Investigation into Wheelchair Mobility Control that Uses a Minimally Invasive Intra-Oral Palate Control Device utilising Resistopalatography techniques

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Abstract— **Interfacing with conventional wheelchair input devices is a major challenge when it comes to patients with high levels of disability. This paper intends to report on the new method of wheelchair mobility interfacing using Resistopalatography. The technique proposed here is based around utilising the tongue as the controlling muscle group to input desired movement into a force sensitive sensing dental retainer. Using the position of the force, and force applied a direction and speed metric can be calculated emulating conventional joystick output data. The resistopalatography technique has been applied to other Human Machine Interfacing areas with success [1].**

I. INTRODUCTION

Whilst advances in this area of research have provided desirable systems to an extent, they seem to lack the major feature outlined by patients; the ability to utilise a technology without having to use modified systems and custom setups. This can be summed up into the phrase the desire for a system to be minimally invasive, non-apparent to others and to be seen as a standard interface. Current solutions such as Head Movement Detection [2] provide control to a certain extent however they dont entirely provide an adequate solution to the problem of wheelchair mobility control in regards to invasiveness and levels of control.

II. RESISTOPALATOGRAPHY

The resistopalatography technique is based on an intra-oral dental retainer clip which is currently fitted with nine force sensitive resistors Fig.1 ,which allow the force location and amount against the patients hard palate to be calculated. Each of the sensors are sampled via an Analogue to Digital Converter, which gives the force applied, which is then coupled with the individual location of each sensor. Once all sensors are sampled, the data is analysed to generate the location of the tip on the tongue causing the pressure against the hard palate. This is then converted into a velocity and direction in order to emulate the ouput from a standard wheelchairs joytsick. This data is then fed into the wheelchairs control circuitry via a General Purpose Serial Bus.

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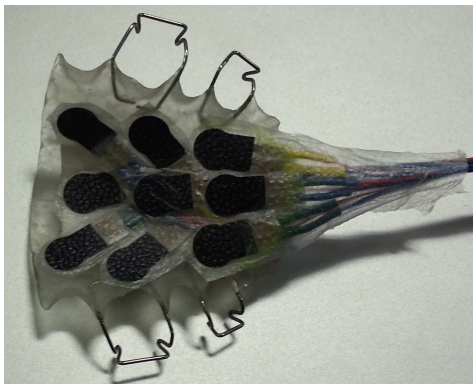

Fig. 1. Dental Retainer with Resistopalatography Sensing unit embedded

III. RESULTS

To validate that the system was adequate for driving a wheelchair, a test was devised to drive the wheelchair with an able bodied subject in figures of eight to establish whether the system could handle tight cornering requirements. To record data regarding the movement of the wheelchair, a 3D capture system was used looking at 3 points of the wheelchair to calculate its movement in the X,Y and Z axis.

The results in Fig.2 show that wheelchair control was achieved and a figure of eight could be driven without the need for the user to make continous corrections.

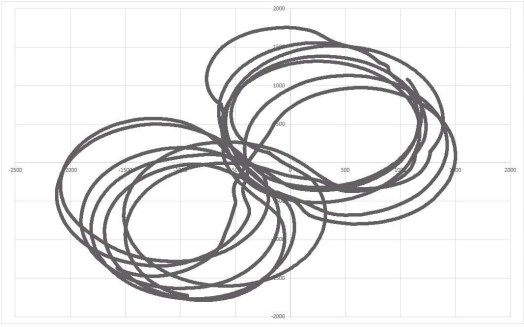

Fig. 2. The Wheelchairs Path during testing

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