DEVELOPING EFFECT OF HTML5 TECHNOLOGY IN WEB GAME

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ABSTRACT

As the development and mature of web game, more and more companies start to focus on developing web game. This is a great market. Many popular applications have been developed by applying some new web technologies. But web game still has many problems because of its content, experience effect and operation. In order to meet the increasingly huge demand of web game system, this paper mainly discusses how to improve the experience effect of web game players and optimize system architecture, database and cache by applying HTML5 technology. The final goal is to make web game operate faster and more stably, and extend to other platforms, such as mobile internet robots.

KEYWORDS

Web game, HTML5, CSS, JavaScript, WebGL, Browsers

1. INTRODUCTION

As the popularization of computer technology, more and more people gradually take online recreation as one way of relaxation. So web games, such as Angry Birds, Happy Farm and Moore Park, are very popular recently. As a kind of internet games, web game runs and plays rapider without installing any procedure. As long as the player can go online, he would conveniently play web game. Because of its timely, high-effective and convenient character, user group of web game is rapidly increasing. Developers pay more attention to enhance the development level of games as well as how to attract the users and get long-time, stable and higher revenue. So the application of HTML5 technology is very helpful to provide new and personalized contents and maintain stable user group.

However, even though web game has existed for a long time, there were no comprehensive research works about the subject. At present, some researchers mainly focus on analyzing the features, types, functions, development trend of web game and discussing business opportunities involved in web game. Some researchers have also applied web game to mobile applications, such as web game of 3G mobile phone or iPad. Other researchers also discuss online communities and social function. For example, Vanhatupa (Vanhatupa 2010) proposed online communities have always grown alongside browser games and many web games have also formed huge online communities.[1] But few persons research web game with applying HTML5.
In our study, we mainly focuses on improve the experience effect of web game and how to optimize system architecture, database and cache by applying HTML5 technology. It also proposes the methods to apply HTML5 technology for web game, and targets at making web game operate faster and more stably, and extend to other platforms.

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This paper proceeds as follows. In Section 2, it mainly discusses the concept, features and functions of web games and HTML5 technology. In Section 3, it presents the application and effect of HTML5 Technology in Web Game. In Section 4, it briefly discusses the capability of browsers for web game with HTML5 technology. Finally, future trend analysis and work is discussed in Section 5.

2. WEB GAME AND HTML5 TECHNOLOGY

2.1. Concept and features of Web Game

Web game is a combination of the website and the game. It is a computer game that is played over the internet using a web browser. Now there is no unified statement for the concept. In Wikipedia and some articles, it is called "browser game" again. It is used for many times because it is created and run using standard web technologies and browser plug-ins.

Fig. 1 Web Game with HTML5 Technology (Source: *http://www.myfreefarm.com/)*

But we think web game may be more accurate according to our study. As we can see from Fig.1, browser is just a dependent platform of playing game and it is difficult to indicate the technology of HTML, CSS, JavaScript and WebGL. But the concept of web game is broader. It has the characteristics of website and game. Web game can be played on not only web browsers but also multiple different devices. It not only indicates these various technologies but also includes all kinds of game genres. It is portable and can be single-player or multiplayer.

Web game is different from client game, such as RAC and MMORPG. It is available, free-to-play and do not need any client software to be installed other than browsers. It has many advantages for attracting core and casual players. So as a kind promising pattern of modern internet games, web game is fast developing by its low cost and rapid application. It is future trend of client game. Fig.2 shows the main differences between client game and web game, which is as follows:

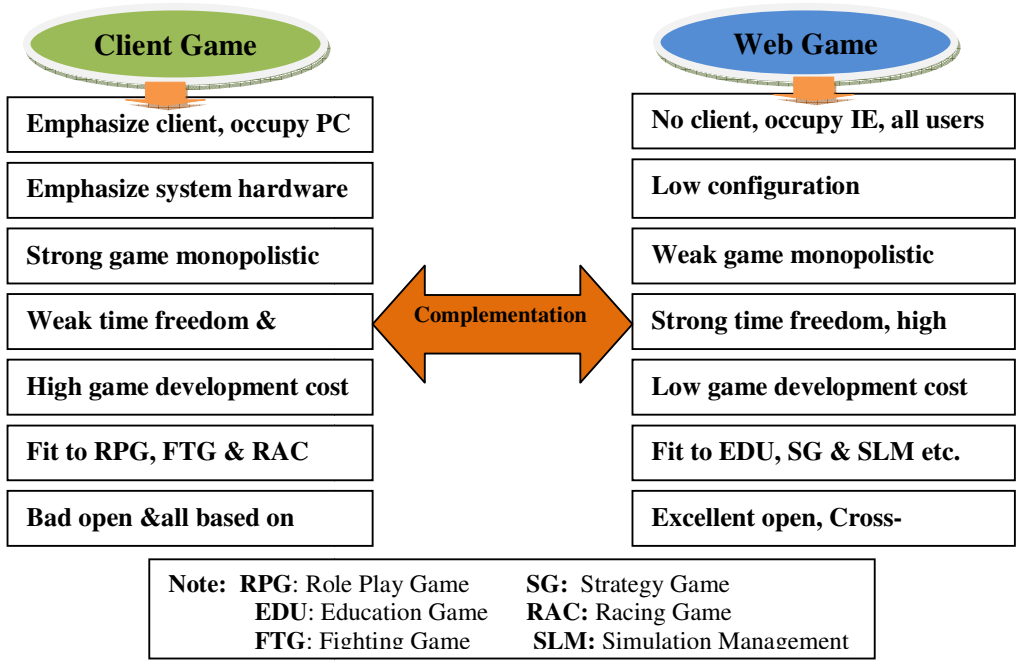
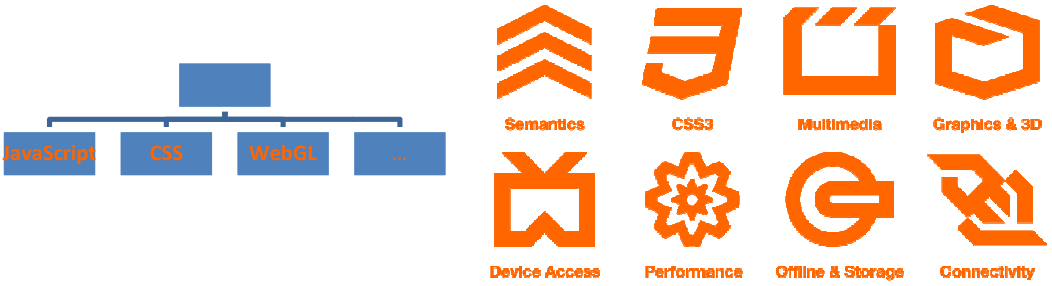


Fig. 2 Differences Between Client Game and Web Game

2.2. Concept and Area of HTML5 Technology

HTML which stands for hypertext mark-up language is supposed to be the main language for web pages. It is simply the latest evolution of HTML with the connection of CSS, JavaScript and WebGL etc., which is as following in Fig.3:



As a mark-up language for structuring and presenting content for the WWW and a kind of core technology of the Internet, it is the fifth revision of the HTML standard. The predecessor of HTML5 draft was called Web Applications 1.0, which was put forward by WHATWG in 2004. The first formal draft was released on Jan 22nd, 2008. [2]

Cascading Style Sheets (CSS) is a style sheet language used for indicating the presentation semantics of a document written in the mar-kup language. The usage is mostly to style web pages that are written in HTML or XHTML. JavaScript is a programming language that is widely used to give sophisticated functionality to web pages. It is a prototype-based scripting language that is dynamic, weakly typed and has first-class functions, and support object-oriented, imperative, and functional programming styles. WebGL(Web Graphics Library) is a JavaScript API for rendering interactive 2D and 3D graphics within compatible browser without plug-ins. It is integrated

completely into all the web standards of browser allowing GPU accelerated usage of physics and image processing and effects as part of web page canvas.

