REPORT

Investigation of the audio-visual material included in the case file of the killing of Tahir Elçi on 28 November 2015

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Contents

1. Introduction 2
   a. Issues to be addressed 2
   b. About Forensic Architecture 3

2. Research framework 4
   a. Sources 4
   b. Assessment of sources 5

3. Methodology 7

4. Research and analysis 11
   a. Setup 11
   b. Video synchronisation 13
   c. Establishing the investigative time frame 14
   d. Shot count analysis 15
   e. 3D modelling 18
   f. Analysis of the actions of the PKK members 21
   g. Analysis of the actions of the police officers 23
   h. Sonic analysis 25

5. Conclusions 28

1. Introduction

Forensic Architecture was commissioned by the Diyarbakır Bar Association to investigate the killing of Tahir Elçi during a press conference he delivered on the 28th of November 2015.

The press conference took place in the historic district of Sur in Diyarbakır, Turkey. Elçi was speaking next to the historic Four-legged Minaret of the 16th century Sheik Matar Mosque. Three days earlier, an exchange of gunfire between Turkish state security forces and the PKK had resulted in damage to this monument. Elçi was calling for an end to the conflict, which had erupted in the city four months ago.

The incident was preceded by another shooting, which occurred moments earlier on the adjacent Gazi Avenue. Two members of PKK's youth wing (known as the YDG-H) shot two police officers, who later died.

The two PKK members then fled down Yenikapı Street, where Elçi's press conference was taking place. As the press conference was being filmed, the scene unfolded in front of multiple cameras. Plain-clothes police officers at the press conference opened fire at the PKK members as they ran through the scene. The only fatality from this shooting was Elçi, who was shot in the back of the head.

Forensic Architecture undertook a spatial investigation of the incident by analysing visual, sonic, and documentary evidence provided by the Diyarbakır Bar Association and reconstructed the events in an accurate 3D digital model.

a. Issues to be addressed

The mandate given to Forensic Architecture by the Diyarbakır Bar Association was to determine, using the audio-visual material in the case file, whether it would be possible to:

- Identify the time Elçi was killed.
- Identify the individuals that could have fired the lethal shot.
- Determine whether or not it was possible for Tahir Elçi to have been shot by a long-range weapon fired from outside of Yenikapı street.
- Determine whether the PPK members running down Yenikapı Street should be considered suspects in the killing of Elçi.
- Determine whether and which police officers at the scene should have been considered suspects in the killing.
- Determine whether there was an attempt to offer Elçi with adequate medical aid after he was hit.

b. About Forensic Architecture

Forensic Architecture is a research agency, based at Goldsmiths, University of London. The team includes architects, scientists, academics, journalists, filmmakers and technology experts and other specialized professionals and experts.

Forensic Architecture undertakes advanced architectural and media research on behalf of international prosecutors, human rights organisations, as well as political and environmental justice groups.

We have provided spatial research and evidence for numerous human rights investigations and prosecutions under international law, including into drone warfare, on behalf of the United Nations (UN) Special Rapporteur for Counter Terrorism at the UN General Assembly in New York in October 2013 and the UN Human Rights Council in Geneva in 2014.

Our video investigation and report on the murder of Pavlos Fyssas by Golden Dawn, was presented on 10 and 11 September 2018 at the Court of Appeal in Athens, where Golden Dawn is currently facing trial.

We presented evidence in the Israeli High Court for the (Palestinian) village of Battir vs. the Ministry of Defence through Michael Sfard, who won this case on 4 January 2015.

Our report, 'The Use of White Phosphorous in Urban Environments' was presented at the UN Human Rights Council in Geneva in November 2012, and in March 2011 at the Israeli High Court (for the Yesh Gvul movement, and human rights lawyer Michael Sfard).

The Forensic Oceanography team (Charles Heller and Lorenzo Pezzani) from Forensic Architecture presented the case of the Left-to-Die Boat before the French Tribunal de Grand Instance in April 2012, the Brussels Tribunal de Première Instance in November 2013, and in courts in Spain and Italy on June 2013.

The 'Gaza Platform' and our 'Rafah: Black Friday' report about the 2014 Gaza War, developed together with Amnesty International, was submitted to the UN Independent Commission of Inquiry on March 2015, and to the International Criminal Court in March and September 2015.

Members of the Forensic Architecture team are also part of the Technology Advisory Board of the International Criminal Court.

For more info, please visit: www.forensic-architecture.org.

2. Research framework

a. Sources

Forensic Architecture was given access to the Diyarbakır Bar Association's case file relating to the killing of Elçi. This includes footage filmed by journalists and police officers, witness statements given to the police by civilians and police officers, reports prepared by the official authorities of the Republic of Turkey and independent reports commissioned by members of the Diyarbakır Bar Association. This report examines the audio-visual material and witness testimonies contained in the case file.

More specifically, the following source material was used by Forensic Architecture in the course of the investigation:

Witness statements:

- Tanık M.T. İfade Tutanağı, Soruşturma No. 2015/42414, 29/11/2015
- XXX598 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42413, 10/12/2015
- XXX197 Sicil Numaralı Polis Memuru Bilgi Alma Tutanağı, 28/11/2015
- XXX726 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42414, 28/11/2015
- XXX078 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42414, 02/12/2015
- XXX658 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42414, 30/11/2015
- XXX300 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42414, 30/11/2015
- XXX196 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42414, 28/11/2015
- XXX500 Sicil Numaralı Polis Memuru Bilgi Alma Tutanağı, 28/11/2015
- XXX997 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42414, 28/11/2015
- XXX708 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42413, 10/12/2015
- XXX840 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42413, 02/12/2015
- XXX006 Sicil Numaralı Polis Memuru Bilgi Alma Tutanağı, 28/11/2015
- XXX945 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42414, 30/11/2015
- XXX906 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42413, 10/12/2015
- XXX383 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42414, 30/11/2015
- XXX724 Sicil Numaralı Polis Memuru Bilgi Alma Tutanağı, 28/11/2015
- XXX356 Sicil Numaralı Polis Memuru Bilgi Alma Tutanağı, 30/11/2015
- XXX419 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42414, 30/11/2015
- XXX509 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42413, 02/12/2015
- XXX894 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42414, 30/11/2015

- XXX811 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42414, 30/11/2015
- XXX437 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42414, 30/11/2015
- XXX979 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42414, 28/11/2015
- XXX857 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42413, 10/12/2015
- XXX805 Sicil Numaralı Polis Memuru Bilgi Alma Tutanağı, 29/11/2015
- XXX805 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42414, 30/11/2015
- XXX602 Sicil Numaralı Polis Memuru Bilgi Alma Tutanağı, 28/11/2015

Video files:

- 20151128115239önemli.MTS
- KAÇAN ŞAHIS-VURULMA ANI.mp4
- M2U01959.MPG
- 00021.MTS
- 28.11.2015 10_50_00 (UTC+02_00)_002.avi
- tahir elçi - ölüm sonrası - üstten video.mp4

Reports:

- Expert medical opinion by independent forensic pathologist Dr. Ümit Biçer, presented to the Chair of Diyarbakır Bar Association
- Experts' report on the 17 March 2016 official crime scene inspection, 19 March 2016.
- Ballistic reports
- Official autopsy report, 28 November 2015

Architectural Drawings:

- Diyarbakır Chamber of Architects, Plans and elevations of Yenikapı Street, February 2014.

b. Assessment of sources

There were multiple videos in the case file that captured the press conference, the incident of the shooting and the ensuing gunfire. Out of these, four videos captured the incident in which Elçi was shot:

- Camera 1: 20151128115239önemli.MTS
- Camera 2: KAÇAN ŞAHIS-VURULMA ANI.mp4
- Camera 3: M2U01959.MPG
- Camera 4: 00021.MTS

Videos from Camera 1, 3 and 4 were filmed by journalists covering the press conference, while Camera 2 was filmed by a police officer tasked with gathering intelligence at the press conference. The videos captured multiple actors: police officers, PKK members, civilian attendees of the press

conference, and passers-by. The footage spans from a point in time when Elçi was still alive to several minutes after his death.

Despite the numerous cameras present at the press conference, none of the cameras captured Elçi at the moment he was shot.

The videos recorded clear visual evidence of weapons being fired by police officers, while the audio recordings further captured the sonic signature of shots that were not seen being fired.

The witness testimonies offer a narrative description of the event, and supplement and corroborate our understanding of the scene from other sources.

