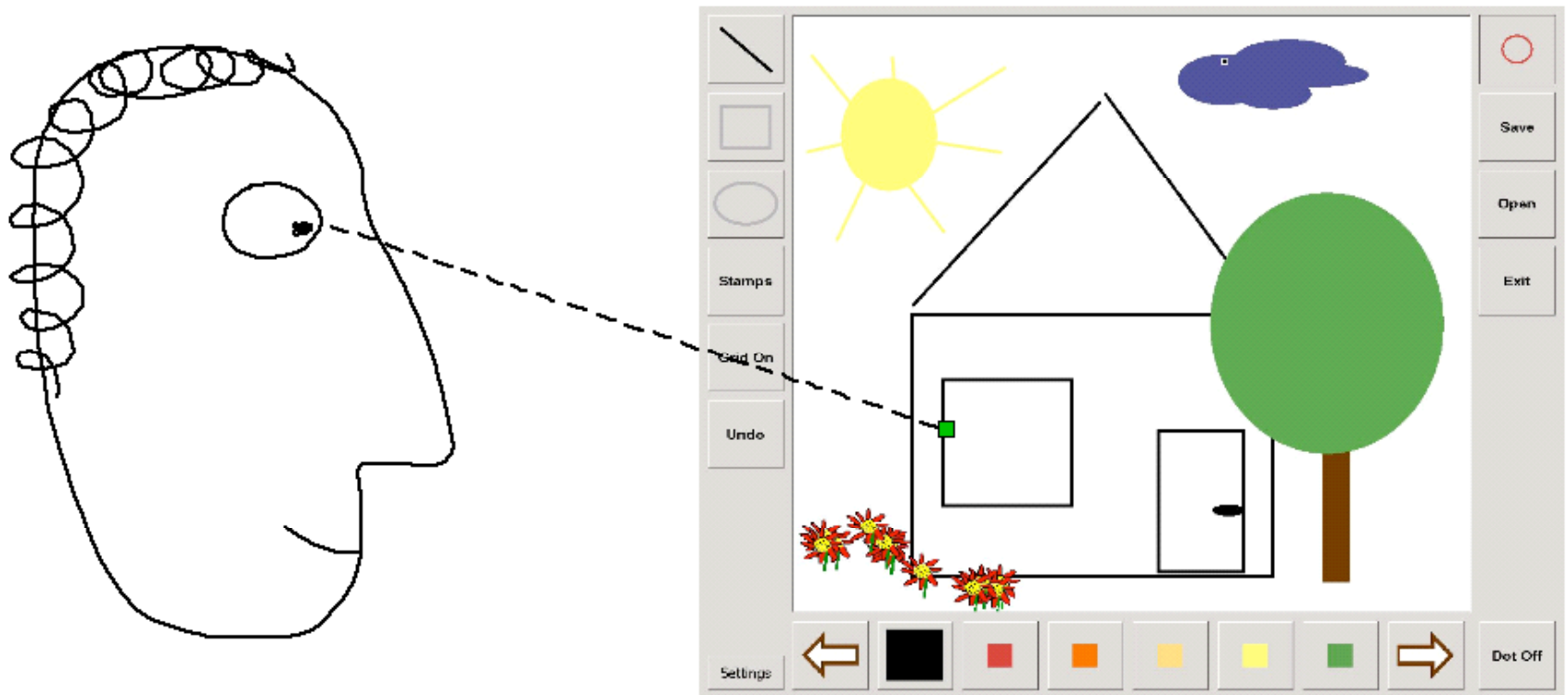


EyeDraw: A System for Drawing Pictures with Eye Movements

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University of Oregon, Sponsored in part by NSF and ONR



The 3 Main Points of This Talk

1. EyeDraw is a software system that enables children to draw pictures by just moving their eyes.
2. EyeDraw utilizes and introduces new low-level techniques for controlling a computer with the eyes.
3. EyeDraw has been successfully user-tested with its target user group—children with severe motor impairments.

Eye Tracking is Used For...

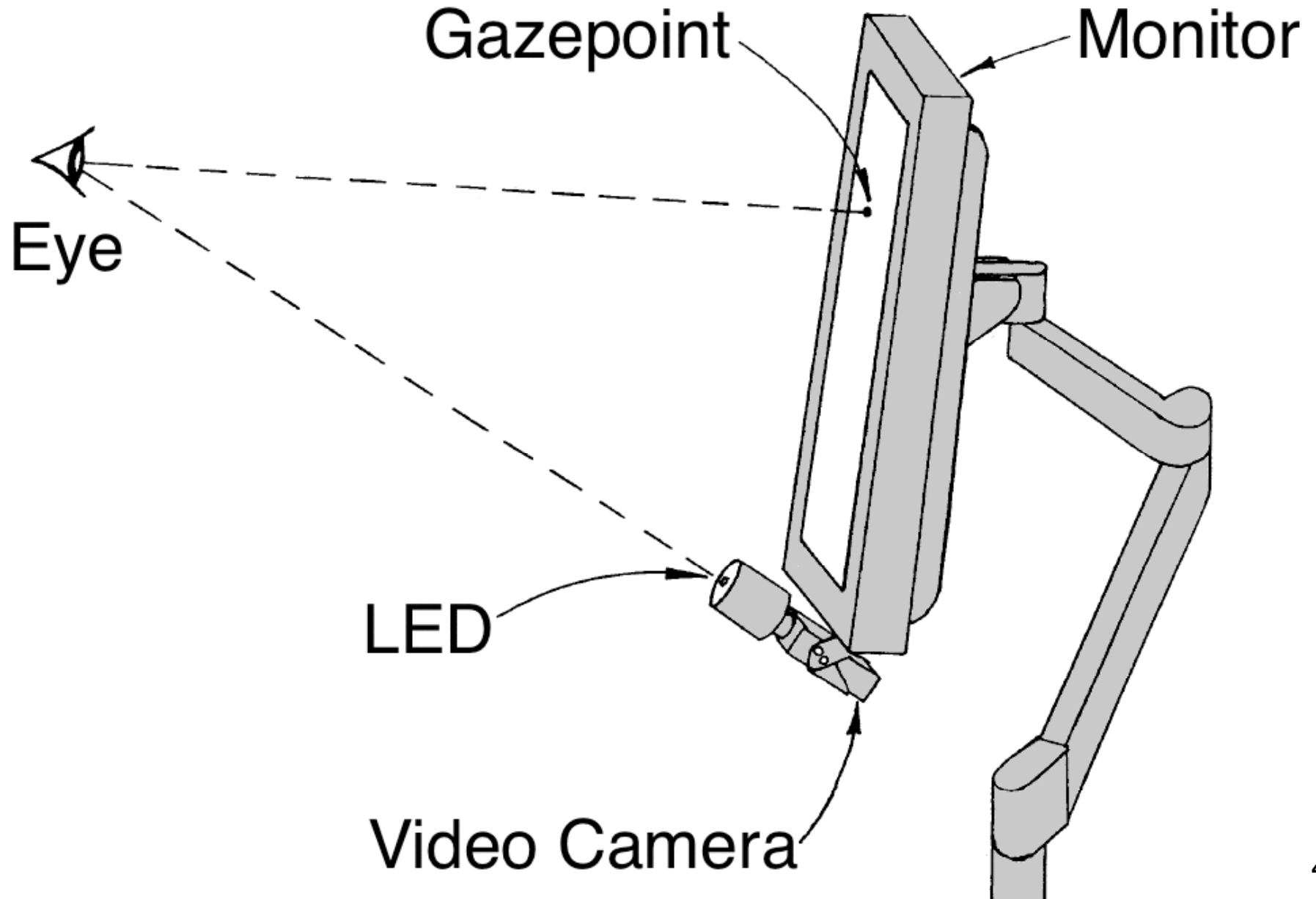
1. Retrospective analysis

- To figure out how people completed a visual task.

