Methodology Report

**Preliminary Investigation
Potential Escape from the Arena Bar**

Kesselstadt, Hanau, Germany

19 February 2020

Contents

1. Introduction

On 19 February 2020 in Hanau, Germany, nine people were murdered in a racist terror attack. The victims are:

Said Nesar Hashemi	Sedat Gürbüz	Gökhan Gültekin
Mercedes Kierpacz	Hamza Kurtović	Vili Viorel Păun
Fatih Saraçoğlu	Ferhat Unvar	Kaloyan Velkov

The attack took place between 21:55 and 22:01 at two locations, in central Hanau and in the suburb of Kesselstadt. After the attacks, the perpetrator, Tobias Rathjen, fled to his house, where he killed his mother, Gabriele Rathjen, before killing himself.

Forensic Architecture (FA), together with its Berlin-based sister agency FORENSIS, has been commissioned by the Initiative 19. Februar, and separately by the lawyer for the Gültekin family, to investigate a range of issues relating to the attacks, and to produce material for a range of purposes, across legal, political, and cultural forums, as well as media, activism, and advocacy.

This methodology report, and the video that accompanies it, relates to FA's research into the events at the second attack location: the Arena Bar at Kurt-Schumacher-Platz in Kesselstadt, Hanau, where, in the bar, the neighbouring kiosk, and in the car park outside, six[1] of the victims were killed.

1.1 Summary of findings

This methodology report should be read alongside the video report available at this link: vimeo.com/657463633.

The central finding of that video report, which relies upon the methodology outlined below, is that

if the emergency exit door at the Arena Bar was open on the night of the attack, 19 February 2020, and

if the five young men in the bar that night had attempted to escape through it during the attack,

then they would very likely all have survived the attack.

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[1] Vili Viorel Păun, Ferhat Unvar, Mercedes Kierpacz, Gökhan Gültekin, Said Nesar Hashemi, and Hamza Kurtović.

1.2 About Forensic Architecture and FORENSIS

FA is a research agency based at Goldsmiths, University of London. Our team includes architects, scientists, filmmakers, journalists, developers, technologists, and other specialized professionals. The agency undertakes advanced media and spatial research with and on behalf of legal teams, human rights organisations, environmental justice groups, and communities affected by state violence. Since 2011, FA has published over eighty investigations and presented them in national and international courts, truth commissions and exhibitions worldwide. In 2021, FA's Berlin-based sister agency FORENSIS e.V. was founded to expand upon this work.[2]

We have provided research and evidence for numerous human rights investigations and prosecutions under international law, including on drone warfare at the UN General Assembly in New York in October 2013 and the Human Rights Council in Geneva in 2014.

Our report on 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 in the Israeli High Court.

Our Forensic Oceanography team 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 the courts of Spain and Italy in June 2013.

In 2017, our investigation into the murder of Halit Yozgat was presented to the Committee of Inquiry of the Hessen Parliament, and cited in the final reports of both this Committee, and the second Federal Committee of Inquiry into the NSU killings.

Our investigation of the murder of Pavlos Fyssas was played before the Court of Appeal of Athens in 2018, as part of the ongoing trial of 69 members of the Golden Dawn political organisation, helping in their conviction.

Our investigation into the 2014 presence of Russian military units in eastern Ukraine was submitted to the European Court of Human Rights in 2019 as part of an ongoing case.

In 2020, our investigation into intentional fire-setting to clear rainforest land in Papua contributed to legal challenges against the palm oil agglomerate Korindo, by Greenpeace and partners, and was presented in Indonesian courts.

More information at www.forensic-architecture.org.

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[2] References to 'FA' throughout this document should be understood to refer jointly to the activities, and findings, of FA and FORENSIS together.

2. Research framework and materials

The framework for this research is given by the public statements of some of the survivors and families of victims of the attack at the Arena Bar, concerning why the group of five young men[3] who were sat in the bar at the time of the attack did not attempt to escape via the bar's emergency exit, and whether, had they tried to do so, they would have had time to escape.[4]

For example, Piter Minnemann, a survivor of the attack, told Bild: "All we wanted was to get out. The question was how? We would have run to the emergency exit, but everyone knew it was locked. It had been locked for years."[5]

Said Etris Hashemi, brother of the victim Said Nesar Hashmi and himself a survivor of the attack, told WDR's Monitor: "I can't say that maybe everyone would have made it, but some of us would definitely have managed to run out of there."[6]

Armin Kurtović, father of the victim Hamza Kurtović, told RTL News: "If the emergency exit had been open, my son would not have died."[7]

Only after a criminal complaint from relatives and survivors did the Public Prosecutor's office in Hanau initiate criminal proceedings regarding the question of the locked emergency exit. There are reports, including in documents from the Hanau Public Prosecutor's office, that the emergency exit had been previously found to be locked.[8] Additional reports claim that his practice of locking the emergency exit was routine. These reports underline that the history of how the Arena Bar was policed and surveilled is complex and concerning.

The Hanau Public Prosecutor discontinued the criminal proceedings on 23 August 2021 and justified this with, amongst others, the fact that it could not be assumed with sufficient certainty that two of the victims "would have managed to escape through an unlocked emergency exit if they had fled to this instead of heading towards the storage room."[9] The Federal Public Prosecutor did not investigate the emergency exit and otherwise closed his proceedings on 15 December 2021.