2.3. Features and Function of HTML5 Technology

HTML5 is a language that used to create web pages, its fifth revision of HTML, a core technology of internet and basic language of designing. It adds many new syntactical features and tags that indicate website designs with special effects and awesome layouts. It is no longer based on SGML despite the similarity of its mark-up. It introduces new elements and attributes that reflect typical usage on modern websites. Some of them are semantic replacements for common uses of generic block ( ) and inline () elements. Some deprecated elements from HTML 4.01 have been dropped, including purely presentational elements such as <font> and , whose effects have long been superseded by the much more powerful CSS. There is also a renewed emphasis on the importance of JavaScript in web behaviour.

```
<!DOCTYPE html>
<html>
    <head> <meta charset="utf-8" /> <title>HTML 5 complete</title>
        <!--[if IE]><script src="http://html5shiv.googlecode.com/svn/trunk/html5.js">
        </script><![endif]-->
        <style> article, aside, details, figcaption, figure, footer, header, hgroup, menu,nav,section
        {display: block;} </style>
    </head>
    <body> <p>Hello World!</p> </body>
</html>
```

Hence, HTML5 has some obvious advantages apart from no installation, such as faster loading times, the compatibility for mobile devices, geo locations, offline application cache, the enhanced forms and so on. It also possesses increased semantic values as well as a good consistency. Frankly, HTML5 has the potential to emerge as the next big standard. However, as WHATWG and W3C don't reach a consensus each other, HTML5 still has no unified standard until now. HTML5 still aims at improving the language with support for the latest multimedia while keeping it easily readable and consistently understood by computers or other devices.

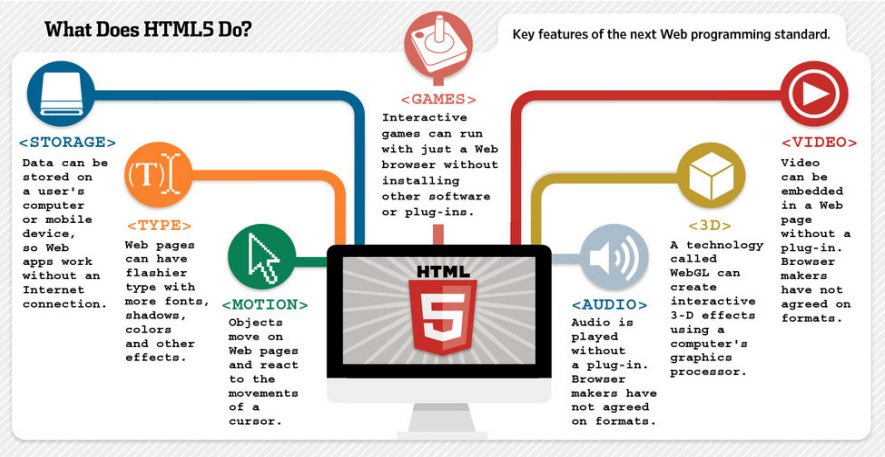


Fig. 4 HTML5's Function (Source: *http://designthewebway.tumblr.com/*)

From Fig.4, we can see the increasing growth of web applications has boosted the usage of HTML5 technology because of all the above functionalities. This technology is especially used to developing games. Now developer can build different kind of attractive and advanced games for game lovers. HTML5 technology can do improve the development efficiency of web game. We believe HTML5 will play an increasingly important role in future game development.

3. APPLICATION AND EFFECT OF HTML5 TECHNOLOGY IN WEB GAME

3.1. Application of HTML5 Technology in Web Game

HTML5 has many new applications and specifies scripting application programming interfaces (APIs) that can be used with CSS, JavaScript and WebGL. It can extend existing document object model (DOM) interfaces. Here are some new APIs, such as:

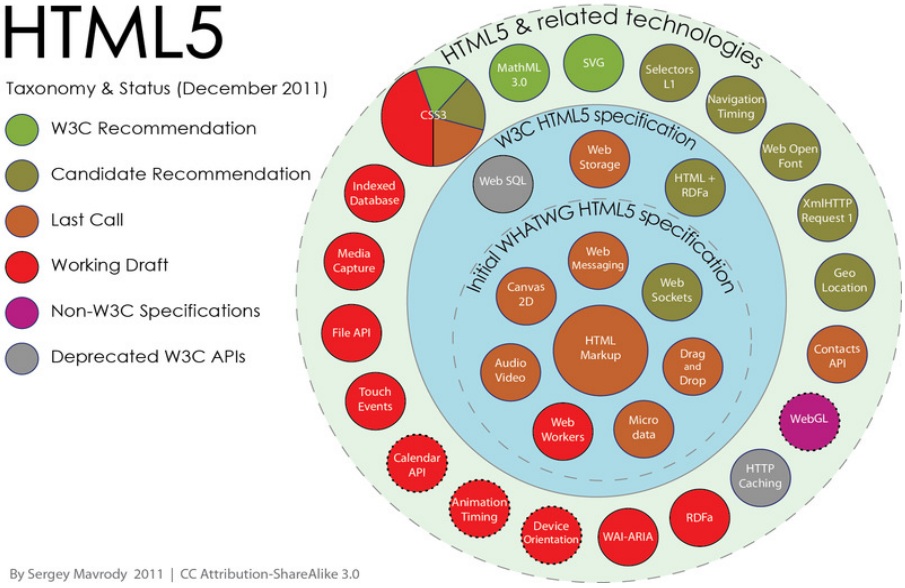


Fig. 5 The Related APIs of HTML5 (Source: *Sergey M. Sergey's HTML5 & CSS3. 2012*)

As we can see from Fig.5, not all of the above technologies are included in the HTML5 specification. Some technologies that were originally defined in HTML5 itself are now defined in separate specifications.

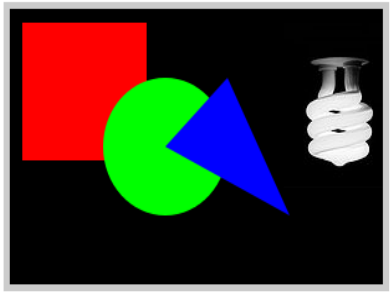


Fig. 6 2D graphics by JavaScript

For example, JavaScript is used to draw functions of 2D graphics (like Fig.6) for web game that are embedded in HTML and that interact with the DOM of the page. The following codes are the application of JavaScript in drawing 2D graphics:

This following code example indicates JavaScript has simple grammar and development process. It can interact with HML5 form and directly react to the client events. Many new web games have been developed by the technology. The developed web game based on JavaScript is the only one of crossing 3 platforms of desktop, web and mobile.[3]

```
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01//EN"
"http://www.w3.org/TR/html4/strict.dtd">
<html>
 <head><title>simple example</title></head>
 <body>
  <h1 id="header">This is development example</h1>
  <script type="text/javascript">
    function draw(){
        var canvas = document.getElementById("mycanvas");
        if (canvas.getContext){
          var ctx=canvas.getContext('2d');
          // Draw Rectangle
          ctx.fillStyle="rgb(255,0,0)";
          ctx.fillRect(10,10,100,100);
          //Draw Circle
          ctx.fillStyle="rgb(0,255,0)";
          ctx.beginPath();
          ctx.arc(125,100,50,0,Math.PI*2,true);
          ctx.fill();
          ctx.closePath();
          //Draw Custom Shape With Lines
          ctx.fillStyle="rgb(0,0,255)";
          ctx.beginPath();
          ctx.moveTo(125,100);
          ctx.lineTo(175,50);
          ctx.lineTo(225,150);
          ctx.fill();
          ctx.closePath();
          //Draw Image From External File
          Var myImage=new Image();
     myImage.onload=function(){
            ctx.drawImage(myImage,220,10);
          }
          myImage.src="sample.jpg";
         }
        }
  </script>
 <canvas id="mycanvas" width="300" height="200" >Fallback content,in case the browser
does not support canvas.</canvas>
 </body>
</html>
```

3.2. Effect of HTML5 Technology in Web Game

Web game is a kind of modern internet game pattern, which is convenient, rapid and cheap for players. A successful web game requires not only high quality of graphics and attractive story line but also impressive sound effects to attract the players. According to my investigation, most players are mainly younger as well as part of the elders and children. They would like to play more high-quality interesting web games with more interaction content or more astonishing 3D effects. [4] HTML5 technology can do realize the effects for web game.

3.2.1. 3D Graphics Effects of Web Game

Web game is one of the first beneficiaries of HTML5 and WebGL for 3D graphics. Now some developers are dedicating in WebGL game development. They can create beautiful 3D game sceneries. For example, "FastKat2" in Fig.7 is a web game by WebGL and JavaScript, which takes players on a high speed race through the asteroid belt. The asteroids are actually multi-colored diamonds and it's really hard to get out of the way. Web game provides 3 dimensional angles and can be played with excellent 3D visual experience on any browser enabled for WebGL. The players can control the direction just by keyboard.

