

Towards Usable and Secure Location-based Smartphone Authentication

Geumhwan Cho

Sungkyunkwan University

Sungsu Kwag

Samsung Research

Jun Ho Huh

Samsung Research

Bedeuro Kim

Sungkyunkwan University

Choong-Hoon Lee

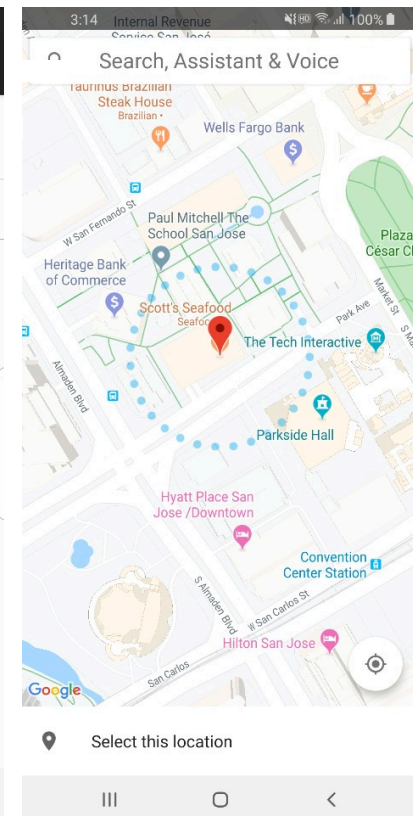
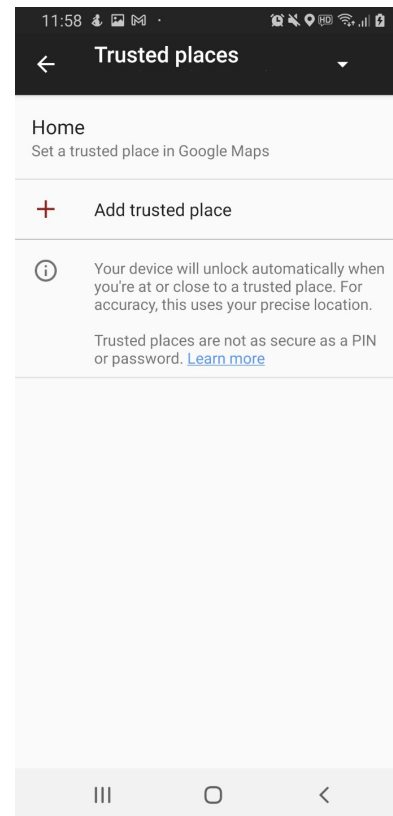
Samsung Research

Hyoungshick Kim

Sungkyunkwan University

Location-based Authentication

- Android currently provides a location-based authentication option (using GPS)
 - As a result, phones may remain unlocked within a radius of up to about 80 meters (from the registered spot)



Requirements Study

- We conducted an interview study with 18 participants
 - Understanding users' perceptions and expectations on location-based smartphone authentication
- We asked participants three simple questions about how location-based authentication service would work in practice
 - e.g., *“What happens to your phone when you physically move to a place that you already registered as a trusted location?”*

Requirements Study: Results

- We summarized 6 key design requirements
 - Indoor locations
 - Multiple locations
 - Adjustable location sizes
 - Setup time
 - False rejection rates and false acceptance rates
 - Battery use

Field Study

- We implemented a fully functional location-based authentication application (**Loclock**)
- We investigated what type of trusted locations are registered and gauge how useful the app is in reducing users' manual phone unlock burden
- 29 participants completed the study
 - Were asked to use Loclock Android app with their own smartphone for 3 weeks
 - Were instructed to register/remove trusted locations freely, and select/adjust trusted location sizes based on their needs
 - Came back to revisit and participate in a short post-interview

Results: Registered Locations

- 65 locations were registered at the end of the study
 - 21 participants (72%) registered two or more locations as trusted locations
- **“Home”** was the most frequently registered trusted location
 - It seems to be the most representative trusted place for location-based authentication
- **“Office”** was the second most frequently registered

Location (# Participants)	Zero (1)	One (7)	Two (13)	Three (3)	Four (3)	Five (1)	Six (1)	Total (29)
Home	0	0	10	2	2	1	0	15
Office	0	3	5	2	2	1	0	13
My room	0	3	4	1	1	0	0	9

Results: Registered Locations

- Several public locations were registered

Location (# Participants)	Zero (1)	One (7)	Two (13)	Three (3)	Four (3)	Five (1)	Six (1)	Total (29)
Church	0	0	4	2	0	0	0	6
Sport facility	0	0	1	1	1	2	1	6
Lecture room	0	0	0	0	1	0	2	3
Cafe	0	0	0	0	0	1	1	2
Hospital	0	0	0	0	1	0	0	1
Library	0	0	0	0	0	0	1	1
Subway station entrance	0	0	0	0	0	0	1	1

