

MOBILE PHONE MOVEMENT BEHAVIOR IN STADIA FIRE EVACUATIONS




Presented by:

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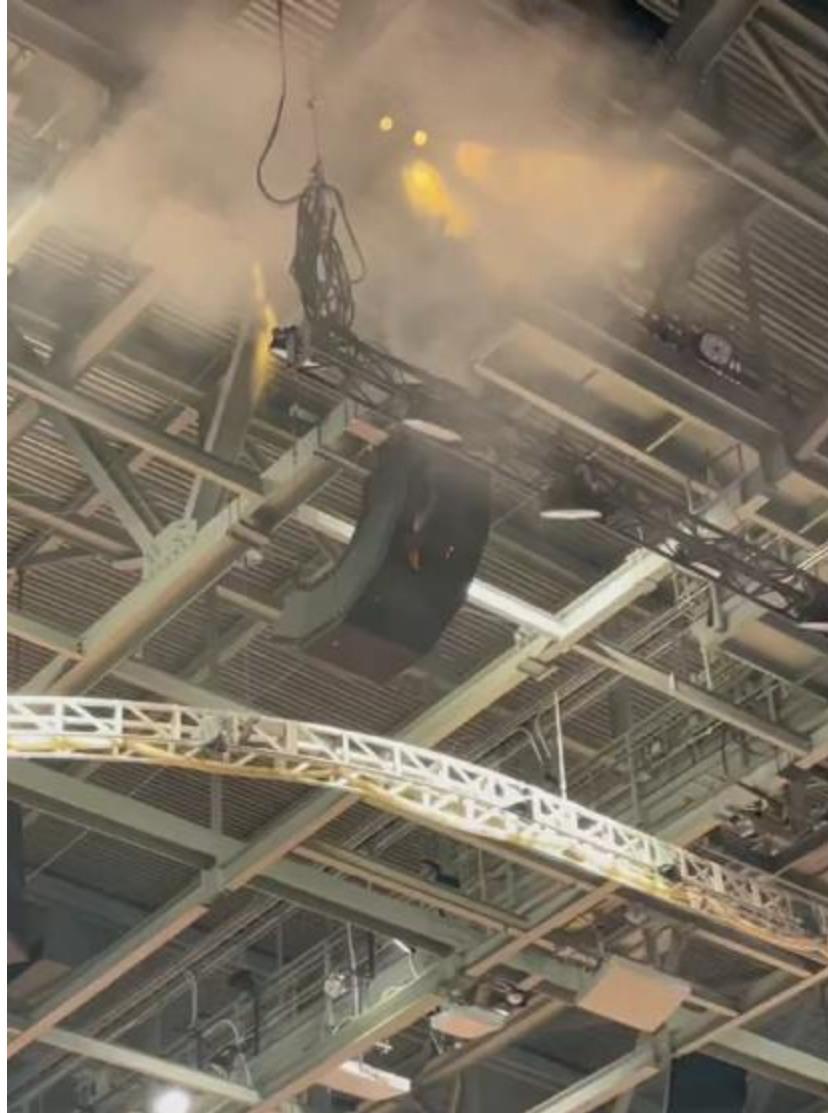
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Canada Stadium Fire (2022)



Professional sporting event in Canada with fire in the roofing structure (2022). Localized evacuation followed by full evacuation when game was stopped.