3. Methodology

Since the available video material did not capture the fatal moment of Elçi's shooting, it was necessary to reconstruct the scene in space and time, and to locate all actors within it. Furthermore, we had to establish the time frame within which Elçi was shot, and determine which of the shots for which we had a sound recording, but no visual recording, could have been the fatal shot.

To carry out this research, Forensic Architecture used a series of multimedia analyses and spatial surveying techniques.

Video synchronization:

Firstly, in order to watch and compare moments within the incident from different perspectives, we synchronized the four video files (Camera 1, 2, 3, 4), provided by the Diyarbakır Bar Association by identifying and matching audio and visual information present in those videos. The four cameras were chosen for the investigation as they provide the most diverse coverage of the incident.

The videos were synchronized by reference to their audio tracks, and corroborated by visual indicators, using the following video processing software:

- Adobe Premiere Pro
- Adobe After Effects

Establishing the investigative time frame:

As the moment of Elçi being struck by the fatal bullet happened outside the frame of any of the four cameras, we needed to reconstruct this moment by cross-referencing all other available evidence and testimony within our model. We began by establishing the shortest possible time frame in which Elçi could have been killed. We did this by observing the last moment at which he was seen alive and the first moment at which his body was seen on the ground.

The videos were analyzed visually using the following video processing software:

- Adobe Premiere Pro
- Adobe After Effects

Shot count analysis:

Within the investigative time frame, we counted and logged all shots heard and seen by analyzing the audio and visual channels of the 4 synchronized videos. This allowed us to identify and label which shots were fired by specific individuals present at the scene.

The videos were analyzed visually and sonically using the following video processing software:

- Adobe Premiere Pro
- Adobe After Effects

3D reconstruction of the incident:

We constructed a digital 3D model of the scene using archive drawings of the historical area of Yenikapı Street, as well as through spatial information found on the footage.

We used architectural plans and elevations of Yenikapı Street provided by Diyarbakır Chamber of Architects as the basis for our digital model of Yenikapı Street and its junction with Gazi Avenue. The architectural drawings provided the 'footprint' and elevation information for our model as well as the elevation of Yenikapı Street.

The digital 3D model was created using the following software:

- Rhinoceros 5.0
- Maxon Cinema 4D

We created the macro-scale model of the district of Sur and the surrounding districts in Diyarbakır using the 'DEM Earth' plug-in in Maxon Cinema 4D.

The 3D model allowed us to analyse and measure the relationship between objects and bodies in time and space. When we could not always observe the shooter and the trajectory of each shot through the footage, the 3D model helped us to reconstruct specific moments and to compare the location and orientation of actors seen firing their weapons, in relationship to the location of Elçi.

In order to locate Elçi, the PKK members, the police officers, and members of press in space, we used a technique called 'camera calibration'. This process estimates a camera's internal optical properties, such as its focal length, barrel distortion, and optical center, as well as external parameters such as the camera's position and orientation in relation to identifiable spatial elements. Through this process of calibration we could thus determine the location, orientation, and scale of objects and people within the scene[1].

[1] Camera calibration is dependent on multiple parameters. Although all measures have been taken to accurately position the actors and objects that appear in the scene, some discrepancies on the scale of centimetres can be expected. Our study qualifies the results based on this understanding.

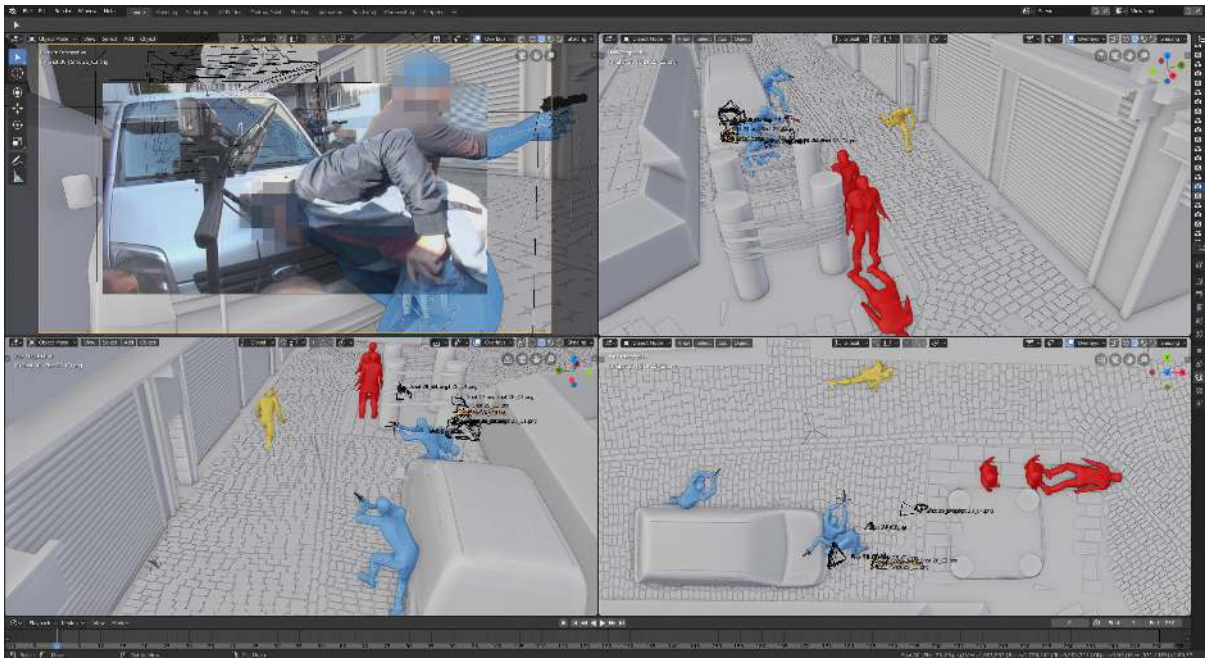


Figure 1. Example of camera calibration.

The camera calibration was done using the following software:

- Maxon Cinema 4D
- Blender
- fSpy

We analyzed the movement and orientation of Camera 2, through a process known as 'motion tracking'. Motion tracking analyses the motion of objects in a piece of video footage, in order to simulate the movement and orientation of a camera within a 3D model. We were thus able to reconstruct the path of Camera 2 within our 3D environment, and to observe whether Elçi's fall could have been captured through this footage, based on his estimated location.

The motion tracking was done using the following software:

- Maxon Cinema 4D

<u>Analysis of the actions of PKK members:</u>

To determine whether either of the two PKK members could have fired the lethal shot, we carefully analysed the video from cameras 1 to 4. We analysed the videos frame by frame, and observed the motion, behaviour and positioning of the two PKK members.

The analysis was undertaken using the following software:

- Adobe Premiere Pro
- Adobe After Effects

Analysis of the actions of police officers:

We then examined whether any of the five police officers visible at the scene could have fired the lethal shot, by tracing their possible line of fire to see whether they had a direct, unobstructed view of Tahir Elçi.

The analysis was undertaken using the following software:

- Maxon Cinema 4D
- Adobe Premiere Pro
- Adobe After Effects

Sonic Analysis:

We undertook an acoustic analysis of all the shots within the investigative time frame to ascertain whether any of those shots were of different type of ammunition, or fired by a different calibre of weapon, to those that are visible in the available video footage. We did this by observing the sonic signature of the gunshots within spectrograms of each video. By comparing the sonic signatures of the gunshots to each other, we examined whether any of these shots could have been fired by a long-range weapon from beyond Yenikapı Street.

The analysis was undertaken using the following software:

- Adobe Audition
- Adobe After Effects
- Praat

4. Research and analysis

a. Setup

i. For the purposes of our research, we annotated and colour-coded all of the actors present at the scene:

- We coloured Tahir Elçi in red and labelled him as 'TE'.
- We coloured members of the press in grey.
- We coloured the two PKK members in yellow. The first PKK member seen passing the press conference is referred to as 'Runner 1' or 'R1' and the second is referred to as 'Runner 2' or 'R2'.
- We coloured all police officers in blue, and labelled them as police officers A, B, C, D, E.

The key table below outlines these actors.

