Possibilities of displaying moving images in HTML5 and their use, including the limitations when compared to Adobe Flash

Bachelor-Thesis

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Abstract

For several years the dominant technology for displaying moving images (videos and animations) in websites has been the use of Adobe Flash, however Adobe Flash has become increasingly criticized and discredited in the recent years due to the its instability and its susceptibility to attacks to the point that the company Adobe decided that it shut down the Adobe Flash Platform in 2018. The new standards of the W3C (Wide Web Consortium) i.e. HTML5 offers new features including elements that facilitate the display of moving images on web pages. HTML5 is now replacing Adobe Flash as the dominant method for the task of displaying moving images in web pages. In this thesis I will demonstrate the possibilities that HTML5 offers for displaying moving images as well as its limitation when compared to Adobe Flash.

Content

Possibilities of displaying moving pictures in HTML5, their uses, including limitations to Adobe Flash and other video display formats

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Fabrice, Feugang Kemegni

Possibilities of displaying moving pictures in HTML5, their uses, including limitations to Adobe Flash and other video display formats

Introduction

The tendency for websites to display moving images has increased to the extent that even personal websites now display videos. The dominant technique for displaying videos and animations in web pages in the past has been the use of Adobe Flash. However, Adobe Flash has become relatively unstable and a constant victim to hacking and software attacks. In the recent years HTML5 has evolved as the new version of HTML with new features and tools including elements that greatly simplify the display of videos and animations. With these new features, HTML5 has been increasingly gaining grounds in replacing Adobe Flash as the main method to display moving images in websites.

The goal of this thesis is to demonstrate the possibilities that the new HTML5 offers for displaying videos and animations (moving images) on websites, and to point out some of the limitations of HTML5 in doing that as compared to Adobe Flash.

In order to achieve this goal, this thesis has been subdivided into chapters and sections. Each chapter builds upon the preceding one. Each chapter builds the foundation for the next chapter. Chapter 1 will introduce a brief discussion of what an Image means and what a video means in the domain of computer science, then discus some of the components of a video, followed by the reasons why videos are been embedded in webpages. In chapter 2 I will discuss the most common video formats use in websites today and what technology is required to play them. Afterwards I discuss some popular methods of displaying videos on websites.

Chapter 3 discusses the Adobe Flash methods of displaying videos in websites, followed by some of its limitations and some of the reasons that encouraged the evolution of alternative methods.

Chapter 4 discusses HTML5, what it is, how it is used to embed videos (display videos) on a website. Chapter 5 Highlights some advantages and imitations of using HTML5 to display videos in webpages as compared to Adobe Flash.

Chapter 6 discusses some usage statistics over the web, i.e. what percentage of applications use HTML5, or Adobe Flash to embed their videos and how the tendency is growing. This chapter is followed by the conclusion chapter where I state my appreciation on the tendency, as well as a little analysis on how the tendency is likely going to grow and why.

Problem Statement

Adobe Flash The dominant method for embedding videos on websites has been increasingly criticized due to its instability, it's poor performance on mobile devices and its susceptibility to software attacks. Recently HTML5 has been published as the latest version of HTML, offering new features, including the ability to display videos in web pages. The question is: To what extent can HTML5 replace Adobe Flash in the task of displaying moving images on websites and what are the limitations when compared to Adobe Flash.

Goals

In this thesis, I will demonstrate what possibilities HTML5 offers for displaying moving images (videos and animations) in websites, and what are the limitations when compared to other techniques mainly Adobe flash.

Methodology

In the course of developing this subject and solving the task on hand, I will carry some researches through reading from several sources including books, internet forums and websites and I will carry out tests myself on my computer to prove or disprove and support the information obtained from the searches. The principal source of information for this work is the internet because one doesn't learn how to climb a tree from a fish, but instead from a monkey. This means, because the topic of the thesis is essentially web related, the best source of information is the web.

1. Overview of moving Images

This chapter discusses some brief definitions about the structure and main components of a video which is an image. The first section discusses what an image is and what it is composed of, the second section build on what have been learn about an image to describe what a video is and the characteristics of a video. The last section of this chapter discusses the reasons why videos are being displayed (embedded) in websites.

1.1 What is an Image

The definition of an image varies deeply across domains and fields of studies. In computing and computer science an image is a two dimensional signal or a mathematical function $f(x, y)$ where x and y are the horizontal and vertical coordinates of pixels. The value of $f(x, y)$ at any point gives the pixel value at that point of an image. The pixel carries the value of a Colour, intensity as well as some other image information. The figure below explains the relationship between an image and its pixels.
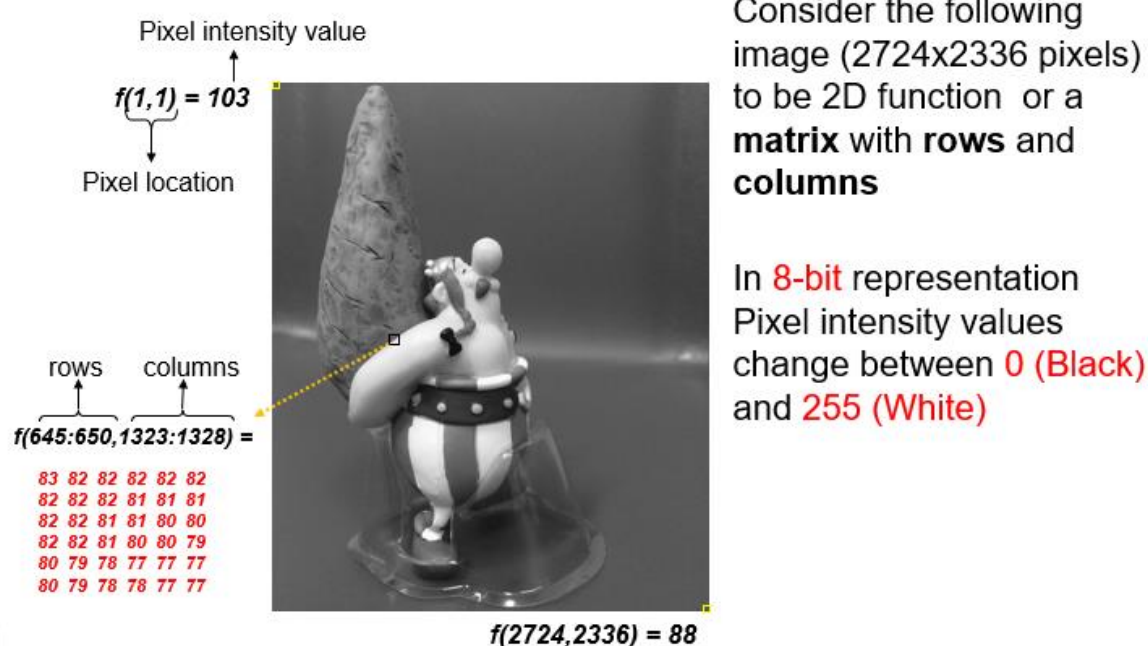
Figure 1 : Digital Image (2740x2336 Pixels)

This a 2750x2336 Image viewed as a 2D function. The little yellow box at the top left of the image represents a pixel at coordinate f(1,1) and the value 103 which represents a grayscale or colour. In this example the pixels are 8-bit, which means the pixel values range between 0 to 255 (decimal representation of 8-bit range).

A detailed discussion on pixels in this work is out of scope, readers should simply consider a pixel as the basic component of an image and that an image is a collection of pixels that build a visible perceptible object.

The technical aspect of an image is not required for this work. For simplicity, an image is defined here as graphical object that is displayed over a display medium. This definition does not embody dynamic images like gifs, but only static 2-dimensional images.

1.2   What are moving Images

Moving image or moved image is a term that encompasses videos, animations and other files that display images changing over a period of time. In technical terms it is a 3-dimensional image. A video is basically a collection of superimposed images that are displayed one at the time and one after the other in a specific order and time lap.

A video could be understood as a stack of images, each marked with a timestamp in the time interval, such that each timestamp corresponds to an image in the stack. Supposing a stack of 60 images, and a time interval of 60 seconds, each image in the stack is marked with a unique time as second in this interval. Placing these stacked images in a device that will display each image of the stack at the specified timestamp. Such a device is called a video player. The result of displaying these images at the stated timestamp is what we see as a video. Hence requesting a particular image to the playing device by providing its timestamp is the equivalent of jumping to a time interval in the video just like what we do when we fast-forward a video in YouTube or VLC player. Figure 2 below illustrate a basic video consisting of stacked images.
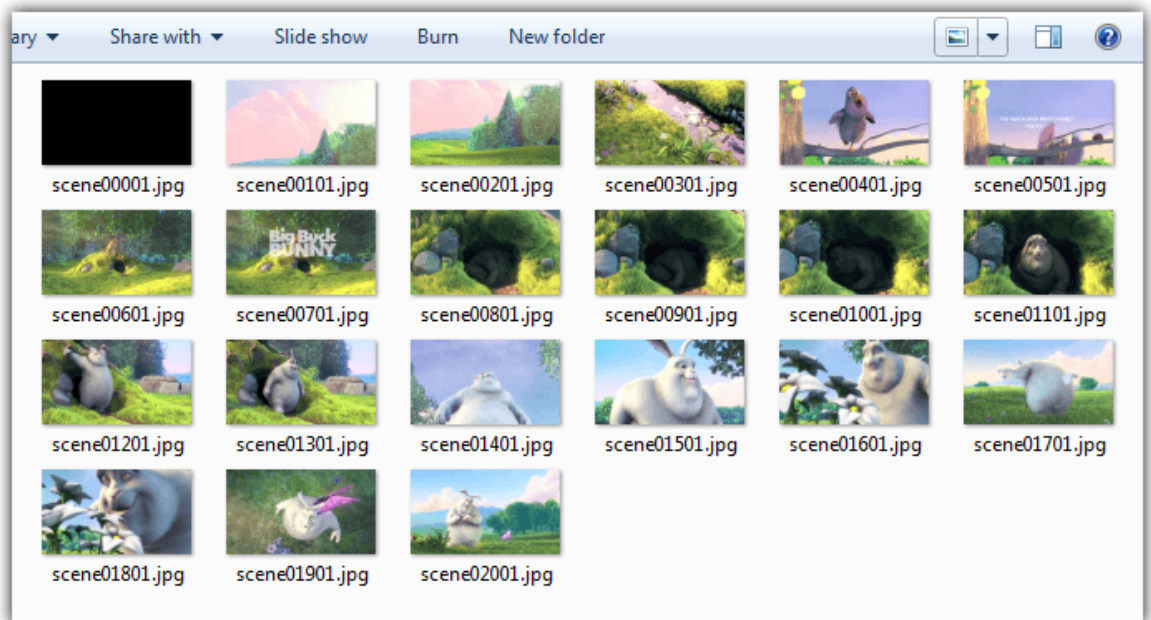
Figure 2: Video Frames