Methodology

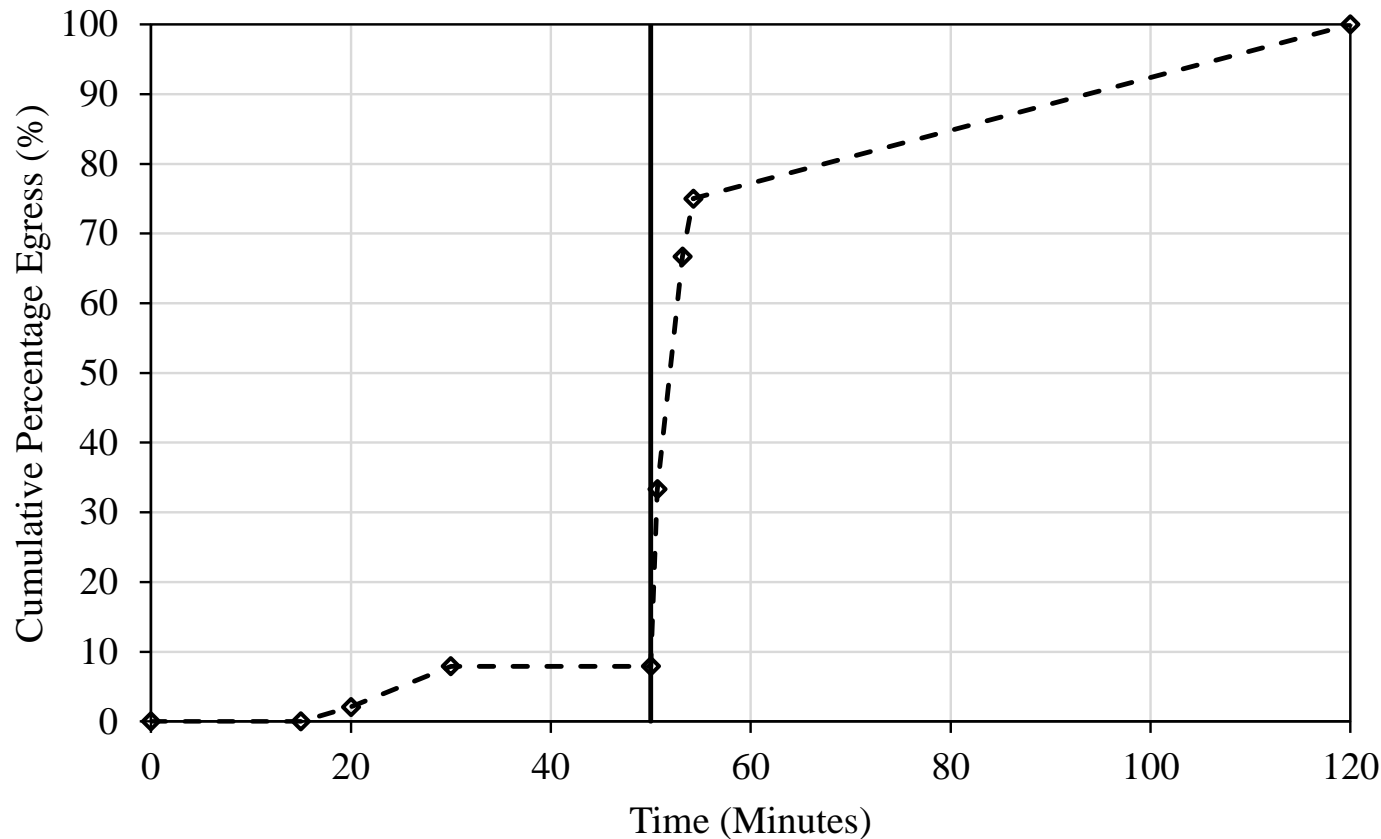
- Ethics consultation on HPRC with York University on secondary analysis. Project **ethics were approved** via letter from board.
- **Reviewed footage** from TikTok, Twitter (currently being called X by its owner at the time of writing), Instagram, Reddit, YouTube, and local news outlets (stations redacted to preserve anonymity).
- **Searched for keywords across various social media platforms** were “home team name”, “home team stadium name”, ‘speaker’, and ‘fire’.
- The keywords were then turned into key phrases searched throughout these platforms such as; “[home team stadium name] arena fire”, “[home team name] fire”, “[home team name and stadium name] fire”, “[home team stadium name] speaker fire”, for a more in-depth search of the event.
- The choice of phrases is somewhat arbitrary though focused on the key theme observed.

Collected Videos

- 22 videos with 27 minutes of stadium stand observation
- Videos placed in timeline and analyzed for total evacuation, mobile user behavior and alcohol consumption (later study).

Video #	Short description	Source
1	Fire investigation	TV
2	Fire announcement evacuation	TV
3	Concourse	TV
4	Speaker on fire	TV
5	Close up of speaker on fire	Twitter
6	Bottom view of speaker	Twitter
7	Fire dept clearing out section below speaker	Twitter
8	Video of whole event (sequence of 4 compiled videos)	Twitter
9	Fans evacuated after fire at stadium	News
10	Floor seat view of evacuation	Instagram
11	Comparison of during the game (evacuation shows at the end of the video)	Instagram
12	Last slide shows evac	Instagram
13	Underneath shot of the fire	TikTok
14	Far side profile of the fire	TikTok
15	Near Side profile of fire	TikTok
16	Video of evacuation of people	TikTok
17	Sound of fire alarm	TikTok
18	Announcement of fire and full evacuation	TikTok
19	Reporting and evacuation	YouTube
20	Teams leaving while crowd stays	Twitter
21	Speaker on fire while play continues	Twitter
22	Video of the speaker on fire	Reddit

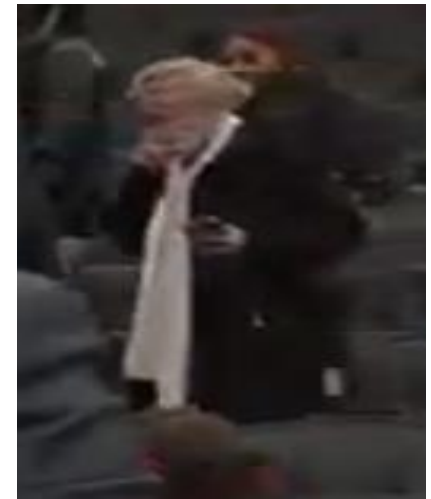
Egress with Time of Fire Discovery



Videos extracted by assuming full capacity and counting number of empty seats when available. Dashed line denotes uncertainty.

