



04-05-2011

“Auto-stereoscopic displays,
the future has already begun”

an outline of ASD technologies and market developments



<http://www.youtube.com/watch?v=Uef17zOCDb8>

Content

- Introduction Dimenco
- 3D some basic insights
 - 2010 the year of 3D
 - 3D an example of disruptive innovation
 - Why 3D now
 - 3D the consumer decides
 - 3D an industry push
- Autostereoscopic displays
 - ASD - definition
 - How does ASD work – different technologies
 - Parallax barrier a short introduction
 - Lenticular display technology
 - Market players (CE) and developments
 - Technological challenges
- Opinion and vision about the ASD-market
- Questions

Dimenco

Founded: 1st of June 2010
Founded: By 4 former Philips 3D solutions employees
Employees: 12

Focus area's: 3D Consultancy, 3D Content Conversion, 3D Display Technology, 3D Software, 3D Rendering.



Achievements / highlights:

1. Dimenco acquires full 3D Technology License from Philips IP&S.
2. Dimenco signs Philips IP&S as consultancy customer.
3. Dimenco demonstrates with Philips TV a 56" QFHD 3D ASD.
4. Dimenco demonstrates during CES Switchable and WQHD prototypes.
5. Dimenco signs exclusive agreement with MMD to market, develop and manufacture Philips branded 3D signage displays.
6. Dimenco moves to its new office with own cleanroom and manufacturing facilities.

Visiting address:
De Run 4281
5503LM Veldhoven

Postal address:
Postbus 237
5500 AE Veldhoven

DIMENCO[®]



Dimenco activities and scope



[Find more information at www.dimenco.eu](http://www.dimenco.eu)

DIMENCO[®]





3D Display offering

3D autostereoscopic displays:

- 52" 3D display (Philips branded or whitelabel) with Dimenco Rendering core – available
- 56" QFHD 3D display with Dimenco Rendering core – prototype shown at IFA2010
- 27" WQHD 3D display with Dimenco Rendering core – prototype shown during CES2011
- 22" and 4.3" switchable 3D Display with Dimenco Rendering core – prototype shown during CES2011

Dimenco supports customers in the design and creation of new prototypes. Advanced technologies are available like:

- Slanted smart sampling lenses technology
- 2D and 3D dual mode technology
- Cone and view distance configuration
- Soft cone transitions





Fixed and competitive pricing

Conversion method:	Input:	Output:	one minute of 25 fps clip
Manual conversion	2D	2D+Z	€ 999,-
Offline rendering service	2D+Z	Stereo	€ 119,-
Offline rendering service	2D+Z	N-view	€ 239,-
Semi-automatic conversion	3D-stereo	2D+Z	€ 749,-



Former Philips 3D Solutions

Founded:	2005
Objective:	To develop and bring to market Philips autostereoscopic display technology
Employees:	+/-65fte
Stopped in:	2009

Philips 3D Solutions summary:

1. Target display market: Pro-AV / Digital Signage Market, end goal 3DTV
2. Products developed and brought to market: 42", 20"(22", 52", 8")
3. Sales numbers: a few hundred per year, pricing first 42" €17.500
4. Hundreds of filed patents in 3D display technology, file format and content conversion technology/algorithms.
5. Main task in 2008 – 2009 find a leading Licensing partner
6. 2009 - Philips 3D Solutions was discontinued due to:
 1. Consumer market was too far off.
 2. Change of corporate focus – Health and Wellbeing
 3. Economic downturn



3D some basic insights



- 2010 the year of 3D
- 3D an example of disruptive innovation
- 3D the consumer decides
- 3D an industry push

2010 – the year of 3D

3d tv



- A** [Sony set to roll out 3D TV in 2010](#)
Sydney Morning Herald - Sep 2 2009
- B** [LG sets 3D TV target, to offer new lineup in 2010](#)
Reuters US - Dec 15 2009
- C** [Discovery, ESPN to launch 3D TV channels](#)
San Francisco Chronicle - Jan 6 2010
- D** [First Look: Sony 3D TV](#)
Sydney Morning Herald - Feb 25 2010
- E** [3D TV](#)
Daily Mail - Mar 10 2010
- F** [LG aims at 25 percent of global 3D TV market](#)
Reuters - Mar 25 2010

[Sony set to roll out 3D TV in 2010](#)

[LG sets 3D TV target, to offer new lineup in 2010](#)

[Discovery, ESPN to launch 3D TV channels](#)

[First Look: Sony 3D TV](#)

[3D TV](#)

[LG aims at 25 percent of global 3D TV market](#)

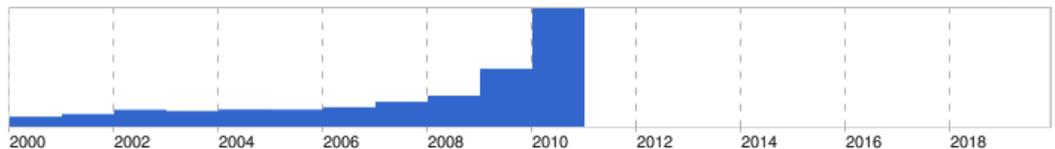
News Archives [News Articles](#) - [Timeline](#)

Results 1 - 1

[View recent news results for 3d tv](#)

2000-10 [Search other dates](#)

Click region to select time period



DIMENCO[®]



3D an example of disruptive innovation



“3D often spontaneously mentioned during consumer groups as an anticipated next step in creating a more immersive and captivating experience.”

consumer research

3D driven by \$\$ in Hollywood and...



