Thesis Portfolio

Developing a Multimodal Entertainment Tool with Intuitive Navigation, Hands-Free Control, and Avatar Features, to Increase User Interactivity
(Technical Report)

Exploring the Relationship Between Technology and Physical Activity
(STS Research Paper)

An Undergraduate Thesis

Presented to the Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements of the Degree
Bachelor of Science, School of Engineering

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Spring, 2022

Department of Systems Engineering

Table of Contents

Sociotechnical Synthesis

My technical project is titled "Developing a Multimodal Entertainment Tool with Intuitive Navigation, Hands-Free Control, and Avatar Features, to Increase User Interactivity" This project was completed with a large entertainment company. The objective of this project was to create a novel entertainment experience that fosters high user interactivity. My STS research paper focuses on the how technology has removed normal physical activity from daily activities. The main goals of this study were to explore the rise in these technologies using the SCOT framework. The perspectives of for-profit companies, parents & teachers, and government instutitutions were compared and contrasted. The technical project focused on fostering user interactivity beyond the couch within an entertainment & video streaming company. Thus, I wanted to focus my STS research topic around similar technologies that have contributed to a culture sedentarism in the US.

The technical portion of my project produced a prototype of a novel multimodal cooking application. This prototype includes an interactive tree-like recipe map, a hands-free voice command mode, and avatars that enhance the entertainment aspect. To develop this prototype, we chose a use case that would naturally be conducive to physical activity and had high potential for a hands-free mode. Thus, we chose cooking. Next, we iterated on various designs especially focusing on making the multimodal map structure more user intuitive as it was the most novel aspect. Feedback from the client's product and UX design team was given on a biweekly basis. Usability evaluations in a kitchen setting where ingredients were provided for the user were conducted. The prototype was refined based on user feedback. The project was presented at the 2022 IEEE Systems and Information Engineering Design Symposium.

The STS portion of my project allowed me to learn more about the negative impacts the

rise in technology has inadvertently had on health in the US. While poor food choices has often been thought of as the main culprit for America's obesity epidemic, physical activity has also played an important role. Through the increased efficiency provided by recent technological advancements like transportation, communication, and entertainment the average person is now burning less calories from their daily activities. With only 45.5% of Americans reaching sufficient activity levels and a 42% and rising obesity rate it is fair to say the culture of sedentarism and its relationship with obesity is an imperative issue. In addition, I evaluate the feasibility of introducing physical activity into various sectors using their respective product success metrics. Focusing on the entertainment industry, I explore health-forward directions entertainment companies can take.

During my technical project, I was able to develop fluency in Figma, design reviews, and conducting usability tests. Key human-computer interaction principles I focused on within ideation and user testing included efficiency, intuitive design, natural mapping. However, we didn't explicitly focus on the level of physical activity that the structure of our application fosters. My STS research paper informed me that having high intensity physical activity within certain applications can actually have a reverse effect due to unforeseen consequences like increased appetite. Thus, just engaging users off the couch was an effective step towards slowly but surely breaking our culture of sedentarism. Overall, researching my STS topic brought new light to this relevant and imperative topic.

I would like to thank Professor Hannah Rogers and Peter Norton for advising me on my STS paper, as I am grateful for their insight and support. I would also like to acknowledge Professor Gregory Gerling for being my technical advisor and his contribution to our technical project. I'd also like to acknowledge my teammates Nathaniel Barrington, Caton Gayle, Erin

Hensien, Grace Ko, and Sreya Palnati for their hard work and dedication.

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Grace Ko
Sreya Palnati

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

Signature _____ Date_____
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Approved _____ Date_____
Gregory Gerling, Department of Systems Engineering

Developing a Multimodal Entertainment Tool with Intuitive Navigation, Hands-Free Control, and Avatar Features, to Increase User Interactivity

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***Abstract*—Advances in user interactivity in digital entertainment offer the potential to engage users beyond traditional passive and solitary experiences. Indeed, a high level of interactivity is inherent in tasks involving cooking, auto repair, and home improvement, all of which require users to complete multiple, detailed, and interdependent steps. Such tasks also require access to visual and audio instructions while a user's hands are engaged in a primary, physical task, and are often conducted in unique locations, e.g., kitchen or garage. This effort describes the design of an interactive, multimodal digital entertainment user experience for an 'edutainment' cooking show. The prototype wireframes incorporate three novel features, identified through requirements gathering and iterative design, of an interactive recipe map for hierarchical content navigation, voice command hands-free control, and avatars to further engage users. The overall design and three features were evaluated via usability testing in real kitchen settings in the conduct of actual cooking with real ingredients with a diverse range of seven participants. The results illustrate that the hierarchical navigational feature, alongside interactive voice communication, were effective at reducing users' cognitive load, and streamlined necessary information in order to support task completion.**

I. Introduction

Digital, in-home entertainment is a roughly $295 billion USD industry [1] that has become mainstream and ubiquitous over the past decade, due in part to its pricing model and the availability of broadband internet streaming. Through various private companies and governmental agencies, individuals can now access, on demand, a wide range of programming options. While now in common usage on mobile platforms, the majority of users tend to engage with such media in a solitary, sedentary fashion and with very little interaction. In particular, consumers are usually seated, and not prompted to act while in the middle of a show, in contrast to the high amount of interaction inherent in a video game. As a result, multiple entertainment companies are working on developing novel, next-generation paradigms.

Recent signals point toward a transition to increased engagement with entertainment programming and virtual reality. For example, Facebook, rebranded as "Meta," has promoted the "metaverse," which is defined as "a virtual world where people can socialize, work, and play" [7], which may change how people integrate their virtual and real lives. In addition, other companies have begun to integrate "Choose Your Own Adventure" content into their platforms, taking inspiration from second-person point of view children's books stemming from the 1970s to the present [3]. For example, Netflix now offers an interactive trivia game called "Trivia Quest," in which users receive a reward for answering questions correctly [8]. Users directly input their answers on a mobile or laptop screen or use a remote control to do so on a standard television. Disney+ offers a similar interactive episode called "Baymax Dreams," where users will use touch input to progress through an episode [2].

Moreover, beyond traditionally passive and sedentary experiences, a high level of interactivity is inherently found in tasks such as cooking, auto repair, and home improvement. Such tasks tend to require users to complete multiple, detailed, and interdependent steps. In addition, such tasks require access to visual and audio instructions while a user's hands are engaged in a primary, physical task, and are often conducted in locations, e.g., kitchen or garage, other than those for which media are traditionally viewed. In these cases, interactive guidance may enable users to efficiently break down difficult concepts and tasks, and become personalized to a user's or situation's specific needs, thereby reaching a wider variety of users, and regardless of disability or device limitation. In specific, those with motor impairments in the form of limited hand dexterity may benefit from hands-free, voice only interaction [4]. Such interactive applications also aid in dealing with pervasive issues such as mental health in the form of health behavior apps [5].

II. Methods

In the work herein, we describe the design of an interactive, digital entertainment experience that utilizes multimedia and multimodal methods to engage users in an active 'edutainment' how-to experience. The specific use case is tied with the task of cooking, chosen due to its hands-on nature and ubiquity, and conducted by people who range widely in age and other demographics. Focusing upon three novel features involving hierarchical content navigation, hands-free voice commands, and digital avatars, the prototype design aims to increase user interactivity and engagement with the content. First, an interactive map of a tree-like format allows the user to navigate the timeline and hierarchically organized content in completing a recipe. Second, a limited subset of hands-free voice commands allows users to control the navigation and video clips. Indeed, user may not be able use their hands to navigate the platform because they are covered in ingredients or residues. Third, two digital avatars support the entertainment aspect, one for comedic relief and one for educational tidbits, delivered in a question-style, multiple-choice format. Five common attributes of usability are taken into account in the design, including efficiency, satisfaction,

learnability, memorability, and a low error rate [6]. Most importantly, the design seeks to emphasize the importance of active engagement in the field as compared with more traditional and passive, sedentary entertainment.

III. Methods: Requirements Gathering

Requirements for building the user interface and experience were derived from interviews with various stakeholders coming from a large demographic range. Both information and functional requirements were iteratively refined during the initial design phases. The major constraints in the information requirements focused upon accessibility concerns with regards to recipes. Functional requirements focused on providing a medium for users to follow a recipe and to navigate the medium so that they can complete the recipe. The details of these requirements are listed below.

A. Information Requirements

Clear and Intuitive Formatting: The user interface must be easily learnable through the means in which information is presented to the user via its navigation, video, or tutorial.

Ingredients and Materials Overview: An overview of ingredients and materials necessary to cook the recipe will be provided before cooking begins. This makes the cooking process more efficient, and less error-prone, as users will not have to stop cooking midway into the recipe to retrieve necessary items.

Group Size and Allergies Information: To curate a personalized experience, basic parameters in the form of a pre-recipe questionnaire, tied to the recipe quantity, number of individuals to be fed, allergies or ingredients to be removed, etc. will be presented before cooking begins.

Recipe Selection Detail: Information at various levels of detail to allow users to initially choose between and select a recipe, including its name, duration of time to complete, if there is a particular celebrity involved, etc.

Recipe Completion Status: Clear guideposts are needed for users to know where they are temporally within the process of completing the recipe.

Suggested Chronology of Tasks: The user should be able to easily discern the suggested chronological order of completing the steps in the recipe. Individual steps throughout the process shall be broken into smaller tasks, each composed of individual ingredients, and include visual indication of completion.

Hands-Free Navigation Instructions: To utilize the hands-free component of this platform, the keywords must fit within lexicons commonly used for other common applications, and users will need a means to access keywords.