Mobile User Behaviour

Term	Definition	# of observed
Talking	Phone to ear/side of head, assumed to be on a phone call with someone	14
Texting	Phone in hand, head looking down at phone, not necessarily texting but phone usage is occurring	44
Filming	Phone in handheld close to head height away from body, facing towards event that is occurring	48



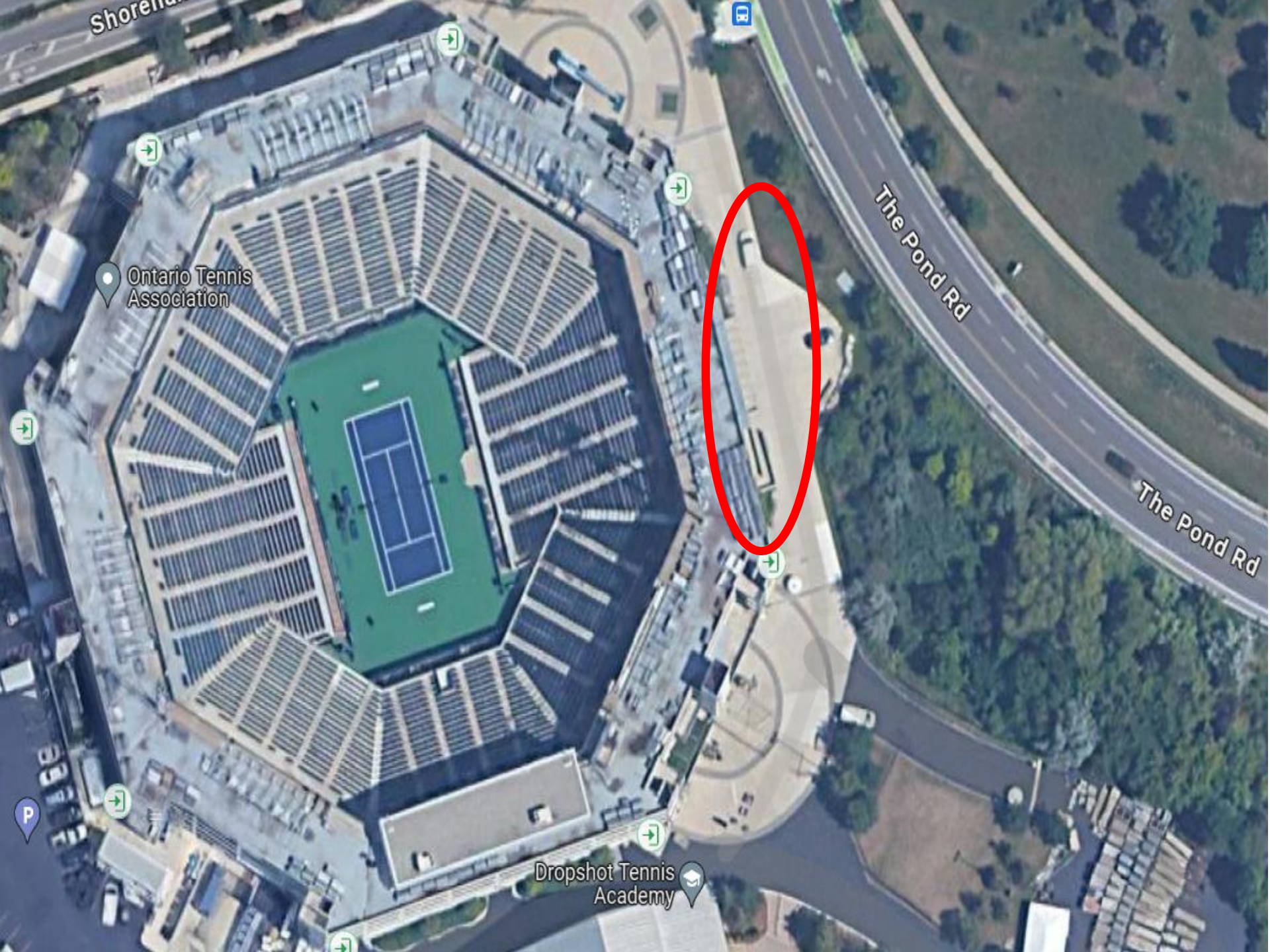
Analysis

While the results are preliminary and under analysis at the time of presentation and writing, several conclusions may be drawn:

- More controlled data collection exercises are needed,
- The observed cell phone users in the videos represent a **distinctly low proportion of the total population**, barring the individuals who were actively filming the videos obtained, 106 distinct individuals were observed of which 80 were observed during the full evacuation process,
- Thirty-eight can be confirmed to be visibly moving while using the phone,
- In one observable instance, a mobile phone user trips over garbage left in the stands as they are looking at their screen,
- **Videos and film are limited to the individuals observed travel path**, hence the authors in this case do not and cannot derive movement speeds as their full path is not recorded, and
- Most users of phones are **actively filming or looking for information** on their phones.