FA's research does not examine *whether* the emergency exit was indeed locked on the night of the attack. Instead, our research examines the public prosecutor's claim

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[3] The five are Said Nesar Hashimi, Said Etris Hashimi, 'Momo', Hamza Kurtović, and Peter Minnemann.
[4] There were seven people in the Arena Bar at the time of the attack. Our analysis focuses on the group of five customers (named above) since they are seen running in response to the perpetrator's arrival. Their paths toward the rear of the bar provide us with the data from which our hypothesis begins.
[5] https://www.bild.de/news/inland/news/anschlag-von-hanau-staatsanwaltschaft-ermittelt-wegen-notausgangstuer-74923496.bild.html
[6] https://www1.wdr.de/daserste/monitor/sendungen/hanau-versaeumnisse-100.html
[7] https://www.rtl.de/cms/skandal-um-anschlag-in-hanau-menschen-tot-weil-notausgang-zu-war-4686563.html
[8] Those claims are referred to here; https://www.hessenschau.de/panorama/anschlag-von-hanau-ermittlungen-wegen-notausgang-eingestellt,hanau-anschlag-ermittlungen-notausgang-100.html
[9] Quotation translated from https://www.hessenschau.de/panorama/anschlag-von-hanau-ermittlungen-wegen-notausgang-eingestellt,hanau-anschlag-ermittlungen-notausgang-100.html

 above, beginning from the assumption that the five young men present in the Arena Bar at the time of the attack *believed* that they would find the emergency exit closed, if they tried to escape through it. Based on this assumption, FA's research seeks to answer the following question:

If any of those present in the Arena Bar at 10pm on 19 February 2020 had run toward the emergency exit, and it had been open, would they have had time to escape?

To attempt to answer this question, FA evaluated a copy of the recordings made by the CCTV cameras in the Arena Bar at the time of the attack. The research presented in this document is based on an extensive analysis of this footage. These are preliminary research results, that may have to, or can be, updated as new facts become known.

3. Analysis and reconstruction

To reconstruct the trajectories of each person inside the bar and kiosk, we drew detailed plans of the building based on scans of architectural drawings, which were calibrated according to photographs of the space and the CCTV footage.
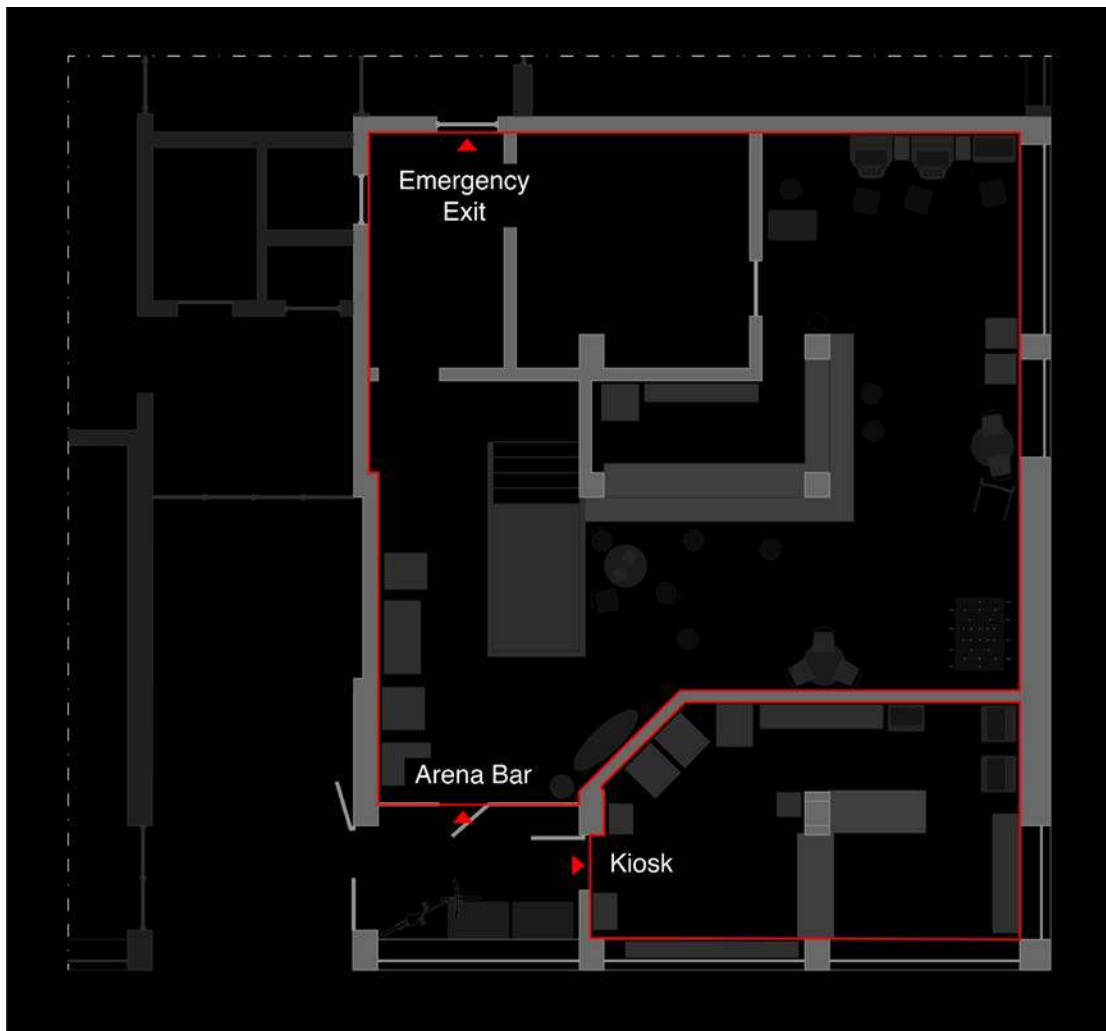
Fig.1: Digitised drawing of Arena Bar and Kiosk, within a floor plan of the larger building.

