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Information Transfer Rate Analysis of the Dual Mode Tongue Driven System for the Disabled Person

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Abstract:
Nowaday's alternative control for computer access and wheeled mobility for the disabled people are considered the most important for today's active lifestyle since they can improve the users' quality of life (QoL) by easing two major limitations: effective communication and independent mobility. In this paper it has been showed that a new wireless and wearable human computer interface called the dual-mode Tongue Drive System (d TDS), allows people with severe disabilities to use computers more effectively with increased speed, flexibility, usability, and independence through their tongue motion and speech. The effectiveness of the d TDS is proved by calculating the Information Transfer Rate using the Ns2 simulator.The high Information Transfer Rate proves that the d TDS is better than either unimodal forms based on the tongue motion or speech alone, particularly in completing tasks that require both pointing and text entry.

Key words*: Wireless sensor networks, Network Animator (NAM), BNEP protocol, Information Transfer Rate*

1. Introduction

A wireless sensor network is a collection of nodes organized into a cooperative network. Each node consists of processing capability (one or more microcontrollers, CPUs or DSP chips), may contain multiple types of memory (program, data, and flash memories), have a power source and accommodate various sensors and actuators. A wireless sensor network (WSN) consists of spatially distributed autonomous sensors to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling control of sensor activity. Individuals with severe disabilities, such as those paralyzed as a result of spinal cord injuries (SCI) at levels C4 and above, stroke, amyotrophic lateral sclerosis (ALS), or traumatic brain injuries (TBI), heavily rely on assistive technologies (AT) to carry out various tasks in their everyday lives. Among ATs, those providing Computers and internet are regarded as great equalizers that allow all individuals to have similar vocational and recreational opportunities. The tongue, as one of the most flexible and capable parts of human body, has been considered as a suitable candidate for sophisticated motor control tasks by various researchers inthe fields of AT and human computer interaction (HCI). By taking advantage of the rich capabilities of tongue, an existing wireless and wearable tongue-operated human computer interface, called the Tongue Drive System (TDS) is developed which can enable individuals with severephysical disabilities to control their environments, access computers, and drive powered wheelchairs through their volitional tongue movements. The Information Transfer Rate of the TDS is obtained by simulation process (Ns2).Ns-2 is a widely used tool to simulate the behavior of wired and wireless networks.

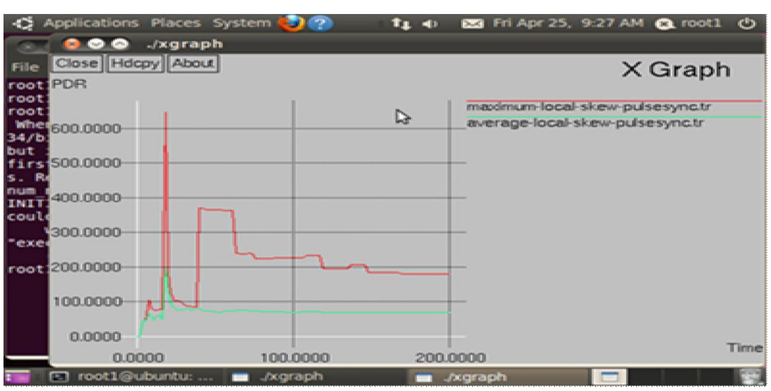

Figure 1: ITR analysis of TDS system

The above fig.1 shows the Information Transfer rate of the Tongue driven System, which proves that the information transfers from the disabled person to the system within 200ms.This shows that the ITR is slow

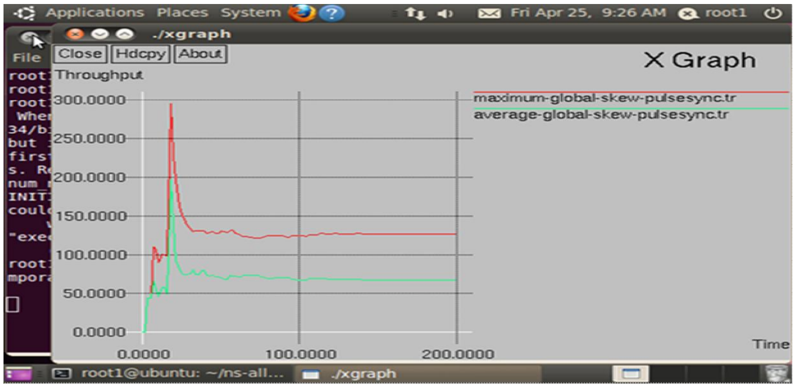

Figure 2: ITR analysis of SR technology

The above fig.1 shows the Information Transfer rate of the Tongue driven System, which proves that the information transfers from the disabled person to the system within 200ms.

