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7. Conclusion
Chapter 1. Overview

1.1. Research Background
1.2. Research Methodology
1.1. Research Background

Starting with the movie, “Avatar”, interests in 3D began to explosively increase. Accordingly, major TV makers endeavor to rapidly expand the 3D TV market. Samsung Electronics has launched the world’s first shutter glass type 240Hz 46” and 55” 3D LED TVs in February 25. The company intends to lead the premium 3D TV market following the LED TV market. LG, Sony, and Panasonic also accelerate their product launches and the competition between 3D TV makers fully begins.

Based on such trend, the year 2010 is expected to become the first year of 3D TV generalization which sells over 6 million 3D TVs. Upon the full market opening, Displaybank prepares a report under the title, “3D TV Industry Trend and Market Forecast” which discusses the emergence background of 3D TV, issue, business strategy by major maker, and market forecast.

[Major Research Item]
- Analysis of 3D TV emergence background and growth factor
- Professional analysis of 3D TV issue
- Expected 3D TV sales volume and business strategy of major TV makers
- Mid to long-term 3D TV market forecast until 2014

This report intends to assist 3D TV related companies, new companies with interests in 3D business, and TV makers to forecast 3D industry and 3D TV market.
1.2. Research Methodology

Displaybank collects information at all times through various conference data, display industry related exhibition data, corporation result data and analysis data, press release data, and internet search. Through these information, Displaybank analyzes supply & demand, price trend, cost, and technology systematically.

Displaybank is a market research company specialized in display and possesses a broad research range from materials and equipments to finished products including LCD panel, PDP panel, OLED panel, component, equipment, TV, monitor, NotePC, LED, PV, and secondary cell. It secures about 100 kinds of periodical reports regarding display related industries. Displaybank analyzes and forecasts market more organically and accurately through professional data and human network accumulated in various fields.

In particular, this report proceeds with mid to long-term 3D TV market forecast based on the analysis of the emergence background of 3D TV in the TV industry, 3D TV issue, and 3D TV business strategies of major TV makers.
Chapter 2. 3D Industry and 3D Technology

2.1. History of 3D Technology Advancement

2.2. 3D Industry Trend
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2.1. History of 3D Technology Advancement

“3D technology has been advancing in 60-year intervals during the past 170 years”

The 3D technology has been blooming in 60-year intervals during the past 170 years. The first peak came in 1890 when the 3D movie technology was invented and the second peak was in 1950s with the 3D movie production boom. In 1890, which was the first peak of the industry, the 3D movie technology was invented, but the 3D had failed in commercialization. In 1950s, which was the second peak, the industry had failed in resolving the visual fatigue issue despite the 3D movie production boom. Instead, the emergence of black and white TV drew people's attention. The present time is faced with the third peak of the industry due to generalization of 3D TV which brings the 3D industry to homes as the 3D movies became big hits along with advancements of 3D technology.
2.2. 3D Industry Trend

2.2.1. Background of 3D Industry Emergence- 3D Movie Boom

“rapidly growing global 3D industry”

Interests in 3D heightens across the globe due to the movie, Avatar. Avatar has set a phenomenal record of No. 1 box office in North America, No.1 box office in the world, No.1 box office in Japan, China, and the U.S. for 8 consecutive weeks, and exceeding 13 million viewers in Korea. Such success of Avatar not only suggested the achievement of a single movie, but introduced a new trend to the 3D image industry, a new image industry.

“the history of movie will be divided into pre- and post-Avatar”

“make 2010 World Cup more exciting”
2.3. 3D Technology Overview

2.3.1. Principle of 3D Realization

Physiological factors of 3D recognition: binocular parallax, motion parallax, convergence, accommodation

3D displays are produced by using various factors of human sensation. Human’s stereoscopic recognition involves physiological and psychological factors.

Physiological factors are the ones that give a sense of depth through an actual and physical stimulation. Human’s optic nerves or eye muscles are physically stimulated. These factors include a binocular parallax, motion parallax, convergence, and accommodation.

