



University
of Dundee

GRAPHIC NOVEL SUBTITLES

AC40001 Honours Project

BSc (Hons) Applied Computing

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Abstract

There is a large amount of video content available to the modern viewer. Some viewers don't have the time to keep up to date with all their favourite shows. Currently there is not a good alternative to watching the show so some viewers fall behind and give up watching the show altogether.

Some users also have trouble taking in all the information from a show at the standard pace of the show.

In this work, we present Graphic Novel Subtitles. Which is an alternative method of viewing video content. The basic concept is to take a subtitle file and for each line of subtitles find a corresponding frame from the video and display them together in a Graphic Novel type format.

1 Introduction

Around 7.5 million people (18%) use subtitles as part of their television viewing experience [15] with 20% of this number being people who are deaf or hard of hearing. [15] Subtitles are typically used as static text appearing at the bottom of the screen. Subtitles are used in a variety of different media such as TV, Film, and Computer Games.

In 2017 the comic book market in North America was worth an estimated \$1.015 billion [12]. Comic books are as popular as they have ever been in recent years [6]. Comic books share some qualities with subtitled video.

There is great potential in an alternative method of using subtitles. This work will investigate the possibility of adapting video content into the form of a graphic novel via the use of subtitles. There are a number of potential benefits to this, for example if a user was trying to

have less screen time they could print out a graphic novel of their desired television show instead of watching the video on screen. Or if a user was just wanting to do more reading then they could convert their desired television show into a readable format.

2 Background and Related Work

2.1 Graphic Novels

A graphic novel is “a story that is presented in comic-strip format and published as a book” [19]. The graphic novel is a medium that combines visual and verbal communication [17]. Graphic novels have great transformative potential in the classroom [4]. Due to the prevalence of visual media in modern society there are a number of benefits to their use. They are more appealing to people who don't read as the visual element makes them more accessible. Studies carried out with graphic novels have shown to increase levels of reading enjoyment for participants [21]. Brodsky states that:

“The beauty of graphic novels in the high-school classroom is that they truly offer a multilevel reading experience for all readers. Students not only have to read the words for the plot but the images for the plot, too. By having students read on the two levels of text and image, they are not only improving their basic reading ability, but also their analytical skills by evaluating how the images work with the text” [2]

Which is a valuable insight into the potential for using graphic novels as a learning aid.

Graphic Novels share some similarities with subtitled video. A subtitled video is a series of frames displayed very quickly, and speech is overlaid as text. A comic is a singular image with speech displayed on it as text.

2.2 Subtitling

A subtitle is generally text shown at the bottom of video content that represents what is being said in the video. There are multiple reasons for wanting to use subtitles. They are used by people who are deaf or hard of hearing so that they can understand what is being said. They are used by people who do not speak the language that the content was created in, subtitles can be displayed in the viewers native language to allow them to enjoy foreign media. People use them to watch content in noisy places where they would not be able to hear the audio, and also in quiet places where playing the audio would be disruptive. They are also used by people who do not fall into any of these categories, some people use them supplementary to the video to ensure that they don't miss what was being said, perhaps a character has a hard to understand accent[8].

Generally subtitles appear as white text on a black background to increase legibility[1], but colour of subtitles can be used for situations with multiple speakers to aid speaker identification common colours are Yellow, Cyan and Green[1]. Standard practice is to place the subtitles at bottom of the video, more recently there has been the creation of dynamic subtitles that are placed near the speaker on screen, thus helping speaker identification. (ref) There are issues with subtitles in certain situations such as; when there are multiple speakers, when a speaker is off screen, when there is narration. (ref) Some subtitle users find that they miss out on some of the visuals as they are too busy focusing on the text [5] Some people deem them unnecessary and cant see why you would want to 'read a movie'[5]. for some readers subtitles can be too fast to keep up with[14]. Some foreign language subtitling is Trans-created as opposed to transcribed whereby the translator does not translate word for word and instead keeps the meaning and context but changes the phrasing to be more appropriate to the language. [9]



(a) Visual sound effects.



(b) Comic style panelling.

Figure 1: Two images from Scott Pilgrim representing comic styles.

2.3 Immersion in TV and Film

There has been a large number of comic to film adaptations in recent years. One studio which has received high levels of acclaim for this is Marvel with their Cinematic Universe. There are currently twenty one films that make up the marvel cinematic universe with a large number of comic book characters making the jump from the comic book to the silver screen [10].

Adding to this, the adaption of the Scott Pilgrim comics into the 2010 movie heavily draw from the comic book style [20], such as how sound effects are displayed visually on screen(1a) and the use of comic style panels(1b).

Whilst it is common for comic book movie adaptions to be live action, a recent trend has seen animated movies being created from their comic book counterparts. In 2018 Marvel and Sony released Spider-Man:

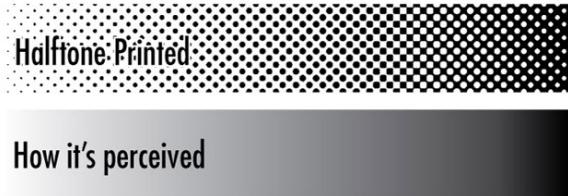


Figure 2: How halftones are used to create gradient and shading.

Into the Spider-Verse[16] which draws heavily on the artistic stylings from different iterations of the Spider-Man comic book series. You can pause the movie at any point and it looks like it was taken straight from a comic book[18]. This was achieved using a number of techniques such as a limited colour palette and half toning, where dots and patterns of colour in different sizes are used to indicate dark and light[18] see Figure 2. Spider-verse takes a different approach to a comic book to movie adaptation, where as most adaptations take the characters from a comic book and put them in the movie, spider-verse really feels like a comic book come to life.

Another movie that uses similar techniques to Spider-Verse particularly the limited colour palette is the 2005 movie Sin City [11]. Unlike Spider-Verse Sin City is live action but it achieves a comic feel through being almost entirely Black and white, some things are coloured such as when blood appears 3a, and one of the villains is bright yellow (fig 3b). Colour is used to draw your focus to objects.

