

Abuse Vectors

A Framework for Conceptualizing IoT-Enabled Interpersonal Abuse

Sophie Stephenson, Majed Almansoori, Pardis Emami-Naeini,
Danny Yuxing Huang, and Rahul Chatterjee



WISCONSIN
UNIVERSITY OF WISCONSIN-MADISON

MAD S&P

Duke
UNIVERSITY



NYU

IoT devices

69%

of US households
have at least one
IoT device

[Martin 2019]



Thermostat by [Dan LeFebvre](#) on [Unsplash](#); lightbulb and AirTag by Unknown Author, licensed under CC BY and CC BY-NC-ND

IoT devices are used in interpersonal abuse

ALBERT FOX CAHN

EVA GALPERIN

IDEAS MAY 13, 2021 9:00 AM

Apple's AirTags Are a Gift to Stalkers

Thermostats, Locks and Lights: Digital Tools of Domestic Abuse

"IoT abuse"

FAMILY & TECH: JULIE JARGON

These Parents Use Baby Monitors to Track Older Children— Even Teens

[Cahn 2021]

[Bowles 2018]

[Jargon 2022]

Author, licensed under CC BY-SA and CC BY-NC-ND

researchers are investigating IoT abuse

Characterizing Everyday Misuse of Smart Home Devices

Phoebe Moh*, Pubali Datta†, Noel Warford*, Adam Bates†, Nathan Malkin*, Michelle L. Mazurek*

**University of Maryland*

†University of Illinois

Anticipating Smart Home Security and Privacy Threats with Survivors of Intimate Partner Abuse

Roxanne Leitão

University of the Arts London

London, United Kingdom

r.leitao@csm.arts.ac.uk

Threat Modeling Intimate Partner Violence: Tech Abuse as a Cybersecurity Challenge in the Internet of Things

Julia Slupska and Leonie Maria Tanczer

Are Smart Home Devices Abandoning IPV Victims?

Ahmed Alshehri

Accenture Labs

Arlington, VA

alshehri@mines.edu

Malek Ben Salem

Accenture Labs

Arlington, VA

malek.ben.salem@accenture.com

Lei Ding

American University

Washington, D.C.

ding@american.edu

researchers are investigating IoT abuse

Characterizing Everyday Misuse of Smart Home Devices

Phoebe Moh*, Pubali Datta†,

ek*

We need a better understanding of the problem we are trying to solve.

Threat Modeling Intimacy and Violence: Tech Abuse as a Security Challenge in the Internet of Things

Julia Shupska and Leonie Maria

Security and Privacy Threats from Smart Home Partner Abuse

London
dom
uk

Abandoning IPV Victims?

Ahmed Alshehri
Accenture Labs
Arlington, VA
alshehri@mines.edu

Malek Ben Salem
Accenture Labs
Arlington, VA
malek.ben.salem@accenture.com

Lei Ding
American University
Washington, D.C.
ding@american.edu

research questions

RQ1 Which IoT **devices** can be involved in abuse, and **in what ways** are they misused?

RQ2 Which **properties** of these devices enable abuse?

RQ3 How can we better **conceptualize** this problem?

