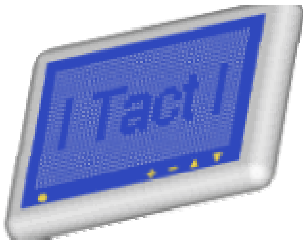

ITACTI

IST - 2001 - 32240

Smart Interactive Tactile Interface Effecting Graphical Display for the Visually Impaired

DELIVERABLE D6.2 & D6.3

Technical Verification Report

Report Version: 1

Report Preparation Date: November 2005

Classification: internal/rest. Public

Contract Start Date: 1st August 2001 Duration: 42 Month

Project Co-ordinator: De Montfort University

Partners: Smart Technology Group Limited (SMART)

Kaunas University of Technology (KUT)

Metec Ingenieur-AG Medizintechnik-Feinwerktechnik (METEC AG)

Associazione Nazionale Subvedenti (ANS)

Project funded by the European Community under the "Information Society Technology" Programme (1998-2002)

Index

1.0 Executive Summary

This report covers the testing and evaluation of pre-prototype ITACTI tablets. A composite evaluation plan has been developed to provide a benchmark for testing. A refined subset of the evaluation plan has been applied and testing and evaluation, in a controlled environment, undertaken by a number of screened 'users'. Evaluation has been carried out by expert evaluators including ITACTI consortia personnel allied to the intended user community and from the technical partners. Important information concerning the performance of pre-prototype ITACTI tablets has been gained from the testing and evaluation. A potential for further development has been demonstrated to exist and knowledge as to the required advances, so as to allow realisation of an operational 'consumer-user' tablet, has been established.

The ITACTI tablet has been subject to testing and evaluation that has demonstrated that it performance complies with the agreed specification.

- Braille text can be displayed in a state such that competent Braille readers can read the displayed text.
- When used to display graphics the device is able to display raster images using any number of the pins available.
- Graphics images generated by way of external PC based software can be displayed on the tablet.
- The maximum refresh speed is less than the pre-specified rate of 10 seconds.
- Users found the tablet to be a flexible graphical display comprising a large display that can accommodate both graphics and Braille and its realisation was judged to have exciting potential.
- Touch position accuracy has been shown to be equivalent to one finger width.

2.0 Testing & Evaluation

2.1 ITACTI Testing Criteria

A comprehensive set of testing criteria has been developed covering the following:-

Basic Braille representation
Basic graphic shape recognition 2D
Ergonomics
Touch Sensitive feedback
Refresh rate
Device Control

2.2 Evaluators

Evaluation against pre-set objective criteria as to the operation of the ITACTI tablet by the selected users was made by three experts each of whom has extensive experience of training persons in the use of Braille based equipment

Evaluator 1 – 10 years experience of teaching, training and evaluating trainees in a training environment for blind persons
Evaluator 2 - 20 years experience of teaching, training and evaluating trainees in a training environment for blind persons
Evaluator 3 - 15 years experience of teaching, training and evaluating trainees in a training environment for blind persons

2.3 Testers

A pool of testers has been established. The members of which possess various levels of experience and skill at reading Braille on Braille display devices from very competent to no competence. Certain members had experience of interpreting graphic information presented on paper. No one had previous experience of interpreting graphics on a full page display such as the ITACTI tablet.

Tester 1 - Blind and fully skilled in reading Braille as presented in all media forms including electronic Braille line displays. Age 30+ years.
Tester 2 - Blind expert reader of Braille as presented in all media forms including electronic Braille line displays. Age 50+ years.
Tester 3 - Blind skilled reader of Braille with experience predominately of Braille on paper media form. Age 20+ years.
Tester 4 - Sighted reader of Braille with limited skill level. Narrow experience, predominately of reading Braille on paper media form. Age 30+ years.
Tester 5 - Blind skilled reader of Braille with experience predominately of Braille on paper media form. Age 40+ years.
Tester 6 - Blind and fully skilled in reading Braille as presented in all media forms including electronic Braille line displays. Age 15+ years.

2.4 Test Environment

All evaluation was conducted in a room heated to office standards such that it was warm and welcoming and not cold. The room was relatively isolated from outside noise and only a tester and an evaluator were present when tests were being conducted. On refresh the ITACTI tablet generates a noise level that is perceptible in a quiet room.

2.5 Test Set-up

The ITACTI tablet was placed on a standard height desk in a comfortable position for use by testers. Immediately adjacent to the tablet was the electronic control box that was interfaced to a standard PC which provided the software control. Operation of the PC was undertaken by the evaluators.

2.6 Test Methodology

Before testing commenced each evaluator gave a description of the ITACTI tablet and an introduction to the display capabilities of the device being used for the tests. Testers were instructed as to the features of the ITACTI tablet and operating procedures. Once familiarisation had been judged to have been achieved by an evaluator testing commenced. Evaluators asked questions of the testers to enable judgement to be made against specified criteria.

3.0 Test Outcomes

3.1 Basic Braille representation

Braille dot size – pin diameter and the hemispherical end form were found to be entirely satisfactory and comparable with current electronic Braille displays.