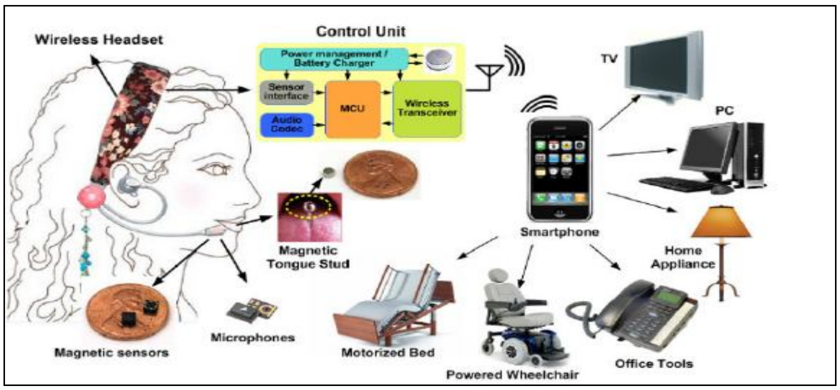

Figure 3: Pictorial Representation of the dual-mode Tongue Drive System (d TDS)

The d TDS, which block diagram, is shown in Fig. 3, operates based on the information collected from two independent input channels; free voluntary tongue motion and speech.The two input channels are processed independently, while being simultaneously accessible to the users. The primary d TDS modality involves tracking tongue motion in the 3D oral space using a small magnetic tracer attached to the tongue via adhesives, piercing, or implantation and an array of magnetic sensors, similar to the original TDS.The secondary d TDS input modality is based on the user's speech, captured using a microphone, conditioned, digitized, and wirelessly transmitted to the Smartphone/PC along with the magnetic sensor data. Both TDS and SR modalities are simultaneously accessible to the d TDS users, particularly for mouse navigation and typing, respectively, and they have the flexibility to choose their desired input mode for any specific task without external assistance. The tongue-based primary modality is always active and regarded as the default input modality.

2. Overview

Dual mode Tongue Drive system is mainly used for interfacing disabled peoples with computer.The setup consists of a magnetic sensor node,user micro phone node, SR node and a receiver microphone node. The disabled persons can easily utilize this for interacting with PC/smart phone. The user first gives the command by his tongue movement or by his speech. The tongue movement is traced by a magnetic sensor node. Then his speech was captured by microphone node. Now the magnetic sensor node and the microphone nodes output was combined i.e. the signal and speech was combined and given as input to the SR(Speech Recognition) node which classifies tongue signal and speech signal in order to recognize the command.Then the combined output signals were transmitted as RF packet to the receiver microphone node. The receiver microphone node will manipulate the commands send by the disabled person. Usually the command given by user is mouse cursor navigation, typing and reading.

The performance of the d TDS was evaluated by drawing graph for total time taken for executing the commands.

- Operating in dual mode
- Time taken for signal processing is low
- Flexible to use

The Total number of nodes considered for the packet transmission is 40 nodes. In that the node number 1,2,3,4 are taken as the speech recognition nodes, remaining half is divided into magnetic sensor node and receiver side node. The protocol used for transmission is BNEP protocol.

3. Modules Description

3.1. Magnetic Sensor Node Creation

Two types of magnetic sensor nodes are considered. One is for sender node another one is for receiver node. That means user signal sensor and the PC or smart phone sensor. The two magnetic sensors are necessary for interfacing computer with the disabled person.The sender magnetic sensor nodes are accurately traces the input signal given by the disabled person. A small tracer is desired to minimize any risk of discomfort and potential impact on the user's speech, which is important in achieving high accuracy with commercial SR software. It means that all disabled persons can't speak with correct pronunciations and fluency so the magnetic sensor needed to be more accurate in tracing the signals.

3.2 Speech Recognition Node Foration

The speech recognition node is mainly used to process the combined data from tongue signal and the speech signal. The algorithms used hear is SSP (Sensor Signal Processing). This separates the tongue signal and the speech signal. The algorithm handles both the tongue signal and the speech signal given by the microphone node. The proper processing of these two signals will lead to execute the correct command send by the user. The speech recognition is nothing but recognizing the correct command send by user. The speech recognized output signal is then transmitted to the receiver magnetic sensor node. Then the Pc or smart phone magnetic sensor will take the necessary action such as reading loudly, typing or mouse cursor navigation.

4. Performance Evaluation

The performance evaluation is the process of evaluating the performance of the proposed system and comparing the results with existing system. Here the performance evaluation is done by using drawing graph for total time taken by the system to complete the action. The total time is nothing but time taken between getting signals and processed them to activate the commands.

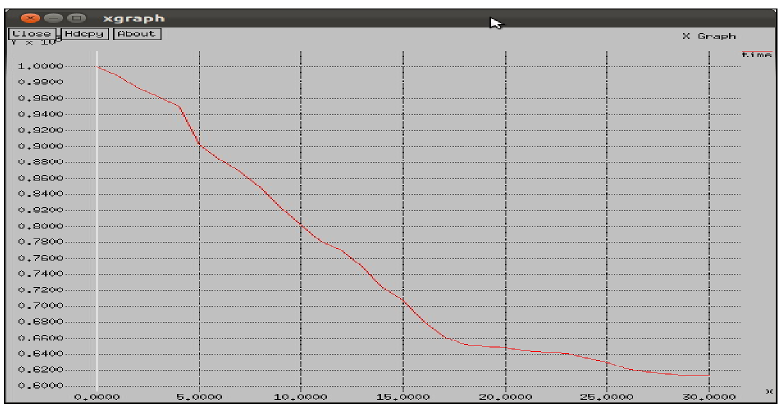

Figure 4: Performance Graph

5. Conclusion

In this paper, the Information Transfer Rate(ITR) for the dual mode tongue driven system is determined using the Network simulator software. Then this ITR is compared with the tongue driven systems ITR. In comparison, it can be proven that the dual mode tongue driven system is very much beneficial to the disabled people because of its high ITR.

6. References

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