It is important to understand elements brought from comics to movies in order to understand how to properly turn a movie into a comic. Perhaps half-toning and a limited colour palette could be applied to make our comic feel more comic-like.

When talking about immersion an important thing to consider is the concept of flow. Which is at its core is the balance of challenge and skills. If your skills are far greater than the challenge then you will slip into boredom and conversely if the challenge is significantly greater than your skills you will slip into anxiety. There are also some other factors that affect flow such as clear



(a) All black and white except the red blood.



(b) All black and white except the yellow villain.

Figure 3: Two images from Sin City showing limited use of colour.

goals, rules and feedback, and also allowing concentration without distraction or ambiguity. A variety of different activities are capable of creating flow experiences. Characteristics of a flow experience include[7];

- **An altered perception of time** - Time can either feel condensed, time feels like it's going by quicker than it is, or expanded time is going by slower than it is. Being in flow has been described as timeless.
- **Effortlessness** - Actions are completed effortlessly and almost subconsciously.
- **Autotelic** - not only completing the task is rewarding but also the task is rewarding while being undertaken
- **Control** - It is a state of security and relaxation with the complete absence of worry.

These characteristics can be caused by the television watching experience and also affected by the use of subtitles, as subtitles can either aid or harm immersion depending on execution.

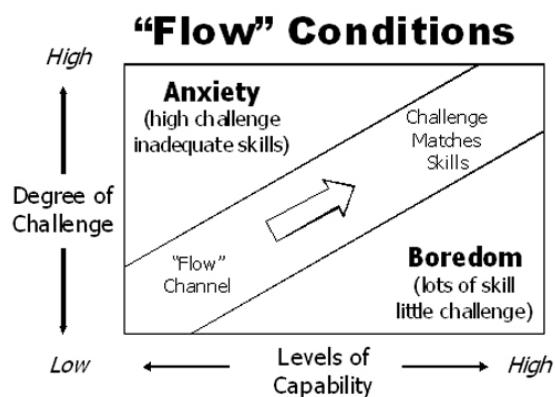


Figure 4: Factors affecting flow.

A framework exists that allows us to look at the UX of subtitles. A team from BBC R&D were conducting a study on the user experience of dynamic subtitles, which are subtitles that are dynamically placed on the screen based on speaker position, and they noticed a lack of an existing framework for reviewing the user experience of subtitles. Key factors that can be assessed to evaluate the UX of subtitles were identified. Methods of measuring these factors were also identified. The factors identified were as follows;[3]

- Attention - Is the awareness of what is going on in relation to the video content.
- Aesthetics - Measures the visual appeal of the subtitled content.
- Involvement - Measures how engaged users are with the content. Differs from attention as attention is more about focus rather than engagement.
- Familiarity - Is how the subtitles match the users expectations. Is there a clear link between the subtitles and video content?

- Perceived usability - Measures how easy the subtitled content is to understand.
- Endurability - How willing is a user to keep viewing subtitled content the same way in future?

Measuring the User experience of the system created will be important to determine how successful the Graphic Novel Subtitles implementation ends up being.

Based on the above, this work will;

- Assess potential users thoughts and opinions on the Graphic Novel Subtitles Concept
- Create a website capable of generating graphic novel subtitling content
- Conduct a study to determine levels of user experience of graphic novel subtitles in comparison to a subtitled video

This will allow us to answer the following;

Research Question - Can a graphic novel created with a subtitled movie file create similar levels of UX when compared to the video file itself?

3 Initial Survey

Initial enquiry was needed to examine potential users perceptions of comic books and use of subtitles, and also to gain insight into their thoughts towards the use of the graphic novel subtitle concept.

3.1 Methodology

The Survey was circulated via a number of different channels. It was distributed to Students at the University of Dundee through the use of email. It was

also distributed through social media such as Facebook and Twitter, and lastly it was posted on Reddit's r/samplesize.

Following the ethical approval acquired from the university, participants were required to read through an information page and then filled out a few questions confirming they agree to take part and understand the situation. The Participants were then given some demographic questions to determine their subtitle and graphic novel use.

Then finally they were presented with a mock up image of what graphic novel subtitles could look like followed by a mixture of quantitative and qualitative questions to determine perception and thoughts of the graphic novel subtitles concept. The questionnaire should take around five to ten minutes depending on the length of answers given.

3.2 Survey Design

A survey was created in order to investigate participants current usage of subtitled media and to gain an understanding of initial perceptions towards the concept of graphic novel subtitles. The survey was made up of 5 sections which covered:

- Ethical Information
- Explanation of the study
- Demographic Information
- Qualitative Questions
- Quantitative Questions

3.3 Participants

Fourty-Eight participants completed the survey, of this 45 were between the ages of 18-25, one was between the ages 25-40, and two were between the ages 41-60. 43 participants were from the UK, and then there was one

participant from each of Australia, Denmark, Estonia, and The United States. No participants were discarded from the survey as all met the criteria and suitably filled out the ethics questions.

3.4 Results

3.4.1 Subtitle and Graphic novel use

Participants indicated a wide spread of subtitle use as seen in Table 1. Additionally there was also a wide range in the amount people read graphic novels and comics as seen in Table 2.