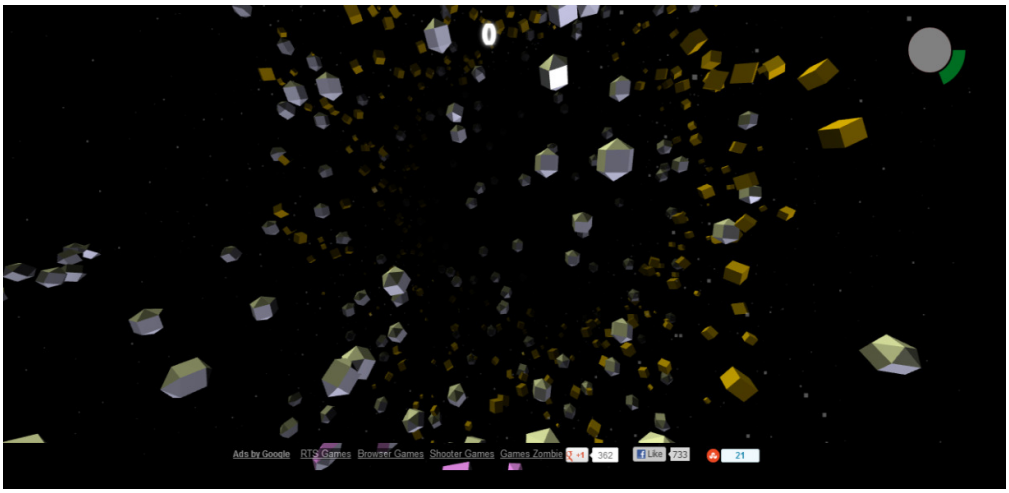


Fig. 7 WebGL's Graphics Effect (Source: http://www.omiod.com/games/FK2/)

From Fig.7, we can see a 3D graphics effect. It feels like we're in movie or sky. It is very astonishing and interesting for players. So web game really benefits a lot by WebGL and other HTML5 technologies. WebGL is an excellent tool for web game.

As a matter of fact, WebGL is based on OpenGL and provides an API for 3D graphics, which uses the HTML5 canvas and is accessed using DOM interface. Before WebGL, in order to achieve 3D effects, we have to use special web language or plug-ins for browser, such as Flash, Silverlight etc. But now, automatic memory management is offered as part of JavaScript. WebGL directly provides not only a solution for developers to 3D web games with other HTML5 technology but also API to generate hardware-accelerated 3D graphics to any compatible browser without plug-ins. It extends the capability of JavaScript to generate the power of hardware acceleration. Now WebGL has become one of the hottest technologies.

3.2.2. Sound Effects of Web Game

As the language for structuring and presenting content for the WWW, the audio or video elements technology behind HTML5 has the framework to fundamentally change how we interact with the web. Adding sound effects to web game is not only can enhance its entertainment value, it also contributes to the game's overall cachet of quality. Sound is one of the key elements for building successful game. Here is an example of how to add sound effects using HTML5 technology. We can easily attach a sound effects to the canvas game with the help of HTML5 technology –"Audio" tag.

```
<body onLoad="drawGameCanvas()">
  <canvas id="gameBoard" width="300" height="300"></canvas>
  <audio id="soundEfx" style="display: none;">
       <source src="demo-audio.ogg"/>  <source src="demo-audio.mp3"/>
   </audio>
</body>
```

Fig. 8 Audio Effect by HTML5 Technology

Fig. 8 shows the audio effect by HTML5 canvas and audio tag. In order to add graphics, we can makeup it like this:

```
<video width="320" height="240" controls preload="none" poster="videoframe.jpg">
   <source src="demo-video.mp4" type="video/mp4"/>
       <source src="demo-video.ogv" type="video/ogg"/>
  </video>
```

Then we can see the effect as follows in Fig. 9:

Fig. 9 Video Effect by HTML5 Technology

It is the easiest and simplest way to create a game. In order to design more astonishing effect, we can continue to make web game interesting. In this game, bounce sound effects occur when the ball hits something. And in above codes, ID– "soundEfx" is assigned to the audio tag for DOM access in JavaScript later and pre-load a bounce sound effects for later use as well. We have the

audio tag defined in our HTML structure. Let's implement it to the game through JavaScript. First of all, we require 2 variables for that, which is "soundEfx" and "soundLoad".

```
// Global variables.
var ballX = 150; // Ball x position.
var ballY = 150; // Ball y position.
var ballDX = 2; // Change in ball x position.
var ballDY = 4; // Change in ball y position.
var boardX = 300; // Board width.
var boardY = 300; // Board height.
var racquetX = 150; // Initial racquet location.
var racquetH = 10; // racquet height.
var racquetD = boardY - racquetH; // racquet depth.
var soundEfx; // Sound Efx
var soundLoad = "over.wav"; //Game Over sound efx
```

