



Computer Vision for Indoor Multimedia Geolocation

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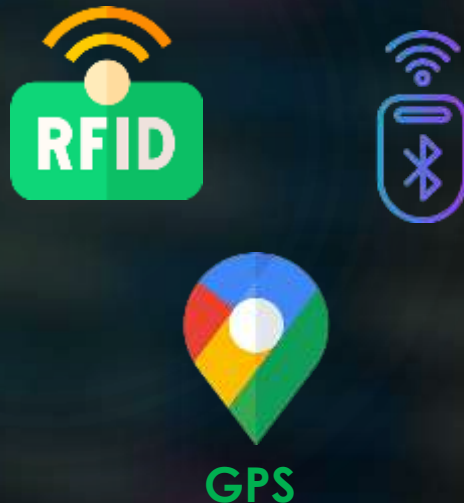


Multimedia Geolocation

- ▶ Multimedia Geolocation: Identifying the Real-World Locations of Images and Videos.

Key Techniques for Multimedia Geolocation

Hardware Sensors



Metadata Analysis



Computer Vision



Problem statement

Why Is Indoor Geolocation Still a Challenge?

- ▶ GPS works well outdoors but struggles indoors.
- ▶ Indoor navigation sensors has range, accuracy, and cost limitations.
- ▶ Social media strips metadata from shared multimedia.
- ▶ Indoors, similar layouts, furniture, and decor make identification difficult.
- ▶ Different angles and frequent renovations can alter image recognition.
- ▶ Lighting changes impact image consistency and accuracy

Computer Vision: A Promising Solution for Indoor Multimedia Geolocation

Primary Motivation

Helping Law Enforcement in Digital Evidence Acquisition

- ▶ Hotel identification is crucial for law enforcement in combating human trafficking and child exploitation [1].
- ▶ Determining locations, serves to identify if certain locations serve as 'hot spots' where victims might be trafficked or abused again.
- ▶ Pinpointing the location allows for faster intervention, potentially saving lives [2].



1. Bamigbade, Opeyemi, John Sheppard, and Mark Scanlon. "Computer vision for multimedia geolocation in human trafficking investigation: A systematic literature review." *arXiv preprint arXiv:2402.15448* (2024).

2. Bhavanasi, Sai Shreyas, and Abby Stylianou. "Hotel Recognition Using Object Ensembles." *2023 IEEE Applied Imagery Pattern Recognition Workshop (AIPR)*. IFFF, 2023.

Victim Identification: Trace An Object



This is a hotel room. Do U know which one?
This info can help police solve a child sexual abuse case. Tell us on europol.europa.eu/stopchildabuse...



5:00 AM · 11 Aug 2017

5,124 Retweets · 629 Likes

130 · 5.1K · 629



peter @under_less · 13.08.17

Replying to @Europol
marlin-creek.com/gallery.html

25 · 25 · 394 ·



Europol @Europol · 13.08.17

Thank you! We have passed on this info to the investigators who will further check it.

2 · 17 · 95 ·



NaNo @NaNONL · 13.08.17

Give the man a present.

1 · 1 · 36 ·



This child sexual abuse image shows what is likely a hotel spa. Do you recognise the place? Your information can help police save a victim. Thank you for sending us your leads on europol.europa.eu/stopchildabuse... #StopChildAbuse



Bo @Huan00 · Aug 13
As I said, Qin Hai motel, Taiwan.



13 · 26 · 262



Replying to @Huan00

Thanks a lot for your contribution! The information has been sent to the investigators!

5:56 AM · 13 Aug 2016

15 Retweets · 81 Likes

3 · 15 · 81



Geek Inked Girl @gucgeek · Aug 13

Replying to @Europol @meowbird @miki000
when I do a reverse image search I do get links to home decoration videos on

[Secondary Application Areas]

Misinformation Detection and Public Safety: Disinformation Spreads Like Fire, endangering Lives



- ▶ During natural disasters disinformation on social media can cause panic hindering effective disaster management.
- ▶ False location claims, such as showing the Hollywood Sign in flames, spread on social media during the January 2025 Southern California wildfires. This created unnecessary panic and diverted attention from actual danger zones [3].
- ▶ AI and computer vision can help verify locations, enabling stakeholders to provide timely and targeted aid.

Research Focus: Content Based Image Retrieval

CBIR is a technique that retrieves images from a database based on their visual content.

- ▶ Global features (colour, shape, texture)
- ▶ Local features (SIFT, SURF)
- ▶ Automated feature extraction (Neural Network)
- ▶ Similarity based on objects
- ▶ Beyond appearance semantic context

Evaluation Methods

1. Automated Computer Vision Evaluation

Uses Mean Average Precision (mAP) @ 5 to assess retrieval accuracy.

2. AI Aided Human Expert Evaluation

When an initial search retrieves 5 to 25* images from a dataset of 50,000, a domain expert reviews the results for relevance.

*Precise threshold is an open question

Fear of AI: Is Ethical Tension in AI Research Hindering Progress?

- ▶ AI needs large datasets for training.
- ▶ Sensitive data (e.g., human trafficking) requires extra caution.
- ▶ Human rights perspective helps address ethical AI challenges.
- ▶ Explainable AI improves transparency.
- ▶ AI is there to assist humans, not replace humans
- ▶ Humans can achieve results, but computer vision can help only speeds it up.
- ▶ The final decision should always rest with humans.



Always “AI-aided Investigation”; never “Go directly to jail, do not pass Go”

Future Directions



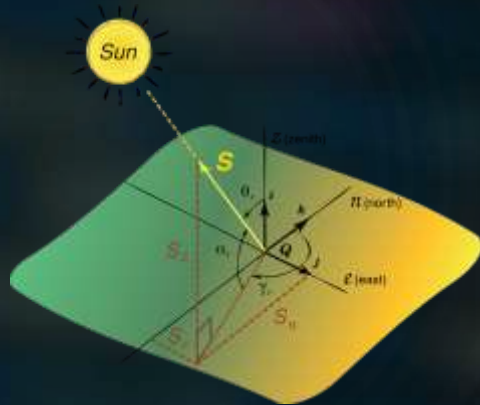
Electrical Plug
Sockets



Beverage Can



Brand/Logo



Sun azimuth



Unique Patterns



Inside Out

Trace an Object Projects



STOPCHILDBABUSE
TRACE an OBJECT

www.europol.europa.eu/stopchildabuse

EUROPOL

WE NEED YOUR HELP

STOPCHILDBABUSE
TRACE an OBJECT



accce.gov.au/trace

Australian Centre to Counter Child Exploitation

AFF