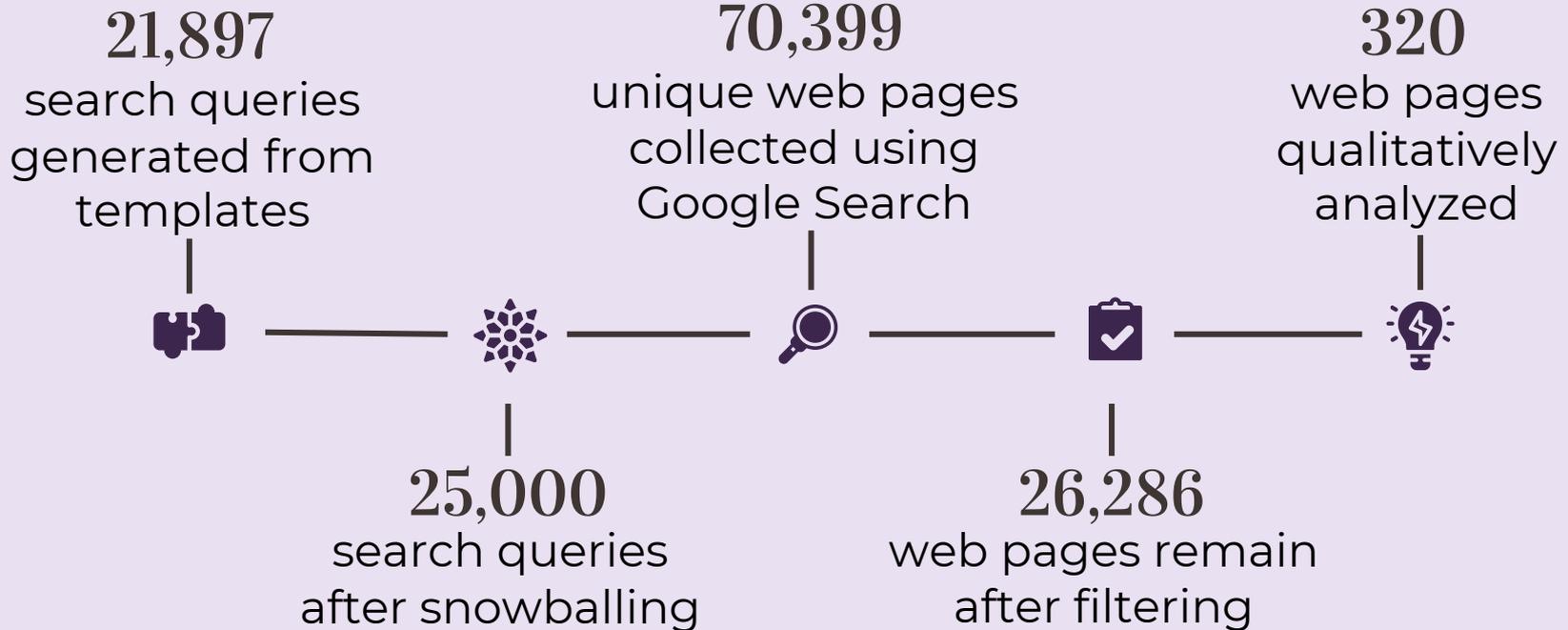
method: systematic survey of web content

21,897
search queries
generated from
templates



spy on [agent] using [device]

method: systematic survey of web content



overview of web pages

types

- News articles
- Forum posts
- How-to pages for potential abusers
- ...

targets

- Intimate partners
- Family members
- Roommates
- Neighbors
- ...

IoT abuse

- First-person accounts
- Third-person accounts (*e.g., news stories*)
- Potential for abuse (*e.g., how-to articles*)

characterizing IoT abuse

Context	Category	Device	Discussed Strategies		Abuse Vectors
			Spy	Harass	
Home control	Smart speaker	Smart speaker	🔊📹🔒	👊🔗	- U R -
		Control tablet	🔊📹🔒	- - -	- U R -
	TV	TV	🔊📹 -	👊 -	- U R I
		Thermostat	- - 🔍	👊🚨	- U R -
		Lights	- - -	👊 -	- U - I
		Router	- - -	👊 -	- - R I
	Smart appliances	Plug	- - -	👊 -	- - R I
		Kettle	- - -	👊 -	- - - I
		Smoke alarm	- - -	👊 -	- - R -
		Fridge	- - -	👊 -	- - R -
Shared-use devices	Mattress	- - -	🔍 -	- - R -	
	Doorbell	🔊📹🔒	👊 -	- U - I	
Security systems	Security camera	📹🔒	- - -	- U - I	
	General camera	🔊📹 -	- - -	C U - I	
	Baby monitor	🔊📹 -	- - -	C - - I	
	Lock	- - -	👊🚨	- U - I	
	Motion sensor	- - -	👊 -	C - - I	
	Presence sensor	- - -	👊 -	C - - I	
Vehicles	Garage door opener	- - -	- - 🚨	- - - R I	
	Car	- - -	👊🚨	- - - I	
Tracking devices	Car accessory	- - -	👊 -	C - R -	
	Watch	🔊📹🔒	- - -	- - R -	
Entertainment	Item tracker	- - -	👊 -	C - - -	
	Bluetooth headphones	🔊 -	👊 -	C U R -	
Personal-use devices	Smart toy	🔊 -	- - -	- - R -	
	Hidden camera	🔊📹 -	- - -	C - - -	
	Spy drone	- 📹👊	- - -	C - - -	
	Thermal camera	- 📹 -	- - -	C - - -	
	Listening device	🔊 -	- - -	C - - -	
	Landline recorder	🔊 -	- - -	C - - -	
	GPS tracker	- - -	👊 -	C - - -	
USB keylogger	- - -	🔒 -	C - - -		

