

**THE SPEECH ACTIVITY CENTRE: A SPEECH TRAINING AID
FOR PRE-LINGUAL CHILDREN**

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INTRODUCTION

It is known that hearing children have a language by the age of 3, in that they can understand in the region of 3,000 words. Deaf children of the same age though, will have little or no spoken language and face an uphill struggle during their developing years within education and day to day life.

A deaf child has no audio feedback, and is oblivious (as far as we know) during their initial years to the speaking world that surrounds them. It is therefore essential that at a very early age deaf children recognise the fact they have a voice and then begin to use it. This gives the child confidence and helps make the next process of actual speech production an easier problem to deal with.

To help hearing impaired children to discover the use their voices some form of training aid is required to given them meaningful feedback, either visual or tactile. Hopefully this will enhance their chances of better integration in a talking society where most normal hearing people are insensitive to the problems of the deaf.

The remainder of the paper will describe a training aid which is specifically aimed at very young children. In particular it will describe the techniques used to realise suitable displays and a means of displaying time dependent information in a consistent manner.

CHILD CHARACTERISTICS

Small children have several characteristics which significantly affect the design of a speech training aid. These are:

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THE SPEECH ACTIVITY CENTRE: A SPEECH TRAINING AID FOR PRE-LINGUAL CHILDREN

a) Simplicity

Small children are attracted by simple but exciting (to them) objects. Highly complex displays can be both confusing and paradoxically less exciting.

b) Short attention span

Small children tend not to concentrate on any one task for a long period of time. Instead they tend to flit from task to task. This means any training activity or aid which requires sustained attention is likely to be less successful.

c) Playing

Small children explore and test their environment and try out different things with the objects in their environment. This playing with the environment forms a significant, and enjoyable, part of their learning.

d) Home/"Mother" centred lifestyle

The pre-school child spends most of his time at home interacting with his mother (or someone who fulfils that role). The ability to receive the necessary stimulation and training as part of the home environment is a necessity. Therefore speech training aids need to be able to be used at home if they are to be truly effective.

The child needs to develop her/his voice and in order to do this, displays covering some or all of the following areas would be useful.

- 1) An indication that the child is making (any) noise, preferably with some kind of volume indication so that they can practice control.
- 2) An indication of voicing contrast. Ideally this should be a display which does not make a hard decision but gives some indication of degrees of voicing.
- 3) An indication of pitch and pitch dynamics. The dynamics need to be represented in a way which is meaningful to a small pre lingual child.

**THE SPEECH ACTIVITY CENTRE: A SPEECH TRAINING AID
FOR PRE-LINGUAL CHILDREN**

- 4) More complex displays such as formant position.

Given the short attention span of small children it would be useful to have a multiactivity toy which allowed the child to flit from activity to activity without being distracted by excess information.

The Speech Activity Centre

The speech activity centre is an approach to achieving some of the above requirements. It is modelled on the activity centre concept which is currently used to encourage manual and visual skills in young children.

A drawing of the speech activity centre is shown in Figure 1. It consists of four faces on which there is a separate activity. The slopes of the faces are such that a small child can use it comfortably while both the centre and the child are sitting on the floor.

A block diagram of the system is shown in Figure 2, although one could have four speech activities in fact only three were implemented in this arrangement. The fourth facet was used for a mechanical toy.

Description of the activities

- 1) Jerry the Giraffe, Figure 3. This is a simple volume indicator. The display responds logarithmically to the sound level. A loud sound is required to fully illuminate the giraffe.
- 2) The second display is a voicing contrast indicator. The purpose of this display is to feedback some indication of the voicing of the sound. Thus it should respond differently to voiced, unvoiced and mixed voicing sounds. It does this by filtering the sounds via a fourth order low pass filter and second order high pass filter both with a cut-off frequency of 1khz. The amplitudes of the outputs of these filters are used to drive the x and y axes of an LED display, see Figure 4. The result which is shown in Figure 5 is to have a display in which the dot that is lit depends on the frequency content of the sound and so types of voicing light up different areas of the display.
- 3) The third display is a pitch display based on the pitch detector developed by Howard [1]. However in many cases one is interested in the rate and direction of pitch change as well. The traditional way of showing this is to

THE SPEECH ACTIVITY CENTRE: A SPEECH TRAINING AID FOR PRE-LINGUAL CHILDREN

use an oscilloscope type display with a time base. However this type of display will show an arbitrary time shift for the same variation in the parameter. This makes the same stimulus look different. While one can mentally compensate for the time shift, it is difficult to explain this technique to a prelingual child.

What is required is a time independent method of displaying these time varying characteristics. The way we have developed is to obtain the derivative with respect to time of the pitch parameter and use that to drive an orthogonal axis on the display. The result of this for different pitch variations is shown in Figure 6.

The effect of this circuit is that the position of the dot on a display is a function of both the value and instantaneous rate of change of the parameter, in this case pitch. This means that the path the dot takes depends on the pitch contour of the speech signal. More importantly, it will take the same path if the same contour happens again irrespective of the absolute time of occurrence of the event. This avoids the confusing time shift artefact introduced by an oscilloscope type of display.