2. Real-time input

- To respond to eye movements as they occur.
- To enable people with severe motor impairments to control a computer with their eyes.

An eye tracker reports the gaze point.



How the Eyes Move

The eyes move with **saccades**, or quick ballistic jumps (~30 ms).

Between saccades, the gaze is stationary (with a slight tremor) for **fixations** that last 100 to 400 ms.

A long fixation is a **dwell**.

Software for Controlling a Computer with the Eyes



Eye gaze used with
“Speaking Dynamically Pro”

ESC	<-	->	^	v	Hom	End	PgU	PgD	-	=	OUT
'	1	2	3	4	5	6	7	8	9	0	DEL
TAB	q	w	e	r	t	y	u	i	o	p	ENT
SHF	a	s	d	f	g	h	j	k	l	;	SHF
	z	x	c	v	b	n	m	,	.	/	
SL	CTL	ALT	SPK	SPACE					PSE	<-BACK	

Eye typing with Eyegaze

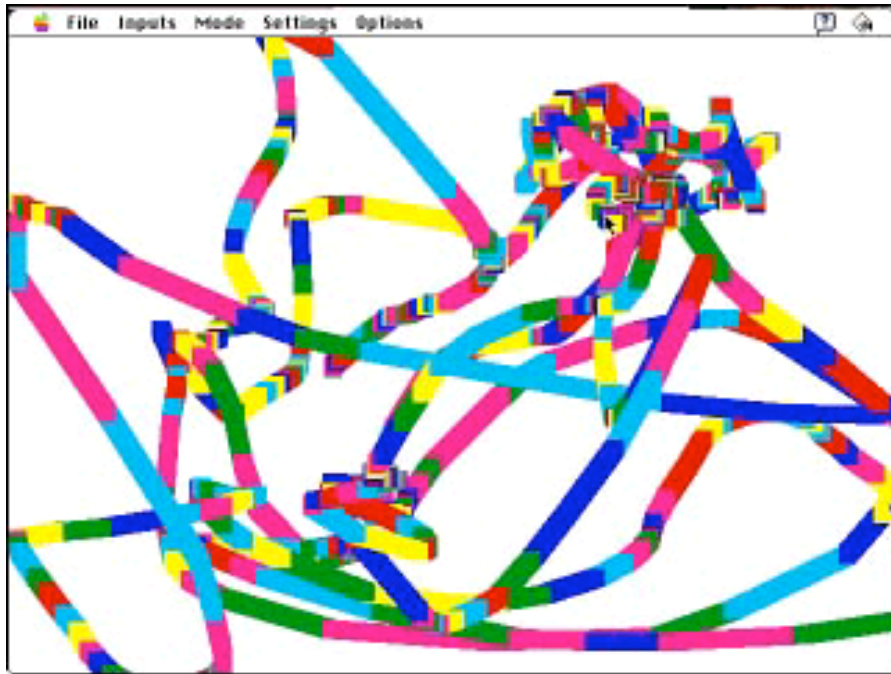
The eye tracker can move the mouse on a second computer, but it is slow and tedious.



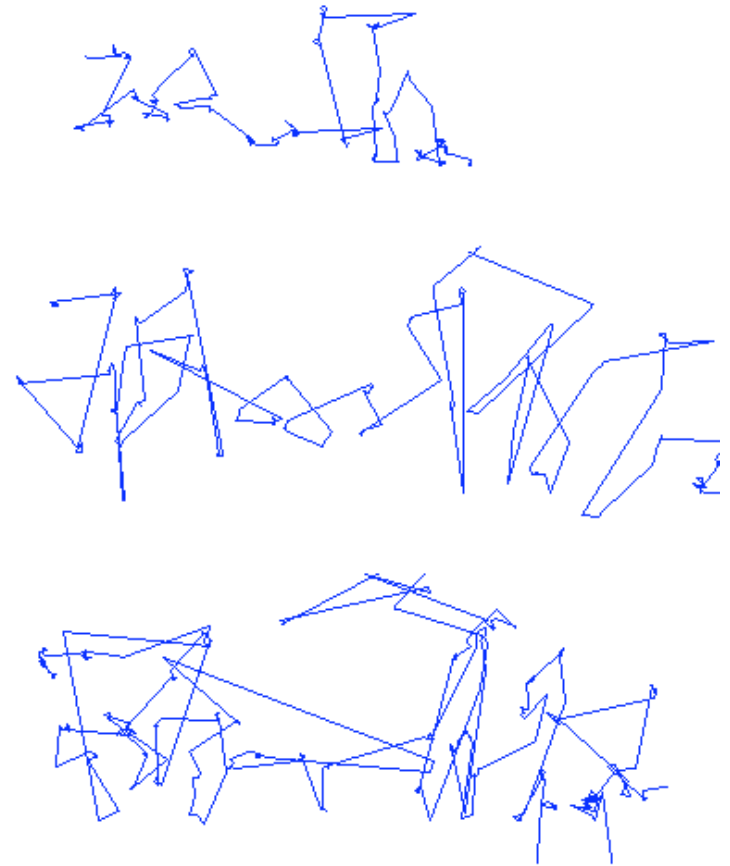
There is not much eye-controlled software for children or for drawing.

Free-Eye Drawing

Digital ink “pours” out of the gaze point.



EaglePaint
(Gips and Olivieri, 1996)



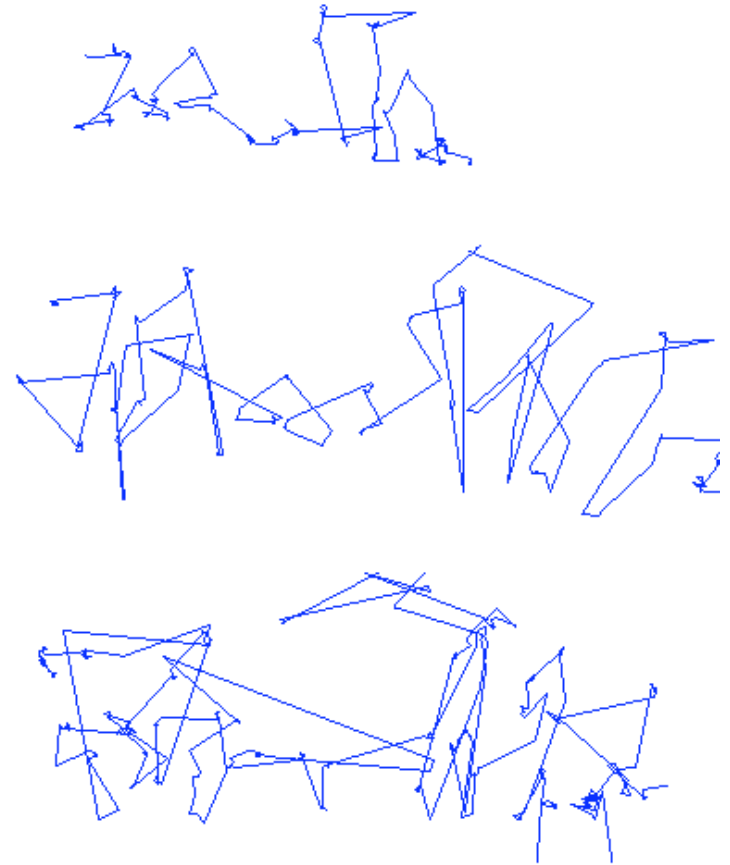
(Tchalenko, 2001)

Free-Eye Drawing

Digital ink “pours” out of the gaze point.