<table>
<thead>
<tr>
<th>Binocular Parallax</th>
<th>Motion Parallax</th>
<th>Convergence</th>
<th>Accommodation</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Binocular Parallax Image" /></td>
<td><img src="image2.png" alt="Motion Parallax Image" /></td>
<td><img src="image3.png" alt="Convergence Image" /></td>
<td><img src="image4.png" alt="Accommodation Image" /></td>
</tr>
</tbody>
</table>

- **Binocular Parallax**: The binocular parallax occurs due to 65mm distance between two eyes of human. It occurs because the two eyes view slightly different images when looking at the same object due to the distance. Images from left and right eyes are delivered to the brain through optic nerves. Then, the brain recognizes the parallax through homologous point analysis and it recognizes the depth.

- **Motion Parallax**: The motion parallax occurs due to relative movement of observer and object. The sense of depth is gained when the observer moves as objects in front appears to move faster. In addition, the 3D effect is gained as the image view by the observer differs per location.

- **Convergence**: The convergence is a recognition of depth through rotation angle of two eyes that gaze at a single object.

- **Accommodation**: The accommodation is a recognition of depth through adjustment of lens focus of a single eye.
2.3.2. 3D Display Technology Classification

a. Overall

The 3D display realization method is classified based on image recognition method, viewpoint, and glass application. The glass type is divided into a polarized glass type and shutter glass type, whereas the no glass type includes a lenticular lens type and parallax barrier type. In addition, integral photography, holography, and volumetric display fall under the no glass type, but they are currently being tested.
Chapter 3. 3D TV, Broadcasting, and Standardization Trend

3.1. History of 3D TV
   3.1.1. Milestone
   3.1.2. 3D TV Launch Trend by Year

3.2. 3D TV Launch Trend
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   3.2.2. 3D TV Launched in 2008 – Hyundai IT
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3.3. 3D TV Structure

3.4. 2D TV vs. 3D TV Cost Analysis

3.5. 3D PDP TV vs. 3D LCD TV

3.6. 2D TV Brightness vs. 3D TV Brightness

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   3.7.5. 3D Standardization Contents
3.1. History of 3D TV

3.1.1. Milestone

“In 2010, 3D TV market is expected to be fully created”

In order to discuss the history of 3D TV, we will take a look at the big flow since 2008 first.

In 2008, Samsung has launched a shutter glass type 3D PDP TV. In the shutter glass type, a cross-talk effect, of which left and right eye images are superposed upon a slow frame transition speed, occurs. At this time, PDP’s MPRT (Motion Picture Response Time) was less than 3ms and LCD’s MPRT was about 16ms. It was easier to realize the 3D with PDP TV so the 3D TV was launched in PDP TV. Hyundai IT has launched a polarized glass type 46” 3D TV targeting Japan market. In 2009, LG Electronics also launched a polarized glass type 47” 3D LCD TV. As the 3D TV drew huge attention in 2010, Samsung Electronics, LG Electronics, and Panasonic launch shutter glass type 3D TVs one after another and the 3D TV market competition becomes intensified.
3.2. 3D TV Launch Trend

3.2.1. 3D TV Launched in 2008 – Samsung Electronics PAVV Cannes PDP 3D TV A450

Samsung Electronics has realized the industry’s first 1 million : 1 contrast ratio and launched 42” and 50” 3D Ready TVs, “PAVV Cannes 450™”, which enables 3D contents such as 3D games and movies in February 2008. The 3D Ready PDP TV applied a black panel and cell light control, which display deep black color, to realize a mega contrast ratio. The TV was also installed with an image quality improving chip, “DNIe+ (Digital Natural Image engine +)” and focused on displaying clearer image quality.

[3D Ready PDP TV Analysis Launched in 2008 – Samsung Electronics Cannes A450]

<table>
<thead>
<tr>
<th>Model</th>
<th>PN42A450P1D</th>
<th>PN50A450P1D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Screen Size</td>
<td>42”</td>
<td>50”</td>
</tr>
<tr>
<td>Type</td>
<td>Shutter Glass Type</td>
<td></td>
</tr>
<tr>
<td>Resolution</td>
<td>HD (1024×768) 60Hz</td>
<td>HD (1366×768) 60Hz</td>
</tr>
<tr>
<td>Contrast Ratio</td>
<td>1 million :1</td>
<td></td>
</tr>
<tr>
<td>Connection Terminal</td>
<td>Three HDMI 1.3 terminal employment</td>
<td></td>
</tr>
<tr>
<td>Content</td>
<td>Singed supply contract with Electronic Arts</td>
<td></td>
</tr>
<tr>
<td>Size</td>
<td>1055×668×94mm</td>
<td>1231×756×95mm</td>
</tr>
<tr>
<td>Weight</td>
<td>27Kg</td>
<td>35Kg</td>
</tr>
<tr>
<td>Product Price</td>
<td>KRW 1.75M</td>
<td>KRW 2.5M</td>
</tr>
</tbody>
</table>

