# Interactive Video Virtual Tours

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## Abstract

We all know that "a picture is worth a thousand words" so now we could say that "a virtual tour is worth ten thousand words." With the expansion of Internet use, virtual tours became the most popular way of traveling through time or space, applied to varieties of undertakings such as travel tours, architecture, history, estate agencies and so on. In this paper we will evaluate whether the video based touring gives a greater sense "of being there" than the photo based touring by measuring the presence and immersion of the viewer using the case study of Sarajevo's old city –Bascarsija.

**Keywords:** virtual walkthroughs, virtual reality, presence, interactive storytelling

## 1   Introduction

A virtual tour (or virtual reality tour) is virtual reality simulation of an actually existing location, usually comprising 2D or 3D panoramic images [8], a sequence of images  followed by HTML [9], pre-recorded and edited movie [10], QTVR clips [11] and/or image-based models of the real location, as well as other multimedia elements such as sound effects, music, narration, and text. Substituting traveling, virtual tour viewing evokes an experience of moving through the represented space.

Regardless of what technology is used, virtual tour offers something out of the ordinary. It adds a view that graphically explains a story or even shows up the space. Thus, we can learn the historic story [9] only by watching number of static photographs and its attendant text or visit buildings [8] by watching panorama views of their chambers and information about objects inside. Such Virtual tours allow the user to move easily between different rooms or places and obtain an overall picture of the location. Hotspots guide the visitor through the doors into other rooms, down different streets or around the corners - places that a static picture only alludes to. Furthermore, QTVR panoramas will let you navigate in a 360 degree circle, viewing everything that is visible from one spot [11].

With the expansion of video on the Internet, video-based virtual tours are also growing in popularity [10].One can say they are most immersive, yet until now such video tours offered low or no user interaction.

Our idea is to provide a user with real, live and interactive exploration of space, through its home computer, without lack of feeling of being there and then compare it with existing photo based tour. To do that, we integrated video techniques, as the most trustworthy representation of the space, with techniques of moving through space with full user interaction and immersion.

The rest of the paper is organized as follows. Section 2 provides a brief overview of related and up to now work. Section 3 reviews our video virtual tour concepts,. Implementation of the tour is presented in Section 4. User study conducted to explore the presence of the viewer in our tour comparing it to an ordinary photo virtual tour is described in Section 5 together with the results. Finally, in Section 6, conclusions are drawn and directions for future work presented.

## 2   Related work

Presence (defined as a sense of "being there" in a mediated environment) could be used as a global quality metric for evaluating advanced multimodal media systems [1]. In order to learn the best way for evaluating presence as a quality parameter for our virtual tour experience we were exploring the following related work.

Ladeira was examining the relationship between presence and story experience in a virtual storytelling [2]. They were using the IGroup Presence Questionnaire (IPQ) that focuses on measuring three factors: the sense of being physically present in a VE (spatial presence), attention given to the VE and realism [3]. They chose to use the IPQ since it has been proved valid and reliable and is applicable to desktop VR.

Sometimes presence is considered as a synonym for immersion, but Slater and Wilbur propose a distinction between presence and immersion, where immersion is an objective description of the system and presence is a subjective phenomenon of user's experience. According to Slater and Wilbur, both of these dimensions are measurable [4].

Lessiter has presented a presence selfreport measure, the ITC-Sense of Presence Inventory (ITC-SOPI),that comprises four empirically derived scales: Sense of Physical Space, Engagement, Ecological Validity, and

Negative Effects. Two applications of the ITC-SOPI are presented in [1].

For our evaluation of interactive video virtual tour it is also important whether the user is already familiar with the location. Similar idea was presented by Ladeira et al. when exploring the use of thematic priming in order to improve the presence experience of a virtual environment (VE) [5]. They were offering the users to familiarize with the environment by presenting them with materials thematically related to the VE's content (the priming manipulation) prior to their experience. Therefore we will consider this as one of the factors in the evaluation of our virtual tour.