The 21 Pictures/Images in the figure will constitute frames when grouped together to form a video. Each of the images (frames in the figure above could

be marked with a timestamp e.g. 1 second, this can then be viewed as a video 21 seconds long.
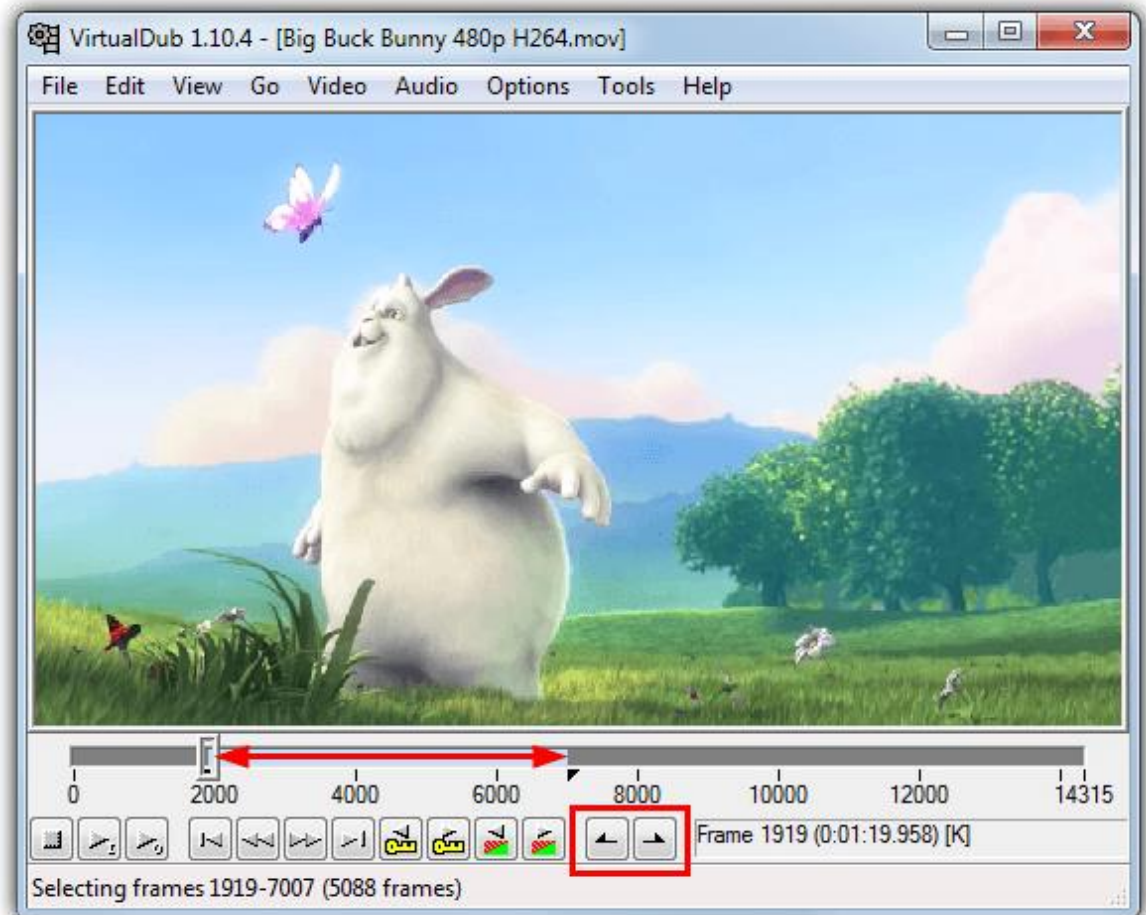
Figure 3: Frame Clipping

The Figure attempts to illustrate how the Images/frames are stacked together to produce a video.

Each image in such a stack/video is called a frame and the interval or time lap in most videos is between 24-30 images per second (this means 24-30 images are displayed each second), where the term Frame Per Second (FPS). Video files simply store all frames together and a video player plays them in order.

With such a brief introduction and description of what images and videos are, it is now possible to illustrate the most important components or elements of a video on the web.

1.3   Video Components

Videos are stored in a compressed form to reduce the amount of space they may use. A video file typically consists of a container consisting of a - video data in video coding format and audio data in audio coding format. The container format can also contain synchronization information, subtitles, and metadata such as title. A standardized (or in some cases de facto standard) video file type such as .webm is a profile specified by a restriction on which container format and which video and audio compression formats are allowed.

There are hundreds of types of videos and video formats and each type/format serves a purpose better than the others. It is to be noted that a video can be converted from one format into another format using algorithms.

1.3.1   Codec

A codec is a computer algorithm that encodes/decodes or compresses/decompresses digital stream data like videos or audios, it also interprets the data stream (e.g. video/audio) and determines how best to play the video on the output medium. Electronic devices capable of displaying videos all come with some preinstalled codecs, computers for example come with some codecs and users are mostly required to download install more codecs, this is often the case when the computer encounters errors like "file extension not supported" or "cannot play media".

1.3.2   Video Containers

A video container is a bundle of media files, often consisting of a video and an audio codecs and sometimes some additional information like subtitles. Containers allows user to choose one codec for the video and another codec for the audio.

1.4   Reasons for Displaying videos in web pages

There are hundred reasons why videos are being displayed on websites, below are some of these reasons:

Shopping websites must display images and videos on their websites so as to show to the potential customers what their products and services look like. An example here is in the vacation industry, where videos of beaches, hotels, mountains, cruising tours must be shown to users to motivate them into committing to carry purchase.

If not displaying an unpurchased product, companies may also need to illustrate how the customers should or could use their purchased products. These include videos of installation guides, after sale supports where a video featuring a trained personal demonstrating how to assemble a chair, bicycle, a tent or any product that could have been purchased in a disassembled state and requiring the customer be assembled the product themselves.

The academics also make use of videos in their web pages. This could be videos for tutorials, videos of welcome, new Students orientation, visitor's orientation etc. Thus, requiring videos to be embedded in their websites.

Television channels also have some branches that are online and requiring live broadcasts or archives or shows. These either require streaming of videos either live streaming or not. Viewers have the opportunity to choose among viewing their favourite shows live on Television or on web browser. This increasing the need to display videos on web pages.

Video sharing websites make extensive use of videos in their websites and these videos constitute more than 80% of the content of their websites. YouTube, Netflix, even Facebook make extensive use of videos in their web application.

Videos are also used as advertisements in websites. These often come in the form of animations and GIFs (Graphics Interchange Format).

As stated before, the list of reasons why websites may contain videos is exhaustive, I have just provided some common reasons why videos may be found in a website.

1.5   Videos in Web pages vs in other Media

Videos in a website differ from videos in other media in several ways. One of the main difference is that a video in a website requires bandwidth and buffers. A website requires the video to be buffered, i.e. a certain percentage of the video must be loaded before the video starts playing. This in comparison to a video played on the computer from a video player does not require the video to be buffered, the video is instantly played. Web videos require internet in order to load the video content from the source or server to the user.

Refreshing the browser page makes the video restart from the beginning, and the amount of already buffered video is lost. The video restarts each time the connection to the internet is lost. This means if you are watching a video over a web browser, then the internet goes off and on, the video needs to restart as the browser needs to re-establish a connection with the website.

Low bandwidth leads to poor viewing quality as the video will frequently freeze while it is being buffered, this may lead to inconveniences and bad user experience compared to a video been viewed from a video player program on the computer.

Displaying a video on a website requires the dimensions of the video to be customized. Not all the videos are being embedded the same way in to a website. The videos width, height, scale and other parameters need to be edited, otherwise the video will be either cropped, hidden or wrongly scaled, distorted. In comparison to playing a video over a video player in the computer or television, where no additional setting is required for videos of different sizes. The video sizes and ratios are automatically adapted to the display.

These differences highlight the attention required for displaying videos in websites, which make it a little more difficult. In the next chapter, I discuss some video formats used over the internet and how the differ among each other and some of the methods used to display videos on webpages.

