

# Gaze-driven app for infants (DGI17)

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[T]here is a clear opportunity to explore the design of apps for very young children, starting as early as 12 to 17 months of age. The evidence presented in this paper suggests a majority [of] children in this age group and older can understand and use basic apps. The research question is how to design them such that they have similar characteristics to beneficial television shows, while helping children build communication, visual, and motor skills, and increase their connections to their caregivers.<sup>1</sup>

<sup>1</sup> Hourcade et al., 2015, p. 1923.

## Background

### Pursuits

Pursuits<sup>2</sup> enables calibration-free interaction with graphical devices using only gaze. It introduces a new type of graphical user interface element that is based on movement (see figure 1). A user selects an element by following its specific movements.

Pursuits utilizes the smooth pursuits movements of the eye, which is a type of movement that only happens when we are following something with our eyes. Most people can not reproduce this movement on their own, which means that triggering false positives while “just looking” can largely be avoided.

As this technique does not depend on having to identify the position on the screen a user is gazing, only that the gaze is moving in a specific pattern, it seems to be less dependent on exact readings and, better yet, calibration is not necessary as only relative eye movements are relied upon.

### Infant development

Neonates<sup>3</sup> can sometimes track objects if they are large and move slowly but they seem to rely on saccades<sup>4</sup> rather than smooth pursuits. From about six weeks, smooth pursuits improves and infants begin to track things moving in a smooth pattern. At five months, smooth pursuits reaches adult performance when it comes to sinusoidally and horizontally moving targets. At the same time, motor skills in hands and fingers of five month old children are very far from adult performance.

Hourcade et al., 2015 analyzed videos on YouTube to investigate with what ability infants and toddlers<sup>5</sup> used tablets. It turns out that while most children under 12 months did not seem able to make meaningful use of the devices, the majority of children 12–17 months had reached moderate ability, and by the age of two, 90% had.

<sup>2</sup> See Vidal et al., 2015; and the related video Vidal, 2013.

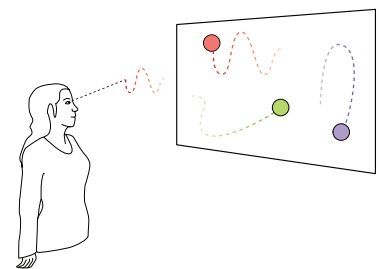


Figure 1: Some examples of Pursuits gaze patterns (Vidal et al., 2015, p. 8).

<sup>3</sup> Children less than four weeks old.

<sup>4</sup> Rapid jumps between different fixation points in the same direction, usually occurring several times per second. This is a different type of eye movement than smooth pursuits.

<sup>5</sup> Children one to three years of age.

## Discussion

As tablets are touch based, the results of the study on YouTube is likely consistent with when children develop accurate enough motor skills in hands and fingers. The question is if we could provide young children with alternatives to touch UIs, would they be able — and perhaps more importantly — would they want – to use those even earlier? Perhaps the limitation lies mainly in the design of current tablet UIs?

The existing literature suggests that young children may benefit from using computers under the right circumstances. At the same time, it is clear that we know very little about the use of computers by children under the age of three, and even less for children under the age of two.<sup>6</sup>

<sup>6</sup> Hourcade et al., 2015, p. 1917.

To explore this uncharted territory, Pursuits seem to be a particularly good match, especially if limited to smooth horizontal movement patterns. As infant motor skills develop slower than their vision, there should be a window for gaze-only interaction design of *at least* six months.

## Interaction design for infants

For me, there are a few particularly interesting aspects. First; if we want to know if it is possible for infants to learn to use applications equipped with gaze interaction, what kind of interfaces do we construct in order to try to find that out?

Second; what if we could get these gaze-driven applications in the hands of (millions of) parents through tablets, mobiles and the web? It is here that I think Pursuits could be extremely useful. The built-in video capabilities of most devices today should be good enough to identify gaze-following (at least with exaggerated motions), and since there is no calibration step to go through (which is difficult when it comes to infants), the big technical obstacles may very well be out of the way.

The thing is that it would really only take a few children to provide a starting point for iterative improvements. Once we know it is possible, we have a sort of baseline from which we can start exploring the design of these user interfaces.

Third; if successful, what do we do with that knowledge? What interesting research questions could we then hope to answer? What interesting applications will be developed?

## Implementation

First, I will implement an app based on Pursuits that in its basic form could potentially be used to find out if infants are capable of using gaze-based interfaces before touch.

The difficulty will then be in designing a middle ground between being able to answer the research question, while at the same time

providing something that parents would want their children to use and, most importantly, that their children will find motivating and rewarding enough to use.

### About me and the project

I am a second year Datalogi student at SU, aiming for an A. I will continue working on the project during the summer as it is exploratory in nature with lots of interesting aspects to get side-tracked by.

I will use Swift and Core Image (and/or OpenCV) to develop an app for the Apple iPad<sup>7</sup>, so that it will be possible for other parents of young children to try the app as well.

I'm hoping that I will manage to do a perceptual study with appropriately aged children but in the least case, I have a six month-old at home which will be more than happy to help out with user testing if treated to small pieces of fruit.

<sup>7</sup> Preliminary testing with an iPhone gave that the processor is fast enough for live video processing and the front camera has good enough resolution. However, the small screen on the iPhone makes it difficult to provide big enough movement such that the resulting eye movements can be accurately picked up by the camera. The screen on the 10.5" iPad will be much better suited for this purpose.

### References

- Hourcade, J. P. et al. (2015). "Look, My Baby Is Using an iPad! An Analysis of YouTube Videos of Infants and Toddlers Using Tablets." In: *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*. CHI '15. Seoul, Republic of Korea: ACM, pp. 1915–1924. ISBN: 978-1-4503-3145-6.
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