Detecting Social Interactions using Multi-Modal Mobile Sensing

Kleomenis Katevas, Katrin Hänsel, Richard Clegg,
Ilias Leontiadis, Hamed Haddadi, Laurissa Tokarchuk

12-13 September, MobiUK 2018

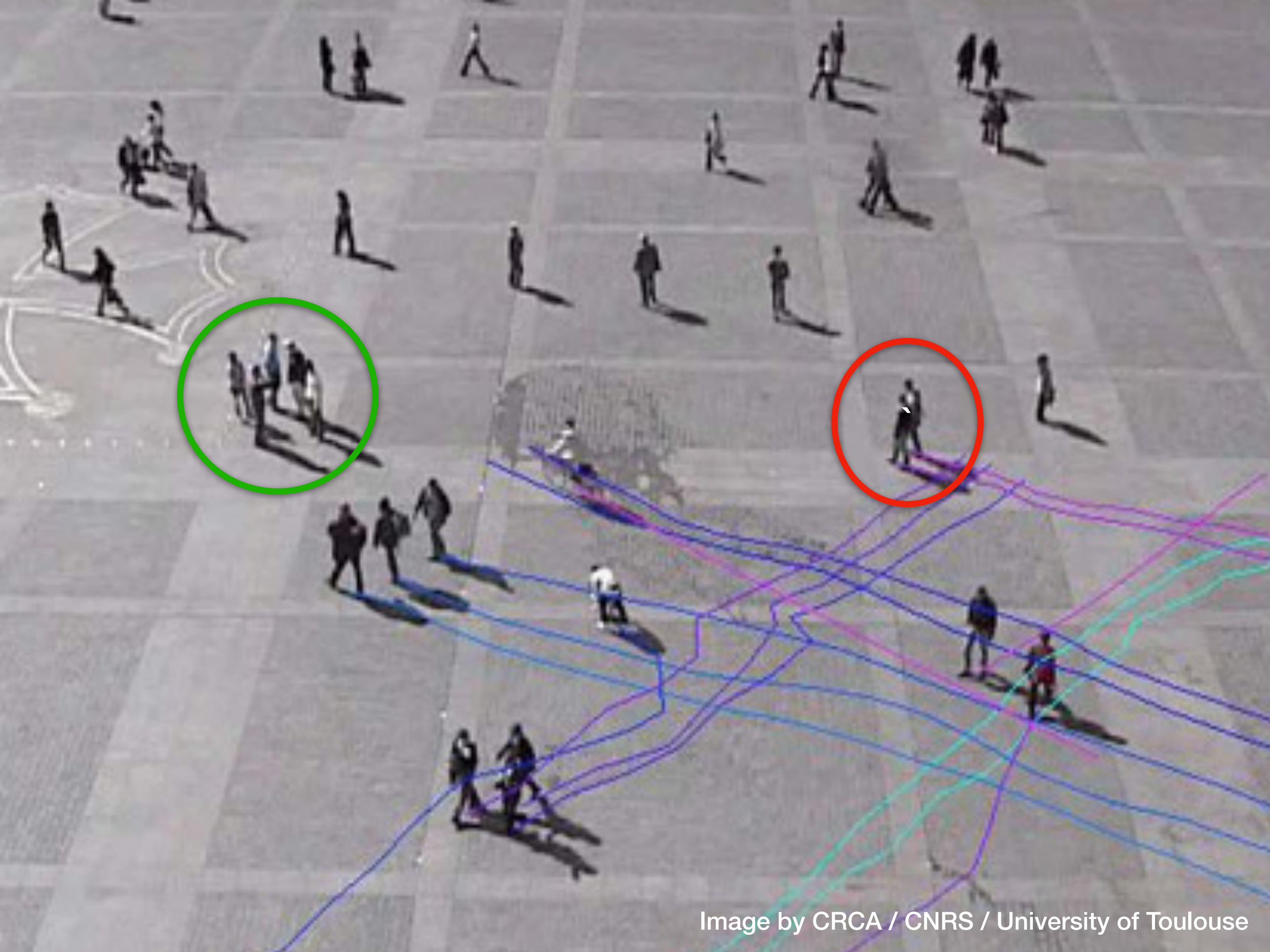
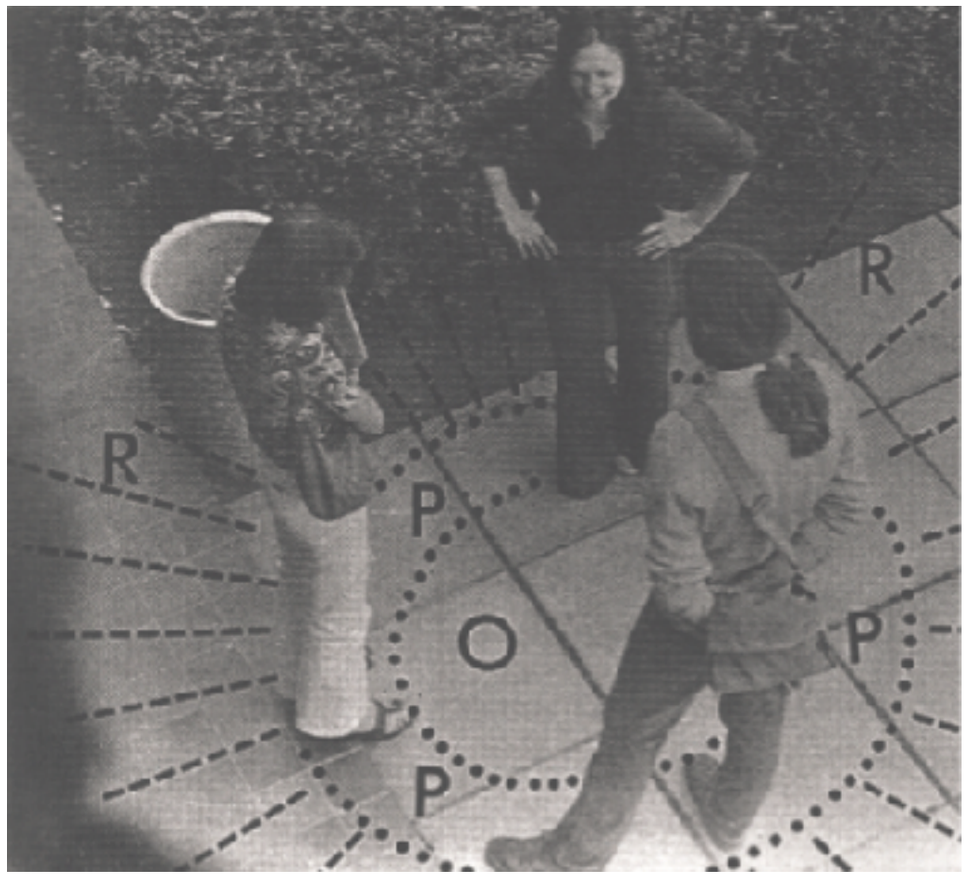


