Video Games as Motivation for Exercise

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Abstract
Using Microsoft's Flight Simulator X, we transform a recumbent exercise bike into a virtual aircraft to create a unique game-play experience. The prototype manipulates resistance to vary physical intensity to assist the player with achieving the objectives of the video game and reaching fitness goals.

Keywords
Exertion interfaces, video games, cycle simulations, game design, prototyping and flight simulators

ACM Classification Keywords
H.5.2. Information Interfaces & Presentation, User Interfaces, Prototyping

Introduction
Digital media has permeated the lives of youth across the nation, particularly interactive media in the form of video games. Unsurprisingly, a growing number of children prefer the interaction of video games over the spectator-like entertainment that television offers. Children ages 8 to 18, spend an average of 44.5 hours per week in front of a computer or television screen [11]. These stationary hours of game-play contribute to a growing obesity epidemic in America [12]. 30.4% of teenagers are overweight and 16% are obese [1]. These numbers indicate an urgent need to investigate alternatives that promote regular participation in physical activities.

In response to this growing epidemic, we offer a solution that maximizes the appeal of video games as a fitness alternative. We design a prototype of an exertion interface that manipulates intensity as a component of game-play, combining fitness goals with playing video games.

Related Work

Within the past two decades, there have been several initiatives to unite media entertainment and exercise. Research on exertion interfaces encompasses a variety of sports like boxing, Ping-Pong, breakout and baseball [5, 7]. Much of the research has primarily investigated cycling interfaces with virtual environments. IJsselsteijn et al. [6] constructed an exercise environment with a stationary bike, a virtual race track and a virtual coach; subjects rated the coach as a positive influence on users' enjoyment and increased average speed. Carraro et al. [2] designed a bicycle simulation to train competitive road racing athletes, displaying players as avatars on the screen. Mokka et al. [8] developed the Virku project for recreational users, emphasizing immersive, virtual terrains as the motivating factor for repeated exercise. Findings demonstrate psychological benefits as well, including enhanced energy levels and greater rapport with other players [3, 4, 5, 7, 8, 9]. Building prior research, we investigate video games as a sufficient source of motivation for players who typically do not follow an exercise program.

Design & Implementation

Our exertion interface encompasses flight simulation while riding an exercise bike. System requirements include: Recumbent exercise bike, Microsoft Flight Simulator X, CPU with a minimum of 10 GB of memory, a graphics card and access to the internet.

G-Force Recumbent Bike

We design a prototype of a 3D aircraft game system that features a re-engineered LeMond Fitness recumbent exercise bike with a 17-inch flat panel monitor as the game interface. We selected the recumbent bike as it supports long periods of exercise.

During game-play, the monitor displays Revolutions Per Minute (RPM) using sensors placed on the wheels, velocity of aircraft, and time of game-play. The joystick, located underneath the display, functions as the controller. Using the joystick, the user can manipulate resistance. Pressing the right and left buttons allows users to change viewpoint. Pressing top and bottom buttons changes resistance. Users move the joystick in the preferred direction to navigate aircraft. The bike and monitor connect to a PC via a USB port.

Microsoft Flight Simulator X

We utilize the immersive, virtual environment of Microsoft's Flight Simulator X (FSX) to integrate the new game control devices into a 3D virtual world where players pilot an Ultra Light aircraft. Players navigate the aircraft towards hot air balloon targets without losing altitude and crashing into the targets while maintaining appropriate speed with variable winds. The game-play experience familiarizes players with game controls and the knowledge required to successfully pilot an aircraft. The prototype randomly varies resistance during game-play, alternating between periods of downhill and uphill pedaling. The player pedals continuously with added resistance to complete take off and decreases velocity to successfully land. For these reasons, we believe the prototype achieves limited integration of physical interaction with mental engagement in game-play.

Conclusion

We posit that video games offer sufficient motivation for sustained and repeated periods of exercise for users who typically play video games and yet do not engage in a regular exercise program. Our model varies physical intensity and unites physical interaction with mental engagement so that the user experiences a deeper emotional commitment to exercise similar to the psychological experiences associated with playing traditional video games. Therefore, we create an adaptable, challenging and yet fun experience for exercise.

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