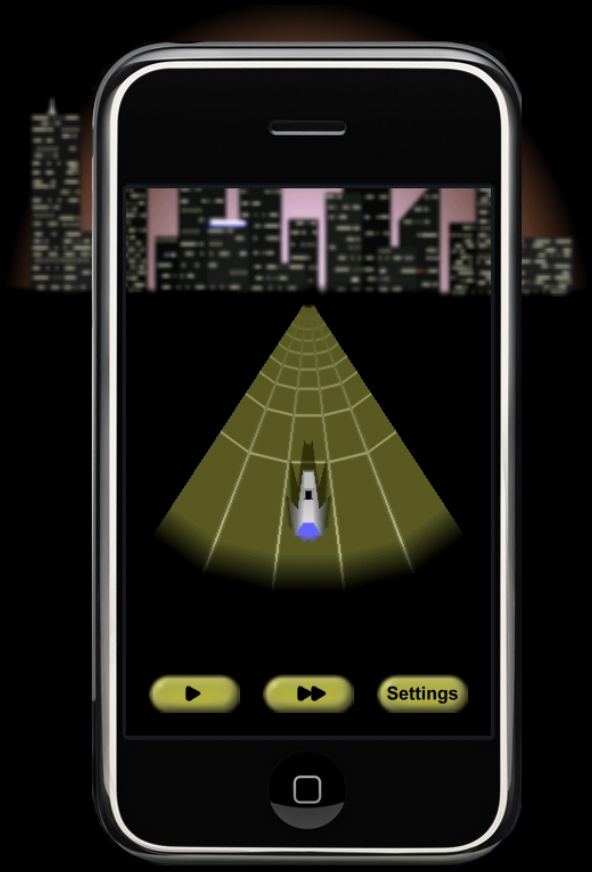
Autostereoscopy and Motion Parallax for Mobile Computer Games Using Commercially Available Hardware



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Agenda

- Introduction / Motivation
- Background
- Implementation
- Study
- Results & Discussion

Introduction / Motivation

- Recent push towards 3D displays
- 3D solutions for home & mobile entertainment “just around the corner”
- Concentration on movies, tv, etc.
  - Also studies
  - However: limited content
- In most games 3D description of world already included → 3D displays could be easily introduced
  - NVIDIA 3D Vision
  - Several other systems announced, may come already this year

Introduction / Motivation

- Can already existing systems be turned into (good) 3D displays?
- Do gamers want 3D displays?
- Chosen System:
  - Iphone 3G with Wazabee 3Dee-Shell
  - A simple non-interactive scene from a futuristic racing game

Background

- What is a 3D display?
  - Basically every display that heightens the depth reception
  - Stereoscopy
  - Motion Parallax

Background

- Motion parallax
- The change of the perspective in accordance to the occurring movement.
- Can be meaningful for gameplay

Background

- Motion parallax
  - Introduces via user tracking (e.g. face tracking, eye tracking)
  - Approximation via accelerometer possible
  - Usable with many modern gaming systems
  - Limitation: one user only (if not combined with multiview display)!