3.1. Chronolocation and synchronisation

First, we checked whether the 'timestamp' displayed on the CCTV footage is accurate to real time, or not. To do this, we examined the CCTV footage for visual clues that could be cross-referenced with other data which corresponds to 'real time'.

During the night of the attack, a football match was broadcast on one of the TVs inside the bar. This broadcast is visible in the footage captured by one of the cameras.[10] By synchronising the footage which captures the football match with events in the football match whose real time were known, we could confirm the real time of the events captured in the CCTV footage.

We located online an audio livestream of the football match in question[11] ('Video A'). The metadata for that livestream indicated when it started and finished, in real time (see fig.2). We located a second video,[12] which included both audio and video footage from the match ('Video B'). We used Adobe Premiere Pro software to synchronise the audio in Videos A and B.[13] This was done by examining the audio signature of each file at significant moments in the match, such as when a goal is scored. This process means we now know exactly when, in real time, a goal was scored in the match that was captured in the CCTV footage.

Next, we used the same software to synchronise Videos A and B with the broadcast captured on the CCTV, using moments that are visible in both Video B and the CCTV.

Thus, the combined audio-visual data in Video B established a connection between the visual data in the CCTV footage and the audio data in Video A. As a result, we could now connect the CCTV footage to real time. This process confirmed that the timestamp on the CCTV system (see fig.3) is 7 minutes and 1 second 'ahead' of real time: what the CCTV camera says is 00:00:00am, is 00:07:01am in real time.

```
{
    "actualStartTime": "2020-02-19T19:30:38Z",
    "actualEndTime": "2020-02-19T22:08:47Z"
}
```

Fig.2: Screenshot of a metadata extraction tool, detailing the actual start and end time of Video A.

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[10] The hardcoded metadata on that Camera refers to it as 'Camera 5'. It is the camera facing east, across the Arena Bar toward the 'table football' table.

[11] https://youtu.be/hT3NcfXTC4Q

[12] https://youtu.be/jzPkJScvKXk

[13] To 'synchronise' two video or audio files is to digitally 'align' them, so that they show the same events at the same time.

Fig.3: Video B (right) is synchronised with footage from the CCTV system (left), by capturing distinct movements of players after a goal. Above Video B, real time is displayed, as determined by the audio synchronisation with Video A. In the upper left, the time at the same moment according to the CCTV system is displayed. The difference between real time and CCTV footage time is 7 minutes and 1 second.

With that camera successfully calibrated to real time, all six CCTV cameras could be synchronised both between themselves, and to real time.

The CCTV recordings from the night are incomplete; the footage 'jumps' (or 'skips') at different and irregular moments, for seconds or even whole minutes at a time, resulting in noncontinuous coverage. Additionally, while the frame rate of the videos is 25 frames per second (fps), this was not always consistent, resulting in some individual frames (a time duration of 0.04s) also being 'skipped', likely as a result of how the video data was compressed as it was written to a hard disk.

To account for this incompleteness, we used Adobe Premiere Pro software to process the footage from each of the six cameras. This processing consisted of properly positioning the various video files from each of the six cameras, filling in the gaps created by 'skipping' with blank space, in order that the footage contained in the file corresponded to real time (see fig.4).

This process resulted in a 'multi-camera' synchronised sequence, in which each of the cameras, real time, and the time according to the CCTV cameras could be viewed simultaneously (see fig.5).
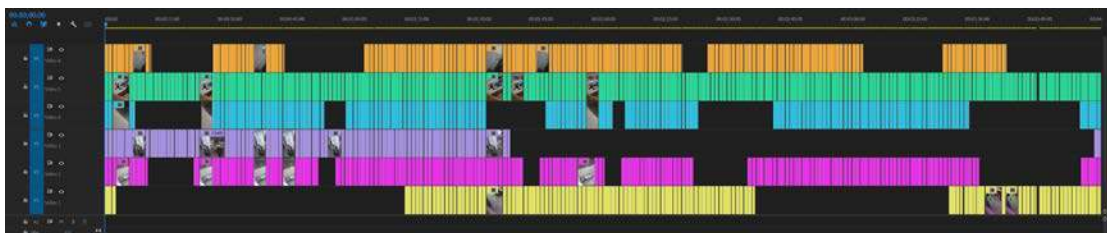

Fig.4: Screenshot of the Premiere Pro file. Each of the 6 cameras corresponds to a coloured 'track'. The black gaps on each track correspond to where the original video files have 'skipped'.
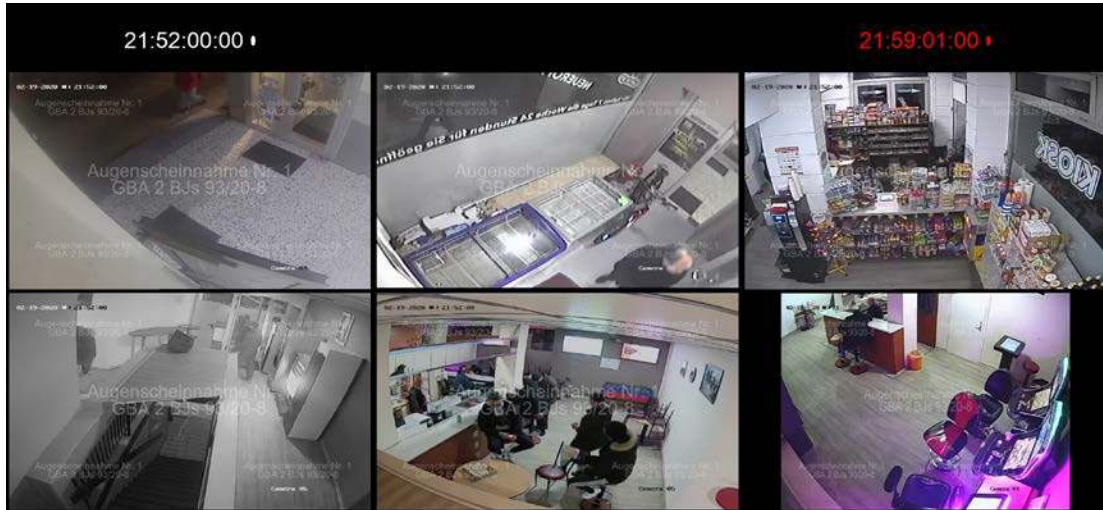
Fig.5: Screenshot of the Premiere Pro file, in which all 6 cameras are synchronised between them, and according to real time. In white is the CCTV system time; in red, real time.