Full spying: Remote audio (🔊) and video (📹) surveillance, precise location tracking (📍), and accessing private data (🔒).
Limited spying: Distance-limited audio/video spying (🔊📹, 📹📍); location tracking with stationary device (📍📍).
Harassment: Disrupting the home environment (👊), threatening physical safety (🚨), and manipulating private data (🔗).
Abuse vectors (discussed in § 7): Covert Spying (C), Unauthorized Access (U), Repurposing (R), Intended Use (I)

many IoT devices can be used for abuse

shared use



Home control



Smart appliances



Security systems



Vehicles

personal use



Tracking devices



Entertainment
(e.g., AirPods)



Covert spy devices
(e.g., hidden cameras)

abusers can spy with IoT devices

01 Audio surveillance

02 Video surveillance

03 Location tracking

04 Accessing private data

abusers can harass with IoT devices

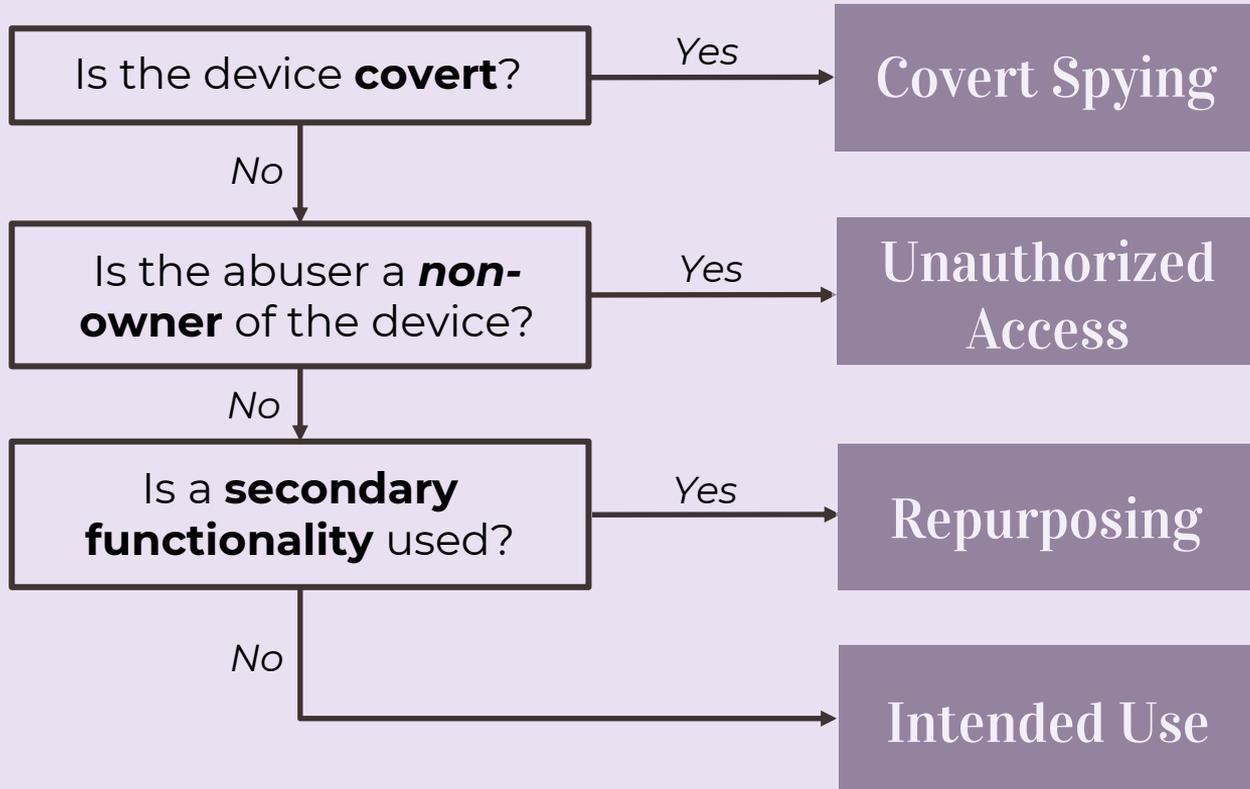
01 Disrupting the home environment

02 Threatening physical safety

03 Manipulating private data

04 Psychological control

the abuse vectors framework



Photos by Unknown Author licensed under CC BY-SA, CC BY-NC, CC BY-ND, CC BY

tailored solutions for each vector

Covert Spying	Unauth. Access	Repurposing	Intended Use
<ul style="list-style-type: none">❑ Detecting hidden devices❑ Preventing sale of spy devices❑ Announcement of dual-use devices	<ul style="list-style-type: none">❑ Easier access revocation❑ Providing more legal options	<ul style="list-style-type: none">❑ Identifying dangerous secondary functionality	<ul style="list-style-type: none">❑ Updating access control protocols❑ Improving transparency of IoT devices❑ Increasing attestability

leveraging the abuse vectors framework

researchers

Work towards addressing each vector
Focus on holistic solutions

manufacturers

Consider vectors during design

policymakers

Promote protective legislation [NY CPL 530.12]
Require action from vendors

Abuse Vectors: A Framework for Conceptualizing IoT-Enabled Interpersonal Abuse