Average US opening weekends revenue (Per screen)



Chicken Little
2005



Monster House
2006



Beowulf
2007



Journey to the
Center of the Earth
2008

3-D \$24,419

3-D \$13,483

3-D \$10,782

3-D \$12,093

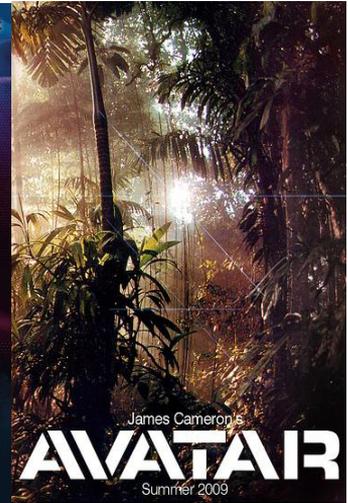
2-D \$6,760

2-D \$4,798

2-D \$3,946

2-D \$4,106

Quelle: Financial Times FT.com



TICKETS NOW AVAILABLE

Watch the epic battle of legendary heroes
like it has never been seen before
in the newest breakthrough in Philippine cinema

**BEOWULF
IN DIGITAL 3D**

Experience **CLARITY** in vision and sound
(with no scratches or ghosting)

Guaranteed **PERFECTION** in projection
(even after several runs)

Full **IMMERSE** action with polarized 3D glasses
(that you can bring home after the movie)

**OPENS NOVEMBER 14 AT
THE BLOCK CINEMA 1, SM CITY NORTH EDSA**
Please call 929 5452 for inquiries.

the TV industry sells more TV's...

3D TV sales: no blockbuster here!
The newest tech in TV is dogged by little content, no standards and big price tags.
Source lbtimes.com

Lack of content leaves 3D TV sales flat!
Source FT.com

3D TV Prices Slashed, Sales Lower than Expected! source: BNET

The sales volume of the 3D TV still increases fast!

source lsupply



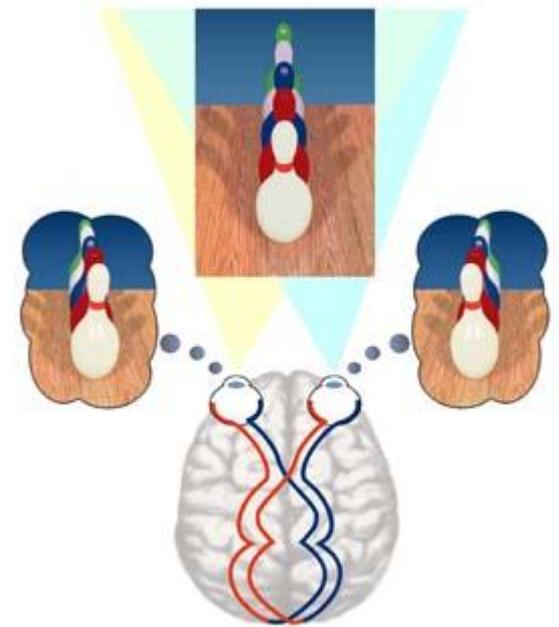
But are the glasses sold?

But are they really...

How does 3D work

Depth requires two eyes. For adult humans, the two eyes stand approximately 65 mm apart, and although this is a small distance, the result is that the left and right eye look differently at the world, receive slightly different images on the retina and the brain is able to construct depth from these images and their differences.

The same principle of feeding two slightly different images to the eyes and the brain creating perceived depth is the basis for 3D experiences, ranging from 3D feature films in cinemas to the well-known postcards with plastic grooves.



The average interpupillary distance is between 58 and 72mm.

How does 3D work (2)

Perceiving depth is based on several cues;

1. Perspective
2. Motion parallax
3. Occlusion
4. Stereopsis (binocular disparity)
5. Convergence
6. But also, light, shadow, memories...



The most important one is Stereopsis and 3D displays (and 3D cinema) is in principle solely based on providing a stereopsis cue additional to other cues which are also present in 2D content

3D, the consumer decides?

- 83% of consumers say 3D isn't enough to buy a new television.
- 60% are not willing to pay extra for a television with 3D capabilities
- 21% is willing to pay 10% more for a 3D television
- 30% of respondents did not like wearing 3D glasses
- 40 % of Generation Y respondents said they would buy a 3D set that require glasses. Approximately 55 percent of those people said they would buy a 3D TV if glasses were not required.

“3D glasses are a barrier to the multitasking that consumers engage in while watching TV”

- 31 % does not think 3D enhances their entertainment experience
- 13% of those surveyed said they “get physically ill or uncomfortable after 3D”

Source: Deloitte

3D, the consumer decides?

