



**College of Engineering**  
**COMP 437/537 – Intelligent User Interfaces**  
**Project Proposal**

**VIRTUAL WORKOUT**

**Spring 2023**

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**Github Link: <https://github.com/osserifogullari18/comp437project.git>**

**Abstract**

Physical and mental health benefits of daily exercise are well known, but many people find it difficult to make time for gym visits, face high costs or crowded environments, and ultimately struggle to maintain a consistent workout routine. This project aims to create an iPad application that brings the gym environment and workout motivation to users, regardless of their reasons for avoiding the gym. The application will offer different workout types, including yoga, weightlifting, and pilates, and provide guidance on proper technique to prevent injuries. The app will leverage computer vision and augmented reality technologies, allowing users to set a virtual workout environment, and use their device's front camera to track their body position and provide real-time guidance. In case of incorrect moves, the app will provide warning alerts and suggest corrective actions to improve form, such as recommending the use of a lower weight if a user is using their entire body to lift a weight while targeting their arms. Overall, this app aims to make exercise accessible, enjoyable, and safe for users who cannot or choose not to visit the gym.

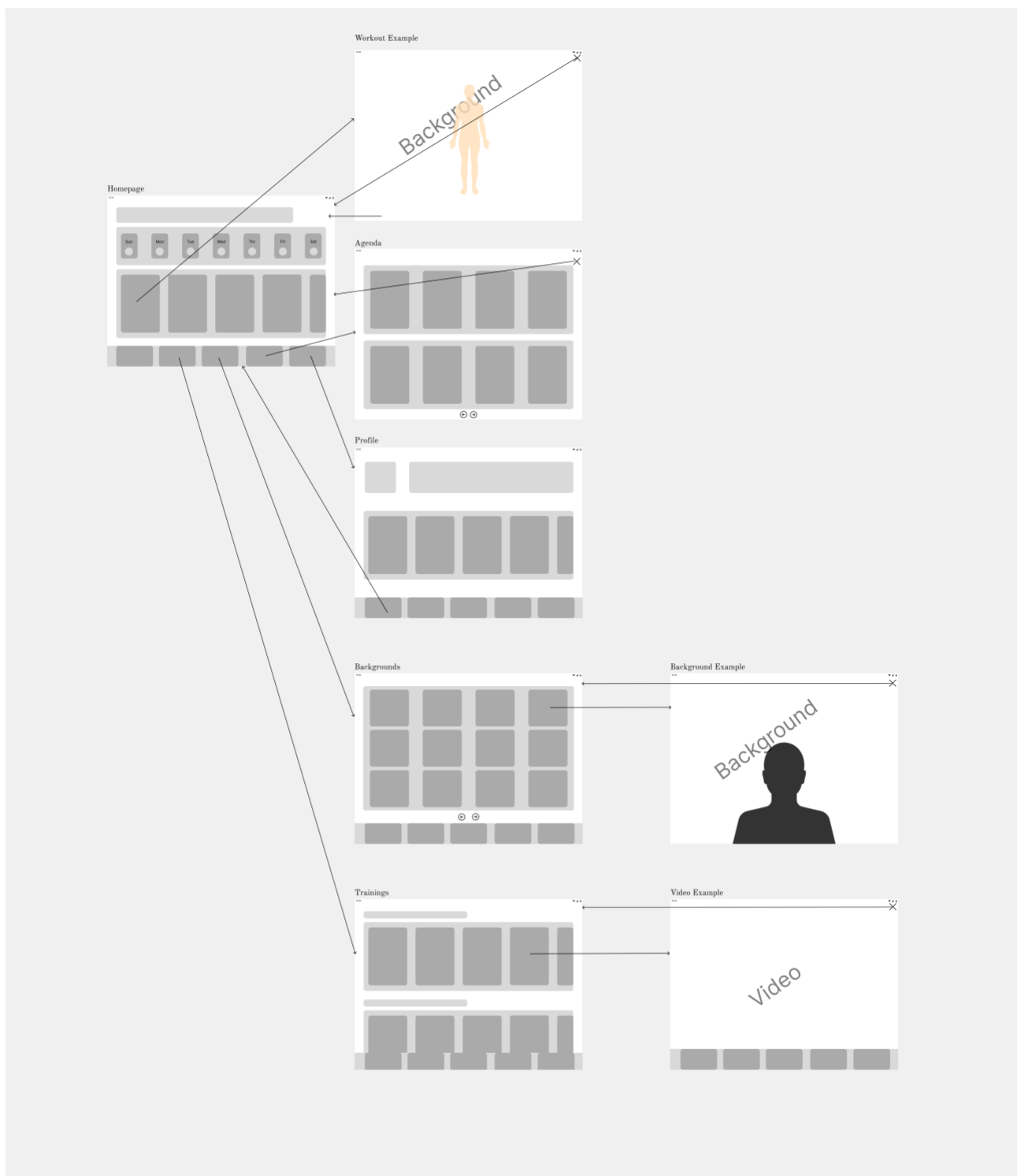
## **TABLE OF CONTENTS**

<b>SECTION 1 INTRODUCTION.....</b>	<b>4</b>
1.1 CONCEPT .....	4
1.2 OBJECTIVES .....	5
1.3 BACKGROUND .....	5
<b>SECTION 2 S/T METHODOLOGY AND ASSOCIATED WORK PLAN.....</b>	<b>6</b>
2.1 METHODOLOGY .....	7
2.2 WORK PACKAGE DESCRIPTIONS .....	7
2.3 DEMONSTRATION .....	8
2.4 IMPACT.....	5
2.5 RISK ANALYSIS .....	5
2.6 GANTT CHART .....	5
<b>SECTION 3 ECONOMICAL AND ETHICAL ISSUES .....</b>	<b>5</b>
<b>SECTION 4 REFERENCES.....</b>	<b>9</b>

# Section 1 Introduction

## 1.1 Concept

The project aims to create an iOS app that motivates users to do daily workouts by providing a gym environment and workout guidance. Many people find it challenging to go to the gym due to time constraints, cost, and crowds, and this app aims to provide an alternative solution. The app will use computer vision and augmented reality technologies to guide users through different types of workouts, such as yoga, weightlifting, and pilates. The app will also include video guides from professionals to demonstrate proper techniques and prevent injuries. Users can choose from different backgrounds, such as a gym or a beach, to create an immersive workout environment. The app will also track daily activity and provide a user profile that includes past and favorite activities. The project's methodology involves developing and testing the app on an iPad platform, incorporating user feedback to improve the app's effectiveness. The expected outcome of the project is an easy-to-use, effective workout app that encourages daily physical activity and improves users' physical and mental health.



## 1.2 Objectives

The objective of this project is to develop an iPad application that provides users with a personalized workout experience, regardless of their reasons for avoiding the gym, by the end of the semester. The application will aim to improve users' physical and mental health by motivating them to exercise regularly and safely, while also providing guidance and feedback on proper technique to prevent injuries.