Controlled Data Collection



Shorena

Ontario Tennis Association

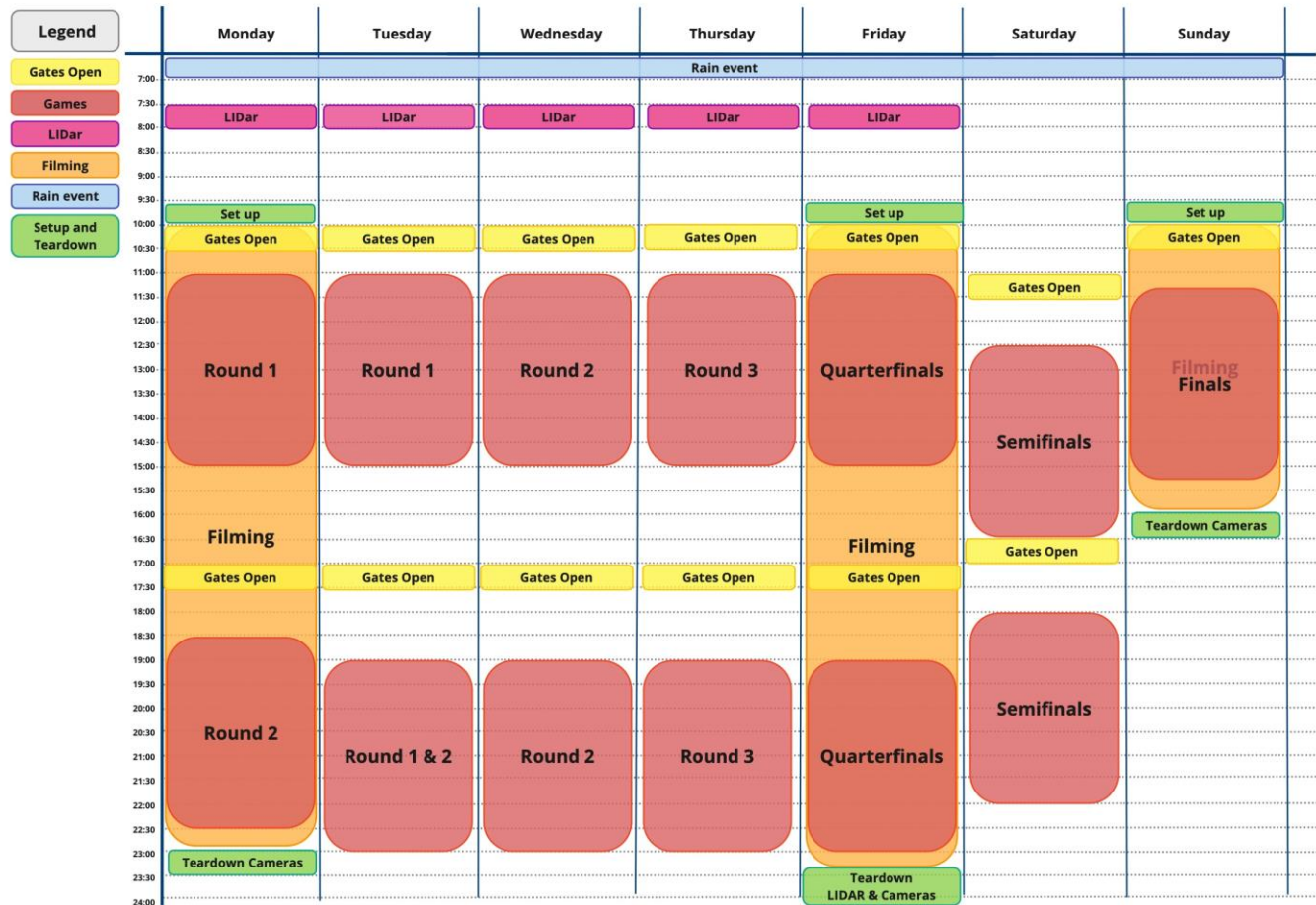
The Pond Rd

The Pond Rd

Dropshot Tennis Academy

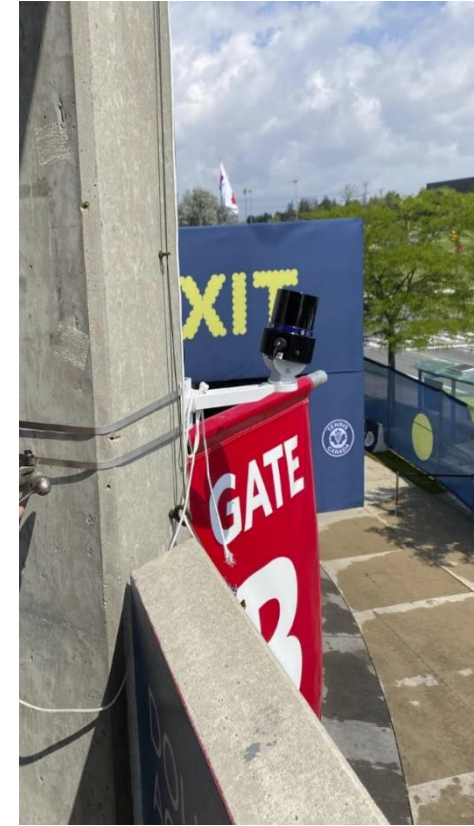
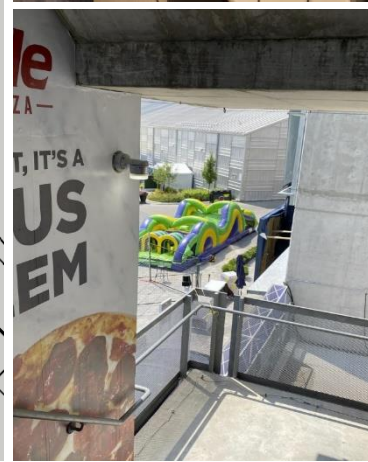
