

Augmented Reality based Game to promote Healthy Food Habits

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Abstract

Unhealthy eating habits pose a problem and are affecting the lives of adolescents in Oman. It is well-established that persuasive technology use has a long-term effect on behaviour. This paper is about the design and implementation of an augmented reality (AR) cooking game meant to promote healthy-eating habits to young people in Oman. The player is provided with a game experience while deciding on recipes and ingredients. The game is meant to be a mix of education and entertainment. Moreover, the application is mobile-based, and offers the player some relevant health information about the dishes with appropriate score upon finishing the game. The application has a 3D kitchen environment that is projected onto a surface when the camera detects the image target. The game consists of several menu screens with multiple game modes, designed using a variety of software including Unity, 3ds max, AR unity packages, and Vuforia. The findings show that video games have a strong impact on habits and everyday lives, and a large percentage of the target age group plays games daily. The findings also show that players value a stable game that has both fast and slow-paced elements and of view that the use of AR makes games more interesting. Testing was done with the client along with potential users, and the feedback suggests that the requirements and aims of the project were met. The final product demonstrates a fast-paced entertaining game can shift the player's perspective depending on the education content of the game.

Keywords: Augmented Reality, Gaming, Unity, Healthy lifestyle, AR in Healthcare

1. Introduction (Background and Rationale)

Everyone needs food to live. The eating habits of an individual can affect their life significantly as unhealthy eating behaviour contributes to the onset of health conditions and diseases. Over-eating can lead to obesity and diabetes. Developing food habits starts from a young age and is widely shaped by how parents treat food. Many families in Oman have become dependent on takeaways and fast food, and many children are getting used to eating it multiple times a week. Possible solutions to these problems would be to reduce the number of times a person buys fast food each month, and to integrate cooking into their lifestyle more often. It is a good time to teach the younger generations some simple meals that they can prepare themselves that may not even need any fire or sharp knives. A cooking game can teach them some simple recipes and present them in an appealing manner.

The purpose of this paper is to raise the awareness of the younger generations to issues relating to unhealthy food consumption habits. The paper seeks to introduce an augmented reality cooking game with simple recipes targeting young people in Oman to promote healthy eating habits. The use of augmented reality technology simplifies the creation of 3D games with menus and effective user interface for a relaxing and appealing 3D game environment.

Many free and open-source software tools are used to enhance learning experience in education sector as well as other areas of implementation. (NAIDU et al., 2017)(Mohammed et al., 2019)(Naidu, Al Balushi, et al., 2017) Open-source software gives freedom to customize as per user's need and necessity. There are various emerging trends that is being implemented to enhance the learning experience, such as learning analytics, machine learning, cloud concepts and implementation of various HTML5 based tools, which are supported in conventional browser and doesn't require additional setup in usage. (Sharma & Naidu, 2020)(Naidu, Singh, et al., 2017) (Naidu, Singh, et al., 2020) Apart from these, it is most important to ensure the usability aspects of user interface of these applications which are meant for educational purposes. Jacob Neilson's 10 heuristics are considered to be the broad rule of thumb to design and evaluate

the user interface, so that the user experience can be enhanced after evaluation at the very beginning level. (Al Mahdi et al., 2019)(Naidu, Srinivas, et al., 2020).

The enrichment in the current technologies is continuously driving the necessity of development of learning experience especially when it comes to the public information or any information that falls under the category of awareness. Awareness of healthy lifestyle is one such enhancement.

2. Supporting Literature

A literature review was carried out including expert knowledge reports and the following could be deduced.

2.1 Fast food consumption by adolescents in Muscat

A study carried out in Muscat with the objective of identifying the factors influencing fast food consumption in subjects aged from 11 to 22, and whether the subjects were calorie conscious. After carrying out this study, it was discovered that income levels and behavioural factors did not have a significant effect on the rate of consumption of fast food. The only relevant factor is that people who were calorie conscious consumed less, and that the age of the subjects was indirectly proportional to their fast-food consumption (Al-Kharusi, et al. 2012). This showed that younger people are at a greater risk of the health issues that over-eating and regular consumption of fast food could cause. Therefore, raising awareness and making certain younger teens are educated about nutrition is a must.

2.2 Study on Health-Promoting Mobile Applications

In terms of persuasive technology and its use in health-promoting mobile applications, a survey was conducted to analyse different persuasive strategies and the effect of tailoring apps to the personalities of users on the success of the app (Kientz, et al. 2010). This showed that there could be improvements to the initial game idea, and it could be expanded to meet the needs of different people. If the game can be more customisable to people with different personalities, then it could achieve its goals on a wider scale. The focus should be placed on the user and user-centred design, and its importance when designing a mobile application.

2.3 Culturally Relevant Guidelines for Encouraging Better Eating Habits

The association of culture with unhealthy eating behaviour and how to use persuasive technology to encourage the opposite was also explored. The issue was analysed with cultural groups in mind and as a result, two approaches to the problem were proposed. One that could motivate most of the population and not demotivate any user, while the other was a more personalised approach that focused on a specific cultural group. This provides useful guidelines for the encouragement of healthy eating habits and identifies the approaches that are most useful when designing persuasive intervention applications. It also helped to show the difference between approaching the application with the users as individuals or as a collective and helped developers tailor applications, so they are suitable for all. Moreover, it encourages user-centred design in mobile applications (Orji, et al. 2014).