Frequency	Participants	Percentage
Never	3	6.3%
Very Rarely	6	12.5%
Rarely	8	16.7%
Occasionally	12	25.0%
Frequently	10	20.8%
Very Frequently	9	18.8%

Table 1: Frequency with which participants use subtitles

Frequency	Participants	Percentage
Never	11	22.9%
Very Rarely	12	25%
Rarely	9	18.7%
Occasionally	8	16.7%
Frequently	5	10.4%
Very Frequently	3	6.3%

Table 2: Frequency with which participants read comics or graphic novels

Participants reported a number of reasons for using subtitles, this included

- 'To compensate for some kind of hearing problem' (n = 5)

- ‘To watch foreign media’ (n = 21)
- ‘To supplement the viewing experience, but don’t have hearing problem’ (n = 29)

A number of other responses were given in the ‘Other’ option; ‘I don’t’, ‘Not Applicable’, ‘Sometimes I can’t grasp peoples accents’, and ‘To assist if I’m not entirely focusing on the media at hand’

3.4.2 Missing Information

There were concerns from some participants that some information would be missed out on when viewing the content in this way. P9 stated *”Useful, but only provided the scene is not particularly dependent on non verbal communication or is particularly action packed.”* Which indicates P9 thought the concept was a good idea but has a very valid concern on missing out on non verbal information, perhaps as P9 says the concept would not be well suited to action packed scenes, unless it were possible to be very precise with the images chosen for each scene. Similar concerns were echoed by P23 *”I think the sense of drama and film techniques (i.e camera angles and sound/music) would be lost due to this which might make it seem less dramatic if portrayed that way”* Which again is a very valid criticism and an issue to consider, all genres may not be well suited to being converted to a graphic novel format.

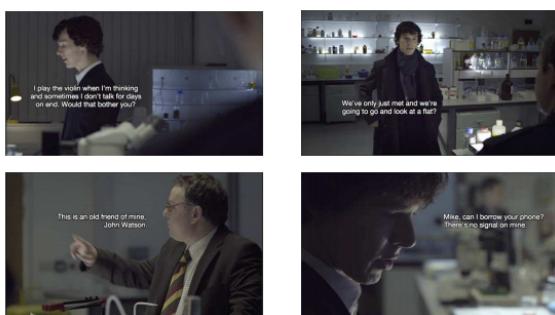


Figure 5: Example of shown to users of what graphic novel subtitles could look like.

3.4.3 Speaker Identification

The image shown to participants as an example had the subtitle text placed next to the speaker to indicate who was speaking, there was some concerns that text placed this way could get in the way. P48 says *”Can help clarify the speaker but if done badly could get in the way.”* Which is a valid concern, perhaps in situations where there is a particularly long subtitle it could take up too much space. It might be a good idea to explore alternative methods for speaker identification. As well as carefully consider the size of the subtitles to find a middle ground between being too small and unreadable, and being too large and taking up too much space in the overall image.

3.4.4 Portability

a factor that a number of participants identified was that you can view the GNS content in a wider variety of locations than video as in a noisy environment you might not be able to properly view a video either due to not being able to hear or due to an environmental distraction causing you to miss something. P34 says *”It might be useful as a way of “watching” a show in a public space where listening could be difficult.”* P39 said *”easier to view in certain locations e.g. quiet areas such as libraries.”* P30 offered an interesting use case however I would never condone it they said, *”If you don’t have headphones and bored in a lecture”*.

3.4.5 Pace of Consumption

An anticipated benefit was that GNS would allow users to consume video content at their own pace. The logic behind this is that with a subtitled video you are forced to watch and read at the pace of the video, whereas with a still image with the subtitle displayed over it you can consume the content at your own pace and as a result not miss out on any of the speech, which will better help you understand what is going on in the content and improve the experience. This reasoning was echoed by

participants in the survey, P41 stated "*Can follow at your own pace*". P39 said "...*able to enjoy content at own pace*.", P23 said "*Can read at your own pace rather than overflowing the user with information*". While a number of participants gave this answer unprompted later in the survey participants were given a statement which reads "*This concept would allow viewers to consume video content at their own pace*" then indicated on a 5 point scale, from disagree being 1 to agree being 5, whether they agree with the statement. The mean for this was 4.25 and the mode was 5. This shows that the vast majority of participants agree that GNS would allow users to view the content at their own pace.

3.4.6 Encouraging More Reading

Another anticipated benefit of GNS was that it would allow users to do more reading and still let them keep up to date with their favourite shows. A couple of participants had similar thinking such P8 suggests that GNS could be used for "*Improving comprehension skills with children by providing them with graphic novels rather than videos*." P16 echoes this stating "*possibly very sought after for parents with younger children as an alternative to effortlessly watching a movie or program*." This thinking is in line with information discussed in the background research around the potential for comics and graphic novels to be used as a learning aid as media continues to become more visual. GNS could allow readers to gain the benefits of reading while not missing out on their favourite video content, this could be a key factor in persuading children to read more. But this doesn't just have to be about persuading children to read more, it can be for persuading everyone to read more. Participants tended to agree, when asked whether they agree that "*This concept could provide a good middle ground between reading a book and watching television*" on a 1 to 5 scale disagree to agree the mean value was 3.6 and the mode was 4. Participants were also asked if they agree with "*This would allow people to do more reading while not missing out on their favourite TV shows*" the mean value from that was 3.7 and the mode was 4.

3.4.7 Genres

Participants were asked which genres they thought would be the most suited to GNS. Participants could select multiple options and also add anything missing from the list given via the "other" option. the results of this are shown in Table 3.

Genre	Participants	Percentage
Adventure	28	58.3%
Sci-Fi	28	58.3%
Fantasy	27	56.3%
Animated	27	56.3%
Drama	25	52.1%
Action	24	50.0%
Comedy	23	47.9%
Documentary	19	39.6%
Musical	8	16.7%
None	1	2.1%

Table 3: Which Genres participants thought would be suited to GNS

Most genres performed pretty similarly with the exception of musicals which understandably scored very low as you would miss out on a lot in a musical, you wouldn't be able to hear the tune of the song which is a lot of the attraction to musicals, you lose the sing-a-long factor. Its curious that Documentary didn't do quite as well as the other genres as I cant think of a particular reason that Documentaries in particular wouldn't be suited to GNS. The "None" option was added by a participant using the "Other" option who didn't think that the GNS concept was particularly worthwhile.

