

This presentation is part of the COGAIN Deliverable D3.4

Eye Control Hints and Tips

by

the Network of Excellence on
Communication by Gaze Interaction

www.cogain.org

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to hear the presentation)*



Which software can we use for Eye-Control?

Assessment and Implementation.
An Introduction.

Mick Donegan, ACE Centre

Which software can we use for eye-control?
Assessment and Implementation.
An introduction.

This presentation...



1. Software for Introducing Eye Control

2. Software for Communication and Control

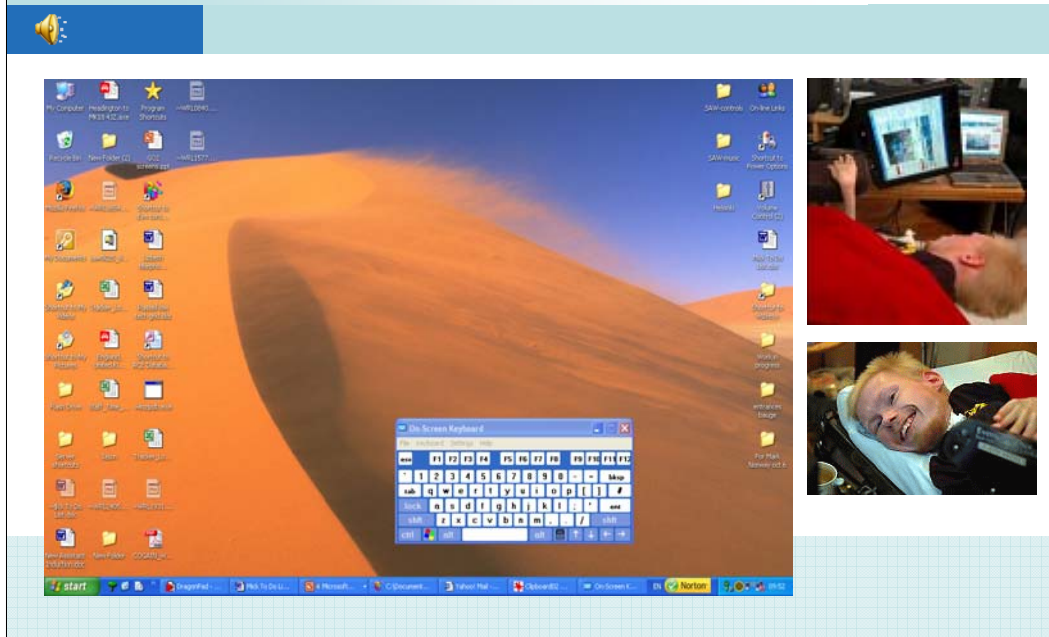
- software included within the eye control system
- 'off the shelf' software
- 'framework' software



This presentation is intended to provide an introduction to eye-control software.

Firstly, there will be an introduction to the kinds of software that can be used for introducing eye control to someone for the first time, followed by some examples of software that can be used to enable someone with a disability to gain maximum benefit from eye-control technology both for communication and control. We hope that, by the end of the presentation, you will have found out about some of kinds of software that are already available and be given some ideas of your own so that you can adapt customisable software to meet individual needs.

... Bjorn Andre can use eye control easily...



Before we start, It must be noted that not everyone NEEDS special software to go with their eye control system, nor do they need much time to become an expert with it! Just give them an on-screen keyboard and they are away!

Bjorn Andre, for example, keeps his head very still when he is using his eye control system. His vision is very good and he has very good control over his eye movements. As a result of this combination of factors, it is easier for the computer to interpret his eye movement accurately than if he had involuntary movement or visual difficulties. Indeed, Bjorn Andre is SO accurate with his eye control that he doesn't need any special software whatsoever. All he needs to use is the Windows Accessibility on-screen keyboard combined with pointer control. For mouse clicks, he simply uses the software that comes with his eye control system. As a result, he is able to do just about everything that anyone else can on a Windows computer.

1. Software for Introducing Eye Control



Non-challenging

Age, ability and interest related

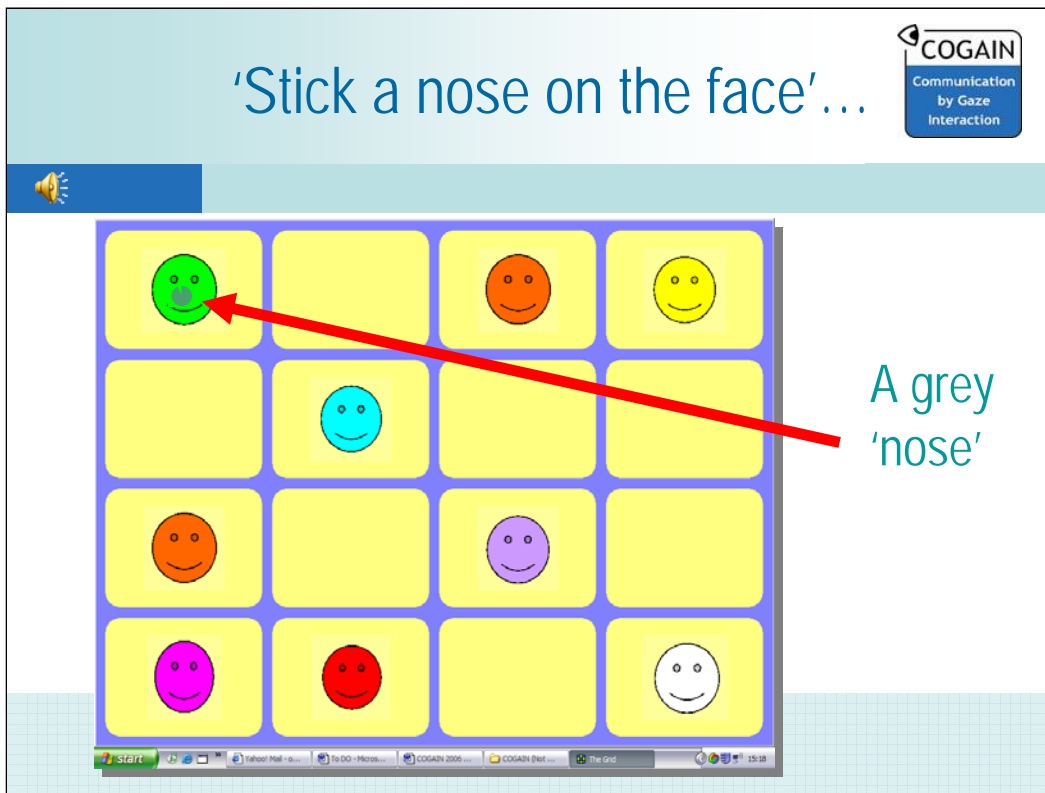
However, not everyone can be as accurate as Bjorn Andre and many people who need to use eye control technology have difficulties with their accuracy because of either visual difficulties or involuntary movement. As a result, they will need special software. For them, great care must be taken when introducing eye control. If they were simply presented with a small on-screen keyboard like the one that Bjorn Andre uses, they would soon fail and begin a downward spiral that could, for example, result in greater anxiety and increased involuntary movement. From the work that has been done so far with people who have complex physical difficulties, the COGAIN project has found that it is important to take care to ensure that introductory activities are non-challenging and related to the age, ability and interests of the person involved.



Helen



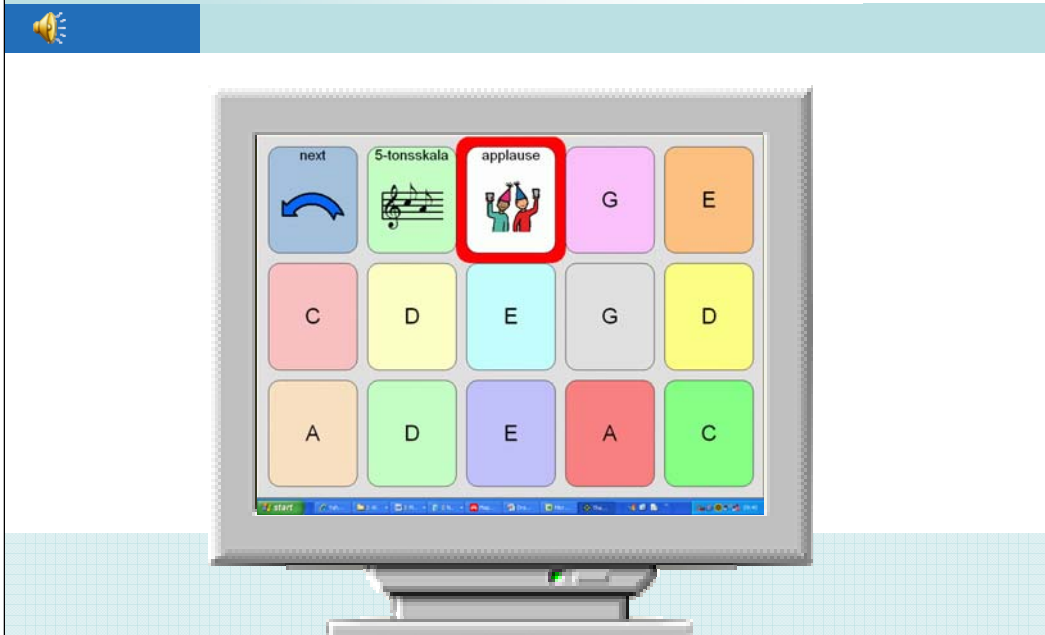
Helen, for example, is a young person who has involuntary movement. In her case, her involuntary movement is due to a rare metabolic disorder. She can control the computer with a switch or switches and even her voice to an extent, but these control methods are very demanding for her.



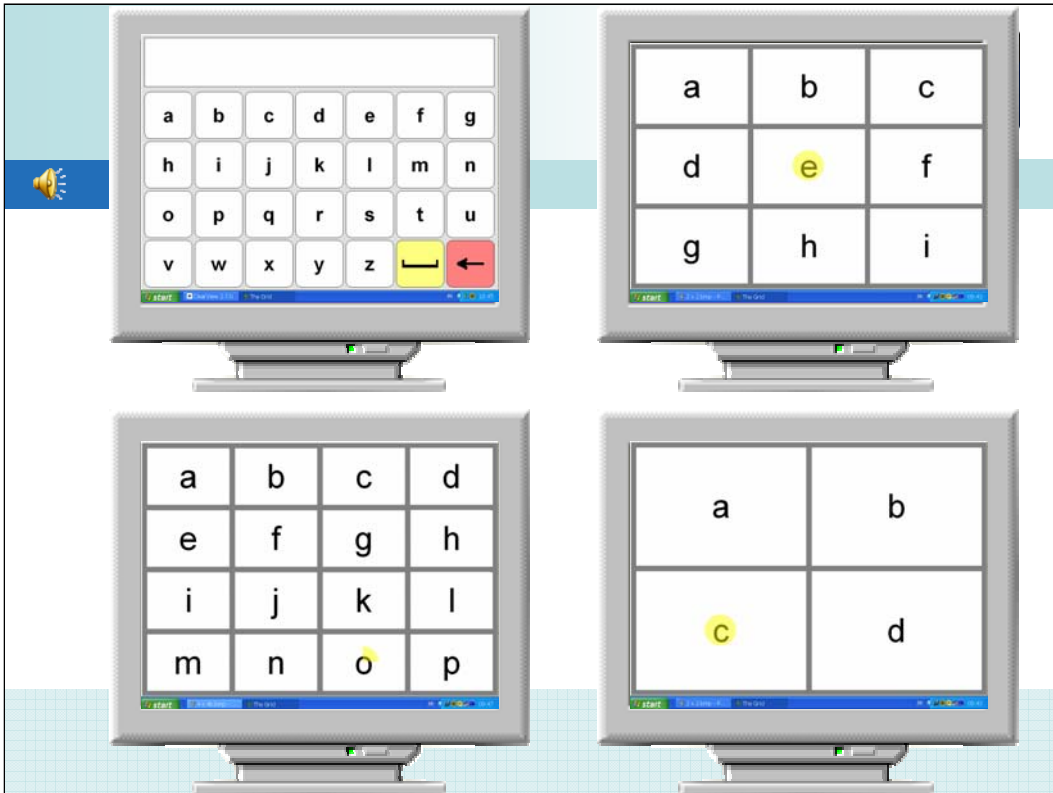
For Helen, we began with activities that were interesting and fun for her but were designed to try to ensure that she didn't fail. Because of her involuntary movement, Helen needs large targets to aim at. Here, for example, is an activity that is designed to find out what size of targets she needed. This is a 4 x 4 grid – that's 4 cells across and 4 down. Helen was simply asked to look at the different coloured faces on the screen.