Since our video virtual tour can be considered as an interactive movie of the location, we were exploring concepts of non-linear story, branching and hypertext narratives from [6]. Glassner mainly deals with stories which have a plot and characters and discusses the possibility of enabling the audience to influence character's decisions. He refers to a "non-linear story" as to "non-reflective mirror" emphasizing the importance of linearity for every story. In our case, even having not a typical story to tell, we interrupt the continuity of the overall movie by deciding which part will be played next. In our case all problems with interactive storytelling mentioned in [6] are implicitly solved.

Hu and Barneck conducted a cross cultural study to test the influences of different cultural backgrounds on the user's presence experience in interacting with a distributed interactive movie. In addition they were interested in the effects of embodied interaction on presence. The influence of culture background was clear - Chinese participants perceived more presence than Dutch participants in all conditions [7]. We will explore the amount of presence in our virtual tour comparing Bosnian viewers' and foreigners' impressions.

# 3   Concept

Interactive video virtual tour offers a virtual representation of some location, which allows audience to be fully immersed into presented environment. Instead of photos or panoramic photos, we offered movies as elements of the tour and allowed users to choose the direction of their journey through the presented location.

Our concept consists of three equally important components:

**Interactive map** – represents the map which provides the user with significant information such as: what area he/she explores, where the decision points are placed and what is the current position of the user. To enhance interactivity, the map enables a user to view the decision points, choose decision points he/she wants to visit and presents a simple navigation panel used for

more efficient preview (zoom in, zoom out, pan over etc.)

**Decision points** –are points where a user can decide in which direction he wants to move when he comes to a crossroad of the streets. The user can decide between one, two or more movies or going back to the previous movie, which led him/her to the current decision point.

**Movies** – represent the record of the actual streets. Movies are sequences edited from shots taken by video camera in particular streets. They also have soundtrack containing the real sound of the environment mixed with the traditional Bosnian music. In the further presentation we will sometimes refer to movies as just "videos", even if they have an audio component included.

Putting together these three components gives us the main concept of the tour: selection of the decision point (crossroad) that user wants to see (directly on the map), presentation of the first frames of movies (streets) within the selected decision point and finally selection of the movie. After going through one decision point and one street, user is led to the following decision point automatically. The user then can walk further sequentially by selecting the offered streets, going back to previous street or completely changing the decision point by clicking on the map.

Before implementation of this concept we had to decide for which area we want to make the Interactive Video Virtual Tour, and we chose the old town of Sarajevo –Baščaršija.

Next step was the detailed work on the scheme of streets (videos-movies) and crossroads (decision points) based on the real map of the chosen area, given on the Figure 1 (V-Videos, D –Decision points).
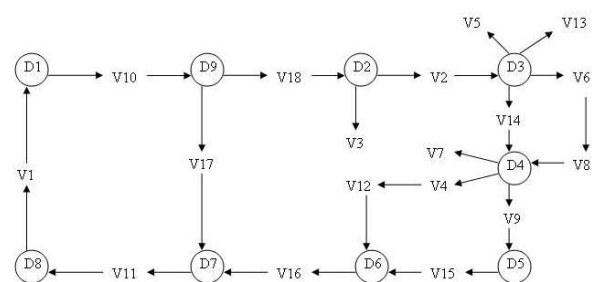


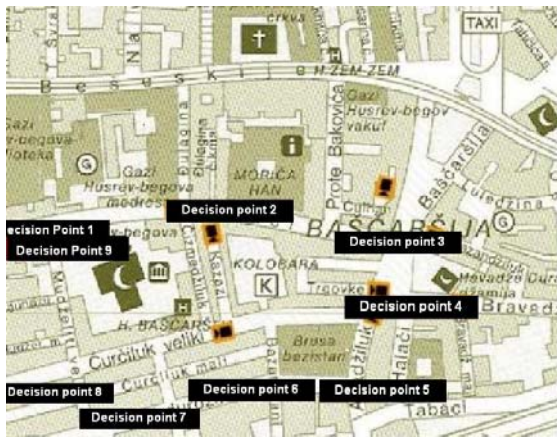*Figure 1 – The scheme of streets and crossroads*

*Figure 2 –Interactive map*

# 4   Implementation

Videos used in this project are recorded by SONY DCR-HC35 video camera, and then edited using Adobe Premiere 1.5 Pro. The reason for editing the raw film material was to show and emphasize the most significant parts of a certain street in a limited amount of time (approximately one minute per street) and create the rhythm in the sequence of shots to make it more interesting for the viewer.