3.5 Limitations

Judging from some of the answers in the survey some participants misunderstood what Graphic Novel Subtitles is it seemed that some thought that the concept was more like a video with Dynamic Subtitles than still images with the subtitles overlaid. This could potential be

caused by two things, either the description given of the GNS concept was insufficient, or the participants didn't properly read the description and made an assumption based off of the image provided. Ideally I would have liked a much more even spread of ages participating in the study but unfortunately its a lot easier for a university student such as myself to reach other university students to participate in my study than its is to find fifty year old's to participate in my study.

4 Artefact Development

This section describes the development of a prototype system that will let users generate GNS content themselves by uploading a Video file and a Subtitle file.

4.1 Personas

In order to better understand potential users and user motivations for using the system and goals while using it personas were created. Three personas were created that cover three different Users and Stakeholders. Personas were created based on results from the initial survey.

4.1.1 Peter Richardson



Gender - Male

Age - 29

Occupation - Financial Adviser

About - Peter Works long hours and also has an hour commute to and from work, consequently he doesn't

have much free time. He likes watching TV, and also likes to read, unfortunately he struggles to find time to do both and tends to end up not doing much reading.

Goals

- To keep up to with his favourite shows
- To do more Reading

4.1.2 Sarah Lawrence



Gender - Female

Age - 45

Occupation - Daycare

About - Sarah works in her family run daycare, in her free time she likes to watch her favourite TV shows. Sarah has a cognitive impairment that makes it harder for her to follow along with what's on the TV, using subtitles helps but it can still be too fast for her to follow.

Goals

- To be able to watch television and not miss out on what's going on.

4.1.3 David Peters



Gender - Male

Age - 52

Occupation - Stay at Home Dad

About - David has two sons aged 8 and 10. His sons spend a lot of their time watching YouTube videos and TV. David is concerned that his kids are not doing enough reading and may fall behind classmates in terms of reading ability, but he struggles to find ways to persuade them to read. David is also currently searching for jobs so does not have as much time to look after and entertain his kids as he normally does.

Goals

- Wants something to occupy the kids so that he can try to find a job
- Wants an attractive alternative to watching TV to persuade his children to read more

4.2 Requirements

Requirements were developed based on feedback from the initial survey, and the personas that were created.

4.2.1 Functional Requirements

- A User must be able to upload a .mp4 video file.
- A user must be able to upload a .srt subtitle file.
- The System must be load the video into an object for manipulation.
- The System must be able load the subtitles into an object for manipulation.
- The System must Find an image corresponding to each subtitle.
- The System must display the subtitles and their corresponding image to the user.

4.2.2 Non-Functional Requirements

- A User should be able to identify who said which subtitle.
- A User could be able to save the output for later viewing.
- Subtitles should be displayed in a manner that means they will not blend in with the background.
- Loading times should be short so the user is not kept waiting
- A User should be able to choose two files and press go in less than a minute (not taking into account upload times)

4.3 Development Tool Choices

An investigation was carried out to compare Java, MEAN stack, and LAMP stack for development. All of the above had advantages and disadvantages to their usage. Initially Java was considered due to having a wide range of libraries available, it was finally decided that LAMP would be used due to the following:

- A PHP library, FFMPEG “php-ffmpeg”, has functionality for the manipulation of videos, the function of most interest was the one that lets you get a frame from a video if you give the function a timestamp.
- A PHP library, ”srt-loader”, which allows you to parse .srt files into objects that can easily be manipulated.
- These libraries both integrate well with Composer, which will be used as the package manager throughout the project.

It also would have been possible to do all these things using Node.js and node package manager as there are .js libraries for ffmpeg and srt parsing, however these libraries had limited documentation compared to their PHP (LAMP) counterparts.

4.4 Development Environment

Site was developed on a windows system. Github was used for version control, this had the benefit of being able to roll back to a previous version if something went wrong. The text editor visual studio code was chosen due to its easy to use user interface and its GitHub integration making version control very straightforward. Another text editor that could have been used was atom as it has very similar functionality to Visual studio code, in the end it came down to personal preference.

A way to run the site locally in order to rapidly prototype was needed, as a Lamp stack is being used it makes sense to prototype using a local Apache server. There are a number of tools that can do this such as Xampp and Wamp they are both lightweight methods of running an Apache server locally the advantage Xampp has over Wamp is that it is supported by multiple operating systems, Xampp was chosen for this reason as due to it being supporting multiple operating systems there is more documentation, and if there are any compatibility issues with any other tools used there is a higher chance that someone else has had the same problem and found a solution.

4.5 Activity Diagram

An activity diagram was created in order to better understand the individual steps that the website will take to generate GNS content (Figure 6). The diagram takes you right from the beginning of the process where the user is asked to Select a subtitle file and video file for input to the end of the process where the content is either displayed to the user or downloaded for later viewing.

4.6 User Interface Design

In order to better plan the layout of the website before beginning development some wire-frames were created to represent the two main pages of the website. The first page which you can see in Figure 7 is the Homepage,

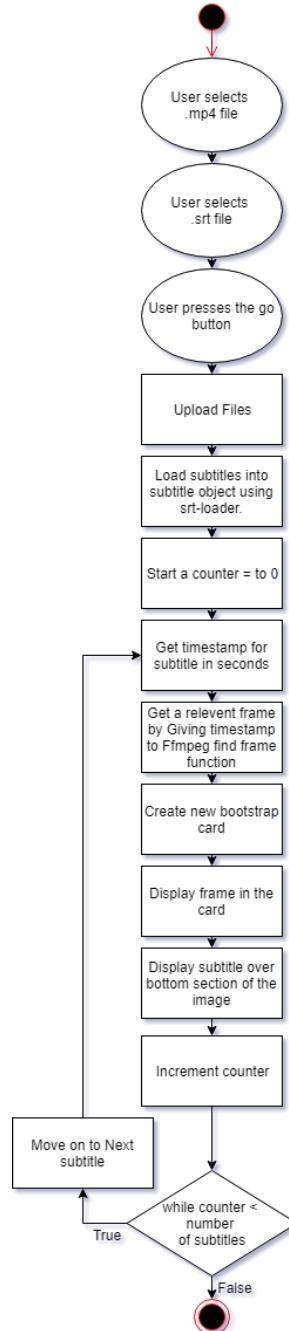


Figure 6: Activity Diagram.

from the homepage you will be able to select a video file (.mp4) and a subtitle file (.srt) then when you press go the website will generate a graphic novel and display it on the page you see in Figure 8 the images will be displayed in a 3 column grid with the corresponding subtitles displayed over them. originally the plan was to have a 4 column grid as you can see in the activity diagram (fig 6) but when creating the wire frames it looked better in 3 columns due to the images being larger.