CONCLUSION

We have described a multifaceted toy, a speech activity centre, which contains several disparate speech displays.

The purpose of this toy is to allow pre lingual children with hearing impediments to play with and get in touch with their voices. The toy has been played with by both normally hearing and hearing impaired children and all seemed to enjoy it. Further development could result in a generally useful and enjoyable educational toy.

ACKNOWLEDGEMENTS

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REFERENCES

- 1 Howard D M (1989) Peak-picking fundamental period estimation for hearing prostheses, *Journal of the Acoustical Society of America*, 86, 3, 902-910.

**THE SPEECH ACTIVITY CENTRE: A SPEECH TRAINING AID
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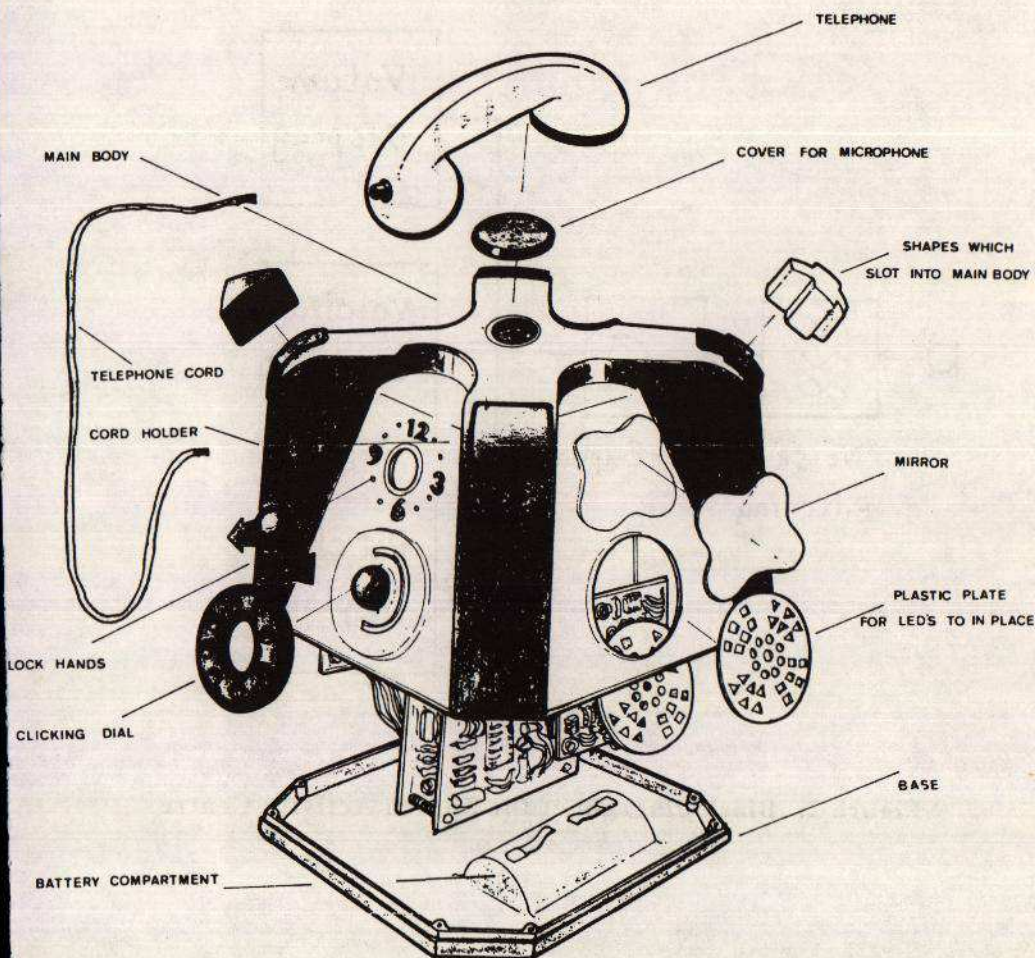