Layout was designed and implemented using combination of Sothink SWF Quicker and Actionscript 2.0. Having in mind the importance of interactivity, where the user is the one who decides what he wants to see next, separate layouts had to be created for each decision point and video. Coding in Actionscript made it possible to interconnect these layouts containing decision points and videos, using the algorithm developed from the scheme above. Mentioned algorithm for a part of the scheme is given below:

(Presume that user current position is on D9 – Decision point 9, where following options are given: exploring videos - V18 or V17 or going back to V10 which led user to D9)
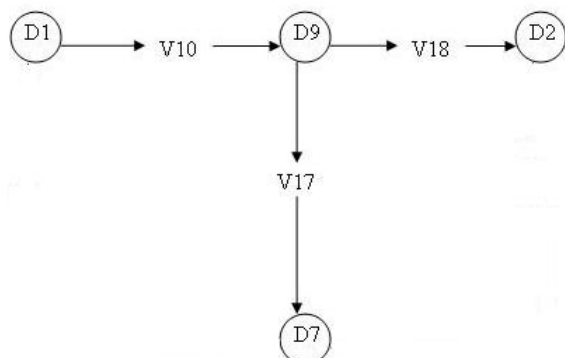


*Figure 3 – Extracted part of scheme for the algorithm*

ActionScript code for decision point D9 is presented as follows:
*If button V18 is released*
*then getUrl(“V18“,““),*

*else If button V17 is released*
*then getUrl (“V17“,““),*
*else If button V10 is released then getUrl (“V10“,““);*

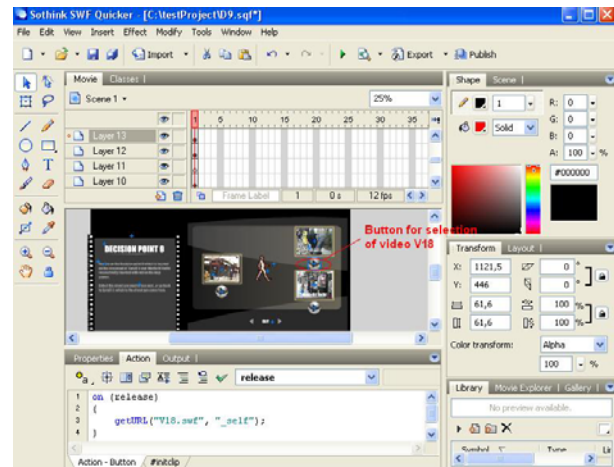Figure 4 presents a screenshot of video V18 selection, at decision point D9 in Actionsript:



*Figure 4 – Video V18 at D9 with Actionscript*

The interactive map (Figure 2) was created from the sketch drawn on a piece of paper and then scanned. This was inadequate for any kind of zooming since raster graphics are resolution dependent and they cannot be scaled to an arbitrary resolution without an apparent loss of quality. Our solution was to combine Zoomify plugin for Flash and Actionscript.