As Helen looked at particular faces on the grid, the 'MyTobii cursor would appear in the middle of that cell. We used this feature to play a game with Helen by asking her to put a 'nose' on the face. We had a range of similar grids for Helen to try, too, all with cells of different sizes. By trying grids with different sized cells we were able to find the best size of cell for Helen to use reliably.

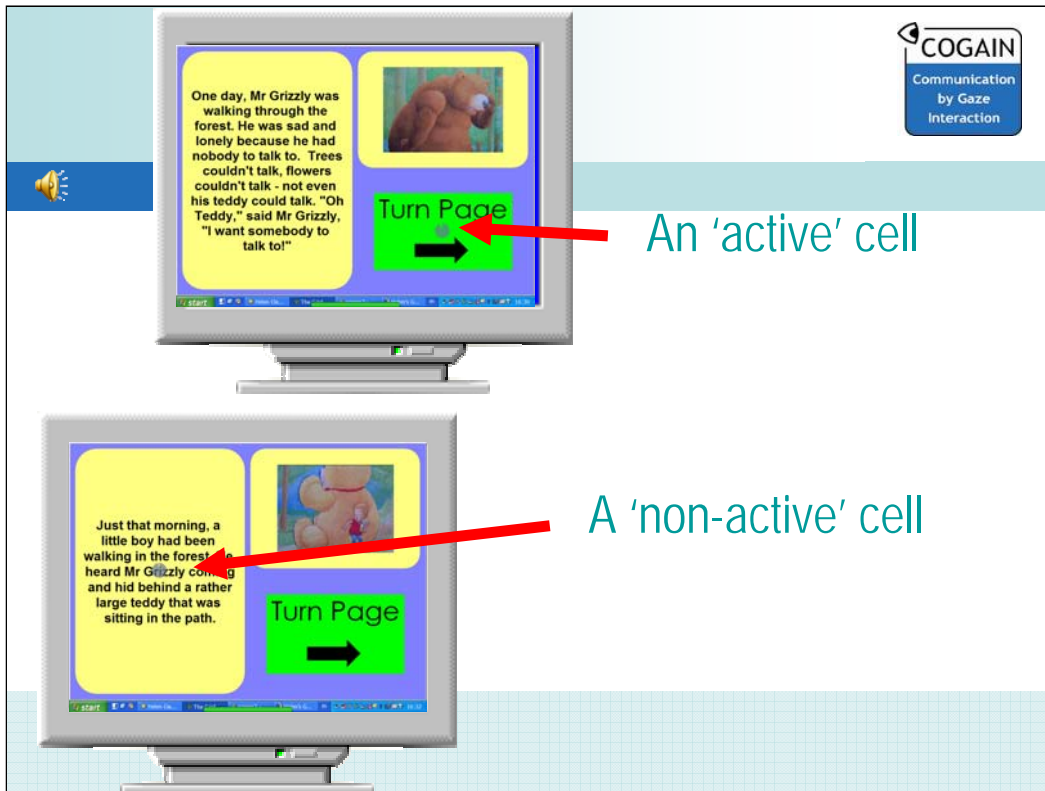
Playing music with eye control



This is an activity that can be used for a similar purpose. As the person dwells on a particular cell, a musical note or chord is played. This has been found to be an excellent activity that ensures success, while still enabling the user and those working with them to discover which sized cell they can access accurately. The user can even give themselves a round of applause!

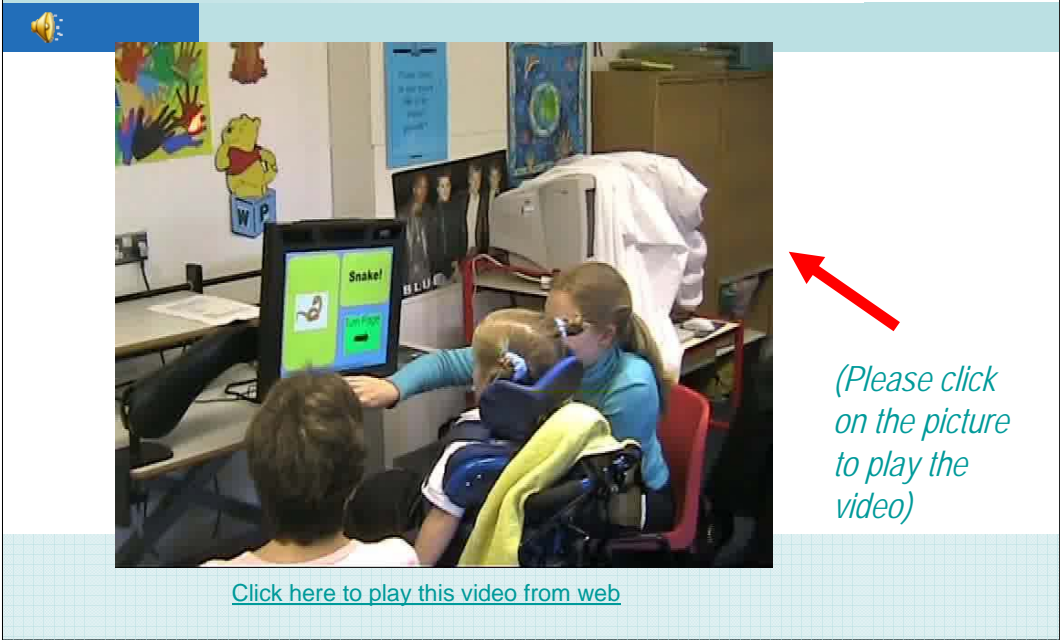


Here are some examples of assessment screens designed to find out the best size of cells to enable the user to select the target reliably.



This is another idea for an enjoyable way to introduce someone to eye control. This is a set of grids that link together to make a storybook.

It has been set up so that the person can turn the page just by looking at it. On the top screen, for example, when the person looks at the green 'Turn Page' cell, the grid changes to show a new page as you can see from the bottom screen. However, this cell, like the cell with the picture on it is a 'non-active' cell. In other words, while the person is reading the page or looking at a picture, nothing happens. It is only when the person deliberately looks at the 'Turn Page' cell, an 'active cell', that something happens.



[Click here to play this video from web](#)

(Please click on the picture to play the video)

If you click on the picture, you will see a video of Helen turning pages in her book simply by looking.

The video is available online at
http://www.cogain.org/user_involvement/eye-control-hints-and-tips/software_and_activities/EyeControl.mpg

Going shopping...

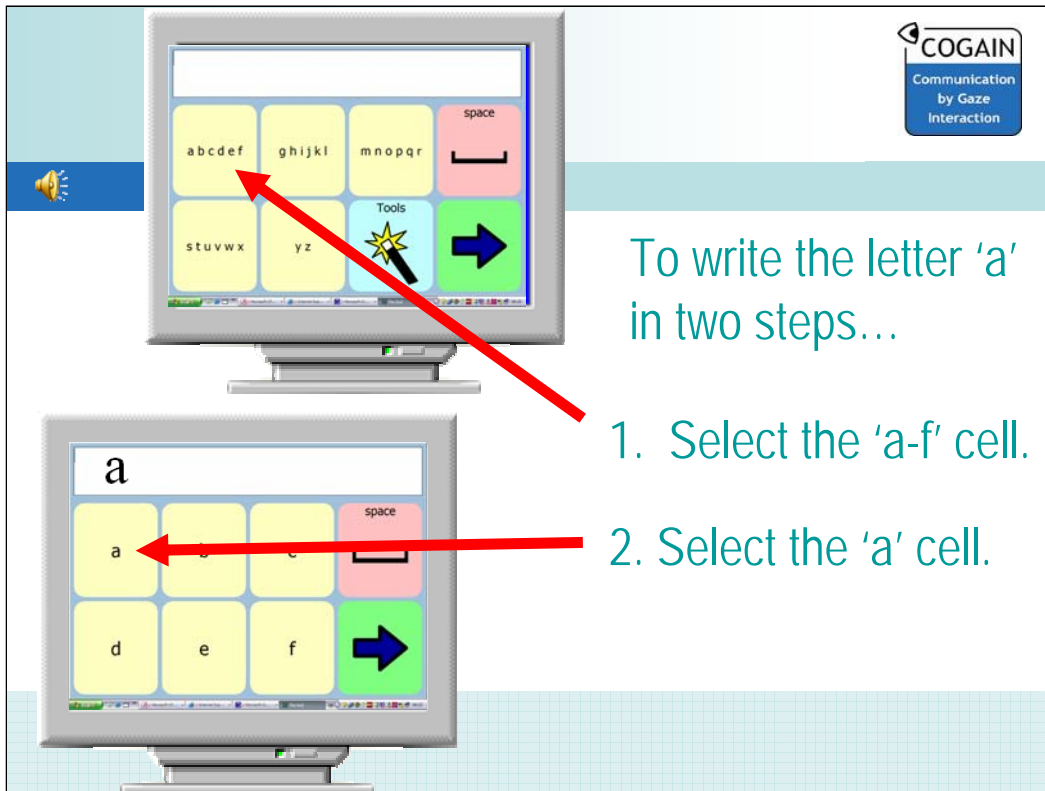


Here is a similar idea where the eye control user indicates the type of shoes that she would like to buy. The pink cells are not active but they do enable her to respond to questions by indicating her choice. With this particular example, the arrow key is the only active key. When the eye control user has finished making her choice, she simply looks at the arrow key to turn to the next page where there might, for example, be some dresses, hats, or jewellery to choose from.

Writing with whole words and phrases...

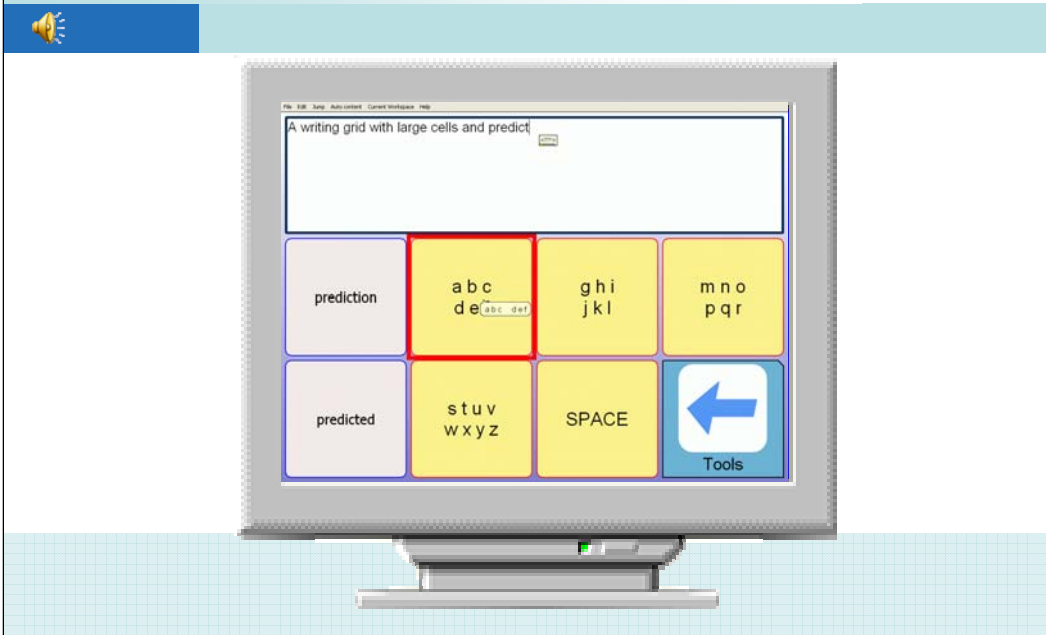


Even though Helen could read, she had never written before so, to encourage her to write with her eyes, we enabled her to build up sentences by selecting whole words and phrases from large cells.