2.   Displaying Videos

In the previous chapter, I defined what a video is in the context of computing, I also highlighted the structure of a video and finally I gave some reasons why videos are displayed in websites. In this chapter I will discuss some of the most common video formats in use in web applications, some methods used in the past by websites to display videos, and finally which of these methods have evolved and which are no longer in use today.

2.1   Some Video Formats

As previously Introduced, there are dozens of video formats, each with their characteristics, abilities and each being appropriate for a specific purpose. Video formats are often referred to as video containers. Below are 6 of the most commonly encountered videos formats used in websites. This list does not order nor sorted.

A more comprehensive list of video formats can be found on the Mozilla Website (https://developer.mozilla.org/en-US/) under the following link https://developer.mozilla.org/en-US/docs/Web/HTML/Supported_media_formats http://websitehelpers.com/video/formats.html

2.1.1   .AVI (Audio Video Interleave)

Developed and published by Microsoft in 1992 AVI is one of the oldest video formats. Due to its simple architecture, AVI files are able to run on several architectures like Windows, Macintosh, Linux, and also supported by popular web browsers. AVI files are opened with: Microsoft Windows Media Player, Apple QuickTime Player and VideoLAN VLC media player.

2.1.2   .FLV, .SWF, .FLA (Flash Video Format, Small Web Format, Flash)

These are files that are encoded by the Adobe Flash Software, can be played via the Adobe Flash Player, Adobe Flash web browser plugins and on several third-party programs. Since virtually every browser has the Adobe Flash plugin installed, it has become the most common online video viewing platform on the web. Almost all video sharing sites including YouTube stream videos in Flash. The Flash Video format is also what many video-sharing sites convert videos to, from formats that were uploaded by their users in something other than Flash. This is because videos in the FLV format remain in high quality even after compression to a smaller file size, which means that the videos on the Web load quickly and won't spend a lot of time using up bandwidth. Some notable users of the Flash Video are YouTube, Yahoo! Video, VEVO, Hulu and Myspace among many others.

2.1.3   .WMV (Windows Media Video)

Developed by Microsoft, it was originally designed for web streaming applications, but can now cater to more specialized content. WMV files are the tiniest video files over the Web, as their file size decreases significantly after compression, resulting to poor video quality. However, this small file sized format allows users to upload and share their videos through the e-mail system.
Being a Microsoft software, the Windows Media Player is the main application that is used to play WMV files on all Microsoft's Windows operating systems, but there are also WMV players available for free for the Macintosh operating system.

2.1.4   .MOV (Apple QuickTime Movie)

Developed by Apple. Inc, the QuickTime file format is a popular type of video sharing and viewing format amongst Macintosh users. It is often used on the Web, and for saving movie and video files. There is a free version of the QuickTime Player available for

the Windows Operating System among many other players. MOV files are of high quality and are usually big in file size.

2.1.5   .MP4 (Moving Pictures Expert Group 4)

MP4 is an abbreviated term for MPEG-4 Part 14, a standard developed by the Motion Pictures Expert Group who was responsible for setting industry standards regarding digital audio and video, and is commonly used for sharing video files on the Web. This video format uses separate compression for audio and video. The video track is compressed with MPEG-4 or H.264 video encoding, while the audio track is compressed using AAC compression. It is also a great file sharing format for the Web as MP4 file sizes are relatively small but the quality remains high even after compression. Due to its compatibility with both online and mobile browsers and the fact that it is supported by the new HTML5, MP4 standard is also becoming more popular than FLV for online video sharing, as it compatible

2.1.6   .ASF (Advanced Systems Format)

Another offering from Microsoft, the ASF container normally houses files compressed with Microsoft's WMA (Windows Media Audio) and WMV codec. Just to confuse the matter further, the files are usually given the .wmv or .wma suffix and not the expected .asf. A form of copy protection is offered with this container through Digital Rights Management (DRM). This file format opens with: VideoLAN VLC media player and Microsoft Windows Media Player.

These 6 Video file formats listed above is not the complete list of all video file formats available, instead a list the most frequently encountered formats for computer users, there are many more formats available, but listing all of them is out of scope for this thesis. The idea of listing these is just to familiarize the reader with some terms that will reoccur in future chapters.

2.2 Overview of Video Display Methods in Web Pages

This section describes some methods used to display videos throughout websites. Each way you embed your video will depend on the video format that you want to display. Some of these formats are discussed in the previous section. The desired format then requires the use of a video player that can play the video format. The video player is easily downloadable over the Internet. Below are the steps to embed your videos into your website.

2.2.1 Embed Tag

This method is frequently used for short videos (about 10 seconds long), and when the bandwidth and buffering times is no issue. This is the traditional method. You just need to use the html tag "embed" and link the source of the video to the tag. The browser will handle the rest. The code below illustrates how to embed a video using the html embed tag.

```
<embed src="my-mp4.mp4"
        width="500"
        height="auto">
```
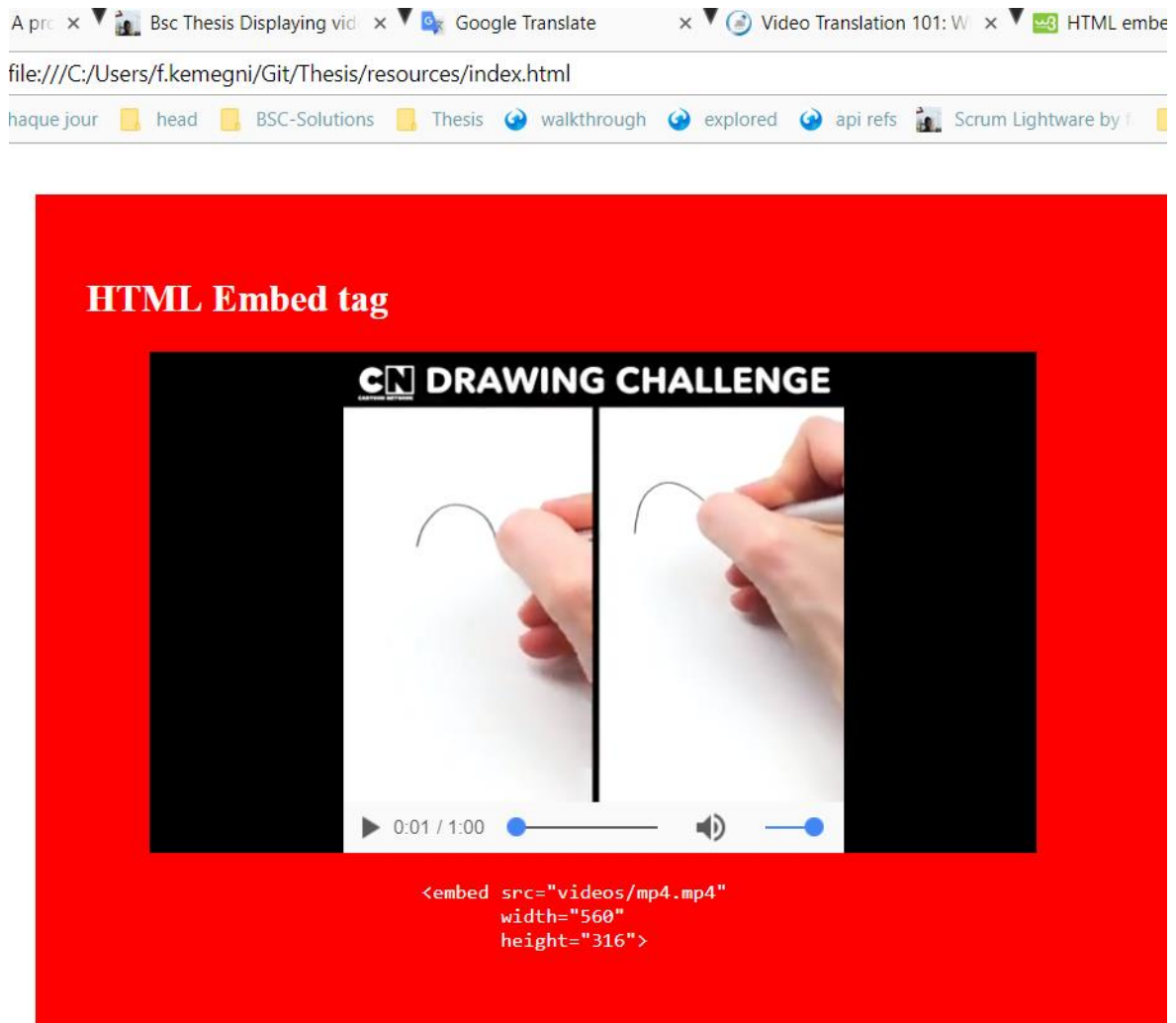
Figure 4: Displaying a Video using html embed tag

This optimal. The only requirements are the relative path of the video and the dimensions (also optional). To avoid distortion of the video, it is advised to set only one attribute of the video (only the height or only the width) in the tag, then set the value of the other to 'auto' in the stylesheet file, especially when you are not sure of the exact dimensions of the video.

2.2.2   YouTube

YouTube is often used to embed videos when the normal embed tag takes too long to load the video. This method is fast and free, but requires that the video be first uploaded to YouTube, then referencing the id of the uploaded YouTube video on your website. To use this method, you need to create a YouTube account, then upload the video to this account, YouTube automatically generates the embed Tag that you need to insert in your

website code.