Zoomify is a set of Flash APIs and it is used for converting images in standard formats such as TIF, BMP, and JPEG into pieces - just like the tiles of a mosaic. These pieces are actually created for views of the image at many different resolutions or levels of zoom. The pieces can then be loaded on-demand (using Actionscript), so that wherever a user zooms and pans, his/her view is always sharp and clear. Our scanned map is thus converted into a series of pictures which are later called in Flash using relative path of the folder where they are saved and connected to the instance of NavWindow (component of Zoomify which enables reading the file where images are stored – Figure 5)
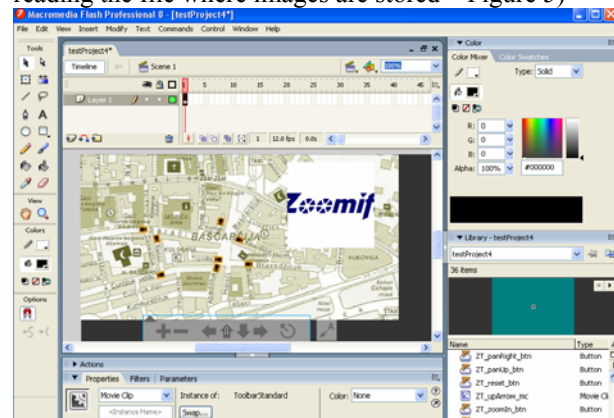


*Figure 5 – Interactive map created with Zoomify plugin for Flash*

In the similar way, the toolbar is created as well as the hotspots representing the Decision points. Since each Decision point has its place on the map, for each separately created Decision point, an interactive map with its corresponding location was made. Maps are then loaded externally in an empty movie clip.

To improve the virtual tour, besides the map, we added a display containing instructions for the user at the Decision point, and a display containing information about the street that user explores. The final appearance of the graphical user interface is shown in Figures 6 and 7.
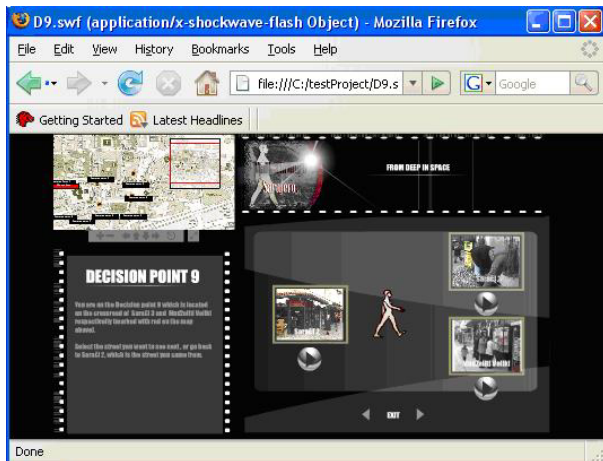

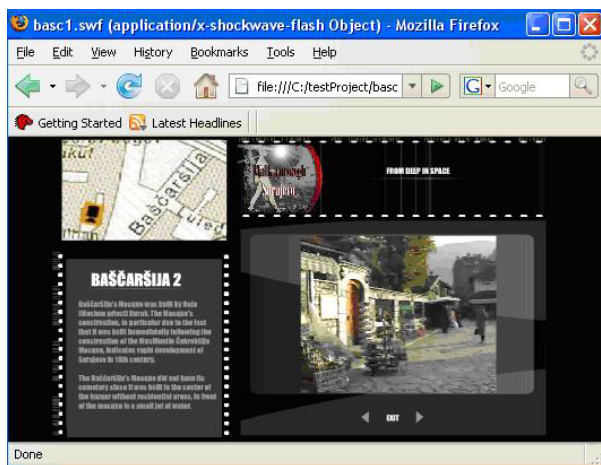*Figure 6 –Graphical user interface of the decision point*


*Figure 7 –Graphical user interface –video*

Now the user can travel through the streets of Bascarsija watching an interactive movie of the location and navigating through the map and the decision points. In order to check whether our concept is offering the viewers more presence in the virtual environment, we conducted an user study presented in the following chapter.

# 5   User study

## 5.1       Questionnaire

We have based our questionnaire on Lessiter's ITC-SOPI presence selfreport measure. We were evaluating the sense of the physical space, engagement and negative effects. The ecological validity factor from ITC SOPI was not applicable to our user study.

Our user study was performed on two groups, first containing 64 subjects, all Bosnians, aged between 20 and 25, all students of computer science. They were watching our video tour and a virtual tour of Oxford based on panoramic photos [12]. After watching both tours they were asked to fill out a questionnaire.