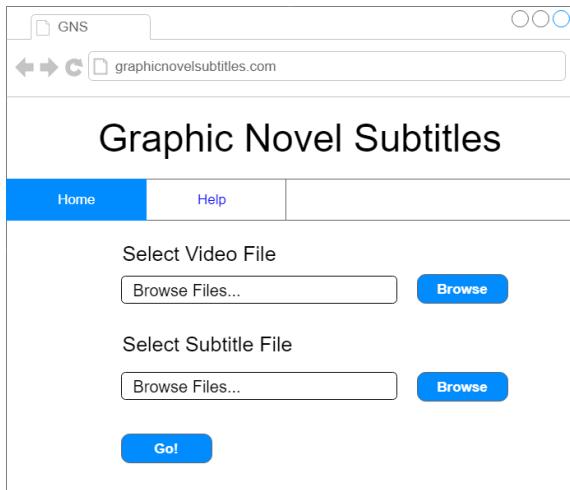


Figure 7: Homepage user interface design.

4.7 Issues Encountered in Development

Overall development went relatively smoothly and any problems encountered were able to be solved. There were problems with POST requests due to the size of files being uploaded, but I discovered that you can edit the maximum post request size manually by editing your 'php.ini' file. There were issues with the cards in bootstrap not formatting correctly or generally behaving as expected, It turned out that a very outdated version of bootstrap was being used by mistake which was causing a lot of the issues.

While the original plan was to allow the user choose whether they wanted to download or view the Graphic novel, it turned out that creating a pdf and formatting it



Figure 8: User interface design for the Graphic novel presentation.

correctly then downloading it was more difficult than anticipated, and the fact that you can save a web-page as a pdf very easily in most web browsers had not been considered, so it was deemed a largely unnecessary feature.

4.8 Final Product

In Figure 9 you can see the homepage. The main functionality of the home page is to allow users to select their .mp4 and .srt files. Once you have selected your files you can press go.

After a short wait while the file uploads, you will be presented with a Graphic novel version of your video (Figure 10). Subtitles will be coloured for speaker identification if the .srt file given contained colour information.

If you are viewing on a device with a smaller screen the website will dynamically change to accommodate this.

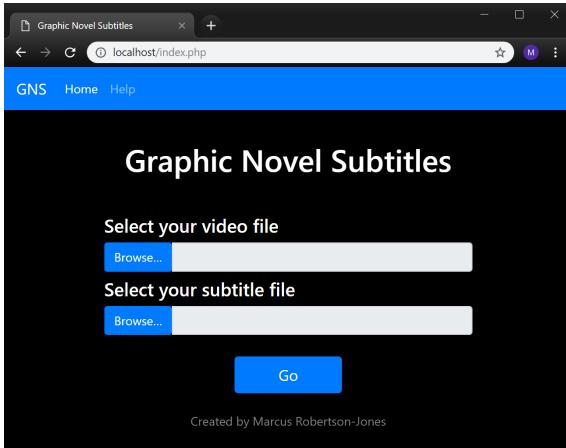


Figure 9: Homepage.



Figure 10: Graphic Novel Layout.

As you can see in Figure 11 The images are no longer displayed in a three column grid and are now displayed one per line.

You will notice that a dark theme was used for the site, this was in the hope that it would cause less strain on the readers eyes due to it being less bright, this could be particularly useful in longer viewing sessions.

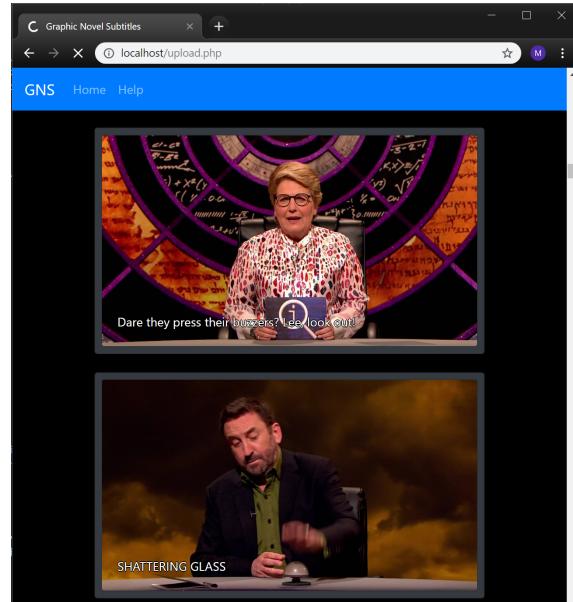


Figure 11: Graphic Novel Layout on a thinner screen.

4.9 Artefact Testing

Throughout the development process the system was tested through the use of the apache server to run the website and ensure it was functioning as expected. Following Development the system was evaluated to ensure requirements had been met.

