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A NEW PORTABLE TYPE UNIT FOR ELECTROPALATOGRAPHY*

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Introduction

Electropalatography displaying the dynamic patterns of tongue-palate contact during speech is a valuable method of observing articulatory tongue gestures. In general, the electropalatographic instrument consists of an artificial palate with implanted electrodes and an electronic device to detect and display tongue-palate contact patterns. On-line use of a computer for this system has been used for several years in the Research Institute of Logopedics and Phoniatrics for basic research, and in the National Center of Speech and Hearing Disorders for speech training.[1)2) 3)] Recently, we have developed a portable type electropalatographic unit for the wider application of this technique in both research and clinical fields.****

Instruments

Figure 1 shows a block diagram of the system using the on-line computer at the Research Institute of Logopedics and Phoniatrics. A similar system, with some modifications for use in practical training, has been installed at the National Center of Speech and Hearing Disorders. In these systems, the square wave pulses are generated by the computer and fed to a common electrode, which is attached to the ear lobe of the subject. Each electrode on the artificial palate is connected to one of the multiplexer input terminals. The contact signals is fed into the computer via an analog-to-digital converter. The contact patterns are stored in the computer's memory, together with the sampled values of the speech envelope.

Our new portable type hardware unit is shown in Fig. 2. The unit is powered by an installed battery. The unit is 20 cm in width; 39 cm in depth; 16 cm in height, and 5.2 kg in weight. The upper front of the unit is a display panel, which contains 63 light-emitting diodes. The lower front part of the unit is a control panel with push buttons. All functions of the uhit are realized by the digital hardware circuit.

The functions of the unit are explained in Fig. 3. In this unit, pulse signals are fed to 63 electrodes via a distributor. The contact signal is picked up by a common electrode with is placed on the back surface of the artificial palate so as to contact with the palatal mucosa. In the normal mode, the contact patterns are displayed in real time at a rate of 64 frames per second. At the same time, patterns of 1 second each are recorded in a digital memory. When the operation mode is switched to READ by a push

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**** The portable type hardware system is manufactured by the RION COMPANY LTD., Tokyo, Japan.

button, the stored patterns are read out and played back. The speed of the play-back can be varied in 3 steps: real speed, slow motion for 3 times and for 10 times. A still display of a selected frame is possible via the STOP button. A frame by-frame inspection of the contact patterns is also possible via the SINGLE STEP button.

The contact signal can also be recorded in a data recorder for later processing. The possibility of using an ordinary audio cassette recorder is also being explored. Contact signals played back in slow motion can be fed to a small printer to obtain a hard copy of the contact pattern.

A simplified technique for making the artificial palate has also been developed as shown in Fig. 4. Instead of implanting each of the small electrodes on the plastic plate by hand, the electrodes and lead-wires are printed on a thin flexible film. This film is then pressed and attached to the plastic palate. As is illustrated in the lower part of Fig. 4, the electrodes are printed on the oral side of the film base and the lead wires are printed on the opposite side which is attached to the plastic palate. The electrode and its corresponding lead wire are connected by use of a through-hole metal coating method. The electrodes are located along an equal-depth contour on the curved surface of the palate as shown in the upper right portion of Fig. 4.

Of course, there are individual differences in the shape and the size of the palate. The shape and size of the palate also vary according to age. In order to cover these variations, several types of printed films are manufactured. By using our new technique, the problem of the time-consuming process of making artificial palates by hand has been removed.

Application to Articulation Training

Visual monitoring of tongue-palate contact patterns gives the patient a powerful feed back route for detecting and correcting his defective articulatory placements. At the National Center of Speech and Hearing Disorders, this method is being applied to articulation training for deaf patients or patients with severe hearing impairments, cerebral palsy, dysarthria, cleft palate and so-called functional articulation disorders. Although the training technique should be varied according to conditions such as the age of the patient, the type and extent of the disorders, and the underlying pathology of individual cases, there are some common rules in the use of this method.

The first step is a general orientation. The spatial correspondence between various locations on the display and those on the palate should be established. Second, the kinesthetic sensation of the tongue gestures should be trained by placing the tongue in a position that gives a certain configuration of the contact area, and also by moving the tongue so that a certain dynamic change in the contact pattern is achieved.

In training articulatory placement, the presentation of an outline of the correct pattern (target pattern) superimposed on the display is of great help. Some examples are shown in Fig. 5. Systematic training programs using our new electropalatographic system are now being developed.

