A Low-Cost Approach to Exertion Games

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ABSTRACT
Computer games do not afford a large amount of physical activity and hence do not require significant energy expenditure, which can contribute to the prevalence of a sedentary lifestyle. In contrast, a "hand exerciser" handgrip can help strengthen hand and forearm muscles through a simple spring mechanism. We are presenting the mousegrip, an exertion interface to control computer games while simultaneously exercising muscles. Unlike conventional vision or accelerometer-based exertion interface devices, the mousegrip is very low in cost and supports force-feedback through a simple spring mechanism. Due to its mobile form factor and compatibility to existing mouse drivers, the mousegrip can augment traditional computer games with an exertion activity to make exercising more enjoyable and gameplay healthier. With our approach, we hope to encourage other researchers to incorporate exertion activity into their interfaces in order to support a healthy lifestyle.

Keywords
Handgrip, exercise, Exertion Interface, physical, tangible, sports, active, exhausting, sweat.

INTRODUCTION
The western world faces an escalating obesity problem, mainly due to the lack of activity in our sedentary lifestyles; children in particular are affected [8, 10]. Especially computer games are often criticized for facilitating a "couch potato" experience. Button presses on game pads and joysticks do not afford high energy expenditure. In contrast, a "hand exerciser" handgrip is a small device that can help strengthen a user's grip and improve the hand's motor skills and increase circulation (according to our handgrip's manual). It can be used in high repetitions for endurance training, and rock climbers use it to strengthen their finger, hand and forearm muscles. It has also been suggested as a stress management tool. Users hold the handgrip device in their hand and try to make a fist against a built-in spring mechanism. Some studies suggest that handgrip exercises can help lower blood pressure [3]. Others suspect a correlation between handgrip strength and a person's overall strength [9] and some suggest usage by musicians.

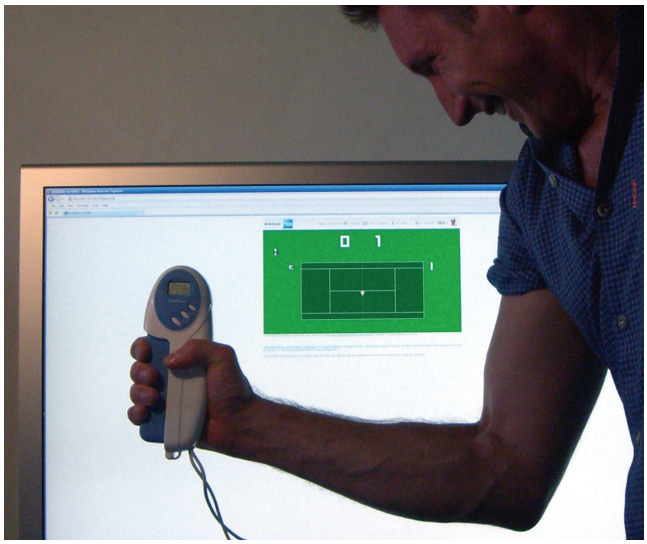

Figure 1. User playing Pong with the mousegrip.

However, the handgrip usually does not offer any quantifiable feedback and the force applied is not utilized further.

RELATED WORK
An example of electronically measuring arm strength is *Telephonic Arm Wrestling* [11]; there are now several instances installed in museums across the USA to arm-wrestle another visitor over a distance [2]. *Push'N'Pull* [6] is a networked exercise machine which measures how much you pull or push an isometric bar in order to control a cooperative game. *Virtual Tug-of-War* [7] measures the force applied to a rope in order to allow two distributed teams to compete in a tug-of-war competition. These setups usually require a dedicated device that is designed for stationary use, and involve a significant financial investment. Exercise bicycles have been used to control a virtual car's speed in racing games [4], and vision-based systems such as the EyeToy [1] track the player's hand movements to control games. The Nintendo Wii [12] uses sensors in their input device to measure the player's arm movements to control a virtual character on the screen. These devices do not support any strong force-feedback besides vibration, and are more expensive than our approach.

MOUSEGRIP

Figure 2. The mousegrip components.

We have taken a conventional handgrip device and augmented it with computing technology in order to allow gamers to exercise their hand and forearm muscles while being engaged in a computer game. We call our prototype *mousegrip* due to its synergy of a handgrip and the mouse interactions it facilitates: the pressing action exhibited on the handgrip controls the mouse cursor on a standard computer. The stronger the force the user applies to the handgrip device, the further the mouse cursor travels. Figure 1 shows a user with our prototype controlling an unmodified Pong game that runs in a browser. The action required can exhaust the user very quickly, and therefore the device satisfies the requirements for an *Exertion Interface* [5].

TECHNICAL IMPLEMENTATION

The *mousegrip* was designed from two main components: a commercially available handgrip and the parts of an old mechanical computer mouse [Figure 2]. We augmented the handgrip with the components of the mouse so that the pressing action of the handgrip is measured with the infrared receiver that was removed from the mouse. No special driver is required, and therefore any game that uses a mouse input is suitable for the *mousegrip*.

Due to the nature of a handgrip device, a *mousegrip* can only support mouse movements along one axis. In order to control the mouse in the horizontal and vertical axis, we have built two handgrips, one for each hand. Additionally, we have incorporated a mouse button equivalent into the device. We are now interested in evaluating the use of the *mousegrip* with gamers and want to measure the energy expenditure the device facilitates during gameplay.

BENEFITS

The main benefits of our *mousegrip* are size and costs: the handgrip is only slightly bigger than a fist and takes not much more space than a traditional mouse. The original handgrip we modified cost less than $US 10, and the total cost for the current prototype was approximately $US 30.

CONCLUSION

We have presented *mousegrip*, a low cost input device for computer games that affords exertion of the hand and forearm muscles. It uses standard mouse drivers and is therefore platform independent. The *mousegrip* can be used discreetly and spontaneously due to its small size. We believe the *mousegrip* can promote and support physical activity in computer games for a very low cost. We believe it is capable of providing a valuable augmentation to traditional input devices for pervasive gaming due to its health benefits and can therefore have a positive impact on people's lives.

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