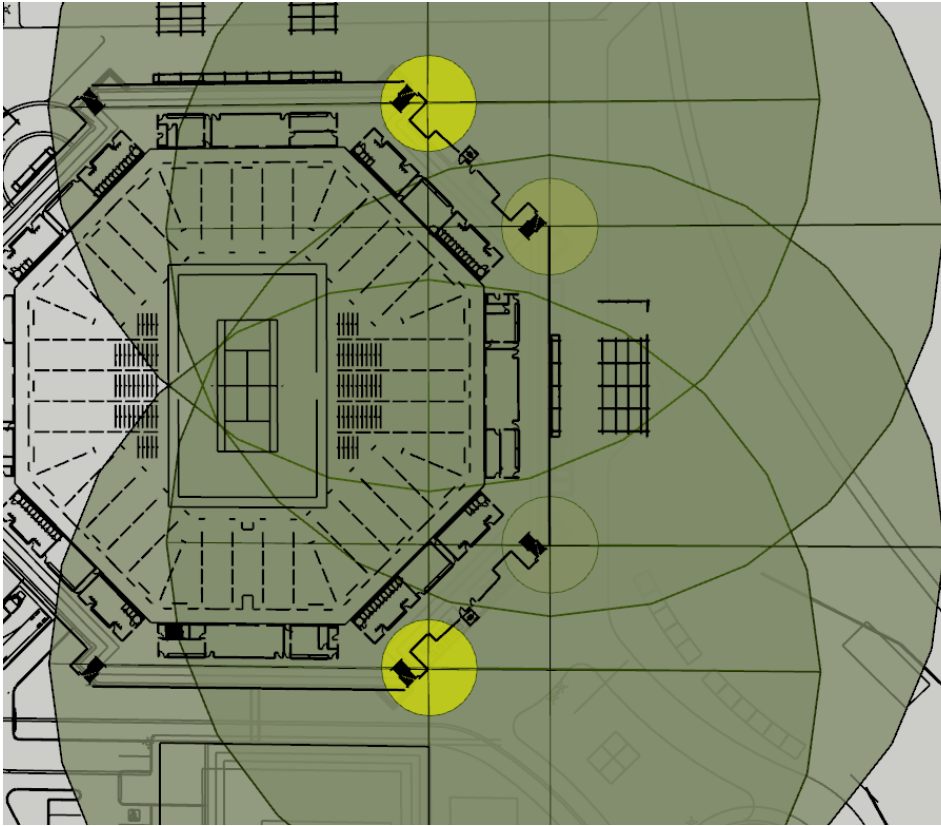
Data Collection Schedule

- LiDAR filmed Monday to Friday
- Videos Monday, Thursday (rain) and Friday
- STU 2023-078 ethics protocol for research project (renewed in 2024)



