A Detection Mechanism for Miss-Measuring Points in Human Probe Sensing

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Abstract: Participatory sensing is emerging system for collecting minute statistical information by gathering information from participants as the rapid spread of Smartphone mounted multiple sensors. However, noise from participants during walking is not taken into consideration of device heterogeneity. In this position paper, we describe that design and implementation participatory environmental sensing system using Smartphone, and conducted the walking experiment with 40 participants for sensing the noise of Setagaya Ward. Additionally, we presented the method for calibration of sensing data.

Keywords: Participatory sensing, Mobile Sensing, Data Calibration, Environmental Sensing

1. INTRODUCTION

Participatory sensing [1] with large numbers of users is one of the emerging research fields. Especially to monitor and evaluate comfort of living environment is one of the important application of participatory sensing[2] for reducing stress of local residents and workers[3]. However this kinds of research [4,5] still stay in the small field work not large scale evaluation.

We have evaluated large town Setagaya Ward which is more than 60km^2. At total, more than 40 people join this noise sensing project.

In this position paper, we report the middleware of noise sensing and results.

2. RELATED WORK

[8] was tried spectral analysis of noise and specify the source of sound. However it is quite difficult to do this kinds of monitoring in real-time on the resource limited Smartphone

H. Lu[7] have classified the sound into several categories like music sound, talking sound.

on the Smartphone. However the cost of energy and running duration is not evaluated at the real situation.

To estimate user's indoor location, [9] use not only sound but camera and other sensors on Smartphone

R.K. Rana [10] have developed noise sensing system using Nokia N95 and HP iPAQ.

and proposed the method to create noise map complementary. However they used only the prepared data by special still of noise sensing.

We try to create a system which support by general Smartphone users without any special training and knowledge.

3. LARGE SCALE SENSING

3.1 Sensing Application

Fig1 show Trajectory sensing appli for Android. This application can record acceleration, gyro, light and sound volume with GPS data. We have developed a Check map for mark the sensed places. If a pedestrian finished a sensing point, she/he can mark green on the map application. It suggest nearest marking point and direction by calculating distance.

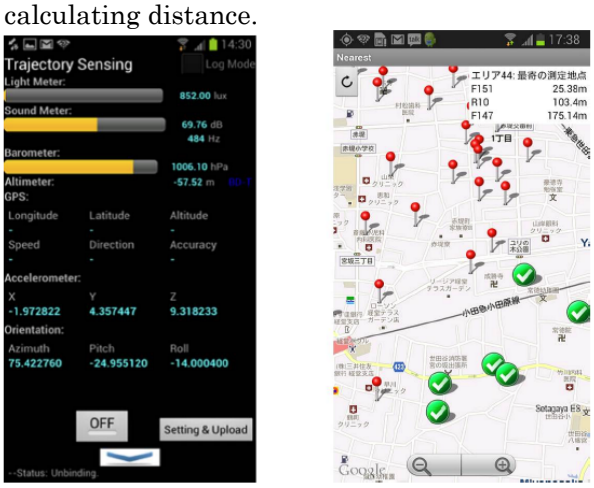

Fig1. Trajectory Sensing Appli which can record various sensor value(Right), Check map appli for users.

3.2 Data Correction

We previously have analyzed difference of noise level in side an anechoic chamber room(Fig2)

Each android phone has a specific characteristic of mic configuration. We create correction curve for each smartphones.

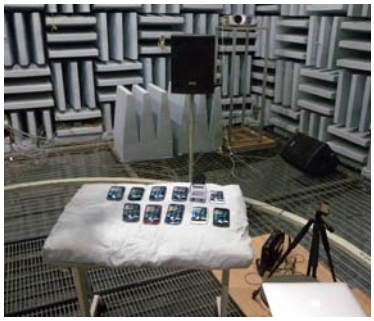

Fig2 show the correction analysis of android devices

4. EXPERIMENT

4.1 Experiment at Setagaya Ward

All participants have arm band to hold smartphone

and they also have another phone to use a Check map appli.