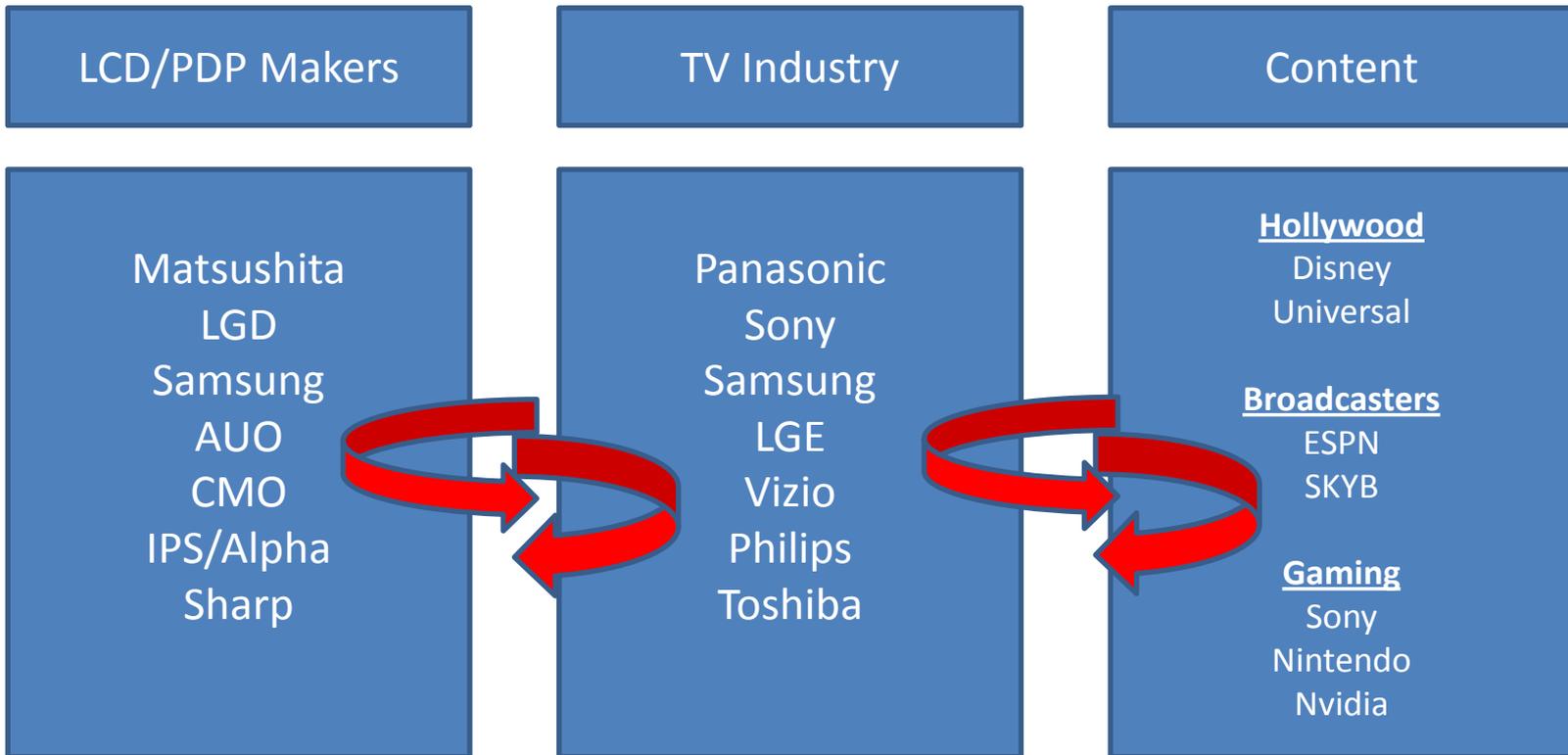
James Cameron, the director of the highest grossing film of all time, "Avatar," could be said to be an authoritative voice for 3-D technology. Cameron said for 3-D to appeal to the television viewing audience, the glasses have to go. "That is the point where the curve (of buyers) is going to go ballistic," he said.

"Using glasses was always an interim step. For normal consumers, it's got to be glasses-free. The technology must advance to where that's not required,"

Michael Gartenberg, research director at Gartner Inc.,

Source: Deloitte

3D Industry main players



Why are they interested in 3D

LCD/PDP Makers

Price erosion of LCD
and PDP panels

PDP loses advantages
in comparison with
LCD

TV Industry

Becoming more and
more difficult to add
value.