By the end of the project, we expect to have a fully functional application that includes a variety of workout types, personalized virtual environments, real-time guidance and feedback, and a user-friendly interface. The application will be evaluated based on its usability, effectiveness, and user satisfaction.

The primary target audience for this application includes individuals who struggle to make time for gym visits, face high costs or crowded environments, or prefer to workout in the comfort of their own home. Additionally, this application could be useful for individuals who are physically unable to go to the gym, such as those with disabilities or injuries.

The project timeline will be set to allow for the development and testing of the application, incorporation of user feedback, and revisions before the end of the semester. The success of the project will be evaluated based on the level of user engagement, satisfaction, and adherence to a regular workout routine.

## 1.3 Background

Engaging in physical activity or exercise can decrease the likelihood of developing various illnesses such as cancer, cardiovascular disease, and type 2 diabetes. Regular exercise can also lessen feelings of stress and anxiety, increase levels of positive neurochemicals, enhance self-esteem, improve cognitive abilities, enhance memory retention, and strengthen the musculoskeletal system.[1] According to the systematic review of physical activity in school-aged children and youth done by Janssen et al., engaging in physical activity offers various health benefits. Observational studies showed that there is a direct relationship between the amount of physical activity and the health benefits derived from it. In contrast, experimental studies showed that even small amounts of physical activity can have significant health benefits for high-risk groups such as those who are overweight or have high blood pressure.[2]

Despite the benefits of daily physical activity, there are some barriers for people to do exercise regularly. X. Chen et al. conducted a study on fitness app activity and its correlation with users' movement range, regular mobility, and financial situation. The research found that individuals with a larger range of movement tend to engage in non-workout activities, as they may have limited time for exercising due to other commitments. In contrast, individuals with regular mobility patterns in a week tend to engage in both cardio and strength training, indicating that they are more health conscious. The study also revealed that the decline in workout app usage is more significant for strength exercises than aerobic training, as strength exercises require more resources such as time, expense, and a proper workout environment. Additionally, the research found that richer individuals tend to work out more frequently than those with lower income, as they may have more time and resources to afford gym memberships or other fitness-related expenses. This is because wealthier individuals tend to prioritize their body condition over work-related matters. The study further showed that there is a higher increase in total user numbers for the workout app compared to the step counting app, which indicates that income plays a significant role in influencing people's workout activities.[3]

