Exer-Game Controls for
Transhumera & Transradial Amputees

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Abstract: *There are some sorts of people who stay away from gaming because of their physical disability. Like people with Transhumeral or Transradial amputation can't operate the gaming controls due to upper limb amputation, in order to make them control these games we adopt exer-game controls. Exergaming or exer-gaming* **is** *a term used for video games that are also a form of exercise. Exergaming relies on technology that tracks body movement or reaction. The genre has been credited with upending the stereotype of gaming as a sedentary activity, and promoting an active lifestyle. Exergames are seen as evolving from technology changes aimed at making video games more fun. Applying the concepts of exer-gaming and by using a tilt sensor (accelerometer) and pedal usb with selected limited keys to operate the directions in the game we can able to control. And by inserting this tilt sensor into a gaming wheel we can use for direction movements for normal users avoiding stress and pressure on the fingers even in case of continues gaming for hours, preventing the chances of Carpal Tunnel Syndrome.*

Keywords: Transhumeral, Transradial, Exergaming, accelerometer, pedal usb, carpal tunnel syndrome.

I. Introduction

Entertainment is the action of providing or being provided with amusement or enjoyment. One of the forms of entertainment, we show great interest is in "Games". At its most elementary level then we can define game as an exercise of voluntary control systems in which there is an opposition between forces, confined by a procedure and rules in order to produce a disequilibria outcome, (Elliot Avedon and Brian Sutton-Smith). Most often games remind us simulation games like video games and pc/computer games. These games are being played using the gaming controls i.e. either keyboard or joysticks. Continues or long run gaming with keyboard/joystick controls generate stress and pressure on the fingers, may leads to Carpal Tunnel Syndrome.

Carpal tunnel syndrome is a condition in which there is pressure on the median nerve -- the nerve in the wrist that supplies feeling and movement to parts of the hand. It can lead to numbness, tingling, weakness, or muscle damage in the hand and fingers. There are some sorts of people who stay away from gaming because of their physical disability (Amputee). Like people with Transhumeral or Transradial amputation can't operate the gaming controls due to upper limb amputation, in order to make them control these games we adopt exer-game controls. Some statistics on these amputees stood as a motivation to work on this paper.

II.   Statistics on Hand and Arm Loss
(Numbers and percents on amputations):

- 50,000 new amputations every year in USA based on information from National Centre for Health Statistics
- ratio of upper limb to lower limb amputation is 1:4

- most common is partial hand amputation with loss of 1 or more fingers, 61,000
- next common is loss of one arm, 25,000
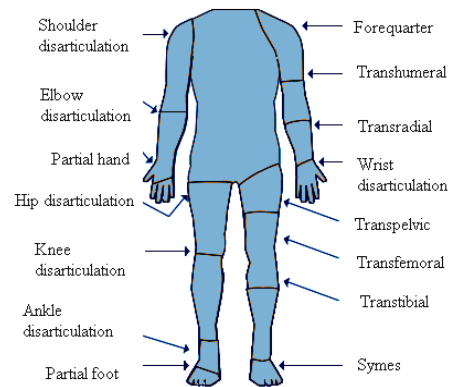
- existence of 350,000 persons with amputations in USA, 30% have upper limb loss
- Of this, wrist and hand amputations are estimated to make up 10% of upper limb population
- Transradial amputations make up 60% of total wrist and hand amputations
- which means 70% of all persons with upper limb amputations have amputations distal to the elbow
- In US 41,000 persons are registered who had an amputation of hand or complete arm
- 60% of arm amputations are between ages 21 and 64 years and 10% are under 21 years of age
  Causes leading to amputation:
- Reasons for amputation include cardiovascular disease, traumatic accidents, infection, tumours, nerve injury (tropic ulceration), and congenital anomalies
- most frequent causes of upper limb amputation are trauma and cancer, followed by vascular complications of disease
- right arm more frequently involved in work related injuries
- Congenital upper limb deficiency has an incidence of approximately 4.1 per 10000 live births

Table 1 - Causes of Upper Extremity Amputation (in percent)