TV is becoming an
expensive monitor

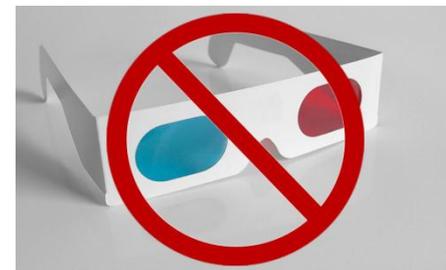
Content

Hollywood
Leverage on 3D movies

Broadcasters
More competition from
Youtube

Gaming
Sell more games

3D TV industry and its push to add value



2008/2009

Shutter based 3D TV's
BOM cost 3D TV +/- €0,50
Glasses cost: €69 - €149,-
MSRP: +€150 - €400

2010/2011

Polarized based 3D TV's
BOM cost 3D TV +/- €50 - €150
Glasses cost: €3 - €49,-
MSRP: +€150 - €400

2011/2013

No glasses 3D TV's
BOM cost 3D TV +/-15%
(QFHD necessary)
MSRP: +€400 - €1000

All TV industry players focus on FHD 3D



Samsung

Shutter based 3D TV's in combination with LED



Sony

Pushes 3D as its lifesaver – mainly shutter glasses based



Panasonic

Shutter based 3D TV's,
Exclusive deal with
Avatar



LG

Is moving from Shutter based 3D to
Polarized 3D TV's,

Philips

Technology follower

Content industry is pushing 3D

- James Cameron
 - *“3D isn't just for theaters. The real revolution comes as games and television also start appearing in three dimensions.”*
 - *“Games, in particular, stand to benefit. You are in the game, this is the ultimate immersive media.”*



- Jeffrey Katzenberg – *“3D the next great frontier for filmmakers”*
- Disney and Pixar have announced a plan to release all forthcoming films in digital-3D, further underscoring the current revolution in cinema technology.

....Towards the home

- Only 8% of the revenue comes from the Cinema, majority of money is made from pay-per-view, rental, sales and broadcast
- The movie industry is driving the 3D standardization for Blu-ray
 - Why should people buy Blu-ray? 3D
- The games industry has surpassed the movie industry in turnover



Conclusion

“Voice of the industry” is stronger than the “Voice of the consumer” in 2010 with 3D

“A lot of times, people don’t know what they want until you show it to them.”

Steve Jobs

Autostereoscopic display technology



- ASD - definition
- How does ASD work – different technologies
- Parallax barrier a short introduction
- Lenticular display technology
- Market players (CE) and developments
- Technological challenges

Autostereoscopic display definition

“**Autostereoscopy** is any method of displaying stereoscopic images (adding perception of 3D depth) **without the use of special headgear or glasses** on the part of the viewer. Because headgear is not required, it is also called "glasses-free 3D" or "glasses-less 3D". The technology also includes two broad approaches used in some of them to accommodate motion parallax and wider viewing angles: those that use eye-tracking, and those that display multiple views so that the display does not need to sense where the viewers' eyes are located. Examples of auto-stereoscopic displays include parallax barrier, lenticular, volumetric, electro-holographic, and light field displays.”

source: www.wikipedia.org

Autostereoscopic displays = seeing 3D without glasses

Different technologies – same principle

2 Technologies mostly used in the industry

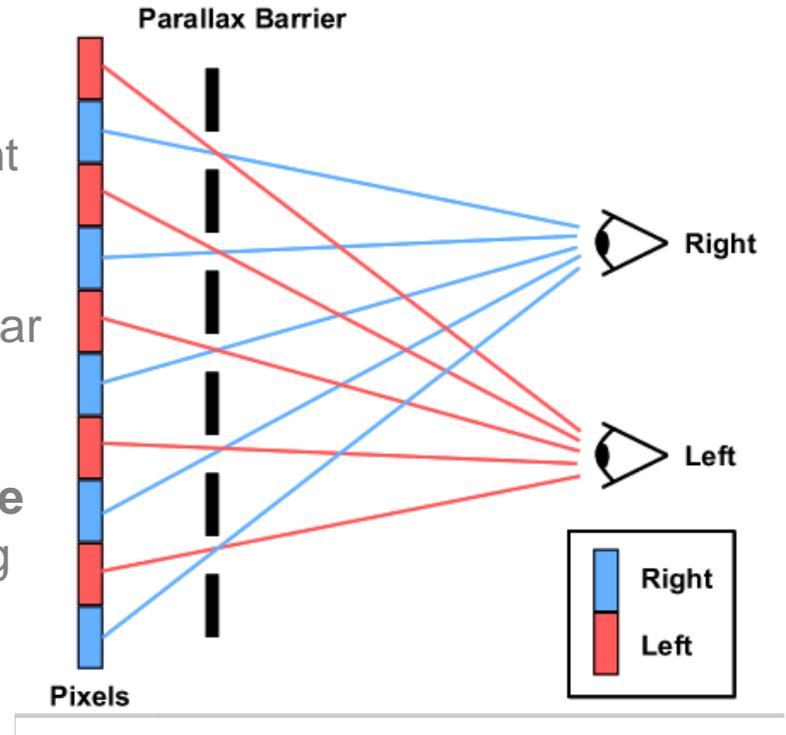
- Parallax barrier
- Lenticular
- (Directional backlight)

Other technologies are:

- Holographics
- Laser based 3D displays
- Etc.

Parallax barrier how does it work

A **parallax barrier** is a device placed in front of an image source, such as a liquid crystal display, to allow it to show a stereoscopic image without the need for the viewer to wear 3D glasses. Placed in front of the normal LCD, it consists of a layer of material with a series of precision slits, allowing **each eye to see a different set of pixels**, so creating a sense of **depth through parallax**.



