

Design Brief

Problem Statement.

Many residents in institutionalized nursing care facilities suffer from some kind of physical or cognitive impairment, and this is almost always combined with some sort of psychological distressor. Currently, Activity Coordinators/ Recreational Therapists struggle to keep their residents engaged and socially active. Meaningful, social, and engaging activities are rare, but such activities could contribute volumes to the quality of life of a disabled individual, mitigating loneliness and depression-- which is so often tied to alienation. Depression affects approximately 40% of nursing home residents, according to the American Geriatrics Society[1]. Despite its prevalence, few elders residing in these facilities will openly admit that they are depressed, which means in many cases, the family must look for the warning signs, which can be subtle. Thus, depression often goes undiagnosed and untreated-- or treated as a "normal" part of aging. Because the signs of depression can mirror the signs of dementia, diagnosing depression in an older adult can be difficult [3]. Furthermore, independent of selected physical health measures, results in one study showed that severe cases of depression increased the likelihood of death by 59% [2]. Such activities could break up the monotony of regimented bingo schedules or systematic card games. In one interview we conducted, the Activities Coordinator at Nursing and Rehabilitation Center, LLC said,

“It’s getting them out. That’s half the battle. With this population, you don’t want them to be in social isolation, you want them out as much as possible, although it is their right to say no.”

Furthermore, the physical activity component has a wide impact, for it can greatly help in preventing 35 different chronic conditions related to inactivity[4]. In addition, with the increasing number of younger residents inhabiting nursing homes, generational conflicts arise, and perhaps the solution to minimizing such generational divides can come in the form of a relevant yet familiar, non-generation-specific piece of technology, where 42-year-old Jimmy challenges his 83-year-old buddy, Sal, to a race of snow sledding or a game of beach volleyball. On the Activity Coordinator/ Recreational Therapists’ side, exergaming provides a unique approach to solving the problems of social isolation, depression, and physical activity, while also

providing potential residents and their families with an innovative and modern perspective of facility, thus differentiating themselves from competing institutions.

Methods/Approach/Solutions Considered.

An innovative approach to resolve the problems associated with depression, social isolation and many others was with the use of Active Video Gaming (AVG), also known as exergames.

Typical video game play requires only simple push button or joystick actions for player engagement, but AVGs refer to a category of video games in which game play, progress, and scoring require substantially greater levels of body movement. We decided to build an AVG controller that is compatible with individuals who have varying levels of physical and cognitive disabilities and market the product in an institutionalized nursing care setting. Originally, the clientele for this potential technology encompassed physical/occupational therapy clinics for patients that had one or more of the conditions/diseases/disorders previously mentioned. To query the landscape of clients those were already using exergaming in their practice, our team called 123 different clinics comprising 21 different therapy companies throughout the state of Alabama. Of those 123 clinics, we identified 8 that had a Wii Fit board, and one other that did not have a Wii Fit, but did have some other AVG exergaming device. We then met with these clinics to understand how they used the board, what customers they use it on, etc. and then asked general questions about purchasing power and reimbursement rates. Feedback obtained from these interviews yielded a better understanding of the market itself, including its high barriers to entry: heavy regulation and policy on observable outcomes, low capital intensity, high competition, and high-touch rather than high-tech, to name a few. Probably the most important finding, however, was that no real problem surfaced... clinics differed in their wants from place to place, but no one ever expressed a real need for high-quality, accessible exergaming. As a result, we started collaborating with others and researching different markets to uncover a sophisticated, reoccurring problem that could potentially be solved by active video gaming. It was this pivot that led us to institutionalized nursing care facilities. As a result, the clients (payers) for the proposed design are Elderly Care Facility Decision Makers, which could include the Activity Coordinators/ Recreational Therapists or other admin (Facility Directors or Executives).

Description of Final Approach and Design.

The proposed product is a gaming board for active video gaming, specifically designed for accessibility and safety. Users may operate the device in two gaming modes: standing or wheelchair. For the standing mode, the user mounts the 2" board and navigates menus via the console's standard controller. For the wheelchair mode, one must unfold the ramps and slide out the footrest to expose recessed tracks for the wheelchair. When the game starts, the user leans/bends/balances to actuate the game, exerting physical activity in the process. Incorporation of the CronusMAX allows this gaming platform to be connected with any console or PC, making the product a universal peripheral device. Movement from the user is captured by four load cells beneath the board, and the communication between load cells allows center of balance (COB) to be obtained. For users with minimal range of motion, a sensitivity adjustment allows the user to actuate the game with the same input as a higher-functioning user, essentially eliminating barriers that prevent persons with disabilities from utilizing.