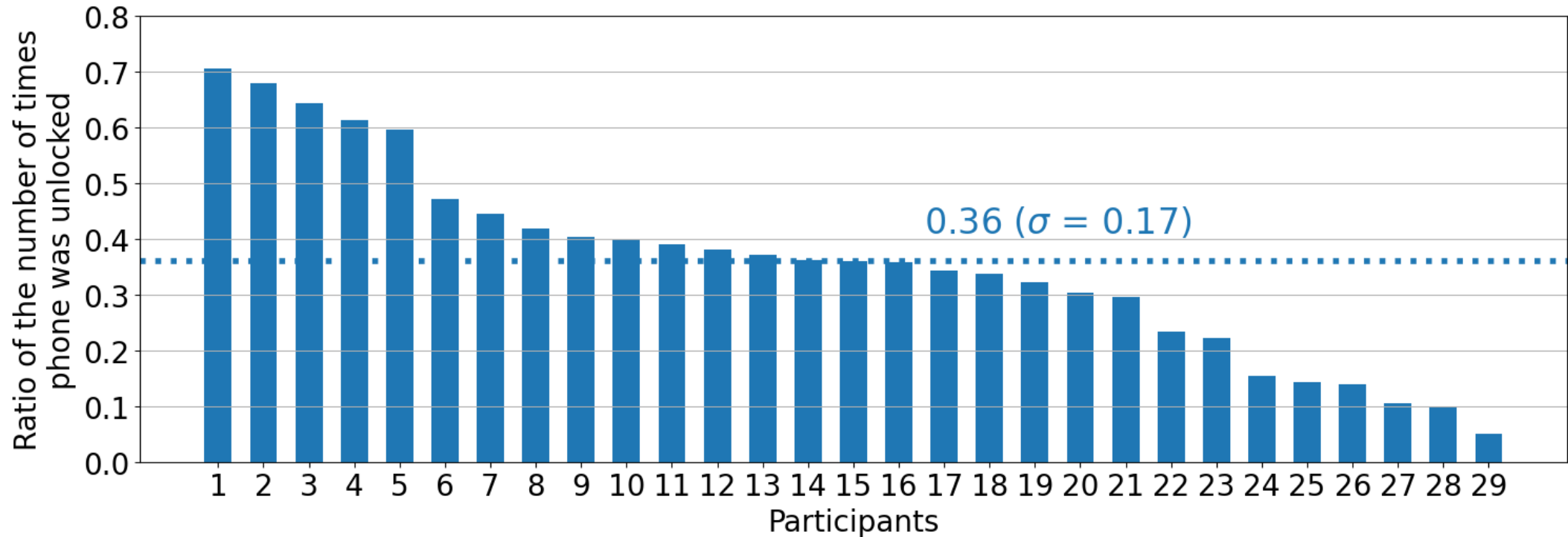
Results: Trusted Location Sizes

- Only one instance of “my room” was registered with a size smaller than 5 meters
- A large portion of public locations was registered with sizes “>10m” (11 out of 20 public locations)
 - Raise security concerns about some users’ size preferences

Location	0-5m	5-10m	>10m
Home	0	6	9
Office	0	6	7
My room	1	7	1
Church	0	2	4
Sport facility	0	4	2
Living room	0	5	0
Lecture room	0	0	3
Bathroom	0	1	1
Cafe	0	2	0
Hospital	0	1	0
Kitchen	0	1	0
Library	0	0	1
Subway station entrance	0	0	1
Total	1 (2%)	35 (54%)	29 (45%)

Results: # of Unlock Attempts

- Loclock reduced manual unlock attempts by 36% ($\sigma=17\%$)



Results: Security of Registered Locations

- 52 out of 65 registered locations were considered insecure
 - All public places were considered “**insecure**” except for one instance of church registration
 - 12 “home” were considered “**insecure**”
 - ✓ four “my room,” two “living room,” and two “bathroom” were also considered insecure

* we labeled a given registered location as “**insecure**” if a participant said her phone can be accessed by unwanted individuals

# Locations	Secure	Insecure	Total
Home	3	12	15
Office	1	12	13
My room	5	4	9
Church	1	5	6
Sport facility	0	6	6
Living room	3	2	5
Lecture room	0	3	3
Bathroom	0	2	2
Cafe	0	2	2
Hospital	0	1	1
Kitchen	0	1	1
Library	0	1	1
Subway station entrance	0	1	1
Total	13	52	65

Conclusion

- Identified essential requirements for building usable and secure location-based authentication services
- Reduced 36% of explicit authentication attempts
 - Clear usability benefits
- Revealed that people tend to register insecure locations
 - Convenience or perceived low likelihood of phones being attacked in those locations



CONTACT

Security Lab.

Sunkyunkwan University

hyoung@skku.edu