Image by CRCA / CNRS / University of Toulouse

Kendon's F-formation System

"two or more people cooperate together to maintain a space between them to which they all have direct and exclusive access"
(Kendon,1990)

- Directly facing each other.
- A distance between people exists (O-space).
- Rarely cross the "O-space".
- Re-adjusting their position to maintain the F-formation.
- They remain structured and organised among most situations.



Research Questions

- *How can we detect stationary social interactions happening in planned events using mobile sensing technology?*

- *Which phone sensors are the most appropriate?*

Why is this important?

Social Networking Study

Case Study:

- 45 minutes speed networking event.
- 24 Participants:
  - 10 Male and 14 Female
  - Age 19 - 28 years
- iPhone users using a data collection app based on SensingKit framework.

SensingKit
https://sensingkit.org

Collected Data:

- Accelerometer
- Gyroscope
- Motion Activity
- iBeacon™ Proximity
- *Magnetometer*
- *Arm acceleration*
- *Heart rate*
- *Temperature*
- *GSR (skin conductivity)*

Radius RadBeacon Dot

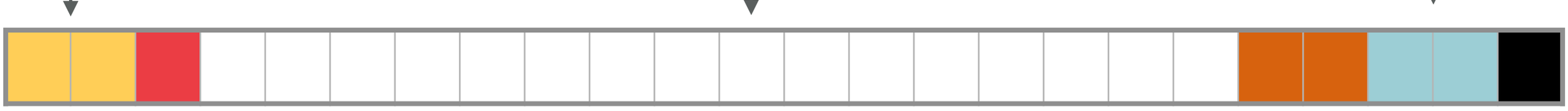
Estimote Location Beacon

iBeacon™ Proximity

Company ID
(Apple: 0x004C)

UUID
(16 byte hex)

Minor
(uint 0-36535)



Type
(always 0x02)

Major
(uint 0-36535)

Measured Power
(rssi in 1m distance)