B. Functional Requirements

Intuitive Navigational Structure: By following the navigational hierarchical structure both vertically and horizontally, users shall be able to complete the recipe's steps in the most efficient order. It should be made intuitive that the ingredients on the bottom nodes of the recipe map are dependent on the node they are attached to above.

Active Navigation: The user must directly interact with the experience using either touch or voice to navigate through the recipe to reach completion.

Hands-free Controllability: Users must be able to navigate the interface entirely via voice-interaction if necessary for both accessibility concerns and users who are not able to use their hands (i.e., hands are wet/dirty from chopping, do not want to touch their phone).

Full User Autonomy: Users must be able to actively navigate through the hierarchical structure, maintain access to the recipe and tutorials/instructions, and have on-demand control of the flow of the show if they so choose.

Flexible and Decision Driven Environment: Throughout the experience, the user must be able to navigate through each step at their own pace, with the freedom to skip any additional functions that they deem unnecessary to their experience. Additionally, users must be able to return to previous steps if they feel the need to.

Active Engagement Opportunities: The avatars must be fully functional, timely, and add to the overall experience. The avatars must be equipped with the relevant data they need to execute their intended tasks, which are comedic content and trivia questions. The user must be able to easily opt out of such additional content.

IV. Methods: Prototype Development

Over the course of the user experience design, multiple prototype iterations were produced, evolving with feedback from stakeholders, and focusing more precisely on the scope of the final content. The wireframing tool Figma was used to create prototypes. Several model recipes were evaluated to help pinpoint issues, e.g., longer recipes required more complex and detailed navigational structure. To perform usability testing, the application Framer was used, which allowed us to integrate mock cooking videos into the prototype screens created in Figma.

A. Alternatives Generated

The first design concept sought to develop a navigational hierarchy by utilizing a horizontal mapping structure to illustrate the necessary steps to completion, with the ability to break down the cooking experience into separate sessions (Fig. 1A). The horizontal structure sought to optimize readability as the eye naturally travels from left to right across the screen. The user had the ability to select the number of sessions in which they would like to complete the recipe in order to promote flexibility and customization. Color-coded components signified the order of completion. The design lacked progress tracking to help the user orient themselves within the recipe, contained an overwhelming amount of text and colors, and did not maximize usage of the screen space. Therefore, the second iteration aimed to decrease the user's cognitive load while providing additional information (Fig. 1B). This goal was achieved by simplifying the map overview while including more informational depth in subsection pages. The subsection pages include the ingredients and their associated actions, indicating to the user how to best prepare

ahead of viewing the video content. The prior horizontal mapping structure was changed to a vertical format in order to maximize usage of screen space. A duration bar was added at the bottom of the page to offer feedback on completion progress. Separation by session, which allowed a recipe to be conducted over multiple days, was removed and the color scheme was simplified. Overall, we found that the prototype oversimplified the representation of the recipe, in both its iterations. Moving forward, we focused upon identifying and streamlining necessary information in order to maintain a reasonable cognitive load while still supporting task completion.

B. Final Concept and Designs

The final prototype design took feedback from preliminary user testing and stakeholder discussions to incorporate three main features: hierarchical content navigation, hands-free voice commands, and two entertainment focused avatars. Each novel feature is described in detail.

Hierarchical Content Navigation: An interactive map was designed to allow users to vertically and horizontally navigate a recipe at their pace (Fig. 2). First, an overview of the navigation with a tree-like format is displayed, with the main node being "Garlic Bread" and each subsequent sub-node describing a step of the recipe that connects to form its entirety (Fig. 2A). When the user zooms in, a more detailed view with images is shown that provides the user with information such as how much time each step of the recipe will take and quick tips for the recipe (i.e., "Best when used immediately" (Fig. 2B). A scroll button to the left traverses down the content vertically (Fig. 2C). Once a sub-node has been completed, a green overlay and a checkmark indicate completion of that step. The recommended next sub-node of the recipe is then highlighted with a yellow box outline (Fig. 2D). Once a sub-node is interacted with, a timed intermittent screen will pop up with a list of materials needed to complete this step of the recipe so the user can prepare for the video to begin (Fig. 2E). The video will then begin, providing several useful functions including an icon to get back to the main overview recipe map (Fig. 2F).

Hands-Free Voice Commands: Voice command functionality was added to avoid common issues of touching an electronic device with messy hands. If a user is preoccupied with other tasks while cooking, they may not always be able to return to the recipe. By touching the microphone icon (Fig. 3A) or by saying the phrase "Show me voice commands," an overlay of possible voice commands is introduced (Fig. 3B), with "Fast Forward," "Next Ingredient," and "Back to Map" meant to assist the user in navigating through the recipe. This aspect also considers a wider range of users, for example, users who have a disability and do not have use of their hands.

Avatars: The user can see where the different avatars will appear in the video using the transparent icons on the video timeline. The avatars may be turned on and off using the question mark and funny face icons pictured on the right side of the screen (Fig. 4A). The first avatar is named "Albert", who probes users with trivia questions related to the recipe (Fig. 4B). The second avatar is named "Otis", who interjects the recipe with humorous jokes (Fig. 4C).

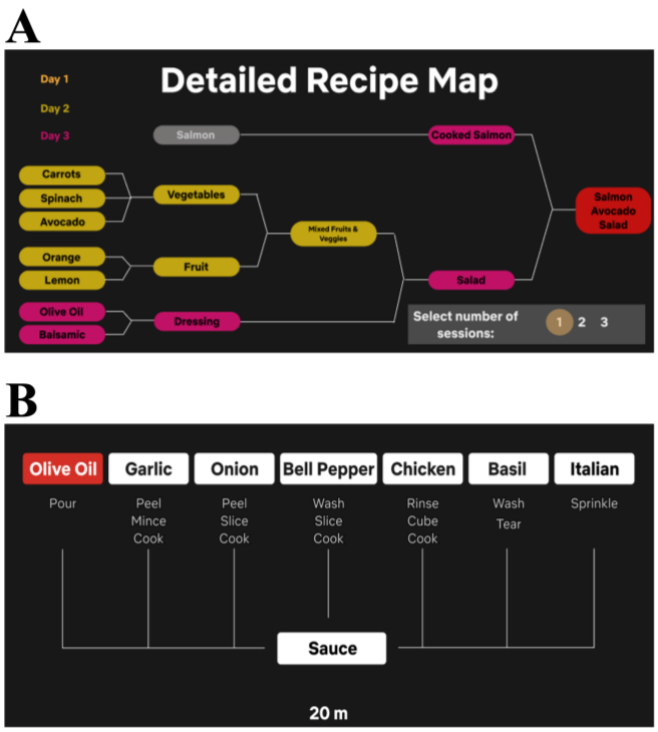

Fig. 1. Alternative maps generated. (A) The first hierarchical content navigation prototype focused on optimizing user flexibility and engagement **(B)** The second navigation prototype focused on increasing provided information and decreasing cognitive load.

V. Methods: Usability Evaluation

Users: Usability testing with volunteers was conducted to evaluate the features, overall flow, and diagnose concerns. User testing was completed with seven individuals from two age groups, the first with an average age of 23, and the second with an average age of 65. Four men and three women participated, across a range of cooking and technical expertise, and experience with voice commands, to reduce bias, given the small sample size.

Procedures: Each evaluation was procured in the same type of environment, i.e., that participant's own kitchen, to reduce the role of external factors in the usability evaluation. All participants cooked in their kitchen with a computer screen in front of them, which simulated the area of a mobile phone. The same recipe was used for everyone, which was making garlic bread with an air-fryer (Fig. 1). All ingredients necessary to make the garlic bread were provided, and tools were those of the individual's kitchen. Through the use of the Framer tool, which aids in screen-to-screen transitions, and Wizard-of-Oz (WoZ) techniques, participants traversed through the recipe. With respect to the voice commands, users spoke those to a facilitator, we then through WoZ manually input the commands into the prototype system in place of a working voice recognition system.