Another study conducted by Cadmus-Bertram et al. on physical activity among rural women, found that the preferred modes of delivery for physical activity programs were in-person group sessions, smartphone apps, and printed materials mailed to participants. Both active and inactive women rated individualized coaching as moderately important. In terms of intervention components, both groups were interested in home-based programs and those tailored to their respective stages of life. Both active and inactive women also agreed on the most problematic barriers, which included lack of motivation, fatigue, and challenges posed by winter weather. These top three barriers were consistent across both groups.[4]

Even if some people overcome economic barriers, and become a member of a gym, attending to gym is still a problem for individuals due to lack of motivation and time. Participants in the study of Kopp et al. on attendance at fitness center, overestimated their reported self-workout attendance by %39 margin.[5]

DellaVigna et al. discovered that, despite modest transaction fees of withdrawal, unsubsidized monthly members spend \$187 on average during absences before canceling, according to their analysis of data from three U.S. health clubs.[6] Additionally, more monthly members than annual members are still covered by a flat-rate contract after a year. Strangely, members are more inclined to renew past a year if they pay greater fees for the choice to cancel each month. Lastly, with a monthly contract, average attendance declines by 20% during the first six months and the following six months, in contrast to the pattern observed for annual contracts.[6] To sum up, regardless of financial difficulties, people may continue to lack motivation even after signing up for and paying for a gym membership.

On the other hand, mobile apps can serve as a highly effective alternative for motivating individuals to engage in physical activity. Such apps can accomplish this by sending reminders, tracking personal activity levels, and providing personalized exercise recommendations in situations where going outside is not possible. This was demonstrated in a study conducted by Liu R et al. during the COVID-19 pandemic in China[7], where individuals preferred using mobile apps during lockdowns in order to maintain their regular exercise routines and avoid the mental and physical harms associated with inactivity. In fact, traditional methods of physical activity were found to be less popular among participants, as people are increasingly drawn to technology. The study also revealed that individuals prefer virtual reality workout experiences, which can be completed at home, in place of more traditional forms of physical activity. Overall, these findings highlight the growing importance of technology in promoting physical activity and suggest that virtual exercise experiences may become increasingly popular in the future.

In the project, I am planning to use augmented reality technologies to make people feel themselves in a place that they want without leaving their home. I am planning to use mirror metaphor with the LiDAR scanner and front camera of the device. According to M. Noreikis et al., gamified AR applications have shown great potential for enhancing user enjoyment.[8] In their research, they found that gamified AR applications provide users with a more immersive and engaging experience, which can lead to improved learning outcomes. They also discovered that the use of gamification in AR applications can increase motivation and engagement, as users are more likely to complete tasks and progress through levels when there are rewards and incentives involved. Additionally, Noreikis et al. note that AR technology can facilitate better interaction and collaboration among users, as it allows for the sharing and manipulation of digital content in real-time. Overall, their research highlights the numerous advantages of gamified AR applications and suggests that they have the potential to revolutionize the way we learn, play, and interact with digital content.

Santos et al. states that theories such as multimedia learning theory, animate vision theory, and experiential learning theory highlight the cognitive benefits of AR in educational settings.[9] AR facilitates interactions with information, reduces cognitive load, and enables embodied interactions, leading to more natural ways of learning. Moreover, contextual, and experiential learning approaches consider the whole learning experience, indicating that AR technology can create new and engaging learning experiences, ultimately resulting in better learning outcomes. Additionally, according to the paper, Blum et al. (2012) employed the mirror metaphor in a computer application that simulates x-ray vision, providing users with an inside view of their body on a computer screen. For students who studies human anatomy and sports science can take the advantage of this kind of systems for better understanding. The mirror metaphor proves advantageous in this application since it aligns with the subject matter being studied.[9]

In conclusion, physical activity is essential for maintaining good physical and mental health. Regular exercise can help reduce the risk of chronic diseases such as heart disease, diabetes, and obesity, and also improve mental health conditions such as depression and anxiety. However, going to the gym can be costly, time-consuming, and may not provide the motivation required to maintain a consistent workout routine. Fortunately, mobile apps have emerged as a viable alternative to going to the gym, as they allow users to work out at their convenience and offer motivation and encouragement to stay on track. Furthermore, with the integration of augmented reality technologies, mobile apps can increase engagement, learning, and enjoyment of the workout experience, providing users with a fun and interactive way to stay fit and healthy.