Advantages / Disadvantages - products

Advantages:

- Low production cost
- Large “pop-out” effect
- Relatively easy to design/implement
- Proven switchable principle
- Easy 2-view system

Disadvantages:

- Color distortion
- Contrast
- Less brightness
- Quality 2D Image



Nintendo 3DS



Tridality



LG 3D Optimus

Parallax barrier switchable (Nintendo 3DS)

2D display mode

The switching liquid crystal is controlled so as to make the parallax barrier transparent, allowing all the light to pass through. This causes the same image to be seen by the right and left eyes, resulting in a two-dimensional display.

3D display mode

A parallax barrier is created by controlling the switching liquid crystal, thereby separating the light into two images. This causes different images to be seen by the right and left eyes, creating a sense of depth.

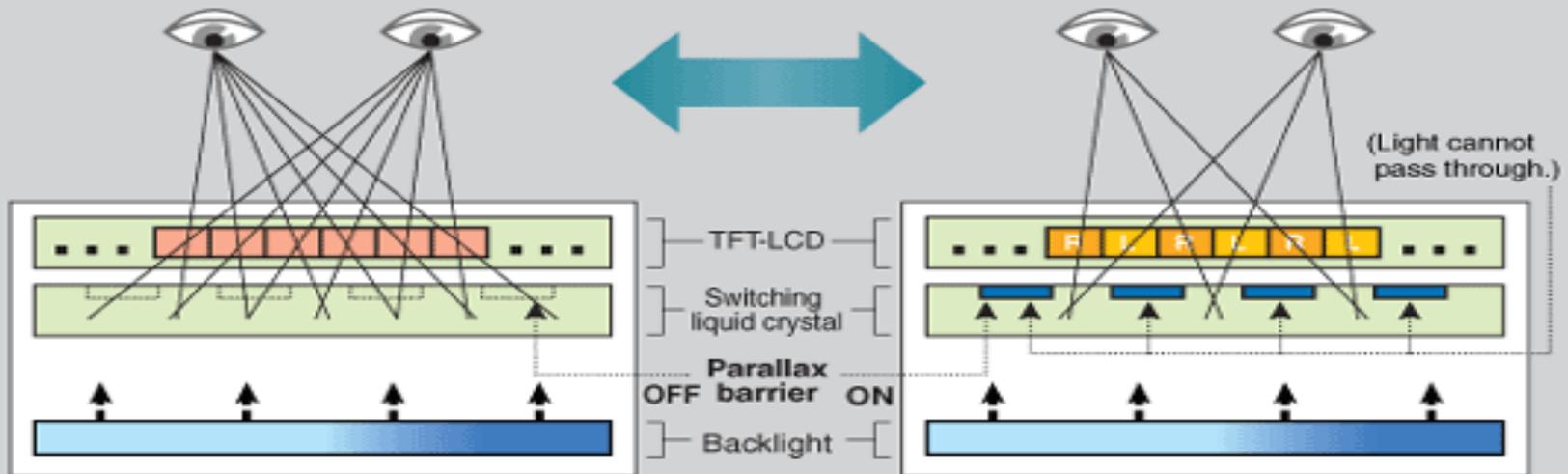
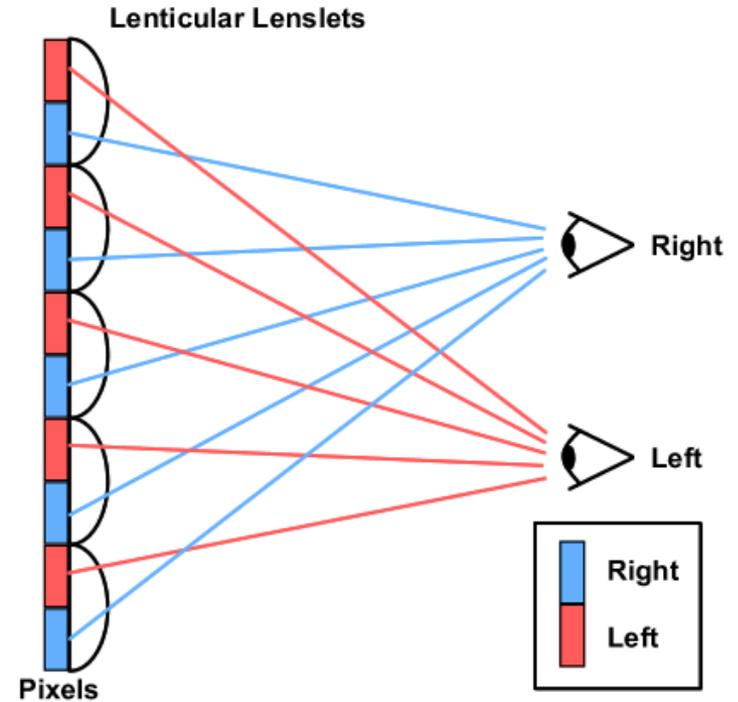


