Battery-free wireless assistive tongue controlled switches and joystick technology

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This paper will present an outline of new wireless assistive tongue controlled switching technology with an anticipated application for tetraplegic people to control wheel chairs or computer mouses. A particular benefit of the mouth tag system proposed is that no battery, or significant electronics needs to be placed inside the mouth.

Background

In this abstract we outline a new wireless switching and joystick technology where an individual retains fine motor control of the tongue. The work has been carried out as part of the SYSIASS project which is developing navigating & obstacle avoiding chairs. It is acknowledged that even for autonomous (robotic) chairs, there is always a requirement for the user to have some input or element of control and any interface with the user should be as discrete as possible. The technology under investigation is passive UHF RFID (Radio Frequency Identification) [1]. This is commonly encountered in systems such as Oyster Cards which operate at 13.56MHz and have a very short read range (about 10-20cm). We investigate UHF RFID as an enabling technology which operates at 868MHz and has unobstructed read ranges of several metres. As a wireless system, the attraction of RFID is that its RADAR style operation uses a backscattered signal with all the required energy coming from an external reader antenna. The tag simply switches information onto the reflected signal which returns to the reader and no battery needed at the tag (Passive System). There is a challenge in designing thin, unobtrusive tags for use on human tissue and the read range is significantly reduced when tags are mounted on skin or on dental plates within the mouth, [2].

Methodology

The authors have published the world's first temporary transfer tattoo RFID tag, [3], where the conducting antenna is formed of ink which is inkjet printed onto a polymer receiving layer. The tattoo ink is separated from the skin by an adhesive layer about 18µm thick. This tag was designed to be mounted on the skin, but retuning to a length of 50mm and width of 20mm allowed it to be tested on the tongue with the mouth both open and closed. Successful reading operation occurred which led to the tag then being placed on the hard palate, attached by dental adhesive. The tongue was brought within a range of distances from the tag and the reflected power was measured for each tongue-to-tag separation. To remove experimental error, and radio fading effects, each tongue-to-tag separation was measured 5 times and an average taken of the reflected power.

Results

The retuned mouth mounted tag gave a read range of 1m which compares to 2.2m for the original skin-mounted tattoo. As the tongue approached the tag, detuning occurs due to a capacitive loading effect, which is most extreme when the tongue is very close to, or touching, the tag. With the mouth open, a 5dB range in reader power was obtained between the maximum and minimum tongue-to-tag spacing and this is sufficient for proximity sensing, giving a clear distinction between on and off (read/no read). Good repeatability was observed for similar spacings in independent measurements, [4].

Conclusion and future work

The concept of tongue touch and proximity sensing RFID has been successfully demonstrated in the mouth. Future work will develop multi-chip tags of appropriate size to fit on dental palates. Four separate RFID transponder microchips will be investigated to provide left/right/forward/backward direction, speed and select function. Ultimately, the system

technology will be investigated to make it cost effective and disposable. Current work on printing technologies is supporting this [5].

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