3.2. Fields of view

We determined the 'field of view' of each of the six cameras by matching points within the image frame to their corresponding points on the 2D plan (see fig.6). By repeating this process for all six cameras (see fig.7), we created a 'map' of the coverage areas of all the cameras within and immediately outside of the Arena Bar and kiosk (see fig.8). This 'mapping' process was necessary for the subsequent tracking of each person's movements. It also showed us 'blind' areas; areas in which a person would not be visible to the cameras.[14]
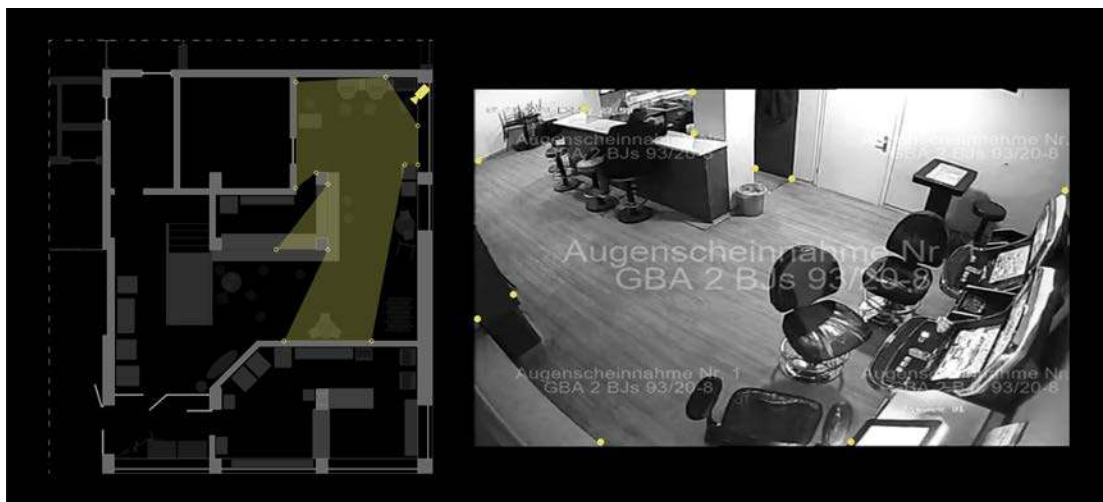

Fig.6: Tracking points in the frame of Camera 1, and their corresponding points onto the 2D plan of the Arena Bar and kiosk. The yellow overlay captures the approximate field of view of Camera 1.

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[14] Note: the plan view of visible/invisible areas does not take into account some areas (e.g. behind service counters) that are hidden from the camera's field of view.
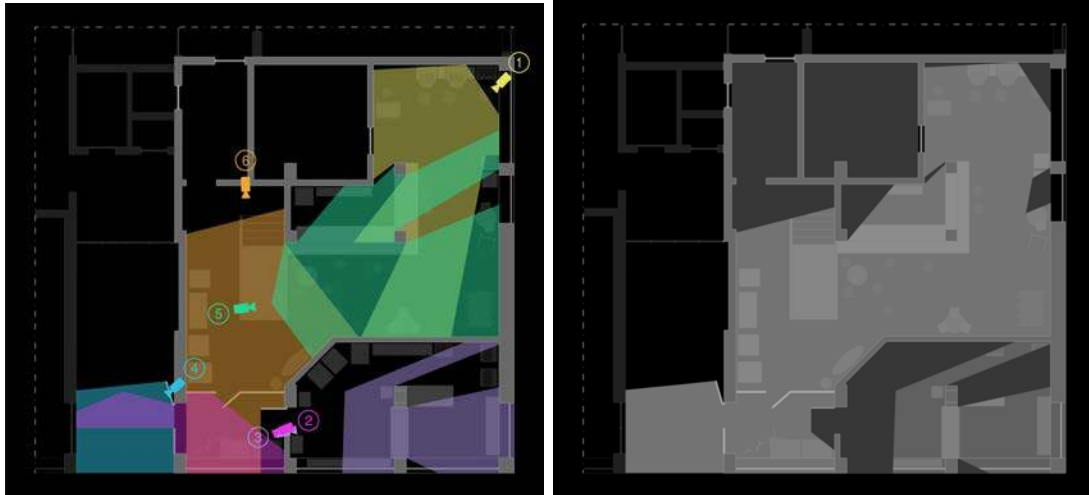
Fig.7 and 8: The left-hand drawing (fig. 7) depicts each of the six cameras installed in the Arena Bar and kiosk, and the area that they capture. The right-hand drawing (fig. 8) depicts the overall coverage area: white signifies visible areas, grey signifies that the area is hidden from all cameras' views.

3.3. Tracking movements

With the CCTV footage calibrated and synchronised to real time, we tracked the movement of each person present in the bar and kiosk. The tracking process started from one minute before the perpetrator arrives at Kurt-Schumacher-Platz (21:59:09 in real-time, 21:58:08 in the CCTV timecode), until after he leaves the premises.