The trade off with this method is that you lose all control over your video, as anyone else on youtube can freely download and also embed your video to their site.
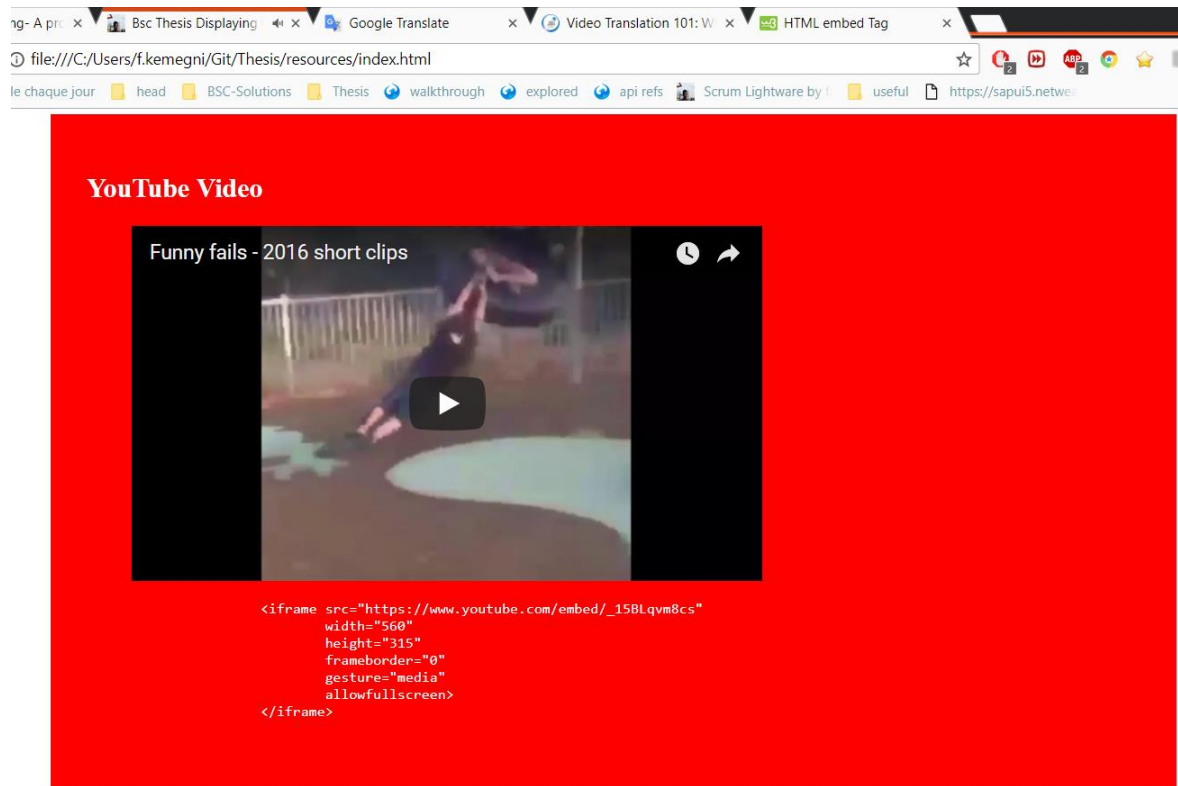
Figure 5: Embed a Youtube Video

Once you have uploaded a video to youtube, youtube offers the possibility to embed the video to your website, right click on the video and choose "Copy embed code", paste the content of the link into your website code.

2.2.3   Facebook Video Integrated

Facebook doesn't officially provide any video embedding options, still if your video is available only on Facebook, there is a workaround. Each video on Facebook has an id, to view this right click on the video and select show video URL, copy the url which shows in the URL, e.g. http://www.facebook.com/video/video.php?v=2894326448598 Copy this link to your website code.

The code snippets below show how to embed a Facebook into a website, and the figure following the code snippet shows how the embedded video is displayed on the browser.

```html
<object width="560" height="315" >
    <param name="allowfullscreen" value="true" />
    <param name="allowscriptaccess" value="always" />
    <param name="movie" val-
ue="https://www.facebook.com/plugins/video.php?href=https%3A%2F%2Fwww.fac
ebook.com%2FSarahRayTV%2Fvideos%2F1263433353761368%2F" />
    <embed
src="https://www.facebook.com/plugins/video.php?href=https%3A%2F%2Fwww.fa
cebook.com%2FSarahRayTV%2Fvideos%2F1263433353761368%2F"
            type="application/x-shockwave-flash"
            allowscriptaccess="always"
            allowfullscreen="true"
            width="500"
            height="auto">
    </embed>
</object>
```

Below is another way to embed the same Facebook video to the webpage.

```html
<iframe
src="https://www.facebook.com/plugins/video.php?href=https%3A%2F%2Fwww.fa
cebook.com%2FSarahRayTV%2Fvideos%2F1263433353761368%2F"
        width="560"
        height="315"
        style="border:none;overflow:hidden"
        scrolling="no"
        frameborder="0"
        allowTransparency="true"
        allowFullScreen="true">
</iframe>
```

Figure 6: Embedding a Facebook Video in to the website

While viewing any video on Facebook, the video has an option at its corner, click on the option button and choose 'Embed', a dialog opens where you can copy the html tag of the video, you then need only to paste this code in your website.

You can then put the code on any web pages and the Facebook video will play just like any other Flash video. You can optionally change the player size, add more parameters like auto play or loop.

2.2.4 Apple QuickTime

This requires the Apple QuickTime to be installed on the browser. The figure below describes how to embed a video to use flash player. Additional instructions how to install or uninstall QuickTime plugin can be found https://support.mozilla.org/en-US/kb/quicktime-plugin-play-audio-and-video#w_testing-quicktime.

Below is a code snippet of how to embed a video to be played by the Apple Quick-Time Player. The Browser output is displayed in the figure following the code snippet.

```
<object classid="clsid:02BF25D5-XXXXXXXXXXXXXXXX"
        codebase="http://apple.com/qtactivex/qtplugin.cab"
        width="560"
        height="315">
    <param name="src" value="my-mp4.mp4">
    <param name="autoplay" value="true">
    <embed src="my-mp4.mp4"
           type="image/x-macpaint"
           pluginpage="http://www.apple.com/quicktime/download"
           width="560"
           height="316"
           autoplay="true">
    </embed>
</object>
```
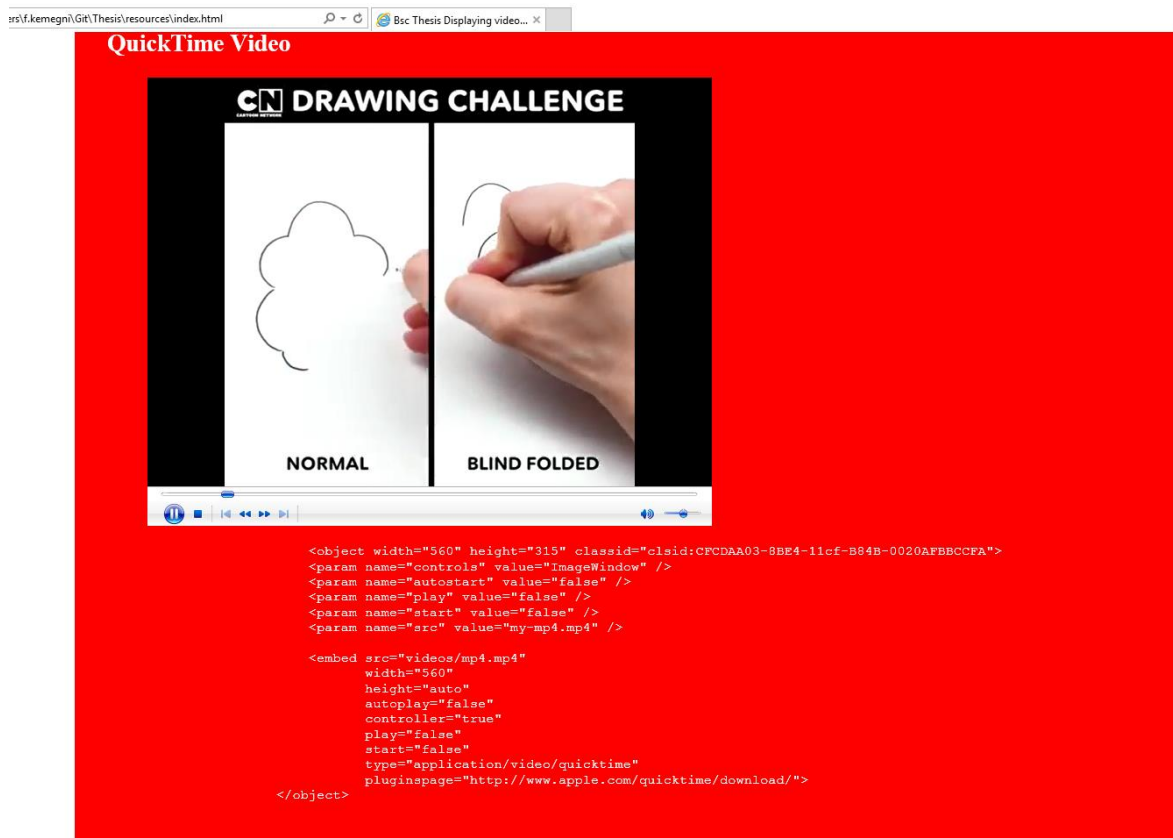