4.9.1 Functional Requirements

- A User must be able to upload a .mp4 video file. [Fulfilled]
- A user must be able to upload a .srt subtitle file. [Fulfilled]
- The System must be load the video into an object for manipulation. [Fulfilled]
- The System must be able load the subtitles into an object for manipulation. [Fulfilled]
- The System must Find an image corresponding to each subtitle. [Fulfilled]

- The System must display the subtitles and their corresponding image to the user. [Fulfilled]

4.9.2 Non-Functional Requirements

- A User should be able to identify who said which subtitle. [Fulfilled]
- A User could be able to save the output for later viewing. [Fulfilled]
- Subtitles should be displayed in a manner that means they will not blend in with the background. [Fulfilled]
- Loading times should be short so the user is not kept waiting [Fulfilled]
- A User should be able to choose two files and press go in less than a minute (not taking into account upload times) [Fulfilled]

5 Methodology

The study took the format of an A/B test where the participants viewed both the graphic novel format generated by the website and viewed a video clip with subtitles enabled. Participants were given twelve quantitative questions for both the Graphic Novel and the subtitled video so that the scores for both can be compared. The questions were scored using a seven point likert scale. Participants were also given six qualitative questions based on the Graphic Novel. The twelve Quantitative questions are based on prior work measuring the User Experience of subtitles with two questions for each of the six factors (Focused Attention, Perceived Usability, Aesthetics, Endurability, Familiarity, and Involvement) [1, 13]

Participants were given an information sheet to read through describing the task and what the task will involve. Then participants were asked if they had any Questions before moving on. The next step was the explanation and completion of the consent form to ensure

participants agree and understand the ethical implications of the task. Experiemnt conditions were counterbalanced in the study (Figure 12 Half the participants started with the Graphic Novel Implementation then Filled out the Quantitative Questions for the Graphic Novel, Then they did the same for the Video with Subtitles. The other Half of the participants did the same tasks but watched the video first and then viewed the Graphic Novel. Following these two tasks participants were given the qualitative question sheet to fill out. With this being used as a prompt for further inquiry within the study session. Throughout the study if anything that seemed relevant and not covered by the questions was noticed a note was taken of it.

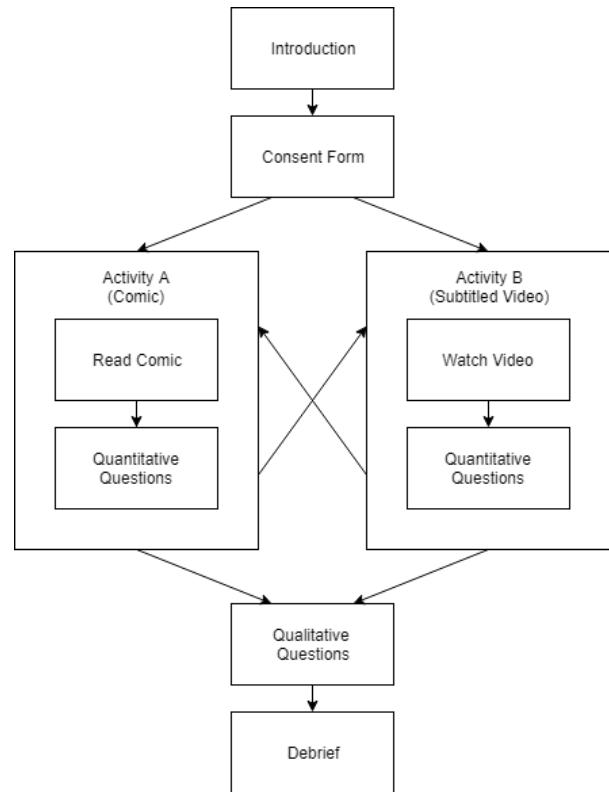


Figure 12: Design of Study.

5.1 Materials

The materials Required for the study were as follows; Information Sheet Describing the study, Laptop or computer, Access to the Graphic novel Subtitles Website, A video clip (.mp4) with a corresponding subtitle (.srt) file, Printed out question sheets, Printed out consent forms. The study was conducted in a quiet distraction free environment to reduce the influence of environmental factors on the results of the study.

Assessment Element	Video		Graphic Novel	
	M	SD	M	SD
Focused Attention	5.00	1.47	4.88	1.65
Perceived Usability	1.67	1.35	2.63	1.87
Aesthetics	5.67	0.98	5.38	1.18
Familiarity	5.25	1.40	6.01	1.22
Novelty	5.29	1.17	5.54	1.31
Involvement	5.83	0.87	6.04	1.17

Table 4: Mean results for each assessment element with standard deviations

5.2 Participants

Participants were primarily recruited through social media, some participants were also approached in the computing labs and asked if they would be interested in participating. There were twelve participants total, nine were male three female, all were aged 18-24. Four of the participants had not done the previous survey so where unfamiliar with the GNS concept, this had the benefit of being able to get a true first impression from those participants. There was wide range of subtitle use throughout the participants with some claiming to barely use subtitles, and others saying that they almost always do use subtitles. All twelve participants were students at the University of Dundee.

6 Results

6.1 Quantitative Results

Each UX factor had 2 questions representing it so in table 4 you can see an average of how each media performed by category with standard deviations shown, with each media coming out on top in 3 of the categories. Showing that the user experience of the Graphic novel created is of a similar level to a subtitled video.

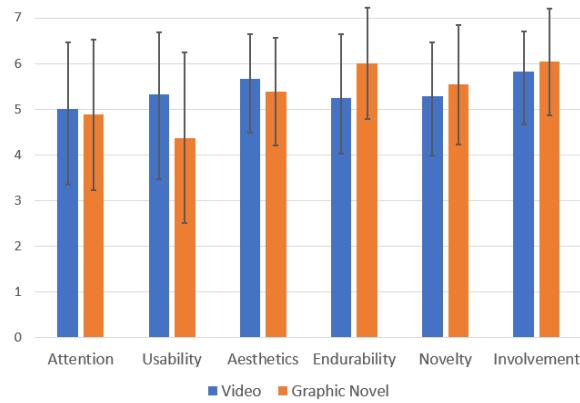


Figure 13: Bar graph for comparison of performance in each Assessment element

6.2 Qualitative Results

6.2.1 Attention

Is the awareness of what is going on in relation to the video content.