The tracking process entails mapping the position of each person onto the two-dimensional plan of the building using 3D animation software Cinema4D. This allowed us to recreate the trajectory of each person (figs. 9, 10), in turn enabling us to analyse properties such as movement speed and acceleration for each one.

Fig.9: The path of each person in the Arena Bar and kiosk during the attack, between 21:59:09, one minute before the perpetrator enters, and 22:00:52, when he leaves the building.

As well as tracking their movements, we used a 'directional' icon equivalent in size to a human body. This allowed us to also indicate which way they are looking, as well as where they are moving towards.

Fig.10: The initial and end position of each person in the Arena Bar and kiosk, between 21:59:09, one minute before the perpetrator enters, and 22:00:52, when he leaves the building.

4. Timeline

Our analysis of the footage determines the following timeline. Each of the events below is noted in our video report at this link: vimeo.com/657463633

22:00:06   The perpetrator (TR) exits his car in the car park

22:00:09-11   Shots fired in the car park; Piter Minnemann and Said Etris Hashimi turn toward the sound

22:00:23   Said Etris Hashimi sees TR

22:00:25   TR enters the kiosk

22:00:27-29   Shots fired in the kiosk

22:00:32   TR enters the bar

22:00:35-47   Shots fired in the bar

22:00:52   TR exits the building

5. Research Question

According to his own statements, Said Etris Hashemi saw the perpetrator moving across the lobby, holding a gun.[15] Our analysis shows that this happened at 22:00:23, and that the perpetrator does not enter the Arena Bar until 22:00:32. This means that the occupants of the bar had 9 seconds to escape. If any of those present had run toward the emergency exit in those 9 seconds, did they have enough time to escape?

5.1. Analysis of paths

We analysed the paths of each of the five young men present in the bar, from shortly after 22:00:23, when Said Etris Hashemi saw a gun in the perpetrator's hand, as they move toward the rear of the bar, each arriving there between 22:00:29 and 22:00:31.[16]

Fig.11: Drawing illustrating each path in a different colour. The tracked paths begin at the service counter and end at the rear of the bar.

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[15] https://www.deutschlandfunk.de/gedenken-an-das-attentat-das-grosse-leid-der-familie-100.html
[16] We used the following 'departure' and 'arrival' times for each of the five: 22:00:24.60–:30.00 (Said Nesar Hashimi), 22:00:26.04–:30.44 (Piter Minneman), 22:00:24.96–:30.56 (Said Etris Hashimi), 22:00:26.88–:30.88 (Hamza Kurtović), 22:00:27.40–:30.80 ('Momo').

From the duration and distance of their paths, we also determined the speed of each person at different moments as they moved toward the rear of the bar, including their maximum speed at any point during that journey.[17]

We also cross-referenced their speeds over time with the time period during which shots were fired in the kiosk. Doing so indicates that at, or immediately after, shots began to be fired in the kiosk, every one of the five increased their speed.
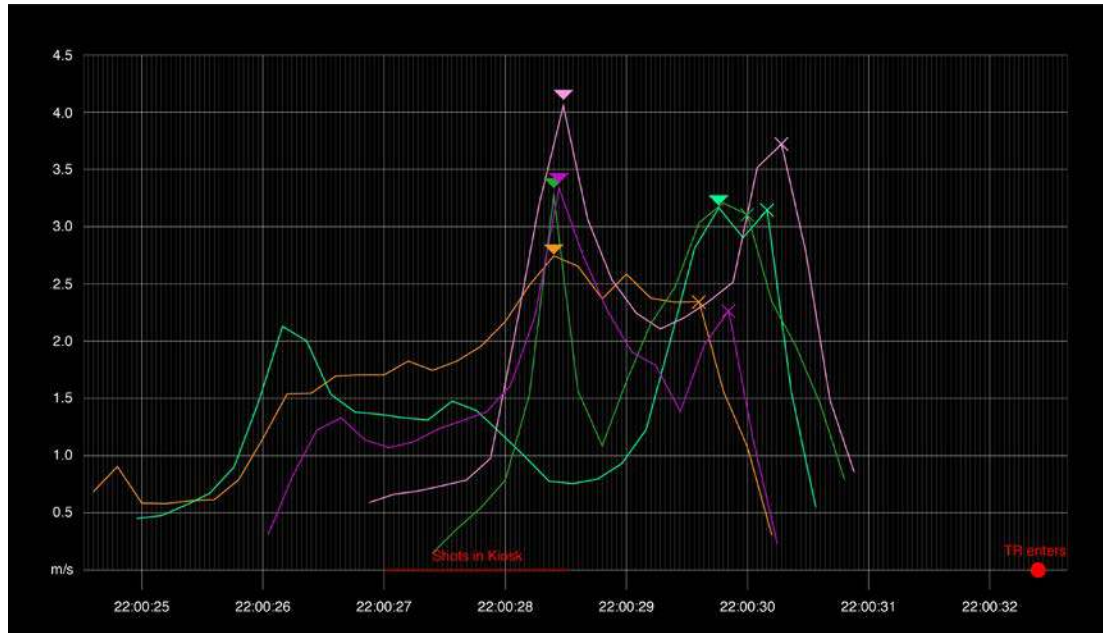

Fig.12: This graph shows the speed of each of the five people over time. Their acceleration in response the sound of shots is clearly visible, and their maximum speed is marked with an arrow. The positions of the 'X' indicate the moment each starts to decelerate, having run into a dead end.

The combined speed graph (Fig.12) shows a broadly similar 'M'-shaped pattern for each person. When viewed alongside the CCTV footage, this is understood as an initial acceleration around the time that shots are fired in the kiosk (from 22:00:27), and a subsequent deceleration in speed as a result of congestion in a small space and the near-collision of bodies, followed by a second acceleration, and a final deceleration when they each arrive in a dead end.

