Characterizing pedestrian mobility and wireless network performance in public transport environment

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(1) Motivations: In wireless networking environment, mobility patterns of nodes have been found to have significant effects on network performance. However, current theoretical mobility models and real trace (randomness) can not reflect the network simulation results properly. Therefore, this work aims to characterize realistic pedestrian mobility patterns based on real-world human walking traces and use them to evaluate wireless network performance in public transport environment.

(2) Data: The trace data were collected from a train station in Japan (Fig. 1), including two data sets: a five-minute set with 367 pedestrians, and a ten-minute set with 2,438 pedestrians from 7:00 and 8:00 inclusive. Each trajectory has a description about 20 seconds, including a pedestrian ID number, frame tag, time tag, and location information.

(3) Methods: We characterized pedestrian mobility features including the distribution of pedestrian population, walking speed, travel distance, and lifetime from the data. To capture the human walking information in the network, we determined a general parameter set for the pedestrian mobility model. Two parameter sets are used: a stationary set which captures the spatial component of user movement, and a mobile set which captures the user's temporal behaviors. We found that a set of pedestrians are doing the similar activities during a few sub-regions; pedestrian movement patterns have reference-oriented features; and different types of users exist. Based on these observations, we develop a public transport area pedestrian (TSP) mobility model which extends the existing data sets by capturing the walking people's preference-oriented features, and classifies users in three types: busy, leisure and random users.

(4) Evaluations: The simulation is to determine the impact of realistic pedestrian mobility patterns on the wireless network routing performance. We evaluate the wireless networking routing protocols AODV and DSR in TSP, real trace and RWP. In TSP, preliminary simulation results show that when the pedestrian moves fast, the packet delivery ratio is high, and the average end to end delay is low, because the preference-oriented characteristics of pedestrian mobility influence the neighbor patterns of each user which in turn influence the wireless routing performance.

(5) Conclusions: Our work is an important step towards characterizing real-world pedestrian mobility in different outdoor environments. This work supports designers of wireless networking applications to understand inherent design constrains in the real world and provision of trace-based simulation tools. Such tools could be used to design future pervasive applications such as simulating how users aggregate in a target region to play a friend-finder game, or other context aware services.

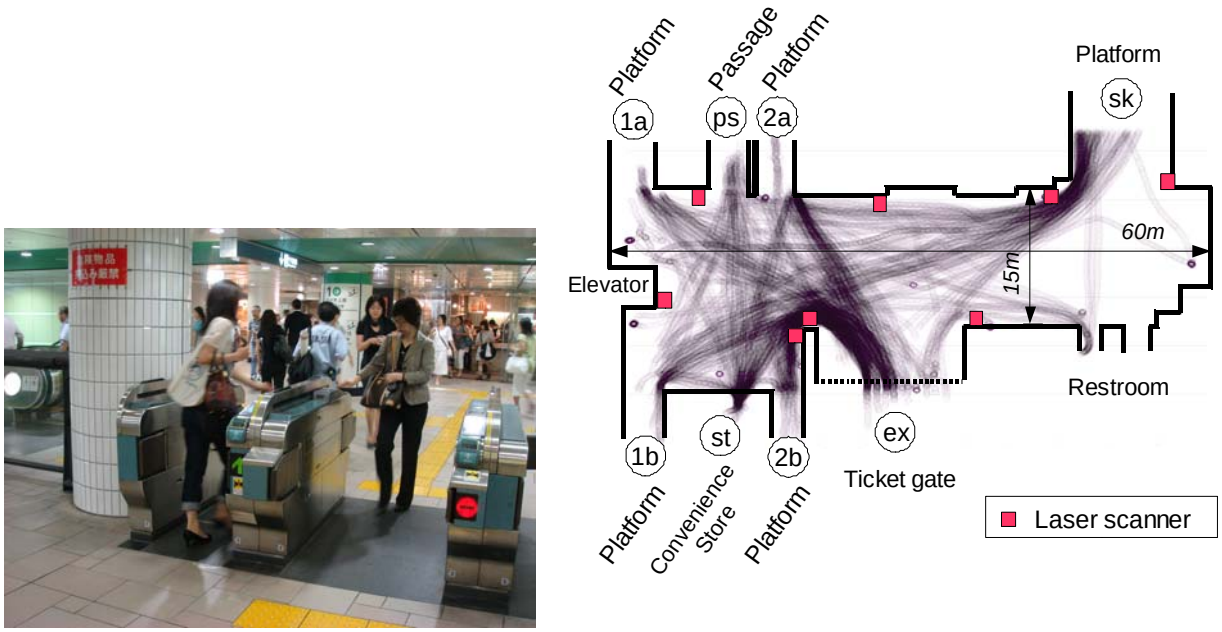

Fig. 1: Pedestrian walking trajectories in a train station.