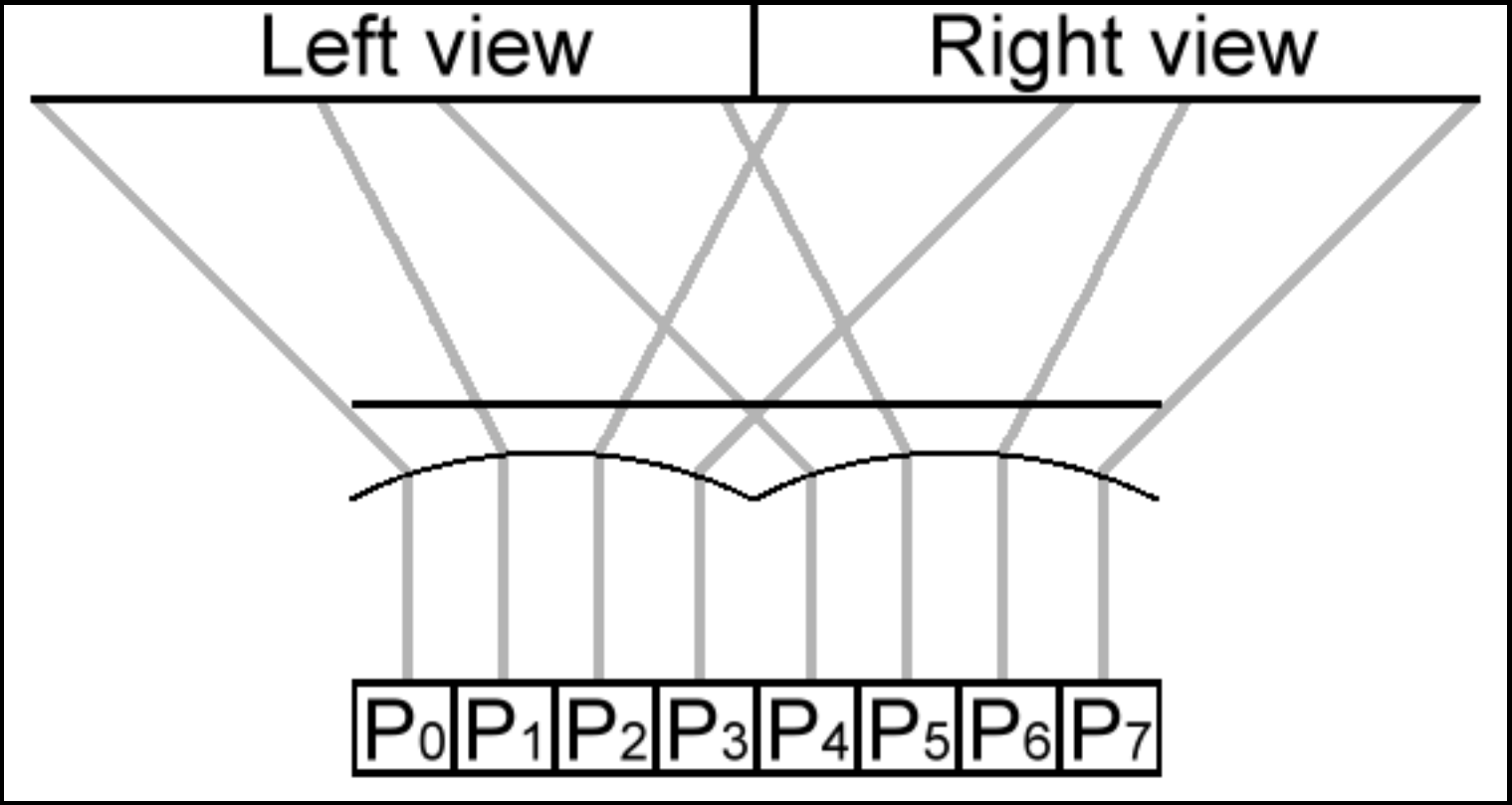
Background

- Stereoscopy:
  - Creating a different image for each eye using optical elements

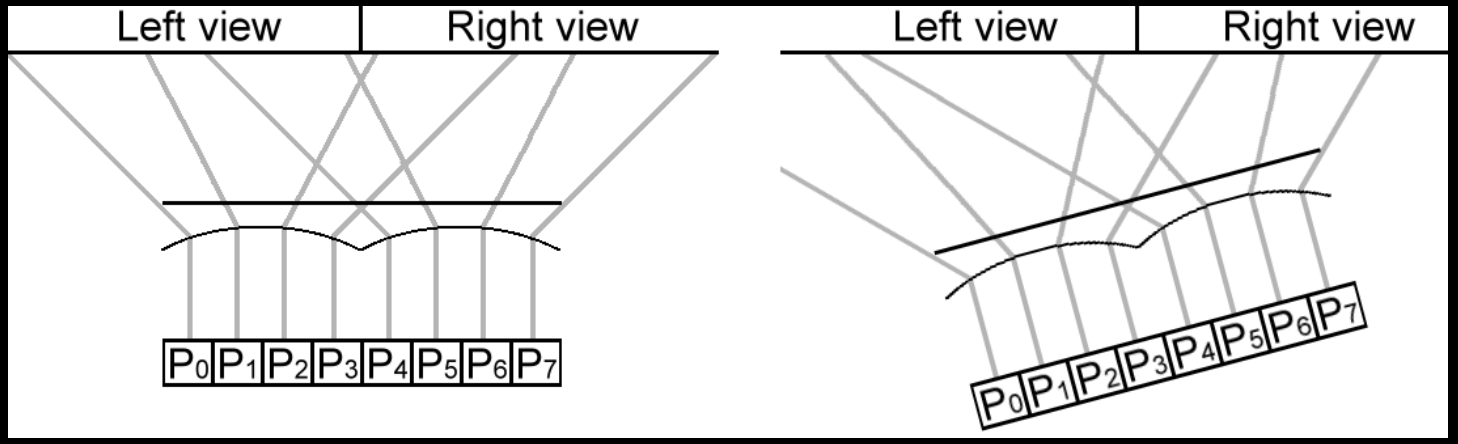
est. 1840

Background

- Autostereoscopy:
  - Creating a different image for each eye using e.g. lenticular sheets



