SPEECH CONTROLLED MULTI PURPOSE MICRO COMPUTER SYSTEM FOR THE
SEVERE HANDICAPPED.

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ABSTRACT

In our institute, a rehabilitation centre, we developed a
computer-based system for the severe handicapped (e.g. muscle
dystrophia, multiple sclerose, A.L.S., spinal cord injury). With
help of this computer-system patients can control various
apparatus in their surroundings by means of spoken commands.
Examples of possible connected apparatus are: telephone,
typewriter, audio-equipment, TV set, video recorder, remote
control unit for electrical appliances (e.g. lights, doors,
curtains, windows etc.),page turner, central heating and last but
not least 'call for help' systems.

I INTRODUCTION

In our institute we have a number of severe handicapped
patients. Their diagnosis is often very different (muscle
dystrophia, multiple sclerose, A.L.S., high level spinal cord
injury).The common property of these diagnosis is that there often
is no sufficient control on the limbs in order to communicate with
the surroundings. This means that these patients are not able to
read a book, control the TV, typing a letter, without help.
In the past we developed a system to make it possible to them to
control these functions. We made use of the monoselection method,
which means that all options are scanned one by one.
Although it is a nice and simple method it makes no optimal use of
the resting functions of most patients. Therefore we developed a
system that uses the voice in order to control the environment.
In this paper we will discuss the system we developed.
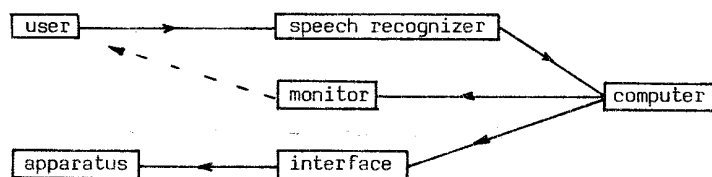
II SYSTEM DISCRIPTION

Fig.1: The schematic system.

A. Speech recognizer

The speech recognizer interpretes the spoken commands of the user. It sends information to the computer according to the recognized commands. The speech recognizer used is able to recognize isolated words and is user-dependant. It recognizes up to 80 different words or short phrases with a maximal length of 1.25 seconds. The response time itself is less than 125 msec. Before the speech recognizer can be applied it has to be initialized. This is done by speaking the commands several times (preferable under different circumstances) into a microphone that is connected to the speech recognizer. In this way the voice-pattern of the user is obtained. The microphone is an unidirectional noise suppressing model. Optional is a wireless microphone.
It is obvious that close resembling sounding commands should be avoided in order to lower the change on recognizion-faillures.

B. The monitor

Visual feedback is given via the monitor. In this way the user is informed about the status in which the system is at any time. On the screen is shown what commands can be used at a particular moment. Unviable commands are rejected. Not only the commands are shown, but also the consequences of those commands. This turned out to speed-up the learning proces considerably.

C. Connectable apparatus

It is possible to connect the following units: telephone, typewriter, audio equipment, TV set, remote control unit for electrical appliances, page turner, central heating and last but not least 'call-for-help' systems.

1. Telephone:

For this system we developed a special number dialer connected to a loud speaking telephone. This interface enables the user to do all the necessary actions in order to make phone calls. The user can dial a phone number by saying it number by number. It is also possible to recall the last number and to store some up to 20 numbers which the user often needs.

2. Typewriter:

We developed special word processor software for this purpose. Text is inputted by spelling the words. Corrections can be made, letters can be stored and retrieved from disk and printed on a connected typewriter. Optional is a sheetfeeder on the typewriter.

3. Audio equipment, TV set and video recorder:

By means of a special developed interface, all remote control units of a normal commercial available equipment can be controlled. Considering the fact that most of these sets have facillities for remote control this is less expensive than adapting the sets themselves. Another advantage is that there are

no restrictions on the guarantee. The remote control unit can
still be used in the normal way.
4. Other electrical devices:
A commercial available remote control system has been adapted, to
interface the computer. This unit sends information via the normal
power supply network to a number of switches (up to 16). With
these switches all kind of electrical devices can be switched on
and off. Light bulbs can be dimmed. No extra wiring is needed with
this unit.

5. Central heating:
Via an interface, it is possible to adjust the temperature of most
central heating systems.

6. Page turner:
With little adaptation standard page turners can be controlled.

7. 'Call-for-help' system:
There are a number of possibilities in emergency cases. All
existing 'call-for-help' systems can be used. It is also possible
to dial a number of preprogrammed telephone numbers (e.g.
neighbours, family etc.)