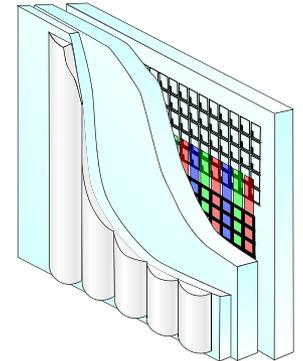
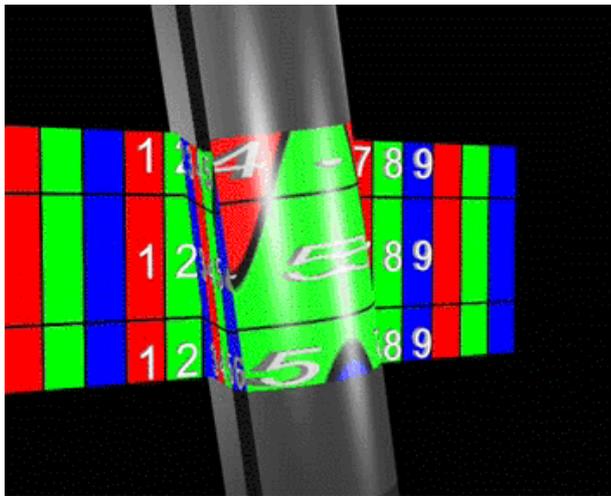
Image from Sharp-World.com

Lenticular technology how does it work

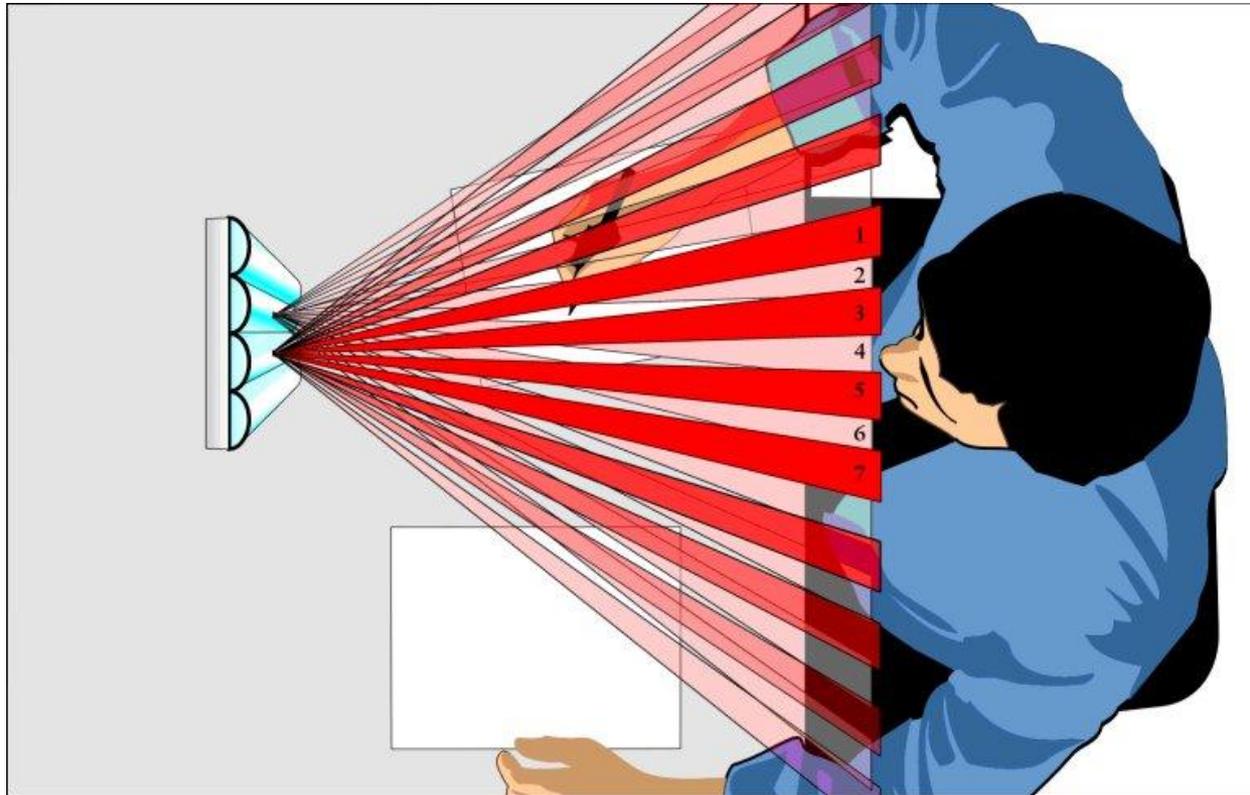
Lenticular based autostereoscopic technology is based on **lens technology** which **zooms in on different groups of pixels** when looking from different viewpoints. Thus each eye sees a different group of pixels. By rendering different images for different viewpoints depth perception is realized without the need of cumbersome glasses. Keeping the amount of viewpoints limited and repeating the sets of viewpoints ensures that resolution loss is limited together with a convincing and sharp 3D perception.