Key	Description	Photo
TE	Tahir Elçi	
PKK members		
R1	Runner 1	
R2	Runner 2	
Police officers		

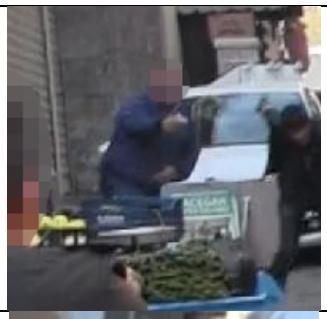
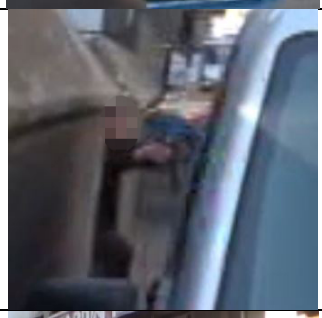
A	‘Blue jacket’ police officer	
B	Police officer at the gate of the mosque	
C	‘Black jacket’ police officer	
D	‘Brown jacket’ police officer	
E	‘Grey jacket’ police officer	

Figure 2. Actors key table.

ii. The footage in our investigation has a frame rate of 25 frames per second. This means that each second of video is composed of 25 still images. Throughout the investigation we denote time by using a ‘seconds:frames’ format. For example, ‘07:14’ equates to ‘seven seconds and 14 frames’.

b. Video Synchronisation:

We identified the segment of each video that captured the moment at which the two PKK members run past the conference, and at which the police open fire. We aligned the audio and video channels of each piece of footage so as to match the first and last shots within this timeframe (see 'A' in Figure 3). We also identified a small audio segment recorded directly afterwards to corroborate the synchronization (see 'B' in Figure 3). We repeated this process with each video, aligning them with one another.

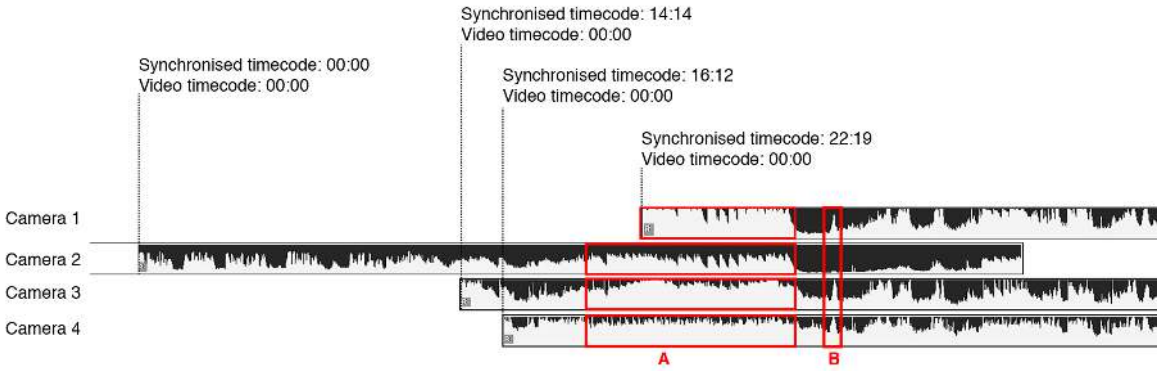


Figure 3. Synchronized audio channels of all four cameras. 'Synchronized Timecode' is the time value relative to the synchronization of all 4 videos, 'Video Timecode' is the time value relative to the original file.

Camera 1 | Camera 2 | Camera 3 | Camera 4

Figure 4. All four cameras synchronized at 05:00.

We adjusted and verified the synchronization with the help of visual details, such as the movement of a cat which appears in two of the cameras, and by matching the movements of people's legs. The synchronized footage allowed us to watch different moments during the incident from different perspectives.

Camera 2
Synchronized timecode: 22:01

Camera 4
Synchronized timecode: 22:10

Figure 5. Synchronization is verified by looking at visual information across all cameras.

c. Establishing the investigative time frame

The shooting occurred at approximately 10:55am[2]. In order to analyze the relation of each of the different actors to the killing of Elçi, we had to establish the time frame of the shooting within the four synchronized videos.

We identified the last frame in which Elçi is seen standing, to mark the beginning of the time frame of our analysis, and we identified the first frame in which Elçi is seen lying on the ground, to mark the end of the investigative time frame (see Figure 6).

The sound of the last shot fired within these two markers helped us to reduce this time frame further. The duration of our investigative time frame from the last frame in which Elçi is seen alive until the time that the last shot is fired is 09:10 (nine seconds and ten frames).

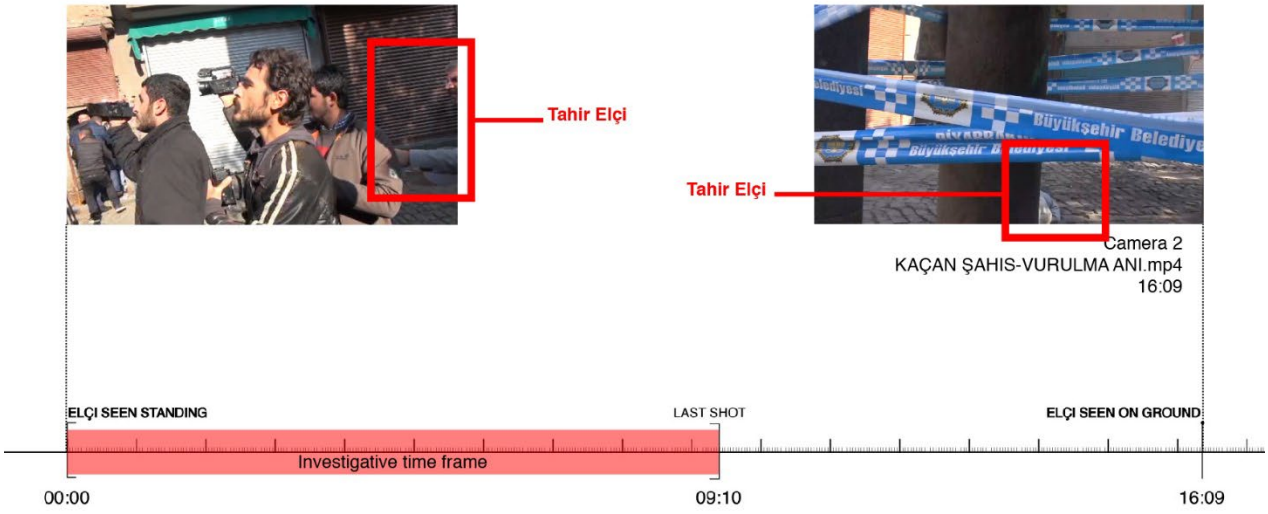


Figure 6. Timeline: Visual markers framing the investigative time frame.

From this point onwards, all timecode values have been expressed relative to the investigative time frame in which 00:00 denotes the start of the investigative time frame and 09:10 the end. See Figure 7 for a conversion from Video Timecode to Investigative Timecode.

Camera	Start of investigative time frame	End of investigative time frame
Investigative time frame	00:00	09:10
1	N/A	06:12
2	19:19	29:04
3	05:07	14:17
4	03:09	12:19

Figure 7. Conversion table of timecodes for the investigative time frame.

[2] The exact time of the killing is not important for this study. The study is concerned with the relative time of actions within the recorded videos.

d. Shot count analysis

Within the nine seconds and ten frames (9:10) of the investigative time frame, we counted a total of forty distinct shots, and compiled them in a table (see Figure 8), giving each shot an ID number and a timecode relative to the investigative time frame. Additionally, we identified the origin of the shot and its target or direction.

We can observe the bullets impacting the ground and piercing through the metal shop fronts, suggesting that the shots seen fired are not blanks or rubber bullets (see Figure 9)[3].

Shot_ID	Timecode	Shooter	Target/Impact
1	00:00:00:18	Unknown	Unknown
2	00:00:01:08	Unknown	Unknown
3	00:00:01:14	Unknown	Unknown
4	00:00:01:22	A	Feet of Runner 2
5	00:00:02:02	B	Step of Mardin Kebap Evi
6	00:00:02:03	A	Feet of Runner 2
7	00:00:02:13	B	Feet of Runner 1
8	00:00:02:15	Unknown	Unknown
9	00:00:02:19	Unknown	Unknown
10	00:00:02:22	Unknown	Feet of Runner 2
11	00:00:03:01	A	Towards the minaret
12	00:00:03:04	Unknown	Towards the minaret
13	00:00:03:06	C	Runner 2
14	00:00:03:09	Unknown	Unknown
15	00:00:03:13	Unknown	Unknown
16	00:00:03:19	Unknown	Unknown
17	00:00:04:00	Unknown	Unknown
18	00:00:04:04	C	Runner 2
19	00:00:04:11	C	Runner 2
20	00:00:04:14	Unknown	Unknown
21	00:00:04:22	C	Mardin Kebap Evi store front
22	00:00:05:05	D	Shoots towards Mardin Kebap Evi
23	00:00:05:10	C	Mardin Kebap Evi store front
24	00:00:05:20	C	Shoots towards Pindo Café
25	00:00:06:00	Unknown	Unknown
26	00:00:06:09	C	Shoots towards Pindo Café
27	00:00:06:20	D	Shoots towards Gift Shop
28	00:00:06:20	C	Shoots towards Pindo Café
29	00:00:07:05	C	Shoots towards Gift Shop
30	00:00:07:07	D	Shoots towards Gift Shop
31	00:00:07:15	C	Shoots towards Gift Shop

[3] An instance of a bullet piercing through a metal shop fronts can be seen in Cameras 3 and 4 at 04:22.