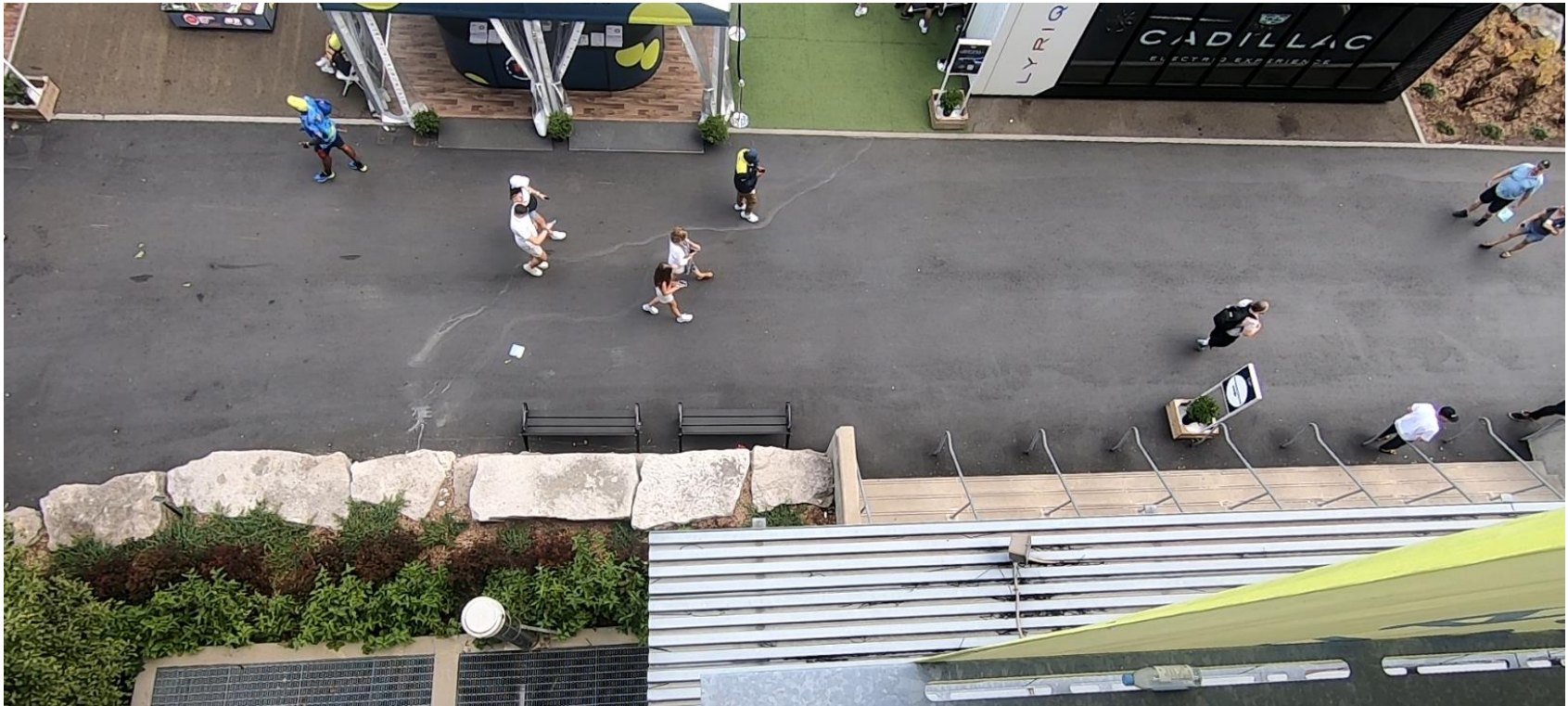
Data Collection Locations

- Four LiDAR locations, stereoscope camera on stands, six stationary filming locations with Go-Pros (including said walkway).



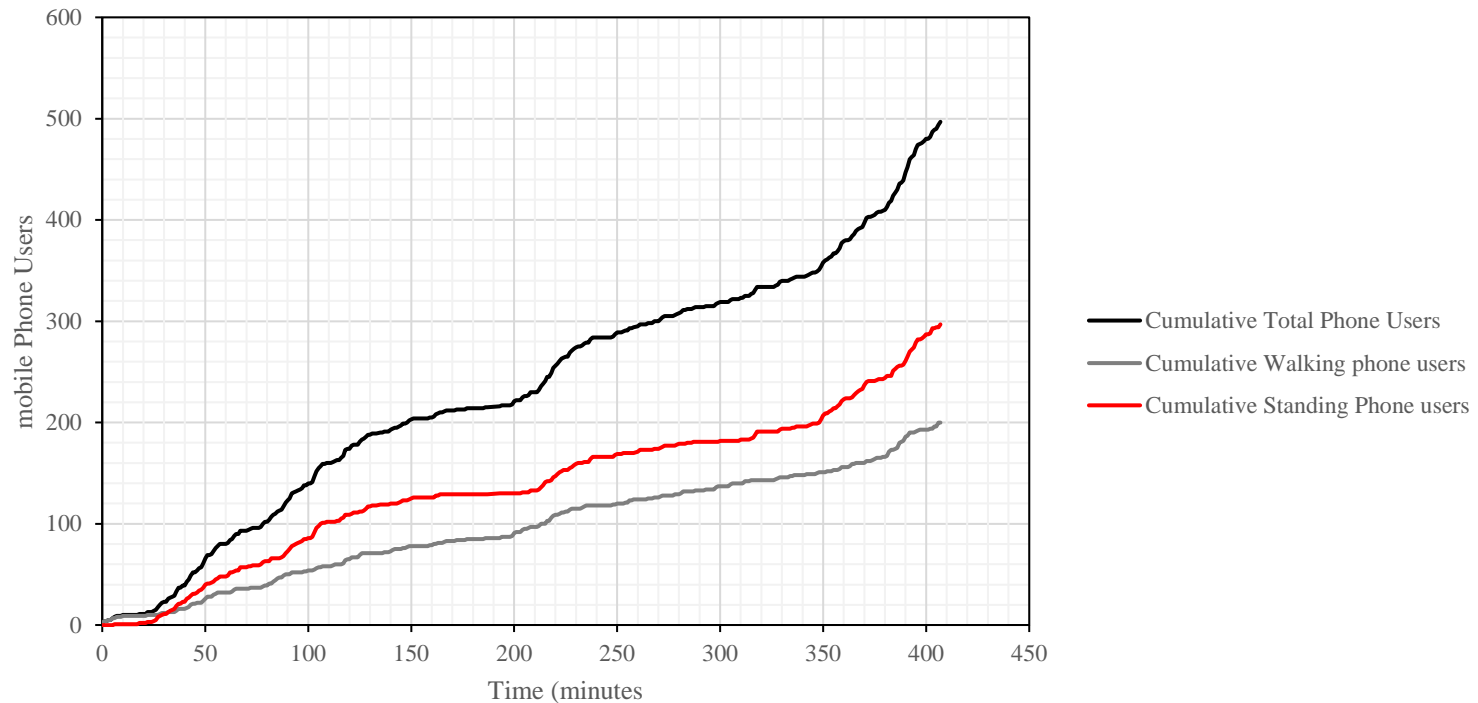
Walkway data collection location

- Walkway was targeted for collecting mobile phone users (Go Pro)