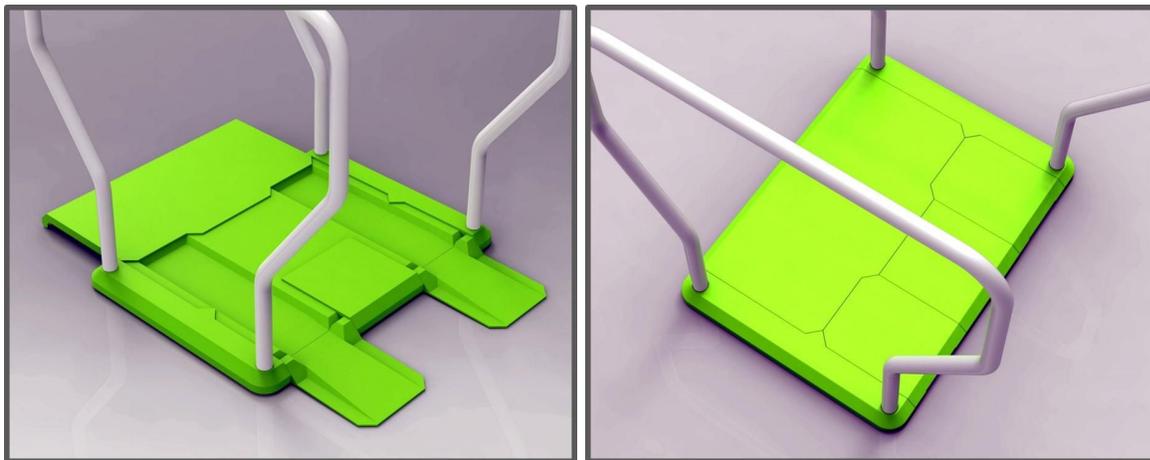


Figure 1 and 2: Wheelchair Mode(left) and Standing Mode(right) of the Platform



Figure 3 and 4: Platform used by a mobile(left) and a Wheelchair User(right)

This device is intended to be used by wheelchair and/or walker users, a person with a physical disability, an elderly person, or a perfectly ambulating individual. It is intended to be used in an elder care facility/clinic which includes all levels of care (independent living, assisted living, skilled nursing and rehabilitation and traditional nursing). The device is intended to be used by such individuals for recreational activity, social engagement and mental stimulation purposes. The handrails are rigidly connected to the board and are intended to be removed only for replacement purposes when future versions of handrails are released and accessible by consumers. The device is not safe for use without the handrails even under the supervision of an activity coordinator/recreational therapist. Additionally, G-PAC is intended to be used by one individual at a time. The device is intended to be stationary while in use or when an individual is mounting or dismounting from the platform. The device consists of embedded Aluminum plates under the U channels, for better structural stability, an ADA compliant inbuilt ramp, handrails for support, and the platform would be made out of polyurethane. RIM (reaction injection molding) manufacturing process will be used to manufacture the device, as it will be cost-effective for mass manufacturing purposes and will be able to design and produce the intricate features in the model accurately.

Outcome.

We tested our device model in various stress analysis softwares including FEMAP and SolidWorks to analyze for the different loading conditions. We also took into consideration, the intended user's weight plus the weight of the wheelchair when designing the product. From

central loading and four-point loading, we determined that our device would be able to withstand 440lbs rated weight in the worst case scenario. We further tested the model using different materials to evaluate the deflection and stress for specific materials, and realized that polyurethane for the platform and aluminum 6061 for the embedded plates are the best fit for our purpose.

Cost.

The detailed list of parts needed, their part name, number and the total cost are mentioned below.

Table 1: Parts and their Costs

Category	Material	Qty needed	Unit Cost (\$)	Total Cost (\$)
Z Bracket	316 Stainless Steel	4	14.56	14.56
Standoff		4	4.89	4.89
Standoff	18-8 Stainless Steel	4	5.67	45.36
Din Rail	Zinc-Plated Steel	1	5.03	10.06
Load Cell	Aluminium Alloy (LY12CZ)	4	7	28
Screws	Zinc-plated Steel	?	6.88	6.88
	Zinc-plated Steel	?	10.06	10.06
	Zinc-plated Steel	?	14.09	14.09
Hinge	Unfinished Steel (Dull)	4	1.33	5.32
Hand rail	Birch Rod	6	7.83	46.98
Wood for Platform	Baltic Birch Plywood	5 sheets		250
Collet	3D printed plastic	4	?	
Foot Plate	3D printed plastic	4	?	
Foot Retaining Ring	3D printed plastic	4	?	
Cleat	6061 Aluminum	2	6.25	12.5
	304 Stainless Steel	2	1.08	3.24
	Zinc-plated Steel	8	3.62	3.62
Bits	Carbide	1	9.443	

	Carbide		23.34	
	Carbide		15.65	
Total Cost				451.94

Significance.

The significance of our device lies in the design of our platform that creates a compact and effective platform that is large enough to enable wheelchair bound individuals to use it by unfolding the ramps to expose the recessed U channels that the wheelchair user will roll into. This ramp and the recessed U channels are specific and unique to our design unlike any other commercial design within our competition. Along with the ramp and the recessed U tracks, the handrails are very unique to our design. No competitor incorporates handrails in their designs, and the handrails we have incorporated are novel in their design. We also make use of CRONUSMAX which will allow the device to connect to any console like Xbox, playstation and will provide the user with wide variety of games to choose from. Exergaming provides a new and fun way to exercise, but assumes the user has no physical disabilities. This product has the ability to serve many patients in many settings, but here we target the institutionalized nursing care market since a lack of physical and social activities are evident.

References and Acknowledgements.

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8. Sean Simmons, Industrial designer at Objective Design, also provided the RIM pictures