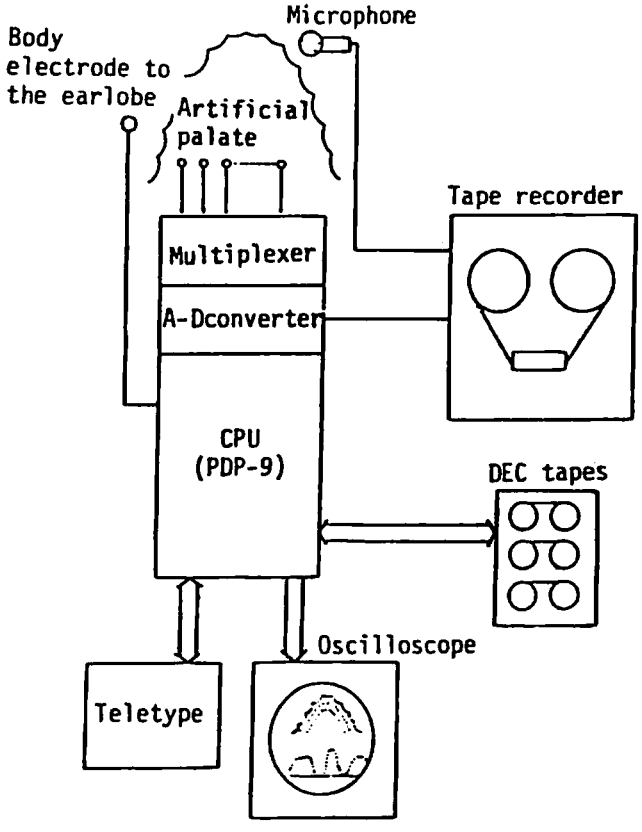

Fig. 1: Block diagram of the electropalatographic system using an on-line computer.

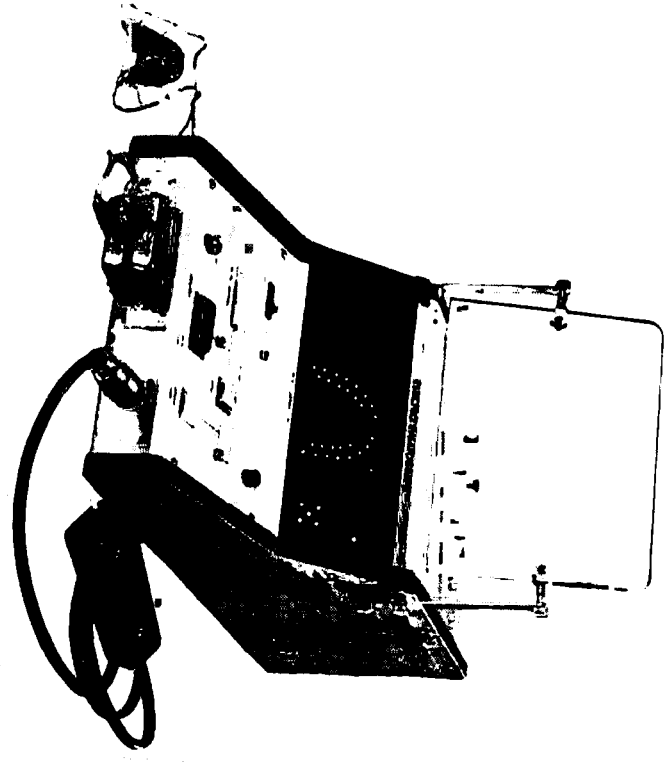

Fig. 2.: New portable type palatographic system.