## **Section 2 S/T methodology and associated work plan**

## 2.1 Methodology

**Research:** I will conduct an extensive literature review to gain insights into the best practices for developing workout applications, as well as the current state of the art in computer vision and augmented reality technologies. This will help me to identify gaps in existing solutions and determine how the application can be more effective and innovative.

**Design:** Based on my research findings, I will develop a design plan that outlines the user interface, workout types, virtual environments, guidance and feedback system, and other key features of the application. I will also define the technical specifications required to build the application, such as programming languages, software tools, and hardware requirements.

**Development:** Using the design plan as a guide, I will develop the application using agile software development methodologies. This will allow me to iterate quickly and incorporate feedback from users throughout the development process. I will also conduct rigorous testing to ensure that the application is reliable, user-friendly, and meets the objectives outlined in the proposal.

**Evaluation:** To assess the effectiveness of the application, I will conduct a series of user tests to gather feedback on its usability, effectiveness, and overall user experience. This feedback will be used to identify areas for improvement and inform future iterations of the application.

The relevance of this methodology lies in its focus on providing users with a personalized workout experience that is convenient, safe, and motivating. By incorporating computer vision and augmented reality technologies, the application offers a novel approach to home workout routines that has the potential to improve users' physical and mental health. By following this methodology, I aim to build an application that is innovative, effective, and user-friendly.

## 2.2 Work Package Descriptions

Days	Deliverable	Detailed Description
2	State-of-art augmented reality technologies	I will research about the latest technologies for augmented reality. How other applications such as zoom understand the background and replace it? How LiDAR Scanner work? How can I integrate it to my project?
4	iPadOS technologies for augmented reality.	Since this application will be on iPadOS, I will learn about AR technologies of Apple from their web site for developers. How can I achieve extract the human body and change only the background? How can I avoid from moved body parts disappear on the screen because of being indistinguishable from background like happens in the zoom?
6	A program that changes background	First implementation that changes the background with using LiDAR technologies of iPadOS in Swift language. I will try to understand the challenges,

		mistakes and try to find the solutions of them.
8	Object detection technologies for distinguishing human body.	I will research about how a human body detect from front camera and follow its movements. How can I create a skeleton of the body mesh and control its position? Is there an Apple solution for it, what is it? What are the technologies used by the companies with similar purpose such as snapchat, clothing applications that understand the body parts and put clothes on it? How camera, and LiDAR scanners use to detect the distance and the position of the user in 3D space?
10	A program detects human body and create the skeleton of it.	I will try to implement the result of my previous research in swift. I will try to track movements and the posture of the body. I will detect the challenges and the mistakes and try to find their solutions.
12	User flow	I will make a user flow from the registration to ending a workout.
14	Interface design of the application and prototype	I will design the pages, interactions, and navigation of the application and prototype it with using Figma.

## 2.3 Demonstration

User satisfaction metrics: I will conduct surveys and user feedback sessions with my friends and professors to gather information on user satisfaction with the application's features, usability, and overall user experience with prototyping it. These metrics will help me to identify areas of the application that are most effective and those that need improvement.

Technical performance metrics: I will test the application's technical performance by evaluating its speed, responsiveness, and stability under different conditions by using monitoring and load testing. These metrics will help me to ensure that the application is reliable and performs well in a range of scenarios.

At the end of the semester, I will conduct a final user experience research that includes an observation session and a survey with same people who helped me for previous evaluations. I will make a presentation and show a demo of it in the class and take the feedbacks.

The expected impacts of the project outcomes include:

Improved accessibility to workout routines: By providing users with a personalized workout experience that can be done from home, our application will increase accessibility to workout routines, particularly for those who do not have access to gym facilities.

Improved motivation and engagement: By incorporating virtual environments and guidance and feedback



systems, our application will provide users with a more engaging and motivating workout experience.

**Improved physical and mental health:** Regular exercise is essential for maintaining physical and mental health, and our application aims to make it more accessible and engaging for users. By promoting regular exercise, our application has the potential to improve users' overall health and wellbeing.

**Innovative use of computer vision and augmented reality technologies:** By incorporating these technologies into a workout application, our project represents an innovative approach to home workout routines that has the potential to inspire further research and development in this area.

## Section 3 References

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