32	00:00:07:19	D	Shoots towards Gift Shop
33	00:00:07:24	Unknown	Unknown
34	00:00:08:04	D	Shoots towards Gift Shop
35	00:00:08:10	D	Shoots towards Gift Shop
36	00:00:08:14	E	Shoots towards Gift Shop
37	00:00:08:18	D	Shoots towards Gift Shop
38	00:00:09:01	E	Shoots towards Gift Shop
39	00:00:09:01	D	Shoots towards Gift Shop
40	00:00:09:10	D	Shoots towards Gift Shop

Figure 8. Shot count table.

Shots fired from the guns of actors present at the scene can be observed with the following visual indicators (see Figure 9):

- Slide recoil
- The expulsion of bullet shells
- The discharge flash
- The impacts of the bullets on the built environment

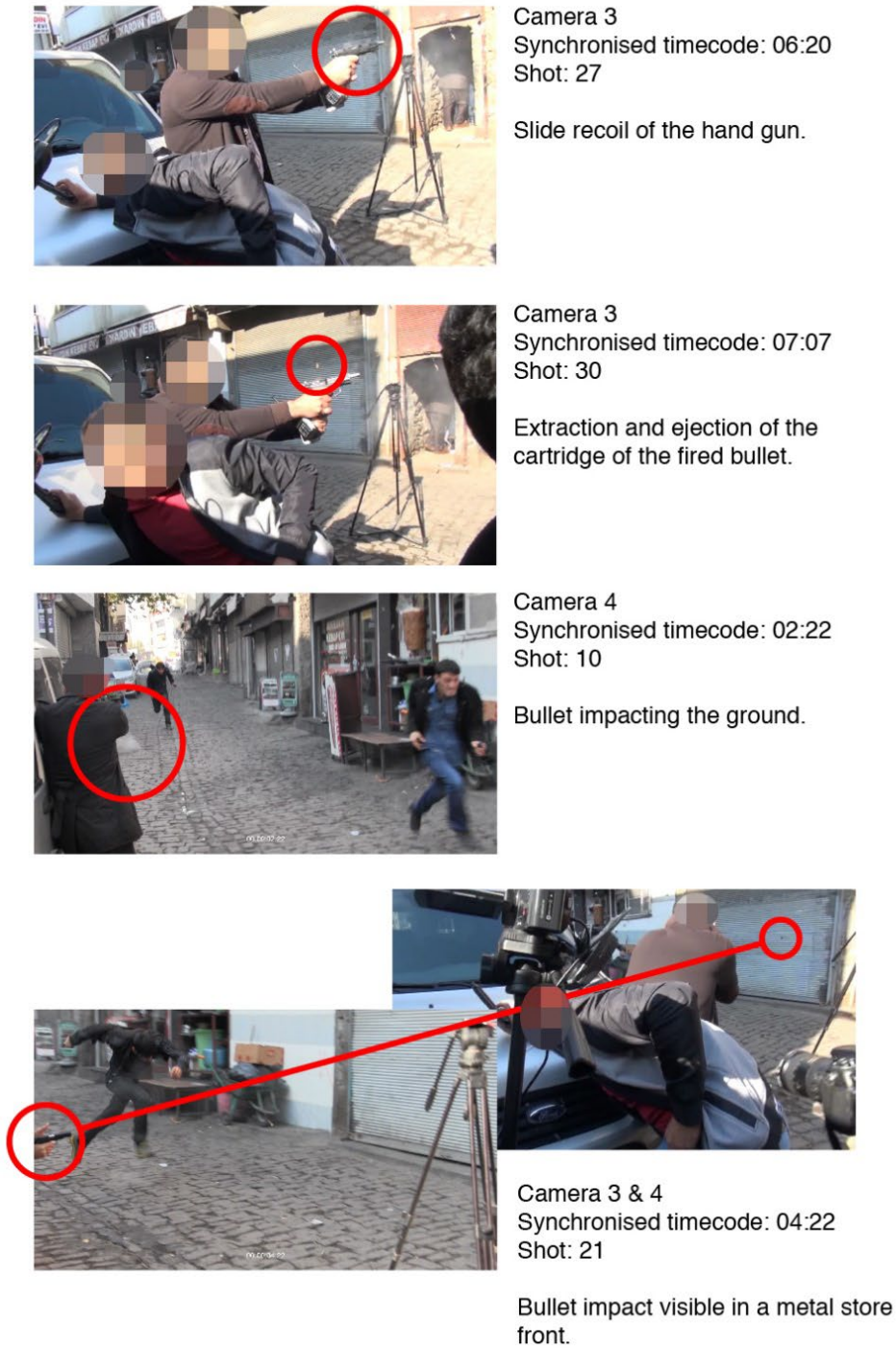


Figure 9. Examples of visual evidence of shots.

Shots can also be identified by reference to the audio channel of the videos (see Figure 22 to 25).

In the footage, we can observe that a total of twenty-six gunshots were fired by police officers present at the scene, while fourteen shots were fired by unknown shooters.

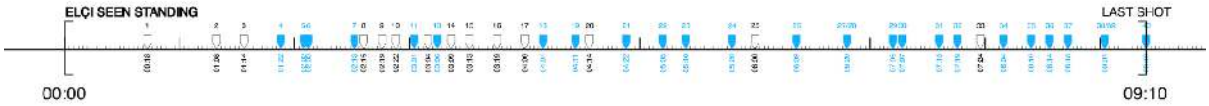


Figure 10. Timeline: Shot count. In white, we marked the shots by 'unknown' shooters; in blue, we mark the shots fired by police officers.

e. 3D modelling

i. <u>Locating objects and people present at the scene:</u>

The process of camera calibration allowed us to locate and orient the five police officers (police officer A, B, C, D, E) and the two running PKK members (Runner 1 and 2) present at the scene at different times during the investigative time frame. This also allowed us to establish the position of two vehicles parked in Yenikapı Street at the time.

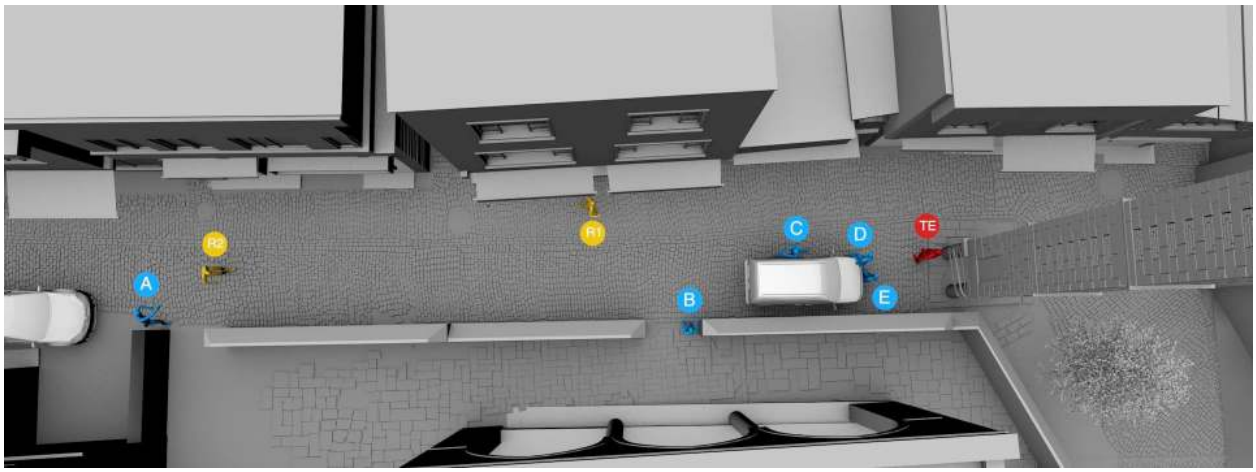
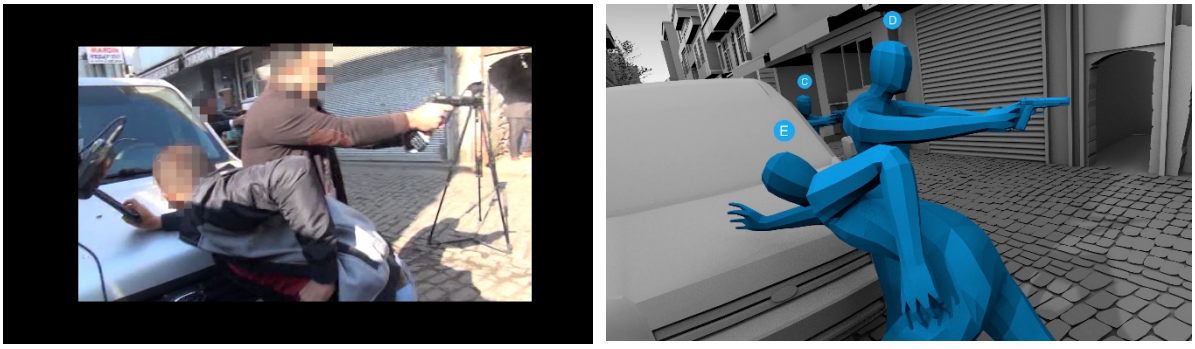