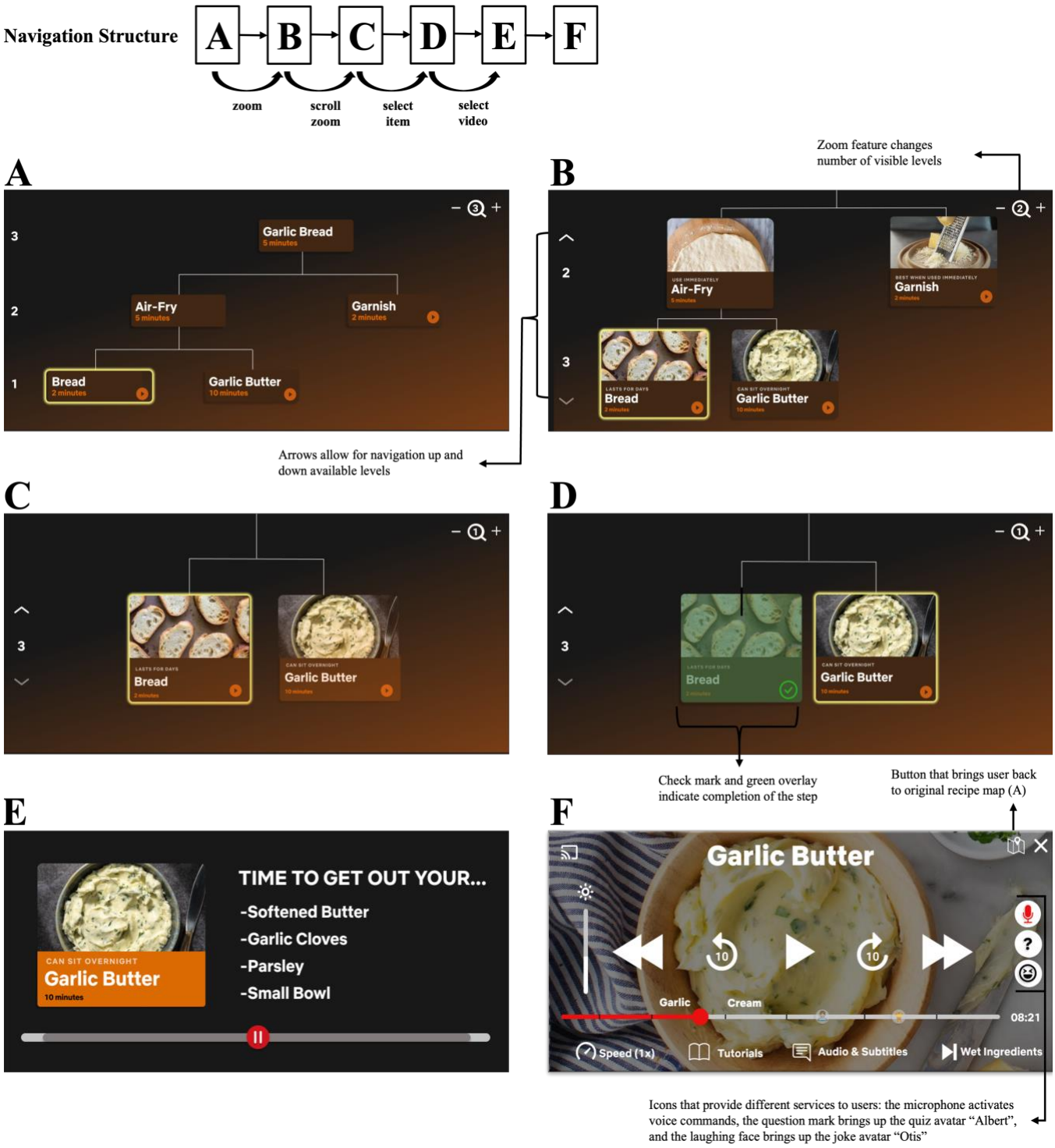

Fig. 2. Overall navigation flow of the multimodal tool. (A) Hierarchical content navigation **(B)** Zoomed-in view of the first two levels of the recipe map in A **(C)** After clicking the plus icon of the zoom arrow, the third level ingredients under the step "Airfry" are revealed **(D)** After the "Bread" step has been completed, a green overlay will cover the box, prompting the user to go to the next step "Garlic Butter" **(E)** Informational overview page appears before the recipe video starts informing the user on the needed ingredients and tools **(F)** Paused screen view of "Garlic Butter" video.

Evaluation Metrics: Multiple metrics were used throughout the evaluation process: whether participants completed the recipe fully, duration of time to complete the recipe, how many of the features they rated positively/negatively, and the number and severity of pain points. Throughout, the participants were highly encouraged to use the "talk-aloud" method to articulate their thought processes for each cognitive choice and selection action, even if their thoughts were not

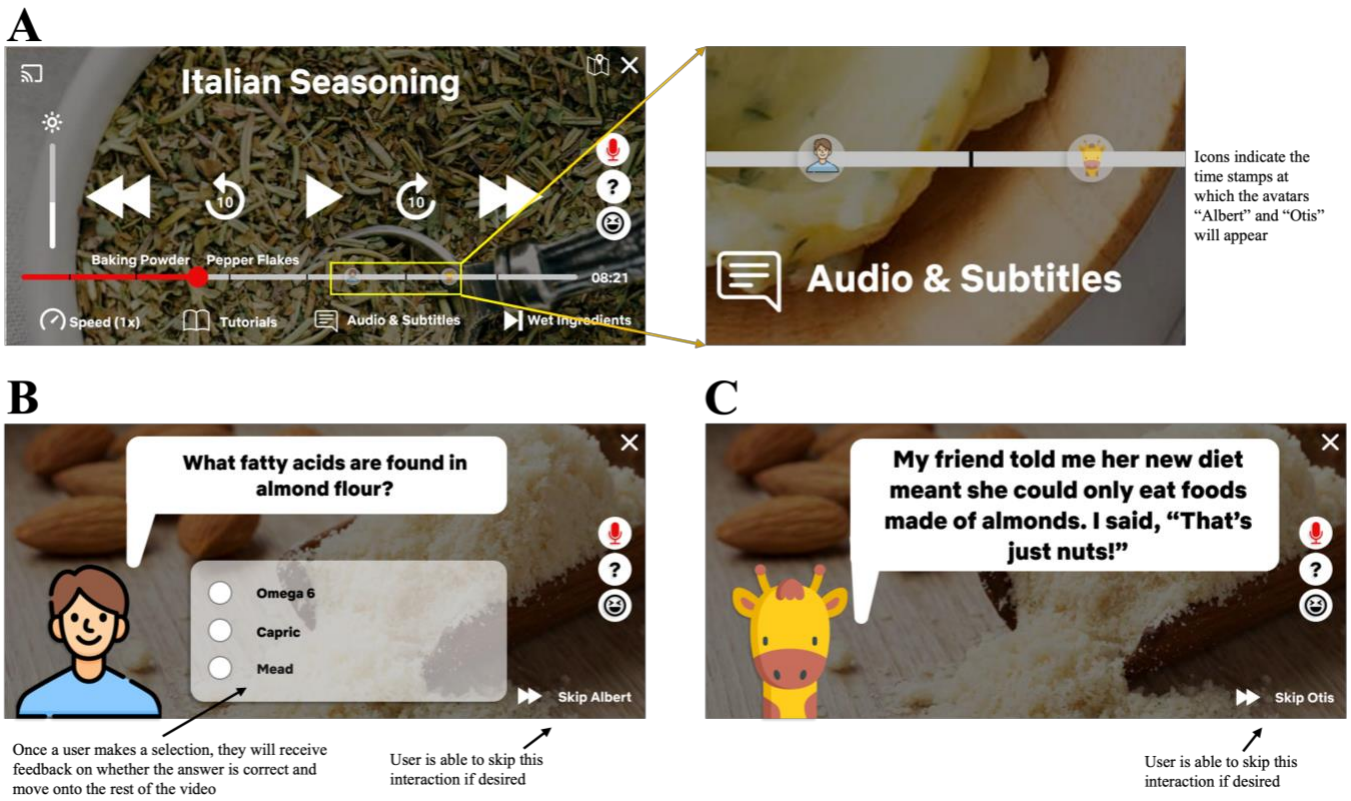

Fig. 3. Video screen and avatars. (A) Video overlay screen with time stamps of upcoming avatar interactions indicated on slider **(B)** Avatar named Albert that asks the user an interactive trivia question related to the recipe **(C)** Avatar named Otis that inputs entertaining jokes to keep user engaged.

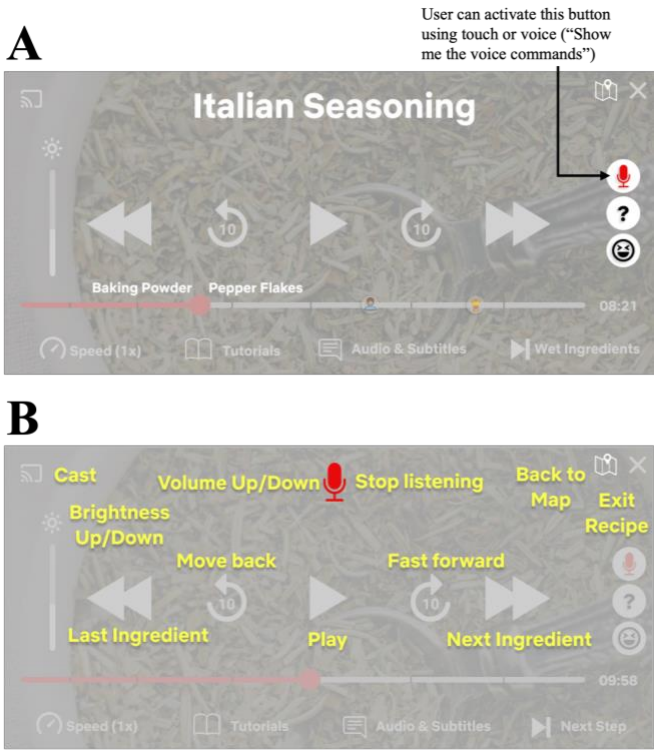

Fig. 4. Voice commands. (A) The hands-free function is displayed by the red microphone button which can be activated by either voice or by touch. **(B)** Once activated, an overlay of common voice commands will fill the screen to inform the user of what actions they can take.

connected directly to a voice command. Users were also instructed to progress through the prototype evaluation under the presumption that the facilitator was not there. However, the participant was able to ask questions to the facilitator in order to clarify any issues or offer suggestions. Additionally, participants were also asked a series of questions about their overall experience with the interface at the conclusion of their functionality test. Examples of these questions include: "What aspect did you feel most engaged with?," "What features did you expect or wish were included that were not available?," and "How likely would you be to use this product again in the future?" These questions provided general feedback on certain aspects of the interface, while the "talk-aloud" articulation throughout the evaluation provided deeper insights into pain points with the prototype interface.

VI. Results

The usability tests, utilizing the streamlined garlic bread recipe, involved seven individual users, all of whom successfully used the service to cook a meal. Each test was completed in approximately 45 minutes, with one participant's duration extending beyond an hour. After completion, each participant was asked an identical series of questions about their experience, with a particular emphasis on the three main features. Overall participant evaluations of both the hierarchical content navigation and avatars were positive, while the voice commands received a more neutral

evaluation. On average, facilitator intervention was required twice during each evaluation. Certain qualitative sentiments were consistently observed.