Sophie Stephenson

sophie.stephenson@cs.wisc.edu

sophiestephenson.notion.site



MAD S&P

Duke
UNIVERSITY



NYU

CREDITS: This presentation template was created by **Slidesgo**, including icons by **Flaticon**, infographics & images by **Freepik**

References

- Ahmed Alshehri, Malek Ben Salem, & Lei Ding (2020). Are Smart Home Devices Abandoning IPV Victims? *2020 IEEE 19th International Conference on Trust, Security and Privacy in Computing and Communications (TrustCom)*, 1368–1375.
- Nellie Bowles. Thermostats, locks and lights: Digital tools of domestic abuse. *The New York Times*, Jun 2018.
- Albert Fox Cahn and Eva Galperin. Apple's AirTags Are a Gift to Stalkers. *Wired*, May 2021.
- Chuck Martin. Smart home technology hits 69% penetration in U.S. *MediaPost*, Sept 2019.
- Roxanne Leitão. Anticipating smart home security and privacy threats with survivors of intimate partner abuse. In *Proceedings of the 2019 on Designing Interactive Systems Conference*, pages 527–539, 2019.

References

- Tara Matthews, Kathleen O’Leary, Anna Turner, Manya Sleeper, Jill Palzkill Woelfer, Martin Shelton, Cori Manthorne, Elizabeth F Churchill, and Sunny Consolvo. Stories from survivors: Privacy & security practices when coping with intimate partner abuse. In Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems, pages 2189–2201, 2017
- Phoebe Moh, Pubali Datta, Noel Warford, Adam Bates, Nathan Malkin, and Michelle L Mazurek. Characterizing everyday misuse of smart home devices. In 2023 IEEE Symposium on Security and Privacy (SP), pages 1558–1572. IEEE Computer Society, May 2023.

References

- Julia Slupska and Leonie Maria Tanczer. Threat modeling intimate partner violence: Tech abuse as a cybersecurity challenge in the internet of things. In *The Emerald International Handbook of Technology Facilitated Violence and Abuse*. Emerald Publishing Limited, 2021.
- Criminal procedure law (CPL) 530.12: Protection for victims of family offenses. The New York State Senate.