Eventually, Helen was ready to write words of her own by selecting from individual letters. However, because of her involuntary movement, the computer could not pick up her eye movement well enough to enable her to select from a whole alphabet of letters on the screen at the same time. Each letter would have been too small. For this reason, instead of selecting a single letter with a single selection, we set up grid-sets that enabled Helen to benefit from having larger targets with which she could use write a letter by using 'two hits'. For example, to choose the letter 'a', Helen first chooses the cell with 'abcdef' in it first, as illustrated on the top screen. Then, when the screen changes and all of the letters from 'a to f' are in their own cell, she can then select the individual letter 'a'.

Using prediction with the '2' hit method...



Whilst the 'two hit' method might seem slow, text production can be speeded up by using techniques such as prediction.

2. Software for Communication and Control

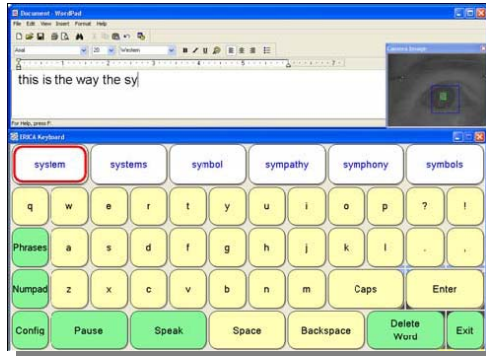


- (a) included within the system
- (b) off the shelf
- (c) framework software

2. Software for communication and control.

There is a wide range of software available for eye-controlled communication and computer control. Firstly, I'd like to look at examples of software that come with the eye control system.

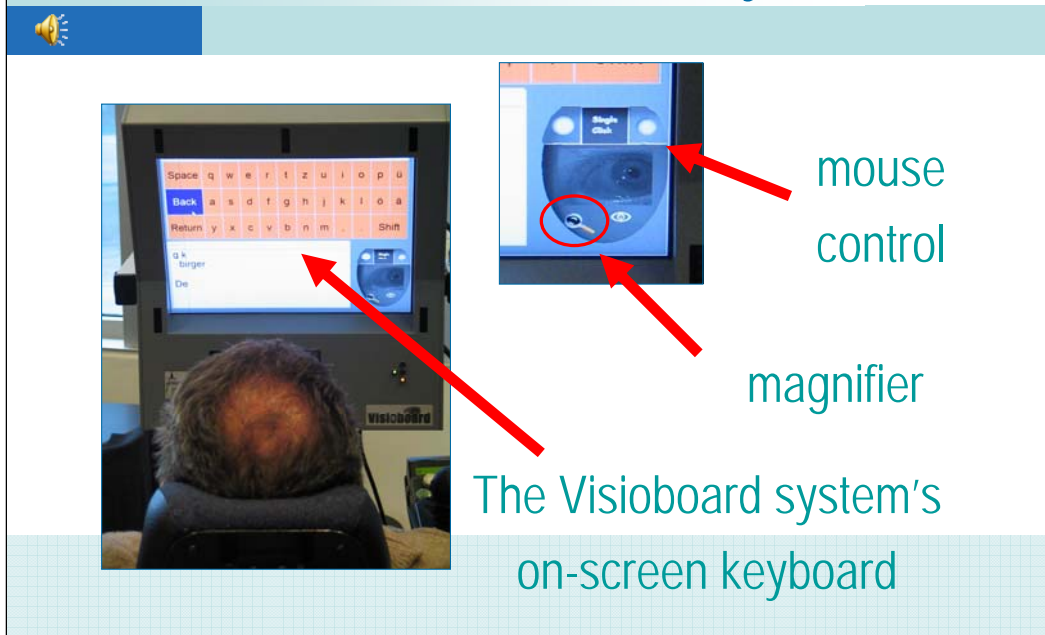
2(a) Software included with the system



The Erica system's on-screen Keyboard

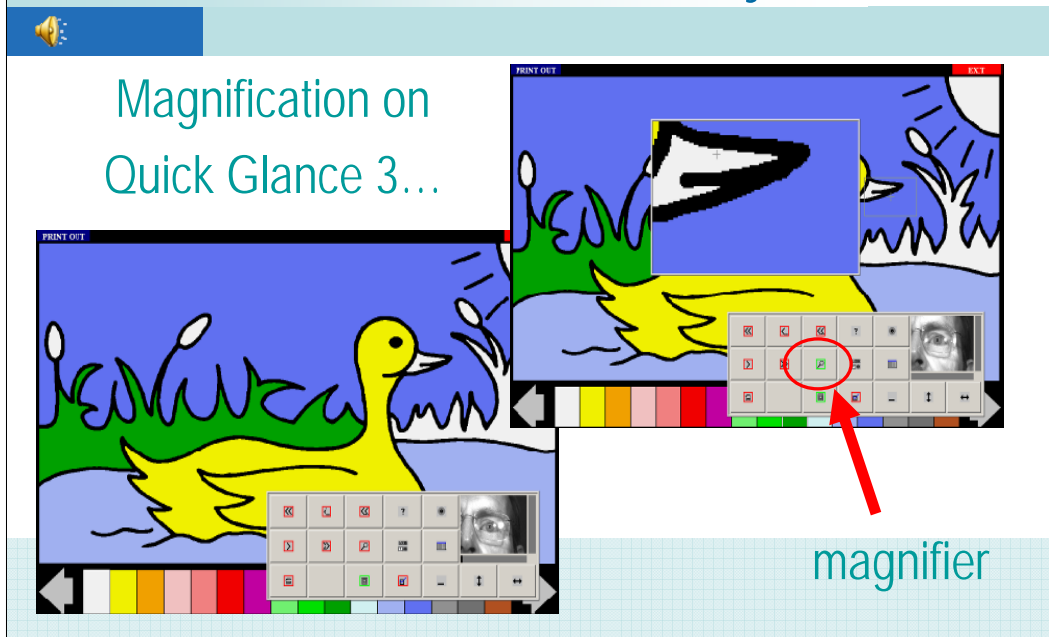
This is a keyboard that comes with the Erika system. As you can see, it works successfully with mainstream applications in Windows. If the eye control user is able to achieve an accurate enough calibration to be able to control the on-screen pointer reasonably accurately, the keyboard is all that the user needs in order to access whatever Windows program they wish to. Also, as you can see, the on-screen keyboard includes prediction.

2(a) Software included with the system



This is the Visioboard on-screen keyboard. As with most eye control systems, it also has mouse control utilities too. Just by looking at the on-screen mouse, the user can choose whether they want to left click, right click, double click, drag and drop etc. In addition, as with some other eye control systems, like the Erica, there is a magnification feature, too. This is helpful in achieving a high level of accuracy. When this is switched on, the first glance at an object enlarges it. As a result, the target is much easier to select with the second glance. This simple, though very important, feature can make all the difference between enabling someone to manage with an on-screen keyboard and mouse utilities alone and having to use a grid-based system.

2(a) Software included with the system



From this example, it is easy to see the difference that magnification can make. This is a colouring in activity. The eye control user looks at a colour at the bottom of the screen to select it and then looks at the area of the screen they wish to colour in. Without magnification, the duck's beak is quite a small, difficult target. However, once the magnification option has been selected, the beak can be enlarged and it becomes a very easy target.

2(a) Software included with the system



```
Dear Uncle Charlie,
It was good to see you last week. I tried to call you on the phone yesterday
but the line was busy. I'll call again tomorrow.

```

ESC	F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	OUT
,	1	2	3	4	5	6	7	8	9	0	Prt	Pse	SPK
CTL	ALT	q	w	k	j	g	p	<-BACK	NLk	/	*	-	
TAB	SL	u	t	h	e	r	l	ENT	Hom	^	PgU		
	SHF	f	s	SPACE	n	g	SHF	<-	PSE	->			+
\	/	c	d	o	a	i	m	[]	End	✓	PgD	ENT
;	'	,	z	x	v	b	.	-	=	INS	DEL		

Eye-typing with LC Eyegaze

This is one of a range of keyboard layouts that are available with the LC Eyegaze system. It is worth noting that some people become so quick with selecting individual letters on an on-screen keyboard that they prefer not to use prediction.

2(a) Software included with the system

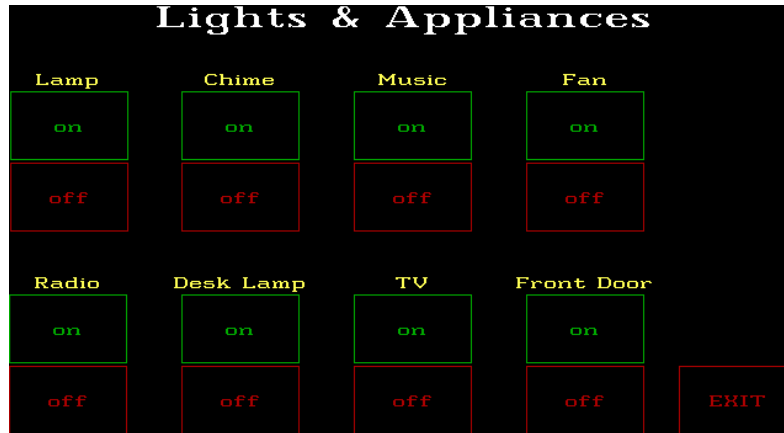


Hello	Good Bye	Good to see you	Where have you been
How have you been?	I've missed you	I'm Happy!	I'm Sad
I need a Hug	Good	I like that	Talk to me
Yes	No	Pause	Menu

Quick communication

The LC system also includes the opportunity to use a whole words and phrases in order to speed up communication. These whole words and phrases can be personalised.

2(a) Software included with the system



Environmental control

Not only communication but other utilities can be provided as part of a package with some eye control systems. This is a screenshot from the LC's environmental control system.

2. Software for Communication and Control



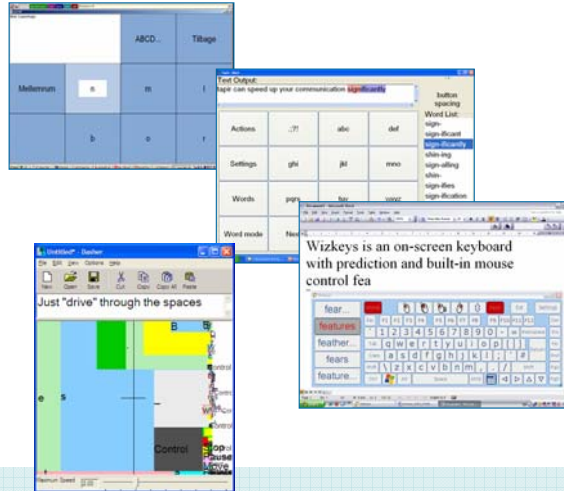
- (a) included within the system
- (b) off the shelf
- (c) framework software

There is a range of software for communication and control that can be bought 'off-the-shelf' or is available as open source software. In this context, 'off-the-shelf' means that the software is ready to be used with very little modification or personalisation.