Two Problems:

1. Eye movements are ballistic and jerky.
2. Midas Touch Problem:
Distinguish between
(a) just looking
(b) an eye-command.



(Tchalenko, 2001)

How EyeDraw Works

1. EyeDraw puts an eye-cursor on the screen.
2. The user moves the eye-cursor.
3. The user dwells (> 500 ms).
4. The eye-cursor changes from green to red, thus asking: “Start drawing here?”
5. User responds “no” by moving their eyes.
User responds “yes” by continuing to dwell.

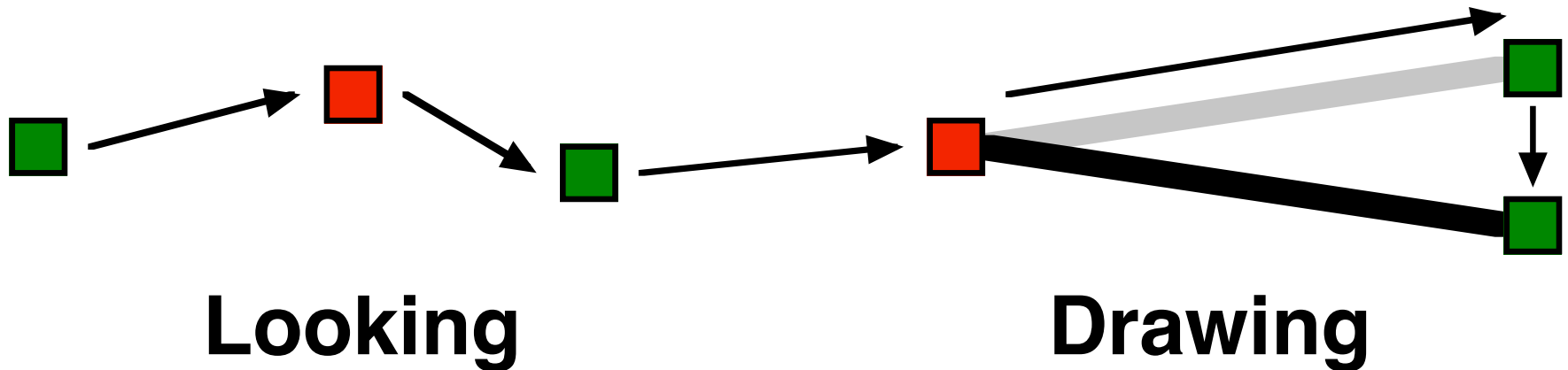
Switching Between Looking and Drawing

Looking

1. User makes fixations < 500 ms.
2. User dwells but then keeps moving.

Drawing

3. User dwells and then holds the dwell.



Benefits of the EyeDraw Cursor Control

1. No Midas Touch Problem:
The user switches between just looking and issuing commands.
2. The user can select arbitrary points.
3. Works with ballistic eye movements.
4. Works with the error in eye trackers.

Two Versions of EyeDraw

Version 1

Lines, circles, grid, undo, save, open.

Version 2

Colors, stamps, eye-controlled drawing settings, user needs.

User Observation Studies

Version 1 tested by:

- Users without disabilities
- Users with disabilities

Version 2:

- Users without disabilities
- Users with disabilities

Users

Without disabilities

- First time using an eye tracker

With disabilities

- Severe cerebral palsy
- Nonverbal
- No functional use of arms or legs
- Normal use of eyes
- Routine use of an eye tracker