2.4 Slow Casual Game for Long-term Dietary Behaviour Change

With respect to slow-casual educational games, it was proposed that a simple game like Lunchtime that focuses on educating people about healthy eating while keeping a health goal in mind, could motivate people to make good decisions when eating outside their home. The principles used are fairly similar to those being considered in this research. Therefore, its results and feedback can help mitigate mistakes and make improvements faster. It also showed the need for gamification concepts that could result into fun applications that many people could enjoy (Orji, et al. 2012).

2.5 Design Flow for Enhancing Mobile Gaming Experiences

Additionally, a review focused on the design of mobile augmented reality gaming experiences, specifically the design flow in user interaction was conducted. The benefits of augmented reality and how it transforms the experience into a three-dimensional field were expressed. It suggested that 3D cooking games should focus on strong interaction with

the cooking tasks and should have a carefully thought-out sequence that the player must complete. Looking at the game scenario, such games are very detailed and complicated in a sense of realistic cooking and this research intends to capture some of the more relevant features.

The game would have a multiple phase development process for the purpose of this research, where the initial game will have a simple combination of ingredients for preparing dishes. The player would place the ingredients in a pot and after an animation plays, they would be presented with the outcome and some information. The focus will not be on the cooking process but more on the result (Koh 2010). In future research, the game will be enhanced with additional features such as allowing players to control heat through distance. These would benefit the game as it would have many layers of difficulty and interactions that could make the game more realistic or have a detailed cooking experience.

3. Methods

The chosen model for this research is the incremental model. This decision was reached after the in-depth analysis and comparisons carried out. It was discovered to be a suitable model that can facilitate a successful implementation and functional software development. It follows the iterative methodology where the development is done in increments and the previous stages can be revisited after the first pass. This model is suitable for the project as there are clearly separate requirements. The first increment could be the combination system, which would be more focused on 3D modelling and visual development. The second increment could be the cooking mini games where each dish could be a separate increment. It simplifies the combining of all these into the same program (different scenes) at the end to meet all the functional requirements. The mini games will use some of the same models chosen/developed for the combination mode. There are going to be various actions to be completed and ingredients to be chosen, and so it is more focused on programming than creating 3D assets. Using this model is time-consuming but it also benefits the project more than the other models. The time can be managed though to effectively avoid running low or behind schedule.

The data collection method will be through online questionnaires, which were conducted in two stages. The first stage was before the start of development with potential users, the questions covered their expectations and their thoughts about the effectiveness of the project. The second stage was a questionnaire conducted where the subjects played the prototype of the application and were asked to share their thoughts and feedback about the actual application. Since this is also a client-based project, two interviews were conducted with the client; once before development for requirement gathering, and once after they tested the application for final feedback.

4. Results

The target audience of the game are younger people, and half the participants of the questionnaire are between 10 to 19. This includes the pre-teen and the teenager demographics. Around 40% are 20-24 which is college aged people. This is a result of asking people from MEC and other colleges as well as some younger people who are still in school. The majority of participants have played some kind of augmented reality game before. Only 8.7% have never played one before showing that it is a widely known technology. The overlap of the player-base of the similar applications identified before and the potential players of the AR game. The most played game is Zelda. 73.9% of the participants have played the game before and are already familiar with similar features so learning the game will be simple. 43.5% of the participants play mobile games every single day. These results are self-reported, and the options given are very general. This only gives a rough estimate for the activity levels. 4.3% of the people said they never play mobile games; this shows that the majority either occasionally play or play on a regular basis.

The questionnaire included a self-reported test about the feelings of the participants regarding the effects of games on their habits. Since the aim of the project is to affect the habits in a positive way, the way people perceive the game is important. Approximately 70% voted yes, showing that the majority of players know that video games are affecting them. The users being made aware might have a significant impact on the success of the project. If they know the aim of the game is to change their mind about something, they might then be less likely to be open to that change. On the other hand, they might want to improve themselves and gain more knowledge about the topic after playing the game.

Over half of the participants said they are okay with both slow and fast paced games. The participants selected the most important features of a mobile app and the most important was stability with 73.9% deeming it very important. The least voted was the menu design with 34.8% only. Ease of use was the second most important, third was the lack of annoying ads, fourth was the art style. Participants suggested to not have micro transactions, to focus on the game content, have a plot/story in the game, and game optimisation.

The questionnaire focused on the opinions of the participants when it comes to the use of AR in the app. Getting the feedback from the users shows if the use of this technology is worth it. Only 8.7% of the participants disagree about AR making the game better. 30.4% of the participants do not think the AR aspect affects the level of interest or challenge that the game has. The greater majority agrees or strongly agrees that AR will make the game better. This concludes that using AR in the game is a good decision.