Figure 1: The Speech Activity Centre

**THE SPEECH ACTIVITY CENTRE: A SPEECH TRAINING AID
FOR PRE-LINGUAL CHILDREN**

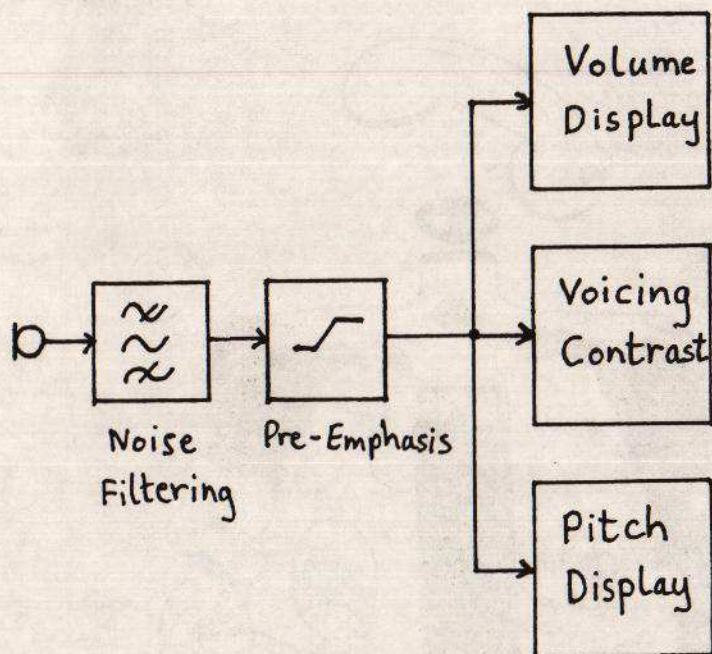


Figure 2: Block diagram of the Speech Activity Centre

**THE SPEECH ACTIVITY CENTRE: A SPEECH TRAINING AID
FOR PRE-LINGUAL CHILDREN**



Figure 3: Jerry the Giraffe

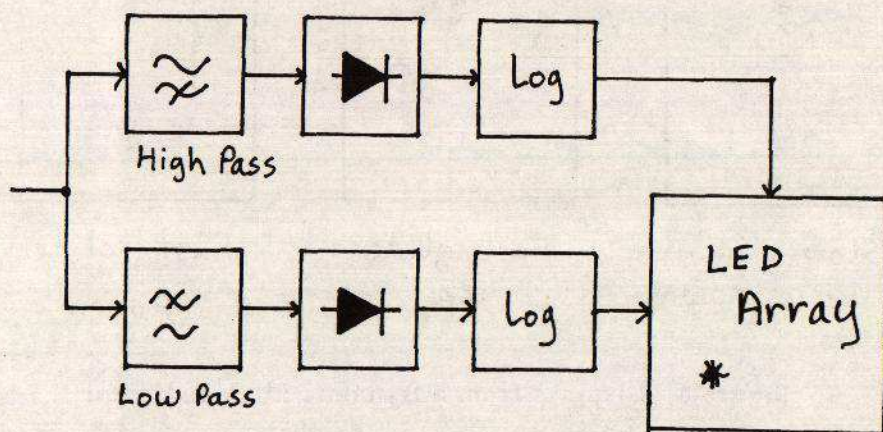


Figure 4: Block Diagram of Voicing Contrast Indicator

**THE SPEECH ACTIVITY CENTRE: A SPEECH TRAINING AID
FOR PRE-LINGUAL CHILDREN**

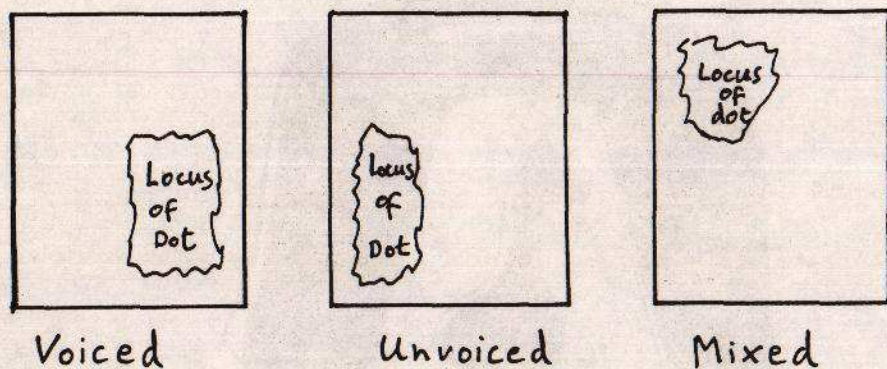


Figure 5: Displays from the Voicing Contrast Indicator

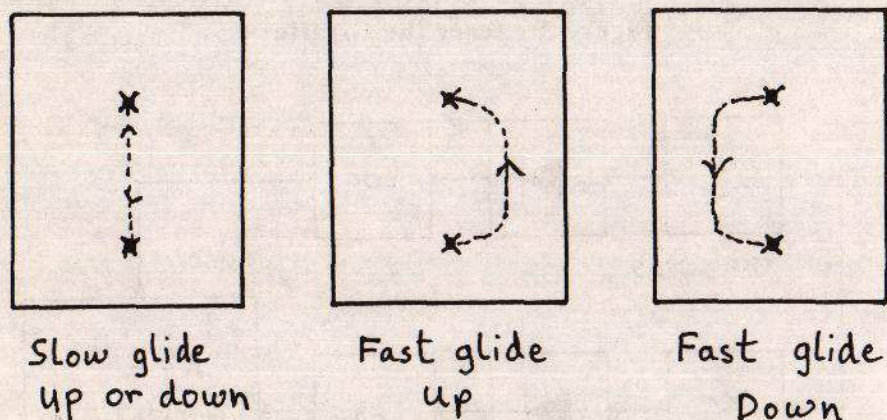


Figure 6: Displays from a Dynamic Pitch Indicator