

# Gathering Information on User Environment

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Nowadays people use mobile devices on daily basis. Coverage of wireless networks, mobile devices and software platforms is making mobile computing mainstream issue. Every user is situated in certain environment, which provides contextual information. Context represents situation or condition [2]. Context can be simple as location, or complex like emotions. In our work we focus on obtaining location context as contribution to social context acquiring. We need to define effective way of obtaining location context. We propose method for tracking user's location in time, estimate future location of user and define user's important places. These information can be further used in recommendation systems.

There are existing solutions based on acquisition location using GPS module on mobile devices. This is not very battery efficient, so our solution use GSM transmitters. We map GSM transmitter towers to GPS positions which solves problem with energy consumption. There is certain lack of accuracy in using position obtained by using GSM transmitter, but it is still pretty accurate for our purposes and we can use this lack of accuracy for privacy and security improvement.

There are services for obtaining user's and friend's location. They are mostly oriented for real time tracking. It means that user needs internet connection for obtaining location and also GPS module. There are cons for these solutions, for example high energy consumption due to using GPS module. The advantage is that these solutions are relatively accurate (less than 10 – 20 meters).

People visit various places daily and their location can form connection between people, friend via places. People's co-presence in places provides linkage between people or between places. [1]. This can be useful for us determine social context for user. If we can determine social connection between user and his friend, we can easily suggest, for instance, meeting or any other activity using other context – calendar. Our concept of obtaining user's location lies in implementing mobile application, which provides useful service for user and also helps to obtain location context. User is motivated to use our application when he wants prediction of his friend's location. He gets estimation of friend's location and then he can contact friend and arrange meeting.

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Our method is based on tracking user location and analyzing this data. First we find important places for user to filter other unimportant places, i.e. when user is commuting. Important places are those, where user spent certain time. The most important for us is to determine whether user is at home or at work. Assuming that average person sleeps at night and works during day we estimate whether user is at home or at work/school. In our experiment we estimate user's home with success 93% and user's work with success 68%. For predicting user's future location in time, we create time vector and try to find appropriate similar vector in our database of user's logs.

Table 1. Time vector sample

Minute / 60	Hour / 24	Day / 7	Week / 4	Month / 12	Year/10000
0.232	0.543	0.468	0.887	0.229	0.2012

Time vector (see Table 1) consists of five columns. Minute of the hour, hour of the day, day of week, week of month, month of year and year / 10000. This time vector is compared with history using cosine similarity to estimate future location. There are some options of adjustment for vector components, i.e. hour of the day is more important component than year, or month. Day of week and hour of day are more important vector components than month or year in discovering user's behavior pattern, so we adjust cosine similarity vectors.

To evaluate our solution, we use retrospective analysis – implicit feedback. We predict location in future time and we are able to verify whether our prediction was correct or not. For verification user's home/work location we use explicit feedback. To sum up we presented method for location prediction, which supports contact between people by implementing mobile application for Android OS. This application tracks user position and estimates future position of user's friend and important locations. In future work we want to discover relationships between friends based on common location as contribution to social context acquiring.

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## References

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- [2] Zeleník D.: *An Approach to Context Aware Event Reminding*. In *Proc. of the Information Sciences and Technologies Bulletin of the ACM Slovakia*, pages 126-130. ACM, 2011