A Field Study of Run-Time Location Access Disclosures on Android Smartphones

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Why Run-Time Location Access Disclosures on Smartphones?

- Large amount of users use Android phones (76 million Android users in US)
- 74% smartphone users use location-based services
- Users are interested to know about their location usage by apps
  - Previous technical report showed that more than 70% of participants (n=791) desired to know about location data collection by apps on mobile devices (Balebako 2013)
- Feedback is one of the two principles in privacy design (Bellotti 1993) and immediate notifications was effective to inform users about location request for contextual instant messaging (Hsieh 2007)
Existing Location Access Disclosures

- Android permissions at installation time

- Permissions are **not effective**
  - Users ignore the permission list
  - Users do not understand the permissions
Existing Location Access Disclosures

- Android GPS icon flashing at run-time
  - When the app is trying to update location using GPS, the GPS icon flashes on the upper left corner

- Effectiveness? Unknown
What is the **effectiveness** of Android GPS icon flashing at run-time?

What **better** run-time location access disclosure methods should be?

What are users’ reactions if they were notified of their apps accessing location in daily life? We note that these apps are used of their own choice on their own phones.
User level study app can be installed on participants’ phones without any changes
- Detect apps’ location access at run-time
- No changes to participants’ phones
Study App’s Disclosure Features

- Run-time location access disclosure features
  - Notifications in the notice bar
  - Toast notification on screen
Four-Week Field Study

- Recruitment
  - Flyers, Mailing list, craigslist, enrollment on campus
- Study Procedures
  - Entry Interview
  - Install study app
  - 4 weeks intervention in daily life
  - Exit Interview
Four-Week Field Study

- Assign randomly to two groups before entry interview
- Totally 22 participants in two groups to analyze
  - Disclosure group (n=13)
  - No Disclosure group (n=9)
Almost all participants had several apps unexpected to access location in both groups

12 out of 13 participants in the Disclosure group unexpected some apps to access location

- Mean of number of apps: 6.4, sd=5.4

8 out of 9 participants in the No Disclosure group unexpected some apps to access location

- Mean of number of apps: 5.7, sd=3.3
Results: Reactions in the Disclosure Group

- Uninstall apps after receiving disclosures
  - P11 **uninstalled** a Launcher App unexpected to access location
    
    "a launcher app did not need location for its function"

- Uninstall app was an **extreme action**, the apps were not available on the phones any more after being uninstalled.
Results: Reactions in the Disclosure Group

- Uninstall apps after receiving disclosure notifications
  - P4 uninstalled 3 game apps

  "not like these apps accessing location, not need these apps any more"
Stop using some apps after receiving disclosure notifications

- P4 and P5 stopped playing some games unexpected to access location

“If a game access my location I will not play the game anymore.”
Results: Reactions in the Disclosure Group

- Reduce frequency of using some apps

- P6 tried to use other apps to replace the apps unexpected to access location by using other apps

“would pay attention to these apps and use them more carefully”

“not have reasons to access location”
Results: Reactions in the Disclosure Group

- Disable location access setup for the app
  - P2 disabled location access of a game app unexpected to access location
  - “still worked well after location being disabled”

- Most participants might prefer this action, but participants assumed most apps did not give the option to disable location
Disclosure group Learned How Apps Used Their Location Data

- Apps’ location usage learned from run-time disclosure

- Participants learned how often each app accessed location. They might make different decisions depending the frequency.

“I would like to know the times each app accessed location… if I know some apps access my location too often, I would probably stop using them.”

“Your app used to notify me … which of the app was accessing location at what time. Sometimes I was surprised, oh this app used my location sort of that way.”
Disclosure Group Appreciated the Transparency

- Transparency brought by the run-time disclosure was appreciated by participants in the Disclosure group.
  - Most participants would like to be aware of what was happening on their phones.
    - “Actually it made me more aware of what was going on. I appreciated that.”
  - Most participants would like to continue receiving the notifications in the notice bar.
Questions?

Thank You!