D. The computer
          The computer we use is a standard Apple IIe with one
disk-drive. The software we developed interpretes the information
from the speech recognizer, gives feedback via the monitor and
controls the apparatus connected to the system. This software has
been stored on disk, together with the voice-pattern of the user.
It is also possible to use standard software like games,
educational software etc. With little adaptation most of these
programs can be controlled by voice.

III EXAMPLE OF THE USE OF THE SYSTEM

          In order to clearify the use of the system two examples
will be given; e.g. the control of the TV set and the control of
the lights.
It should be noted that these are just examples, because the
software is very flexible, so that it can easily be adapted to
meet the needs and abillities of the user.
When the system is turned on the 'index-page' appears on the
screen of the monitor. This 'index' contains all the options
available to the user (fig.2)
By saying 'TV set' a new page is shown on the monitor with all the
commands concerning the control of the TV set. (fig.3)
At this moment the user can turn the TV set on by saying 'on'. If
he wants to choose another channel he says 'channel'. The next
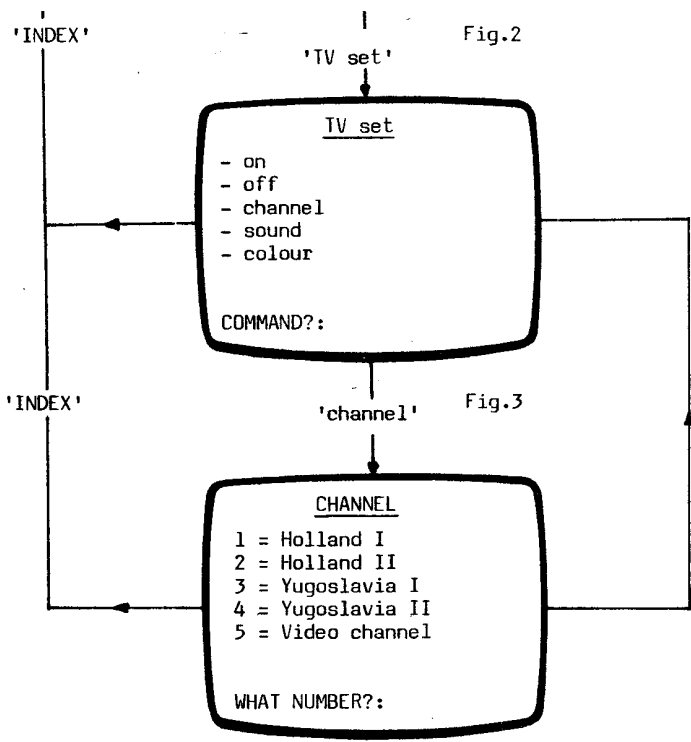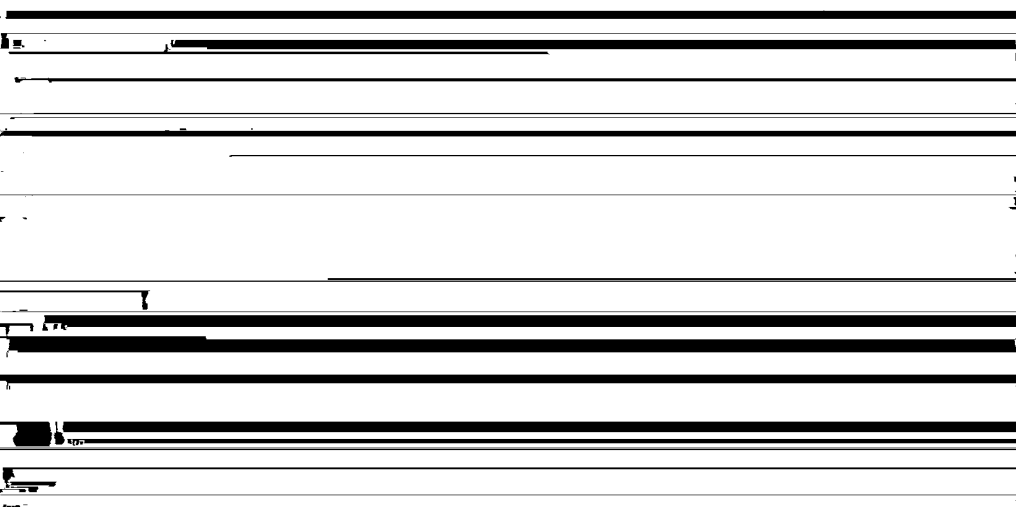page is shown on the screen (fig.4).