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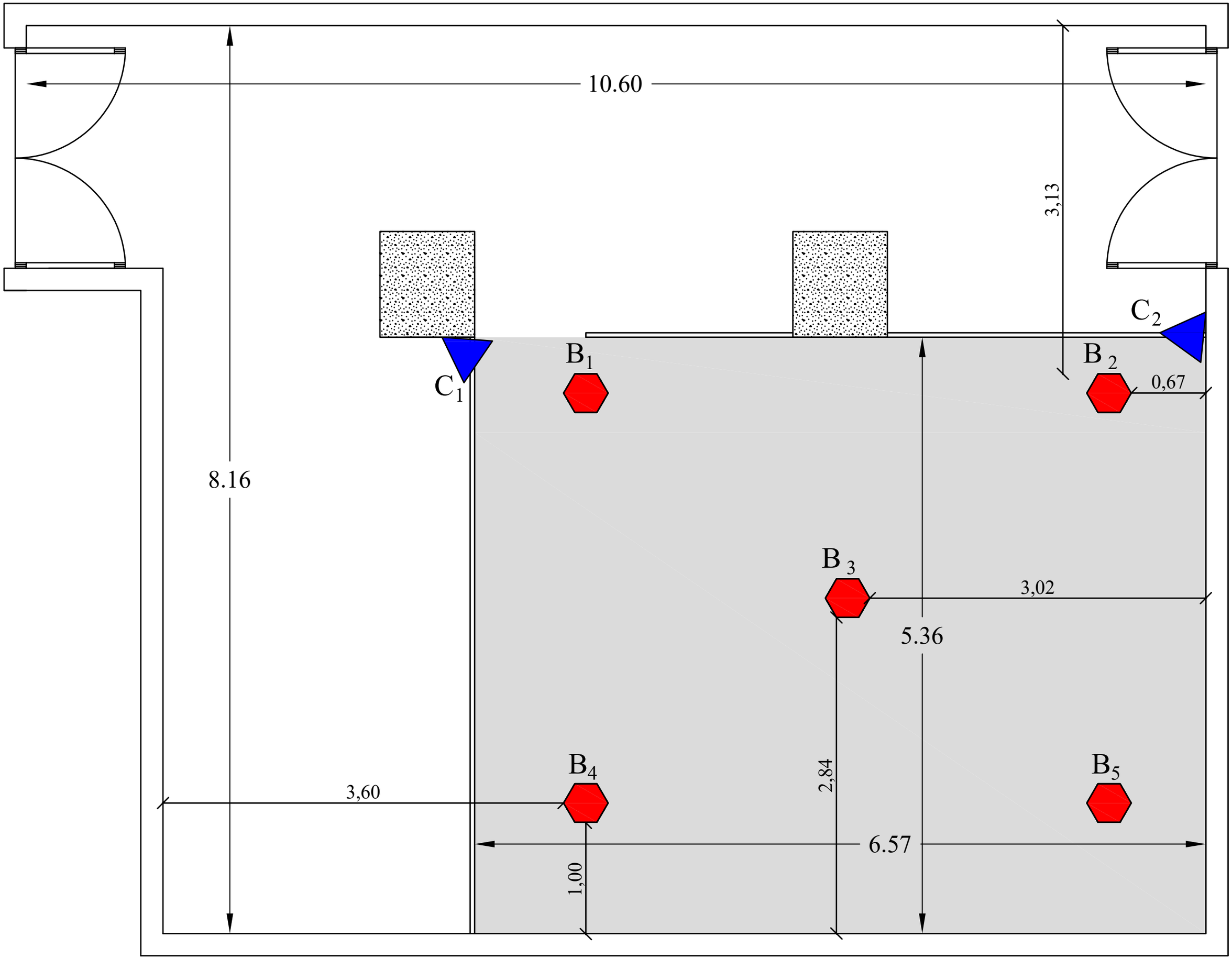
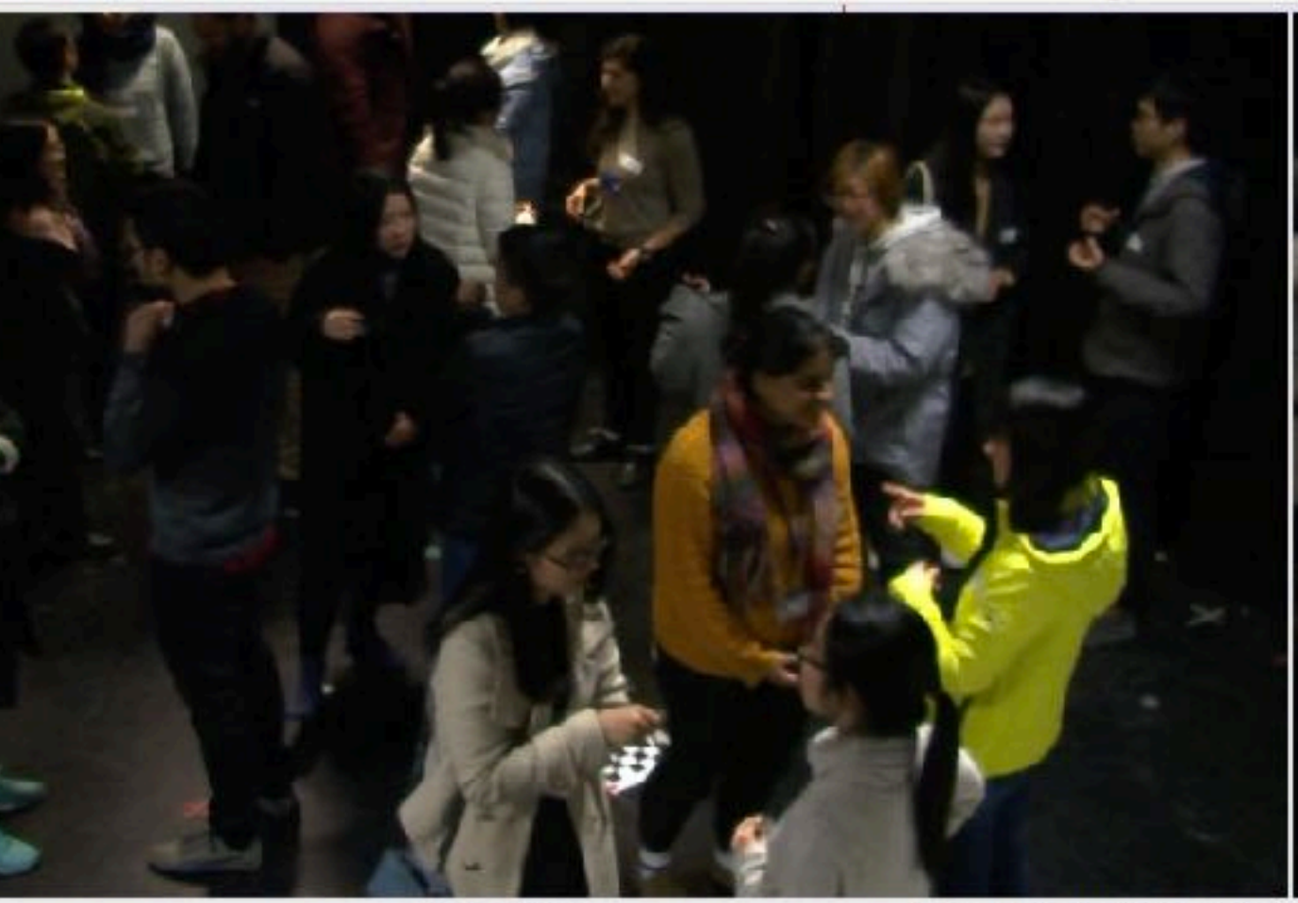