Figure 7: Browser output for a playing a video using Apple's QuickTime Player

2.2.5 Windows Media

Requires Windows Media Player installed on the web browser.

```
<OBJECT id='mediaPlayer1' width="180" height="50"
        standby='Loading Microsoft Windows Media Player components...'
        type='application/x-oleobject'>
    <param name='fileName' value="Stream URL or Full File Path Goes
Here">
    <param name='animationatStart' value='true'>
    <param name='transparentatStart' value='true'>
    <param name='autoStart' value="false">
    <param name='showControls' value="true">
    <param name ="ShowAudioControls"value="true">
    <param name="ShowStatusBar" value="true">
    <param name='loop' value="false">
    <EMBED type='application/x-mplayer2'
           plugin-
spage='http://microsoft.com/windows/mediaplayer/en/download/'
           id='mediaPlayer'
           name='mediaPlayer'
           displaysize='4'
           autosize='-1'
           showcontrols="true"
           showtracker='-1'
           showdisplay='0'
           showstatusbar='-1'
           videoborder3d='-1'
           width="420"
           height="380"
           src="videos/wmv.wmv"
           autostart="true"
           designtimesp='5311'
           loop="false">
</OBJECT>
```

The browser's output is shown in the figure below.
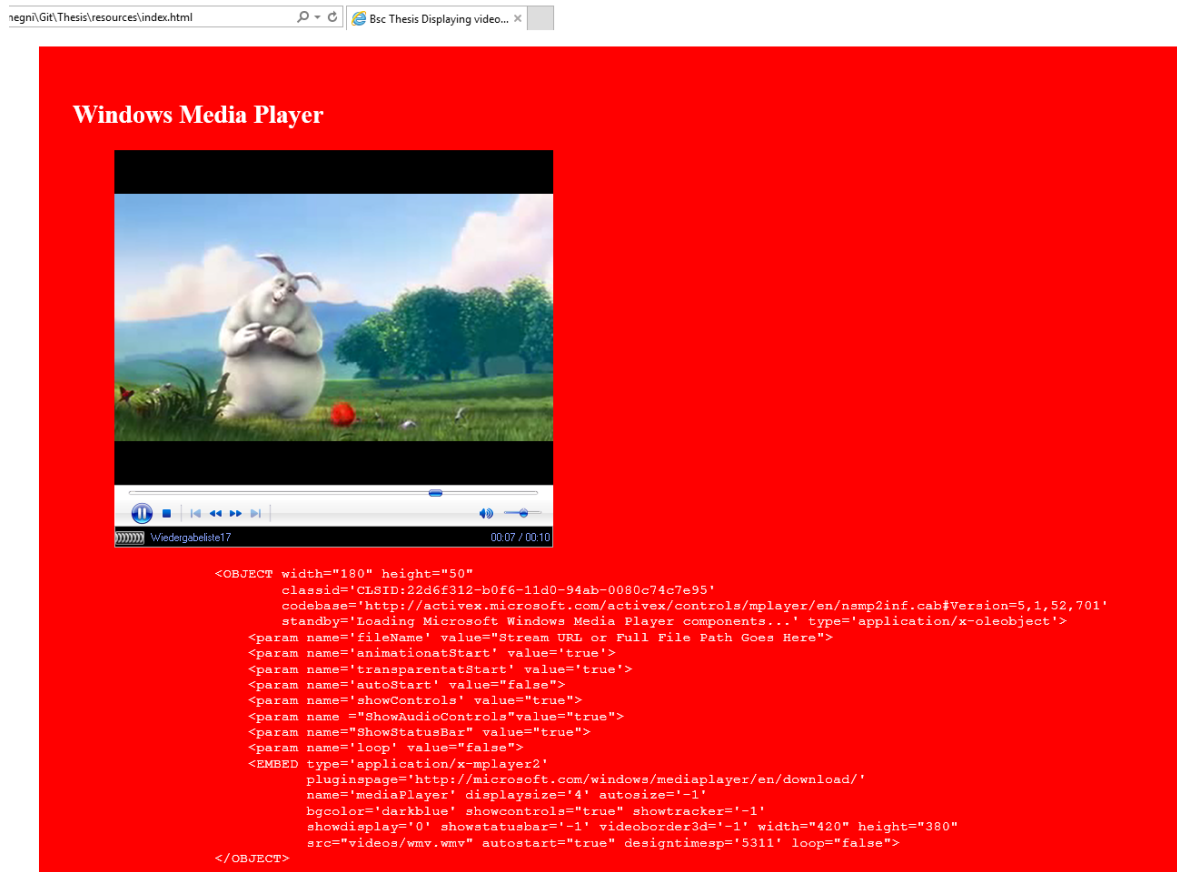
Figure 8: Displaying a Video using the Windows Media Player Plugin

Installing the windows media player is easy, you got to the Microsoft website in the downloads section (the link is not included here because it changes constantly, so it is better to just go to Microsoft). Download the player and place it in your website folder.
The alternative to downloading the player is to reference it as a video attribute(see the code snippet).

2.2.6   HTML5

HTML5 is one of the most straightforward new techniques of video embedment. The new <video> tag in HTML5 mark-up allows web developers to add videos into a web page without any special plugins. To make the most of HTML5 video, you have to prepare your video in three variants – H.264, Theora OGG and WebM, since different web browser support this or that video codec for the new HTML5 standard. The sample code for HTML5 video looks like this: https://www.w3schools.com/html/html5_video.asp. Below are the code snippet and the browser output when embedding a video using the HTML5 method.

```html
<video width="500" controls>
    <source src="mov_bbb.mp4" type="video/ogg">
    <source src="my-mp4.mp4" type="video/mp4">
    Your browser does not support HTML5 video.
</video>
```
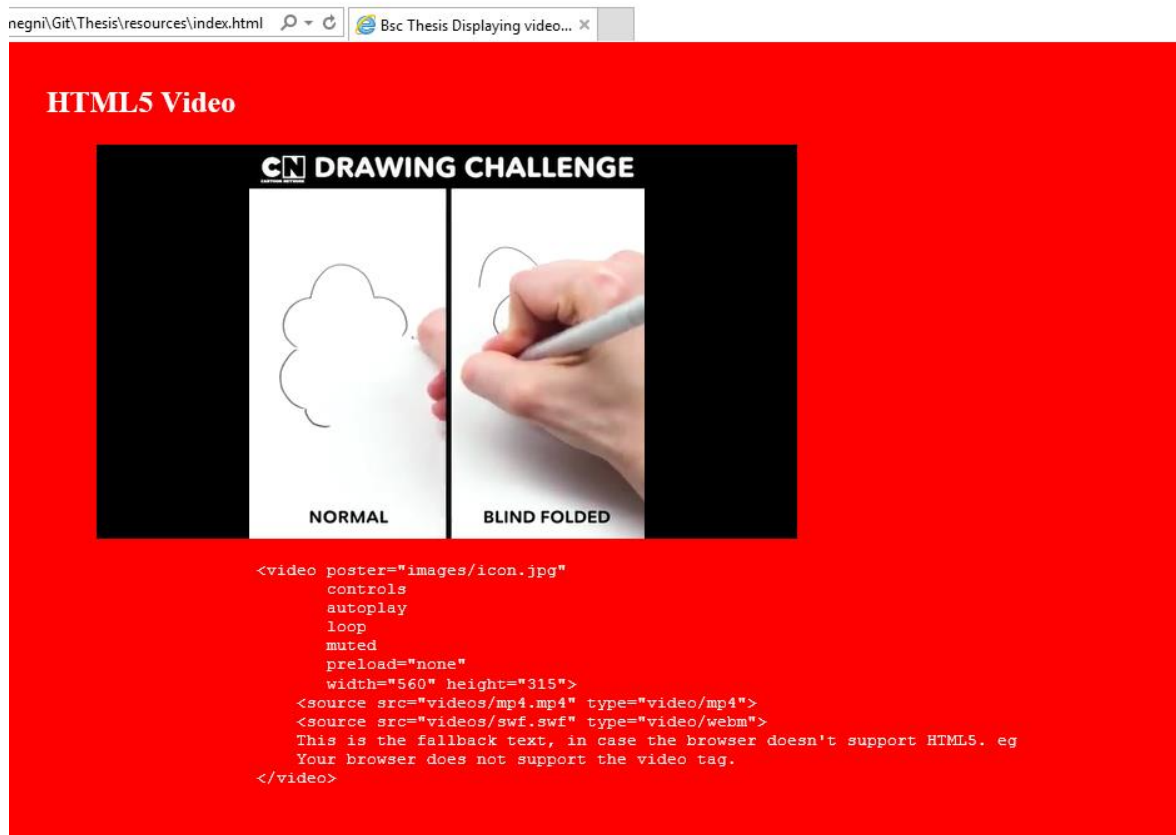

Figure 9: Displaying a Video using the HTML5 method

*A detailed discussion of this method is presented in **Chapter 4.6.***

2.2.7   Adobe Flash

To use the media Player, you first need to download the Windows Media Player which is free to download under google

http://code.google.com/p/youplayer/downloads/detail?name=mediaplayer.swf

After downloading the player, place it in to your website folder or server. Include the embed code in your website.

A Detailed illustration of embedding videos on a webpage using the Adobe Flash Method is presented in the next following.