* Product price is based on launch price
### 3.4. 2D TV vs. 3D TV Cost Analysis

As of Q1’10, the edge type LED LCD TV (2D TV) cost composition is explored to find the 46” 2D TV’s material cost is

<table>
<thead>
<tr>
<th>Product</th>
<th><strong>46” LED TV (Edge)</strong></th>
<th><strong>55” LED TV (Edge)</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frame rate</td>
<td>120Hz</td>
<td>240Hz</td>
</tr>
<tr>
<td>2D TV</td>
<td>2D TV</td>
<td>2D TV</td>
</tr>
<tr>
<td>3D TV</td>
<td>3D TV</td>
<td>3D TV</td>
</tr>
<tr>
<td>LCD Module</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuner (Combo)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Video Processor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audio Processor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Circuit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circuit sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mechanical sum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>etc. (CKD Pack + Tax + Freight + Loss + H/C)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Material cost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manufacturing O/H</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Manufacturing Cost</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Additional Cost</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3.6. 2D TV Brightness vs. 3D TV Brightness

The brightness and resolution of polarized glass type and shutter glass type 3D TV and 3D TV were compared.

The polarized glass type installs a polarization filter in front of a panel that its brightness compared to 2D shutter glass.

<table>
<thead>
<tr>
<th></th>
<th>Polarized Glass</th>
<th>Shutter Glass</th>
</tr>
</thead>
<tbody>
<tr>
<td>2D Brightness %</td>
<td>2D</td>
<td>3D</td>
</tr>
<tr>
<td>3D Glasses</td>
<td>3D</td>
<td>3D</td>
</tr>
<tr>
<td>Resolution</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

※ Measurement Condition: measured with maximum brightness in darkroom in 50 cm distance through brightness measurement instrument (Minolta's product)

The 3D TV’s resolution decreases by ½ when transitioned from 2D to 3D for polarized glass type. The 2D/3D resolution is the same for shutter glass type.
### 3.7. 3D Broadcasting and Standardization Trend

#### 3.7.1. History of 3D Broadcasting

The world’s first trial 3D broadcast was carried out in the U.S. in 1953. At this time, the 3D movie boom had just begun and the broadcast was simply an experiment. The first 3D commercial broadcast was done in 1980 through Select TV. The history of 3D broadcast is summarized in the following:

- **1953** – U.S. begins the world’s first trial 3D TV broadcast
- **1980** – LA-based Select TV carried out the world’s first broadcast
  - image quality was inferior (red-blue type or time-multiplex type was used)
- **1990s** – new hope for 3D Television
  - transition from ‘Analog’ to ‘Digital’ TV service
  - International standards, MPEG: MPEG-2 “MVP (Multi-view Profile)” standard completion LED LCD TV By Low Power RGB LED
- **1998** – Japan-based NHK developed 3D HDTV transmission system (broadcasted Nagano Winter Olympics)
- **2002** – ETRI developed 3D HDTV transmission system (broadcasted FIFA World Cup)
- **2007** – Japan-based BS11 satellite TV began commercial 3D TV broadcasts (1hr/day)
- **2008** – BSkyB proceeded with trial3DTV broadcasts and developed 3D transmission technology (prepares for 2012 London Olympics opening broadcasts)
- **2009** – at KCAT 2009, ETRI demonstrates 3D signal transmission and compression technology
- **2010** – KCC begins trial 3DTV service (scheduled)
  - plans for World Cup South Africa broadcasts
- **2012** – plans for London Olympics opening 3D broadcasts