This source code shows "soundEfx" is used for quick access to the audio tag in HTML. "soundLoad" is used to store another sound effects file and use it when the game is over. Then assign the audio tag to the soundEfx variable when the page is load. So, we can achieve this by writing this line of code and place it inside the function of "drawGameCanvas".

Next, we insert the following code into where the bounce happens.

```
soundEfx.play();
```

In this case, we want the bounce sound play during the following circumstance:

```
// Bounce on a left or right edge.
if (ballX + ballDX > boardX - 15 || ballX + ballDX < 15) {
    ballDX = -ballDX;
    soundEfx.play(); }
// If ball hits the top, bounce it.
if (ballY + ballDY < 15) {
    ballDY = -ballDY;
    soundEfx.play(); }
// If the ball hits the bottom, check see if it hits a racquet.
else if (ballY + ballDY > boardY - 15) {
  // If the ball hits the racquet, bounce it.
  if (ballX > racquetX && ballX < racquetX + racquetW) {
      ballDY = -ballDY;
      soundEfx.play();  }
```

From this source code, we'll see if ball hits the top or racquet, bounce it. And then change the source of the audio to the sound effects of game over, and play it when the ball hits on the bottom edge, which is as follows:

```
//game over sound
soundEfx.src = soundLoad;
soundEfx.play();
clearInterval(gameLoop);
//alert("Game over!");
ctx.font = titleFontSize;
ctx.fillStyle = "red";
ctx.fillText("Game Over", 80, 130);
ctx.font = contentFontSize;
ctx.fillStyle = "blue";
ctx.fillText("Please refresh the page to replay", 55, 150);
```

At last, we can successfully add bounce sound effects and improve the experience effect of web game using HTML5 technology. It aims at attracting players and making game more humanized with richer audio-visual feeling.

Thus, not only WebGL but also Canvas and JavaScript push 3D web game forward. Audio API allows real time audio manipulation and playback making interactive sound a reality. Besides, other important HTML5 features also promote web game fast develop forward. For instance, WebSockets allow true bi-directional networking, hence enabling efficient low latency communication for multiplayer games. App Cache allows us to load a website once and cache it, making the burden of large game downloads palatable. It is a new feature of HTML5, which offers a smarter way to cache the web application, making it available offline. These are important for the development of web game.

4. CAPABILITY OF BROWSERS FOR WEB GAME WITH HTML5

As we know, the purpose of a browser is to read the HTML documents and then compose them into either audible or visible websites. The main browsers in the market are Chrome, Firefox, Opera, Safari, IE and Mobile etc.

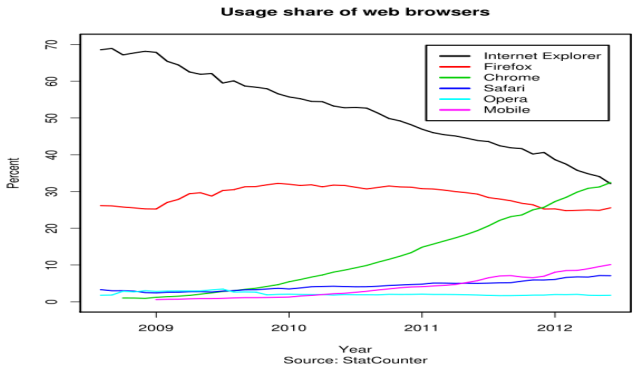


Fig. 10 Usage Share of Web Browsers (Source: Daniel.Cardenas, *StatCounter*, 2012-06.)

Fig. 10 shows usage share of web browsers recently. At present, Chrome and Firefox take the second and the third market share of the global market.