Congenital	8.9%
Tumour . . . . …….....	8.2%
Disease . . . . ………….	5.8%
Trauma . . . . ……	77%

III. METHODS AND MATERIALS

Exergaming or exer-gaming is a term used for video games that are also a form of exercise. Exergaming relies on technology that tracks body movement or reaction. The

genre has been credited with upending the stereotype of gaming as a sedentary activity, and promoting an active lifestyle. Exergames are seen as evolving from technology changes aimed at making video games more fun. Applying The block diagram explains the working procedure of the device the client uses the tilt sensor i.e. The accelerometer and the pedal control for operating games. This will act as the external device for operating the game. Since these are been operated without using the keyboard, it becomes easier to play.

IV. WORKING

While playing games the majorly used keys are the four arrow keys these keys works for the movement in different directions during the game. we are using accelerometer for the left and right keys and usb pedals for up and down keys.
The system hardware consists of accelerometer (adxl335) and aurdino. Aurdino micro-controller makes ON or off based upon the analog outputs of the accelerometers, from which acceleration can be determined. It sends them to the host computer operate the directions in the game we can able to control. And by inserting this tilt sensor into a gaming wheel we can use for direction movements for normal users avoiding stress and pressure on the fingers even in case of continues gaming for hours, preventing the chances of Carpal Tunnel Syndrome.

PEDAL CONTROLS BLOCK DIAGRAM:

In addition to the four arrow keys we include two more keys which we require very often while gaming. These are the "ESC" & "ENTER" keys for selecting any tool or entering into the game we use enter key and to get out of the game we use esc key as back button.
The following figure contains the circuit diagram which explains how the accelerometer is interfaced with the microcontroller and works for changing directions in game.

BLOCK DIAGRAM:
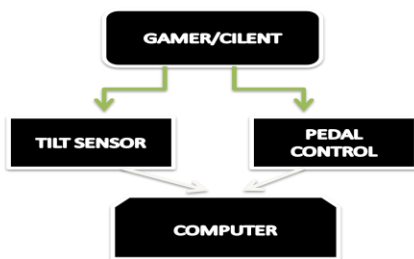
the concepts of exer-gaming and by using a tilt sensor (accelerometer) and pedal usb with selected limited keys to
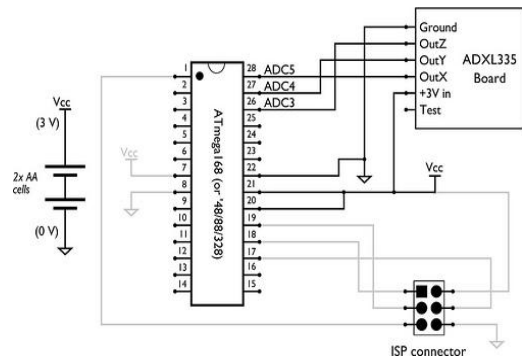

Figure: circuit diagram

And coming to the pedal control, we can simply use the usb computer keyboard circuit. The keyboard PCB circuit contains the pins at back end which are connected to different keys in different combinations using matrix form.
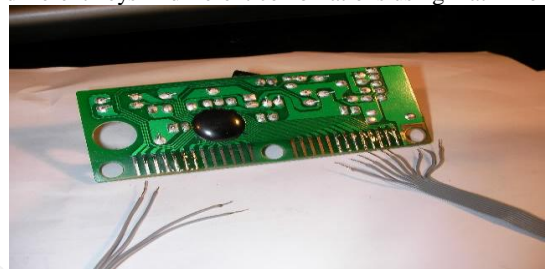

Figure: keyboard PCB

Using these combinations we can make our own switches by connecting the required pins from the combination. Thus we can make our own pedal controls here we are using only four combination keys for operating. We can choose more keys if required.

V. Results and Conclusions

As we finish with our hardware, we need to select some basic computer games which require only few controls while gaming like NFS, MOTO GP, etc. Then the device have to be connected with the computer since the pedal control is keyboard the computer detects as a keyboard, accelerometer should be programmed and connected. Now we can have to place the tilt sensor either on the shoulders of client or on head for easy movements. And the pedal controls are used by their feet. Thus we can make the amputee to control games easily.

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