2(b) 'Off-the-shelf' eye control software

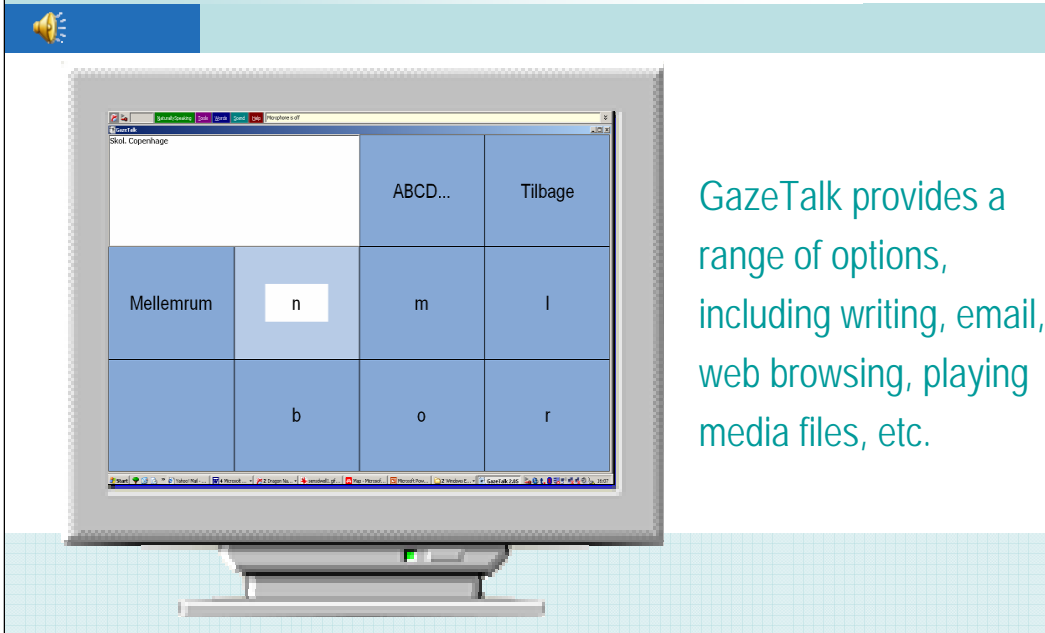


- GazeTalk
- Tapir
- Wizkeys
- Dasher



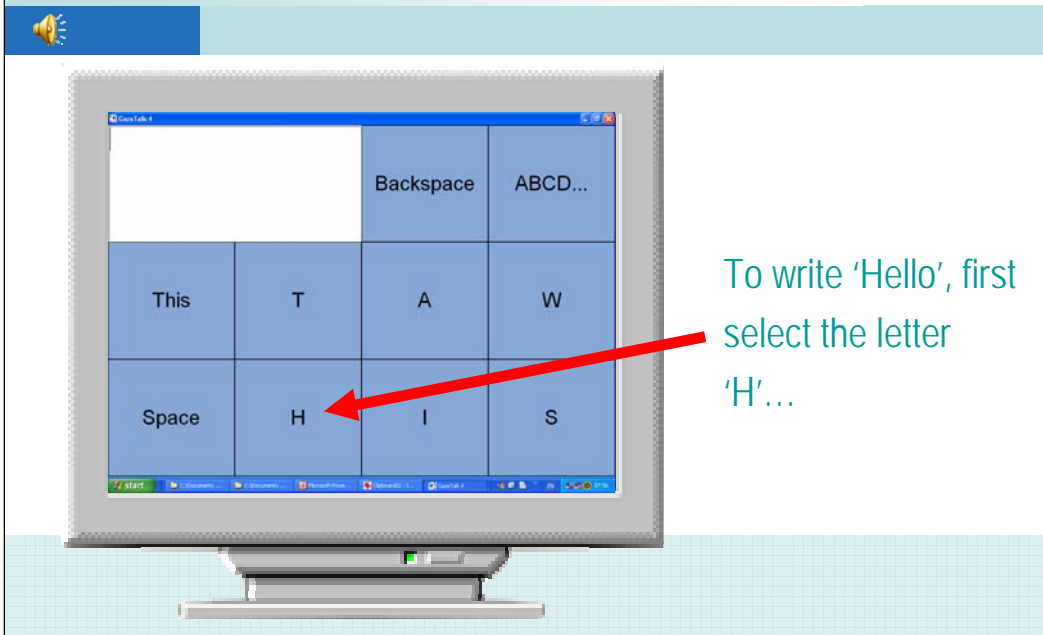
The range of 'off-the-shelf' software includes Gazetalk, Tapir, WizKeys and Dasher.

2(b) 'Off-the-shelf' eye control software - GazeTalk



Gazetalk provides a range of options, including writing, email, web browsing, playing media files, etc.

2(b) 'Off-the-shelf' eye control software - GazeTalk



For writing, there are 10 active cells in Gazetalk. To write 'Hello', using Gaze talk, first select the letter 'H'...

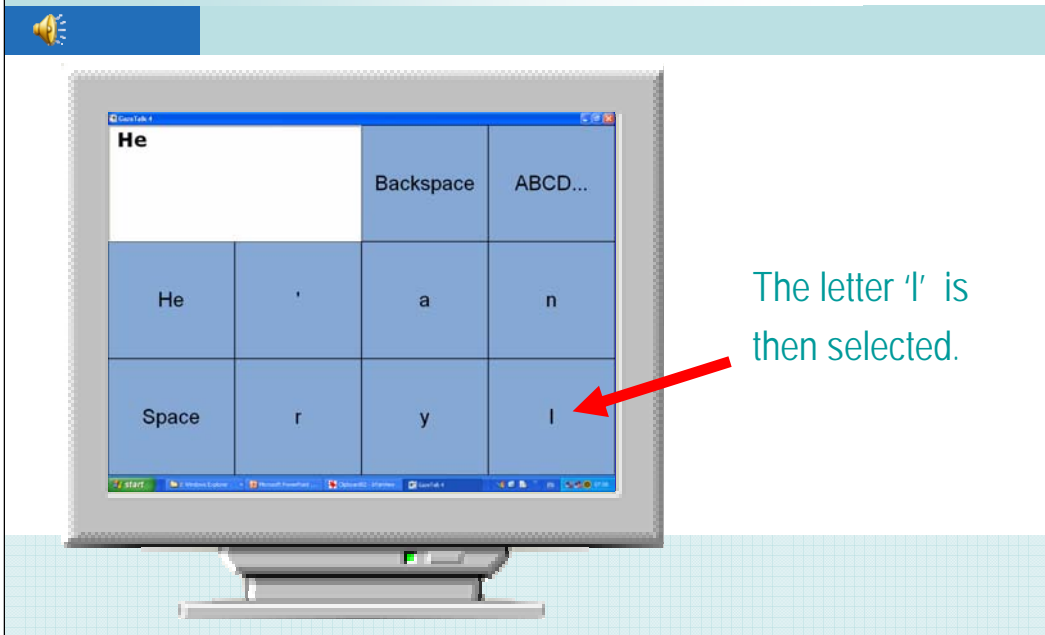
2(b) 'Off-the-shelf' eye control software - GazeTalk



As a result of typing the letter 'H', the letter 'e' is one of the choices available, so this is selected.

As a result of typing the letter 'H', the letter 'e' is one of the choices available, so this is selected.

2(b) 'Off-the-shelf' eye control software - GazeTalk



Now, another choice of characters is offered, based on a predictive model, from which the letter 'l' can be selected.

2(b) 'Off-the-shelf' eye control software - GazeTalk

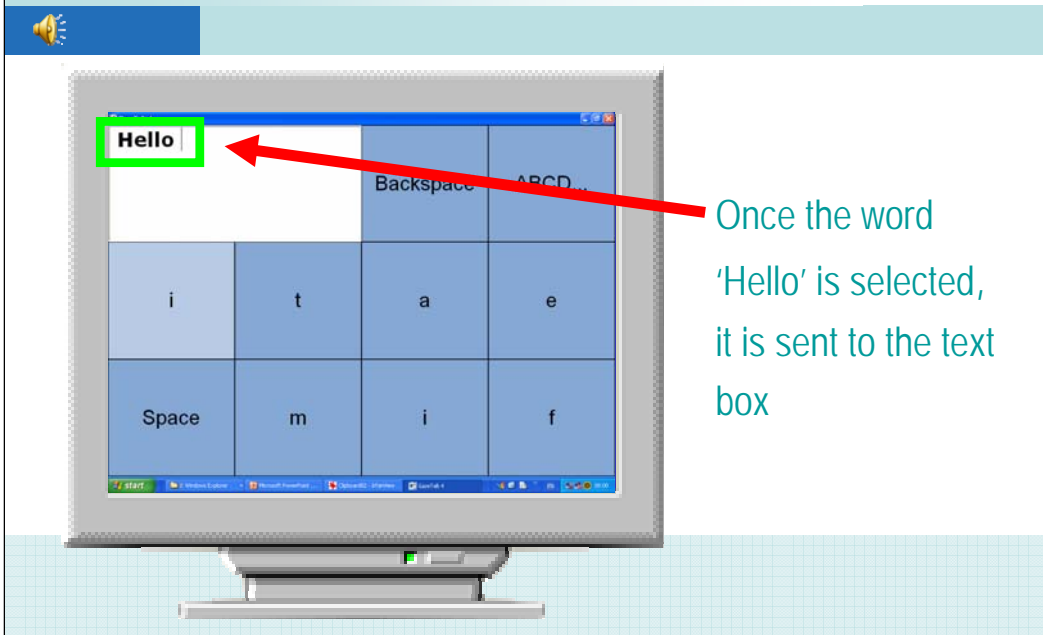


The screenshot shows a computer monitor displaying the GazeTalk application. The application window has a title bar that says 'GazeTalk - 1'. Inside the window, there is a text input field containing the text 'Hel'. Below the input field is a grid of buttons. The top row of buttons contains 'Backspace' and 'ABCD...'. The second row contains 'Hello', 'm', 'l', and 'p'. The third row contains 'Space', 'e', 'd', and 'i'. A red arrow points from the 'Hello' button to the text 'Hel' in the input field. The Windows taskbar is visible at the bottom of the screen.

As a result of typing the letters 'Hel'... the word 'Hello' is offered as a prediction

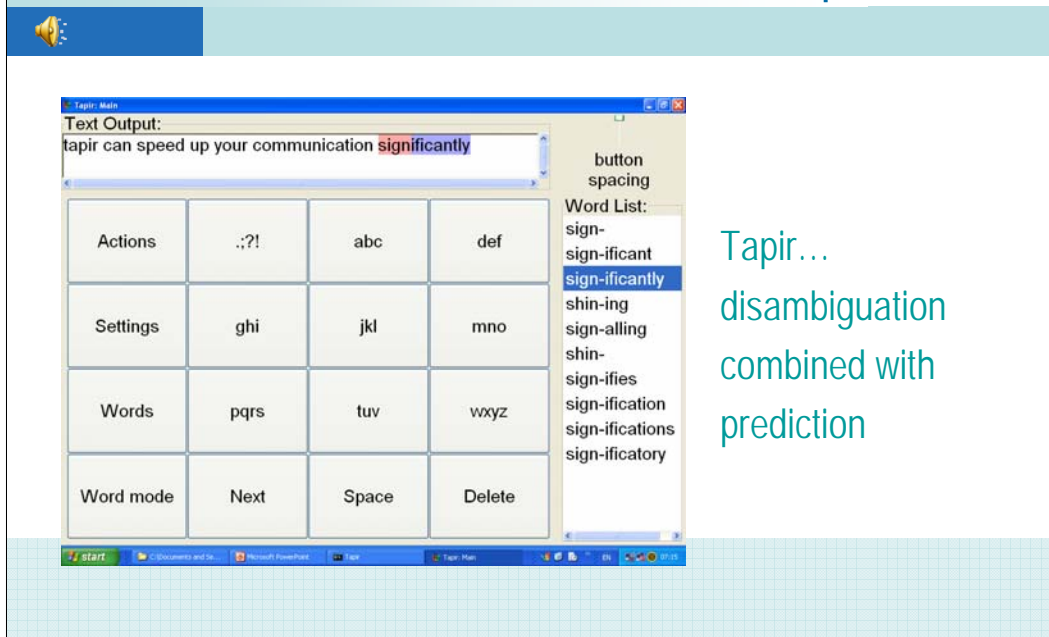
As a result of typing the letters 'Hel'... the word 'Hello' is offered as a prediction.