2.2.8   Vimeo Embed Code

https://vimeo.com

Vimeo is YouTube's main rival, especially in the area of video embedment options. Vimeo videos are also viewed by millions of web users and can be easily integrated into other websites or blogs. Vimeo player is very handsome and streamlined. The blue "Embed" button in the upper right of the video leads to a dialog box with the embedding options. Basic account holders are allowed to customize player size, text colors and add other elements, while Vimeo Plus members enjoy the complete control over the player, including options to choose what happens next and where the video can appear.
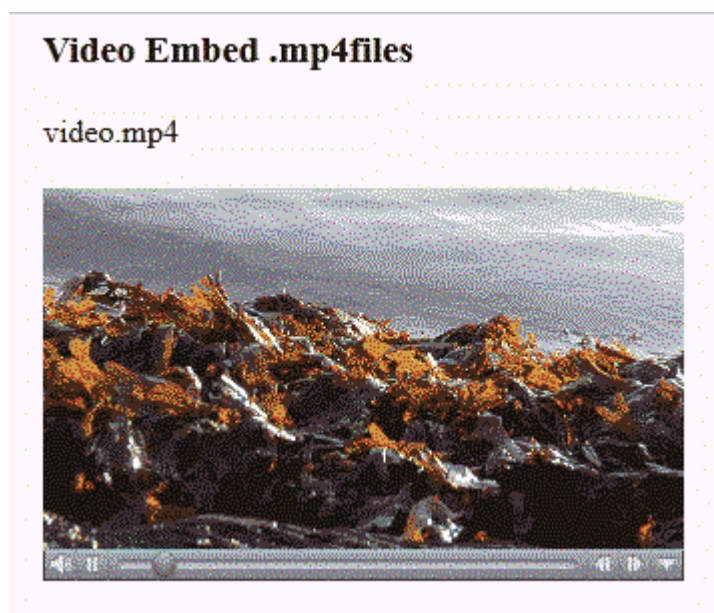
There are several other Methods for displaying videos in websites, most of which are web based and provide step by step instructions to even novice users on how to embed a video to their website. Some of these methods include:

https://oembed.com/

http://www.cocoonsoftware.com/en/

http://www.freevideocoding.com/

http://videolightbox.com/

http://easyhtml5video.com/

3. Displaying Videos on web Sites using Adobe Flash

As stated in the problem statement and goal of this thesis, Adobe Flash and HTML5 are the point of interest. The previous chapters have already provided some foundations on which to build upon. It is already clear what a video is, types and formats of videos, why and how to embed a video in a website.

In this chapter I provide a detailed discussion on Adobe Flash. In the first section I describe Adobe Flash player and how to use it, in the second section I provide a sample program that illustrate how adobe flash player displays a video in the website.

3.1 Adobe Flash

Adobe Flash is a mobile software platform used to produce animations, rich internet applications, desktop applications, mobile applications, mobile games and web browser video players.

Adobe is the name of the organization and Flash is one of their several Platforms, hence the name Adobe Flash. The Flash Platform displays text, vector graphics and raster graphic to provide animations, video games and applications. It allows streaming of video and audio and can capture mouse, keyboard, microphone and camera input.

Artists may use the Adobe Animation to produce Flash Graphics, Software developers may use Adobe Flash Builder, Flash Catalyst and Flash Develop or any text editor combined with the Apache Flex SDK to produce applications and video games.

End users can view Flash content via **Flash Player** (for web browsers) Flash Air (for desktop or mobile Apps). Adobe Flash Lite enables viewing Flash content on older smartphones.

3.2 Adobe Flash Player

Adobe Flash Player as described above is a video player plugin for web browsers. In most web browsers it is built in, so users do not need to install nor to activate it. It may be downloaded here. It is often labelled Shockwave Flash in internet explorer and Firefox. It is a freeware to use with software created on the Adobe Flash Platform. These include viewing multimedia and executing internet applications, streaming videos and audios.

Adobe Flash can run on a web browser as a plug-in or can be ran on supported mobile devices. It runs SWF (Small Web Format) files that are create

3.2.1   Requirements and Installation

Currently (winter semester 2017/18) Adobe Flash Player is build-in in Google Chrome browser, however for the Firefox browser can be downloaded here.

The systems requirements are also displayed on the download page. See requirements These requirements include:

Windows

- Microsoft Windows: 32-or-64 bits

- Microsoft Windows xp 32 bits,

- Windows 7, Windows 8.x and Windows 10

- Latest versions of Internet Explorer

- Microsoft Edge

- Mozilla Firefox

- Google Chrome and Opera

Mac OS

- Latest versions of Safari, Mozilla Firefox, Google Chrome, and Opera

- Mac OS X v10.9, or later

Linux

- YUM, TAR.GZ, RPM and APT packages for NPAPI and PPAPI

- Latest versions of Firefox or Google Chrome

As stated on the download page, in most browsers the plugin is built-in but may be disabled. In case the plugin is disabled on a browser, It may be enabled following these steps

The first section of this chapter has provided some information about what adobe flash player is and how it may be acquired. However, users often do not need to install nor to enable the Flash Player because it is preinstalled in the browser. In case the Flash Player

is missing, it is very easy to install it because an error message is always shown to the user together with the steps required to install the browser, which the user simply needs to follow.

In the following section, I will go into details on how to display a video on a website using Adobe Flash Player.

3.3   A Sample Program

In the Attachment submitted with this thesis is a copy of a website that contains all samples of the methods of displaying videos using html. In this section I will provide step by step explanations on how to display a video in a website.

3.3.1   Acquire the video file

The first step is to acquire the video. This doesn't simply mean capturing a video. This step is more complex as it sounds like. The video needs a scale and some ratio, otherwise it will not be displayed correctly in the browser. Videos often occupy the whole screen in a website and videos are rarely square in shape. The best way to go is to configure the camera to have some proportions. 4:3 is widely used, this implies the width 400px width and 300px height and multiples of these.

In case you are not capturing the video yourself and are using an available video, you may need to resize the video so as to obtain such scales. This can be done online through free online video resizers like ezgif.com or free software like Filmora video editor, Movavi video Converter.

```
The fall-back method will be to use the html attributes
height="100%" width="auto"
```
 and let the browser do its best to keep the video's ratios.

3.3.2   Convert the file into the format .swf

Adobe Flash Player recognises files with the extension .swf and .flv, so you must convert you video into one of these formats. This can be done online or with the help of a video converter software like Format Factory. Some Video recording devices can also convert videos by default.

3.3.3   Embed the Video into html

Once the video is ready i.e. Scaled and converted it can be embedded into the website. The code snippet below shows how to do that. The result of doing so can be viewed in the program submitted wit this thesis.

3.3.4   Embed using HTMLObject

```html
<object type="application/x-shockwave-flash" height="auto" width="100%">
    <!-- link to the video-->
    <param name="movie" value="videos/my-mp4.swf"/>

    <!-- Sets the Window Mode property of the see documentation-->
    <param name="wmode" value="opaque"/>

    <!-- play the video automatically ?-->
    <param name="play" value="false"/>

    <!-- Should the video restart once it is over? -->
    <param name="loop " value="false"/>

    <!-- should playback controls be displayed? -->
    <param name="menu" value="true"/>

    <!-- Trade-off between performance and video quality-->
    <param name="quality" value="best"/>

    <!-- Should the Flash Player be able to occupy the whole screen-->
    <param name="allowFullScreen " value="true"/>
</object>
```

3.3.5   Embed embedded in HTMLObject

This fundamentally the same method, with the exception that the actual video is placed in the html embed tag which is surrounded by the HTML Object Tag. The distinc-

tion between the two methods is not clear, however using one or the other method is a question of programmer's taste. The code Snippet below shows how this is done.

```
<object classid="clsid:d27cdb6e-ae6d-11cf-96b8-444553540000"
        code-
base="http://fpdownload.macromedia.com/pub/shockwave/cabs/flash/swflash.c
ab#version=7,0,0,0"
        id=0 align="middle" width=100% height="auto">
    <param name="menu"      value="true" />
    <param name="quality"   value="high" />
    <param name="bgcolor"   value="#FFFFFF" />
    <param name="wmode"     value="transparent" />
    <param name="controls"  value="true"/>
    <param name=movie value="videos/.my-mp4.swf">
    <param name=allowFullScreen value=true>
    <param name=flashvars value="videos/my-mp4.swf">
    <embed src="videos/my-mp4.swf"
        wmode="transparent"
        play="false"
        menu="true"
        quality="high"
        bgcolor="black"
        width="100%" height="auto"
        name="player"
        align="middle"
        allowScriptAccess="sameDomain"
        type="application/x-shockwave-flash"
        pluginspage="http://www.macromedia.com/go/getflashplayer" >
</object>
```

A list of supported parameters/attributes and their corresponding values can be found here
Apply OBJECT and EMBED tag attributes in Adobe Flash Professional

3.3.6   Playback Controls

Playback controls include buttons like buttons to pause/play, stop, re-sume, forward, mute etc. By default, the embedded video doesn't display the playback controls event when you set the parameter

```
<param name="menu" value="true"/>
```

The controls can be views by right clicking on the video. Thus, the video will automatical-ly start playing when the webpage has finished loading (it will not if the parameter play=false had been given).

The playback controls can be included with the video in one of these 3 ways

1. Embedding the video directly from adobe Dreamweaver.

2. Converting the video and including the controls directly.

3. Program the control using JavaScript.

3.4 Limitations of Adobe Flash

Using adobe flash player to embed videos in to web pages is one of the most popular methods over the internet. Until recent years it was undoubtedly the most efficient way to do that. However, because of some of its limitations, it has been increasingly criticized, and its popularity has fallen. Some of the drawbacks of using adobe flash player include the following.

