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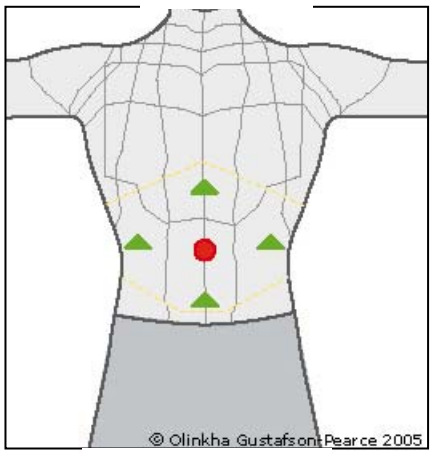
TUGS: I feel what you see

As our environments become more cluttered, more restrictive, and more populated by large numbers of people with very different needs, the issues of location and navigation within these environments becomes more complicated. Even a location a few streets away can be difficult for pedestrians to navigate to, especially if the pedestrian has a visual disability. For this group, the problem may be so overwhelming that some individuals may feel uncomfortable venturing outside of their homes, unless they are accompanied by a sighted companion. At Brunel University our efforts to address these issues, resulted in the Brunel GPS Navigation System for Blind and Visually Impaired Pedestrians. This system offered continual assistance to the pedestrian via an audio link. The user equipment includes two small web cams and a GPS location device. This equipment streamed information back to the operator, and allowed them to see where the user was. The operator is located in a remote (from the user) control centre and is connected to the user through the telecommunication and satellite networks. The equipment is small and easily carried but the audio feedback proved, in trials, to be extremely hard to use. Problems with the use of 'natural' language were encountered and the user had difficulties hearing the message, particularly in noisy environments.

It was decided that an entirely new method of transmitting navigational messages was required. For the purpose of transmitting spatial/navigational information to the user, utilising the tactile sense was a considered design choice. In this case other methods of informational input to the user were either overloaded (hearing), impractical (taste) or unusable (sight). A tactile interface, located on the users body, was designed and tested. This location leaves the hands free for safety and other tasks. The ability to transfer spatial information onto the cutaneous physical covering allowed the team to relate

appropriate world locations onto this already existing 'located on the user' interface.

Tugs (Tactile User Guidance System) is an innovative interface which transmits directional navigational and hazard/warning messages using five miniature vibrating actuators that are located on the users body. The audio system is still used but its use is restricted to essential 'conversational' interaction. Examples of the use of the two complementary systems is that the audio system may be for the user to enquire what the destination of an approaching bus might be, whilst Tugs transmits basic directional messages. Tugs is worn over a lightweight undergarment and is not affected by any outerwear, therefore making it virtually invisible to most observers. This is important for many users since they do not want to wear 'outlandish' equipment which stigmatises them as 'disabled'. Tugs has now been through two extensive trials with over fifty volunteers, both sighted and visually impaired, spanning a period of more than a year. All the volunteers found Tugs extremely easy to use and had no problems following the instructions conveyed by the system. There was no training period; the system was introduced to the volunteer, the messages explained (left vibrator actuated, you turn left) and the system put on. In all cases, it was immediately useable and no-one found it uncomfortable or unpleasant to wear.



Tugs Interface.
Illustration shows location of

Vibrotactile actuators relating to,
up/down, left/right and stop.

The placing of the actuators corresponds to a directional location in the environment, therefore left, right, up, down correspond to the actuator that is physically located on the user, in the appropriate area. All these commands can be moderated by the length of the signal. Therefore the message 'bear left' can be given by pulsing the left actuator whilst the message 'turn left' can be given by a long signal from the left actuator. The only actuator that has no moderation to the signal is the centre actuator that is located on the solar plexus, which projects a 'stop' signal. This is a safety feature and means that the pedestrian should wait for further clarification through the audio channel.

The Tugs interface has proved to be an extremely effective method of transmitting simple command information and it does not rely on a GPS link. Standing stations can be established in the environment and can be triggered to give a signal upon approach of the Tugs system. These standing stations are small and can be disguised and hidden in any environment. Within urban 'street' environments they may be incorporated into existing structures, (street furniture, lamp posts, etc.) or in buildings they might form part of the telecommunication network. For rural situations they can be connected to an overall system that uses 'wire free' technology and they can be hidden within the natural landscape. The message coding system may be automated and used in conjunction with remote map centres.

Although designed for use with the Brunel GPS Navigation System for the Blind, trials show that the interface becomes 'intuitive' after a very short period of use and does not rely on language, sight or other 'decoding of information' skills. Therefore it has broad use for many groups of users who require information that can be transmitted in this simple form. These groups include, tourists who use the GPS networks to navigate around an unfamiliar city, and emergency workers, for example rescue teams, trying to find their way around a smoke filled building.

For more information visit: www.dea.brunel.ac.uk/tugs

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