2(b) 'Off-the-shelf' eye control software – GazeTalk



Once the word 'Hello' is selected it is sent to the text box.

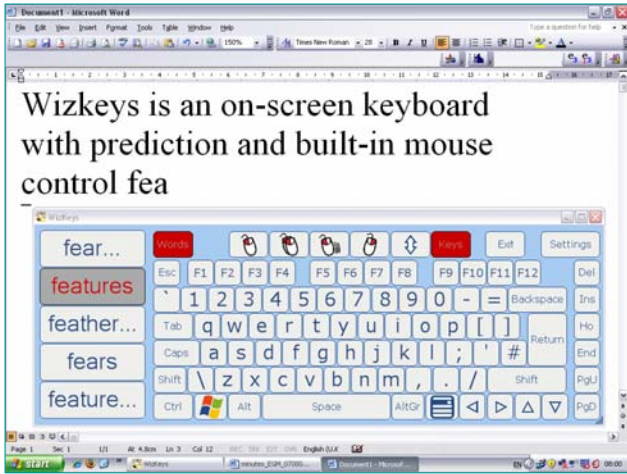
2(b) 'Off-the-shelf' eye control software - Tapir



This is Tapir. It is way of writing that includes the techniques of both disambiguiton and prediction. As with Gazetalk, one of the benefits for the eye control user is that they can write efficiently without having to choose from small targets.

2(b) 'Off-the-shelf' eye control software - Wizkeys



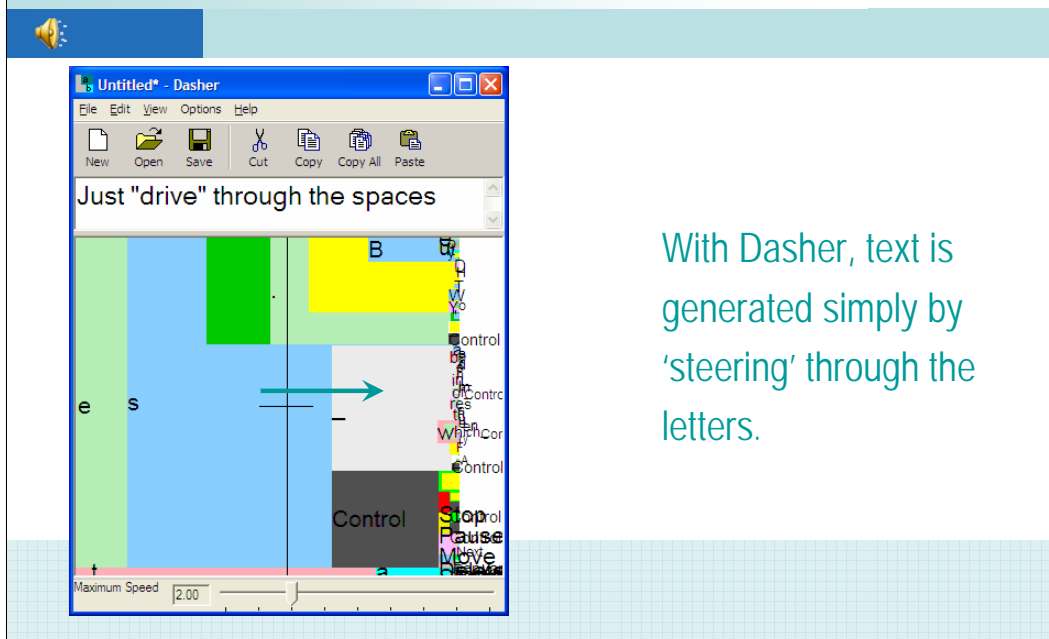


Wizkeys is an on-screen keyboard with prediction and built-in mouse control fea

Wizkeys provides prediction and mouse utilities, if required, and can be resized.

Wizkeys is an on-screen keyboard that can be used with eye control or any other form of pointer control. It is available in a wide range of European languages and offers prediction and mouse utilities if required. It can be resized and repositioned to match the user's requirements.

2(b) 'Off-the-shelf' eye control software - Dasher



With Dasher, text is generated simply by 'steering' through the letters.

Dasher is potentially the quickest way to produce text using eye control. The technique is to simply steer the cursor through the letters offered in order to form words. For people who are skilled users of Dasher, this means that very little eye-movement is required and text can be generated extremely quickly in over 100 different languages.

2. Software for Communication and Control



- (a) included within the system
- (b) off the shelf
- (c) framework software

Many of the 'off the shelf' systems just described provide a variety of options but don't incorporate all of the features required by all potential eye-control users. For example, to use the on-screen keyboards illustrated, the end user needs to be literate and have reasonably good eye control. If not, they will need to use customisable or 'framework' software.

2(c) Framework Software



All of these people have...

Visual difficulties and/or
Involuntary head movement

They need customisable,
'framework' software



Even though all of these people are intelligent and literate, they all have difficulties either with controlling their head movements or eye movements. As a result, the off-the-shelf solutions are not appropriate for them. This makes it necessary to design a personalised eye control interface using customisable framework software.

Michael



Stroke

Intelligent, well motivated

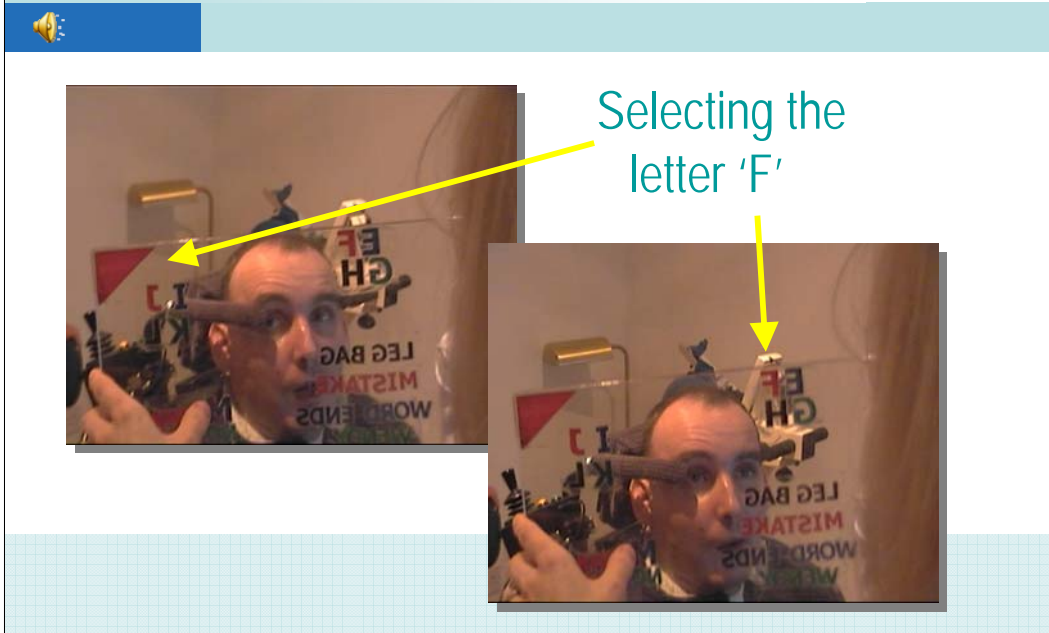
Head switch - environment &
wheelchair

Wants something quicker and
easier



Michael, who suffered a stroke a few years ago is intelligent and well motivated.

He uses a head switch for environmental and wheelchair control. He wants to use the computer for business and is looking for something quicker and easier to use than switch access to the computer.



Michael uses an Etran frame to communicate. To select the letter 'F', for example, he looks at the corner of the Etran frame to show his communication partner that the letter he wants is coloured red. He then looks at a the group of letters which includes the letters 'E', 'F', 'G' and 'H'. His communication partner then knows that it is the letter 'F' he wants because this is the letter that is coloured red. Even though Michael has involuntary eye movement, it is quite straightforward for Michael's communication partner to read his eye pointing because he is looking at large areas on the Etran frame. Context knowledge is also very helpful in interpreting where Michael is looking.

Michael



Difficulties for eye control system to accommodate ...e.g nystagmus.

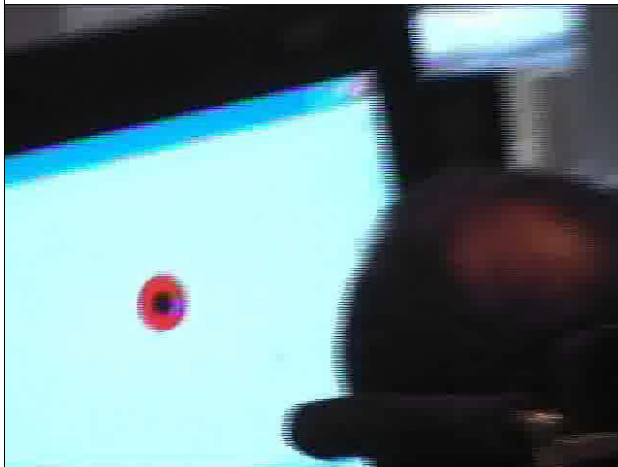


[Click here to play the video from web](#)

(Please click on the picture to play the video)

For an eye controlled computer, though, interpreting Michael's eye movement is more difficult. As you will see from clicking on the video clip, Michael has a certain amount of involuntary eye movement, nystagmus.

The video clip is available online at
http://www.cogain.org/user_involvement/eye-control-hints-and-tips/software_and_activities/EyeMovement.mpg



Visual Tracking



*(Please click
on the picture
to play the
video)*

[Click here to play the video from web](#)

In this video clip, where Michael is trying to follow the movement of the red ball with his eyes, it is possible to gain an insight into just how much involuntary movement there is. For someone without a visual difficulty, there would be a virtually straight blue line following the red ball.