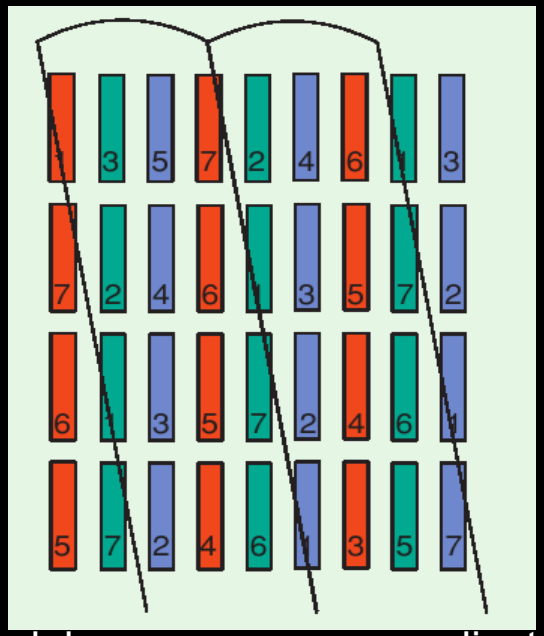
Background



- Autostereoscopy
  - User needs to sit at a certain position
  - Not possible together with motion parallax?
- Solution:
  - Move LEDs or optical element
  - Alternatively: dynamical allocation of the (sub)pixels to the views (e.g. using (sub)pixel masks)
  - called tilt-compensation in the following (since tracking via accelerometer)

Background

- Autostereoscopy, limitations:
  - Picketfence Effect
    - Visible black lines if optical element aligned with LED grid
    - Solution: use slanted optical element



    - Pixelmask becomes more complicated and irregular
      → may want to use anti-alias to remove introduced artifacts

Background

- Autostereoscopy, limitations:
  - Cross-Talk / Ghosting
    - One or both eyes see(s) pixel(s) destined to the other one
    - Can cause eye strain (eye pain, headache, disorientation)

Background

- Autostereoscopy, limitations:
  - Other artifacts exists
    - Less visible
    - Mostly solvable by finetuning the software

Implementation

- Wazabee 3Dee Shell
  - Autostereoscopic lenticular sheet for Iphone
  - Comes with its own shell, removable lenticular sheet

(Source: Manufacturer's Homepage)

Implementation

- Drawbacks
  - Touchscreen below lenticular sheet unusable
  - Since detachable: needs calibration every time when newly attached

Implementation

- Drawbacks
  - Iphone 3G: fixed graphics pipeline => no subpixel resolution, no anti-alias!

Implementation

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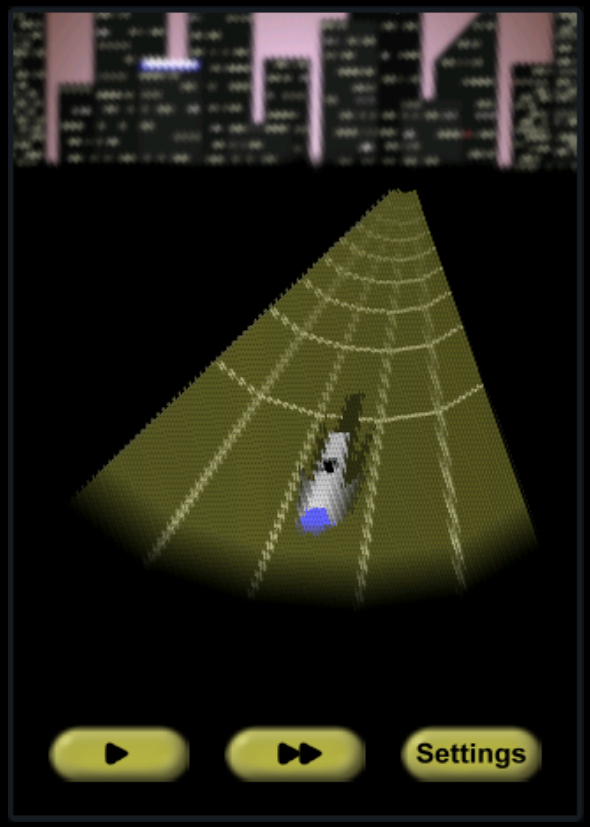