Line

Circle

Grid Off

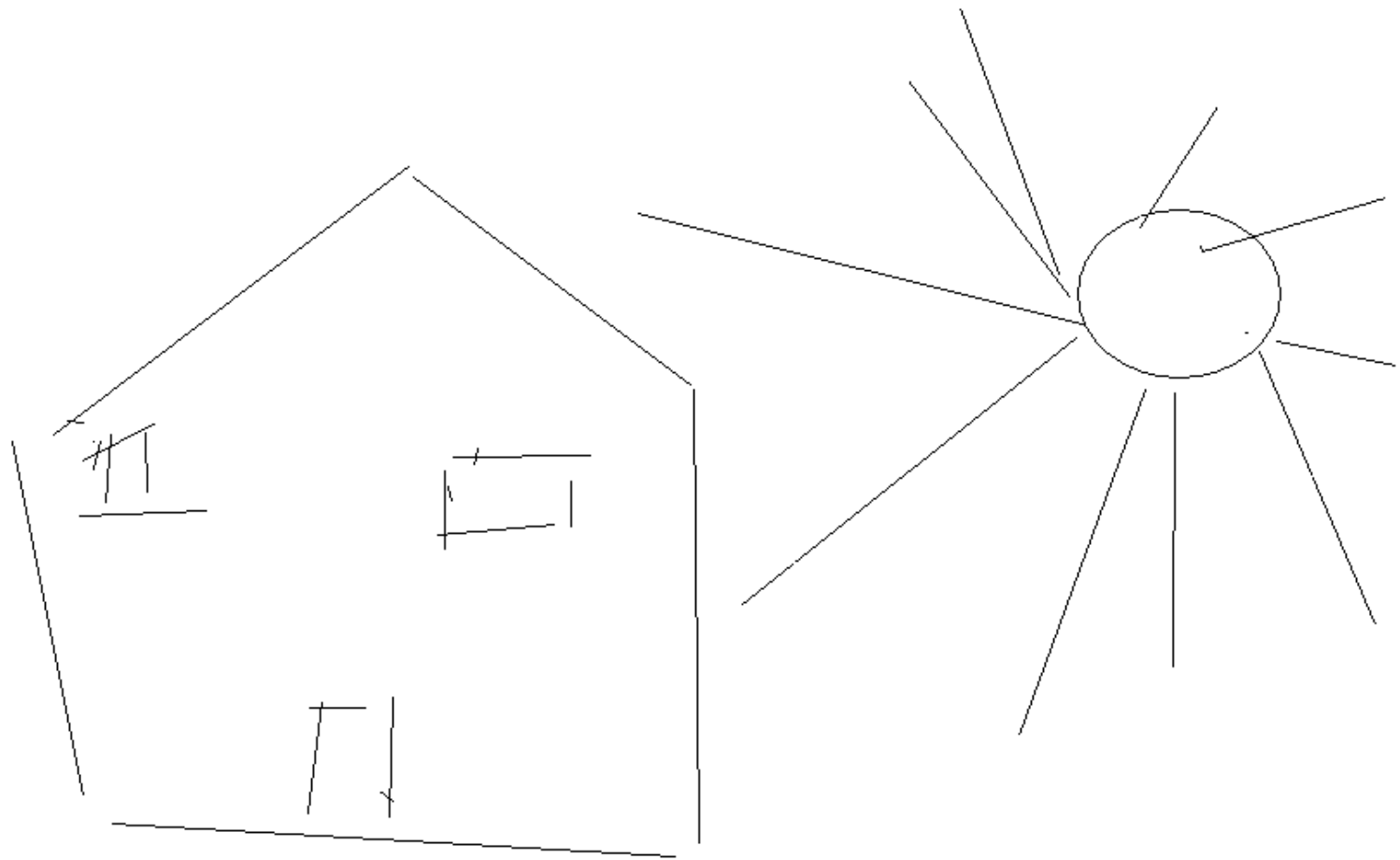
Undo

Version 1

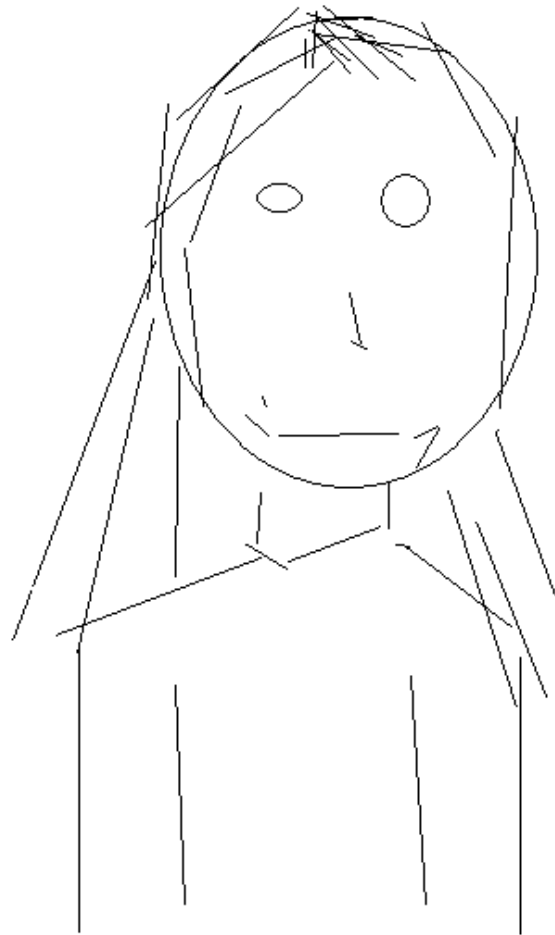
Save

Open

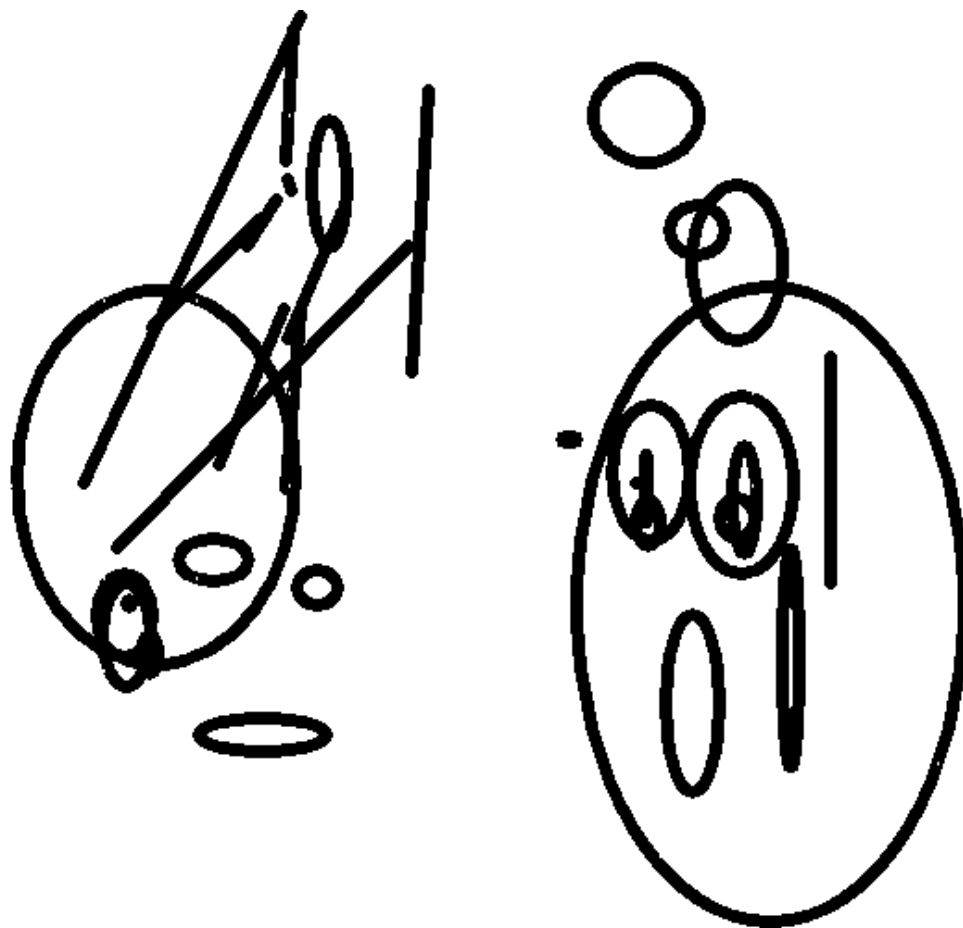
Exit



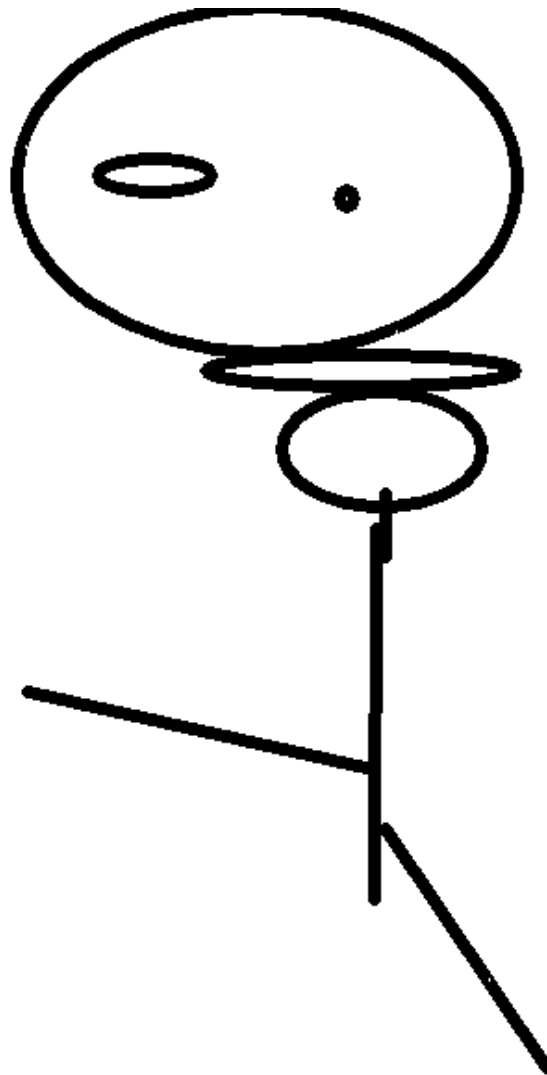
10-year-old girl without disabilities



13-year-old girl without disabilities



18-year-old woman with cerebral palsy.
She eye-typed that it is “someone yelling.”