4.1: Resulting Design –Component Diagram

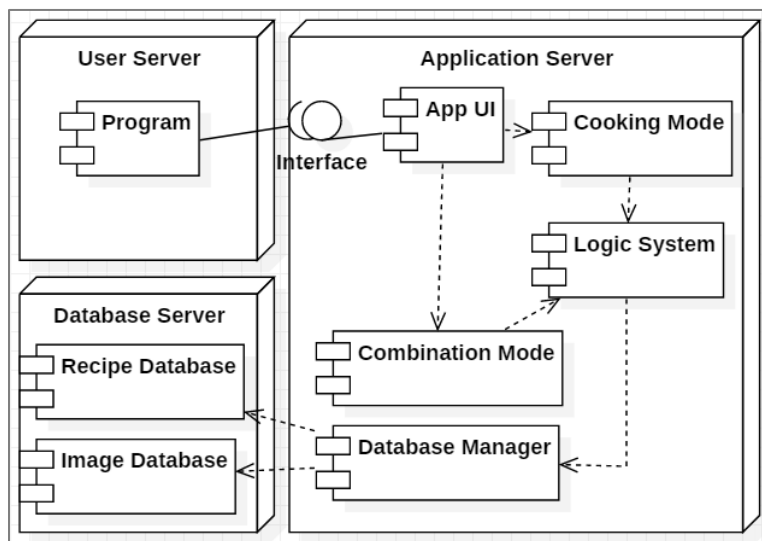


Figure 1: Component Diagram

The user starts the application and interacts with the interface. The splash screen for unity is the first screen shown, the splash screen for the game is the second screen shown. The menu UI is opened, and the user can select start playing, the application then opens the camera in order to detect the image target. The image target is stored in the database. The current image target is a hundred baisa note for testing purposes. The cooking mode starts which starts the timer and the score count, which are updated continuously. The orders depend on recipes from the database.

4.2: Final Design– Implementation on Mobile



Figure 2: The menu as seen on the mobile device

The menu design was shown to potential users and positive feedback was received. The colour scheme is bright and colourful to be appealing to younger ages. There are buttons to start playing, to read an explanation of how to play, to access settings to adjust volume, and the quit button to exit the application. The logo of the client and MEC were added.



Figure 3: Game mode projected on testing target image

Figure 3 shows the outcome of the design. The cooking game mode starts when the image target is detected after the user selects the play button. The user can move the chef character with the on-screen joystick. There is a timer that counts down until the end of the level, and different orders that pop up. The aim is to get a high score by completing orders, there is a logic system that calculates how much score an order is worth depending on the speed at which the user completed it in.

Discussion

After the testing stage the application needs to be assessed, look at the merits and whether it meets the standards and objects that were set in the planning and design stages. The success of the project could be measured by comparing the output to the objectives that it started with. The first objective was about creating an appealing 3D environment with a number of assets. The number that was stated was relatively high at 20 assets, the ones that are used in the application are closer to 10. There are the ingredients, appliances, player character, and the walls. Since this objective is mostly met it could be considered a pass. Most testers said the game was visually appealing and the colour scheme was good.

The second point was about the menu which needed to have at least two screens. The menu has the main screen, the help page, the levels sub menu, and the settings. This means this objective was met fully. The third objective was to have a cooking mode where ingredients can be combined into a dish. The orders appear at the top of the screen for the player to complete by getting the ingredients and cooking them together so that means this objective was also met. The last objective is that the app uses AR technology.

Conclusion

The project was developed in order to provide an AR mobile gaming experience while also encouraging users to adopt better food habits. The main way this was accomplished was by placing the player in an environment where they are responsible for creating dishes and go through a simplified version of cooking. The game met the requirements set out by the client and fulfilled the expectations of the potential users that participated in the questionnaire.

The results of the testing show that there is interest in this type of mobile application and a market for it in Oman. The questionnaire also showed that there are many potential users who would want to play the game from a range of different ages.

The project is an interactive game that shows the players that cooking by themselves is possible and that it is a useful skill they should pursue in their lives. The score and order system makes the players motivated to complete the levels and have purpose in continuing to play the game. The information presented in the game encourages the player to have balanced meals and improve their eating habits.

The environment of the game was initially intended to be on a farmhouse, but the current environment looks like a kitchen in a restaurant. The style is suitable for young people and the gameplay proved to be enjoyable if not stressful because of the fast pace. The timer could be extended further to make the pace slower and make the players feel more accomplished after completing a level.

This game has several areas it could be applied to other than promoting better food habits. It could help in time-management and it could improve motor skills in younger children. In areas related to food, it could be applied as a tool to teach recipes to kids and a younger audience. It could also help teach young kids about safety in kitchens like fire safety and how to use certain equipment only when an adult is supervising.

Limitations

The project has some limitations. The game only has one level currently so there is not much variety, and the player might get bored easily. The quality of the interface and the design could be improved with more large-scale feedback after deployment. There are no ways to personalise the game so the players will all have the same experience even though some would prefer to play differently or to change the character for example.

Limitations to testing included not being able to test all aspects while still in development as some AR features did not function with a webcam. It was also more difficult to conduct testing and communicate with the client due to circumstances, but online video calls and screen-sharing tools were utilised to overcome these issues.

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