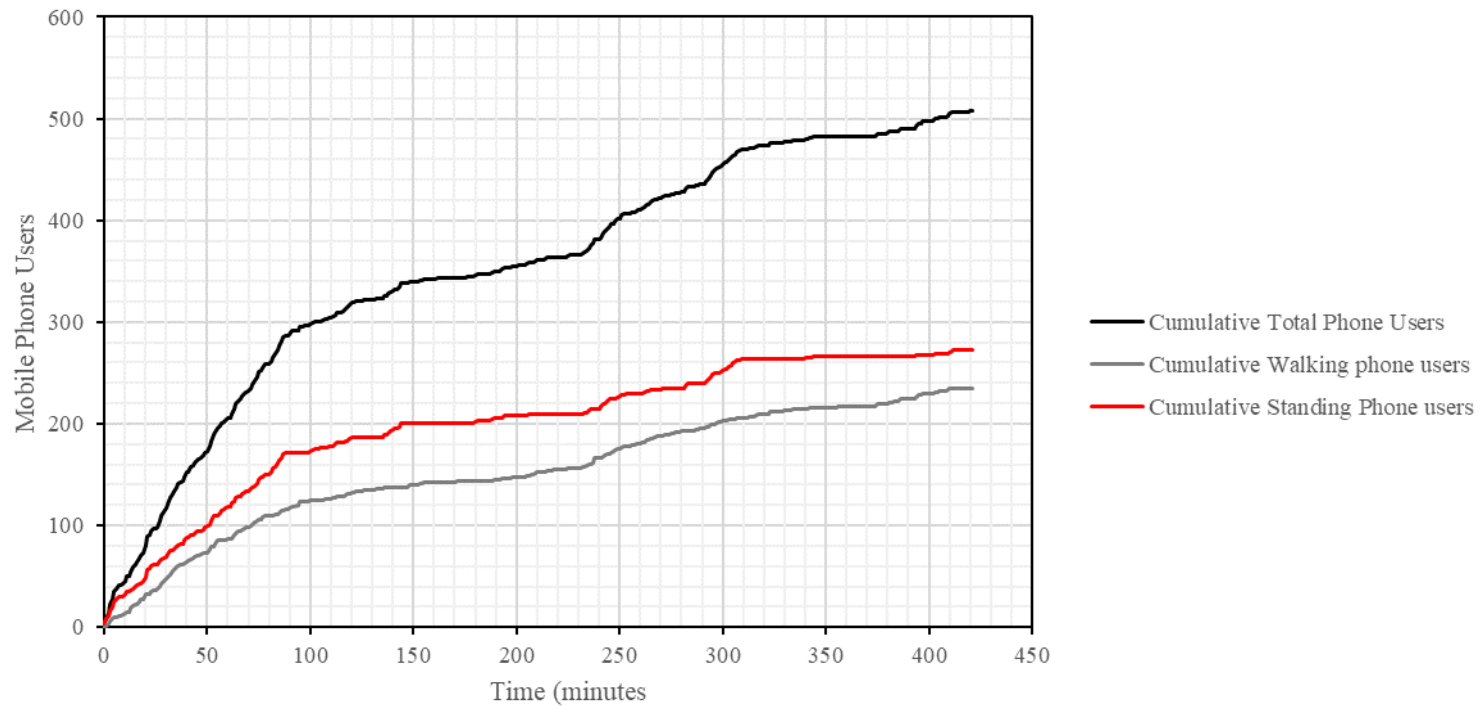
Mobile phone users during the day

Data subdivided by those standing and those moving, possible to further break into demographics



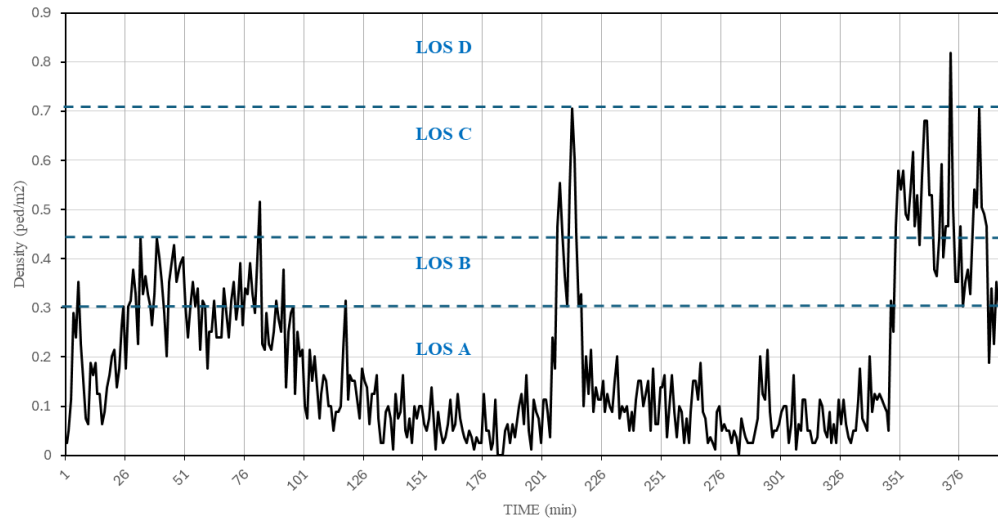
Mobile phone users at night

At night, it was easier to observe users as the screen contrast would appear well on the screen, though the frequency of these users dips when visibility is poor.