Braille dot height – dot height was found to be entirely satisfactory and comparable with current electronic Braille displays.

Braille dot centre distance intra cell – the 2.5 mm centre distance was found to be entirely satisfactory and did not impeded a competent Braille reader to read the display.

Braille dot centre distance inter cell - the inter cell spacing was found to be entirely satisfactory

Braille readability - all testers were able to correctly read, within their level of competence,
letters and words as displayed.

3.2 Basic Graphic Shape Recognition

The ITACTI tablet was programmed to display a series of simple shapes/objects. Testers were asked to determine as to whether they could recognise the shape/object. No time limit was placed on the decision making process of individual testers or indeed the time they spent exploring the display. Evaluators made a judgement as to the appropriateness of the tester's response to the shape/object displayed.

In general, with a level of prompting by an evaluator dependant upon the shape/object in question, testers were capable of determining the shape/object contained within the display.

The objects/shapes displayed were:

Figure 1 : Three circles

Figure 2 : Chequer board

Figure 3 : Carrot

Figure 4: Cup

A video recording of the displays is presented on a CD held in appendix 1.

3.3 Ergonomics

Testers expressed a view that the ergonomics of a pre-prototype ITACTI tablet was less than good and improvements were necessary before the tablet would be acceptable to mainstream electronic Braille display users. The technical criteria controlling the development of the pre-prototypes had placed ergonomic relatively low down as a necessary key feature. The development goal was to provide a platform that would allow the technical challenges to be faced and overcome together with providing a refreshable display area To generate a basis for further objective assessment beyond that could be offered by the pre-prototype tablet full size mock-ups have been produced by industrial design engineers. The mock-ups offered to the tester the opportunity to assess the ergonomics of the design casing that could house the ITACTI tablet. Figure 5 shows a photograph of the most favoured mock-up. Testers rated the usability/functionality of competing designs. The key factors that emanated from the study were height of array display above the surface it rested on and the consequential area of surround surface to support the users wrist. The mock-up shown in Figure 5 was judged to have overcome these issues.

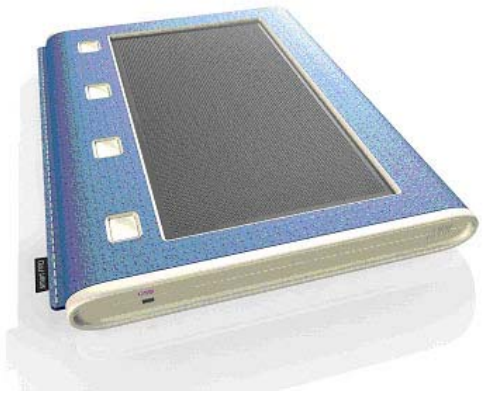

Figure 5 - Figure showing style and position of control buttons

3.4 Touch Sensitive Feedback

An important functional requirement for the pre-prototype ITACTI tablet is the ability for a user to input to the tablet system the position of a required action (the equivalent to a mouse click on say a function button). The provide this functionality the ITACTI consortium developed touch sensitive capability upon the tablet display surface. To determine the performance and accuracy of touch sensitive capability a programme of testing of accuracy of position has been carried out. The results of the accuracy experimentation is presented in Appendix 3. It was determined that within 80% of the display tablet area the accuracy of position was within one finger width (a 5*5 array of Braille pins).

3.5 Refresh Rate

A key parameter with respect to operational functionality of the ITACTI tablet is the time taken to refresh the display. Refresh rate being the time to lower and lift the complete array of 128 *64 pins. A series of experiments have been conducted to determine the refresh rate. The ITACTI control software was programmed to refresh the display over 10 cycles (all pins up and all pins down) and the time taken for this to occur was recorded. An average time was calculated from the result.

The ITACI tablet was shown to be able to effect a refresh in a time of 8.9 seconds, 1.1 seconds faster than the time specified in the requirements specification. The ITACTI tablet was found to be fully functional after each refresh.

3.6 Device Control

It was not part of the pre-prototype ITACTI tablet design to have on-board control functions. During testing and evaluation a required function had to be defined in software and effected from the controlling PC. A function such as refresh is 'automatically' effected by the hardware under command of the controlling PC. What is happened in practice was that all electric current was removed from the controlling micro-valves leaving them in the open state and the fluid pressure within the tablet was reduced such that gravity brought down the pins.

It was recognised that some controlling keys would need to be available to a user. The mock up shown above provided four keys allowing a minimum of four single action functions and another six functions through double action - pressing two keys simultaneously (such as ctl. enter).

4.0 Conclusions

The ITACTI tablet has been subject to testing and evaluation that has demonstrated that it performance complies with the agreed specification.

- Braille text can be displayed in a state such that competent Braille readers can read the displayed text.
- When used to display graphics the device is able to display raster images using any number of the pins available.
- Graphics images generated by way of external PC based software can be displayed on the tablet.
- The maximum refresh speed is less than the pre-specified rate of 10 seconds.
- Users found the tablet to be a flexible graphical display comprising a large display that can accommodate both graphics and Braille and its realisation was judged to have exciting potential.
- Touch position accuracy has been shown to be equivalent to one finger width.