Hierarchical Content Navigation: Five participants found the interactive nature of the hierarchical content navigation enhanced their enjoyment of the prototype, while two participants felt the additional steps of the navigation prevented them from accessing the cooking portion in a timely manner. A specific issue among participants involved confusion with the zoom-based navigation within the hierarchy. During the test, the participants could adjust the number of visible steps by altering the zoom level. Four users noted that the limited number of visible options at the maximum zoom directed them to the incorrect steps in the process because the appropriate step was not immediately visible. This misunderstanding would likely lead future users to initiate an unintended portion of the recipe and derail the flow of the experience.

Voice Commands: The users were divided into two groups based on their preexisting familiarity with voice command systems. Some users' previous experience with voice command technology such as Amazon's Alexa and Apple's Siri led to seamless and persistent usage of the hands-free voice commands. Those participants with less prior experience were more intimidated and confused with these functions, leading to infrequent usage. This disparity could develop feelings of alienation in a potentially large user-base and discourage their use.

Avatars: General user sentiment on the avatar involvement was positive, however three users raised a common complaint relating to avatar interjections. These users felt that the avatars could be overly intrusive and that they were more of an interruption of the experience rather than an enhancement. All three users suggested improvements, including their integration into the video itself with smaller pop-ups that do not interrupt the video.

VII. Discussion

This project developed an interactive, multimodal entertainment tool that has three main features. The prototype wireframes incorporate three novel features, identified through requirements gathering and iterative design, of an interactive recipe map for hierarchical content navigation, voice command, hands free control, and avatars to further engage users. After conducting usability testing with a diverse set of users and stakeholders, several changes were made, including streamlining the navigation, a more comprehensive tutorial, and more accessible information. All of these changes increased the ease of using this tool.

The user experience design considered herein differs from traditional passive and sedentary experiences because it focuses on actively engaging the users in tasks with a high level of interactivity. Additionally, the design focuses heavily on voice commands as a way to engage a new section of users that are not traditionally considered in the design process, which limits motor capacity.

One limitation to this project was the constraint of time for creating the prototypes and conducting user testing. Some capabilities of our user testing platform were non-functional and this limited the scope of our usability testing results. The novelty and success of this multimodal tool demonstrates the potential for active engagement in entertainment experiences.

Acknowledgment

We would like to thank Victoria Bellotti and Avi Naim for their support and guidance.

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Exploring the Relationship Between Technology and Physical Activity

A Research Paper submitted to the Department of Engineering and Society

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In Partial Fulfillment of the Requirements of the Degree
Bachelor of Science, School of Engineering

Megan Lin

Spring, 2022

On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

Signature _____ Date _____
Megan Lin

Approved _____ Date _____
Hannah Rogers, Department of Engineering and Society

Abstract

The primary objective of this thesis is to analyze how technology has created a culture of sedentarism and obesity in the US and explore feasible solutions to reintroduce physical activity into daily life. Sedentarism is the culture of daily routines and habits that require low levels of physical activity. Although there is not a specific list of habits this culture encapsulates, it can be generalized to habits that have feasible alternatives that require moderate to high levels of activity. Examples include using an elevator over stairs, microwaving a frozen dinner over cooking from scratch, and shopping online over in person. Many of these activities vary in the type of alternatives, but many are influenced by modern breakthroughs in technology. Overall, these technologies have developed efficient alternatives to many daily tasks which have, in turn, contributed to our obesity crisis. However, there have been efforts made to reincorporate physical activity into these tasks in a neutral or attractive way to the user, like the standing desk. This paper will elaborate on sociotechnical perspectives including the government's, entertainment companies', and various organizations using the Social Construction of Technology framework (Klein & Kleinman). It was found that although there are some breakthroughs in technologies that incorporate physical activity like the Nintendo Switch and France's soda tax, overall these are rarely implemented as it is difficult to please the major groups involved.

Introduction

Physical activity is essential to one's long-term health & wellness, but Americans especially are not getting nearly enough as proven by our jump from 30.5% to 42.4% adult obesity rate in the last 20 years (*Adult obesity facts*, 2021). While there are a degree of factors

that influence risk of obesity like genetics, medication, and accessibility to nutritional foods– sedentary activities are a key modifiable risk factor (National Heart Lung and Blood Institute; Xiao et al., 2014). The growth in sedentary activities can be seen in the workplace with the transition from the Industrial to the Electronics & Telecommunications Revolution (Woessner et al., 2021). With the transition from the factory floor to desk jobs, we have decreased typical low to medium intensity activity. This transition is especially crucial as the workplace typically takes up ⅓ of our day. Furthermore, there has been a surge in popularity of incorporating electronic technology with leisure. This can be seen through the rise in the intersection of entertainment and technology– especially during COVID-19. Notable sedentary activities that rose in popularity include the video games Among Us & Animal Crossing, binging Netflix Shows like Tiger King, and Zoom calling friends. Because of this surge in popularity, I am interested in researching the culture of sedentarism, its consequences, and how we can effectively battle it.

The key group of technologies we will be evaluating will be named "efficient technologies." These are technologies that replace some aspect of daily activities in a way that requires less physical exertion from the user. These technologies do not necessarily need digital aspects. For example, bicycling is a non-digital technology that replaced walking and burns less calories.

Methodology

The framework utilized in this research paper is Pinch & Bijker's Social Construction of Technology (SCOT) framework. This theory centers around the view that there is a two-way relationship between social structures and the development of technology (Klein & Kleinman, 2002). Each impacts and is influenced by the other. Because we define sedentarism as a culture,

we will be evaluating its relationship with technological innovation. Specifically, we will be looking at the rise of technology in activities of daily living. We will be highlighting the entertainment sector and evaluating the success and creative direction video games and streaming services are going towards. Social groups we will be evaluating include for-profit companies like Nintendo & Netflix, concerned parents & teachers from groups like Fairplay & SHAPE America, and government institutions like the CDC and NRPA.

The main goals of this study are to explore the rise in the culture of sedentarism due to technology and the efforts being made to combat it. As this was a niche area, I scoped out to find scholarly journals and news sources about obesity and physical wellness. I also found company press releases, specifically Nintendo and Netflix's. The purpose of these press releases was to evaluate the commercial success of combining physical activity with technology. Potential bias was taken into account, especially when viewing company press releases as these pieces were intended to paint a good picture of the company for the public and potential stockholders. The research on obesity is more statistically found and less likely to have bias. By incorporating a variety of articles and presentations, I present a research paper that explores how different social groups view "efficient technologies", then compare and contrast these understandings.

Extent of America's Obesity Epidemic

In the United States, the obesity rate is 42 percent and rising. Among adults of all demographics, physical activity is a major cause. Only 45.5 percent of Americans have sufficient activity levels (fig. 1). Internet usage, including compulsive phone or device use, contributes to physical inactivity. SHAPE America and the National Institute for Occupational Safety and Health (NIOSH) promote physical activity, though their success has been modest. Obesity

increases the risk of coronary artery disease by 45 percent, stroke by 60 percent, hypertension by 30 percent, and osteoporosis by 59 percent. Because of its part in mortality from these conditions, obesity may be the leading cause of preventable death in the U.S. (Matusitz & McCormick, 2012).

Characteristic	Overall		Prevalence of Physical Activity Level [b]					
	Sample size (%) [c]		Inactive		Insufficiently Active		Active	
			(N = 19 959)		(N = 10 264)		(N = 20 942)	
			%	(SE)	%	(SE)	%	(SE)
Overall	51 165		34.2	(0.6)	20.2	(0.4)	45.5	(0.5)
Sex								
Male	23 170	(50.2)	32.8	(0.8)	18.5	(0.5)	48.6	(0.6)
Female	27 995	(49.8)	35.6	(0.7)	22.0	(0.5)	42.4	(0.6)
Age (years)								
21–29	6741	(16.2)	27.6	(1.1)	17.5	(1.0)	54.9	(1.3)
30–39	9493	(17.4)	29.3	(0.9)	19.6	(0.6)	51.2	(1.0)
40–49	10 173	(20.2)	32.8	(0.9)	20.5	(0.8)	46.7	(0.9)
50–59	9650	(19.7)	34.2	(1.0)	21.3	(0.7)	44.4	(0.9)
60–69	7119	(13.5)	37.1	(1.3)	22.1	(0.9)	40.7	(1.1)
70–79	4691	(7.8)	42.8	(1.4)	20.8	(1.0)	36.4	(1.3)
≥ 80	3298	(5.2)	56.4	(1.6)	20.3	(1.2)	23.4	(1.3)
Race/ethnicity								
White, non-Hispanic	27 992	(69.0)	30.2	(0.8)	20.7	(0.5)	49.1	(0.6)
Black, non-Hispanic	9749	(11.1)	43.6	(1.1)	19.4	(0.7)	36.9	(0.9)
Hispanic	9638	(13.3)	46.6	(1.1)	18.4	(0.7)	35.0	(1.0)
Other, non-Hispanic	3786	(6.6)	35.2	(1.4)	20.5	(1.3)	44.2	(1.6)

Figure 1. Distribution of prevalence of physical activity level by various sex and ethnicity – US adults, NHIS and MEPS 2006–2011 (Carlson; data from National Health Interview Survey, 2015).

History of Obesity

The boom in worldwide obesity began with the vast advancements in medicine to nearly eliminate infectious diseases, the decline in manual labor after the end of the industrial revolution, and the increasing availability paired with decreasing cost of food.