Figure 11. Aerial view of Yenikapı Street, with actors located. 'R1' and 'R2' mark the two PKK members. A, B, C, D, E mark the five police officers seen in the footage. 'TE' marks Tahir Elçi.

Original frame

Calibrated camera and model reconstruction



Camera 3 – 06:15

Camera 4 – 06:15

Figure 12. Examples of camera calibration locating and positioning police officers C, D and E and one PKK member, R2.

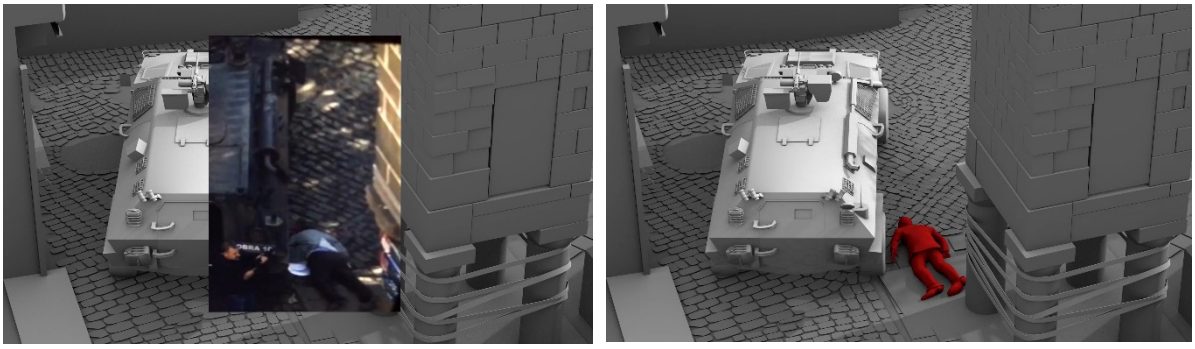
ii. Locating the position Tahir Elçi:

The position and orientation of Tahir Elçi's body was estimated through camera calibration. Referring to the medical opinion of Dr.Ümit Biçer, an independent forensic pathologist, we can estimate approximate maximum area in which Elçi could have been standing at the moment he was struck in the head.

Dr.Ümit Biçer's expert medical opinion states the following:

- Tahir Elçi's wounds and scratch marks on his face and hands suggest that he did not try to resist the fall. Therefore, the bullet must have killed or rendered him unconscious instantly.
- The direction of the scratch marks and the position of the body on the ground indicate that Elçi was shot from up Yenikapı Street, from west to east.
- Dr. Biçer suggests that when he was struck, Elçi could have been standing up to 1 meter back from the position of his body on the ground.

By positioning a standing figure of Tahir Elçi in our 3D model at the base of the minaret, a figure of Elçi lying on the floor in the position indicated by the photograph at Figure 13, and another standing figure of Elçi one metre back according to his direction of movement, we can estimate the maximum area in which he was standing (figure 15).



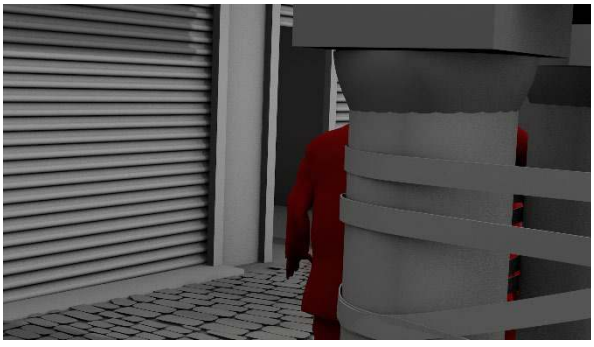
Original frame | Calibrated camera and model reconstruction

Figure 13. Camera calibration of the location of Tahir Elçi's fallen body.

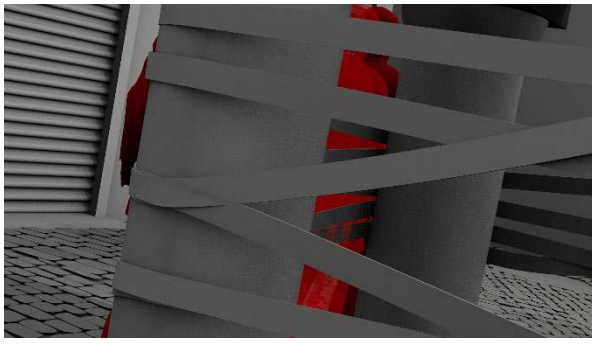
Had Elçi been struck while Camera 2 was pointed in this direction, we would have been able to see his body moving or falling between the two columns as shown in the video investigation, and at Figure 14 below. This further reduced the timeframe of the investigation to seven seconds and twelve frames, and ruled out shots 31 to 40.

Original frame at 07:12.

Original frame at 09:10



Calibrated camera and model reconstruction at 07:12.



Calibrated camera and model reconstruction at 09:10

Figure 14. Still images demonstrating the reconstruction of the movement and orientation of Camera 2, and indicating the impossibility of Tahir Elçi falling during this time.

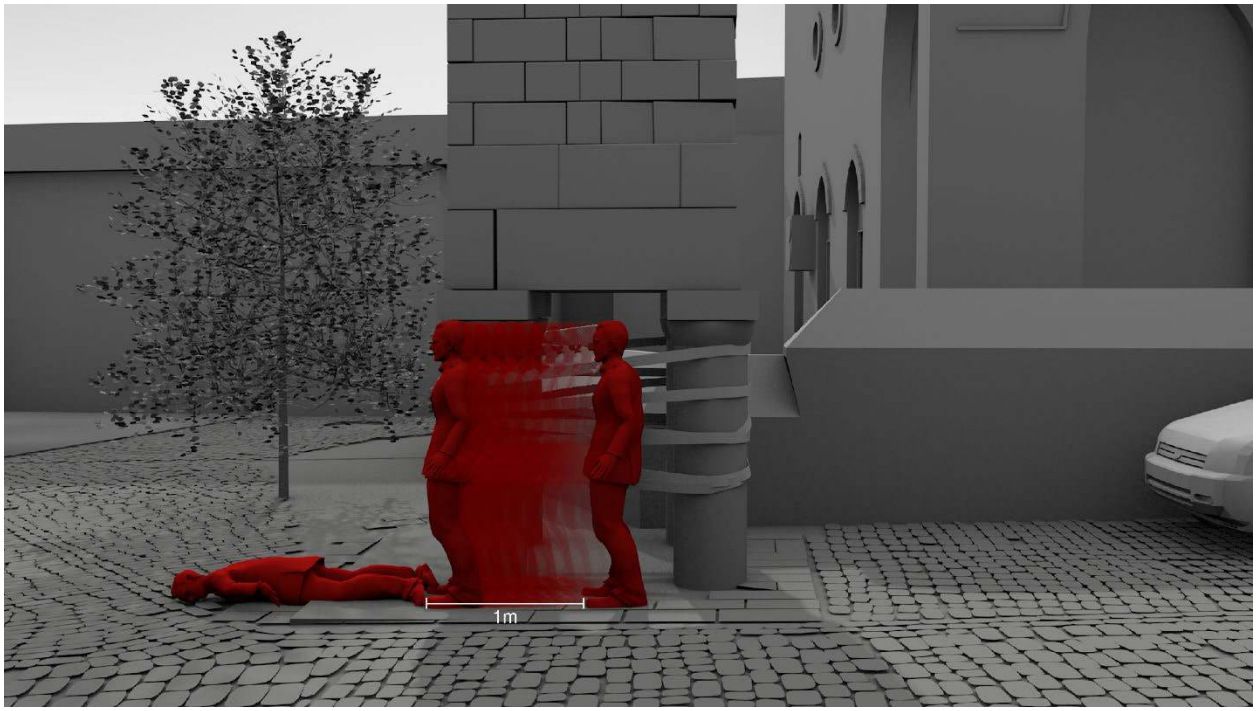


Figure 15. Locating Tahir Elçi's position at the time of his fall.