The second user study was performed on 10 subjects, aged between 20 and 25, who have never visited the presented location and therefore are not familiar with it. They were watching our video tour and a virtual tour of Bascarsija based on panoramic photos [14]. After watching both tours they were asked to fill out a questionnaire.

Our questionnaire consists of two parts. In the first part the participants are asked to compare the video and photo virtual tours. Every question has Likert psychometric response scale for both tours. The second part of the questionnaire was related to the video tour. We conducted this part in order to get the feedback of the users to our tour and evaluate its quality.

## 5.2       Results

The presented results are obtained using Independent samples t–test, which is one of the statistical tests offered by software called SPSS for Windows [13]. The Independent samples t -test is used to test the statistical significance of differences between two classification systems, in our case video and photo tour. In fact we test the hypothesis that the difference between the means of two samples is equal to 0 (this hypothesis is therefore called the null hypothesis). The program displays the difference between two means, and the 95% Confidence Interval (CI) of this difference. Following are the test statistic: the Degrees of Freedom (DF) and the P- value. When the P-value is less than the conventional 0.05, the null hypothesis is rejected and the conclusion is that the two means do indeed differ significantly.

The test results with corresponding chart for the first group are sorted by questions and given below.

Sense of physical space
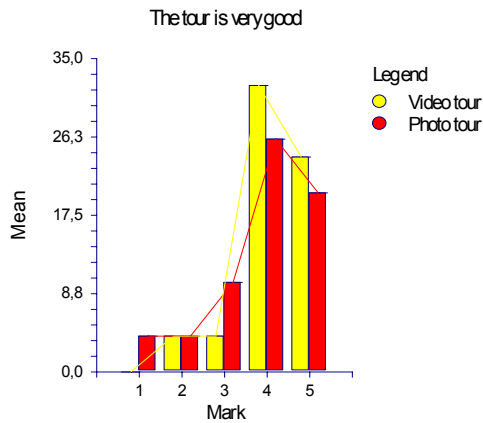
Question 1: The tour is very good

*Chart 1–Obtained results for the quality of two examined tours*

| | Video tour | Photo tour |
|---|---|---|
| 95% CI for the mean | -4,89 to 30,499 | 0,55 to 25,04 |
| Variance | 203,2000 | 97,2000 |
| Standard deviation | 14,2548 | 9,8590 |
| P- value | P=0,1093 | |

*Table 1- Independent samples t- test for the first question*
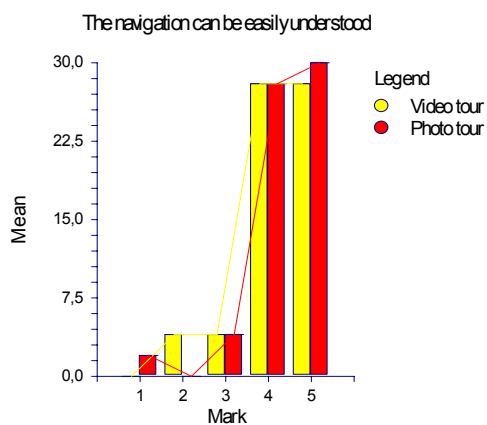
Question 2: The navigation can be easily understood



*Chart 2 –Obtained results for the navigation quality of two examined tours*

| | Video tour | Photo tour |
|---|---|---|
| 95% CI for the mean | -4,54 to 30,147 | 5,66 to 31,26 |
| Variance | 195,2000 | 221,2000 |
| Standard deviation | 13,9714 | 14,8728 |
| P -value | P=0,1941 | |