Fig3 Participatory Noise Sensing Style

4.2 Results

Fig4 show the GPS trajectories of 40 participants. Each user walks 2hours at a time.

Fig4 trajectories of 40 pedestrians

In Each trip, there are several noise levels like Fig5.Normally it is noisy around station or near large load.

Fig5 difference of noise level in one trajectory

Data from each phone is converted to correct vale of noise level.Fig6 shows the total map of converted noise level at Setagaya Ward.

From this map, we can estimate noisy area and quiet area at a glance. This map can be adapted analysis of housing fee and monitoring of factory noise impact.

Fig6 Noise Map of total Setagaya Ward

5.Error Detection

Fig7 shows a regular path of sensing.

However there are several miss sensing patern like Fig8-Fig11.

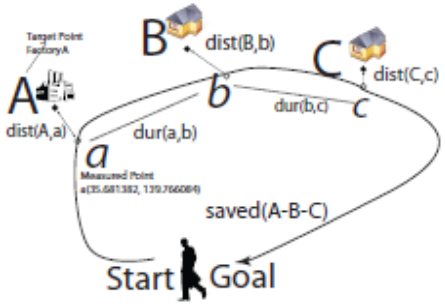

Fig7 Regular pattern

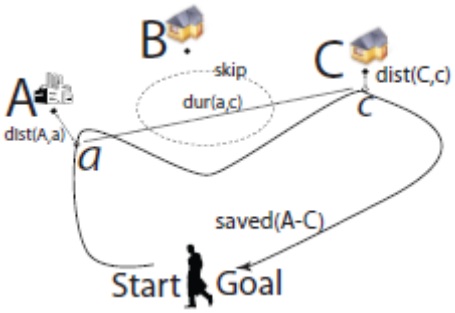

Fig8: Skipping Failure

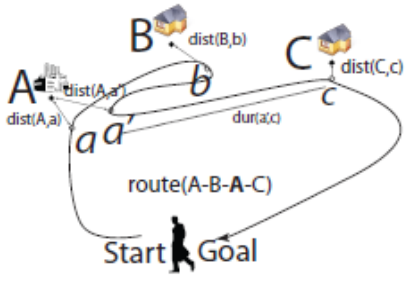

Fig9 Double checking Failure

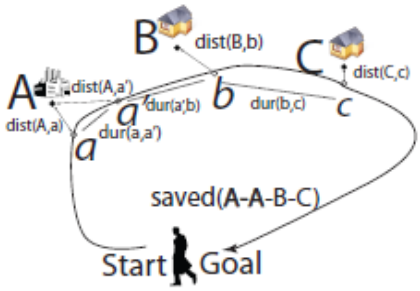

Fig10 Miss tapping Failure

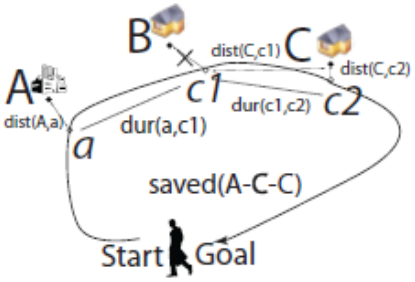

Fig11 Confusion Failure

We define an index of doubtful sensing points like Fig12. First criteria are the distance from measured point and target point. Second criteria are the duration of sensing by one person. Third criteria are number of visiting by one person.

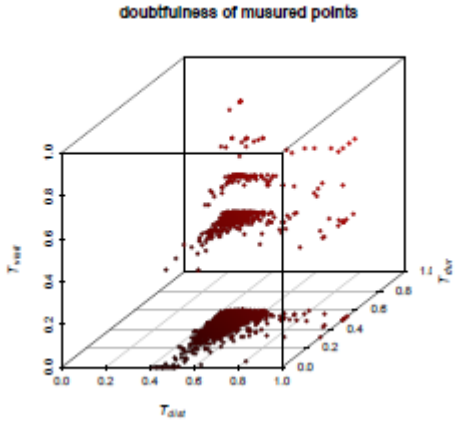

Fig Visualizing of Doubtful point using Duration, visiting Times, and Distance

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