iii. Column simulation and the further narrowing of the investigative time frame:

By 'motion tracking' Camera 2, we are able to further narrow down the investigative time frame. Camera 2 is the first to turn towards the columns of the minaret. It captures the space between two of the columns from 7:12 to the end of the time frame at 9:10.

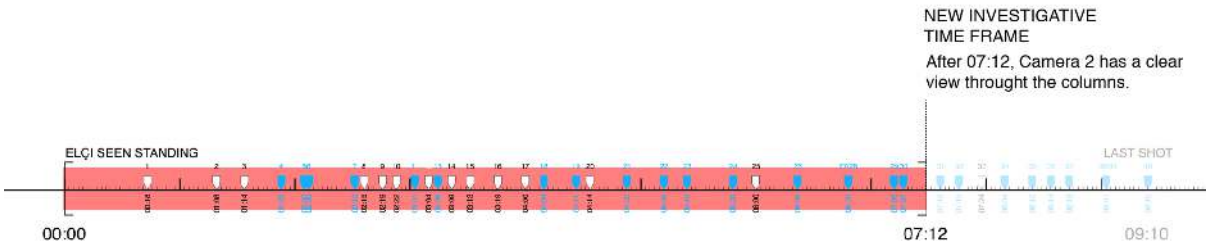


Figure 16. Timeline of the new investigative timeframe.

f. Analysis of the actions of the PKK members

In order to identify if either of the two PKK members could have been responsible for the killing, we first disregarded all shots visibly fired by police officers on the scene. Instead, we focused this part of our analysis on the shots whose shooters are 'unknown', as these could have been fired by either of the PKK members. We examined whether any of the unidentified shots could be assigned to R1 and R2, and whether these shots could be responsible for the killing of Elçi.

Shot	Key Moment	Timecode	Comment
	R1 appears on camera.	*0:00*	*R1 is holding a handgun.*
1		0:18	R1 does not appear to point or shoot his gun in the direction of Elçi and R2 does not have a direct line of fire towards Elçi.
	R2 appears on camera.	*1:07*	*R2 is holding a handgun.*
2		1:08	R1 and R2 are not directing their guns towards Elçi.
3		1:14	R2 is not aiming his weapon and R1 does not appear to discharge his gun.
	R1 switches his handgun from his right to his left hand and from the grip to the barrel.	*2:00*	*From now until he goes off camera, R1 could not have fired his gun during this time as he is still holding the gun by the barrel.*
8		2:15	Police testimony[4] states that R2 fired his weapon at least once during this timeframe in the direction of police officer A (opposite to the direction of Tahir Elçi) without turning towards him, striking him in the lower abdomen. Runner 2 does not aim his gun in Elçi's direction, making it very unlikely that he could have shot him.
9		2:19	
10		2:22	
12		3:04	
14		3:09	
15		3:13	
16		3:19	
17		4:00	
	R1 runs past the minaret and goes off camera.	*4:02*	*From now until the end of the investigative timeframe, R1 could no longer have shot Tahir Elçi from up Yenikapı Street.*
	R2 throws his gun towards Police C.	*4:07*	*From this point onwards, Runner 2 no longer held a gun and could not have killed Tahir Elçi.*
20		4:14	R1 and R2 could not have shot Tahir Elçi.
25		6:00	

Figure 17. 'Unknown' shots analysis table.

From the analysis above, we can ascertain that during our investigative time frame, it is highly unlikely that the PKK members could have shot Elçi.

[4] See XXX078 Sicil Numaralı Polis Memuru İfade Tutanağı, Soruşturma No. 2015/42414, 02/12/2015, p. 2.

g. Analysis of the actions of the police officers

Furthermore, we examined the possibility that Elçi was killed by one of the police gunshots.

First, we focused our analysis on shots known to be fired by police officers at the scene. We analysed each shot visibly fired by a police gun and from those, we eliminated shots that did not have a direct line of fire towards Elçi.

We used our 3D model in order to test whether or not police officers A, C and D seen shooting at the scene had a direct line of fire towards Elçi. Police officer B does not have a line of towards Elçi[5]. For each police officer, we draw a 3D shape which extends from the shoulders of the police officer in question to the extreme corners of the zone in which Elçi could have been standing the moment he was shot. This shape allowed us to observe to what extent the line of fire of each police officer could have been obstructed by objects and people present at the scene. We tracked our results on the following table (Figure 21).

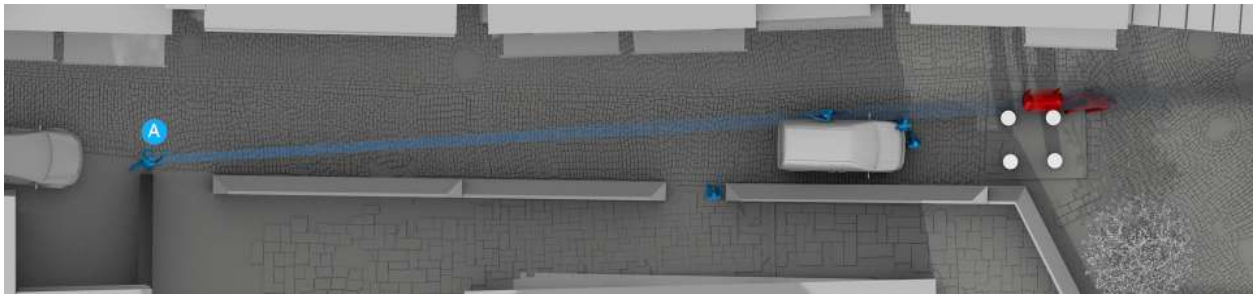


Figure 18. Line of fire of police officer A.

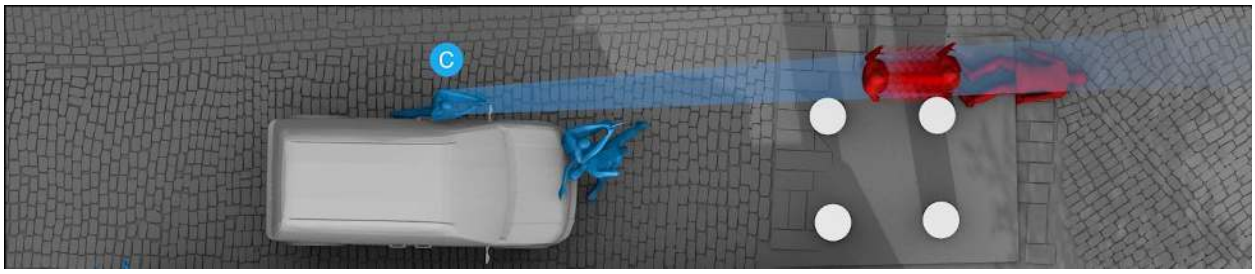


Figure 19. Line of fire of police officer C.

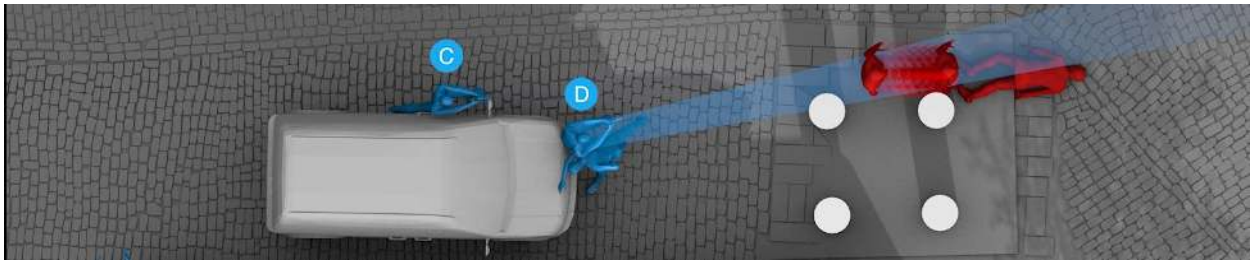


Figure 20. Line of fire of police officer D.