*Table 2-Independent samples t-test for the second question*

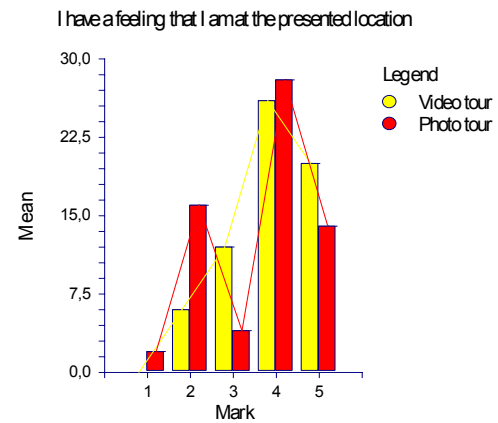Question 3: I have a feeling that I am at the presented location



*Chart 3 –Obtained results for the presence elements of two examined tours*

| | Video tour | Photo tour |
|---|---|---|
| 95% CI for the mean | -0,17 to 25,77 | -0,18 to 32,18 |
| Variance | 109,2000 | 170,0000 |
| Standard deviation | 10,4499 | 13,0384 |
| P- value | P=0,0199 | |

*Table 3-Independent samples t-test for the third question*

Engagement

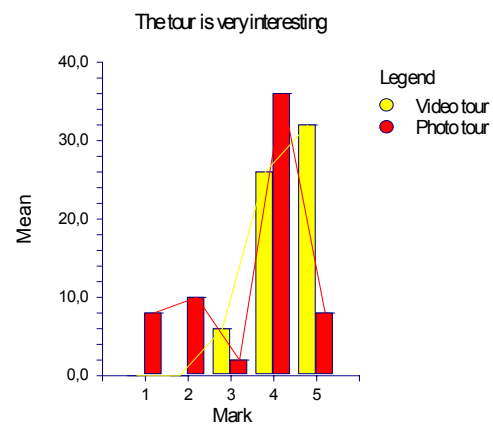Question 4.: Tour is very interesting



*Chart 4 –Obtained results for the user attraction of two examined tours*

| | Video tour | Photo tour |
|---|---|---|
| 95% CI for the mean | -5,99 to 31,59 | -3,72 to 29,32 |
| Variance | 229,2000 | 177,2000 |
| Standard deviation | 15,1394 | 13,3116 |
| P- value | P = 0,0001 | |

*Table 4 -Independent samples t-test for the fourth question*

Negative effects

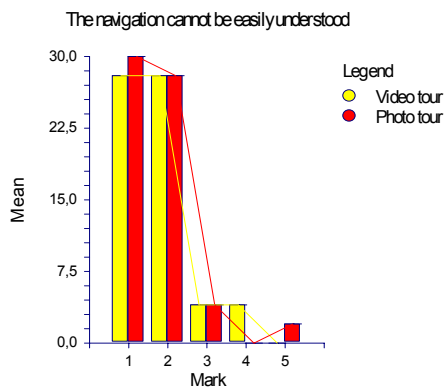Question 6.: The navigation cannot be easily understood



Chart 5 –Obtained results for the navigation quality of
two examined tours

|  | Video tour | Photo tour |
|---|---|---|
| 95% CI for the mean | -4,8997 to 30,499 | 2,3015 to 24,8985 |
| Variance | 203,2000 | 82,8000 |
| Standard deviation | 14,2548 | 9,0995 |
| P- value | P = 0,0001 | |

Table 5 -Independent samples t-test for the fourth
question

The output indicates that the observed difference for the first, second and the fifth question is not significant since their P values are greater than 0.05. However, this does not mean that the difference does not exist, as visible from the charts for mentioned questions. Note that in those charts, greater number of attractiveness examinees gave the highest marks for the video tour. Third and forth question showed the difference (P value less than 0.05) in the test as well as on the chart. Those two questions however are the most relevant for this paper, since we questioned examinees about the attractiveness of the tour and the feeling of presence. Again the video tour took the advantage, when compared to photo tour.