10.60
3,13
8.16
C1
B1
B2
C2
0,67
B3
3,02
5.36
B4
3,60
2,84
B5
6.57
1,00

ELAN 6.2 - Experiment.eaf



00:08:13.000 Selection: 00:00:00.000 – 00:00:00.000 0

Selection Mode Loop Mode

00:03:20.000 00:05:00.000 00:06:40.000 00:08:20.000 00:10:00.000 00:11:40.000 00:13:20.000 00:15:00.000 00:16:40.000 00:18:20.000 00:20:00.000

S1

P1 G005x G012x G2, G015x G037x G038x

P2 G004x G016x G018x G035x G034x G039x

P3 G001x G G011x G019x G040x G051x

P4 G008x G020x G035x G043x G044x

P5 G007x G017x G045x G G046x G048x

P6 G010x G006x G2, G015x G049x G050x

P7 G003x G021x G028x G037x G042x G051x

P8 G009x G023x G025x G045x G G052x G053x

Data Analysis

Binary Target Variable:

{1} a pair is interacting together

{0} a pair is not interacting

74 features for each of the C(24,2) = 276 user combinations:

- Interpersonal Space (2)
- Device Position (one-hot encoded)
- Indoor Positioning (5)
- Motion & Orientation (7)
- Past Information (56)

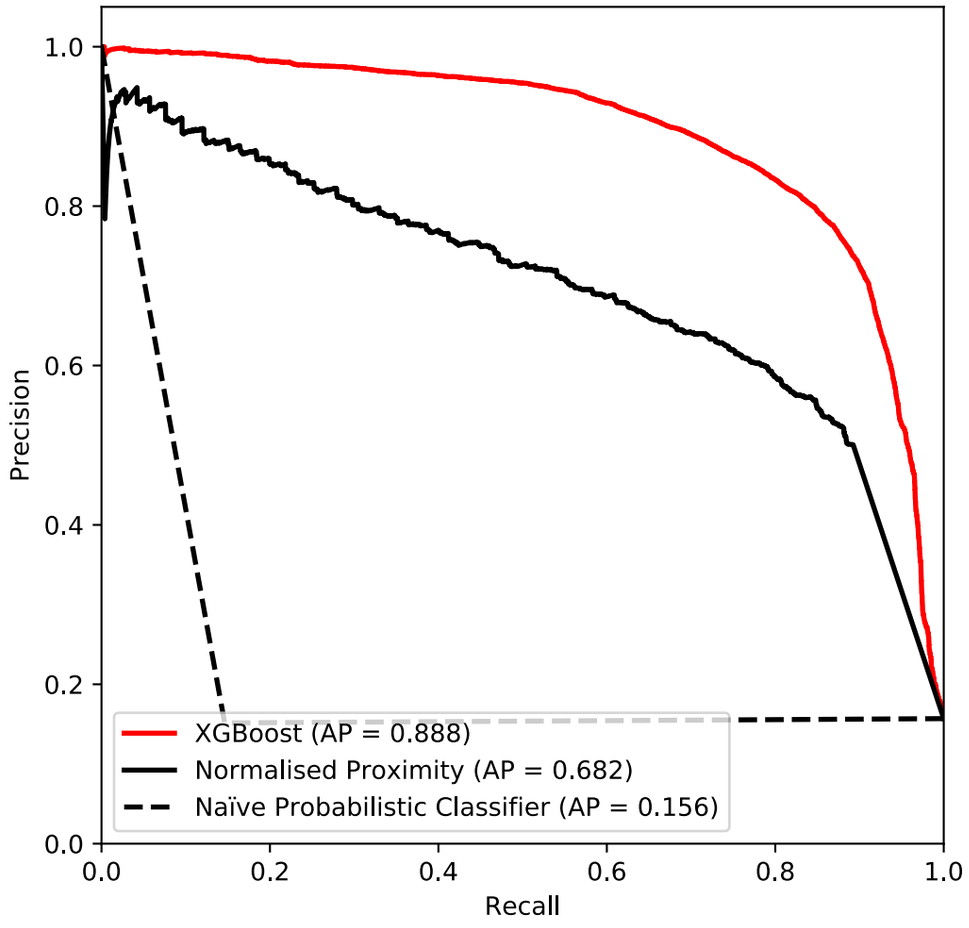
Evaluation

- **Link-level** - a link represents an interaction between a pair of participants.