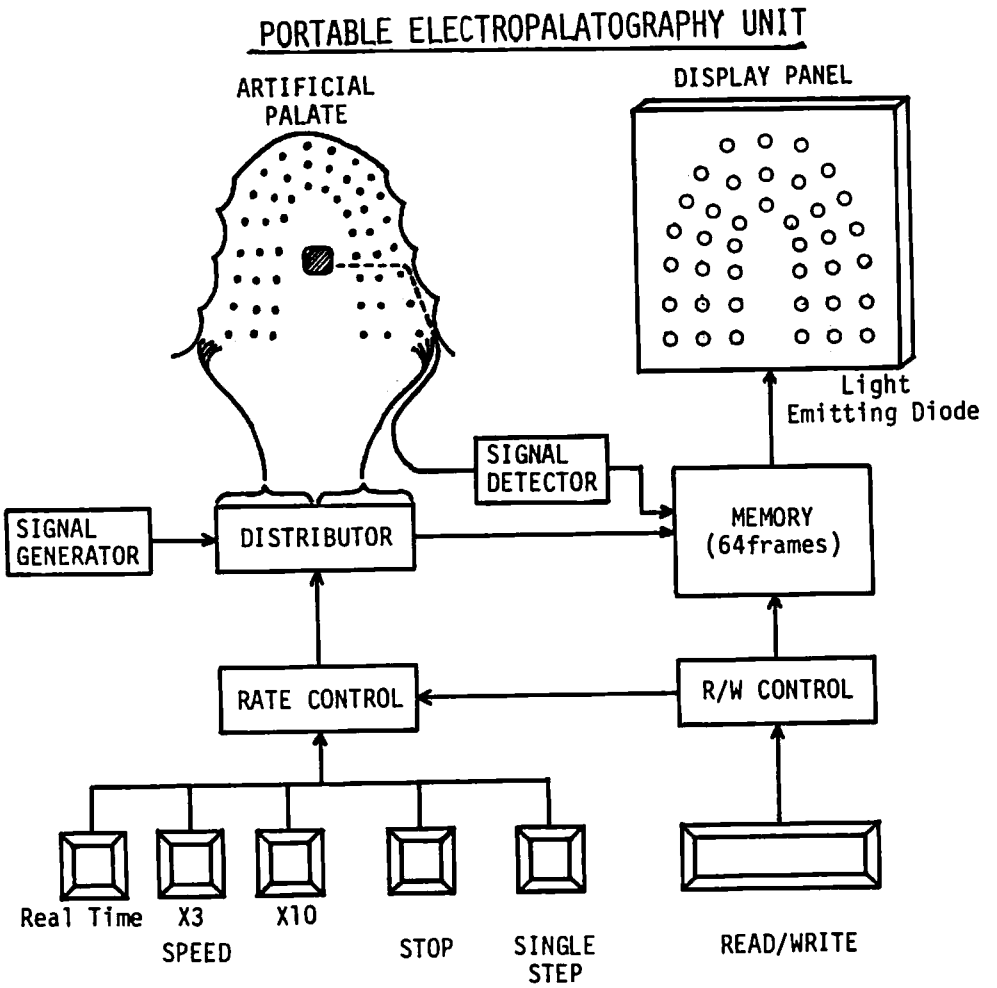

Fig. 3. : Block diagram of the portable unit.

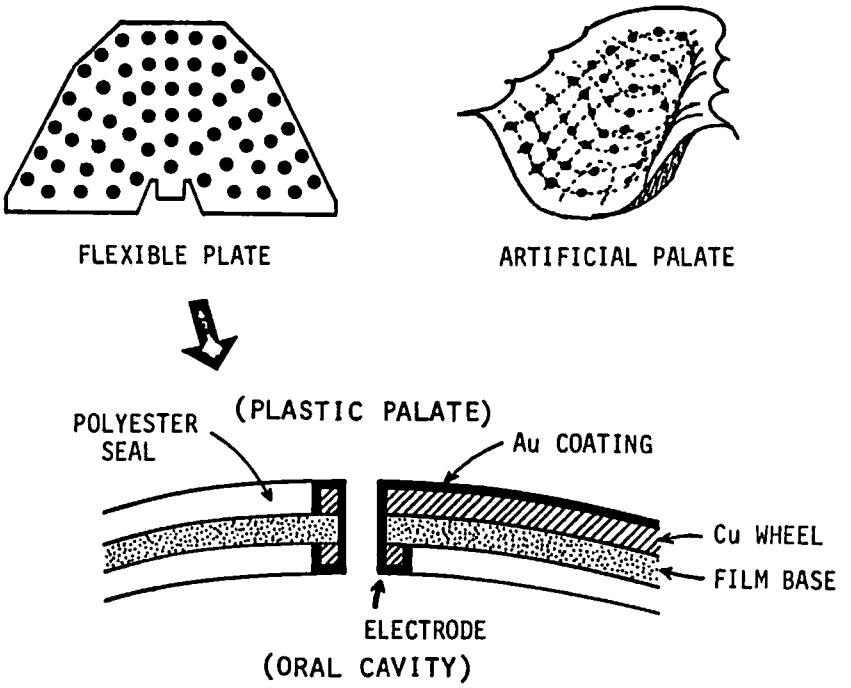

Fig. 4. : Flexible printed film.

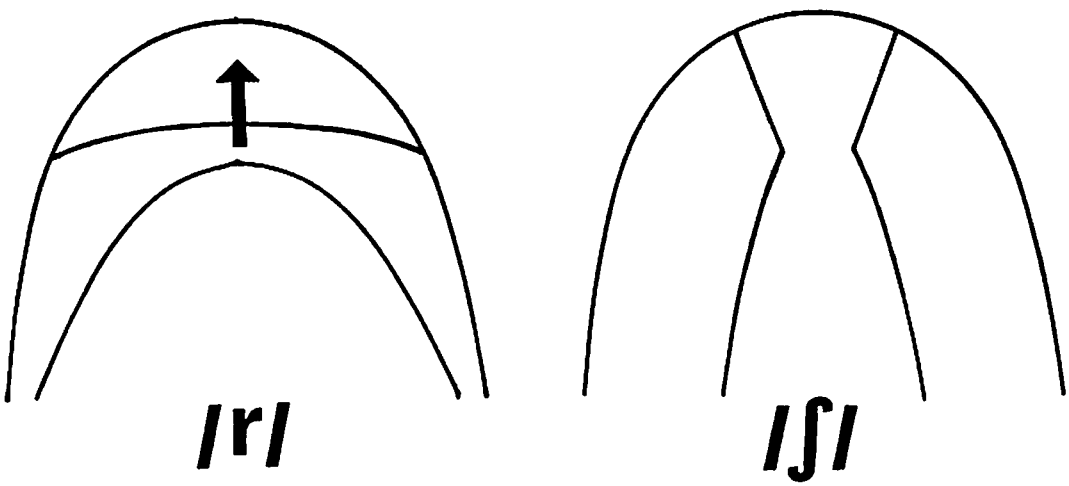

Fig. 5. : Outlines of target patterns for /r/ and /ʃ/.

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