Results of the user study performed on the second group showed to be almost identical, meaning that the P value less than 0.05 occurred only when we questioned our examinees on attractiveness of the tour and the feeling of presence. In other words, video tour showed to be significantly more interesting and immersive, as shown in Charts 6 and 7, as well as in the Tables 6 and 7.
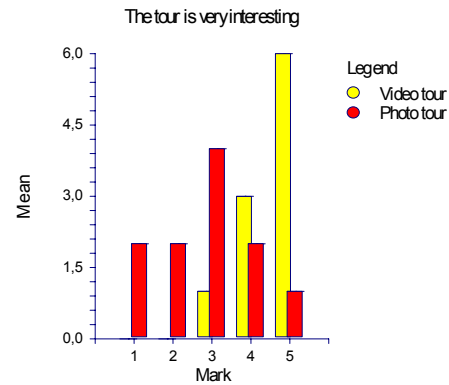


Chart 6 –Obtained results for the user attraction of two
examined tours for the second group

|  | Video tour | Photo tour |
|---|---|---|
| 95% CI for the mean | -1,16 to 5,16 | 1,12 to 2,87 |
| Variance | 6,5000 | 1,5000 |
| Standard deviation | 2,5495 | 0,7071 |
| P- value | P = 0,029 | |

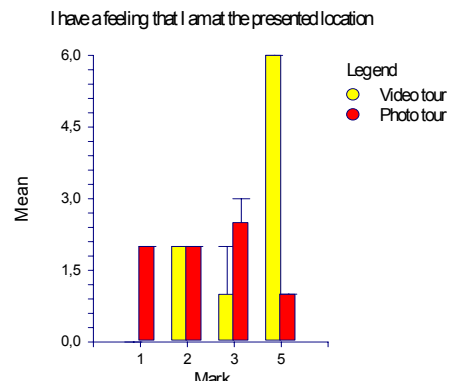Table 6 -Independent samples t-test for the fourth
question - the second group



Chart 7 – Obtained results for the presence elements of
two examined tours for the second group

|  | Video tour | Photo tour |
|---|---|---|
| 95% CI for the mean | 2,21 to 6,21 | 0,75 to 3,24 |
| Variance | 11,5000 | 1,000 |
| Standard deviation | 3,3912 | 1,000 |
| P- value | P = 0,036 | |

Table 7 -Independent samples t-test for the fourth
question- the second group

Regarding the Video tour itself, we examined the quality of the complete tour, quality of interactive maps, video files, graphical user interface and graphical design and at the end we asked our examinees, if they were

visiting an unfamiliar location, which virtual tour they would rather take. Here is the summary of the obtained results: On the scale from 0 to 10, in both groups, average mark for:

Quality of video tour : 8.85;
Quality of interactive maps:  8.7;
Quality of video files:  8.75;
Graphical user interface: 8.8;
Graphical design:  9.15;

When asked which tour they would rather take, 50 from 64 examinees of the first group (78%) chose the video tour, 4 examinees (6%) could not decide and 10 of them (16%) said that they would rather take the photo tour. When the same question was asked in the second group 3 from 10 (30%) chose the photo tour, while 7 of them (70%) strongly decided for the video tour.

Having in mind that user impressions are the most important for a project like this, we can conclude that the results are quite satisfactory and consider their comments for future work.

## 6   Conclusion and future work

We created a virtual tour using movies instead of panoramic or other kinds of photos. Our concept consists of an interactive map of the presented location, decision points as crossroads on the map and movies edited from the video recordings of the streets accompanied with traditional music mixed with the sounds of the environment.

In order to evaluate the presence of the user in our tour we conducted a case study comparing our concept with a photo tour. As a tool for measuring the presence we developed a questionnaire based on the three of four elements of ITC-SOPI [1].

Our results show that users feel more sense of physical space visiting the video tour than visiting the photo tour. Engagement is higher in video tour and it has less negative effects such as the user being confused or lost in the environment. We have also learned the weak points of our concept so we could improve it in the future. The case study has shown that users appreciate the concept of interactive movie and find it interesting for the purpose of virtual tour.

Our future work is to perform a similar user study with users familiar with both tested locations and explore the influence of priming on their sense of presence in the environment, in order to gain more real and unbiased evaluation. Also we tend to increase the number of examinees and improve the interactive map and navigation in the tour.

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