18-year-old woman with cerebral palsy.
“someone trying to do the jumping jacks”

Results of Version 1 User Testing

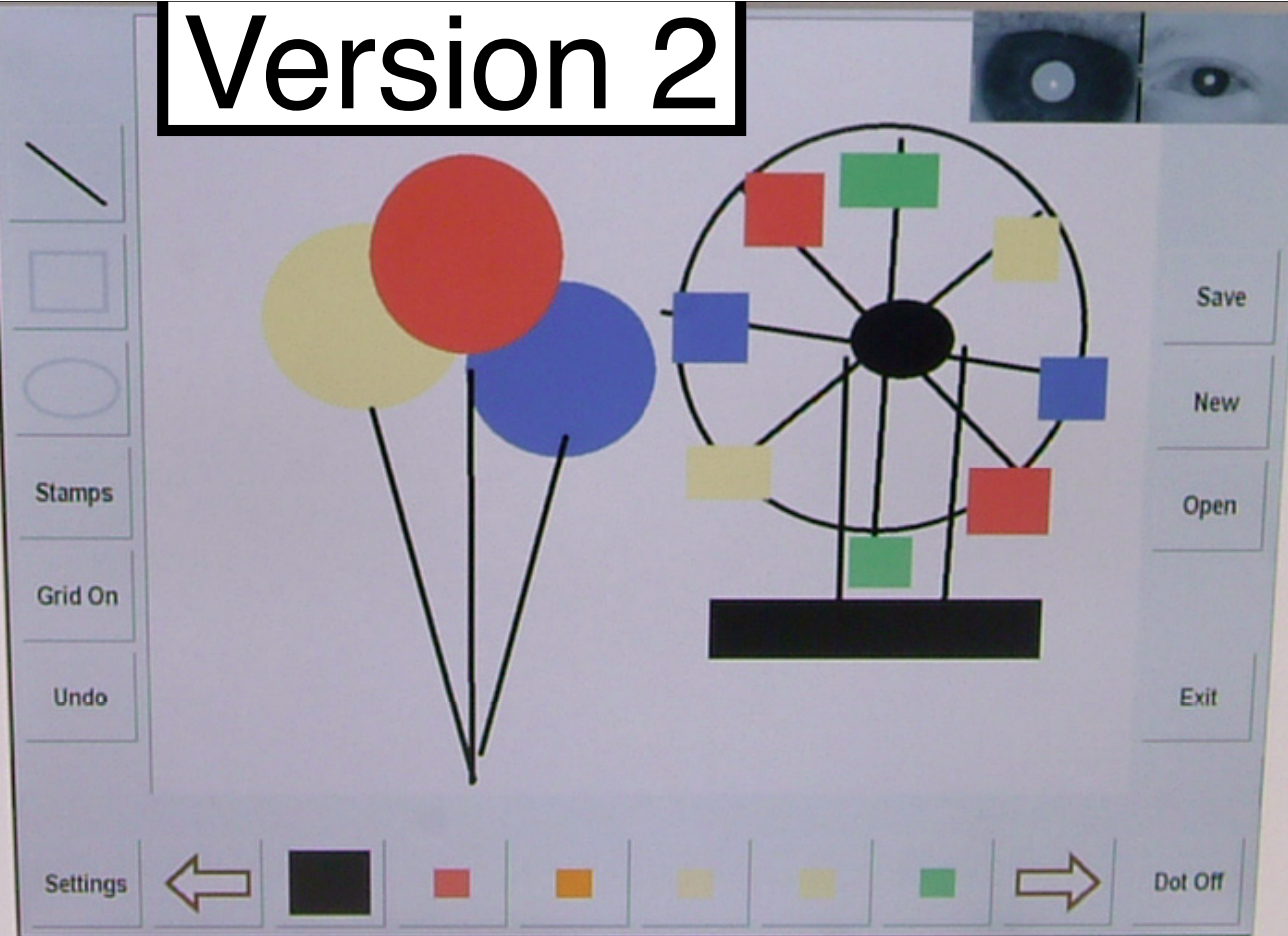
Users without disabilities:

- EyeDraw seems to work: 7 out of 8 users drew recognizable drawings.
- Refined some eye-control settings.

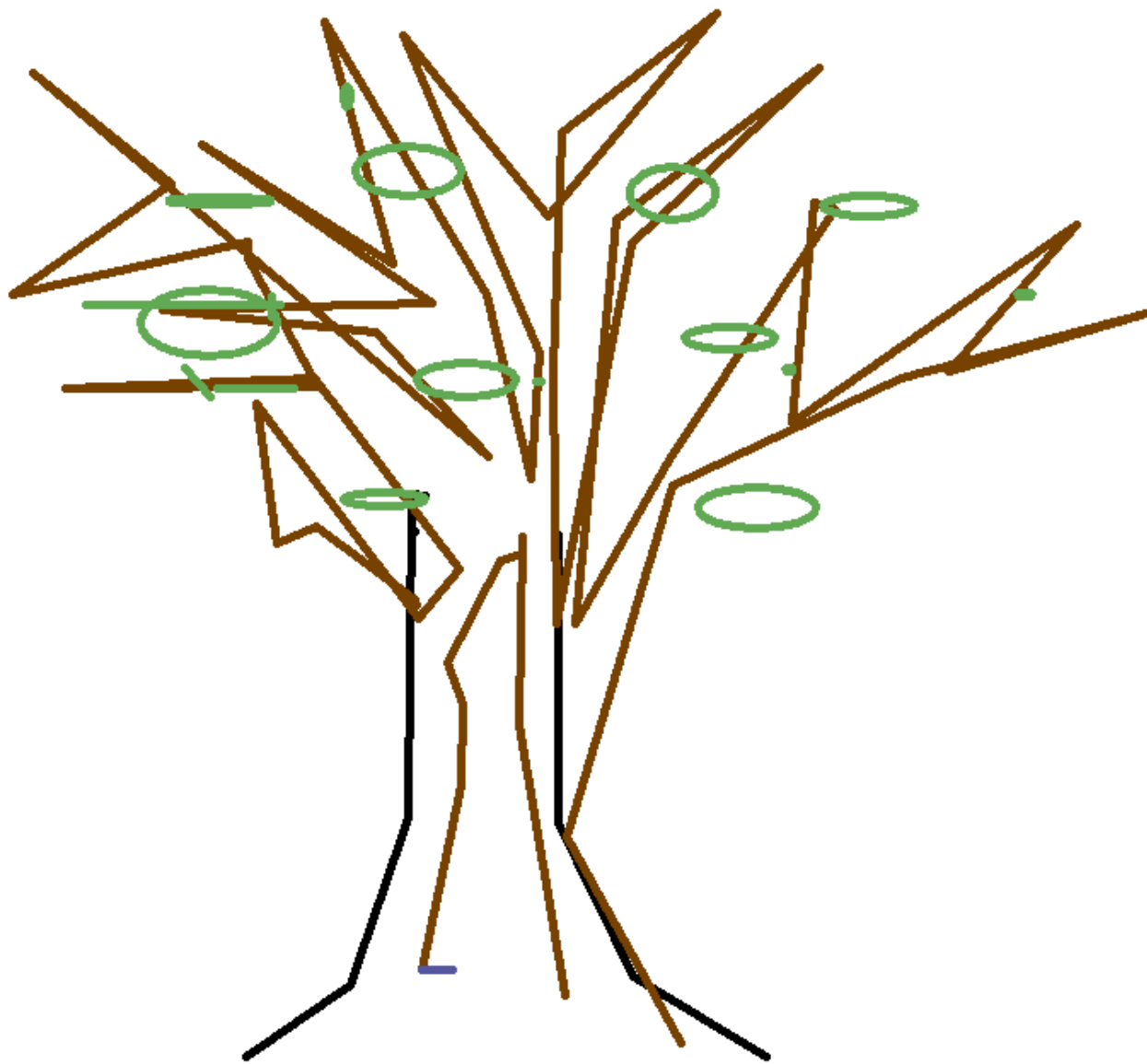
Users with disabilities:

- It sort of works. It is hard at first.
- EyeDraw needs to be accessible without caregiver intervention.
- Eye image needs to be on the screen.

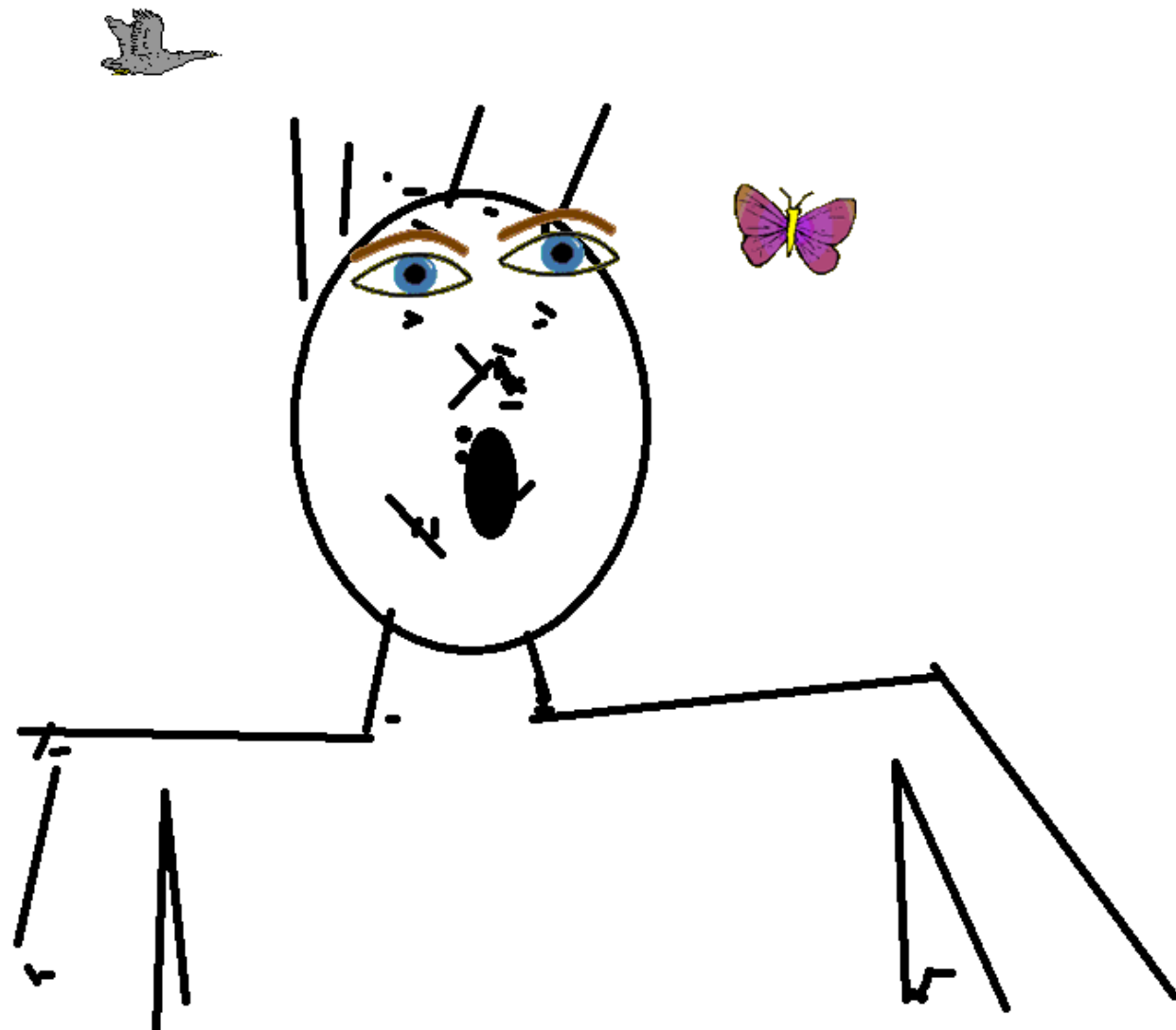
Version 2



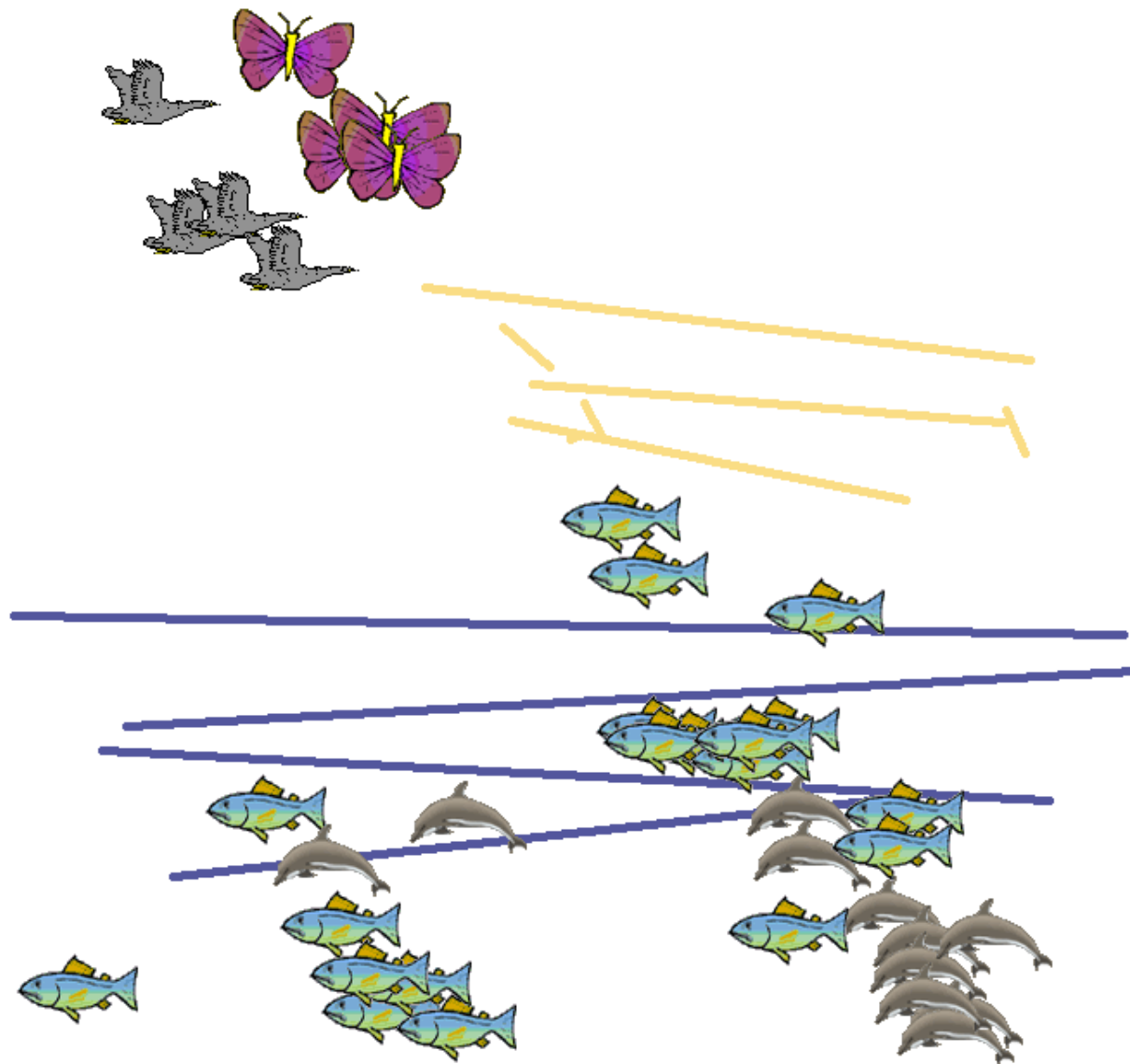
ViewSonic



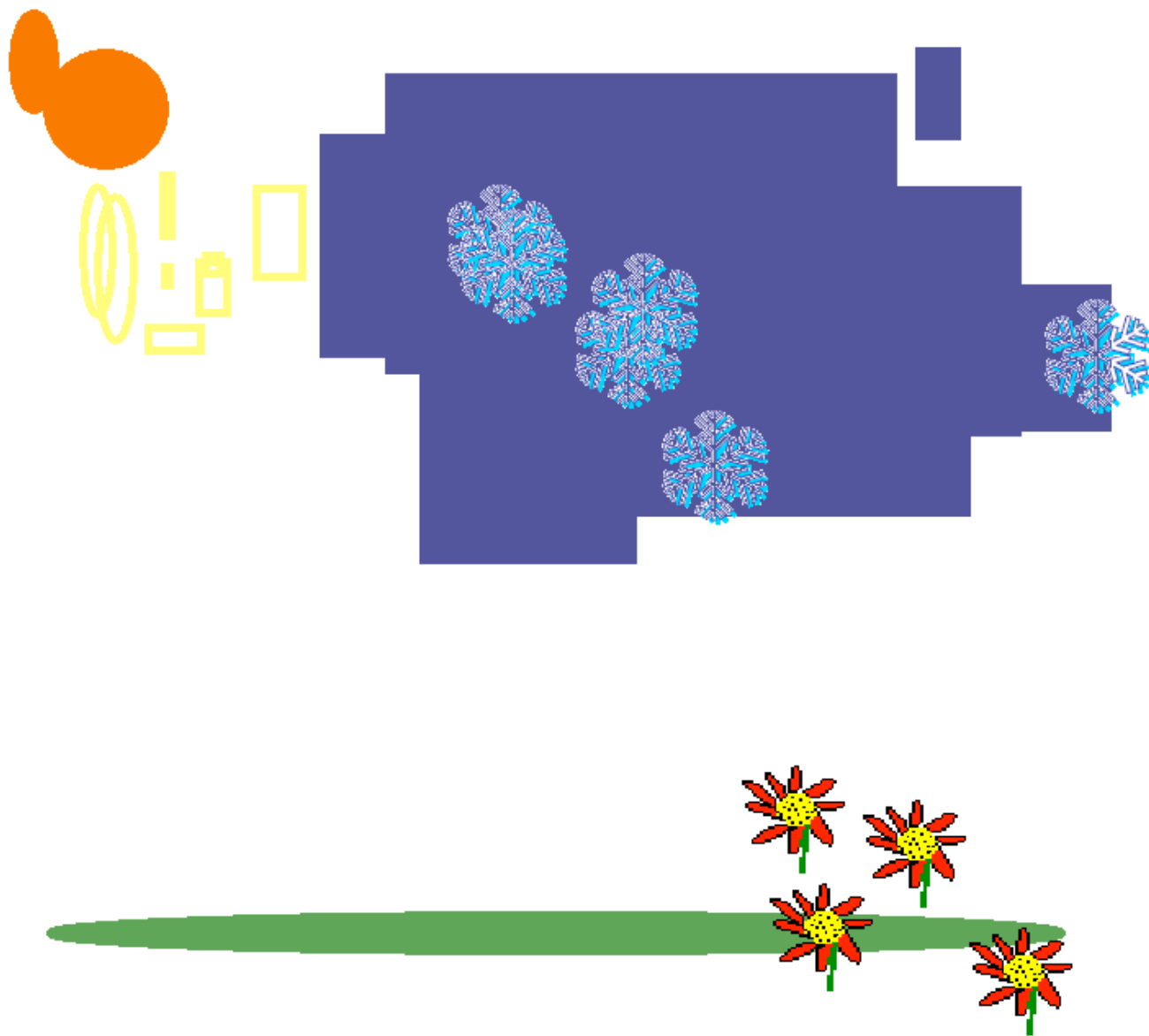
13-year-old girl without disabilities



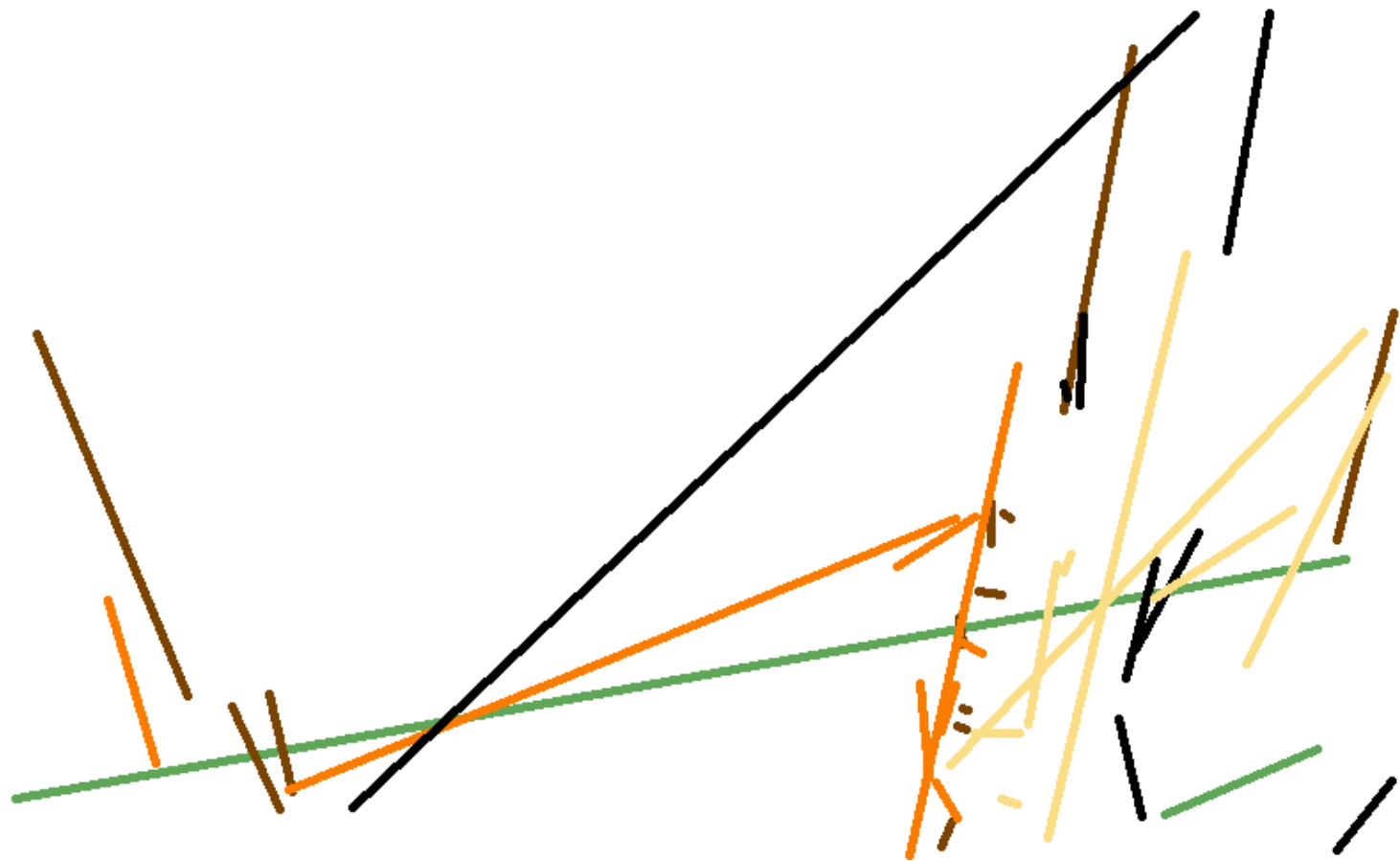
12-year-old boy without disabilities



18-year-old woman with cerebral palsy.