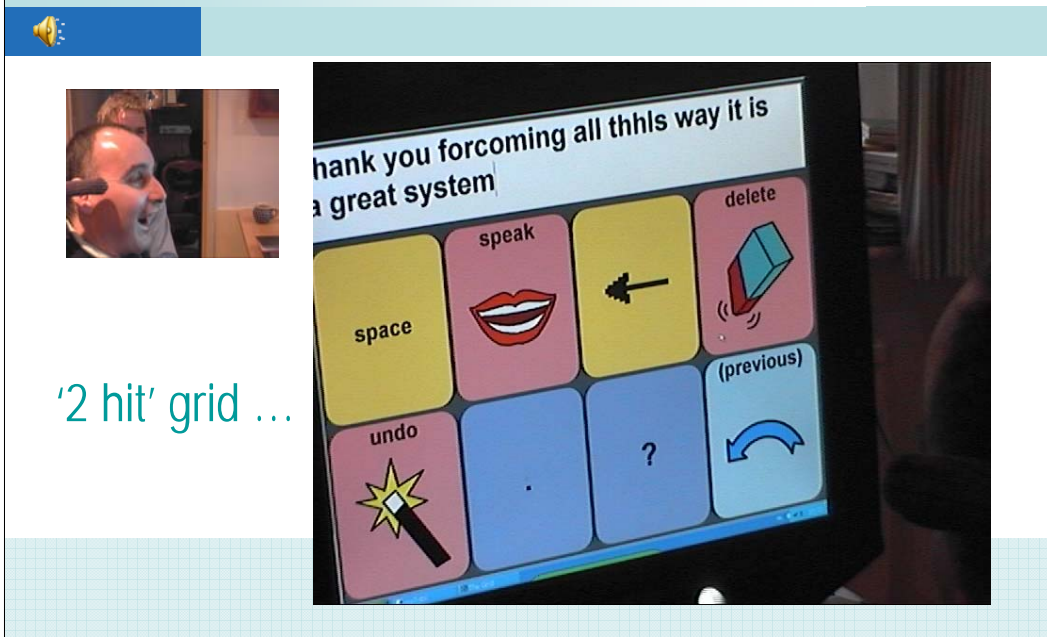
The video clip is available online at

http://www.cogain.org/user_involvement/eye-control-hints-and-tips/software_and_activities/TrackingClip.mpg



The nature and extent of Michael's involuntary eye movement.

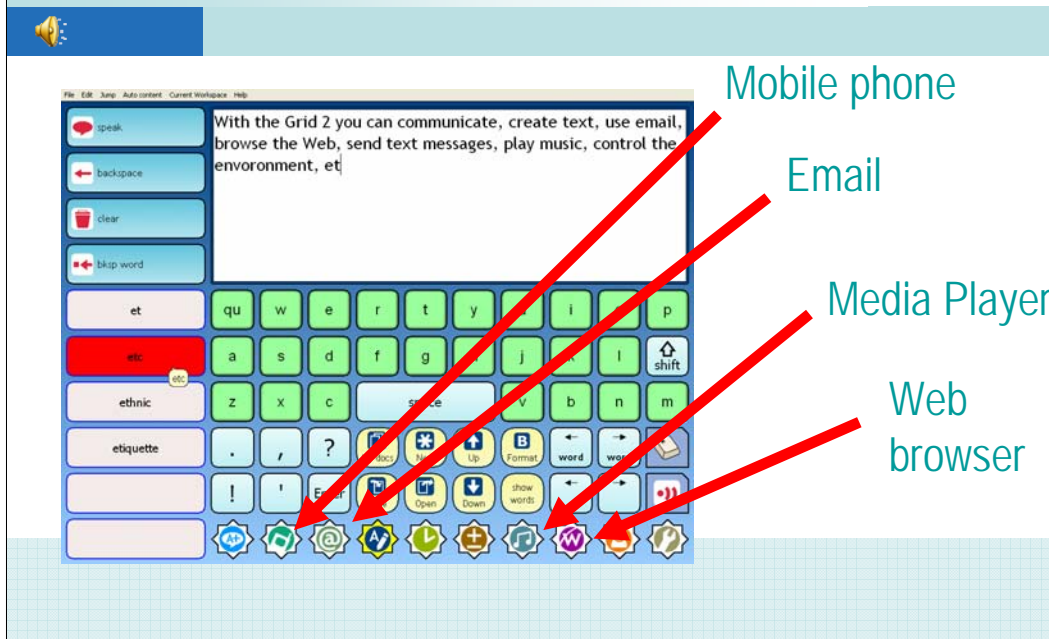
This 'still' taken from the video, indicates how much involuntary eye movement there is over a period of about half a second.



'2 hit' grid ...

The MyTobii is a system that can accommodate a certain amount of involuntary eye and head movement, so Michael was able to use eye control for typing using the type of '2 hit' grid described earlier.

2(c) Framework Software

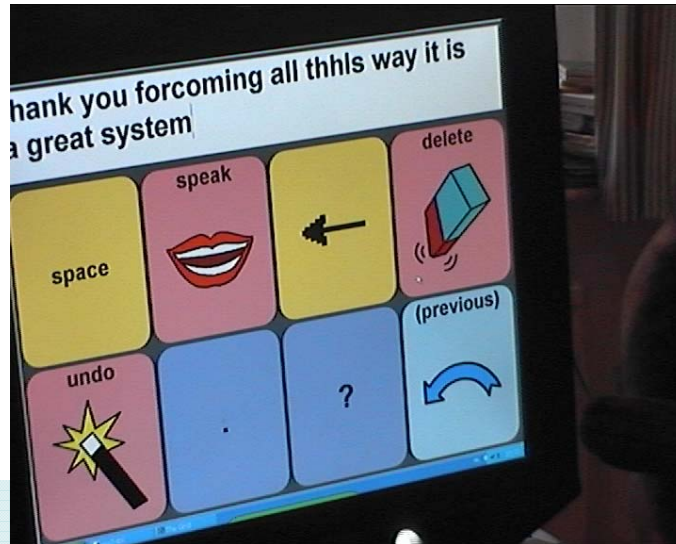


It must be acknowledged that framework software isn't just for special, customised access, by providing large targets. Here, for example, is the Grid 2 with a full on-screen keyboard, prediction and access to a wide range of utilities, all available from a single screen. With this grid-set, for example, the user can independently move between text-messaging, communication, writing, emailing, using a calculator, web browsing, etc. Nonetheless, if the user requires larger cells, being framework software the Grid can be modified to do this.

2(c) Framework Software

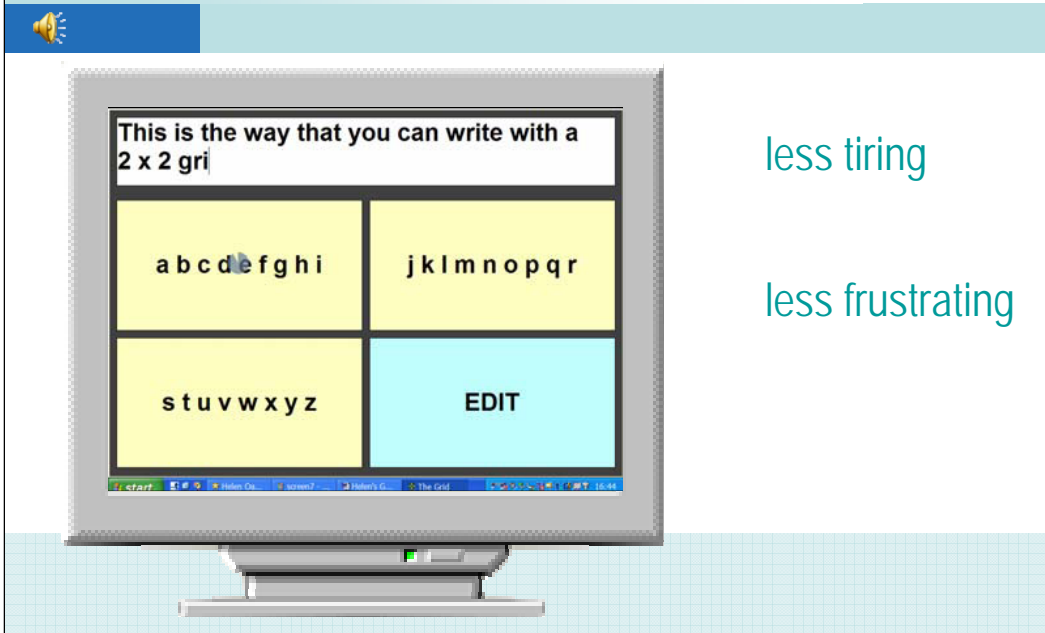


Some mistakes...



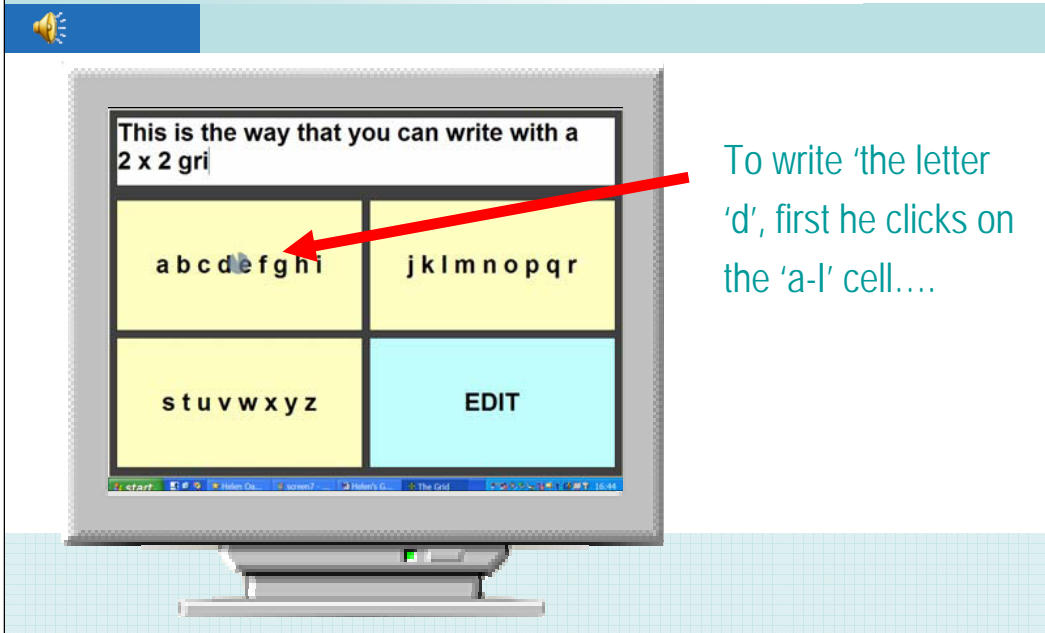
Going back to the earlier slide again we can see that Michael has, in fact, made a few errors. Over a period of time, we found that, for Michael, even cells this large were too small. Michael kept making mistakes. He had to keep deleting letters, which was tiring and frustrating. Also, there was very little margin for error with his calibration and he had to work very hard to select a cell. As a result, we tried even larger cells with Michael, as you can see from the next slide.

Less 'efficient' BUT...



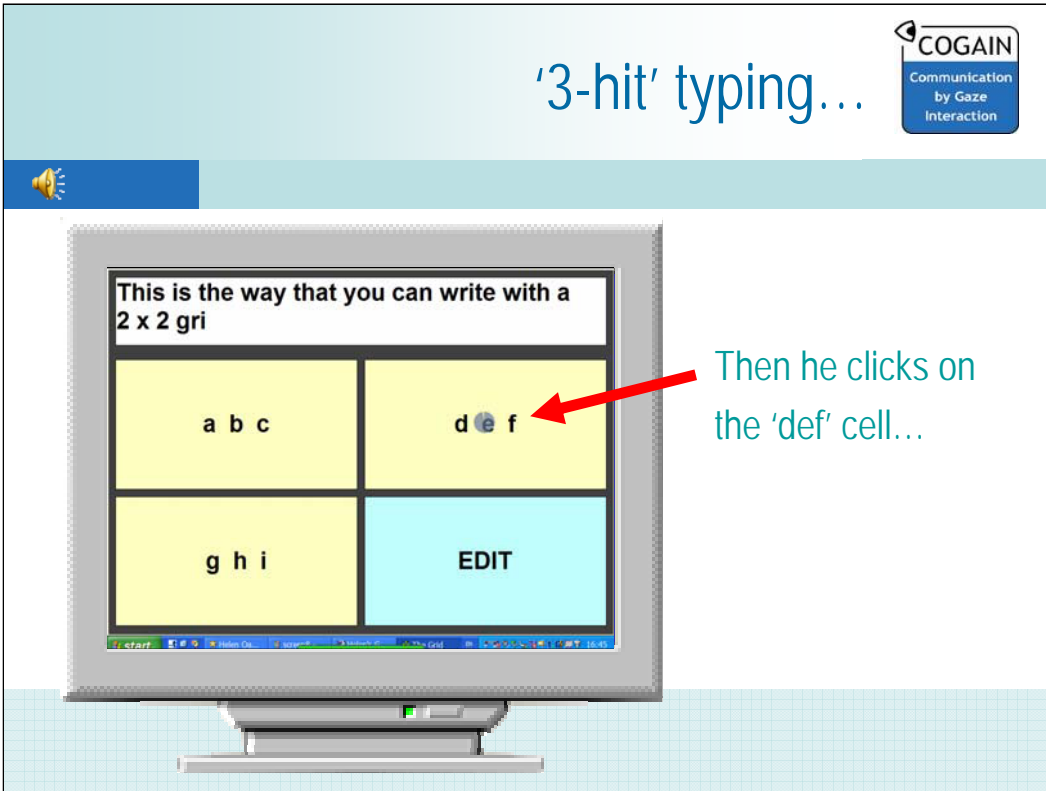
With this size of cell, Michael found that he didn't have to work so hard. In addition, it wasn't as difficult for the computer to interpret his eye movements. Therefore there were less errors. Even though, with smaller cells, the layout was less 'efficient', Michael preferred this layout. For him, the overriding factors were that (a) he was less tired when using it and could therefore use it for longer and (b) he made less mistakes and was therefore less frustrated.