Obesity itself has some combination of calorie intake, diet content, and amount of physical activity. Therefore, there are multiple factors that can be altered to decrease the risk of obesity.

> In some cultures, lack of physical activity can be a more important determinant of obesity; in other cultures, overeating or food composition may be the more important determinant of obesity. It is also true that within countries, individuals could differ in the causes of obesity. For instance, changes in activity might be more characteristic of women or men resulting in different reasons for obesity by gender. (Vasunilashorn, 2013)

Key Examples of "Efficient Technology"

As previously defined, "efficient technologies" are technologies that replace some aspect of daily activities in a way that requires less physical exertion from the user. These technologies do not necessarily need digital aspects.

Transportation is a key source of physical activity that we have made more efficient in the land, air, and sea. We can see the evolution from the wheel to horseback carriages, bikes, and cars. In the era of COVID, we also see the elimination of physical transportation altogether through working from home using technologies like Zoom, Slack, and Gmail.

In the same vein, communication has evolved drastically over time. While face-to-face remains a key method of communication, letters, emails, texts, phone calls, and video calls have become feasible alternatives to leaving the house to talk to others. This has been especially solidified as a feasible alternative to communication during the pandemic as normal face-to-face communication was highly discouraged for public safety.

A key factor to obesity is also caloric intakes and food sources. Regardless of dietary choices, the method of obtaining food also factors into daily caloric intake. Over time, we have evolved from foraging, hunting, & gathering to grocery shopping & cooking, microwave meals,

and ordering delivery to your door. Not only has food evolved to be more processed and less nutritionally balanced, but the act of obtaining it has become sedentary.

Difficulties to Add Physical Activity to Efficient Technologies

As activities of daily living have declined, sedentary living and exertion-free activities have displaced them. The consequent deficit in physical activity increases the likelihood of obesity (Matusitz & McCormick, 2012). Because exercise for health is nonessential to daily routines and requires planning, many do not engage in it (Hutt, 2017). However, can for-profit companies incorporate physical activity back into their technologies?

The two key factors to product feasibility are typically user buy-in and profitability. An example of a product with high-user adoption that would not ne profitable would be state-of-the-art VR play centers in every neighborhood. On the other hand, a profitable but not user-friendly product could be the Peloton, depending on the user, or a subsidized fresh food delivery infrastructure.

Typically, key metrics of success in technological innovation are speed and effort. It can be generalized that increasing speed and decreasing effort are basis for improvement in product design. Reintroducing physical activity into most sectors of technology directly contradicts these guidelines to product success.

For example, within transportation with the most recent technological developments of the car, boat, and plane, there is not a clear path to how activity can be feasibly reintroduced. At best, boats have been transformed into cruises and cars can be substituted by party buses, but these are expensive and typically reserved for special occasions.

Within communication, there is also not a clear area of opportunity. Most communication has been digitized to computer & phone screens. While there have been some efforts made like Apple Health's steps counted functionality, there are no clear areas social media companies could venture into.

Lastly, in cooking, there is opportunity in the food's dietary value itself, but speed and efficiency are still prioritized in obtaining the food itself. This leaves the same void for potential active technologies.

Overall, we see that incorporating physical activity while satisfying relevant stakeholders is a difficult task that requires creativity, research, and planning.

Opportunities to Engage in Digital Entertainment

An interesting area of growth of digitization is entertainment. While entertainment has varied drastically over time with social trends, we can see the growth from simple games like tag and hopscotch to physical games like marbles and cards. We can most recently see the shift with digitization to video games and TV.

Compared to other sectors, the success metric for entertainment is the amount of enjoyment or the "fun" factor the product brings, not speed or efficiency. This differentiates entertainment and is why we will evaluate further in this paper on the feasibility of incorporating physical activity into entertainment.

While an obvious area of entertainment that incorporates physical activity are sports, this is often high-intensity and requires multiple players. This creates difficulty in adoption due to logistical barriers and personal preference for lower intensity activities. We will be focusing on

digital entertainments like TV and video games as these are a generally accessible, sedentary experience.

Corporate Social Responsibility in User Health

A key player in the digital entertainment space, Netflix is a prime example for a source of sedentary leisure. According to Hastings (2018), Netflix plans to factor its effects on users' health into its evaluations of corporate performance. The success of Netflix's unlimited access business model tends to exacerbate sedentary living among its customers.

The Nintendo Wii, and now Switch, are examples of how a company has induced a more active user experience. Nintendo had been best known for its handheld games, such as the DS, but the Wii made gameplay active. According to Nintendo, it revolutionized gaming to "a place where playing is no longer just about looks, it's about the feel" (Nintendo, 2006). We can see the extent of Nintendo's success in active gaming through the massive success of Wii Fit, Pokemon Go, and Just Dance.

However, active gaming's level of success in adoption amongst users and improving user's health is contested. In one study by BMC Public Health, it was found that:

> Sedentary activities such as watching TV and playing video games, have been found to be associated with negative health outcomes such as overweight and obesity, partly independent of diet and moderate to vigorous physical activity. It has been suggested that reductions in sedentary behavior may be as effective as or even more effective than increasing physical activity directly in decreasing BMI, and percentage overweight. (Simons et al., 2014)

Thus, BMC's research predicts that simply reducing sedentary time without directly increasing physical activity may be more feasible and effective in creating a healthy lifestyle. If

this hypothesis is proven, this opens up entertainment companies to more facets of varying levels of active entertainment.

When tested, BMC found that no significant evidence was found pointing to meaningful changes in lifestyle behaviors between the active and passive gaming test groups. A major reason was that users tasked with active gaming on their Playstation Move were not reaching their weekly quota of 1 hour of play time per week. Thus, this low dose of active game play "might thus have been insufficient to induce differences in the anthropometrics between the intervention and the control group (Simons et al., 2014)."

This research shows that adoptability of active entertainment systems like the Playstation Move or Microsoft Kinect may be a major barrier to the success of their parent companies and towards improving the physical wellbeing of their users. While Nintendo has made breakthroughs with their consoles and games, we haven't seen comparatively successful products amongst similar gaming companies or across the rest of the entertainment industry.

Pushback Against Technologies: Parents & Teachers

Amongst pushbacks against technologies in entertainment, concerned groups of parents are a significant group who are against tech companies' reach onto younger demographics. We will be evaluating the stances from the Campaign for Commercial-Free Childhood (CCFC, recently rebranded as Fairplay), National Environmental Education Foundation (NEEF), and the Society of Health and Physical Educators (SHAPE America).

Fairplay is working to limit certain big tech companies' reach citing increased obesity, body dysmorphia, and unhealthy sleep habits (CCFC 2018 and 2021). They have most recently prevented the launch of FB Messenger Kids (2018) and a kid-targeted Instagram variant (2021).

While the introduction to sedentarism and addiction are often cited concerns from these parental groups, toxic internet culture is more often prioritized as a concern. As cited in Fairplay's letter to Facebook's CEO, Mark Zuckerberg:

> Our 2018 letter presented research linking adolescent social media use with depression, poor sleep habits, and unhealthy body image. We asked why, given this research, Facebook was targeting children as young as five, who are even less equipped to navigate the challenges and harms of social media. (CCFC 2018)

Outside of social media, Fairplay also puts a spotlight on the dangers of video games. As said by Tracy Markle in a Fairplay podcast, video games are rewarding and engaging, but guide players too much so that they aren't engaging their brain (*Is it Video Game Addiction or Not? Navigating Summer with Children during COVID-19*, 2020). Furthermore, as seen through the success of Animal Crossing: New Horizons at the height of the pandemic, there is a risk for escapism and negative feelings when forced to leave these virtual realities for the real world (Nguyen, 2021).

Aside from the similar call for concern in regards to physical wellness and toxic online culture, Fairplay highlights the tension and power struggles that can be introduced between child and parent. These tensions arise because video games are built upon the success metric of hours of playing games which easily creates childhood addictions. Kids are an especially vulnerable group for video games as they lack impulse control and ability to regulate emotions (*Is it Video Game Addiction or Not? Navigating Summer with Children during COVID-19*, 2020). This can cause lashing out and tantrums when kids want to play "just one more" game.

Similar to Fairplay, NEEF is a charitable organization focused on lifelong environmental learning with a subgroup focused on K-12 education (*K-12 education*, n.d.). NEEF posted a list of tips to balance screen & nature time as advised by the World Health Organization (WHO) and

Mayo Clinic. These tips are centered around the WHO's recommendations that physical activity benefits all ages, but specifically "children younger than age five need to spend less time sitting watching screens—and more time dedicated to active play—to grow up healthy." Furthermore, they state that "unstructured playtime is important for a young child's developing brain." These tips include creating tech-free environments, eliminating background TV from daily activities, and prioritizing unstructured playtime (*The right mix of screen time, Nature time*, n.d.).

From NEEF's resources, we can see that they prioritize children's mental development in conjunction with physical activity.

SHAPE America (2013) is a society for professionals in health, physical education, recreation, and dance that also advocates for children's health. SHAPE America seeks more and better physical and health education programs in schools. While groups like SHAPE America have created helpful resources for children like the National Health Education Standards, there are significantly less resources aimed towards adults in the US. In adulthood, exercise requires initiative and planning while in childhood it is mandated by schools or parents. This creates a high barrier towards upholding physical health and wellness due to low resource availability and creativity.

Overall, adults are at higher risk than children to be obese in the US. In 2017-2018, 19.3% of children were obese while 42.4% of adults were obese (*Childhood obesity facts*, 2021 and *Adult obesity facts*, 2021). It is clear these childhood resources and structures do not carry into adulthood based on these statistics.