“Here’s an ocean that I made up in my mind.”



18-year-old woman with cerebral palsy.



12-year-old boy with cerebral palsy.

Results of Version 2 User Testing

Users without disabilities:

- Too many features all at once.
- It is hard but gets easier over time.

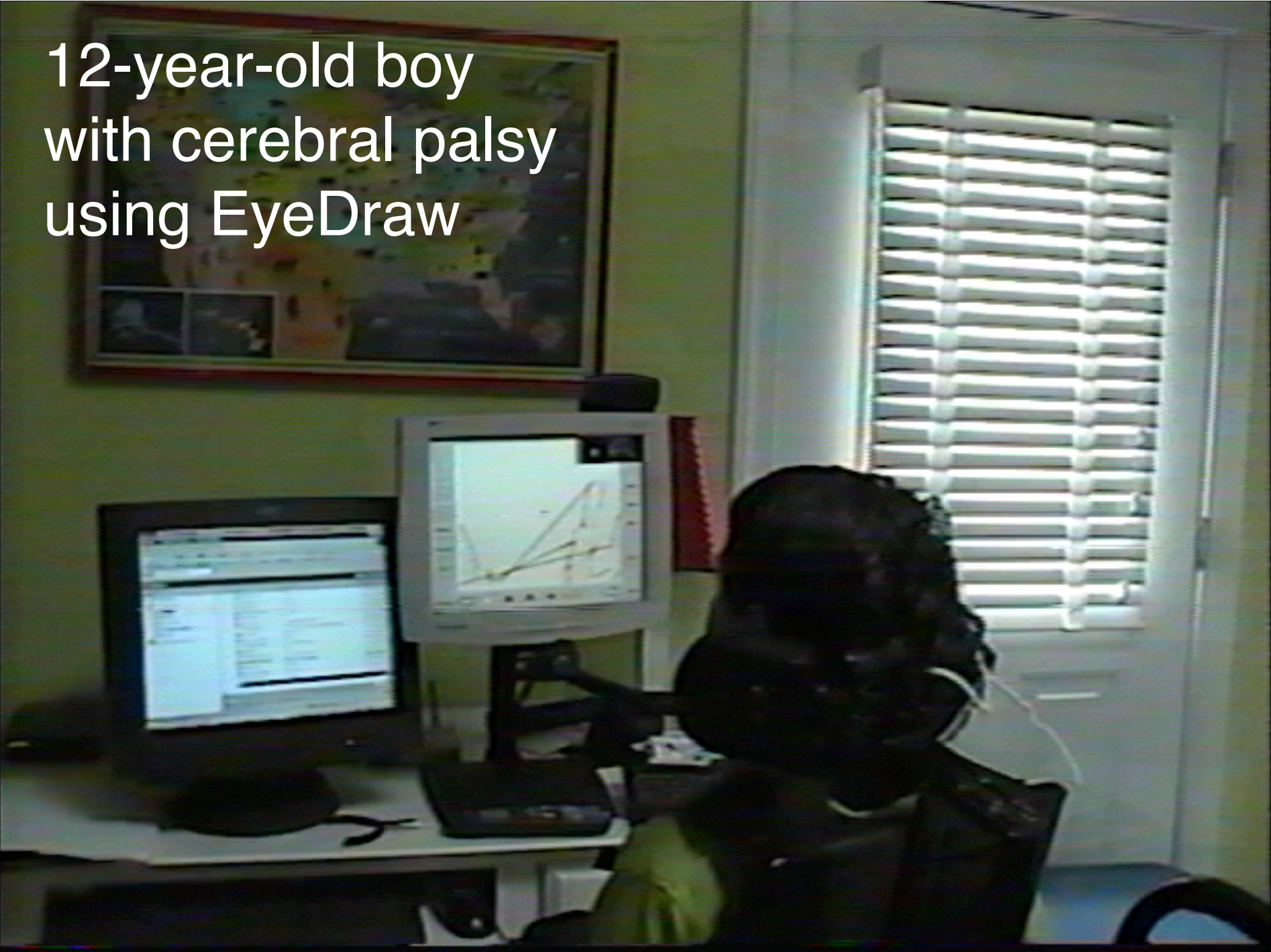
Users with disabilities:

- It works.
- It generally takes several sessions until a “breakthrough” occurs and the drawing starts.

Future Challenges with EyeDraw

1. Insure that the users experience instant success. Perhaps start with free-eye drawing and gradually introduce other features.
2. Continue to work with children with disabilities.
3. Figure out other eye-controlled software for children—math, spelling, storytelling, music-making.

12-year-old boy
with cerebral palsy
using EyeDraw



18-year-old woman
with cerebral palsy
using EyeDraw



15 4:35 PM

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