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1953</td>
<td>world's first trial 3D TV broadcast (U.S.)</td>
</tr>
<tr>
<td>1980</td>
<td>world's first 3D TV broadcast (LA-based Select TV)</td>
</tr>
<tr>
<td>1990s</td>
<td>transition from 'Analog' to 'Digital' TV service</td>
</tr>
<tr>
<td>1998</td>
<td>Japan-based NHK developed 3D HDTV transmission system</td>
</tr>
<tr>
<td>2002</td>
<td>ETRI developed 3D HDTV transmission system</td>
</tr>
<tr>
<td>2007</td>
<td>Japan-based BS11 satellite TV began commercial 3D TV broadcasts</td>
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<tr>
<td>2008</td>
<td>BSkyB proceeded with trial3DTV broadcasts and developed 3D transmission technology</td>
</tr>
<tr>
<td>2009</td>
<td>at KCAT 2009, ETRI demonstrates 3D signal transmission and compression technology</td>
</tr>
<tr>
<td>2010~</td>
<td>KCC begins trial 3DTV service (scheduled)</td>
</tr>
</tbody>
</table>

**Diagram:**
- 1953: World's first trial 3D TV broadcast (U.S.)
- 1980: World's first 3D TV broadcast (LA-based Select TV)
- 2008: Trial sports broadcast (England-based BSkyB)
- 2010~: World Cup South Africa broadcast (Japan-based Sony)
Chapter 4. 3D TV Technology Issue

4.1. Image Quality Issue
   4.1.1. 2D/3D Transition Technology
   4.1.2. 240Hz Drive Technology
   4.1.3. Cross-talk

4.2. 3D Glasses
   4.2.1. 3D Glasses Comparison
   4.2.2. 3D Shutter Glasses Structure
   4.2.3. 3D Shutter Glasses Operation Principle
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4.3. 3D Polarization Filter
   4.3.1. Micro Polarizer Structure
   4.3.2. Micro Polarizer Manufacturing Method
   4.3.3. X-pol Structure
   4.3.4. X-pol Adhesion Technology
   4.3.5. Polarization Filter Issue

4.4. LCD Panel
   4.4.1. LCD TV Panel Technology Roadmap
   4.4.2. 240Hz Panel Roadmap
4.1. Image Quality Issue

4.1.1. 2D/3D Transition Technology

In order to supplement deficient 3D contents from the initial 3D TV launch, a compatibility with the conventional 2D image is needed. The 2D/3D transition technology extracts characteristics of 2D image and analyzes them to produce 3D images. There are two methods of 2D/3D transition technology. One is to manually give 3D effects to individual images and realize them through SW. The other is to realize the transition from 2D to 3D with a single chip.
Chapter 5. 3D TV Strategy By Major Maker

5.1. Overall - 3D TV Line-up by TV Maker
5.2. 2010 3D TV Line-up and Business Strategy by TV Maker
  5.2.1. Samsung Electronics
  5.2.2. LG Electronics
  5.2.3. Sony
  5.2.4. Panasonic
5.3. Partnership by 3D TV Maker
5.4. 3D TV Technology Type Positioning by TV Maker
5.1. Overall – 3D TV Line-up by TV Maker

As the 3D TV rises in the TV Set market, 2010 products are fully launched. Samsung Electronics and LG Electronics actively began 3D LCD TV sales, whereas Panasonic plans to launch 3D PDP TVs in April. Sony is expected to launch 3D 240Hz LED TVs in the market after June.

In particular, the number of Samsung’s 3D TV line-up is the largest of all and the company is predicted to lead the 2010 3D TV market based on various products including LED, LCD, and PDP. In addition, the edge type LED 3D TV, rather than the direct type, is expected to lead the market for a while.

<table>
<thead>
<tr>
<th>Maker</th>
<th>Device</th>
<th>Type</th>
<th>40”</th>
<th>42”</th>
<th>46”</th>
<th>47”</th>
<th>50”</th>
<th>52”</th>
<th>54”</th>
<th>55”</th>
<th>58”</th>
<th>60”</th>
<th>63”</th>
<th>65”</th>
<th>72”</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Samsung</td>
<td>LED TV</td>
<td>Edge</td>
<td></td>
<td></td>
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<td></td>
<td>LCD TV</td>
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<td></td>
<td>PDP TV</td>
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<tr>
<td>LG Electronics</td>
<td>LED TV</td>
<td>Edge</td>
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<td>Direct</td>
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<tr>
<td></td>
<td>PDP TV</td>
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<td>Sony</td>
<td>LED TV</td>
<td>Edge</td>
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<td>PDP TV</td>
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</table>
In February 25, Samsung Electronics has launched shutter glass type 240Hz 46” and 55” 3D LED TVs. The company began a full marketing in North America and Europe markets in March.