5.2. Mirroring of Paths

We then transposed this data onto five *hypothetical* paths, from the starting positions of each of the five toward the emergency exit (see fig.13). Since the path toward the emergency exit is in precisely the opposite direction to the rear of the bar, we refer to this process as 'mirroring'.

'Mirroring' only alters the direction of the path. Other parameters, such as acceleration and deceleration, time taken, and distance covered, remain the same.

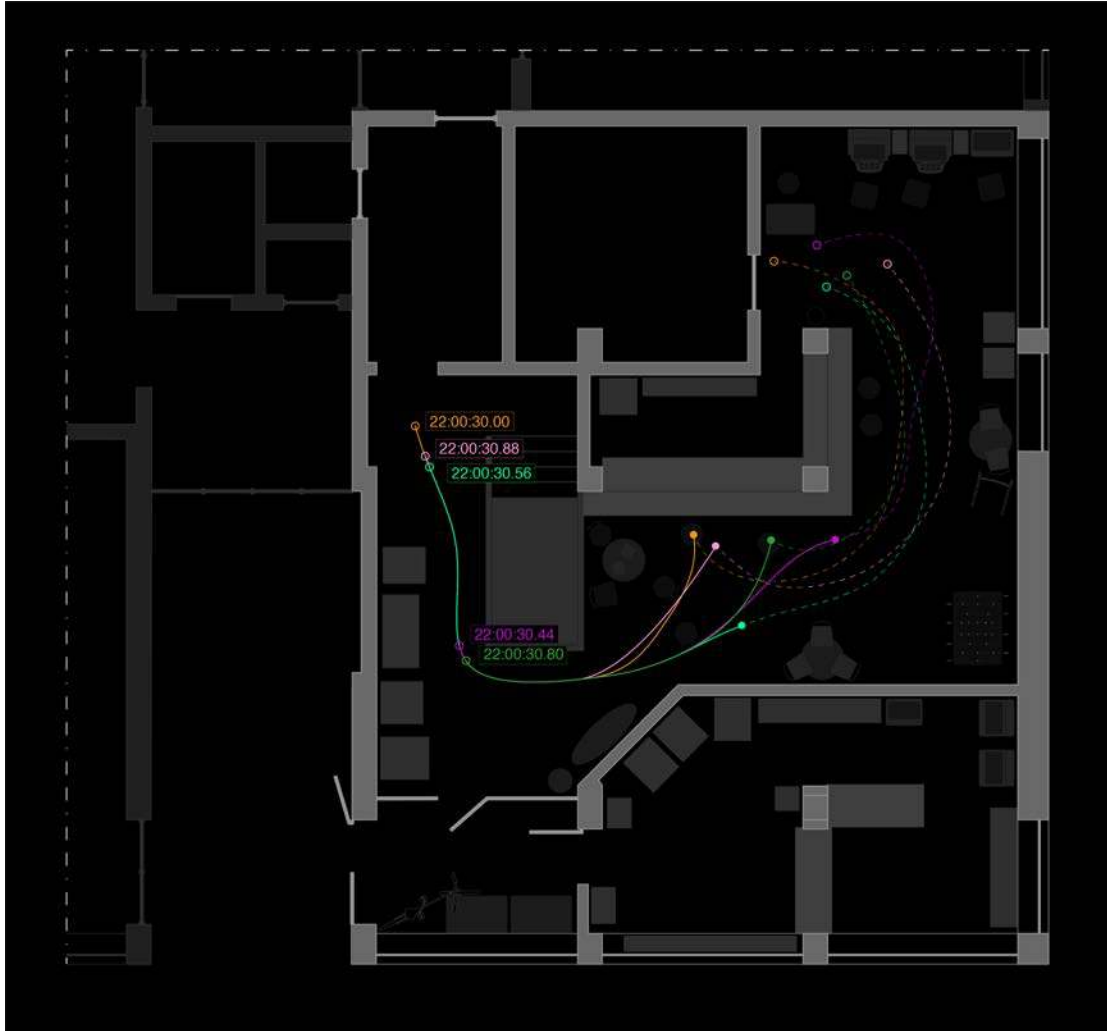[17] We determined the speed across 0.2s (5 frame) intervals.

Fig.13: The 'mirrored' paths of the group of five, toward the emergency exit. By the time these paths are completed, the perpetrator is still in the Kiosk.

Since each of the five individuals started moving at a different time, travelled a slightly different distance, and at a slightly different speed, the 'mirrored' paths result in some of them being further than others along the hypothetical route towards the emergency exit.

5.3. Extension of 'mirrored' paths

As noted above, these 'mirrored' paths are of different durations, and begin at different times. Nevertheless, each path ends before 22:00:32, when the perpetrator enters the Arena Bar.