3.4.1 Instability

3.4.2 Reliability Security and Performance

I have no real experience with Adobe and searching the web, I found this open letter written by Steve Jobs directed to the Adobe Platform. In this letter, Jobs openly points to some criticisms of the Flash platform. Amongst these criticisms, there is this point "*Third, there's reliability, security and performance.*

Symantec recently highlighted Flash for having one of the worst security records in 2009. We also know first hand that Flash is the number one reason Macs crash. We have been working with Adobe to fix these problems, but they have persisted for several years now. We don't want to reduce the reliability and security of our iPhones, iPods and iPads by adding Flash.

In addition, Flash has not performed well on mobile devices. We have routinely asked Adobe to show us Flash performing well on a mobile device, any mobile device, for a few years now. We have never seen it. Adobe publicly said that Flash would ship on a smartphone in early 2009, then the second half of 2009, then the first half of 2010, and now they say the second half of 2010. We think it will eventually ship, but we're glad we didn't hold our breath. Who knows how it will perform?" **Steve Jobs 2010** https://www.apple.com/hotnews/thoughts-on-flash/

3.4.3 Susceptibility to Attacks

Flash Player is one of the most widely distributed piece of software in the world, and as such is target to malicious hackers. No matter how hard Adobe has been actively working on Flash Player's security, hackers have been working on counter effort even harder. "Exploit kits" packets of code that take advantage of these flash player's vulnerabilities in browser to push malware or ransomware have used Flash to futz with countless sites. The so called zero-day vulnerabilities (a security hole that hackers find before the software company does) are found on Flash with such regularity they almost feel like a feature.

3.4.4 Performance

Sites that make use of Flash technology have always been slower than the sites that do not use it. On the article titled Tested: How Flash destroys your browser's performance (https://www.pcworld.com/article/2960741/browsers/tested-how-flash-destroys-your-browsers-performance.html) written by **Mark Hachman** Senior Editor at https://www.pcworld.com/ where he tested major browsers (Chrome 44, Windows 10's Edge 12, Firefox 39, Internet Explorer 11, and Opera 31—all the latest versions at press time) abilities to handle Flash. The test ran on a windows 10 machine with sufficient RAM with several websites containing a number of flash videos and flash ads. He measured the browsers CPU consumption with flash enabled then with flash disabled. The results were then the difference in CPU consumptions and the conclusions were as follows. About 56.9% increase in CPU consumption in Microsoft Edge, about 74.6 % CPU consumption in Opera, about 25% CPU consumption in Firefox (with tabs crashing), and about 71% CPU consumption in Chrome.

The above test is just one among several tests carried out by experts over the internet. To back up the above results, I decided to carry out some tests by myself by opening several 10 websites containing flash videos and ads in 10 different tabs, enabling adobe flash plugin on each browser then disabling the plugin on the browser page and for each case I measured the CPU performance from the task manager and the differences in CPU usages were tremendously noticeable.

3.4.5 Complexity

If you followed the steps on how to embed a flash video, you won't miss the complexity involved in doing so. In the description, I subdivided that in only five steps, and this is because I had done it several times to get familiar with the process. When comparing this with other steps like uploading Facebook or Youtube videos, it is relatively complex. The playback controls are another issue. Most other ways of embedding a video provide easy playback controls. With Flash, you need to have converted the video a certain way like using Dreamweaver, otherwise visitors need to be aware that they have to right click on the video to view the playback controls, which doesn't reduce complexity.

3.4.6 Adobe is Proprietary

According one of the several points made by **Steve Jobs** in his open letter to the Flash Platform titled: **Thoughts on Flash** https://www.apple.com/hotnews/thoughts-on-flash/

 "*Adobe's Flash products are 100% proprietary. They are only available from Adobe, and Adobe has sole authority as to their future enhancement, pricing, etc. While Adobe's Flash products are widely available, this does not mean they are open, since they are controlled entirely by Adobe and available only from Adobe. By almost any definition, Flash is a closed system.*"

This means that programmers cannot extend the Flash Player. Only Adobe programmers can extend the Adobe products, bring updates and fixes to any issue discovered on Adobe products.

According to this article from https://www.elstel.org/index.html.en , titled :

Videos for the Web with HTML 5 - an Introduction

https://www.elstel.org/html5video/FlashVersusHtml5Video.html.en "*Many different versions of the Adobe Flash Player make life hard for the user as newly converted videos do not run on elder Flash versions. Adobe Flash may often be installed but not in the right version which is often overlooked by web admins.*"

In this chapter, I have presented a brief discussion about Adobe Flash, this included a description of what Adobe is, what Adobe Flash is, how to embed a video in a webpage using Adobe Flash, followed by some discussions about the advantages and limitations of Adobe Flash. It is to note that because this thesis is basically web oriented, most of the information sources come from the internet, because You don't learn how to swim from a monkey, instead you learn that from a fish.

4.   Displaying Videos on web Sites using HTML5

This chapter will describe how to embed a video using HTML5. In the first section, I give some descriptions of what HTML5 is, followed by what is required to use HTL5. Afterwards a detailed example of how to embed a video in a webpage using the HTML5 method. Because videos cannot be displayed on PDF documents, a sample program is included in the web application that is attached to this thesis.

4.1   What is HTML5

HTML5 is the 5th version of HTML5 published in October 2014 by the W3C (World Wide Web Consortium) to improve the language with support for the latest media. It extends, improves and rationalizes the markup available for documents and introduces APIs (Application Programming Interfaces) for complex web applications. It also includes features designed with low-powered devices in mind thus making it candidate for cross platform mobile applications.

New syntactic and tags have been added to handle multimedia and graphic content, for example the <**video**></**video**> and <**audio**></**audio**> Tags. Support for SVG (Scalable Vector Graphics) content and MathML for mathematical formulas. Some other useful tags included in HTML5 include

<**header**> </**header**>,
<**footer**> </**footer**>,
<**aside**> </**aside**>,
<**nav**> </**nav**>
<**figure**> </**figure**>

4.2   Using HTML to display videos on Webpage

To display a video in a webpage using HTML5 is very simple. As stated in the introduction of this chapter, HTML5 has enriched the previous HTML tags with tags to support the consumption of multimedia elements. Such tag is the video tag <video></video> tag. HTML5 supports 3 video formats.

- Mp4

- Ogg

- webM

4.3   Displaying Videos in web apps HTML5

The following code snippet illustrates how easy it is to embed a video content into the webpage.

```html
<video id="html5-video-player"
       controls
       autoplay
       loop
       muted
       preload="none"
       poster="images/icon.jpg"
>
    <source src="videos/my-mp4.mp4" type="video/mp4">
    <source src="videos/mov_bbb.webm" type="video/webm">
    This is the fallback text, in case the browser doesn't support HTML5.
eg
    Your browser does not support the video tag.
</video>
```

Possibilities of displaying moving pictures in HTML5, their uses, including limitations to Adobe Flash and other video display formats

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4.4 Sample Program

Because moving images cannot be displayed on a PDF, I have submitted a web application as an attachment to this Thesis.

5.　　　Advantages and limitations of displaying videos using HTML5 over Adobe Flash

This chapter presents some advantages of using HTML5 as compared to Adobe Flash to display moving images on web pages, as well as the Limitations. The first section gives some advantages of HTML5, he second section presents limitations of HTML5 as compared to Adobe Flash.

5.1　　　Advantages of HTML5

The simplicity and ease to embed videos. It is extremely easy to embed a video using HTML5. As can be seen in the code snippet in section :………………. Above, all that is required is a video of one of the 3 formats (mp4, ogg, webm). Considering that most video capture devices like cameras and mobile phones can be easily configured to capture video in the format mp4, this greatly eases things event more. Once you have your video in the correct format, all you need is to embed it in the source attribute of the video tag.

Built-in Video controls. As seen in the previous 2 chapters, embedding a video using flash often requires that the video controls be programmed manually. HTML5 comes with built-in controls which in addition to facility increases usability and elegance.

One other advantage of embedding videos using HTML5 is that it is an "Open Standard". Open here means it is not proprietary, thus its functionalities can be extended by any one. Adobe flash on the other hand. As stated by Steve Jobs in his open letter to adobe.

[Adobe's Flash products are 100% proprietary. They are only available from Adobe, and Adobe has sole authority as to their future enhancement, pricing, etc. While Adobe's Flash products are widely available, this does not mean they are open, since they are controlled entirely by Adobe and available only from Adobe. By almost any definition, Flash is a closed System. HTML5, the new web standard that has been adopted by Apple, Google and many others, lets web developers create advanced graphics, typography, animations and transitions without relying on third party

browser plug-ins (like Flash). HTML5 is completely open and controlled by a standards committee, of which Apple is a member.]

Another advantage is that of performance. HTML5 doesn't reduce the device's performance, event for low capacity devices, in fact it optimizes performance because it is designed for such purpose. It is designed to be cross-platform compatible and takes into consideration devices performances. Adobe Flash on the other hand was designed mainly for Desktop Computers using mice which already constitutes a barrier. With the advent of mobile devices and touchscreens, adobe has constantly modified its platform to support mobile devices and touch screens. Because of this, its performance is limited and cannot be compared with that of HTML5 which is designed.