Something that came up as a positive or a negative depending on participants was that you have to focus on the task in order to take in all the information. the advantage of this is that you don't miss anything because you are completely focused on the task P11 said *subtitles easier to follow and they held my attention better than normal subtitles*. P5 said "easier to read and pay attention to"

but the disadvantage of this is that it requires more effort from the viewer and the viewer might not want to have to put much effort into viewing the content P12 said "*it was much more difficult to follow what was happening... as you use your full focus and rely on them to understand what is going on*"

6.2.2 Aesthetics

Measures the visual appeal of the subtitled content.

While in the quantitative results the graphic novel did not perform as well as the subtitled video, participants did not raise any major issues with the aesthetics of the subtitles. There was some concern that the white subtitles sometimes blended in to the background. P10 said "*On backgrounds that are white do not use white lettering.*" which suggest more could be done to make the subtitles stand out from the background. currently text has a small black outline, perhaps it could be made thicker, or a semi-transparent background placed behind the subtitles to make them stand out better.

When asked about subtitle size most participants said that they were happy with the size of the subtitles. P8 said "*The size is fine for the size of image as it doesn't distract you from the image*". P10 said "*Good size, may need to be slightly bigger for those who need glasses or elderly*". P11 said "*They are a good size and boldness - easy to read*". Some good positive feedback from participants, and a good point raised about some users with not as good eyesight potentially needing bigger text

In general participants were happy with the placement of the subtitles. P3 said "*The placement was suitable and made them easy to follow*". P4 said "*Good placement, further up would distract from the background*". There was an interesting point raised by P11 "*The placement was appropriate for use on a panel show. perhaps different placement for shows with greater variations of angles.*" the clip used for testing purposes was a clip from QI which is a panel show, P11 suggests that while that placement is appropriate for a panel show which is quite static due to characters on screen being seated behind a

desk, it may not be appropriate for more fast paced formats.

6.2.3 Usability

Measures how easy the subtitled content is to understand.

Participants seemed to find the method of making text different colours for each speaker to aid speaker identification relatively easy to follow, but there were suggestions for improvements. A number of participants suggested the use of a key to help figure out which colour represents which character, one such suggestion came from P3 "*a key for colour = person to help understand who is who*". P9 suggests that the key should follow the user as they scroll so if they stop and come back they can easily remember which colour was who P9 said "*a small key at the side for ease of return if stopping episode part way through*". Another suggestion from participants was to include the speakers name as part of the subtitle P6 said "*name preceding everything said*" and P8 said "*you could use initials at the start of each sentence depending on who is talking*". Both a key and the inclusion of speaker names in subtitles are very good suggestions for how to improve speaker identification, but this information is not available in the .srt subtitle file so could be difficult to implement.

P6 says "*Sometimes its not clear who said something if they are not in shot.*" this can definitely be a problem, especially if the speaker off-screen is one you haven't seen before as the colour won have been seen before or you might still associate that colour with a character who used that colour in a different scene who is no longer present perhaps something could be done to signify that the speaker is off screen, the previous suggestion of the speaker name in the subtitles would likely help resolve this.

While it was anticipated that participants would be able to read at their own pace this was primarily assumed that this would be an advantage to people who struggle to keep up with the pace of the subtitled video. but it also

had benefits to fast readers who did not have to wait for the next subtitle to appear as in they could just move on to the next panel. P5 said "*Much faster to consume the content than video*". From observing, some participants were clearly going at a much faster pace than the video could allow. Some participants also read at a similar speed to the video and also slower than the video, so its clear that GNS supports all different speeds. which was supported by feedback from participants; P5 said "*lets user move at their own pace*". P12 said "You are able to follow at your own pace".

As in the intial survey there was concerns from some participants that you miss out on certain things such as tone, sound effects and music, which can be key story telling elements used in film, again perhaps this goes back to certain genres to be more suited than others to the technique. P7 says "*loses some of the feel of watching the moving video, lose the tone.*" P3 says "*Peoples movements do not translate well, not seeing change in facial expressions etc can lead to a less 'full' experience*"

Participants pointed out that Graphic novel subtitles has the benefit of the user not missing something that was said as you can go back and read something again easily if you missed something, or if you zone out for a little bit you have not been left behind. P1 says "*Easy to see if you didn't catch something*" P12 says "[read] aspects of conversations you may have missed."

6.2.4 Novelty

the quality of being new, original, or unusual.

Testing the Graphic Novel subtitles was a unique experience for all the participants and some showed genuine interest in the concept. P3 said "*They seem like an interesting concept that changes how you interact with the media in an unusual way*" P7 also emphasised on multiple occasions how they felt it was an "interesting concept." and in their final remarks said that it was "a brilliant concept of a project".

It seems bringing in elements from existing video subtitling helped to introduce the new concept while keeping

some familiar elements. P8 said "Its standard subtitle placement so it works as people are used to it."

6.2.5 Involvement

Measures how engaged users are with the content.

Participants reported a variety of levels of involvement, some participants felt very involved with the task. P5 said "*Its equally engaging as watching content*". However It does seem that graphic novel subtitles is not for everyone though as some participants did not feel as involved in the task P2 said "*Felt less immersive than the video, I think sound is a big factor for me*"

6.2.6 Endurability

How willing is a user to keep viewing subtitled content the same way in future?

Some participants indicated genuine interest in the Graphic Novel Subtitles and potential for future use. P10 said "*Very useful, clear, easy to read. Different approach but one that I would definitely try more*". This is also the category that the graphic novel performed the best in versus the Subtitled Video

Another user however that they didn't think the technique lent itself well to "binge-watching" P2 said "*Feels like I would be able to binge-watch a lot of the show, but not be able to binge-read the same amount.*"

6.3 Limitations

Its possible due to the same section of video being used for both tests that participants would have less interest in the second task as they were already familiar with the scene. Although that should even out due to half of the participants doing the tasks the other way around.