50” and 63” 3D PDP TVs, 3D LCD TV, and 3D LED TV 9000 series are scheduled for launch during 1H’10.

Following the 2009 LED TV, Samsung Electronics is expected to strengthen the 3D TV marketing in 2010.

As the company launched the LED TV in 2009, Samsung Electronics has brought the LED as a new TV trend and further enhanced the brand power. In 2010, the company focuses the marketing in the LED 3D in order to create a new trend by combining the 3D with LED.

Of TV makers, Samsung Electronics is the only one that added the LCD 3D TV to line-up through low to medium price premium strategy along with distributed 3D market pioneering.

<table>
<thead>
<tr>
<th>Device</th>
<th>Series</th>
<th>Size</th>
<th>Key Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED TV</td>
<td>C9000</td>
<td>46&quot;</td>
<td>Super Slim(7.98mm), Premium RCU</td>
</tr>
<tr>
<td></td>
<td>C8000</td>
<td>46&quot;, 55&quot;, 60&quot;, 65&quot;</td>
<td>240Hz/3D+enhanced Picture Quality</td>
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<tr>
<td></td>
<td>C7000</td>
<td>46&quot;, 55&quot;, 60&quot;, 65&quot;</td>
<td>240Hz/3D</td>
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<td>LCD TV</td>
<td>C750</td>
<td>46&quot;, 55&quot;</td>
<td>240Hz/3D/CCFL</td>
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<td>PDP TV</td>
<td>C8000</td>
<td>50&quot;, 58&quot;, 63&quot;</td>
<td>3D, Titanium Bezel</td>
</tr>
<tr>
<td></td>
<td>C7000</td>
<td>50&quot;, 58&quot;, 63&quot;</td>
<td>3D, Super-Slim</td>
</tr>
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5.2. 2010 3D TV Line-up and Business Strategy by TV Maker

5.2.1. Samsung Electronics

<table>
<thead>
<tr>
<th>Product Level</th>
<th>2010</th>
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<tbody>
<tr>
<td>High</td>
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<td>LED TV</td>
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<tr>
<td>C9000 (Edge, Slim)</td>
<td>46&quot;, 55&quot;</td>
</tr>
<tr>
<td>C7000 (Edge, Slim)</td>
<td>46&quot;, 55&quot;, 60&quot;, 65&quot;</td>
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<td>Low</td>
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<td>LCD TV</td>
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<td>PDP TV</td>
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</tr>
</tbody>
</table>

plans for launch.
Chapter 6. 3D TV Market Analysis and Forecast (2009~2014)

6.1. 3D TV Market Analysis
   6.1.1. Evolution of TV Industry
   6.1.2. 3D as New TV Function
   6.1.3. Initial Market Entrance of FHD & LED TV
   6.1.4. Endeavor of Omnidirectional 3D Promotion and Content Expansion
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   6.2.2. Overall – Overall TV Market Forecast
   6.2.3. Overall 3D TV Market Forecast and Penetration Rate Forecast
   6.2.4. 3D TV Market Forecast by LCD, PDP, OLED Device
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   6.2.8. 3D LCD TV Market Forecast and Penetration Rate Forecast
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6.3. 3D TV Price Forecast
6.2. 3D TV Market Forecast

6.2.2. Overall – Overall TV Market Forecast

“2010 global TV market is expected to reach 223 million units”

The global TV market is expected to grow from 207 million units in 2009 to 223 million units in 2010 and show CAGR 7.5%. For the TV market, which is expected to show negative growths after 2012, to grow again, demands must be created and new products must be launched.

(Source: Displaybank Report ‘Worldwide TV Shipment Analysis, Q1’10’)

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6.2. 3D TV Market Forecast

6.2.3. Overall 3D TV Market Forecast and Penetration Rate Forecast – Unit Based

“3D TV is expected to record 6.2 million units in 2010 and 83 million units in 2014”

In the 2010 3D TV market, most major TV makers are expected to launch 3D TVs as they secure 3D TV line-ups. The 3D TV is expected to record 6.2 million shipment units which is 3% of overall TV market.

If the popularity of 3D TV continues on, the 3D TV is expected to surpass 33 million units in 2012 to account for 13% of the overall market and exceed 83 million units in 2014 to account for about 31% of overall TV market.
Chapter 7. Conclusion