Furthermore, most health-related technologies aimed toward adults are aimed towards already active adults. For example, the Nike Run Club App is mainly targeted towards adults that

already run. While children are an highly impressionable group that needs guidance, it is clear that adults also need creative and technical resources to get their physical wellness back on track.

Pushback Against Technologies: Government

The US government has put practices in place to promote healthy living in public– especially the workplace and in leisure. In the workplace, Total Worker Health promotes exercise through activities of daily living. This program was developed by the National Institute for Occupational Safety and Health (NIOSH) to encourage healthful substitutions, such as stairs over elevators, walking meetings, and treadmill desks (CDC, 2015).

While there have long been existing technologies including accessories to the typical office space like under-desk pedal bikes, pull-up bars, and stability cushions, they haven't been overly popular. This is because they are accessories users must actively choose to use at their desk. Oftentimes, these tools get shoved aside when the user gets busy and frustrated with work to focus.

However, companies like Herman-Miller, Ikea, and Vivo have ventured into transforming more essential furniture into "work exercise" equipment. For example, we can note the recent rise in popularity of motorized standing desks and accompanying balance boards. When searching the popularity of standing desks on Google Trends, we can see a significant jump from February 2020 to the peak in August 2020. These pieces of furniture require less effort for users to choose to use on a daily basis and are more difficult to "shove aside" compared to the preceding examples.

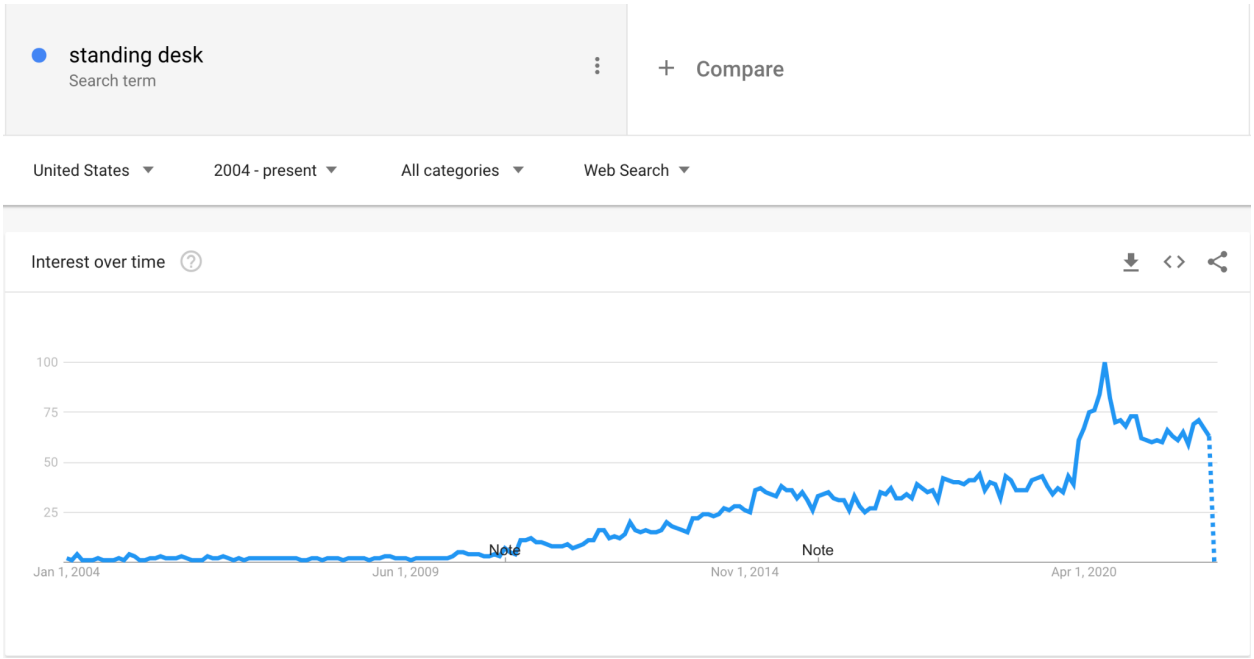

Figure 2. A Google Trends report from 2004- May 3, 2022 on the term "standing desk" within the US. Note that from 1/1/2011 and 1/1/2016 an improvement to geographical assignment and data collection were applied respectively. This data was measured relative to itself with a value of 100 indicating a peak popularity score.

Outside of the workplace and home, American adults often spend their free time doing leisure. This can include parks and recreational facilities, but accessibility is variable based on location.

In the public sector, the National Recreation and Park Association (NRPA) promotes park, recreation, fitness, and sports (PRFS) activities. Almost all areas of PRFS involves some degree of physical activity to the user whether that be through arts & crafts or open basketball games. An added benefit to recreational centers and parks are the financial accessibility and degree of socialization they provide. These are integral as they are key factors people use when deciding if this will become a daily/habitual activity.

The NRPA provides 173,000 parks and recreational facilities at little or no cost to participants (Mowen & Baker, 2009). It contends that "by centering health equity," it "can ensure

that all people — regardless of race, class, ability or identity — have a fair and just opportunity to achieve positive health and well-being outcomes" (NRPA, n.d.).

However, there are four main factors that influence park usage and physical activity levels: accessibility, distribution, facilities, and conditions (NRPA, n.d.). To address each of these factors, ideally the NRPA should be ensuring the following for all citizens:

1. Parks/recreational centers within walking distance
2. Equitable rationing of park acreage regardless of surrounding income levels/race
3. Quality facilities that encourage higher levels of physical activity
4. Facilities that are consistently maintained for hygiene, aesthetics, and safety

International Methods to Tackling Obesity

Obesity is a formula involving caloric intake, diet content, and physical activity– thus by changing any one of these factors will directly affect one's risk for obesity. While we have focused on fostering physical activity in this paper, there are other methods that could be utilized that shifts the onus of responsibility from for-profit companies to the individual, government, or other companies/organizations.

Within Europe, it has become increasingly popular to focus on caloric intake and diet content using the government's power to tax foods that have a higher risk of causing obesity. For example, Hungary has instilled a tax on some foods due to high sugar, salt, or caffeine. Finland has a tax on certain confectionary products due to high sugar and fat content (Public Broadcasting Service, 2013).

However, the success of these types of methods is questionable. For example, France introduced a "soda tax" in 2012 to all sweetened beverages, including diet versions. In one study,

it was found that this tax contributed to a 10ml reduction in weekly purchases of soft drinks which equates to a 3% reduction relative to 2011 average levels. However, when compared to the 5% increase in price with the soda tax, this translated into a low own-price elasticity of -0.60 (Capacci, 2019).

Although the impact of these food taxes may not have as strong of an impact as governments were hoping, governments can use this extra tax revenue towards health initiatives like health education campaigns or subsidizing lower risk foods. Countries including France and Hungary have already used this approach, but this is a politically controversial move for the food industry and on an individual level (Public Broadcasting Service, 2013).

Other areas that these taxes could go towards include subsidizing wearable health decides like FitBits, funding healthy food delivery services like Hello Fresh, or funding GMO technology to increase the nutritional value of foods.

Where Private Companies Can Go

Key companies that have feasible areas of opportunities to incorporate physical activity into their products include Netflix and Apple. Each has their own unique set of products, creative direction, and potential for growth.

First, while Netflix has made moves to further engage their users through the recent launch of interactive "choose your own adventure" episodes, they have not quite gotten their users off the couch yet (Engelbrecht, 2017). This creates a prime area of opportunity for streaming services to venture into by incorporating physical interaction. This would further engage the user by incorporating more senses, thus creating a win-win scenario if companies can successfully incorporate these active components into their product.

For Netflix specifically, their strength is their large catalog of cult-favorite TV shows like *New Girl*, *Squid Game*, and *Floor is Lava*. Netflix could create a post-credits screen detailing to viewers how to play the games in these shows and encourage them to share these instructions with their friends. While the watching experience would still be sedentary, it would encourage users to try the challenges they just saw on the screen in real life like Squid Game's dalgona challenge or red light green light.

Apple is a great example of a company that has begun to encourage physical activity into their products, but there is still room for improvement. Although the Apple Watch is an accessory to the groundbreaking iPhone, Apple has taken fitness trackers to the next level. Although fitness trackers date back to the 1960s in Japan with the manpo-kei, FitBit was actually the first in the US to jump onto the craze with their first launch in 2009 (Rubin, 2018).

While the Apple Watch was originally developed to complement the iPhone and make its experience less invasive during the quiet moments of life, it has gone beyond a sneaky way to check your notifications at the dinner table. Through the implementation of Healthcare, the Apple Watch now keeps track of health data in the background and gives users notifications about mobility metrics including: Cardio Fitness, Six-Minute Walk Distance, and various metrics used to measure walking quality (*Healthcare - Apple Watch*, n.d.). Furthermore, Apple has used gamification to make daily movement fun through their 3 ring system. Each day, users can set moves, exercise, and stand goals for themselves that will be displayed proportionally through a ring in the "Activity" app. This creates a level of fun for the user, forces the user to set physical wellness goals for themselves, and gives a visual aid as to where they are in their progress throughout the day.

To continue this trend of physical activity, Apple could integrate video games into their Watch. Similar to how Wiis work, the paired iPhone could be used as a larger monitor displaying a game, while the Apple Watch acts as a controller. Users could punch, dodge, or dance their way to victory.