'INDEX'   Fig.2

                    'TV set'

```
                  TV set
       - on
       - off
       - channel
       - sound
       - colour


       COMMAND?:
```

'INDEX'   'channel'   Fig.3

```
                  CHANNEL
       1 = Holland I
       2 = Holland II
       3 = Yugoslavia I
       4 = Yugoslavia II
       5 = Video channel


       WHAT NUMBER?:
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selected on the TV set. After this selection the system
automatically switches back to the 'TV set' page (fig.3). Any time
the system ask for a command it is possible to say 'index', which
results in the 'index page' shown again (fig.2). This allows the
user fast switching between all the control options.

While looking at the TV set it may be necessary to dim one or more
lights. The user achieves this as follows. First by saying
'index' the 'index page' is chosen (fig.5).
Next by saying 'lights' the 'lights-page' is shown on the screen
(fig.6).
By saying the number of the relevant light the next page will
appear (fig.7).

```
         INDEX

   - TV set
   - lights
   - typewriter
   - telephone
   - alarm
   - etc.

   COMMAND?:
```

'INDEX'   Fig.5

'lights'

```
         LIGHTS

   1 = desk (light)
   2 = room (light)
   3 = table (light)
   4 = wall (light)


   WHAT NUMBER?:
```

'INDEX'   'one'   Fig.6

```
       DESK LIGHT

   - on
   - off
   - plus
   - minus
   - stop

   COMMAND?:
```
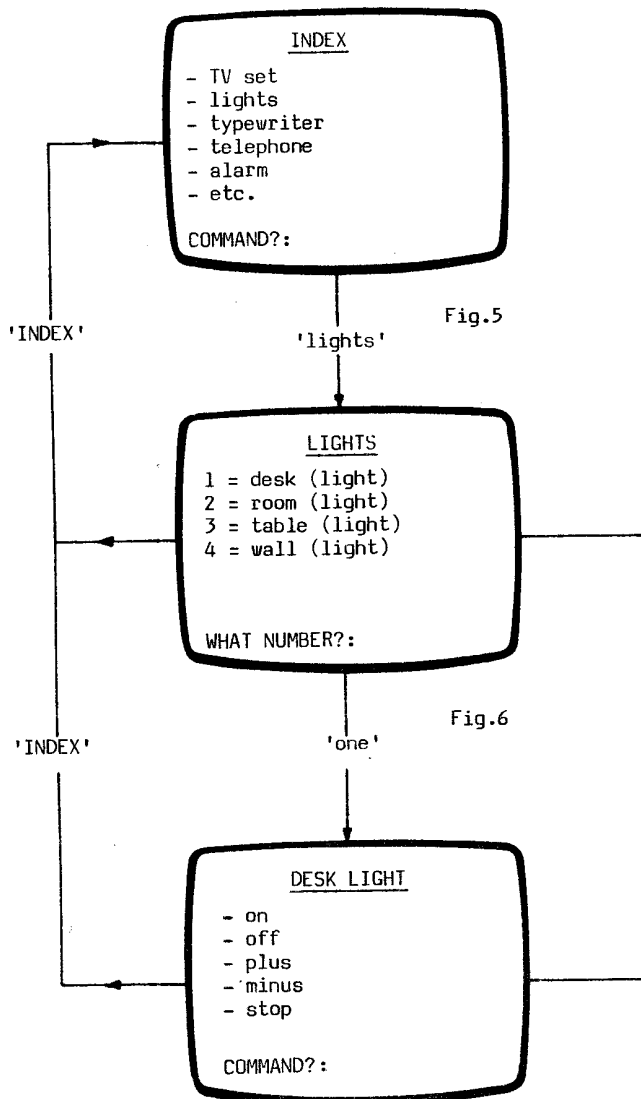
Fig.7

It will be clear that by saying 'on' and 'off' the light will be
turned on or off. By saying 'minus' the light will be dimmed
slowly until the user says 'stop'.

These were two examples of how to control the system. It will be
clear that all other options are controlled in a similar way.

IV CONCLUSIONS:

The flexibillity of the system allows easy adaptations to
the needs and wishes of the user. It is highly modular so that
extensions can be made easily and servicing can be done quickly.
Compared with other similar systems the costs are lowered because
standard modules are used as much as possible. The training period
is relatively short because of the easy way in which the system is
controlled (the feedback by monitor and the fact that spoken
commands are used). The voice-control of this system is much
faster in comparison to the so called 'mono-selection' method.
Therefore we may conclude that the described system is very
compact and relatively cheap in comparison with systems which can
fullfill the same tasks.