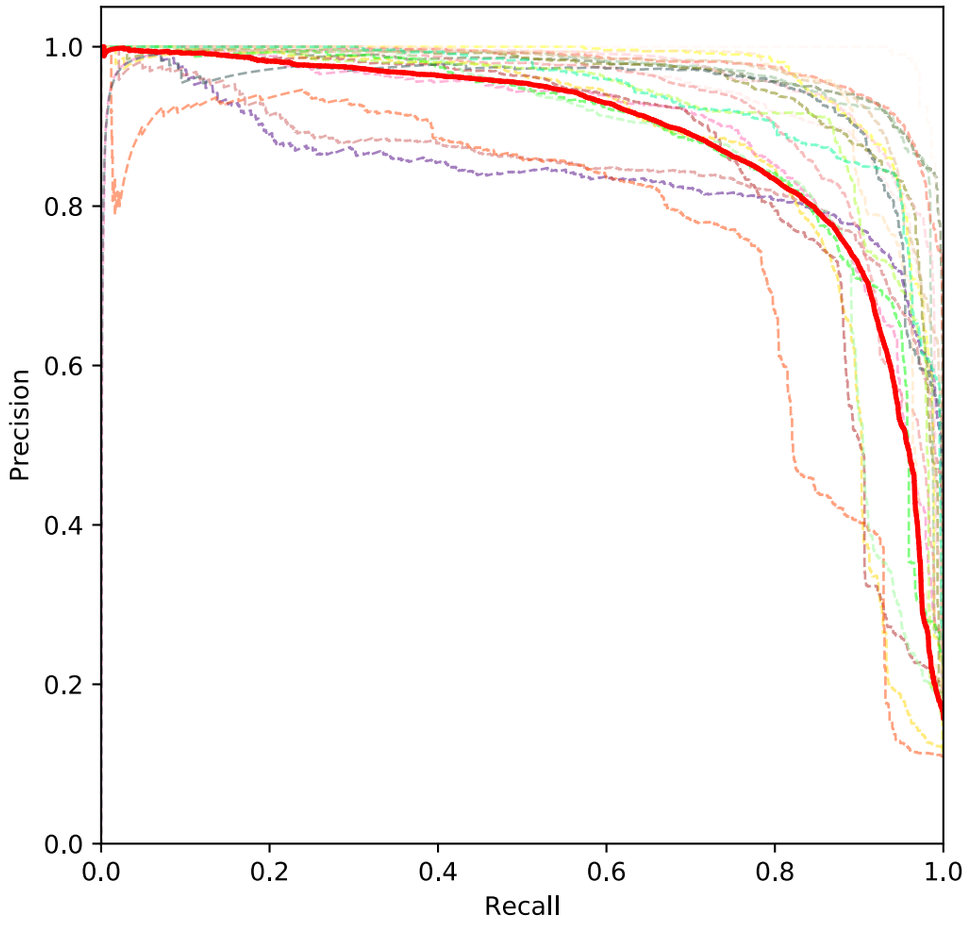
- **Node-level** - a node represents a participant that belongs to the correct interactive group.

- **Group-level** - a group is detected to include the correct participants.