Study

- Overview
  - Part 1: different masks (resolution vs. crosstalk)
  - Part 2: different depth cues (motion parallax, autostereoscopy, none)
  - Questionaire (about the person, overall impression, usage scenarios)

- Testgroup:
  - 12 subjects, mainly male students of a technical program
  - 9 little or less experience with 3D displays, 3 medium

Study

1. Crosstalk optimized mask vs. Resolution optimized masks (higher values are better)

Optimized for:	Crosstalk	Resolution
Image quality	15	21
3D effect	18	18
Stress factor	13	23

Really meaningful or tainted due to artifacts?

Study

2. Stereo Cues

auto-stereo-scopy	tilt compen-sation	motion parallax	distorted image	mean	std. derivat.
				7.83	1.11
		x		**7.83**	1.40
			x	**3.67**	2.35
		x	x	**4.08**	1.83
x				**3.75**	1.48
x		x		**4.5**	1.78
x	x			**4.91**	1.62
x	x	x		**5.5**	1.83

image quality

auto-stereo-scopy	tilt compen-sation	motion parallax	distorted image	mean	std. derivat.
				4.25	2.18
		x		**6.58**	1.93
			x	**3.00**	1.86
		x	x	**5.08**	2.19
x				**3.17**	1.19
x		x		**4.58**	1.88
x	x			**6.42**	1.08
x	x	x		**7.25**	1.14

3D effect

Study

3. Questionaire: Usage Scenarios

Application	games	taking pictures / movies	live streams from events	watching movies / tv series	watching documentaries / news	tv (other)	video-phone	location based services	social networks
use / would use in 2d	9	12	3	8	6	5	4	5	5
would use in 3D	9	5	2	4	1	1	5	4	0

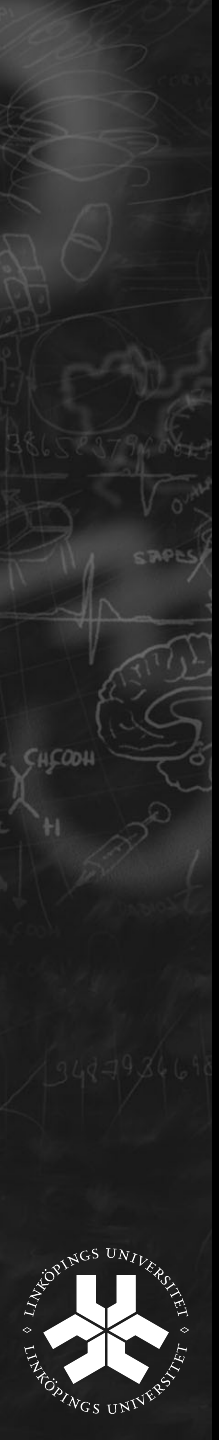
- One subject mentioned that he would even like such a system for professional applications, e.g. physical and chemical simulations

Results

- Can already existing systems be turned into (good) 3D displays?
  - Yes.
  - Especially motion parallax leads to a high increase in the 3D perception and is possible with many current gaming systems
- Do gamers want 3D displays?
  - Yes.

Results

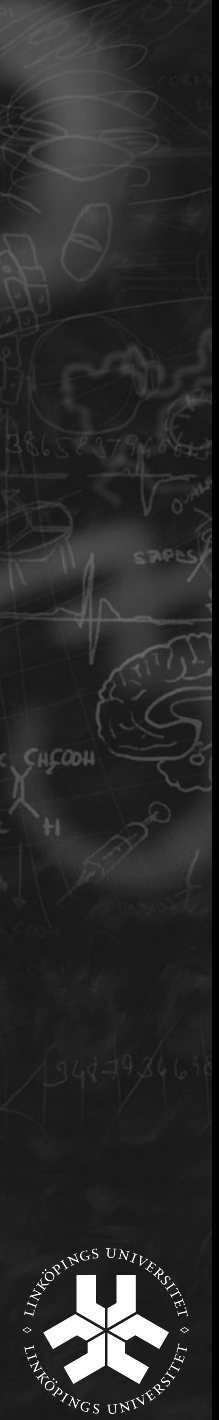
So what are we waiting for?



Results

- Improvements of the used system:
  - Optical tracking of user rather than accelerometer!
  - Use programmable graphics hardware!
  - Resolution to low?

Questions?



Thank you very much!

For more info, visit me at:
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