

Auditory and Tactual Displays  
For Sensory Aids for the Visually Impaired

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Table 1. A summary of the main features of the displays

The increasing use of digital displays, in particular the advent of inexpensive electronic calculators, has renewed interest in non-visual digital displays for the visually handicapped. However, relatively little information has been published on the various devices being developed. This survey is based on replies to a questionnaire circulated in August 1973; the main features of these displays are summarised here.

Display number	Output mode					Output			Application			State of development		Approximate cost £
	Tactual	Audio	Parallel	Serial	Number of characters	Numerals only	Alphanumerics	Any shape	Output for electronic calculators, etc.	Reading machines	Active graphical displays	Prototype produces	Commercially available	
1	+					+			+			+		
2	+		+		6	+			+			+		22
3		+		+		+			+					11
4		+		+		+			+			+		
5	+		+		25		+			+		+		300
6		+		+	12	+			+			+		250
7	+			+	10	+			+			+		
8	+		+		10	+			+			+		490
9	+		+		7	+			+			+		710
10	+			+			+			+		+		29
11		+						+			+	+		
12	+						+			+		+		
13	+			+	8	+			+			+		
14	+	+		+	4	+			+			+		140

Table 1 (continued)

Display number	Output mode				Number of characters	Output			Application			State of development		Approximate cost £
	Tactual	Audio	Parallel	Serial		Numerals only	Alphanumerics	Any shape	Output for electronic calculators, etc.	Reading machines	Active graphical displays	Prototype produces	Commercially available	
15	+			+				+			+			
16		+		+						+			+	450
17	+		+		6			+		+			+	
18	+		+		3	+				+			+	
19		+									+		+	
20		+									+		+	
21	+		+		12	+				+			+	325
22	+			+		+				+			+	430
23	+		+				+			+			+	
24	+		+		8	+				+			+	110
25	+			+				+		+			+	1530
26	+		+		12	+				+			+	770
27	+			+		+				+			+	

1. Developer American Foundation for the Blind  
15 West 16th Street, New York, New York, 10011, U.S.A.
- Application Output for electronic calculators, etc.
- State of development A prototype has been produced but a new version with braille output is being developed.
- Description Tactile display using binary coded decimal.
2. Developer L. Andersson  
Projekt AB Alea, Henriksbergsvagen 104, S-136 67  
Handen, Sweden.
- Application Output for electronic calculators, etc.
- State of development Two prototypes built.
- Description Each dot consists of a small container filled with paraffin and covered with a flexible 'window'. A resistor is embedded in the paraffin so that an electric current through the resistor causes the paraffin to melt and expand; the flexible window forms an embossed dot. It takes about 3 seconds to change state.
- Price Circa \$50 for 6 digit display.
3. Developer L. Andersson  
Projekt AB Alea, Henriksbergsvagen 104, S-136 67  
Handen, Sweden.
- Application Output for electronic calculators, etc.
- State of development Proposal only.
- Description An auditory output for presenting a half braille-digit at a time. A rotary switch selects the half of the digit which consists of 2 dots. The upper one is presented as a high note, the lower one as a low note and both as a medium note.
- Price Circa \$24.
4. Developer Privat-Doz. Dr. H. Bebie, Institut fur theoretische Physik der Universitat, Sidlerstr. 5, CH 3012 Bern, Switzerland and Prof. Dr. F. Fankhauser, Universitats-Augenklinik, Inselspital, CH 3010 Bern, Switzerland.
- Application Output for electronic calculators, etc.
- State of development Prototype built.
- Description An auditory display which can produce the numbers 0 to 9 as spoken words which are stored optically.

5. Developer Clarke and Smith Research Ltd.  
Melbourne House, Melbourne Road, Wallington,  
Surrey, England.
- Application Braille output device.
- State of development General availability September 1975.
- Description A 12, 25, or 72 character 6 dot braille display with  
bit serial input and solenoid activated dots.
- Price Circa £300 for 25 character display.
6. Developer Dr. A. J. Croft and D. T. Smith  
The Clarendon Laboratory, Department of Physics, Uni-  
versity of Oxford, Parks Road, Oxford OX1 3PU, England.
- Application Output for electronic calculators, etc.
- State of development A dozen are being built for further evaluation.
- Description Serial audio output with two tones--short tone is a  
single unit and a long tone is five units. It has  
been made on five printed circuit boards as an integral  
part of a calculator.
- Price Circa £250.
7. Developer K. Cummins  
School of Engineering, University of California  
401 Verano Place, Irvine, California, 92664, U.S.A.
- Application Output for electronic calculators, etc.
- Description The working prototype consists of two units--the  
tactile output device and the main calculator unit.  
The output device has a 10 digit capability but displays  
one digit at a time; a rotary switch selects the digit  
to be displayed. After the output is read for each  
digit, the pins are reset by hand.
8. Developer G. F. Dalrymple  
Sensory Aids, Evaluation, and Development Center  
Massachusetts Institute of Technology  
Cambridge, Massachusetts, 02139, U.S.A.
- Application Braille analogue of 'Nixie' tube or 7 segment numeric  
display.
- State of development Building 10 dual cell numeric only modules for further  
evaluation.

8. Developer G. F. Dalrymple (continued)
- Description The braille display (4 dots in the prototype) is composed of modules each containing two cells. These modules can be stacked to form a line of braille of any desired length. Each pin is connected by a lever to a solenoid; these levers are arranged in layers to prevent mechanical interference. The head can also contain a latch arrangement for holding the braille pattern without expending power in the main solenoids.
- Price Display and drive electronics are estimated at \$100 per unit plus \$200 for each two digits i.e. a 4 digit display is approximately \$500 or a 10 digit display \$1100.
9. Developer The Electro Physics Company  
9303 North Major Avenue, Morton Grove, Illinois,  
60053, U.S.A.
- Application Output for electronic calculators, etc.
- State of development In limited production.
- Description A binary coded decimal display with 7 digit capability. Each cell consists of 4 solenoid-operated pins.
- Price Circa \$1600.
10. Developer W. A. N. Ellis  
Tudor Lodge Cottage, Fairmile Park Road, Cobham,  
Surrey, England.
- Application Braille display as an output for digitally stored information.
- State of development First prototype produced. General availability in 1975.
- Description Serial output to 6 dot braille cell operated by solenoids. The user can set the output rate.
- Price \$65.
11. Developer Dr. R. M. Fish  
1507 West Acre Road, Joliet, Illinois, 60435, U.S.A.
- Application A mobility aid when used in conjunction with a television camera. A non-visual equivalent to the cathode ray oscilloscope.
- State of development Prototype built.

