Video: Enabling Public Cameras to Talk to the Public

Siyuan Cao, Habiba Farrukh, He Wang
Purdue University
{cao208,hfarrukh,hw}@purdue.edu

ABSTRACT

This video presents a real-time end-to-end system which enables cameras to send personalized messages to people in a public area without knowing any addresses of their mobile phones. For facilitating this communication, we solve the problem of digitally associating people in the camera view with their smartphones without prior knowledge of the phones' IP/MAC addresses. The system doesn't need any dedicated devices and doesn't request people to wear digital tags. It utilizes users' motion patterns and leverages the diversity in motion features as the address for communication. The cameras broadcast a message to all the phones in the camera view using the target's motion features as the destination. Then a user's phone can locally compare the "motion address" of the packet against its own sensor data and will accept the packet if it's a "good" match. To protect the privacy of users' sensor data, we keep the users' personal sensing data on their phones instead of asking them to upload the data to server. Moreover, to prevent users' walking behavior from being revealed to public, we transform the raw motion features via principal component analysis (PCA) while maintaining their distinguishing power. On the whole, our system achieves 98%, 95%, 90%, 90%, 87% matching correctness for 2, 4, 6, 8 and 10 users respectively.

CCS CONCEPTS

• **Security and privacy** → **Privacy protections**; • **Networks** → **Naming and addressing**; *Mobile networks*; • **Software and its engineering** → Real-time systems software;

KEYWORDS

Human addressing, motion features, camera, communication, principal component analysis

1 INTRODUCTION

In our demo, we created a museum setting with some paintings and sculptures arranged in a university lobby, as shown in Fig. 1. Volunteers were asked to put a phone in their pocket and naturally

Figure 1: Experiment scenario imitating a museum setting with ten users walking in a university lobby.
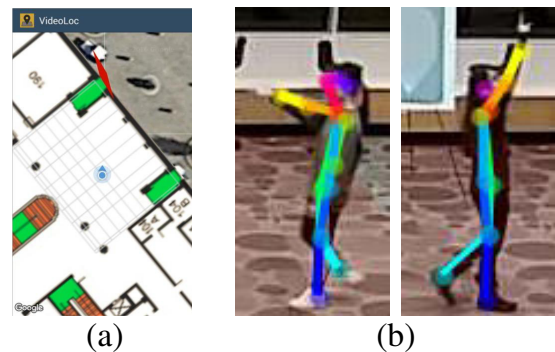

Figure 2: (a) Indoor localization. The app shows user position and direction. (b) Gesture-based messaging. Poses when pointing to the left wall or the roof.

walk around the lobby. When a person shows interest in an exhibit, an introduction about that particular exhibit will be sent to her via a customized message with the user's behavioral address as its identifier.

In the video, we have demonstrated two applications of our system. (1) **Indoor localization**. Our system can be adopted into a localization application by simply using location information obtained from the video as part of customized messages. Fig. 2(a) shows the app we implemented to receive and show real-time locations for the phone users walking in the lobby. The localization accuracy is barely affected by the number of users, since the locations don't rely on any wireless signal. (2) **Gesture-based messaging**. As an example of context-aware messaging, we asked some volunteers to imagine that they could see murals on the walls (left wall, right wall, and the roof of the lobby) and point at them to get introduction messages. We detect these pointing gestures using the body parts generated by OpenPose [1] and send customized messages to the user according to the "mural" that it is pointing at.

REFERENCES

[1] Zhe Cao, Tomas Simon, Shih-En Wei, and Yaser Sheikh. 2017. Realtime Multi-Person 2D Pose Estimation using Part Affinity Fields. In *CVPR*.