To account for those additional 2-3 seconds (varying for each person) until 22:00:32, we continued each path as it extends towards the emergency exit. For each person, we extended the path according to the maximum speed at which that person travelled in the real event (see fig 14).
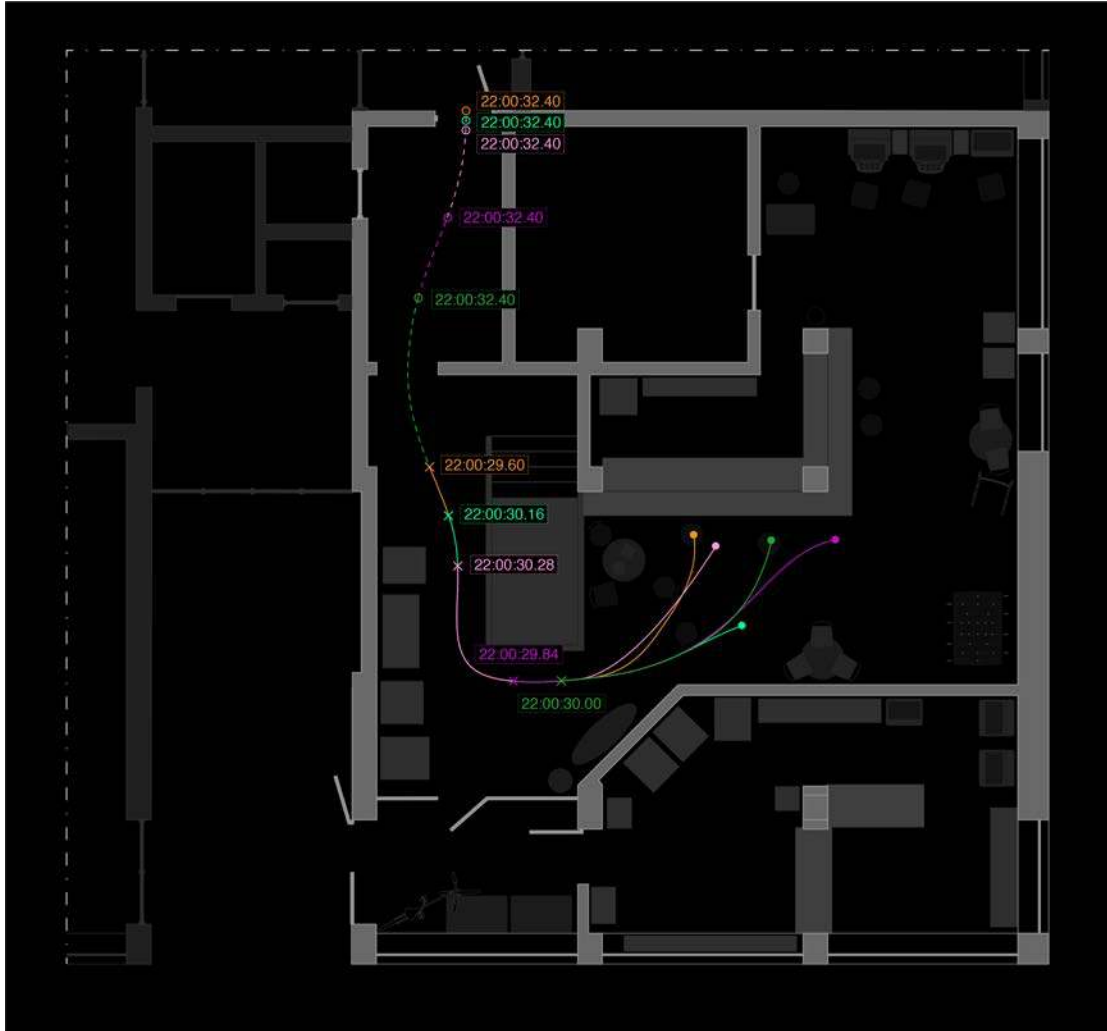
Fig.14: The 'mirrored' paths of the group of five, toward the emergency exit. The position of the 'X', and the timestamp that accompanies it, indicates the starting point of deceleration for each of the five in the real event, after having run into a dead end. In our hypothetical scenario, instead of decelerating at this point, each person continues moving until 22:00:32, at the maximum speed that each achieved.

First, we removed approximately 0.5-1s of the 'mirrored' path, according to when each individual begins to slow down, having reached a dead end at the rear of the bar.[18]

We then extended their paths from that point until 22:00:32 at the maximum speed that each achieved according to our analysis of their actual paths toward the rear of the bar.

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[18] According to our analysis, 'final' deceleration begins for each person at (respectively): 22:00:29.60 (Said Nesar Hashemi), 22:00:29.84 (Piter Minneman), 22:00:30.16 (Said Etris Hashemi), 22:00:30.28 (Hamza Kurtović), 22:00:30.00 ('Momo').

 Following this this methodology, we indicated where each person would be at 22:00:32.40, when the perpetrator enters the bar (see fig.15).