Results - Link Level

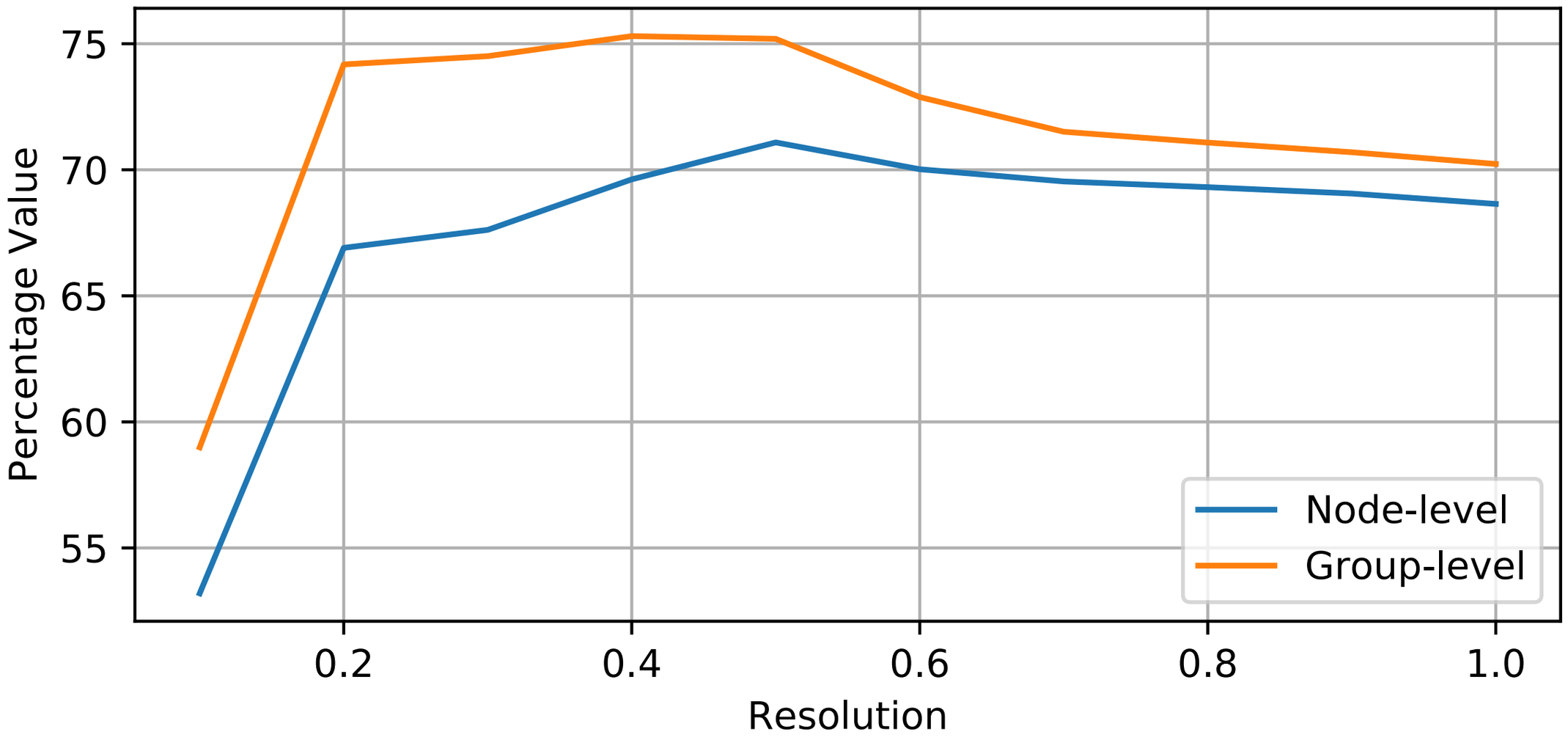


General Performance



Performance per Participant

Results - Node/Group-Level



Summary

- We detect stationary social interactions inside crowds using mobile sensor data.

- We achieved a performance of 77.8% precision and 86.5% recall in link-level, 71.09% in node-level, and 75.19% group-level evaluation.

- Evaluation was made in a natural setting with 24 participants.

- Dataset (anonymised) will be available in CrawDad repository *(https://crawdad.org).*

Future Work

- Explore the use of the relative orientation using the magnetometer sensor.

- Investigate other types of social interactions, such as the flocking behaviour.

- Apply the model in a real-world social event and present analytics about the ways in which people are interacting.

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Laurissa Tokarchuk
Queen Mary University of London

Queen Mary University of London

Imperial College London

Telefónica

Thank you for your attention!

For more details, please read:

Finding Dory in the Crowd: Detecting Social Interactions using Multi-Modal Mobile Sensing
Kleomenis Katevas, Katrin Hänsel, Richard Clegg, Ilias Leontiadis, Hamed Haddadi, Laurissa Tokarchuk
Under Review. Preprint is available in arXiv.

SensingKit — A Multi-Platform Mobile Sensing Framework for Large-Scale Experiments
Kleomenis Katevas, Hamed Haddadi, Laurissa Tokarchuk
Extended abstract, ACM MobiCom 2014, Maui, Hawaii, September 2014.

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