Only one clip was used for testing purposes, it is possible that a Graphic Novel generated from a different show

and genre could have performed better or worse comparatively to its corresponding subtitled video clip.

7 Discussion and Future Work

This discussion will be used to draw together ideas within this work and to answer our research question "Can a graphic novel created with a subtitled movie file create similar levels of UX when compared to the video file itself?". Overall It has been shown that this is possible due to the below.

7.1 Encouraging More Reading

Based on the results of the initial survey the majority of participants agreed that Graphic Novel Subtitles would allow them to keep up to date with their favourite shows and do more reading.

In the user study P5 said "*Its equally engaging as watching content, its also much faster than watching which makes it convenient*". Some users find reading the graphic novel much faster than watching the subtitled video, this means you can catch up with your favourite shows faster freeing up more time in a participants day. This could have a compound effect, Reading your favourite shows instead of watching them could free up more time in which a user could do more reading. the artefact created does encourage some users to do more reading however it seems the format is not for everyone.

Future work in this area could further investigate reading speed and measuring the reading speed versus the speed of watching a video. A study could also be done investigating users feelings towards graphic novel subtitles over longer viewing sessions.

7.2 Quality of Subtitles

Feedback on the subtitling techniques used was largely positive. Participants felt that the position and size of the subtitles were appropriate and felt that colour coding speech was a good way to identify different speakers. the colour coding also helped identify off screen speakers, provided the user was already aware what colour the speakers subtitles were due to previous speech. It seems that Video Subtitling effects can be successfully used as part of Graphic Novel Subtitling, this is supported by how closely The subtitles Performed in the Aesthetics characteristic, however they did not perform as well in perceived usability although this did vary largely from participant to participant with some rating them equally and some even rating Graphic novel subtitles better than the subtitled video.

Future work in this area could investigate different subtitle placements and speaker identification methods such as dynamically placing the subtitle next to the speaker to aid speaker identification and whether these techniques would improve the Graphic Novel Subtitles experience.

7.3 Comic Book Techniques

Unfortunately not much was discovered with regards to applying techniques used in Comic book to movie adaptations. but there are a number of avenues that can be explored in future. effects such as a limited colour palette could be applied to the images displayed in the Graphic novel. The same could be done with halftoning. Certain genres might be better suited to this technique and that could be investigated, there is likely little point in making a panel show appear more comic-like but making a Sci-fi or Drama appear more comic like might add to the experience.

A limited colour palette may potentially be a fairly quick addition to the created website, as ffmpeg has commands that allow the altering of the colour range in a video. ffmpeg also supports dithering, which can be used to create halftone effects so that could be another quick addition. Perhaps some settings could be implemented on the

homepage that determine if the user would like a limited colour palette or halftoning before they press go.

7.4 User Experience

As shown in the results from the User Testing, Graphic Novel Subtitles performed very well versus the Subtitled Video in the User Experience Factors that were assessed. With the exception of Perceived Usability the graphic novel performed very closely. P5 said "Its equally engaging as watching content" and P11 said "*They make subtitles easier to follow and they held my attention better than normal subtitles*". The thoughts given by these participants speak to the great quality of user experience provided by Graphic Novel Subtitles.

Graphic Novel Subtitles also demonstrate characteristics of flow, such as P5 says "*You lose a sense of time when reading*" this is also evidenced by some participants being unsure which media was faster, but it was observed when watching participants that they were in fact reading faster than the pace of the video but were unaware due to an altered perception of time. Participants also demonstrated feelings of Control and Effortlessness, P9 says "*Very useful and easy to follow, can go through the episode at my own pace...Feel more involved with the show*".

Future work in this area could involve investigating how different genres lend themselves to Graphic Novel Subtitles, it is very possible that different genres would perform differently than the comedy panel show used in this work. It is recommended that a future study be undertaken with a similar format to the User Testing done in this work but clips from a variety of genres are tested against each-other to determine which genres are best suited and provide the best user experience when using Graphic Novel Subtitles.

8 Conclusions

In this work the Research Question

"Can a graphic novel created with a subtitled movie file create similar levels of UX when compared to the video file itself?"

has been established and answered. This was achieved via a number of steps. Background Research was conducted into Subtitles, Graphic Novels and Immersion in TV and Film. This led to the establishment of the research question. Following this a survey was conducted to assess potential users thoughts and feelings towards the Graphic Novel Subtitles concept. Requirements were generated from the survey results as were personas. A website to generate graphic novel subtitles was then designed and created. The user experience of the content generated by the website was evaluated and compared to a subtitled video.

This allowed the answering of the research question were it was established that a graphic novel generated from a subtitled movie file can create similar level of user experience to that of a subtitled video.

The system created allows users consume video content at their own pace whether that be faster or slower than the normal pace of a video.

Some users found the format very engaging and would be interested in trying more Graphic Novel Subtitled content. Conversely some users felt less engaged as they felt sound was a big part of their video viewing experience.

9 Legal Social and Ethical Issues

There are no anticipated Social or Ethical issues. However there could be some legal issues with displaying of content. Its unclear how this Graphic Novel content would fit into Copyright Law and whether this method would be classed as making copies of Copyrighted Materials.

10 Reflection

Overall the project went relatively smoothly, there were only some minor issues to overcome. Firstly Participant Recruitment took a lot longer than was anticipated and held up progress, as participants availability's had to be worked around. Secondly If work on the report had been started sooner or done side by side with development, the final few weeks would have been more straightforward.

If the process was done differently the main change would be to try and get more done earlier, for example try to get some more work done over the Christmas holidays to make the semester less stressful.

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Appendices

Appendix A - Website source code

Appendix B - Mid project report

Appendix C - User Guide

Appendix D - Ethics Submission

Appendix E - Degree Show Poster

Appendix F - Minutes of Meetings