Animations are easily created using CSS and JavaScript. This makes HTML5 extremely useful. When compared to older versions of HTML5 which didn't really provide the possibility to animate HTML tags, HTML5 offers superior animation possibilities. HTML tags themselves can be animated as well as their style sheet attributes.

HTML5 contains JS Web Worker API which allows JavaScript and Browser interface to run in separate threads. The offline caching provided by HTML5 is also a great advantage. Videos

HTML5 provides more compatibility than Adobe Flash. It runs on practically every web browsers including Firefox, Internet Explorer, Chrome, Safari and Opera. In addition, HTML5 does not require any update. On the other hand, using Adobe Flash, users constantly have to update their versions of the software in order to catch up with new fixes and features.

HTML5 is now used as fallback option when embedding flash videos. This proves how efficient and reliable HTML5.

5.2 Limitations of HTML5

Although it is obvious that new technologies primarily advantageous because they exploit the existing market situation to satisfy every development industries and HTML5 being no exception, it is however to call out that new technologies also have their limita-

tions. In the case of HTML5 some of the limitations to the extent to which it can be used to display moving images are listed below.

The very first limitation is that of security. The fundamental problem with client-side computing is that users have control over the code running on their browser. Most web browsers offer debugging tools, for example pressing F12 on Firefox and Chrome opens the debugging tool in which the visitor has access to the code. He can then insert break point anywhere and edit the code to their will. Even when these Developers Tools are not built in, they can be easily installed. E.g. Firebug (a JavaScript debugger plugin on Firefox). With this tool, users have access to files, filenames and source code (and even video files that were supposed to be private) that they can use at their will. Although Adobe Flash has security issues, it is not this much easy to access the source code of an animation or video that runs in a flash Player.

Another drawback from HTML5 is that of format incompatibility. The new audio and video tags makes it easy to embed audios and videos with less than 5 lines of codes into a website. However, the problem of media format still pops up. The embedded videos play well on Chrome, Firefox, Safari but not on Internet Explorer. This is to say that although HTML5 is supported by mostly all the major browsers, because this is computing some particular player may play in almost every web browser but not on a single exceptional player, and the developer might need to use fallback methods or to test each embedded video over every possible browser.

Graphics and Animations are restricted. With adobe flash player, we are able to develop rich animations and graphics. Although it is possible to create animations in HTML5 using JavaScript and CSS, these animations are restricted to certain types. Thus, HTML5 cannot be used to produce the same types of animations that would be produced using Adobe Flash.

HTML5 being a new technology, the recommendations are accepted and implemented by web browser developers (thus still not universally supported). According to HTML5 & CSS3 READINESS (https://html5readiness.com), Versions of Opera browser before Opera 12 still does not have support for HTML5, versions of Internet Explorer prior to IE 8 do not support HTML5. This is part of the reason that Flash is still very popular today.

6.   Trends and Usage Statistics over the Web

This chapter provides some brief statistics about the trends in usage of both technologies (Adobe Flash and HTML5) over the internet.

The usage of Adobe Flash has been in such a decline in the recent years that major web bodies have decided to discontinue the use of Adobe Flash.

Citing Anthony **LaForge** Curator of Flash in Chrome "*Adobe Flash Player played a pivotal role in the adoption of video, gaming and animation on the web. Today, sites typically use technologies like HTML5, giving you improved security, reduced power consumption and faster page load times. Going forward, Chrome will de-emphasize Flash in favor of HTML5. Here's what that means for you*."
https://blog.google/products/chrome/flash-and-chrome/

Google chrome has officially replaced Adobe Flash with HTML5 in January 2017, and according to this article by **Google Chrome** https://blog.chromium.org/2016/12/roll-out-plan-for-html5-by-default.html "*In December, Chrome 55 will make HTML5 the default experience, except for sites which only support Flash. For those, you'll be prompted to enable Flash when you first visit the site. Aside from that, the only change you'll notice is a safer and more power-efficient browsing experience.*" Anthony LaForge
https://blog.google/products/chrome/flash-and-chrome/

According to Statistica https://www.statista.com/chart/3796/websites-using-flash/ (A statistics Portal that offers Statistics and Studies from more than 18,000 Sources), **The Web Is Turning Its Back on Flash**. "*These days, Flash is widely regarded as a performance-hampering safety hazard and more and more companies are turning their back on what was once the industry standard for animated content. Slowly but surely, Flash's footprint across the web is vanishing: In October 2016, just 10 percent of websites in the Alexa Top 10,000 used Flash, down from almost 50 percent five years ago.*" (Felix Richter, Dec 12, 2016 https://www.statista.com/chart/3796/websites-using-flash/).

According to Statista (https://www.statista.com/chart/3796/websites-using-flash/) , the percentage of websites using Adobe Flash has reduced from about 50% in 2010 to less than 10% in 2016, and this percentage is to continue sinking.

An online organisation called http://occupyflash.org/ actively fighting a campaign to kill Adobe Flash with the goal to get the world to uninstall the Flash Player plugin from their desktop browsers. This is to show how serious Adobe Flash's death is near.

And to sum it up, Adobe is planning to end the life of Flash in 2020. "*Adobe is planning to end-of-life Flash. Specifically, we will stop updating and distributing the Flash Player at the end of 2020 and encourage content creators to migrate any existing Flash content to these new open formats*". (Adobe Corporate Communications 07-25-2017 https://theblog.adobe.com/adobe-flash-update/). The date 2010 is to permit businesses that have build upon the Adobe Flash technology to gradually migrate to other technologies.

In this chapter, I have provided some statistics on the tendencies on the internet about how Adobe Flash is losing ground to HTML5. More importantly, Adobe has decided to go on its own and by so doing providing a gradual transition, to give time for dependents to adapt and find alternative solutions.

7.   Conclusion

As stated in the title page, the goal of this thesis is to present the possibilities of displaying moving images (videos) on webpages, including the advantages and limitations. To do that, it was essential to subdivide that task into logical chapters. Each chapter built from the other by adding chunks of information to the stack.

In the first chapter, I have given some definitions to the basic terms that would re-occur in throughout the thesis. In the second Chapter I talked about video formats, what they are, which are the most common video formats available over the internet and how these formats can be played (which video players are required to play them), followed by the different methods to display a video on a webpage. Chapter 3 discussed Adobe Flash and the Adobe Flash method to embed videos on a webpage, followed by some advantages and limitations of this method. Chapter 4 discussed HTML5, what is HTML5, how to embed videos using HTML5. Chapter 4 discussed the advantages and limitations of HTML5 method over the Adobe Flash method of embedding videos.
In chapter 6, I discussed some trends over the internet about the percentage usage of web sites still using Adobe Flash, and how the tendency will grow.

Based on the findings in this thesis, it is undoubted that HTML5 video content is better on battery life than that of adobe considering mobile devices. However, it is also un-arguable that Adobe animations are better than HTML5 animations. This is backed up by a Test carried by Yossi Oren in his article titled **HTML5 video - is it good for your battery? (Hint: yes)** https://iss.oy.ne.ro/HTML5-Video-Battery, finding that Flash video resulted in a "17% rise in current draw (and a corresponding reduction in battery life) on the laptop, and a 12% rise on the tablet".
 At this point it is often said that you should use a mix of both technologies, HTML5 for videos and use Adobe Flash for complex animations, especially because both technologies are not mutually exclusive. However, I will not go for this approach. In listing the limitations of Adobe Flash, I mentioned that Adobe Flash was created in the era of desktop computers with mice, and not for tablets and mobile phones with touchpads.

For me, Adobe Flash should die peacefully, and this is what they have decided to do otherwise it will be ejected from the internet. In section 4.4, I have stated the well-known problems of Adobe Flash. Steve Jobs in his open letter to Adobe **Thoughts on Adobe** https://www.apple.com/hotnews/thoughts-on-flash/ went on to publicly criticize the Adobe Flash pointing out some of its limitations, amongst which e stated that it is even useless in today's web and stating how HTML5 is the future of the web.

For me the fact that HTML5 added a canvas element to the available tags enables web developers to create Adobe Flash-similar animations. This was the last nail on the Adobe Flash's coffin. Haven used HTML5 for some time now, and based on opinions of experts on the web, I feel safe to say that turn off Adobe Flash now and use HTML5, because HTML5 can do everything, it can even make your teeth white and make your hairs grow.

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10. List of Abbreviations

API:	Application Programming Interface
ASF:	Advanced System Format
AVI:	Audio Video Interleave
CPU:	Central Processing Unit
CSS:	Cascading Style Sheets
FLA:	Flash
FLV:	Flash Video Format
FPS:	Frame Per Second
GIF:	Graphics Interchange Format
HTML:	Hypertext Mark-up Language
HTML5:	Hypertext Mark-up Language Version 5
MPEG:	Motion Pictures Expert Group
PDF:	Portable Document Format
SVG:	Scalable Vector Graphics
SWF:	Small Web Format
VLC:	Video Lan Client
W3C:	World Wide Web Consortium
WMV:	Windows Media Video

11.   Attachments

11.1   The Thesis DVD

As attachment to this thesis is a DVD containing

1. copies of this thesis as pdf and word formats

2. A website to display the various examples stated in the thesis.
    To access this website, right click on the file name "index" or "index.html" and choose "open with", then select your favourite web browser. I recommend Internet Explorer because I tested the website on internet explorer, and it functioned without requiring any additional installation.

Possibilities of displaying moving pictures in HTML5, their uses, including limitations to Adobe Flash and other video display formats

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