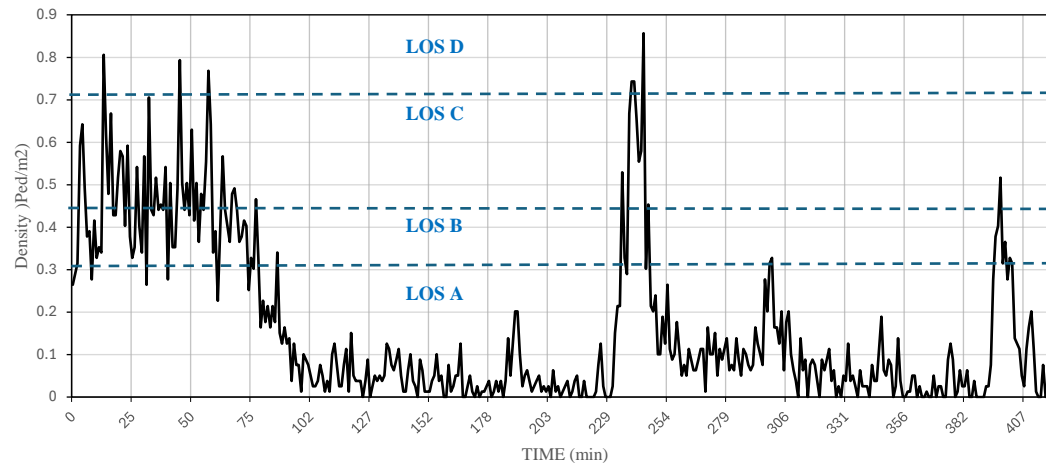


Walkway density and LOS

QUARTER FINALS WALKWAY DAY COUNT



QUARTER FINALS WALKWAY NIGHT COUNT

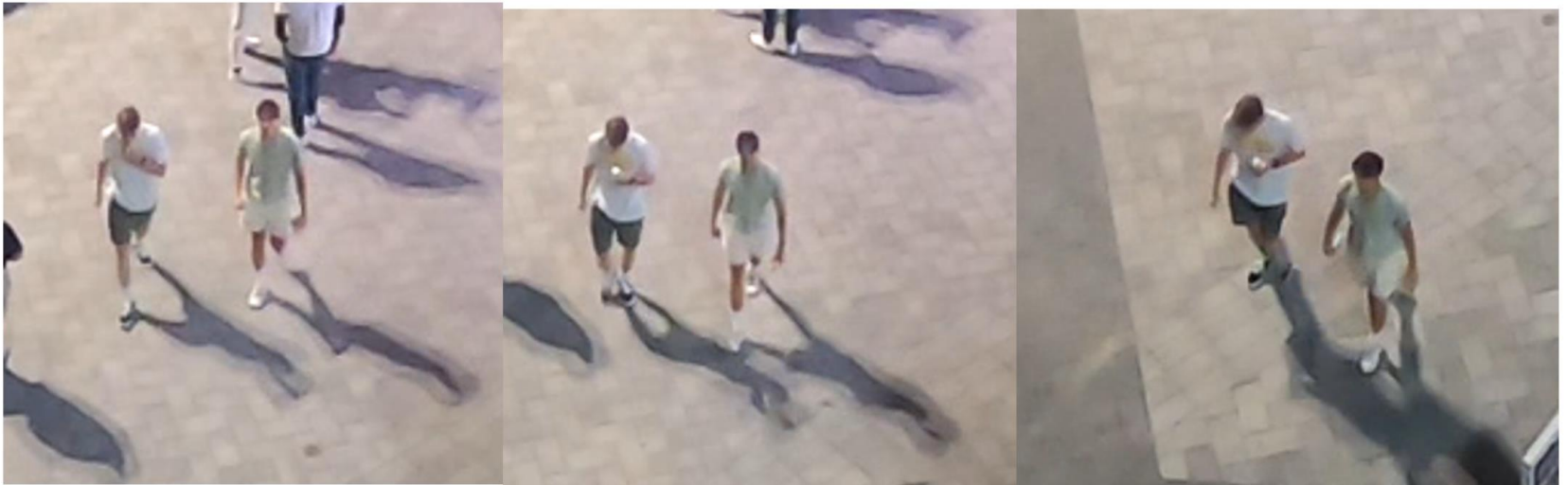


Analysis

- Event's quarterfinals was used for analysis
- Total of **1,003 mobile phone users** in the walkway (just over 10% of the total observed population) during the quarterfinal day of the tournament
- **68% of whom were standing** in one place as they used their phones
 - This statistic suggests that a **majority of the people preferred to stand still while using their phones** (as replicated by the stadium fire observation) while there was still a statistically large number of people moving while using their phone
- Other notes:
 - The count was done per minute for consistency, so some individuals standing in one place were likely counted more than once
 - The walkway was a common area where people were waiting in line to use the restroom, which could have contributed to the higher proportion of stationary phone users

Future work

- Derive movement speeds of mobile phone users
 - Lidar validation (using complimentary data from 2024 as well)
- Elevator data
- **Alcohol users** (free drinking permit in grounds)
 - Data from stadium fire is complementary
- Stadium bowl behaviors during high motivation egresses (etc.)





Conclusions

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While preliminary, the general conclusions are:

- The populations exist to cause congestion during evacuation who use mobile and cell phones,
- That the proportion of these users is potentially small,
- That that proportion is generally stationary, and
- The population(s) are however large enough to cause effects on egress and should have more detailed analysis as this study continues.

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