'3-hit' typing...



With this grid-set, Michael can type an individual letter with three 'hits'. To write the letter 'd' for example, first he clicks on the 'a-i' cell.

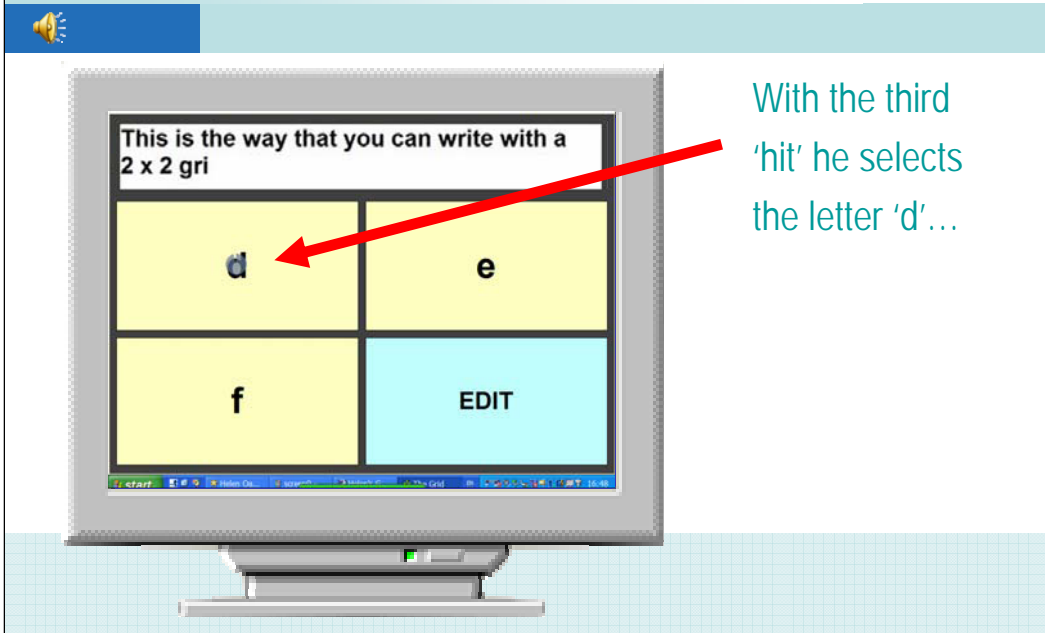
'3-hit' typing...



Then he clicks on the 'def' cell...

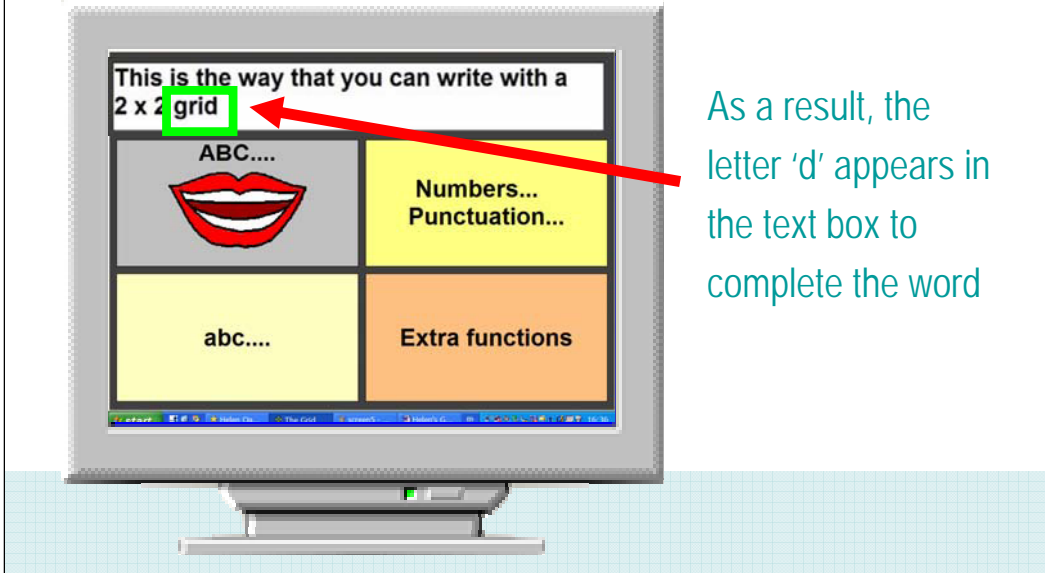
Then he clicks on the 'def' cell.

'3-hit' typing...



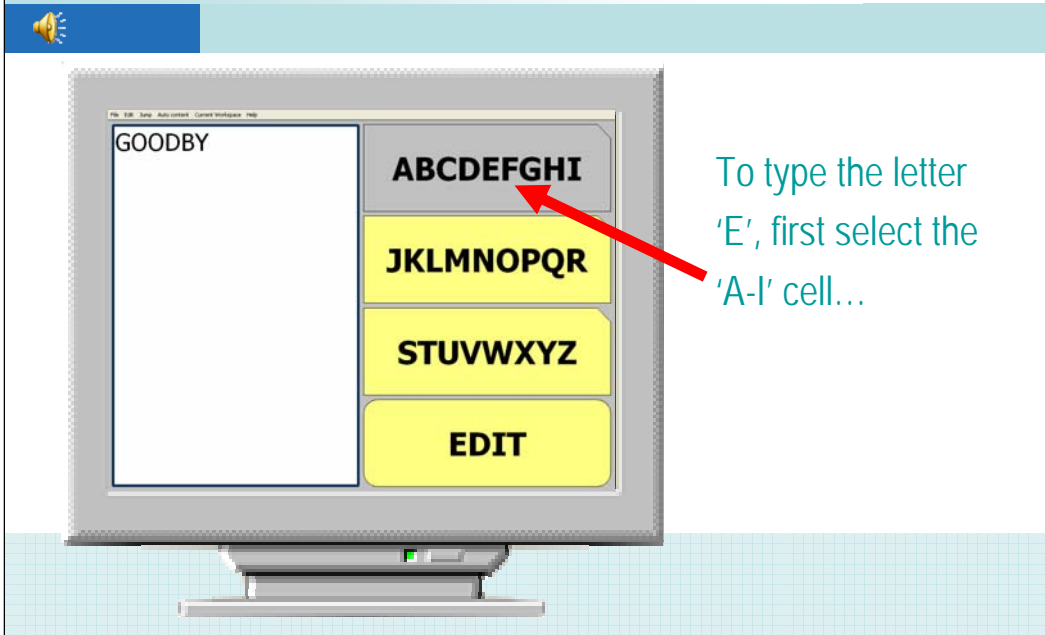
And finally, with the third 'hit', he selects the letter 'd'.

'3-hit' typing...



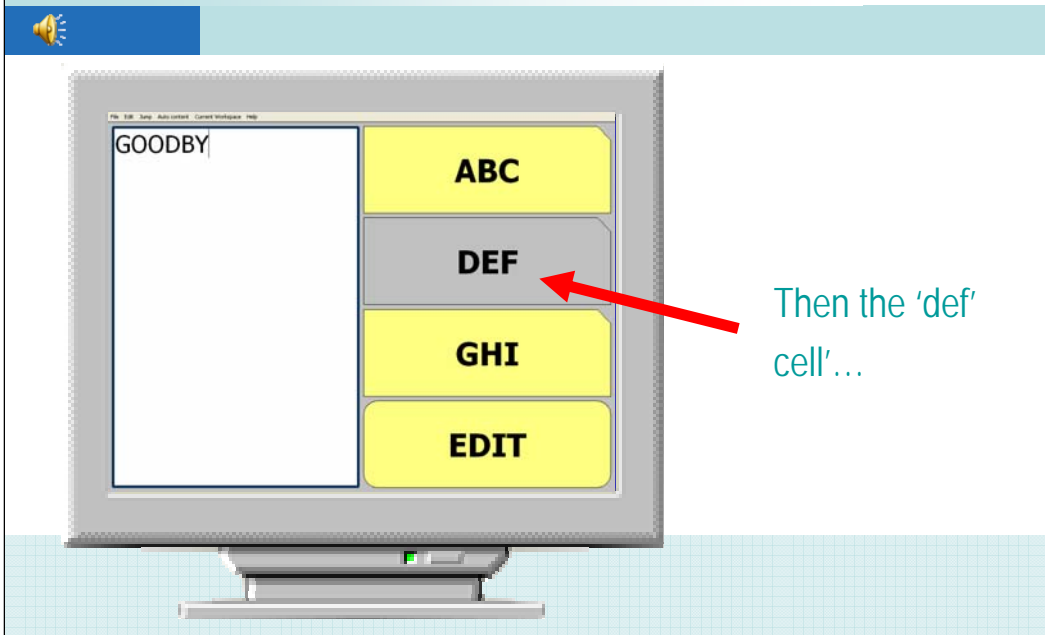
As a result, the letter 'd' goes into the text box.

Vertical '3-hit' typing...



This is a variation of the same idea which was developed for someone with 'locked-in' syndrome. They could only move their vertically and had involuntary eye movement so they could only access large cells. First the 'A-I' cell is selected.

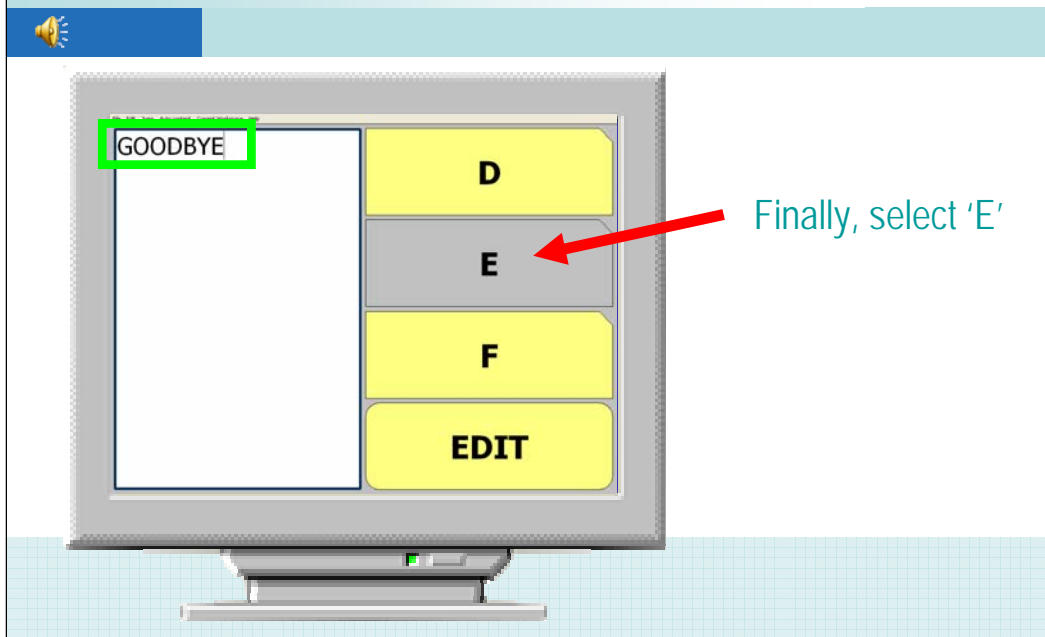
Vertical '3-hit' typing...