Conclusion

Efficient technologies have taken away the natural physical exertion from daily activities. This has contributed to America's obesity epidemic. We explored the stances for-profit companies, parents & teachers, and the government have on efficient technologies and the efforts they are making towards a healthier America. Entertainment in technology was chosen as the most feasible sector that physical activity could be incorporated into because of its dependency on the "fun" factor over speed. While there have been some successful moves made by tech giants like Nintendo to incorporate physical activity, many companies are still remaining conservative in order to maintain profitability and user buy-in. Although difficult, some companies are in a position where they can incorporate physical activity with their existing technology like Netflix and Apple. Ultimately, existing efforts made by various social groups are insufficient in combatting America's obesity epidemic. Thus, for-profit companies must acknowledge their role in it and focus their efforts towards health-promoting technological advancements.

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Developing a Multimodal Entertainment Tool with Intuitive Navigation, Hands-Free Control, and Avatar Features, to Increase User Interactivity
(Technical Paper)

Exploring the Relationship Between Technology and Physical Activity

(STS Paper)

A Thesis Prospectus Submitted to the

Faculty of the School of Engineering and Applied Science
University of Virginia • Charlottesville, Virginia

In Partial Fulfillment of the Requirements of the Degree
Bachelor of Science, School of Engineering
Megan Lin
Spring, 2022

Technical Project Team Members:
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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

Signature _____ Date_____
Megan Lin

Approved _____ Date_____
Gregory Gerling, Department of Systems Engineering

Approved _____ Date_____
Hannah Rogers, Department of Engineering and Society

General Research Problem

How can we promote physical activity?

In the United States, the obesity rate is 42 percent and rising. Among adults of all demographics, physical activity is a major cause. Only 45.5 percent of Americans have sufficient activity levels (fig. 1). Internet usage, including compulsive phone or device use, contributes to physical inactivity. SHAPE America and the National Institute for Occupational Safety and Health (NIOSH) promote physical activity, though their success has been modest. Obesity increases the risk of coronary artery disease by 45 percent, stroke by 60 percent, hypertension by 30 percent, and osteoporosis by 59 percent. Because of its part in mortality from these conditions, obesity may be the leading cause of preventable death in the U.S. (Matusitz & McCormick, 2012).

Characteristic	Overall		Prevalence of Physical Activity Level [b]					
	Sample size (%) [c]		Inactive		Insufficiently Active		Active	
			(N = 19 959)		(N = 10 264)		(N = 20 942)	
			%	(SE)	%	(SE)	%	(SE)
Overall	51 165		34.2	(0.6)	20.2	(0.4)	45.5	(0.5)
Sex								
Male	23 170	(50.2)	32.8	(0.8)	18.5	(0.5)	48.6	(0.6)
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Race/ethnicity								
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Figure 1. Distribution of prevalence of physical activity level by various sex and ethnicity – US adults, NHIS and MEPS 2006–2011 (Carlson; data from National Health Interview Survey, 2015).

User Experience Design in Interactive Multimedia Entertainment

How can Netflix combine audio, textual, and/or visual components to create an active user experience outside of Netflix's existing products?

Digital entertainment has become the norm over the past decade. While movies have always garnered widespread enthusiasm since their inception, the rise of streaming services that also stream TV series, games, live sports, and more in the palm of one's hand has undoubtedly changed the way people consume media. Netflix has been the driving force in this industry. Their continued desire to develop new forms of entertainment for their user base has culminated in the project of Professor Gregory Gerling's Capstone team.

The project aims to reimagine the Netflix multimedia experience, specifically in terms of a cooking use case. Many platforms such as YouTube, Hulu, and Netflix themselves, offer one-dimensional cooking experiences with little engagement. Specifically, a subject is typically filmed in a single continuous video that requires no decision-making from the user. This continuous video follows a linear recipe that at times has an arbitrary ordering of instructions. Youtube specifically has adopted this linear concept and developed the key moments feature to provide better visual aids for their users (fig. 2).

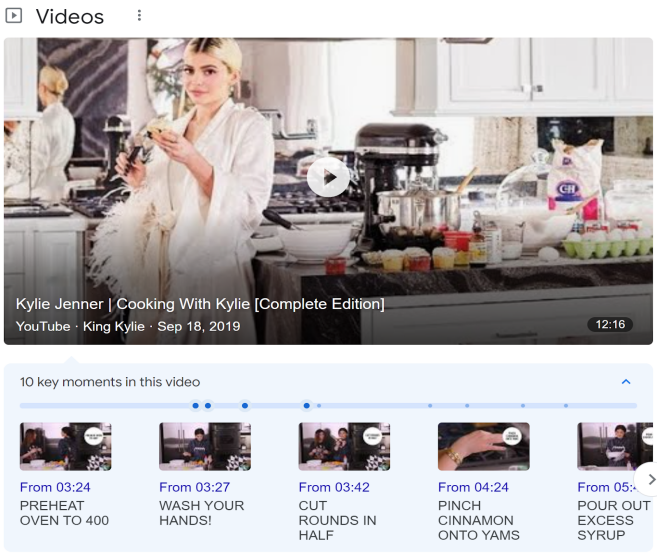
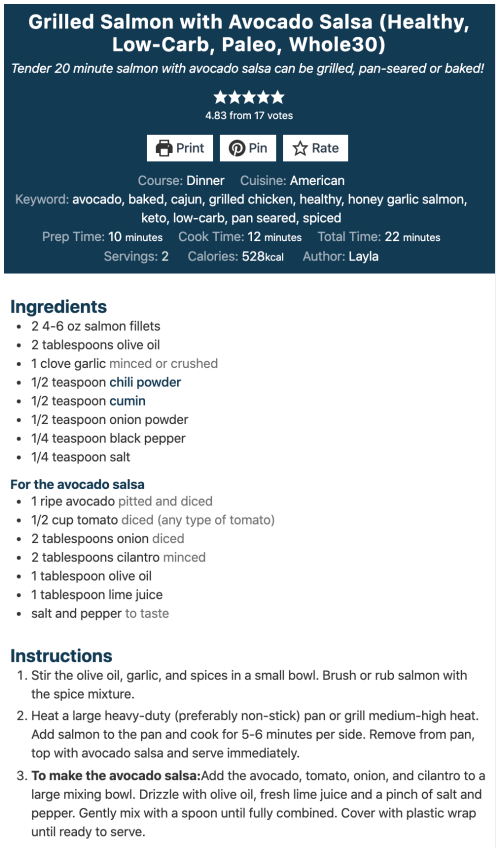


Figure 2. Example of a linear recipe being conveyed through a tutorial with key moments displayed through a timeline (Jenner, 2019).

However, this concept of linear recipes has limitations due to the arbitrary ordering of steps. For example, in figure 3 the recipe has two primary components: grilled salmon and avocado salad. These components are independent until the last step where they are plated together. Thus, this develops a pain point that disregards the user's preferences and circumstances. In this recipe, the user would have their salmon sitting out getting cold while they make the salad. If the user preferred their salmon piping hot, it would be advantageous to move step 3 up as step 1.



Grilled Salmon with Avocado Salsa (Healthy, Low-Carb, Paleo, Whole30)

Tender 20 minute salmon with avocado salsa can be grilled, pan-seared or baked!

★★★★★
4.83 from 17 votes

Print Pin Rate

Course: Dinner Cuisine: American
Keyword: avocado, baked, cajun, grilled chicken, healthy, honey garlic salmon, keto, low-carb, pan seared, spiced
Prep Time: 10 minutes Cook Time: 12 minutes Total Time: 22 minutes
Servings: 2 Calories: 528kcal Author: Layla

Ingredients

- 2 4-6 oz salmon fillets
- 2 tablespoons olive oil
- 1 clove garlic minced or crushed
- 1/2 teaspoon chili powder
- 1/2 teaspoon cumin
- 1/2 teaspoon onion powder
- 1/4 teaspoon black pepper
- 1/4 teaspoon salt

For the avocado salsa

- 1 ripe avocado pitted and diced
- 1/2 cup tomato diced (any type of tomato)
- 2 tablespoons onion diced
- 2 tablespoons cilantro minced
- 1 tablespoon olive oil
- 1 tablespoon lime juice
- salt and pepper to taste

Instructions

1. Stir the olive oil, garlic, and spices in a small bowl. Brush or rub salmon with the spice mixture.
2. Heat a large heavy-duty (preferably non-stick) pan or grill medium-high heat. Add salmon to the pan and cook for 5-6 minutes per side. Remove from pan, top with avocado salsa and serve immediately.
3. **To make the avocado salsa:**Add the avocado, tomato, onion, and cilantro to a large mixing bowl. Drizzle with olive oil, fresh lime juice and a pinch of salt and pepper. Gently mix with a spoon until fully combined. Cover with plastic wrap until ready to serve.

Figure 3. Example of a linear recipe for grilled salmon with avocado salsa demonstrating the arbitrary nature of how instructions are ordered (Layla, 2021).

The current Capstone team comprised of Nathaniel Barrington, Caton Gayle, Erin Hensien, Grace Ko, Megan Lin, and Sreya Palnati are working to not only reimagine the linear cooking experience, but also incorporate an interactive aspect through hand gestures, voice recognition, and textual elements to simplify the cooking experience and increase Netflix's user engagement.

While cooking itself is an active act, its current form within existing multimedia platforms is a passive experience. This creates a contradiction. Why sit back on a couch and press play on a cooking video when the videos are rooted in connecting the chef in the show with the user's kitchen? With this Capstone project, said end-state will no longer suffice. However,

with this project, we must keep a focus on entertainment and integration with Netflix's existing portfolio in mind.

There are three main components of the project: the storyline, navigation of the cooking interaction, and gestures & voice interaction.