As HTML5 is becoming more and more popular, these browsers are trying to support for HTML5. Among them, the support performance of Chrome is the best, which is indicated as follows:

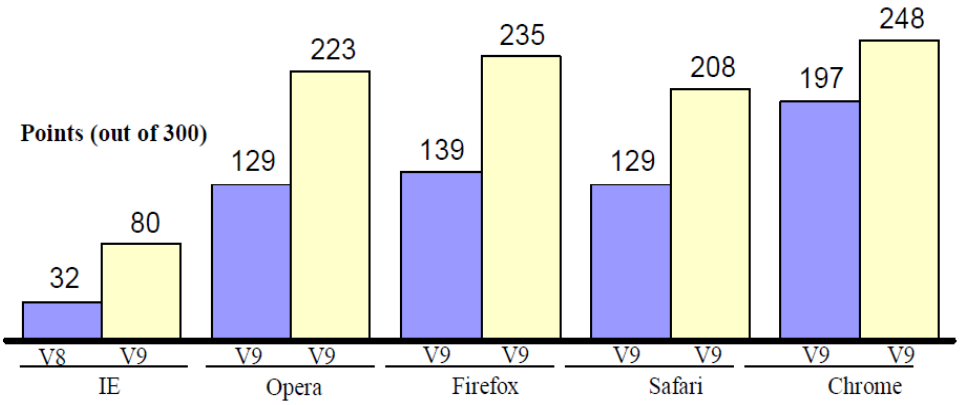


Fig. 11 HTML5 Support Evaluation Score (Data Sources: *html5test.com*)

In Fig.11, browsers are given a weighted score based on their support for features defined in working subset of HTML5. Apple and Google are the leaders for it.

Besides, 3D capability is already showing up in browsers like Firefox4 and Chrome through WebGL. According to the statistics from iResearch, there are more than 450 million users who can do hardware accelerated 3D graphics. More importantly, as the most commonly used browser, IE began to support HTML5 from version 9. That is a huge potential user group for 3D web game. The following table shows the capability of browsers for web game with HTML5 technology.

	WIN								MAC					
	10	4.0	11	5	6	7	8	9	10	4.0	11	4	5	
CSS Selector	○	○	○	○	□	□	□	□	○	○	○	○	○	73%
Canvas	○	○	○	○	□	□	□	○	○	○	○	○	○	84%
CanvasText	○	○	○	○	□	□	□	○	○	○	○	○	○	81%
WebGL 3D	○	○	○	□	□	□	□	○	○	○	○	□	□	59%
Audio	○	○	○	○	□	□	□	○	○	○	○	○	○	80%
Video	○	○	○	○	□	□	□	○	○	○	○	○	○	80%
Geolocation	○	○	○	○	□	□	□	○	○	○	○	○	○	62%
WebSocket	○	○	○	○	□	□	□	□	○	○	○	○	○	70%
Offline App	○	○	○	○	□	□	□	○	○	○	○	○	○	80%

Table1 Capability of Browsers for Web Game with HTML5
(Data Source: *http://html5demos.com, http://html5test.com/)*

From Table1, we are happy to see major browsers like Chrome and Firefox are dedicating to the development of 3D web technology, such as HTML5 and WebGL etc. But due to the support degree of each browser is not consistent, the popularization on the Internet will still need quite a long time for web game with HTML5 technology.[5]

3. CONCLUSIONS AND FUTURE WORK

By the fast development of web game and improving the capability of browsers, it gradually becomes an essential part of people internet life. It will become the main role of internet games in

future. Today, because of the application HTML5 technology, new web games are gradually released and updated. The game content and user experience are gradually improved. Web game developers can rapidly satisfy players' request and keep the players' loyalty by means of HTML5 technology. Thus, HTML5 technology is making web game stride forward more humanized direction by means of its advantage.

This paper mainly talked about the application of HTML5 in web game as a technology as opposed to prevailing tools like Flash and Silverlight. Although there are still a lot of same pattern web games come in short, concentrated bursts. Many games are also lack of innovation and high-quality user experience. But the conclusion will be not a hard and fast decision, but rather, the promising future are the emerging HTML5 technology is likely to play a more important role in developing web game. At present, more and more browsers and software support HTML5, which indicates HTML5 technology would have a greater and more substantial market in future. For future work, the methods to optimize experience effect would be also improved. And we'll try to apply web game into the development of friendly interaction robots for recreation and rehabilitation by means of HTML5 technology.

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