Subsequently, we animated this hypothetical scenario. That animation can be viewed at this link: vimeo.com/657463633
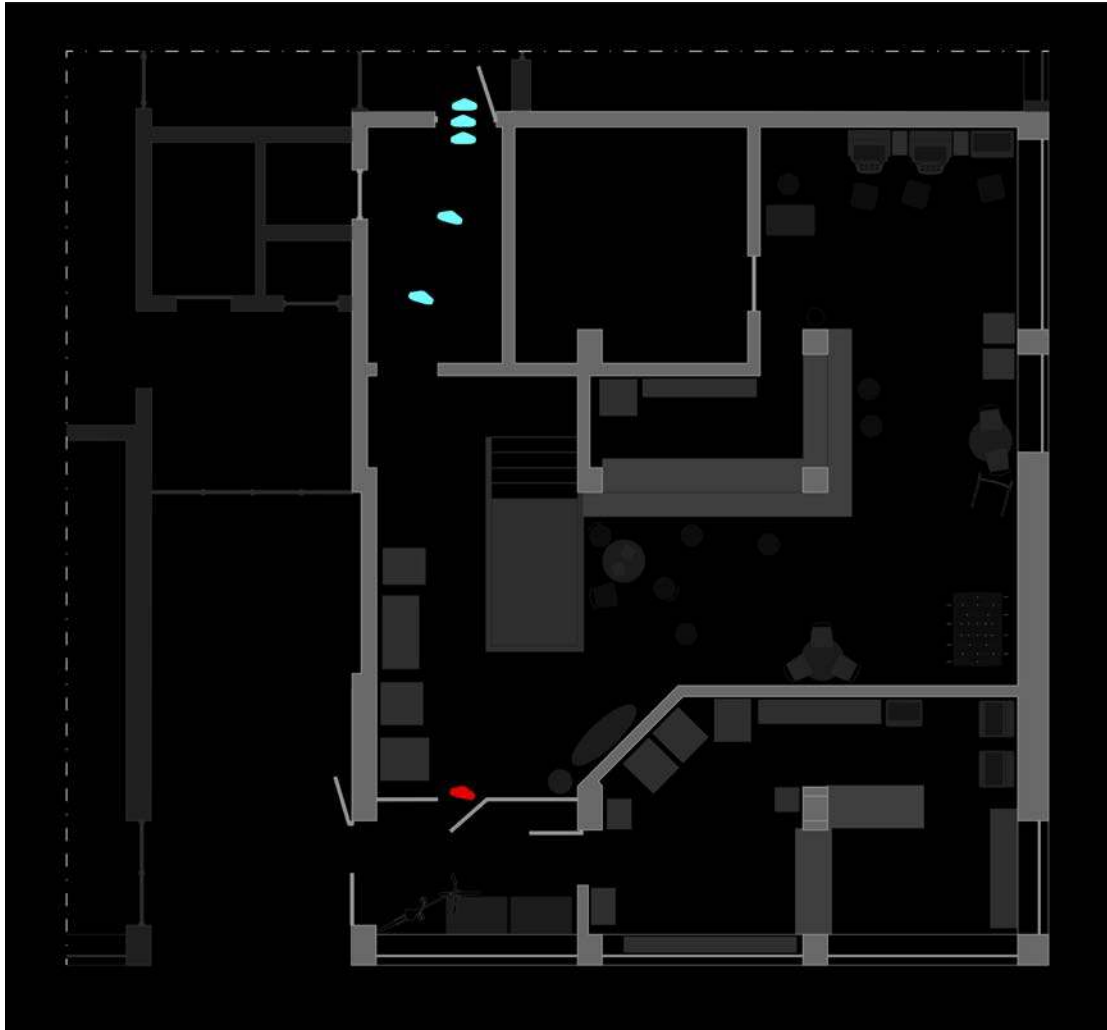

Fig.15. The positions of the group of five at the time that the perpetrator enters the bar (22:00:32.40), according to our hypothetical scenario.

According to our analysis, four of the five people would have been well out of sight of the perpetrator by the time he entered the bar. One person would have been in his line of sight for around 0.2s, around 8m away.

5.4. Caveats and considerations

Studies suggest that an average young adult in good health is very likely to be capable of running at more than 4m/s in an unobstructed environment.[19] Indeed, a reading of the speed graph (Fig.12) suggests that since a consistent maximum speed is never reached and maintained, each occupant may be capable of achieving a higher speed than is recorded, given more space to build up that speed. The route toward the emergency exit is a near-straight-line path of approximately 9m, enabling a more prolonged period of acceleration, and a higher maximum speed sustained over a longer duration.

Thus, the maximum speeds observed in the analysis should be considered conservative. The occupants would likely achieve higher speeds given more space to run, and if we would have considered rather a constant rate of acceleration the conclusion would lean further towards their ability to escape.

Additional adjustments to the animated paths have been made to account for the time required for the first person to reach the emergency exit to slow down, stop and open it (1 second of deceleration), as well as the possibility that individuals moving along the same path may collide with one another or obstruct one another's movements. These considerations are reflected in the final trajectories and positions presented in the hypothetical scenario by this analysis.

Finally, our conclusion determines that 4 out of 5 of the group would definitely be out of sight of the perpetrator by 22:00:32, when he enters the Arena Bar. The fifth, according to the hypothesis, would be partially within his line of sight at that time. However, this would be the case for no longer than 0.2s. Given that the perpetrator's firing accuracy in the events in the Arena Bar was 50% having fired 16 shots, most of which at stationary targets at close range, we consider it extremely unlikely that the perpetrator would have been able to successfully fire at, and hit, that fifth person, in the time available.

[19] In studies into running performance, speeds of 4-5m/s have been cited as an achievable average running speed over short distances, e.g. Hunter, McLeod, Valentine, Low, Ward & Hager, *Running economy, mechanics, and marathon racing shoes*, Journal of Sports Sciences, vol. 37:20, p2367-2373 (2019); Hoogkamer, Kipp, Frank *et al. A Comparison of the Energetic Cost of Running in Marathon Racing Shoes*, Sports Med, vol. 48**,** p1009–1019 (2018)

6. Conclusion

Our analysis shows that:

if the emergency exit was open on the night of the attack, and

if the five younger men occupying the Arena Bar on the night of the attack had moved towards the emergency exit at the same time as they began to move toward the rear of the bar (22:00:23), and at a comparable pace to their movements in the real event,

then by the time the perpetrator arrived in the bar (22:00:32), **four out of five would have been completely out of his line of sight**. He could have had a fraction of a second (around 0.2s) to aim and fire at the last escapee before that person was also out of his line of sight.

Contrary to the claim of the Hanau Public Prosecutor, our analysis demonstrates that:

All of these five individuals had enough time to escape through the emergency exit. If the emergency exit was open, and they had known that, they could all have survived the attack.

This conclusion only underlines the importance of a deep and thorough investigation into the wider questions that have been raised in relation to the Arena Bar.

Central among them, of course, is the question of whether the emergency exit was in fact locked on that night – and if so, how this was allowed to happen.

But more broadly, it is clear that the history of how the Arena Bar has been policed, and how other state offices have interacted with the bar and its owners, are subjects worthy of close attention, not least because of allegations they may have been contributing factors to the emergency exit being closed or perceived closed on the fatal night of 19 February 2020.

7. Credits

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