





Overview of Digital Contact Tracing Technologies and Data in Mapping@Brown

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Google-Apple Exposure Notification (GAEN) System



 In April 2020, Apple and Google worked together to build a decentralized way of allowing individuals to know if they have come into contact with confirmed cases based on Bluetooth Low Energy (BLE) technology.

- Features:
 - Opt-in option
 - No location tracking
 - No identity sharing

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Settings Exposure Not	ifications
Exposure Check Status No exposure identifie Last checked Today at 17:47	ed
Exposure Logging Status Active Your iPhone is exchanging ran phones and logging them. The requests to check your Expos	> Idom IDs with other e past 14 days of ure Log are saved.
Active Region Massachusetts Departn Public Health United States - Massachuse	nent of
Region Website	
Your active region determines t notifying you of possible expos Notifications work	he guidelines for ures. How Exposure
Share a Positive COVID-	-19 Diagnosis
Availability Alerts	
Receive a notification if Expos available in your current regio on a general location check fr	ure Notifications are n. Your region is based om your iPhone.
Turn Off Exposure Notif	ications

PPS Mobility Analysis for Pandemic Preventior Strategies

How GAEN System Works



Components of Digital Tracing



Mapping@Brown

- The objective of Mapping@Brown is to measure and construct social networks at Brown University.
- Note that the core notification function in contact tracing Apps is <u>NOT</u> the focus of this pilot study.

Mobility Analysis for Pandemic Prevention

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Data

Data Needs	Data Collection	Data Analytics	Data Management and Security	Data Privacy and Ethics	
What types of data do we need (ideally) for epidemic modeling and inferences?	What types of data can be collected? Data collection frequency?	How the data collected can be used for epidemic modeling?	Where are the data stored/manag ed? By whom?Reduce the data leakage risk?	Data-first Vs. Privacy- first?	
 MAPPS Mobility Analysis for Pandemic Prevention Strategies 					

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Data Produced in APP Registration Step

Demographic data

- Role
- Age
- Race
- ...

Details regarding behavior patterns

- How many people do you interact with on a daily basis?
- The floor of your office?
- How long do you stay at your office?

Phone Information

- Phone #
- Phone model
- How do you use your phone? [leave it on the table? Put it in the pocket?]

Other . . .



Data Produced in Tracing Step



Outdoor geolocation data Indoor positioning data



Proximity data [relative information]

Distance between two communicating devices

Timestamp data

The moment when two devices "see" each other

The duration of two devices communicating with each other

Mobility Analysis for Pandemic Prevention Strategies

Positioning & Proximity Detection Technologies





GPS: Positioning

- The GPS navigation system uses a network of satellites to locate the exact location of the device.
- Pros
 - Global coverage
 - Helpful in mapping hotspots of transmission
- Cons
 - Battery consumption
 - Bad performance in indoor settings
 - Low resolution for detecting face-to-face interactions

Mobility Analysis for

Privacy concerns



Bluetooth: Proximity Detection & Positioning

- Bluetooth Low Energy (BLE) is an energyefficient, short-range variant of traditional Bluetooth.
- Pros
 - Low power consumption
 - Does not require explicit connections to transfer data between devices
 - Compatibility between different devices/OS

Mobility Analysis for Pandemic Prevention

- Applications
 - Bluetooth for proximity detection
 - Bluetooth for indoor positioning





Bluetooth: Proximity Detection

- Devices can be configured to transmit & scan signals at regular intervals.
- The idea is that the received signal strength (RSSI) provides a rough measure of the distance between the transmitter and receiver.
- Cons
 - The wireless signal is influenced from the operating environment (e.g., furniture, walls, people)
 - Accuracy of the distance approximation



Bluetooth: Positioning

- With the assistance of <u>static</u> Bluetooth beacons, Bluetooth devices can also achieve the indoor positioning goal.
- Requirement:
 - Floor plan map
 - Bluetooth Beacons



Image Source: https://www.ac

WI-FI: Positioning

- WI-FI can also be used to determine devices' locations with the assistance of static WI-FI access points (WAP).
- Cons
 - It requires WI-FI infrastructure that may not be available everywhere, especially outdoors or in remote locations.





Data Collection Flow at Mapping@Brown



Expanding MAPPING@Brown



Auxiliary Data Sources:

Mobility Analysis for

- Sensors on the phone: WI-FI, gyroscope, accelerometer
- Brown's IT facility data (card swipes data, WI-FI access points log data)

Phase 3: Adding Biometrics

Wearable Sensors

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- Sleep
- Activity
- Heart rate (variability)
- Blood oxygen

'Wellness' devices vs. Medical devices

Phase 3 (5-10 yrs+): Adding Biometrics





Translational gaps and opportunities for medical wearables in digital health Shuai Xu, Joohee Kim, Jessica R. Walter, Roozbeh

Challenges:

- App architecture and essential functions/utilities?
- APP adoption?
- Data management? (e.g., what data is stored at where and by whom? Who can access what data?)
- Security? (e.g., the server environment?)
- Privacy? (e.g., what data is produced and by whom? data-first Vs. privacy-first?)
- False positive/negative (e.g., the accuracy of proximity estimation?)



Privacy and Ethics in Pandemic Data Collection and Processing Websites





Workshop Website

https://mapps-brown.github.io/workshop2023/

The workshop materials can be found here. We will post materials to this website throughout the week.

https://icerm.brown.edu/topical_workshops/tw-23-pep/

ICERM Website

The daily agenda will be posted here, and ICERM will live stream the keynotes each day.

