom bun, top bun, burger patty, tomato, lettuce Leaf, bacon, cheese, onion). All ingredients can spawn an unlimited number of times. Two of the ingredients include the top and bottom bun which

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are required ingredients while making the burger. Users can stack any other ingredients on top of the bottom bun. Stacked ingredients will get stuck to the bottom bun and can be lifted as a whole. To finish the burger, the top bun has to be placed at the top. No other ingredients can be stacked on top of Top Bun. (2) Grill: The burger patties can be placed on the grill to cook them. Multiple patties can be placed on the grill, each cooking at the same rate. Each patty has 5 cooking stages shown by changes on the surface (uncooked to burnt). The rate of cooking can be changed in code.

Pizza Station: The pizza station consists of 2 main parts. (1) Ingredients: There are 6 primary ingredients for users to choose from (pizza base, pepperoni, mushrooms, bell Peppers, olives, basil leaves). All ingredients can spawn an unlimited number of times. The pizza base contains pizza sauce and a cheese layer. All other ingredients are put on top of the base and snapped to orient themselves so that all ingredients are uniquely visible. (2) Oven: Once the user is happy with the pizza, they can place it in the oven. Each pizza has 5 cooking stages shown by changes on the surface (uncooked to burnt). The rate of cooking can be changed in code.

Coffee Station: The coffee station has a coffee cup and coffee maker to brew coffee. The coffee can be poured into the cup causing the liquid level to rise in the cup. When the cup is full a lid automatically spawns on top which signifies that cup is full. The coffee maker has a meter to the side with 3 levels, representing how many cups of coffee is left in the pot. The button on the bottom of the coffee maker will start the coffee maker, it pauses when the pot is removed and resumes when it is placed back. The rate of brewing coffee can be changed in code.

Customers: There are 12 meshes for customers (6 female and 6 male). Each customer has 2 animations attached to them. The maximum number of customers at one time is 3. The mesh and animation are randomly chosen when the customer is spawned. The duration and interval between new customers, as well as the number of customers can be easily changed.

2.2 Variable Properties

The purpose of ARtisan Bistro is to provide an environment that can be built upon to test different AR features. To make the development process easier on programmers, a lot of variables are made available in the properties tab in Unity. There are 3 variable categories:

Time based: These variables are used to increase or decrease the time required to complete a certain task. the rate of cooking the burger patty and pizza, the rate at which coffee is filled in both coffee pot and cup, the rate of emptying the coffee pot when pouring, the interval between each new customer, and the time customers wait for their food request

Quantity based: These variables determine the quantities of ingredients for pizzas and burgers requested by customers. The base ingredients for each food item will not change but the number of other ingredients can be controlled from 1 to maximum unique ingredients.

Appearance based: There are 12 meshes provided as mentioned above. Any new mesh can be added to the list which will be selected randomly.

3 Demo

The demo runs on a Microsoft Hololens 2 AR-HMD (optical-see-through). It features a resolution of 1440x936 pixels per eye with a FOV of 43 degree horizontal, 29 vertical and 52 diagonal. The kitchen environment requires approximately an unobstructed 2.5m by 3.5m area. Given that this project was developed using MRTK, any device compatible with MRTK should run the project (but it was only tested on Hololens 2.)

The current state and the demo presented in the conference consists of 2 levels/scenes. The first scene contains instructions on how to use the system. This is designed as a tutorial level as seen in a lot of games. An arrow will guide the user in the direction of the next task (Figure 2(a).) The second scene consists of a simple application that is built on top of it. Notifications are added to the environment that notify user of certain changes (e.g., New customer has arrived, Figure 2(b).)

Although the Hololens caps video recording frame rate to 30 fps, the environment runs at constant 60 fps. This was achieved by the use of low poly meshes and simple textures. This allows the researchers ample amount of processing resources to build a more complex system. Low poly meshes avoid the uncanny valley. Five distinct users found the environment to be easy to use and participants had fun while fulfilling the cooking tasks in an informal setting. The five users told us that they feel comfortable and feel safe moving about the environment.

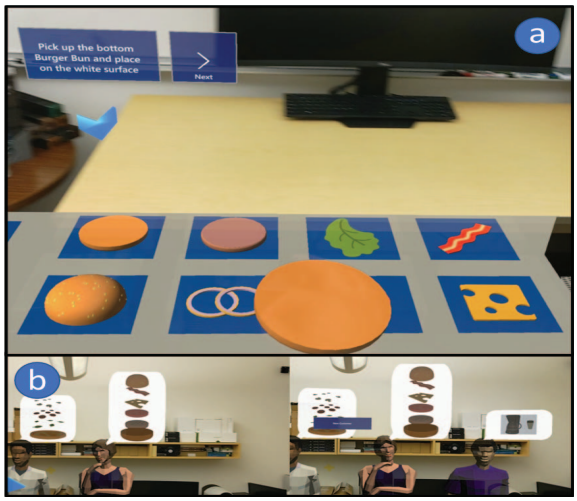

Figure 2: (a) Tutorial Screen showing Burger Station; (b) Notification for new customer.

4 Conclusion and Future Work

Based on the initial user feedback and the system's performance, these elements demonstrate that this can be a new starting point for some researchers. Having an already built environment to simulate a situation that is relatable to the majority of the population will save a lot of development time and can be a good baseline environment for study comparison. Later versions may include a waiter bringing in orders and food delivery service requests. In addition, plastic toy cooking objects may be used to give a more realistic scenario for some of the food. The long term use-case is to allow real-cooking with this application. The application, when released, will be open-source.

Acknowledgments

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