Then the 'def'
cell'...

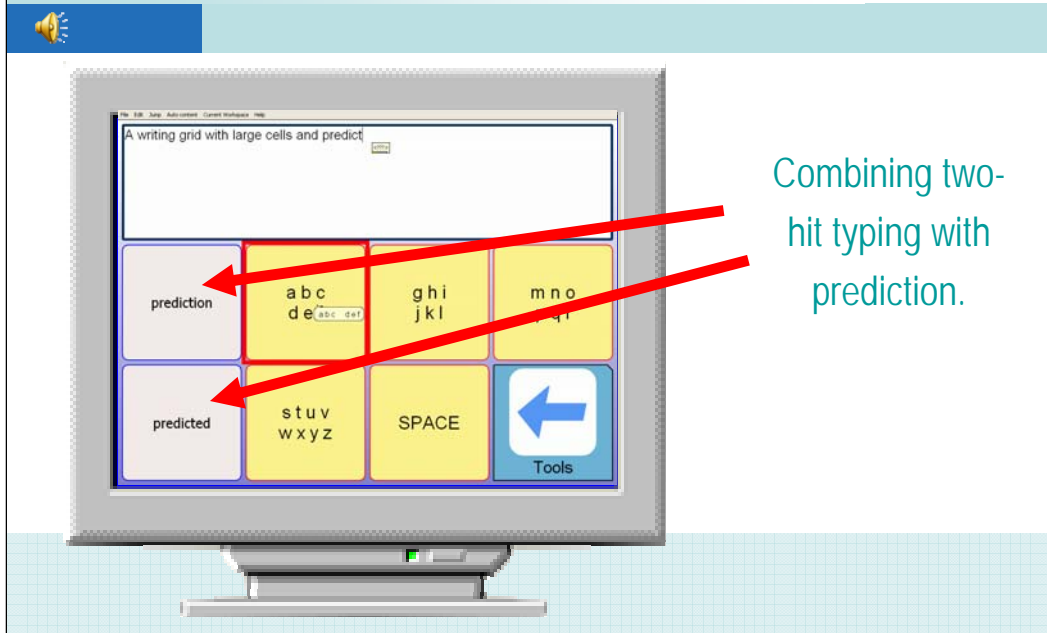
Then the 'd-f' cell.

Vertical '3-hit' typing...



And finally, the individual letter is selected and sent to the text box.

Predictive '2-hit' typing...

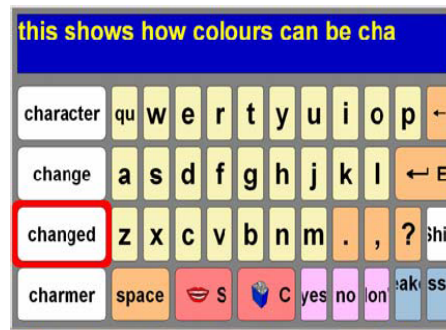


Clearly, two or three 'hits' is less efficient than simply selecting an individual letter on the screen. However, techniques such as disambiguation, abbreviation-expansion and prediction can significantly speed up text generation. Here, for example, we can see prediction being used successfully on a 4 x 2 grid.

As well as text output, user requirements include....



- Resizable cells and grids
- Flexible calibration process
- Speech facilities
- Choice of languages
- Environmental Control
- Choice of symbols or text output, etc...



In fact, the facility to have resizable cells and grids is just one of a range of facilities that users with disabilities have told us they require. Other requirements include...

A flexible calibration process

Speech facilities

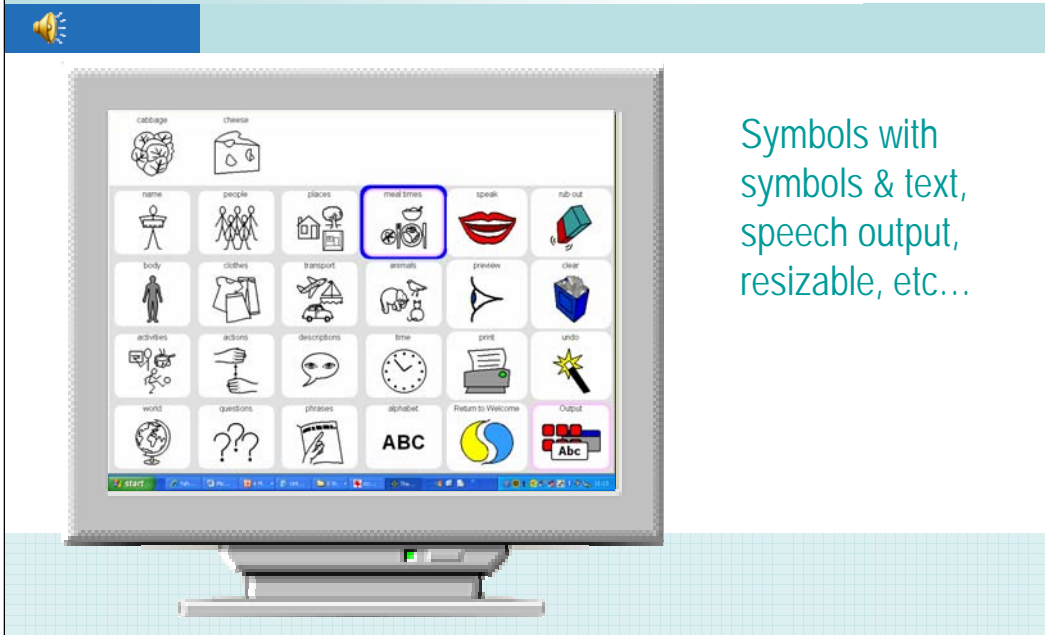
A choice of languages

Environmental Control

A choice of symbols or text output, etc.

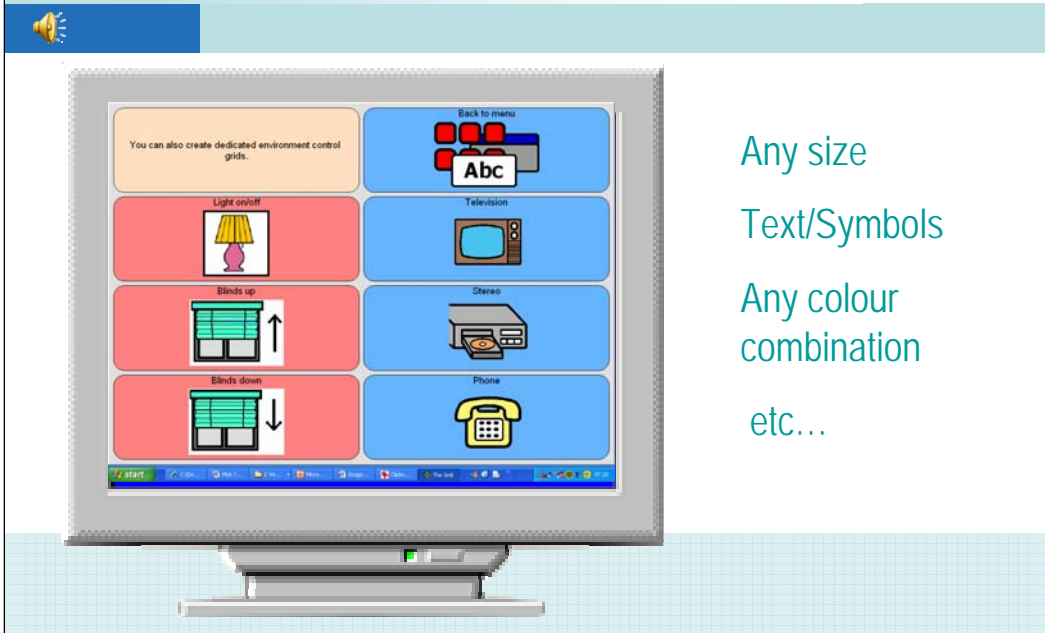
Here, for example, is a grid set for someone with a visual impairment who finds it difficult to see black letters on a white background. Their preference is for yellow text on a blue background.

Symbol input and output...



Here is another grid-set designed with individual needs in mind. This grid set, for example, provides text with symbols for both input and output. It also has speech output.

Highly customisable environmental control



With this framework programme, the user can control their environment using eye control. Amongst the benefits of using framework software for some eye control users are features such as a choice with the size and shape of cells, a choice of text size, font and language. Symbols can also be used if required and any combination of colours can be used.

A wide choice of framework software....



Communicator 3,
The Grid 2
Speaking Dynamically Pro
SAW,
RollTalk,
Clicker 5,
QualiLife,
Wivik,
EZKeys, etc.



It must be strongly emphasised that there is a wide range of framework software that can be used for eye-control. Even though the Grid has been used to illustrate many of the concepts involved in using framework software for eye control, there are many other such programs. These are just a few examples of the wide range of very powerful software that can also be used for eye control and provide a high a level of customisation and personalisation.

A wide choice of framework software....



Here is 'Rolltalk', for example. From the screenshot, we can see that the person using this system uses 'bliss symbols' for their communication. As the pictures illustrate, this particular Rolltalk user has their Rolltalk system mounted on their wheelchair and can access it using eye control. If we look at the screenshot on the right, we can see that the user can easily go from symbol communication to playing media files, to using a mobile phone, etc. just by using their eyes. The photo of the Rolltalk system on the left shows that they can even play music too!

Putting the eye control user at the centre....



'Participatory Design'

Photograph courtesy of Prof. Anthony Hornof, University of Oregon

Whichever framework software is used, it is essential to put the end-user at the centre of the design process, a process often called Participatory Design. Here, Michael is using an Etran frame to tell those supporting him how he feels about the design of a web browser that is being incorporated into his framework software.

Putting the eye control user at the centre....



Photograph courtesy of Prof. Anthony Hornof, University of Oregon

This is not an easy process. Michael now prefers to use a 3 x 2 grid layout. In the photograph, he is trying out a newly designed web browser for the first time. Not only is the design of a web browser difficult and time consuming because of the restrictions of a 2 x 3 layout but Michael's visual difficulties also mean that his Web browser must also be set up to speak out what is on the screen.

Putting the eye control user at the centre....



Participatory
design
+
framework
software
= success

Photograph courtesy of Prof. Anthony Hornof, University of Oregon

However, by listening carefully to Michael's comments and requirements in combination with powerful framework software, those supporting Michael are making excellent progress.

To find out more, please go to...



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Downloads...
Deliverables 3.1, 3.2 & 3.3
...and more...

To find out more, go to www.cogain.org and download Deliverables 3.1, 3.2 and 3.3. More information will be made available in the future.



COGAIN would like to express its sincere thanks to those who have been kind enough to be involved in the project and to give their permission to be used as case studies in this presentation in order to help others.

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