[5] Police officer B is visible in Camera 3 from 01:17 to 03:20.

Shot	Timecode	Police officer	Comment
4	01:22	A	Is not the lethal shot because we can see the impact of the bullet hitting the ground.
5	02:02	B	Is not the lethal shot because the police officer is not shooting in his direction.
6	02:03	A	Is not the lethal shot because we can see the impact of the bullet hitting the ground.
7	02:13	B	Is not the lethal shot because the police officer is not shooting in his direction.
11	03:01	A	Police officer's line of fire appears to be obstructed by police officer C. It is very unlikely that police officer A would have shot Elçi risking hitting another officer.
13	03:06	C	Is not the lethal shot because the police officer is not shooting in his direction.
18	04:04	C	Is not the lethal shot Elçi because the police officer is not shooting in his direction.
19	04:11	C	Is not the lethal shot because the police officer is not shooting in his direction.
21	04:22	C	Is not the lethal shot because the police officer is not shooting in his direction.
22	05:05	D	Is not the lethal shot because the police officer is not shooting in his direction.
23	05:10	C	Is not the lethal shot because the police officer is not shooting in his direction.
24	05:20	C	Police officer has a clear line of fire towards Tahir Elçi.
26	06:09	C	Police officer has a clear line of fire towards Tahir Elçi.
27	06:20	D	Police officer has a direct line of fire that is partially blocked by the column of the minaret.
28	06:20	C	Police officer has a clear line of fire towards Tahir Elçi.

29	07:05	C	Police officer has a clear line of fire towards Tahir Elçi.
30	07:07	D	Police officer has a direct line of fire that is partially blocked by the column of the minaret.

Figure 21. Analysis of shots fired by police officers A, C and D.

Based on our analysis, police officer A, C and D had direct lines of fire towards Elçi (with varying degrees of obstruction) during the times they are seen firing their weapons, and each therefore could have shot him.

Police officer C is the only officer to have had a clear unobstructed line of sight towards Tahir Elçi, when he fired shots 24, 26, 28, and 29.

h. Sonic analysis

Lastly, we examined whether there could have been any additional gunfire from long-range weapons, outside of Yenikapı Street.

A spectrogram of the audio channel of each camera allowed us to conduct a comparative frequency analysis of these shots. The Y axis shows the frequency (in KHz) of the audio recording, while the X axis shows time. The colour indicates the level of the sound (in dB).

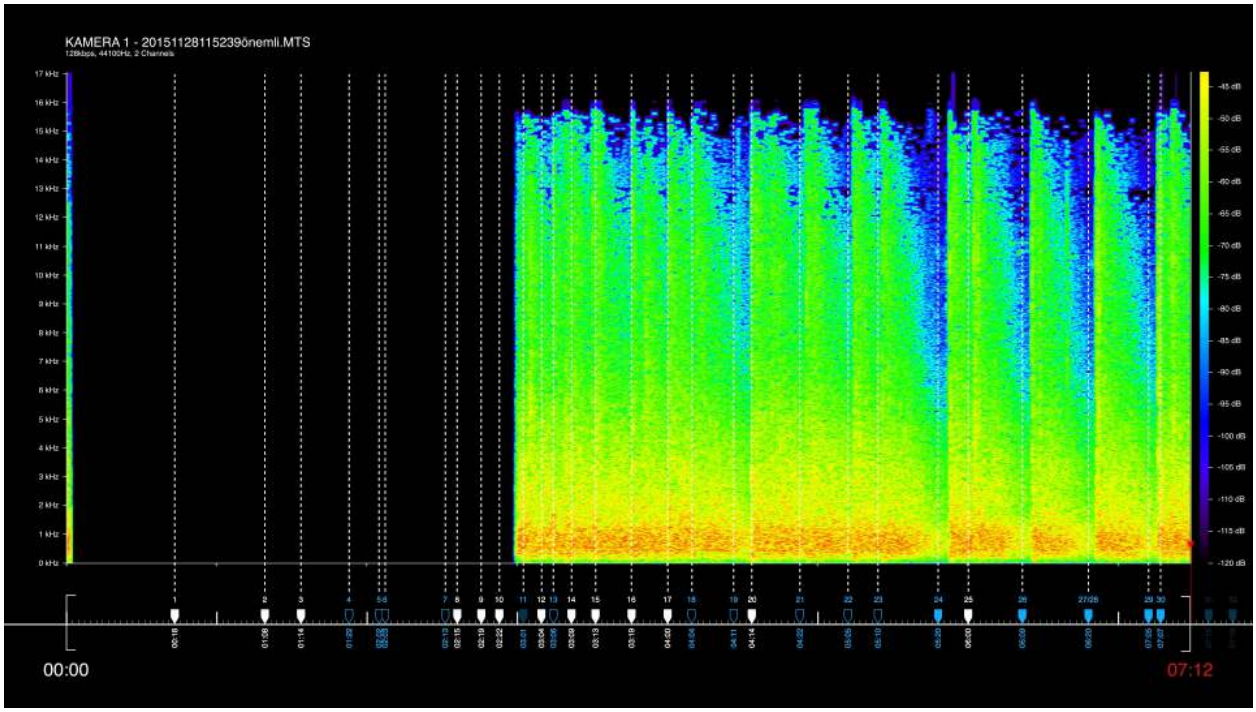


Figure 22. Spectrogram of all thirty shots recorded in the investigative time frame of 07:12 from Camera 1.

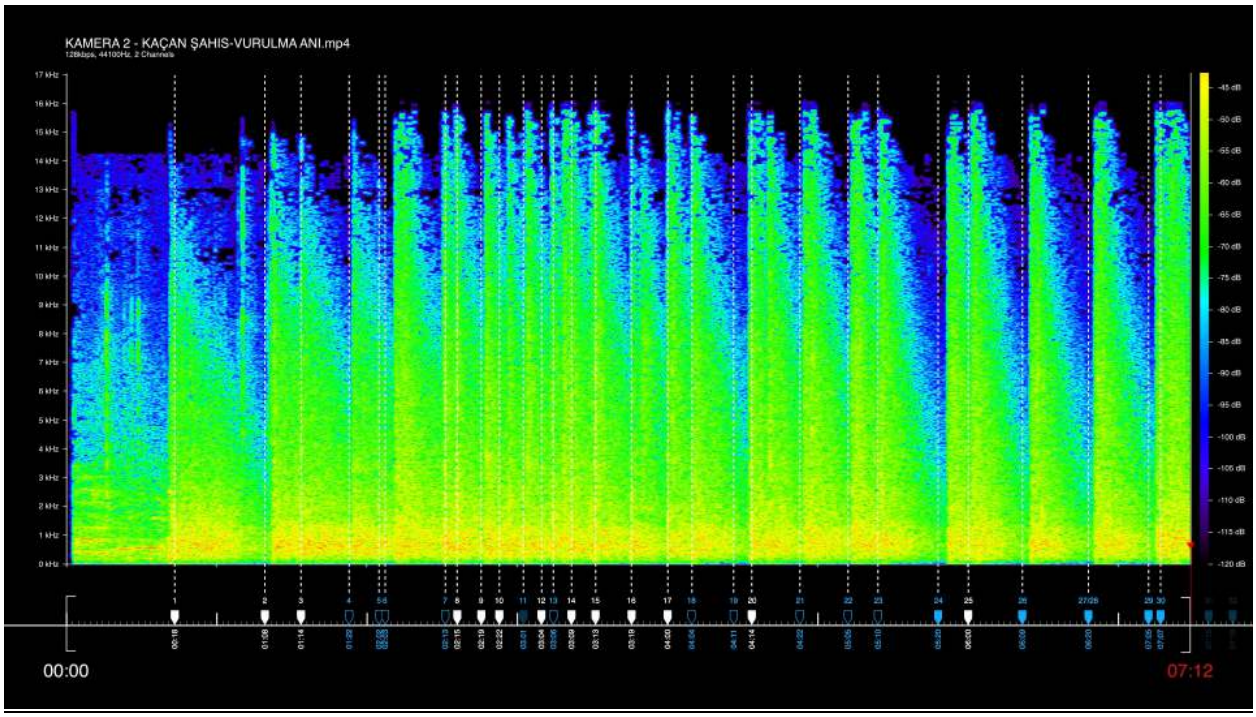


Figure 23. Spectrogram of all thirty shots recorded in the investigative time frame of 07:12 from Camera 2.