Lenticular technology how does it work (2)

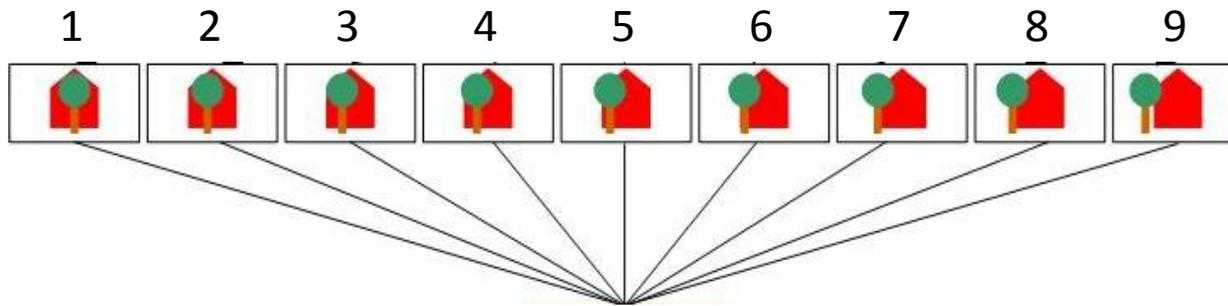


Multiple viewing zones



Multi-view & overlapping viewing zones

- In front of the display:



- Multiple views in a 'cone'
- 'cones' are repeated several times at the left and right side
- total viewing angle of 150° in which there is a good 3D perception
- 'cone' transitions are less visible (with latest lens design)
- intrinsic for any autostereoscopic display technology

Advantages / Disadvantages - products

Advantages:

- Full contrast
- No brightness loss
- 2D image
- Sharpness of the image
- No color distortion

Disadvantages:

- Pricing
- Implementation / manufacturing
- No proven switchable technology



Dimenco 52"



Toshiba 20" & 12"



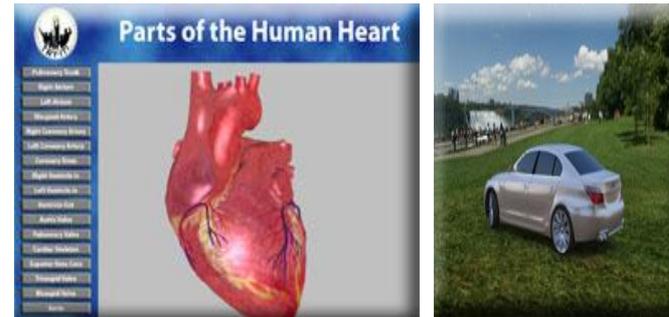
FujiFilm Finepix"

3D Applications

Attracts attention



Accurate data visualization



Exciting and involving



Fun, gadget, differentiator



Perception experiment – 2D vs. 3D digital signage

A “real life” perception experiment was conducted in a store
– the same commercials were shown in 2D and 3D



Results

When showing a commercial on an auto-stereoscopic 3D display:
viewers experience a stronger feeling of presence

- proven by questionnaire ($p < 0.001$)

viewers establish a more positive attitude towards the displayed brands

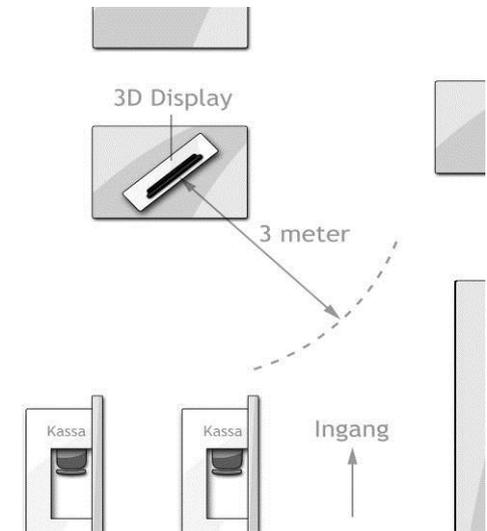
- proven by questionnaire ($p < 0.001$)

viewers are attracted to the display and remain looking for a longer time

- average subjective viewing time: 2D: 54s, 3D 107s

Conclusions:

3D digital signage has a higher stopping power and establishes a more positive brand attitude



Toshiba – disappointing ASD sales

Toshiba's attempt to interest us all in 3D TVs that don't require special glasses has fallen flat. The company sold fewer than half the sets it expected it would in the first month of sales, a senior executive has revealed.



Masaaki Osumi, president of Toshiba's Visual Products Company, revealed the news in an interview, admitting the company sold just 500 of the 20inch models and even fewer of the 12inch ones.

Source Bloomberg

3D market development

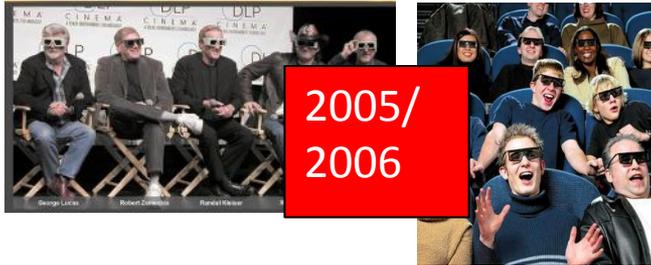


No glasses

3D Cinema

Professional

Out Of Home



Home



Current technological challenges

- Comfort Zone
- Crosstalk
- Interference effects
- Resolution

3D Resolution

- Multiple views are needed to achieve a good balance between comfort zone and depth
- In principle resolution loss is number pixels divided by amount of observed views.
- However sampling an LCD slanted as described demonstrates that perceptual resolution loss is less. Example of 9 views and resolution loss:

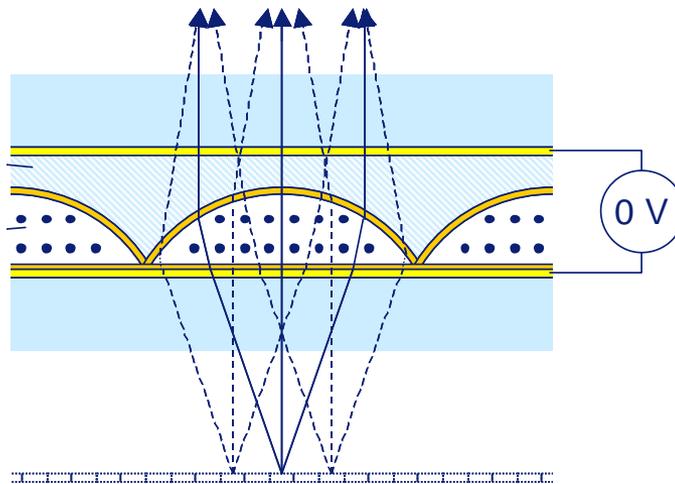


3D Resolution

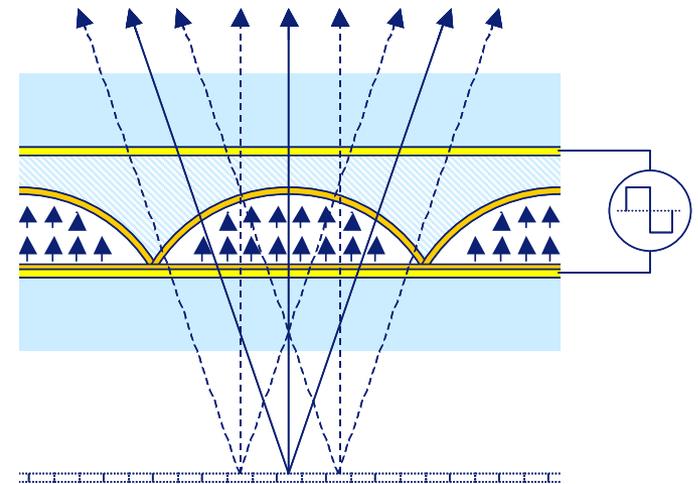
- Up to the product maker how to treat this. Current LCD makers are demonstrating products based on QFHD and specific pixel designs.
- 2 Approaches currently being considered:
 - Ultra high resolution panels
 - Switchable lenses

2D/3D Switchable Lenticular Display Technology

- Fixed lens is “Software” 2D/3D switchable
 - great 2D Picture Quality for B2B applications
- Physically 2D/3D switchable lens for B2C applications
 - full 2D resolution recovery
 - lowest cost solution without industrialization bottlenecks



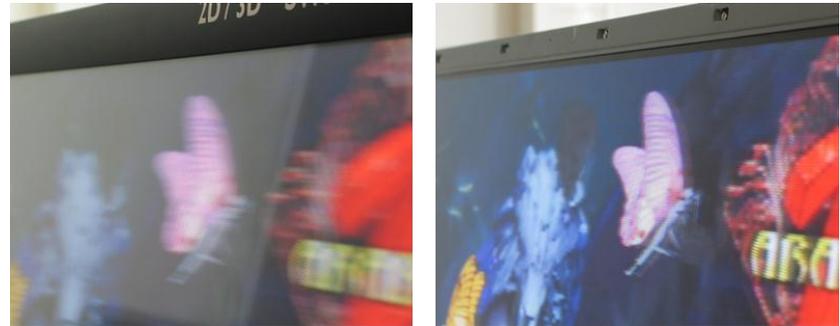
DIMENCO[®] LC // surface: $\Delta n = n_e - n_r$
3D mode



LC ⊥ surface: $\Delta n = n_o - n_r = 0$
2D mode

Challenges - Summary

- A lot is achieved through lens design and processing:
 - E.g. High angle-performance
 - Interference (banding) cancelation
 - Cone edge hiding



However pixeldesign and resolution will help in bringing 3D to the next level.

Is this all...



No we have not even talked about...

...content, formats and standardization.

Topics that need to be addressed to bring ASD to the home....

My own opinion and vision on ASD

- Leading TV manufacturers have shown that they are working on ASD and will show more at IFA2011 and CES2012.
- Lenticular has more advantages and can be sustainable for the TV-industry, barrier will be used in low-cost (handheld) devices.
- QFHD and Switchable LC technologies will enable ASD TV's and support the ambition of the panel and TV makers to maintain ASP
- Content formats will be a challenge, however stereo to auto-stereo algorithms/conversions will solve a big part of the challenge.

**In 2-3 years from now ASD TV's will be available
on the market in the A-segment**

Questions





DIMENCO

High Tech Campus 9,
5656AE Eindhoven,
The Netherlands

Phone: +31 40 8514270
info@dimenco.eu
www.dimenco.eu