The storyline describes a typical user's journey throughout the cooking show. From the channel appearing on the Netflix home page until the user is recommending the recipe to their friends, the storyboard shows the entire process from start to finish through the user's interaction with the software (fig. 4).

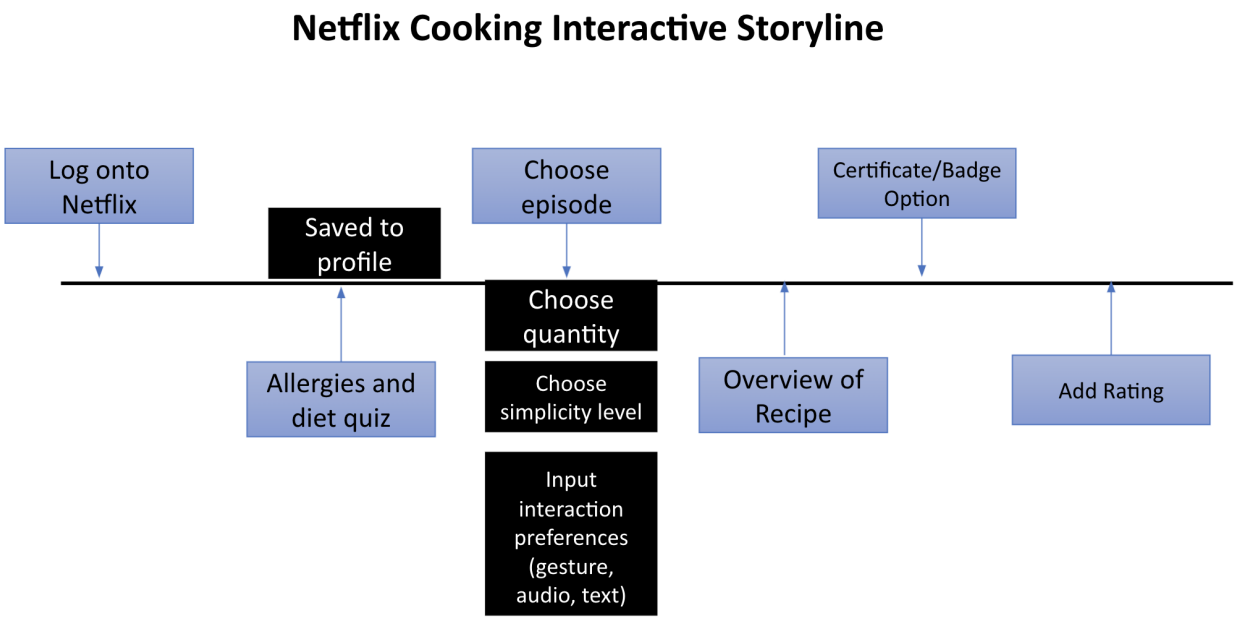


Figure 4. Gerling's Capstone team's proposed storyline for Netflix's users (author).

The navigation aspect of the project describes how the user will interact directly with the cooking aspect of the channel. Cooking has always been seen as a linear process, and the chef must work step-by-step to achieve their desired end goal. Such a framework is obsolete and needs to be revamped. This is what the UVA Netflix Capstone team plans to accomplish through a nodular recipe structure (fig. 5).

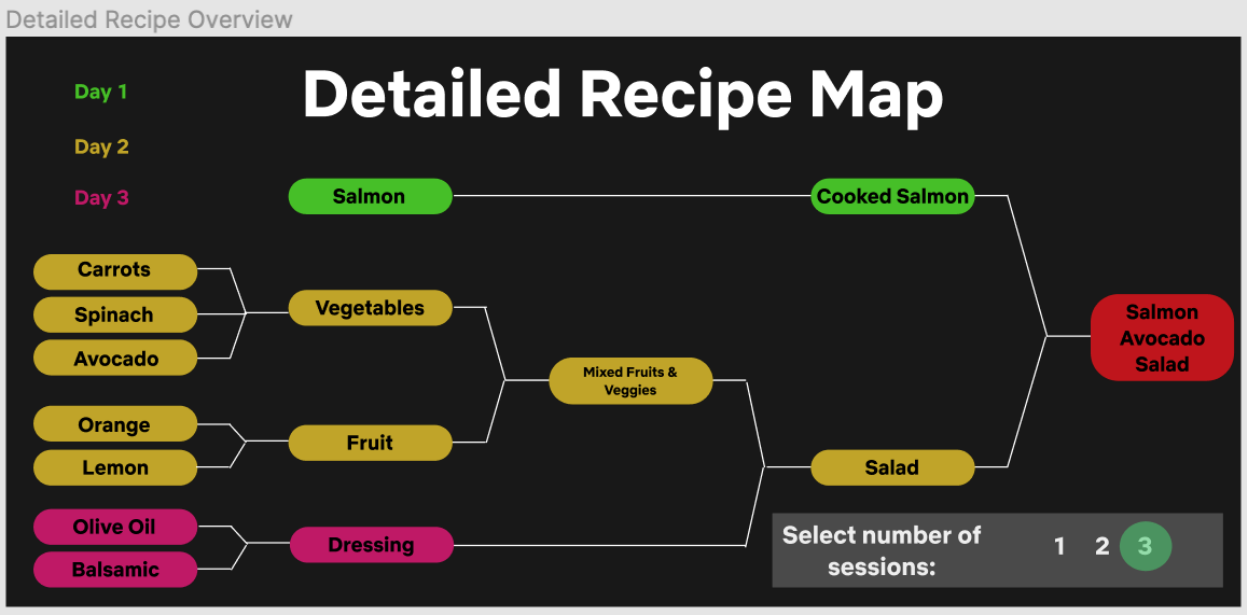


Figure 5. Example of a nodular recipe based on the formerly linear recipe shown in figure 3 (author).

This modular structure groups nodes based on similarity in ingredient type (e.g. vegetables subgroup) and when they are combined (e.g. mixed fruits & veggies). Thus, this will allow flexibility in the ordering of the steps in the recipe depending on the user's preferences and circumstances.

Lastly, different types of gestures will be used in congruence with ordinal touch features. These interactions might take the form of voice recognition, such as the way Siri or Alexa currently operate. Hand gestures may also be utilized to address intuitive use cases. We see high usability and potential in hand gestures as it is a common issue to have dirty hands when cooking. The combination of these three elements will provide a new experience for the user to not just cook, but enjoy the process of it-- something that can be stressful for all parties involved.

Feedback in the form of surveys will be gathered from the target users on these design explorations. This feedback will be used to develop an interactive web mock-up, ideally using voice interaction to control the play of text, audio, and video elements. The final prototype will be created using Figma, a mobile app prototyping software, and remotely presented to Netflix.

To evaluate the feasibility and usability of our prototype, we will trade prototypes with Reid Bailey's capstone group for feedback.

At the end of the project, if successfully completed, the prototype will be researched and modified by Netflix until a launch version is built, implemented into their platform, and maintained/updated long-term. This product would ideally increase physical and mental engagement from users.

Corporate Social Responsibility in User Health

How have tech companies strived to improve their reputations by developing games and other applications intended to promote physical activity in entertainment?

How can we increase physical activity in Americans' daily routines? As activities of daily living (ADL) have declined, sedentary living and exertion-free activities have displaced them. Leisure time is often spent with digital devices. The consequent deficit in physical activity increases the likelihood of obesity (Matusitz & McCormick, 2012). Because exercise for health is nonessential to daily routines and requires planning, many do not engage in it (Hutt, 2017).

Participants include Netflix & other tech companies, health advocacies, and some speakers at influential venues, such as TED, promoting healthful living.

According to Hastings (2018), Netflix plans to factor its effects on users' health into its evaluations of corporate performance. The success of Netflix's unlimited access business model tends to exacerbate sedentary living among its customers. The company, therefore, plans to develop features that engage users beyond their couch, promoting physical activity (Netflix, 2021).

The Nintendo Wii, and now Switch, can also induce a more active user experience. Nintendo had been best known for its handheld games, such as the DS, but the Wii made gameplay active. According to Nintendo, it revolutionized gaming to "a place where playing is no longer just about looks, it's about the feel" (Nintendo, 2006). Though movies and TV have remained passive modes of entertainment, Netflix aspires to change this. This industry-wide lack of innovation creates a prime opportunity for Netflix to create a new standard.

Despite Nintendo's success in active entertainment, health advocacy groups like the Campaign for Commercial-Free Childhood (CCFC) are working to limit certain big tech companies' reach citing increased obesity, body dysmorphia, and unhealthy sleep habits (CCFC 2018 and 2021). The CCFC has most recently prevented the launch of FB Messenger Kids (2018) and a kid-targeted Instagram variant (2021).

SHAPE America (2013) also advocates for children's health. It owns the National Health Education Standards. SHAPE America seeks more and better physical and health education programs in schools (SHAPE America, n.d.). It seeks "a nation where all children are prepared to lead healthy, physically active lives" (SHAPE America n.d.). In adulthood, however, exercise requires initiative and planning.

In the workplace, Total Worker Health promotes exercise through ADL. This program was developed by the National Institute for Occupational Safety and Health (NIOSH) to encourage healthful substitutions, such as stairs over elevators, walking meetings, and treadmill desks (CDC, 2015).

In the public sector, the National Recreation and Park Association (NRPA) promotes park, recreation, fitness, and sports (PRFS) activities. The NRPA provides 173,000 parks and recreational facilities at little or no cost to participants (Mowen & Baker, 2009). It contends that

"by centering health equity," it "can ensure that all people — regardless of race, class, ability or identity — have a fair and just opportunity to achieve positive health and well-being outcomes" (NRPA, n.d.).

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