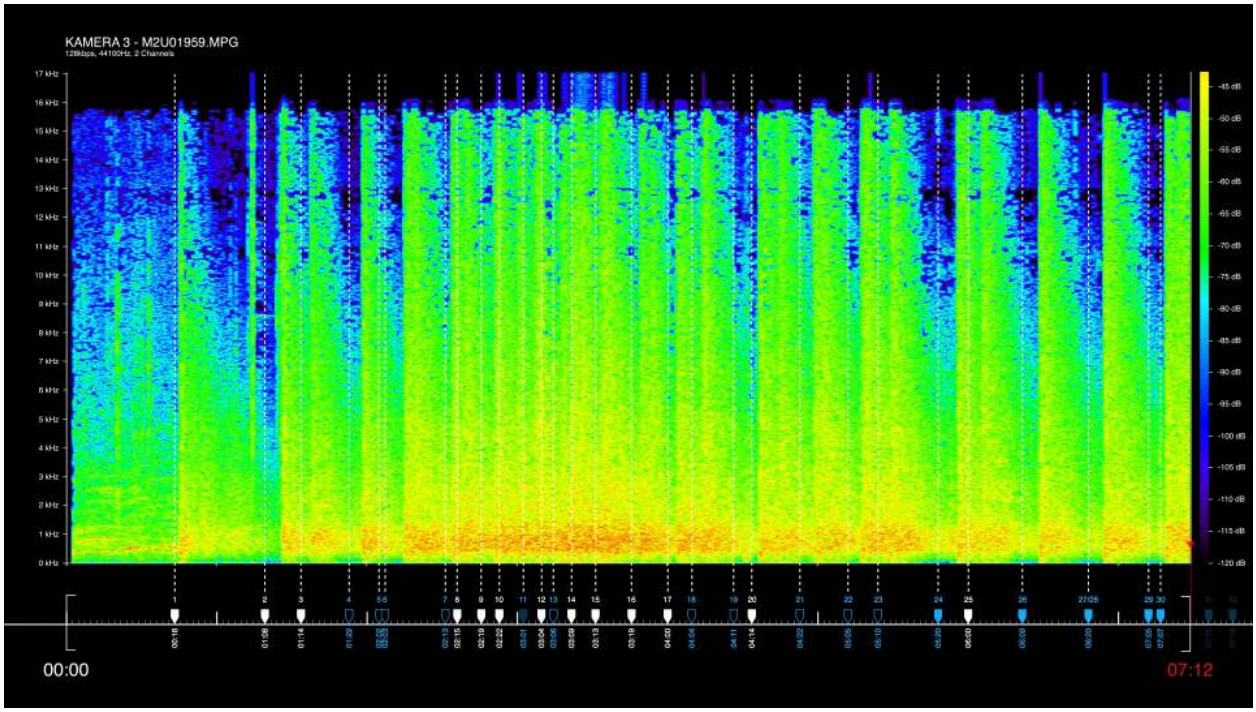


Figure 24. Spectrogram of all thirty shots recorded in the investigative time frame of 07:12 from Camera 3.

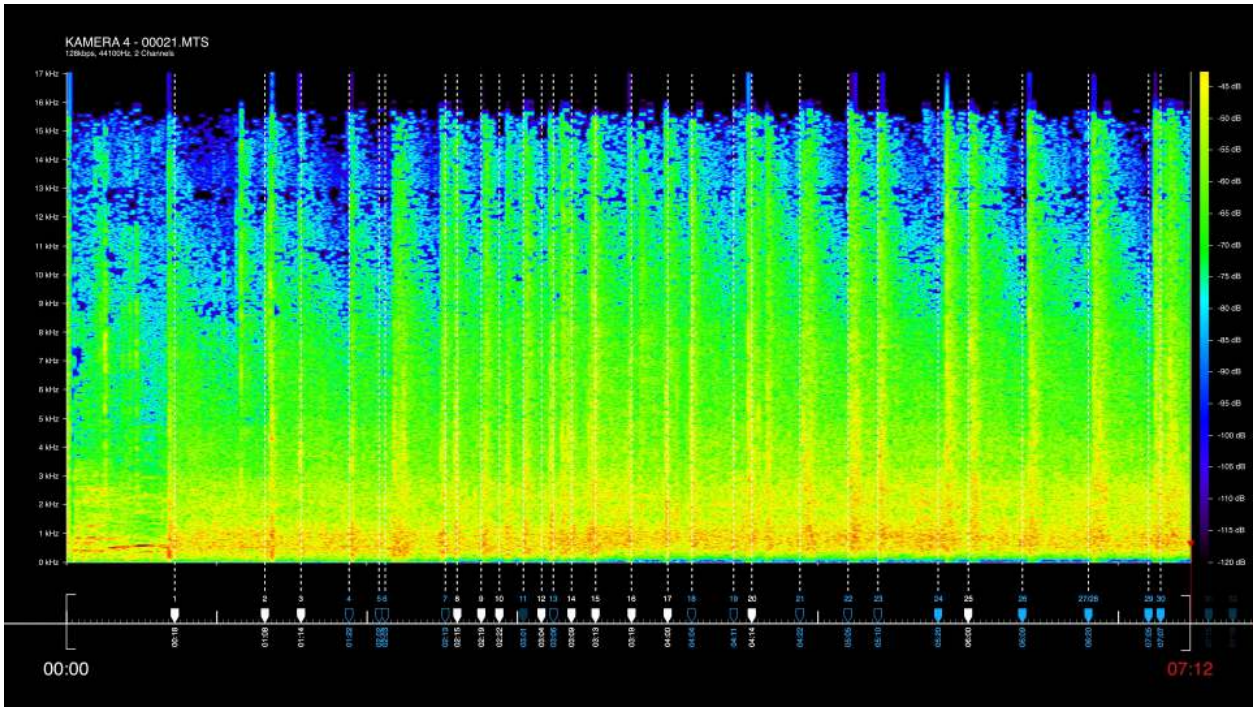


Figure 25. Spectrogram of all thirty shots recorded in the investigative time frame of 07:12 from Camera 4.

All shots are consistent with one another in amplitude, high amplitudes in red and yellow and lower amplitudes in blue. They also all occupy the same range of frequencies.

The shots in three of the four cameras are consistent between 15kHz and 1 kHz.

Camera 2, is the only exception, with a small deviation from the rest, in which shots 1 to 4 are louder in the lower range of the frequency spectrum while Shots 5 to 30 appear to be louder in the upper range. This slight variation in Camera 2 is likely caused by factors internal to the videography; such as the variations in frequency response of the microphones, automatic dynamic range compression in the camera's audio encoding function, as well as changes in the orientations of the camera as it pans. Additional minute variations in the spectrograms can be explained by external factors, such as the variable distance between the police officers and the four cameras.

Overall, the clear consistency of the audio signature of the thirty shots suggest that no other ammunition or calibre of weapon was fired from a far distance during the time frame of the investigation. In the audio captured by all four cameras, no shots fired at the scene have a significantly different audio signature from the police handguns firing at either twenty meters or eight meters away from the four cameras. This includes the ten shots which are still unaccounted for, which can be heard but whose shooters are unknown.

5. Conclusions

This investigation establishes the following conclusions:

- Tahir Elçi was killed when he was struck by a single bullet fired within the time frame of 7 seconds and 12 frames (07:12), at approximately 10:55am on 28 November 2015.

- Neither of the two PKK members appear to have fired the fatal shot.

- All of the shots fired in the investigative time frame have similar sonic signatures and show no auditory evidence of a long-range weapon fired from a considerably different distance.

- Three police officers (A, C and D) had a direct line of fire towards Elçi, and are seen discharging their weapons multiple times. Of them, police officer C is the only officer who discharges his weapon with a clear, unobstructed view towards Elçi.

While the investigation does not determine which of the police officers on scene is responsible for Elçi's death, it does identify the most likely suspects. The investigation does not determine whether the lethal shot was fired with the intention of hitting Elçi.